ISUZU

2013MY C-SERIES

Workshop Manual

Engine (6WG1 model)

POWERSTAR

This service manual only includes the sections in dark shade.

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Engine

Maintenance information

(6WG1)

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Engine maintenance precautions

1. Precautionary measures for engine maintenance

1. Use of circuit testing tools

Unless otherwise specified in the diagnostic flow, do not use the testing lamp for the diagnosis of the transmission electrical system. In case the probe terminal will be used for the diagnostic program, please use the terminal testing adapter kit 5-8840-2835-0.

2. Commercial electronic device

"The secondary market electronic equipment" means the electronic equipment for commercial use on the vehicle after the vehicle ex-works. Note such accessories are not in the special considerations for the vehicle design.

Caution:

● Ensure the power wire and ground wire of the commercial electronic device are not connected in the circuits related to the electronic control system circuit.

Note the electronic control system failure may occur even if the secondary market electronic equipment is correctly installed. The secondary market electronic equipment also includes the units not connected to the vehicle electronic system such as the mobile telephone or broadcasting equipment. Therefore, in the case of electronic system fault diagnosis, first determine whether the causes for the fault relate to the secondary market electronic equipment installed to the vehicle. If so, remove the relevant equipment. Carry out the diagnosis procedures according to the specifications of the fault is not solved after the relevant equipment is removed.

3. Damage caused by ESD

Depending on the design requirements, the electronic components in the electronic control system should operate under the very low voltage and are easy to be damaged due to ESD. Some electronic components may even be damaged by ESD less than or equal to 100V, which cannot be felt by the human body. Please note the human body can only feel the ESD when the voltage reaches 4,000V.

The human body can generate ESD itself in many manners. The typical ones include the tribo-electrification and induction discharge.

For example, when a person is twisting on the seat to and fro and chafing the seat, it will result in ESD.

If the person wearing the insulated shoes is near the high voltage object and contacts the ground, the ESD may occur through the induction. At this point, the charges outflow of same polarity will generate abundant charges of reverse polarity and then the person will be electrified. Since the static electricity may result in the damage, it is necessary to take care when handling and testing the electronic components.

Caution:

● To prevent the damage caused by ESD, do not touch the pins of the ECM terminals or the electronic components soldered to the ECM circuit board.

● Before completing the replacement component preparation, do not unpack the replacement component so as to avoid the damage caused by ESD.

● To prevent the damage caused by ESD, connect the component package to the ground of vehicle under normal operation before unpacking the component.

● To prevent the damage caused by ESD, after sliding over the seat or sitting from standing or walking for a certain distance, connect the component to the ground normal operation before coupling and handling it.

4. Considerations for mechanical maintenance of engine

Pay attention to the following items during the engine maintenance to prevent the engine damage and ensure the reliability of engine performance.

Do not place the jack under the oil pan while jacking or supporting the engine. Use the engine tray and wood framework to support the engine or flywheel housing which is equipped with supporting foot.

After removing the intake/exhaust system, seal the system to prevent the foreign matter entering the cylinders. The ingress of foreign matter may damage the cylinder etc.

Ensure to remove the battery negative terminal during the maintenance. Avoid short circuit while checking the component charging conditions.

Protect and lubricate the sliding components and coat them with sufficient engine oil.

After removing the piston, piston ring, link rod, bearing, injector and other valve relevant components, classify them in turn.

During the assembly, ensure the components used and the installation position are the same as those in the removal.

The gasket, oil seal and O-ring must be replaced with the news if removed.

In the case of liquid washer, completely remove the original liquid gasket. After completely removing the oil, moisture and foreign matter, coat the specified liquid gasket and assemble again.

Carry out the assembly within 5min after coating the liquid gasket; if not, remove the original gasket and coat the new liquid gasket again.

During the assembly and installation, ensure to observe the required torque.

Do not use any dropped or compacted sensor or injector system component; otherwise it may result in fault.

5. Considerations for engine operation

The pore spaces of fuel system fuel path, including the injector inside, must be subjected to the precise grinding treatment. Since the ingress of impurity may result in fault, cover the engine after removing any component so as to prevent the impurity ingress.

6. Considerations for cooling system operation

Warning:

● If the refrigerating fluid is hot, do not unscrew or remove the auxiliary radiator cap; otherwise the steam or too high temperature hot water will result in the scald.

● To remove the auxiliary radiator cap, cover the cap with the thick cloth after the fluid cools down and slowly rotate the cap to release the pressure.

7. Considerations for handling fuel related components

The pore spaces of fuel system fuel path, including the injector inside, must be subjected to the precise grinding treatment. Since the fuel path is highly sensitive to the impurity and the impurity may result in the running fault, it is necessary to prevent the impurity incursion.

In addition, do not use the fuel dehumanizer since the moisture may be absorbed by the diesel oil and result in rusting.

8. Operation procedures for fuel system related components

After removing the fuel line, injector line, injector, supply pump or common rail (fuel rail), immediately seal the fuel ports.

Store the eye bolts and gaskets in the clear parts box (with cover) to prevent the foreign impurity sticking to them.

Since the fuel leak may result in a fire, after completing the operation, wipe off the fuel and check for fuel leak after starting the engine.

9. Considerations for starting system operation

If the gap between the pinion and ring gear is inappropriate, it will cause the meshing fault. (Gap: 2 - 5 mm / 0.0787 - 0.1969 in.)

Fix the front end bracket to the engine side and start the installation.

Ensure to disconnect the battery negative terminal before removing or installing the starter.

Tighten the conductor firmly and then install. The conductor looseness will increase the contact resistance and make the start difficult.

10. Considerations for starting system operation

Ensure the battery is fully charged; the undercharged batter will make the start difficult.

Immediately release the ignition switch after confirming the engine starts.

The duration of once continuous operation should not exceed 10s. Do not restart the engine unless the pinion fully stops rotating.

If the starter does not stop running after the ignition switch is turned off, rotate the engine key switch to OFF position and immediately remove the battery negative terminal.

In the above conditions, check the wiring and switch.

11. Alternator handling

Pay attention to the following items when handling the alternator.

The inverse connection of battery poles may damage the alternator diode.

Do not disconnect the battery terminal or charging circuit conductors with the engine running.

Ensure to connect the terminal conductors according to the terminal symbols.

Do not test the semi-conductor equipment with the megohm meter.

Ensure to disconnect the battery negative terminal before checking the equipment.

In the case of quick charge by the peripheral equipment, disconnect the battery negative terminal first.

Do not directly coat the steam cleaner or water.

In the case of 50A and 60A, tighten terminal B to 11 N.m (1.1 kgf.m/ 95 lb.in) after the wiring. In the case of 90A, tighten to 9N.m (0.9 kgf.m/78 lb.in) after the wiring.

12. Exhaust system

During the assembly, the exhaust system vibration or looseness may cause the exhaust system component out-of-position. Therefore, tighten the bolts temporarily first, and, after installing all the components in position, tighten all the bolts completely from the engine back to the rear section line in turn.

13. Lubrication system

Since the lubrication system is consisting of the precise components, take sufficient protective measures during the maintenance to avoid the dust or dirt ingress.

When removing the components provided with liquid gasket, completely scrape the old gasket, clean it and coat the new liquid gasket to prevent the oil stain, water vapor or foreign matter.

When installing the liquid gasket, pay attention to the volume and avoid too much or too less usage. The excessive liquid gasket will cause the oil passage and injection nozzle seizing while too less volume will result in the oil leak.

During the installation, ensure the origin and termini coincide.

14. Supercharger system

The turbocharger working accuracy is very high and it can rotate at the high speed. Therefore, do not remove it. Where the bent fin, shell or scratch is found, replace the turbocharger assembly.

During the maintenance, take some measures to prevent the foreign impurity entering the turbine housing, compressor housing, oil inlet and oil outlet.

After the turbocharger maintenance and before the oil pipe installation, fill the clean engine oil about 1cc in the oil inlet.

Seizing the actuator rod and lifting the turbocharger will result in the turbocharger deformation and cause fault. To avoid the fault, hold the turbocharger body without seizing the seize actuator rod.

15. Preheating system

In the case of over-tightening, the glow plug will be damaged. Therefore, you should be careful during the operation.

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Engine function, structure and operation

1. Overview of *Engine Control* system

The *ECM* mainly controls the following items.

● Control of electronic control fuel injection system

● Exhaust gas recirculation system controller

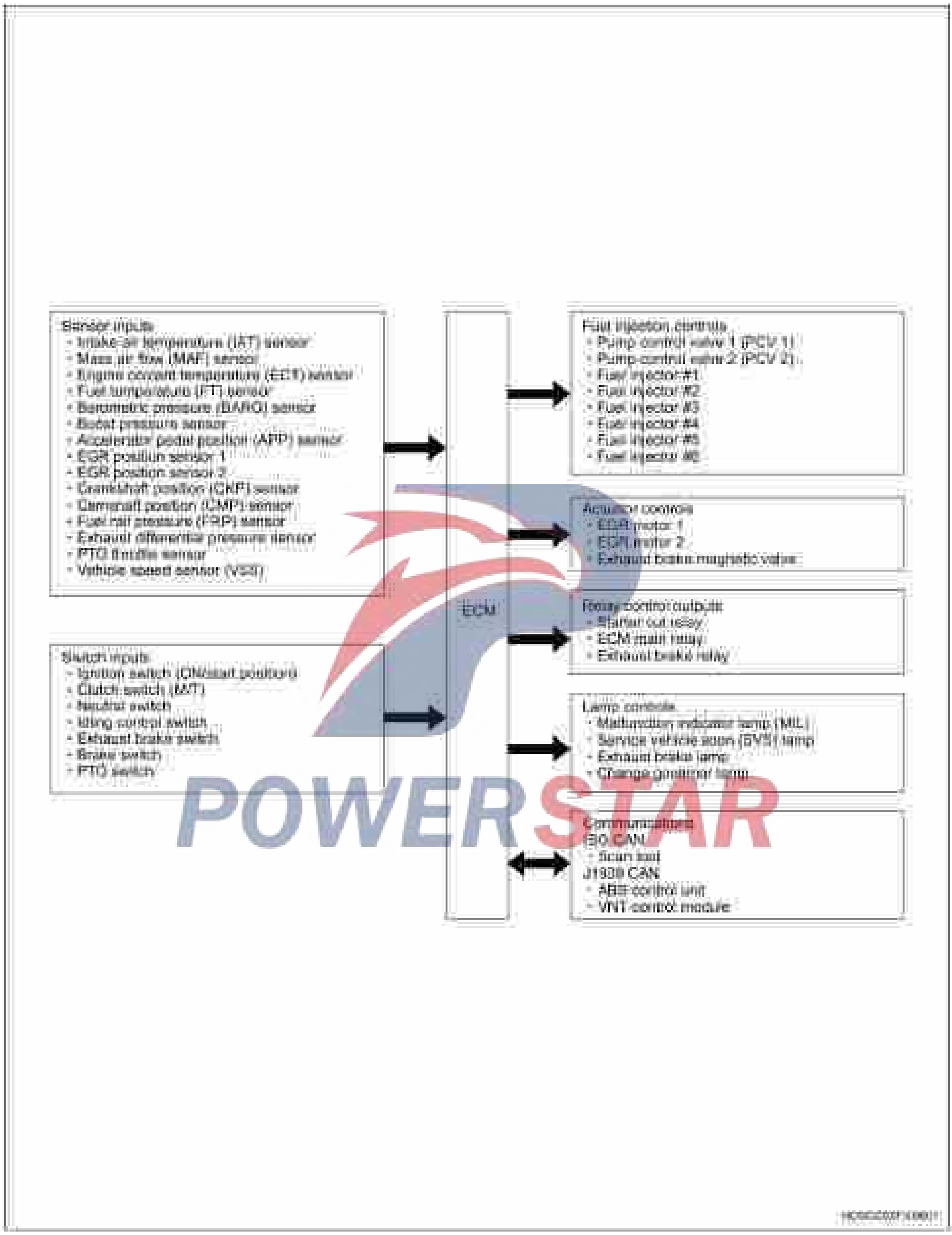
● VNT turbocharger control

● PTO control

● Exhaust brake system control

● Self-diagnostic function

I/O table



2. Fuel system instructions

1. Overview of electronic control system

The electronic control system receives the data from the sensors and implements the calculation according to the ECM control program and applies the calculation results to the overall control over the fuel injection volume, injection timing, start, high elevation compensation and other factors.

2. Electronic control fuel injection system

The ECM in the EFI system acquires the information such as the engine speed and engine load and sends the information to the fuel feed pump and injector to correctly control the injection volume and injection timing of each cylinder.

3. Injection volume control

To optimize the injection volume, regulate the injector according to the engine speed and accelerator opening angle signal mainly.

4. Injection pressure control

To realize the high pressure injection under the low engine speed, control the fuel pressure inside the common rail (the fuel rail). Through calculating the engine, speed and injection volume, it controls the inside pressure of the common rail (the fuel rail). Through the fuel feed pump control, it injects the fuel of properly pressurized to the common rail (the fuel rail).

5. Injection timing control

This control is to regulate the injector by calculating the appropriate fuel injection time according to the engine speed or injection volume instead of the timer function.

6. Injection rate control

To enhance the cylinder internal combustion, inject (pre-injection) a little fuel for ignition. After the ignition, carry out the secondary injection (main injection). Such injection timing and injection volume control are completed through the injector.

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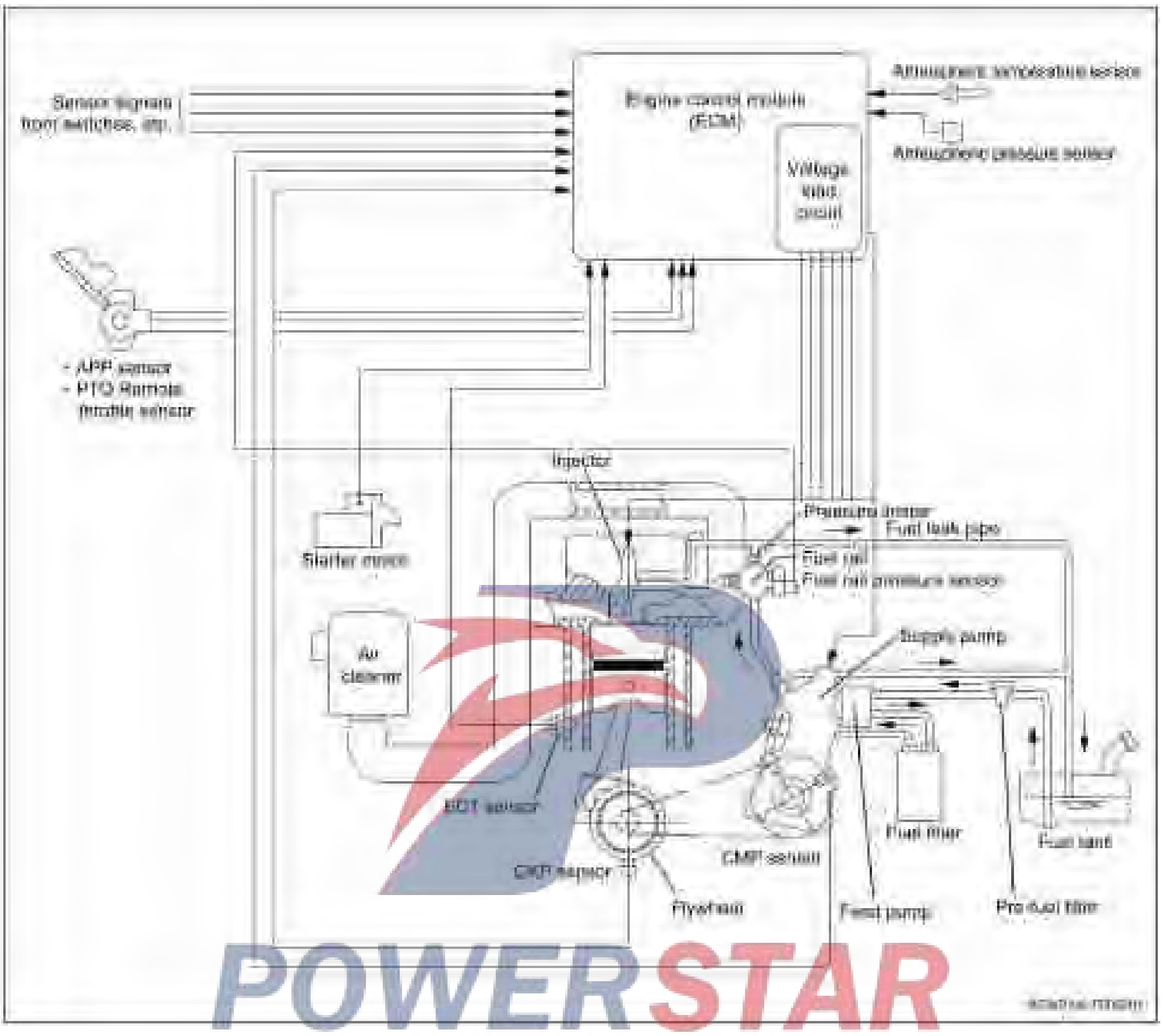
System schematic diagram



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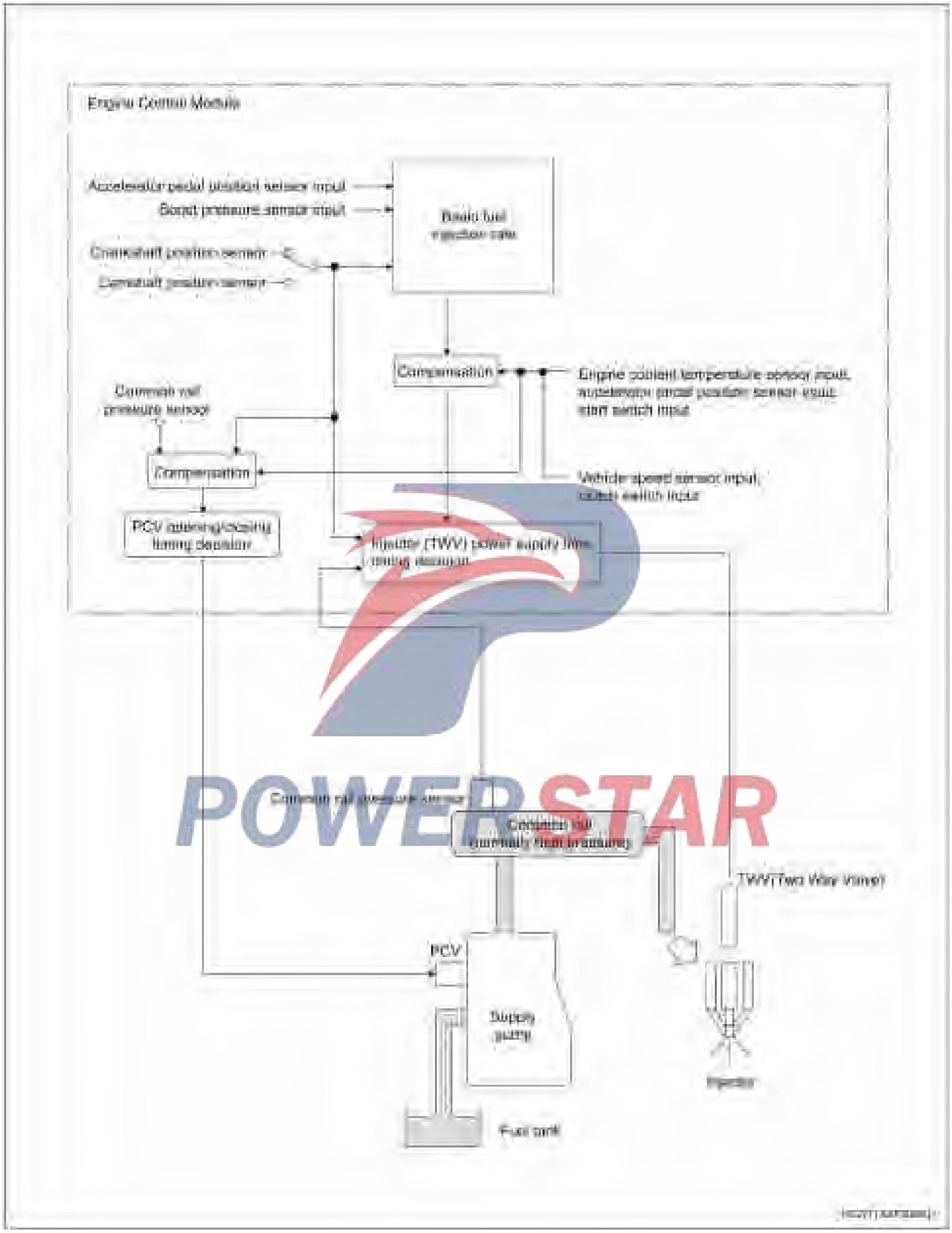
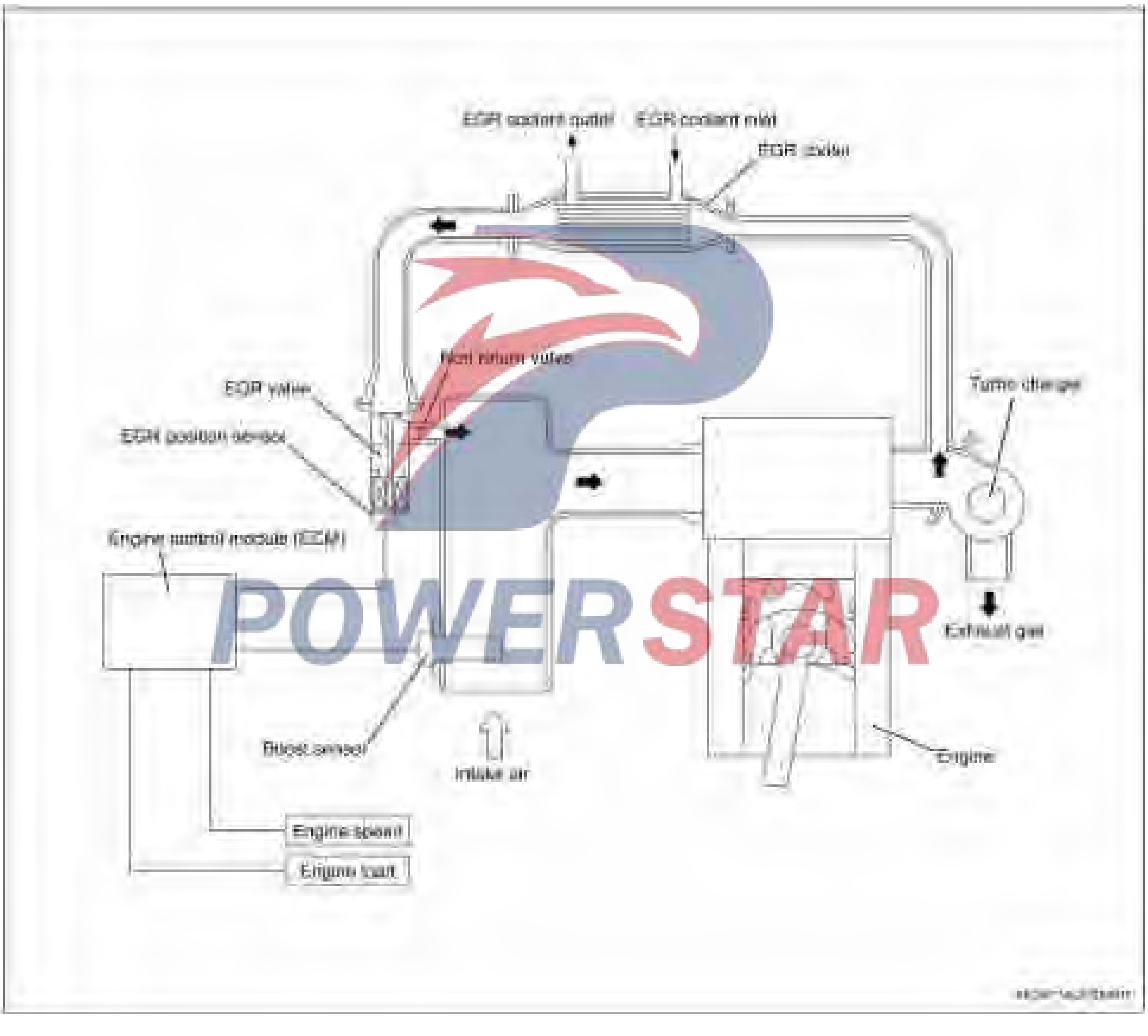
System control schematic diagram



3. EGR system

EGR system forces a part of exhaust gas to return the intake manifold and mixes the inert gas in the air intake to reduce the temperature of combustion and consequently restrain the generation of nitrogen oxides (NOx). By opening and closing the EGR valve installed between the exhaust gas manifold and intake manifold, the EGR volume can be controlled. Determine the EGR volume according to the engine speed and engine load ratio. The EGR volume is controlled through the operation of EGR valve. The cooling system is installed in the EGR air line. The hot exhaust gas recirculation gas is cooled by the cooler and then mixed with the air intake to reduce the mixture temperature (not only the temperature of conventional exhaust gas recirculation system) and consequently reduce the nitrogen oxides. In addition, EGR system is provided with the check valve to prevent the EGR gas flowing back and consequently avoid increasing the EGR volume.



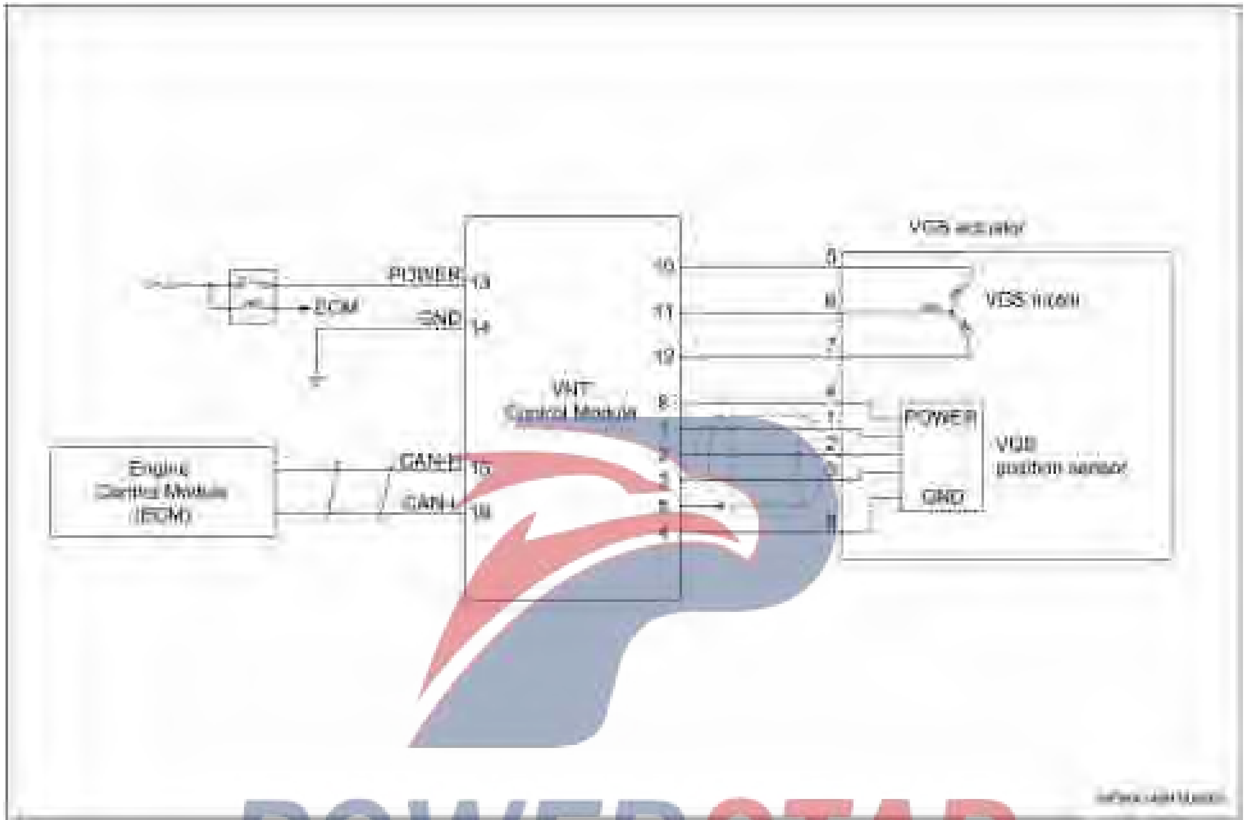
4. Turbocharger description

1. VNT turbocharger control

VNT control is to regulate the opening of nozzle blades inside the turbocharger according to the engine running conditions to maintain the supercharge pressure and airflow under the optimal working conditions.

The ECM can send the expected nozzle opening command to the VNT control module through the CAN communication according to the engine speed, accelerator opening angle and supercharge pressure to correctly control the supercharge pressure and airflow to make them comply with the engine load. VNT control module can drive the variable gear ratio steering actuating unit according to the information acquired from ECM and regulate the nozzle blade opening angle to the optimum value through the control lever.

System circuit diagram



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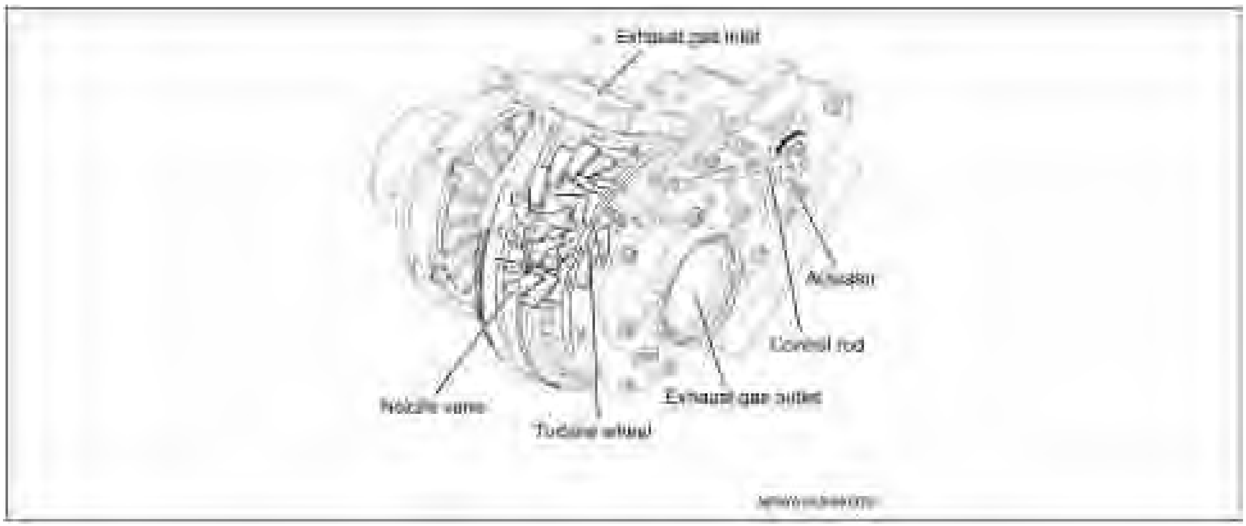
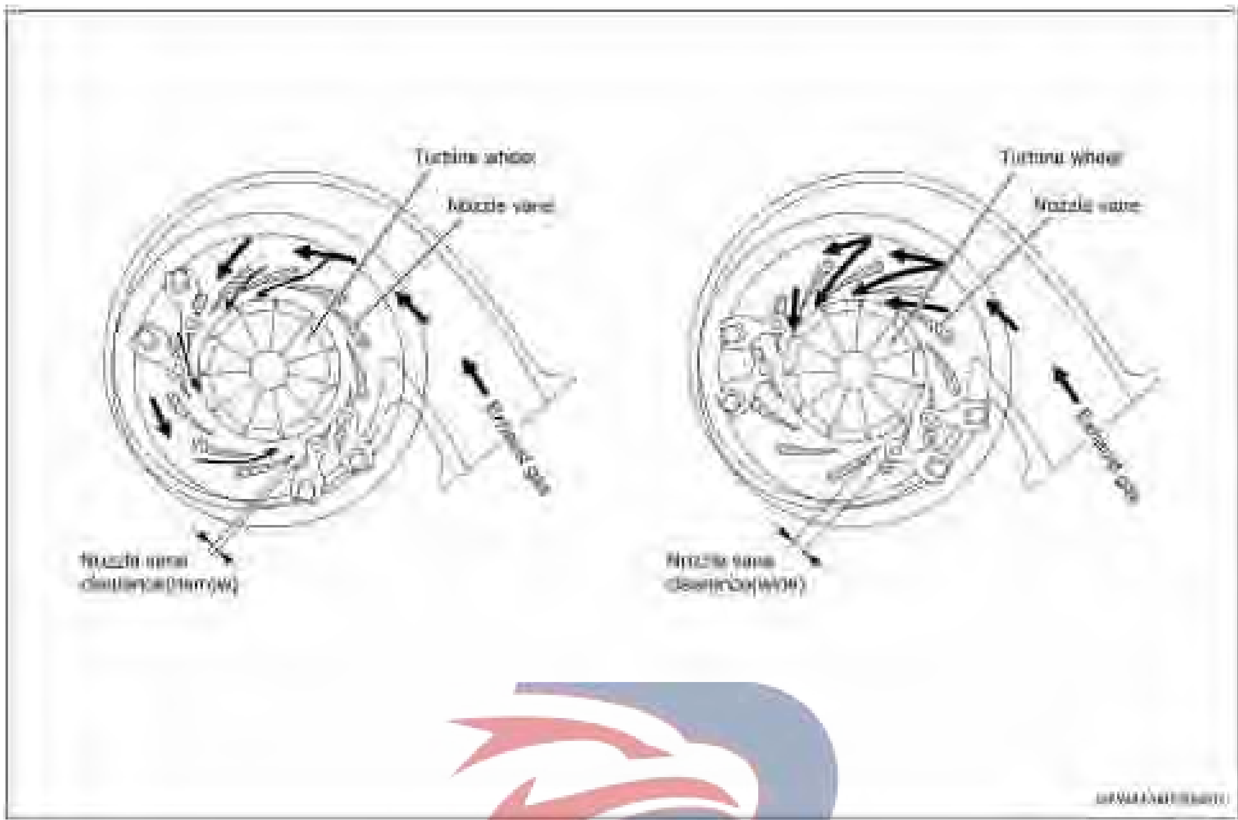
2. Nozzle control actuator running

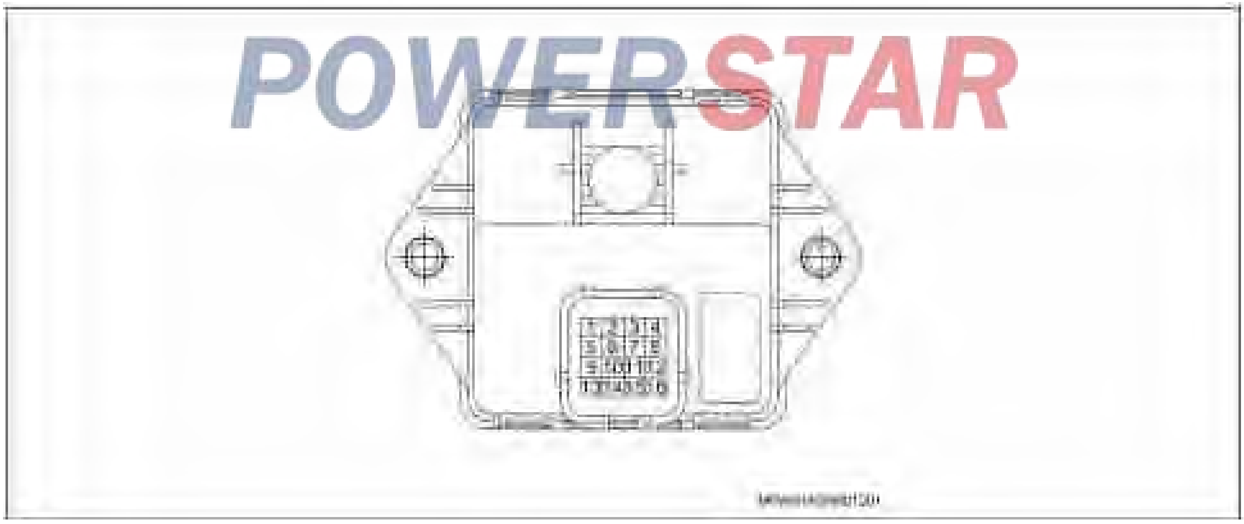
The actuator will start according to the signal of the VNT control module and drive the nozzle control lever to move along. The nozzle blade can open or close according to the motion of the control lever.





3. VNT control module

VNT control module is installed to the engine left side sill. ECM can communicate with VNT control module according to the engine load while VNT control module can control the speed through the motor inside the variable gear ratio steering implementation unit.



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5. Idling control description

The idle speed can be adjusted to the minimum through the idling control switch during the engine warming-up.

The minimum idling speed can become the optimum value along with the change of the engine coolant temperature.

Please note this function will be disabled during the PTO control (the injector characteristic switching).

1. Idle speed control switch

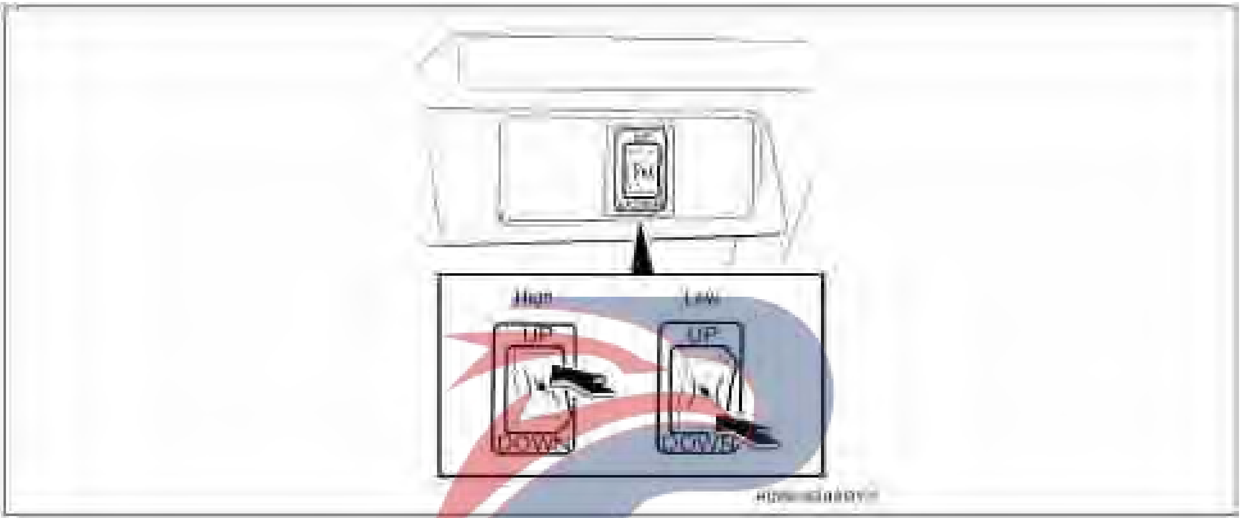
The idling speed can be regulated through the idling control switch. The engine speed upper limit varies from the engine type, vehicle specification and engine warming-up conditions.

2. UP

Pressing the UP side will increase the engine speed and idling speed.

3. DOWN

Pressing the DOWN side will reduce the engine speed and idling speed. Nevertheless, the engine speed cannot be lower than the minimum idling speed.



6. PTO control system description

PTO control in the *Engine Control* system can switch between driving mode and mode, which is called the fuel injection mode switching.

1. Fuel injection characteristic switch

The fuel injection characteristic can only be switched according to the PTO switch input state to the ECM when the external accelerator pedal is connected. However, the fuel injection characteristic must be switched with the vehicle still.

To switch the driving mode to the running mode, all the following conditions should be met.

● The PTO switch is enabled.

● The vehicle is stopped.

● The parking brake is engaged (parking brake switch: ON).

● External accelerator input is normal (PTO sensor voltage is 0.1 - 4.8 V).

● The external accelerator is in idle position (PTO accelerometer less than 5%).

● Drive accelerator in idle position (accelerator sensor less than 5%).

● The PTO accelerator switch is turned off.

Caution:

● These are the switches arranged (modified) for the concrete pump truck specially.

● No DTC to stop power take-off control is set.

To switch the running mode to the driving mode, all the following conditions should be met.

● The PTO switch is turned off.

● The vehicle is stopped.

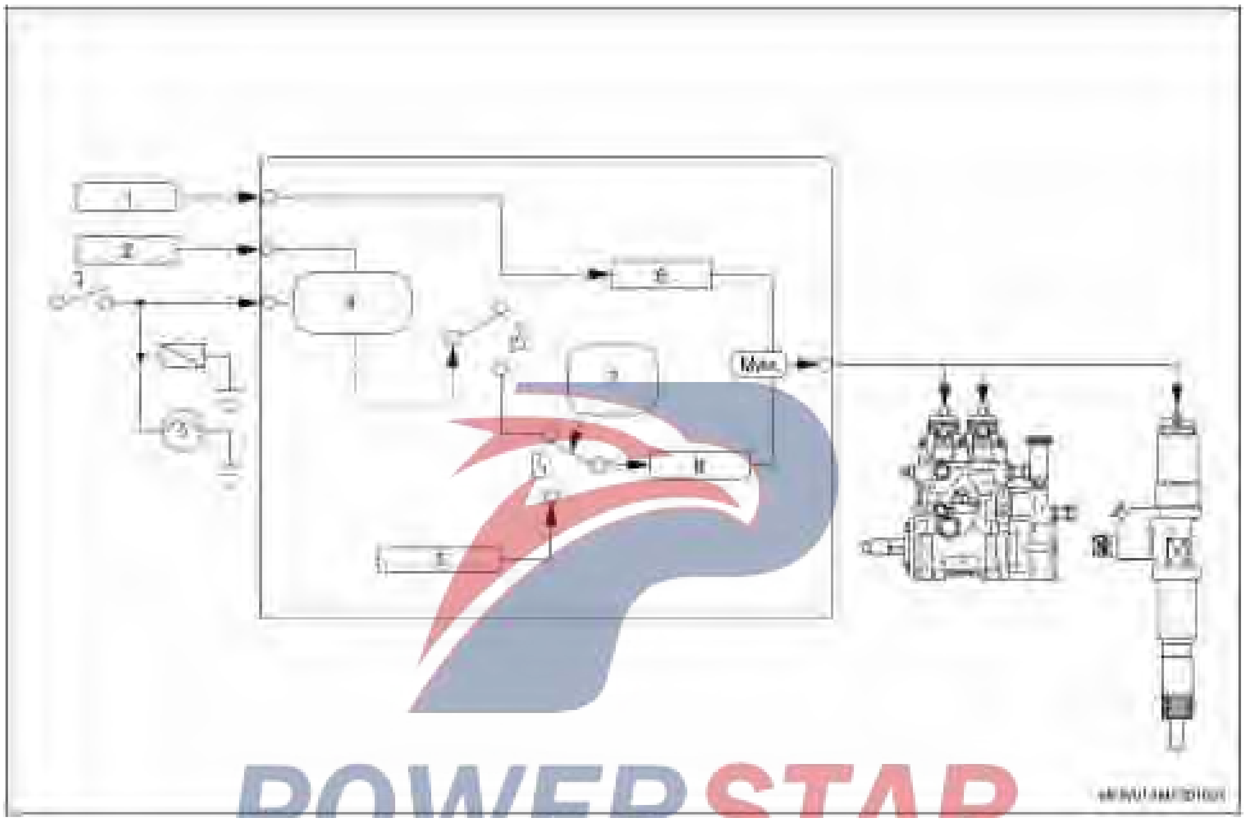
● The parking brake is engaged (parking brake switch: ON).

● External accelerator input is normal (PTO sensor voltage is 0.1 - 4.8 V).

● The external accelerator is in idle position (PTO accelerometer less than 5%).

● Drive accelerator in idle position (accelerator sensor less than 5%).

● The DTC that can stop the PTO control is not set.



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1. Drive accelerator
2. PTO accelerator
3. Power take off switch
4. Fuel injection characteristic switch status
5. Accelerator: 0%
6. Driving mode
7. In running mode, the PTO accelerator switch is in ON state.
8. Running mode

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2. Drive accelerator and external accelerator switch status

To use the external accelerator (using the drive accelerator external accelerator at the same time), all the following conditions should be met.

● The vehicle is stopped.

● The parking brake is engaged (parking brake switch: ON).

● The external accelerator is in idle position (PTO accelerometer less than 5%).

The external accelerator should be disabled (only the drive accelerator available) if any of the following conditions is met.

● The parking brake is released.

● The vehicle is not stopped (the vehicle speed can be detected).

7. Communication with other ECU

1. About ECM communication

The communication among the control units is achieved through the transmission of accelerator opening angle, vehicle speed and various switch signals. The typical communication methods include the pulse width modulation (PWM) and CAN method etc.

2. PWM communication

In any pulse modulation, the frequency and amplitude are constant while the pulse width varies from the signal.

This signal will be generated and changed at the constant rate in each cycle.

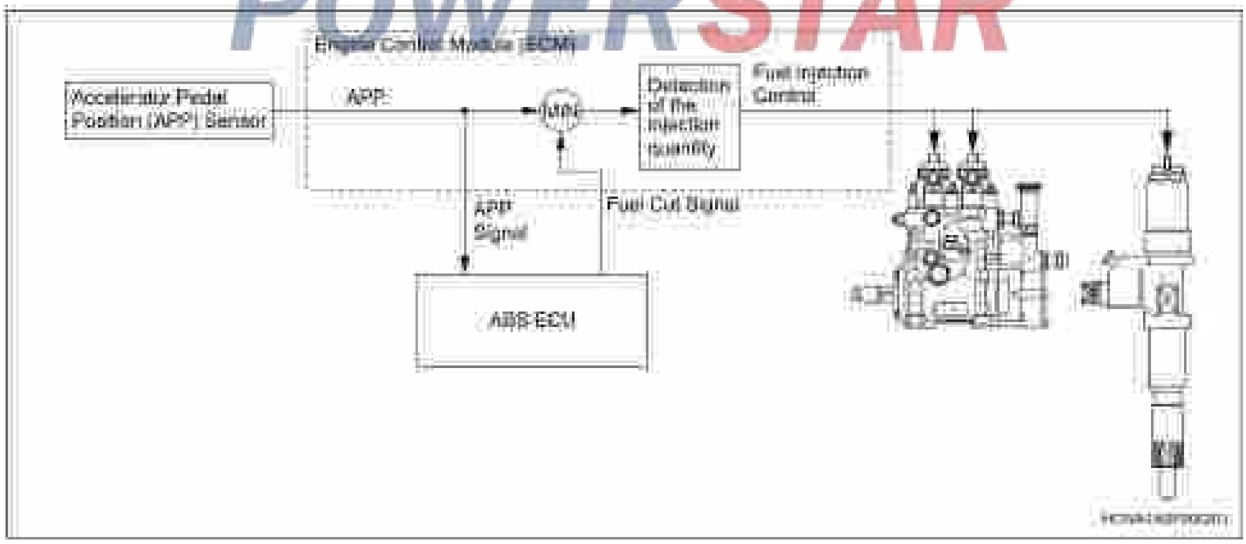
3. Communication method (CAN communication)

CAN communication means to establish the communication line between two pieces of harness among the control units and realize the communication through such line.

The control units can send and receive several data packets according to the transmission speed (high, moderate or low) and signal number. In addition, the signal among the control units can be shared and used for the control of various types.

4. Reduced fuel volume control

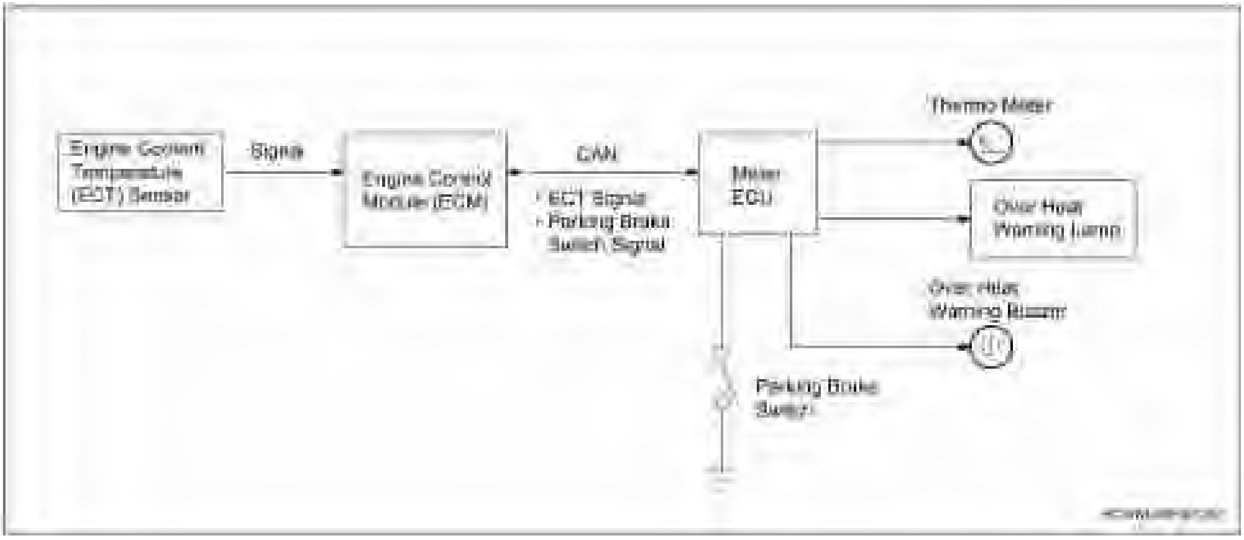
ABS system control unit can detect the driving wheel sliding according to the ABS system accelerator opening angle signal and send the reduced fuel volume signal to ECM. Depending on this signal, ECM can limit the fuel injection volume and consequently restrain the engine output and minimize the driving wheel sliding.



5. Communication between control unit and instrument electronic control unit

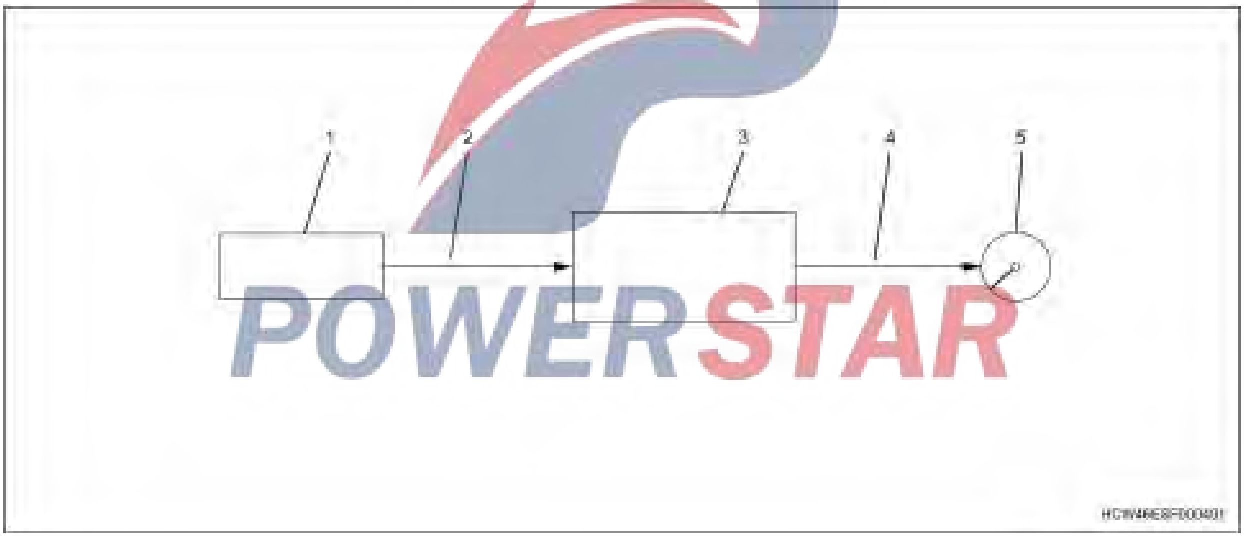
Depending on the ECM inside engine coolant temperature data, overheating signal and overheating warning buzzer opening request signal, the instrument electronic control unit will enable the engine coolant thermometer, overheating warning display and overheating warning buzzer through the CAN communication.

In addition, ECM will acquire the parking switch signal of the instrument electronic control unit through CAN communication.



6. Engine speed output

ECM outputs the engine speed pulse to the tachometer as its output (4 pulses will be generated every engine revolution). The tachometer displays the engine speed according to the engine speed pulse from ECM.

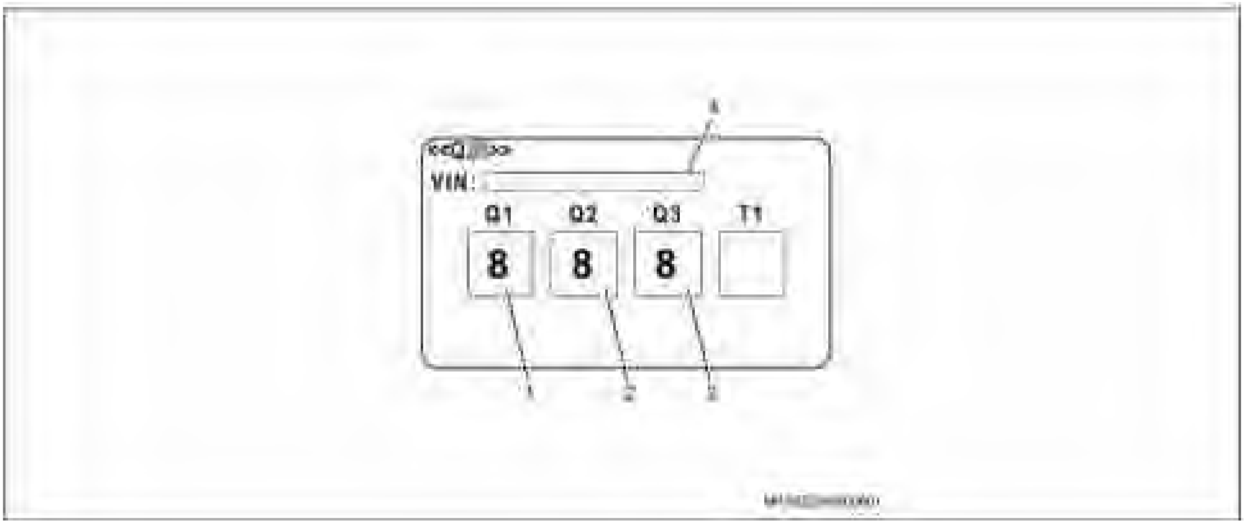


1. Crankshaft position (CKP) sensor
2. Engine speed
3. *ECM* (ECM)
4. Tachometer output
5. Tachometer

7. About Q adjustment data

Affix the label indicating the Q adjustment data to the vehicle during the handling. After scanning, compare the displayed data with the label data. This label is affixed to the lower end of the driver's seat.

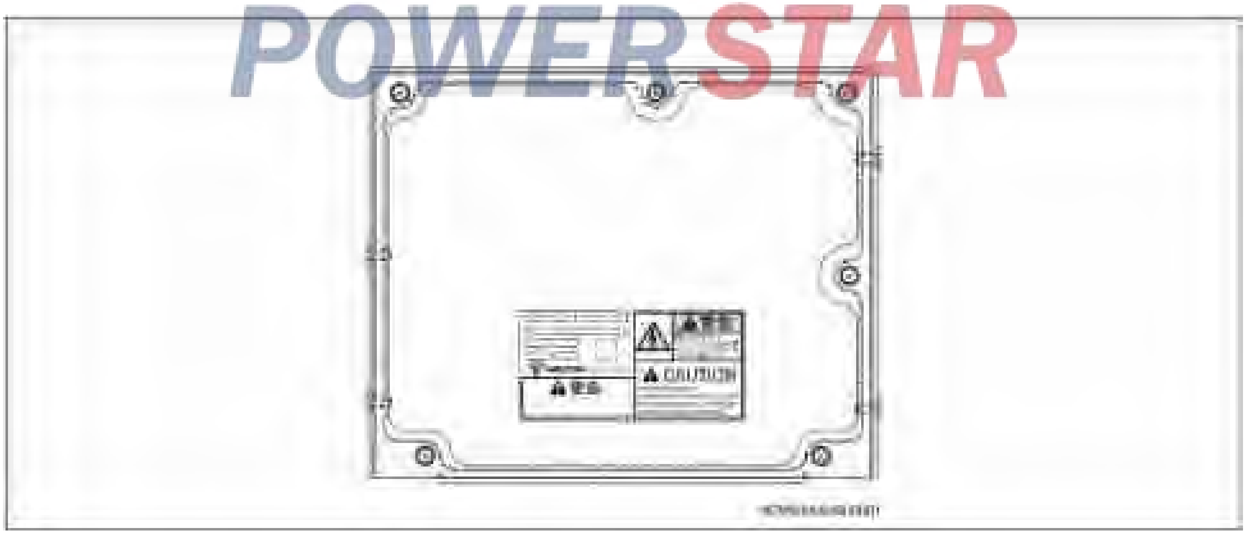
Sealing description



1. Q adjustment data number (Q1)
2. Q adjustment data number (Q2)
3. Q adjustment data number (Q3)
4. Vehicle model

8. *ECM*

ECM is installed in the central dashboard box inside the cab. ECM can continuously monitor the information from every sensor and control the power system. ECM implements the system diagnostics functions to detect the system running problem, reminds the driver of the problem through the MIL or "repair vehicle soon" indicator lamp and stores DTC. DTC identifies the zones where the problem occurs to help the technician in the maintenance.



1. ECM functions

ECM outputs 5V voltage or other specification voltage to power the sensors and switches. Nonetheless, since the power is supplied by the ECM resistor and the resistance is very high, the test lamp will not be lighted even if it is connected to the circuit. Under specific circumstances, the resistance is very low even if the normal voltmeter is used. To display the correct reading, use the digital multimeter of input impedance of 10MΩ at least. The special tool 5 - 8840 - 2691 - 0 is applicable. ECM controls the ground circuit or power circuit through the transistor or other unit and consequently controls the output circuit.

2. ECM and components

With the special design, ECM can maintain the gas emission regulation class while maintaining the excellent steerability and fuel efficiency. ECM monitors the engine and vehicle functions through the sensors (such as the crankshaft position sensor and vehicle speed sensor).

3. ECM voltage description

ECM supplies the reference voltage to several switches and sensors. Since the ECM resistance is very high, though it can supply voltage in this mode, the actual voltage it supplies the circuit is very low and the test lamp will not be lighted even if connected with the circuit. The voltmeters normally used by the repair shops may not display the correct reading since the input impedance of voltmeter is highly low. To display the precise voltage reading, use the digital multimeter of 10 MΩ input impedance (for example, 5-8840-2691-0).

The input/output units of ECM include analog-to-digital converter, signal buffer, counter and special drives. ECM controls most components with the electronic switch.

4. Electronic erasable programmable read-only memory (EEPROM)

EEPROM is the permanent memory chip built in the circuit board inside ECM. It contains the program and calibration information required for the ECM to control the power train running.

Do not replace the EEPROM. In the case of EEPROM malfunction, replace the ECM.

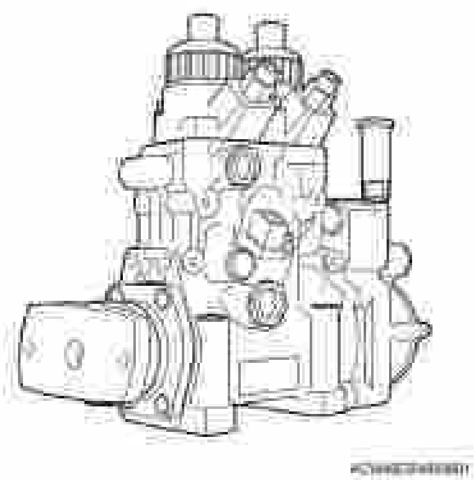
5. Considerations for ECM maintenance

Through the special design, ECM can withstand the conventional current consumption related to the vehicle running. Ensure to avoid the circuit overload. When testing the open circuit or short circuit, do not ground any circuit of ECM or apply voltage unless otherwise indicated. For the testing of such circuits, ensure to use the digital multimeter (5-8840-2691-0).

9. Engine control assembly

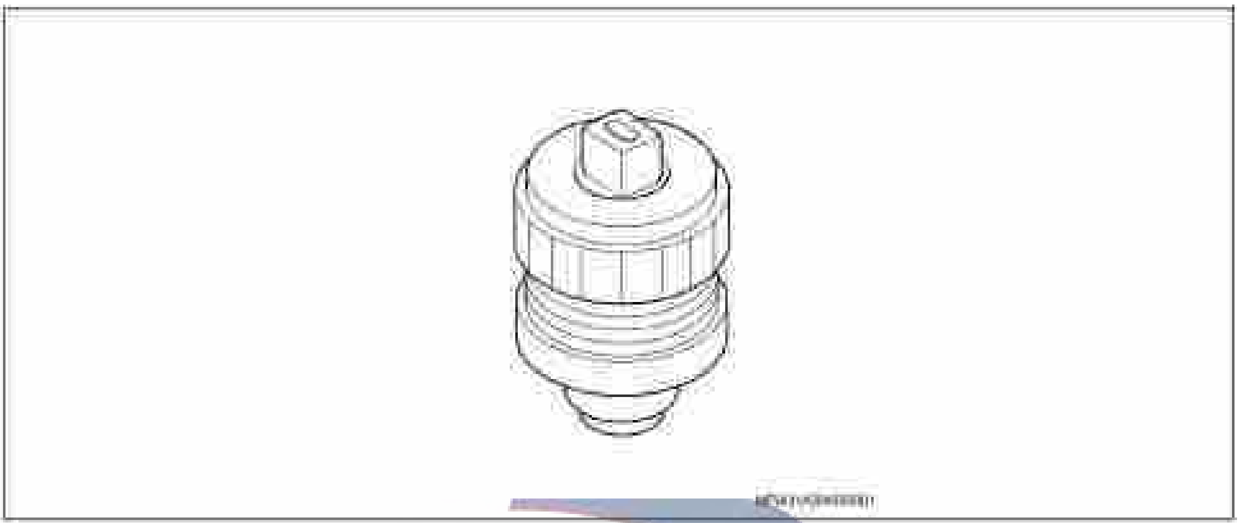
1. Fuel pump

The fuel feed pump increases the fuel pressure through the engine torque and forces the fuel in the common rail (the fuel rail). The proportional control valve, camshaft position sensor and feed pump are installed on the fuel feed pump.



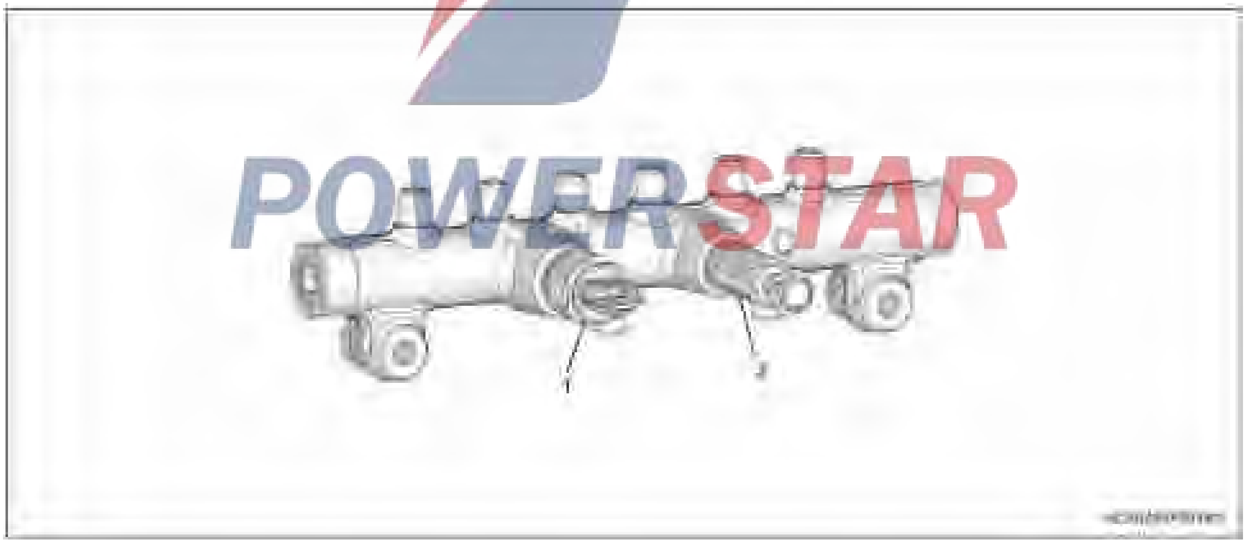
2. Crankcase forced ventilation

The proportional control valve is installed on the fuel feed pump to control the volume of fuel forced into the common rail (the fuel rail). ECM regulates the power-on time of the proportional control valve to control the volume of drained fuel.



3. Common rail

The common rail (the fuel rail) receives the fuel from the fuel feed pump, maintains the fuel pressure and delivers the fuel to each cylinder. The fuel rail pressure sensor and pressure limiter are installed on the common rail (the fuel rail).



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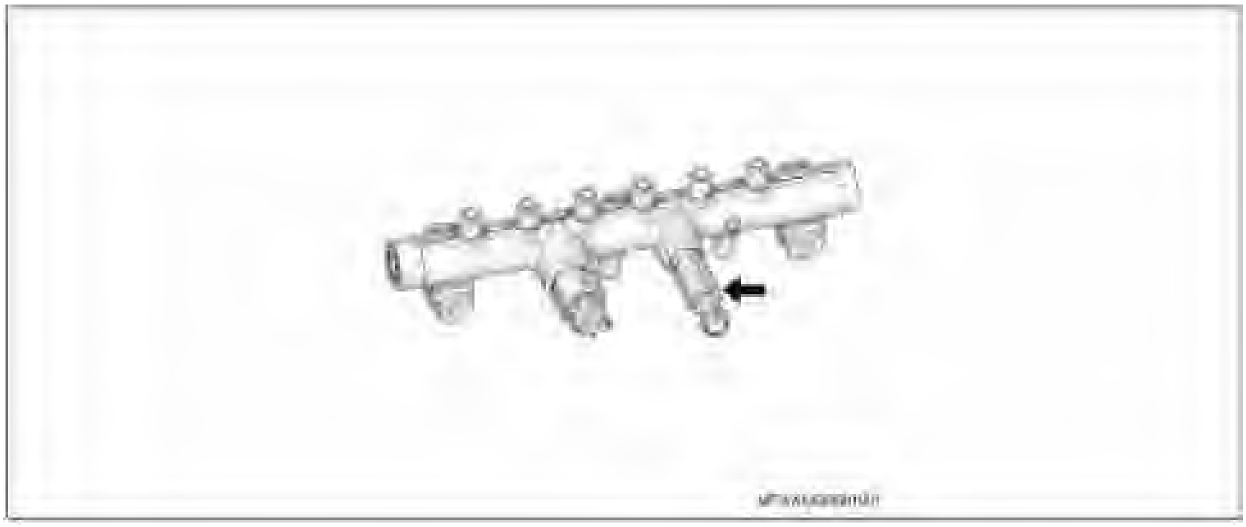
1. Fuel rail pressure sensor

2. Pressure limiter

4. Pressure limiter

To release the pressure inside the common rail (the fuel rail), the pressure limiter will be enabled if the pressure inside the common rail is very high.

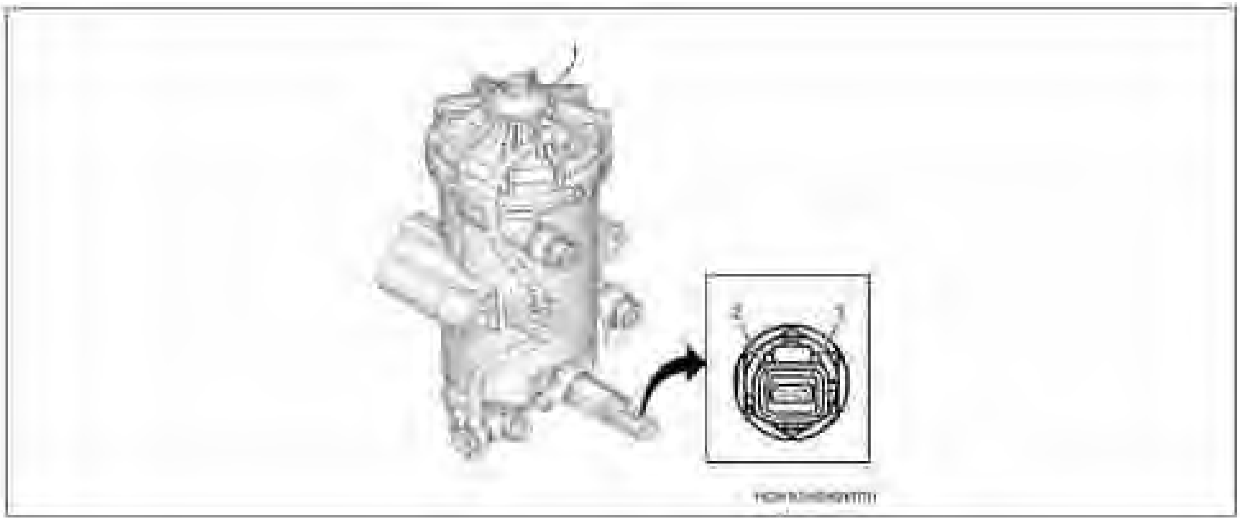


5. Fuel rail pressure (FRP) sensor

The fuel rail pressure sensor is installed on the common rail (the fuel rail) to test the fuel pressure inside the rail, convert the pressure into voltage signal and transmit this signal to ECM. If the pressure is high, the voltage will be high; if the pressure is low, the pressure will be low. ECM calculates the actual fuel pressure according to the voltage signal from the sensor and controls the fuel injection with this result.

6. Fuel temperature sensor

The fuel temperature sensor is installed on the fuel filter and measures the temperature of fuel flowing to the fuel filter. When the fuel temperature sensor temperature is low, the sensor resistance higher. When the oil temperature rises, the sensor resistance decreases.When the sensor resistance is high, ECM will detect high voltage on the signal circuit. When the sensor resistance is low, ECM will detect low voltage on the signal circuit.



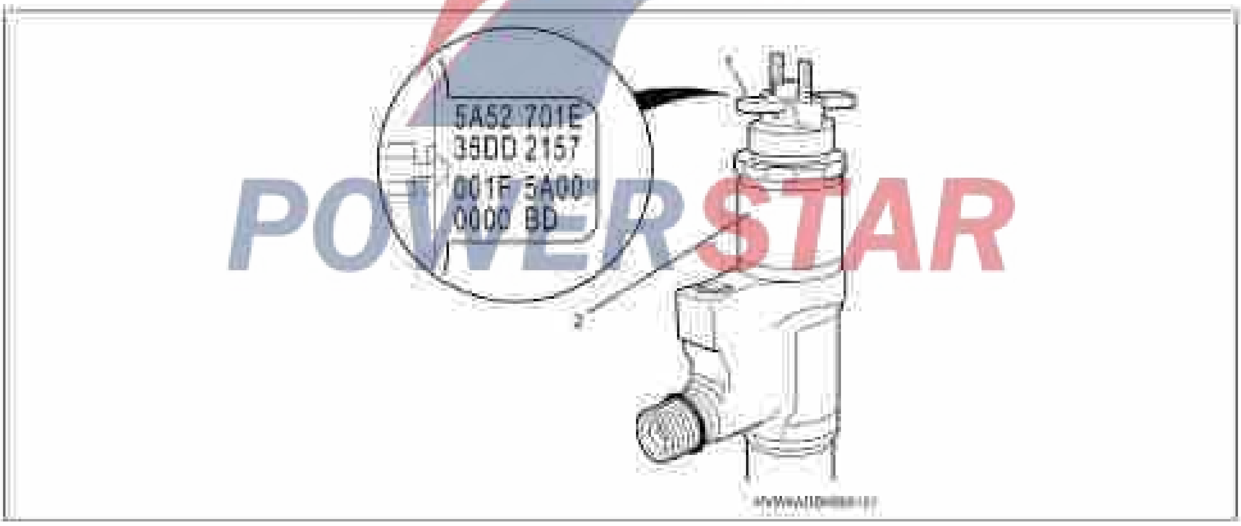
1. Fuel filter

2. Fuel temperature sensor low pressure reference

3. Fuel temperature sensor signal

7. Injector

The injector is installed on the cylinder head, through which the ECM controls the fuel injection. The engine module inside increases the voltage to drive the injector and this voltage is applied to the injector. After this, ECM controls the power-on time of the injector to regulate the fuel injection volume and injection cycle.

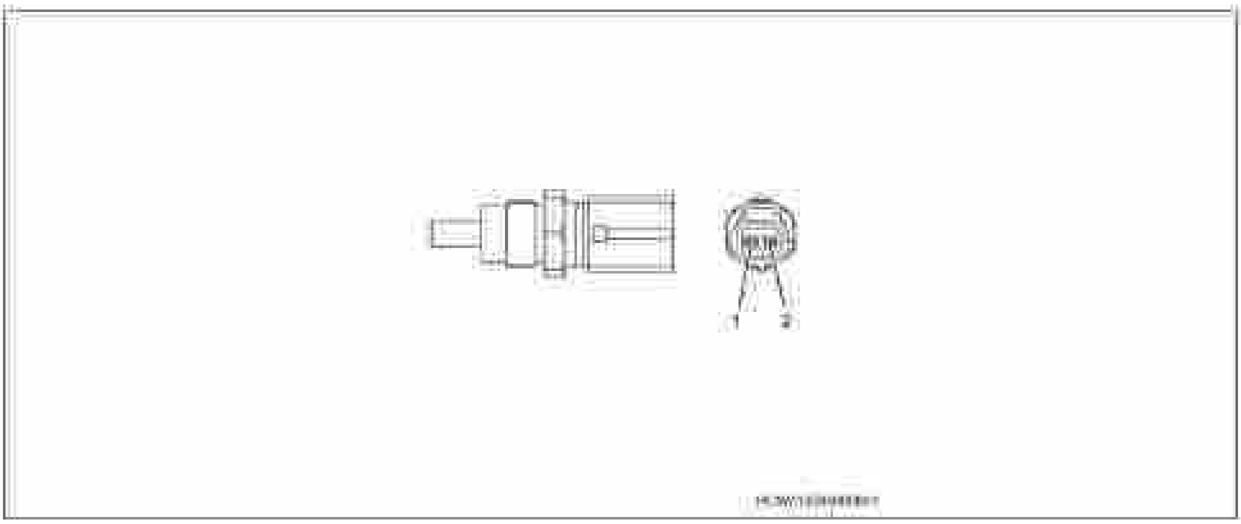


1. Injector identification code plate

2. Injector

8. Engine coolant temperature sensor

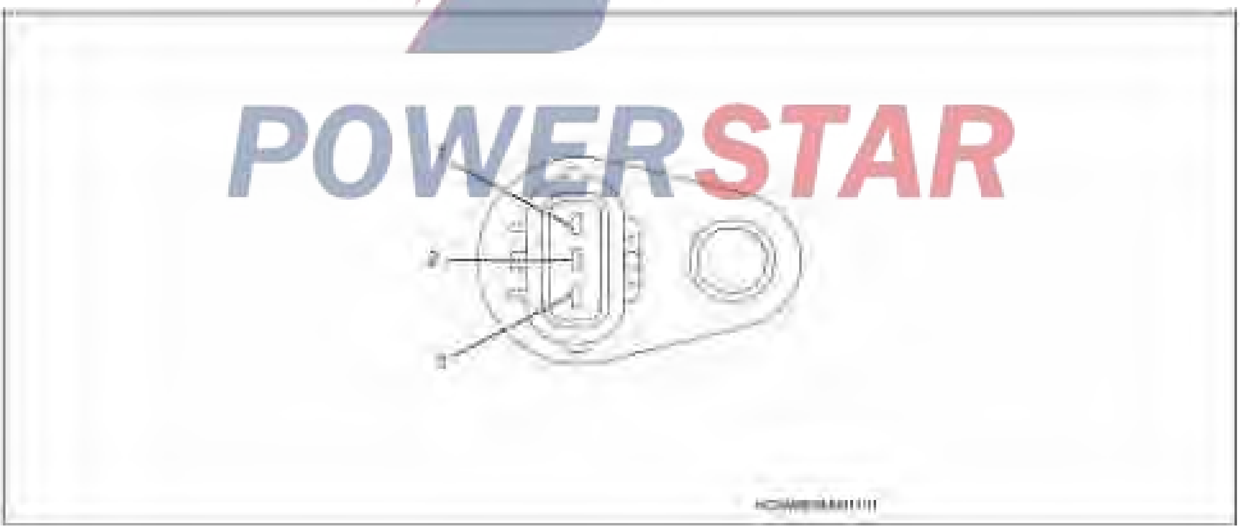
The engine coolant temperature sensor is installed on the engine cylinder block thermostat housing and the thermistor resistance varies from the temperature. When the engine coolant temperature is high, the resistance will be lower; when the engine coolant temperature is low, the resistance will be higher. ECM supplies 5V voltage to the engine coolant temperature sensor through the pull-up resistor and works out the engine coolant temperature according to the voltage change. This temperature is used for various control mechanisms such as the fuel injection control. When the resistance is low (the temperature is high), the voltage will be lower; when the resistance is high (the temperature is low), the voltage will be higher.



1. Engine coolant temperature sensor signal
2. Engine coolant temperature sensor low pressure reference

9. Camshaft position sensor

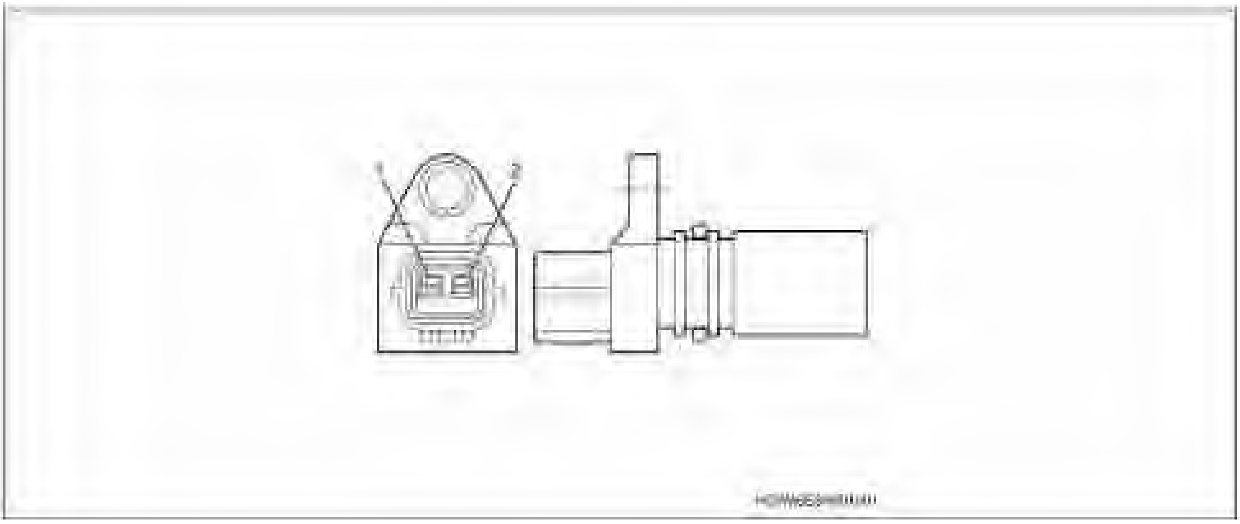
The camshaft position sensor is installed in the fuel feed pump. When the cam section of the camshaft inside the pump passes through the sensor, the camshaft position sensor will generate the camshaft position signal. ECM controls the cylinder through the crankshaft position signal and camshaft position signal from the camshaft position sensor, specifies the crankshaft angle and controls the fuel injection according to this information to calculate the engine speed. In general, this control is realized through the crankshaft position signal. In the case of incorrect crankshaft position signal, the camshaft position signal will be used.



1. Camshaft position sensor signal
2. Camshaft position sensor low pressure reference
3. Camshaft position sensor 5V reference voltage

10. Crankshaft position sensor

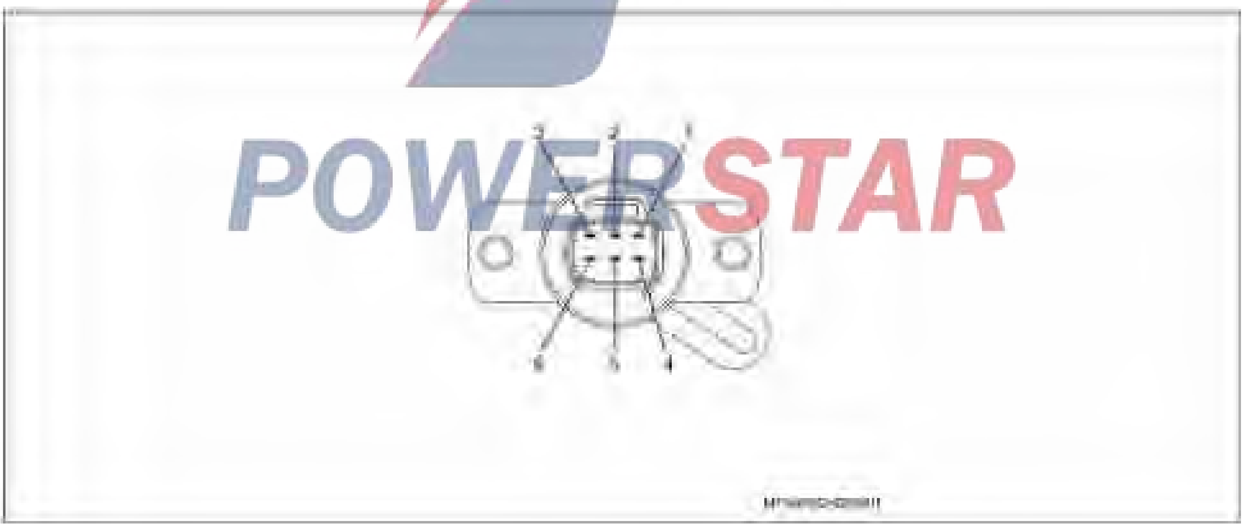
The crankshaft position sensor is installed on the flywheel housing. When the flywheel hole passes through the sensor, the sensor will generate the crankshaft position signal. ECM control the cylinder through the crankshaft position signal and the camshaft position signal from the camshaft position sensor, specifies the crankshaft angle and controls the fuel injection according to this information to calculate the engine speed. In general, this control is realized through the crankshaft position signal. In the case of incorrect crankshaft position signal, the camshaft position signal will be used.



1. Crankshaft position sensor signal (high)
2. Crankshaft position sensor signal (low)

11. Accelerator pedal position sensor

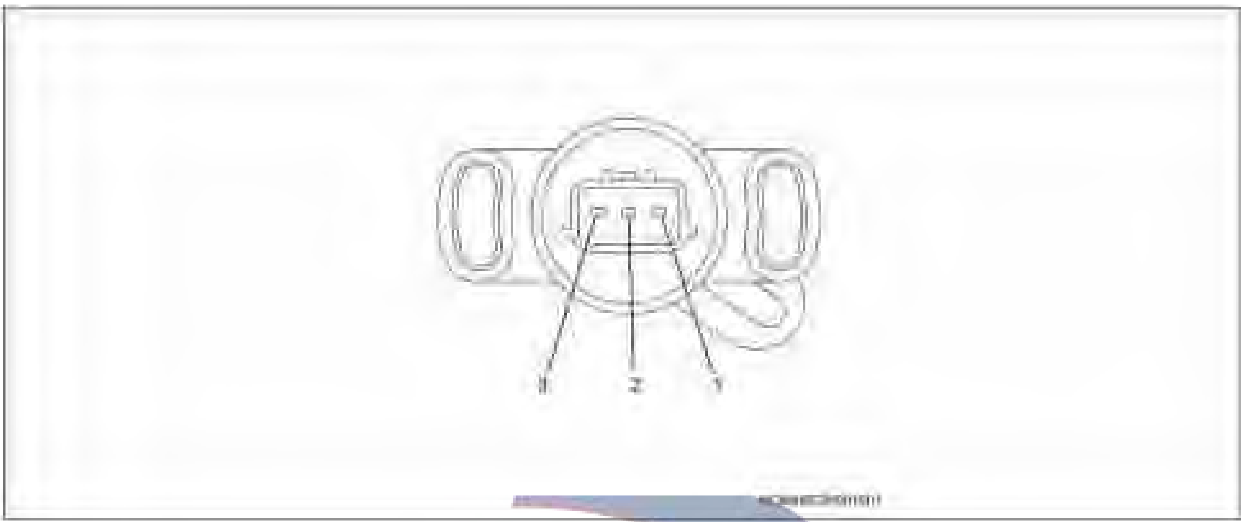
The accelerator pedal position sensor is installed on the accelerator pedal to send the voltage signal upon the accelerator pedal angel change to ECM. ECM calculates the accelerator pedal position according to the voltage signal and controls the injection volume and other items.



1. Accelerator pedal position sensor 2, 5 V standard
2. Accelerator pedal position sensor 2 signal
3. Accelerator pedal position sensor 2 Low voltage reference
4. Accelerator pedal position sensor 1, 5 V standard
5. Accelerator pedal position sensor 1 signal
6. Accelerator pedal position sensor 1 Low voltage reference

12. PTO throttle sensor

The PTO position sensor is installed outside the cab as an external accelerator that sends a voltage signal that varies with the PTO angle to the *ECM* The PTO calculates the PTO accelerator pedal Angle, and uses the result of the calculation for fuel injection control as well as many other controls.



1. PTO throttle sensor Low reference voltage
2. PTO throttle sensor signal
3. PTO throttle sensor 5V reference voltage

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13. Speed sensor

The speed sensor is mounted on the transmission with a Hall effect circuit attached to the output shaft of the magnet which rotates with the shaft and interacts with the generated magnetic field to send a signal to the speed sensor control unit The *ECM* receives signals from the Speed sensor control unit issued by the speed signal.

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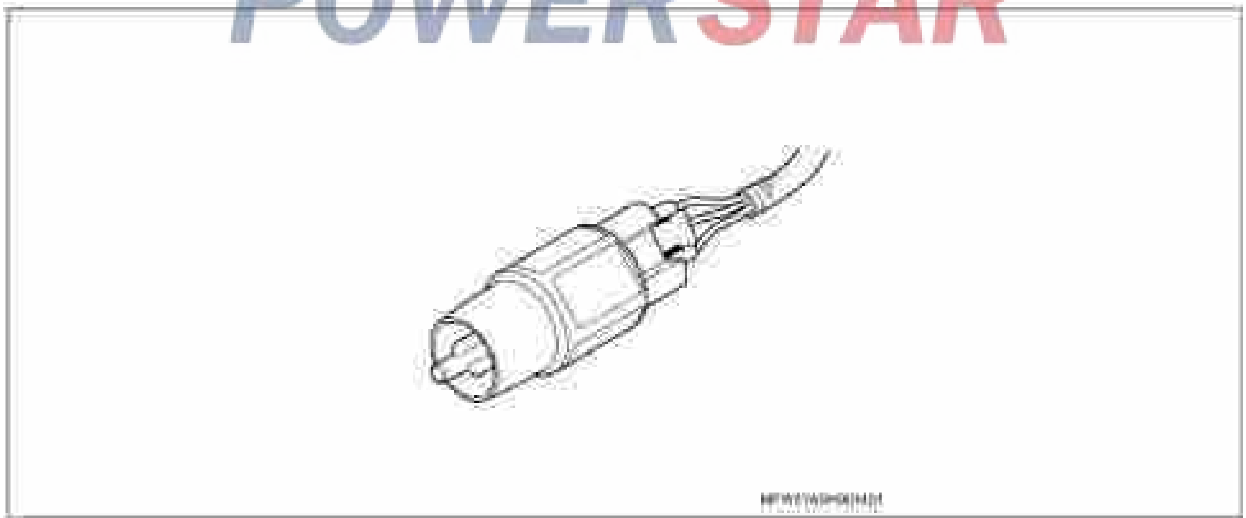
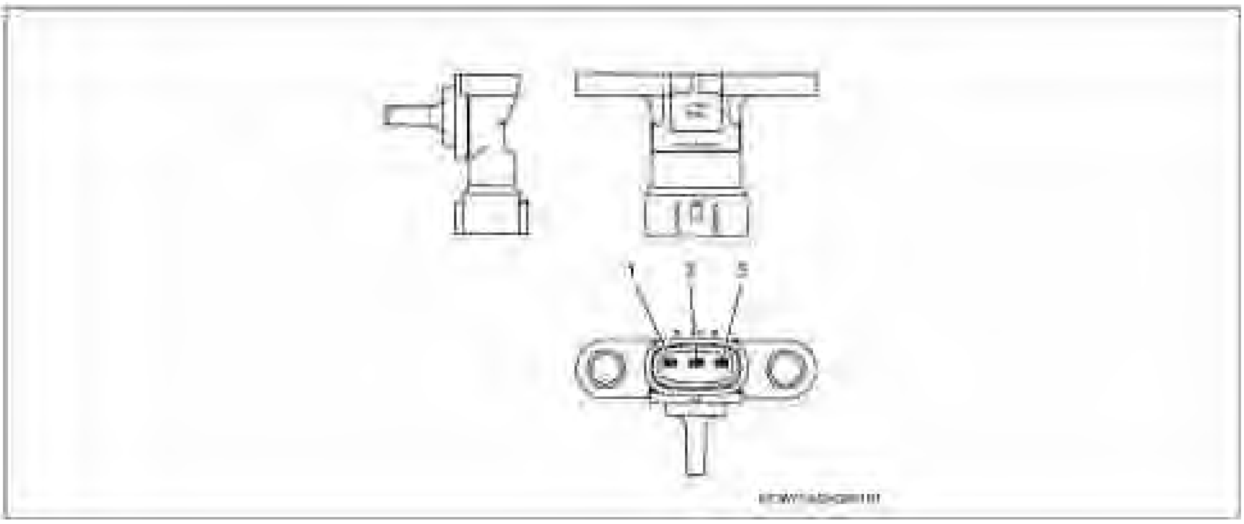


14. Air pressure sensor

Install the air pressure sensor in the dashboard near the pedal bracket Pressure sensor A transducer that changes its voltage in response to a change in air pressure that sends a signal to the *ECM* through a signal circuit associated with a change in air pressure The *ECM* The low signal voltage should be detected at low air pressure (eg, at high altitude) The *ECM* should detect a high signal voltage at high air pressure, and the *ECM* uses this voltage signal to adjust fuel injection and injection timing for altitude compensation.

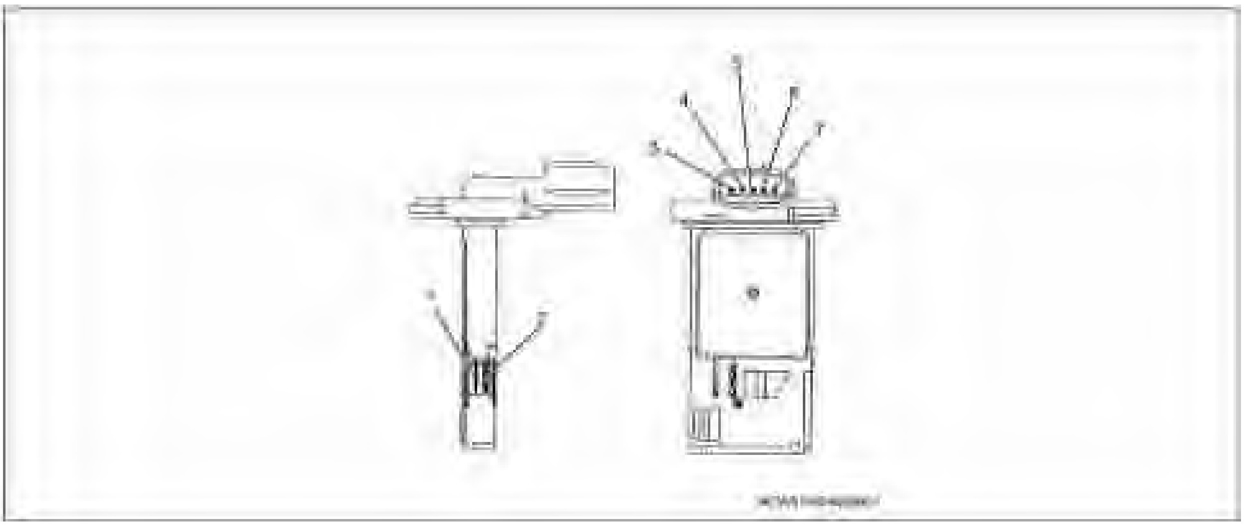


1. Pressure sensor 5 V reference voltage
2. Pressure sensor signal
3. Barometric sensor low reference voltage

15. Mass air flow and intake air temperature sensor

The mass air flow sensor is an air flow meter that measures the amount of air entering the engine. The mass air flow sensor is installed on the line between the air cleaner and the turbocharger. Hour, indicating that the engine is decelerating or in idling state .If the engine intake air volume is large, it indicates that it is accelerating or in a high load state. Mass air flow sensor consists of mass air flow sensor and intake air temperature sensor, The air portion of the measuring pipe is measured.

The intake air temperature sensor is installed on the line between the air cleaner and the turbocharger.The intake air temperature sensor is a variable resistor located in the air flow sensor and measures the temperature of the air flowing into the engine When the intake air temperature The sensor resistance is higher when the sensor temperature is lower, and the sensor resistance is decreased when the air temperature is increased.When the sensor resistance is high, the *ECM* detects that there is a high voltage in the signal circuit.When the sensor resistance is low, the engine The control module detects that there is a low voltage in the signal circuit.



1. Thermal (resistance) line

2. Intake air temperature sensor

3. Intake air temperature sensor low pressure reference

4. Intake air temperature sensor signal

5. Mass air flow sensor signal

6. Mass air flow sensor low pressure reference

7. Mass Air Flow Sensor 12 V Reference

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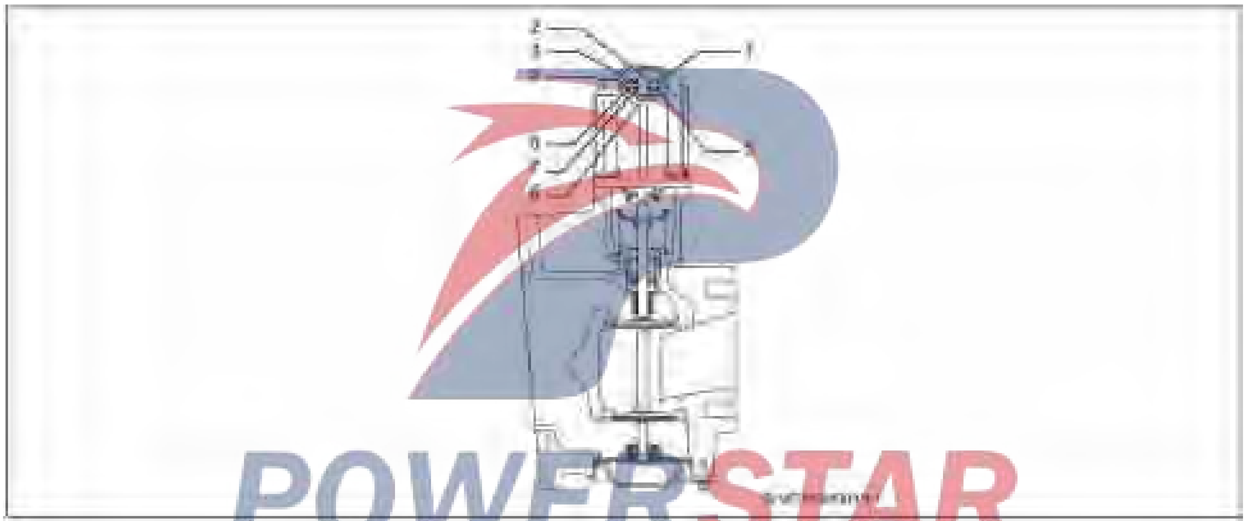
16. EGR valve

The exhaust gas recirculation valve is installed on the intake cover. The *ECM* controls the opening angle of the EGR valve according to the operating status of the engine. The solenoid in the exhaust gas recirculation valve is controlled according to the load ratio signal in the *ECM*. The sensor detects the opening of the exhaust gas recirculation valve The position sensor detects the position of the sensors in the three EGR valves Position sensors 1, 2 and 3 are Hall sensors Positions related to the valve open or closed The sensor output signal varies in proportion to the opening of the EGR valve.



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1. Exhaust gas recirculation position sensor 5 V reference voltage

2. Exhaust gas recirculation position sensor signal 3

3. Exhaust gas recirculation position sensor signal 2

4. Exhaust gas recirculation position sensor signal 1

5. Exhaust gas recirculation position sensor low reference voltage

6. Exhaust gas recirculation motor drive 3

7. Exhaust gas recirculation motor drive 2

8. Exhaust gas recirculation motor drive 1

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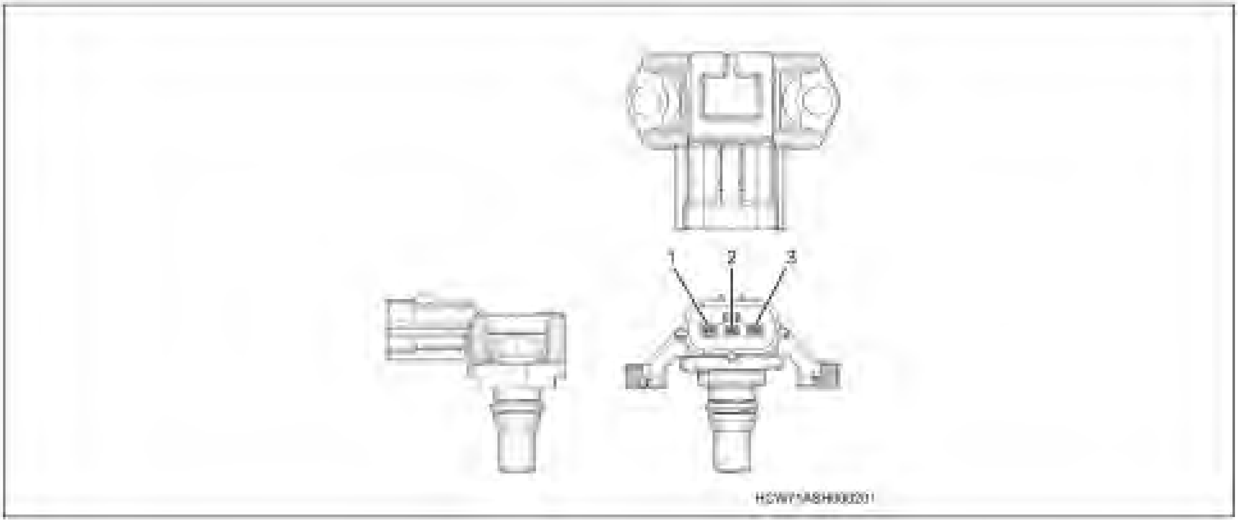
17. Boost pressure sensor

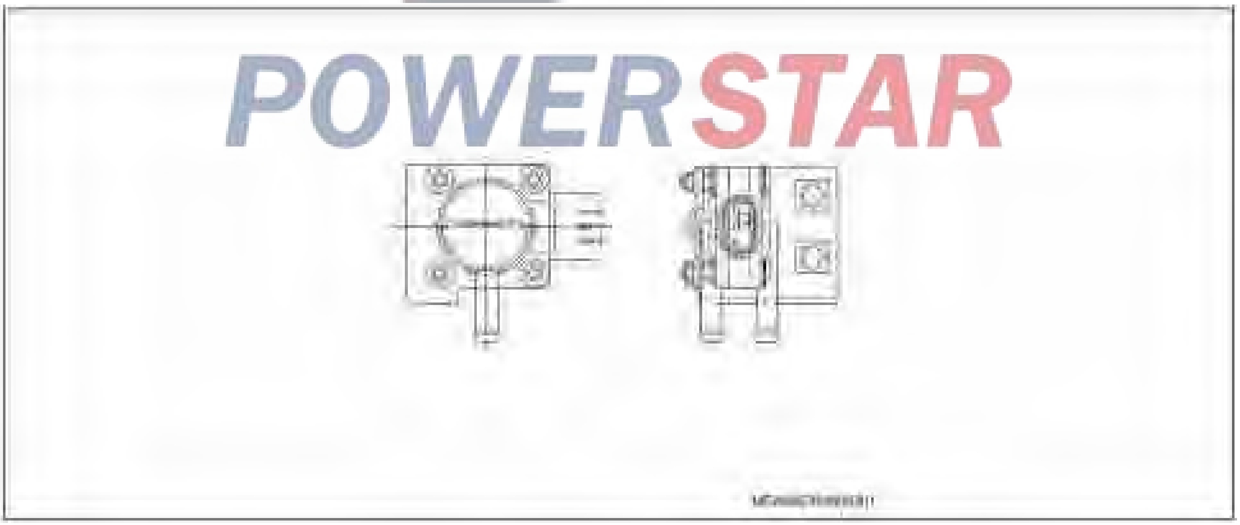
The supercharged pressure sensor is mounted on the engine intake duct and upon detection of intake pressure in the intake manifold the pressure is converted to a voltage signal and sent to the *ECM*.When the pressure is high the voltage becomes more High; when the pressure is low, the voltage becomes lower. The *ECM* calculates the intake pressure based on the voltage signal from the sensor and uses the calculated results to control the fuel injection.



1. Boost pressure sensor 5 V reference voltage
2. Boost pressure sensor low reference voltage
3. Boost pressure sensor signal

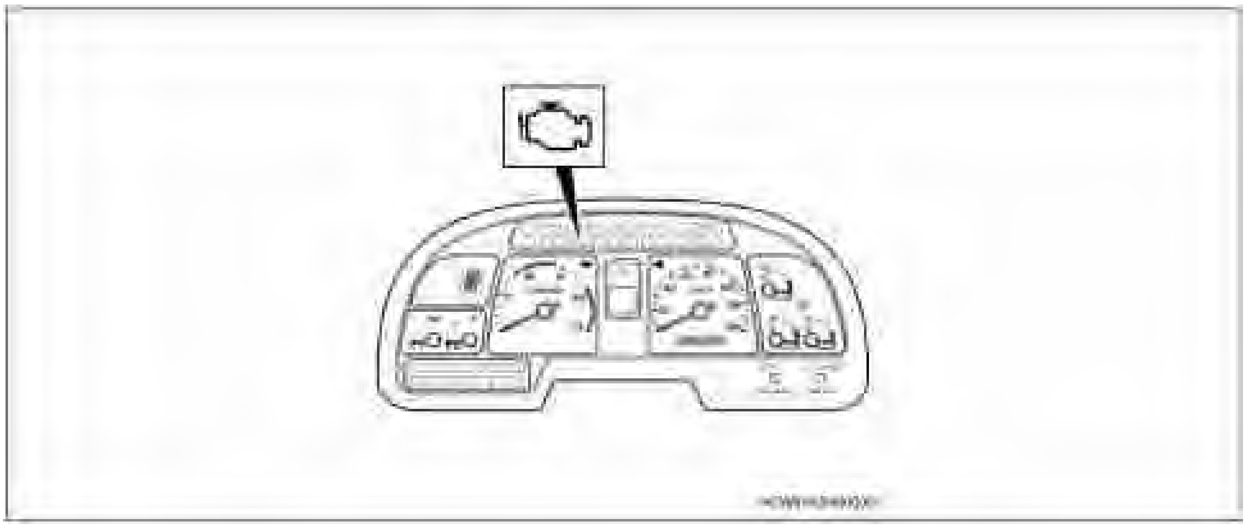
18. Exhaust differential pressure sensor

The exhaust differential pressure sensor is mounted on the chassis frame and near the exhaust muffler assembly. The exhaust differential pressure sensor is a type of transducer that changes the signal voltage based on changes in the exhaust pressure before and after the catalytic converter. The pressure sensor provides a signal to the *ECM* on the signal circuit based on the change in pressure difference before and after the oxidation catalyst. The engine module detects a low signal voltage when the pressure difference is low and the high signal voltage is detected by the engine module when the pressure difference is high.



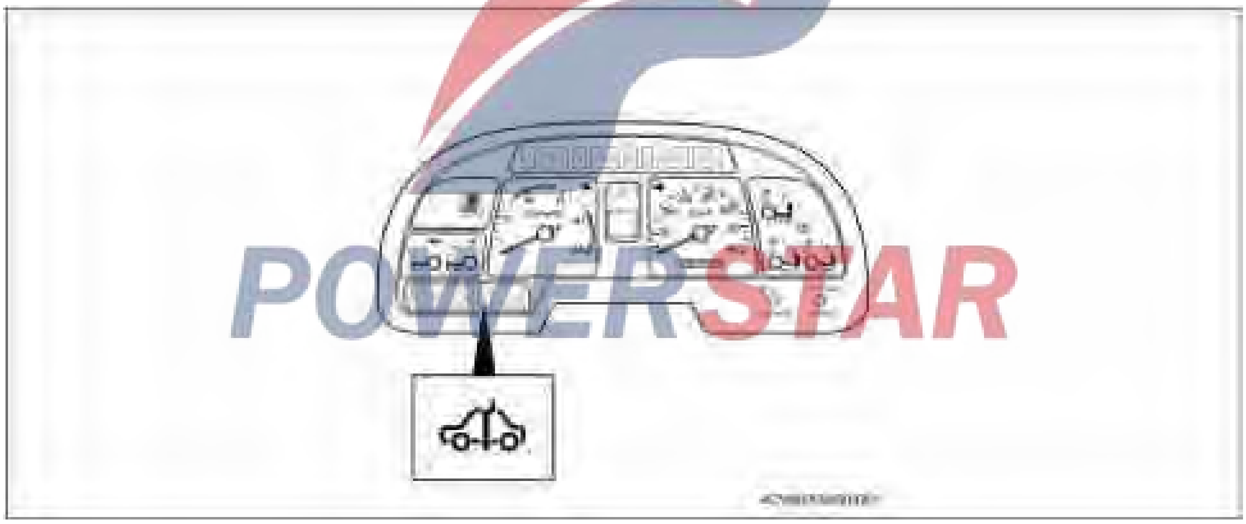
19. MIL

The fault light is located in the dash panel insert to inform the driver of any faults in the exhaust system or related systems. The *ECM* lights the fault indicator when a fault is detected by self-diagnosis.



20. "Repair vehicle as soon as possible" light

The "Service Vehicle as soon as possible" light is located in the dash panel insert to inform the driver of system malfunctions other than exhaust gas or related systems. When the *ECM* detects a fault via the self-diagnostic function, the "Service vehicle as soon as possible" light The terminal of the data communication link connector can be shorted to flash the "Service Vehicle as soon as possible" flag to check the status of the trouble code.



21. Diagnostic switch (diagnostic connector)

The diagnosis switch is installed inside the inspection cover. The "Service Vehicle as soon as possible" light will flash and the trouble diagnosis status can be confirmed after connecting the diagnosis joint and the diagnosis sharing joint.

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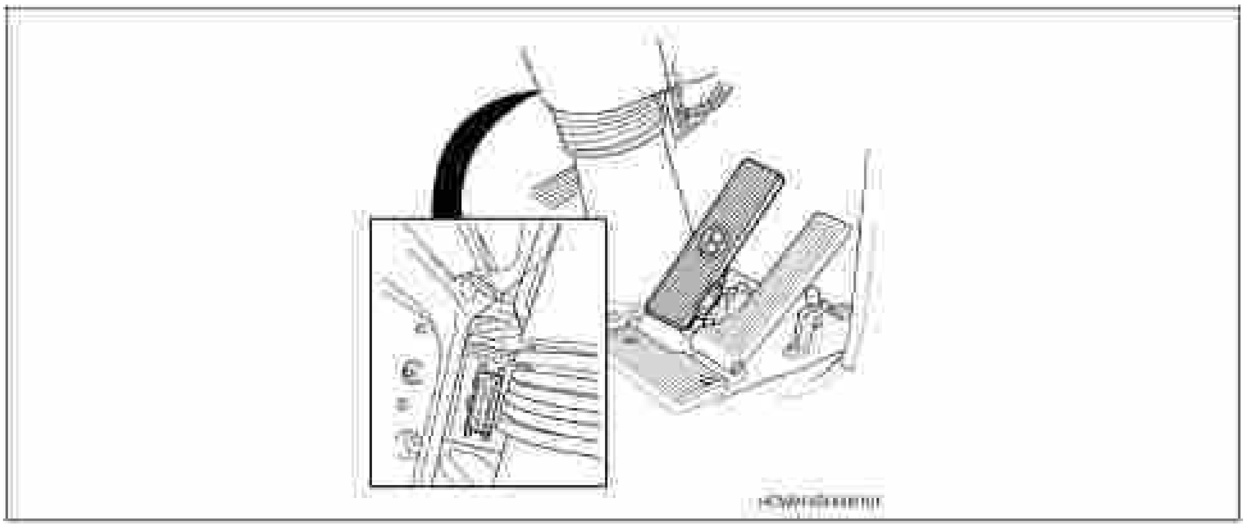
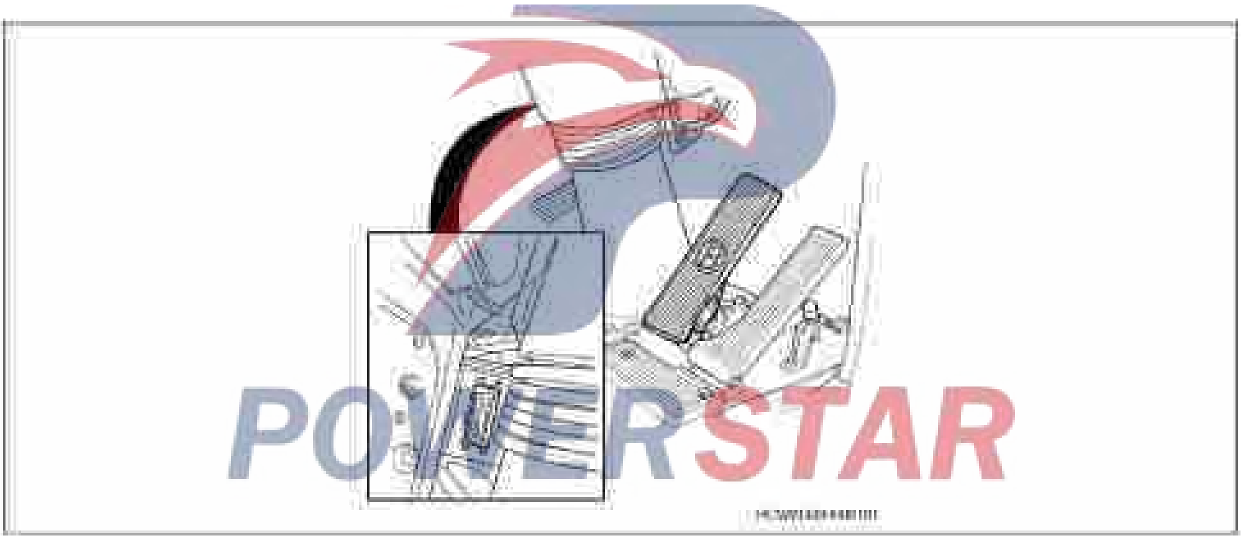


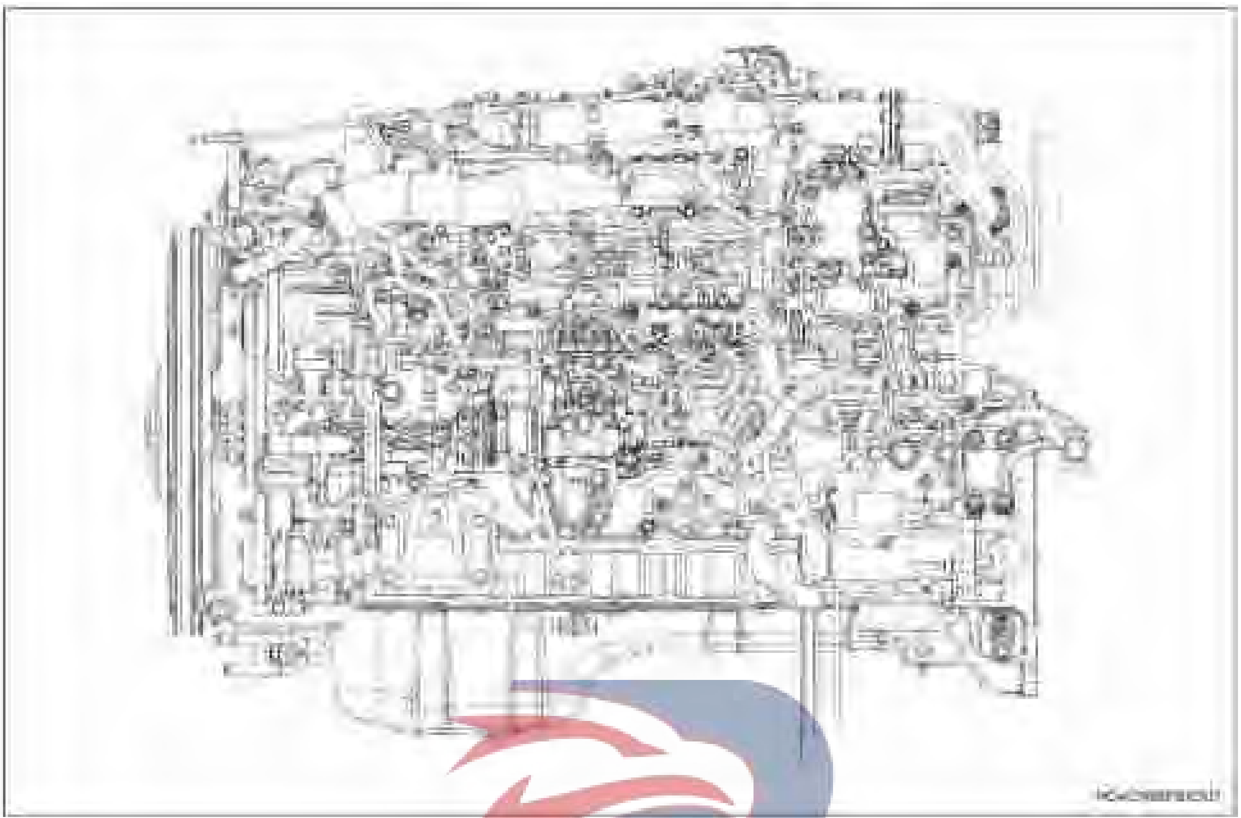
22. Data Communication Link Connector (DLC)

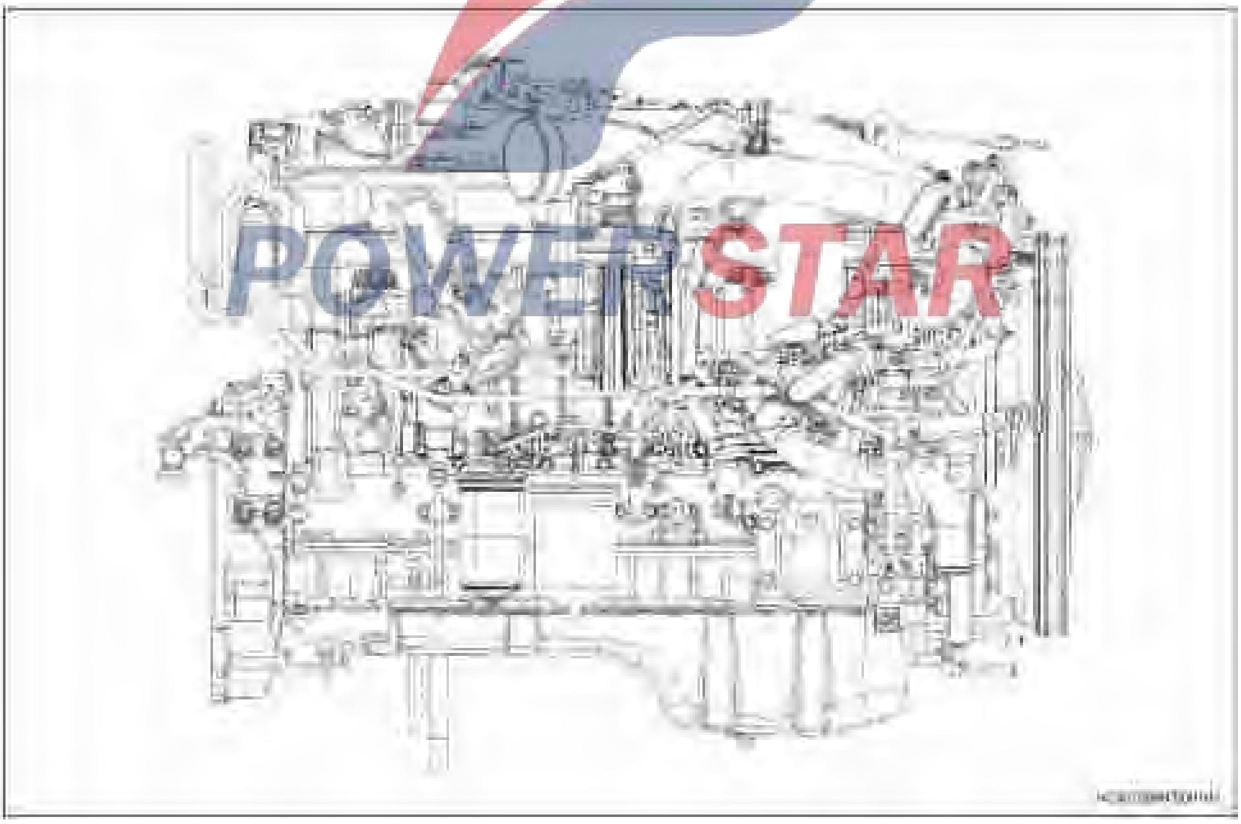
Data communication link connector installed inside the inspection lid, is a realization of external diagnostic equipment and each controller connection and communication connector.



10. Engine mechanical part

1. Engine structure diagram





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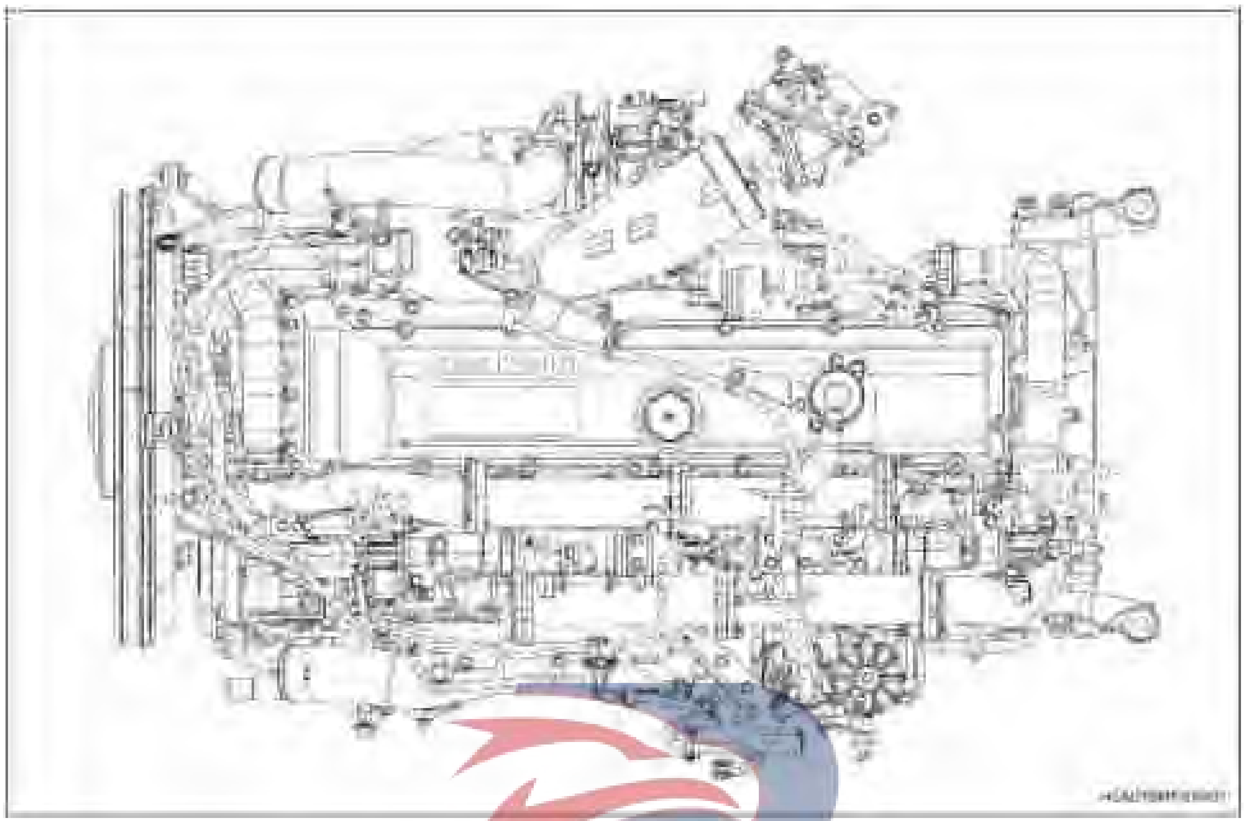

11. Fuel system

1. Fuel system diagram

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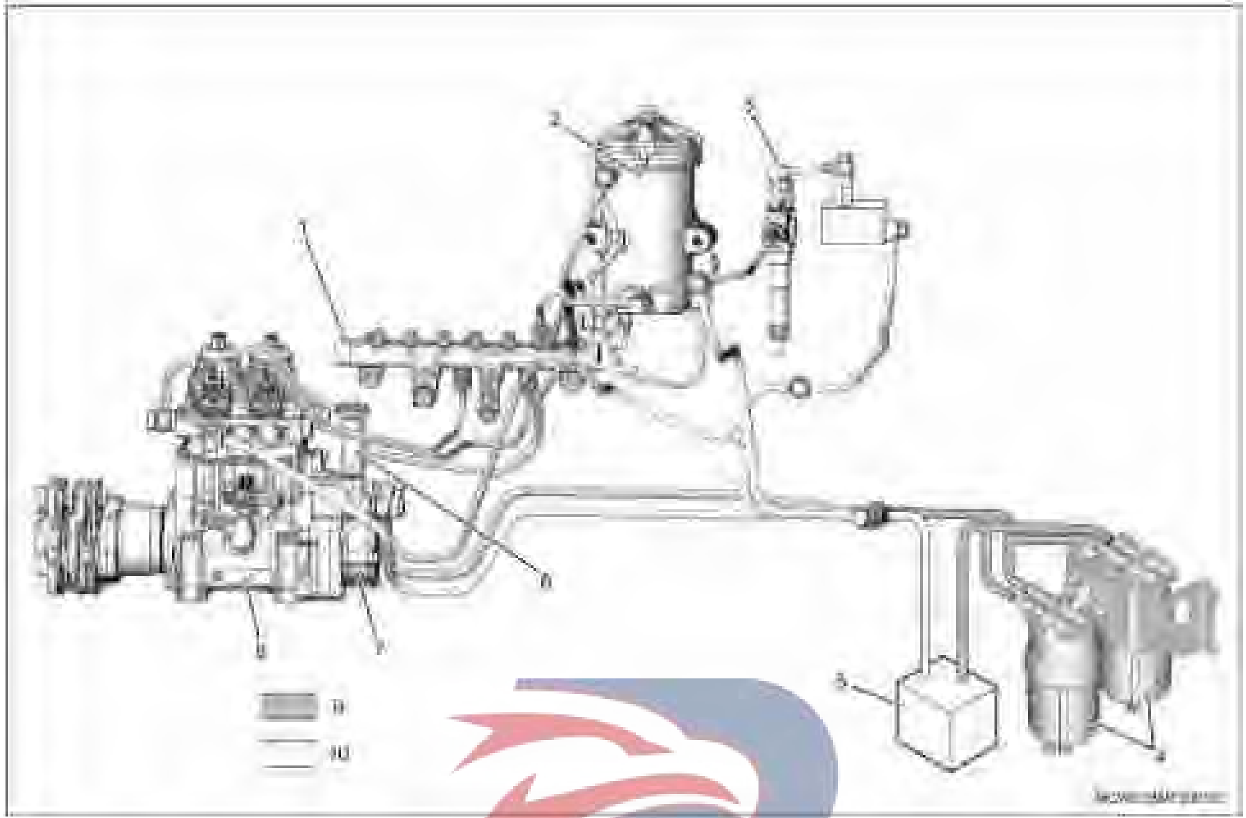

1. Common rail (fuel rail)
2. Fuel filter
3. Injector
4. Fuel pre-filter
5. Fuel tank
6. Priming pump
7. Supply pump
8. Fuel pump
9. Pipeline
10. Return line

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2. Common rail

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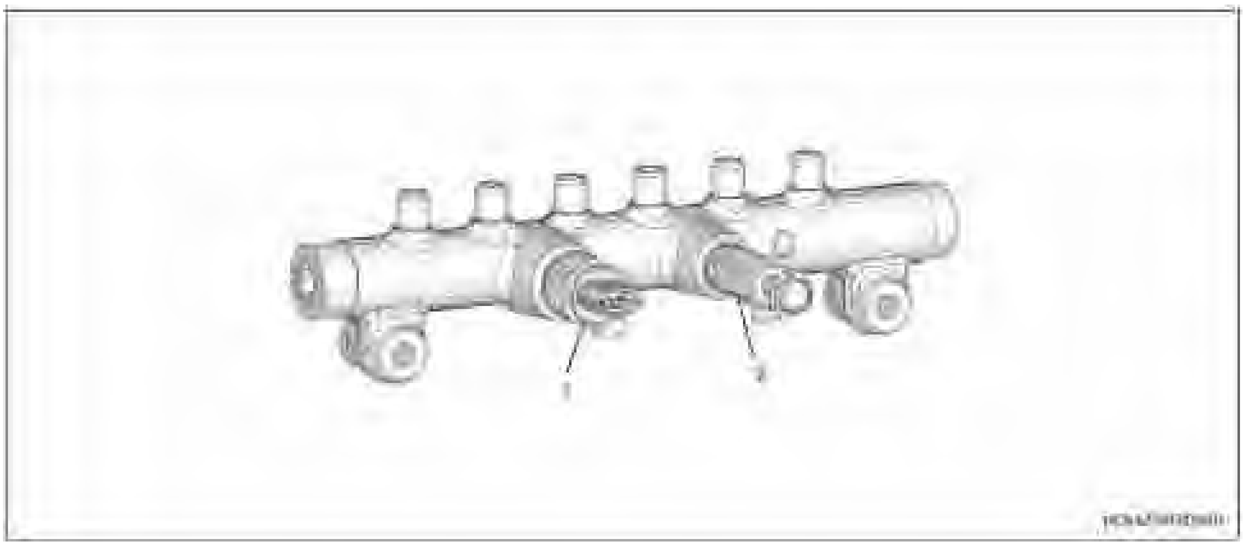
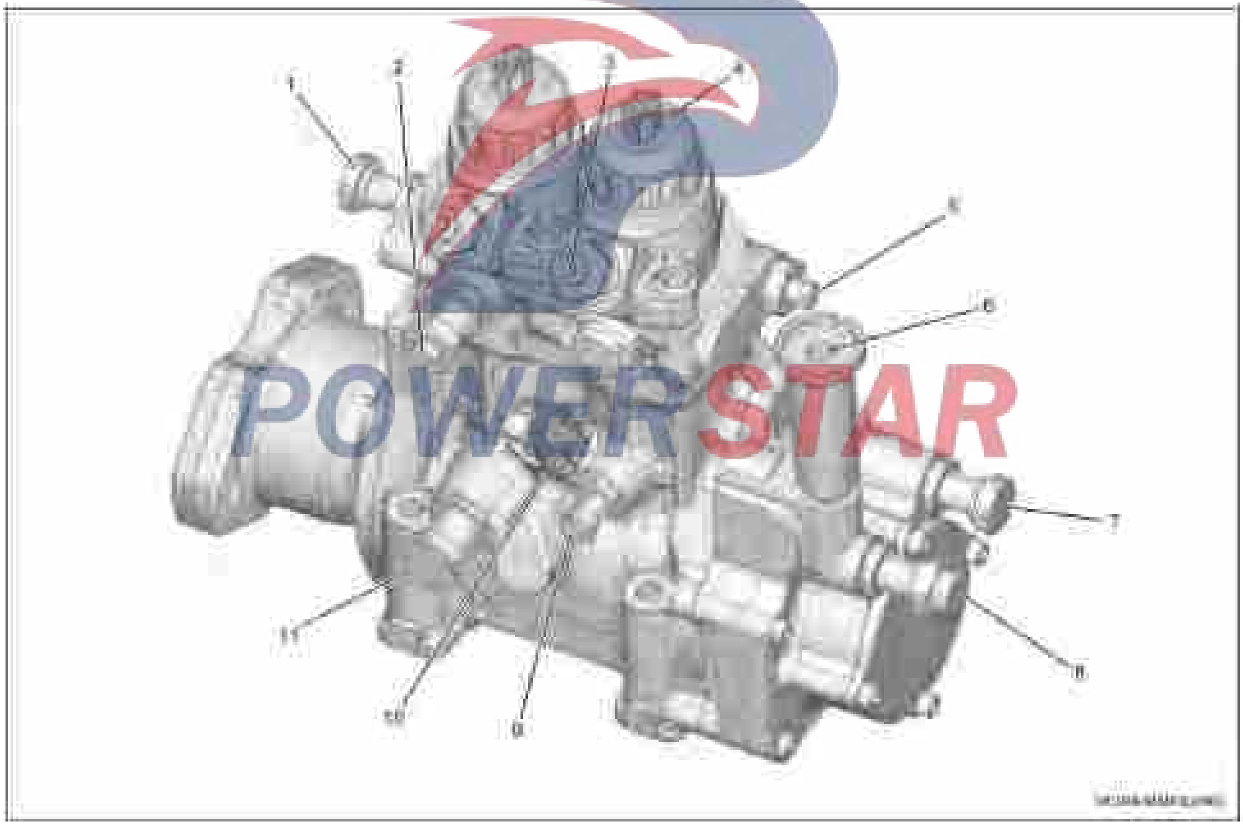


1. FRP sensor

2. Pressure limiter

3. Fuel pump



1. Pump body (inlet side)

2. Relief valve

3. Pump (outlet side)

4. Crankcase forced ventilation

5. Bleed valve

6. Priming pump

7. Outlet (supply pump)

8. Intake port (supply pump)

9. Into the mouth

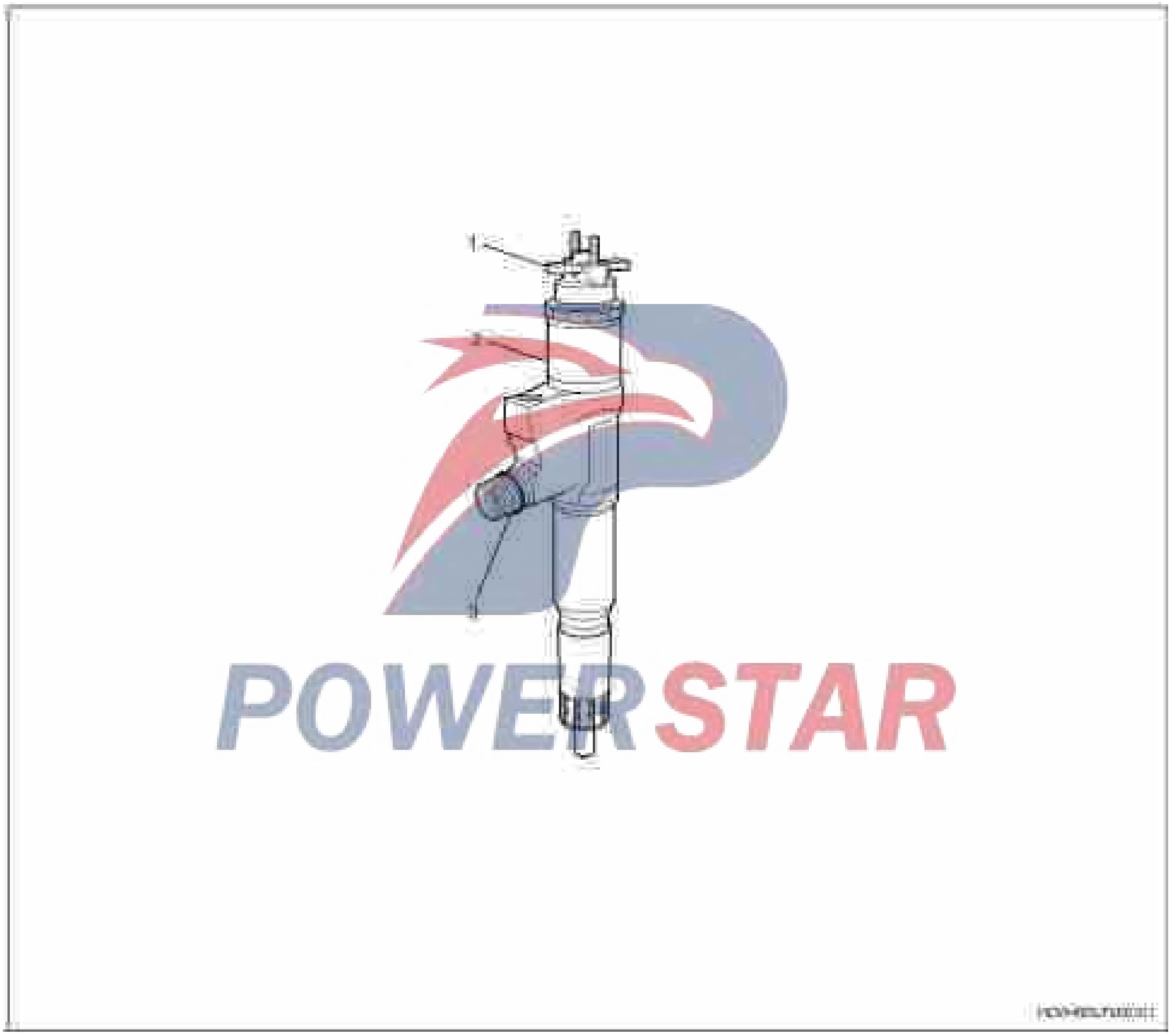
10. Cylinder identification sensor

11. Outlet

Caution:

● Do not disassemble the flow dampers or injectors on the common rail (fuel rail).

4. Injector



1. Identification code plate

2. Injector

3. O-ring

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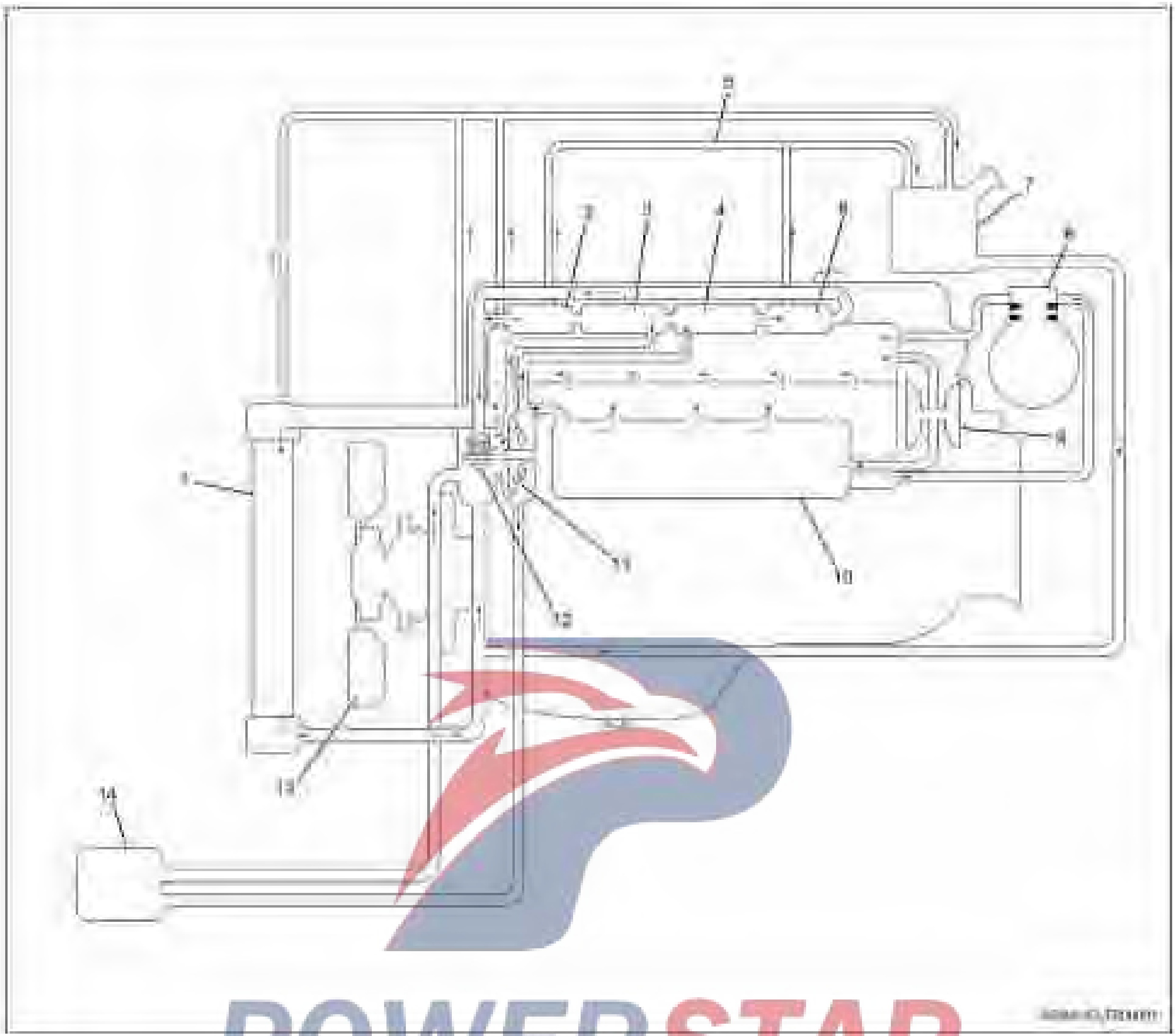
12. Cooling system

The cooling system is a forced circulation system consisting mainly of water pumps, thermostats and radiators that cool the interior of the engine, the interior of the oil cooler, the interior of the turbocharger, the interior of the air compressor and the exhaust gas recirculation .



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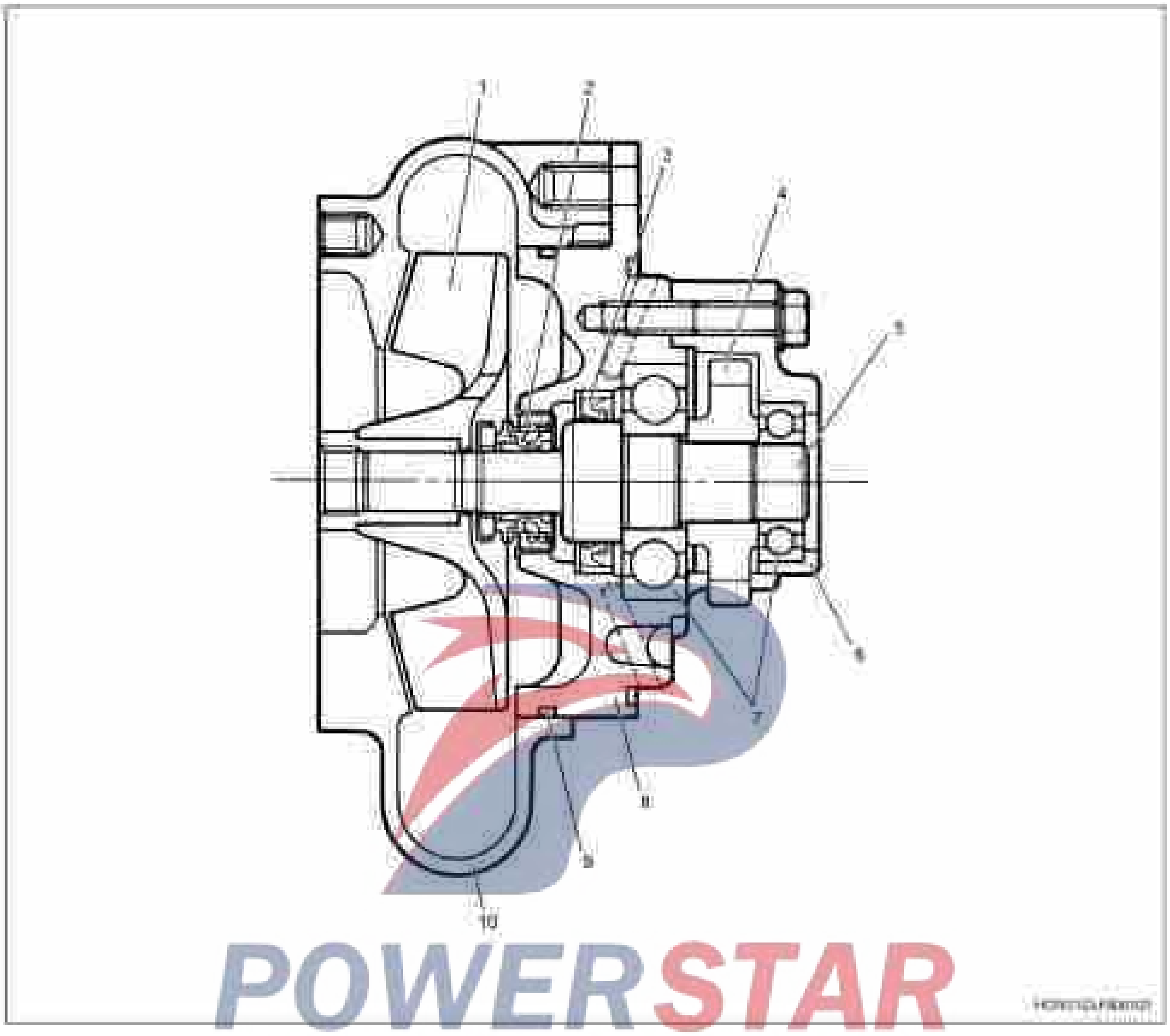
1. Radiator
2. EGR cooler.
3. EGR cooler
4. EGR cooler
5. Deflation pipeline
6. EGR cooler
7. Deputy tank
8. Air compressor
9. Turbocharger
10. Oil cooler
11. Water pump
12. Thermostat
13. Cooling fan
14. Heater core

Water pump structure

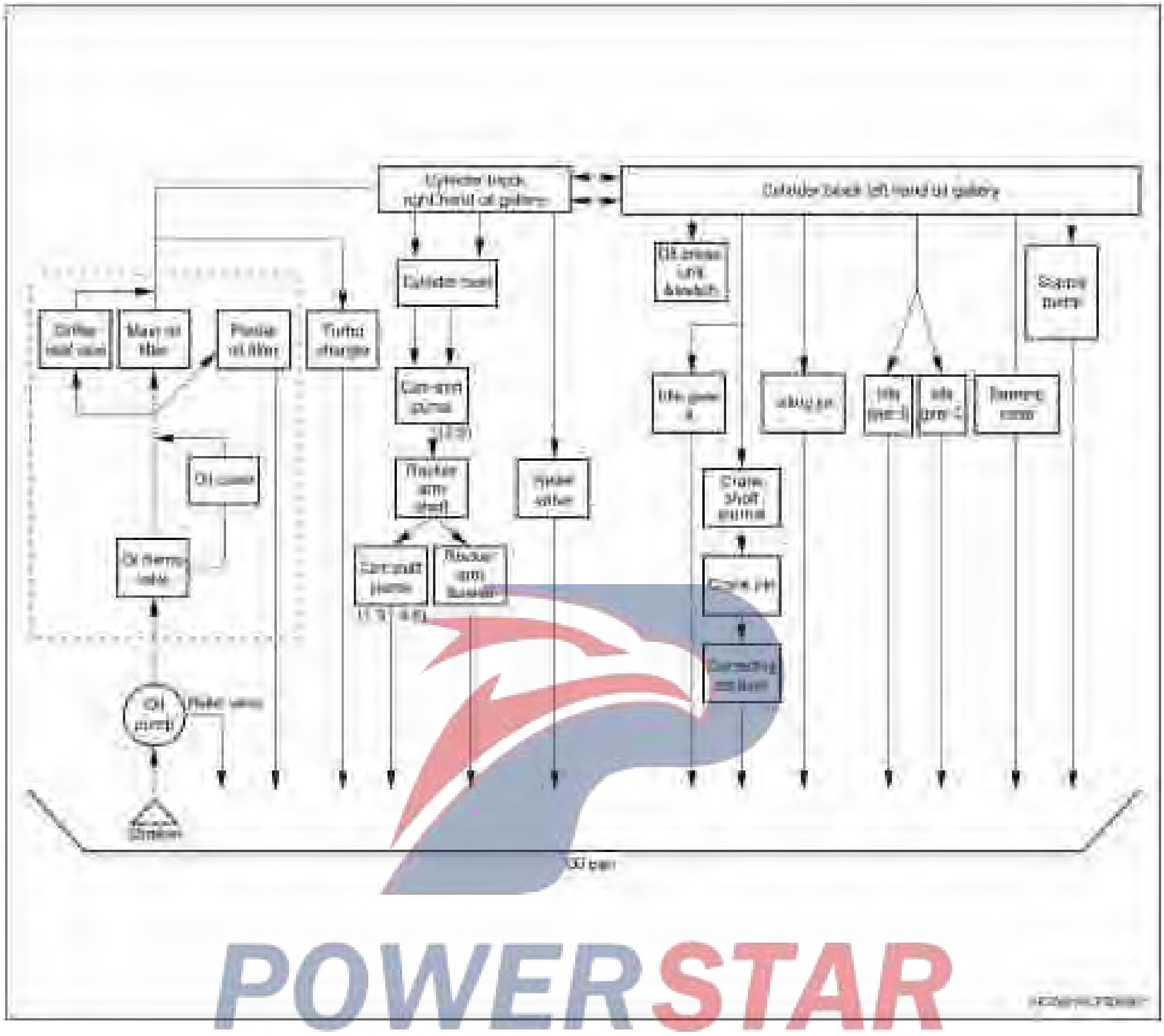


1. Impeller
2. Seal unit
3. Oil seal
4. Gear
5. Shaft
6. Rear cover
7. Shaft
8. Water pump
9. O-ring
10. Front cover

13. Lubrication system

Lubrication system includes gear pump, full flow bypass integrated oil filter, some oil filters, water-cooled oil cooler, oil drain valve and piston cooling oil nozzle.

Lubrication system diagram



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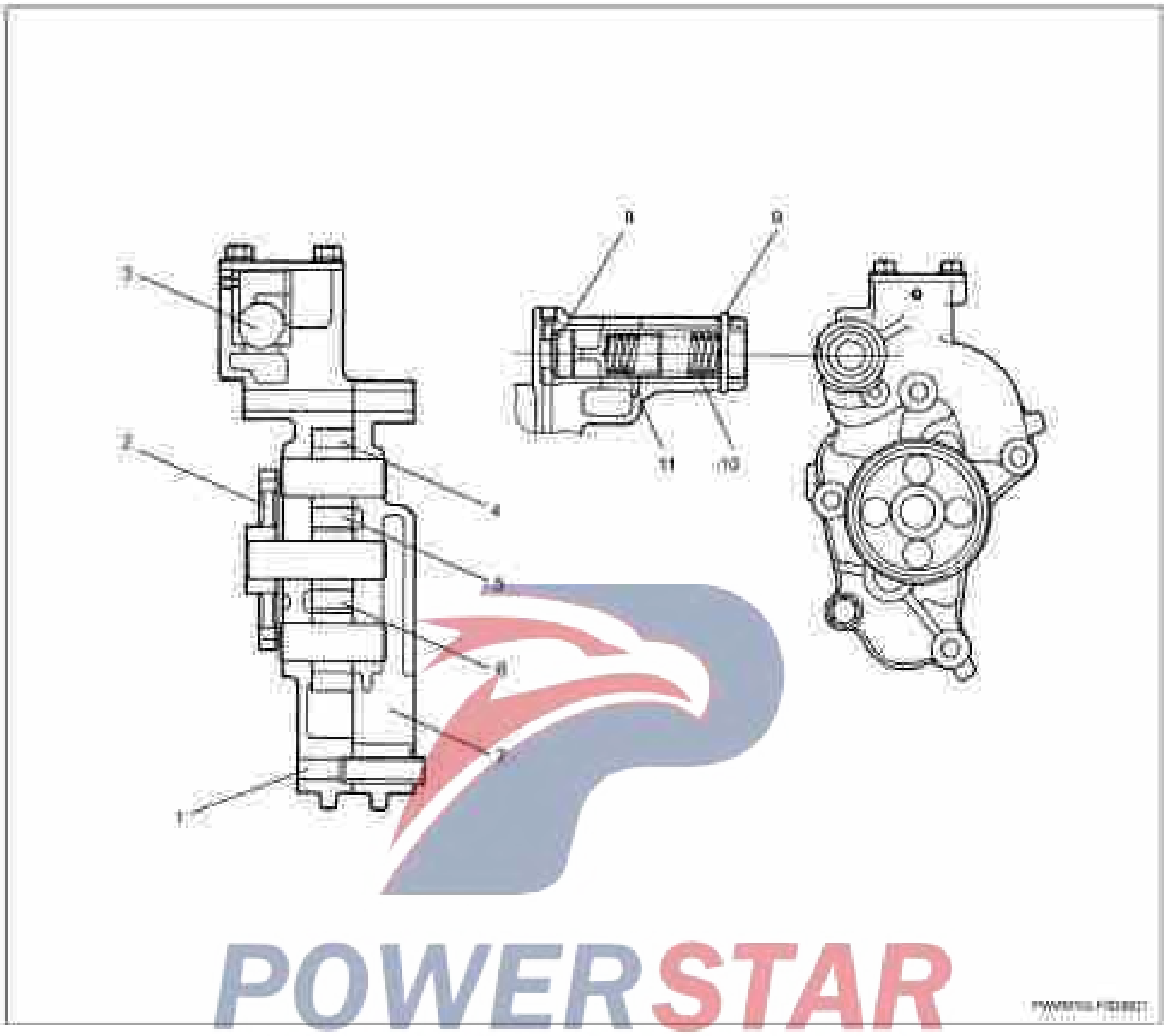
Oil pump structure



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1. Oil pump body
2. Oil pump drive gear
3. Ball
4. Driven gear
5. Drive gear
6. Driven gear
7. Oil pump cover
8. Pressure reducing valve
9. Cotter pin

10 spring seat

11. Spring

14. Exhaust system

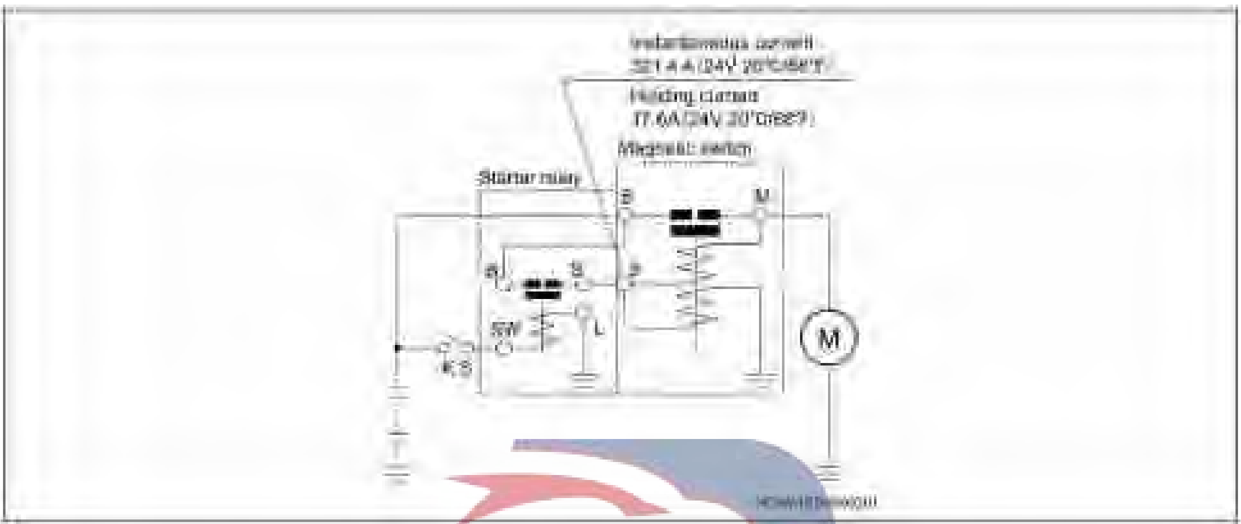
Exhaust brake can be achieved by adjusting the exhaust pressure brake assist, the engine quickly warm up, etc. Silencer integrated in the catalytic converter for cleaning exhaust.

The main components by the exhaust brake, the front exhaust pipe, silencer and rear exhaust pipe.

15. Electrical system

1. Starter circuit

The starting system consists of battery, starter, ignition switch and starter relay.The wiring layout of these main components is as shown in the figure.



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2. Charging circuit

Main generator function

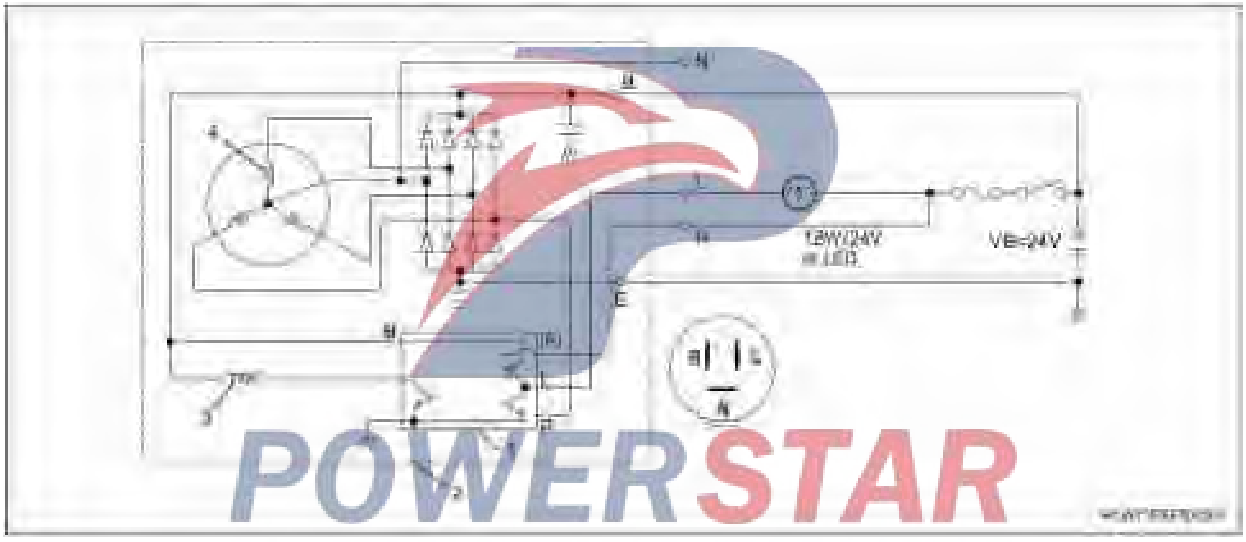
The generator adopts the brushless structure, the main components include rotor, stator, rectifier, front bracket, rear bracket, integrated circuit regulator, bearings, pulleys and so on.

The three-phase alternating current generated in the stator coil is converted into direct current, and six main diodes and two auxiliary diodes are required, among the six main diodes, three are positive and the others are negative. The generator has three terminals: B Terminal (DC output terminal), terminal L and terminal R. When the generator is in the normal state, the L terminal turns off the lamp and starts to generate electricity, and upon detection of a generator fault, it sinks the current so that the lamp is lit. Likewise, it is also the output terminal.

Diagnostic Regulator (Voltage Control and Temperature Correction):

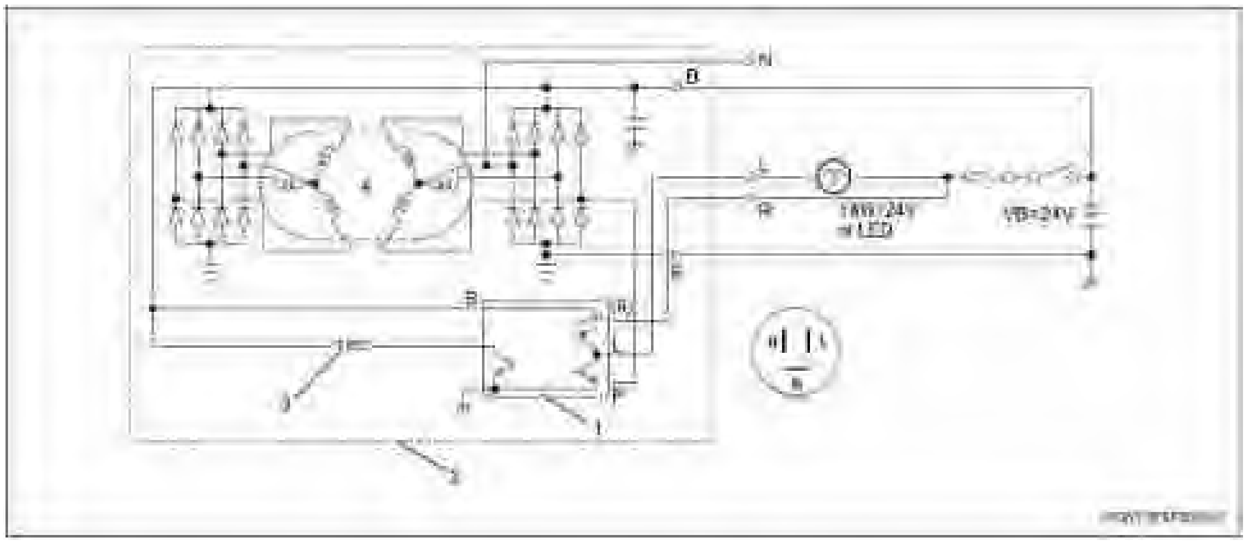
When the ACG is not generating electricity and when the ACG goes out of control (due to over voltage), troubleshooting (lighting) will be performed.

60 A specifications



1. Integrated circuit regulator
2. Generator
3. Excitation coil
4. Stator coil

90 A specifications



1. Integrated circuit regulator
2. Generator
3. Excitation coil
4. Stator coil

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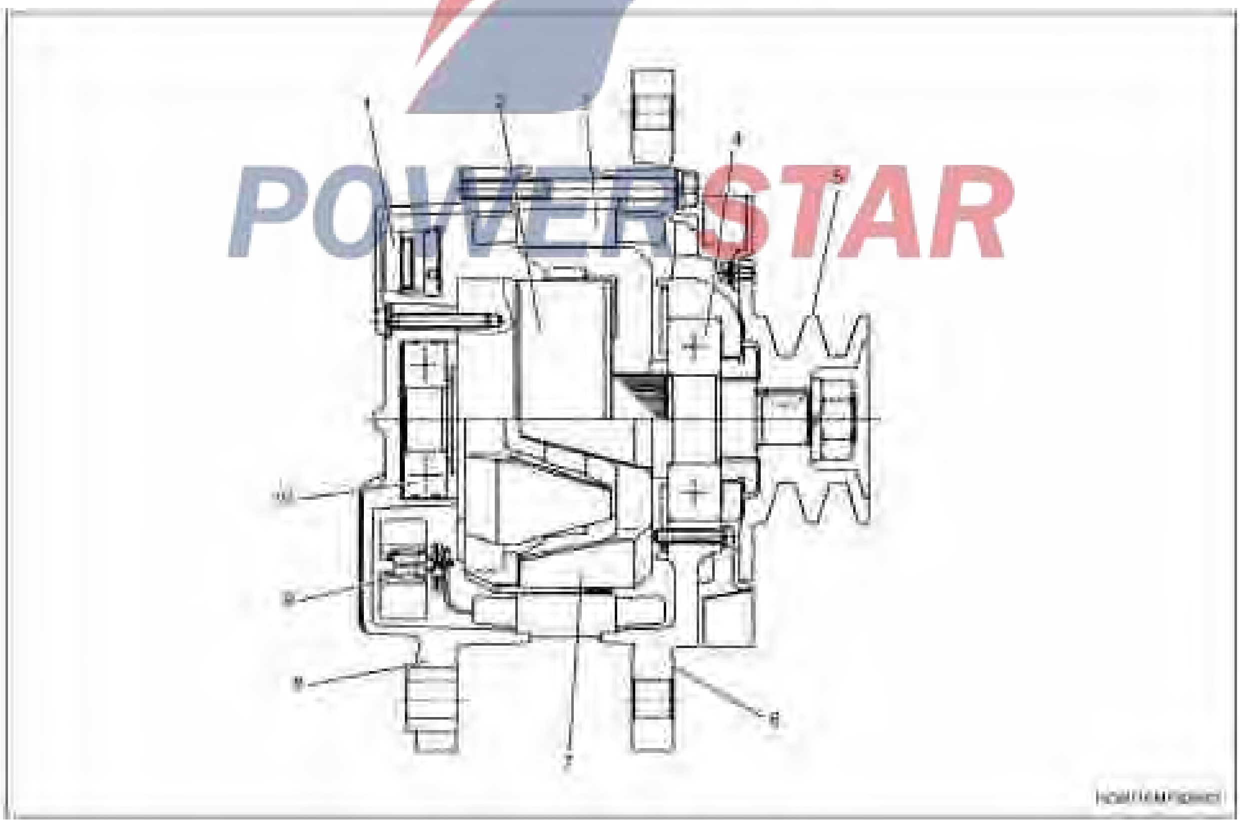
3. Engine cross-section drawings

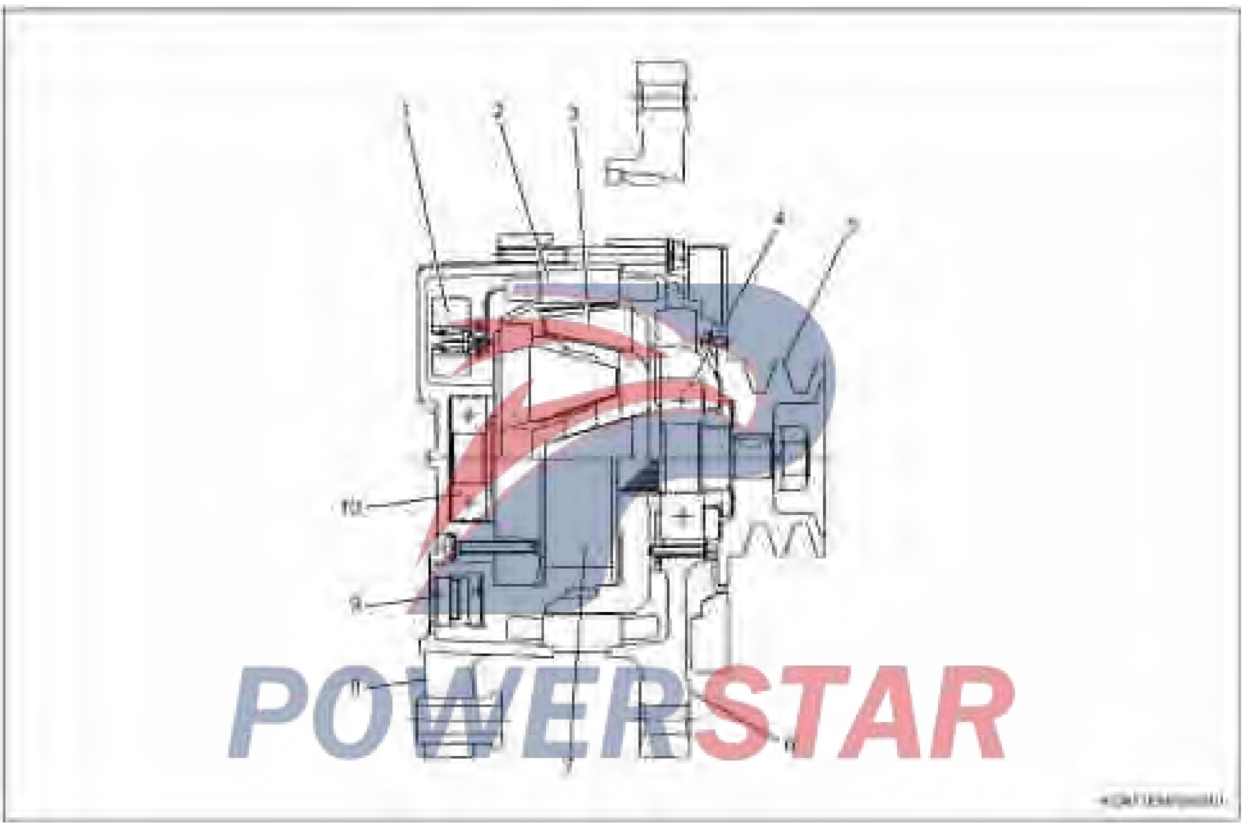
60 A specifications



1. Integrated circuit regulator
2. Excitation coil
3. Stator

4. Front bearing
5. Pulley
6. Front bracket
7. Rotor
8. Rear bracket
9. Rectifier
10. Rear bearing

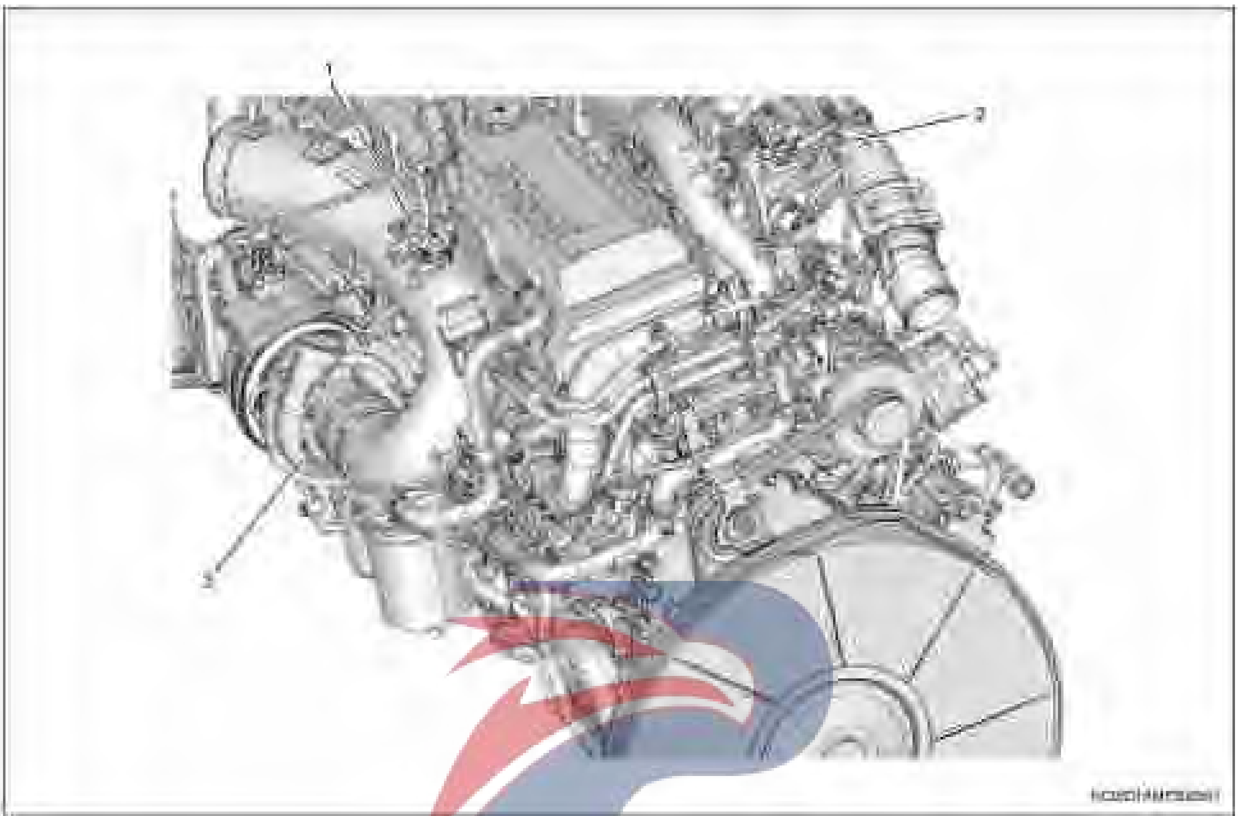
90A specifications



1. Integrated circuit regulator
2. Stator
3. Rotor
4. Front bearing
5. Pulley
6. Front bracket
7. Excitation coil
8. Rear bracket
9. Rectifier
10. Rear bearing

16. Engine Control Component Views

1. Engine parts location map



1. Mass air flow and intake air temperature sensor
2. EGR valve 2
3. Turbocharger

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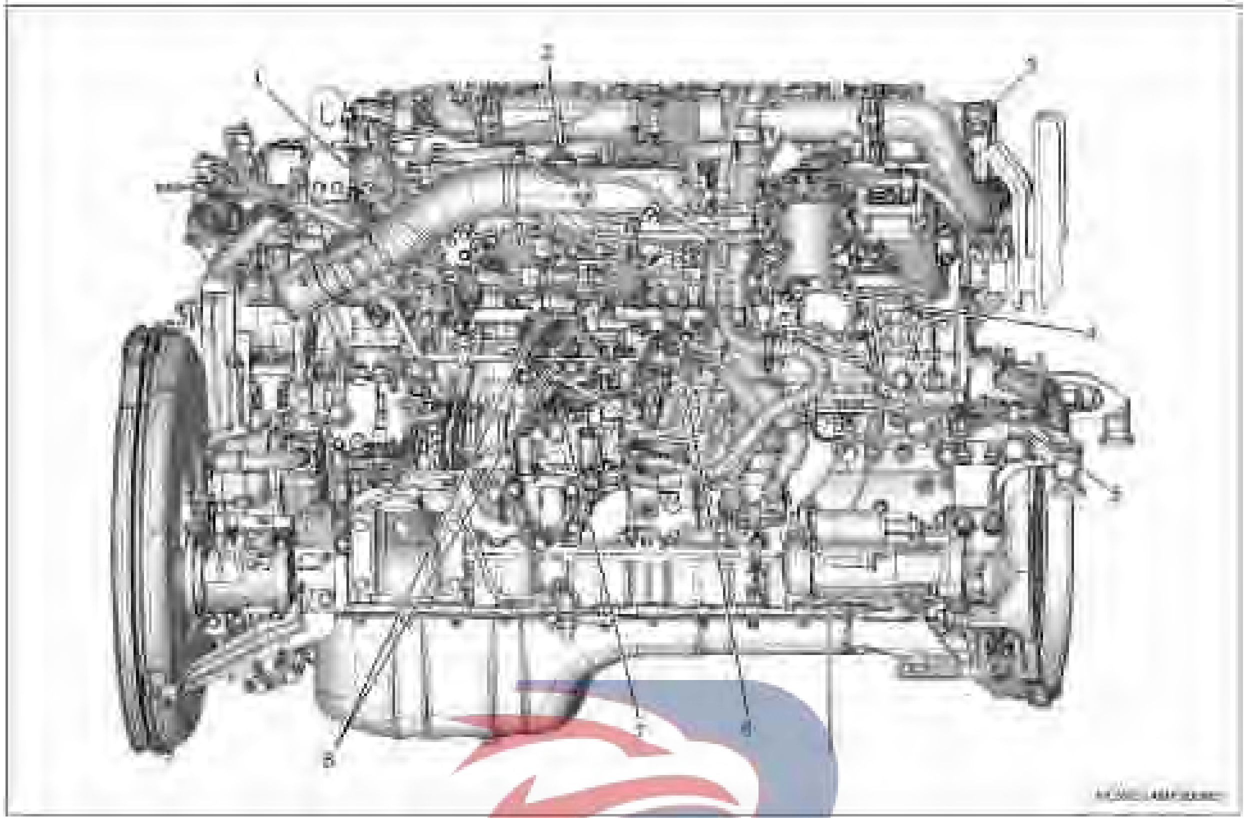

1. Engine coolant temperature sensor
2. Boost pressure sensor
3. EGR valve 1
4. Fuel temperature sensor
5. CMP sensor
6. FRP sensor
7. CMP sensor
8. Crankcase forced ventilation

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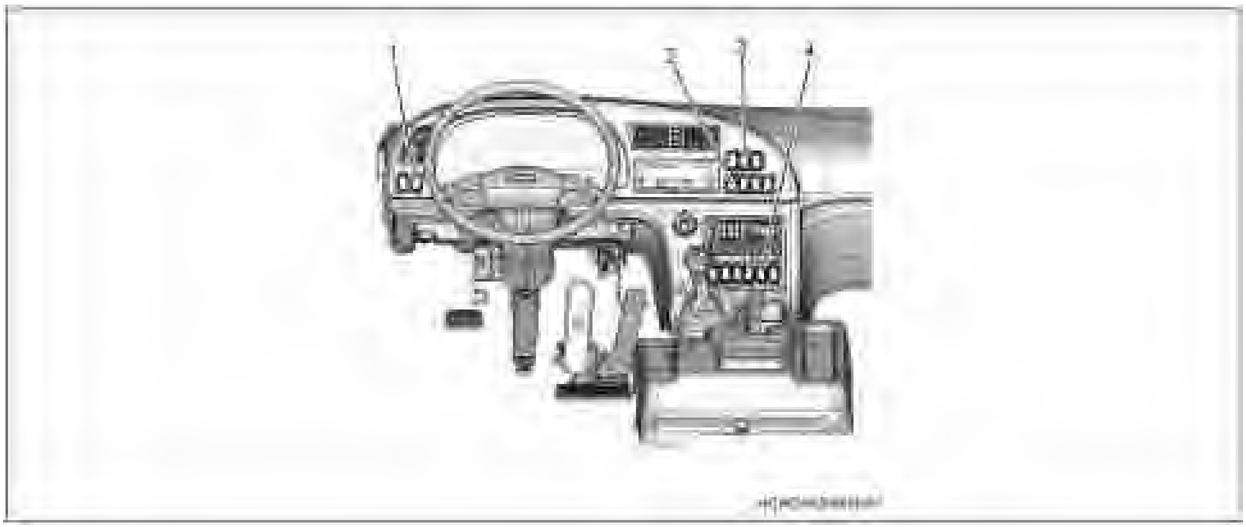
2. Cab switch layout



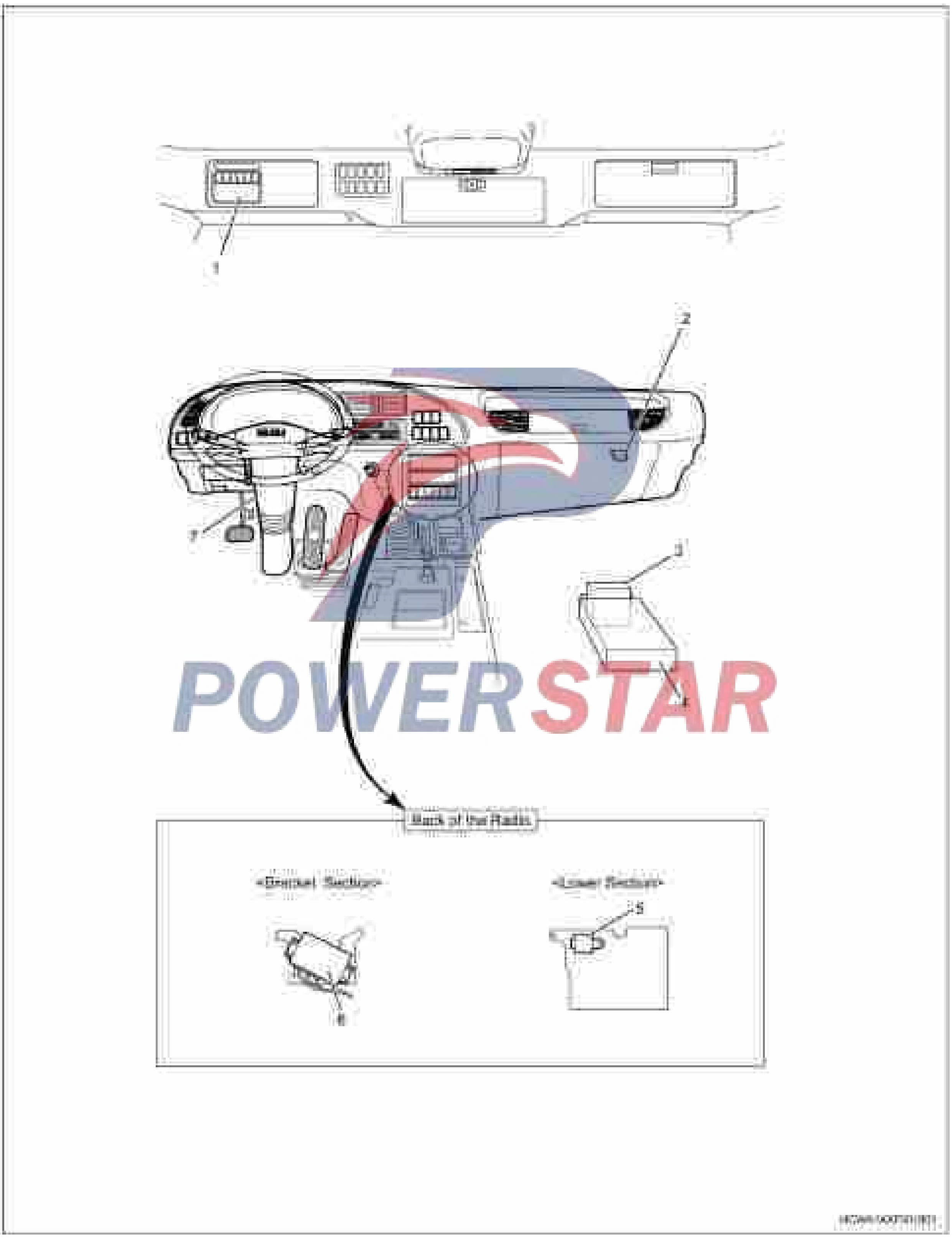
1. Idle speed control switch

2. Engine stop button

3. Power take-off switch

4. Axis differential lock switch

3. Cab control unit layout



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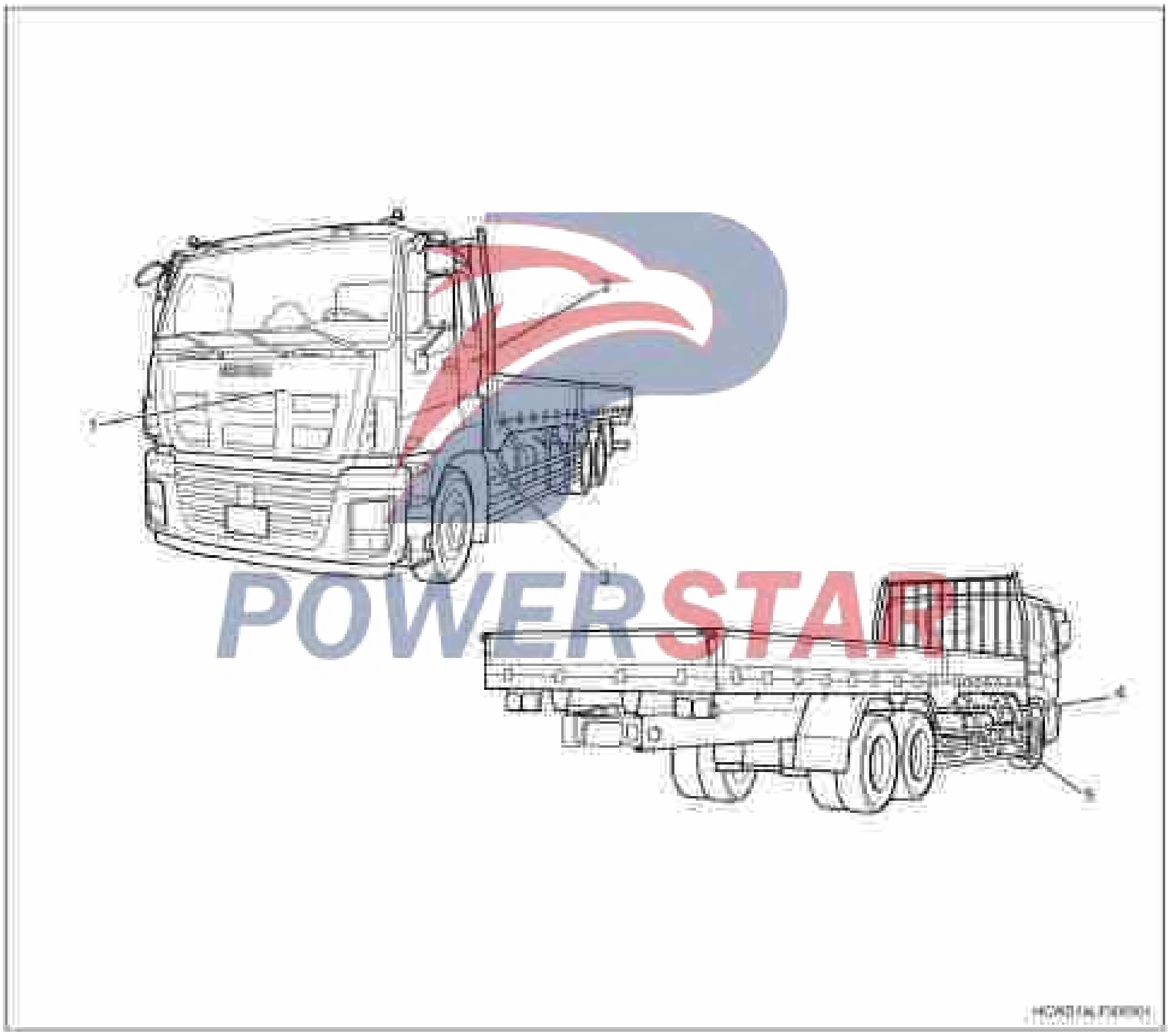
1. Speed recorder
2. Electronic control unit main relay
3. MIMAMORI information module
4. ECM
5. Flasher
6. Anti-lock braking system control unit
7. Speed sensor control unit

4. Chassis components layout

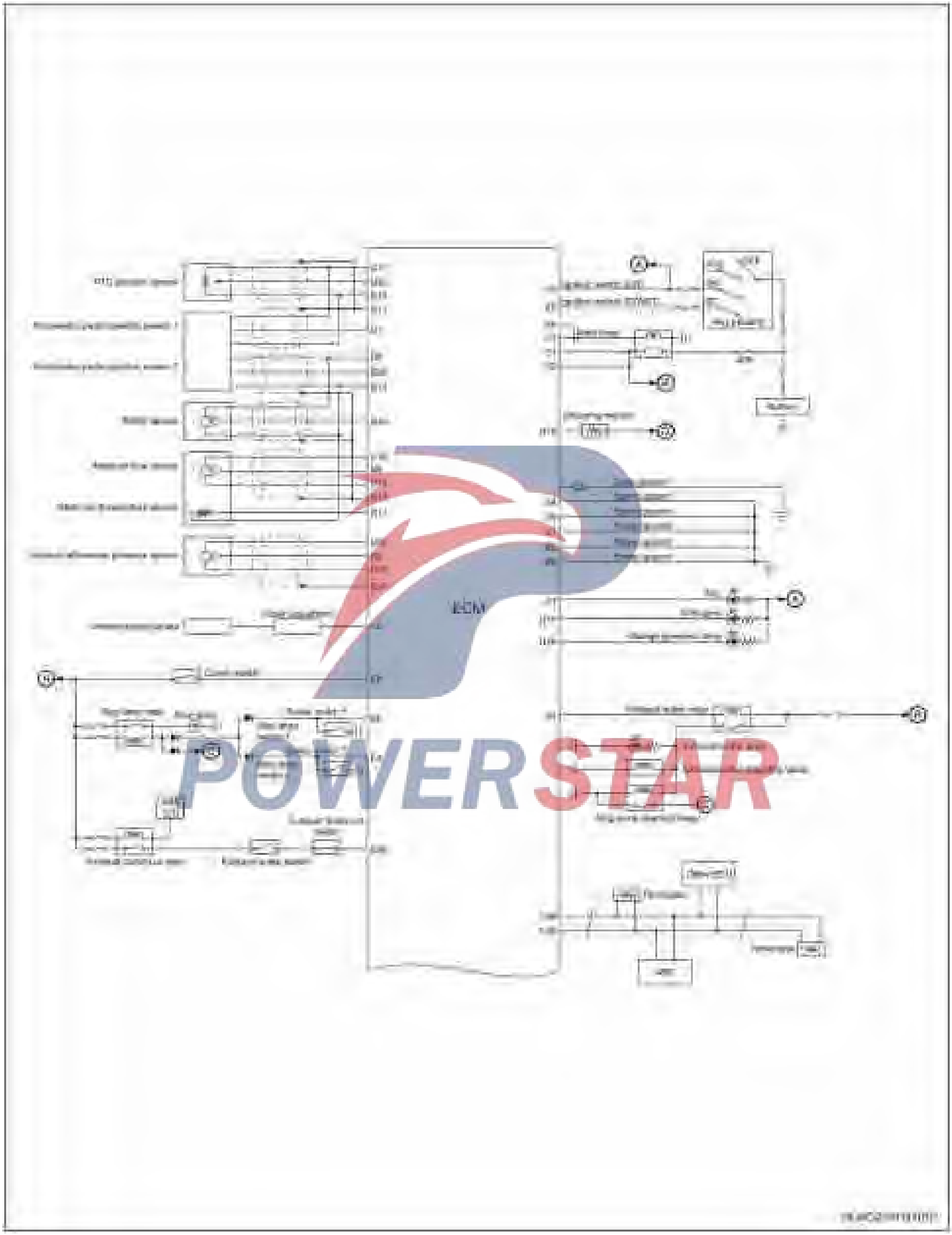
Chassis area



1. Brake valve area
2. Cab back-end component area (solenoid valve, PTO throttle sensor)
3. Transmission area (speed sensor, neutral switch and reverse switch)
4. Battery
5. Air box area

17. Circuit diagram

1. Circuit diagram



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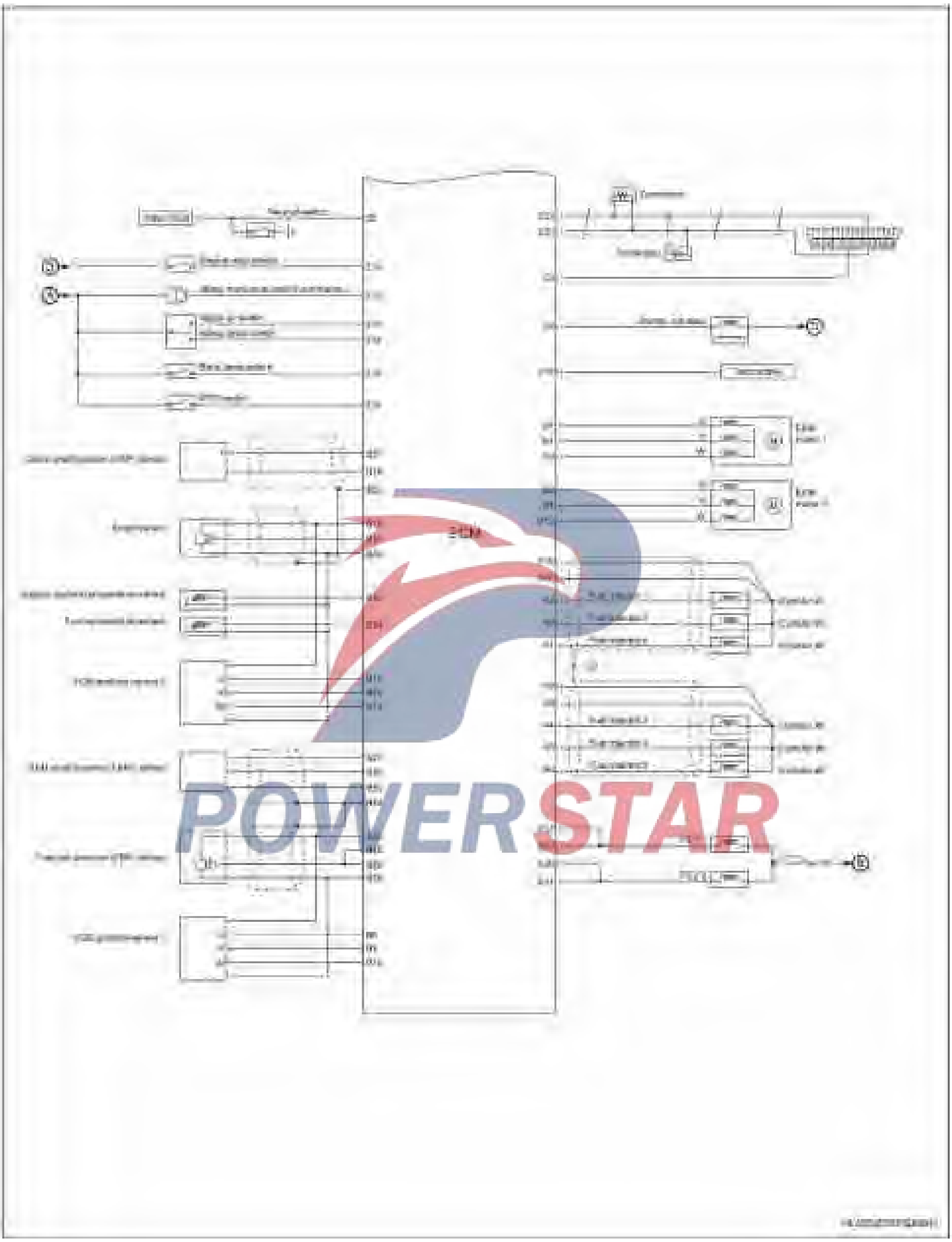
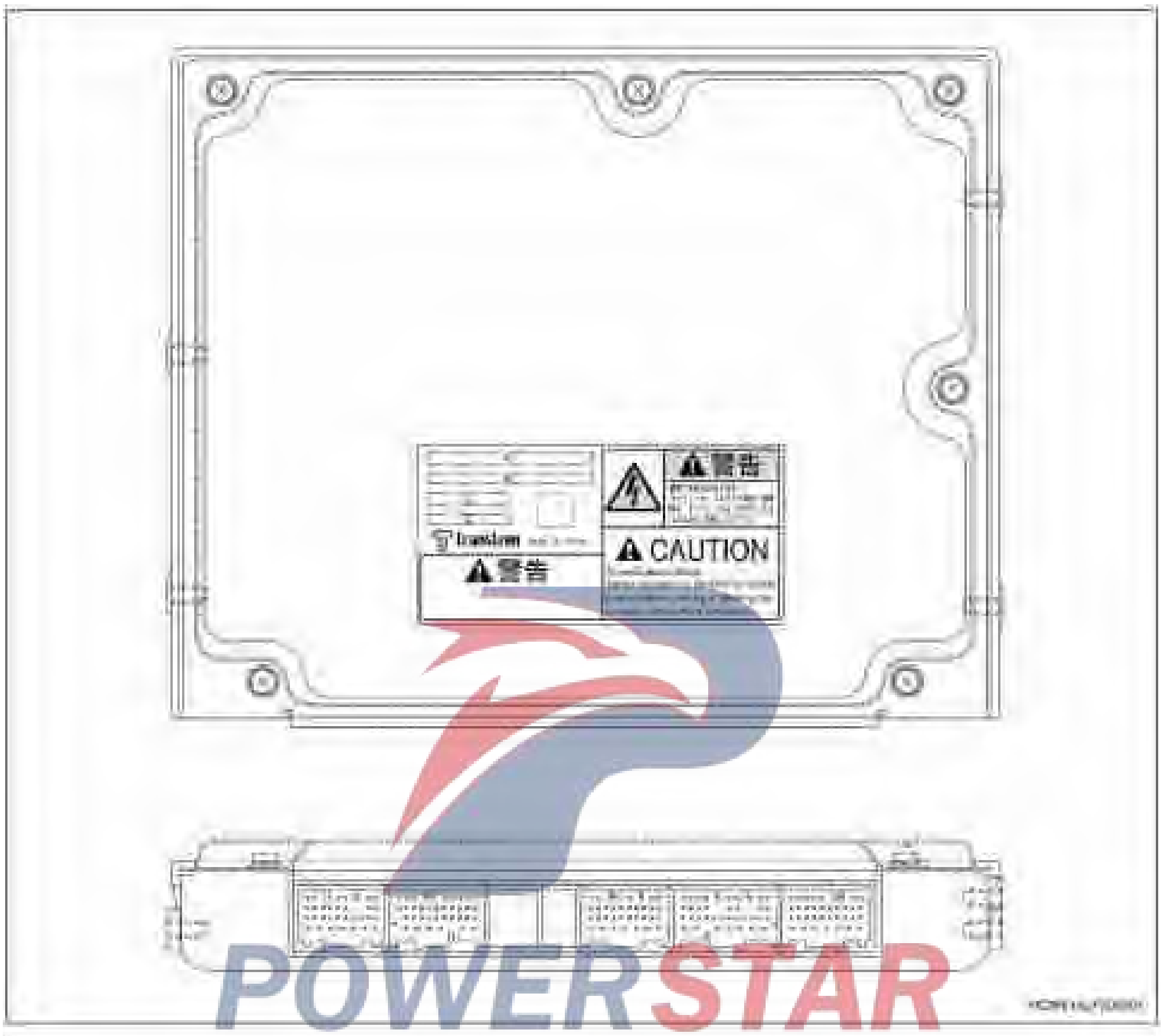
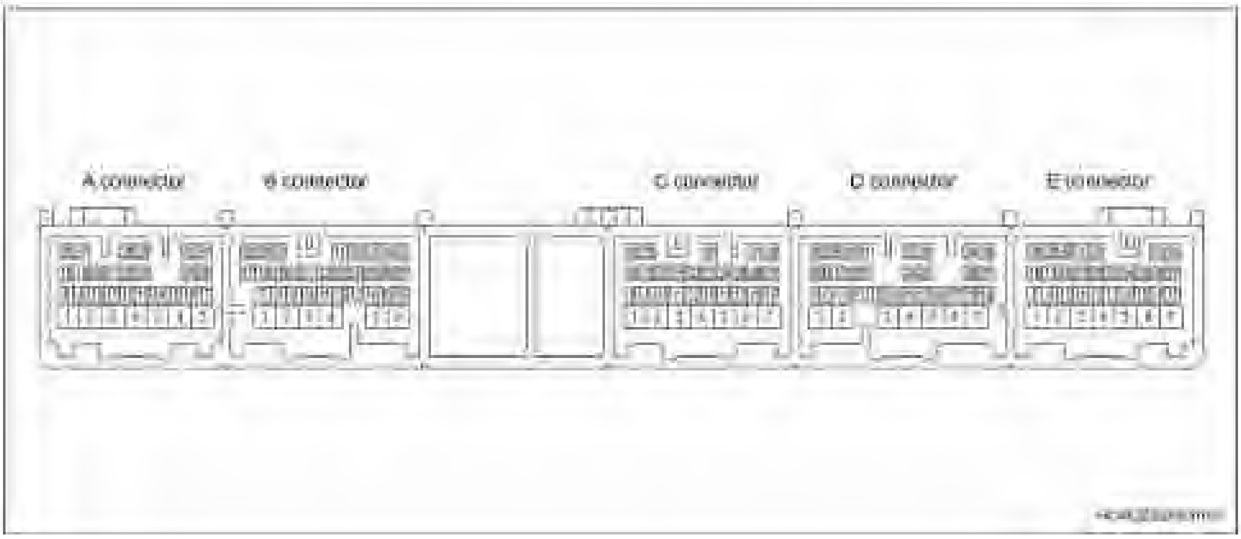


2. ECM Outline View





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3. ECM lead assignment

A connector (E83)

Pin number	Pin function
A1	Cylinder 2 Fuel Injector Control
A2	Cylinder 3 Fuel Injector Control
A3	Cylinder 1 Fuel Injector Control
A4	Cylinder 5 Fuel Injector Control
A5	Cylinder 6 Fuel Injector Control
A6	Cylinder 4 Fuel Injector Control
A7	Power supply to *ECM*
A8	Routine 2 (Cylinder 4, Cylinder 5 and Cylinder 6) Fuel injector charging voltage
A9	Routine 2 (Cylinder 4, Cylinder 5 and Cylinder 6) Fuel injector charging voltage
A10	-
A11	-
A12	-
A13	-
A14	-
A15	-
A16	-
A17	PCV1
A18	Routine 1 (Cylinder 1, Cylinder 2 and Cylinder 3) Fuel injector charging voltage
A19	-
A20	-
A21	-
A22	-
A23	-
A24	-
A25	PCV1
A26	Routine 1 (Cylinder 1, Cylinder 2 and Cylinder 3) Fuel injector charging voltage
A27	-
A28	-
A29	-

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A30	PCV2
A31	PCV2

B connector (E82)

Pin number	Pin function
B1	Exhaust gas recirculation motor 1 (V)
B2	Exhaust gas recirculation motor 1 (W)
B3	Exhaust gas recirculation motor 2 (U)
B4	Exhaust gas recirculation motor 2 (V)
B5	Power supply to *ECM*
B6	Power supply to *ECM*
B7	Exhaust gas recirculation motor 1 (U)
B8	Exhaust gas recirculation position sensor 1 (U)
B9	Exhaust gas recirculation position sensor 1 (V)
B10	Exhaust gas recirculation position sensor 1 (W)
B11	Exhaust gas recirculation position sensor 2 (U)
B12	Exhaust gas recirculation position sensor 2 (V)
B13	Exhaust gas recirculation motor 2 (W)
B14	Exhaust gas recirculation position sensor 2 (W)
B15	Fuel rail pressure sensor signal
B16	Crankshaft position sensor signal (-)
B17	-
B18	Step-down resistor
B19	Exhaust gas recirculation position sensor 2 And boost pressure sensor 5 V special reference voltage
B20	Exhaust gas recirculation position sensor 2, Low reference voltage for boost, fuel temperature, and engine coolant temperature sensors
B21	Camshaft position sensor 5 V reference
B22	Camshaft Position Sensor Low Voltage Reference
B23	Crankshaft position sensor and booster pressure sensor shield ground
B24	Camshaft position sensor and fuel rail pressure sensor shield ground
B25	-
B26	Fuel rail pressure sensor signal
B27	Crankshaft position sensor signal (+)

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B28	-
B29	Exhaust gas recirculation position sensor 1 And fuel rail pressure sensor low reference voltage
B30	Exhaust gas recirculation position sensor 1 And fuel rail pressure sensor 5 V special reference voltage
B31	Boost pressure sensor signal
B32	-
B33	Engine coolant temperature sensor signal
B34	Fuel temperature signal
B35	Camshaft position sensor signal

C connector (FL559)

Pin number	Pin function
C1	Battery voltage
C2	Battery voltage
C3	Ignition switch (on)
C4	Engine control module signal ground
C5	Engine control module signal ground
C6	Main engine control module relay
C7	Main engine control module relay
C8	Speed sensor signal
C9	-
C10	Accelerator pedal position sensor 1 and PTO throttle sensor Low voltage reference
C11	Accelerator pedal position sensor 1 and PTO throttle sensor Shield ground
C12	-
C13	-
C14	-
C15	Mass air flow sensor 12 V special reference voltage
C16	Mass air flow sensor low reference voltage
C17	Accelerator pedal position sensor 1 and PTO throttle sensor 5 V reference
C18	-
C19	-
C20	-
C21	-

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C22	-
C23	-
C24	-
C25	-
C26	-
C27	-
C28	-
C29	-
C30	-
C31	-
C32	-

D connector (FL558)

Pin number	Pin function
D1	Accelerator pedal position sensor 1 signal
D2	Exhaust pressure differential sensor signal
D3	Starter circuit breaker control
D4	Exhaust brake relay control
D5	-
D6	-
D7	Fault indicator control
D8	Accelerator pedal position sensor 2 And pressure sensor 5 V reference
D9	Mass air flow sensor signal
D10	Pressure sensor signal
D11	Intake air temperature sensor signal
D12	Accelerator pedal position sensor 2, Low pressure reference for air pressure sensor and intake air temperature sensor
D13	Accelerator pedal position sensor 2, Air pressure sensor and mass air flow sensor shield ground
D14	-
D15	-
D16	Change speed limiter light control
D17	-
D18	The engine speed signal is output to the tachometer

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D19	"Repair vehicle as soon as possible" light control
D20	Exhaust pressure differential sensor 5 V Reference
D21	-
D22	Exhaust air pressure sensor shield ground
D23	Exhaust differential pressure sensor low pressure reference
D24	-
D25	-
D26	-
D27	-
D28	-
D29	Accelerator pedal position sensor 2 signal
D30	PTO throttle sensor signal
D31	-
D32	-
D33	-
D34	-
D35	-

E connector (FL557)

Pin number	Pin function
E1	-
E2	Ignition switch (start)
E3	Diagnostic switch
E4	Brake switch 2 signal
E5	Brake switch 1 signal
E6	Neutral switch signal
E7	-
E8	Clutch switch signal
E9	-
E10	Engine stop switch signal
E11	-
E12	Idle speed MANU / AUTO switch signal

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E13	Idle rise switch signal
E14	Idling down switch signal
E15	Taillights switch signal
E16	Power take off switch signal
E17	-
E18	-
E19	-
E20	-
E21	-
E22	ISO CAN High-voltage signal
E23	ISO CAN Low-voltage signal
E24	-
E25	-
E26	Exhaust brake switch off signal
E27	-
E28	J1939 Controller LAN high signal
E29	-
E30	J1939 Controller LAN low signal
E31	-
E32	-
E33	-
E34	-

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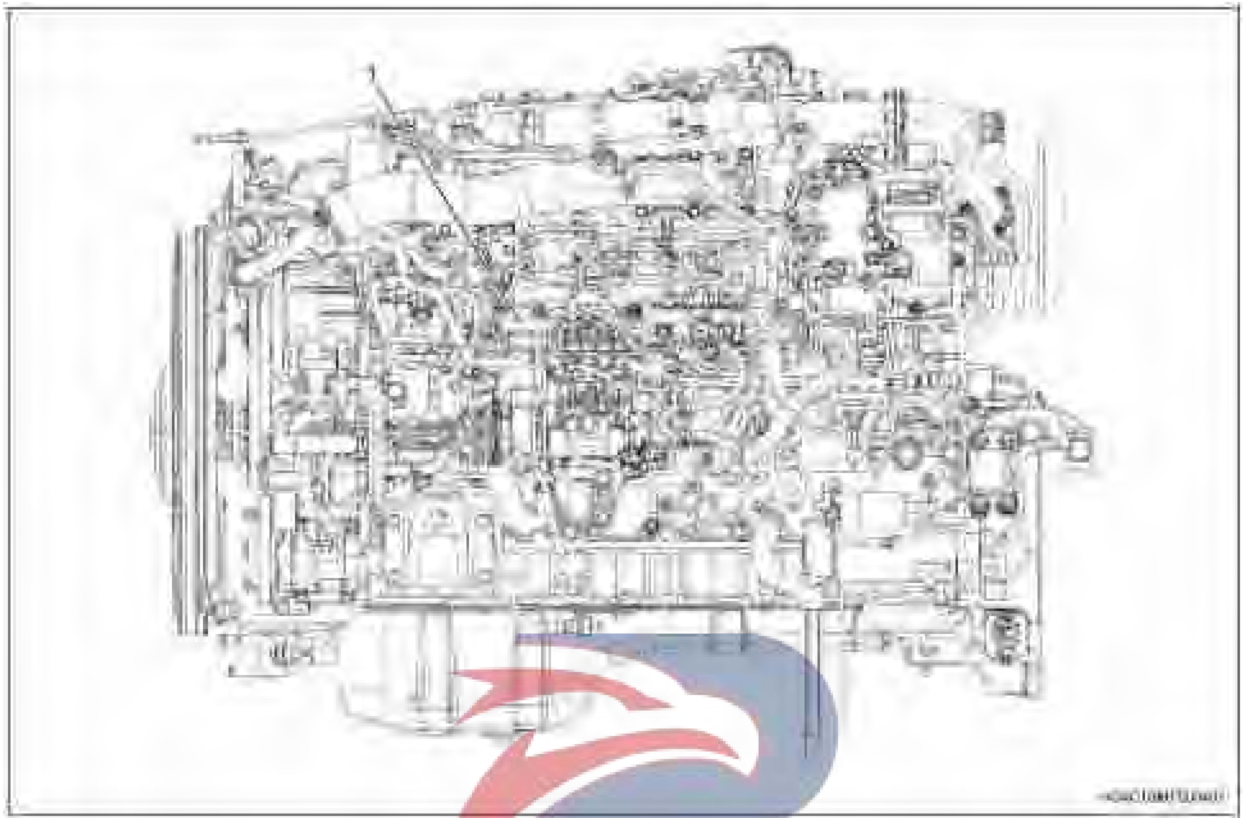
18. Engine number



1. Engine number mark

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Engine main specifications

1. Engine main specifications

1. The main engine data and specifications

Model / Object		6WG1-TC
Engine model		Water-cooled four-stroke inline six-cylinder twenty-four valve overhead camshaft direct injection diesel engine
Cylinder arrangement, cylinder number - ID x stroke		L6 - 147 × 154 mm {5.79 × 6.06 in}
Total piston displacement		15.681 L {956.9 in3}
Compression ratio		: 16.5
Compress the pressure		: 2,840 kPa or more {29 kgf / cm2 or more / 412 psi or more} / 200 rpm
Cylinder liner type		Clearance with dry cylinder liner
Size, length x width x height		1693 x 1033 x 1159 mm (66.65 x 40.67 x 45.63 in)
Curb weight (excluding air filter)		: 1,225 kg { 2,701 lb }
Injection timing		BTDC 0°
Injection sequence		1,5,3,6,2,4
Governor type		Electric type
Timer type		Electric type
Valve clearance (cold state)	Intake valve	: 0.4 mm { 0.0157 mm }
	Vent	: 0.4 mm { 0.0157 mm }
Intake valve on / off time	Start	BTDC 21°
Intake valve on / off time	off	ABDC 27°
Exhaust valve opening / closing time	Start	BBDC 52.5°
Exhaust valve opening / closing time	off	ATDC 17.5°
Fuel filter type		Filter type
Oil filter type		Filter type
Split flow oil filter type		Filter type
Oil pump type		Gear type
Oil cooler type		Water-cooled type
Oil level		:28.5 L {7.53 US gal / 6.27 Imp.gal} Reference

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	: 23.5 L {6.21 US gal / 5.17 Imp.gal} Oil pan capacity
Refrigeration type	Water-cooled, direct coupling
Total volume of coolant	:43.5 L {11.5 US gal / 9.6 Imp.gal}
Thermostat type	Wax
Air filter type	Filter type
Battery type	115F51-2, 145G51-2
Idle speed	: 480 to 520 rpm
Thermostat valve Temperature when beginning to open	: 82 ℃ {180 ℉}
Thermostat fully open temperature / lift volume	: 95 ℃ {203 ℉} / 11 mm {0.433 in}
Intercooler type	Aluminum tubes and end plates
Reduce the leak type	Close type

2. Cooling system main specifications

Object		Specification
Radiator type		Corrugated type
Deputy tank cover working pressure	Pressure valve	: 61.8 to 71.6 kPa {0.63 to 0.73 kgf / cm2 / 8.96 to 10.38 psi}
	Vacuum valve	: 1.96 to 4.90 kPa {0.02 to 0.05 kgf / cm2 / 0.28 to 0.71 psi}
Water pump	Types of	Centrifugal gear type
	Displacement	: 300 L {79 US gal / 66 Imp. Gal} Pump speed 1800 rpm, coolant temperature 80℃ {176 ℉}
Thermostat valve Temperature when beginning to open		: 82℃ {180℉}
Thermostat fully open temperature / lift volume		: 95℃ {203℉} / 11 mm {0.433 in}
Total coolant capacity (including radiator)		: 43.5 L {9.57 Imp.gal / 11.49 US gal}

3. Fuel system specification

Object	Specification
Fuel injection pump type	Electronic Common Rail (Fuel Rail)
Fuel pump type	6UHD
Maximum flow	: 630 mm3 {0.0384 in3} / ST
Rotational direction (when viewed from the drive side)	Right
Pump sequence	1-2-1-2-1-2 / Pump number
Plunger diameter	: 8.5 mm {0.3346 mm}

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Pressure relief valve opening pressure	: 255 kPa {2.6 kgf / cm2 / 37 psi}
Supply pump	Cycloid type, 10.5 cm3 (0.6407 in3) / rev
Injector type	DLL-P
Injector nozzle diameter	: 0.16 mm { 0.0063 in } ×9

4. Electrical system basic specifications

Starter		
Object		Specification
Maker		Mitsubishi
Rating	Voltage	: 24 V
	Output	: 7.0 kW
	Time	30 seconds
Pinion gear number		: 11
Rotational direction (when viewed from the pinion side)		Right
quality		: 12.7 kg { 28.00 Ib }
No-load characteristics	Voltage and current	: 23.5 V / 125 A or below
	speed	: 3,000 rpm or above
Load characteristics	Voltage and current:	15.8 V / 600 A or below
	Torque	: 52 N • m or more {5.3 kgf · m or more / 38 lb • ft or more}
	speed	: 900 rpm or above
Locking feature	Voltage and current	: 5 V / 1,600 A or less
	Torque	: 117 N · m or more {11.9 kgf • m or more / 86 lb • ft or more}

Alternator		
Object	Specification	
Maker	Mitsubishi	
Rated output	24 V - 60 A	24 V - 90 A
Rated speed	: 5,000 rpm	: 5,000 rpm
Regulator type	Integrated circuit type	
Adjust the voltage	5000 rpm (load: 5 A and below. Measured between L and E) 28.0 - 29.0 V.	
Output characteristics (voltage: 27 V)	59A or higher / 2500 rpm 65A or higher / 5000 rpm	77A or higher / 2500 rpm 85A or higher / 5000 rpm
quality	: 15.0 kg { 33.07 lb }	: 18.8 kg { 41.45 lb }

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5. Lubrication system of the main specifications

Object		Specification
Lubrication device		Forced loop type
Oil pump	Displacement	154 L / min, pump speed 3,200 rpm, outlet pressure 539kPa
	Safety valve opening pressure	: 686 kPa { 7.0 kgf/cm2 / 99 psi }
Oil relief valve opening pressure		: 441 kPa { 4.5 kgf/cm2 / 64 psi }
Oil filter bypass valve opening pressure (difference between inlet and outlet hydraulic pressure		: 196 kPa { 2.0 kgf/cm2 / 28 psi }
Oil temperature valve open temperature		: 103℃ { 217℉ }
Oil cooler		6 Water-cooled multi-plate

Maintenance standards

Object		Prescribed value	Limit
Oil pump	The gap between the back of pump body and gear	: 0.050 to 0.098 mm {0.0020 to 0.0039 in}	: 0.15 mm { 0.0059 mm }
	Clearance between oil pump cover and gear	: 0.040 to 0.094 mm {0.0016 to 0.0037 mm}	-
	Driven gear shaft	: 20 mm {0.7874 mm}	: 19.90 mm { 0.7835 mm }
	Driven gear shaft and the gap between the pump	: 0.040 to 0.094 mm {0.0016 to 0.0037 mm}	-

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Introduction to engine fault diagnosis

1. Engine Fault Diagnosis Introduction

1. System diagnostic methods

The system diagnostics method is the standard method for servicing all electrical and electronic systems, and the faults in the electrical/electronic systems are different from the normal vehicle faults and often occur in the following steps.

1) The initial phase of the fault

In the event of a fault occasionally occurring for a short period of time, the customer usually does not find the fault, in which case the customer's complaint is ambiguous and the fault can not be restored, however, the control unit may have stored the fault (historical fault)

2) The middle of the fault phase

Occasionally, and the short duration of the fault, but may occur from time to time, and in a particular case of the situation does not change. Customer complaints and fault content is clear, but the fault situation is not clear. Therefore, the diagnosis of the vehicle Can know the fault condition and restore the fault (intermittent fault, intermittent situation)

3) The real fault stage

Regular failure occurs, and the customer's complaint is true and clear, so people who diagnose the vehicle can restore the fault again, however, the cause of the fault is sometimes multiple (current fault)

2. Diagnostic procedures

Diagnostics are typically used to troubleshoot electrical and electronic control systems and must first be run when service is required The following steps explain how to diagnose.

1) Check and verify customer complaints.

In order to verify the customer's complaint, the person performing the vehicle diagnostics must understand how the system is functioning properly.

2) Implement a preliminary inspection.

● Overall appearance inspection

● Maintenance history review

● When abnormal noise or abnormal odor is found

● Use scan tools to collect information such as trouble codes and data

3) Check if there is any related service notification.

4) Reference diagnostic phenomenon.

Symptom diagnosis includes information about the system that is not displayed in the diagnosis code, and diagnosis of the symptom can confirm the operation status of the related system, so that an appropriate diagnosis method can be worked out.

5) Refer to related topics, such as Engine Mechanical Components.

3. If the diagnostic code is stored

Accurate repairs are performed based on the designated trouble-code chart.

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4. If there is no diagnostic code

According to the phenomenon of failure to select the diagnosis of failure. According to diagnostic procedures to complete the maintenance operation. You can also refer to the function check to implement the inspection operation.

5. If there is no suitable phenomenon

1) Detailed investigation of complaints.

2) Establish a diagnostic plan.

3) The use of schematic and operating principle.

If there is a similar history in the repair history, technical assistance may be required, combining technical knowledge with the availability of effective service bulletins.

6. If it is intermittent

Non-recurrent faults are called intermittent faults. Follow these steps to resolve intermittent faults.

1) Check DTC information and system data.

2) assess the customer described the phenomenon and circumstances.

3) Using a checklist or other method, check the circuit or electrical system components.

7. If no fault is detected

This situation indicates normal running of vehicles. This situation reflects the customer may be normal. By comparison with the other normal vehicles, so as to check customer complaints. However, as the case may be, the failure may be intermittent Before returning to the vehicle, please check the complaint according to the customer's description.

1) Re-investigate the complaint.

If the problem can not be adequately detected or identified, you need to re-implement the diagnosis to identify the problem, which may be intermittent or may be normal.

2) Repair and verify.

Carried out after determining the cause of the problem of maintenance. Check whether the normal operation of the vehicle, if the symptom can be ruled out. Inspection methods include road test or other methods, and verify complaints resolved under the following conditions.

● Verify in customer's condition.

● When diagnosing a trouble code, verify that the trouble has been solved by copying when setting the trouble code.

8. Vehicle repair verification

After the completion of repairs to the electronic control system shall verify the accuracy of maintenance, if the inspection work is not perfect, the vehicle return customers, fault indicator or "vehicle repair as soon as possible" lights can be on again or a fault occurs again In particular, for the maintenance of intermittent faults, the inspection must be carried out according to the information of the complaints simulated fault conditions.

Objective	Objective	Aim	Method
1	Trouble Code Check	After troubleshooting, check the diagnostic code display	Clear the previous troubleshooting code. Fully warm the engine at idle before raising the engine speed to 2,000 rpm to ensure that the test conditions are correct.

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2	Check the idle speed after warming up the engine	Check idle speed control is working properly	When the air conditioner is off, check that the idle speed remains constant between 475 and 525 rpm after the engine temperature rises.
3	Check the data list.	Perform basic checks on *Engine Control* and communication status	Monitor the datasheet and verify it against a typical datasheet Check the typical values in the Datasheets.
4	Start-up follow-up examination	Check if the start control is working properly	Preheat the engine, the start-up time is less than or equal to 5 seconds, and the engine speed is stable after starting.
5	Check the high-power electromagnetic transmitter	When an electromagnetic transmitter (such as a transceiver) is added to the vehicle, make sure there is no interference with the electric wave.	Check for engine idling speed changes when turning on / off electromagnetic transmitters such as radio transceivers. If the problem is found, inform the customer to change the installation location and output settings of the electromagnetic transmitter.

*: In the process of checking the project if it detects high-power electromagnetic signal transmitter failure, you must inform the customer to conduct the following checks.

● The antenna should be installed as far as possible from the vehicle electronic system such as control unit and sensor.

● Mount the antenna rope at least 20 cm from the vehicle electronics, such as the control unit and sensor.

● Do not mix the antenna cord with other wires, and keep the antenna cord as far as possible from other wires.

● Be sure to install the rebuilt equipment according to the corresponding installation manual.

● Do not install a high-output mobile communication device.

9. Non-original equipment Maker production of parts

In all cases, the system adjusts for the use of genuine parts, so when general purpose secondary market sensors, switches, etc. are installed, error diagnostics will be implemented and the fault indicator or "service vehicle as soon as possible" indicator will illuminate Start.

Secondary market electronic apparatus, such as a mobile phone, a stereo system and anti-theft system installation time loss will cause electromagnetic interference into the emission control system leading to erroneous sensor readings, fault indicator is on. Therefore, before the implementation of fault diagnosis may be commercial equipment Power off or remove it.

10. Improper vehicle maintenance

In the event of vehicle maintenance failure, a high-sensitivity system check will illuminate the fault indicator and the "Service vehicle as soon as possible" indicator.

Failure to change oil in time or improper oil viscosity can cause clogged oil filters, fuel filters, and crankcase sediments, which can cause vehicle failure, which can not be classified as "non-vehicle failure". However, due to the high sensitivity of troubleshooting, the vehicle care cycle must be more strictly followed.

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11. Engine compartment appearance inspection

Before performing diagnostic procedures, perform a thorough visual inspection of the engine compartment, which can often be solved without any further steps. For visual inspection, use the following guidelines.

● Check all air hoses for punching, cutting, disconnection and more suitable routing.

● Check hoses that are obscured by other components and are not easy to see.

● Check that all harnesses are properly connected, burned or worn, and improperly tightened or inadvertent contact with sharp sides, hot exhaust manifolds or piping.

12. Ignition cycle

When the ignition switch is turned on, the ignition cycle starts; when the ignition switch is turned off, the ignition cycle ends when the engine control module is turned off.

13. Diagnostic information

This means that through the diagnostic procedure, a fault is detected in the circuit or component, a chart is created under such circumstances, the vehicle is working properly during assembly and no multiple faults are presently present.

A dedicated control function provides a continuous self-diagnostic function. The diagnostic function of the diagnostic program is complementary to the described manual. DTC system serves as a language of the cause of the malfunction is transmitted. If the control unit detects a fault, the fault diagnosis is provided Code, and the fault light or "service vehicle as soon as possible" light will be on.

14. Fault indicator

Refers to a fault indicator warning light, such as fault indicator and "maintenance vehicle as soon as possible" indicator. Basically, when due to a failure in the electronic control system (*ECM*) provided DTC fault indicator And "Service Vehicle as soon as possible" light will come on.

15. Data Communication Link Connector

Communication with the Control Unit is made via the Data Link Connector, which is specially designed to interface with the Scan Tool. The general usage of the Scan Tool is as follows.

● Recognition of stored trouble codes

● Clear the trouble code

● Perform output control test

● Read serial data

16. About vehicle maintenance verification

After completing the repair, follow the steps below to verify the vehicle repair results.

1) Review the diagnosed data or DTC or both and make a note of it.

2) Clear the trouble code.

3) Operate the vehicle based on the data.

4) Observe the diagnosed DTC information until the control unit completes the diagnostic test related to this DTC.

It is important to perform these steps when verifying the effectiveness of repairs, and if these steps are not implemented, unnecessary repairs may occur.

2. Diagnostic trouble codes (DTCs)

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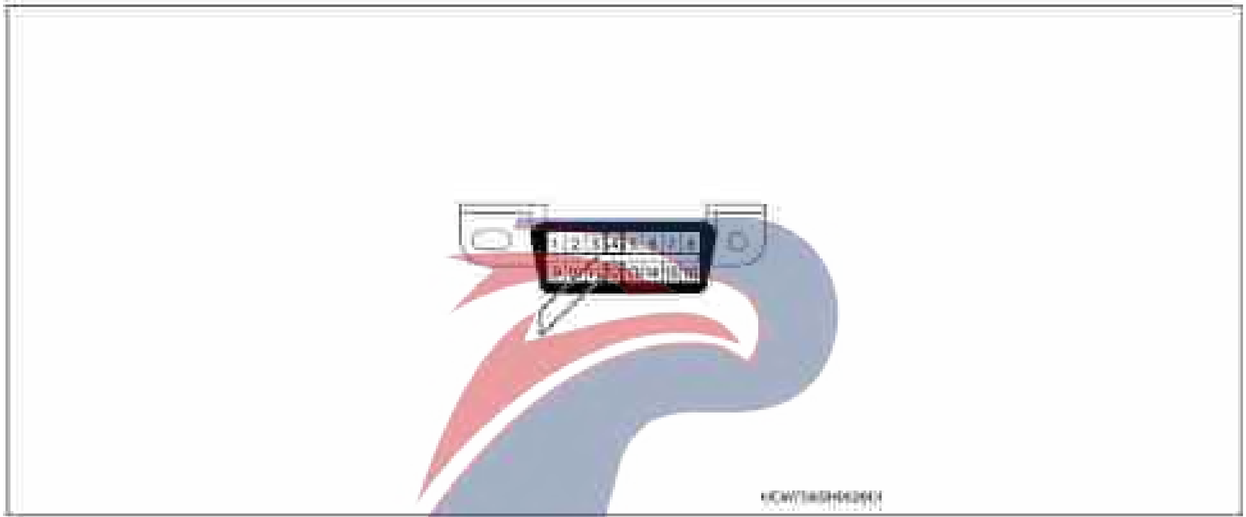
Each time the ignition is turned on, the control unit performs a self-test on most of the wiring and components, records the detected system faults in the control unit memory, and performs backup control based on the DTC. In addition, if the system When a fault affects the running of the vehicle, the fault indicator on the dashboard or the "Service Vehicle as soon as possible" indicator will light up to alert the driver.

1. Trouble code read

The diagnosis code stored in the engine control module can be displayed on the multi-purpose display by connecting the diagnosis switch. The method of displaying the trouble diagnosis code by blinking is as follows.

1) Turn the ignition switch on and check that the "Service Vehicle as soon as possible" light is on.

2) Short the pins 12 and 4 of the data communication link connector with jumpers.



3) Calculate the number of "Faster Vehicle Repair" flashes.

As for the fault diagnosis code, determine the content of the fault according to the fault diagnosis code list.

If a scanning tool is connected, use the scanning tool to read the diagnostic code.

2. If no diagnostic code is stored

If you continue to display code 01, it indicates that no diagnostic code is stored.

3. If the diagnostic code is stored

The stored trouble diagnosis code will be displayed as 3. When two or more fault diagnosis codes have been stored, the trouble diagnosis code will be displayed 3 times, and the fault diagnosis code will be displayed in ascending order After all the DTCs, the display will start again from the smallest DTC, and when all the DTCs have been displayed, the display will start again from DTC 23. This display is performed when the DLC connector is short-circuited ongoing.

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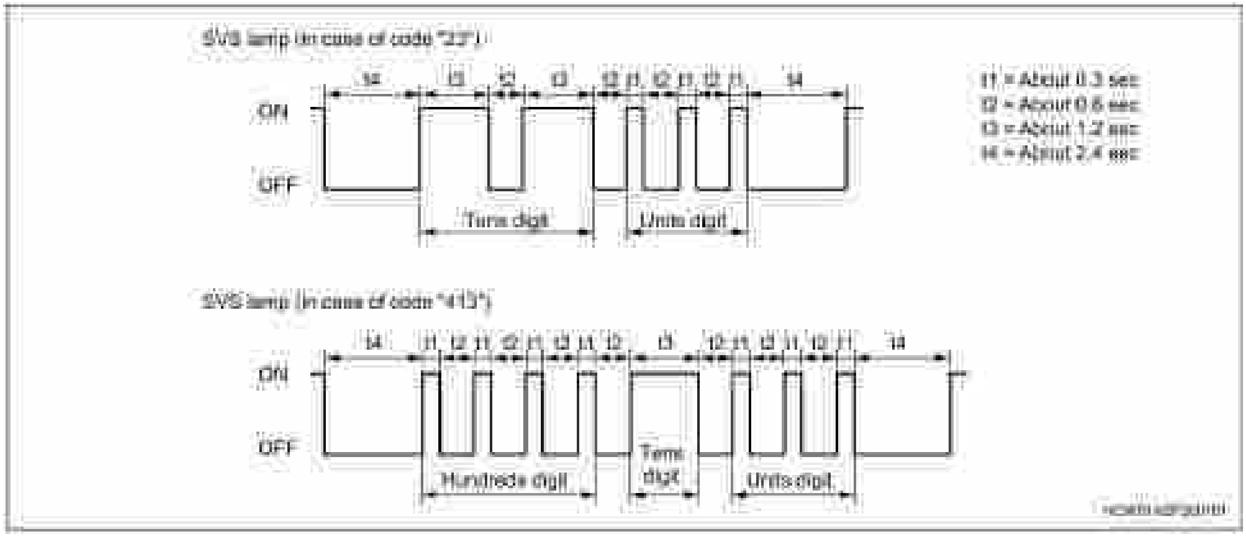

4. Information about the DTC displayed when the "Service Vehicle as soon as possible" indicator is flashing

When the engine is stopped, the current fault diagnosis code and the previous fault diagnosis code are displayed.

3. Oral advice

1. Question

1) To fully understand the instructions given by the customer, use the *Engine Control* system check table.

Reference: Do not mention random questions when asking questions, and focus on systems that are considered to be faulty, based on the symptoms and the actual situation.

2) Accurately determine the fault information.

On the basis of 5W1H have a specific understanding.

For example: low temperature, start-up or smooth operation, close to the engine parts, issued a metal crash sound.

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2. Ask questions

● Content: Symptom

● When: Month, day, hour, frequency of occurrence

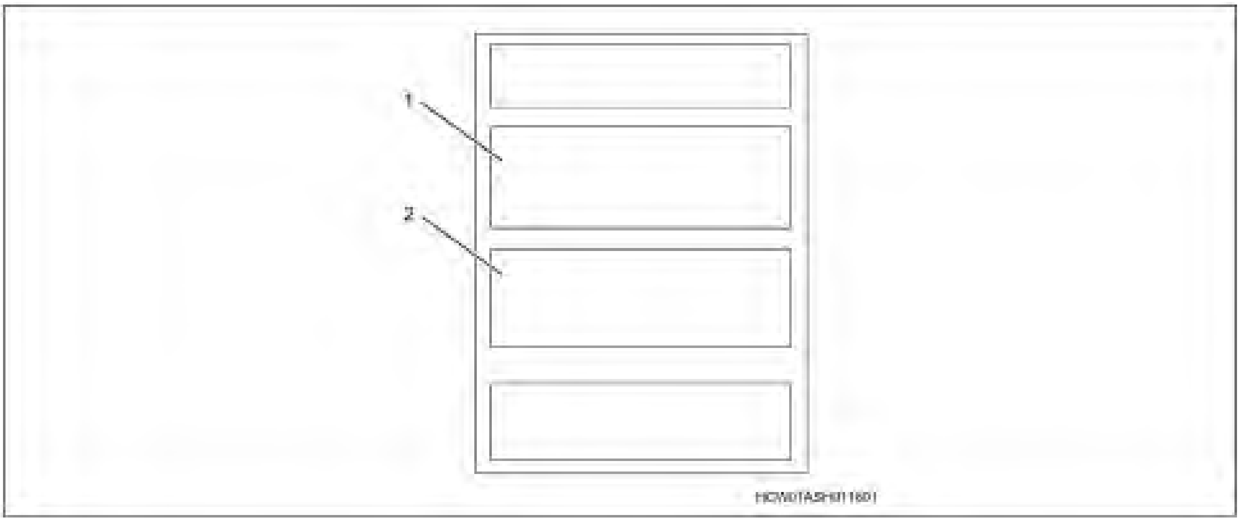
● Where: the road conditions

● Under what circumstances: traffic conditions, operating conditions and weather conditions

● Occurrence: Symptom

3. Engine control system check table

When receiving a vehicle from a customer at a maintenance facility, it is necessary to check with the customer, based on the engine control checklist, the symptom of the malfunction and the data of the failure.



1. Symptom

2. The frequency and conditions of the fault

The reason:

● Trouble phenomenon can not be reproduced in the workshop.

● The customer's complaint may not always be related to the problem.

● Failure to notify the service manager of any malfunction may result in unnecessary maintenance work.

In the maintenance of the factory for in-vehicle diagnosis, maintenance and repair confirmation, you can refer to packing checklist.

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ENGINE CONTROL SYSTEM CHECK SHEET		Inspector's Name	
Customer's Name		Model & Model Year	
Driver's Name		Chassis No.	
Date Vehicle Brought In		Engine No.	
License No.		Odometer Reading	km/miles

Problem Symptoms				
☐ Engine Does Not Run	☐ Engine does not crank	☐ No initial combustion	☐ No complete combustion	
☐ Hard Start	☐ Engine cranks slowly	☐ Other ( )		
☐ Incorrect Idle	☐ Abnormal idling speed ☐ Rough idling ☐ Other ( )	☐ High idling speed (RPM)	☐ Low idling speed (RPM)	
☐ Poor Driveability	☐ Hesitation, sag, stumble ☐ Lack of power, sluggishness, sponginess ☐ Other ( )	☐ Surge	☐ Cut out	
☐ Engine Stall	☐ Soon after starting ☐ During A/C operation ☐ Other ( )	☐ After accelerator pedal depressed ☐ After accelerator pedal released	☐ Shifting from N to D	
☐ Others	☐ Black smoke ☐ Fuel knock, combustion noise ☐ Other ( )	☐ White smoke	☐ Poor fuel economy	

Dates problem occurred				
Problem frequency	☐ Constant ☐ Other ( )	☐ Intermittently (times per day/month)		☐ Once only

Condition When Problem Occurs				
Weather	☐ Fine ☐ Various/Other ( )	☐ Cloudy	☐ Rainy	☐ Snow
Outside Temperature	☐ Hot (approx.) ☐ Any temperature	☐ Warm	☐ Cool	☐ Cold (approx.)
Place	☐ Highway ☐ Downhill	☐ Suburbs ☐ Rough road	☐ City area ☐ Other ( )	☐ Uphill
Load Condition	☐ Over approx. tons ☐ Other approx. tons		☐ No load	
Engine Temperature	☐ Cold ☐ Other ( )	☐ Warming up	☐ After warming up	☐ Any temperature
Engine Operation	☐ Starting ☐ Racing ☐ Deceleration ☐ Other ( )	☐ Just after starting (Min.) ☐ Driving ☐ A/C switch On/Off	☐ Constant speed	☐ Idling ☐ Acceleration
Fuel Amount	☐ Full	☐ About 1/2	☐ Below 1/2	☐ Near empty
Fuel Brand				

Condition of MIL or SVS lamp		☐ Remains On	☐ Intermittently turns On	☐ Does not turn On
Diagnostic Trouble Code (DTC) or Flash Code	Present Code	☐ Nothing	☐ P Code & Symptom Code No. ( )	
	History Code	☐ Nothing	☐ P Code & Symptom Code No. ( )	
Other Additional Condition				

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Engine

Function Check

(6WG1)

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Engine compression pressure check

1. Engine compression pressure check

1) Check battery and starter for any abnormalities.

2) Disconnect the battery ground cable.

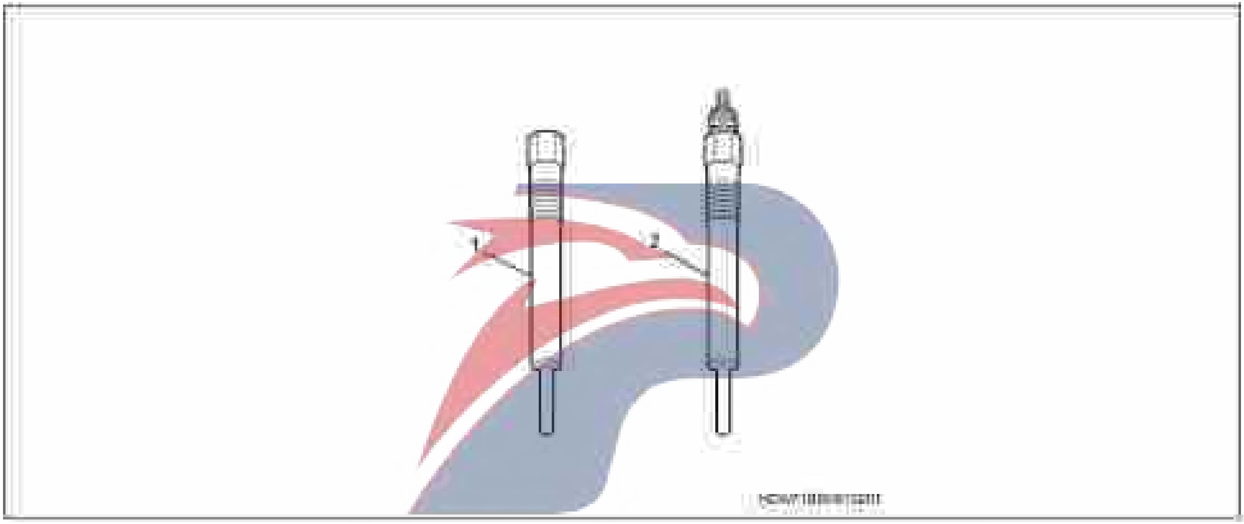
3) Remove the inlet pipe.

4) Remove the exhaust gas recirculation cooler.

5) Remove the empty plug and glow plug from the cylinder head.

Note:

● Disassemble all cylinders.



1. Empty plug

2. Glow plug

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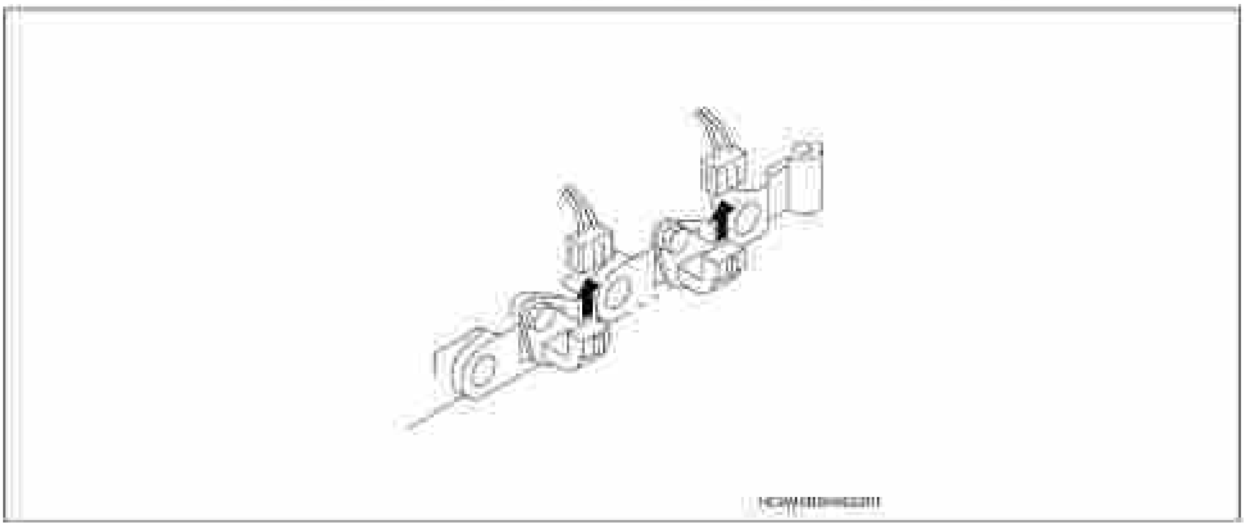
6) Remove the injector harness connector from the lower end cap.

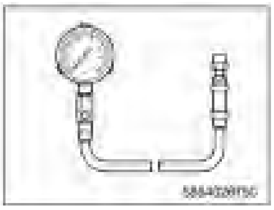


7) Install the special tool on the cylinder head assembly.

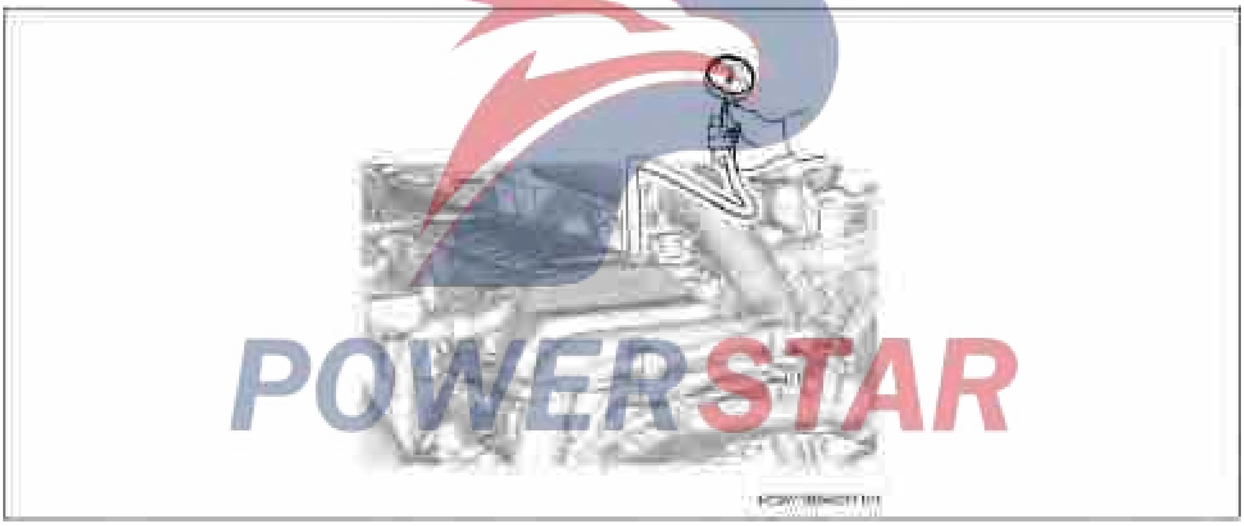
Note:

● Insert the compression fitting into the glow plug mounting hole and install the compression table.

SST: 5-8531-7001-0 - Pressure Gauge Adapter



SST: 5-8840-2675-0 - Pressure Gauges



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8) Engage the starter and read out the stable compression pressure of the compression gauge hand at an engine speed of approximately 200 rpm.

Note:

● Measure the compression pressure of all cylinders.

● Measure the compression pressure when the engine cools.

Standard: 2,840 kPa {29.0 kgf / cm2}

Differences between cylinders: 200 kPa {2.0 kgf / cm2}

Limit: 2,260 kPa {23.0 kgf / cm2}

Caution:

● Please note that if the gas pressure is high during engine operation, the gas will flow out of the glow plug hole.

● Since the ignition switch is ON when the injector harness connector is removed, the *ECM* detects the malfunction and sets the DTC, so be sure to clear the DTC after completing the inspection.

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Engine

Phenomenon(6WG1)

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Intermittent conditions of the engine

1. The phenomenon of intermittent engine conditions

1. Before you begin, carry out important preliminary inspection procedures

Before using the symptom list, perform a system diagnostic check on the *Engine Control*s and check the following.

● Engine control module and fault indicator / "Service vehicle as soon as possible" indicator is operating normally.

● Scanning tool data is within normal operating range values.

● Verify Customer Complaints, fill in Catalog with proper symptoms. Check the items shown under this symptom.

2. Appearance inspection and actual inspection

For some symptoms, it is important to visually check the actuality carefully, which can effectively save the time spent troubleshooting (no further inspection is required.) The inspection items include the following.

● The grounding of the *ECM* should be kept clean and securely in place.

● The vacuum hose is free of bending or twisting, and is properly connected. Please check thoroughly to ensure no leakage or blockage.

● Intake pipe should not be broken or damaged.

● Exhaust pipe should not be broken or damaged.

● The wiring and terminals of the engine harness should be properly connected and these parts should be protected from pressure or disconnection.

3. Intermittent

In the event of an intermittent failure, check for improper installation of electrical components Check for any additional electrical equipment, lights or mobile phones Verify that all additional installations are not connected to serial data circuits such as CAN.

According to the specific circumstances of the fault, the fault indicator / "as soon as possible to repair the vehicle" light may not turn on, or the fault diagnostic code is not stored. Electrical connection or improper wiring may cause intermittent failure. Or perform an actual test to verify that the problem connector has the following conditions.

● The connection between the connectors is incomplete

● The connection of the terminal is faulty

● Terminal damaged or deformed

After repairing or replacing the connector terminals of the defective circuit, make the appropriate connections. After removing the terminals from the connector body, check that the terminals' leads are not properly connected.

Connect the DMM to the suspect circuit, and then carry out a road test on the vehicle. When an error occurs in the reading accompanied by an error, the monitored circuit can be determined to have failed. The scanning tool should be used when checking for intermittent faults. The scanning tool has the following Convenient features.

● In the event of a failure, the snapshot function will record the engine parameters, review the recorded information and understand the specific operating conditions caused by the failure.

● Using the scan tool's plotting function, the selected data parameters can be graphically represented.You can also review recorded information and check for intermittent failures.

If an intermittent fault condition persists, check that the optional electrical equipment such as the lamp or mobile phone is properly installed, and the fault diagnostic code is not recorded under the following conditions, and the fault indicator / Service Vehicle as soon as possible indicator may intermittently light up .

● Grounding or fouling of the engine control module.

● Fault indicator / short circuit to "Repair Vehicle as soon as possible" circuit occurs intermittently.

● In an engine control module-driven solenoid, or in a switch, interference may occur in the electronic system if the relay fails. (These electronic components may cause the voltage to increase sharply.) Normally, problem appear.)

● There is an open diode.

In the following list of symptoms, you have sorted out the causes of the various symptoms.The order of these programs does not matter If the values on the scan tool do not indicate a problem, the next step is to check the most easily detected or most likely the cause s project.

When the complaint is related to the diagnosis of malfunction, please use the following list.

● Engine intermittent failure conditions

● Difficult to start

● Uneven, unstable

● High-speed idle speed

● Resection

● Surge

● Insufficient power, slow operation and weakness

● Unresponsive, depressed, poor

● Abnormal combustion noise

● Low fuel efficiency

● Smoky

● White smoke

● Engine temperature is too high

● Engine overcooling

● The maximum engine speed is too low

● The engine did not stop working

● Starter high-load operation

● Charging system failure

● Generator abnormal noise

● Exhaust system vibration and clicks

● Exhaust system is blocked

● Exhaust gas leaks and makes noise

● Turbocharger malfunction

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There is currently no problem, but there was a diagnostic code before, or the customer's complaint did not involve a diagnostic code, and the phenomenon did not recur.

4. Initial check

Perform diagnostic system check - engine control.

5. Harness and connectors

A number of intermittent open or short circuits caused by vibrations, engine torque, or road jolts that cause the wiring harness or connector to move. Perform the procedures in the following list to test for similar situations.

● Move related connectors and wires while observing the applicable scan tool data.

● Use a scanning tool to instruct the unit to turn on / off (ON / OFF) and then remove the relevant connectors and connections Check the operation of the unit.

● While the engine is running, move the relevant connectors and wires and check the engine operation.

If the harness or connector movement affects data display, parts, system health, or engine operating conditions, inspect the wiring harness or connector and service it if necessary.

6. Electrical connection of the line

Electrical connections, improper terminal installation, or wiring may cause intermittent failures. The following checks should be carried out.

● Poor contact of the connector or poor contact of the terminal with the connector body

● If the terminal is deformed or damaged, check that the terminal is installed correctly.

● If there is a defect in the connection between the terminal and the wiring, including the terminal with insulator, the connection between the main body of the connector and the terminal must be disconnected.

● Rust or water vapor erosion. When there is a hole in the insulation area or damaged, moisture can enter the cable and insolate the conductor in the insulation area. Such erosion is usually not checked. Look for suspicious circuits for swollen or hardened parts.

● Insulation wire damage

● Extruded, cut or worn wire

● Make sure the wires do not come into contact with the hot exhaust system components.

7. Control the power and grounding of the module, as well as the power and grounding of the components

A variety of situations may occur due to poor power connection or grounding.

● Test the power circuits of all control modules • Test the power circuits of all control modules • Many vehicles have multiple circuits that supply control modules • The other components of the system have separate power circuits that also need to be tested. Connect the fuses, component connectors, and the power supply to the module and the intermediate connection between components. Test lights or digital multimeter to indicate the existence of voltage, but neither can test the current circuit has enough current. Check the circuit The current can support the operation of the components.

● Test all control module ground circuits and system ground circuits. The control module may have multiple ground circuits. All other components in the system have their own ground wire and are subject to inspection. Check ground connections for cleanliness and connections to earthing points Check the connection of the parts to the connector cover. Check that the current in the circuit supports the operation of the parts.

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8. Temperature sensitivity

Intermittent problems may occur when a part or connection reaches its operating temperature.If the part or connection is intermittent only in cold or hot conditions, refer to the fault log or snapshot data if conditions permit.

● Outdoor high temperature

● Cab or engine warming

● The circuit heats up due to poor connection or high power load

● Drag or other conditions, the load state is greater than the normal load

If intermittent malfunctions occur due to low temperatures, check the data related to the following items.

● Low outdoor temperature: connectors or parts may freeze under very low temperature conditions Check for the presence of flooding.

● This happens only when cold starts.

● This will not happen again after the vehicle is warmed up.

Based on customer feedback, determine if the problem is caused by temperature.

9. Electromagnetic interference and electrical noise

Some electronic components and circuits may be sensitive to electrical noise generated by electromagnetic interference. Check for the presence or absence of the following conditions.

● When the wiring harness is too close to a high-voltage or high-current device, such as a jetting part, a motor, or a generator due to a wiring error, these parts may make electrical noise on the circuit and interfere with the normal operation of the circuit.

● In the case of an *ECM*-driven solenoid, or in a switch, if there is a malfunction, interference may occur in the electronic system. Under these conditions, a sharp voltage increase may occur. Normally, the faulty part is operated There is a problem when using it.

● Non-factory-built electronic equipment or additional secondary market electronic equipment, such as lights, transceivers, amplifiers, motors, remote starters, warning systems, mobile phones and other improper installation, these accessories will be used in the launch of electromagnetic waves Cause the related trouble, but will not produce the interference under the idle state.

● Test whether the diode is open or not. Some relays include a clamp diode.

● Check the generator rectifier bridge for malfunctions and, if present, AC noise may occur in the electronic system.

10. Reproduction of fault conditions

● If none of the previous tests succeeds, try to copy or log the failure condition.

● If conditions are right, "frame freeze / fault record" will contain what happened when setting the DTC.

● Store "frame freeze / fault record".

● Operate the vehicle under the same conditions, and store the operating conditions in "Frame freeze / fault record." Operate the vehicle with the diagnostic code set.

● Another way is to drive the vehicle after connecting the Diagnostic and Maintenance Monitor to the suspect circuit, and diagnosing and maintaining the monitor will show outliers when problems arise, which may be helpful in identifying the area of the problem.

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11. Scanning tools snapshot

Connect to the scan tool and snapshot the available parameters with the serial data.The snapshot function is used to record the actual data of a certain period of time.The recorded data can be played back and analyzed.The scanning tool can also take a single parameter or multiple parameters as an image Can be compared and displayed in the event of a malfunction, you can manually set the snapshot function, or set the diagnostic code, you can configure the snapshot function to start the recording function of the recorded data of unconventional values may indicate that further Check a system or part.

Difficult to start

1. Explain start-up difficulity

After a long period of time, the crankshaft of the engine turns but the engine does not start, and the engine eventually runs, or can start, but immediately stalls.

2. Diagnostics method of start-up difficulity

1. Initial check

Perform diagnostic system check - engine control.

Verify driver's start-up procedure is correct.

Make sure that the engine control module ground wire is free of dirt and the fixing position is correct.

Check if the harness connector is properly connected.

Check fuel type and quality.

Verify the injector ID for each cylinder.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5℃ {41℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor parameters on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer After the engine stops operating, if the fuel rail pressure sensor shows a value of 0.9 - 1.0 V, then the condition is OK. Otherwise, check for high resistance or sensor failure in each circuit.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

The cam position sensor is mounted and the camshaft gear is not damaged.

3. Fuel system inspection

Check the air in the fuel system.

Check the fuel system for moisture.

Check whether the fuel is frozen.

Check if the fuel filter is clogged.

Check whether the external fuel leak, oil leakage is serious.

Check pressure limiter valve and injector for oil leaks.

Check fuel system between fuel tank and fuel pump for crushing, twisting, improper fastening, rupture or blockage.

Check if the fuel tank breather hose is clogged.

{Fuel tank external impurities into the fuel system may lead to pipeline obstruction.}

Check fuel pump operation.

{The fuel supply pump must be timing tuned to the engine and the regulated valve should be written into the Engine control module. }

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

Observe the fuel rail pressure (FRP) regulator feedback current parameter displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstruction or leakage.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Engine mechanical inspection

Check the compression pressure of the engine.

Check idling gears for incorrect timing.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

7. Electrical system inspection

Check the starting speed.

Check if the battery is degraded.

Check the generator.

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Fluctuation and Instability

1. Explain fluctuation and instability phenomenon

Engine idle speed is unstable. Engine or vehicle may vibrate under harsh conditions. Engine idle speed may vary. Either of the following may cause the engine to stall.

2. Diagnostics method of fluctuation and instability

1. Initial check

Perform diagnostic system check - engine control.

Disassemble and check whether the air filter is polluted, whether the air tube is crushed or has no flow blockage.

Make sure that the engine control module ground wire is free of dirt and the fixing position is correct.

Check if the harness connector is properly connected.

Check fuel type and quality.

Verify the injector ID for each cylinder.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5℃ {41℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

The cam position sensor is mounted and the camshaft gear is not damaged.

3. Fuel system inspection

Check the air in the fuel system.

Check the fuel system for moisture.

Check whether the fuel is frozen.

Check if the fuel filter is clogged.

Check whether the external fuel leak, oil leakage is serious.

Check pressure limiter valve and injector for oil leaks.

Check fuel system between fuel tank and fuel pump for crushing, twisting, improper fastening, rupture or blockage.

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Check if the fuel tank breather hose is clogged.

{Fuel tank external impurities into the fuel system may lead to pipeline obstruction.}

Check fuel pump operation.

{The fuel supply pump must be timing tuned to the engine and the regulated valve should be written into the engine control module. }

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

Observe the fuel rail pressure (FRP) regulator feedback current parameter displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Engine mechanical inspection

Check the compression pressure of the engine.

Check idling gears for incorrect timing.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

Check the basic components of the engine, including the camshaft, cylinder head and piston.

7. Other check

Electromagnetic interference may cause engine malfunction.

The scanning tool usually detects electromagnetic interference according to the engine speed. If the engine speed increases sharply but the actual engine speed does not change, electromagnetic interference may also occur. If abnormality is found, check if the high voltage components such as injector line are connected to the sensor Area near the circuit.

Check engine mounting for any abnormalities.

Check crankshaft pulley for abnormalities.

Check the generator or air conditioner compressor.

Check the generator output voltage.

Check the operation of the exhaust gas recirculation system and implement "Exhaust gas recirculation control system check".

Check the air conditioning operation.

Idle speed is too high

1. Explain high idle speed phenomenon

The engine idling speed is always higher than normal regardless of the engine coolant temperature.

2. Diagnostic method of high idle speed

1. Initial check

Perform diagnostic system check - engine control.

Check if the harness connector is properly connected.

Use scan tools to compare engine speed parameters with tachometer values in the dash panel insert.

Check the air conditioning operation.

Check fuel type and quality.

Check engine oil level.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5 ℃ {41 ℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

Check the fuel rail pressure (FRP) parameter when the vehicle is in neutral or idling Correct operation if the rail pressure (FRP) parameter changes after the accelerator pedal is depressed.

Observe the APP parameter, which is correct if a linear change from 0 to 100% occurs in the accelerator pedal position (APP) depending on the operation of the accelerator pedal.

Observe the Power Throttle Remote Throttle Sensor Parameters When in the minimum position, the Power Take-off Remote Throttle Sensor display parameter is less than or equal to 0.4 V. Otherwise, check for low or high resistance in the low-voltage reference circuit or Sensor problem.

3. Fuel system inspection

Remove and inspect the fuel injector from the outside.

(The injector tip may be damaged.)

Resection.

1. Explain the resection phenomenon

A constant vibration ratio relative to the engine speed {is usually more pronounced when the engine load is increased} A continuous hissing sound is generated in the exhaust when the engine is idling, the engine speed is low or suddenly accelerating, and the fuel is defective). And the engine will eventually be stopped.

2. Diagnostics method of resection

1. Initial check

Perform diagnostic system check - engine control.

Make sure that the engine control module ground wire is free of dirt and the fixing position is correct.

Check if the harness connector is properly connected.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

Observe the Mass Air Flow (MAF) parameter and check the mass air flow sensor for malfunctions or delays.

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

Observe the APP parameter, which is correct if the APP parameter changes linearly from 0 to 100% depending on the operation of the accelerator pedal.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

3. Fuel system inspection

Check the air in the fuel system.

Check the fuel system for moisture.

Check whether the fuel is frozen.

Check if the fuel filter is clogged.

Check pressure limiter valve and injector for oil leaks.

Check fuel system between fuel tank and fuel pump for crushing, twisting, improper fastening, rupture or blockage.

Check if the fuel tank breather hose is clogged.

{Inclusion of fuel in the fuel system by external impurities in the fuel tank may lead to blockage of the piping.

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Other check

Electromagnetic interference may cause engine malfunction.

The scanning tool usually detects electromagnetic interference according to the engine speed. If the engine speed increases sharply but the actual engine speed does not change, electromagnetic interference may also occur. If abnormality is found, check if the high voltage components such as injector line are connected to the sensor area near the circuit.

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Oscillation

1. Explain oscillation phenomenon

The vehicle accelerates and decelerates without any change in the accelerator pedal position.

2. Diagnostics method of oscillation

1. Initial check

Perform diagnostic system check - engine control.

The driver must be familiar with air conditioner compressor operation.

Use the scanning tool to verify that the vehicle speed parameter matches the speedometer value.

Make sure that the engine control module ground wire is free of dirt and the fixing position is correct.

Check if the harness connector is properly connected.

Check fuel type and quality.

Check engine oil level.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

Observe the Mass Air Flow (MAF) parameter and check the mass air flow sensor for malfunctions or delays.

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

Observe the APP parameter, which is correct if the APP parameter changes linearly from 0 to 100% depending on the operation of the accelerator pedal.

3. Fuel system inspection

Check the air in the fuel system.

Check the fuel system for moisture.

Check whether the fuel is frozen.

Check if the fuel filter is clogged.

Check whether the external fuel leak, oil leakage is serious.

Check pressure limiter valve and injector for oil leaks.

Check fuel system between fuel tank and fuel pump for crushing, twisting, improper fastening, rupture or blockage.

Check if the fuel tank breather hose is clogged.

{Fuel tank external impurities into the fuel system may lead to pipeline obstruction.}

Check fuel pump operation.

{The fuel supply pump must be timing tuned to the engine and the regulated valve should be written into the engine control module.}

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Other check

Check the operation of the exhaust gas recirculation system and implement the "Exhaust gas recirculation control system check".

Check the air conditioning operation.

Check for tire deformation in a special speed range that could cause malfunction.

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Insufficient power, slow operation, weakness

1. Explain insufficient power, slow operation and weakness

The engine output is less than the expected output, and the engine speed will increase little or not even if the accelerator pedal is depressed.

2. Diagnostics method of insufficient power and slow operation and weakness

1. Initial check

Perform diagnostic system check - engine control.

Compare the vehicle with a similar vehicle Check the vehicle for any faults.

Disassemble and check whether the air filter is polluted, whether the air tube is crushed or has no flow blockage.

Check tire size changes.

Check if it is overloaded.

Check clutch for slipping.

Check brake resistance.

Check whether the shiftshift mode and downshift operation are normal.

Check the fuel quality.

Check engine oil level and oil quality.

Use the scanning tool to verify that the vehicle speed parameter matches the speedometer value.

Make sure that the engine control module ground wire is free of dirt and the fixing position is correct.

Verify the injector ID for each cylinder.

Check the scan tool data list.

Check the relevant service bulletin.

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2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5 ℃ {41 ℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

Observe the APP parameter, which is correct if the APP parameter changes linearly from 0 to 100% depending on the operation of the accelerator pedal.

After turning the ignition switch on and shutting down the engine, observe the supercharger pressure and the air pressure parameter, and the condition is normal when both parameters are below 7.0 kPa {1.0 psi}.

3. Fuel system inspection

Check the air in the fuel system.

Check the fuel system for moisture.

Check whether the fuel is frozen.

Check if the fuel filter is clogged.

Check whether the external fuel leak, oil leakage is serious.

Check pressure limiter valve and injector for oil leaks.

Check fuel system between fuel tank and fuel pump for crushing, twisting, improper fastening, rupture or blockage.

Check if the fuel tank breather hose is clogged.

{Fuel tank external impurities into the fuel system may lead to pipeline obstruction.}

Check fuel pump operation.

{The fuel supply pump must be timing tuned to the engine and the regulated valve should be written into the engine control module.}

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

Check turbocharger turbine, shaft or compressor impeller for wear or damage.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Engine mechanical inspection

Check the compression pressure of the engine.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

7. Other check

Check the operation of the exhaust gas recirculation system and implement "Exhaust gas recirculation control system check".

Check engine temperature is too high.

Check the air conditioning operation.

Unresponsive, depressed, poor

1. Explain unresponsive, depression and poor phenomenon

The reaction delay occurs when the accelerator pedal is depressed, which occurs regardless of the speed. This is most often the case when starting the vehicle from standstill, and in the worst case the engine May turn off.

2. Diagnosis method of unresponsive, depression and poor

1. Initial check

Perform diagnostic system check - engine control.

Compare the vehicle with a similar vehicle. Check the vehicle for any faults.

Disassemble and check whether the air filter is polluted, whether the air tube is crushed or has no flow blockage.

Check whether the shiftshift mode and downshift operation are normal.

Check the fuel quality.

Check engine oil level and oil quality.

Make sure that the engine control module ground wire is free of dirt and the fixing position is correct.

Verify the injector ID for each cylinder.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5 ℃ {41 ℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

(When the ignition is turned on, the Mass Air Flow Sensor will warm up and the air intake temperature will be higher than the normal air intake temperature.) Observe the MAF parameters to check for mass air flow sensor malfunctions or reactions slow.

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

Observe the APP parameter, which is correct if the APP parameter changes linearly from 0 to 100% depending on the operation of the accelerator pedal.

After turning the ignition switch on and shutting down the engine, observe the supercharger pressure and the air pressure parameter, and the condition is normal when both parameters are below 7.0 kPa {1.0 psi}.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

3. Fuel system inspection

Check the air in the fuel system.

Check the fuel system for moisture.

Check whether the fuel is frozen.

Check if the fuel filter is clogged.

Check whether the external fuel leak, oil leakage is serious.

Check pressure limiter valve and injector for oil leaks.

Check fuel system between fuel tank and fuel pump for crushing, twisting, improper fastening, rupture or blockage.

Check if the fuel tank breather hose is clogged.

{Fuel tank external impurities into the fuel system may lead to pipeline obstruction.}

Check fuel pump operation.

{The fuel supply pump must be timing tuned to the engine and the regulated valve should be written into the engine control module. }

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

Check turbocharger turbine, shaft or compressor impeller for wear or damage.

Check if the turbocharger cylinder is blocked.

5. Exhaust system inspection

Check exhaust system airflow is limited.

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6. Engine mechanical inspection

Check the compression pressure of the engine.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

7. Other check

Check the operation of the exhaust gas recirculation system and implement "Exhaust gas recirculation control system check".

Check engine temperature is too high.

Check the air conditioning operation.

Abnormal combustion noise

1. Explain abnormal combustion noise phenomenon

The engine knocks repeatedly, and in general, knocking becomes more pronounced when accelerating, and when the throttle opening angle changes, a strong metal strike noise occurs.

2. Diagnostics method of abnormal combustion noise

1. Initial check

Perform diagnostic system check - engine control.

Check if the vehicle is faulty.

Check for smoke and combustion noise.

Check the fuel quality.

Verify the injector ID for each cylinder.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5℃ {41℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

3. Fuel system inspection

If the amount of flue gas is excessive, check if the injector is stuck open Check the fuel tank for fuel infiltration.

Remove and inspect the fuel injector from the outside.

Cylinder balance test using scanning tools.

Injector forcing driver using scan tool.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

4. Engine mechanical inspection

Check the compression pressure of the engine.

Check basic engine components including camshaft, cylinder head and piston.

Check the fuel tank for excessive fuel infiltration situation.

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5. Other check

Check for other causes of a similar sound, such as loose parts, brackets, loose mounting parts, or less resilient spring damping of the clutch damper.

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Poor fuel economy

1. Fuel economy is poor

Fuel mileage was significantly lower than expected in actual road tests and in multiple fuel measurements, and the measured fuel mileage was significantly lower than the fuel mileage measured during the historical road test.

2. Poor fuel economy diagnostics

1. Initial check

Disassemble and check whether the air filter is polluted, whether the air tube is crushed or has no flow blockage.

Check the driver's driving habits.

Check that the air conditioner is always ON, or that the defrost mode is always ON.

Verify tire air pressure is appropriate.

Check tire size has changed.

Check if it is overloaded.

Check if acceleration is too fast or too frequent.

Check clutch for slipping.

Check brake resistance.

Check the belt tension.

Check the fuel quality.

Check engine oil level and oil quality.

After replenishing the fuel tank, instruct the owner to recheck the fuel consumption rate.

Check if the odometer is working properly.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5℃ {41℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

3. Fuel system inspection

Check fuel type and quality.

Check fuel leaks.

4. Cooling system check

Check engine coolant level.

Check if the engine thermostat is always on and check that the heating range is not correct.

Check if the engine cooling fan is always "on".

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5. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

Check turbocharger turbine, shaft or compressor impeller for wear or damage.

6. Exhaust system inspection

Check exhaust system airflow is limited.

7. Engine mechanical inspection

Check the compression pressure of the engine.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

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Black smoke

1. Black smoke phenomenon

Black smoke occurs when the engine is loaded, idling or overheating, or when starting the engine at low temperatures.

2. Black smoke diagnostics

1. Initial check

Check if the vehicle is faulty.

Disassemble and check whether the air filter is polluted, whether the air tube is crushed or has no flow blockage.

Make sure that the *ECM* ground wire is free of dirt and the fixing position is correct.

Check the fuel quality.

Check engine oil level and oil quality.

Verify the injector ID for each cylinder.

Check the scan tool data list.

Check the relevant service bulletin.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5℃ {41℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

After turning the ignition switch on and shutting down the engine, observe the supercharger pressure and the air pressure parameter, and the condition is normal when both parameters are below 7.0 kPa {1.0 psi}.

3. Fuel system inspection

Remove and inspect the fuel injector from the outside.

Cylinder balance test using scanning tools.

Use the scanning tool to stop the pre-injection.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

Check if mass air flow sensor is contaminated or damaged.

Check turbocharger turbine, shaft or compressor impeller for wear or damage.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Engine mechanical inspection

Check the compression pressure of the engine.

Check idling gears for incorrect timing.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

Inspect the oil chamber for oil penetration.

7. Other check

Check the operation of the exhaust gas recirculation system and implement the "Exhaust gas recirculation control system check".

Check whether the leak is serious.

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White smoke

1. White smoke phenomenon

White smoke occurs when the engine is under a light load, idling or overheating, or when starting the engine in cold conditions.

2. White smoke diagnostics

1. Initial check

Check if the vehicle is faulty.

Confirm that the ground of engine control module is free from dirt and fix the position accurately.

Check the fuel quality.

Check the injector ID for each cylinder.

Check the scan tool data list.

Confirm Service Technical Report.

2. Sensor check

When the engine is cooling, the coolant temperature, intake air temperature (IAT) and fuel temperature parameters are compared.

When the difference between the temperature values is 5℃ {41℉} or higher, check the high resistance in each circuit and the sensor malfunction after engine cooling.

{When the ignition is turned on, the mass air flow sensor will warm up sooner, so the air intake temperature will be higher than the normal air intake temperature.}

Observe the fuel rail pressure sensor on the scanning tool Turn the ignition on without starting the engine for 1 minute or longer after the engine is stopped If the fuel rail pressure sensor shows a value of 0.9 - 1.0 V , Then the situation is normal.Otherwise, please check the high resistance or sensor failure in each circuit.

When the vehicle is fully neutral and idling, fully depress the accelerator pedal, check the fuel rail pressure (FRP) and the required fuel rail pressure parameters. The display difference should always be between (-5) and 5 MPa {(-725) - 725 psi} below.

The crankshaft position sensor is mounted and the sensor rotor is not damaged.

After turning the ignition switch on and shutting down the engine, observe the supercharger pressure and the air pressure parameter, and the condition is normal when both parameters are below 7.0 kPa {1.0 psi}.

3. Fuel system inspection

Remove and inspect the fuel injector from the outside.

Cylinder balance test using scanning tools.

Use the scanning tool to stop the pre-injection.

Observe the fuel compensation parameters for each cylinder at idle displayed on the scan tool.

4. Check the air intake system

Check air filter and intake line for obstruction, orifice or leakage.

Check for conditions that restrict airflow to the turbocharger intake.

Check intake throttle is blocked.

Check intake manifold for obstructions or gas leaks.

Check if mass air flow sensor is contaminated or damaged.

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Check turbocharger turbine, shaft or compressor impeller for wear or damage.

5. Exhaust system inspection

Check exhaust system airflow is limited.

6. Engine mechanical inspection

Check the compression pressure of the engine.

Check idling gears for incorrect timing.

Check valve clearance.

Check valve spring for damage and fatigue.

Check camshaft for wear.

Check if the thermostat is stuck open.

Inspect the oil chamber for oil penetration.

7. Electrical system inspection

Check glow plug control system operation.

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Engine overheat

1. Engine overheat diagnostics

Insufficient coolant

Supplement

Thermostat failure

Replace.

Pump failure

Replace.

Cooler blocked

Clean or replace

Vice tank cover defects

Replace.

Insufficient engine oil or engine oil model number

Replace or replace the engine oil

Cylinder head gasket defective

Replace.

Loosen the V-belt

Adjust.

Exhaust system blocked

Clean or replace.

Air intake system blocked

Clean or replace.

Fuel injection is too large

Diagnose the engine control system.

Improper fuel injection timing.

Diagnose the engine control system

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Engine overcooling

1. Engine overcooling diagnostics

Thermostat failure

Replace.

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The maximum engine speed is too low

1. The maximum engine speed is too low

Fuel tank vents blocked

Clean.

Fuel line blocked or damaged

Repair or replace.

Engine control system fault

Diagnose the engine control system

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The engine does not stop

1. The engine does not stop diagnostics

Engine control system fault

Diagnose the engine control system.

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Starter speeding

1. Starter speeding diagnostics

Ignition switch reset contact failure

Replace the ignition switch.

Reactor relay contact reset error

Replace starter relay.

Electromagnetic switch coil short circuit

Replace the solenoid switch.

Charging system failure

1. Charging system fault diagnostics

Note:

● Can not charge

Battery failure

Replace.

Open or short circuit or ammeter, or poor connection

Service.

Each coil is open, the generator ground is shorted or the diode is damaged

Replace

Regulator failure

Replace.

Defective regulator terminal connection

Service.

Note:

● Insufficient charge

Battery failure

Replace.

Battery failure

Replace.

Generator drive belt loose

Adjust.

Stator coil layer short circuit

Replace.

Stator coil layer short circuit

Replace.

Terminals mis-contact

Replace it

Terminals mis-contact

Replace it

Defective regulator terminal connection

Service.

Note:

● Too much load

Regulator failure

Replace.

Charge current is not stable

Poor contact or the circuit is about to open

Service.

Generator drive belt loose

Adjust.

Stator coils are close to short or open.

Service.

Poor connection of each terminal

Service.

Regulator failure

Replace.

Defective regulator terminal connection

Service.

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Generator abnormal noise

1. Generator abnormal sound diagnostics

Reduce belt tension

Adjust.

Bearing failure

Replace.

The rotor core is in contact with the stator core

Service.

Diode failure

Replace.

Stator coils are close to short or open.

Service.

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Exhaust system vibration and clicks

1. Exhaust system vibration and click diagnostics

Loose parts or abnormal installation

Align the connectors and retighten, check the hooks, mounting brackets and clamps for damage.

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Exhaust system blocked

1. Exhaust system is blocked

Exhaust brake valve is open

Check the electrical system or solenoid valve, check the fault diagnosis code status, and then solve the abnormal situation.Check the exhaust brake valve shaft is sticky.If you find unusual circumstances, Need to be replaced.

Exhaust pipe blocked or deformed

Repair or replace

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Exhaust gas leak, noise

1. Exhaust gas leaks, noise diagnostics

Improper installation or connection

Adjust the connector and retighten.

Drain or muffler damage or burns

Replace damaged parts.

Exhaust system components, such as pipe clamps, pipes and mufflers, are defective

Replace defective parts.

Silencer internal damage

Replace.

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Turbocharger malfunction

1. Turbocharger fault diagnostics

Note:

● If there is abnormal vibration

The reason for this is that the bearings are damaged and the rotating parts come into contact with the surrounding parts, and the replacement of engine oil, the invasion of extraneous foreign matter into the oil pipe, the blockage of the oil filter, or the failure of the vehicle when it is damaged or stopped repeatedly.

replace.

If there is no problem with the lube oil system, but the rotating part and the surrounding parts are damaged by contact with each other, the rotating part may be out of balance or the crankshaft may be bent, possibly due to bearing wear or damage to the turbine rotor or compressor impeller caused by flying foreign objects.

replace.

Note:

● Although the turbocharger appears to be normal, the output is reduced.

Leak gas from each exhaust area

Repair or replace.

Exhaust resistance caused by deformation of the exhaust muffler or carbon blockage is excessive

Repair or replace.

Air leak on compressor side, or air filter contaminated

Clean or replace.

Compressor internal contaminants

Clean.

Rotor shaft is dirty

Clean.

Note:

● Exhaust is white if oil leaks to the exhaust pipe or intake pipe.

Oil level rises due to dirty or blocked oil separator

Clean or replace.

Drainage tube clogged, crushed or deformed

Repair or replace.

Piston ring wear or piston ring groove wear too much

Replace.

Piston ring damaged due to bearing failure

Replace.

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Engine Control

Troubleshooting

(6WG1)

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Diagnostic System Check - Engine Control Device

1. Diagnostic system check - engine control device function description

The Engine Control system inspection is a systematic method for checking problems caused by malfunctions in the Engine Control system. This system check is the starting point of drivability complaint diagnosis. Move from the system check to the next logical step to diagnose problems. Understanding and correctly using the diagnostic table reduces diagnostic time and prevents the replacement of good parts.

2. Engine control

Refer to "*101.ETM 13B. Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - General Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostic system check - engine control device

● If there are no complaints on drivability, do not perform these diagnostic steps unless otherwise instructed in other sections.

● Check for related Service Bulletins before starting the diagnosis.

● Do not clear the DTC unless instructed to do so in a diagnostic step.

● If a malfunction is found in the engine starting system, check the starting system.

● The battery should be fully charged.

● The battery cable should be normal and securely connected.

● The ground of the ECM should be securely connected to the correct position.

● Verify that the ECM harness connector is clean and correctly connected. Do not attempt to crank the engine with the ECM harness connectors disconnected.

● Verify that the ECM terminals are clean and correctly connected.

● Check if the injector ID Code is programmed correctly.

● If fuel system DTC P0087, P0088, P0089, P1093 or other DTCs are set, diagnose sensor DTCs, solenoid DTCs, actuator DTCs, and relay DTCs first.

1. Scan tool power-up check

1) Connect the scan tool. Does the scan tool power up?

Yes

⇒Proceed to 2. Scan tool communication verification

No

Go to Scan tool does not power up.

Refer to "*Scan tool does not power up*".

2. Scan tool communication verification

1) Turn ON the ignition switch.

2) Check the communication status with the ECM with a scan tool. Does the scan tool communicate with the ECM?

Yes

⇒Proceed to 3. Engine start check

No

Go to Lost communication with the ECM.

Refer to "*Lost communication with the ECM*".

3. Engine start check

1) Start the engine. Does the engine start?

Yes

⇒Proceed to 4. MIL illumination check

No

Go to Starting system check.

Refer to "*Starting system check*".

4. MIL illumination check

1) Turn ON the ignition switch.

2) Check the MIL. Does the MIL illuminate?

Yes

⇒Proceed to 5. Control module DTC check

No

Go to MIL lighting circuit system check.

Refer to "*MIL lighting circuit system check*".

5. Control module DTC check

1) Observe the ECM DTC information with a scan tool. Is the scan tool displaying a control module diagnostic code?

● ECM

● Anti-lock braking system control unit

Yes

⇒Proceed to 6. Communication-related DTC check

No

⇒Proceed to 10. Symptom check

6. Communication-related DTC check

1) Observe the DTC information with a scan tool. Are the DTCs that start with U or DTCs that are related to other control modules?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 7. Control module internal related DTC check

7. Control module internal related DTC check

1) Observe the DTC information with a scan tool. Is the diagnostic code P0601, P0602, P0606, P060B or P1621 set by the *ECM*?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0601 (Flash Code 53) Internal Control Module Memory Check Sum Error*".

Refer to "*DTC P0602 (Flash Code 154) Control Module Programming Error*".

Refer to "*DTC P0606 (Flash Code 51) ECM Processor*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P1621 (Flash Code 54) Control Module Long Term Memory Performance*".

No

⇒ Proceed to 8. Check the system voltage-related trouble codes

8. Check the system voltage related fault diagnosis code

1) Observe the DTC information with a scan tool. Is DTC P0563 set?

Yes

Check the DTC P0563

Refer to "*DTC P0563 (Flash Code 35) System Voltage High.*".

No

=>Proceed to 9. Check for other DTCs

9. Check other DTCs

1) Observe the DTC information with a scan tool. Is other DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 10. Symptom check

10. Symptom check

1) Check if the following symptoms are present.

- Hard start
- Rough, unstable
- High idle speed
- Cuts out
- Surges
- Lack of power, sluggishness, or sponginess
- Hesitation, sag, or stumble
- Abnormal combustion noise
- Poor fuel economy
- Black smoke
- White smoke
- Engine overheat
- Engine overcooling

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- The maximum engine speed is too low
- The engine did not stop working
- Starter high-load operation
- Charging system failure
- Generator abnormal noise
- Exhaust system vibration and clicks
- Exhaust system is blocked
- Exhaust gas leaks and makes noise
- Turbocharger malfunction

Yes

Repair the applicable symptom.

Refer to "*202.Engine 15D.Symptom(6WG1) Hard start*".

Refer to "*202.Engine 15D.Symptom(6WG1) Rough, unstable*".

Refer to "*202.Engine 15D.Symptom(6WG1) High idle speed*".

Refer to "*202.Engine 15D.Symptom(6WG1) Cuts out*".

Refer to "*202.Engine 15D.Symptom(6WG1) Surges*".

Refer to "*202.Engine 15D.Symptom(6WG1) Lack of power, sluggishness or sponginess*".

Refer to "*202.Engine 15D.Symptom(6WG1) Hesitation, sag or stumble*".

Refer to "*202.Engine 15D.Symptom(6WG1) Hesitation, sag or stumble*".

Refer to "*202.Engine 15D.Symptom(6WG1) Poor fuel economy*".

Refer to "*202.Engine 15D.Symptom(6WG1) Black smoke*".

Refer to "*202.Engine 15D.Symptom(6WG1) White smoke*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Engine overheating*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Engine overcooling*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Engine's maximum speed is too low*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Engine does not stop*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Starter Overspeed*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Charging system failure*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) An abnormal sound generator*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Vibration and click of exhaust system*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Exhaust system blocked*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Exhaust gas leak, noise*".

Refer to "*202. Engine 15D. Phenomenon (6WG1) Turbocharger Malfunction*".

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

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Scan tool does not power up

1. Scan tool does not power up description of function

The DLC is a standardized 16-pole connector. Connector design and location are dictated by an industry-wide standard and are required to provide the following.

● The battery voltage of the scan tool power supply is terminal 16.

● The scan tool power supply ground is terminal 4.

● The common signal ground is terminal 5.

However, some modules can communicate only when the ignition switch is in the ON state.

2. Data Link Connector

Refer to "*101. ETM 13K. Body Controls Body Control Data Link Connectors*".

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Scan tool does not power up

Note:

● Check the scan tool power circuit.

● Verify that the scan tool operates properly on another vehicle.

1. Fuse inspection

1) Turn OFF the ignition switch.

2) Inspect for a blown out ROOM LAMP, AUDIO 7.5A fuse. Is the result normal?

Yes

⇒Proceed to 2. DLC inspection

No

Replace the fuse. If the fuse blows out again, repair the short to ground in the circuits relating to the ROOM LAMP, AUDIO 7.5A fuse.

⇒Proceed to 5. Vehicle repair check

2. DLC inspection

1) Check if the data communication link connector (FL765) is misaligned and there is a contact failure or missing terminal. Is the connection status normal?

Refer to "*DLC*".

Yes

⇒Proceed to 3. Inspection for open circuit in DLC battery power supply circuit

No

Repair the terminal as necessary.

⇒Proceed to 5. Vehicle repair check

3. Inspection for open circuit in DLC battery power supply circuit

1) Connect a test lamp between the DLC battery power supply circuit (pin 16 of FL765) and the frame ground. Does the test lamp illuminate?

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Refer to "*DLC*".

Yes

⇒Proceed to 4. Inspection for open circuit in ground circuit of DLC

No

Repair the open circuit in the DLC battery power supply circuit.

⇒Proceed to 5. Vehicle repair check

4. Inspection for open circuit in ground circuit of DLC.

1) Inspect the ground circuit between the DLC and the frame ground (pins 4 and 5 of FL765) for an open circuit or high resistance. Is the result normal?

Refer to "*DLC*".

Yes

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

No

Repair the circuit and clean or tighten the ground terminal as necessary.

⇒Proceed to 5. Vehicle repair check

5. Vehicle repair check

1) Connect a scan tool to the DLC.

2) Power up the scan tool. Does the scan tool power up?

Yes

The system is normal.

No

⇒Proceed to 1. Fuse inspection

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Lost communication with the ECM

1. Lost communication with the ECM description of function

The ECM communicates with the scan tool via the CAN communication.

The following conditions cause poor CAN communication.

● Open circuit in CAN communication circuit

● Short together between the CAN Low circuit and CAN High circuit

● Short to ground or short to the power supply in the CAN communication circuit

● Failure inside the module, which causes a short to ground or a short to the power supply circuit in the CAN communication circuit

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram* " in this section.

4. Lost communication with the ECM

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Scan tool communication verification

Note:

● If IDSS is currently used, check if there is a problem with the IDSS interface device, and if the LED of the IDSS interface device is not lit, refer to the Scanning Tools Power Failure Diagram to verify the power supply.

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Check the communication status with the ECM with a scan tool. Does the scan tool communicate with the ECM?

Yes

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

No

⇒Proceed to 3. DLC inspection

3. DLC inspection

1) Inspect for poor connections at the DLC (pins 6 and 14 of FL765). Is the connection status normal?

Refer to “*DLC*”

Yes

⇒Proceed to 4. ECM harness connector inspection

No

Repair the connection as necessary.

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⇒Proceed to 16. Vehicle repair check

4. ECM harness connector inspection

1)Inspect for poor connections at the ECM harness connector (pins 22 and 23 of FL557). Is the connection status normal?

Refer to "*Controller Area Network*".

Yes

⇒Proceed to 5. Fuse inspection

No

Repair the connection as necessary.

⇒Proceed to 16. Vehicle repair check

5. Fuse inspection

1) Inspect for a blown out fuse. Is the result normal?

Yes

⇒Proceed to 6. Inspection for open circuit in ECM power supply circuit

No

Replace the fuse. If the fuse blows out again, repair the short to ground in the circuits relating to the fuse.

⇒Proceed to 16. Vehicle repair check

6. Inspection for open circuit in ECM power supply circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL559).

3) Turn ON the ignition switch.

4) Connect a test lamp between the ECM power supply circuit (pins 1 and 2 of FL559) and frame ground. Does the test lamp illuminate?

Refer to “Engine Control”.

Yes

⇒Proceed to 7. CAN circuit resistance check

No

Repair the open circuit in the ECM power supply circuit (pins 1 and 2 of FL559).

⇒Proceed to 16. Vehicle repair check

7. CAN circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the scan tool from the DLC if connected.

3) Measure the resistance between the CAN High circuit and the CAN Low circuit (pins 6 and 14 of FU23) with a DMM. Is the resistance within the specified range?

Note:

● Resistor 1 and 2 in the *ECM* with a resistance of 120 Ω have a parallel resistance of 60 Ω.

Refer to “*DLC*”

Value: 50 to 70 Ω

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Yes

⇒Proceed to 9. Inspection for short circuit in CAN circuit

No

⇒Proceed to 8. Inspection for open circuit and short circuit in CAN circuit

8. Inspection for open circuit and short circuit in CAN circuit

1) Inspect for poor connections at the ECM harness connector (pins 22 and 23 of FL557). Is the connection status normal?

2) Inspect the CAN High circuit and the CAN Low circuit between the ECM (pins 22 and 23 of FL557) and the DLC (pins 6 and 14 of FL765) for the following conditions. Is the result normal?

● Open circuit

● Short together between the CAN High circuit and the CAN Low circuit

● High resistance

Refer to "*CAN*"

3) Are all of the results normal?

Yes

⇒Proceed to 15. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 16. Vehicle repair check

9. Inspection for short circuit in CAN circuit

1) Inspect the CAN High circuit and the CAN Low circuit between the ECM (pins 22 and 23 of FL557) and the DLC (pins 6 and 14 of FL765) for the following. Is the result normal?

● Short to ground

● Short to the power supply circuit

Refer to "*CAN*" .

Yes

⇒Proceed to 10. ECM ground circuit inspection

No

Repair the circuit as necessary.

⇒Proceed to 16. Vehicle repair check

10. ECM ground circuit inspection

1) Inspect the ground circuit of the ECM for corrosion or improper installation. Is the result normal?

Note:

● The communication failure will not occur when the grounding circuit of the *ECM* is open.\

Yes

⇒Proceed to 11. ECM main relay inspection

No

Clean or reinstall the ground circuit as necessary.

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⇒Proceed to 16. Vehicle repair check

11. ECM main relay inspection

1) Turn OFF the ignition switch.

2) Connect the ECM harness connector (FL557) .

Refer to *Engine Control*

3) Replace the ECM main relay with a glow relay or a known good relay.

4) Turn ON the ignition switch.

5) Check the communication status with the ECM with a scan tool. Does the scan tool communicate with the ECM?

Yes

Replace the ECM main relay.

⇒Proceed to 16. Vehicle repair check

No

⇒Proceed to 12. Inspection for open circuit in ECM main relay power supply circuit

12. Inspection for open circuit in ECM main relay power supply circuit

1) Turn OFF the ignition switch.

2) Remove the ECM main relay.

3) Connect a test lamp to the ECM main relay power supply circuit (pins 1 and 4 of FL398). Does the test lamp illuminate?

Refer to "*Engine Control*".

Yes

⇒Proceed to 13. Check for open circuit in ECM main relay power supply circuit

No

Repair the open circuit in ECM main relay power supply circuit

⇒Proceed to 16. Vehicle repair check

13. Inspection for open circuit in ECM main relay circuit

1) Install the ECM main relay.

2) While checking the operation sounds of the ECM main relay, turn the ignition switch ON/OFF. When turning the ignition switch ON/OFF, does the ECM main relay make any operation sounds?

Note:

● Wait at least 7 seconds before turning on / off.

Yes

⇒Proceed to 14. Inspection for open circuit in ECM main relay control circuit

No

Repair the open circuit or high resistance between the ECM main relay (pin 2 of FL398) and the frame ground.

⇒Proceed to 16. Vehicle repair check

14. Inspection for open circuit in ECM main relay control circuit

Inspect the ECM main relay control circuit between the ECM (pins 6 and 7 of FL559) and the ECM main relay (pin 2 of FL398) for an open circuit or high resistance. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 16. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 16. Vehicle repair check

15. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 16. Vehicle repair check

16. Vehicle repair check

1) Turn OFF the ignition switch.

2) Reconnect all of the disconnected fuses, relays, or harness connectors.

3) Turn ON the ignition switch.

4) Verify communication with the ECM is established with a scan tool.

Yes

The system is normal.

No

⇒Proceed to 3. DLC inspection

MIL lighting circuit system check

1. MIL lighting circuit system check description of function

When the ignition switch is on, the fault indicator will be on or off according to the following conditions.

● The light will remain on after the light is turned on until the engine is switched on (but will flash 3 times)

The engine control module first checks the starter signal and then the fault indicator is on or off.

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. MIL lighting circuit system check

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. MIL illumination check

1) Turn ON the ignition switch.

2) Check if the other lights in the dashboard are illuminated. Are there any lights not lighting up?

Yes

⇒Proceed to 6. MIL illumination check

No

⇒ Proceed to 3. Instrument panel cluster power supply voltage check

3. Instrument panel cluster power supply voltage check

1) Turn OFF the ignition switch

2) Remove the dash panel.

3) Turn ON the ignition switch.

4) Use a digital multimeter to measure the voltage between the dash panel connector power circuit (pin 30 of FU72) and the chassis ground. Is the measured voltage equal to the Battery voltage?

Refer to “*Instrument panel cluster*”

Yes

⇒Proceed to 5. ECM power supply and ground circuit inspection

No

⇒Proceed to 4. Instrument panel cluster power supply and ground circuit inspection

4. Instrument panel cluster power supply and ground circuit inspection

1) Inspect the power supply or instrument panel cluster ground circuit

2) Repair if necessary.

Procedure completion

⇒Proceed to 5. ECM power supply and ground circuit inspection

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5. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.

Refer to “*ECM power supply and ground circuit inspection*”

2) Repair or replace if necessary

Procedure completion

⇒Proceed to 6. MIL illumination check

6. MIL illumination check

1) Turn ON the ignition switch.

Does the MIL illuminate?

Note:

● After turning the ignition switch on, the fault indicator flashes three times every 15 seconds and then continuously lights up until the engine starts.

Yes

⇒Proceed to 10. Vehicle repair check

No

⇒Proceed to 7. MIL illumination check using fused jumper wire

7. MIL illumination check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL558) .

3) Connect a jumper wire with fuse between the fault LED control circuit of the *ECM* harness connector (pin 7 of FL558) and chassis ground.

Refer to "*Instrument panel cluster*".

4) Turn ON the ignition switch.

5) Check the MIL.Does the MIL illuminate?

Yes

⇒Proceed to 8. Check the MIL signal input

No

Repair or replace the *Control Circuit*

⇒Proceed to 10. Vehicle repair check

8. Check the MIL signal input

1) Connect all the wiring harness connectors that were disconnected before.

2) Turn ON the ignition switch. Does the MIL illuminate?

Note:

● After turning the ignition switch on, the fault indicator flashes three times every 15 seconds and then continuously lights up until the engine starts.

Yes

⇒Proceed to 10. Vehicle repair check

No

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⇒Proceed to 9. ECM replacement

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Vehicle repair check

10. Vehicle repair check

1) Restore the vehicle to its normal operating condition, and verify the repair.

Procedure completion

Go to *Diagnostic System Check - Engine Control Device*

Refer to "*Diagnostic System Check - Engine Control Device*".

POWERSTAR

SVS Lamp Flashing Control System Check

1. SVS Lamp Flashing Control System Check description of function

When the ignition switch is on, the "Service Vehicle as soon as possible" light will be on or off according to the following conditions.

● After turning on, it will keep on turning on until the engine is turned on.

2. Engine control

Refer to "*101.ETM 13B. Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram* " in this section.

4. SVS Lamp Flashing Control System Check

1. Inepect the diagnostic switch circuit for open and short circuit.

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL557).

3) Check that the circuit between the engine control module (pin 3 of FL557) and the data communication link connector (pin 12 of FL765) is open or short circuited.

Refer to *“DLC”*

4) Repair the circuit as necessary.

Procedure completion

⇒ Proceed to 2. Inspect for an open or short circuit in the ground circuit of DLC.

2. Inspect for an open or short circuit in the ground circuit of DLC.

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL557).

3) Check that the circuit between the data communication link connector (pin 12 of FL765) and chassis ground is open or short circuited.

Refer to “*Engine Control*”.

4) Repair or replace if necessary.

Procedure completion

⇒ Proceed to 3. Inspect for SVS lamp control circuit for short circuit.

3. Inspect for SVS lamp control circuit for short circuit.

1) Turn OFF the ignition switch.

2) Disconnect the instrument panel cluster harness connector (FU73).

3) Disconnect the ECM harness connector (FL558).

4) Check for "Short Service Vehicle" light control circuit between the dash panel insert (FU73, pin 18) and *ECM* (pin 19, FL558) for short circuit.

Refer to "*Instrument panel cluster*".

5) Repair or replace if necessary.

Procedure completion

POWERSTAR

⇒Proceed to 4. SVS lamp illumination inspection.

4. SVS lamp illumination inspection

1) Reconnect all of the disconnected harness connectors.

2) Connect a fused jumper wire to the DLC (pins 4 and 12 of FL765).

Refer to “*DLC*”

3) Turn ON the ignition switch.

4) Check the SVS lamp. Does the SVS lamp flash?

Yes

⇒Proceed to 8. Vehicle repair check

No

⇒Proceed to 5. "Repair vehicle as soon as possible" lamp OFF (OFF) Check

5. "Repair vehicle as soon as possible" light OFF check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL558) .

Refer to “*Engine Control*”.

3) Turn ON the ignition switch.

4) Check the SVS lamp. Does the SVS lamp go out?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

Replace the instrument panel cluster.

Refer to "*9.9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Instrument panel cluster removal*".

Refer to "*9.9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Instrument panel cluster installation*".

⇒Proceed to 8. Vehicle repair check

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to “*ECM power supply and ground circuit inspection*”

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Vehicle repair check

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Vehicle repair check

8. Vehicle repair check

1) Reconnect all of the disconnected harness connectors.

2) Turn ON the ignition switch.

3) Connect a fused jumper wire to the DLC (pins 4 and 12 of FL765).

Refer to "*DLC*".

4) Confirm "as soon as possible to repair the vehicle" light flashing state.

Starting system check

1. Starting system check description of function

The starting system inspection is used to find the cause of engine deactivation. The following items are the conditions for performing this diagnosis.

● The battery is fully charged and the battery cable is securely connected.

● The rotation speed when cranking is normal.

● The fuel is sufficiently supplied.

● There is no fuel leakage.

● No air in the fuel

● No abnormal conditions in the air cleaner elements and the fuel filters

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Starting system check

1. Prioritized DTC check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 2. Fuel system inspection

2. Fuel system inspection

1) Inspect while referring to Fuel system check. Is the result normal?

Refer to "*Fuel system check*".

Yes

⇒Proceed to 3. Engine mechanical inspection

No

Repair or replace if necessary.

⇒Proceed to 7. Starter system check

3. Engine mechanical inspection

1) Inspect for the following abnormal conditions. Is the result normal?

● Engine mechanical stops operating

● Improper installation position of the flywheel

● Excessive clogging in the air intake system

● Excessive clogging in the exhaust system

Yes

⇒Proceed to 4. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 7. Starter system check

4. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit check*".

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 7. Starter system check

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Engine start check

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6. Engine start check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Start the engine. Does the engine start?

Yes

⇒Proceed to 7. Starter system check

No

⇒Proceed to 1. Prioritized DTC check

7. Starter system check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 8. Vehicle repair check

8. Vehicle repair check

1) Restore the vehicle to its normal operating condition, bleed the air from the fuel piping again, and verify the repair.

Procedure completion

The system is normal.

POWERSTAR

Fuel system check

1. Fuel system check description of function

The fuel system is divided into a high pressure system and a low pressure system.High pressure system refers to the part between the feed pump and the common rail (fuel rail) injectors.The low pressure system refers to the fuel leakage circuit and the part between the fuel tank and the feed pump Several filters are installed in the fuel system To prevent fuel leakage, the pressure limiter should be installed in the common rail (fuel rail) area and an over flow valve installed in the supply pump area.

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Fuel system check

1. Fuel amount inspection

1) Inspect the fuel amount. Is the fuel amount adequate?

Yes

⇒Proceed to 2. Fuel quality inspection

No

Refill with the fuel.

⇒Proceed to 2. Fuel quality inspection

2. Fuel quality inspection

1) Drain the fuel from the fuel tank.

2) Refill with the specified fuel.

3) Bleed the air from the fuel piping.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel air bleed*".

4) Start the engine. Does the engine start?

Yes

⇒Proceed to 7. Vehicle repair check

No

⇒Proceed to 3. Fuel piping check

3. Fuel piping check

1) Bleed the air from the fuel piping between the fuel tank, the feed pump, the fuel filter, and the supply pump.

2) If fuel does not reach the fuel filter, inspect the supply pump overflow valve and replace if a malfunction is found.

3) If there is no malfunction in the overflow valve, reversely connect the IN side fuel hose above the fuel tank and the OUT side fuel hose to bleed the air. Inspect the fuel tank if fuel comes.

Procedure completion

POWERSTAR

⇒Proceed to 4. Fuel filter inspection

4. Fuel filter inspection

1) Inspect the fuel filter.

2) If there is clogging because of dirt, etc., in the fuel filter, clean or replace.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel filter element removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel filter element installation*".

Procedure completion

⇒Proceed to 5. Fuel piping inspection

5. Fuel piping inspection

1) Inspect for fuel leakage.

2) Inspect the fuel piping for collapsing, bending, cracks, or looseness, and inspect the injector or the filter in the piping of the pump section for abnormal conditions such as the adherence of dirt.

3) Repair or replace if necessary.

Procedure completion

⇒Proceed to 6. Fuel tank inspection

6. Fuel tank inspection

1) Inspect the fuel tank for the following conditions.

● Intrusion of foreign material

● Clogging in the fuel suction inlet

● Bending or cracks in the fuel suction pipe

● Deformation of the fuel tank

● Correct installation of the fuel tank

● Exhaust vent or tank filler line obstruction.

● Water intrusion in the fuel tank

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 7. Vehicle repair check

7. Vehicle repair check

1) Restore the vehicle to its normal operating condition, bleed the air from the fuel piping again, and verify the repair.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel air bleed*".

Procedure completion

The system is normal.

POWERSTAR

Air intake system check

1. Air intake system check description of function

In the air intake system, air intake starts from the air cleaner, and the air is then supplied to the engine through the turbocharger and intercooler. Because the air is highly pressurized by the turbocharger, if an air leakage exists in the piping, it will have an adverse effect on engine performance.

Indicators installed on the air cleaner will detect air in. If dirt or blockage is detected, the signal area of the indicator will turn red to inform.

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Air intake system check

1. Air cleaner inspection

1) Inspect the air cleaner for excessive contamination or clogging.

Refer to "*1.Engine 1F.Induction(*6WG1*) Air cleaner element inspection*".

2) If there is excessive contamination or clogging in the air cleaner, clean or replace.

Refer to "*1.Engine 1F.Induction(*6WG1*) Air cleaner element* removal".

Refer to "*1.Engine 1F.Induction(*6WG1*) Air cleaner element* installation".

Procedure completion

⇒Proceed to 2. Air cleaner case inspection

2. Air cleaner case inspection

1) Inspect the air cleaner case for accumulation of water or dirt.

2) Inspect the water drain valve for abnormal conditions such as clogging.

Refer to "*1.Engine 1F.Induction(6WG1) Air cleaner element inspection*".

3) If there is an abnormal condition in the air cleaner case, clean it. Also, if abnormal conditions such as clogging are found after inspecting the water drain valve, repair or replace.

Refer to "*1.Engine 1F.Induction(6WG1) Air cleaner element removal*".

Refer to "*1.Engine 1F.Induction(6WG1) Air cleaner element installation*".

Procedure completion

⇒Proceed to 3. Air intake piping inspection

3. Air intake piping inspection

1) Inspect the intercooler and the intake pipe for collapsing, looseness, damage, or improper installation.

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 4. Vehicle repair check

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4. Vehicle repair check

1) Restore the vehicle to its normal operating condition, and verify the repair.

Procedure completion

The system is normal.

POWERSTAR

Exhaust system check

1. Exhaust system check description of function

The exhaust brake operation is performed by the *ECM* based on the operation of the exhaust brake solenoid valve, and when the exhaust brake switch is ON, the *ECM* will immediately receive the signal.

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Exhaust system check

1. Prioritized DTC check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 2. Exhaust brake switch check

2. Exhaust brake switch check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Turn ON the ignition switch.

6) Observe the parameters on the scan tool.

7) Operate the exhaust brake switch.

8) Observe the Exhaust Brake Switch parameter on the scan tool. Do ON/OFF in the parameter switch when operating the exhaust brake switch?

Yes

⇒Proceed to 4. Exhaust piping inspection

No

⇒Proceed to 3. Exhaust system inspection

3. Exhaust system inspection

1) Inspect the exhaust system for the following conditions.

● Exhaust brake switch malfunction

● Exhaust brake switch power supply system malfunction

● Open circuit in exhaust brake signal circuit

POWERSTAR

● Excessive clogging in the exhaust system

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 4. Exhaust piping inspection

4. Exhaust piping inspection

1) Inspect the exhaust piping for collapsing, looseness, damage, or improper installation.

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 5. Exhaust brake operation check

5. Exhaust brake operation check

1) Turn ON the ignition switch.

2) Connect the scan tool.

3) Perform the Exhaust Brake with a scan tool. Does the exhaust brake operate?

Yes

⇒Proceed to 10. ECM power supply and ground circuit inspection

No

⇒Proceed to 6. Exhaust brake solenoid valve inspection

6. Exhaust brake solenoid valve inspection

1) Turn OFF the ignition switch.

2) Disconnect the exhaust brake solenoid valve harness connector (B47) .

3)Measure the resistance of the exhaust brake solenoid valve (pin 1 and 2 of B47) with a DMM. Is the resistance within the specified range?

Refer to “Engine Control”.

Value: 34 to 40 Ω

Yes

⇒Proceed to 7. Exhaust brake solenoid valve operation check

No

Replace the exhaust brake solenoid valve.

Refer to "*4.Brakes 4E.Speed Retarder System Exhaust brake solenoid valve removal*".

Refer to "*4.Brakes 4E.Speed Retarder System Exhaust brake solenoid valve installation*".

⇒Proceed to 7. Exhaust brake solenoid valve operation check

7. Exhaust brake solenoid valve operation check

1) Turn ON the ignition switch.

2) Connect the scan tool.

3) Perform the Exhaust Brake with a scan tool. Does the exhaust brake operate?

Yes

⇒Proceed to 10. ECM power supply and ground circuit inspection

No

⇒Proceed to 8. Exhaust brake inspection

8. Exhaust brake inspection

1) Inspect the exhaust brake for the following conditions.

● Exhaust brake solenoid valve malfunction

● Exhaust brake malfunction

● Abnormal conditions in the exhaust brake air and air piping

● Open circuit in the exhaust brake solenoid valve

● Malfunction in the exhaust brake solenoid valve circuit and the relay

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 9. Follow-up exhaust brake solenoid valve operation check

9. Follow-up exhaust brake solenoid valve operation check

1) Turn ON the ignition switch.

2) Connect the scan tool.

3) Perform the Exhaust Brake with a scan tool. Does the exhaust brake operate?

Yes

⇒Proceed to 10. ECM power supply and ground circuit inspection

No

⇒Proceed to 11. ECM replacement

10. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit check*".

Yes

⇒Proceed to 11. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 12. Vehicle repair check

11. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 12. Vehicle repair check

POWERSTAR

12. Vehicle repair check

1) Restore the vehicle to its normal operating condition, and verify the repair.

Procedure completion

The system is normal.

POWERSTAR

EGR control system check

1. EGR control system check description of function

The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing NOx emissions. Emission reduction is achieved by controlling the EGR system. A control current from the ECM operates a motor to control the lift amount of the EGR valve. In addition, the EGR position sensor is used for detection of the actual valve lift amount and for precision control of the EGR amount. The EGR is activated when the specified conditions of engine speed, engine coolant temperature, intake air temperature, and barometric pressure are met. Then, the valve opening position is calculated based on engine speed and the desired fuel injection quantity. The motor drive duty is determined from this valve opening position, and the valve is driven according to the motor drive duty.

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. EGR control system check

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 3. EGR components inspection

3. EGR components inspection

1) Inspect for the following conditions.Is the result normal?

● Missing or damaged EGR valve gasket

● Stuck EGR valve, or air cylinder malfunction

● EGR gas leakage from the EGR passage between the exhaust manifold and the intake manifold

● Collapsed or restricted flow in the EGR passage between the exhaust manifold and the EGR valve

● Conditions that restrict exhaust system flow

● Clogged air cleaner element, collapsing of the duct between the air cleaner and the intake manifold, or a state where flow is restricted

● Leakage in the air intake system

● Water in the air intake system

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● Contamination or foreign material blocking the inlet of MAF sensor

● Misdetection or delayed response of the MAF sensor

● Engine coolant temperature sensor malfunction

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1)Engine coolant temperature sensor Inspection*".

● Barometric pressure sensor malfunction

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1)Barometric pressure sensor Inspection*".

Yes

⇒Proceed to 4. Check the operation of the exhaust gas recirculation valve while depressing the accelerator pedal

No

Repair as necessary.

⇒Proceed to 8. Vehicle repair check

4. Check the operation of the exhaust gas recirculation valve while depressing the accelerator pedal

1) Place the shift lever in the neutral position and apply the parking brake.

2) Start the engine.

3) Warm up the engine until the coolant temperature reaches 80℃ {176℉} or more.

4) While observing the Exhaust Gas Recirculation (EGR) Valve Position and Exhaust Gas Recirculation (EGR) Brushless DC Motor Position 2 parameters on the scan tool, repeatedly depress the accelerator pedal to increase the engine speed. Are the Exhaust Gas Recirculation (EGR) Valve Position and Exhaust Gas Recirculation (EGR) Brushless DC Motor Position 2 positions within the specified range?

Value: -3 to 3 %

Yes

⇒Proceed to 5. EGR valve operation check

No

⇒Proceed to 6. EGR valve inspection

5. EGR valve operation check

1) Perform the EGR a few times with a scan tool.

2) While observing the Exhaust Gas Recirculation (EGR) Valve Position value, command the Desired EGR Position UP and DOWN. Does the Exhaust Gas Recirculation (EGR) Valve Position parameter follow the Desired EGR Position within the specified range?

Value: -3 to 3 %

Yes

The system is normal.

No

⇒Proceed to 6. EGR valve inspection

6. EGR valve inspection

1) Remove the EGR valve

2) Inspect the EGR valve for the following conditions. Is the result normal?

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● The flow in the EGR valve is restricted by foreign material.

● Excessive deposits in the valve

● Bent valve shaft

Yes

⇒Proceed to 7. EGR circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 8. Vehicle repair check

7. EGR circuit inspection

1) Inspect for poor connections at the EGR valve 1 harness connector (pins 1, 2, 3, 4, 5, 6, 7, and 8 of E98). Is the connection status normal?

2) Inspect for poor connections at the EGR valve 2 harness connector (pins 1, 2, 3, 4, 5, 6, 7, and 8 of E99). Is the connection status normal?

3) Inspect for poor connections at the ECM harness connector (pins 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 19, 20, 29 and 30 of E82). Is the connection status normal?

4) Inspect for high resistance between the ECM (pins 1, 2, 7, 8, 9, 10, 29 and 30 of E82) and EGR valve 1 (pins 1, 2, 3, 4, 5, 6, 7, and 8 of E98). Is the result normal?

5) Inspect for high resistance between the ECM (pins 3, 4, 11, 12, 13, 14, 19 and 20 of E82) and EGR valve 2 (pins 1, 2, 3, 4, 5, 6, 7, and 8 of E99). Is the result normal?

Refer to “Engine Control”.

6) Are all of the results normal?

Yes

Replace EGR valve 1 or 2.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 8. Vehicle repair check

No

Repair the circuit or the connection as necessary.

⇒Proceed to 8. Vehicle repair check

8. Vehicle repair check

1) Reconnect all of the disconnected harness connectors and components.

Procedure completion

The system is normal.

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ECM power supply and ground circuit check

1. ECM power supply and ground circuit check description of function

The ECM power supply is applied via the battery, slow blow fuse, ignition switch, and fuse. When the ignition switch is in the ON or in the START position, power is applied to the ECM, the ECM turns the main relay ON, and the main power is supplied to the ECM.

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. ECM power supply and ground circuit check

1. Battery inspection

1) Inspect the battery voltage and density.

2) Charge or replace as necessary.

Procedure completion

⇒Proceed to 2. Fuse and harness inspection

2. Fuse and harness inspection

1) Inspect the fuses and the harnesses.

2) Replace as necessary.

Procedure completion

⇒Proceed to 3. Ignition power supply voltage check

3. Ignition power supply voltage check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL557 和 FL559) .

3) Turn ON the ignition switch.

4) Measure the voltage between the ignition switch ON signal circuit (pin 3 of FL559) and the frame ground with a DMM. Is the voltage equal to Battery voltage?

5) Measure the voltage between the ignition switch START signal circuit (pin 2 of FL557) and the frame ground with a DMM. Is the voltage equal to the Battery voltage?

Refer to "*Engine Control*".

6) Are all of the values normal?

Yes

⇒Proceed to 5. Inspection for open circuit and short circuit in ECM ground circuit

No

⇒Proceed to 4. Ignition switch inspection

4. Ignition switch inspection

1) Inspect for the following abnormal conditions.

● Ignition switch malfunction

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● Open circuit in the ignition switch circuit

● Ignition switch circuit and relay malfunction

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 5. Inspection for open circuit and short circuit in ECM ground circuit

5. Inspection for open circuit and short circuit in ECM ground circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82, E83 and FL559).

3) Check the ground circuit of the *ECM* (pins 5 and 6 of E82, pin 7 of E83, pins 4 and 5 of FL559) and the chassis ground for open or short circuits.

Refer to “*Engine Control*”.

4) Repair or replace if necessary.

Procedure completion

⇒Proceed to 6. Main relay system power supply circuit inspection

6. Main relay system power supply circuit inspection

1) Refer to DTC P0685 or P0687,and inspect the power supply circuit in the main relay system.

Refer to "*DTC P0685 (Flash Code 416) ECM Power Relay Control Circuit Open*".

Refer to "*DTC P0687 (Flash Code 416) ECM Power Relay Control Circuit High*".

2) Repair or replace if necessary.

Procedure completion

⇒Proceed to 7. Battery voltage check

7. Battery voltage check

1) Connect the ECM harness connector.

2) Connect the scan tool.

3) Turn ON the ignition switch.

4) Observe the Battery Voltage parameter on the scan tool.

5) Measure the battery voltage with a DMM.

6) Compare the voltage displayed on the scan tool and the voltage measured using a tester. Are the compared voltages almost the same?

Yes

⇒Proceed to 9. Vehicle repair check

No

⇒Proceed to 8. ECM replacement

8. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 9. Vehicle repair check

9. Vehicle repair check

1) Restore the vehicle to its normal operating condition, and verify the repair.

Procedure completion

The system is normal.

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PTO System Check

1. PTO System Check description of function

The PTO control switches the engine mode and the external accelerator or accelerator pedal depending on the usage conditions of the power-driven unit. The ECM switches the accelerator and engine mode depending on the signal input of the accelerator, PTO switch, engine speed, parking switch, etc.

2. *Engine Control*

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Power take-off system check

1. Check power take-off operation

1) To switch to the operation mode, operate the PTO switch after all of the following conditions have been satisfied.

●The parking brake lever is engaged.

● The gear is in the neutral position.

● When idling

● Depress the clutch pedal.

2) In order to switch to the running mode, follow the procedure described below to operate the PTO switch.

● When idling

● The gear is in the neutral position.

● Release the parking brake.

3) Check whether the operation is normal. Is the operation normal?

Yes

⇒Proceed to 3. Accelerator pedal and external accelerator position check

No

⇒Proceed to 2. PTO operation follow-up check

2. PTO operation follow-up check

1) Check if the PTO operates under normal procedures. Does the PTO operate under normal procedures?

Yes

⇒Proceed to 3. Accelerator pedal and external accelerator position check

No

⇒Proceed to 1. PTO operation check

3. Accelerator pedal and external accelerator position check

1) Check if the accelerator pedal and the external accelerator return. Do the accelerator pedal and external accelerator return?

Yes

⇒Proceed to 4. Fuel injection characteristic switching verification

No

Return the accelerator pedal and external accelerator to the normal position.

⇒Proceed to 4. Fuel injection characteristic switching verification

4. Fuel injection characteristic switching verification

1) Operate the PTO to check if the driving mode and the operational mode in the fuel injection characteristic switching are switched normally.

2) If the idling speed does not change, inspect the idling control switch, circuit, etc., and repair as necessary.

● An external accelerator can be used in the operational mode.

● In the running mode, operation of the idling control switch will change the idle speed.

Procedure completion

⇒Proceed to 5. PTO switch operation check

5. PTO switch operation check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Place the gear in the neutral position.

4) Operate the PTO switch.

5) Verify that ON/OFF on the scan tool data display switch according to the operation of the switch.

6) If the switch input display does not change to ON/OFF, inspect the PTO switch, circuit, etc., and repair as necessary.

Procedure completion

⇒Proceed to 6. External accelerator output voltage check

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6. External accelerator output voltage check

1) Turn ON the ignition switch.

2) Operate the external accelerator and change the output voltage.

3) Check the output voltage of the external accelerator with a DMM.

Value: 0.3 to 0.5 V While idling

Value: 4.2 to 4.6 V Full throttle

4) If the output voltage is abnormal at this time, inspect the circuit, etc., and repair as necessary.

Procedure completion

⇒Proceed to 7. Parking switch operation check

7. Parking switch operation check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Place the gear in the neutral position.

4) Operate the parking switch.

5) Verify the parking switch parameter shows ON/OFF on the scan tool according to the gear operations.

6) If the display does not show ON/OFF, inspect the parking switch, circuit, etc., and repair as necessary.

Procedure completion

⇒Proceed to 8. Accelerator switch check

8. Accelerator switch check

1) Operate the PTO to check if the driving accelerator and the external accelerator in the accelerator switching status are switched normally. Does the engine speed change normally using the driving accelerator or the external accelerator when the PTO is used?

Yes

⇒Proceed to 10. Vehicle repair check

No

⇒Proceed to 9. ECM replacement

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Vehicle repair check

10. Vehicle repair check

1) Restore the vehicle to its normal operating condition, and verify the repair.

Procedure completion

The system is normal.

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DTC List

1. DTC List

DTC	DTC Type	DTC title	Condition for running the DTC	Condition for setting the DTC	Action taken when DTC sets
P0016	A	DTC P0016 (Flash code 16) Crankshaft Position - Camshaft Position Correlation	● DTCs P0335, P0336, P0340, and P0341 are not set. ● The ignition switch is on ● The CKP sensor signal pulses are detected. ● The CMP sensor signal pulses are detected.	● The ECM detects that the CKP sensor signal and the CMP sensor signal are not synchronized while the engine is running.	● The ECM illuminates the MIL. Refer to Action taken when DTC sets - Type A.
P0045	A	Diagnostic code P0045 (blink code 33) Turbocharger boost control solenoid circuit	● The battery voltage is 20 -32 V. ● The ignition switch is on	Any of the following conditions are met. ● The VNT control module detects an overvoltage. ● The VNT control module detects no change in sensor signal at each nozzle position at low pressure or high pressure. ● The VNT control module detects that the solenoid circuit is open or shorted. ● The VNT control module detects a stuck solenoid or nozzle control module.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the EGR control
P0087	B	DTC P0087 (Flash code 225) Fuel Rail/System Pressure - Too Low	● DTCs P0192, P0193, P060B, and P0641 are not set. ● The ignition switch is on ● The engine is running	● The *ECM* detects that the pressure limiter valve will start only if the common rail (fuel rail) pressure is 198 MPa {28,710 psi} or higher.	● The ECM illuminates the MIL. Refer to Action taken when DTC sets - Type B. ● The ECM limits the fuel injection quantity. ● The ECM inhibits the EGR control. ● The ECM limits the fuel injection quantity.
P0088	A	DTC P0088 (Flash code 118) Fuel Rail/System Pressure - Too High	● DTCs P0192, P0193, P060B, and P0641 are not set. ● The ignition switch is on ● Start rail pressure feedback mode.	● The ECM detects that the fuel rail pressure is 198 MPa {28,710 psi} or more for 5 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.

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P0089	B	DTC P0089 (Flash code 151) Fuel Pressure Regulator Performance	● DTCs P0192, P0193, P0335, P0336, P060B, and P0641 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine coolant temperature is 60℃ {140℉} or more. ● Engine speed greater than or equal to 375 rpm. ● Difference cylinder event is completed. ● Start rail pressure feedback mode.	Any of the following conditions are met. ● The *ECM* detects the pressure differential across the common rail (fuel rail) when the specified fuel pressure during engine operation is approximately 40 MPa or higher and lasts for 5 seconds. ● PCV valve closes for 5 seconds at temperatures above 180 ℃A.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B. ● The ECM stops the EGR control.
P0091	A	DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low	● The battery voltage is 18 -32 V. ● The ignition switch is on ● Difference cylinder event is completed. ● Start rail pressure feedback mode.	● When the *ECM* instructs to turn off the lighting, the drive signal circuit in the fuel rail regulator solenoid valve is at a low pressure.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P0092	A	DTC P0092 (Flash code 217) Fuel Pressure Regulator Control Circuit High	● DTC P0091 is not set. ● The battery voltage is 18 -32 V. ● Difference cylinder event is completed. ● Start rail pressure feedback mode.	● When the *ECM* instructs to turn on the lighting, the drive signal circuit in the fuel rail regulator solenoid valve is under high pressure.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P0101	B	DTC P0101 (Flash code 92) Mass Air Flow Sensor Circuit Range/Performance	● DTCs P0102, P0103, P0116, P0117, P0118, P0234, P0237, P0238, P0404, P0409, P0560, P060B, P0641, P0651, P0697, P1404, P140A, P140B, P140C, P2227, P2228 and P2229 are not set ● The battery voltage is 16 -32 V. ● The ignition switch is on Also, the following conditions are met for 3 seconds or more. ● The engine speed is 800-1,800 rpm. ● The EGR control is commanded OFF. ● The engine run time is 5 seconds or more. ● Slow down	● The ECM detects that the MAF sensor signal voltage is not within the predetermined range of the calculated MAF predicted value for 10 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B. ● The ECM stops the EGR control.

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P0102	A	DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input	● DTCs P0560 and P060B are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● Engine speed greater than or equal to 400 rpm.	● The ECM detects that the IAT sensor signal voltage is 0.1 V or less for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The *ECM* sets a default mass air flow value. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P0103	A	DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input	● DTCs P0560 and P060B are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 400-1,200 rpm.	● The ECM detects that the IAT sensor signal voltage is 4.9 V or more for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The *ECM* sets a default mass air flow value. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P0112	A	DTC P0112(Flash Code 22) Intake Air Temperature Sensor Circuit Low	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the IAT sensor signal voltage is 0.1 V or less for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default IAT value. ● The ECM stops the EGR control.
P0113	A	DTC P0113 (Flash Code 22) Intake Air Temperature Sensor Circuit High	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● Engine running time is greater than or equal to 3 minutes.	● The ECM detects that the engine coolant temperature sensor signal voltage is 4.8 V or more for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default IAT value. ● The ECM stops the EGR control.
P0116	B	DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance	● DTCs P0117, P0118, P0201, P0202, P0203, P0204, P0205, P0206, P0500, P0502, P0503, P060B, P0697, P1261, P1262, P2146 and P2149 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The vehicle run time is more than 5 minutes with a vehicle speed of 4 km / h or more. ● The engine speed is 1000 rpm or more and the engine run time is more than 5 minutes. ● Since the start of the engine start calculation, the cumulative amount of fuel injection exceeds the critical value.	● The ECM detects that the difference between the maximum and minimum engine coolant temperatures is less than 0.2 -12 ℃ {0.4 -22℉}.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

P0117	A	DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the engine coolant temperature sensor signal voltage is 0.1 V or less for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default coolant temperature value. ● The ECM stops the EGR control.
P0118	A	DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine run time is 5 seconds or more.	● The ECM detects that the engine coolant temperature sensor signal voltage is 4.85 V or more for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default coolant temperature value. ● The ECM stops the EGR control.
P0182	A	DTC P0182 (Flash code 211) Fuel Temperature Sensor Circuit Low	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the fuel temperature sensor signal voltage is 0.1 V or less for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default fuel temperature value.
P0183	A	DTC P0183 (Flash code 211) Fuel Temperature Sensor Circuit High	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● Engine running time is 3 minutes or longer.	● The ECM detects that the fuel temperature sensor signal voltage is 4.85 Vor more for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default fuel temperature value.
P0192	A	DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low	● DTCs P060B and P0641 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the fuel rail pressure sensor signal voltage is 0.7 V or less	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The *ECM* sets a default common rail (fuel rail) pressure value. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P0193	A	DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High	● DTCs P060B and P0641 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the fuel rail pressure sensor signal voltage is 4.75 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The *ECM* sets a default common rail (fuel rail) pressure value. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.

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P0201	A	DTC P0201 (Flash code 271) Injector Circuit Open - Cylinder 1	● DTCs P1261 and P2146 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The ECM detects that there is an open circuit in the injector solenoid circuit. ● The *ECM* detects that the power circuit is open in the injection solenoid control circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0202	A	DTC P0202 (Flash code 272) Injector Circuit Open - Cylinder 2	● DTCs P1261 and P2146 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The ECM detects that there is an open circuit in the injector solenoid circuit. ● The *ECM* detects that the power circuit is open in the injection solenoid control circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0203	A	DTC P0203 (Flash code 273) Injector Circuit Open - Cylinder 3	● DTCs P1261 and P2146 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The ECM detects that there is an open circuit in the injector solenoid circuit. ● The *ECM* detects that the power circuit is open in the injection solenoid control circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0204	A	DTC P0204 (Flash code 274) Injector Circuit Open - Cylinder 4	● DTCs P1262 and P2149 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The *ECM* detects that the power circuit in the injection solenoid control circuit is open. ● The *ECM* detects that the power circuit is open in the injection solenoid control circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0205	A	DTC P0205 (Flash code 275) Injector Circuit Open - Cylinder 5	● DTCs P1262 and P2149 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The ECM detects that there is an open circuit in the injector solenoid circuit. ● The *ECM* detects that the power circuit is open in the injection solenoid control circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0206	A	DTC P0206 (Flash code 276) Injector Circuit Open - Cylinder 6	● DTCs P1262 and P2149 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The *ECM* detects that the power circuit in the injection solenoid control circuit is open. ● The *ECM* detects that the power circuit is open in the injection solenoid control circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.

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P0217	D	DTC P0217 (Flash code 542) Engine Coolant Over Temperature Condition	● DTCs P0116, P0117, P0118, P060B, and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that there is an open circuit in the injector solenoid circuit.	● The ECM does not illuminate the MIL or SVS lamp.Refer to Action taken when DTC sets - Type D.
P0219	D	DTC P0219 (Flash code 543) Engine Overspeed Condition	-	● The ECM detects that the engine speed is 2,366 rpm or more.	● The ECM does not illuminate the MIL or SVS lamp.Refer to Action taken when DTC sets - Type D.
P0234	A	DTC P0234 (Flash code 42) Turbocharger Overboost Condition	● DTCs P0237, P0238, P060B and P0697 are not set.	● The *ECM* detects that the supercharger pressure is higher than a predetermined value for a duration of 2 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P0237	A	DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the boost pressure sensor signal voltage is 0.1 V or less for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default boost pressure value. ● The ECM stops the EGR control.
P0238	A	DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the boost pressure sensor signal voltage is 4.9 V or more for approximately 3 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default boost pressure value. ● The ECM stops the EGR control.
P0299	B	DTC P0299 (Flash code 65) Turbocharger Underboost	● DTCs P0087, P0088, P0089, P0091, P0092, P0102, P0103, P0116, P0117, P0118, P0192, P0193, P0201, P0202, P0203, P0204, P0205, P0206, P0237, P0238, P0401, P0404, P0409, P0560, P060B, P0641, P0651, P0697, P1062, P1063, P1093, P1261, P1262, P1404, P140B, P140C, P2146, P2149, P2227, P2228, P2229, P2295 and P2296 are not set. ● The ignition switch is on ● The engine speed is 1,200-1,800 rpm. ● The fuel injection quantity is more than or equal to the predetermined value.	● The ECM detects that the boost pressure is lower than a predetermined value for 5 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

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P0335	A	DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit	● DTCs P0016, P0336, P0340 and P0341 are not set. ● The ignition switch is on ● The CMP sensor signal pulses are detected.	● The ECM detects that the CKP sensor signal pulse is not normal while the engine is running.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control. ● *ECM* disables VNT control. ● The ECM assumes a default boost pressure value.
P0336	A	DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance	● DTCs P0016, P0335, P0340, and P0341 are not set. ● The CKP sensor signal pulses are detected. ● The engine is running.	● During engine operation, the *ECM* detected an excessive or transient Crankshaft position sensor signal pulse.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control. ● *ECM* disables VNT control. ● The ECM assumes a default boost pressure value.
P0340	A	DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit	● DTCs P0016, P0335, P0336, and P0341 are not set. ● CKP sensor signal pulses are detected ● The engine is running.	● The *ECM* did not detect the camshaft position sensor signal pulse during engine operation.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0341	A	DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance	● DTCs P0016, P0335, P0336, and P0340 are not set. ● CKP sensor signal pulses are detected ● The engine is running	● During engine operation, the *ECM* detected an excessive or transient Crankshaft position sensor signal pulse.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0401	A	DTC P0401 (Flash code 93) EGR Flow Insufficient Detected	● DTCs P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0404, P0409, P0500, P0502, P0503, P0560, P060B, P0641, P0651, P0697, P1404, P140A, P140B, P2227, P2228, and P2229 are not set. ● The battery voltage is 16 -32 V. ● The ignition switch is on	● The *ECM* detected that the mass air flow on / off position is lower than expected.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0404	A	DTC P0404 (Flash code 45) EGR Control Circuit Range/ Performance	● DTCs P0112, P0113, P0116, P0117, P0118, P0409, P060B ,P0651, P0697, P2227, P2228 and P2229 are not set. ● The battery voltage is 20 -32 V. ● The desired EGR position is stable.	● When the EGR motor output is 75% or more, the difference between the desired EGR position and the EGR 1 opening angle is excessive for 5 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the EGR control.

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P0409	A	DTC P0409 (Flash code 44) EGR Sensor Circuit	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V.	● The signals input from EGR position sensor 1 signals 1, 2, and 3 are all ON or all OFF for approximately 3 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the EGR control.
P0477	A	DTC P0477 (Flash code 46) Exhaust Pressure Control Valve Low	● The battery voltage is 18 -32 V. ● The ECM is commanding the exhaust brake ON.	● The ECM detects a low voltage condition in the exhaust brake solenoid valve control circuit for 3 seconds or more when the exhaust brake is commanded OFF.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the exhaust brake control.
P0478	A	DTC P0478 (Flash code 46) Exhaust Pressure Control Valve High	● The battery voltage is 18 -32 V. ● The ECM is commanding the exhaust brake OFF.	● The ECM detects a high voltage condition in the exhaust brake solenoid valve control circuit for 3 seconds or more when the exhaust brake is commanded ON.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the exhaust brake control.
P0500	A	DTC P0500 (Flash code 25) Vehicle Speed Sensor	● The battery voltage is 18 -32 V. ● The ignition switch is on ● Issue an instruction to prohibit fuel injection when the accelerator pedal is not depressed. ● The engine speed is 1000 rpm or more.	● The ECM detects that no vehicle speed signal has been generated for 7 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0502	A	DTC P0502 (Flash code 25) Vehicle Speed Sensor Circuit Low Input	● DTC P060B is not set. ● The battery voltage is 21 -32 V. ● The ignition switch is on	● The ECM detects that the vehicle speed signal voltage is 0.5 V or less.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0503	A	DTC P0503 (Flash code 25) Vehicle Speed Sensor Circuit High Input	● DTC P060B is not set. ● The battery voltage is 21 -32 V. ● The ignition switch is on	● The ECM detects that the vehicle speed signal voltage is 20 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0560	A	DTC P0560 (Flash code 155) System Voltage	● DTC P060B is not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The *ECM* detects that the voltage of the 12 V reference circuit is 7 V or less, or 19 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
P0563	C	DTC P0563 (Flash code 35) System Voltage High	● DTC P060B is not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the voltage of the ignition power supply circuit is 32 V or more for 30 minutes.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

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P0571	C	DTC P0571 (Flash code 26) Brake Switch Circuit	● The battery voltage is 18 -32 V.	● The ECM detects a correlation error between the stoplight switch 1 signal and the stoplight switch 2 signal 32 times.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.
P0601	A	DTC P0601 (Flash code 53) Internal Control Module Memory Check Sum Error	-	● The ECM detects that the calculated checksum does not match the checksum stored in the ROM.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM inhibits pre-injection.. ● The ECM stops the engine. (The engine is ready to start after the ignition switch is turned OFF for 10 seconds or more.)
P0602	C	DTC P0602 (Flash code 154) Control Module Programming Error	-	Any of the following are met: ● he ECM detects that the fuel delivery rate and the Injector ID Code are not programmed. ● ECM detects an error in the programmed Injector ID Code.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.
P0604	A	DTC P0604 (Flash code 153) Internal Control Module RAM	-	● The ECM detects a malfunction inside the RAM.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM inhibits pre-injection.. ● The ECM stops the engine. (The engine is ready to start after the ignition switch is turned OFF for 10 seconds or more.)
P0606	A	DTC P0606 (Flash code 51) ECM Processor	● The battery voltage is 16 V or more. ● The ignition switch is on	● The ECM detects a malfunction inside the main CPU or the sub integrated circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity.

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P060B	A	*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*	-	● The ECM detects a malfunction inside the A/D converter.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity.
P0641	A	DTC P0641 (Flash code 55) Sensor Reference Voltage 1 Circuit	● DTC P060B is not set. ● The battery voltage is 16 -32 V.	● The ECM detects that the voltage of 5 V reference circuit 1 or 6 is 4.5 V or less, or 5.5 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When a diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking. ● The ECM limits the fuel injection quantity. ● The ECM stops the exhaust brake control.
P0650	A	DTC P0650 (Flash code 77) Malfunction Indicator Light (MIL) Control Circuit	● The battery voltage is 18 -32 V. ● The ignition switch is on	Any of the following are met: ● The ECM detects a low voltage condition in the MIL control circuit when the light is commanded OFF. ● The ECM detects a high voltage condition in the MIL control circuit when the light is commanded ON.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P0651	A	*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*	● DTC P060B is not set. ● The battery voltage is 16 -32 V.	● The ECM detects that the voltage of 5 V reference circuit 2 or 5 is 4.5 V or less, or 5.5 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When a diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control. ● The ECM stops the exhaust brake control.

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P0685	C	DTC P0685 (Flash code 416) ECM Power Relay Control Circuit Open	● DTC P060B is not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects a low voltage condition in the relay voltage supply circuit for approximately 3 seconds when the ECM main relay is commanded ON.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.
P0687	C	DTC P0687 (Flash code 416) ECM Power Relay Control Circuit High	● DTC P0606 is not set.	● When the ECM main relay is commanded OFF, the ECM detects that the ECM main relay is still ON.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.
P0697	A	DTC P0697 (Flash code 57) Sensor Reference Voltage 3 Circuit	● DTC P060B is not set. ● The battery voltage is 16 -32 V.	● The ECM detects that the voltage of 5 V reference circuit 4 is 4.5 V or less, or 5.5 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P1062	A	DTC P1062 (Flash code 257) Fuel Pressure Regulator 1 Solenoid Control Circuit	-	● A malfunction lasting 0.1 second or longer was detected on the regenerative circuit of the PCV 1 drive circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P1063	A	DTC P1063 (Flash code 258) Fuel Pressure Regulator 2 Solenoid Control Circuit	-	● A malfunction lasting 0.1 second or longer was detected on the regenerative circuit of the PCV 2 drive circuit.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P1093	B	DTC P1093 (Flash code 227) Fuel Rail Pressure Too Low	● DTCs P0087, P0091, P0092, P0192, P0193, P0335, P0336, P060B, P0641, P1062, P1063, P2295, and P2296 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The coolant temperature is 60 ℃ {55.56℉} or more. ● Engine speed greater than or equal to 375 rpm. ● Differentiate the cylinder event is completed · Start rail pressure feedback mode.	● The ECM detects that the actual fuel rail pressure is less than the desired fuel rail pressure by 50 MPa {7,250 psi}, or is less than the desired fuel rail pressure for 5 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.

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P1261	A	DTC P1261 (Flash code 34) Injector Positive Voltage Control Circuit Group 1	● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects an open circuit in the injector charge-up circuit of common power supply 1 in the ECM.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P1262	A	DTC P1262 (Flash code 34) Injector Positive Voltage Control Circuit Group 2	● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects an open circuit in the injector charge-up circuit of common power supply 2 in the ECM.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P1404	A	DTC P1404 (Flash code 45) EGR Position Fault	● DTCs P0404, P0409, P0500, P0502, P0503, P060B, P0651 and P215A are not set. ● The ignition switch is OFF.	The ECM detects that the EGR zero position counter is 31 or more or 5 or less when the ignition switch is OFF.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P140A	A	DTC P140A (Flash code 345) EGR 2 Performance	● DTCs P0409, P060B, P0641, P0697, and P140B are not set. ● The battery voltage is 16 -32 V. ● The desired EGR position is stable.	● The ECM detects that when the EGR motor output is 75% or more, the difference between the desired EGR position and the EGR 2 opening angle is excessive for 10 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the EGR control.
P140B	A	DTC P140B (Flash code 344) EGR 2 Position Sensor Performance	● DTCs P060B and P0697 are not set. ● The battery voltage is 18 -32 V.	● The ECM detects that the signals input from EGR position sensor 2 signals 4, 5, and 6 are all ON or all OFF for approximately 3 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM stops the EGR control.
P140C	A	DTC P140C (Flash code 345) EGR 2 Closed Position Performance	● DTCs P0409, P0500, P0502, P0503, P060B, P0641, P0697, P140A, and P140B are not set. ● The ignition switch is OFF.	● The ECM detects that the EGR zero position counter is 40 or more or 5 or less when the ignition switch is OFF.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P1621	A	DTC P1621 (Flash code 54) Control Module Long Term Memory Performance	● Completed checksum calculation.	● The ECM detects that the calculated checksum does not match the checksum stored in the EEPROM.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

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P1664	C	DTC P1664 (Flash code 76) Service Vehicle Soon Lamp Control Circuit	● The battery voltage is 18 -32 V. ● The ignition switch is on	Any of the following are met: ● The ECM detects a low voltage condition in the SVS lamp control circuit when the SVS lamp is commanded OFF. ● The ECM detects a high voltage condition in the SVS lamp control circuit when the SVS lamp is commanded ON.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.
P2122	A	DTC P2122 (Flash code 121) Pedal Position Sensor 1 Circuit Low Input	● DTCs P060B and P0641 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the accelerator pedal position sensor 1 signal voltage is 0.2 V or less.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When a diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking. ● The ECM limits the fuel injection quantity. ● The ECM stops the exhaust brake control.
P2123	A	DTC P2123 (Flash code 121) Pedal Position Sensor 1 Circuit High Input	● DTCs P060B and P0641 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that accelerator pedal position sensor 1 signal voltage is 4.9 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When a diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking. ● The ECM limits the fuel injection quantity. ● The ECM stops the exhaust brake control.
P2127	A	DTC P2127 (Flash code 122) Pedal Position Sensor 2 Circuit Low Input	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the accelerator pedal position sensor 2 signal voltage is 0.2 V or less.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is flashing. ● The ECM limits the fuel injection quantity. ● The ECM stops the exhaust brake control.

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P2128	A	DTC P2128 (Flash code 122) Pedal Position Sensor 2 Circuit High Input	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that accelerator pedal position sensor 2 signal voltage is 4.9 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is flashing. ● The ECM limits the fuel injection quantity. ● The ECM stops the exhaust brake control.
P2138	A	DTC P2138 (Flash code 124) Pedal Position Sensor 1 - 2 Voltage Correlation	● DTCs P060B, P0641 and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● Accelerator pedal position sensor 1 The signal voltage is 0.2 to 4.9 V. ● Accelerator pedal position sensor 2 The signal voltage is 0.2 to 4.9 V.	● The ECM detects that accelerator pedal position sensors 1 and 2 deviate from the range by 45% or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is flashing. ● The ECM stops the exhaust brake control.
P2146	A	DTC P2146 (Flash code 158) Fuel Injector Group 1 Supply Voltage Circuit	● DTCs P0201, P0202,and P0203 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The ECM detects that there is an open circuit, a short to ground or a short to the power supply circuit in the injector charge voltage circuit of common power supply 1, or that there is a short to ground in the injector solenoid coil control circuit of cylinder No. 1, 2, or 3 .	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P2149	A	DTC P2149 (Flash code 159) Fuel Injector Group 2 Supply Voltage Circuit	● DTC P0204, P0205, or P0206 is not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 40 rpm or more.	● The ECM detects that there is an open circuit, a short to ground or a short to the power supply 2 circuit in the injector charge voltage circuit of common power supply 2, or that there is a short to ground in the injector solenoid coil control circuit of cylinder No. 4, 5, or 6.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.

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P2227	B	DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance	● DTCs P0102, P0103, P0116, P0117, P0118, P237, P238, P0500, P0502, P0503, P0560, P060B, P0651, P0697, P2228, and P2229 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on ● The engine speed is 450- 550 rpm. ● The fuel injection quantity is less than or equal to the predetermined value. ● The accelerator pedal is not depressed. ● The vehicle speed is 0 km/h.	● The ECM detects that the difference between the barometric pressure and the boost pressure is 35 kPa {5.1 psi} or more, or 13 kPa {1.9 psi} or less.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.
P2228	A	DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the barometric pressure sensor signal voltage is 0.5 V or less for approximately 5 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default barometric pressure value. ● The ECM stops the EGR control.
P2229	A	DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High	● DTCs P060B and P0651 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The ECM detects that the barometric pressure sensor signal voltage is 4.0 V or less for approximately 5 seconds.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM assumes a default barometric pressure value. ● The ECM stops the EGR control.
P2295	A	DTC P2295 (Flash code 248) Fuel Pressure Regulator 2 Control Circuit Low	● The battery voltage is 18 -32 V. ● The engine is running. ● Crankshaft position sensor and camshaft position sensor did not malfunction at the same time.	● The ECM detects that the PCV 2 signal circuit voltage is abnormal for approximately 4 seconds or more when PCV 2 is OFF.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P2296	A	DTC P2296 (Flash code 218) Fuel Pressure Regulator 2 Control Circuit High	● DTC P2295 is not set. ● The battery voltage is 18 -32 V. ● The engine is running. ● Crankshaft position sensor and camshaft position sensor did not malfunction at the same time.	● The ECM detects that the PCV 2 signal circuit voltage is abnormal for approximately 4 seconds or more when PCV 2 is ON.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity. ● The ECM stops the EGR control.
P244A	B	DTC P244A (Flash code 142) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too Low	● DTCs P0560, P060B, P0697, P2454, and P2455 are not set. ● The battery voltage is 20 V or more. ● The amount of fuel injection is greater than or equal to the predetermined value.	● The ECM detects that the exhaust differential pressure is less than the predetermined value for 30 seconds or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

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P244B	A	DTC P244B (Flash code 141) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too High	● DTCs P0560, P060B, P0697, P2454, and P2455 are not set. ● The battery voltage is 20 V or more. ● Engine speed greater than or equal to 2,000 rpm.	● The ECM detects that the exhaust differential pressure is 60 kPa {8.7 psi} or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P2454	A	DTC P2454 (Flash code 47) Exhaust Pressure Sensor Circuit Low	● DTCs P0560, P060B and P0697 are not set. ● The battery voltage is 20 V or more. ● The ignition switch is on	● The ECM detects that the exhaust differential pressure sensor signal voltage is 0.2 V or less.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P2455	A	DTC P2455 (Flash code 47) Exhaust Pressure Sensor Circuit High	● DTCs P0560, P060B and P0697 are not set. ● The battery voltage is 20 V or more. ● The ignition switch is on	● The ECM detects that the exhaust differential pressure sensor signal voltage is 4.9 V or more.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
P256A	A	DTC P256A (Flash Code 31)Engine Idle Speed Selector Sensor	● DTCs P060B and P0641 are not set. ● The battery voltage is 18 -32 V. ● The ignition switch is on	● The *ECM* detects that the up or down signal of the idle speed control switch is on for a duration of 0.6 seconds or more.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.
U0073	A	DTC U0073 (Flash Code 84)Control Module Communication Bus Off	● The battery voltage is 20 V or more.	● *ECM* detected: CAN communication circuit failed.	● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.
U0110	A	Diagnostic code U0110 (blink code 87) Communication with the VNT system is interrupted	When setting the error message DTCs ● The battery voltage is 20 -32 V. ● The ignition switch is on if the communication with the DTC is interrupted ● Trouble code U0073 is not set. ● The battery voltage is 20 V or more. ● The ignition switch is on	When setting the error message DTCs ● The VNT control module receives a CAN error message from the *ECM*. If communication with DTC is interrupted ● The *ECM* detected CAN messages that did not receive the VNT control module.	When setting the error message DTCs ● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. If communication with DTC is interrupted ● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A. ● The ECM limits the fuel injection quantity.
U0121	C	Diagnostic trouble code U0121 (blink code 89) Communication with anti-lock braking system (ABS) control module interrupted	● Diagnostic code U0073 is not set. ● The battery voltage is 20 V or more.	● After 1 second or 1 second from the start of the ignition switch, communication with the ABS unit can still not be established and lasts for 3 seconds or more.	● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

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DTC type definitions

1. DTC type definitions

There are 4 DTC types: Type A, B, C, and D. Among these DTCs, type A and B DTCs are related to emission whereas type C and D DTCs are related to items other than emission.

1. Action taken when DTC sets - Type A

● The ECM illuminates the malfunction indicator light (MIL).

● The ECM records the operating conditions when the diagnostic runs and fails. The ECM stores this information in the Freeze Frame/Failure Records.

2. Action taken when DTC sets - Type B

● The ECM illuminates the MIL on the second consecutive driving cycle.

● The ECM records the operating conditions when the diagnostic runs and fails. The first time the diagnostic runs and fails, the ECM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive driving cycle, the ECM records the operating conditions at the time of failure and stores this information in the Freeze Frame and updates the Failure Records.

3. Condition for clearing the MIL/DTC - Type A or Type B

● The ECM turns OFF the MIL after 3 consecutive driving cycles that the diagnostic runs and does not fail.

● A current DTC is cleared when the diagnostic runs and passes.

● A history DTC clears after 40 consecutive warm-up cycles if no failures are reported.

● Clear the MIL and the DTC with a scan tool.

4. Action taken when DTC sets - Type C

● The ECM illuminates the service vehicle soon (SVS) lamp when the diagnostic runs and fails.

● The ECM records the operating conditions when the diagnostic runs and fails. The ECM stores this information in the Failure Records.

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5. Condition for clearing the SVS lamp/DTC - Type C

● The ECM turns OFF the SVS lamp after 1 driving cycle that the diagnostic runs and does not fail.

● A current DTC is cleared when the diagnostic runs and passes.

● A history DTC clears after 40 consecutive warm-up cycles if no failures are reported.

● Clear the SVS lamp and the DTC with a scan tool.

6. Action taken when DTC sets - Type D

● The ECM does not illuminate the MIL or SVS lamp.

● The ECM records the operating conditions when the diagnostic runs and fails. The ECM stores this information in the Failure Records.

7. Condition for clearing the DTC - Type D

● A current DTC is cleared when the diagnostic runs and passes.

● A history DTC clears after 40 consecutive warm-up cycles if no failures are reported.

● Clear the DTC with a scan tool.

DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation

1. DTC P0016 DTC information

1. DTC P0016 description

The CKP sensor is installed to the flywheel housing. The sensor rotor is fixed on the flywheel. There are 56 notches spaced 6° apart and a 30° opening. Top dead center (TDC) of cylinder No. 1 can be detected through this opening.

The CMP sensor is installed to the supply pump. The CMP sensor detects the camshaft rotation in the supply pump. The ECM determines compression top dead center of cylinder No. 1 by detecting the opening of the sensor rotor with the CKP sensor and one reference projection with the CMP sensor. If the ECM detects that both signals are out of synchronization, the DTC is set.

2. Condition for setting DTC P0016

Condition for running the DTC

● The ignition switch is on

● The CKP sensor signal pulses are detected.

● The CMP sensor signal pulses are detected.

● DTCs P0335, P0336, P0340, and P0341 are not set.

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

Condition for setting the DTC

● The ECM detects that the CKP sensor signal and the CMP sensor signal are not synchronized while the engine is running

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3. Action taken when DTC P0016 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0016

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0016 diagnostics

Note:

● This DTC is set resulting from a mechanical system malfunction, such as an improperly installed timing gear.

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine. If the engine does not start, crank the engine for 10 seconds.

4) Observe the DTC information with a scan tool. Is DTC P0335, P0336, P0340, or P0341 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

No

⇒Proceed to 3. CKP sensor and CMP sensor inspection

3. CKP sensor and CMP sensor inspection

1) Inspect the CKP sensor and the CMP sensor for the following conditions.

● Damage to the sensor

● Loose or improperly installed sensor

● Excessive gap

● Foreign material passes through the gap between the sensor and the sensor rotor or between the sensor and the camshaft gear.

● Damage to the sensor rotor or camshaft gear

● Loose or improperly installed sensor rotor or camshaft gear

2) Inspect the installation status of the timing gear and the camshaft .

Note:

● If the flywheel ejector pin is lost or pushed, or if the flywheel is not installed properly, a DTC may be set.

3) Repair or replace if necessary.

Procedure completion

⇒Proceed to 4. Repair verification

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4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine. If the engine does not start, crank the engine for 10 seconds.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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Diagnostic code P0045 (flash code 33) Turbocharger boost control solenoid circuit

1. DTC P0045 (blink code 33) Turbocharger boost control solenoid circuit DTC information

1. DTC P0045 Description

The position of the turbocharger nozzle is controlled by the VNT control module according to the engine control module command. The VNT control module can control the driving signal of the turbocharger nozzle control coil installed on the turbocharger assembly through the position sensor input, Thus controlling the turbocharger nozzle.The turbocharger is in an open position when the engine is idle.When the engine is loaded, the VNT control module will command the control coil to close the turbocharger nozzle, increasing the boost effect. The engine control module can vary the amount of boost based on engine load requirements. The VNT control module performs internal diagnostics of the voltage and signal input and output states. When the VNT control module detects an incorrect nozzle position signal, a solenoid control signal error, or a VNT control When the module voltage is incorrect, the VNT control module sends information to the engine control module via the CAN communication bus and sets the diagnostic code.

2. Set the trouble code P0045

Condition for running the DTC

● The battery voltage is 20 - 32 V.

● The ignition switch is on.

Condition for setting the DTC

Any of the following conditions are met.

● VNT control module detects the voltage is too high.

● The VNT control module detects no change in sensor signal at each nozzle position at low pressure or high pressure.

● The VNT control module detects that the solenoid circuit is open or shorted.

● The VNT control module detects a stuck solenoid or injection control module.

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3. What to do when setting DTC P0045

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

4. Clear the trouble diagnosis code P0045

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Trouble Code P0045 (Blink Code 33) Turbocharger Boost Control Solenoid Circuit Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is the fault diagnosis code P0563 set?

Yes

Check the DTC P0563.

Refer to "*DTC P0563 (Flash code 35) System Voltage High*".

No

⇒Proceed to 3. Turbocharger inspection

3. Turbocharger inspection

1) Check the turbocharger for the following conditions: Is the result normal?

● Non-normal conditions, such as damaged or damaged turbocharger

● Worm turbocharger nozzle control linkage broken

● Non-normal conditions, such as damaged or damaged VNT actuators and sensors

● Abnormal conditions, such as abnormalities or loose mounting of the VNT actuator and sensor

Yes

⇒Proceed to 4. Check the operating voltage of the solenoid

No

Repair as necessary.

⇒Proceed to 17. Repair verification

4. Check the solenoid coil voltage

1) Turn OFF the ignition switch.

2) Disconnect the VNT actuator harness connector (E110).

3) Access the test lamp between each solenoid circuit (pins 6, 7 and 8 of E110) and the frame ground.

Refer to “*Engine Control*”.

4) Turn ON the ignition switch.Does the test lamp illuminate?

Caution:

Use test lights to check each circuit.

Yes

⇒Proceed to 5. Check whether the electromagnetic circuit is short-circuited

No

⇒Proceed to 6. Check the solenoid circuit for open and short circuits

5. Check the electromagnetic circuit is shorted

1) Check the solenoid circuit between the VNT control module (pins 10, 11 and 12 of E120) and the VNT actuator (pins 6, 7 and 8 of E110) for a short circuit.

Refer to “*Engine Control*”.

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Yes

⇒Proceed to 7. Check the position sensor's power supply voltage

No

Repair the circuit as necessary.

⇒Proceed to 17. Repair verification

6. Check the solenoid circuit for open and short circuit

1) Check the electromagnetic circuit between the VNT control module (pins 10, 11 and 12 of E120) and VNT actuator (pins 6, 7 and 8 of E110) that did not illuminate the test light for the following conditions: Is the result normal?

● Open circuit

● Short to ground

● Short to the power supply circuit

● Short to position sensor circuit

● High resistance

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. Check the position sensor's power supply voltage

No

Repair the circuit as necessary.

⇒Proceed to 17. Repair verification

7. Check the position sensor supply voltage

1) Turn ON the ignition switch.

2) Use a digital multimeter to measure the voltage between the position sensor power circuit (pin 1 of E110) and the frame ground. Is the voltage within the specified range?

Refer to "*Engine Control*".

Value: 8.0 to 10.0 V

Yes

⇒Proceed to 8. Check the position sensor signal voltage

No

⇒Proceed to 11. Check if the position sensor power circuit is open and shorted

8. Check the position sensor signal voltage

1) Turn ON the ignition switch.

2) Use a digital multimeter to measure the voltage between each position sensor signal circuit (pins 2, 3, and 4 of E110) and the frame ground. Is the voltage within the specified range?

Refer to "*Engine Control*".

Value: 4.0 to 6.0 V

Yes

⇒Proceed to 9. Check if the position sensor signal circuit is short-circuited

No

⇒Proceed to 11. Check if the position sensor power circuit is open and shorted

9. Check position sensor signal circuit for short circuit

1) Check the position sensor signal circuit of the VNT control module (pins 1, 2 and 3 of E120) and the VNT actuator (pins 1, 2, 3 and 4 of E110) for a short circuit.

Refer to "*Engine Control*".

Yes

⇒Proceed to 10. Check the position sensor voltage

No

Repair the circuit as necessary.

⇒Proceed to 17. Repair verification

10. Check the position sensor voltage

1) Turn ON the ignition switch.

2) Use a digital multimeter to measure the voltage between the position sensor power circuit and the low reference circuit (pins 1 and 5 of E110). Is the voltage within the specified range?

Refer to "*Engine Control*".

Value: 8.0 to 10.0 V

Yes

⇒Proceed to 14. Check the VNT actuator harness connector

No

⇒Proceed to 13. Check if the position sensor low-voltage reference circuit is open

11. Check position sensor power circuit is open and short circuit

1) Check the position of the VNT control module (pin 8 of E120) and VNT actuator (pin 1 of E110) for the following conditions: Is the result normal?

● Open circuit

● Short to ground

● Short to the low reference circuit

● Short to the power supply circuit

● High resistance

Refer to "*Engine Control*".

Yes

⇒ Proceed to 15. Check the VNT control module harness connector

No

Repair the circuit as necessary.

⇒Proceed to 17. Repair verification

12. Check position sensor signal circuit for open or short circuit

1) Check the position sensor signal circuit of the VNT control module (pins 1, 2 and 3 of E120) and VNT actuator (pins 1, 2 and 3 of E110) for the following conditions.

● Open circuit

● Short to ground

● Short to the low reference circuit

● Short to the 5 V reference circuit

● Short to the power supply circuit

● High resistance

Refer to “*Engine Control*”.

Yes

⇒ Proceed to 15. Check the VNT control module harness connector

No

Repair the circuit as necessary.

⇒Proceed to 17. Repair verification

13. Check if the position sensor low voltage reference circuit is open

1) Check if there is an open circuit or high resistance in the sensor low reference circuit of VNT control module (pin 4 of E120) and VNT actuator (pin 5 of E110). Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒ Proceed to 15. Check the VNT control module harness connector

No

Repair the circuit as necessary.

⇒Proceed to 17. Repair verification

14. Check VNT actuator harness connector

1) Check that the VNT actuator harness connector (pins 1, 2, 3, 4, 5, 6, 7 and 8 of E110) is not properly connected.

Refer to “*Engine Control*”.

Yes

Replace the turbocharger.

Refer to "*1. Engine 1F. Intake (6WG1) Turbocharger Removal*".

Refer to "*1. Engine 1F. Intake (6WG1) Turbocharger Installation*".

⇒Proceed to 17. Repair verification

No

Repair the connection as necessary ..

⇒Proceed to 17. Repair verification

15. Check the VNT control module harness connector

1) Check if the VNT control module harness connector (pins 1, 2, 3, 4, 8, 10, 11 and 12 of the E120) is poorly connected.

Refer to “*Engine Control*”.

Yes

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⇒ Proceed to 16. Replace the VNT control module

No

Repair the connection as necessary ..

⇒Proceed to 17. Repair verification

16. Replace the VNT control module

Refer to "*1. Engine 1Z. Engine Electrical Control (6WG1) VNT Control Module Removal*".

Refer to "*1. Engine 1Z. Engine Electrical Control (6WG1) VNT Control Module Installation*".

Procedure completion

⇒Proceed to 17. Repair verification

17. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0087 (Flash Code 225) Fuel Rail/System Pressure - Too Low

1. DTC P0087 DTC information

1. DTC P0087 description

The fuel rail system is composed of 2 fuel pressure sections. A suction side between the fuel tank and the fuel supply pump, and a high pressure side between the fuel supply pump and the injectors. Fuel is drawn from the fuel tank and then supplied to the fuel rail by the 2 plungers located inside the supply pump. The fuel rail pressure is controlled by the ECM, which controls the FRP regulator based on signals from the fuel rail pressure sensor. If the fuel rail pressure becomes excessively high, the fuel rail pressure limiter valve opens to release the excessive pressure and returns the fuel to the fuel tank. The ECM sets this DTC if the fuel rail pressure sharply decreases after the pressure goes excessively high. This DTC detects activation of the pressure limiter valve.

2. Condition for setting DTC P0087

Condition for running the DTC

● The ignition switch is on

● The engine is running

● DTCs P0192, P0193, P060B, and P0641 are not set.

Refer to "*DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low*".

Refer to "*DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The ECM detects that the fuel rail pressure is 198 MPa{28,710 psi} or more and the pressure limiter valve is activated.

3. Action taken when DTC P0087 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0087

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation -Circuit Diagram* " in this section.

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4. DTC P0087 diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is DTC P0088, P0089, P0091, P0092, P0192, P0193, P0201, P0202, P0203, P0204, P0205, P0206, P2146, or P2149 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0088 (Flash Code 118) Fuel Rail/System Pressure - Too High*".

Refer to "*DTC P0089 (Flash code 151) Fuel Pressure Regulator Performance*".

Refer to "*DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low*".

Refer to "*DTC P0092 (Flash code 217) Fuel Pressure Regulator Control Circuit High*".

Refer to "*DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low*".

Refer to "*DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High*".

Refer to "*DTC P0201 (Flash Code 271) Injector Circuit Open - Cylinder 1*".

Refer to "*DTC P0202 (Flash Code 272) Injector Circuit Open - Cylinder 2*".

Refer to "*DTC P0203 (Flash Code 273) Injector Circuit Open - Cylinder 3*".

Refer to "*DTC P0204 (Flash Code 274) Injector Circuit Open - Cylinder 4*".

Refer to "*DTC P0205 (Flash Code 275) Injector Circuit Open - Cylinder 5*".

Refer to "*DTC P0206 (Flash Code 276) Injector Circuit Open - Cylinder 6*".

Refer to "*DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit*".

Refer to "*DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit*".

No

⇒Proceed to 3. DTC check when revving engine

3. DTC check when revving engine

1) Turn OFF the ignition switch.

2) Place the shift lever in the neutral position and apply the parking brake.

3) Start the engine.

4) While observing the DTC information with a scan tool, repeatedly depress the accelerator pedal from idle to full throttle to rev the engine. Is a DTC set?

Yes

⇒Proceed to 4. Fuel rail pressure sensor signal voltage check

No

An intermittent problem due to foreign object in the fuel can be suspected.

⇒Proceed to 12. Replace the fuel filter element.

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4. Fuel rail pressure sensor signal voltage check

1) Turn OFF the ignition switch.

2) Wait for 2 minute to reduce the fuel pressure of the fuel rail.

3) Turn ON the ignition switch.

4) Observe the Fuel Rail Pressure Sensor parameter on the scan tool. Is the Fuel Rail Pressure Sensor parameter within the specified range?

Value: 0.9 to 1.0 V.

Yes

⇒Proceed to 5. Injector inspection using scan tool

No

⇒Proceed to 13. Fuel rail pressure sensor circuit inspection

5. Injector inspection using scan tool

1) Start the engine.

2) Perform the Cylinder Balance Test with a scan tool.

3) Command each injector OFF and verify the engine speed changes for each injector. Are there any injectors that do not change the engine speed when commanded OFF?

Yes

Replace the injectors that do not change.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(*6WG1*) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(*6WG1*) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 14. Repair verification

No

⇒Proceed to 6. High-pressure side fuel piping inspection

6. High-pressure side fuel piping inspection

1) Inspect that the fuel piping between the fuel tank and the fuel supply pump is properly connected, there are no cuts or cracks in the fuel hoses, and proper clamps are used.

Is the result normal?

Note:

● The fuel piping between the fuel tank and the fuel supply pump is slightly vacuumed when the engine is running. Therefore, if the piping is not connected securely, air can get inside. If the engine speed or the engine load increases while air has entered the fuel system, fluctuation in the fuel rail pressure occurs, and this DTC may be set.

2) Operate the priming pump until the force required for pressing increases.

Note:

● When a leak exists in the fuel system between the primping pump and fuel supply pump, the pushing weight of the priming pump does not get heavy.

3) Start the engine.

4) Inspect the high-pressure side of the fuel system and check for any fuel leakage between the fuel supply pump and the fuel rail.

Note:

● Check for fuel leakage from the high pressure piping inlet to the bottom of the cylinder head cover. If a fuel leakage exists, the engine oil level will rise. Inspect the engine oil for fuel contamination.

Yes

⇒Proceed to 7. DTC check during fuel supply

No

Repair as necessary.

⇒Proceed to 14. Repair verification

7. DTC check during fuel supply

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch.

3) Perform a test run while supplying fuel with other piping connected to the fuel supply pump inlet. Replace the fuel hoses with transparent hoses at this time and visually inspect whether air is contained.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 8. Fuel pressure verification

No

⇒Proceed to 9. Suction side return fuel piping inspection

8. Fuel pressure verification

1) Turn ON the ignition switch.

2) Observe the Fuel Rail Pressure (FRP) parameter on the scan tool.

3) Start the engine.

4) While observing the Fuel Rail Pressure (FRP) parameter on the scan tool, repeatedly depress the accelerator pedal from idle to full throttle to rev the engine. Are the Fuel Rail Pressure (FRP) parameters for when the engine is stopped, when the engine is idling, and when revving the engine equal to the specified values?

Value: -30 MPa { -4,350 psi } When the engine is stopped

Value: -5 to 5 MPa { -725 to 725 psi } When idling the engine, when revving the engine

Yes

⇒Proceed to 10. Suction side feed fuel piping inspection

No

⇒Proceed to 11. PCV circuit inspection

9. Suction side return fuel piping inspection

1) Inspect for damage or twisting in the fuel system between the fuel supply pump and the fuel tank. Is the result normal?

2) If possible, inspect for foreign material in the fuel tank or for foreign material that may cause clogging of the fuel. Is the result normal?

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3) Are all of the results normal?

Yes

⇒Proceed to 12. Replace the fuel filter.

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

10. Suction side feed fuel piping inspection

1) Inspect for clogging in the fuel system between the fuel tank and the fuel supply pump, for a cut or a crack in the fuel hoses, and if proper clamps are used. Is the result normal?

Yes

⇒Proceed to 11. PCV circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

11. PCV circuit inspection

1) Inspect for poor connections at the PCV harness connector (pins 1 and 2 of E44 and E43). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 17, 25, 30, and 31 of E83). Is the connection status normal?

3) Inspect for high resistance between the ECM (pins 17, 25, 30, and 31 of E83) and the PCV (pins 1 and 2 of E44 and E43). Is the result normal?

Refer to “Engine Control”.

4) Are all of the results normal?

Yes

Replace the fuel supply pump and the fuel filter.

Note:

● If the fuel supply pump is replaced, the fuel filter must be replaced at the same time.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 12. Replace the fuel filter.

No

Repair the circuit or the connection as necessary.

⇒Proceed to 14. Repair verification

12. Replace the fuel filter.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel filter element removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel filter element installation*".

Procedure completion

⇒Proceed to 14. Repair verification

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13. Fuel rail pressure sensor circuit inspection

1) Inspect for poor connections at the fuel rail pressure sensor harness connector (pins 1, 2, and 3 of E42). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 15, 26, 29, and 30 of E82). Is the connection status normal?

3) Inspect for high resistance in the circuit between the ECM (pins 15, 26, 29, and 30of E82) and the fuel rail pressure sensor (pins 1, 2, and 3 of E42). Is the result normal?

Refer to “Engine Control”.

4) Are all of the results normal?

Yes

Replace the fuel rail pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor installation*".

⇒Proceed to 14. Repair verification

No

Repair the circuit or the connection as necessary.

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0088 (Flash Code 118) Fuel Rail/System Pressure - Too High

1. DTC P0088 DTC information

1. DTC P0088 description

The fuel rail pressure sensor is installed to the fuel rail and detects the fuel rail pressure. If the fuel rail pressure changes according to the engine condition, the output voltage of the fuel rail pressure sensor changes. If the fuel rail pressure is low, the output voltage becomes low, and if the pressure is high, the output voltage becomes high. The ECM interprets this output voltage as an actual fuel rail pressure and uses it for control. The sensor 5 V reference, signal, and low reference circuits of the fuel rail pressure sensor are dedicated circuits and are connected to the ECM. Also, the sensor circuit is shielded to prevent intrusion of electronic noise, etc.

2. Condition for setting DTC P0088

Condition for running the DTC

● The ignition switch is on

● Start rail pressure feedback mode.

● DTCs P0192, P0193, P060B, and P0641 are not set.

Refer to "*DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low*".

Refer to "*DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The ECM detects that the fuel rail pressure is 198 MPa {28,710 psi} or more for 5 seconds or more.

3. Action taken when DTC P0088 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0088

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4.DTC P0088 diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

POWERSTAR

1) Bleed the air.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool. Is DTC P0088 set?

Yes

⇒Proceed to 3. Fuel rail pressure sensor harness connector inspection

No

⇒Proceed to 16. Repair verification

3. Fuel rail pressure sensor harness connector inspection

1) Inspect for poor connections at the fuel rail pressure sensor harness connector (pins 1, 2, and 3 of E42). Is the connection status normal?

Refer to “Engine Control”.

Yes

⇒Proceed to 4. Fuel supply pump inspection

No

Repair the connection as necessary.

⇒Proceed to 16. Repair verification

4. Fuel supply pump inspection

1) Inspect the installation status of the fuel supply pump. Is the installation status normal?

Yes

⇒Proceed to 5. Fuel pipe and fuel filter inspection

POWERSTAR

No

Repair as necessary.

⇒Proceed to 16. Repair verification

5. Fuel pipe and fuel filter inspection

1) Inspect for any abnormal conditions such as collapsing or clogging in all fuel pipes, and for any abnormal conditions in the fuel filters, etc.

Is the result normal?

Yes

⇒Proceed to 6. Cylinder injection correction amount check

No

Repair or replace if necessary.

⇒Proceed to 16. Repair verification

6. Cylinder injection correction amount check

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the Fuel Compensation parameter for each cylinder on the scan tool. Is the Fuel Compensation parameter within the normal range?

Value:-4 - 4 mm3/st

Yes

⇒Proceed to 7. Inspection for open circuit and short circuit in fuel rail pressure sensor circuit

No

Inspect and clean the injectors of the applicable cylinders, and replace as necessary.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector Removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector Installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM Setting*".

⇒Proceed to 16. Repair verification

7. Inspection for open circuit and short circuit in fuel rail pressure sensor circuit

1) Inspect between the fuel rail pressure sensor (pins 1, 2, and 3 of E42) and the ECM (pins 15, 26, 29, and 30 of E82) for an open circuit or a short circuit. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 8. Fuel rail pressure check

No

Repair or replace if necessary.

⇒Proceed to 16. Repair verification

8. Fuel rail pressure check

1) Turn ON the ignition switch.

2) Observe the Fuel Rail Pressure (FRP) parameter on the scan tool. Is the Fuel Rail Pressure (FRP) parameter equal to the specified value?

Value: about 0 MPa { about 0 psi }

Yes

⇒Proceed to 9. Fuel rail pressure check when idling

No

⇒Proceed to 11. Fuel rail pressure sensor inspection

9. Fuel rail pressure check when idling

1) Turn OFF the ignition switch.

2) Install the oil cooler hose.

3) Connect the scan tool.

4) Start the engine.

5) Observe the Fuel Rail Pressure (FRP) parameter on the scan tool. Is the Fuel Rail Pressure (FRP) parameter more than or equal to the specified value?

POWERSTAR

Value: 0 MPa { 0 psi }

Yes

⇒Proceed to 10. Fuel rail pressure check during accelerator pedal operation

No

⇒Proceed to 11. Fuel rail pressure sensor inspection

10. Fuel rail pressure check during accelerator pedal operation

1) Observe the Fuel Rail Pressure (FRP) parameter on the scan tool while operating the accelerator pedal. Does the Fuel Rail Pressure (FRP) parameter change?

● When the accelerator pedal is depressed, it changes to the positive side.

● After releasing the accelerator pedal, it switches to negative.

Yes

⇒Proceed to 12. Fuel supply pump operation check

No

⇒Proceed to 11. Fuel rail pressure sensor inspection

11. Fuel rail pressure sensor inspection

1) Check the dirt attached to the fuel rail pressure sensor, etc. Is the result normal?

Yes

⇒Proceed to 12. Fuel supply pump operation check

No

Replace the fuel rail pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor installation*".

⇒Proceed to 12. Fuel supply pump operation check

12. Fuel supply pump operation check

1) Observe the Fuel Rail Pressure (FRP) parameter on the scan tool while operating the accelerator pedal. Does the Fuel Rail Pressure (FRP) parameter change?

● When the accelerator pedal is depressed, it changes to the positive side.

● When the accelerator pedal is released, it changes to the negative side.

Yes

⇒Proceed to 13. Pressure limiter operation check

No

Replace the fuel supply pump.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 16. Repair verification

13. Pressure limiter operation check

1) Bleed the air.

2) Reconnect all of the disconnected harness connectors.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool.Is DTC P0088 set?

Yes

Replace the pressure limiter.

Refer to "*1.Engine 1C.Fuel System(6WG1) Pressure limiter removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Pressure limiter installation*".

⇒Proceed to 14. Pressure limiter signal input check

No

⇒Proceed to 16. Repair verification

14. Pressure limiter signal input check

1) Bleed the air.

2) Reconnect all of the disconnected harness connectors.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Start the engine.

6) Observe the DTC information with a scan tool.Is DTC P0088 set?

Yes

⇒Proceed to 15. ECM replacement

No

⇒Proceed to 16. Repair verification

15. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 16. Repair verification

16. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0089 (Flash code 151) Fuel Pressure Regulator Performance

1. DTC P0089 (Flash code 151) Fuel Pressure Regulator Performance DTC information

1. DTC P0089 description

The fuel rail pressure sensor is installed to the fuel rail and detects the fuel rail pressure. If the fuel rail pressure changes according to the engine condition, the output voltage of the fuel rail pressure sensor changes. If the fuel rail pressure is low, the output voltage becomes low, and if the pressure is high, the output voltage becomes high. The ECM interprets this output voltage as an actual fuel rail pressure and uses it for control. The sensor 5 V reference, signal, and low reference circuits of the fuel rail pressure sensor are dedicated circuits and are connected to the ECM. Also, the sensor circuit is shielded to prevent intrusion of electronic noise, etc.

2. Condition for setting DTC P0089

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine coolant temperature is 60℃ {140℉} or more.

● The engine speed is 375 rpm or more

● Differentiate cylinder events.

● Start rail pressure feedback mode.

● DTCs P0192, P0193, P0335, P0336, P060B, and P0641 are not set.

Refer to "*DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low*".

Refer to "*DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

Any of the following conditions are met.

● The common rail (fuel rail) fuel pressure differential during engine starting is sensed by the *ECM* and the expected fuel pressure set by the *ECM* is about 40 MPa or more for a duration of 5 seconds.

● The proportional control valve closes at approximately 180 CA for a duration of more than 5 seconds.

3. What to do when setting the trouble code P0089

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0089

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation – Circuit Diagram*" in this section.

4. DTC P0089 diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Bleed the air.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool.Is DTC P0089 set?

Yes

⇒Proceed to 3. Fuel rail pressure sensor harness connector inspection

No

⇒Proceed to 16. Repair verification

3. Fuel rail pressure sensor harness connector inspection

1) Inspect for poor connections at the fuel rail pressure sensor harness connector (pins 1, 2, and 3 of E42). Is the connection status normal?

Refer to "Engine Control".

Yes

⇒Proceed to 4. Fuel supply pump inspection

No

Repair the connection as necessary..

⇒Proceed to 16. Repair verification

4. Fuel supply pump inspection

1) Inspect the installation status of the fuel supply pump. Is the installation status normal?

Yes

⇒Proceed to 5. Fuel pipe and fuel filter inspection

No

Repair as necessary.

⇒Proceed to 16. Repair verification

5. Fuel pipe and fuel filter inspection

1) Inspect for any abnormal conditions such as collapsing or clogging in all fuel pipes, and for any abnormal conditions in the fuel filters, etc.Is the result normal?

Yes

⇒Proceed to 6. Cylinder injection correction amount check

No

Repair or replace if necessary.

⇒Proceed to 16. Repair verification

6. Cylinder injection correction amount check

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the Fuel Compensation parameter for each cylinder on the scan tool. Is the Fuel Compensation parameter within the normal range?

Value:-4 - 4 mm3/st

Yes

⇒Proceed to 7.Inspection for open circuit and short circuit in fuel rail pressure sensor circuit

No

Inspect and clean the injectors of the applicable cylinders, and replace as necessary.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 16. Repair verification

7.Inspection for open circuit and short circuit in fuel rail pressure sensor circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and fuel rail pressure sensor harness connector (E42).

3) Inspect between the fuel rail pressure sensor (pins 1, 2, and 3 of E42) and the ECM (pins 15, 26, 29, and 30 of E82) for. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 8. Fuel rail pressure sensor signal voltage check

No

Repair or replace if necessary.

⇒Proceed to 16. Repair verification

8. Fuel rail pressure sensor signal

1) Turn ON the ignition switch.

2) Observe the Fuel Compensation parameter for each cylinder on the scan tool. Is the Fuel Compensation parameter within the normal range?

Value: 0.9 to 1.0 V

Yes

⇒Proceed to 9. Fuel rail pressure check during accelerator pedal operation

No

⇒Proceed to 11. Change the fuel rail pressure sensor

9. Fuel rail pressure check during accelerator pedal operation

1) Turn OFF the ignition switch for at least 30 seconds.

2) Turn ON the ignition switch.

3) While observing the rail pressure (FRP) parameter on the scanning tool, depress the accelerator pedal several times to increase the throttle to full throttle. Are the rail pressure FRP parameters meeting the specifications quickly?

Value: -2 to 2 MPa {-290 to 290 psi}

Yes

⇒ Proceed to 10. Fuel rail pressure sensor inspection

No

⇒Proceed to 11. Change the fuel rail pressure sensor

10. Fuel rail pressure sensor inspection

1) Check the dirt attached to the fuel rail pressure sensor, etc. Is the result normal?

Yes

⇒ Proceed to 12. Fuel supply pump operation check

No

⇒Proceed to 11. Change the fuel rail pressure sensor

11. Replace the fuel rail pressure sensor

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor installation*".

Procedure completion

⇒Proceed to 12. Fuel supply pump operation check

12. Fuel supply pump operation check

1) Observe the Fuel Rail Pressure (FRP) parameter on the scan tool while operating the accelerator pedal. Does the Fuel Rail Pressure (FRP) parameter change?

● When the accelerator pedal is depressed, it changes to the positive side.

● When the accelerator pedal is released, it changes to the negative side.

Yes

⇒Proceed to 16. Repair verification

No

Replace the fuel supply pump.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 13. Pressure limiter operation check

13. Pressure limiter operation check

1) Bleed the air.

2) Reconnect all of the disconnected harness connectors.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 15 seconds.

5) Start the engine.

6) Observe the DTC information with a scan tool.Is DTC P0089 set?

Yes

Replace the pressure limiter.

Refer to "*1.Engine 1C.Fuel System(6WG1) Pressure limiter removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Pressure limiter installation*".

⇒Proceed to 14. Pressure limiter signal input check

No

⇒Proceed to 16. Repair verification

14. Pressure limiter signal input check

1) Bleed the air.

2) Reconnect all of the disconnected harness connectors.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Start the engine.

6) Observe the DTC information with a scan tool.Is DTC P0089 set?

Yes

⇒Proceed to 15. ECM replacement

No

⇒Proceed to 16. Repair verification

15. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 16. Repair verification

POWERSTAR

16. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low

1. DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low DTC information

1. DTC P0091 description

The PCV controls the amount of fuel force-fed to the fuel rail. The PCV closes the valve after the signal voltage is sent to the PCV installed to the supply pump, and then the fuel is force-fed from the supply pump to the fuel rail. The ECM activates the PCV by controlling the valve opening timing. The earlier the valve opening time of the PCV is, the larger the amount of fuel force-fed to the fuel rail is, and the fuel rail pressure rises. Two PCVs are installed to the supply pump and only a normal PCV can be activated even if one side fails. Because the PCV corresponds to each fuel injection cylinder, the DTC is not set but the engine is stopped if the harness is connected reversely.

2. Condition for setting DTC P0091

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● Differentiate cylinder events.

● Start rail pressure feedback mode.

Condition for setting the DTC

● When the command light is off, the *ECM* detects that the drive signal circuit in the fuel rail pressure (FRP) regulator solenoid valve is under low pressure.

3. Action taken when DTC P0091 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0091

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Check whether DTC P0091 is a current failure with a scan tool. Is DTC P0091 a current failure?

Yes

⇒Proceed to 3. Inspection of each harness connector and PCV1 installation

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Inspection of each harness connector and PCV1 installation

1) Inspect for poor connections at the PCV1 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

2) Inspect the installation status of the PCV1 body. Is the result normal?

3) Are all of the results normal?

Yes

⇒Proceed to 4. PCV1 inspection

No

Repair or replace if necessary.

⇒Proceed to 10. Repair verification

4. PCV1 check

1) Turn OFF the ignition switch.

2) Disconnect the PCV1 harness connector (E43).

Refer to “*Engine Control*”.

3) Measure the resistance of PCV1 with a DMM. Is the resistance equal to the specified value?

Value: about 3.2 Ω At room temperature

Yes

⇒Proceed to 5. PCV1 power supply voltage check

No

Replace the fuel supply pump.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 10. Repair verification

5. PCV1 power supply voltage check

1) Turn ON the ignition switch.

2) Measure the voltage between the PCV1 power supply circuit (pin 1 of E43) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 20 V

Yes

⇒Proceed to 7. Inspection for open circuit or short circuit in PCV1 control circuit

No

⇒Proceed to 6. Fuse inspection

6. Fuse inspection

1) Inspect for a blown out ECM MAIN 15 A fuse. Is the result normal?

Yes

Repair or replace the power circuit between the 15 A fuse of the engine electronics control unit and the proportional control valve 1 (pin 1 of E43).

⇒Proceed to 10. Repair verification

No

Replace the fuse. Also, inspect for a short circuit which could cause a fuse blowout in the circuits related to the fuse, and repair or replace the harness as necessary.

⇒Proceed to 10. Repair verification

7. Inspection for open circuit or short circuit in PCV1 control circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83).

3) Connect a fused jumper wire between the PCV1 control circuit (pin 2 of E43) and the frame ground.

4) Measure the resistance between the PCV 1 control circuit (pins 17 and 25 of F83) and the frame ground with a DMM (Check for open circuit in PCV 1 control circuit). Is the resistance lower than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 10 Ω

5) Disconnect the fused jumper wire from between the PCV1 control circuit (pin 2 of E43) and frame ground.

6) Measure the resistance between the PCV1 control circuit (pins 17 and 25 of F83) and frame ground with a DMM (Check for short circuit in PCV1 control circuit). Is the resistance more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 10 Ω

7) Are all of the values normal?

Yes

⇒Proceed to 8. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 10. Repair verification

8. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 9. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 10. Repair verification

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9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0092 (Flash code 217) Fuel Pressure Regulator Control Circuit High

1. DTC information

1. DTC P0092 description

The PCV controls the amount of fuel force-fed to the fuel rail. The PCV closes the valve after the signal voltage is sent to the PCV installed to the supply pump, and then the fuel is force-fed from the supply pump to the fuel rail. The ECM activates the PCV by controlling the valve opening timing. The earlier the valve opening time of the PCV is, the larger the amount of fuel force-fed to the fuel rail is, and the fuel rail pressure rises.

Two PCVs are installed to the supply pump and only a normal PCV can be activated even if one side fails. Because the PCV corresponds to each fuel injection cylinder, the DTC is not set but the engine is stopped if the harness is connected reversely.

2. Condition for setting DTC P0092

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● Differentiate cylinder events.

● Start rail pressure feedback mode.

● DTC P0091 is not set.

Refer to "*DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low*".

Condition for setting the DTC

● When the command light is on, the *ECM* detects that the drive signal circuit in the fuel rail pressure (FRP) regulator solenoid valve is under high pressure.

3. Action taken when DTC P0092 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0092

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram* " in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Check whether DTC P0092 is a current failure with a scan tool. Is DTC P0092 a current failure?

Yes

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⇒Proceed to 3. Inspection of each harness connector and PCV1 installation

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Inspection of each harness connector and PCV1 installation

1) Inspect for poor connections at the PCV1 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

2) Inspect the installation status of the PCV1 body. Is the result normal?

3) Are all of the results normal?

Yes

⇒Proceed to 4. PCV1 inspection

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

4. PCV1 inspection

1) Turn OFF the ignition switch.

2) Disconnect the PCV1 harness connector (E43).

3) Measure the resistance of the PCV1 connector (pin 1 and pin 2 of E43) with a digital multimeter .Is the resistance equal to the specified value?

Refer to "*Engine Control*".

Value: 3.2 Ω At room temperature

Yes

⇒Proceed to 5. PCV1 power supply voltage check

No

Replace the fuel supply pump.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 8. Repair verification

5. PCV1 power supply voltage check

1) Turn ON the ignition switch.

2) Measure the voltage between the PCV 1 control circuit (pin 1 of E43) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: about 0 V

Yes

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

No

POWERSTAR

⇒Proceed to 6. ECM power supply and ground circuit inspection

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0101 (Flash code 92) Mass Air Flow Sensor Circuit Range/Performance

1. DTC information

1. DTC P0101 description

The MAF sensor is an air flow meter that measures the amount of air that enters the engine. It is installed between the air cleaner and the turbocharger. When the amount of air entering the engine is small, it indicates deceleration or idling speed. When the amount of air entering the engine is large, it indicates acceleration or a high load state. The ECM calculates predicted MAF value and compares the actual MAF sensor voltage signal to the predicted MAF value. This comparison determines if the signal is stuck, or is too low or too high for a particular operating condition. If the ECM detects that the actual MAF sensor signal voltage is not within the predetermined range of the calculated MAF predicted value, the DTC is set.

2. Condition for setting DTC P0101

Condition for running the DTC

● The battery voltage is 16 - 32 V.

● The ignition switch is on.

● DTCs P0102, P0103, P0116, P0117, P0118, P0234, P0237, P0238, P0404, P0409, P0560, P060B, P0641, P0651, P0697, P1404, P140A, P140B, P140C, P2227, P2228 and P2229 are not set.

Refer to "*DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input*".

Refer to "*DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input*".

Refer to "*DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance*".

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P0234 (Flash code 42) Turbocharger Overboost Condition* ".

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High* ".

Refer to "*DTC P0404 (Flash code 45) EGR Control Circuit Range/ Performance*".

Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit* ".

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P1404 (Flash code 45) EGR Position Fault* ".

Refer to "*DTC P140A (Flash Code 345) EGR 2 Performance*".

Refer to "*DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance*".

Refer to "*DTC P140C (Flash Code 345) EGR 2 Closed Position Performance*".

Refer to "*DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low* ".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

Also, the following conditions are met for 3 seconds or more.

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● The engine speed is 800- 1,800 rpm.

● The EGR control is commanded OFF.

● The engine run time is 5 seconds or more.

● Slow down

Condition for setting the DTC

● The ECM detects that the MAF sensor signal voltage is not within the predetermined range of the calculated MAF predicted value for 10 seconds or more.

3. Action taken when DTC P0101 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0101

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Air intake/exhaust system inspection

1) Inspect for the following conditions.Is the result normal?

● Clogged air cleaner element, collapsing of the air piping between the air cleaner and the intake manifold, or a state where flow is restricted or damage is present

● Leakage in the air intake system

● Contamination or foreign material blocking the inlet of MAF sensor

● Misdetection or delayed response of the MAF sensor

● Water intrusion in the air intake system

● Any kind of restriction that happens in the exhaust system

● Stuck EGR valve

● Stuck exhaust brake valve

Yes

⇒Proceed to 3. Individual harness connector inspection

No

Repair or replace if necessary.

⇒Proceed to 5. Repair verification

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3. Individual harness connector inspection

1) Inspect for poor connections at the MAF sensor harness connector (pins 1, 2, and 3 of E107). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 15 and 16 of FL559; pin 9 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 4. MAF sensor circuit inspection

No

Repair the connection as necessary..

⇒Proceed to 5. Repair verification

4. MAF sensor circuit inspection

1) Inspect for high resistance at the MAF sensor harness connector (pins 1, 2, and 3 of E107). .Is the result normal?

Refer to “*Engine Control*”.

Yes

Replace the MAF sensor..

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor removal*".

Refer to "1.*Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor installation*".

⇒Proceed to 5. Repair verification

No

Repair the circuit as necessary.

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input

1. DTC information

1. DTC P0102 description

The MAF sensor is an air flow meter that measures the amount of air that enters the engine. It is installed between the air cleaner and the turbocharger. When the amount of air entering the engine is small, it indicates deceleration or idling speed. When the amount of air entering the engine is large, it indicates acceleration or a high load state. The sensor has the following circuits.

● 12 V reference circuit

● Low reference circuit

● MAF sensor signal circuit

The ECM monitors the MAF sensor signal voltage. The scan tool displays this output voltage in voltage and grams per cylinder (g/cyl). If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P0102

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine speed is equal to or more than 400 rpm.

● DTCs P0560 and P060B are not set.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the MAF sensor signal voltage is 0.1 V or less for approximately 3 seconds.

3. What to do when setting trouble diagnosis code P0102

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The engine control module sets a default mass air flow temperature value.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0102

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation – Circuit Diagram* " in this section.

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4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is DTC P0560 set at the same time?

Yes

Go to DTC P0560 diagnosis.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

No

⇒Proceed to 3. MAF sensor signal voltage check

3. MAF sensor signal voltage check

1) Observe the MAF Sensor (Mass Air Flow) parameter on the scan tool. Is the MAF Sensor (Mass Air Flow) parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 4. MAF sensor 12 V reference voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

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4. MAF sensor 12 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the MAF/IAT sensor harness connector (E107).

3) Connect a test lamp between the MAF sensor 12 V reference circuit (pin 1 of E107) and the frame ground.

Refer to “*Engine Control*”.

4) Turn ON the ignition switch.Does the test lamp illuminate?

Yes

⇒Proceed to 5. MAF sensor signal output voltage check using fused jumper wire

No

⇒Proceed to 6. Inspection for open circuit in MAF sensor 12 V reference circuit

5. MAF sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the MAF sensor 12 V reference circuit and the signal circuit (pins 1 and 3 of E107).

Refer to “*Engine Control*”.

2) Observe the MAF Sensor (Mass Air Flow) parameter on the scan tool. Is the MAF Sensor (Mass Air Flow) parameter more than or equal to the specified value?

Value: 4.9 V

Yes

⇒Proceed to 8. MAF/IAT sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit and short circuit in MAF sensor signal circuit

6. Inspection for open circuit in MAF sensor 12 V reference circuit

1) Inspect the 12 V reference circuit between the ECM (pin 15 of FL559) and the MAF sensor (pin 1 of E107) for an open circuit or high resistance.Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit and short circuit in MAF sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 9 of FL558) and the MAF sensor (pin 3 of E107) for the following conditions.Is the result normal?

Refer to “*Engine Control*”.

● Open circuit

● Short to ground

● Short to the low reference circuit

● High resistance

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Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. MAF/IAT sensor harness connector inspection

1) Check if the mass air flow / intake air temperature sensor harness connector (pins 1 and 3 of E107) is poorly connected. Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the MAF sensor..

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary..

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 9 of FL558, pin 15 of FL559). Is the connection status normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary..

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input

1. DTC information

1. DTC P0103 description

The MAF sensor is an air flow meter that measures the amount of air that enters the engine. It is installed between the air cleaner and the turbocharger. When the amount of air entering the engine is small, it indicates deceleration or idling speed. When the amount of air entering the engine is large, it indicates acceleration or a high load state. The sensor has the following circuits.

● 12V reference circuit

● Low reference circuit

● MAF sensor signal circuit

The ECM monitors the MAF sensor signal voltage. The scan tool displays this output voltage in voltage and grams per cylinder (g/cyl). If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P0103

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● The engine speed is 400- 1,200 rpm.

● DTCs P0560 and P060B are not set.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the IAT sensor signal voltage is 4.9 V or more for approximately 3 seconds.

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3. Action taken when DTC P0103 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The engine control module sets a default mass air flow temperature value.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0103

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”.

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. *Engine Control* system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. MAF sensor signal voltage check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the MAF Sensor (Mass Air Flow) parameter on the scan tool. Is the MAF Sensor (Mass Air Flow) parameter more than or equal to the specified value?

Value: 4.9 V

Yes

⇒Proceed to 3. MAF sensor 12 V reference voltage and signal voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*" in this ection.

3 Quality air flow sensor 12 V reference voltage and signal voltage check

1) Use the scanning tool to observe DTC information, and set the trouble diagnosis code P0560 at the same time.

2) Turn OFF the ignition switch.

3) Disconnect the MAF/IAT sensor harness connector (E107).

Refer to "*Engine Control*".

4) Turn ON the ignition switch.

5) Observe the MAF Sensor (Mass Air Flow) parameter on the scan tool.

Value: 0.1 V

The reading is more than the specified value.

⇒Proceed to 5. Inspection for short to power supply in MAF sensor signal circuit

The reading is less than or equal to the specified value and DTC P0560 is set.

Go to DTC P0560 diagnosis.

Refer to "DTC P0560 (Flash code 155) System Voltage ".

The reading is less than or equal to the specified value and DTC P0560 is not set.

⇒Proceed to 4. MAF sensor low reference circuit inspection using test lamp

4. MAF sensor low reference circuit inspection using test lamp

1) Connect a test lamp between the MAF sensor low reference circuit (pin 2 of E107) and the battery power supply. Does the test lamp illuminate?

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. MAF/IAT sensor harness connector inspection

No

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⇒Proceed to 6. Inspection for open circuit in MAF sensor low reference circuit

5. Inspection for short to power supply in MAF sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 9 of FL558) and the MAF sensor (pin 3 of E107) for the following conditions.Is the result normal?

● Short to the power supply circuit

● Short to the 12 V reference circuit

● Short to the 5 V reference circuit

Note:

● The MAF sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

6. Inspection for open circuit in MAF sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 16 of FL559) and the MAF sensor (pin 2 of E107) for an open circuit or high resistance. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 8. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

7. MAF/IAT sensor harness connector inspection

1) Inspect for poor connections at the MAF/IAT sensor harness connector (pin 2 of E107). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the MAF sensor..

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor installation*".

⇒Proceed to 10. Repair verification

No

Repair the connection as necessary..

⇒Proceed to 10. Repair verification

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8. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 16 of FL559). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the connection as necessary..

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0112(Flash Code 22) Intake Air Temperature Sensor Circuit Low

1. DTC P0112(Flash Code 22) Intake Air Temperature Sensor Circuit Low DTC information

1. DTC P0112 description

The IAT sensor is installed between the air cleaner and the turbocharger and is integrated with the MAF sensor. The IAT sensor is a variable resistor and measures the temperature of the air flowing into the engine. This sensor has a signal circuit and a low reference circuit. The ECM supplies 5 V to the signal circuit and grounds to the low reference circuit. The IAT sensor resistance is high at a low temperature. As the air temperature rises, the sensor resistance decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P0112

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that the IAT sensor signal voltage is 0.1 V or less for approximately 3 seconds.

3. Action taken when DTC P0112 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default IAT value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0112

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. *Engine Control*

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”.

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation – Circuit Diagram* " in this section.

4. DTC P0112(Flash Code 22) Intake Air Temperature Sensor Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 3. IAT sensor signal output voltage check

3. IAT sensor signal output voltage check

1) Observe the Intake Air Temperature Sensor parameter on the scan tool. Is the Intake Air Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 4. IAT sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. IAT sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the MAF/IAT sensor harness connector (E107).

Refer to “Engine Control”.

3) Turn ON the ignition switch.

4) Observe the Intake Air Temperature Sensor parameter on the scan tool. Is the Intake Air Temperature Sensor parameter more than or equal to the specified value?

Value: 4.8 V

Yes

Replace the MAF sensor..

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor installation*".

⇒Proceed to 8. Repair verification

No

⇒Proceed to 5. Inspection for short to ground in IAT sensor signal circuit

5. Inspection for short to ground in IAT sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 11 of FL558) and the IAT sensor (pin 4 of E107) for the following conditions. Is the result normal?

● Short to ground

● Short to the low reference circuit

Refer to “*Engine Control*”.

Yes

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⇒Proceed to 6. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 8. Repair verification

6. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 11 and 12 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 7. ECM replacement

No

Repair the connection as necessary..

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

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1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0113 (Flash Code 22) Intake Air Temperature Sensor Circuit High

1. DTC P0113 (Flash Code 22) Intake Air Temperature Sensor Circuit High DTC information

1. DTC P0113 description

The IAT sensor is installed between the air cleaner and the turbocharger and is integrated with the MAF sensor. The IAT sensor is a variable resistor and measures the temperature of the air flowing into the engine. This sensor has a signal circuit and a low reference circuit. The ECM supplies 5 V to the signal circuit and grounds to the low reference circuit. The IAT sensor resistance is high at a low temperature. As the air temperature rises, the sensor resistance decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P0113

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine run time is 3 minutes or more.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that the engine coolant temperature sensor signal voltage is 4.8 V or more for approximately 3 seconds.

3. Action taken when DTC P0113 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default IAT value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0113

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0113 (Flash Code 22) Intake Air Temperature Sensor Circuit High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 3. IAT sensor signal output voltage check

3. IAT sensor signal output voltage check

1) Observe the Intake Air Temperature Sensor parameter on the scan tool. Is the Intake Air Temperature Sensor parameter more than or equal to the specified value?

Value: 4.8 V

Yes

⇒Proceed to 4. IAT sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. IAT sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the MAF/IAT sensor harness connector (E107).

3) Turn ON the ignition switch.

4) Measure the voltage between the IAT sensor signal circuit (pin 4 of E107) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “Engine Control”.

Value: 5.5 V

Yes

⇒Proceed to 5. Inspection for short to power supply in IAT sensor signal circuit

No

⇒Proceed to 6. IAT sensor low reference circuit inspection using fused jumper wire

5. Inspection for short to power supply in IAT sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 11 of FL558) and the IAT sensor (pin 4 of E107) for the following conditions. Is the result normal?

● Short to the power supply circuit

● Short to the 12 V reference circuit

Note:

● The IAT sensor may be damaged if the sensor signal circuit is shorted to the power supply.

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Refer to “*Engine Control*”.

Yes

⇒Proceed to 13. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

6. Use a fused jumper to check the low voltage reference circuit of the intake air temperature sensor

1) Connect a jumper wire with fuse between the intake air temperature sensor signal circuit and the low reference circuit (pins 4 and 5 of E107).

Refer to “*Engine Control*”.

2) Observe the Intake Air Temperature Sensor parameter on the scan tool. Is the Intake Air Temperature Sensor parameter more than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 10. Inspection for short to 5 V reference in IAT sensor signal circuit

No

⇒Proceed to 7. IAT sensor signal output voltage check using fused jumper wire

7. IAT sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the IAT sensor signal circuit (pin 4 of E107) and the frame ground.

Refer to “Engine Control”.

2) Observe the Intake Air Temperature Sensor parameter on the scan tool. Is the Intake Air Temperature Sensor parameter more than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 9. Inspection for open circuit in IAT sensor low reference circuit

No

⇒Proceed to 8. Inspection for open circuit in IAT sensor signal circuit

8. Inspection for open circuit in IAT sensor signal circuit

1) Check that the signal circuit between the engine control module (pin 11 of FL558) and intake air temperature sensor (pin 4 of E107) is open or of high resistance. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

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9. Inspection for open circuit in IAT sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 12 of FL558) and the IAT sensor (pin 4 of E107) for an open circuit or high resistance. Is the result normal?

Refer to “*Engine Control*”.

Caution:

● The IAT sensor shares the low reference circuit with other sensors. A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

10. Inspection for short to 5 V reference in IAT sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 11 of FL558) and the IAT sensor (pin 4 of E107) for a short to the 5 V reference circuit. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 11. IAT sensor harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

11. IAT sensor harness connector inspection

1) Inspect for poor connections at the IAT sensor harness connector (pins 4 and 5 of E107). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the MAF sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor removal* ".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor installation*".

⇒Proceed to 14. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

12. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 11 and 12 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

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⇒Proceed to 13. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

13. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance

1. DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance DTC information

1. DTC P0116 description

The engine coolant temperature sensor is installed in the thermostat housing. The engine coolant temperature sensor is a variable resistor and measures the temperature of the engine coolant. If the ECM detects that the difference of the engine coolant temperature is less than the calculated range under the predetermined conditions, the DTC is set. The ECM diagnoses this DTC 1 time only per 1 ignition cycle.

2. Condition for setting DTC P0116

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The vehicle run time is more than 5 minutes with a vehicle speed of 4 km/h or more.

● The engine speed is 1000 rpm or more and the engine run time is more than 5 minutes.

● The accumulated fuel injection quantity since engine start-up is more than the threshold.

● DTCs P0117, P0118, P0201, P0202, P0203, P0204, P0205, P0206, P0500, P0502, P0503, P060B, P0697, P1261, P1262, P2146, and P2149 are not set.

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P0201 (Flash Code 271) Injector Circuit Open - Cylinder 1*".

Refer to "*DTC P0202 (Flash Code 272) Injector Circuit Open - Cylinder 2*".

Refer to "*DTC P0203 (Flash Code 273) Injector Circuit Open - Cylinder 3*".

Refer to "*DTC P0204 (Flash Code 274) Injector Circuit Open - Cylinder 4*".

Refer to "*DTC P0205 (Flash Code 275) Injector Circuit Open - Cylinder 5*".

Refer to "*DTC P0206 (Flash Code 276) Injector Circuit Open - Cylinder 6*".

Refer to "*DTC P0500 (Flash code 25) Vehicle Speed Sensor*".

Refer to "*DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input*".

Refer to "*DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1*".

Refer to "*DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2*".

Refer to "*DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit*".

Refer to "*DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit*".

Condition for setting the DTC

● The ECM detects that the difference between the maximum and minimum engine coolant temperatures is less than 0.2 - 12℃ {0.4 - 22℉}.

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3. Action taken when DTC P0116 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0116

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance diagnosis.

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Engine coolant system inspection

1) Inspect the engine cooling system for the following conditions. Is the result normal?

● Improper engine coolant level

● Engine coolant leakage

Yes

⇒Proceed to 3. Individual harness connector inspection

No

Repair or replace if necessary.

⇒Proceed to 5. Repair verification

3. Individual harness connector inspection

1) Inspect for poor connections at the engine coolant temperature sensor harness connector (pins 1 and 2 of E102). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 20 and 33 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 4. Engine coolant temperature sensor circuit inspection

No

Repair the connection as necessary.

⇒Proceed to 5. Repair verification

4. Engine coolant temperature sensor circuit inspection

1) Inspect for high resistance in the circuit between the ECM (pins 20 and 33 of E82) and the engine coolant temperature sensor (pins 1 and 2 of E102). Is the result normal?

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Refer to “*Engine Control*”.

Yes

Replace the engine coolant temperature sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor installation*".

⇒Proceed to 5. Repair verification

No

Repair the circuit as necessary.

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) While observing the Coolant Temperature parameter on the scan tool, start the engine and wait until it is completely warmed up. Is the Coolant Temperature parameter within the specified range?

Value: 50 to 80℃{122 to176℉}

Yes

Observe the DTC information with a scan tool.

No

⇒Proceed to 2. Engine coolant system inspection

POWERSTAR

DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low

1. DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low DTC information

1. DTC P0117 description

The engine coolant temperature sensor is installed in the thermostat housing. The engine coolant temperature sensor is a variable resistor and measures the temperature of the engine coolant. This sensor has a signal circuit and a low reference circuit. The ECM supplies 5 V to the signal circuit, and the low reference circuit connects to ground. The engine coolant temperature sensor resistance is high at a low temperature. As the engine coolant temperature increases, the sensor resistance decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P0117

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the engine coolant temperature sensor signal voltage is 0.1 V or less for approximately 3 seconds.

3. Action taken when DTC P0117 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default coolant temperature value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0117

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”.

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 3. Engine coolant temperature sensor signal voltage check

3. Engine coolant temperature sensor signal voltage check

1) Observe the Engine Coolant Temperature Sensor parameter on the scan tool. Is the Engine Coolant Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 4. Engine coolant temperature sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Engine coolant temperature sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the engine coolant temperature sensor harness connector (E102).

Refer to “Engine Control”.

3) Turn ON the ignition switch.

4) Observe the Engine Coolant Temperature Sensor parameter on the scan tool. Is the Engine Coolant Temperature Sensor parameter more than or equal to the specified value?

Value: 4.8 V

Yes

Replace the engine coolant temperature sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor installation*".

⇒Proceed to 8. Repair verification

No

⇒Proceed to 5. Inspection for short to ground in engine coolant temperature sensor signal circuit

5. Inspection for short to ground in engine coolant temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 33 of E82) and the engine coolant temperature sensor (pin 2 of E102). Is the result normal?

● Short to ground

● Short to the low reference circuit

Refer to “*Engine Control*”.

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Yes

⇒Proceed to 6. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 8. Repair verification

6. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 20 and 33 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 7. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High

1. DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High DTC information

1. DTC P0118 description

The engine coolant temperature sensor is installed in the thermostat housing. The engine coolant temperature sensor is a variable resistor and measures the temperature of the engine coolant. This sensor has a signal circuit and a low reference circuit. The ECM supplies 5 V to the signal circuit, and the low reference circuit connects to ground. The engine coolant temperature sensor resistance is high at a low temperature. As the engine coolant temperature increases, the sensor resistance decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P0118

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine run time is 5 seconds or more.

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the engine coolant temperature sensor signal voltage is 4.85 V or more for approximately 3 seconds.

3. Action taken when DTC P0118 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default coolant temperature value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0118

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”.

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

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2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 3. Engine coolant temperature sensor signal voltage check

3. Engine coolant temperature sensor signal voltage check

1) Observe the Engine Coolant Temperature Sensor parameter on the scan tool. Is the Engine Coolant Temperature Sensor parameter more than or equal to the specified value?

Value: 4.8 V

Yes

⇒Proceed to 4. Engine coolant temperature sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Engine coolant temperature sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the engine coolant temperature sensor harness connector (E102).

3) Turn ON the ignition switch.

4) Measure the voltage between the engine coolant temperature sensor signal circuit (pin 1 of E102) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “Engine Control”.

Value: 5.5 V

Yes

⇒Proceed to 5. Inspection for short to power supply in engine coolant temperature sensor signal circuit

No

⇒Proceed to 6. Engine coolant temperature sensor low reference circuit inspection using fused jumper wire

5. Inspection for short to power supply in engine coolant temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 33 of E82) and the engine coolant temperature sensor (pin 2 of E102) for a short to the power supply circuit.Is the result normal?

Note:

● The engine coolant temperature sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to “*Engine Control*”.

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Yes

⇒Proceed to 13. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

6. Engine coolant temperature sensor low reference circuit inspection using fused jumper wire

1) Connect a fused jumper wire between the engine coolant temperature sensor signal circuit and the low reference circuit (pins 1 and 2 of E102).

Refer to “*Engine Control*”.

2) Observe the Engine Coolant Temperature Sensor parameter on the scan tool. Is the Engine Coolant Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 10. Inspection for short to 5 V reference in engine coolant temperature sensor signal circuit

No

⇒Proceed to 7. Engine coolant temperature sensor signal output voltage check using fused jumper wire

7. Engine coolant temperature sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the engine coolant temperature sensor signal circuit (pin 1 of E102) and the frame ground.

Refer to “Engine Control”.

2) Observe the Engine Coolant Temperature Sensor parameter on the scan tool. Is the Engine Coolant Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

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Yes

⇒Proceed to 9. Inspection for open circuit in engine coolant temperature sensor low reference circuit

No

⇒Proceed to 8. Inspection for open circuit in engine coolant temperature sensor signal circuit

8. Inspection for open circuit in engine coolant temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 33 of E82) and the engine coolant temperature sensor (pin 2 of E102).Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

9. Inspection for open circuit in engine coolant temperature sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 20 of E82) and the engine coolant temperature sensor (pin 1 of E102) for an open circuit or high resistance.Is the result normal?

Refer to “*Engine Control*”.

Caution:

● The engine coolant temperature sensor shares the low reference circuit with other sensors. A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

10. Inspection for short to 5 V reference in engine coolant temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 33 of E82) and the engine coolant temperature sensor (pin 2 of E102) for a short to the 5 V reference circuit.Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 11. Engine coolant temperature sensor harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

11. Engine coolant temperature sensor harness connector inspection

1) Inspect for poor connections at the engine coolant temperature sensor harness connector (pins 1 and 2 of E102). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the engine coolant temperature sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor installation*".

⇒Proceed to 14. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

12. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 20 and 33 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

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⇒Proceed to 13. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

13. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0182 (Flash code 211) Fuel Temperature Sensor Circuit Low

1. DTC P0182 (Flash code 211) Fuel Temperature Sensor Circuit Low DTC information

1. DTC P0182 description

The fuel temperature sensor is installed to the fuel filter. The fuel temperature sensor is a variable resistor that measures the temperature of the fuel entering the supply pump. This sensor has a signal circuit and a low reference circuit. The ECM supplies 5 V to the signal circuit, and the low reference circuit connects to ground. When the fuel temperature sensor is at low temperature, the resistance of the sensor is high. When the fuel temperature increases, sensor resistance decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P0182

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the fuel temperature sensor signal voltage is 0.1 V or less for approximately 3 seconds.

3. Action taken when DTC P0182 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default fuel temperature value.

4. Condition for clearing DTC P0182

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. *Engine Control*

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0182 (Flash code 211) Fuel Temperature Sensor Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

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3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 3. Fuel temperature sensor signal voltage check

3. Fuel temperature sensor signal voltage check

1) Observe the Fuel Temperature Sensor parameter on the scan tool. Is the Fuel Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 4. Fuel temperature sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Fuel temperature sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the fuel temperature sensor harness connector (E97).

Refer to “*Engine Control*”.

3) Turn ON the ignition switch.

4) Observe the Fuel Temperature Sensor parameter on the scan tool. Is the Fuel Temperature Sensor parameter more than or equal to the specified value?

Value: 4.8 V

Yes

Replace the fuel temperature sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Fuel temperature sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Fuel temperature sensor installation*".

⇒Proceed to 8. Repair verification

No

⇒Proceed to 5. Inspection for short to ground in fuel temperature sensor signal circuit

5. Inspection for short to ground in fuel temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 34 of E82) and the fuel temperature sensor (pin 1 of E97) for the following conditions. Is the result normal?

- Short to ground
- Short to the low reference circuit

Refer to “*Engine Control*”.

Yes

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⇒Proceed to 6. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 8. Repair verification

6. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 20 and 34 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 7. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0183 (Flash code 211) Fuel Temperature Sensor Circuit High

1. DTC P0183 (Flash code 211) Fuel Temperature Sensor Circuit High DTC information

1. DTC P0183 description

The fuel temperature sensor is installed to the fuel filter. The fuel temperature sensor is a variable resistor that measures the temperature of the fuel entering the supply pump. This sensor has a signal circuit and a low reference circuit. The ECM supplies 5 V to the signal circuit, and the low reference circuit connects to ground. When the fuel temperature sensor is at low temperature, the resistance of the sensor is high. When the fuel temperature increases, sensor resistance decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P0183

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine run time is 3 minutes or more.

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the fuel temperature sensor signal voltage is 4.85V or more for approximately 3 seconds.3. Action taken when DTC P0183 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default fuel temperature value.

4. Condition for clearing DTC P0183

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0183 (Flash code 211) Fuel Temperature Sensor Circuit High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 3. Fuel temperature sensor signal voltage check

3. Fuel temperature sensor signal voltage check

1) Observe the Fuel Temperature Sensor parameter on the scan tool. Is the Fuel Temperature Sensor parameter more than or equal to the specified value?

Value: 4.8 V

Yes

⇒Proceed to 4. Fuel temperature sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Fuel temperature sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the fuel temperature sensor harness connector (E97).

3) Turn ON the ignition switch.

4) Measure the voltage between the fuel temperature sensor signal circuit (pin 2 of E97) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

POWERSTAR

Value: 5.5 V

Yes

⇒Proceed to 5. Inspection for short to power supply in fuel temperature sensor signal circuit

No

⇒Proceed to 6. Fuel rail pressure sensor low reference circuit inspection using fused jumper wire

5. Inspection for short to power supply in fuel temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 34 of E82) and the fuel temperature sensor (pin 2 of E97) for a short to the power supply circuit.Is the result normal?

Note:

● The fuel temperature sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to “*Engine Control*”.

Yes

⇒Proceed to 13. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

6. Fuel rail pressure sensor low reference circuit inspection using fused jumper wire

1) Connect a fused jumper wire between the fuel temperature sensor signal circuit and the low reference circuit (pins 1 and 2 of E97).

Refer to “*Engine Control*”.

2) Observe the Fuel Temperature Sensor parameter on the scan tool. Is the Fuel Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 10. Inspection for short to 5 V reference in fuel temperature sensor signal circuit

No

⇒Proceed to 7. Fuel temperature sensor signal output voltage check using fused jumper wire

7. Fuel temperature sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the fuel temperature sensor signal circuit (pin 1 of E97) and the frame ground.

Refer to “*Engine Control*”.

2) Observe the Fuel Temperature Sensor parameter on the scan tool. Is the Fuel Temperature Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 9. Inspection for open circuit in fuel temperature sensor low reference circuit

No

⇒Proceed to 8. Inspection for open circuit in fuel temperature sensor signal circuit

8. Inspection for open circuit in fuel temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 34 of E82) and the fuel temperature sensor (pin 2 of E97) for an open circuit or high resistance.

Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

9. Inspection for open circuit in fuel temperature sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 20 of E82) and the fuel temperature sensor (pin 1 of E97) for an open circuit or high resistance.

Is the result normal?

Refer to “*Engine Control*”.

Caution:

● The fuel temperature sensor shares the low reference circuit with other sensors. A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

10. Inspection for short to 5 V reference in fuel temperature sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 34 of E82) and the fuel temperature sensor (pin 2 of E97) for a short to the 5 V reference circuit. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 11. Fuel temperature sensor harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

11. Fuel temperature sensor harness connector inspection

1) Inspect for poor connections at the fuel temperature sensor harness connector (pins 1 and 2 of E97). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the fuel temperature sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Fuel temperature sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Fuel temperature sensor installation*".

⇒Proceed to 14. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

12. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 20 and 34 of E82) Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 13. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

POWERSTAR

13. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low

1. DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low DTC information

1. DTC P0192 description

The fuel rail pressure sensor is installed to the fuel rail. The sensor detects the fuel rail pressure and converts the pressure to a voltage signal. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Fuel rail pressure sensor signal circuit

The ECM monitors the fuel rail pressure sensor signal voltage. The signal voltage increases as the fuel rail pressure rises, and it decreases as the pressure declines. The ECM calculates the actual fuel rail pressure from the voltage signals and uses the result in fuel injection control and other control tasks. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P0192

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● DTCs P060B and P0641 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The ECM detects that the fuel rail pressure sensor signal voltage is 0.7 Vor less.

3. Action taken when DTC P0192 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default fuel rail pressure.

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0192

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low diagnosis.

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 3. Fuel rail pressure sensor signal voltage check

3. Fuel rail pressure sensor signal voltage check

1) Observe the Fuel Rail Pressure Sensor parameter on the scan tool. Is the Fuel Rail Pressure Sensor parameter less than or equal to the specified value?

Value: 0.7 V

Yes

⇒Proceed to 4. Fuel rail pressure sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Fuel rail pressure sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the fuel rail pressure sensor harness connector (E42).

Refer to "*Engine Control*".

3) Turn ON the ignition switch.

4) Observe the Fuel Rail Pressure Sensor parameter on the scan tool. Is the Fuel Rail Pressure Sensor parameter more than or equal to the specified value?

Value: 4.5 V

Yes

⇒Proceed to 5. Fuel rail pressure sensor 5 V reference voltage check

No

⇒Proceed to 6. Inspection for short to ground in fuel rail pressure sensor signal circuit

5. Fuel rail pressure sensor 5 V reference voltage check

1) Measure the voltage between the fuel rail pressure sensor 5 V reference circuit (pin 3 of E42) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to "*Engine Control*".

Value: 4.5 V

Yes

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⇒Proceed to 8. Fuel rail pressure sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit in fuel rail pressure sensor 5 V reference circuit

6. Inspection for short to ground in fuel rail pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pins 15 and 26 of E82) and the fuel rail pressure sensor(pin 2 of E42)for the following conditions. Is the result normal?

● Short to ground

● Short to the low reference circuit

Refer to "*Engine Control*".

Yes

⇒Proceed to 10. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit in fuel rail pressure sensor 5 V reference circuit

1) Inspect the 5 V reference circuit between the ECM (pin 30 of E82) and the fuel rail pressure sensor (pin 3 of E42) for an open circuit or high resistance.Is the result normal?

Refer to "*Engine Control*".

Caution:

● The fuel rail pressure sensor shares the 5 V reference circuit with other sensors. A malfunction in the 5 V reference circuit may set DTCs on sensors that share this circuit.

Yes

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⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Fuel rail pressure sensor harness connector inspection

1) Inspect for poor connections at the fuel rail pressure sensor harness connector (pin 3 of E42). Is the connection status normal?

Refer to "*Engine Control*".

Yes

Replace the fuel rail pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 30 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting"*.

Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High

1. DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High DTC information

1. DTC P0193 description

The fuel rail pressure sensor is installed to the fuel rail. The sensor detects the fuel rail pressure and converts the pressure to a voltage signal. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Fuel rail pressure sensor signal circuit

The ECM monitors the fuel rail pressure sensor signal voltage. The signal voltage increases as the fuel rail pressure rises, and it decreases as the pressure declines. The ECM calculates the actual fuel rail pressure from the voltage signals and uses the result in fuel injection control and other control tasks. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P0193

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0641 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The ECM detects that the fuel rail pressure sensor signal voltage is 4.75 Vor more.

3. Action taken when DTC P0193 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default fuel rail pressure.

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0193

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

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4. DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High diagnosis.

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 3. Fuel rail pressure sensor signal voltage check

3. Fuel rail pressure sensor signal voltage check

1) Observe the Fuel Rail Pressure Sensor parameter on the scan tool. Is the Fuel Rail Pressure Sensor parameter more than or equal to the specified value?

Value: 4.75 V

Yes

⇒Proceed to 4. Fuel rail pressure sensor signal output voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

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4. Fuel rail pressure sensor signal output voltage check

1) Turn OFF the ignition switch.

2) Disconnect the fuel rail pressure sensor harness connector (E42).

3) Turn ON the ignition switch.

4) Measure the voltage between the fuel rail pressure sensor signal circuit (pin 2 of E42) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 5.5 V

Yes

⇒Proceed to 10. Inspection for short to power supply in fuel rail pressure sensor signal circuit

No

⇒Proceed to 5. Fuel rail pressure sensor signal output voltage check using test lamp

5. Fuel rail pressure sensor signal output voltage check using test lamp

1) Connect a test lamp between the fuel rail pressure sensor signal circuit (pin 2 of E42) and the frame ground.

2) Measure the voltage between the fuel rail pressure sensor signal circuit (pin 2 of E42) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to "*Engine Control*".

Value: 4.75 V

Yes

⇒Proceed to 9. Inspection for short to 5 V reference in fuel rail pressure sensor signal circuit

No

⇒Proceed to 6. Fuel rail pressure sensor low reference circuit inspection using fused jumper wire

6. Fuel rail pressure sensor low reference circuit inspection using fused jumper wire

1) Connect a fused jumper wire between the fuel rail pressure sensor signal circuit and the low reference circuit (pins 1 and 2 of E42).

Refer to "*Engine Control*".

2) Observe the Fuel Rail Pressure Sensor parameter on the scan tool. Is the Fuel Rail Pressure Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 11. Fuel rail pressure sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit in fuel rail pressure sensor low reference circuit

7. Inspection for open circuit in fuel rail pressure sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 29 of E82) and the fuel rail pressure sensor (pin 1 of E42) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Caution:

● The fuel rail pressure sensor shares the low reference circuit with other sensors. A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 8. Inspection for open circuit in fuel rail pressure sensor signal circuit

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

8. Inspection for open circuit in fuel rail pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pins 15 and 26 of E82) and the fuel rail pressure sensor (pin 2 of E42) for an open circuit or high resistance.

Is the result normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 12. ECM harness connector inspection

No

Repair the circuit as necessary.

POWERSTAR

⇒Proceed to 14. Repair verification

9. Inspection for short to 5 V reference in fuel rail pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pins 15 and 26 of E82) and the fuel rail pressure sensor (pin 2 of E42) for a short to the 5 V reference circuit. Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 13. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

10. Inspection for short to power supply in fuel rail pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pins 15 and 26 of E82) and the fuel rail pressure sensor (pin 2 of E42) for a short to the power supply circuit. Is the result normal?

Note:

● The fuel rail pressure sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to “*Engine Control*”.

Yes

⇒Proceed to 13. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 14. Repair verification

11. Fuel rail pressure sensor harness connector inspection

1) Inspect for poor connections at the fuel rail pressure sensor harness connector (pins 1 and 2 of E42). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the fuel rail pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor installation*".

⇒Proceed to 14. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

12. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 15 and 26 of E82) Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 13. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

13. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0201 (Flash code 271) Injector Circuit Open - Cylinder 1

1. DTC information

1. DTC P0201 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors.

2. Condition for setting DTC P0201

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine speed is 40 rpm or more.

● DTCs P1261 and P2146 are not set.

Refer to "*DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1*".

Refer to "*DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit*".

Condition for setting the DTC

● The ECM detects that there is an open circuit in the injector solenoid circuit.

● The engine control module detects a short circuit to the supply circuit in the injection solenoid control circuit.

3. Action taken when DTC P0201 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0201

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4.Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2.Cylinder No. 1 injector circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Measure the resistance between each injector circuit (F40) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage circuit (pins 18 and 26 of E83)

Refer to “Engine Control”.

Value: 0.5 Ω

4) Measure the resistance between each injector circuit (E83) with a DMM (No. 1 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 1 injector control circuit

(pins 3 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

5) Measure the resistance between each injector circuit (E83) with a DMM (No. 1 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 1 injector control circuit (pin 3 of E83) and the frame ground

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the frame ground

Value: ∞Ω

● Between the cylinder No. 1 injector control circuit (pin 3 of E83) and the injector body

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the injector body

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Value: ∞Ω Room temperature

Refer to “*Engine Control*”.

6) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 1 injector circuit resistance check using fused jumper wire

No

⇒Proceed to 3. Cylinder No. 1 injector inspection

3. Cylinder No. 1 injector inspection

1) Inspect the connection status of the harness connector in the cylinder block (pins 2, 3, and 4 of H179), and repair as necessary.

2) Disconnect the cylinder No. 1 injector harness (E53) .

3) Measure the resistance of the injector terminal (pins 1 and 2 of E53) with a DMM. Is the resistance within the specified range?

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

4) Measure the resistance between the injector terminal (pins 1 and 2 of E71) and the injector body with a DMM. Is the resistance equal to the specified value?

Refer to “Engine Control”.

Value: ∞Ω

5) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 1 injector circuit resistance check using fused jumper wire

No

Replace the cylinder No. 1 injector.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 6. Repair verification

4. Cylinder No. 1 injector circuit resistance check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 1 injector harness (E53) .

4) Connect a fused jumper wire to the cylinder No. 1 injector harness (pins 1 and 2 of E53) .

5) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage circuit (pins 18 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

6) Measure the resistance between each injector circuit (E83) with a DMM (No. 1 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 26 of E83)

Refer to “*Engine Control*”.

Value:0.3 to 1.3 Ω

7) Measure the resistance between each injector circuit (E83) with a DMM (No. 1 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 1 injector control circuit (pin 3 of E83) and the frame ground

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

● Between the cylinder No. 1 injector control circuit (pin 3 of E83) and the injector body

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the injector body

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Refer to “Engine Control”.

8) Are all of the values normal?

Value: ∞Ω

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0202 (Flash code 272) Injector Circuit Open - Cylinder 2

1. DTC information

1. DTC P0202 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors.

2. Condition for setting DTC P0202

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● The engine speed is 40 rpm or more.

● DTCs P1261 and P2146 are not set.

Refer to "*DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1*".

Refer to "*DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit*".

Condition for setting the DTC

● The ECM detects that there is an open circuit in the injector solenoid circuit.

● The engine control module detects a short circuit to the supply circuit in the injection solenoid control circuit.

3. Action taken when DTC P0202 sets

The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0202

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation – Circuit Diagram* " in this section.

4.Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Cylinder No. 2 injector circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

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3) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage circuit (pins 18 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

4) Measure the resistance between each injector circuit (E83) with a DMM (No. 2 injector internal resistance check). Is it within the specified range?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

5) Measure the resistance between each injector circuit (E83) with a DMM (No. 2 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 2 injector control circuit (pin 1 of E83) and the frame ground

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Value: ∞Ω

● Between the cylinder No. 2 injector control circuit (pin 1 of E83) and the injector body

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the injector body

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Value: ∞Ω Room temperature

Refer to “*Engine Control*”.

6) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 2 injector circuit resistance check using fused jumper wire

No

⇒Proceed to 3. Cylinder No. 2 injector check

3.Cylinder No. 2 injector check

1) Inspect the connection status of the harness connector in the cylinder block (pins 3, 4, and 7 of H179), and repair as necessary.

2) Disconnect the cylinder No. 2 injector harness (E54) .

3) Measure the resistance of the injector terminal (pins 1 和 and 2 of E54) with a DMM. Is the resistance within the specified range?

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

4) Measure the resistance between the injector terminal (pins 1 and 2 of E54) and the injector body with a

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DMM. Is the resistance equal to the specified value?

Refer to “*Engine Control*”.

Value: ∞Ω

5) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 2 injector circuit resistance check using fused jumper wire

No

Replace the cylinder No. 2 injector.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 6. Repair verification

4. Cylinder No. 2 injector circuit resistance check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 2 injector harness (E54) .

4) Connect a fused jumper wire to the cylinder No. 2 injector harness (pins 1 and 2 of E54).

5) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage circuit (pins 18 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

6) Measure the resistance between each injector circuit (E83) with a DMM (No. 2 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

7) Measure the resistance between each injector circuit (E83) with a DMM (No. 2 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 2 injector control circuit (pin 1 of E83) and the frame ground

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

● Between the cylinder No. 2 injector control circuit (pin 1 of E83) and the injector body

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the injector body

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Refer to “*Engine Control*”.

Value: ∞Ω

8) Are all of the values normal?

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0203 (Flash code 273) Injector Circuit Open - Cylinder 3

1. DTC information

1. DTC P0203 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors. Injector operation is mainly divided into two steps: First, the voltage applied to the injector, the second is the voltage injected by the injector signal to the *ECM*, the signal controlled by the engine control module.

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● The engine speed is 40 rpm or more.

● DTCs P1261 and P2146 are not set.

Refer to "*DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1*".

Refer to "*DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit*".

Condition for setting the DTC

● The ECM detects that there is an open circuit in the injector solenoid circuit.

● The engine control module detects a short circuit to the supply circuit in the injection solenoid control circuit.

3. Action taken when DTC P0203 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0203

● Condition for clearing t

2. Condition for setting DTC P0203

he MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Cylinder No. 3 injector circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage

circuit (pins 18 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

4) Measure the resistance between each injector circuit (E83) with a DMM (No. 3 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 26 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

5) Measure the resistance between each injector circuit (E83) with a DMM (No. 3 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 3 injector control circuit (pin 2 of E83) and the frame ground

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Value: ∞Ω

● Between the cylinder No. 3 injector control circuit (pin 2 of E83) and the injector body

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the injector body

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Value: ∞Ω Room temperature

Refer to “*Engine Control*”.

6) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 3 injector circuit resistance check using fused jumper wire

No

⇒Proceed to 3.Cylinder No. 3 injector inspection

3. Cylinder No. 3 injector inspection

1) Inspect the connection status of the harness connector in the cylinder block (pins 3, 4, and 6 of H179), and repair as necessary.

2) Disconnect the cylinder No. 3 injector harness (E55) .

3) Measure the resistance of the injector terminal (pins 1 and 2 of E55) with a DMM. Is the resistance within the specified range?

Refer to "*Engine Control*".

Value: 0.3 to 1.3 Ω

4) Measure the resistance between the injector terminal (pins 1 and 2 of E55) and the injector body with a DMM. Is the resistance equal to the specified value?

Refer to "*Engine Control*".

Value: ∞Ω

5) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 3 injector circuit resistance check using fused jumper wire

No

Replace the cylinder No. 3 injector.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 6. Repair verification

4. Cylinder No. 3 injector circuit resistance check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 3 injector harness (E55) .

4) Connect a fused jumper wire to the cylinder No. 3 injector harnesses (pins 1 and 2 of E55).

5) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage circuit (pins 18 and 26 of E83)

Refer to "*Engine Control*".

Value: 0.5 Ω

6) Measure the resistance between each injector circuit (E83) with a DMM (No. 3 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 26 of E83)

Refer to "*Engine Control*".

Value: 0.3 to 1.3 Ω

7) Measure the resistance between each injector circuit (E83) with a DMM (No. 3 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 3 injector control circuit (pin 2 of E83) and the frame ground

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

● Between the cylinder No. 3 injector control circuit (pin 2 of E83) and the injector body

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the injector body

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Refer to “*Engine Control*”.

Value: ∞Ω

8) Are all of the values normal?

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0204 (Flash code 274) Injector Circuit Open - Cylinder 4

1. DTC information

1. DTC P0204 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors. Injector operation is mainly divided into two steps: First, the voltage applied to the injector, the second is the voltage injected by the injector signal to the *ECM*, the signal controlled by the engine control module.

2. Condition for setting DTC P0204

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine speed is 40 rpm or more.

● DTCs P1262 and P2149 are not set.

Refer to "*DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2*".

Refer to "*DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit*".

Condition for setting the DTC

The ECM detects that there is an open circuit in the injector solenoid circuit.

● The engine control module detects a short circuit to the supply circuit in the injection solenoid control circuit.

3. Action taken when DTC P0204 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0204

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram* " in this section.

4.Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Cylinder No. 4 injector circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage circuit (pins 8 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

4) Measure the resistance between each injector circuit (E83) with a DMM (No. 4 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

5) Measure the resistance between each injector circuit (E83) with a DMM (No. 4 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 4 injector control circuit (pin 6 of E83) and the frame ground

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

Value: ∞Ω

● Between the cylinder No. 4 injector control circuit (pin 6 of E83) and the injector body

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the injector body

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the injector body

Value: ∞Ω Room temperature

Refer to “*Engine Control*”.

6) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 4 injector circuit resistance check using fused jumper wire

No

⇒Proceed to 3. Cylinder No. 4 injector inspection

3. Cylinder No. 4 injector inspection

1) Inspect the connection status of the harness connector in the cylinder block (pins 2, 3, and 4 of H180) , and repair as necessary.

2) Disconnect the cylinder No. 4 injector harness (E56) .

3) Measure the resistance of the injector terminal (pins 1 and 2 of E56) with a DMM. Is the resistance within the specified range?

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

4) Measure the resistance between the injector terminal (pins 1 and 2 of E56) and the injector body with a DMM. Is the resistance equal to the specified value?

Refer to “*Engine Control*”.

Value: ∞Ω

5) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 4 injector circuit resistance check using fused jumper wire

No

Replace the cylinder No. 4 injector.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 6. Repair verification

4. Cylinder No. 4 injector circuit resistance check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83).

3) Disconnect the cylinder No. 4 injector harness (E56).

4) Connect a fused jumper wire to the cylinder No. 4 injector harness (pins 1 and 2 of E56).

5) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage circuit (pins 8 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

6) Measure the resistance between each injector circuit (E83) with a DMM (No. 4 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

7) Measure the resistance between each injector circuit (E83) with a DMM (No. 4 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 4 injector control circuit (pin 6 of E83) and the frame ground

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● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

● Between the cylinder No. 4 injector control circuit (pin 6 of E83) and the injector body

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the injector body

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the injector body

Refer to “*Engine Control*”.

Value: ∞Ω

8) Are all of the values normal?

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0205 (Flash code 275) Injector Circuit Open - Cylinder 5

1. DTC information

1. DTC P0205 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors. Injector operation is mainly divided into two steps: First, the voltage applied to the injector, the second is the voltage injected by the injector signal to the *ECM*, the signal controlled by the engine control module.

2. Condition for setting DTC P0205

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● The engine speed is 40 rpm or more.

● DTCs P1262 and P2149 are not set.

Refer to "*DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2*".

Refer to "*DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit*".

Condition for setting the DTC

● The ECM detects that there is an open circuit in the injector solenoid circuit.

● The engine control module detects a short circuit to the supply circuit in the injection solenoid control circuit.

3. Action taken when DTC P0205 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0205

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Cylinder No. 5 injector circuit resistance check

1) Turn OFF the ignition switch.

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2) Disconnect the ECM harness connector (E83) .

3) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage

circuit (pins 8 and 9 of E83)

Refer to "*Engine Control*".

Value: 0.5 Ω

4) Measure the resistance between each injector circuit (E83) with a DMM (No. 5 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 9 of E83)

Refer to "*Engine Control*".

Value: 0.3 to 1.3 Ω

5) Measure the resistance between each injector circuit (E83) with a DMM (No. 5 injector body insulation check). Is the

● Between the cylinder No. 5 injector control circuit (pin 4 of E83) and the frame ground

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

Value: ∞ Ω

● Between the cylinder No. 5 injector control circuit (pin 4 of E83) and the injector body

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the injector body

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the injector body

Value: ∞ Ω Room temperature

Refer to "*Engine Control*".

6) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 5 injector circuit resistance check using fused jumper wire

No

⇒Proceed to 3. Cylinder No. 5 injector inspection

3. Cylinder No. 5 injector inspection

1) Inspect the connection status of the harness connector in the cylinder block (pins 3, 4, and 7 of H180), and repair as

2) Disconnect the cylinder No. 5 injector harness (E57) .

3) Measure the resistance of the injector terminal (pins 1 and 2 of E57) with a DMM. Is the resistance within the specified

Refer to "*Engine Control*".

Value: 0.3 to 1.3 Ω

4) Measure the resistance between the injector terminal (pins 1 and 2 of E57) and the injector body with a DMM. Is the resistance equal to the specified value?

Refer to “*Engine Control*”.

Value: ∞ Ω

5) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 5 injector circuit resistance check using fused jumper wire

No

Replace the cylinder No. 5 injector.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 6. Repair verification

4. Cylinder No. 5 injector circuit resistance check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 5 injector harness (E57) .

4) Connect a fused jumper wire to the cylinder No. 5 injector harness (pins 1 and 2 of E57).

5) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage circuit (pins 8 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

6) Measure the resistance between each injector circuit (E83) with a DMM (No. 5 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

7) Measure the resistance between each injector circuit (E83) with a DMM (No. 5 injector body insulation check). Is the

● Between the cylinder No. 5 injector control circuit (pin 4 of E83) and the frame ground

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

● Between the cylinder No. 5 injector control circuit (pin 4 of E83) and the injector body

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the injector body

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the injector body

Refer to “*Engine Control*”.

Value: ∞ Ω

8) Are all of the values normal?

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0206 (Flash code 276) Injector Circuit Open - Cylinder 6

1. DTC information

1. DTC P0206 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors. Injector operation is mainly divided into two steps: First, the voltage applied to the injector, the second is the voltage injected by the injector signal to the *ECM*, the signal controlled by the engine control module.

2. Condition for setting DTC P0206

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● The engine speed is 40 rpm or more.

● DTCs P1262 and P2149 are not set.

Refer to "*DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2*".

Refer to *"DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit*".

Condition for setting the DTC

● The ECM detects that there is an open circuit in the injector solenoid circuit.

● The ECM detects a short circuit to the supply circuit in the injection solenoid control circuit.

3. Action taken when DTC P0206 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0206

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Cylinder No. 6 injector circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage). Is the resistance less than or equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage circuit (pins 8 and 9 of E83)

Refer to "*Engine Control*".

Value: 0.5 Ω

4) Measure the resistance between each injector circuit (E83) with a DMM (No. 6 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 9 of E83)

Refer to "*Engine Control*".

Value: 0.3 to 1.3 Ω

5) Measure the resistance between each injector circuit (E83) with a DMM (No. 6 injector body insulation check). Is the resistance equal to the specified range?

● Between the cylinder No. 6 injector control circuit (pin 5 of E83) and the frame ground

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

Value: ∞ Ω

● Between the cylinder No. 6 injector control circuit (pin 5 of E83) and the injector body

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the injector body

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the injector body

Value: ∞ Ω Room temperature

Refer to "*Engine Control*".

6) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 6 injector circuit resistance check using fused jumper wire

No

⇒Proceed to 3. Cylinder No. 6 injector inspection

3. Cylinder No. 6 injector inspection

1) Inspect the connection status of the harness connector in the cylinder block (pins 3, 4, and 6 of H180), and repair as necessary.

2) Disconnect the cylinder No. 6 injector harness (E58) .

3) Measure the resistance of the injector terminal (pins 1 and 2 of E58) with a DMM. Is the resistance within the specified range?

Refer to "*Engine Control*".

Value: 0.3 to 1.3 Ω

4) Measure the resistance between the injector terminal (pins 1 and 2 of E58) and the injector body with a

DMM. Is the resistance equal to the specified value?

Refer to “*Engine Control*”.

Value: ∞ Ω

5) Are all of the values normal?

Yes

⇒Proceed to 4. Cylinder No. 6 injector circuit resistance check using fused jumper wire

No

Replace the cylinder No. 6 injector.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 6. Repair verification

4. Cylinder No. 6 injector circuit resistance check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 6 injector harness (E58) .

4) Connect a fused jumper wire to the cylinder No. 6 injector harness (pins 1 and 2 of E58).

5) Measure the resistance between each injector circuit (E83) with a DMM (Check for open circuit in charge voltage). Is the resistance less than or equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage circuit (pins 8 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

6) Measure the resistance between each injector circuit (E83) with a DMM (No. 6 injector internal resistance check). Is the resistance within the specified range?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.3 to 1.3 Ω

7) Measure the resistance between each injector circuit (E83) with a DMM (No. 6 injector body insulation check). Is the resistance equal to the specified value?

● Between the cylinder No. 6 injector control circuit (pin 5 of E83) and the frame ground

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

● Between the cylinder No. 6 injector control circuit (pin 5 of E83) and the injector body

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● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the injector body

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the injector body

Refer to “*Engine Control*”.

Value: ∞ Ω

8) Are all of the values normal?

Yes

⇒Proceed to 5. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0217 (Flash code 542) Engine Coolant Over Temperature Condition

1. DTC P0217 (Flash code 542) Engine Coolant Over Temperature Condition DTC information

1. DTC P0217 description

The engine coolant temperature sensor is a variable resistor and measures the temperature of the engine coolant. If the ECM detects an excessively high coolant temperature, the DTC is set.

2. Condition for setting DTC P0217

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● DTCs P0116, P0117, P0118, P060B, and P0697 are not set.

Refer to "*DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance*".

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the engine coolant temperature is 111℃ {232℉} or more for 5 seconds.

3. Action taken when DTC P0217 sets

● The ECM does not illuminate the MIL or SVS lamp. Refer to Action taken when DTC sets - Type D.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0217

● Condition for clearing the DTC - Refer to Type D.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0217 (Flash code 542) Engine Coolant Over Temperature Condition diagnosis.

Note:

● After starting the engine, the engine coolant temperature rises to 80 - 85℃ {176 - 185℉} then stabilizes when the thermostat opens.

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

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4) Observe the DTC information with a scan tool.Is DTC P0117 set at the same time?

Yes

Go to DTC P0117 diagnosis.

Refer to "DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low".

No

⇒Proceed to 3. Engine cooling system inspection

3. Engine cooling system inspection

1) Inspect the engine cooling system for the following conditions.

Is the result normal?

● Insufficient coolant level

● Coolant leakage

Refer to "*1. ENGINE 1D. COOLING (6WG1) COOLANT CHECK*".

● Cooling fan belt slip

Refer to "*1. Engine 1D. Cooling (6WG1) Cooling Fan Check*".

● Cooling fan clutch malfunction

Refer to "*1. Engine 1D. Cooling (6WG1) Cooling Fan Clutch Check*".

● Thermostat malfunction

Refer to "*1. Engine 1D. Cooling (6WG1) Thermostat Check*".

● Water pump malfunction

Refer to "*1. Engine 1D. Cooling (6WG1) Pump Check*".

● Radiator clogging

Refer to "*1. Engine 1D. Cooling (6WG1) Radiator Check*".

Yes

⇒Proceed to 4. Coolant temperature check

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

4. Coolant temperature check

1) While observing the Coolant Temperature parameter on the scan tool, start the engine and wait until it is completely warmed up. Is the Coolant Temperature parameter on the scan tool more than or equal to the specified value?

Value: 108℃{226℉}

Yes

⇒Proceed to 5. Engine coolant temperature sensor inspection

No

Ask the driver if the overheat occurred due to low engine coolant level, etc.

If an engine overheat has occurred in the past, make sure to inspect the engine, and repair as necessary.

⇒Proceed to 6. Repair verification

5. Engine coolant temperature sensor inspection

1) Test the engine coolant temperature sensor at various temperatures, and evaluate the possibility of sensor malfunction. Is the result normal?

Yes

Refer to the corresponding table to test the engine coolant temperature sensor at different temperatures and evaluate the possibility of a sensor malfunction.

Sensor failure may reduce drivability.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1)Engine coolant temperature sensor Inspection*".

⇒Proceed to 6. Repair verification

No

Replace the engine coolant temperature sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Engine coolant temperature sensor installation*".

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) While observing the Coolant Temperature parameter on the scan tool, start the engine and wait until it is completely warmed up. Is the Coolant Temperature parameter on the scan tool more than or equal to the specified value?

Value: 108℃{ 226℉}

Yes

⇒Proceed to 2. Prioritized DTC check

No

Observe the DTC information with a scan tool.

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DTC P0219 (Flash code 543) Engine Overspeed Condition

1. DTC P0219 (Flash code 543) Engine Overspeed Condition DTC information

1. DTC P0219 description

The CKP sensor is installed to the flywheel housing. The ECM calculates the engine speed and accurate crankshaft position based on the signal pulse from the CKP sensor. If the ECM detects that the engine is in a state of overrun, the DTC is set.

2. Condition for setting DTC P0219

Condition for setting the DTC

● The ECM detects that the engine speed is 2,366 rpm or more.

3. Action taken when DTC P0219 sets

● The ECM does not illuminate the MIL or SVS lamp. Refer to Action taken when DTC sets - Type D.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0219

● Condition for clearing the DTC - Refer to Type D.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0219 (Flash code 543) Engine Overspeed Condition diagnostics

Note:

● If there is electromagnetic interference in the CKP sensor circuit, this DTC may be set.

Caution:

● This DTC is set by an engine overrun condition due to driver error, for example, downshifting of a manual transmission on a steep downhill slope.

Engine overrun may damage internal engine components.

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0335 or P0336 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

No

⇒Proceed to 3. Engine speed verification

3. Engine speed verification

1) Connect the scan tool.

2) Start the engine.

3) While raising the engine speed as necessary, observe the Engine Speed parameter on the scan tool. Is the Engine Speed parameter more than or equal to the specified value?

Value: 2,366 rpm

Yes

⇒Proceed to 4. CKP sensor inspection

No

Ask the driver if the overrun was caused by gear slip-out, shift error, down-slope driving, etc. If an engine overrun has occurred in the past, be sure to inspect the engine, and repair as necessary.

⇒Proceed to 5. Repair verification

4. CKP sensor inspection

1) Inspect the CKP sensor and the sensor rotor for the following conditions.

Is the result normal?

● Damage to the sensor

● Loose or improperly installed sensor

● Excessive gap

● Foreign material passes through the gap between the sensor and the sensor rotor.

● Damage to the sensor rotor

● Loose or improperly installed sensor rotor

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Yes

Replace the CKP sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CKP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CKP sensor installation*".

⇒Proceed to 5. Repair verification

No

Repair or replace if necessary.

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) While observing the Engine Speed parameter on the scan tool, repeatedly depress the accelerator pedal from idle to full throttle to increase the engine speed. Is the Engine Speed parameter more than or equal to the specified value?

Value: 2,366 rpm

Yes

⇒Proceed to 2. Prioritized DTC check

No

Observe the DTC information with a scan tool.

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DTC P0234 (Flash code 42) Turbocharger Overboost Condition

1. DTC P0234 (Flash code 42) Turbocharger Overboost Condition DTC information

1. DTC P0234 description

The boost pressure sensor is installed on the intake duct and detects the pressure in the intake manifold. If the pressure in the intake manifold changes according to the turbocharger conditions, the boost pressure sensor output voltage changes. If the pressure in the intake manifold is low, the output voltage becomes low, and if the pressure is high, the output voltage becomes high. The ECM reads this change in output voltage, converts it to boost pressure, and uses it for control. The boost pressure sensor 5 V reference circuit is shared with the engine coolant temperature sensor, fuel temperature sensor, and EGR position sensor 2.

2. Condition for setting DTC P0234

Condition for running the DTC

● DTCs P0237, P0238, P060B and P0697 are not set.

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance"*.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the supercharger pressure is higher than a predetermined value for a duration of 2 seconds or more.

3. Action taken when DTC P0234 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0234

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation – Circuit Diagram*" in this section.

4. DTC P0234 (Flash code 42) Turbocharger Overboost Condition diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Observe the DTC information with a scan tool.Is DTC P0237, P0238, P0697, P2228, or P2229 set at the same time?

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Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low*".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

No

⇒Proceed to 3. Boost pressure sensor connector inspection

3. Boost pressure sensor connector inspection

1) Inspect for poor connections at the boost pressure sensor connector (pins 1, 2, and 3 of E105). Is the connection status normal?

Refer to “*Engine Control*”.

2) Visually inspect to ensure that the rubber hose is correctly installed and that there are no cracks or clogging. Is the result normal?

3) Are all of the results normal?

Yes

⇒Proceed to 4. Current DTC check

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

4. Current DTC check

1) Observe the DTC information with a scan tool. Is DTC P0234 set?

Yes

⇒Proceed to 5. Boost pressure sensor harness connector inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

5. Boost pressure sensor harness connector inspection

1) Inspect for poor connections at the boost pressure sensor harness connector (pins 1, 2, and 3 of E105). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 6. Boost pressure sensor signal voltage check

No

Repair the connection as necessary.

⇒Proceed to 13. Repair verification

6. Boost pressure sensor signal voltage check

1) Turn ON the ignition switch.

2) Observe the Boost Pressure Sensor parameter on the scan tool. Is the Boost Pressure Sensor parameter within the specified range?

Value: 0.1 to 4.9 V

Yes

⇒Proceed to 9. Turbocharger inspection

No

⇒Proceed to 7. Boost pressure sensor 5 V reference voltage check

7. Boost pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the boost pressure sensor harness connector (E105) .

3) Turn ON the ignition switch.

4) Measure the voltage between the boost pressure sensor 5 V reference circuit (pin 3 of E105) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: about 5 V

Yes

⇒Proceed to 9. Turbocharger inspection

No

⇒Proceed to 8. Inspection for open circuit and short circuit in boost pressure sensor circuit

8. Inspection for open circuit and short circuit in boost pressure sensor circuit

1) Turn OFF the ignition switch.

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2) Disconnect the ECM harness connector (E82) and boost pressure sensor harness connector (E105) .

3) Connect a fused jumper wire between each circuit of the boost pressure sensor harness connector (E105), and measure the resistance between each circuit of the ECM harness connector (E82) with a DMM. Is the resistance equal to the specified value?

● Jumper: Between the signal circuit and the 5 V reference circuit (pins 1 and 3 of E105)

● Measure: Between the signal circuit and the 5 V reference circuit (pins 19 and 31 of E82)

Value: 0.5 Ω (With a jumper wire)

Value: ∞ Ω (Without a jumper wire)

● Jumper: Between the signal circuit and the low reference circuit (pins 1 and 2 of E105)

● Measure: Between the signal circuit and the low reference circuit (pins 20 and 31 of E82)

Value: 0.5 Ω (With a jumper wire)

Value: ∞ Ω (Without a jumper wire)

● Jumper: Between the signal circuit and the low reference circuit (pins 1 and 2 of E105)

● Measure: Between the signal circuit and the low reference circuit (pins 19 and 20 of E82)

Value: 0.5 Ω (With a jumper wire)

Value: ∞ Ω (Without a jumper wire)

Refer to “*Engine Control*”.

Yes

Replace the boost pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor installation.*".

⇒Proceed to 13. Repair verification

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

9. Turbocharger inspection

1) Inspect the turbocharger. Is the result normal?

Refer to "*1.Engine 1F.Induction(6WG1) Turbocharger inspection*".

Yes

⇒Proceed to 10. Air intake system inspection

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

10. Air intake system inspection

1) Air intake system inspection

Is the result normal?

Refer to "*Air intake system inspection*".

Yes

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⇒Proceed to 13. Repair verification

No

⇒Proceed to 11. ECM power supply and ground circuit inspection

11. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Note:

● If DTC P0237 or P0238 is set, first address the DTCs that are set.

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High*".

Yes

⇒Proceed to 12. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 3. Boost pressure sensor connector inspection

12. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 13. Repair verification

13. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low

1. DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low DTC information

1. DTC P0237 description

The boost pressure sensor is installed to the intake duct. The boost pressure sensor changes the signal voltage in accordance with changes in air pressure in the air intake pipe. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Boost pressure sensor signal circuit

The boost pressure sensor transmits the signals related to air pressure changes within the air intake pipe to the ECM. The ECM detects a low signal voltage in low boost pressure, such as when the engine is under low load. The ECM detects a high signal voltage in high boost pressure, such as when the engine is under high load. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P0237

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the boost pressure sensor signal voltage is 0.1 V or less for approximately 3 seconds.

3. Action taken when DTC P0237 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default boost pressure value.

● The ECM inhibits the EGR control.

4. Clear the trouble diagnosis code P0237 situation

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram* " in this section.

4. DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 3. Boost pressure sensor signal voltage check

3. Boost pressure sensor signal voltage check

1) Observe the Boost Pressure Sensor parameter on the scan tool. Is the Boost Pressure Sensor parameter less than or equal to the specified value?

Value: 0.1 V

Yes

⇒Proceed to 4. Boost pressure sensor 5 V reference voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Boost pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the boost pressure sensor harness connector (E105) .

3) Turn ON the ignition switch.

4) Measure the voltage between the boost pressure sensor 5 V reference circuit (pin 3 of E105) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.9 V

Yes

⇒Proceed to 5. Boost pressure sensor signal output voltage check using fused jumper wire

No

⇒Proceed to 6. Inspection for open circuit in boost pressure sensor 5 V reference circuit

5. Boost pressure sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the boost pressure sensor 5 V reference circuit and the signal circuit (pins 1 and 3 of E105).

Refer to “*Engine Control*”.

2) Observe the Boost Pressure Sensor parameter on the scan tool. Is the Boost Pressure Sensor parameter more than or equal to the specified value?

Value: 4.5 V

Yes

⇒Proceed to 8. Boost pressure sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit and short circuit in boost pressure sensor signal circuit

6. Inspection for open circuit in boost pressure sensor 5 V reference circuit

1) Inspect the 5 V reference circuit between the ECM (pin 19 of e82) and the boost pressure sensor (pin 3 of E105) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Caution:

● The boost pressure sensor shares the 5 V reference circuit with other sensors. A malfunction in the 5 V reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit and short circuit in boost pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 31 of E82) and the boost pressure sensor (pin 1 of E105) for the following conditions. Is the result normal?

Is the result normal?

● Open circuit

● Short to ground

● Short to the low reference circuit

● High resistance

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Boost pressure sensor harness connector inspection

1) Inspect for poor connections at the boost pressure sensor harness connector (pins 1 and 3 of E105). Is the connection status normal?

Refer to "*Engine Control*".

Yes

Replace the boost pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor installation*".

POWERSTAR

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 19 and 31 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High

1. DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High DTC information

1. DTC P0238 description

The boost pressure sensor is installed to the intake duct. The boost pressure sensor changes the signal voltage in accordance with changes in air pressure in the air intake pipe. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Boost pressure sensor signal circuit

The boost pressure sensor transmits the signals related to air pressure changes within the air intake pipe to the ECM. The ECM detects a low signal voltage in low boost pressure, such as when the engine is under low load. The ECM detects a high signal voltage in high boost pressure, such as when the engine is under high load. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P0238

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the boost pressure sensor signal voltage is 4.9 V or more for approximately 3 seconds.

3. Action taken when DTC P0238 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default boost pressure value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0238

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram* " in this section.

4. DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Boost pressure sensor signal voltage check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the Boost Pressure Sensor parameter on the scan tool. Is the Boost Pressure Sensor parameter more than or equal to the specified value?

Value: 4.9 V

Yes

⇒Proceed to 3. Boost pressure sensor 5 V reference voltage and signal voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Boost pressure sensor 5 V reference voltage and signal voltage check

1) Observe the DTC information with a scan tool for DTC P0697 being set at the same time.

2) Turn OFF the ignition switch.

3) Disconnect the boost pressure sensor harness connector (E105) .

Refer to "*Engine Control*".

4) Turn ON the ignition switch.

5) Observe the Boost Pressure Sensor parameter on the scan tool.

Value: 0.1 V

The reading is more than the specified value.

⇒Proceed to 5. Inspection for short to power supply in boost pressure sensor signal circuit

The reading is less than or equal to the specified value and DTC P0697 is set.

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

The reading is less than or equal to the specified value and DTC P0697 is not set.

⇒Proceed to 4. Boost pressure sensor low reference circuit inspection using test lamp

4. Boost pressure sensor low reference circuit inspection using test lamp

1) Connect a test lamp between the boost pressure sensor low reference circuit (pin 2 of E105) and the battery power supply. Does the test lamp illuminate?

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. Boost pressure sensor harness connector inspection

No

⇒Proceed to 6. Inspection for open circuit in boost pressure sensor low reference circuit

5. Inspection for short to power supply in boost pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 31 of E82) and the boost pressure sensor (pin 1 of E105) for the following conditions. Is the result normal?

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● Short to the power supply circuit

● Short to the 5 V reference circuit

Note:

● The boost pressure sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

> Go to 10. Repair verification

6. Inspection for open circuit in boost pressure sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 20 of E82) and the boost pressure sensor (pin 2 of E105) for an open circuit or high resistance. Is the result normal?

Is the result normal?

Refer to “*Engine Control*”.

Caution:

● The boost pressure sensor shares the low reference circuit with other sensors.A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 8. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

7. Boost pressure sensor harness connector inspection

1) Inspect for poor connections at the boost pressure sensor harness connector (pin 2 of E105). Is the connection status

Refer to “*Engine Control*”.

Yes

Replace the boost pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor installation.*".

⇒Proceed to 10. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

8. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 20 of E82). Is the connection status normal?

POWERSTAR

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0299 (Flash Code 65) Turbocharger Underboost

1. DTC P0299 (Flash Code 65) Turbocharger Underboost DTC information

1. DTC P0299 description

The boost pressure sensor is located in the air intake pipe. This sensor changes the signal voltage in accordance with changes in air pressure in the air intake pipe. The ECM monitors the boost pressure sensor signal. If the ECM detects an excessively low sensor signal, the DTC is set. This indicates that the boost pressure is excessively low.

2. Condition for setting DTC P0299

Condition for running the DTC

● The ignition switch is on

● The engine speed is 1,200- 1,800 rpm.

● The fuel injection quantity is more than or equal to the predetermined value.

● DTCs P0087, P0088, P0089, P0091, P0092, P0102, P0103, P0116, P0117, P0118, P0192, P0193, P0201, P0202, P0203, P0204, P0205, P0206, P0237, P0238, P0401, P0404, P0409, P0560, P060B, P0641, P0651, P0697, P1062, P1063, P1093, P1261, P1262, P1404, P140B, P140C, P2146, P2149, P2227, P2228, P2229, P2295 and P2296 are not set.

Refer to "*DTC P0087 (Flash Code 225) Fuel Rail/System Pressure - Too Low*".

Refer to "*DTC P0088 (Flash Code 118) Fuel Rail/System Pressure - Too High*".

Refer to "*DTC P0089 (Flash code 151) Fuel Pressure Regulator Performance*".

Refer to "*DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low*".

Refer to "*DTC P0092 (Flash code 217) Fuel Pressure Regulator Control Circuit High*".

Refer to "*DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input*".

Refer to "*DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input*".

Refer to "*DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance*".

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low*".

Refer to "*DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High*".

Refer to "*DTC P0201 (Flash Code 271) Injector Circuit Open - Cylinder 1*".

Refer to "*DTC P0202 (Flash Code 272) Injector Circuit Open - Cylinder 2*".

Refer to "*DTC P0203 (Flash Code 273) Injector Circuit Open - Cylinder 3*".

Refer to "*DTC P0204 (Flash Code 274) Injector Circuit Open - Cylinder 4*".

Refer to "*DTC P0205 (Flash Code 275) Injector Circuit Open - Cylinder 5*".

Refer to "*DTC P0206 (Flash Code 276) Injector Circuit Open - Cylinder 6*".

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High*".

Refer to "*DTC P0401 (Flash code 93) EGR Flow Insufficient Detected*".

Refer to "*DTC P0404 (Flash code 45) EGR Control Circuit Range/ Performance*".

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Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit*".

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P1062 (Flash Code 257) Fuel Pressure Regulator 1 Solenoid Control Circuit*".

Refer to "*DTC P1063 (Flash Code 258) Fuel Pressure Regulator 2 Solenoid Control Circuit*".

Refer to "*DTC P1093 (Flash code 227) Fuel Rail Pressure Too Low*".

Refer to "*DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1*".

Refer to "*DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2*".

Refer to "*DTC P1404 (Flash code 45) EGR Position Fault* ".

Refer to "*DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance*".

Refer to "*DTC P140C (Flash Code 345) EGR 2 Closed Position Performance*".

Refer to "*DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit*".

Refer to "*DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit*".

Refer to "*DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low*".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

Refer to "*DTC P2295 (Flash Code 248) Fuel Pressure Regulator 2 Control Circuit Low*".

Refer to "*DTC P2296 (Flash Code 218) Fuel Pressure Regulator 2 Control Circuit High*".

Condition for setting the DTC

● The ECM detects that the boost pressure is lower than a predetermined value for 5 seconds or more.

3. Action taken when DTC P0299 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0299

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0299 (Flash Code 65) Turbocharger Underboost diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

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1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0237, P0238, P2227, P2228, or P2229 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High*".

Refer to "*DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low*".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

No

⇒Proceed to 3. Boost pressure control components inspection

3. Boost pressure control components inspection

1) Inspect for the following conditions that cause a low boost pressure.

Is the result normal?

● Air leakage around the boost pressure sensor or foreign material covering the sensor hole

● Air leakage around the air intake pipe between the turbocharger and the intake manifold. Damaged components and loose clamps

● Biting of the turbine shaft, which causes a decrease in the rotation speed of the turbocharger shaft

Refer to "*1.Engine 1F.Induction(6WG1) Turbocharger inspection*".

● Clogged air cleaner element, collapsing of the intake pipe between the air cleaner and the boost pressure sensor, or a state where flow is restricted

● Oil in the air intake pipe that may cause a boost pressure sensor signal error. If the oil is attached to inside the piping, intercooler, or turbocharger, it is necessary to wipe it off.

Yes

⇒Proceed to 4. Boost pressure and barometric pressure difference check

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

4. Boost pressure and barometric pressure difference check

1) Turn ON the ignition switch.

2) Observe the difference between the Boost Pressure parameter and the Barometric Pressure parameter on the scan tool. Is the difference between the Boost Pressure parameter and the Barometric Pressure parameter more than or equal to the specified value?

Value: 10 kPa { 1.5 psi }

Yes

⇒Proceed to 5. Barometric pressure check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

5. Barometric pressure check

1) Refer to the table and compare the Barometric Pressure parameter on the scan tool with the surrounding barometric pressure. Is the Barometric Pressure parameter within the specified range?

Altitude measured in meters (m)	Altitude measured in feet(ft)	Barometric pressure measured in kilopascals(kPa)
4267	14000	56-64
3962	13000	58-66
3658	12000	61-69
3353	11000	64-72
3048	10000	66-74
2743	9000	69-77
2438	8000	71-79
2134	7000	74-82
1829	6000	77-85
1524	5000	80-88
1219	4000	83-91
914	3000	87-95
610	2000	90-98
305	1000	94-102
0	0(Sea level)	96-104
-305	-1000	101-105

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Yes

⇒Proceed to 6. Boost pressure sensor circuit inspection

No

⇒Proceed to 7. Barometric pressure sensor circuit inspection

6. Boost pressure sensor circuit inspection

1) Inspect for poor connections at the boost pressure sensor harness connector (pins 1 and 3 of E105). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 19 and 31 of E82). Is the connection status normal?

3) Inspect for high resistance in the circuit between the ECM (pins 19 and 31 of E82) and the boost pressure sensor (pins 1 and 3 of E105). Is the result normal?

Is the result normal?

Refer to “Engine Control”.

4) Are all of the results normal?

Yes

Replace the boost pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor installation.*".

⇒Proceed to 8. Repair verification

No

Repair the circuit or the connection as necessary.

⇒Proceed to 8. Repair verification

7. Barometric pressure sensor circuit inspection

1) Inspect for poor connections at the barometric pressure sensor harness connector (pin 1 of FL740). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pin 12 of FL558). Is the connection status normal?

3) Inspect the low reference circuit between the ECM (pin 1 of FL740) and the barometric pressure sensor (pin 12 of FL558) for high resistance. Is the result normal?

Refer to “*Engine Control*”.

4) Are all of the results normal?

Yes

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Replace the barometric pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor installation*".

⇒Proceed to 8. Repair verification

No

Repair the circuit or the connection as necessary.

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit

1. DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit DTC information

1. DTC P0335 description

The CKP sensor detects the engine speed. When the sensing holes installed in the flywheel housing pass the tip of the CKP sensor, this emits voltage, which generates a pulse signal. The ECM reads this pulse signal and determines the engine speed, the injection cylinder, and the injection timing based on the signal.

2. Condition for setting DTC P0335

Condition for running the DTC

● The ignition switch is on.

● The CMP sensor signal pulses are detected.

● DTCs P0016, P0336, P0340 and P0341 are not set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

Condition for setting the DTC

● The ECM detects that the CKP sensor signal pulse is not normal while the engine is running.

3. Action taken when DTC P0335 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

● The ECM module disables VNT control.

● The ECM assumes a default boost pressure value.

4. Condition for clearing DTC P0335

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. CKP sensor installation inspection

1) Inspect the installation status of the CKP sensor. Is the result normal?

Yes

⇒Proceed to 3. Current DTC check

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

3. Current DTC check

1) Check whether the DTC is a past failure with a scan tool. Is DTC P0335 a past failure?

Yes

⇒Proceed to 4. ECM harness connector inspection

No

⇒Proceed to 5. CKP sensor harness connector inspection

4. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 16 and 27 of E82). Is the connection status normal?

Note:

● In the case of a past failure, poor connections or intermittent conditions are suspected in the ECM harness connector.

Refer to "*Engine Control*".

2) Repair the connection as necessary.

Procedure completion

⇒Proceed to 14. Repair verification

5. CKP sensor harness connector inspection

1) Inspect for poor connections at the CKP harness connector (pins 1 and 2 of E45). Is the connection status normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 6. CKP sensor signal circuit resistance check

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

6. CKP sensor signal circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) .

3) Measure the resistance of the CKP sensor signal circuit (pins 16 and 27 of E82) with a DMM (Signal circuit internal resistance check). Is the resistance within the specified range?

Refer to "*Engine Control*".

Value: 109 to 143 Ω

Yes

⇒Proceed to 8. Inspection for open circuit and short circuit in CKP sensor circuit

No

⇒Proceed to 7. CKP sensor inspection

7. CKP sensor inspection

1) Disconnect the CKP sensor harness connector (E45) .

2) Measure the resistance of the CKP sensor connector (E45) (Internal resistance check). Is the resistance within the

● In the CKP sensor signal circuit (pins 1 and 2 of E45)

Refer to "*Engine Control*".

Value: 109 to 143 Ω

3) Measure the resistance of the CKP sensor connector (E45) (Insulation check). Is the resistance equal to the specified value?

● Between the CKP sensor signal circuit (pin 1 of E45) and the frame ground

● Between the CKP sensor signal circuit (pin 2 of E45) and the frame ground

Refer to "*Engine Control*".

Value: ∞ Ω

4) Are all of the values normal?

Yes

⇒Proceed to 8. Inspection for open circuit and short circuit in CKP sensor circuit

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

8. Inspection for open circuit and short circuit in CKP sensor circuit

1) Inspect for an open circuit or a short circuit between the ECM (pins 16, 23, and 27 of E82) and the CKP sensor (pins 1 and 2 of E45). Is the result normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. Engine speed verification using scan tool

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

9. Engine speed verification using scan tool

1) Reconnect all of the disconnected harness connectors.

2) Connect the scan tool.

3) Start and idle the engine.

4) Observe the Desired Idle Speed parameter and the Engine Speed parameter on the scan tool. Are both parameters same?

Yes

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⇒Proceed to 10. Engine speed verification during operation

No

⇒Proceed to 12. ECM power supply and ground circuit inspection

10. Engine speed verification during operation

1) Check whether the engine speed changes. Is the engine speed stable?

Yes

⇒Proceed to 14. Repair verification

No

⇒Proceed to 11. CKP sensor and flywheel inspection

11. CKP sensor and flywheel inspection

1) Visually inspect the CKP sensor and the flywheel for scratches or dirt.Is the result normal?

Yes

⇒Proceed to 12. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

12. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Note:

● If DTC P0016, P0340, or P0341 is set, first address the DTCs that are set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

Yes

⇒Proceed to 13. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 3. Current DTC check

13. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 14. Repair verification

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14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance

1. DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance DTC information

1. DTC P0336 description

The CKP sensor detects the engine speed. When the sensing holes installed in the flywheel housing pass the tip of the CKP sensor, this emits voltage, which generates a pulse signal. The ECM reads this pulse signal and determines the engine speed, the injection cylinder, and the injection timing based on the signal.

2. Condition for setting DTC P0336

Condition for running the DTC

● The CKP sensor signal pulses are detected.

● The engine is running.

● DTCs P0016, P0335, P0340, and P0341 are not set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

Condition for setting the DTC

● During engine operation, the engine control module detected an excessive or transient Crankshaft position sensor signal pulse.

3. Action taken when DTC P0336 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

●The ECM disables VNT control.

● The ECM assumes a default boost pressure value.

4. Condition for clearing DTC P0336

Condition for clearing the MIL / DTC - Refer to Type A.

● Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. CKP sensor installation inspection

1) Inspect the installation status of the CKP sensor. Is the result normal?

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Yes

⇒Proceed to 3. Current DTC check

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

3. Current DTC check

1) Check whether the DTC is a past failure with a scan tool. Is DTC P0336 a past failure?

Yes

⇒Proceed to 4. ECM harness connector inspection

No

⇒Proceed to 5. CKP sensor harness connector inspection

4. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 16 and 27 of E82). Is the connection status normal?

Note:

● In the case of a past failure, poor connections or intermittent conditions are suspected in the ECM harness connector.

Refer to "*Engine Control*".

2) Repair the connection as necessary.

Procedure completion

⇒Proceed to 14. Repair verification

5. CKP sensor harness connector inspection

1) Inspect for poor connections at the CKP harness connector (pins 1 and 2 of E45). Is the connection status normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 6. CKP sensor signal circuit resistance check

No

Repair the connection as necessary.

⇒Proceed to 14. Repair verification

6. CKP sensor signal circuit resistance check

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) .

3) Measure the resistance of the CKP sensor signal circuit (pins 16 and 27 of E82) with a DMM (Signal circuit internal resistance check). Is the resistance within the specified range?

Refer to "*Engine Control*".

Value: 109 to 143 Ω

Yes

⇒Proceed to 8. Inspection for open circuit and short circuit in CKP sensor circuit

No

⇒Proceed to 7. CKP sensor inspection

7. CKP sensor inspection

1) Disconnect the CKP sensor harness connector (E45) .

2) Measure the resistance of the CKP sensor connector (E45) (Internal resistance check). Is the resistance within the

● In the CKP sensor signal circuit (pins 1 and 2 of E45)

Refer to “*Engine Control*”.

Value: 109 to 143 Ω

3) Measure the resistance of the CKP sensor connector (E45) (Insulation check). Is the resistance equal to the specified value?

● Between the CKP sensor signal circuit (pin 1 of E45) and the frame ground

● Between the CKP sensor signal circuit (pin 2 of E45) and the frame ground

Refer to “*Engine Control*”.

Value: ∞ Ω

4) Are all of the values normal?

Yes

⇒Proceed to 8. Inspection for open circuit and short circuit in CKP sensor circuit

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

8. Inspection for open circuit and short circuit in CKP sensor circuit

1) Inspect for an open circuit or a short circuit between the ECM (pins 16, 23, and 27 of E82) and the CKP sensor (pins 1 and 2 of E45).

Is the result normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. Engine speed verification using scan tool

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

9. Engine speed verification using scan tool

1) Reconnect all of the disconnected harness connectors.

2) Connect the scan tool.

3) Start and idle the engine.

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4) Observe the Desired Idle Speed parameter and the Engine Speed parameter on the scan tool. Are both parameters same?

Yes

⇒Proceed to 10. Engine speed verification during operation

No

⇒Proceed to 12. ECM power supply and ground circuit inspection

10. Engine speed verification during operation

1) Check whether the engine speed changes. Is the engine speed stable?

Yes

⇒Proceed to 14. Repair verification

No

⇒Proceed to 11. CKP sensor and flywheel inspection

11. CKP sensor and flywheel inspection

1) Visually inspect the CKP sensor and the flywheel for scratches or dirt. Is the result normal?

Yes

⇒Proceed to 12. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

12. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit. Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Note:

● If DTC P0341 or P0340 is set, first address the DTCs that are set.

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

Yes

⇒Proceed to 13. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

13. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

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Procedure completion

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit

1. DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit DTC information

1. DTC P0340 description

The CMP sensor detects the camshaft rotation in the supply pump and identifies the cylinder. When the pulsar installed in the camshaft passes the tip of the CMP sensor, this emits voltage, which generates a pulse signal. The ECM reads this pulse signal and identifies the cylinder based on the signal.

2. Condition for setting DTC P0340

Condition for running the DTC

● CKP sensor signal pulses are detected

● The engine speed is greater than or equal to idle speed.

● DTCs P0016, P0335, P0336, and P0341 are not set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance*".

Condition for setting the DTC

● During engine operation, the ECM hasn't detected an excessive or transient crankshaft position sensor signal pulse.

3. Action taken when DTC P0340 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0340

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Turn ON the ignition switch.

2) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Prioritized DTC check

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No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Prioritized DTC check

1) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 4. CMP sensor installation inspection

4. CMP sensor installation inspection

1) Inspect the installation status of the CMP sensor.Is the result normal?

Yes

⇒Proceed to 5. CMP sensor harness connector inspection

No

Repair or replace if necessary.

⇒Proceed to 15. Repair verification

5. CMP sensor harness connector inspection

1) Inspect for poor connections at the CMP sensor harness connector (pins 1, 2, and 3 of E46). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 6. CMP sensor 5 V reference voltage check

No

Repair the connection as necessary.

⇒Proceed to 15. Repair verification

6. CMP sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the CMP sensor harness connector (E46) .

3) Turn ON the ignition switch.

4) Measure the voltage between the CMP sensor 5 V reference circuit (pin 3 of E46) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: about 5 V

Yes

⇒Proceed to 10. Inspection for open circuit and short circuit in CMP sensor circuit

No

⇒Proceed to 7. Individual harness connector inspection

7. Individual harness connector inspection

1) Inspect for poor connections at the CMP sensor harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 10. Inspection for open circuit and short circuit in CMP sensor circuit

No

Repair or replace if necessary.

⇒Proceed to 8. CMP sensor signal input check

8. CMP sensor signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P0340 set?

Yes

⇒Proceed to 9. CMP sensor inspection

No

⇒Proceed to 14. ECM replacement

9. CMP sensor inspection

1) Remove the CMP sensor, and inspect the sensor tip for scratches or damage. Is the result normal?

Yes

⇒Proceed to 10. Inspection for open circuit and short circuit in CMP sensor circuit

No

Replace the CMP sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CMP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CMP sensor installation*".

⇒Proceed to 15. Repair verification

10. Inspection for open circuit and short circuit in CMP sensor circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and the CMP sensor harness connector (E46) .

3) Connect a fused jumper wire between each circuit of the CMP sensor harness connector (E46) .

● Between the camshaft position sensor signal circuit and the 5 V reference circuit (pin 1 and pin 3 of E46)

● Between the camshaft position sensor signal circuit and the low reference circuit (pin 1 and pin 2 of E46)

● Between the 5 V reference circuit for the camshaft position sensor and the low reference circuit (pin 2 and pin 3 of E46)

● Between the camshaft position sensor shield and the low reference circuit (pin 2 of E46)

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4) Using a digital multimeter to measure the resistance between the various circuits of the *ECM* harness connector (E82) (check for the presence of an open circuit.) Is the resistance equal to the specified value?

● Between the camshaft position sensor signal circuit and the 5 V reference circuit (pin 21 and pin 35 of E82)

● Between the camshaft position sensor signal circuit and the low-voltage reference circuit (pin 22 and pin 35 of E82)

● Between the 5 V reference circuit for the camshaft position sensor and the low reference circuit (pin 21 and pin 22 of E82)

Refer to "*Engine Control*".

Value: 0.5 Ω

5) Disconnect the fused jumper between each circuit of the camshaft position sensor harness connector (E46).

6) Measure the resistance between each circuit of the ECM (E82) and the camshaft position sensor (E46) using a digital multimeter (Check for short circuit). Is the resistance equal to the specified value?

● 5 V reference circuit between ECM (pin 21 of E82) and camshaft position sensor (pin 3 of E46)

● Signal circuit between the ECM (pin 35 of E82) and the camshaft position sensor (pin 1 of E46)

● Low reference circuit between the ECM (pin 22 of E82) and the camshaft position sensor (pin 2 of E46)

Refer to "*Engine Control*".

Value: ∞ Ω

Yes

⇒Proceed to 11. Inspection for short to ground in CMP sensor circuit

No

Repair or replace the malfunctioning circuit.

⇒Proceed to 15. Repair verification

11. Inspection for short to ground in CMP sensor circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and the CMP sensor harness connector (E46) .

3) Measure the resistance between each circuit of the ECM harness connector (F41) and the frame ground with a DMM (Check for short circuit). Is the resistance equal to the specified value?

● Between the CMP sensor signal circuit (pin 35 of E82) and the frame ground

● Between the CMP sensor 5 V reference circuit (pin 21 of E82) and the frame ground

Refer to "*Engine Control*".

Value: ∞ Ω

Yes

⇒Proceed to 12. Inspection for short to power supply in CMP sensor circuit

No

Repair the short to ground in the CMP sensor circuit.

⇒Proceed to 15. Repair verification

12. Inspection for short to power supply in CMP sensor circuit

1) Turn OFF the ignition switch.

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2) Disconnect the CMP sensor harness connector (E46) .

3) Turn ON the ignition switch.

4) Measure the voltage between each circuit on the CMP sensor harness connector side (E46) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: 0V

Yes

⇒Proceed to 13. ECM power supply and ground circuit inspection

No

Repair the short to the power supply in the CMP sensor circuit.

⇒Proceed to 15. Repair verification

13. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Note:

● If DTC P0016, P0335, or P0336 is set, first address the DTCs that are set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Yes

⇒Proceed to 14. ECM replacement

No

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Repair or replace if necessary.

⇒Proceed to 15. Repair verification

14. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 15. Repair verification

15. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance

1. DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance DTC information

1. DTC P0341 description

The CMP sensor detects the camshaft rotation in the supply pump and identifies the cylinder. When the pulsar installed in the camshaft passes the tip of the CMP sensor, this emits voltage, which generates a pulse signal. The ECM reads this pulse signal and identifies the cylinder based on the signal.

2. Condition for setting DTC P0341

Condition for running the DTC

● CKP sensor signal pulses are detected

● The engine is running

● DTCs P0016, P0335, P0336, and P0340 are not set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P0340 (Flash code 14) Camshaft Position Sensor Circuit*".

Condition for setting the DTC

● During engine operation, the ECM detected an excessive or transient Crankshaft position sensor signal pulse.

3. Action taken when DTC P0341 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0341

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine Control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0341 (Flash code 14) Camshaft Position Sensor Circuit Range/Performance diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Turn ON the ignition switch.

2) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Prioritized DTC check

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No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*" in this section.

3. Prioritized DTC check

1) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 4. CMP sensor installation inspection

4. CMP sensor installation inspection

1) Inspect the installation status of the CMP sensor. Is the result normal?

Yes

⇒Proceed to 5. CMP sensor harness connector inspection

No

Repair or replace if necessary.

⇒Proceed to 15. Repair verification

5. CMP sensor harness connector inspection

1) Inspect for poor connections at the CMP sensor harness connector (pins 1, 2, and 3 of E46). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 6. CMP sensor 5 V reference voltage check

No

Repair the connection as necessary.

⇒Proceed to 15. Repair verification

6. CMP sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the CMP sensor harness connector (E46) .

3) Turn ON the ignition switch.

4) Measure the voltage between the CMP sensor 5 V reference circuit (pin 3 of E46) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: about 5 V

Yes

⇒Proceed to 10. Inspection for open circuit and short circuit in CMP sensor circuit

No

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⇒Proceed to 7. Individual harness connector inspection

7. Individual harness connector inspection

1) Inspect for poor connections at the CMP sensor harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 10. Inspection for open circuit and short circuit in CMP sensor circuit

No

Repair or replace if necessary.

⇒Proceed to 8. CMP sensor signal input check

8. CMP sensor signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P0341 set?

Yes

⇒Proceed to 9. CMP sensor inspection

No

⇒Proceed to 14. ECM replacement

9. CMP sensor inspection

1) Remove the CMP sensor, and inspect the sensor tip for scratches or damage. Is the result normal?

Yes

⇒Proceed to 10. Inspection for open circuit and short circuit in CMP sensor circuit

No

Replace the CMP sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CMP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CMP sensor installation*".

⇒Proceed to 15. Repair verification

10. Inspection for open circuit and short circuit in CMP sensor circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and the CMP sensor harness connector (E46) .

3) Connect a jumper with fuses to each circuit of the camshaft position sensor harness connector (E46).

● Between the camshaft position sensor signal circuit and the 5 V reference circuit (pin 1 and pin 3 of E46)

● Between the camshaft position sensor signal circuit and the low reference circuit (pin 1 and pin 2 of E46)

● Between the 5 V reference circuit for the camshaft position sensor and the low reference circuit (pin 2 and pin 3 of E46)

● Between the camshaft position sensor shield and the low reference circuit (pin 2 of E46)

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4) Using a digital multimeter to measure the resistance between the various circuits of the *ECM* harness connector (E82) (check for the presence of an open circuit.) Is the resistance equal to the specified value?

● Between the camshaft position sensor signal circuit and the 5 V reference circuit (pin 21 and pin 35 of E82)

● Between the camshaft position sensor signal circuit and the low-voltage reference circuit (pin 22 and pin 35 of E82)

● Between the 5 V reference circuit for the camshaft position sensor and the low reference circuit (pin 21 and pin 22 of E82)

Refer to "*Engine Control*".

Value: 0.5 Ω

5) Disconnect the fuse jumper between each circuit of the CMP sensor harness connector (E46).

6) Measure the resistance between each circuit of the ECM (E82) and the camshaft position sensor (E46) using a digital multimeter (Check for short circuit) Is the resistance equal to the specified value?

● 5 V reference circuit between ECM (pin 21 of E82) and camshaft position sensor (pin 3 of E46)

● Signal circuit between the ECM (pin 35 of E82) and the camshaft position sensor (pin 1 of E46)

● Low reference circuit between the ECM (pin 22 of E82) and the camshaft position sensor (pin 2 of E46)

Refer to "*Engine Control*".

Value: ∞ Ω

7) Are all of the values normal?

Yes

⇒Proceed to 11. Inspection for short to ground in CMP sensor circuit

No

Repair or replace if necessary.

⇒Proceed to 15. Repair verification

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11. Inspection for short to ground in CMP sensor circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and the CMP sensor harness connector (E46) .

3) Measure the resistance between each circuit of the ECM harness connector (E82) and the frame ground with a DMM (Check for short circuit). Is the resistance equal to the specified value?

● Between the camshaft position sensor signal circuit (pin 35 of E82) and vehicle body ground

● Between the C axis position sensor 5 V reference circuit (pin 21 of E82) and body ground

Refer to "*Engine Control*".

Value: ∞ Ω

Yes

⇒Proceed to 12. Inspection for short to power supply in CMP sensor circuit

No

Repair the short to ground in the CMP sensor circuit.

⇒Proceed to 15. Repair verification

12. Inspection for short to power supply in CMP sensor circuit

1) Turn OFF the ignition switch.

2) Disconnect the CMP sensor harness connector (E46) .

3) Turn ON the ignition switch.

4) Measure the voltage between each circuit of the CMP sensor harness connector (E46) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: 0 V

Yes

⇒Proceed to 13. ECM power supply and ground circuit inspection

No

Repair the short to the power supply in the CMP sensor circuit.

⇒Proceed to 15. Repair verification

13. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit. Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Note:

● If DTC P0016, P0335, or P0336 is set, first address the DTCs that are set.

Refer to "*DTC P0016 (Flash Code 16) Crankshaft Position - Camshaft Position Correlation*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Yes

⇒Proceed to 14. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 15. Repair verification

14. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 15. Repair verification

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15. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0401 (Flash code 93) EGR Flow Insufficient Detected

1. DTC information

1. DTC P0401 description

The ECM controls the opening and closing of the EGR valve based on the driving condition of the engine by controlling the EGR motor. The EGR valve position is detected by the position sensor and is sent to the ECM. When the proper clearance requirements are met, the ECM opens the EGR valve while monitoring the MAF signal. An expected MAF difference should be detected between the closed and open positions of the valve. If the ECM detects an MAF difference that is less than expected, this DTC is set. The ECM diagnoses this DTC 1 time only per 1 ignition cycle.

2. Condition for setting DTC P0401

Condition for running the DTC

● The battery voltage is 16 - 32 V.

● The ignition switch is on.

● DTCs P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0404, P0409, P0500, P0502, P0503, P0560, P060B, P0641, P0651, P0697, P1404, P140A, P140B, P2227, P2228, and P2229 are not set.

Refer to "*DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input*".

Refer to "*DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input*".

Refer to "*DTC P0112(Flash Code 22) Intake Air Temperature Sensor Circuit Low*".

Refer to "*DTC P0113 (Flash Code 22) Intake Air Temperature Sensor Circuit High* ".

Refer to "*DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance*".

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P0404 (Flash code 45) EGR Control Circuit Range/ Performance*".

Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit* ".

Refer to "*DTC P0500 (Flash code 25) Vehicle Speed Sensor* ".

Refer to "*DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input*".

Refer to "*DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input*".

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P1404 (Flash code 45) EGR Position Fault* ".

Refer to "*DTC P140A (Flash Code 345) EGR 2 Performance*".

Refer to "*DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance*".

Refer to "*DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low*".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

Condition for setting the DTC

● The ECM detected a mass air flow on / off position less than expected.

3. Action taken when DTC P0401 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0401

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0101, P0102, P0103, or P0560 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0101 (Flash code 92) Mass Air Flow Sensor Circuit Range/Performance*".

Refer to "*DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input*".

Refer to "*DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input*".

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

No

⇒Proceed to 3. Current DTC check

3. Current DTC check

1) Start and completely warm up the engine until the engine coolant temperature reaches 80℃ {176℉} or more.

2) Idle the engine for at least 3 minutes while observing the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 4. EGR components inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. EGR components inspection

1) Inspect the air intake/exhaust system for the following conditions.Is the result normal?

● Missing or broken EGR valve gasket

● Stuck EGR valve

● EGR gas leakage from the EGR passage between the exhaust manifold and the intake manifold

● Restricted or broken EGR passage between the exhaust manifold and the EGR valve

● Any kind of restriction that happens in the exhaust system

● Clogged air cleaner element, collapsing of the air piping between the air cleaner and the intake manifold, or a state where flow is restricted or damage is present

● Leakage in the air intake system

● Water intrusion in the air intake system

● Contamination or foreign material blocking the inlet of MAF sensor

● Misdetection or delayed response of the MAF sensor

● Stuck exhaust brake valve

● The ventilation duct is connected to the exhaust tail pipe. Remove the duct and retest if it is connected.

Yes

⇒Proceed to 5. EGR operation check using scan tool

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

5. EGR operation check using scan tool

1) Perform EGR a few times with the scan tool.

2) While observing the Exhaust Gas Recirculation (EGR) Valve Position value, command the Desired EGR Position UP and DOWN.

3) Observe the exhaust gas recirculation (EGR) valve position parameter displayed on the scanning tool Is the exhaust gas recirculation (EGR) valve position parameter and the ideal exhaust gas recirculation (EGR) valve position parameter within the specified limits?

Value: -5 to 5 %

Yes

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

No

Replace the EGR valve.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0404 (Flash code 45) EGR Control Circuit Range/ Performance

1. DTC information

1. DTC P0404 description

The EGR motor is installed inside the EGR valve. The EGR motor used on this vehicle is a brushless DC motor and is driven by the three-phase motor. EGR motor has the following circuits.

● EGR motor 1 drive circuit 1

● EGR motor 1 drive circuit 2

● EGR motor 1 drive circuit 3

The ECM drives the EGR motor via EGR motor 1 drive circuits 1, 2, and 3. The ECM outputs the drive signal by switching inside the ECM, and the motor rotates according to the combination of the three-phase signal. Also, the valve opening angle is controlled by the duty. If the EGR motor drive duty is large and the difference between the desired EGR opening angle and the EGR 1 opening angle is excessive, the ECM sets the DTC.

2. Condition for setting DTC P0404

Condition for running the DTC

● The battery voltage is 20 - 32 V.

● The desired EGR position is stable.

● DTCs P0112, P0113, P0116, P0117, P0118, P0409, P060B ,P0651, P0697, P2227, P2228 and P2229 are not set.

Refer to "*DTC P0112(Flash Code 22) Intake Air Temperature Sensor Circuit Low*".

Refer to "*DTC P0113 (Flash Code 22) Intake Air Temperature Sensor Circuit High* ".

Refer to "*DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance*".

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low* ".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

Condition for setting the DTC

● When the EGR motor output is 75% or more, the difference between the desired EGR position and the EGR 1 opening angle is excessive for 5 seconds or more.

3. Action taken when DTC P0404 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

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4. Condition for clearing DTC P0404

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. EGR operation check using scan tool

1) Clear the DTC with a scan tool.

2) Perform EGR a few times with the scan tool.

3) While observing the Exhaust Gas Recirculation (EGR) Valve Position value, command the Desired EGR Position UP and DOWN.

4) Observe the exhaust gas recirculation (EGR) valve position parameter displayed on the scanning tool Does the exhaust gas recirculation (EGR) valve position parameter change with the ideal exhaust gas recirculation (EGR) valve position parameter value?

Yes

⇒Proceed to 3. Current DTC check

No

⇒Proceed to 4. Inspection for open circuit and short circuit in EGR motor 1 drive circuit

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3. Current DTC check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P0404 set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Inspection for open circuit and short circuit in EGR motor 1 drive circuit

1) Inspect the drive circuit between the ECM (pins 1, 2, and 7 of E82) and EGR motor 1 (pins 6, 7, and 8 of E98) for the following conditions. Is the result normal?

● Open circuit

● Short to ground

● Short to the power supply circuit

● High resistance

Refer to “*Engine Control*”.

Yes

Replace EGR valve 1.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 5. EGR valve operation signal input check

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

5. EGR valve operation signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P0404 set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

⇒Proceed to 8. Repair verification

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

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Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0409 (Flash code 44) EGR Sensor Circuit

1. DTC information

1. DTC P0409 description

The EGR position sensor is installed inside the EGR valve. The EGR position sensor is a Hall IC type sensor installed in a total of 3 locations, and the motor phase is set by the polarity output ON/OFF of each sensor. EGR position sensor 1 has the following circuits.

● 5 V reference circuit

● Low reference circuit

● EGR position sensor 1 signal circuit 1

● EGR position sensor 1 signal circuit 2

● EGR position sensor 1 signal circuit 3

The ECM supplies 5 V to EGR position sensor 1 signals 1, 2, and 3 via the 5 V reference circuit and grounds to the ECM via the low reference circuit. Also, the EGR position sensor, via each signal circuit, outputs the polarity of either EGR position sensor 1 signals 1, 2, or 3 as ON/OFF to the ECM. The ECM detects the EGR valve position by counting the number of times the polarity changes. If all the polarity signal inputs of EGR position sensor 1 signals 1, 2, and 3 turn ON or OFF at the same time, the ECM sets a DTC.

2. Condition for setting DTC P0409

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that the signals input from EGR position sensor 1 signals 1, 2, and 3 are all ON or all OFF for approximately 3 seconds or more.

3. Action taken when DTC P0409 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0409

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

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4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Individual harness connector inspection

1) Inspect for poor connections at the EGR valve 1 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in 5 V reference circuit of EGR position sensor 1

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

3. Inspection for open circuit and short circuit in 5 V reference circuit of EGR position sensor 1

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and the EGR valve 1 harness connector (E98) .

3) Inspect the 5 V reference circuit between the ECM (pin 30 of E82) and EGR position sensor 1 (pin 1 of E98) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 1 circuit (pins 8,9,10 and 29 of E82)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 4. Inspection for open circuit and short circuit in EGR position sensor 1 signal circuit 1

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

4. Inspection for open circuit and short circuit in EGR position sensor 1 signal circuit 1

1) Inspect signal circuit 1 between the ECM(pin 8 of E82) and EGR position sensor 1 (pin 4 of E98) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 1 circuit (pins 9,10,29 and 30 of E82)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 5. Inspection for open circuit and short circuit in EGR position sensor 1 signal circuit 2

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

5. Inspection for open circuit and short circuit in EGR position sensor 1 signal circuit 2

1) Inspect signal circuit 2 between the ECM (pin 9of E82) and EGR position sensor 1 (pin 3 of E98) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 1 circuit (pins 8,10,29 and 30 of E82)

Refer to "*Engine Control*".

Yes

⇒Proceed to 6. Inspection for open circuit and short circuit in EGR position sensor 1 signal circuit 3

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

6. Inspection for open circuit and short circuit in EGR position sensor 1 signal circuit 3

1) Inspect signal circuit 3 between the ECM (pin 10 of E82) and EGR position sensor 1 (pin 2 of E98) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 1 circuit (pins 8,9,29 and 30 of E82)

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. Inspection for open circuit in EGR position sensor 1 low reference circuit

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

7. Inspection for open circuit in EGR position sensor 1 low reference circuit

1) Inspect the low reference circuit between the ECM (pin 25 of E82) and EGR position sensor 1 (pin 5 of E98) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 1 circuit (pins 8,9,10 and 30 and E82)

Refer to "*Engine Control*".

Yes

⇒Proceed to 8. EGR position check

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

8. EGR position check

1) Turn OFF the ignition switch.

2) Reconnect all of the disconnected harness connectors.

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3) Connect the scan tool.

4) Turn ON the ignition switch.

5) Observe the EGR Position parameter on the scan tool. Do the EGR Position 1, 2, and 3 parameters all show OFF?

Yes

⇒Proceed to 9. EGR valve 1 operation check

No

⇒Proceed to 11. ECM power supply and ground circuit inspection

9. EGR valve 1 operation check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P0409 set?

Yes

Replace EGR valve 1.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 10. EGR position sensor 1 signal input check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

10. EGR position sensor 1 signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P0409 set?

Yes

⇒Proceed to 11. ECM power supply and ground circuit inspection

No

⇒Proceed to 13. Repair verification

11. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

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Yes

⇒Proceed to 12. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

12. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 13. Repair verification

13. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0477 (Flash code 46) Exhaust Pressure Control Valve Low

1. DTC P0477 (Flash code 46) Exhaust Pressure Control Valve Low DTC information

1. DTC P0477 description

The exhaust brake solenoid valve is installed on the right side of the cab rear side member. The exhaust brake solenoid valve controls the supply of air to the exhaust brake valve. If the exhaust brake switch is turned ON and the exhaust brake operating conditions are established, the ECM supplies power to the exhaust brake relay. The ECM controls the exhaust brake solenoid valve and operates the exhaust brake.

2. Condition for setting DTC P0477

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ECM is commanding the exhaust brake ON.

Condition for setting the DTC

● The ECM detects a low voltage condition in the exhaust brake solenoid valve control circuit for 3 seconds or more when the exhaust brake is commanded OFF.

3. Action taken when DTC P0477 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P0477

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0477 (Flash code 46) Exhaust Pressure Control Valve Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Individual harness connector inspection

1) Inspect for poor connections at the exhaust brake solenoid valve, the exhaust brake relay, each exhaust brake cut relay, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 3. Exhaust brake relay operation check using scan tool

No

Repair or replace if necessary.

⇒Proceed to 9. Repair verification

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3. Exhaust brake relay operation check using scan tool

1) Turn OFF the ignition switch.

2) Remove the exhaust brake relay.

3) Connect the scan tool.

4) Turn ON the ignition switch.

5) Select Exhaust Brake under Actuator Test on the scan tool, and turn ON the exhaust brake relay.

6) Measure the voltage of the circuit on the coil side of the exhaust brake relay installation section (pins 2 and 4 of R/B 2 exhaust brake relay) with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: 20 V

Yes

Replace the exhaust brake relay.

⇒Proceed to 9. Repair verification

No

⇒Proceed to 4. Exhaust brake relay power supply voltage check

4. Exhaust brake relay power supply voltage check

1) Turn ON the ignition switch.

2) Measure the voltage between the power supply circuit on the coil side of the exhaust brake relay installation section (pin 2 of R/B 2 exhaust brake relay) and frame ground with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: 20 V

Yes

⇒Proceed to 6. Inspection for open circuit and short circuit in exhaust brake relay control circuit

No

⇒Proceed to 5. Fuse inspection

5. Fuse inspection

1) Inspect for a blown out Exhaust Brake 7.5A fuse. Is the result normal?

Yes

Repair or replace the circuit between the ECM main relay and the exhaust brake relay.

⇒Proceed to 9. Repair verification

No

Replace the fuse. Also, inspect for a short circuit which could cause a fuse blowout in the circuits related to the fuse, and repair or replace the harness as necessary.

⇒Proceed to 9. Repair verification

6. Inspection for open circuit and short circuit in exhaust brake relay control circuit

1) Turn OFF the ignition switch.

2) Install the exhaust brake relay.

3) Disconnect the ECM harness connector (FL558) .

4) Turn ON the ignition switch.

5) Measure the voltage between the exhaust brake relay control circuit (pin 4 of FL558) and frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: 20V

Yes

⇒Proceed to 7. ECM power supply and ground circuit inspection

No

Repair or replace the exhaust brake relay control circuit between the exhaust brake relay (pin 4 of R/B 2 exhaust brake relay) and the ECM (pin 4 of FL558).

⇒Proceed to 9. Repair verification

7. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 8. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 9. Repair verification

8. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 9. Repair verification

9. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0478 (Flash Code 46) Exhaust Pressure Control Valve High

1. DTC P0478 (Flash Code 46) Exhaust Pressure Control Valve High DTC information

1. DTC P0478 description

The exhaust brake solenoid valve is installed on the right side of the cab rear side member. The exhaust brake solenoid valve controls the supply of air to the exhaust brake valve. If the exhaust brake switch is turned ON and the exhaust brake operating conditions are established, the ECM supplies power to the exhaust brake relay. The ECM controls the exhaust brake solenoid valve and operates the exhaust brake.

2. Condition for setting DTC P0478

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ECM is commanding the exhaust brake OFF.

Condition for setting the DTC

● The ECM detects a high voltage condition in the exhaust brake solenoid valve control circuit for 3 seconds or more when the exhaust brake is commanded ON.

3. Action taken when DTC P0478 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P0478

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) – Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0478 (Flash Code 46) Exhaust Pressure Control Valve High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Individual harness connector inspection

1) Inspect for poor connections at the exhaust brake solenoid valve, exhaust brake relay, ECM harness connector, and intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 3. Exhaust brake relay circuit voltage check using the scan tool

No

Repair or replace if necessary.

⇒Proceed to 7. Repair verification

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3. Exhaust brake relay circuit voltage check using the scan tool

1) Turn OFF the ignition switch.

2) Remove the exhaust brake relay.

3) Connect the scan tool.

4) Turn ON the ignition switch.

5) Select Exhaust Brake under Actuator Test on the scan tool, and turn OFF the exhaust brake relay.

6) Measure the voltage of the circuit on the coil side of the exhaust brake relay installation section (pins 2 and 4 of R/B 2 exhaust brake relay) with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: about 0 V

Yes

Replace the exhaust brake relay.

⇒Proceed to 7. Repair verification

No

⇒Proceed to 4. Inspection for short to power supply in exhaust brake relay control circuit

4. Inspection for short to power supply in exhaust brake relay control circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL558) .

3) Turn ON the ignition switch.

4) Measure the voltage between the circuit on the coil side of the exhaust brake relay installation section (pins 2 and 4 of R/B 2 exhaust brake relay) and frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: about 0 V

Yes

⇒Proceed to 5. ECM power supply and ground circuit inspection

No

.Repair or replace the exhaust brake relay control circuit between the exhaust brake relay (pin 4 of R/B 2 exhaust brake relay) and the ECM (pin 4 of FL558).

⇒Proceed to 7. Repair verification

5. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 6. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 7. Repair verification

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6. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 7. Repair verification

7. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0500 (Flash code 25) Vehicle Speed Sensor

1. DTC P0500 (Flash code 25) Vehicle Speed Sensor DTC information

1. DTC P0500 description

The vehicle speed sensor detects the vehicle speed. The vehicle speed sensor is installed on the transmission output section. The vehicle speed sensor is driven via the drive gear, and the sensor shaft section rotates. When the shaft rotates, the magnet installed on the sensor generates a voltage and outputs it as a pulse signal. For the sensor output signals, the time period between the pulse signals change according to the vehicle speed. When the sensor shaft speed is low, a low frequency pulse is outputted, and when the sensor shaft speed is high, a high frequency pulse is outputted. The ECM converts the vehicle speed sensor signal to the vehicle speed and uses it for the vehicle speed suppression control, etc.

The speed sensor control unit is installed in order to correct changes in pulse signals from the vehicle speed sensor that vary due to different transmission and differential gear ratios or different tire radiuses, and to allow the instrument panel cluster or the various controls to use accurate vehicle speed information. A vehicle speed of 60 km/h is equivalent to a vehicle speed sensor shaft speed of 637 rpm. The pulse signal changes the voltage between a High level of approximately 14 V and a Low level of approximately 2 V.

2. Condition for setting DTC P0500

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● Issue a command when the accelerator pedal is not depressed so that the fuel injection amount is off.

● The engine speed is 1000 rpm or more.

Condition for setting the DTC

● The ECM detects that no vehicle speed signal has been generated for 7 seconds.

3. Action taken when DTC P0500 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0500

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0500 (Flash code 25) Vehicle Speed Sensor diagnostics

1. Engine Control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

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2. Vehicle speed sensor connector inspection

1) Inspect for poor connections at the vehicle speed sensor connector. Is the connection status normal?

Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in VSS signal circuit

No

Repair the connection as necessary.

⇒Proceed to 9. Repair verification

3. Inspection for open circuit and short circuit in VSS signal circuit

1) Turn OFF the ignition switch.

2) Disconnect the harness connector from the ECM (FL559), the speed sensor control unit (FL11) , and the vehicle speed sensor (M1) .

3) Inspect for an open circuit or a short circuit between the ECM (pin 8 of FL559) and the speed sensor control unit(pin 3 of FL11_).

Is the result normal?

4) Inspect for an open circuit or a short circuit between the speed sensor control unit (pins 2,5 and 7 of FL11)and the vehicle speed sensor (M1 1,2,3). Is the result normal?

Refer to "*Pulse Regulator*".

Refer to "*Pulse Regulator*".

5) Are all of the results normal?

Yes

⇒Proceed to 4. Vehicle speed check

No

Repair or replace if necessary.

⇒Proceed to 9. Repair verification

4. Vehicle speed check

1) Start the engine and drive the vehicle.

2) Check whether the Vehicle Speed parameter is normal on the scan tool. Is the value normal?

Yes

⇒Proceed to 9. Repair verification

No

⇒Proceed to 5. Vehicle speed sensor inspection

5. Vehicle speed sensor inspection

1) Turn OFF the ignition switch.

2) Remove the vehicle speed sensor.

3) Inspect the vehicle speed sensor shaft and gear for abnormal conditions. Also inspect the gear section of the transmission as necessary, and perform repairs if any abnormal condition is found.

4) Connect the vehicle speed sensor harness connector.

5) Turn ON the ignition switch.

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6) Rotate the shaft of the vehicle speed sensor slowly and check whether the voltage changes. Does the voltage change within the specified range below?

Value: 1.0 to 3.0 V

Value: 12.0 to 15.0 V

Yes

⇒Proceed to 6. Vehicle speed pulse input check

No

Replace the vehicle speed sensor.

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJT) Speed Sensor Removal*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJT) Vehicle Speed Sensor Installation*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJX16) Speed Sensor Removal*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJX16) Vehicle Speed Sensor Installation*".

⇒Proceed to 9. Repair verification

6. Speed pulse input check

1) Turn OFF the ignition switch.

2) Connect the vehicle speed sensor harness connector.

3) Start the engine and drive the vehicle.

4) Check whether the Vehicle Speed parameter is normal on the scan tool. Is the value normal?

Yes

⇒Proceed to 7. Switch check

No

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Replace the speed sensor control unit.

Note:

● Perform programming after replacing the ECM.

Refer to "*9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Speed sensor control unit setting*".

⇒Proceed to 9. Repair verification

7. Switch check

1) Operate the following switches, and observe whether input is normal with a scan tool. Is each switch input normal?

● Neutral Switch

● Clutch Pedal Switch

● Park Brake Switch

Yes

⇒Proceed to 8. ECM replacement

No

Repair or replace as necessary.

⇒Proceed to 9. Repair verification

8. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 9. Repair verification

9. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input

1. DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input DTC information

1. DTC P0502 description

The vehicle speed sensor detects the vehicle speed. The vehicle speed sensor is installed on the transmission output section. The vehicle speed sensor is driven via the drive gear, and the sensor shaft section rotates. When the shaft rotates, the magnet installed on the sensor generates a voltage and outputs it as a pulse signal. For the sensor output signals, the time period between the pulse signals change according to the vehicle speed. When the sensor shaft speed is low, a low frequency pulse is outputted, and when the sensor shaft speed is high, a high frequency pulse is outputted. The ECM converts the vehicle speed sensor signal to the vehicle speed and uses it for the vehicle speed suppression control, etc.

The speed sensor control unit is installed in order to correct changes in pulse signals from the vehicle speed sensor that vary due to different transmission and differential gear ratios or different tire radiuses, and to allow the instrument panel cluster or the various controls to use accurate vehicle speed information. A vehicle speed of 60 km/h is equivalent to a vehicle speed sensor shaft speed of 637 rpm. The pulse signal changes the voltage between a high level of approximately 14 V and a low level of approximately 2 V.

2. Condition for setting DTC P0502

Condition for running the DTC

● The battery voltage is 21 - 32 V.

● The ignition switch is on.

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the vehicle speed signal voltage is 0.5 V or less.

3. Action taken when DTC P0502 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0502

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine Control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input diagnostics

1. Engine Control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

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2. Vehicle speed sensor connector inspection

1) Inspect for poor connections at the vehicle speed sensor connector. Is the connection status normal?

Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in VSS signal circuit

No

Repair the connection as necessary.

⇒Proceed to 9. Repair verification

3. Inspection for open circuit and short circuit in VSS signal circuit

1) Turn OFF the ignition switch.

2) Disconnect the harness connector from the ECM (FL559), the speed sensor control unit (FL11), and the vehicle speed sensor (M1).

3) Inspect for an open circuit or a short circuit between the ECM (pin 8 of FL559) and the speed sensor control unit(pin 3 of FL11). Is the result normal?

4) Inspect for an open circuit or a short circuit between the speed sensor control unit (pin 2,5,7 of FL11)and the vehicle speed sensor (pin 1,2,3 of M1). Is the result normal?

Refer to "*Pulse Regulator*".

Refer to "*Pulse Regulator*".

5) Are all of the results normal?

Yes

⇒Proceed to 4. Speed check

No

Repair or replace if necessary.

⇒Proceed to 9. Repair verification

4. speed check

1) Start the engine and drive the vehicle.

2) Check whether the Vehicle Speed parameter is normal on the scan tool. Is the value normal?

Yes

⇒Proceed to 9. Repair verification

No

⇒Proceed to 5. Vehicle speed sensor inspection

5. Vehicle speed sensor inspection

1) Turn OFF the ignition switch.

2) Remove the vehicle speed sensor.

3) Inspect the vehicle speed sensor shaft and gear for abnormal conditions. Also inspect the gear section of the transmission as necessary, and perform repairs if any abnormal condition is found.

4) Connect the vehicle speed sensor harness connector.

5) Turn ON the ignition switch.

6) Rotate the shaft of the vehicle speed sensor slowly and check whether the voltage changes. Does the

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voltage change within the specified range below?

Value: 1.0 to 3.0 V

Value: 12.0 to 15.0 V

Yes

⇒Proceed to 6. Vehicle speed pulse input check

No

Replace the vehicle speed sensor.

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJT) Speed Sensor Removal*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJT) Speed Sensor Installation*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJX16) Vehicle Speed Sensor Removal*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJX16) Vehicle Speed Sensor Installation*".

⇒Proceed to 9. Repair verification

6. Speed pulse input check

1) Turn OFF the ignition switch.

2) Connect the vehicle speed sensor harness connector.

3) Start the engine and drive the vehicle.

4) Check whether the Vehicle Speed parameter is normal on the scan tool. Is the value normal?

Yes

⇒Proceed to 7. Switch check

No

Replace the speed sensor control unit.

Note:

● Perform programming after replacing the ECM.

Refer to "*9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Speed sensor control unit setting*".

⇒Proceed to 9. Repair verification

7. Switch check

1) Operate the following switches, and observe whether input is normal with a scan tool. Is each switch input normal?

● Neutral Switch

● Clutch Pedal Switch

● Park Brake Switch

Yes

⇒Proceed to 8. ECM replacement

No

Repair or replace as necessary.

⇒Proceed to 9. Repair verification

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8. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 9. Repair verification

9. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input

1. DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input DTC information

1. DTC P0503 description

The vehicle speed sensor is driven via the drive gear, and the sensor shaft section rotates. When the shaft rotates, the magnet installed on the sensor generates a voltage and outputs it as a pulse signal. For the sensor output signals, the time period between the pulse signals change according to the vehicle speed. When the sensor shaft speed is low, a low frequency pulse is outputted, and when the sensor shaft speed is high, a high frequency pulse is outputted. The ECM converts the vehicle speed sensor signal to the vehicle speed and uses it for the vehicle speed suppression control, etc.

The speed sensor control unit is installed in order to correct changes in pulse signals from the vehicle speed sensor that vary due to different transmission and differential gear ratios or different tire radiuses, and to allow the instrument panel cluster or the various controls to use accurate vehicle speed information. A vehicle speed of 60 km/h is equivalent to a vehicle speed sensor shaft speed of 637 rpm. The pulse signal changes the voltage between a High level of approximately 14 V and a Low level of approximately 2 V.

2. Condition for setting DTC P0503

Condition for running the DTC

● The battery voltage is 21 - 32 V.

● The ignition switch is on

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the vehicle speed signal voltage is 20 V or more.

3. Action taken when DTC P0503 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0503

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine Control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Vehicle speed sensor connector inspection

1) Inspect for poor connections at the vehicle speed sensor connector. Is the connection status normal?

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Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in VSS signal circuit

No

Repair the connection as necessary.

⇒Proceed to 9. Repair verification

3. Inspection for open circuit and short circuit in VSS signal circuit

1) Turn OFF the ignition switch.

2) Disconnect the harness connector from the ECM (FL559), the speed sensor control unit (FL11) , and the vehicle speed sensor (M1) .

3) Inspect for an open circuit or a short circuit between the ECM (pin 8 of FL559) and the speed sensor control unit (pin 3 of FL11).

Is the result normal?

4) Inspect for an open circuit or a short circuit between the speed sensor control unit (pin 2,5,7 of FL11) and the vehicle speed sensor (pin 1,2,3 of M1). Is the result normal?

Refer to "*Pulse Regulator*".

Refer to "*Pulse Regulator*".

5) Are all of the results normal?

Yes

⇒Proceed to 4. Vehicle speed check

No

Repair or replace if necessary.

⇒Proceed to 9. Repair verification

4. Vehicle speed check

1) Start the engine and drive the vehicle.

2) Check whether the Vehicle Speed parameter is normal on the scan tool. Is the value normal?

Yes

⇒Proceed to 9. Repair verification

No

⇒Proceed to 5. Vehicle speed sensor inspection

5. Vehicle speed sensor inspection

1) Turn OFF the ignition switch.

2) Remove the vehicle speed sensor.

3) Inspect the vehicle speed sensor shaft and gear for abnormal conditions. Also inspect the gear section of the transmission as necessary, and perform repairs if any abnormal condition is found.

4) Connect the vehicle speed sensor harness connector.

5) Turn ON the ignition switch.

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6) Rotate the shaft of the vehicle speed sensor slowly and check whether the voltage changes. Does the voltage change within the specified range below?

Value: 1.0 to 3.0 V

Value: 12.0 to 15.0 V

Yes

⇒Proceed to 6. Vehicle speed pulse input check

No

Replace the vehicle speed sensor.

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJT) Speed Sensor Removal*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJT) Speed Sensor Installation*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJX16) Vehicle Speed Sensor Removal*".

Refer to "*5. Transmission, Transaxle 5Z. Transmission Electrical Control (MJX16) Vehicle Speed Sensor Installation*".

⇒Proceed to 9. Repair verification

6. Speed pulse input check

1) Turn OFF the ignition switch.

2) Connect the vehicle speed sensor harness connector.

3) Start the engine and drive the vehicle.

4) Check whether the Vehicle Speed parameter is normal on the scan tool. Is the value normal?

Yes

⇒Proceed to 7. Switch check

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No

Replace the speed sensor control unit.

Note:

● Perform programming after replacing the ECM.

Refer to "*9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Speed sensor control unit setting*".

⇒Proceed to 9. Repair verification

7. Switch check

1) Operate the following switches, and observe whether input is normal with a scan tool. Is each switch input normal?

● Neutral Switch

● Clutch Pedal Switch

● Park Brake Switch

Yes

⇒Proceed to 8. ECM replacement

No

Repair or replace as necessary.

⇒Proceed to 9. Repair verification

8. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 9. Repair verification

9. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0560 (Flash code 155) System Voltage

1. DTC P0560 (Flash code 155) System Voltage DTC information

1. DTC P0560 description

The ECM supplies 12 V reference to the MAF sensor. Battery power is supplied to the ECM via the dropping resistor, and it is converted into 12 V. The ECM monitors the voltage of the 12 V reference circuit. If the ECM detects an excessively low or high voltage, the DTC is set.

2. Condition for setting DTC P0560

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the voltage of the 12 V reference circuit is less than or equal to 7 V, or 19 V or more.

3. Action taken when DTC P0560 sets

● The ECM illuminates the MIL. Action

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0560

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

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2. Engine Control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0560 (Flash code 155) System Voltage diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. MAF sensor circuit check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. MAF sensor circuit check

1) Turn OFF the ignition switch for at least 30 seconds.

2) Disconnect the MAF/IAT sensor harness connector (E107).

Refer to “*Engine Control*”.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 4. Dropping resistor circuit check

No

⇒Proceed to 12. MAF/IAT sensor harness connector inspection

4. Dropping resistor circuit check

1) Turn OFF the ignition switch for at least 30 seconds.

2) Keep the MAF/IAT sensor harness connector (E107) disconnected.

3) Disconnect the dropping resistor harness connector (FL593) .

Refer to “*Engine Control*”.

4) Turn ON the ignition switch.

5) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 9. Inspection for short circuit in dropping resistor voltage supply circuit

No

⇒Proceed to 5. Dropping resistor inspection

5. Dropping resistor inspection

1) Measure the resistance of the dropping resistor (pins 1 and 2 of FL593) with a DMM. Is the resistance within the specified range?

Refer to “*Engine Control*”.

Value: 45 to 55 Ω

Yes

⇒Proceed to 6. Ignition voltage feed voltage check

No

Replace the dropping resistor.

⇒Proceed to 15. Repair verification

6. Ignition voltage feed voltage check

1) Turn ON the ignition switch.

2) Measure the voltage between the ignition voltage feed circuit (pin 2 of FL593) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to "*Engine Control*".

Value: 18.0V

Yes

⇒Proceed to 7. Dropping resistor voltage supply voltage check

No

Inspect the fuse first and repair the open circuit or high resistance in the power supply circuit between the VGS 7.5A fuse and the dropping resistor(pin 2 of FL593) .

⇒Proceed to 15. Repair verification

7. Dropping resistor voltage supply voltage check

1) Measure the voltage between the dropping resistor voltage supply circuit (pin 1 of FL593) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to "*Engine Control*".

Value: 13.0 V

Yes

⇒Proceed to 11. Dropping resistor harness connector inspection

No

⇒Proceed to 8. Inspection for open circuit in ignition voltage feed circuit

8. Inspection for open circuit in ignition voltage feed circuit

1) Inspect the ignition voltage feed circuit between the VGS 7.5A fuse and the dropping resistor (pin 2 of FL593) for an open circuit or high resistance. Inspect the VGS 7.5A fuse first. Is the result normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 13. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 15. Repair verification

9. Inspection for short circuit in dropping resistor voltage supply circuit

1) Inspect the voltage supply circuit between the ECM (pin 18 of E82) and the dropping resistor (pin 1 of FL593) for the following conditions. Is the result normal?

● Short to ground

● Short to the power supply circuit

Refer to "*Engine Control*".

Yes

⇒Proceed to 10. Inspection for short circuit in MAF sensor 12 V reference circuit

No

Repair the circuit as necessary.

⇒Proceed to 15. Repair verification

10. Inspection for short circuit in MAF sensor 12 V reference circuit

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1) Inspect the 12V reference circuit between the ECM (pin 15 of FL559) and the MAF sensor (pin 1 of E107) for the following conditions. Is the result normal?

● Short to ground

● Short to the power supply circuit

● Short to the low reference circuit

Refer to “*Engine Control*”.

Yes

⇒Proceed to 14. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 15. Repair verification

11. Dropping resistor harness connector inspection

1) Inspect for poor connections at the dropping resistor harness connector (pins 1 and 2 of FL593). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

No

Repair the connection as necessary.

⇒Proceed to 15. Repair verification

12. MAF/IAT sensor harness connector inspection

1) Inspect for poor connections at the MAF sensor harness connector (pin 1 of E107). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the MAF sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) MAF and IAT sensor installation*".

⇒Proceed to 15. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 15. Repair verification

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13. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 18 of E82). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 14. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 15. Repair verification

14. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 15. Repair verification

15. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0563 (Flash code 35) System Voltage High

1. DTC P0563 (Flash code 35) System Voltage High DTC information

1. DTC P0563 description

The ECM monitors the ignition voltage to verify that the voltage stays within the appropriate range. When the ECM detects that the ignition voltage is excessively high, this DTC is set.

2. Condition for setting DTC P0563

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the voltage of the ignition power supply circuit is 32 V or more for 30 minutes.

3. Action taken when DTC P0563 sets

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0563

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0563 (Flash code 35) System Voltage High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Vehicle maintenance check

1) Check if the battery charger has been recently connected to the battery.

Yes

⇒Proceed to 6. Repair verification

No

⇒Proceed to 3. Ignition voltage check

3. Ignition voltage check

1) Connect the scan tool.

2) Start the engine.

3) Observe the Ignition Voltage parameter on the scan tool. Is the Ignition Voltage parameter less than or equal

to the specified value?

Value: 32.0V

Yes

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

No

⇒Proceed to 4. Charging system inspection

4. Charging system inspection

1) Inspect the charging system. Is the result normal?

Refer to "*1.Engine 1J.Electrical(6WG1) Generator inspection*".

Yes

⇒Proceed to 5. ECM replacement

No

Repair the charging system.

Refer to "*1.Engine 1J.Electrical(6WG1) Generator removal*".

Refer to "*1.Engine 1J.Electrical(6WG1) Generator disassembly*".

Refer to "*1.Engine 1J.Electrical(6WG1) Generator reassembly*".

Refer to "*1.Engine 1J.Electrical(6WG1) Generator installation*".

⇒Proceed to 6. Repair verification

5. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 6. Repair verification

6. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the Ignition Voltage parameter on the scan tool. Is the Ignition Voltage parameter less than or equal to the specified value?

Value: 32.0 V

Yes

Observe the DTC information with a scan tool.

No

⇒Proceed to 4. Charging system inspection

DTC P0571 (Flash code 26) Brake Switch Circuit

1. DTC P0571 (Flash code 26) Brake Switch Circuit DTC information

1. DTC P0571 description

The stoplight switch is installed to the brake pedal bracket. There are two stoplight switches, and the two switches are turned ON together when the brake pedal is depressed. Power supply voltage is provided to the stoplight switch via the stoplight relay, the stoplight relay diode, and the stoplight switch diode. When the stoplight switch is turned ON, the ground circuit is established, and the signal is input to the ECM. The ECM sets the DTC if the stoplight switch 1 and 2 signal input counts do not match.

2. Condition for setting DTC P0571

Condition for running the DTC

● The battery voltage is 18 - 32 V.

Condition for setting the DTC

● The ECM detects a correlation error between the stoplight switch 1 signal and the stoplight switch 2 signal 32 times.

3. Action taken when DTC P0571 sets

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0571

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0571 (Flash code 26) Brake Switch Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Brake Switch 1 parameter check

1) Turn ON the ignition switch.

2) Press and release the brake switch.

3) Observe the Brake Switch 1 parameter on the scan tool. Does the Brake Switch 1 parameter show ON/OFF?

Yes

⇒Proceed to 9. Brake Switch 2 parameter check

No

⇒Proceed to 3. Inspection of each harness connector related to stoplight switch 1

3. Inspection of each harness connector related to stoplight switch 1

1) Inspect for poor connections at the stoplight switch 1 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 4. Stoplight switch 1 circuit check using fused jumper wire

No

Repair or replace if necessary.

⇒Proceed to 8. Brake pedal switch 1 signal input check

4. Stoplight switch 1 circuit check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the stoplight switch 1 harness connector (FL21) .

3) Connect a fused jumper wire to the stoplight switch 1 circuit (pins 1 and 2 of FL21).

Refer to "*Engine Control*".

4) Turn ON the ignition switch.

5) While observing the Brake Switch 1 parameter on the scan tool, disconnect the jumper wire. Does the Brake Switch 1 parameter show ON/OFF?

Yes

Replace stoplight switch 1.

Refer to "*9.Body, Cab, Accessories 9A.Lighting Systems Stoplight switch removal*".

Refer to "*9.Body, Cab, Accessories 9A.Lighting Systems Stoplight switch installation*".

⇒Proceed to 8. Brake pedal switch 1 signal input check

No (Does not turn ON)

⇒Proceed to 5. Inspection for open circuit in stoplight switch 1 circuit

No (Does not turn OFF)

⇒Proceed to 6. Stoplight switch 1 circuit voltage check

5. Inspection for open circuit in stoplight switch 1 circuit

1) Inspect for an open circuit or high resistance between the ECM (pin 5 of FL557) and stoplight switch 1 (pin 1 of FL21). Is the result normal?

2) Inspect for an open circuit or high resistance between stoplight switch 1 (pin 2 of FL21) and the frame ground. Is the result normal?

Refer to "*Engine Control*".

3) Are all of the results normal?

Yes

⇒Proceed to 16. Stoplight switch diode harness connector voltage check

No

Repair or replace if necessary.

⇒Proceed to 8. Brake pedal switch 1 signal input check

6. Stoplight switch 1 circuit voltage check

1) Turn OFF the ignition switch.

2) Disconnect the stoplight switch 1 harness connector (FL21) .

3) Turn ON the ignition switch.

4) Measure the voltage between the stoplight switch 1 circuit (pin 1 of FL21) and frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 18 V

Yes

⇒Proceed to 7. Inspection for short to ground in stoplight switch 1 circuit

No

⇒Proceed to 16. Stoplight switch diode harness connector voltage check

7. Inspection for short to ground in stoplight switch 1 circuit

1) Inspect for a short to ground between the ECM (pin 5 of FL557) and stoplight switch 1 (pin 1 of FL21). Is the result normal?

2) Inspect for a short to ground between stoplight switch 1 (pin 1 of FL21) and the stoplight switch diode (pin 3 of FL149). Is the result normal?

Refer to “*Engine Control*”.

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 15. Inspection for open diode across stoplight switch

No

Repair or replace if necessary.

⇒Proceed to 8. Brake pedal switch 1 signal input check

8. Brake pedal switch 1 signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P0571 set?

Yes

⇒Proceed to 9. Brake Switch 2 parameter check

No

⇒Proceed to 24. Repair verification

9. Brake Switch 2 parameter check

1) Turn ON the ignition switch.

2) Press and release the brake switch.

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3) Observe the Brake Switch 2 parameter on the scan tool. Does the Brake Switch 2 parameter show ON/OFF?

Yes

⇒Proceed to 24. Repair verification

No

⇒Proceed to 10. Inspection of each harness connector related to stoplight switch 2

10. Inspection of each harness connector related to stoplight switch 2

1) Inspect for poor connections at the stoplight switch 2 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 11. Stoplight switch 2 circuit check using fused jumper wire

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

11. Stoplight switch 2 circuit check using fused jumper wire

1) Turn OFF the ignition switch.

2) Disconnect the stoplight switch 2 harness connector (FL20) .

3) Connect a fused jumper wire to the stoplight switch 2 circuit (pins 1 and 2 of FL20).

Refer to “*Engine Control*”.

4) Turn ON the ignition switch.

5) While observing the Brake Switch 2 parameter on the scan tool, disconnect the jumper wire. Does the Brake Switch 2 parameter show ON/OFF?

Yes

Replace stoplight switch 2.

Refer to "*9.Body, Cab, Accessories 9A.Lighting Systems Stoplight switch removal*".

Refer to "*9.Body, Cab, Accessories 9A.Lighting Systems Stoplight switch installation*".

⇒Proceed to 24. Repair verification

No (Does not turn ON)

⇒Proceed to 12. Inspection for open circuit in stoplight switch 2 circuit

No (Does not turn OFF)

⇒Proceed to 13. Stoplight switch 2 circuit voltage check

12. Inspection for open circuit in stoplight switch 2 circuit

1) Inspect for an open circuit or high resistance between the ECM (pin 4 of FL557) and stoplight switch 2 (pin 1 of FL20). Is the result normal?

2) Inspect for an open circuit or high resistance between stoplight switch 2 (pin 2 of FL20) and the frame ground. Is the result normal?

Refer to “*Engine Control*”.

3) Are all of the results normal?

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Yes

⇒Proceed to 22. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

13. Stoplight switch 2 circuit voltage check

1) Turn OFF the ignition switch.

2) Disconnect the stoplight switch 2 harness connector (FL20) .

3) Turn ON the ignition switch.

4) Measure the voltage between the stoplight switch 2 circuit (pin 1 of FL20) and frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value:18 V

Yes

⇒Proceed to 14. Inspection for short to ground in stoplight switch 2 circuit

No

⇒Proceed to 15. Inspection for open diode across stoplight switch

14. Inspection for short to ground in stoplight switch 2 circuit

1) Inspect for a short to ground between the ECM (pin 4 of FL557) and stoplight switch 2 (pin 1 of FL20).

Is the result normal?

2) Inspect for a short to ground between stoplight switch 2 (pin 1 of FL20) and the stoplight switch diode (pin 1 of FL149). Is the result normal?

Refer to “*Engine Control*”.

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 22. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

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15. Inspection for open diode across stoplight switch

1) Inspect for an open circuit or high resistance between the stoplight switch diode (pin 3 of FL149) and stoplight switch 1 (pin 1 of FL21). Is the result normal?

2) Inspect for an open circuit or high resistance between the stoplight switch diode (pin 1 of FL149) and stoplight switch 2 (pin 1 of FL20). Is the result normal?

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 16. Stoplight switch diode harness connector voltage check

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

16. Stoplight switch diode harness connector voltage check

1) Turn OFF the ignition switch.

2) Disconnect the stoplight switch diode harness connector (FL149) .

3) Turn ON the ignition switch.

4) Measure the voltage between the stoplight switch diode harness connector (pin 2 of FL149) and frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 18 V

Yes

Replace the stoplight switch diode.

⇒Proceed to 24. Repair verification

No

⇒Proceed to 17. Fuse inspection

17. Fuse inspection

1) Inspect for a blown out STOP LAMP 15 A fuse. Is the result normal?

Yes

⇒Proceed to 18. Stoplight relay inspection

No

Replace the fuse. If the fuse blows out again, repair the short to ground in the circuits relating to the STOP LAMP 15 A fuse.

⇒Proceed to 24. Repair verification

18. Stoplight relay inspection

1) Inspect the stoplight relay.Is the result normal?

Yes

⇒Proceed to 19. Inspection for open circuit between fuse and stoplight relay

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

19. Inspection for open circuit between fuse and stoplight relay

1) .Inspect for an open circuit or high resistance between the STOP LAMP 15 A fuse and the stoplight relay (pin 2 of R/B 1 STOP LAMP). Is the result normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 20. Inspection for open circuit between stoplight relay and stoplight relay diode

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

20. Inspection for open circuit between stoplight relay and stoplight relay diode

1) Inspect for an open circuit or high resistance between the stoplight relay (pin 4 of R/B 1 STOP LAMP) and the stoplight relay diode (pin 2 of FL149). Is the result normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 21. Inspection for open circuit between stoplight relay diode and stoplight switch diode

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

21. Inspection for open circuit between stoplight relay diode and stoplight switch diode

1) Inspect the circuit between the stoplight relay diode (pin 2 of FL149) and the stoplight switch diode (pins 1 and 3 of FL149) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Yes

Replace the stoplight relay diode.

⇒Proceed to 24. Repair verification

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

22. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 23. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 24. Repair verification

23. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 24. Repair verification

24. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0601 (Flash code 53) Internal Control Module Memory Check Sum Error

1. DTC P0601 (Flash code 53) Internal Control Module Memory Check Sum Error DTC information

1. DTC P0601 description

This diagnosis applies to the microprocessor inside the ECM.

2. Condition for setting DTC P0601

Condition for setting the DTC

The ECM detects that the calculated checksum does not match the checksum stored in the ROM.

3. Action taken when DTC P0601 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits pre-injection.

● The ECM stops the engine. (The engine is ready to start after the ignition switch is turned OFF for 10 seconds or more.)

4. Condition for clearing DTC P0601

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0601 (Flash code 53) Internal Control Module Memory Check Sum Error diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM replacement

No

⇒Proceed to 4. Repair verification

3. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

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Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 4. Repair verification

4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0602 (Flash code 154) Control Module Programming Error

1. DTC P0602 (Flash code 154) Control Module Programming Error DTC information

1. DTC P0602 description

The injector ID code information is stored in EEPROM within the ECM. If no injector ID code is programmed in the ECM or the ECM detects an error in the programmed injector ID code, the DTC is set.

2. Condition for setting DTC P0602

Condition for setting the DTC

Any of the following conditions are met.

● The ECM detects that the fuel delivery rate and the injector ID code are not programmed.

● The ECM detects an error in the programmed injector ID Code.

3. Action taken when DTC P0602 sets

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0602

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

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4. DTC P0602 (Flash code 154) Control Module Programming Error diagnostics

1. Engine Control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Verify that all the tool connections are securely connected.

2) Verify that the programming device operates properly.

3) Connect the scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Turn ON the ignition switch.

6) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Injector ID code and fuel delivery rate verification

No

⇒Proceed to 5. Repair verification

3. Injector ID code and fuel delivery rate verification

1) Verify that the correct injector ID code and fuel delivery rate are input to the ECM with a scan tool.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

2) If the injector ID code and the fuel delivery rate are correctly input, clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Turn ON the ignition switch.

5) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 4. ECM replacement

No

⇒Proceed to 5. Repair verification

4. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P0604 (Flash code 153) Internal Control Module RAM

1. DTC information

1. DTC P0604 description

This diagnosis applies to the microprocessor inside the ECM.

2. Condition for setting DTC P0604

Condition for setting the DTC

● The ECM detects a malfunction inside the RAM.

3. Action taken when DTC P0604 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits pre-injection.

● The ECM stops the engine. (The engine is ready to start after the ignition switch is turned OFF for 10 seconds or more.)

4. Condition for clearing DTC P0604

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

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4.Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM replacement

No

⇒Proceed to 4. Repair verification

3. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 4. Repair verification

4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0606 (Flash code 51) ECM Processor

1. DTC information

1. DTC P0606 description

This diagnosis applies to the microprocessor inside the ECM.

2. Condition for setting DTC P0606

Condition for running the DTC

● The battery voltage is 16 V or more.

● The ignition switch is on

Condition for setting the DTC

● The ECM detects a malfunction inside the main CPU or sub integrated circuit.

3. Action taken when DTC P0606 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P0606

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM replacement

No

⇒Proceed to 4. Repair verification

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3. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 4. Repair verification

4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance

1. DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance DTC information

1. DTC P060B description

This diagnosis applies to the microprocessor inside the ECM.

2. Condition for setting DTC P060B

Condition for setting the DTC

● The ECM detects a malfunction inside the A/D converter.

3. Action taken when DTC P060B sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

4. Condition for clearing DTC P060B

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. *DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance* diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM replacement

No

⇒Proceed to 4. Repair verification

3. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

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Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 4. Repair verification

4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit

1. DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit DTC information

1. DTC P0641 description

The ECM supplies 5 V reference to the following sensors through 5 V reference circuit 1.

● Accelerator pedal position sensor 1

● PTO throttle sensor

Also, the ECM supplies 5 V reference to the following sensors through 5 V reference circuit 6.

● Fuel rail pressure sensor

● EGR position sensor 1

5V reference circuits 1 and 6 are independent of each other outside the ECM but share the bus inside the ECM. Therefore, all of 5 V reference circuits 1 and 6 may be affected by a short circuit in one of the sensor 5 V reference circuits. The ECM monitors the voltage of 5 V reference circuits 1 and 6, and if it detects that the voltage is excessively low or high, the DTC is set.

2. Condition for setting DTC P0641

Condition for running the DTC

● The battery voltage is 16 - 32 V.

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the voltage of 5 V reference circuit 1 or 6 is 4.5 V or less, or 5.5 V or more.

3. Action taken when DTC P0641 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking.

● The ECM limits the fuel injection quantity.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P0641

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

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1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. 5 V reference voltage check for EGR position sensor 1

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. 5V reference voltage check for EGR position sensor 1

1) Turn OFF the ignition switch.

2) Disconnect the EGR valve 1 harness connector (E98) .

3) Turn ON the ignition switch.

4) Measure the voltage between the 5 V reference circuit of EGR position sensor 1 (pin 1 of E98) and the frame ground with a DMM.

Refer to “*Engine Control*”.

Value: 4.5 to 5.5 V

The reading is more than the specified value.

⇒Proceed to 8. Inspection for short to power supply circuit in 5 V reference circuit

The reading is within the specified range.

Replace EGR valve 1.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 10. Repair verification

The reading is less than the specified value.

⇒Proceed to 4. Fuel rail pressure sensor 5 V reference voltage check

4. Fuel rail pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the fuel rail pressure sensor harness connector (E42) .

3) Turn ON the ignition switch.

4) Measure the voltage between the 5 V reference circuit of EGR position sensor 1 (pin 1 of E98) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 5. 5 V reference voltage check for accelerator pedal position sensor 1

No

Replace the fuel rail pressure sensor.

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Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) FRP sensor installation*".

⇒Proceed to 10. Repair verification

5. 5V reference voltage check for accelerator pedal position sensor 1

1) Turn OFF the ignition switch.

2) Disconnect the accelerator pedal position sensor harness connector (FL648) .

3) Turn ON the ignition switch.

4) Measure the voltage between the 5 V reference circuit of EGR position sensor 1 (pin 1 of E98) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes (Models equipped with PTO throttle sensor)

⇒Proceed to 6. PTO throttle sensor 5 V reference voltage check

Yes (Except models equipped with PTO throttle sensor)

⇒Proceed to 7. Inspection for short to ground in 5 V reference circuit

No

Replace the Accelerator pedal position sensor 1.

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 10. Repair verification

6. PTO throttle sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the PTO throttle sensor harness connector (B14) .

3) Turn ON the ignition switch.

4) Measure the voltage between the 5 V reference circuit of EGR position sensor 1 (pin 1 of E98) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 7. Inspection for short to ground in 5 V reference circuit

No

Replace the PTO throttle sensor.

⇒Proceed to 10. Repair verification

7. Inspection for short to ground in 5 V reference circuit

1) Inspect 5 V reference circuit 1 between the ECM (pin 17 of FL559) and the following components for a short to ground or a short to the low reference circuit. Is the result normal?

● Accelerator pedal position sensor 1(pin 4 of FL648)

● PTO throttle sensor (pin 3 of B14)

Refer to "*Engine Control*".

Refer to "*Engine Control*".

2) .Inspect 5 V reference circuit 6 between the ECM (pin 30 of E82) and the following components for a short to ground or a short to the low reference circuit. Is the result normal?

● Fuel rail pressure sensor (pin 3 of E42)

● EGR position sensor 1(pin 1 of E98)

Refer to "*Engine Control*".

Refer to "*Engine Control*".

3) Are all of the results normal?

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

8. Inspection for short to power supply circuit in 5 V reference circuit

1) Inspect 5V reference circuit 1 between the ECM (pin 17 of FL559) and the following components for a short to the power supply circuit. Is the result normal?

● Accelerator pedal position sensor 1(pin 4 of FL648)

● PTO throttle sensor (pin 3 of B14)

Refer to "*Engine Control*".

Refer to "*Engine Control*".

2) Inspect 5 V reference circuit 6 between the ECM (pin 30 of E82) and the following components for a short to the power supply circuit. Is the result normal?

● Fuel rail pressure sensor (pin 3 of E42)

● EGR position sensor 1 (pin 1 of E98)

Refer to "*Engine Control*".

Refer to "*Engine Control*".

3) Are all of the results normal?

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

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Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0650 (Flash code 77) Malfunction Indicator Light (MIL) Control Circuit

1. DTC P0650 (Flash code 77) Malfunction Indicator Light (MIL) Control Circuit DTC information

1. DTC P0650 description

The MIL is in the instrument panel cluster. The MIL informs the driver that a malfunction has occurred in the Engine Control system and that it is necessary to repair the vehicle. The ECM monitors for any status that is different from the MIL command status in the MIL control circuit. The circuit is defective if the ECM detects a low voltage when the MIL is commanded OFF, or if the ECM detects a high voltage when the MIL is commanded ON. If the ECM detects any abnormal value in the control circuit voltage, the DTC is set.

2. Condition for setting DTC P0650

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

Condition for setting the DTC

Any of the following conditions are met.

● The ECM detects a low voltage condition in the MIL control circuit when the light is commanded OFF.

● The ECM detects a high voltage condition in the MIL control circuit when the light is commanded ON.

3. Action taken when DTC P0650 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0650

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0650 (Flash code 77) Malfunction Indicator Light (MIL) Control Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

Current DTC check

1) Check the operation of the dash panel.

2) Connect the scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Turn ON the ignition switch for at least 10 seconds.

5) Start the engine.

6) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Fuse inspection

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No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Fuse inspection

1) Inspect for a blown out METER 7.5A fuse. Is the result normal?

Yes

⇒Proceed to 4. Inspection for short to ground in MIL control circuit

No

Replace the fuse. If the fuse blows out again, repair the short to ground in the circuits relating to the METER 10 A fuse.

⇒Proceed to 12. Repair verification

4. Inspection for short to ground in MIL control circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL558) .

Refer to "*Instrument panel cluster*".

3) Turn ON the ignition switch.

4) Check the MIL.Does the MIL turn OFF?

Yes

⇒Proceed to 5. Inspection for short to power supply in MIL control circuit

No

Repair the short to ground in the MIL control circuit between the ECM (pin 7 of FL558) and the instrument panel cluster (pin 8 of FU74).

⇒Proceed to 12. Repair verification

5. Inspection for short to power supply in MIL control circuit

1) Remove the Meter 7.5 A fuse.

2) Turn ON the ignition switch.

3) Measure the voltage between the MIL control circuit (pin 7 of FL558) and the frame ground with a DMM. Is the voltage less than or equal to the specified value?

Refer to "*Instrument panel cluster*".

Value: 1V

Yes

⇒Proceed to 6. MIL illumination check using fused jumper wire

No

Repair the short to the power supply circuit in the MIL control circuit between the ECM (pin 7 of FL558) and the instrument panel cluster (pin 8 of FU74).

⇒Proceed to 12. Repair verification

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6. MIL illumination check using fused jumper wire

1) Turn OFF the ignition switch.

2) Install the METER 7.5 A fuse.

3) Turn ON the ignition switch.

4) Connect a fused jumper wire between the MIL control circuit (pin 7 of FL558) and the frame ground.

Refer to "*Instrument panel cluster*".

5) Check the MIL.Does the MIL illuminate?

Yes

⇒Proceed to 10. ECM harness connector inspection

No

⇒Proceed to 7. Instrument panel cluster power supply voltage check

7. Instrument panel cluster power supply voltage check

1) Connect a test lamp between the ignition power supply circuit (pin 30 of FU72) and the frame ground.

Refer to "*Instrument panel cluster*".

2) Turn ON the ignition switch.Does the test lamp illuminate?

Yes

⇒Proceed to 8. Inspection for open circuit in MIL control circuit

No

Repair the open circuit or high resistance in the ignition power supply circuit between the METER 10 A fuse and the instrument panel cluster (pin 30 of FU72).

⇒Proceed to 12. Repair verification

8. Inspection for open circuit in MIL control circuit

1) Inspect the MIL control circuit between the ECM (pin 7 of FL558) and the instrument panel cluster (pin 8 of FU74) for an open circuit or high resistance. Is the result normal?

Refer to "*Instrument panel cluster*".

Yes

⇒Proceed to 9. Instrument panel cluster harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 12. Repair verification

9. Instrument panel cluster harness connector inspection

1) Inspect for poor connections at the instrument panel cluster harness connector (pins 30 of FU72 and pin 8 of FU74). Is the connection status normal?

Refer to "*Instrument panel cluster*".

Yes

Repair or replace the instrument panel cluster.

Refer to "*9.9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Instrument panel cluster removal*".

Refer to "*9.9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Instrument panel cluster installation*".

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⇒Proceed to 12. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 12. Repair verification

10. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 7 of FL558). Is the connection status normal?

Refer to "*Instrument panel cluster*".

Yes

⇒Proceed to 11. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 12. Repair verification

11. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 12. Repair verification

12. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch for at least 10 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool.

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DTC P0651 (Flash Code 56)Sensor Reference Voltage 2 Circuit

1. DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit DTC information

1. DTC P0651 description

The ECM supplies 5 V reference to the following sensors through 5 V reference circuit 2.

● Accelerator pedal position sensor 2

● Barometric pressure sensor

In addition, the ECM also supplies 5 V reference to the following sensors through 5 V reference circuit 5.

● CMP sensor

5 V reference circuits 2 and 5 are independent of each other outside the ECM but share the bus inside the ECM. Therefore, all of 5 V reference circuits 2 and 5 may be affected by a short circuit in one of the sensor 5 V reference circuits. The ECM monitors the voltage of 5 V reference circuits 2 and 5, and if it detects that the voltage is excessively low or high, the DTC is set.

2. Condition for setting DTC P0651

Condition for running the DTC

● The battery voltage is 16 - 32 V.

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the voltage of 5 V reference circuit 2 or 5 is 4.5 V or less, or 5.5 V or more.

3. Action taken when DTC P0651 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking.

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P0651

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

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2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. CMP sensor 5 V reference voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. CMP sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the CMP sensor harness connector (E46) .

3) Turn ON the ignition switch.

4) Measure the voltage between the CMP sensor 5 V reference circuit (pin 3 of E46) and the frame ground with a DMM.

Refer to “*Engine Control*”.

Value: 4.5 to 5.5 V

The reading is more than the specified value.

⇒Proceed to 7. Inspection for short to power supply circuit in 5 V reference circuit

The reading is within the specified range.

Replace the CMP sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CMP sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) CMP sensor installation*".

⇒Proceed to 9. Repair verification

The reading is less than the specified value.

⇒Proceed to 4. Barometric pressure sensor 5 V reference voltage check

4. Barometric pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the barometric pressure sensor harness connector (FL740) .

3) Turn ON the ignition switch.

4) Measure the voltage between the CMP sensor 5 V reference circuit (pin 3 of E46) and the frame ground with a DMM.Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 5. 5 V reference voltage check for accelerator pedal position sensor 2

No

Replace the barometric pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor installation*".

⇒Proceed to 9. Repair verification

5. 5V reference voltage check for accelerator pedal position sensor 2

1) Turn OFF the ignition switch.

2) Disconnect the accelerator pedal position sensor 2 harness connector (FL648) .

3) Turn ON the ignition switch.

4) Measure the voltage between the CMP sensor 5 V reference circuit (pin 3 of E46) and the frame ground with a DMM.Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 6. Inspection for short to ground in 5 V reference circuit

No

Replace the accelerator pedal position sensor 2.

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 9. Repair verification

6. Inspection for short to ground in 5 V reference circuit

1) Inspect 5 V reference circuit 2 between the ECM (pin 8 of FL558) and the following components for a short to ground or a short to the low reference circuit. Is the result normal?

● Accelerator pedal position sensor 2 (pin 1 of FL648)

● Barometric pressure sensor (pin 3 of FL740)

Refer to “*Engine Control*”.

Refer to “*Engine Control*”.

2) Inspect 5 V reference circuit 5 between the ECM (pin 21 of E82) and the following components for a short to ground or a short to the low reference circuit. Is the result normal?

● CMP sensor (pin 3 of E46)

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 8. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 9. Repair verification

7. Inspection for short to power supply circuit in 5 V reference circuit

1) Inspect 5 V reference circuit 2 between the ECM (pin 8 of FL558) and the following components for a

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short to the power supply circuit. Is the result normal?

● Accelerator pedal position sensor 2 (pin 1 of FL648)

● Barometric pressure sensor (pin 3 of FL740)

Refer to “*Engine Control*”.

Refer to “*Engine Control*”.

2) Inspect 5 V reference circuit 5 between the ECM (pin 21 of E82) and the following components for a short to the power supply circuit. Is the result normal?

● CMP sensor (pin 3 of E46)

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 8. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 9. Repair verification

8. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 9. Repair verification

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9. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P0685 (Flash code 416) ECM Power Relay Control Circuit Open

1. DTC information

1. DTC P0685 description

The ECM main relay is energized in order to supply battery power to the ECM through the relay switch side when the ECM receives an ignition switch ON signal. When the ignition switch turns OFF, voltage application to the ECM main relay is stopped after a predetermined period of length of time has passed. If the ECM detects a low voltage status in the ECM main relay voltage supply circuit when 3 seconds have passed after tuning the ignition switch ON, the DTC is set.

2. Condition for setting DTC P0685

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects a low voltage condition in the relay voltage supply circuit for approximately 3 seconds when the ECM main relay is commanded ON.

3. Action taken when DTC P0685 sets

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0685

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM main relay inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. ECM main relay inspection

1) Turn OFF the ignition switch for at least 30 seconds.

2) Replace the ECM main relay with a glow relay or a known good relay.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 4. Fuse inspection

No

Replace the ECM main relay.

⇒Proceed to 7. Repair verification

4. Fuse inspection

1) Inspect for poor connections at the frame ground, and retighten or clean the corroded area as necessary.

2) Inspect for a blown out ECM 40 A slow blow fuse. Is the result normal?

Yes

⇒Proceed to 5. ECM main relay circuit inspection

No

Replace the slow blow fuse. If the slow blow fuse blows out again, repair the short to ground in the circuits relating to the ECM 40 A slow blow fuse.

⇒Proceed to 7. Repair verification

5. ECM main relay circuit inspection

1) Inspect for poor connections at the ECM harness connector (pins 1, 2, 6, and 7 of FL559). Is the connection status normal?

2) Inspect each relay circuit for an open circuit or high resistance.Is the result normal?

● Between the ECM (pins 1 and 2 of FL559) and the ECM main relay (pin 4 of FL398)

● Between the ECM (pins 6 and 7 of FL559) and the ECM main relay (pin 2 of FL398)

● Between the ECM 40 A slow blow fuse and the ECM main relay (pin 1 of FL398)

● Between the ECM main relay (pin 3 of FL398) and the frame ground

Refer to “*Engine Control*”.

3) Are all of the results normal?

Yes

⇒Proceed to 6. ECM replacement

No

Repair the circuit or the connection as necessary.

⇒Proceed to 7. Repair verification

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6. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 7. Repair verification

7. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool.

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DTC P0687 (Flash code 416) ECM Power Relay Control Circuit High

1. DTC information

1. DTC P0687 description

The ECM main relay is energized in order to supply battery power to the ECM through the relay switch side when the ECM receives an ignition switch ON signal. When the ignition switch turns OFF, voltage application to the ECM main relay is stopped after a predetermined period of length of time has passed.

If the ECM detects that the ECM is ON when 5 seconds have passed after tuning the ignition switch OFF, the DTC is set.

2. Condition for setting DTC P0687

Condition for running the DTC

● DTC P0606 is not set.

Refer to "*DTC P0606 (Flash code 51) ECM Processor* ".

Condition for setting the DTC

● The ECM detects that the ECM is ON when the ECM main relay is commanded OFF.

3. Action taken when DTC P0687 sets

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P0687

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4.Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Inspection for short to power supply in battery voltage feed circuit

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

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3. Inspection for short to power supply in battery voltage feed circuit

1) Turn OFF the ignition switch for at least 30 seconds.

2) Remove the ECM main relay.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool.Is DTC P0685 set?

Yes

⇒Proceed to 4. ECM main relay inspection

No

Repair the short to the power supply circuit in the battery voltage feed circuit between the ECM (pins 1 and 2 of FL559) and the ECM main relay (pin 4 of FL398).

⇒Proceed to 5. Repair verification

4. ECM main relay inspection

1) Turn OFF the ignition switch for at least 30 seconds.

2) Replace the ECM main relay with a glow relay or a known good relay.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Repair the short to the power supply circuit between the ECM (pins 6 and 7 of FL559) and the ECM main relay (pin 2 of FL398).

⇒Proceed to 5. Repair verification

No

Replace the ECM main relay.

⇒Proceed to 5. Repair verification

POWERSTAR

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

4) Observe the DTC information with a scan tool.

DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit

1. DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit DTC information

1. DTC P0697 description

The ECM supplies 5 V reference to the following sensors through 5 V reference circuit 4.

● Boost pressure sensor

● EGR position sensor 2

The ECM monitors the voltage of 5 V reference circuits 4, and if it detects that the voltage is excessively low or high, the DTC is set.

2. Condition for setting DTC P0697

Condition for running the DTC

● The battery voltage is 16 - 32V.

● DTC P060B is not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Condition for setting the DTC

● The ECM detects that the voltage of 5 V reference circuit 4 is 4.5 V or less, or 5.5 V or more.

3. Action taken when DTC P0697 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P0697

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

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Yes

⇒Proceed to 3. Boost pressure sensor 5 V reference voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Boost pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the boost pressure sensor harness connector (E105) .

3) Turn ON the ignition switch.

4) Measure the voltage between the boost pressure sensor 5 V reference circuit (pin 3 of E105) and the frame ground with a DMM.

Refer to “*Engine Control*”.

Value: 4.5 to 5.5 V

The reading is more than the specified value.

⇒Proceed to 6. Inspection for short to power supply circuit in 5 V reference circuit

The reading is within the specified range.

Replace the boost pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor installation.*"

⇒Proceed to 8. Repair verification

The reading is less than the specified value.

⇒Proceed to 4. 5 V reference circuit inspection for EGR position sensor 2

4. 5V reference circuit inspection for EGR position sensor 2

1) Turn OFF the ignition switch.

2) Disconnect the EGR valve 2 harness connector (E99) .

3) Turn ON the ignition switch.

4) Measure the voltage between the boost pressure sensor 5 V reference circuit (pin 3 of E105) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 5. Inspection for short to ground in 5 V reference circuit

No

Replace the EGR valve 2.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 8. Repair verification

5. Inspection for short to ground in 5 V reference circuit

1) Inspect 5 V reference circuit 4 between the ECM (pin 19 of E82) and the following components for a short to ground or a short to the low reference circuit. Is the result normal?

● Boost pressure sensor (pin 3 of E105)

● EGR position sensor 2 (pin 1 of E99)

Refer to "*Engine Control*".

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 8. Repair verification

6. Inspection for short to power supply circuit in 5 V reference circuit

1) Inspect 5 V reference circuit 4 between the ECM (pin 19 of E82) and the following components for a short to the power supply circuit. Is the result normal?

● Boost pressure sensor(pin 3 of E105)

● EGR position sensor 2(pin 1 of E99)

Refer to "*Engine Control*".

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

POWERSTAR

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1062 (Flash Code 257) Fuel Pressure Regulator 1 Solenoid Control Circuit

1. DTC P1062 (Flash Code 257) Fuel Pressure Regulator 1 Solenoid Control Circuit DTC information

1. DTC P1062 description

The PCV flyback circuit in the ECM controls the PCV drive voltage through 2 systems, PCV1 and PCV2.

2. Condition for setting DTC P1062

Condition for setting the DTC

● A malfunction lasting 0.1 seconds or longer was detected on the regenerative circuit of the PCV1 drive circuit.

3. Action taken when DTC P1062 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P1062

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P1062 (Flash Code 257) Fuel Pressure Regulator 1 Solenoid Control Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "ECM power supply and ground circuit inspection".

Yes

⇒Proceed to 3. ECM harness connector inspection

No

Repair or replace if necessary.

⇒Proceed to 5. Repair verification

3. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 17 and 25 of E83). Is the connection status normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 4. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 5. Repair verification

4. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1063 (Flash Code 258) Fuel Pressure Regulator 2 Solenoid Control Circuit

1. DTC P1063 (Flash Code 258) Fuel Pressure Regulator 2 Solenoid Control Circuit DTC information

1. DTC P1063 description

The PCV flyback circuit in the ECM controls the PCV drive voltage through 2 systems, PCV1 and PCV2.

2. Condition for setting DTC P1063

Condition for setting the DTC

● A malfunction lasting 0.1 second or longer was detected on the regenerative circuit of the PCV2 drive circuit.

3. Action taken when DTC P1063 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P1063

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P1063 (Flash Code 258) Fuel Pressure Regulator 2 Solenoid Control Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 3. ECM harness connector inspection

No

Repair or replace if necessary.

⇒Proceed to 5. Repair verification

3. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 30 and 31 of E83). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 4. ECM replacement

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No

Repair the connection as necessary.

⇒Proceed to 5. Repair verification

4. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1093 (Flash code 226) Fuel Rail Pressure Too Low

1. DTC information

1. DTC P1093 description

The ECM monitors the fuel rail pressure based on the fuel rail pressure sensor signals. If the pressure is low, the ECM adjusts the operation of the supply pump PCV, and increases the fuel rail pressure. If a failure in the fuel supply to the supply pump or a malfunction in the supply pump occurs, raising the fuel rail pressure will become impossible. If the fuel rail pressure becomes higher than a predetermined level, the pressure limiter in the fuel rail is activated, which lowers the fuel rail pressure and prevents engine mechanical failure.

2. Condition for setting DTC P1093

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

● The water temperature is 60℃{132℉} or more.

● Engine speed greater than or equal to 375 rpm.

● Differentiate cylinder events.

● Start rail pressure feedback mode.

● DTCs P0087, P0091, P0092, P0192, P0193, P0335, P0336, P060B, P0641, P1062, P1063, P2295, and P2296 are not set.

Refer to "*DTC P0087 (Flash Code 225) Fuel Rail/System Pressure - Too Low*".

Refer to "*DTC P0091 (Flash code 247) Fuel Pressure Regulator Control Circuit Low*".

Refer to "*DTC P0092 (Flash code 217) Fuel Pressure Regulator Control Circuit High*".

Refer to "*DTC P0192 (Flash code 245) Fuel Rail Pressure Sensor Circuit Low*".

Refer to "*DTC P0193 (Flash code 245) Fuel Rail Pressure Sensor Circuit High*".

Refer to "*DTC P0335 (Flash code 15) Crankshaft Position Sensor Circuit*".

Refer to "*DTC P0336 (Flash code 15) Crankshaft Position Sensor Circuit Range/Performance*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P1062 (Flash Code 257) Fuel Pressure Regulator 1 Solenoid Control Circuit*".

Refer to "*DTC P1063 (Flash Code 258) Fuel Pressure Regulator 2 Solenoid Control Circuit*".

Refer to "*DTC P2295 (Flash Code 248) Fuel Pressure Regulator 2 Control Circuit Low*".

Refer to "*DTC P2296 (Flash Code 218) Fuel Pressure Regulator 2 Control Circuit High*".

Condition for setting the DTC

● The ECM detects that the actual fuel rail pressure is less than the desired fuel rail pressure by 50 MPa {7,250 psi} or more for 5 seconds or more.

3. Action taken when DTC P1093 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P1093

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Fuel system inspection

1) Inspect the fuel amount. Refill if the level is low.

2) Bleed the air in the fuel.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel air bleed*".

Procedure completion

⇒Proceed to 3. Current DTC check

3. Current DTC check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool.Is a DTC set?

Yes

⇒Proceed to 4. Inspection for leakage, collapsing, or clogging of the fuel pipe and fuel filter inspection

No

⇒Proceed to 13. Repair verification

4. Inspection for leakage, collapsing, or clogging of the fuel pipe and fuel filter inspection

1) Turn OFF the ignition switch.

2) Check for any abnormal conditions such as fuel leakage, collapsing, or clogging in all fuel pipes. And, inspect for any abnormal conditions in the fuel filters, etc. Is the result normal?

Yes

⇒Proceed to 5. Fuel high pressure piping inspection

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

5. Fuel high pressure piping inspection

1) Start the engine.

2) Depress the accelerator pedal.

3) Inspect for fuel leakage from the fuel high pressure piping. Is the result normal?

Yes

⇒Proceed to 6. Cylinder injection correction amount check

No

Repair or replace the parts leaking fuel.

⇒Proceed to 13. Repair verification

6. Cylinder injection correction amount check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Start the engine.

4) Observe the Fuel Compensation parameter for each cylinder on the scan tool. Is the Fuel Compensation parameter within the normal range?

Value:-4 - 4 mm3/st

Yes

⇒Proceed to 7. PCV1 inspection

No

Replace the cylinder injector that is outside the specified value.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 7. PCV1 inspection

7. PCV1 inspection

1) Start the engine.

2) Disconnect the PCV1 harness connector (E43) while the engine is idling..

Refer to “*Engine Control*”.

3) Check the engine condition. Does the engine stall?

Caution:

● DTC P0091 is set if the PCV 1 harness connector (E43) is disconnected. Clear the DTC after inspection.

Yes

⇒Proceed to 9. Fuel supply pump replacement

No

⇒Proceed to 8. PCV2 inspection

8. PCV2 inspection

1) Connect the PCV1 harness connector (E43) .

2) Start the engine.

3) Disconnect the PCV2 harness connector (E44) while the engine is idling.

Refer to "*Engine Control*".

4) Check the engine condition. Does the engine stall?

Caution:

● DTC P2295 is set if the PCV 2 harness connector (E44) is disconnected. Clear the DTC after inspection.

Yes

⇒Proceed to 9. Fuel supply pump replacement

No

⇒Proceed to 10. Pressure limiter inspection

9. Fuel supply pump replacement

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

Procedure completion

⇒Proceed to 13. Repair verification

10. Pressure limiter inspection

1) Remove the fuel pipe from the pressure limiter.

2) Install a hose, etc., to the fuel pipe to prepare the fuel leakage check.

3) Perform a test-run. Does fuel leak from the pressure limiter?

Yes

Replace the pressure limiter.

Refer to "*1.Engine 1C.Fuel System(6WG1) Pressure limiter removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Pressure limiter installation*".

⇒Proceed to 13. Repair verification

No

⇒Proceed to 11. Pressure limiter operation check

11. Pressure limiter operation check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool. Is DTC P1093 set?

Yes

⇒Proceed to 12. ECM replacement

No

⇒Proceed to 13. Repair verification

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12. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 13. Repair verification

13. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1

1. DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1 DTC information

1. DTC P1261 description

The charge-up circuit within the ECM increases the voltage applied to the injector. The charge-up circuit is divided into 2 banks: common power supply 1 and common power supply 2. Common power supply 1 serves the injectors of cylinders No. 1, 2, and 3, and common power supply 2 serves the injectors of cylinders No. 4, 5, and 6. If an open circuit occurs in the injector charge-up circuit of common power supply 1 in the ECM, the DTC is set.

2. Condition for setting DTC P1261

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

Condition for setting the DTC

● The ECM detects an open circuit in the injector charge-up circuit of common power supply 1 in the ECM.

3. Action taken when DTC P1261 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P1261

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine Control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P1261 (Flash Code 34) Injector Positive Voltage Control Circuit Group 1 diagnostics

1. Engine Control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM replacement

No

⇒Proceed to 4. Repair verification

3. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 4. Repair verification

4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2

1. DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2 DTC information

1. DTC P1262 description

The charge-up circuit within the ECM increases the voltage applied to the injector. The charge-up circuit is divided into 2 banks: common power supply 1 and common power supply 2. Common power supply 1 serves the injectors of cylinders No. 1, 2, and 3, and common power supply 2 serves the injectors of cylinders No. 4, 5, and 6. If an open circuit occurs in the injector charge-up circuit of common power supply 2 in the ECM, the DTC is set.

2. Condition for setting DTC P1262

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on

Condition for setting the DTC

● The ECM detects an open circuit in the injector charge-up circuit of common power supply 2 in the ECM.

3. Action taken when DTC P1262 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P1262

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

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2. Engine Control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P1262 (Flash Code 34) Injector Positive Voltage Control Circuit Group 2 diagnostics

1. Engine Control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. ECM replacement

No

⇒Proceed to 4. Repair verification

3. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 4. Repair verification

4. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1404 (Flash code 45) EGR Position Fault

1. DTC information

1. DTC P1404 description

The EGR motor is installed inside the EGR valve. The EGR motor used on this vehicle is a brushless DC motor and is driven by the three-phase motor. EGR motor has the following circuits.

● EGR motor 1 drive circuit 1

● EGR motor 1 drive circuit 2

● EGR motor 1 drive circuit 3

The ECM drives the EGR motor via EGR motor 1 drive circuits 1, 2, and 3. The ECM outputs the drive signal by switching inside the ECM, and the motor rotates according to the combination of the three-phase signal. Also, the valve opening angle is controlled by the duty. If EGR motor drive duty is large and the difference between the desired EGR opening angle and the EGR 1 opening angle is excessive, the ECM sets a DTC.

2. Condition for setting DTC P1404

Condition for running the DTC

● The ignition switch is OFF.

● DTCs P0404, P0409, P0500, P0502, P0503, P060B,and P0651 are not set.

Refer to "*DTC P0404 (Flash code 45) EGR Control Circuit Range/ Performance*".

Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit* ".

Refer to "*DTC P0500 (Flash code 25) Vehicle Speed Sensor* ".

Refer to "*DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input*".

Refer to "*DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that the EGR zero position counter is 31 or more or 5 or less when the ignition switch is OFF.

3. Action taken when DTC P1404 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P1404

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

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1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. EGR operation check using scan tool

1) Clear the DTC with a scan tool.

2) Perform EGR a few times with the scan tool.

3) While observing the Exhaust Gas Recirculation (EGR) Valve Position value, command the Desired EGR Position UP and DOWN.

4) Observe the Exhaust Gas Recirculation (EGR) Valve Position value. Does the Exhaust Gas Recirculation (EGR) Valve Position parameter follow the Desired EGR Position?

Yes

⇒Proceed to 3. Current DTC check

No

⇒Proceed to 4. Inspection for open circuit and short circuit in EGR motor 1 drive circuit

3. Current DTC check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P1404 set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Inspection for open circuit and short circuit in EGR motor 1 drive circuit

1) Inspect the drive circuit between the ECM (pins 1, 2, and 7of E82) and the EGR motor (pins 6, 7, and 8 of E98) for the following conditions.

Is the result normal?

● Open circuit

● Short to ground

● Short to the power supply circuit

● High resistance

Refer to "*Engine Control*".

Yes

Replace EGR valve 1.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

POWERSTAR

⇒Proceed to 5. EGR valve operation signal input check

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

5. EGR valve operation signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P1404 set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

⇒Proceed to 8. Repair verification

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P140A (Flash Code 345) EGR 2 Performance

1. DTC P140A (Flash Code 345) EGR 2 Performance DTC information

1. DTC P140A description

The EGR motor is installed inside the EGR valve. The EGR motor used on this vehicle is a brushless DC motor and is driven by the three-phase motor. EGR motor 2 has the following circuits.

● EGR motor 2 drive circuit 1

● EGR motor 2 drive circuit 2

● EGR motor 2 drive circuit 3

The ECM drives the EGR motor via EGR motor 2 drive circuits 1, 2, and 3. The ECM outputs the drive signal by switching inside the ECM, and the motor rotates according to the combination of the three-phase signal. Also, the valve opening angle is controlled by the duty. If the EGR motor drive duty is large and the difference between the desired EGR opening angle and the EGR 2 opening angle is excessive, the ECM sets the DTC.

2. Condition for setting DTC P140A

Condition for running the DTC

● The battery voltage is 16 - 32 V.

● The desired EGR position is stable.

● DTCs P0409, P060B, P0641, P0697, and P140B are not set.

Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance*".

Condition for setting the DTC

● The ECM detects that when the EGR motor output is 75% or more, the difference between the desired EGR position and the EGR 2 opening angle is excessive for 10 seconds or more.

3. Action taken when DTC P140A sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P140A

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P140A (Flash Code 345) EGR 2 Performance diagnostics

POWERSTAR

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. EGR operation check using scan tool

1) Clear the DTC with a scan tool.

2) Perform EGR a few times with the scan tool.

3) While observing the Exhaust Gas Recirculation (EGR) Valve Position value, command the Desired EGR Position UP and DOWN.

4) Observe the Exhaust Gas Recirculation (EGR) Brushless DC Motor Position 2 value. Does the Exhaust Gas Recirculation (EGR) Brushless DC Motor Position 2 parameter follow the Desired EGR Position?

Yes

⇒Proceed to 3. Current DTC check

No

⇒Proceed to 4. Inspection for open circuit and short circuit in EGR motor 2 drive circuit

3. Current DTC check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P140A set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

POWERSTAR

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Inspection for open circuit and short circuit in EGR motor 2 drive circuit

1) Inspect the drive circuit between the ECM (pins 3, 4, and 13 of E82) and EGR motor 2 (pins 6, 7, and 8 of E99) for the following conditions.

Is the result normal?

- Open circuit
- Short to ground
- Short to the power supply circuit
- High resistance

Refer to “*Engine Control*”.

Yes

Replace the EGR valve 2.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 5. EGR valve operation signal input check

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

5. EGR valve operation signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P140A set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

⇒Proceed to 8. Repair verification

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance

1. DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance DTC information

1. DTC P140B description

The EGR position sensor is installed inside the EGR valve. The EGR position sensor is a Hall IC type sensor installed in a total of 3 locations, and the motor phase is set by the polarity output ON/OFF of each sensor. EGR position sensor 2 has the following circuits.

● 5 V reference circuit

● Low reference circuit

● EGR position sensor 2 signal circuit 4

● EGR position sensor 2 signal circuit 5

● EGR position sensor 2 signal circuit 6

The ECM supplies 5 V to EGR position sensor 2 signals 4, 5, and 6 via the 5 V reference circuit and grounds to the ECM via the low reference circuit. Also, the EGR position sensor, via each signal circuit, outputs the polarity of either EGR position sensor 2 signals 4, 5, or 6 as ON/OFF to the ECM. The ECM detects the EGR valve position by counting the number of times the polarity changes. If all the polarity signal inputs of EGR position sensor 2 signals 1, 2, and 3 turn ON or OFF at the same time, the ECM sets a DTC.

2. Condition for setting DTC P140B

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● DTCs P060B and P0697 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the signals input from EGR position sensor 2 signals 4, 5, and 6 are all ON or all OFF for approximately 3 seconds or more.

3. Action taken when DTC P140B sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P140B

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance diagnostics

POWERSTAR

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Individual harness connector inspection

1) Inspect for poor connections at the EGR valve 2 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in 5 V reference circuit of EGR position sensor 2

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

3. Inspection for open circuit and short circuit in 5 V reference circuit of EGR position sensor 2

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E82) and the EGR valve 2 harness connector (E99) .

3) Inspect the 5 V reference circuit between the ECM (pin 19 of E82) and EGR position sensor 2 (pin 1 of E99) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 2 circuit (pins 11, 12, 14, and 20 of E82)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 4. Inspection for open circuit and short circuit in EGR position sensor 2 signal circuit 1

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

4. Inspection for open circuit and short circuit in EGR position sensor 2 signal circuit 1

1) Inspect signal circuit 1 between the ECM (pin 11 of E82) and EGR position sensor 2 (pin 4 of E99) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 2 circuit (pins 12, 14, 19, and 20of E82)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 5. Inspection for open circuit and short circuit in EGR position sensor 2 signal circuit 2

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

5. Inspection for open circuit and short circuit in EGR position sensor 2 signal circuit 2

1) Inspect signal circuit 2 between the ECM (pin 12 of E82) and EGR position sensor 2 (pin 3 of E99) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 2 circuit (pins 11, 14, 19, and 20 of E82)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 6. Inspection for open circuit and short circuit in EGR position sensor 2 signal circuit 3

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

6. Inspection for open circuit and short circuit in EGR position sensor 2 signal circuit 3

1) Inspect signal circuit 3 between the ECM (pin 14 of E82) and EGR position sensor 2 (pin 2 of E99) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 2 circuit (E82 pins 11,12,19 and 20)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 7. Inspection for open circuit in EGR position sensor 2 low reference circuit

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

POWERSTAR

7. Inspection for open circuit in EGR position sensor 2 low reference circuit

1) Inspect the low reference circuit between the ECM (pin 20 of E82) and EGR position sensor 2 (pin 5 of E99) for the following conditions. Is the result normal?

● Open circuit

● High resistance

● Short to the ground circuit of EGR position sensor 2 circuit (E82 pins 11,12,14 and 19)

Refer to “*Engine Control*”.

Yes

⇒Proceed to 8. EGR position check

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

8. EGR position check

1) Turn OFF the ignition switch.

2) Reconnect all of the disconnected harness connectors.

3) Connect the scan tool.

4) Turn ON the ignition switch.

5) Observe the EGR Position parameter on the scan tool. Do the EGR Position 4, 5, and 6 parameters all show OFF?

Yes

⇒Proceed to 9. EGR valve 2 operation check

No

⇒Proceed to 11. ECM power supply and ground circuit inspection

9. EGR valve 2 operation check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool.Is DTC P140B set?

Yes

Replace the EGR valve 2.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 10. EGR position sensor 2 signal input check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

10. EGR position sensor 2 signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P140B set?

Yes

⇒Proceed to 11. ECM power supply and ground circuit inspection

No

⇒Proceed to 13. Repair verification

POWERSTAR

11. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 12. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 13. Repair verification

12. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 13. Repair verification

13. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P140C (Flash Code 345) EGR 2 Closed Position Performance

1. DTC P140C (Flash Code 345) EGR 2 Closed Position Performance DTC information

1. DTC P140C description

The EGR motor is installed inside the EGR valve. The EGR motor used on this vehicle is a brushless DC motor and is driven by the three-phase motor. EGR motor 2 has the following circuits.

● EGR motor 2 drive circuit 1

● EGR motor 2 drive circuit 2

● EGR motor 2 drive circuit 3

The ECM drives the EGR motor via EGR motor 2 drive circuits 4, 5, and 6. The ECM outputs the drive signal by switching inside the ECM, and the motor rotates according to the combination of the three-phase signal. Also, the valve opening position is controlled by the duty. If EGR motor drive duty is large and the difference between the desired EGR opening angle and the EGR 2opening angle is excessive, the ECM sets a DTC.

2. Condition for setting DTC P140C

Condition for running the DTC

● The ignition switch is OFF.

● DTCs P0409, P0500, P0502, P0503, P060B, P0641, P0697, P140A, and P140B are not set.

Refer to "*DTC P0409 (Flash code 44) EGR Sensor Circuit* ".

Refer to "*DTC P0500 (Flash code 25) Vehicle Speed Sensor* ".

Refer to "*DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input*".

Refer to "*DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input*".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P140A (Flash Code 345) EGR 2 Performance*".

Refer to "*DTC P140B (Flash Code 344) EGR 2 Position Sensor Performance*".

Condition for setting the DTC

● The ECM detects that the EGR zero position counter is 40 or more or 5 or less when the ignition switch is OFF.

3. Action taken when DTC P140C sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P140C

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

POWERSTAR

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P140C (Flash Code 345) EGR 2 Closed Position Performance diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. EGR operation check using scan tool

1) Clear the DTC with a scan tool.

2) Perform EGR a few times with the scan tool.

3) While observing the Exhaust Gas Recirculation (EGR) Valve Position value, command the Desired EGR Position UP and DOWN.

4) Observe the Exhaust Gas Recirculation (EGR) Brushless DC Motor Position 2 value. Does the Exhaust Gas Recirculation (EGR) Brushless DC Motor Position 2 parameter follow the Desired EGR Position?

Yes

⇒Proceed to 3. Current DTC check

No

⇒Proceed to 4. Inspection for open circuit and short circuit in EGR motor 2 drive circuit

3. Current DTC check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P140C set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Inspection for open circuit and short circuit in EGR motor 2 drive circuit

1) Inspect the EGR motor drive circuit between the ECM (pins 3, 4, and 13 of E82) and EGR motor 2 (pins 6, 7, and 8 of E99) for the following conditions. Is the result normal?

● Open circuit

● Short to ground

● Short to the power supply circuit

● High resistance

Refer to "*Engine Control*".

Yes

Replace the EGR valve 2.

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve removal*".

Refer to "*1.Engine 1H.Aux. Emission Control Devices(6WG1) EGR valve installation*".

⇒Proceed to 5. EGR valve operation signal input check

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

5. EGR valve operation signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is DTC P140C set?

Yes

⇒Proceed to 6. ECM power supply and ground circuit inspection

No

⇒Proceed to 8. Repair verification

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

POWERSTAR

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P1621 (Flash code 54) Control Module Long Term Memory Performance

1. DTC P1621 (Flash code 54) Control Module Long Term Memory Performance DTC information

1. DTC P1621 description

This diagnosis applies to the microprocessor inside the ECM.

2. Condition for setting DTC P1621

Condition for running the DTC

● Completed checksum calculation.

Condition for setting the DTC

● The ECM detects that the calculated checksum does not match the checksum stored in the EEPROM.

3. Action taken when DTC P1621 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P1621

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P1621 (Flash code 54) Control Module Long Term Memory Performance diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Device connection check

1) Verify that all the tool connections are securely connected.

2) Verify that the programming device operates properly.

3) Connect the scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Turn ON the ignition switch.

6) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Current DTC check

No

⇒Proceed to 5. Repair verification

3. Current DTC check

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch.

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4) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 4. ECM replacement

No

⇒Proceed to 5. Repair verification

4. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 5. Repair verification

5. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P1664 (Flash code 76) Service Vehicle Soon Lamp Control Circuit

1. DTC P1664 (Flash code 76) Service Vehicle Soon Lamp Control Circuit DTC information

1. DTC P1664 description

The SVS lamp is in the instrument panel cluster. The SVS lamp informs the driver that a non-emission related malfunction has occurred and repair must be performed.

The ECM monitors for any status that is different from the SVS lamp command status in the SVS lamp control circuit. The circuit is defective if the ECM detects a low voltage when the SVS lamp is commanded OFF, or if the ECM detects a high voltage when the MIL is commanded ON. If the ECM detects any abnormal value in the control circuit voltage, the DTC is set.

2. Condition for setting DTC P1664

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

Condition for setting the DTC

Any of the following conditions are met.

● When the SVS lamp is commanded OFF, the ECM detects a low voltage condition in the SVS lamp control circuit.

● When the SVS lamp is commanded ON, the ECM detects a high voltage condition in the SVS lamp control circuit.

3. Action taken when DTC P1664 sets

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P1664

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P1664 (Flash code 76) Service Vehicle Soon Lamp Control Circuit diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Check the operation of the dash panel.

2) Connect the scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Turn ON the ignition switch for 10 seconds.

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5) Start the engine.

6) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Fuse inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Fuse inspection

1) Inspect for a blown out METER 7.5 A fuse. Is the result normal?

Yes

⇒Proceed to 4. Inspection for short to ground in SVS lamp control circuit

No

Replace the fuse. If the fuse blows out again, repair the short to ground in the circuits relating to the METER 10 A fuse.

⇒Proceed to 12. Repair verification

4. Inspection for short to ground in SVS lamp control circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (FL558) .

Refer to "*Instrument panel cluster*".

3) Turn ON the ignition switch.

4) Check the SVS lamp. Does the SVS lamp turn OFF?

Yes

⇒Proceed to 5. Inspection for short to power supply in SVS lamp control circuit

No

Repair the short to ground in the SVS lamp control circuit between the ECM (pin 19 of FL558) and the instrument panel cluster (pin 18 of FU73).

⇒Proceed to 12. Repair verification

5. Inspection for short to power supply in SVS lamp control circuit

1) Remove the Meter 7.5 A fuse.

2) Turn ON the ignition switch.

3) Measure the voltage between the SVS lamp control circuit (pin 19 of FL558) and the frame ground with a DMM. Is the voltage less than or equal to the specified value?

Refer to "*Instrument panel cluster*".

Value: 1 V

Yes

⇒Proceed to 6. SVS lamp illumination check using fused jumper wire

No

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Repair the short to the power supply circuit in the SVS lamp control circuit between the ECM (pin 19 of FL558) and the instrument panel cluster (pin 18 of FU78).

⇒Proceed to 12. Repair verification

6. SVS lamp illumination check using fused jumper wire

1) Turn OFF the ignition switch.

2) Install the METER 7.5 A fuse.

3) Turn ON the ignition switch.

4) Connect a fused jumper wire between the SVS lamp control circuit (pin 19 of FL558) and the frame ground.

Refer to "*Instrument panel cluster*".

5) Check the SVS lamp. Does the SVS lamp illuminate?

Yes

⇒Proceed to 10. ECM harness connector inspection

No

⇒Proceed to 7. Instrument panel cluster power supply voltage check

7. Instrument panel cluster power supply voltage check

1) Connect a test lamp between the ignition power supply circuit (pin 30 of FU72) and the frame ground.

Refer to "*Instrument panel cluster*".

2) Turn ON the ignition switch.Does the test lamp illuminate?

Yes

⇒Proceed to 8. Inspection for open circuit in SVS lamp control circuit

No

Repair the open circuit or high resistance in the ignition power supply circuit between the METER 10 A fuse and the instrument panel cluster (pin 30 of FU72).

⇒Proceed to 12. Repair verification

8. Inspection for open circuit in SVS lamp control circuit

1) Inspect the SVS lamp control circuit between the ECM (pin 19 of FL558) and the instrument panel cluster (pin 18 of FU73) for an open circuit or high resistance. Is the result normal?

Refer to "*Instrument panel cluster*".

Yes

⇒Proceed to 9. Instrument panel cluster harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 12. Repair verification

9. Instrument panel cluster harness connector inspection

1) Inspect for poor connections at the instrument panel cluster harness connector (pin 30 of FU72 and pin 18 of FU73). Is the connection status normal?

Refer to "*Instrument panel cluster*".

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Yes

Repair or replace the instrument panel cluster.

Refer to "*9.9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Instrument panel cluster removal*".

Refer to "*9.9.Body, Cab, Accessories 9E.Instrumentation, Driver Info. Instrument panel cluster installation*".

⇒Proceed to 12. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 12. Repair verification

10. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 19 of FL558). Is the connection status normal?

Refer to "*Instrument panel cluster*".

Yes

⇒Proceed to 11. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 12. Repair verification

11. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 12. Repair verification

12. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Turn ON the ignition switch for at least 10 seconds.

4) Start the engine.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P2122 (Flash code 121) Pedal Position Sensor 1 Circuit Low Input

1. DTC P2122 (Flash Code 121)Pedal Position Sensor 1 Circuit Low Input DTC information

1. DTC P2122 description

The accelerator pedal position sensor is installed to the accelerator pedal bracket. The sensor consists of 2 sensors in 1 housing. The ECM uses the accelerator pedal position sensor to calculate target acceleration and deceleration. Accelerator pedal position sensor 1 has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Accelerator pedal position sensor 1 signal circuit

The accelerator pedal position sensor 1 sends signals related to accelerator pedal angle changes to the ECM via the signal circuit. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P2122

Condition for running the DTC

● The battery voltage is 18 - 32V.

● The ignition switch is on.

● DTCs P060B and P0641 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The ECM detects that the accelerator pedal position sensor 1 signal voltage is 0.2 V or less.

3. Action taken when DTC P2122 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking.

● The ECM limits the fuel injection quantity.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P2122

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2122 (Flash Code 121) Pedal Position Sensor 1 Circuit Low Input diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

POWERSTAR

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is DTC P0641 set at the same time?

Yes

Go to DTC P0641 diagnosis.

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

No

⇒Proceed to 3. Signal voltage check for accelerator pedal position sensor 1

3. Signal voltage check for accelerator pedal position sensor 1

1) Fully depress and release the accelerator pedal while observing the APP Sensor 1 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value less than or equal to the specified value while depressing and releasing the pedal?

Value: 0.2V

Yes

⇒Proceed to 4. 5 V reference voltage check for accelerator pedal position sensor 1

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. 5V reference voltage check for accelerator pedal position sensor 1

1) Turn OFF the ignition switch.

2) Disconnect the accelerator pedal position sensor 1 harness connector (FL648) .

3) Turn ON the ignition switch.

4) Measure the voltage between the 5 V reference circuit of accelerator pedal position sensor 1 (pin 4 of FL648) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.9 V

Yes

⇒Proceed to 5. Accelerator pedal position sensor 1 signal output voltage check using fused jumper wire

No

⇒Proceed to 6. Inspection for open circuit in 5 V reference circuit of accelerator pedal position sensor 1

5. Accelerator pedal position sensor 1 signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the 5 V reference circuit of accelerator pedal position sensor 1 and the signal circuit (pins 4 and 5 of FL648).

Refer to “*Engine Control*”.

POWERSTAR

2) Observe the APP Sensor 1 (Accelerator Pedal Position) parameter on the scan tool. Is the APP Sensor 1 (Accelerator Pedal Position) parameter more than or equal to the specified value?

Value: 4.9 V

Yes

⇒Proceed to 8. Accelerator pedal position sensor 1 harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit and short circuit in accelerator pedal position sensor 1 signal circuit

6. Inspection for open circuit in 5 V reference circuit of accelerator pedal position sensor 1

1) Inspect the 5 V reference circuit between the ECM (pin 17 of FL559) and accelerator pedal position sensor 1 (pin 4 of FL648) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Caution:

● Accelerator pedal position sensor 1 shares the 5 V reference circuit with other sensors. A malfunction in the 5 V reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit and short circuit in accelerator pedal position sensor 1 signal circuit

1) Inspect the signal circuit between the ECM (pin 1 of FL558) and accelerator pedal position sensor 1 (pin 5 of FL648) for the following conditions. Is the result normal?

● Open circuit

● Short to ground

● Short to the low reference circuit

● High resistance

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Accelerator pedal position sensor 1 harness connector inspection

1) Inspect for poor connections at the accelerator pedal position sensor 1 harness connector (pins 4 and 5 of FL648). Is the connection status normal?

Refer to "*Engine Control*".

Yes

POWERSTAR

Replace accelerator pedal position sensor 1.

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 1 of FL558 , pin 17 of FL559). Is the connection status normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

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Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the APP Sensor 1 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value less than or equal to the specified value while depressing and releasing the pedal?

Value: 0.2 V

Yes

⇒Proceed to 3. Signal voltage check for accelerator pedal position sensor 1

No

Observe the DTC information with a scan tool.

DTC P2123 (Flash code 121) Pedal Position Sensor 1 Circuit High Input

1. DTC P2123 (Flash Code 121)Pedal Position Sensor 1 Circuit High Input DTC information

1. DTC P2123 description

The accelerator pedal position sensor is installed to the accelerator pedal bracket. The sensor consists of 2 sensors in 1 housing. The ECM uses the accelerator pedal position sensor to calculate target acceleration and deceleration. Accelerator pedal position sensor 1 has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Accelerator pedal position sensor 1 signal circuit

The accelerator pedal position sensor 1 sends signals related to accelerator pedal angle changes to the ECM via the signal circuit. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P2123

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0641 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The ECM detects that accelerator pedal position sensor 1 signal voltage is 4.9 V or more.

3. Action taken when DTC P2123 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking.

● The ECM limits the fuel injection quantity.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P2123

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2123 (Flash Code 121)Pedal Position Sensor 1 Circuit High Input diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Signal voltage check for accelerator pedal position sensor 1

POWERSTAR

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the APP Sensor 1 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value more than or equal to the specified value while depressing and releasing the pedal?

Value: 4.9V

Yes

⇒Proceed to 3. 5 V reference voltage and signal voltage check for accelerator pedal position sensor 1

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. 5V reference voltage and signal voltage check for accelerator pedal position sensor 1

1) Observe the DTC information with a scan tool for DTC P0641 being set at the same time.

2) Turn OFF the ignition switch.

3) Disconnect the accelerator pedal position sensor 1 harness connector (FL648) .

Refer to “*Engine Control*”.

4) Turn ON the ignition switch.

5) Observe the APP Sensor 1 (Accelerator Pedal Position) parameter on the scan tool.

Value: 0.1 V

The reading is more than the specified value.

⇒Proceed to 5. Inspection for short to power supply in accelerator pedal position sensor 1 signal circuit

The reading is less than or equal to the specified value and DTC P0641 is set.

Go to DTC P0641 diagnosis.

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

The reading is less than or equal to the specified value and DTC P0641 is not set.

⇒Proceed to 4. Accelerator pedal position sensor 1 low reference circuit inspection using test lamp

4. Accelerator pedal position sensor 1 low reference circuit inspection using test lamp

1) Connect a test lamp between the accelerator pedal position sensor 1 low reference circuit (pin 6 of FL648) and the battery power supply. Does the test lamp illuminate?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 7. Accelerator pedal position sensor 1 harness connector inspection

No

⇒Proceed to 6. Inspection for open circuit in accelerator pedal position sensor 1 low reference circuit

5. Inspection for short to power supply in accelerator pedal position sensor 1 signal circuit

1) Inspect the signal circuit between the ECM (pin 1 of FL558) and accelerator pedal position sensor 1 (pin 5 of FL648) for the following conditions. Is the result normal?

● Short to the power supply circuit

● Short to the 5 V reference circuit

Note:

● Accelerator pedal position sensor 1 may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

6. Inspection for open circuit in accelerator pedal position sensor 1 low reference circuit

1) Inspect the low reference circuit between the ECM (pin 10 of FL559) and accelerator pedal position sensor 1 (pin 6 of FL648) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Caution:

● Accelerator pedal position sensor 1 shares the low reference circuit with other sensors. A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 8. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

7. Accelerator pedal position sensor 1 harness connector inspection

1) Inspect for poor connections at the accelerator pedal position sensor 1 harness connector (pin 6 of FL648). Is the connection status normal?

Refer to "*Engine Control*".

Yes

Replace accelerator pedal position sensor 1.

Refer to "*1.Engine 11.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 11.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 10. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

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8. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 10 of FL559). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the APP Sensor 1 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value more than or equal to the specified value while depressing and releasing the pedal?

Value: 4.9 V

Yes

⇒Proceed to 2. Signal voltage check for accelerator pedal position sensor 1

No

Observe the DTC information with a scan tool.

DTC P2127 (Flash code 122) Pedal Position Sensor 2 Circuit Low Input

1. DTC P2127 (Flash code 122) Pedal Position Sensor 2 Circuit Low Input DTC information

1. DTC P2127 description

The accelerator pedal position sensor is installed to the accelerator pedal bracket. The sensor consists of 2 sensors in 1 housing. The ECM uses the accelerator pedal position sensor to calculate target acceleration and deceleration. Accelerator pedal position sensor 2 has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Accelerator pedal position sensor 2 signal circuit

The accelerator pedal position sensor 2 sends signals related to accelerator pedal angle changes to the ECM via the signal circuit. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P2127

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that the accelerator pedal position sensor 2 signal voltage is 0.2 V or less.

3. Action taken when DTC P2127 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the ECM will indicate that the exhaust brake light is blinking.

● The ECM limits the fuel injection quantity.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P2127

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2127 (Flash code 122) Pedal Position Sensor 2 Circuit Low Input diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 3. Signal voltage check for accelerator pedal position sensor 2

3. Signal voltage check for accelerator pedal position sensor 2

1) Fully depress and release the accelerator pedal while observing the APP Sensor 2 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value less than or equal to the specified value while depressing and releasing the pedal?

Value: 0.2V

Yes

⇒Proceed to 4. 5 V reference voltage check for accelerator pedal position sensor 2

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. 5V reference voltage check for accelerator pedal position sensor 2

1) Turn OFF the ignition switch.

2) Disconnect the accelerator pedal position sensor 2 harness connector (FL648) .

3) Turn ON the ignition switch.

4) Measure the voltage between the 5 V reference circuit of accelerator pedal position sensor 2 (pin 1 of FL648) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.9V

Yes

⇒Proceed to 5. Accelerator pedal position sensor 2 signal output voltage check using fused jumper wire

No

⇒Proceed to 6. Inspection for open circuit in 5 V reference circuit of accelerator pedal position sensor 2

5. Accelerator pedal position sensor 2 signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the 5 V reference circuit of accelerator pedal position sensor 2 and the signal circuit (pins 1 and 2 of FL648).

Refer to “*Engine Control*”.

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2) Observe the APP Sensor 2 (Accelerator Pedal Position) parameter on the scan tool. Is the APP Sensor 2 (Accelerator Pedal Position) parameter more than or equal to the specified value?

Value: 4.9 V

Yes

⇒Proceed to 8. Accelerator pedal position sensor 2 harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit and short circuit in accelerator pedal position sensor 2 signal circuit

6. Inspection for open circuit in 5 V reference circuit of accelerator pedal position sensor 2

1) Inspect the 5 V reference circuit between the ECM (pin 8 of FL558) and accelerator pedal position sensor 2 (pin 1 of FL648) for an open circuit or high resistance. Is the result normal?

Refer to “*Engine Control*”.

Caution:

● Accelerator pedal position sensor 2 shares the 5 V reference circuit with other sensors. A malfunction in the 5 V reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit and short circuit in accelerator pedal position sensor 2 signal circuit

1) Inspect the signal circuit between the ECM (pin 29 of FL558) and accelerator pedal position sensor 2 (pin 2 of FL648) for the following conditions. Is the result normal?

● Open circuit

● Short to ground

● Short to the low reference circuit

● High resistance

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Accelerator pedal position sensor 2 harness connector inspection

1) Inspect for poor connections at the accelerator pedal position sensor 2 harness connector (pins 1 and 2 of FL648). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

POWERSTAR

Replace the accelerator pedal position sensor 2.

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the APP Sensor 2 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value less than or equal to the specified value while depressing and releasing the pedal?

Value: 0.2 V

Yes

⇒Proceed to 3. Signal voltage check for accelerator pedal position sensor 2

No

Observe the DTC information with a scan tool.

POWERSTAR

DTC P2128 (Flash code 122) Pedal Position Sensor 2 Circuit High Input

1. DTC P2128 (Flash code 122) Pedal Position Sensor 2 Circuit High Input DTC information

1. DTC P2128 description

The accelerator pedal position sensor is installed to the accelerator pedal bracket. The sensor consists of 2 sensors in 1 housing. The ECM uses the accelerator pedal position sensor to calculate target acceleration and deceleration. Accelerator pedal position sensor 2 has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Accelerator pedal position sensor 2 signal circuit

The accelerator pedal position sensor 2 sends signals related to accelerator pedal angle changes to the ECM via the signal circuit. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P2128

Condition for running the DTC

● The battery voltage is 18 - 32V.

● The ignition switch is on.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that accelerator pedal position sensor 2 signal voltage is 4.9 V or more.

3. Action taken when DTC P2128 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking.

● The ECM limits the fuel injection quantity.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P2128

Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2128 (Flash code 122) Pedal Position Sensor 2 Circuit High Input diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Signal voltage check for accelerator pedal position sensor 2

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the APP Sensor 2 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display the specified value while depressing and releasing the pedal?

Value: 4.9V

Yes

⇒Proceed to 3. 5 V reference voltage and signal voltage check for accelerator pedal position sensor 2

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. 5V reference voltage and signal voltage check for accelerator pedal position sensor 2

1) Observe the DTC information with a scan tool for DTC P0651 being set at the same time.

2) Turn OFF the ignition switch.

3) Disconnect the accelerator pedal position sensor 2 harness connector (FL648) .

Refer to “*Engine Control*”.

4) Turn ON the ignition switch.

5) Observe the APP Sensor 2 (Accelerator Pedal Position) parameter on the scan tool.

Value: 0.1 V

The reading is more than the specified value.

⇒Proceed to 5. Inspection for short to power supply in accelerator pedal position sensor 2 signal circuit

The reading is less than or equal to the specified value and DTC P0651 is set.

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

The reading is less than or equal to the specified value and DTC P0651 is not set.

⇒Proceed to 4. Accelerator pedal position sensor 2 low reference circuit inspection using test lamp

4. Accelerator pedal position sensor 2 low reference circuit inspection using test lamp

1) Connect a test lamp between the accelerator pedal position sensor 2 low reference circuit (pin 3 of FL648) and the batteryDoes the test lamp illuminate?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 7. Accelerator pedal position sensor 2 harness connector inspection

No

⇒Proceed to 6. Inspection for open circuit in accelerator pedal position sensor 2 low reference circuit

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5. Inspection for short to power supply in accelerator pedal position sensor 2 signal circuit

1) Inspect the signal circuit between the ECM (pin 29 of FL558) and accelerator pedal position sensor 2 (pin 2 of FL648) for the following conditions.

● Short to the power supply circuit

● Short to the 5 V reference circuit

Note:

● Accelerator pedal position sensor 2 may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

6. Inspection for open circuit in accelerator pedal position sensor 2 low reference circuit

1) Inspect the low reference circuit between the ECM (pin 12 of FL558) and accelerator pedal position sensor 2 (pin 3 of FL648) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Caution:

● Accelerator pedal position sensor 2 shares the low reference circuit with other sensors. A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 8. ECM harness connector inspection

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No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

7. Accelerator pedal position sensor 2 harness connector inspection

1) Inspect for poor connections at the accelerator pedal position sensor 2 harness connector (pin 3 of FL648). Is the connection status normal?

Refer to "*Engine Control*".

Yes

Replace the accelerator pedal position sensor 2.

Refer to "*1.Engine 11.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 11.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 10. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

8. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 12 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the APP Sensor 2 (Accelerator Pedal Position) parameter on the scan tool. Does the scan tool display a value more than or equal to the specified value while depressing and releasing the pedal?

Value: 4.9 V

Yes

⇒Proceed to 2. Signal voltage check for accelerator pedal position sensor 2

No

Observe the DTC information with a scan tool.

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DTC P2138 (Flash Code 124) Pedal Position Sensor 1 - 2 Voltage Correlation

1. DTC P2138 (Flash Code 124) Pedal Position Sensor 1 - 2 Voltage Correlation DTC information

1. DTC P2138 description

The accelerator pedal position sensor is installed to the accelerator pedal bracket. The sensor consists of 2 sensors in 1 housing. Accelerator pedal position sensor 1 and accelerator pedal position sensor 2 are hall IC type sensors with the following circuits.

● 5 V reference circuit

● Low reference circuit

● Signal circuit

The ECM supplies 5 V to the accelerator pedal position sensors via the 5 V reference circuit, and the low reference circuit connects to ground. The accelerator pedal position sensor sends signals related to accelerator pedal angle changes to the ECM via the signal circuit. The signal voltage of accelerator pedal position sensor 1 is kept low at first and increases as the pedal is depressed. The signal voltage of accelerator pedal position sensor 2 is kept high at first and decreases as the pedal is depressed. If the ECM detects that the voltages of both the accelerator pedal position sensor 1 signal and the accelerator pedal position sensor 2 signal do not correlate, the DTC is set.

2. Condition for setting DTC P2138

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● Accelerator pedal position sensor 1 signal voltage is 0.2- 4.9 V.

● Accelerator pedal position sensor 2 signal voltage is 0.2- 4.9 V.

● DTCs P060B, P0641 and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

● The ECM detects that accelerator pedal position sensors 1 and 2 deviate from the range by 45% or more.

3. Action taken when DTC P2138 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● When the diagnostic operation fails, the *ECM* will indicate that the exhaust brake light is blinking.

● The ECM stops the exhaust brake control.

4. Condition for clearing DTC P2138

● Condition for clearing the MIL / DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

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3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2138 (Flash Code 124) Pedal Position Sensor 1 - 2 Voltage Correlation diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0641, P0651, P2122, P2123, P2127, or P2128 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Refer to "*DTC P2122 (Flash Code 121) Pedal Position Sensor 1 Circuit Low Input*".

Refer to "*DTC P2123 (Flash Code 121)Pedal Position Sensor 1 Circuit High Input*".

Refer to "*DTC P2127 (Flash code 122) Pedal Position Sensor 2 Circuit Low Input*".

Refer to "*DTC P2128 (Flash code 122) Pedal Position Sensor 2 Circuit High Input*".

No

⇒Proceed to 3. DTC check during accelerator pedal operation

3. DTC check during accelerator pedal operation

1) Fully depress and release the accelerator pedal while observing the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 4. Accelerator pedal position sensor circuit inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Accelerator pedal position sensor circuit inspection

1) Inspect for poor connections at the accelerator pedal position sensor harness connector (pins 1, 2, 3, 4, 5, and 6 of FL648). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 1,8, 12 and 29 of FL558; pins 10 and 17 of FL559). Is the connection status normal?

3) Inspect for high resistance between the ECM harness connector (pins 1,8, 12 and 29 of FL558; pins 10 and 17 of FL559).and the accelerator pedal position sensor (pins 1, 2, 3, 4, 5, and 6 of FL648). Is the result normal?

Refer to “*Engine Control*”.

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4) Are all of the results normal?

Yes

⇒Proceed to 5. Inspection for short circuit in accelerator pedal position sensor signal circuit

No

Repair the circuit or the connection as necessary.

⇒Proceed to 8. Repair verification

5. Inspection for short circuit in accelerator pedal position sensor signal circuit

1) Inspect the signal circuit between the ECM (pins 1 and 29 of FL558) and the accelerator pedal position sensor (pins 2 and 5 of FL648) for a short circuit. Is the result normal?

Refer to "*Engine Control*".

Yes

Replace the accelerator pedal position sensor.

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link removal*".

Refer to "*1.Engine 1I.Speed Control Systems(6WG1) Accelerator control link installation*".

⇒Proceed to 6. Accelerator pedal position sensor signal input check

No

Repair the circuit as necessary.

⇒Proceed to 8. Repair verification

6. Accelerator pedal position sensor signal input check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

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4) Start the engine.

5) Fully depress and release the accelerator pedal while observing the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 7. ECM replacement

No

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Fully depress and release the accelerator pedal while observing the DTC information with a scan tool.

5) Observe the DTC information with a scan tool.

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DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit

1. DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit DTC information

1. DTC P2146 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors. Injector operation is mainly divided into two steps: First, the voltage applied to the injector, the second is the voltage injected by the injector signal to the ECM, the signal controlled by the engine control module.

2. Condition for setting DTC P2146

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine speed is 40 rpm or more.

● DTCs P0201, P0202,and P0203 are not set.

Refer to "*DTC P0201 (Flash Code 271) Injector Circuit Open - Cylinder 1*".

Refer to "*DTC P0202 (Flash Code 272) Injector Circuit Open - Cylinder 2*".

Refer to "*DTC P0203 (Flash Code 273) Injector Circuit Open - Cylinder 3*".

Condition for setting the DTC

● The ECM detects that there is an open circuit, a short to ground or a short to the power supply circuit in the injector charge voltage circuit of common power supply 1, or that there is a short to ground in the injector solenoid coil control circuit of cylinder No. 1, 2, or 3 .

3. Action taken when DTC P2146 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P2146

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2146 (Flash Code 158) Fuel Injector Group 1 Supply Voltage Circuit diagnostics

1. Engine control system check

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Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in injector

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Inspection for open circuit and short circuit in injector

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 1, 2, and 3 injector harnesses (E53, E54, and E55) from the injectors.

4) Measure the resistance between each circuit of the ECM harness connector (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the common power supply 1-2 charge voltage circuit (pins 18 and 26 of E83)

Refer to "*Engine Control*".

Value: 0.5Ω

5) Measure the resistance between each circuit of the ECM harness connector (E83) with a DMM (Check for short circuit).Is the resistance equal to the specified value?

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 18 of E83)

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 18 of E83)

● Between the common power supply 1-1 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 18 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 26 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 26 of E83)

● Between the common power supply 1-2 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 26 of E83)

● Between the common power supply 1-1 charge voltage circuit (pin 18 of E83) and the frame ground

● Between the common power supply 1-2 charge voltage circuit (pin 26 of E83) and the injector body

Refer to "*Engine Control*".

Value: ∞ Ω

6) Are all of the values normal?

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Yes

⇒Proceed to 4. Inspection for open circuit in injector circuit using fused jumper wire

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

4. Inspection for open circuit in injector circuit using fused jumper wire

1) Turn OFF the ignition switch.

2) Connect a fused jumper wire between each terminal of the cylinder No. 1, 2, and 3 injectors (E53, E54, and E55) and measure the resistance between each circuit on the ECM harness connector (E83) with a DMM. Is the resistance less than or equal to the specified value?

● Jumper: Between the cylinder No. 1 injector terminals (pins 1 and 2 of E53)

● Measure: Between the common power supply 1-1 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 18 of E83)

● Measure: Between the common power supply 1-2 charge voltage circuit and the cylinder No. 1 injector control circuit (pins 3 and 26 of E83).

Value: 0.5 Ω

● Jumper: Between the cylinder No. 2 injector terminals (pins 1 and 2 of E54)

● Measure: Between the common power supply 1-1 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 18 of E83)

● Measure:Between the common power supply 1-2 charge voltage circuit and the cylinder No. 2 injector control circuit (pins 1 and 26 of E83).

Value: 0.5 Ω

● Jumper: Between the cylinder No. 3 injector terminals (pins 1 and 2 of E55)

● Measure:Between the common power supply 1-1 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 18 of E83).

● Measure:Between the common power supply 1-2 charge voltage circuit and the cylinder No. 3 injector control circuit (pins 2 and 26 of E83).

Value: 0.5 Ω

Refer to “*Engine Control*”.

Yes

⇒Proceed to 5. Inspection for short to power supply in injector circuit

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

5. Inspection for short to power supply in injector circuit

1) Measure the voltage between the charge voltage circuit of common power supply 1 (pins 18 and 26 of E83) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: About 0 V

Yes

⇒Proceed to 6. Injector inspection

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

6. Injector inspection

1) Disconnect the cylinder No. 1, 2, and 3 injector harnesses (E53, E54, and E55) from the injectors.

Refer to “*Engine Control*”.

2) Measure the resistance of the injector terminal with a DMM (Injector internal resistance check). Is the resistance within the specified range?

Value: 0.3 to 1.3 Ω

3) Measure the resistance between the injector terminal and the injector body with a DMM (Injector insulation check). Is the resistance equal to the specified value?

Value: ∞ Ω

4) Are all of the values normal?

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

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5) Observe the DTC information with a scan tool.

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DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit

1. DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit DTC information

1. DTC P2149 description

An injector is a device that performs fuel injection. The injectors are installed on the engine head, and the ECM controls the fuel injection quantity and timing by regulating the injector energization time. Also, 100 V or more for operating the injectors is created inside the ECM, and the boosted voltage of 100 V or more is applied to the injectors. Injector operation is mainly divided into two steps: First, the voltage applied to the injector, the second is the voltage injected by the injector signal to the ECM, the signal controlled by the engine control module.

2. Condition for setting DTC P2149

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine speed is 40 rpm or more.

● DTC P0204, P0205, or P0206 is not set.

Refer to "*DTC P0204 (Flash Code 274) Injector Circuit Open - Cylinder 4*".

Refer to "*DTC P0205 (Flash Code 275) Injector Circuit Open - Cylinder 5*".

Refer to "*DTC P0206 (Flash Code 276) Injector Circuit Open - Cylinder 6*".

Condition for setting the DTC

● The ECM detects that there is an open circuit, a short to ground or a short to the power supply circuit in the injector charge voltage circuit of common power supply 2, or that there is a short to ground in the injector solenoid coil control circuit of cylinder No. 4, 5, or 6

3. Action taken when DTC P2149 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P2149

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2149 (Flash Code 159) Fuel Injector Group 2 Supply Voltage Circuit diagnostics

1. Engine control system check

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Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Connect the scan tool.

2) Turn ON the ignition switch.

3) Observe the DTC information with a scan tool. Is a DTC set?

Yes

⇒Proceed to 3. Inspection for open circuit and short circuit in injector

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Inspection for open circuit and short circuit in injector

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Disconnect the cylinder No. 4, 5, and 6 injector harnesses (E56, E57 and E58) from the injectors.

4) Measure the resistance between each circuit of the ECM harness connector (E83) with a DMM (Check for open circuit in charge voltage circuit). Is the resistance less than or equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the common power supply 2-2 charge voltage circuit (pins 8 and 9 of E83)

Refer to “*Engine Control*”.

Value: 0.5 Ω

5) Measure the resistance between each circuit of the ECM harness connector (E83) with a DMM (Check for short circuit).Is the resistance equal to the specified value?

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 8 of E83)

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 8 of E83)

● Between the common power supply 2-1 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 8 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 9 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 9 of E83)

● Between the common power supply 2-2 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 9 of E83)

● Between the common power supply 2-1 charge voltage circuit (pin 8 of E83) and the frame ground

● Between the common power supply 2-2 charge voltage circuit (pin 9 of E83) and the frame ground

Refer to “*Engine Control*”.

6) Are all of the values normal?

Value: ∞ Ω

Yes

⇒Proceed to 4. Inspection for open circuit in injector circuit using fused jumper wire

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

4. Inspection for open circuit in injector circuit using fused jumper wire

1) Turn OFF the ignition switch.

2) Connect a fused jumper wire between each terminal of the cylinder No. 4, 5, and 6 injectors (E56, E57, and E58) and measure the resistance between each circuit on the ECM harness connector (E83) with a DMM. Is the resistance less than or equal to the specified value?

● Jumper: Between the cylinder No. 4 injector terminals (pins 1 and 2 of E56)

● Measure:Between the common power supply 2-1 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 8 of E83).

● Measure:Between the common power supply 2-2 charge voltage circuit and the cylinder No. 4 injector control circuit (pins 6 and 9 of E83).

Value: 0.5 Ω

● Jumper: Between the cylinder No. 5 injector terminals (pins 1 and 2 of E57)

● Measure:Between the common power supply 2-1 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 8 of E83).

● Measure:Between the common power supply 2-2 charge voltage circuit and the cylinder No. 5 injector control circuit (pins 4 and 9 of E83).

Value: 0.5 Ω

● Jumper: Between the cylinder No. 6 injector terminals (pins 1 and 2 of E58)

● Measure:Between the common power supply 2-1 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 8 of E83).

● Measure:Between the common power supply 2-2 charge voltage circuit and the cylinder No. 6 injector control circuit (pins 5 and 9 of E83).

Value: 0.5 Ω

Refer to "*Engine Control*".

Yes

⇒Proceed to 5. Inspection for short to power supply in injector circuit

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

5. Inspection for short to power supply in injector circuit

1) Measure the voltage between the charge voltage circuit of common power supply 2 (pins 8 and 9 of E83) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: about 0 V

Yes

⇒Proceed to 6. Injector inspection

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

6. Injector inspection

1) Disconnect the cylinder No. 4, 5, and 6 injector harnesses (E56, E57 and E58) from the injectors.

Refer to "*Engine Control*".

2) Measure the resistance of the injector terminal with a DMM (Injector internal resistance check). Is the resistance within the specified range?

Value: 0.3 to 1.3 Ω

3) Measure the resistance between the injector terminal and the injector body with a DMM (Injector insulation check). Is the resistance equal to the specified value?

Value: ∞ Ω

4) Are all of the values normal?

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

Note:

● If an injector has been replaced, be sure to set the injector ID code on the ECM.

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Injector installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

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5) Observe the DTC information with a scan tool.

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DTC P2227 (Flash code 71) Barometric Pressure Sensor Circuit Range/Performance

1. DTC information

1. DTC P2227 description

The barometric pressure sensor is installed within the instrument panel on the passenger side. The barometric pressure sensor changes voltage according to changes in air pressure. Diagnosis is performed inside the ECM by comparing the barometric pressure sensor input with the boost pressure sensor input. If the ECM detects that those inputs are not within each specified range, the DTC is set.

2. Condition for setting DTC P2227

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● The engine speed is 450- 550 rpm.

● The fuel injection quantity is less than or equal to the predetermined value.

● The accelerator pedal is not depressed.

● Vehicle speed is 0 km/h.

DTCs P0102, P0103, P0116, P0117, P0118, P237, P238, P0500, P0502, P0503, P0560, P060B, P0651, P0697, P2228, and P2229 are not set.

Refer to "*DTC P0102 (Flash code 91) Mass Air Flow Sensor Circuit Low Input*".

Refer to "*DTC P0103 (Flash code 91) Mass Air Flow Sensor Circuit High Input*".

Refer to "*DTC P0116 (Flash code 23) Engine Coolant Temperature Sensor Circuit Range/Performance*".

Refer to "*DTC P0117 (Flash code 23) Engine Coolant Temperature Sensor Circuit Low*".

Refer to "*DTC P0118 (Flash code 23) Engine Coolant Temperature Sensor Circuit High*".

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High* ".

Refer to "*DTC P0500 (Flash code 25) Vehicle Speed Sensor* ".

Refer to "*DTC P0502 (Flash Code 25) Vehicle Speed Sensor Circuit Low Input*".

Refer to "*DTC P0503 (Flash Code 25) Vehicle Speed Sensor Circuit High Input*".

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low* ".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

Condition for setting the DTC

● The ECM detects that the difference between the barometric pressure and the boost pressure is 35 kPa {5.1 psi} or more, or 13 kPa {1.9 psi} or less.

3. Action taken when DTC P2227 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

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Refer to "*DTC type definitions*".

4. Condition for clearing DTC P2227

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0237, P0238, P2228, or P2229 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0237 (Flash code 32) Turbocharger Boost Sensor Circuit Low*".

Refer to "*DTC P0238 (Flash code 32) Turbocharger Boost Sensor Circuit High* ".

Refer to "*DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low* ".

Refer to "*DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High*".

No

⇒Proceed to 3. Boost pressure and barometric pressure difference check

3. Boost pressure and barometric pressure difference check

1) Turn ON the ignition switch.

2) Compare the Boost Pressure parameter to the Barometric Pressure (BARO) parameter on the scan tool.

3) Check whether both parameters are within each specified range. Is the parameter within the specified range?

Yes

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

No

⇒Proceed to 4. Barometric pressure check

4. Barometric pressure check

1) Refer to the table and compare the Barometric Pressure (BARO) parameter on the scan tool with the surrounding barometric pressure.

2) Observe the Barometric Pressure (BARO) parameter on the scan tool. Is the Barometric Pressure (BARO) parameter within the specified range?

Altitude measured in meters (m)	Altitude measured in feet(ft)	Barometric pressure measured in kilopascals(kPa)
4267	14000	56-64
3962	13000	58-66
3658	12000	61-69
3353	11000	64-72
3048	10000	66-74
2743	9000	69-77
2438	8000	71-79
2134	7000	74-82
1829	6000	77-85
1524	5000	80-88
1219	4000	83-91
914	3000	87-95
610	2000	90-98
305	1000	94-102
0	0(Sea level)	96-104
-305	-1000	101-105

POWERSTAR

Yes

⇒Proceed to 5. Individual harness connector inspection

No

⇒Proceed to 7. Barometric pressure sensor circuit inspection

5. Individual harness connector inspection

1) Inspect for poor connections at the boost pressure sensor harness connector (pins 1, 2, and 3 of E105). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 19, 20, and 31 of E82). Is the connection status normal?

Refer to "*Engine Control*".

3) Are all of the results normal?

Yes

⇒Proceed to 6. Inspection for high resistance in boost pressure sensor circuit

No

Repair the circuit or the connection as necessary.

⇒Proceed to 9. Repair verification

6. Inspection for high resistance in boost pressure sensor circuit

1) Inspect for high resistance in the circuit between the ECM (pins 19, 20, and 31 of E82) and the boost pressure sensor (pins 1, 2, and 3 of E105). Is the result normal?

Refer to “*Engine Control*”.

Yes

Replace the boost pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Boost pressure sensor installation.*".

⇒Proceed to 9. Repair verification

No

Repair the circuit as necessary.

⇒Proceed to 9. Repair verification

7. Barometric pressure sensor circuit inspection

1) Inspect for poor connections at the barometric pressure sensor harness connector (pins 1, 2, and 3 of FL740). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 8, 10, and 12of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

3) Are all of the results normal?

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Yes

⇒Proceed to 8. Inspection for high resistance in barometric pressure sensor circuit

No

Repair the circuit or the connection as necessary.

⇒Proceed to 9. Repair verification

8. Inspection for high resistance in barometric pressure sensor circuit

1) Inspect for high resistance in the circuit between the ECM (pins 8, 10, and 12 of FL558) and the barometric pressure sensor (pins 1, 2, and 3 of FL740). Is the result normal?

Refer to “*Engine Control*”.

Yes

Replace the barometric pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor installation*".

⇒Proceed to 9. Repair verification

No

Repair the circuit as necessary.

⇒Proceed to 9. Repair verification

9. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P2228 (Flash code 71) Barometric Pressure Sensor Circuit Low

1. DTC information

1. DTC P2228 description

The barometric pressure sensor is installed within the instrument panel on the passenger side. The barometric pressure sensor changes voltage according to changes in air pressure. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Barometric pressure sensorsignal circuit

The barometric pressure sensor activates according to changes in air pressure, sending signals to the ECM. The ECM detects a low voltage when air pressure is low, such as in high altitude locations. The ECM detects a high voltage when the air pressure is high. The ECM uses this signal voltage to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P2228

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

The ECM detects that the barometric pressure sensor signal voltage is 0.5 V or less for approximately 5 seconds.

3. Action taken when DTC P2228 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default barometric pressure value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P2228

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

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Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0651 set at the same time?

Yes

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

No

⇒Proceed to 3. Barometric pressure sensor signal voltage check

3. Barometric pressure sensor signal voltage check

1) Observe the Barometric Pressure Sensor parameter on the scan tool. Is the Barometric Pressure Sensor parameter less than or equal to the specified value?

Value: 0.5 V

Yes

⇒Proceed to 4. Barometric pressure sensor 5 V reference voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Barometric pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the barometric pressure sensor harness connector (FL740) .

3) Turn ON the ignition switch.

4) Measure the voltage between the barometric pressure sensor 5 V reference circuit (pin 3 of FL740) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 5. Barometric pressure sensor signal output voltage check using fused jumper wire

No

⇒Proceed to 6. Inspection for open circuit in barometric pressure sensor 5 V reference circuit

5. Barometric pressure sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the barometric pressure sensor 5 V reference circuit and the signal circuit (pins 2 and 3 of FL740).

Refer to “*Engine Control*”.

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2) Observe the Barometric Pressure Sensor parameter on the scan tool. Is the Barometric Pressure Sensor parameter more than or equal to the specified value?

Value: 4.5 V

Yes

⇒Proceed to 8. Barometric pressure sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit and short circuit in barometric pressure sensor signal circuit

6. Inspection for open circuit in barometric pressure sensor 5 V reference circuit

1) Inspect the 5 V reference circuit between the ECM (pin 8of FL558) and the barometric pressure sensor (pin 3 of FL740) for an open circuit or high resistance. Is the result normal?

Refer to “*Engine Control*”.

Caution:

● The barometric pressure sensor shares the 5 V reference circuit with other sensors. A malfunction in the 5 V reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit and short circuit in barometric pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 10 of FL558) and the barometric pressure sensor (pin 2 of FL740) for the following conditions. Is the result normal?

● Open circuit

● Short to ground

● Short to the low reference circuit

● High resistance

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Barometric pressure sensor harness connector inspection

1) Inspect for poor connections at the barometric pressure sensor harness connector (pins 2 and 3 of FL740). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the barometric pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 8 and 10 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 11. Repair verification

POWERSTAR

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

DTC P2229 (Flash code 71) Barometric Pressure Sensor Circuit High

1. DTC information

1. DTC P2229 description

The barometric pressure sensor is installed within the instrument panel on the passenger side. The barometric pressure sensor changes voltage according to changes in air pressure. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Barometric pressure sensorsignal circuit

The barometric pressure sensor activates according to changes in air pressure, sending signals to the ECM. The ECM detects a low voltage when air pressure is low, such as in high altitude locations. The ECM detects a high voltage when the air pressure is high. The ECM uses this signal voltage to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P2229

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0651 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

Condition for setting the DTC

The ECM detects that the barometric pressure sensor signal voltage is 4.0 V or less for approximately 5 seconds.

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3. Action taken when DTC P2229 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM assumes a default barometric pressure value.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P2229

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Barometric pressure sensor signal voltage check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the Barometric Pressure Sensor parameter on the scan tool. Is the Barometric Pressure Sensor parameter more than or equal to the specified value?

Value: 4.0 V

Yes

⇒Proceed to 3. Barometric pressure sensor 5 V reference voltage checkand signal voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Barometric pressure sensor 5 V reference voltage checkand signal voltage check

1) Observe the DTC information with a scan tool for DTC P0651 being set at the same time.

2) Turn OFF the ignition switch.

3) Disconnect the barometric pressure sensor harness connector (FL740) .

Refer to "*Engine Control*".

4) Turn ON the ignition switch.

5) Observe the Barometric Pressure Sensor parameter on the scan tool.

Value: 0.1 V

The reading is more than the specified value.

⇒Proceed to 5. Inspection for short to power supply in barometric pressure sensor signal circuit

The reading is less than or equal to the specified value and DTC P0651 is set.

Go to DTC P0651 diagnosis.

Refer to "*DTC P0651 (Flash Code 56) Sensor Reference Voltage 2 Circuit*".

The reading is less than or equal to the specified value and DTC P0651 is not set.

⇒Proceed to 4. Barometric pressure sensor low reference circuit inspection using test lamp

4. Barometric pressure sensor low reference circuit inspection using test lamp

1) Connect a test lamp between the barometric pressure sensor low reference circuit (pin 1 of FL740) and the battery power supply. Does the test lamp illuminate?

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. Barometric pressure sensor harness connector inspection

No

⇒Proceed to 6. Inspection for open circuit in barometric pressure sensor low reference circuit

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5. Inspection for short to power supply in barometric pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 10 of FL558) and the barometric pressure sensor (pin 2 of FL740) for the following conditions. Is the result normal?

● Short to the power supply circuit

● Short to the 5 V reference circuit

Note:

● The barometric pressure sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

6. Inspection for open circuit in barometric pressure sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 12 of FL558) and the barometric pressure sensor (pin 1 of FL740) for an open circuit or high resistance. Is the result normal?

Caution:

● The barometric pressure sensor shares the low reference circuit with other sensors.A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Refer to “*Engine Control*”.

Yes

⇒Proceed to 8. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 10. Repair verification

7. Barometric pressure sensor harness connector inspection

1) Barometric pressure sensor harness connector inspection(pin 1 of FL740). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

Replace the barometric pressure sensor.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) barometric pressure sensor installation*".

⇒Proceed to 10. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

8. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 12 of FL558). Is the connection status

normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 9. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P2295 (Flash code 248) Fuel Pressure Regulator 2 Control Circuit Low

1. DTC P2295 (Flash Code 248) Fuel Pressure Regulator 2 Control Circuit Low DTC information

1. DTC P2295 description

The PCV controls the amount of fuel force-fed to the fuel rail. The PCV closes the valve after the signal voltage is sent to the PCV installed to the supply pump, and then the fuel is force-fed from the supply pump to the fuel rail. The ECM activates the PCV by controlling the valve opening timing. The earlier the valve opening time of the PCV is, the larger the amount of fuel force-fed to the fuel rail is, and the fuel rail pressure rises.

Two PCVs are installed to the supply pump and only a normal PCV can be activated even if one side fails. Because the PCV corresponds to each fuel injection cylinder, the DTC is not set but the engine is stopped if the harness is connected reversely.

2. Condition for setting DTC P2295

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The engine is running.

● Crankshaft position sensor and camshaft position sensor did not malfunction at the same time.

Condition for setting the DTC

● The ECM detects that the PCV 2 signal circuit voltage is excessively low for approximately 4 seconds or more when PCV 2 is OFF.

3. Action taken when DTC P2295 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P2295

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2295 (Flash Code 248) Fuel Pressure Regulator 2 Control Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Check whether DTC P2295 is a current failure with a scan tool. Is DTC P2295 a current failure?

Yes

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⇒Proceed to 3. Inspection of each harness connector and PCV2 installation

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Inspection of each harness connector and PCV2 installation

1) Inspect for poor connections at the PCV2 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

2) Inspect the installation status of the PCV2 body. Is the result normal?

3) Are all of the results normal?

Yes

⇒Proceed to 4. PCV2 inspection

No

Repair or replace if necessary.

⇒Proceed to 10. Repair verification

4. PCV2 inspection

1) Turn OFF the ignition switch.

2) Disconnect the PCV2 harness connector (E44) .

3) Measure the resistance of the PCV2 connector (pins 1 and 2 of E44) with a DMM. Is the resistance equal to the specified value?

Refer to “*Engine Control*”.

Value: about 3.2 Ω At room temperature

Yes

⇒Proceed to 5. PCV2 power supply voltage check

No

Replace the fuel supply pump.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 10. Repair verification

5. PCV2 power supply voltage check

1) Turn ON the ignition switch.

2) Measure the voltage between the PCV2 power supply circuit (pin 1 of E44) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: 20 V

Yes

⇒Proceed to 7. Inspection for open circuit and short circuit in PCV2 control circuit

No

⇒Proceed to 6. Fuse inspection

6. Fuse inspection

1) Inspect for a blown out ECM MAIN 15 A fuse. Is the result normal?

Yes

Repair or replace the power supply circuit between the ECM MAIN 15A fuse and PCV 2 (pin 1 of E44).

⇒Proceed to 10. Repair verification

No

Replace the fuse. Also, inspect for a short circuit which could cause a fuse blowout in the circuits related to the fuse, and repair or replace the harness as necessary.

⇒Proceed to 10. Repair verification

7. Inspection for open circuit and short circuit in PCV2 control circuit

1) Turn OFF the ignition switch.

2) Disconnect the ECM harness connector (E83) .

3) Connect a fused jumper wire between the PCV control circuit (pin 2 of E44) and the frame ground.

4) Measure the resistance between the PCV2 control circuit (pins 30 and 31 of E83) and frame ground with a DMM (Check for open circuit in PCV2 control circuit). Is the resistance less than or equal to the specified value?

Refer to "*Engine Control*".

Value: 10 MΩ

5) Disconnect the fused jumper wire from between the PCV control circuit (pin 2 of E44) and frame ground.

6) Measure the resistance between the PCV2 control circuit (pins 30 and 31 of E83) and frame ground with a DMM (Check for short circuit in PCV2 control circuit). Is the resistance more than or equal to the specified value?

Refer to "*Engine Control*".

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Value: 10 MΩ

7) Are all of the values normal?

Yes

⇒Proceed to 8. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 10. Repair verification

8. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit. Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 9. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 10. Repair verification

9. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 10. Repair verification

10. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P2296 (Flash code 218) Fuel Pressure Regulator 2 Control Circuit High

1. DTC P2296 (Flash Code 218) Fuel Pressure Regulator 2 Control Circuit High DTC information

1. DTC P2296 description

The PCV controls the amount of fuel force-fed to the fuel rail. The PCV closes the valve after the signal voltage is sent to the PCV installed to the supply pump, and then the fuel is force-fed from the supply pump to the fuel rail. The ECM activates the PCV by controlling the valve opening timing. The earlier the valve opening time of the PCV is, the larger the amount of fuel force-fed to the fuel rail is, and the fuel rail pressure rises.

Two PCVs are installed to the supply pump and only a normal PCV can be activated even if one side fails. Because the PCV corresponds to each fuel injection cylinder, the DTC is not set but the engine is stopped if the harness is connected reversely.

2. Condition for setting DTC P2296

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The engine is running.

● Crankshaft position sensor and camshaft position sensor did not malfunction at the same time.

● DTC P2295 is not set.

Refer to "*DTC P2295 (Flash Code 248) Fuel Pressure Regulator 2 Control Circuit Low*".

Condition for setting the DTC

● The ECM detects that the PCV 2 signal circuit voltage is excessively high for approximately 4 seconds or more when PCV 2 is ON.

3. Action taken when DTC P2296 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

● The ECM inhibits the EGR control.

4. Condition for clearing DTC P2296

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2296 (Flash Code 218) Fuel Pressure Regulator 2 Control Circuit High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Current DTC check

1) Check whether DTC P2296 is a current failure with a scan tool. Is DTC P2296 a current failure?

Yes

⇒Proceed to 3. Inspection of each harness connector and PCV2 installation

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Inspection of each harness connector and PCV2 installation

1) Inspect for poor connections at the PCV2 harness connector, the ECM harness connector, and the intermediate connector. Is the connection status normal?

2) Inspect the installation status of the PCV2 body.Is the result normal?

3) Are all of the results normal?

Yes

⇒Proceed to 4. PCV2 inspection

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

4. PCV2 inspection

1) Turn OFF the ignition switch.

2) Disconnect the PCV2 harness connector (E44) .

3) Measure the resistance of PCV 2 with a DMM (E44 pins 1 and 2) .Is the resistance equal to the specified value?

Refer to “*Engine Control*”.

Value: about 3.2 Ω At room temperature

Yes

⇒Proceed to 5. PCV2 Power supply voltage inspection

No

Replace the fuel supply pump.

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump removal*".

Refer to "*1.Engine 1C.Fuel System(6WG1) Fuel supply pump installation*".

⇒Proceed to 8. Repair verification

5. PCV2 Power supply voltage inspection

1) Turn ON the ignition switch.

2) Measure the voltage between the PCV 2 control circuit (pin 1 of E44) and the frame ground with a DMM. Is the voltage equal to the specified value?

Refer to “*Engine Control*”.

Value: about 0 V

Yes

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

No

⇒Proceed to 6. ECM power supply and ground circuit inspection

6. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 7. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 8. Repair verification

7. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

POWERSTAR

DTC P244A (Flash code 142) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too Low

1. DTC P244A (Flash code 142) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too Low DTC information

1. DTC P244A description

The exhaust differential pressure sensor is installed to the chassis frame located near the exhaust silencer. The exhaust differential pressure sensor changes signal voltage in accordance with changes in the exhaust gas pressure in front of and behind the exhaust silencer. If the exhaust differential pressure is detected to be too low under predetermined conditions, this DTC is set.

2. Condition for setting DTC P244A

Condition for running the DTC

● The battery voltage is 20 V or more.

● The fuel injection quantity is more than or equal to the predetermined value.

● DTCs P0560, P060B, P0697, P2454, and P2455 are not set.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P2454 (Flash code 47) Exhaust Pressure Sensor Circuit Low* ".

Refer to "*DTC P2455 (Flash code 47) Exhaust Pressure Sensor Circuit High* ".

Condition for setting the DTC

● The ECM detects that the exhaust differential pressure is less than the predetermined value for 30 seconds or more.

3. Action taken when DTC P244A sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type B.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P244A

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P244A (Flash code 142) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Exhaust differential pressure sensor functional inspection

1) Inspect the exhaust differential pressure sensor for the following conditions.

● Incorrect piping or disconnection of the exhaust differential pressure hose or pipe.

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● Clogging, collapsing, or twisting of the exhaust differential pressure hose or pipe

● Incorrect installation of the exhaust differential pressure sensor

● Damage to the exhaust differential pressure sensor

● Contamination or foreign material blocking the exhaust differential pressure sensor port.

● Misdetection or delayed response of the exhaust differential pressure sensor

Note:

● Installation direction of the exhaust differential pressure sensor hose is specified.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor installation*".

2) Repair or replace if necessary.

Note:

● If the exhaust differential pressure sensor is replaced, learning must be performed.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor inspection*".

Procedure completion

⇒Proceed to 3. Exhaust system inspection

3. Exhaust system inspection

1) Inspect the air intake/exhaust system for the following conditions.Is the result normal?

● Missing or damaged exhaust pipe gasket

● Exhaust gas leakage from the exhaust pipe, gasket, exhaust silencer, or the exhaust differential pressure sensor hose or pipe.

● Exhaust system modification

● Stuck exhaust brake valve

Refer to "*4.Brakes 4E.Speed Retarder System Exhaust brake valve inspection*".

Yes

⇒ Proceed to 4. Catalytic converter check

No

Repair or replace if necessary.

⇒Proceed to 6. Repair verification

4. Catalytic converter check

1) Remove the exhaust silencer.

Refer to "*1.Engine 1G.Exhaust(6WG1) Exhaust pipe removal*".

2) Inspect the exhaust silencer for damage, cracking, or burnouts. Is the result normal?

Yes

⇒Proceed to 5. Exhaust differential pressure sensor circuit inspection

No

Replace the exhaust silencer as necessary.

Refer to "*1.Engine 1G.Exhaust(6WG1) Exhaust pipe removal*".

Refer to "*1.Engine 1G.Exhaust(6WG1) Exhaust pipe installation*".

⇒Proceed to 6. Repair verification

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5. Exhaust differential pressure sensor circuit inspection

1) Inspect for poor connections at the exhaust differential pressure sensor harness connector (pins 1, 2, and 3 of FB491). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 2, 20, 22, and 23 of FL558). Is the connection status normal?

3)Inspect for high resistance in the circuit between the ECM (pins 2, 20, 22, and 23 of FL558) and the exhaust differential pressure sensor (pins 1, 2, and 3 of FB491). Is the result normal?

Refer to “*Engine Control*”.

4) Are all of the results normal?

Yes

Replace the exhaust differential pressure sensor.

Note:

● If the exhaust differential pressure sensor is replaced, learning must be performed.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor installation*".

⇒Proceed to 6. Repair verification

No

Repair the circuit or the connection as necessary.

⇒Proceed to 6. Repair verification

6. Repair verification

1) Reconnect all of the disconnected harness connectors.

2) Turn ON the ignition switch for 30 seconds.

Note:

● This is to have the exhaust differential pressure sensor relearn.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Start the engine.

6) Operate the vehicle under the conditions for running the DTC.

7) Observe the DTC information with a scan tool.

POWERSTAR

DTC P244B (Flash code 141) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too High

1. DTC P244B (Flash code 141) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too High DTC information

1. DTC P244B description

The exhaust differential pressure sensor is installed to the chassis frame located near the exhaust silencer. The exhaust differential pressure sensor changes signal voltage in accordance with changes in the exhaust gas pressure in front of and behind the exhaust silencer. If the ECM detects that the exhaust differential pressure is excessively high, this DTC is set.

2. Condition for setting DTC P244B

Condition for running the DTC

● The battery voltage is 20 V or more.

● The engine speed is 2000 rpm or more.

● DTCs P0560, P060B, P0697, P2454, and P2455 are not set.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Refer to "*DTC P2454 (Flash code 47) Exhaust Pressure Sensor Circuit Low* ".

Refer to "*DTC P2455 (Flash code 47) Exhaust Pressure Sensor Circuit High* ".

Condition for setting the DTC

● The ECM detects that the exhaust differential pressure is 60 kPa {8.7 psi} or more.

3. Action taken when DTC P244B sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P244B

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P244B (Flash code 141) Diesel Oxidation Catalyst (DOC) Exhaust Pressure Too High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Exhaust differential pressure sensor functional inspection

1) Inspect the exhaust differential pressure sensor for the following conditions.

● Incorrect piping or disconnection of the exhaust differential pressure hose or pipe.

● Incorrect piping or disconnection of the exhaust differential pressure hose or pipe.

● Incorrect installation of the exhaust differential pressure sensor

● Damage to the exhaust differential pressure sensor

● Contamination or foreign material blocking the exhaust differential pressure sensor port.

● Misdetection or delayed response of the exhaust differential pressure sensor

Note:

● Installation direction of the exhaust differential pressure sensor hose is specified.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor installation*".

2) Repair or replace if necessary.

Note:

● If the exhaust differential pressure sensor is replaced, learning must be performed.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor inspection*".

Procedure completion

⇒Proceed to 3. Exhaust system inspection

3. Exhaust system inspection

1) Inspect the air intake/exhaust system for the following conditions.Is the result normal?

● Missing or damaged exhaust pipe gasket

● Exhaust gas leakage from the exhaust pipe, gasket, exhaust silencer, or the exhaust differential pressure sensor hose or pipe.

● Exhaust system modification

● Stuck exhaust brake valve

Refer to "*4.Brakes 4E.Speed Retarder System Exhaust brake valve inspection*".

Yes

⇒Proceed to 4. Exhaust differential pressure sensor circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 5. Repair verification

4. Exhaust differential pressure sensor circuit inspection

1) Inspect for poor connections at the exhaust differential pressure sensor harness connector (pins 1, 2, and 3 of FB491). Is the connection status normal?

2) Inspect for poor connections at the ECM harness connector (pins 2, 20, 22, and 23 of FL558). Is the connection status normal?

3) Inspect for high resistance in the circuit between the ECM (pins 2, 20, 22, and 23 of FL558) and the exhaust differential pressure sensor (pins 1, 2, and 3 of FB491). Is the result normal?

Refer to "*Engine Control*".

4) Are all of the results normal?

Yes

Replace the exhaust differential pressure sensor.

Note:

● If the exhaust differential pressure sensor is replaced, learning must be performed.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor installation*".

⇒Proceed to 5. Repair verification

No

Repair the circuit or the connection as necessary.

⇒Proceed to 5. Repair verification

5. Repair verification

1) Reconnect all of the disconnected harness connectors.

2) Turn ON the ignition switch for 30 seconds.

Note:

● This is to have the exhaust differential pressure sensor relearn.

3) Clear the DTC with a scan tool.

4) Turn OFF the ignition switch for at least 30 seconds.

5) Start the engine.

6) Operate the vehicle under the conditions for running the DTC.

7) Observe the DTC information with a scan tool.

POWERSTAR

DTC P2454 (Flash code 47) Exhaust Pressure Sensor Circuit Low

1. DTC P2454 (Flash code 47) Exhaust Pressure Sensor Circuit Low DTC information

1. DTC P2454 description

The exhaust differential pressure sensor is installed to the chassis frame located near the exhaust silencer. The exhaust differential pressure sensor changes signal voltage in accordance with changes in the exhaust gas pressure in front of and behind the exhaust silencer. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Exhaust differential pressure sensor signal circuit

The exhaust differential pressure sensor sends signals related to exhaust differential pressure changes to the ECM via the signal circuit. The ECM detects a low signal voltage when the differential pressure is low. The ECM detects a high signal voltage when the differential pressure is high. If the ECM detects an excessively low signal voltage, the DTC is set.

2. Condition for setting DTC P2454

Condition for running the DTC

● The battery voltage is 20 V or more.

● The ignition switch is on.

● DTCs P0560, P060B and P0697 are not set.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the exhaust differential pressure sensor signal voltage is 0.2 V or less.

3. Action taken when DTC P2454 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P2454

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2454 (Flash code 47) Exhaust Pressure Sensor Circuit Low diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

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2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 3. Current DTC check

3. Current DTC check

1) Observe the DTC information with a scan tool. Is DTC P2454 set?

Yes

⇒Proceed to 4. Exhaust differential pressure sensor 5 V reference voltage check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Exhaust differential pressure sensor 5 V reference voltage check

1) Turn OFF the ignition switch.

2) Disconnect the exhaust differential pressure sensor harness connector (FB491) .

3) Turn ON the ignition switch.

4) Measure the voltage between the exhaust differential pressure 5 V reference circuit (pin 3 of FB491) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 4.5 V

Yes

⇒Proceed to 5. Exhaust differential pressure sensor signal output voltage check using fused jumper wire

No

⇒Proceed to 6. Inspection for open circuit in exhaust differential pressure sensor 5 V reference circuit

5. Exhaust differential pressure sensor signal output voltage check using fused jumper wire

1) Connect a fused jumper wire between the exhaust differential pressure sensor 5 V reference circuit and the signal circuit (pins 2 and 3 of FB491).

Refer to “*Engine Control*”.

2) Observe the Exhaust differential pressure sensor parameter on the scan tool. Is the Exhaust differential pressure sensor parameter more than or equal to the specified value?

Value: 4.5 V

Yes

⇒Proceed to 8. Exhaust differential pressure sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit and short circuit in exhaust differential pressure sensor signal circuit

6. Inspection for open circuit in exhaust differential pressure sensor 5 V reference circuit

1) Inspect the 5 V reference circuit between the ECM (pin 20 of FL558) and the exhaust differential pressure sensor (pin 3 of FB491) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit and short circuit in exhaust differential pressure sensor signal circuit

1) Inspect the signal circuit between the ECM (pin 2 of FL558) and the exhaust differential pressure sensor (pin 2 of FB491) for the following conditions. Is the result normal?

● Open circuit

● Short to ground

● Short to the low reference circuit

● High resistance

Refer to "*Engine Control*".

Yes

⇒Proceed to 9. ECM harness connector inspection

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Exhaust differential pressure sensor harness connector inspection

1) Inspect for poor connections at the exhaust differential pressure sensor harness connector (pins 2 and 3 of FB491). Is the connection status normal?

Refer to "*Engine Control*".

Yes

Replace the exhaust differential pressure sensor.

Note:

● If the exhaust differential pressure sensor is replaced, learning must be performed.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

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⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pins 2 and 20 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P2455 (Flash code 47) Exhaust Pressure Sensor Circuit High

1. DTC P2455 (Flash code 47) Exhaust Pressure Sensor Circuit High DTC information

1. DTC P2455 description

The exhaust differential pressure sensor is installed to the chassis frame located near the exhaust silencer. The exhaust differential pressure sensor changes signal voltage in accordance with changes in the exhaust gas pressure in front of and behind the exhaust silencer. The sensor has the following circuits.

● 5 V reference circuit

● Low reference circuit

● Exhaust differential pressure sensor signal circuit

The exhaust differential pressure sensor sends signals related to exhaust differential pressure changes to the ECM via the signal circuit. The ECM detects a low signal voltage when the differential pressure is low. The ECM detects a high signal voltage when the differential pressure is high. If the ECM detects an excessively high signal voltage, the DTC is set.

2. Condition for setting DTC P2455

Condition for running the DTC

● The battery voltage is 20 V or more.

● The ignition switch is on.

● DTCs P0560, P060B and P0697 are not set.

Refer to "*DTC P0560 (Flash code 155) System Voltage* ".

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

Condition for setting the DTC

● The ECM detects that the exhaust differential pressure sensor signal voltage is 4.9 V or more.

3. Action taken when DTC P2455 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC P2455

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P2455 (Flash code 47) Exhaust Pressure Sensor Circuit High diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

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2. Current DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P2455 set?

Yes

⇒Proceed to 3. Prioritized DTC check

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

3. Prioritized DTC check

1) Observe the DTC information with a scan tool.Is DTC P0697 set at the same time?

Yes

Go to DTC P0697 diagnosis.

Refer to "*DTC P0697 (Flash Code 57) Sensor Reference Voltage 3 Circuit*".

No

⇒Proceed to 4. Exhaust differential pressure sensor signal voltage check

4. Exhaust differential pressure sensor signal voltage check

1) Turn OFF the ignition switch.

2) Disconnect the exhaust differential pressure sensor harness connector (FB491) .

3) Turn ON the ignition switch.

4) Measure the voltage between the exhaust differential pressure sensor signal circuit (pin 2 of FB491) and the frame ground with a DMM. Is the voltage more than or equal to the specified value?

Refer to “*Engine Control*”.

Value: 0.1 V

Yes

⇒Proceed to 6. Inspection for short to power supply in exhaust differential pressure sensor signal circuit

No

⇒Proceed to 5. Exhaust differential pressure sensor low reference circuit inspection using test lamp

5. Exhaust differential pressure sensor low reference circuit inspection using test lamp

1) Connect a test lamp between the exhaust differential pressure sensor low reference circuit (pin 1 of FB491) and the battery power supply. Does the test lamp illuminate?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 8. Exhaust differential pressure sensor harness connector inspection

No

⇒Proceed to 7. Inspection for open circuit in exhaust differential pressure sensor low reference circuit

6. Inspection for open circuit in exhaust differential pressure sensor low reference circuit

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1) Inspect the signal circuit between the ECM (pin 2 of FL558) and the exhaust differential pressure sensor (pin 2 of FB491) for the following conditions. Is the result normal?

● Short to the power supply circuit

● Short to the 5 V reference circuit

Note:

● The exhaust differential pressure sensor may be damaged if the sensor signal circuit is shorted to the power supply.

Refer to "*Engine Control*".

Yes

⇒Proceed to 10. ECM replacement

No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

7. Inspection for open circuit in exhaust differential pressure sensor low reference circuit

1) Inspect the low reference circuit between the ECM (pin 23 of FL558) and the exhaust differential pressure sensor (pin 1 of FB491) for an open circuit or high resistance. Is the result normal?

Refer to "*Engine Control*".

Caution:

● The exhaust differential pressure sensor shares the low reference circuit with other sensors.

A malfunction in the low reference circuit may set DTCs on sensors that share this circuit.

Yes

⇒Proceed to 9. ECM harness connector inspection

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No

Repair the circuit as necessary.

⇒Proceed to 11. Repair verification

8. Exhaust differential pressure sensor harness connector inspection

1) Inspect for poor connections at the exhaust differential pressure sensor harness connector (pin 1 of FB491). Is the result normal?

Refer to "*Engine Control*".

Yes

Replace the exhaust differential pressure sensor.

Note:

● If the exhaust differential pressure sensor is replaced, learning must be performed.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) Exhaust differential pressure sensor installation*".

⇒Proceed to 11. Repair verification

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

9. ECM harness connector inspection

1) Inspect for poor connections at the ECM harness connector (pin 23 of FL558). Is the connection status normal?

Refer to “*Engine Control*”.

Yes

⇒Proceed to 10. ECM replacement

No

Repair the connection as necessary.

⇒Proceed to 11. Repair verification

10. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 11. Repair verification

11. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC P256A (Flash Code 31)Engine Idle Speed Selector Sensor

1. DTC P256A (Flash Code 31)Engine Idle Speed Selector Sensor DTC information

1. DTC P256A description

The idling control switch is a switch to adjust the idle speed during warm-up. If the Up or Down buttons on the idling control switch are pressed, the signal is input to the ECM. The ECM sets the DTC if the signal input on both the Up side and the Down side of the idling control switch are ON at the same time.

2. Condition for setting DTC P256A

Condition for running the DTC

● The battery voltage is 18 - 32 V.

● The ignition switch is on.

● DTCs P060B and P0641 are not set.

Refer to "*DTC P060B (Flash Code 36) Internal Control Module A/D Processing Performance*".

Refer to "*DTC P0641 (Flash Code 55) Sensor Reference Voltage 1 Circuit*".

Condition for setting the DTC

● The *ECM* detects that the upstream and downstream signals of the idle speed control switch are ON for 0.6 seconds or longer.

3. Measures to be taken when setting the DTC P256A

● The ECM illuminates the SVS lamp.Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Action taken when DTC P256A sets

● Refer to Condition for clearing the SVS lamp/DTC - Type C.

Refer to "*DTC type definitions*".

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2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. DTC P256A (Flash Code 31)Engine Idle Speed Selector Sensor diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Idling control switch check

1) Turn OFF the ignition switch.

2) Disconnect the idling control switch harness connector (FU67) .

Refer to "*Engine Control*".

3) Turn ON the ignition switch.

4) Observe the Idle Up Switch parameter and the Idle Down Switch parameter on the scan tool. Do the Idle Up Switch parameter and the Idle Down Switch parameter show OFF?

Yes

Replace the idling control switch.

⇒Proceed to 7. Repair verification

No

⇒Proceed to 3. Idle-up signal voltage check

3. Idle-up signal voltage check

1) Measure the voltage between the idle-up signal circuit (pin 3 of FU64) and frame ground with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: about 0 V

Yes

⇒Proceed to 4. Idle-down signal voltage check

No

Repair or replace if necessary.

⇒Proceed to 7. Repair verification

4. Idle-down signal voltage check

1) Measure the voltage between the idle-down signal circuit (pin 1 of FU67) and frame ground with a DMM. Is the voltage equal to the specified value?

Refer to "*Engine Control*".

Value: about 0 V

Yes

⇒Proceed to 5. ECM power supply and ground circuit inspection

No

Repair or replace if necessary.

⇒Proceed to 7. Repair verification

5. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 6. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 7. Repair verification

6. ECM replacement

Note:

● Perform programming after replacing the ECM.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

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Procedure completion

⇒Proceed to 7. Repair verification

7. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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DTC U0073 (Flash Code 84)Control Module Communication Bus Off

1. DTC U0073 (Flash Code 84)Control Module Communication Bus Off DTC information

1.DTC U0073 description

The ECM communicates with other electronic control units such as the antilock brake system control unit via the CAN communication circuit.The ECM data is output via the CAN high circuit and the data from the electronic control unit is input via the CAN low circuit.CAN communication Can be continuously implemented at a constant speed, the output of the time data and the input must match .If the ECM detects any malfunction in the CAN communication circuit, the DTC is set.

2. Condition for setting DTC U0073

Condition for running the DTC

● The battery voltage is 20 V or more.

Condition for setting the DTC

● The ECM detects a malfunction in the CAN communication circuit.

3. Action taken when DTC U0073 sets

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

4. Condition for clearing DTC U0073

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

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4. DTC U0073 (Flash Code 84)Control Module Communication Bus Off diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool.Is DTC P0601, P0606, or P1621 set at the same time?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0601 (Flash code 53) Internal Control Module Memory Check Sum Error* ".

Refer to "*DTC P0606 (Flash code 51) ECM Processor* ".

Refer to "*DTC P1621 (Flash code 54) Control Module Long Term Memory Performance*".

No

⇒Proceed to 3. Current DTC check

3. Current DTC check

1) Observe the DTC information with a scan tool.Is DTC U0073 set?

Yes

⇒Proceed to 4. Individual harness connector inspection

No

Go to Intermittent conditions.

Refer to "*202.Engine 15D.Symptom(6WG1) Intermittent conditions of engine*".

4. Individual harness connector inspection

1) Inspect for poor connections at all harness connectors and intermediate connectors related to the CAN communication circuit. Is the connection status normal?

Yes

⇒Proceed to 5. CAN circuit resistance check

No

Repair the connection as necessary.

⇒Proceed to 15. Repair verification

5. CAN circuit resistance check

1) Turn OFF the ignition switch.

2) Remove all electronic control units related to CAN communication.

3) Measure the resistance between the CAN High circuit and the CAN Low circuit of the ECM harness connector (pins 28 and 30 of FL557) with a DMM. Is the resistance equal to the specified value?

Refer to "*Controller Area Network*".

Value: about 120 Ω

Yes

⇒Proceed to 8. CAN high voltage circuit check

No

⇒Proceed to 6. Resistor 1 CAN internal circuit check

6. Resistor 1 CAN internal circuit check

1) Remove the resistor 1.

2) Using a digital multimeter, measure the resistance between the CAN high-voltage circuit harness connector and the CAN low-voltage circuit (pins 28 and 30 of the FL557) of the *ECM* harness resistor. Is the resistance equal to the specified value?

Refer to "*Controller Area Network*".

Value: about 120 Ω

Yes

Replace the resistor 1.

⇒Proceed to 15. Repair verification

No

⇒ Proceed to 7. Resistor 2 CAN internal circuit check

7. Resistor 2 CAN internal circuit check

1) Install resistor 1, then remove resistor 2.

2) Using a digital multimeter, measure the resistance between the CAN high-voltage circuit harness connector and the CAN low-voltage circuit (pins 28 and 30 of the FL557) of the *ECM* harness resistor. Is the resistance equal to the specified value?

Refer to "*Controller Area Network*".

Value: about 120 Ω

Yes

Replace the resistor 2.

⇒Proceed to 15. Repair verification

No

⇒Proceed to 8. CAN high voltage circuit check

8. CAN high voltage circuit check

1) Remove the resistor 2.

2) Use a digital multimeter to measure the resistance between CAN high voltage circuit (pin 28 of FL557) and frame ground of the *ECM* harness connector. Is the resistance higher or equal to the specified value?

Refer to "*Controller Area Network*".

Value: 10 MΩ

Yes

⇒Proceed to 9. CAN low voltage circuit check

No

Repair as necessary.

⇒Proceed to 15. Repair verification

9. CAN low voltage circuit check

1) Use a digital multimeter to measure the resistance between CAN low voltage circuit (pin 30 of FL557) and chassis ground of the ECM harness connector Is the resistance higher or equal to the specified value?

Refer to "*Controller Area Network*".

Value: 10 MΩ

Yes

⇒Proceed to 10. CAN high voltage circuit harness check

No

Repair as necessary.

⇒Proceed to 15. Repair verification

10. CAN high voltage wiring harness inspection

1) Use a digital multimeter to measure the resistance between the high voltage CAN circuit (pin 2 of E126) in the first resistance mounting area and the CAN high voltage circuit (pin 25 of FU72) in the second resistance mounting area. Is the resistance higher than or equal to the specified value?

2) Using a digital multimeter, measure the resistance of the CAN high-voltage circuit between the *ECM* (pin 28 of the FL557) and the mounting area of the resistor No.1 (pin 2 of E126). Is the resistance higher than or equal to the specified value?

Refer to "*Controller Area Network*".

Refer to "*Controller Area Network*".

Value: 10 MΩ

3) Are all of the values normal?

Yes

⇒Proceed to 11. CAN low voltage circuit harness check

No

Repair as necessary.

⇒Proceed to 15. Repair verification

11. CAN low voltage circuit harness check

1) Use a digital multimeter to measure the resistance between the low voltage CAN circuit (pin 1 of E126) in the first resistance mounting area and the CAN low voltage circuit (pin 24 of FU72) in the second resistance mounting area. Is the resistance higher than or equal to the specified value?

2) Using a digital multimeter, measure the resistance of the CAN low-voltage circuit between the *ECM* (pin 30 of the FL557) and the mounting area of the resistor No.1 (pin 1 of E126). Is the resistance higher than or equal to the specified value?

Refer to "*Controller Area Network*".

Refer to "*Controller Area Network*".

Value: 10 MΩ

3) Are all of the values normal?

Yes

⇒Proceed to 12. CAN communication-related trouble code check

No

Repair as necessary.

⇒Proceed to 15. Repair verification

12. CAN communication related trouble code check

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Turn ON the ignition switch.

5) After 10 seconds have passed, check the DTC information of all the *ECM*s used in the vehicle. Check if the diagnostic code is related to CAN communication setting.

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Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 13. ECM power supply and ground circuit inspection

13. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit.Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒Proceed to 14. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 15. Repair verification

14. ECM replacement

Note:

● The replaced ECM requires programming and learning.

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control(6WG1) ECM setting*".

Procedure completion

⇒Proceed to 15. Repair verification

15. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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Diagnostic code U0110 (blink code 87) Communication with the VNT system is interrupted

1. Trouble diagnosis code U0110 (flashing code 87) Communication with VNT system fault diagnostic code information

1. Trouble Code U0110 Description

The *ECM* and the VNT control module send and receive control and diagnostic information via CAN communication and the *ECM* monitors the CAN operating status by acquiring a constant flow of information from the VNT control module.If the *ECM* can not obtain the required information , This trouble code will be set.

2. Set the trouble code U0110

Condition for running the DTC

When setting the error message DTCs

● The battery voltage is 20 - 32 V.

● The ignition switch is on.

If communication with DTC is interrupted

● The battery voltage is 20 V or more.

● The ignition switch is on

● Trouble code U0073 is not set.

Refer to "*DTC U0073 (Flash Code 84) Control Module Communication Bus Off*".

Condition for setting the DTC

When setting the error message DTCs

● The VNT control module receives a CAN error message from the *ECM*.

If communication with DTC is interrupted

● The *ECM* detected CAN messages that did not receive the VNT control module.

3. What to do when setting the trouble code U0110

When setting the error message DTCs

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

If communication with DTC is interrupted

● The ECM illuminates the MIL.Refer to Action taken when DTC sets - Type A.

Refer to "*DTC type definitions*".

● The ECM limits the fuel injection quantity.

4. Clear the trouble code U0110

● Condition for clearing the MIL/DTC - Refer to Type A.

Refer to "*DTC type definitions*".

2. Engine control

Refer to “*101.ETM 13B. - Engine - Engine Control - Engine Control*”

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostic Trouble Code U0110 (Blink Code 87) Communication with VNT system interrupt diagnostic method

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Are both DTCs U0073 or P0045 set?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC U0073 (Flash Code 84) Control Module Communication Bus Off*".

Refer to "*DTC P0045 (blink code 33) Turbocharger boost control solenoid circuit*".

No

⇒Proceed to 3. Check if the controller LAN circuit is open

3. Check if the controller LAN circuit is open

1) Turn OFF the ignition switch.

2) Disconnect the VNT control module harness connector (E120).

3) Turn ON the ignition switch.

4) Use a digital multimeter to measure the voltage between CAN low voltage circuit (E120 pin 16) and chassis ground. Is the voltage within the specified range?

5) Use a digital multimeter to measure the voltage between the CAN high voltage circuit (pin 15 of E120) and the frame ground. Is the voltage within the specified range?

Refer to "*Controller Area Network*".

Value: 1.5 to 3.5 V

6) Are all of the values normal?

Yes

⇒ Proceed to 4. Check if the VNT control module power circuit is open

No

Repair open circuit or high resistance faults in CAN high voltage circuits and CAN low voltage circuits between the VNT control module (pins 15 and 16 of E120) and the intermediate connector.

⇒ Proceed to 8. Repair verification

4. Check if the VNT control module power circuit is open

1) Connect the test lamp between the ignition supply circuit (pin 13 of E120) and the frame ground. Does the test lamp illuminate?

Refer to “*Engine Control*”.

Yes

⇒ Proceed to 5. Check if the ground circuit of the VNT control module is open

No

First check the fuses and then repair the open circuit or high resistance of the power circuit between the 7.5 A fuse of the electronic Engine Control unit and the VNT control module (pin 13 of E120).

⇒ Proceed to 8. Repair verification

5. Check if the VNT control module ground circuit is open

1) Connect the test lamp between the ignition power circuit and ground circuit (pins 13 and 14 of E120). Do the test lamp illuminate?

Refer to "*Engine Control*".

Yes

⇒ Proceed to 6. Check the VNT control module harness connector

No

Repair open circuit or high resistance faults in the ground circuit between the VNT control module (pin 14 of E120) and the frame ground and, if necessary, re-fasten or clean the corroded area.

⇒ Proceed to 8. Repair verification

6. Check the VNT control module harness connector

1) Check that the VNT control module harness connector (pins 13, 14, 15 and 16 of E120) is not properly connected. Is the connection status normal?

Refer to "*Engine Control*".

Yes

⇒Proceed to 7. Replace the VNT control module

No

Repair the connection as necessary.

⇒ Proceed to 8. Repair verification

7. Replace the VNT control module

Refer to "*1. Engine 1Z. Engine Electrical Control (6WG1) VNT Control Module Removal*".

Refer to "*1. Engine 1Z. Engine Electrical Control (6WG1) VNT Control Module Installation*".

Procedure completion

⇒Proceed to 8. Repair verification

8. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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Diagnostic trouble code U0121 (blink code 89) Communication with anti-lock braking system (ABS) control module interrupted

1. DTC U0121 (blink code 89) Interrupt with ABS control module DTC information

1. Trouble Code U0121 Description

The ECM communicates with other electronic control units such as the antilock brake system control unit via the CAN communication circuit.The ECM data is output via the CAN high circuit and the electronic control unit data is input via the CAN low circuit.CAN communication Can be continuously executed at a constant speed and the output of the time data must be matched with the input. If CAN communication is interrupted by the ABS control unit, the ECM will set the DTC.

2. Set the trouble code U0121 situation

Condition for running the DTC

● The battery voltage is 20 V or more.

● Trouble code U0073 is not set.

Refer to "*DTC U0073 (Flash Code 84) Control Module Communication Bus Off*".

Condition for setting the DTC

● An anti-lock braking system control unit can not establish communication for 1 second or 1 second after the ignition switch is turned on and lasts for 3 seconds or more.

3. What to do when setting trouble code U0121

● The ECM illuminates the SVS lamp. Refer to Action taken when DTC sets - Type C.

Refer to "*DTC type definitions*".

4. Clear the trouble diagnosis code U0121 situation

● Refer to Condition for clearing the SVS lamp / DTC - Type C.

Refer to "*DTC type definitions*".

2. Engine control

Refer to "*101.ETM 13B. - Engine - Engine Control - Engine Control*"

3. Circuit diagram

Refer to "*202. Engine 15B. Maintenance Information (6WG1) - Engine Function, Structure and Operation - Circuit Diagram*" in this section.

4. Diagnostic trouble code U0121 (blink code 89) Interruption of communication with the ABS control module diagnostics

1. Engine control system check

Refer to "*Diagnostic System Check - Engine Control Device*".

2. Prioritized DTC check

1) Connect the scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Observe the DTC information with a scan tool. Is the fault diagnosis code P0601, P0606 or P1621 set?

Yes

Go to the applicable DTC diagnosis.

Refer to "*DTC P0601 (Flash code 53) Internal Control Module Memory Check Sum Error*".

Refer to "*DTC P0606 (Flash code 51) ECM Processor*".

Refer to "*DTC P1621 (Flash code 54) Control Module Long Term Memory Performance*".

No

⇒ Proceed to 3. Current DTC check

Current DTC check

1) Observe the DTC information with a scan tool. Is the trouble code U0121 set?

Yes

⇒ Proceed to 4. Check CAN high voltage circuit for open and short circuit

No

Go to Intermittent conditions.

Refer to "*202. Engine 15D.Symptom (6WG1) Intermittent conditions of engine*".

4. Check CAN high voltage circuit for open and short circuit

1) Turn OFF the ignition switch.

2) Remove resistor 1 and resistor 2.

3) Remove all electronic control units related to CAN communication.

4) Connect a jumper wire with fuse between CAN high circuit (pin 10 of FL330) and chassis ground of ABS control harness connector.

5) Use a digital multimeter to measure the resistance between CAN high voltage circuit (pin 28 of FL557) and frame ground of the *ECM* harness connector. Is the resistance lower than or equal to the specified value?

Refer to "*Controller Area Network*".

Value: 10 MΩ

6) Disconnect the fused jumper wire between CAN high circuit (pin 10 of FL330) and chassis ground of the ABS brake harness control system harness connector.

7) Use a digital multimeter to measure the resistance between the CAN high-voltage circuit harness connector (pin 28 of FL557) and the frame ground of the *ECM* harness resistor. Is the resistance higher than or equal to the specified value?

Refer to "*Controller Area Network*".

Value: 10 MΩ

8) Are all of the values normal?

Yes

⇒Proceed to 5. Check CAN low voltage circuit for open circuit and short circuit

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

5. Check CAN low voltage circuit for open and short circuit

1) Connect a jumper wire with fuse between the low CAN circuit (pin 4 of FL330) and the chassis ground of the ABS control harness connector.

2) Use a digital multimeter to measure the resistance between CAN low voltage circuit (pin 30 of FL557) and frame ground of the *ECM* harness connector. Is the resistance less than or equal to the specified value?

Refer to "*Controller Area Network*".

Value: 10 MΩ

3) Disconnect the fused jumper wire between the CAN low circuit (pin 4 of FL330) and chassis ground of the ABS brake harness control system harness connector.

4) Use a digital multimeter to measure the resistance between CAN low voltage circuit (pin 30 of FL557) and frame ground of *ECM* harness connector. Is the resistance higher than or equal to the specified value?

Refer to "*Controller Area Network*".

5) Are all of the values normal?

Value: 10 MΩ

Yes

⇒Proceed to 6. CAN high signal voltage check

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

6. CAN high signal voltage check

1) Turn ON the ignition switch.

2) Use a digital multimeter to measure the voltage between the CAN high voltage circuit (pin 28 of FL557) of the ECM harness connector and the frame ground. Is the voltage equal to the specified value?

Refer to "*Controller Area Network*".

Value: About 0 V

Yes

⇒Proceed to 7. CAN low signal voltage check

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

7. CAN low signal voltage check

1) Turn ON the ignition switch.

2) Use a digital multimeter to measure the voltage between CAN low voltage circuit (pin 30 of FL557) and frame ground of the *ECM* harness connector. Is the voltage equal to the specified value?

Refer to "*Controller Area Network*".

Value: About 0 V

Yes

⇒Proceed to 8. Trouble Code Follow-up inspection

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No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

8. Troubleshooting code follow-up inspection

1) Reconnect all of the disconnected harness connectors.

2) Clear the DTC with a scan tool.

3) Turn OFF the ignition switch for at least 30 seconds.

4) Start the engine.

5) Operate the vehicle under the conditions for running the DTC.

6) Observe the DTC information with a scan tool. Is the trouble code U0121 set?

Yes

⇒ Proceed to 2. Prioritized DTC check

No

⇒Proceed to 9. Check the anti-lock braking system control unit CAN communication related trouble code

9. Check the anti-lock braking system control unit CAN communication related diagnostic trouble code

1) Observe the DTC information on the anti-lock braking system control unit using the scanning tool. Is fault diagnostics related to CAN communication set?

Yes

Go to the applicable DTC diagnosis.

No

⇒ Proceed to 10. ECM power supply and ground circuit inspection

10. ECM power supply and ground circuit inspection

1) Inspect the ECM power supply or ground circuit. Is the result normal?

Refer to "*ECM power supply and ground circuit inspection*".

Yes

⇒ Proceed to 11. ECM replacement

No

Repair or replace if necessary.

⇒Proceed to 14. Repair verification

11. ECM replacement

Note:

The Replaced ECM requires programming and learning.

Refer to "*1.Engine 1Z.Engine Electrical Control (6WG1) ECM removal*".

Refer to "*1.Engine 1Z.Engine Electrical Control (6WG1) ECM installation*".

Refer to "*1.Engine 1Z.Engine Electrical Control (6WG1) ECM setting*".

Procedure completion

⇒Proceed to 12. Check whether there are any other DTCs besides the DTC Brake Control Unit DTCs.

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12. Check whether there is any other DTC except for the DTC anti-lock brake unit control unit.

1) Turn OFF the ignition switch.

2) Connect the anti-lock braking system control unit harness connector (FL330).

Refer to "*Controller Area Network*".

3) If the harness connector is connected to the electronic control unit other than the antilock brake control unit, disconnect it.

4) Turn ON the ignition switch.

5) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 13. Control module diagnostic code check

13. Control module troubleshooting code check

1) Connect the harness connector to all electronic control units.

2) Start the engine.

3) Observe the DTC information with a scan tool. Is a DTC set?

Yes

Go to the applicable DTC diagnosis.

No

⇒Proceed to 14. Repair verification

14. Repair verification

1) Clear the DTC with a scan tool.

2) Turn OFF the ignition switch for at least 30 seconds.

3) Start the engine.

4) Operate the vehicle under the conditions for running the DTC.

5) Observe the DTC information with a scan tool.

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Engine

Removal

1. Engine Safety information

Caution:

● Make sure to place chock blocks to the wheels.

● Select and use an engine hoist that is able to bear the weight of the engine.

● Do not go under the engine while it is hoisted.

● Do not put your hands where they can get easily caught.

● Be careful of pinching, dropping, interference, and damage.

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

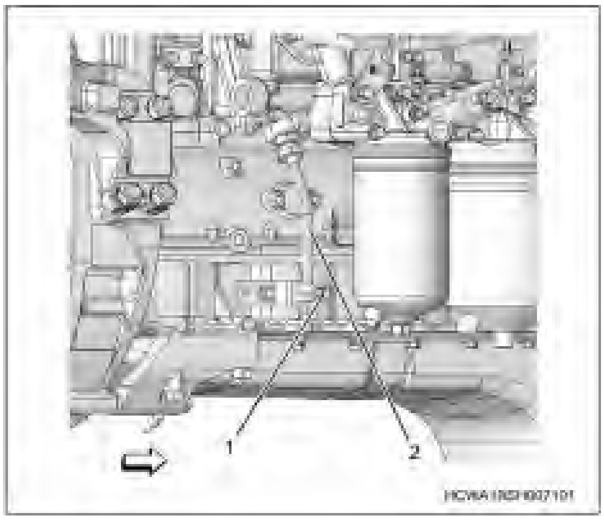
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

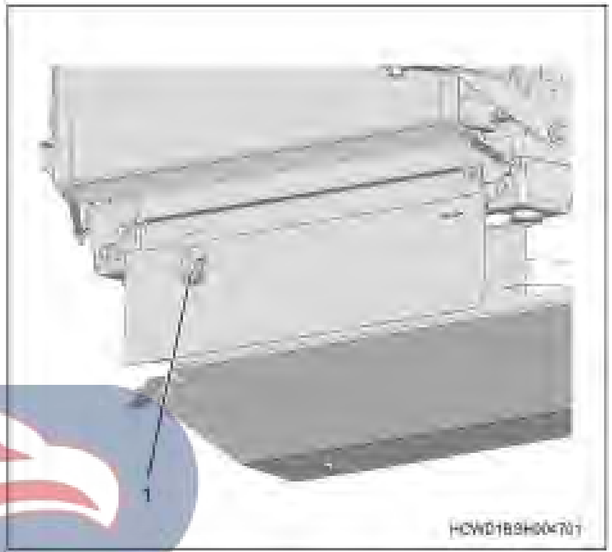
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Engine oil Drain

1) Remove the drain plug from the oil pan, and drain the engine oil to a pan.

2) Install the drain plug to the oil pan.

Caution:

● Do not forget to tighten the drain plug.

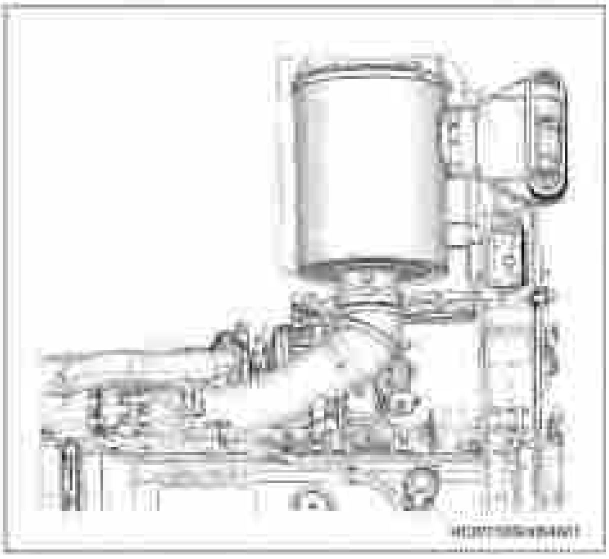
Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

5. Air cleaner Removal

1) Remove the air cleaner duct from the air cleaner.

2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



6. Mud guard Removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

7. Noise shutter panel Removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

8. Exhaust cover Removal

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1) Remove the exhaust cover from the frame.

9. Exhaust brake valve removal

1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

10. Transmission Removal

Refer to "*5.Transmission, Transaxle 5C.Manual(MJT) Transmission removal*".

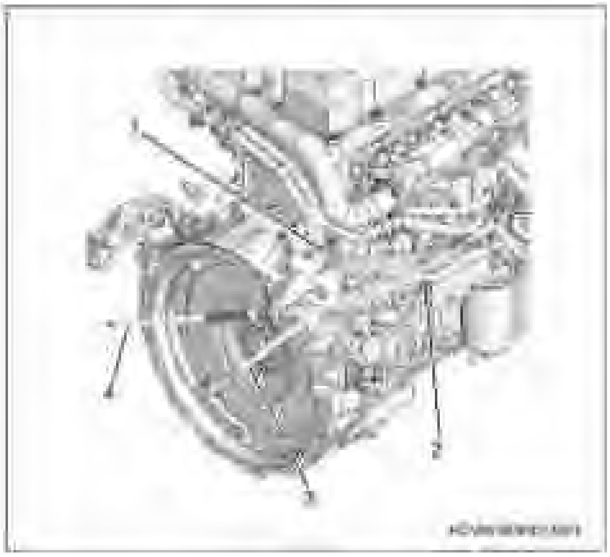
Refer to "*5.Transmission, Transaxle 5C.Manual(MJX16) Transmission removal*".

11. Remove the pole bracket

1) Remove the shift cable from the relay pole bracket.

2) Remove the selector cable from the relay pole bracket.

3) Remove the relay rod holder on the flywheel housing.



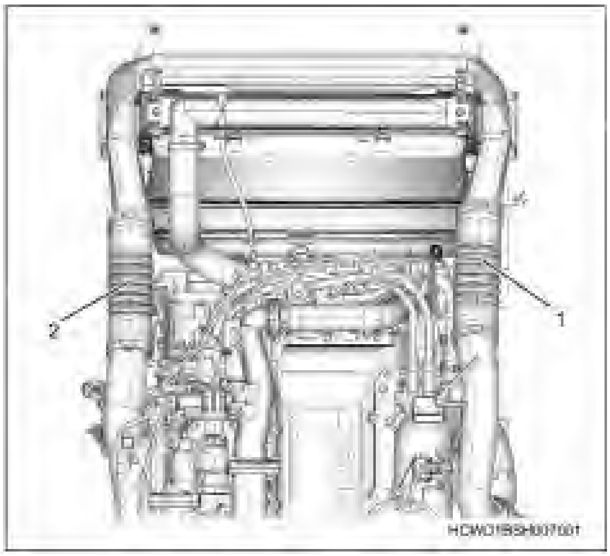
1. Relay rod bracket
2. Shifting cable
3. Connecting rod.
4. Selecting cable

12. Intercooler hose Removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

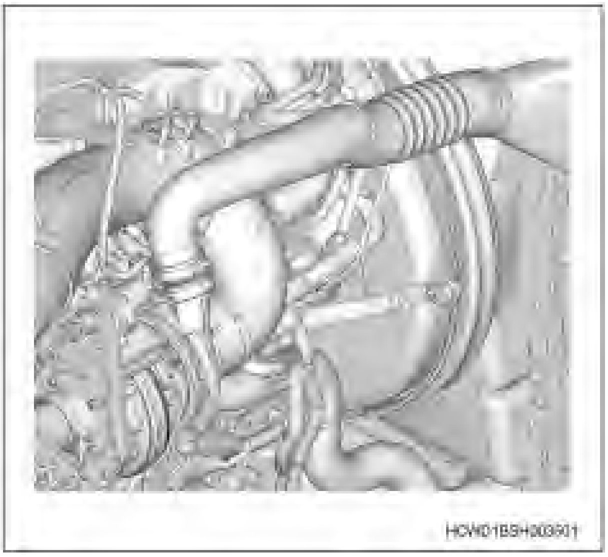
2) Remove the intercooler hose outlet on the intake line.

3) Disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



13. Radiator upper hose Removal

1) Remove the radiator upper hose from the water

2) Remove the radiator upper hose from the radiator.

3) Disconnect the radiator air leak hose from the radiator.

14. Radiator lower hose Removal

1) Remove the radiator lower hose from the water intake pipe and the radiator.

2) Remove the radiator lower hose from the radiator.

15. Heater hose Removal

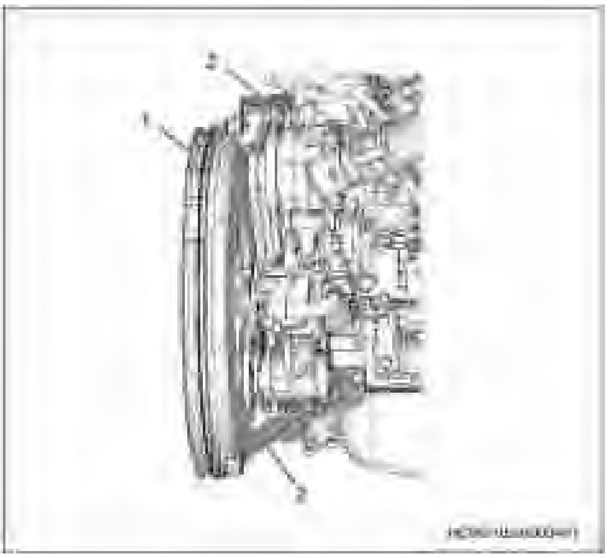
1) Remove the feed and return heater hose from the heater pipe.

16. Radiator fan cover Disconnection

1) Disconnect the fan guide bracket from the engine.

Caution:

● Do not remove the fan duct connected to the air duct bracket.



1. Fan guide

2. Fan guide bracket

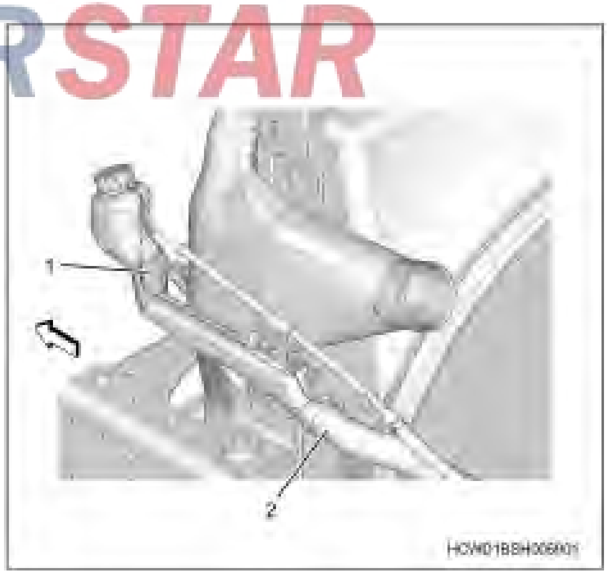
2) Disconnect the radiator fan cover from the fan guide cover.

17. Oil level gauge guide tube Removal

1) Remove the oil level gauge guide tube from the cylinder block.

18. Refueling pipeline Removed

1) Remove the refuel line and rubber hose from the timing gearbox.



1. Refuel pipeline

2. Rubber hose

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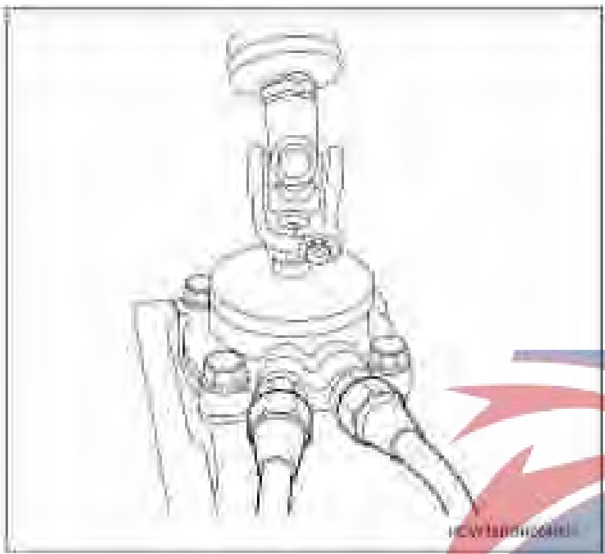
19. Power steering fluid Drain

1. Models not equipped with emergency assistance steering system

1) Jack up the front of the vehicle and attach a chassis stand.

2) Prepare an oil pan, and loosen the steering unit oil pipe.



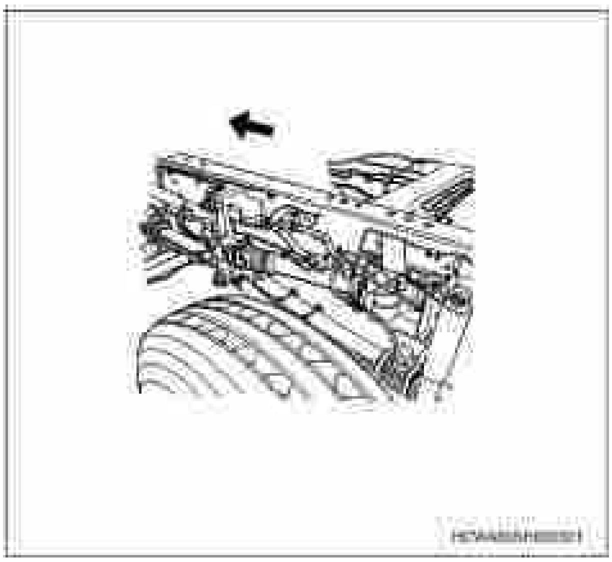
3) Slowly turn the steering wheel to the left and right to discharge power steering fluid from the steering unit.

2. Equipped with emergency assisted steering system models

1) Jack up the front of the vehicle and attach a chassis stand.

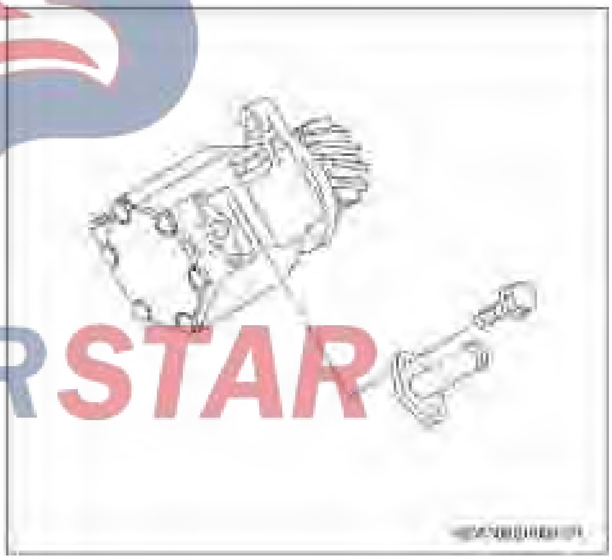
2) Prepare the oil pan, loosen the power steering booster tubing.

3) Turn the steering wheel slowly to the left and right to drain the power steering fluid from the power steering booster.



20. Power steering oil tank Removal

1) Remove the suction pipe and O-ring from the power steering pump.



2) Remove the oil pipe and washer from the power steering pump.

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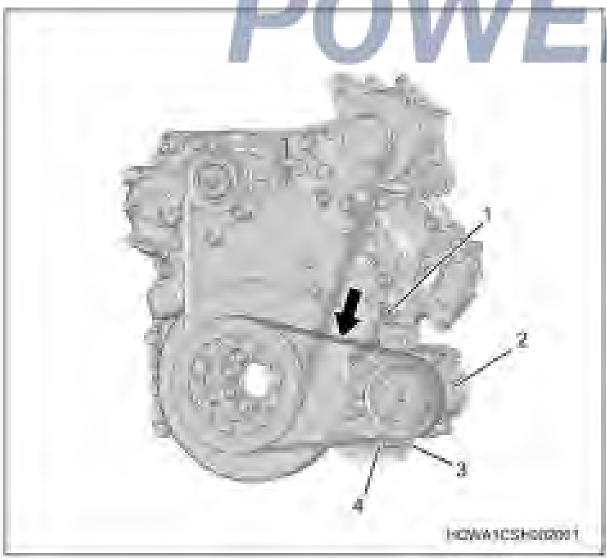
3) Remove the power steering pump and O-ring from the engine.

Caution:

● Install the seal ring on the pipe and hose mounting section, and then install the seal on the oil pump removal surface to prevent foreign particles from entering.

21. A / C compressor drive belt Removal

1) Loosen the nuts and the auxiliary bolts and then remove the A / C compressor drive belt of the A / C compressor and crankshaft pulley.



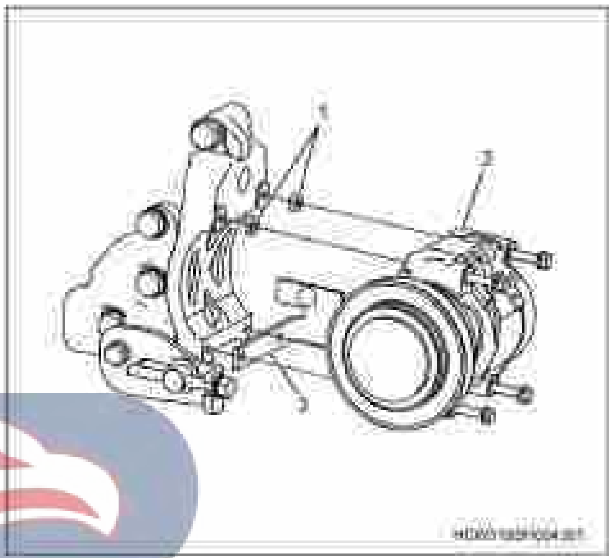
1. Bolt
2. A / C compressor
3. Adjust bolt
4. Nut (back end)

22. A/C compressor Disconnect

1) Disconnect the A/C compressor from the bracket.

Note:

● Without removing the gas pipe, move the pipe together with the A/C compressor to a position that will not interfere with work.



1. Collar
2. A / C compressor
3. Bracket

23. Air charge pipe Disconnect

1) Disconnect the air compressor governor pipe from the air compressor.

2) Disconnect the gas line from the air charge pipe.

3) Disconnect the air charge pipe from the fitting.

24. Engine harness Disconnect

1) Disconnect the engine harness connector from the chassis side harness connector.

2) Disconnect the ground cable from the frame.

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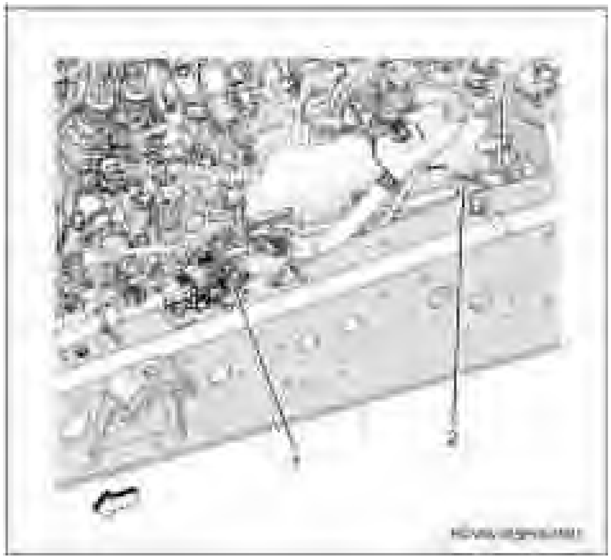


1. Engine harness connector

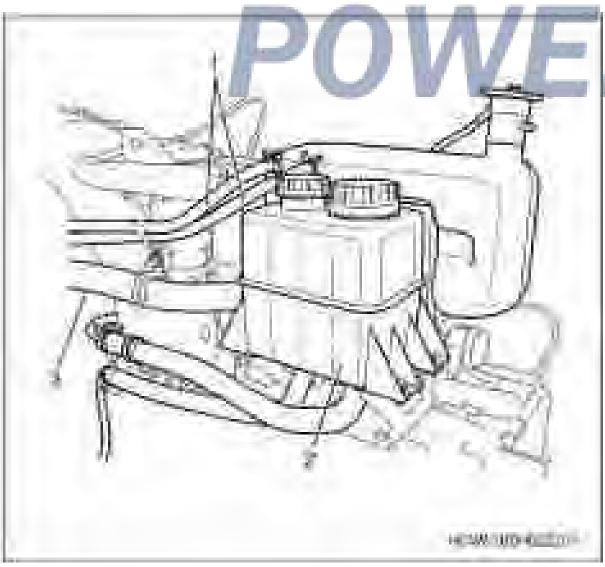
2. Ground cable

3) Disconnect the B-terminal and the S-terminal of the starter cable from the starter.

4) Disconnect the harness connector from the generator.

25. Power steering tank hose disconnected

1) Disconnect the 2 power steering hoses at the power steering fuel tank and drain all the power steering oil into the oil sump.

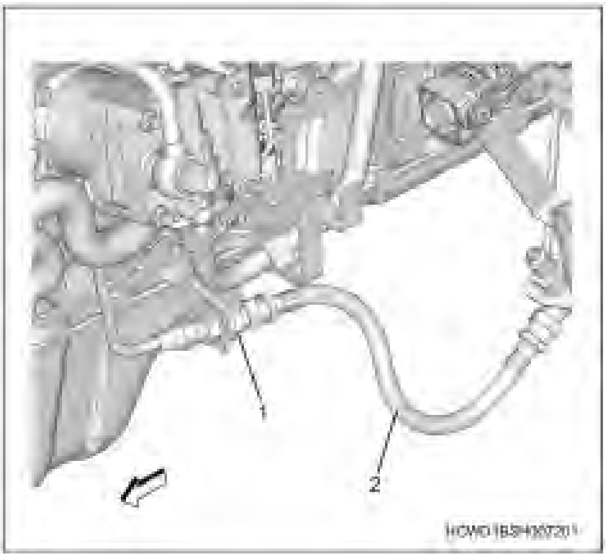


1. Radiator air leak hose

2. Power steering oil tank

3. Sub-tank hose

2) Disconnect the power steering flexible hose connection from the pipe connector.



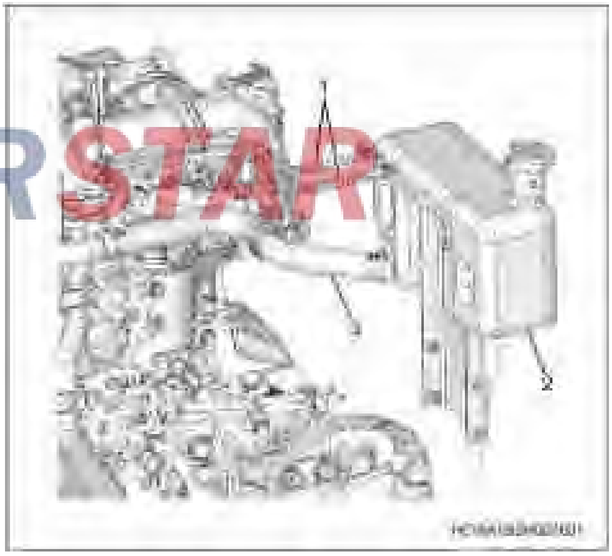
1. Union

2. Power steering flexible hose

26. Sub-tank hose Disconnect

1) Disconnect the sub-tank hose from radiator sub-tank.

2) Disconnect the radiator air leak hose from the radiator sub-tank.



1. Radiator air leak hose

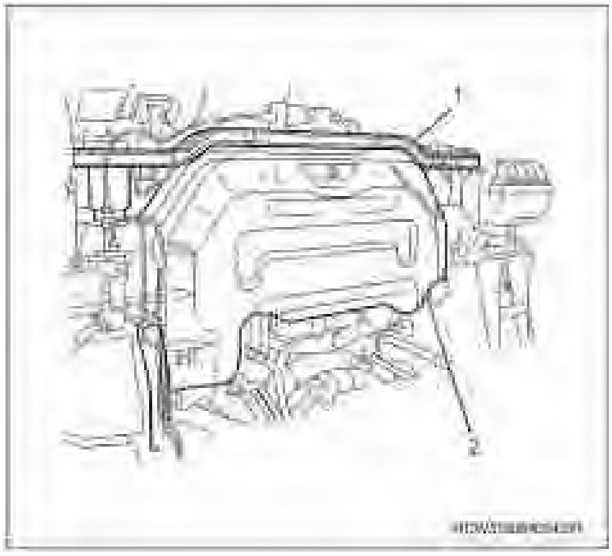
2. Deputy tank

3. Sub-tank hose

27. Cab back member noise cover Removal

1) Remove the cab back member noise cover from the cab mounting rear member.

POWERSTAR



1. Cab rear mounting member

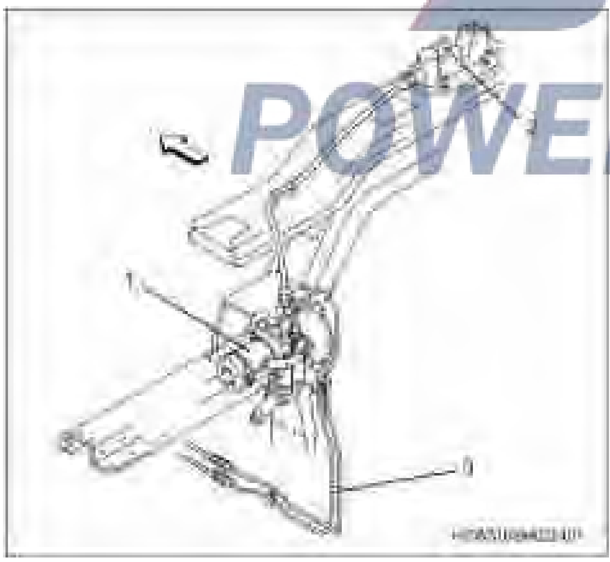
2. Cab back member noise cover

28. Cab tilt pump Removal

1) Remove the bracket and clip from the cab mounting rear member.

Note:

● Without disconnecting the oil pipe, move it aside in a position not in the way of work.



1. Cab tilt pump

2. Cab latch

3. Oil pipe

29. Fuel hose Disconnect

1) Disconnect the fuel hose from the fuel suction pipe.

2) Disconnect the fuel hose from the fuel leak-off pipe.

30. Engine foot Disconnect

1) Install special tool to the cylinder head.

Tightening torque: 117.5 N• m { 12.0 kgf • m / 39.46 kg • ft }

SST: 8-9761-4276-0 - engine hanger

2) Prepare the hoist.

3) Install the wire to the engine hanger and the hoist, and hold the engine.

4) Remove the nut and bolt, and disconnect the engine foot from the engine mounting.

31. Engine Removal

1) Remove the engine from vehicle using the hoist.

Caution:

● Pay careful attention to the interference from various parts when performing the procedure.

● Never go under the engine while it is hoisted.

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Installation

1. Engine Installation

1) Install the engine to vehicle using the hoist.

2) Pay careful attention to the interference from various parts when performing the procedure.

3) Never go under the engine while it is hoisted.

2. Engine foot Connect

1) Connect the engine foot to engine mounting.

Tightening torque: 228 N • m { 23.2 kgf • m / 168 lb • ft } Front side

Tightening torque: 490 N • m { 50.0 kgf • m / 361 lb • ft } Rear side

2) Remove the wire from the engine hanger and the hoist.

3) Remove special tool from the cylinder head.

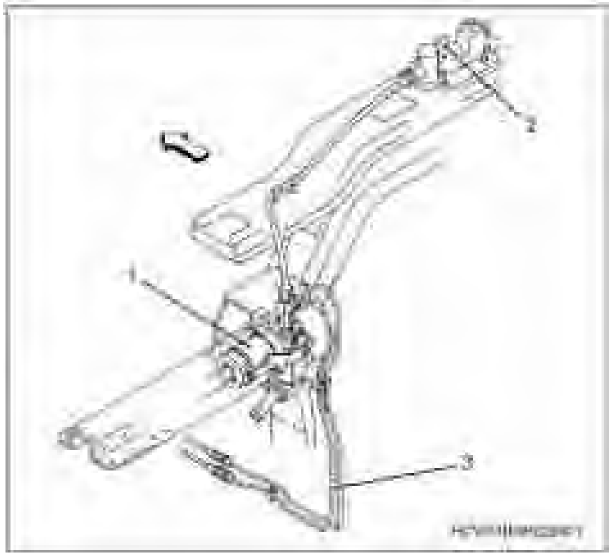
3. Fuel hose Connect

1) Connect the fuel hose to the fuel leak-off pipe.

2) Connect the fuel hose to the fuel suction pipe.

4. Cab tilt pump Installation

1) Install the cab tilt pump and cab latch to the cab mount rear element.



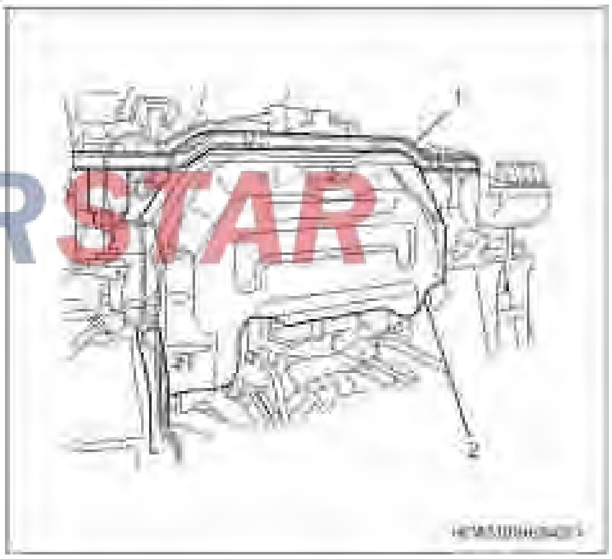
1. Cab tilt pump

2. Cab latch

3. Oil pipe

5. Cab back member noise cover Installation

1) Install the cab back member noise cover to the cab rear mounting member.



1. Cab rear mounting member

2. Cab back member noise cover

6. Sub-tank hose Connect

1) Connect the radiator air leak hose to the radiator sub-tank.

2) Connect the sub-tank hose to radiator.

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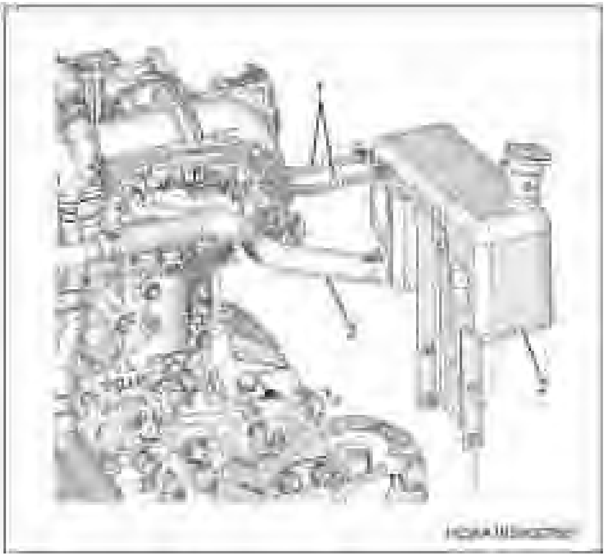
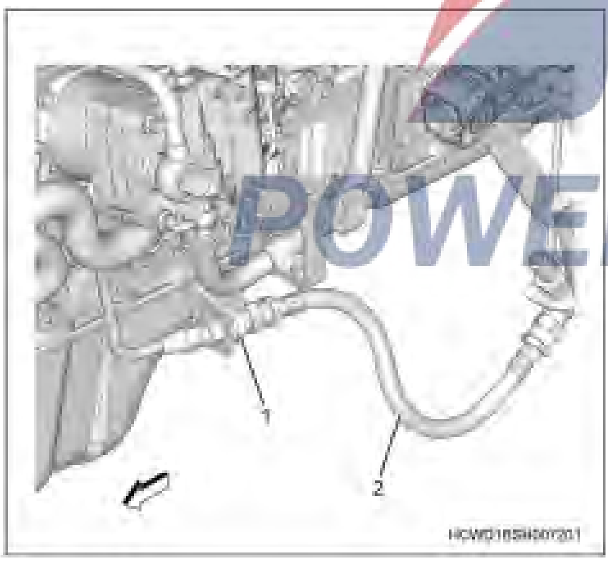


1. Radiator air leak hose
2. Deputy tank
3. Sub-tank hose

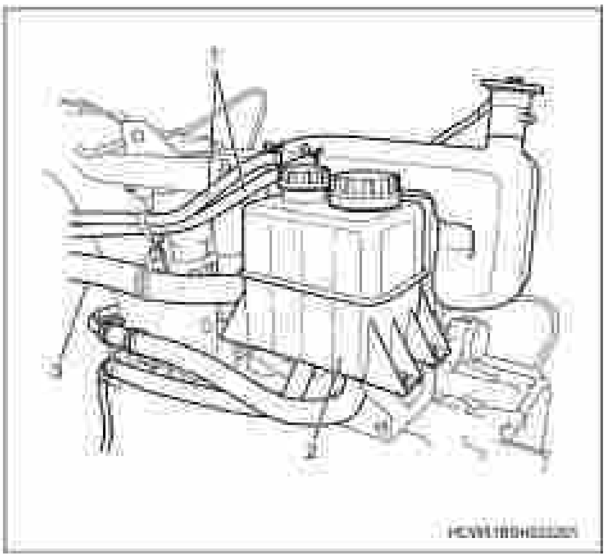
7. Power steering oil tank Installation

1) Install the power steering oil tank to the cab back member.



1. Union
2. Power steering flexible hose

2) Connect the inlet and outlet oil tank hose to the power steering oil tank.



1. Radiator air leak hose
2. Power steering oil tank
3. Sub-tank hose

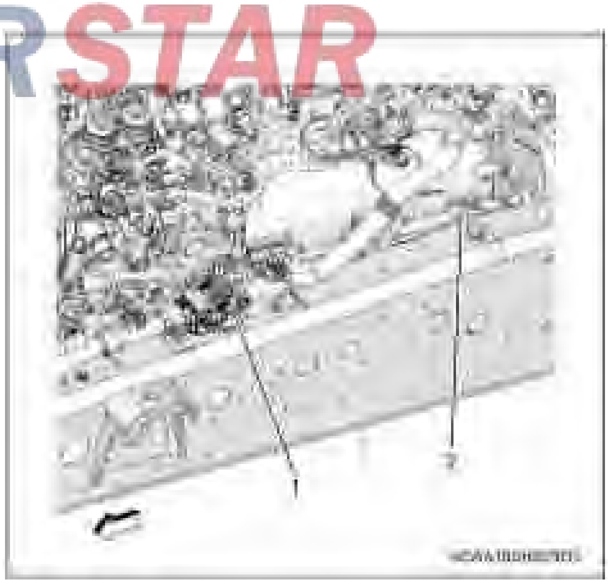
8. Engine harness Connect

1) Connect the harness connector to the generator.

2) Connect the B-terminal and the S-terminal of the starter cable to the starter.

3) Connect the earth cable to the frame.

4) Connect the engine harness connector to the chassis side harness connector.



1. Engine harness connector
2. Ground cable

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9. Air charge pipe Connect

1) Connect the air charge pipe to the air compressor..

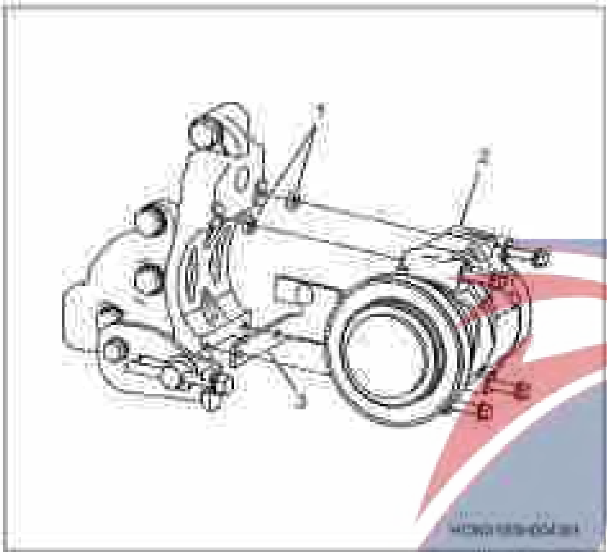
2) Connect the air tube to the air charge pipe.

3) Connect the air compressor governor pipe to the air compressor.

10. A/C compressor connect

1) Connect the A/C compressor to the bracket.

Tightening torque: 22 N • m { 2.2 kgf • m / 7.26 kg • ft }



1. Collar
2. A / C compressor
3. Bracket

11. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

12. A / C compressor drive belt adjustment

1. Adjust the A / C compressor drive belt.

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

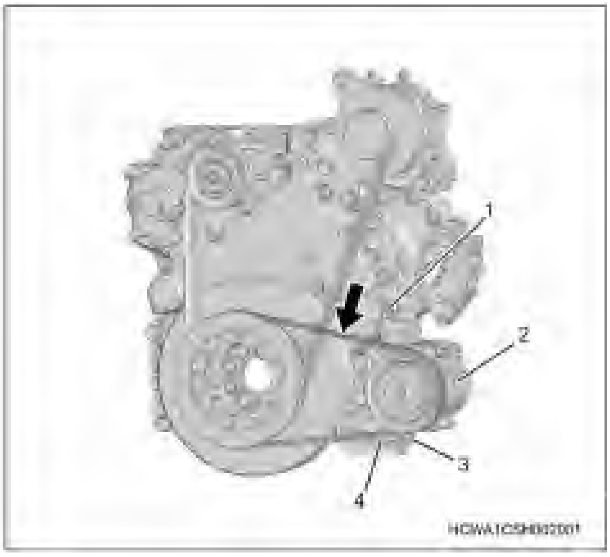
If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A/C compressor pulley and the crankshaft pulley.

Air conditioner compressor belt tension specified value

Adjustment conditions	When new	When adjusting tension
Tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0 to 40.0kg }
Deflection	: 11 to 14mm { 0.4 to 15.24mm }	: 15 to 17mm { 0.6 to 17.78mm }
Vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



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1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

13. Power steering oil pump installation

1) Apply engine oil to the O-ring.

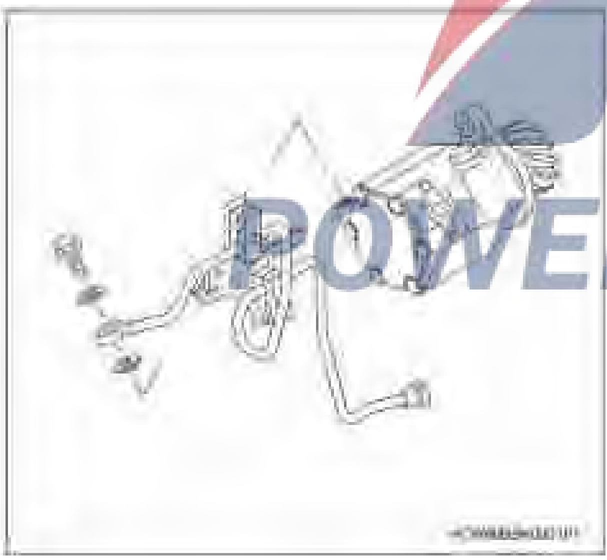
2) Install the O-ring on the power steering oil pump

3) Install the power steering oil pump on the engine

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

4) Connect the tubing and 2 washers to the power steering pump.

Tightening torque: 59 N • m { 6.0 kgf • m / 19.96 kg • ft }



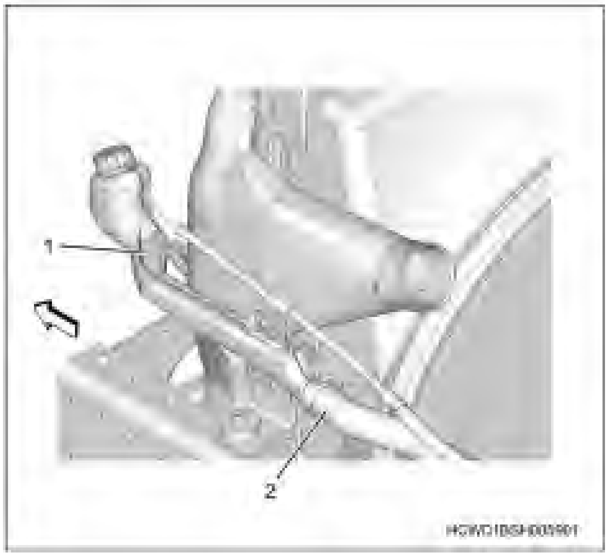
5) Install the suction pipe to the power steering pump.

Tightening torque: 22 N • m {2.2 kgf • m / 7.26 kg • ft}

6) Install the oil pipe to the steering unit.

14. Refueling pipe installation

1) Install the refueling line and rubber hose to the timing gearbox.

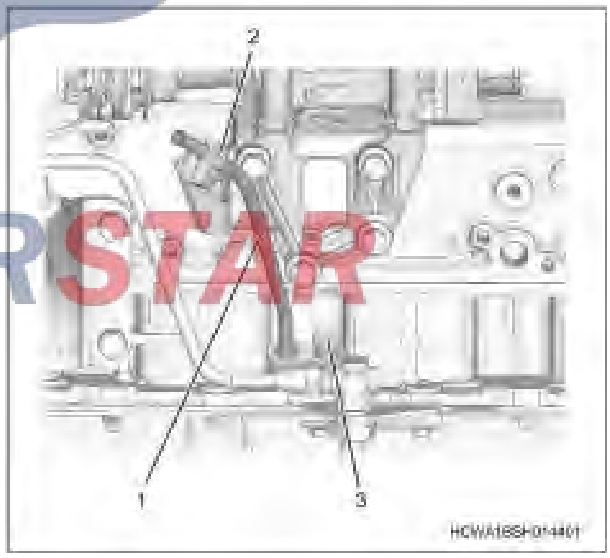


1. Refuel pipeline
2. Rubber hose

15. Oil level gauge conduit installed

1) Apply engine oil to the O-ring.

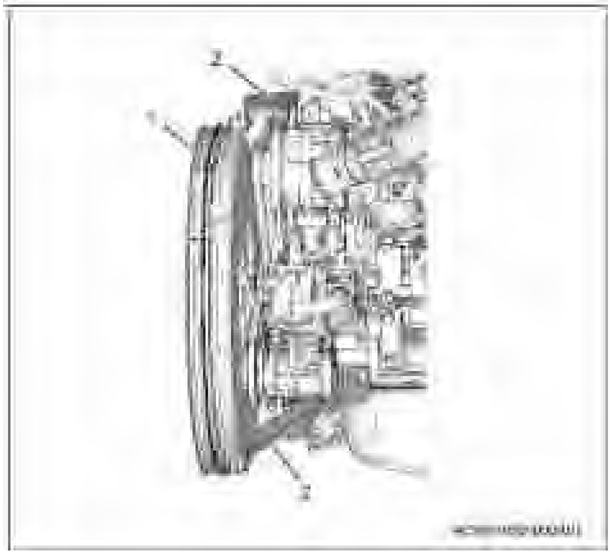
2) Install the fuel gauge pipe to the cylinder block.



1. Oil level gauge catheter
2. Clip
3. Plug

16. Radiator fan cover Connect

1) Install the fan guide bracket to the engine.

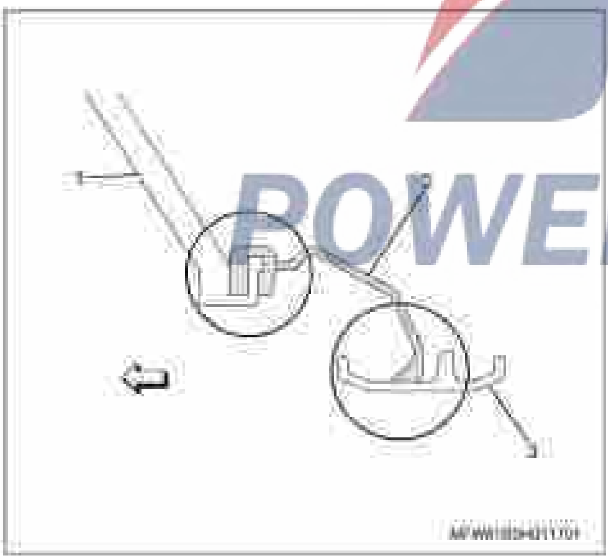


1. Fan guide
2. Fan guide bracket

2) Connect the radiator fan cover to the fan guide.

Caution:

● Verify that the entire circumference of the radiator fan cover is in contact with the fan guide.



1. Fan guide
2. Fan cover
3. Fan guide

17. Heater hose installation

1) Install the feed and return heater hose to the heater pipe.

18. Radiator lower hose installation

1) Install the radiator lower hose to the radiator and the water intake pipe.

Tightening torque: 5 N• m { 0.5 kgf • m / 44 lb • in }

19. Radiator upper hose installation

1) Connect the radiator air leak hose to the radiator.

2) Install the radiator upper hose to the water outlet duct and the radiator.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

20. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N · m {4.0 kgf • m / 13.15 kg • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 32.21 kg • in}

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 25.85 kg • in }

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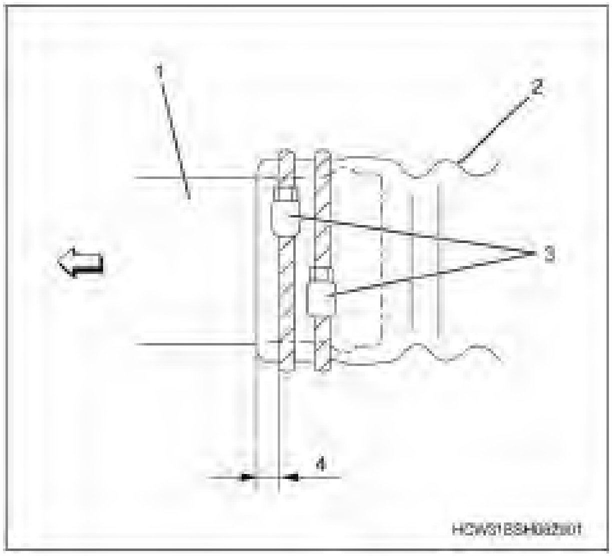


1. Intercooler pipe

2. Intercooler hose

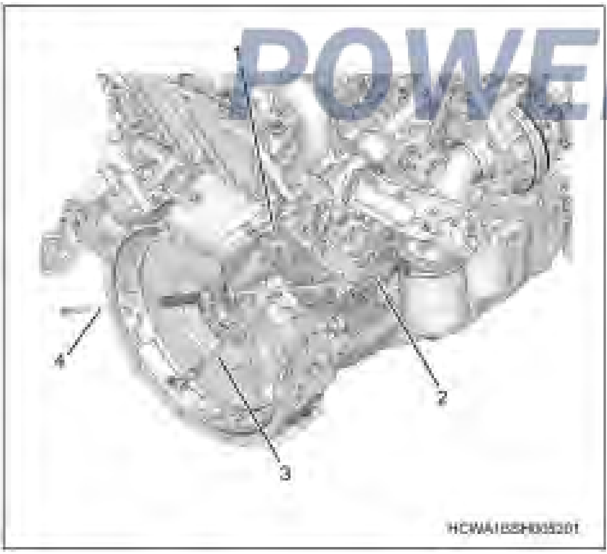
3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

21. Relay bar bracket installation

1) Mount the relay lever bracket to the flywheel housing.

Tightening torque: 26.5 N • m {2.7 kgf • m / 9.07 kg • ft}



1. Relay rod bracket

2. Shifting cable

3. Connecting rod.

4. Selecting cable

2) Mount the shift cable to the relay pole bracket.

3) Mount the speed change cable to the relay pole bracket.

22. Transmission installation

Refer to "*5.Transmission, Transaxle 5C.Manual Transmission (MJT) installation*".

Refer to "*5.Transmission, Transaxle 5C.Manual Transmission (MJX16) installation*".

23. Exhaust cover installation

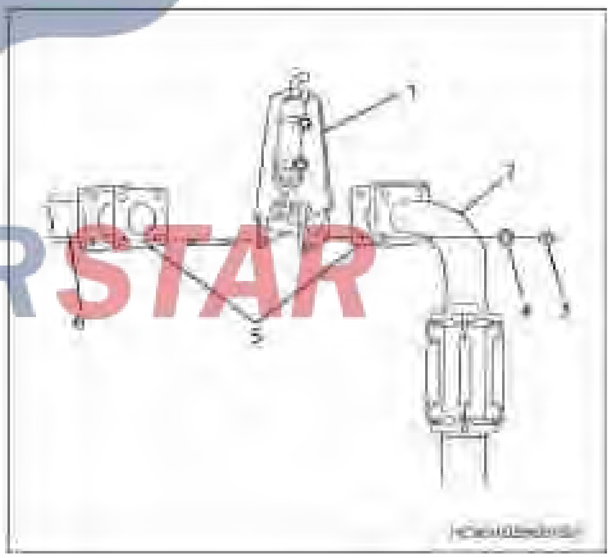
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N• m { 6.0 kgf • m / 19.96 kg • ft }



1. Exhaust brake valve

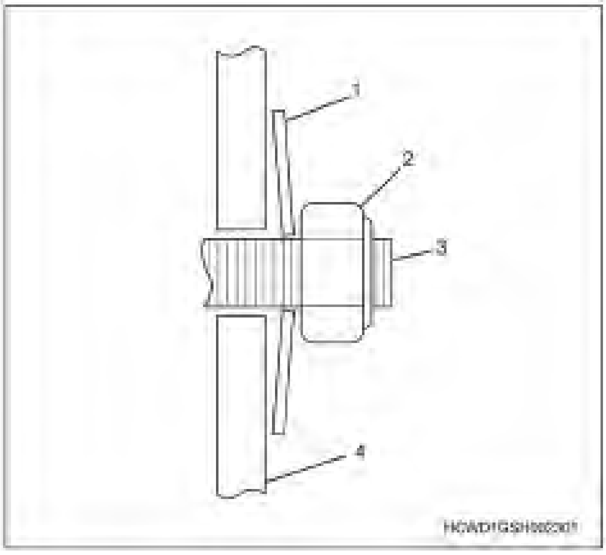
2. Front exhaust pipe A

3. Nut

4. washer

5.Gasket

6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

24. Exhaust cover installation

1) Install the exhaust cover to the frame.

25. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

26. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

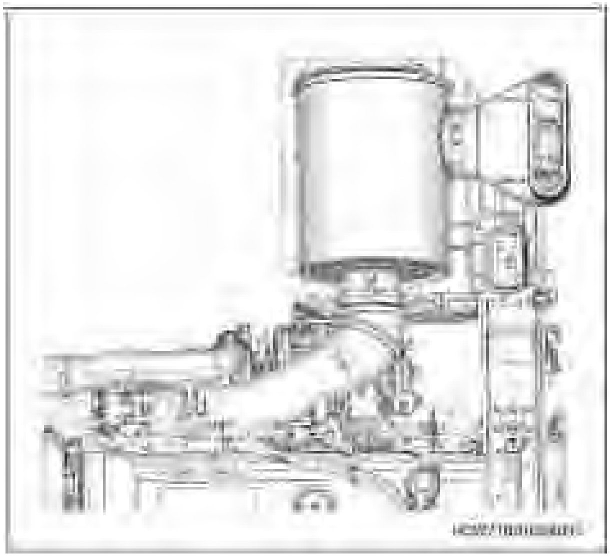
27. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



28. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N• m { 8.0 kgf • m / 58 lb • ft }

2) Replenish the engine with the engine oil.

29. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is

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possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15)Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

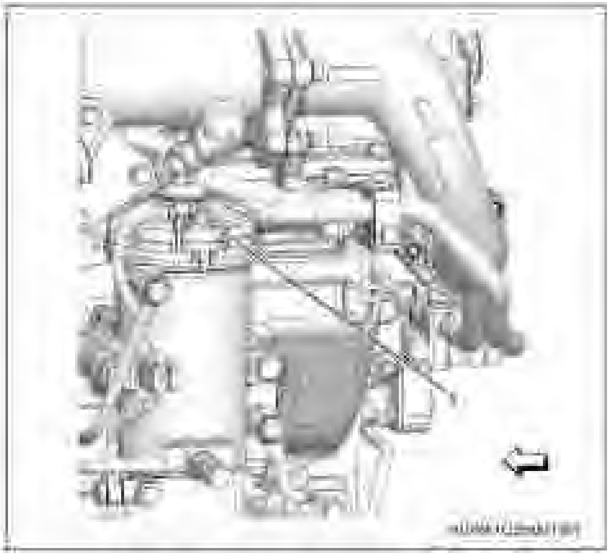
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

30. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N• m { 0.7 kgf • m / 28.12 kg • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N• m { 0.6 kgf • m / 24.04 kg • in }

Caution:

● Do not excessively tighten the bleeder screw.

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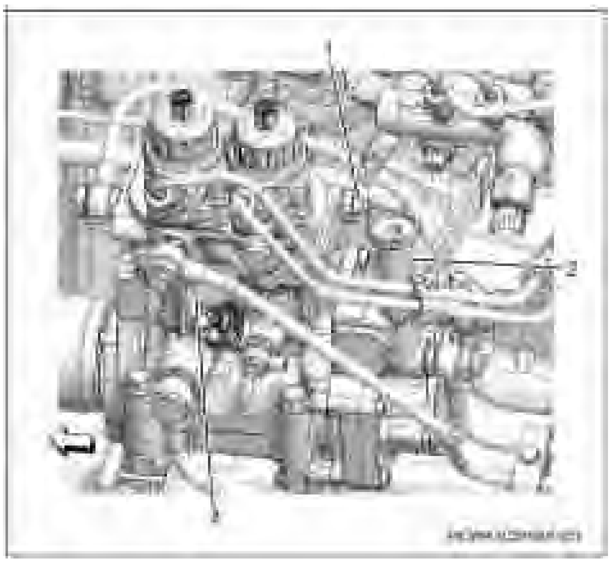

1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

31. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

32. Power steering fluid filling

1. Supplement (models not equipped with emergency auxiliary steering system)

1) Jack up the front of the vehicle and attach a chassis stand.

2) Refill the oil tank with power steering fluid.

Note:

● Refill up to the level marked on the oil tank.

3) Repeatedly turn the steering wheel to the rightmost and leftmost positions with the engine stopped.

Note:

● In this state, the air from the power steering pipe will be released in the form of large bubbles.

4) Refill the oil tank with power steering fluid.

5) Start the engine.

6) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

7) Lower the vehicle.

8) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

9) Check for an abnormal sound.

Note:

● If no abnormal noise is heard, air removal is completed.

10) Inspect the fluid level of the oil tank and for oil leakage from each joint section.

2. Supplement (models equipped with emergency assistance steering system)

1) Tighten the oil supply hose connector.

2) Jack up the front of the vehicle and attach a chassis stand.

3) Refill the oil tank with power steering fluid.

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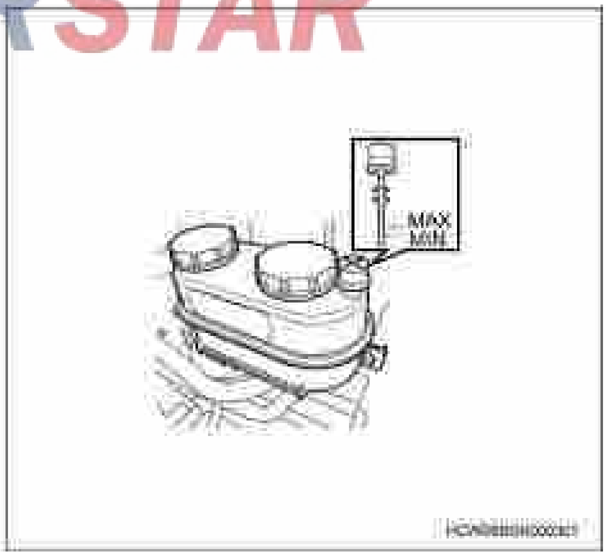


Note:

● Refill up to the level marked on the oil tank.

4) Repeatedly turn the steering wheel to the rightmost and leftmost positions with the engine stopped.

Note:

● In this state, the air from the power steering pipe will be released in the form of large bubbles.

5) Refill the oil tank with power steering fluid.

6) Start the engine.

7) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

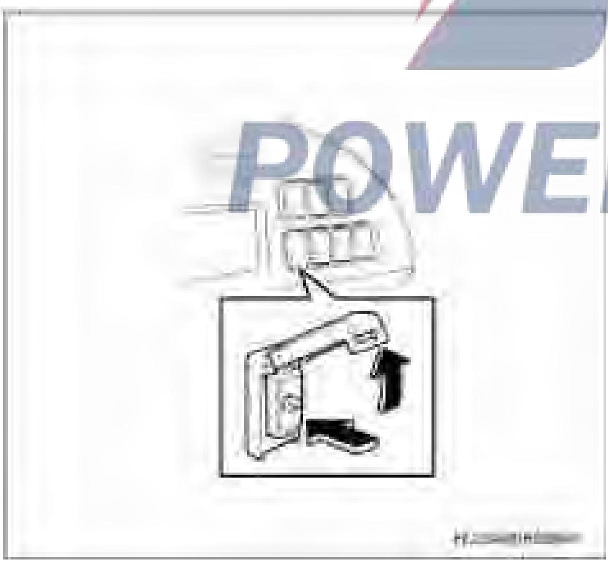
8) Lower the vehicle.

9) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

10) Press the power steering check switch of the emergency assist steering system and stop the engine.



11) Start the emergency assist steering system and turn the steering wheel to the rightmost and leftmost 5 times.

12) After the exhaust operation is completed, press the power steering check button of the emergency assist steering system again to reset the button.

Note:

● Do not operate emergency assist steering system for a long time.

13) Check for an abnormal sound.

Note:

● If no abnormal noise is heard, air removal is completed.

14) Inspect the fluid level of the oil tank and for oil leakage from each joint section.

33. ECM setting

1. Write injector ID

Note:

● When replacing the engine, implement injector identification code programming.

1) Connect the scanning tool to the data communication link connector.

2) Turn ON the ignition switch.

3) Select the scan tool item.

● Diagnosis

● Engine

● Engine model

● Programming

● Injector ID Code

● Write the injector identification code

4) Program the Injector ID Code into the ECM by following the instructions on the screen.

5) After the programming is completed, turn OFF the ignition switch.

34. Engine Settings

Note:

● Perform the setting after replacing the engine body.

1. Clear fuel consumption data

1) Connect the scanning tool to the data communication link connector.

2) Turn ON the ignition switch.

3) Select the scan tool item.

● Diagnosis

● Information

POWERSTAR

● Other functions

● Clear fuel consumption measurement data

4) Follow the instructions on the screen to clear the data.

5) Check the multi-function display on the comprehensive fuel economy and driving fuel economy display is deleted.

6) After clearing the data, clear the data logger module data (engine).

2. Clear data logging module data (engine)

1) Select the scan tool item.

● Diagnosis

● Information

● Data logging module function

● Clear data record module data

2) Follow the on-screen instructions to clear the engine data.

3) After clearing the data, change the engine type.

Caution:

● If the engine model is not changed, do not implement the engine model change instruction.

3. Engine model change

1) Select the scan tool item.

● Diagnosis

● Information

● Set or change the end of life data

2) Follow the on-screen instructions to change the engine model.

3) After the operation is completed, check if the displayed engine type matches the set engine type.

4) The ignition switch is OFF after the engine type has been changed.

35. Engine vehicle inspection

1. Check before starting the engine

1) Check the following items.

● Oil level

● Coolant level

● Objects around the engine that may be stuck

2. Check after starting the engine

1) Check the following items.

● Abnormal noise appears

● Abnormal vibration

● Fuel leak

● Oil leak

● Leakage

● Leakage

● Exhaust gas leaks

● Exhaust color

3. Check after stopping the engine

1) Check the following items.

● Oil level

● Coolant level

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Engine mounting

Removal

1. Engine removal

Refer to "*Engine removal*".

2. Engine mounting removal

1) Remove the front side engine mounting from the frame.

2) Remove the rear side engine mounting from the frame.

Installation

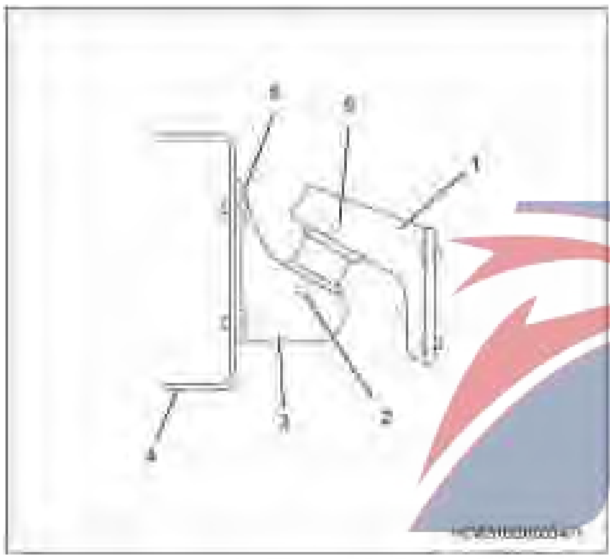
1. Engine mounting installation

1) Install the front side engine mounting to the frame.

Tightening torque: 113 N • m { 11.5 kgf • m / 37.65 kg • ft }

Chassis side rubber nut

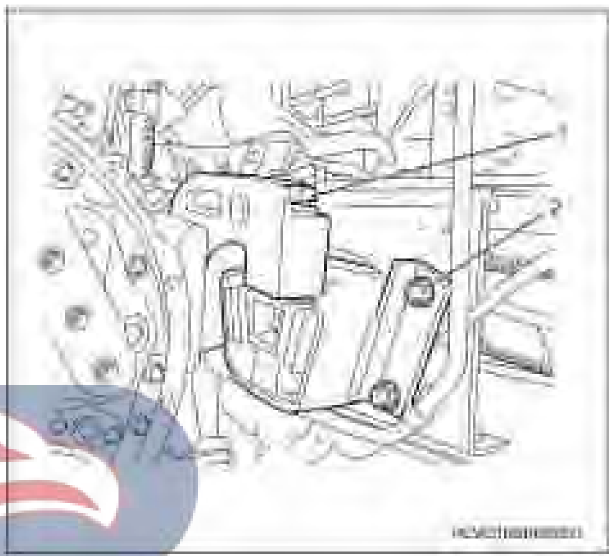
Tightening torque: 157 N • m { 16.0 kgf • m / 116 lb • ft } Bolt



1. Engine foot
2. Chassis side rubber nut
3. Cushion rubber bracket
4. Frame
5. Bolt
6. Engine side rubber nut

2) Install the rear side engine mounting to the frame.

Tightening torque: 157 N • m { 16.0 kgf • m / 116 lb• ft } Chassis side bolt



1. Engine side bolt
2. Chassis side bolt

2. Engine installation

Refer to "*Engine installation*".

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Intake manifold

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

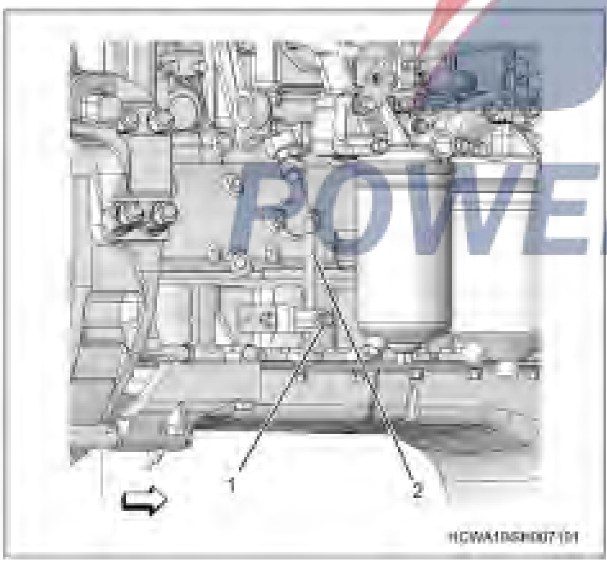
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

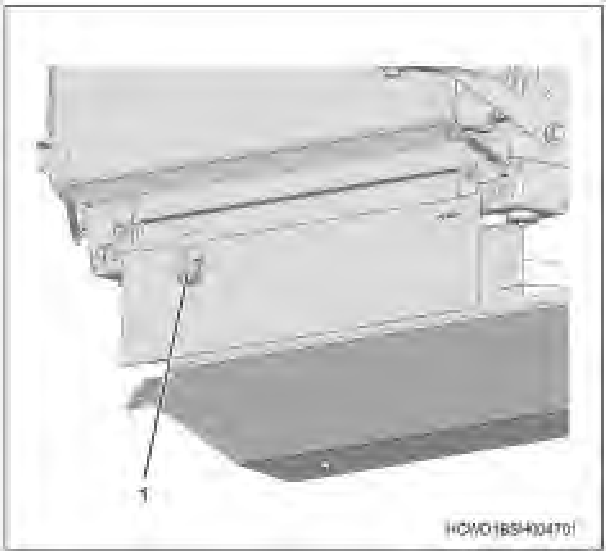
2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug
2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

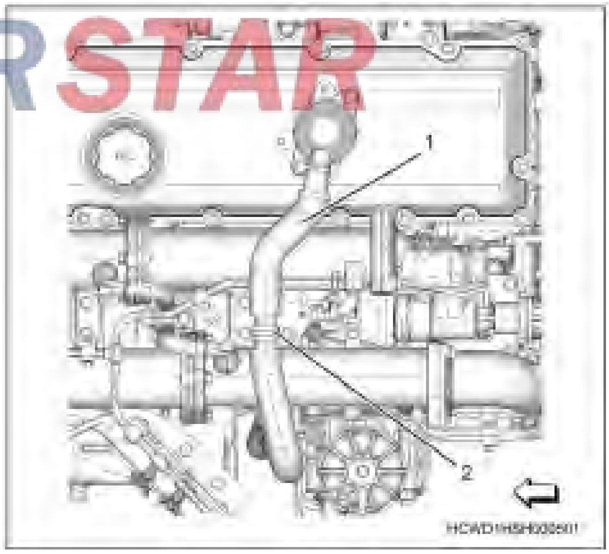
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



1. Ventilation hose
2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

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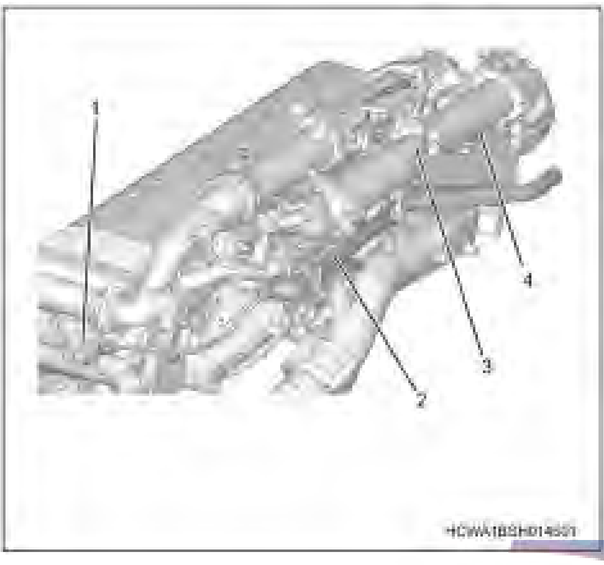
2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end trachea
4. Front leakage tube

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

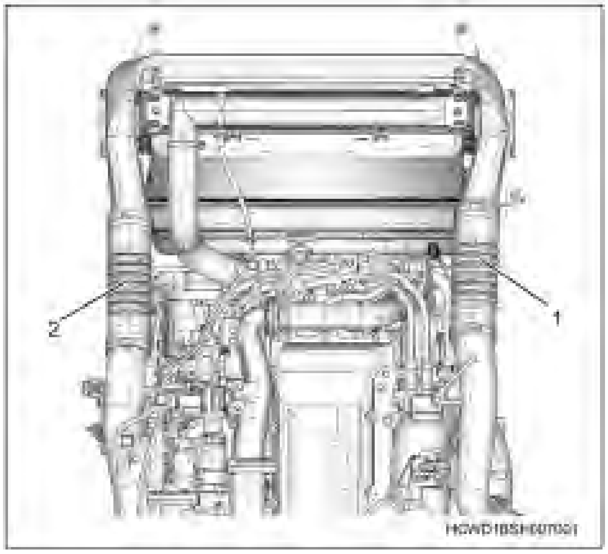
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.



1. intercooler hose on the intercooler inlet side
2. intercooler hose on the intercooler outlet side

7. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.

8. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

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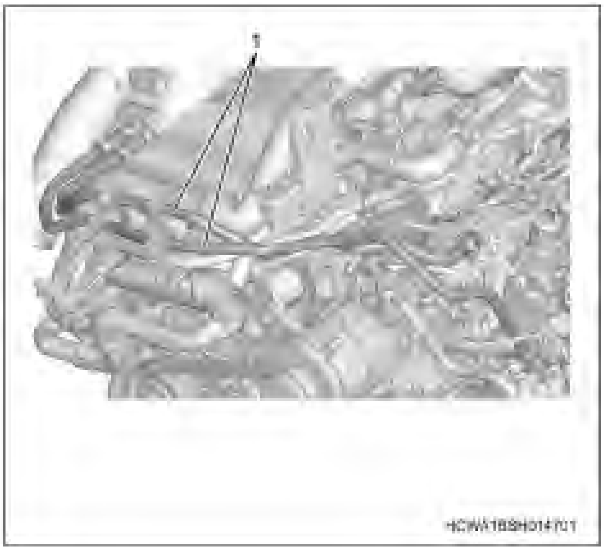
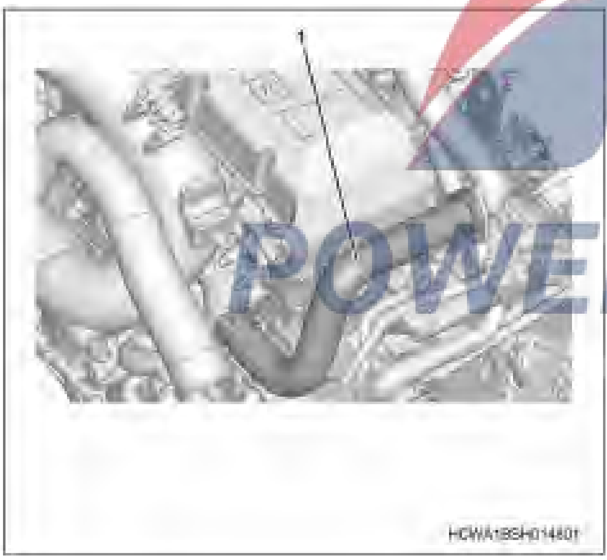


1. Exhaust pipe

9. EGR cooler removal

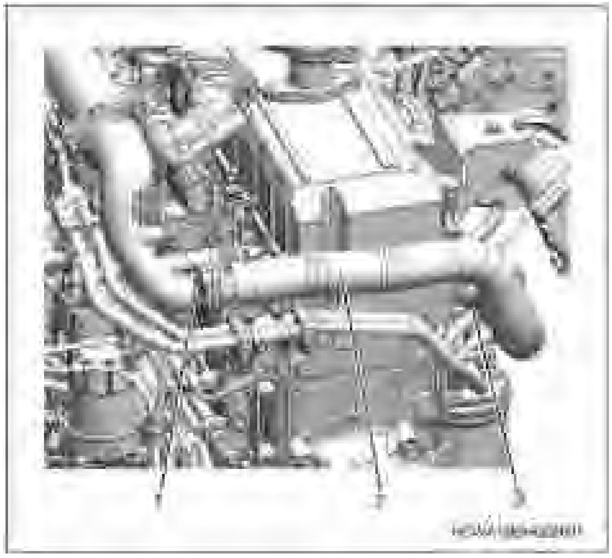
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

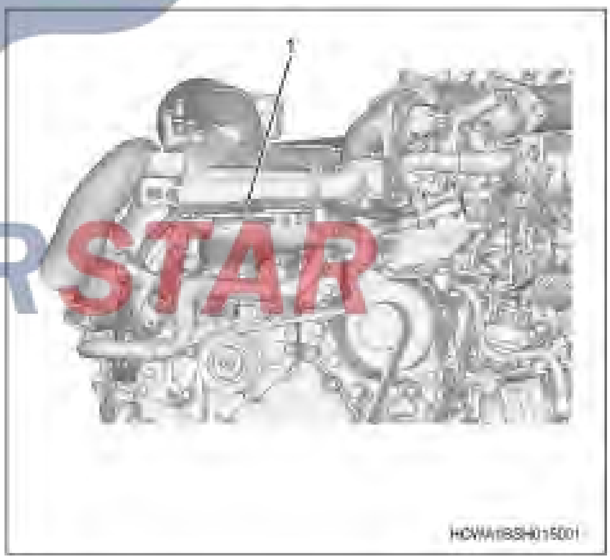


1. Standard bolt

2. Exhaust gas recirculation line B

3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.



1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.

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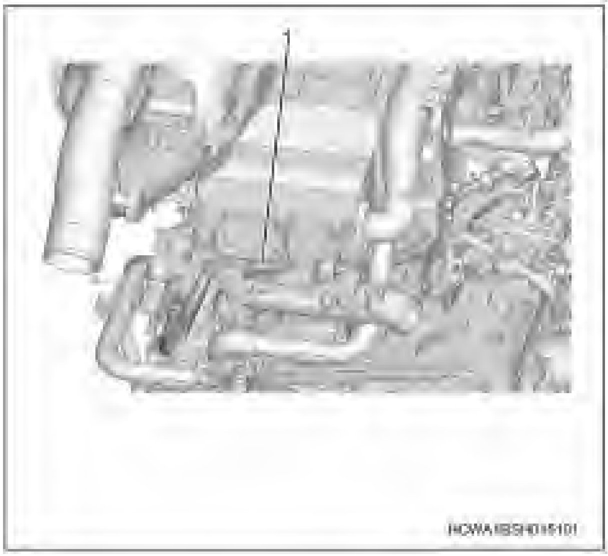
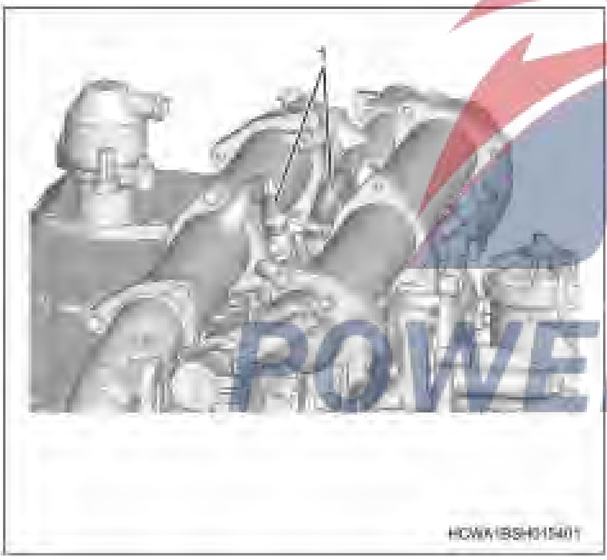


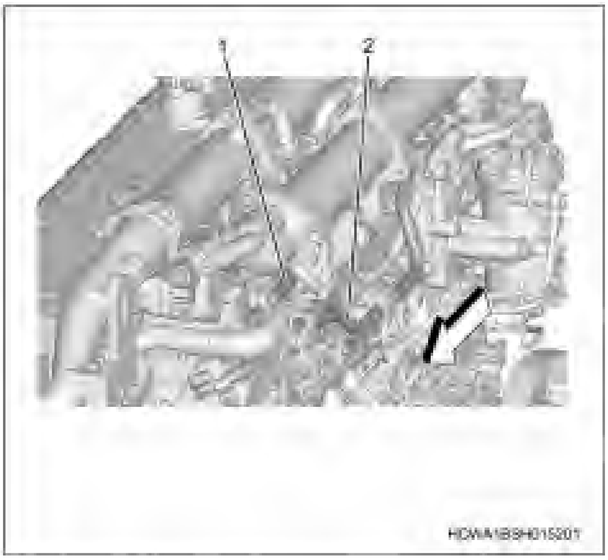
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. Water feed hose

7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



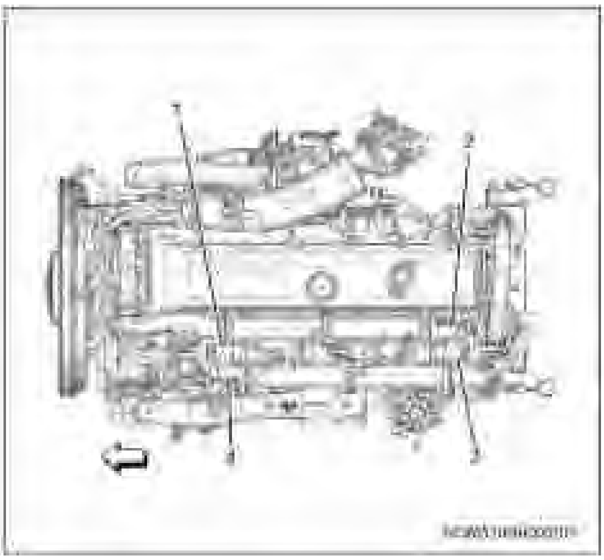
1. Front-end water supply pipe
2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

1. Front return pipe
2. Rear return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.

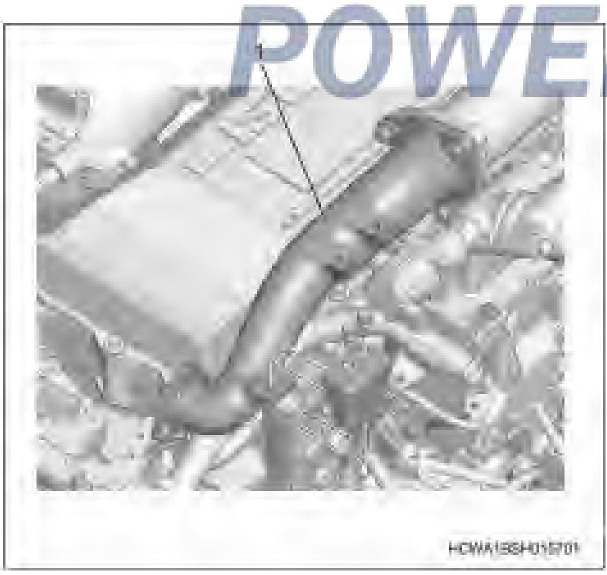


1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

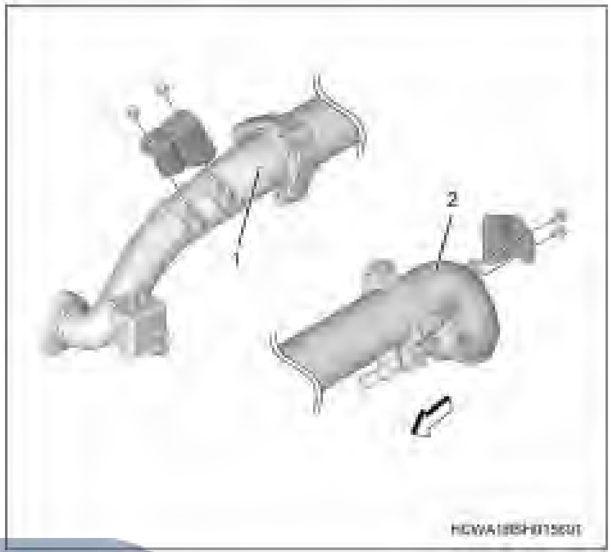
13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.



1. Exhaust gas recirculation cooler duct A

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A
2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.

1. Front-end exhaust gas recirculation conduit bracket
2. Exhaust gas recirculation valve thermal protection device
3. Exhaust Gas Recirculation Cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket

6. Exhaust gas recirculation valve thermal protection device

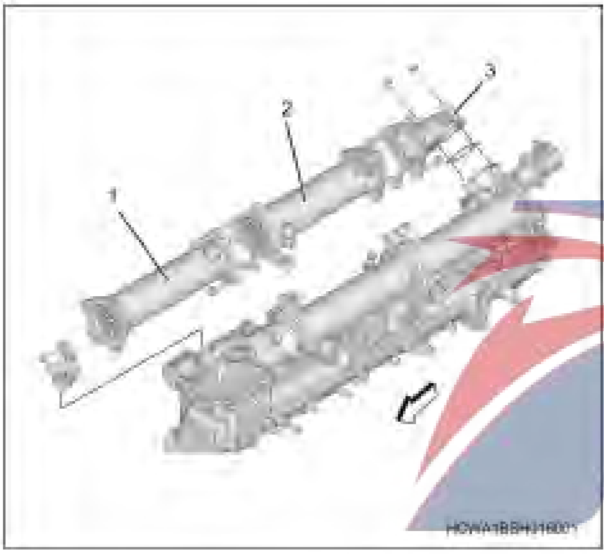
7. Exhaust Gas Recirculation Cooler duct C

8. EGR cooler C

17) Remove the EGR cooler bracket on the EGR cooler.

18) Remove the exhaust gas recirculation cooler bracket on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

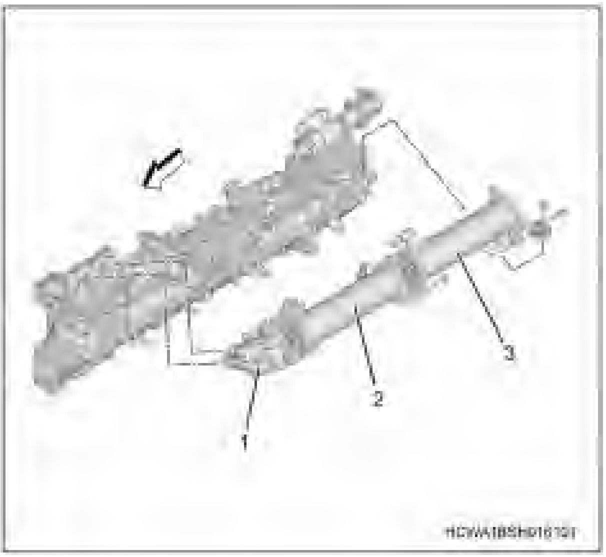


1. EGR cooler A.

2. EGR cooler B

3. Exhaust Gas Recirculation Cooler duct B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



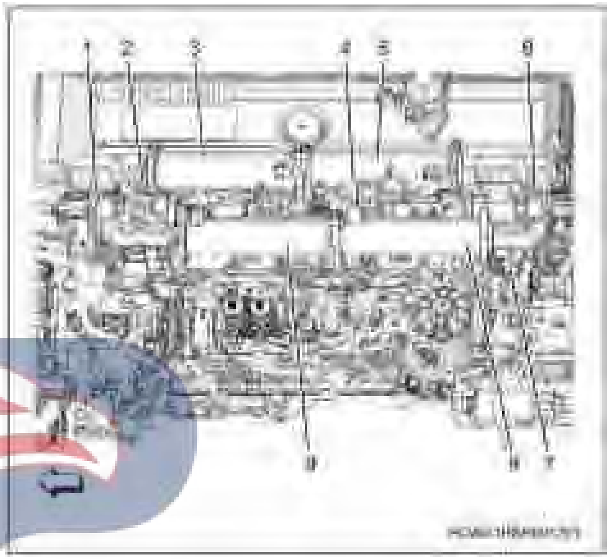
1. Exhaust gas recirculation cooler duct D

2. EGR cooler D

3. EGR cooler C.

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.



1. EGR valve 2

2. Exhaust gas recirculation cooler bracket

3. EGR cooler A.

4. Leakage tube bracket

5. EGR cooler B.

6. EGR valve 1

7. Exhaust gas recirculation cooler bracket

8. EGR cooler C

9. EGR cooler D

10. Exhaust gas recirculation valve removed

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve duct A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve duct A.

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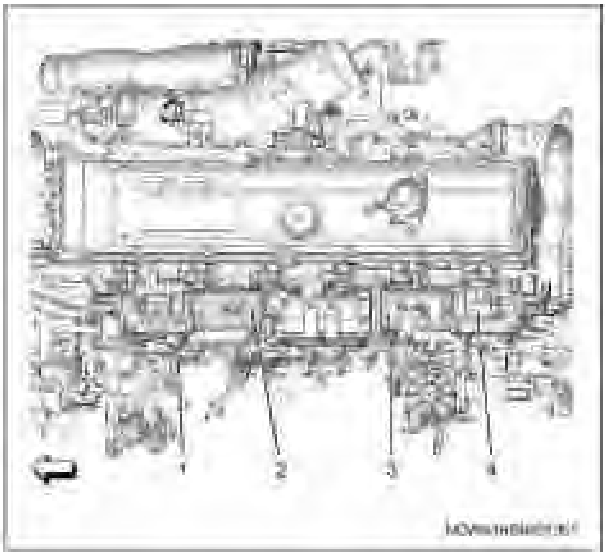


1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

11. Pilot valve Removal

1) Remove pilot valve from EGR valve duct A.

2) Remove pilot valve from EGR valve duct B.

12. Discharge oil drain pipe

1) Disconnect the fuel drain pipe from the fuel supply pump.

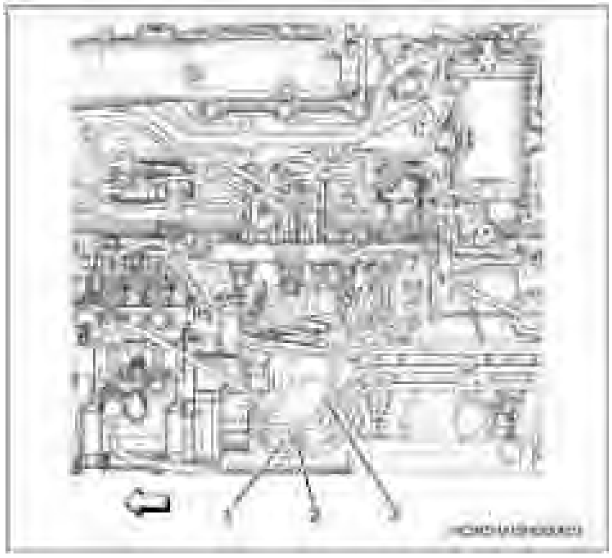
2) Disconnect the fuel drain pipe from the fuel filter.

13. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel supply line from the fuel filter

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

14. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

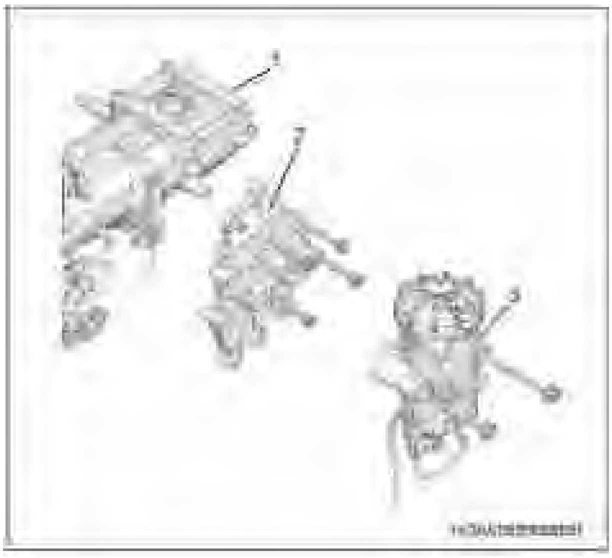
3) Remove the fuel pipe from the fuel supply pump.

15. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter bracket.

3) Remove the fuel filter bracket from the intake manifold.



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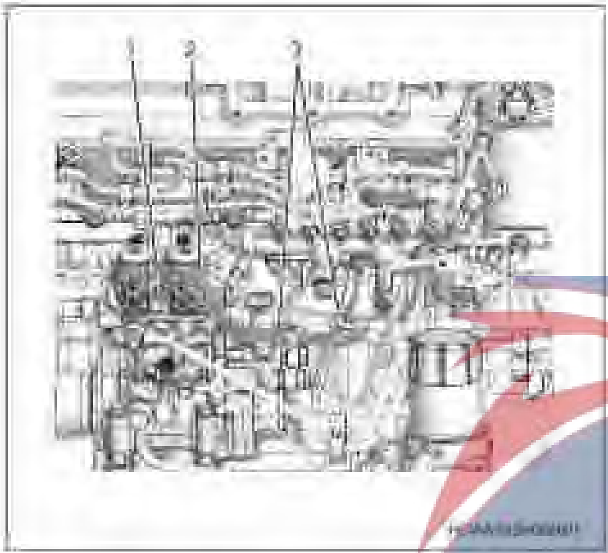
1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

16. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.



1. Fuel pipe
2. Fuel pipe
3. Clip

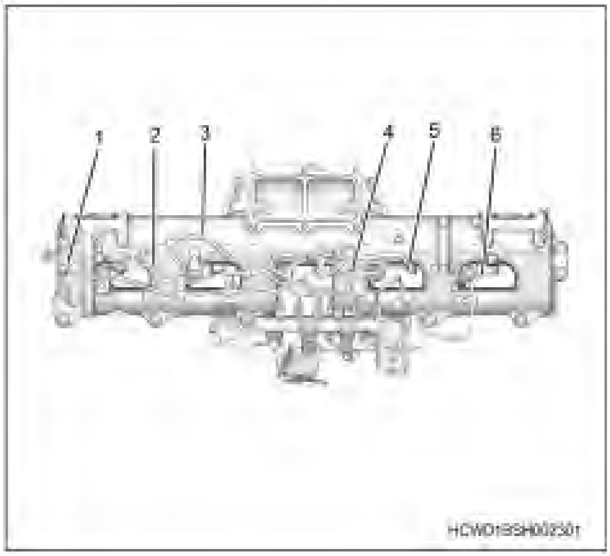
17. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

18. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.

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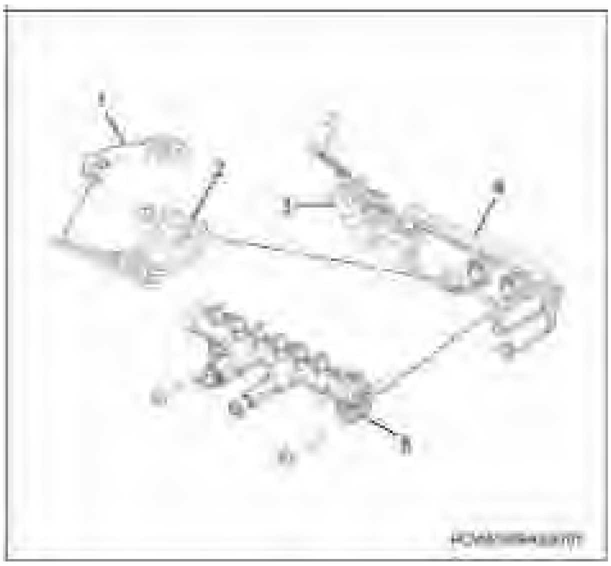


1. Injection pipe clamp bracket

2. Injection pipe clamp bracket

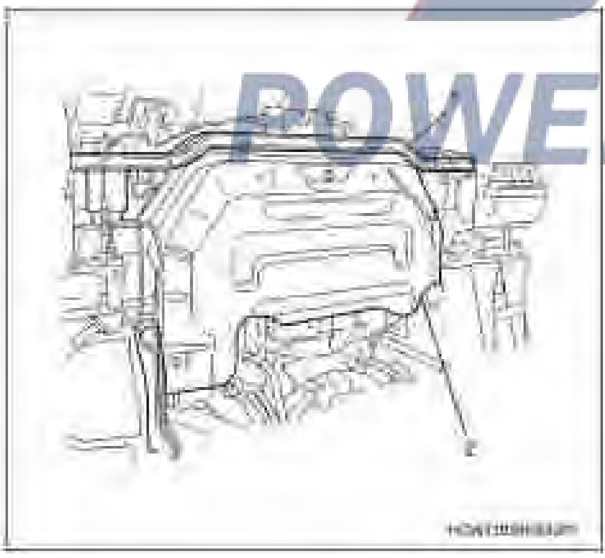
3. Fuel pipeline bracket

4. Common rail (fuel rail) bracket

5. Common rail (fuel rail)

19. Cab back member noise cover removal

1) Remove the cab back member noise cover from the cab mounting rear member.



1. Cab rear mounting member

2. Cab back member noise cover

20. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the fuel suction pipe from the bracket.

21. Fuel pump removed

1) Disconnect the harness connector connected to the camshaft position sensor.

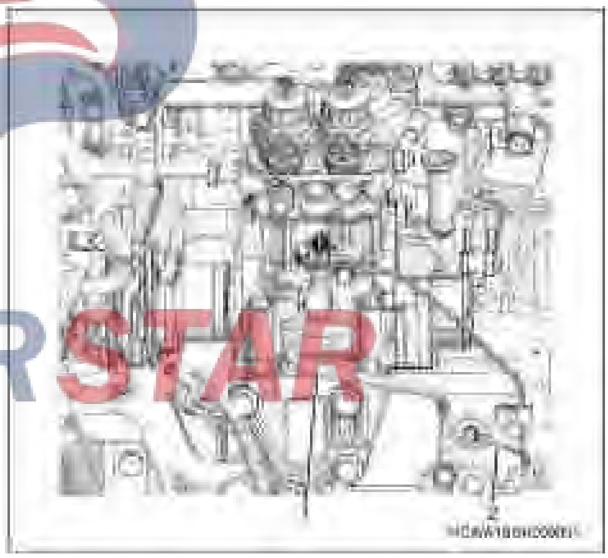
2) Disconnect PCV harness connector.

3) Disconnect the fuel supply pipe to the fuel supply pipe.

4) Remove the oil supply pipe from the cylinder block.

5) Disconnect the oil return pipe from the fuel supply pump.

6) Remove the oil return pipe from the cylinder block.



1.Oil return pipe

2. Oil feed pipe

7) Remove the pin bolts and coupling bolts on the coupling.

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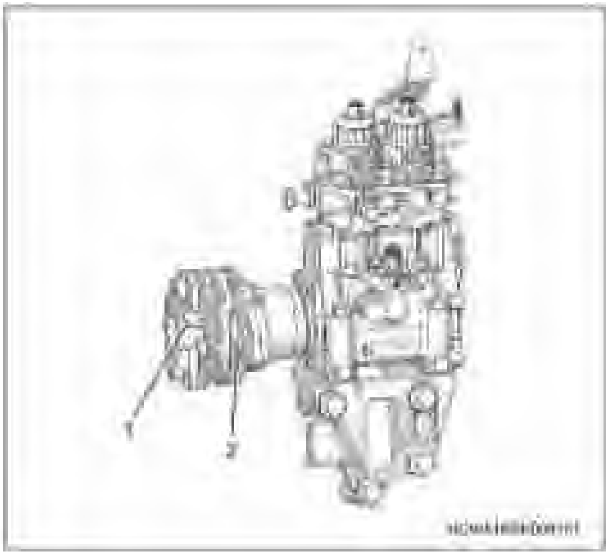


1. Cotter bolt
2. Coupling tightening bolt

8) Remove fuel supply pump from supply pump bracket.

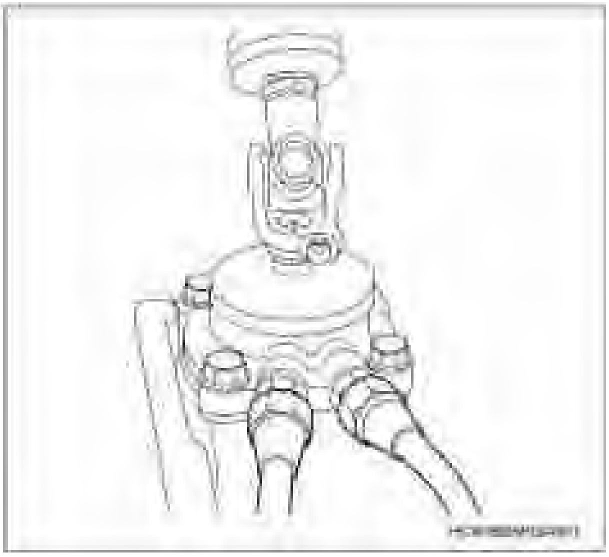
9) Remove the supply pump bracket from the cylinder block.

22. Power steering fluid drain

1. Models not equipped with emergency assistance steering system

1) Jack up the front of the vehicle and attach a chassis stand.

2) Prepare an oil pan, and loosen the steering unit oil pipe.



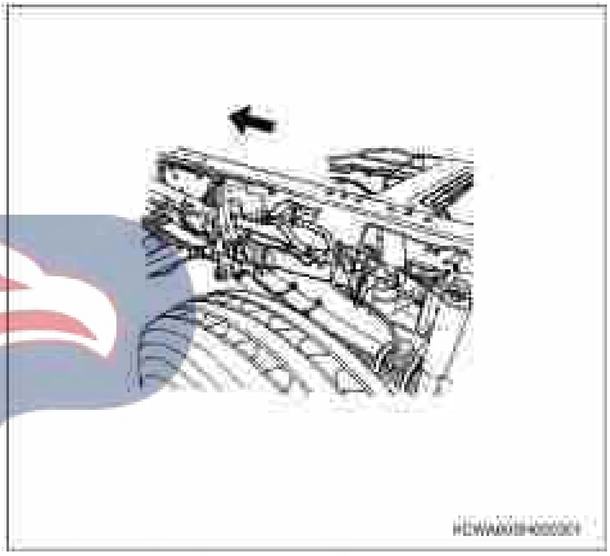
3) Slowly turn the steering wheel to the left and right to discharge power steering fluid from the steering unit.

2. Equipped with emergency assisted steering system models

1) Jack up the front of the vehicle and attach a chassis stand.

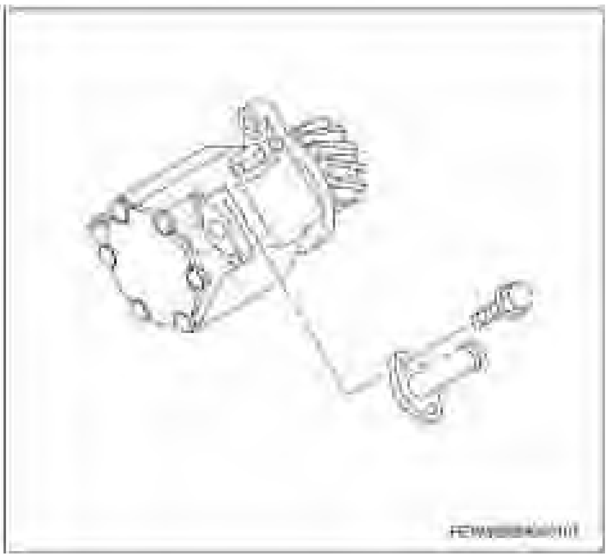
2) Prepare the oil pan, loosen the power steering booster tubing.

3) Turn the steering wheel slowly to the left and right to drain the power steering fluid from the power steering booster.



23. Power steering oil tank removal

1) Remove the suction pipe and O-ring from the power steering pump.



2) Remove the oil pipe and washer from the power steering pump.

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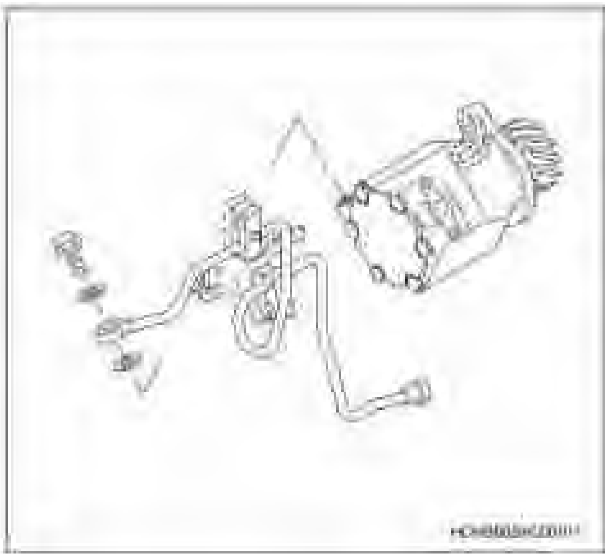


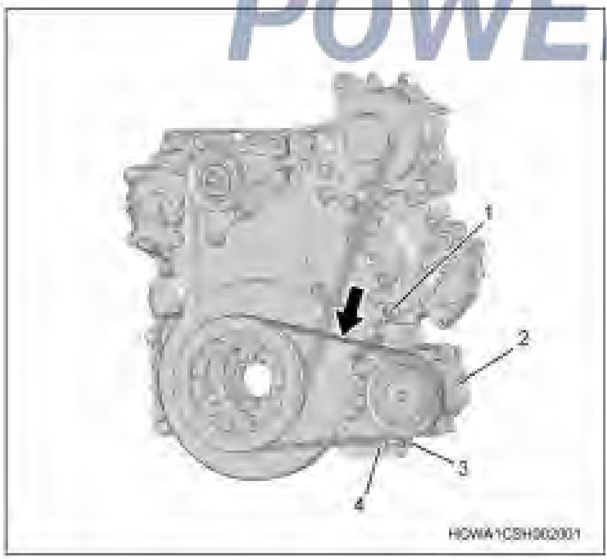
3) Remove the power steering pump and O-ring from the engine.

Caution:

● Install the seal ring on the pipe and hose mounting section, and then install the seal on the oil pump removal surface to prevent foreign particles from entering.

24. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



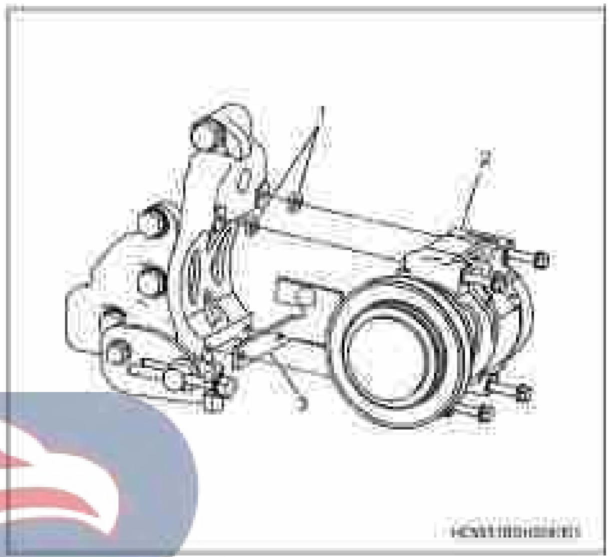
1. Bolt
2. A / C compressor
3. Adjust bolt
4. Nut (back end)

25. A / C compressor disconnect

1) Disconnect the A / C compressor from the bracket.

Note:

● Without removing the gas pipe, move the pipe together with the A / C compressor to a position that will not interfere with work.



1. Collar
2. A / C compressor
3. Bracket

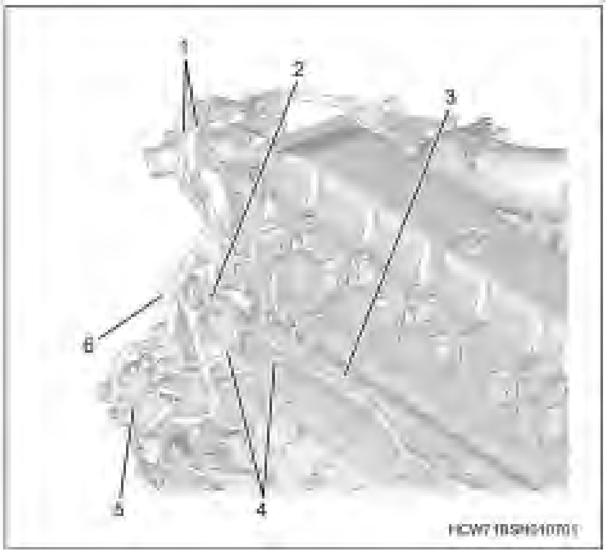
26. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

27. A / C compressor removal

1) Remove the oil pipe from the cylinder block.

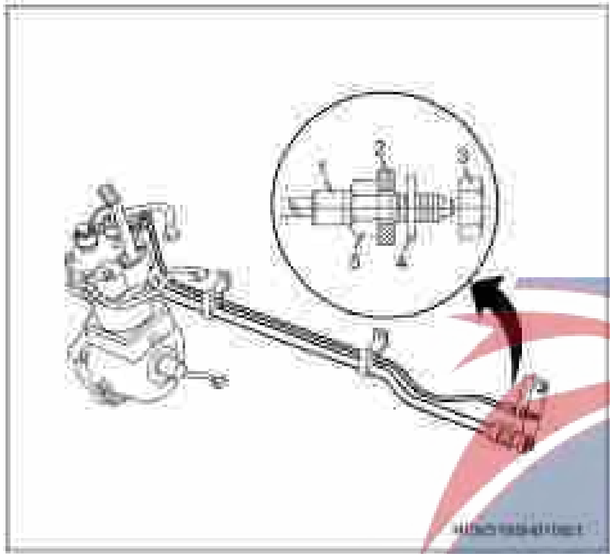
2) Remove the water pipe from the cylinder block.



POWERSTAR

1. Exhaust pipe
2. Water return pipe
3. Air compressor pressure pipe
4. Water feed pipe
5. Air compressor
6. Inflatable tube

3) Disconnect the air charge pipe and the air compressor pressure tube from the fitting.



1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

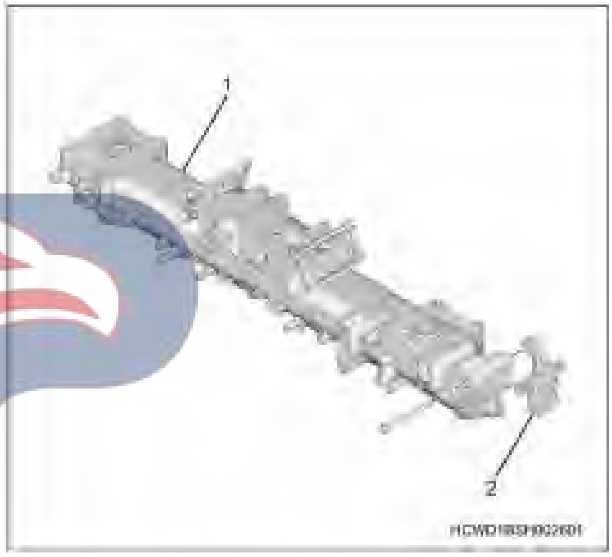
4) Remove the air compressor from the timing gearbox.

28. Intake manifold removal

1) Remove the front and rear brackets on the intake manifold.

2) Remove the intake manifold from the cylinder head.

3) Remove the gasket from the cylinder head cover.



1. Intake manifold
2. Bracket

POWERSTAR

Installation

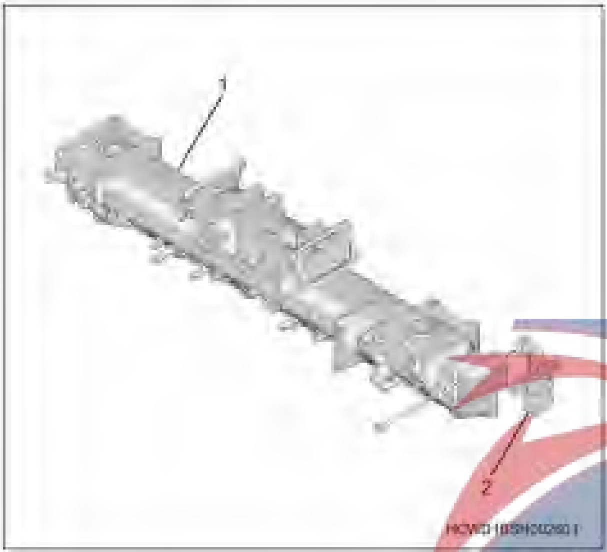
1. Intake manifold installation

1) Install the gasket to the cylinder head.

2) Install the intake manifold to the cylinder head.

Tightening torque: 45 N • m {4.6 kgf • m / 14.97 kg • ft}

3) Mount the bracket to the intake manifold.



1. Intake manifold
2. Bracket

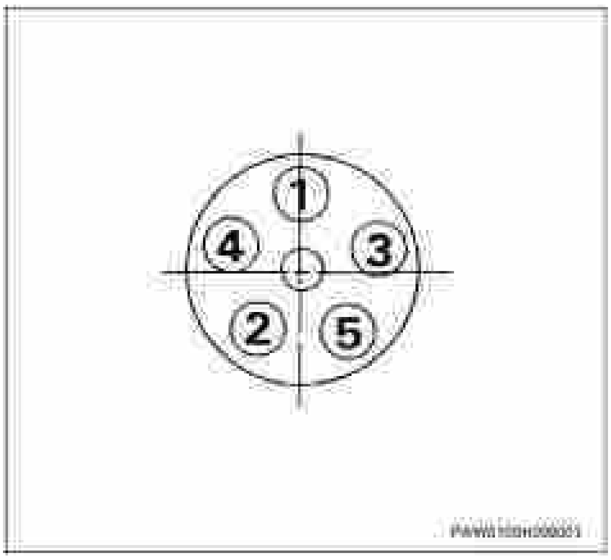
2. Air compressor installation

1) Apply molybdenum disulphide grease to the threaded surface of bearing surfaces and air compressor gear mounting bolts.

2) Install the gears on the air compressor according to the figures in numerical order.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

Prescribed angle: 90 to 120 ° second

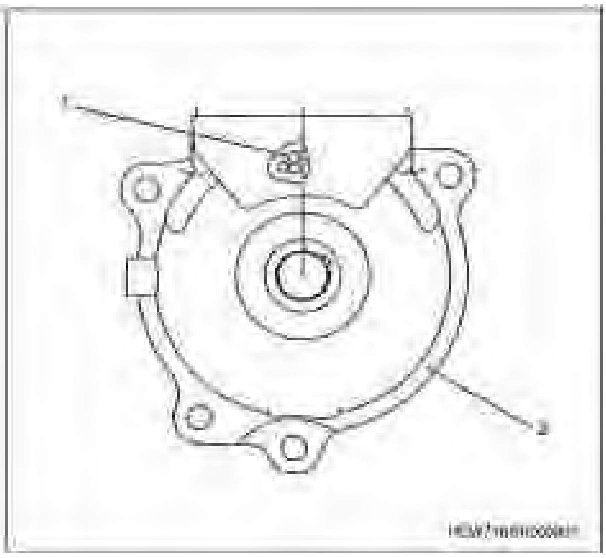


3) Install the O-ring onto the gearbox mounting flange area.

4) Referring to the diagram, align the pointer with the A mark.

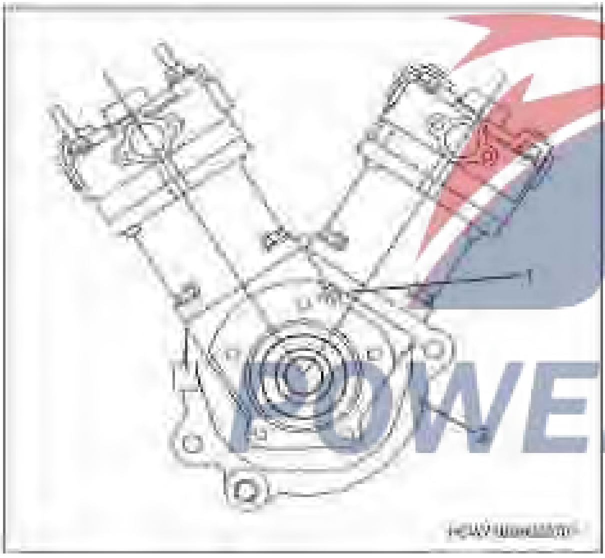
1. Pointer
2. S mark
3. A mark

POWERSTAR



1. Pointer

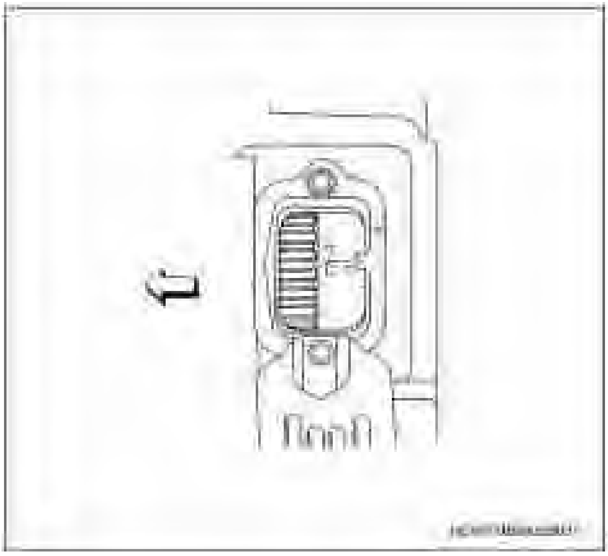
2. Air compressor



1. Pointer

2. Air compressor

5) Align the No.1 cylinder to compression top dead center.



6) Install the air compressor on the timing gearbox.

Note:

● Insert the air compressor and make sure that the idle gear in the gear box is firmly installed.

Caution:

● After the installation is completed, if the pointer and the S mark are not aligned, it must be re-installed.

Tightening torque: 137 N • m {14.0 kgf • m / 101 lb • ft} M14 bolt

Tightening torque: 133 N • m {13.6 kgf • m / 98 lb • ft} M14 nut

1. Pointer

2. S mark

3. A mark

7) Connect the air compressor governor pipe to the air compressor.

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

8) Connect the air charge pipe to the air compressor.

Tightening torque: 147 N • m {15.0 kgf • m / 48.99 kg • ft}

9) Connect the air compressor regulator to the fitting.

Note:

● Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 28 N • m {2.9 kgf • m / 9.53 kg • ft}

Flare nut

Tightening torque: 69 N • m {7.0 kgf • m / 23.13 kg • ft}

Nut

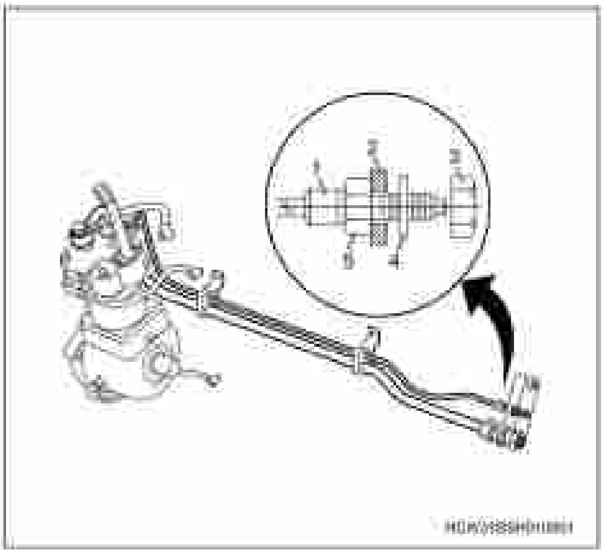
10) Connect the air charge pipe to the air compressor.

Note:

● Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 129 N • m {13.2 kgf • m / 95 lb • ft} Flare nut

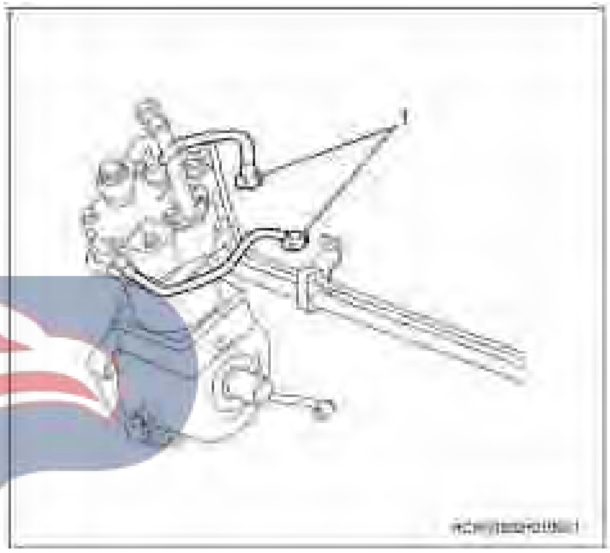
Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} nut



1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

11) Install two water pipes to the cylinder block.

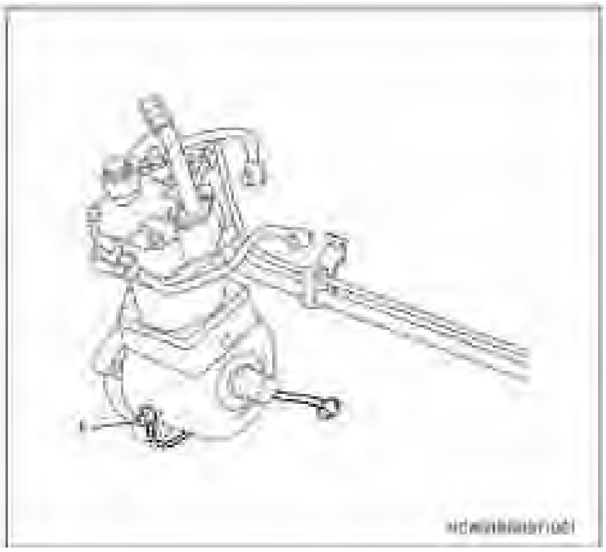
Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}



1. Water pipe

12) Install the oil pipe to the cylinder block.

Tightening torque: 27 N • m {2.8 kgf • m / 9.07 kg • ft}



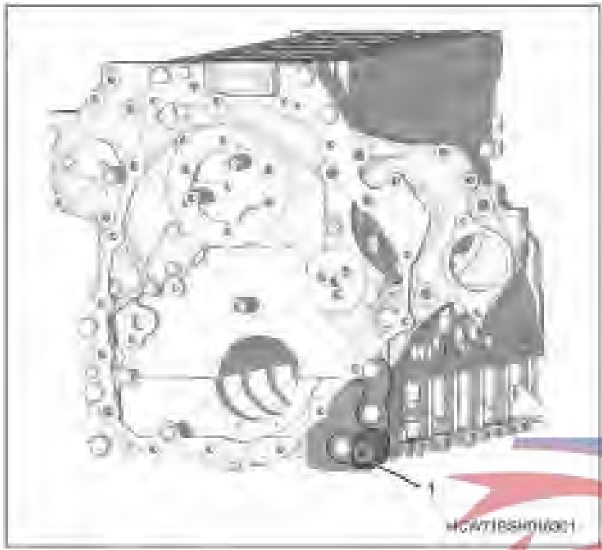
1. Eyebolt

POWERSTAR

3. A / C compressor bracket installation

1) Install the air conditioner compressor bracket to the timing gearbox.

Tightening torque: 135 N • m {13.8 kgf • m / 45.36 kg • ft}

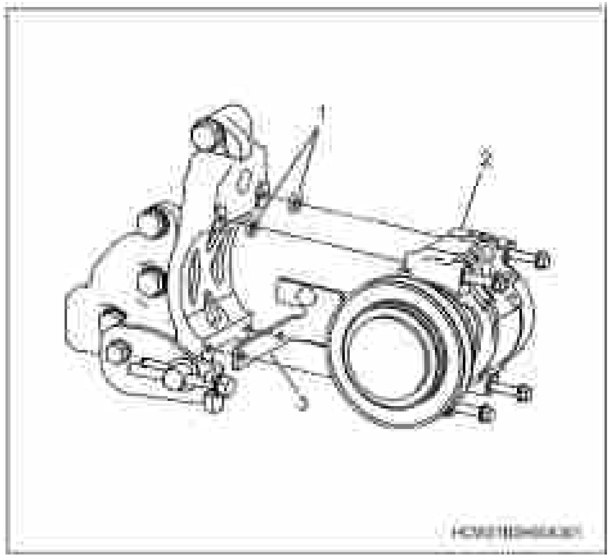


1. Air conditioner compressor bracket

4. A/C compressor connect

1) Connect the A/C compressor to the bracket.

Tightening torque: 22 N• m { 2.2 kgf• m / 7.26 kg • ft }



1. Collar

2. A / C compressor

3. Bracket

5. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

6. A / C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A / C compressor pulley and the crankshaft pulley.

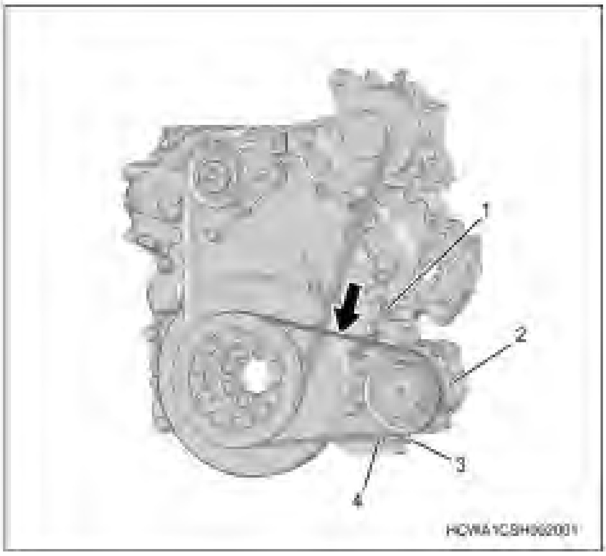
Air conditioner compressor belt tension specified value

Adjustment conditions	When new	When adjusting tension
tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0 to 40.0kg }
deviation	: 11 to 14mm { 0.4 to 15.24mm }	: 15 to 17mm { 0.6 to 17.78mm }
Vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.

POWERSTAR



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

7. Power steering oil pump installation

1) Apply engine oil to the O-ring.

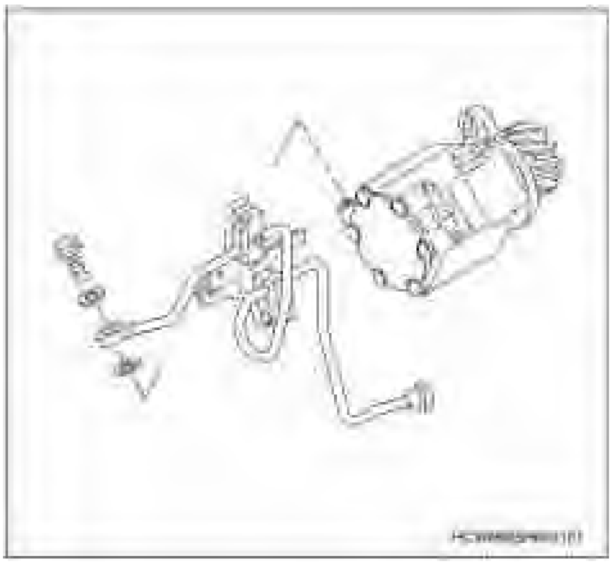
2) Install the O-ring on the power steering oil pump

3) Install the power steering oil pump on the engine

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

4) Connect the tubing and 2 washers to the power steering pump.

Tightening torque: 59 N • m {6.0 kgf • m / 19.96 kg • ft}



5) Install the suction pipe to the power steering pump.

Tightening torque: 22 N • m {2.2 kgf • m / 7.26 kg • ft}

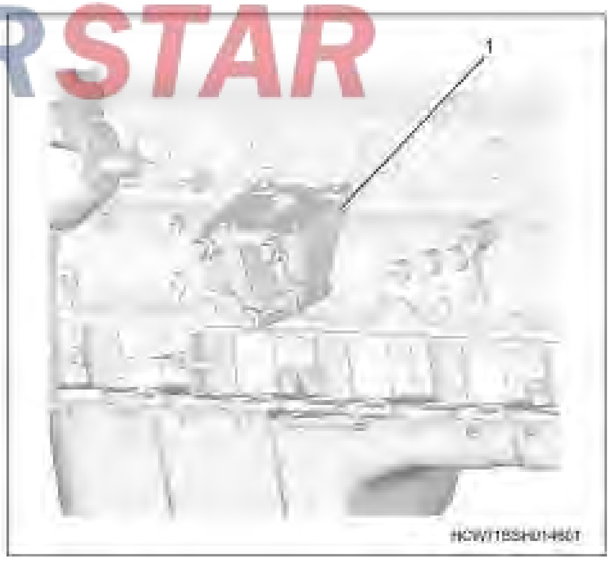
6) Install the tubing to the steering unit.

8. Fuel pump installed

1) Attach the feed pump bracket to the cylinder block.

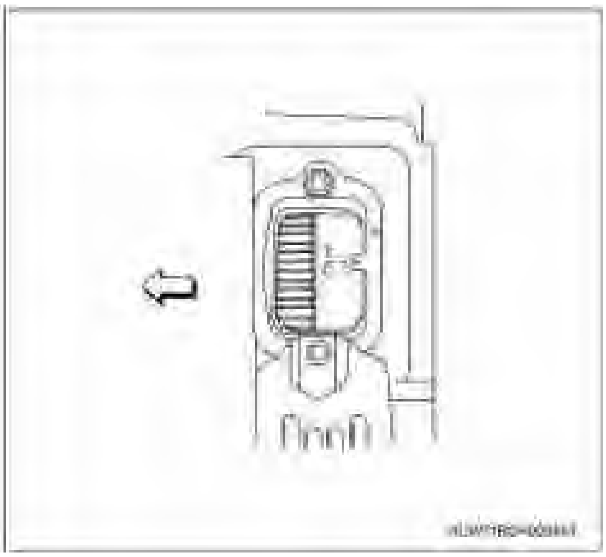
Tightening torque: 108 N • m {11.0 kgf • m / 36.29 kg • ft}

POWERSTAR



1. Fuel pump bracket

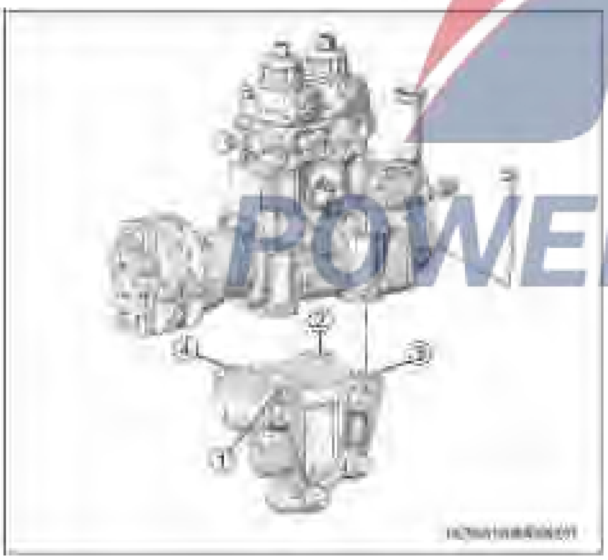
2) Align the No.1 cylinder to compression top dead center.



3) Align the pipe marked on the pipe with the marked pipe on the pump.

4) Install the fuel delivery pump in the order of numbers on the supply pump bracket.

Tightening torque: 57 N • m {5.8 kgf • m / 19.05 kg • ft}

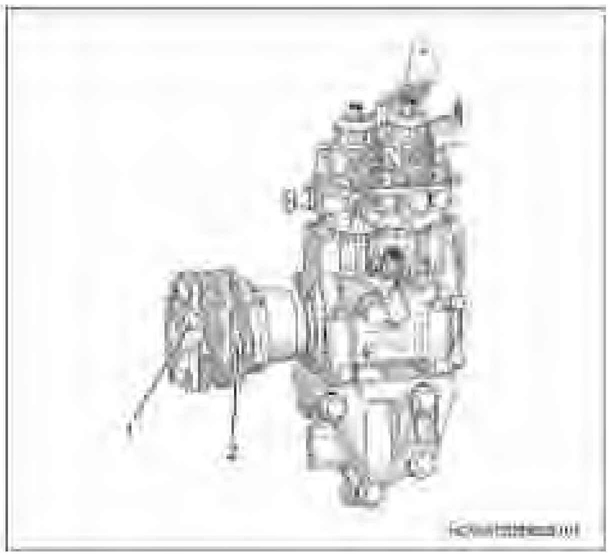


5) Slide the coupling to confirm firm contact with the feed pump and tighten the coupling bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 30.39 kg • ft}

6) After checking and making sure that the coupling laminate is not bent, tighten the pin bolt.

Tightening torque: 91 N · m {9.3 kgf • m / 30.39 kg • ft}

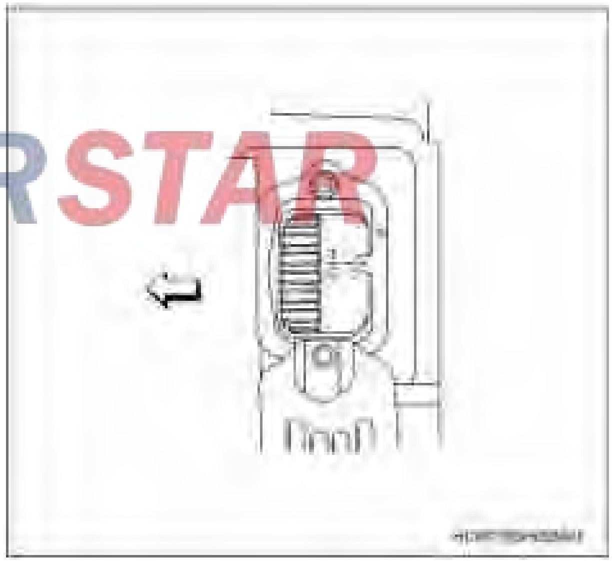


1. Cotter bolt
2. Coupling tightening bolt

7) Rotate the crankshaft forward to align cylinder # 1 to the top dead center of compression.

Note:

Align with the center of the compression stop in a toothless state.

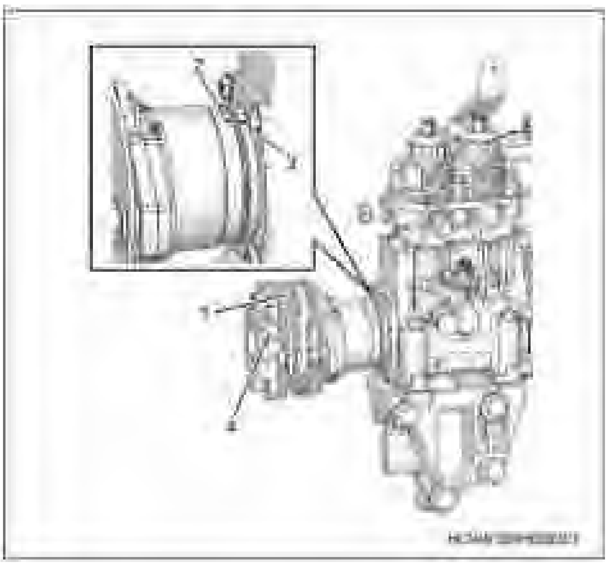


8) Verify that the marked pipe on the pipe fitting matches the marked pipe on the pump.

Caution:

● If the marking line is out of service, use the 2 oval bolts on the coupling to readjust.

POWERSTAR



1. Coupling bolts

2. Coupling end marking line

3. Pump end marking line

4. Cotter bolt

9) Install the oil return pipe to the cylinder block.

10) Install the oil return pipe to the fuel supply pump.

11) Install the oil feed pipe to the cylinder block.

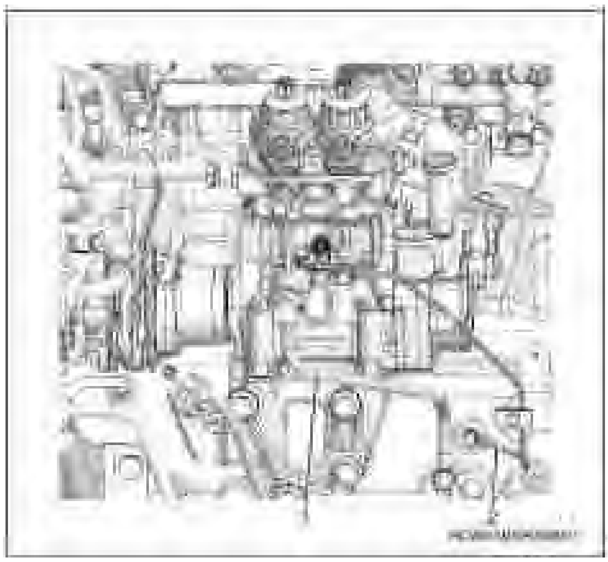
12) Install the oil feed pipe to the fuel supply pump.

Tightening torque: 28 N • m {2.9 kgf • m / 9.53 kg • ft}

M10

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

M14



1. Oil return pipe

2. Oil feed pipe

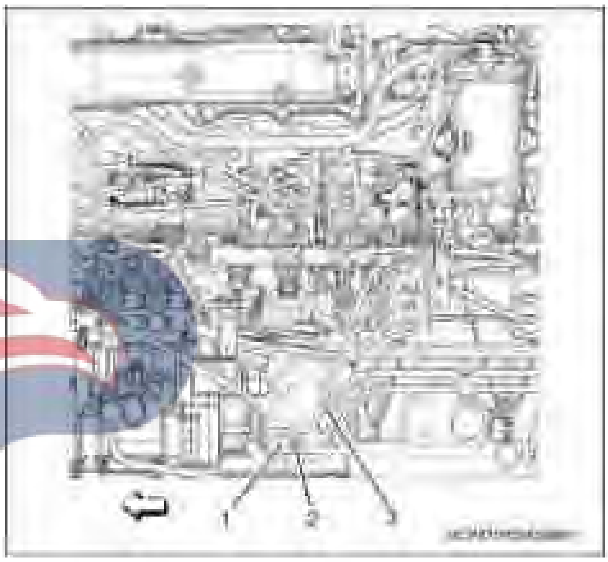
13) Connect the harness connector to the PCV.

14) Connect the harness connector to the camshaft position sensor.

9. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



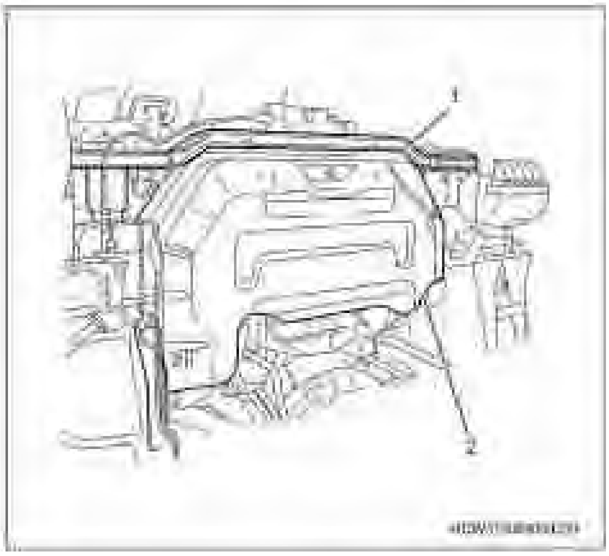
1. Fuel suction pipe

2. Clip

3. Oil feed pipe

10. Cab back member noise cover installation

1) Install the cab back member noise cove on the cab mounting rear element.



POWERSTAR

1. Cab rear mounting member
2. Cab back member noise cover

11. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 13.61 kg • ft}

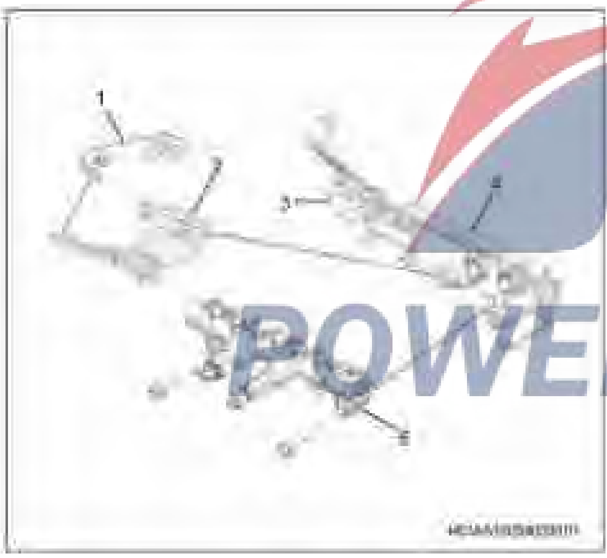
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 13.61 kg • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

4) Connect the harness connector to the fuel rail position sensor.

12. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

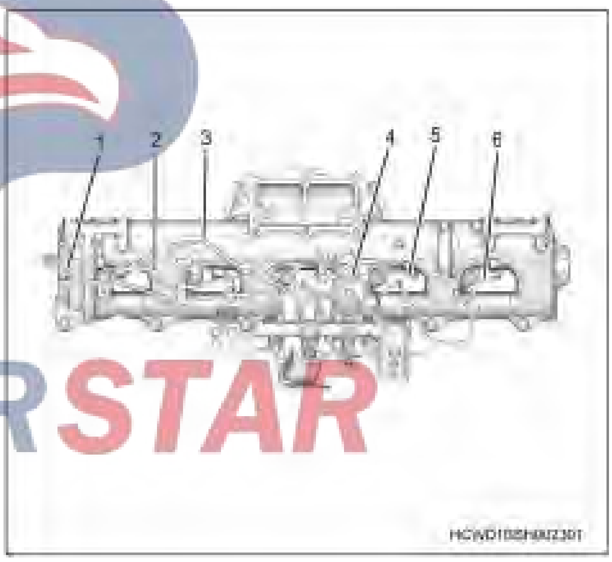
Tightening torque: 9 N • m {0.9 kgf • m / 36.29 kg • in}

4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 16.33 kg • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m {4.5 kgf • m / 14.51 kg • ft}



POWERSTAR

1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

13. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

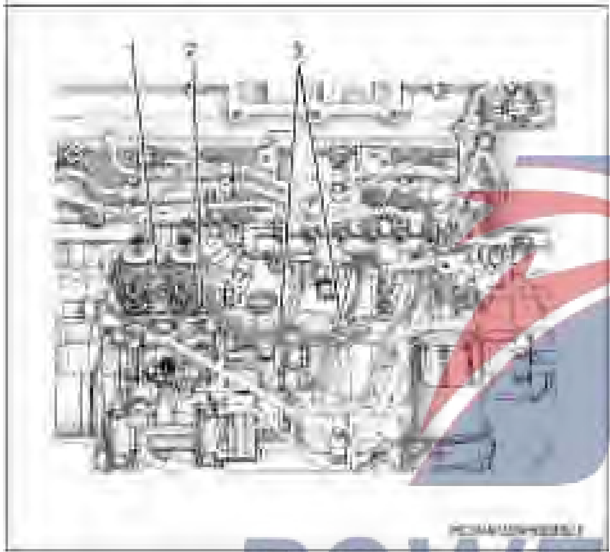
5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 14.51 kg • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 14.51 kg • ft}

7) Fasten the clip to the fuel tube.



1. Fuel pipe
2. Fuel pipe
3. Clip

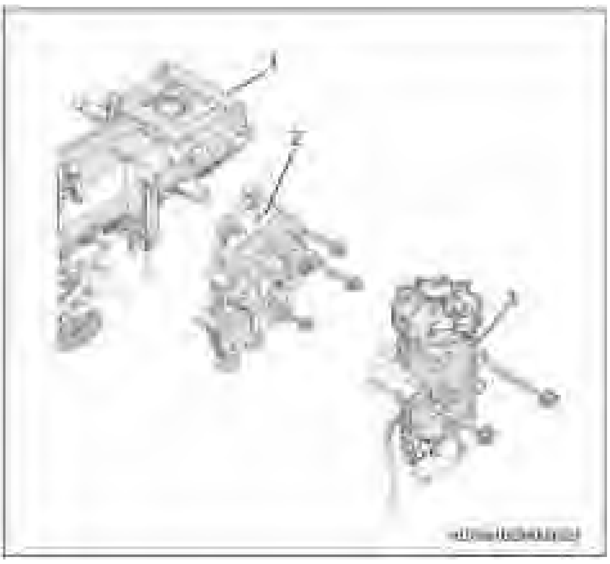
14. Fuel filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 14.97 kg • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 32.66 kg • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

15. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 7.26 kg • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 36.29 kg • in}

16. Oil feed pipe installation

1) Temporarily fasten the fuel drain pipe to the cylinder head.

2) Tighten the fuel drain pipe to the cylinder head.

Eyebolt tightening torque list

Dimensions	Tightening torque
M8	: 15 N• m { 1.5 kgf• m / 4.99 kg• ft }
M10	: 27 N• m { 2.8 kgf• m / 9.07 kg• ft }

POWERSTAR

M12	: 34 N• m { 3.5 kgf• m / 11.34 kg• ft }
M14	: 41 N• m { 4.2 kgf• m / 13.61 kg• ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

17. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

18. Pilot valve installation

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 40.37 kg • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 40.37 kg • in}

19. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N• m { 0.5 kgf• m / 44 lb• in }

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

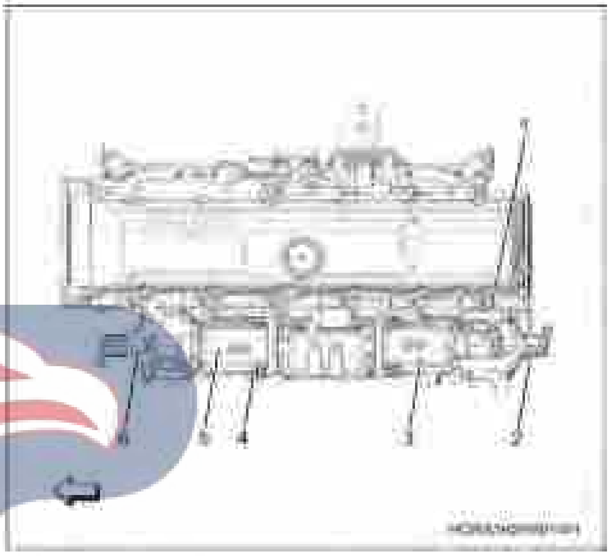
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe bracket
5. EGR Valve duct A
6. EGR valve 1

5) Final Tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 14.51 kg • ft}

6) Tighten the exhaust gas recirculation valve duct B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 14.51 kg • ft}

7) Final tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

POWERSTAR

Tightening torque: 43.8 N • m {4.5 kgf • m / 14.51 kg • ft}

8) Tighten the exhaust gas recirculation valve duct B on the EGR valve and the water manifold of the intake manifold.

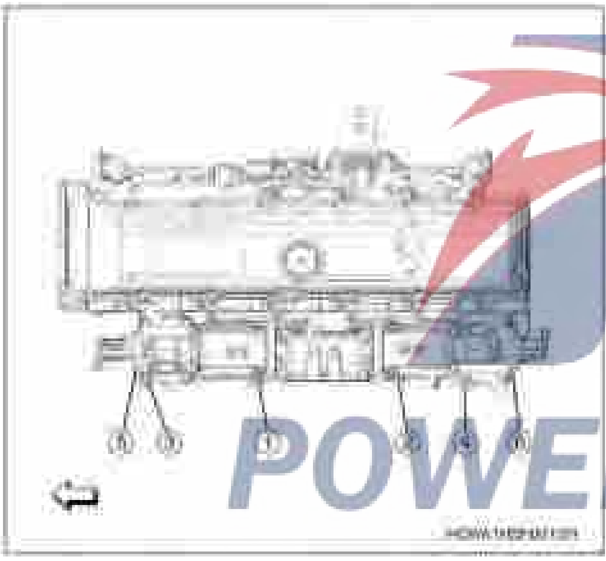
Tightening torque: 43.8 N • m {4.5 kgf • m / 14.51 kg • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m {4.5 kgf • m / 14.51 kg • ft}



20. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gas kets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

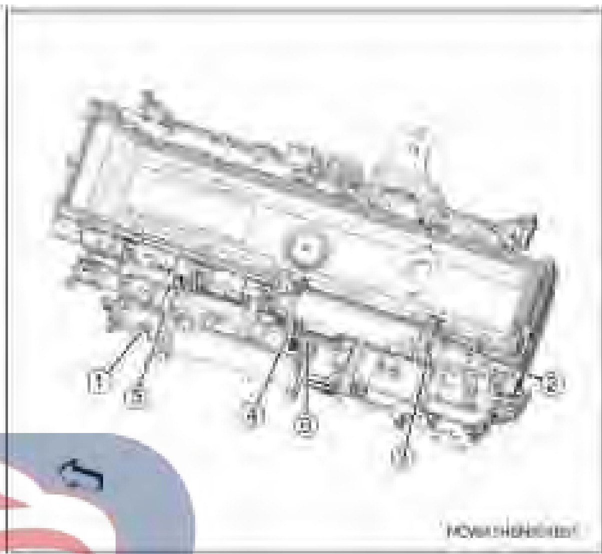
● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N• m { 0.5 kgf• m / 44 lb• in }



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

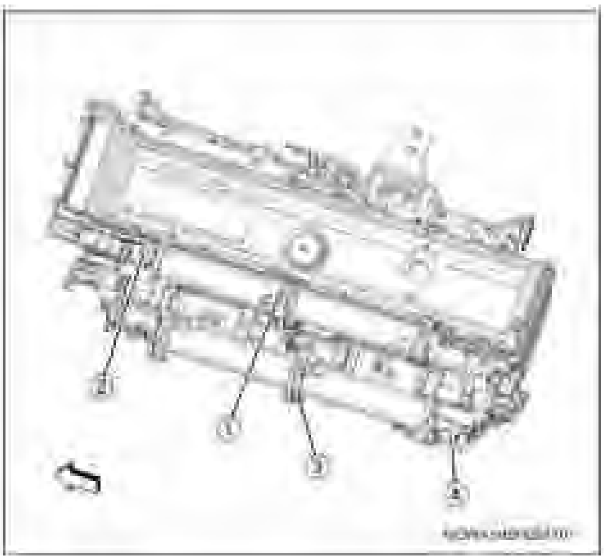
● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



POWERSTAR

3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

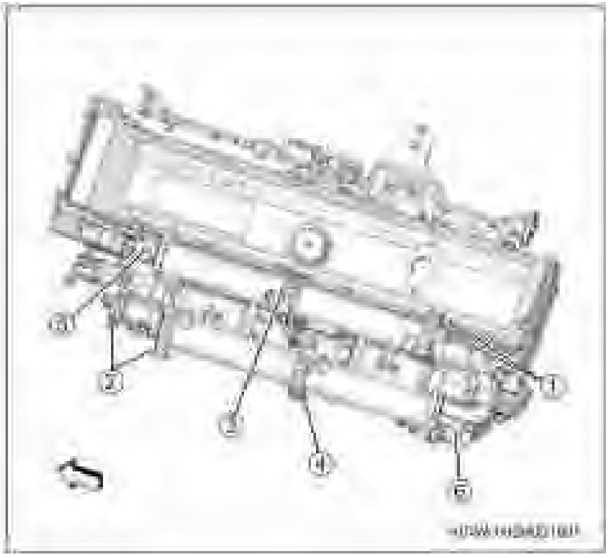
Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 1,2

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 3,4,5 (M10), 6 (M10)

Tightening torque: 25 N • m {3 kgf • m / 18 lb • ft} 5 (M8), 6 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

● EGR duct B.

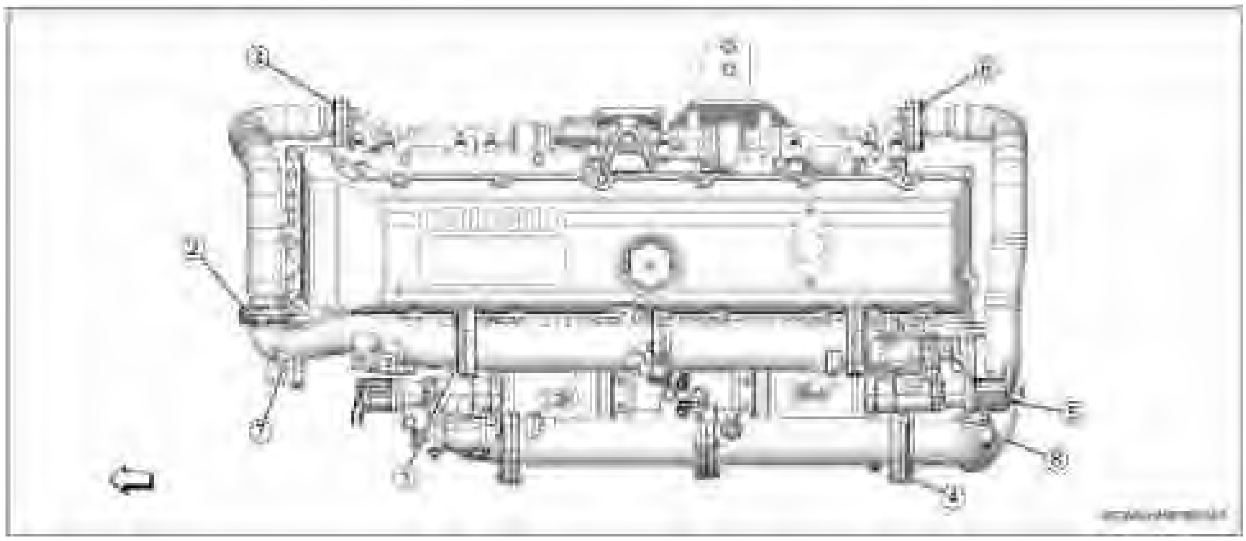
● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N• m { 0.5 kgf• m / 44 lb• in }

POWERSTAR



5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

- EGR cooler duct A.
- EGR duct A
- EGR cooler duct C.
- EGR duct B.
- Bracket

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 1 (M10), 2,3,9 (M10), 10 (M10)

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 4

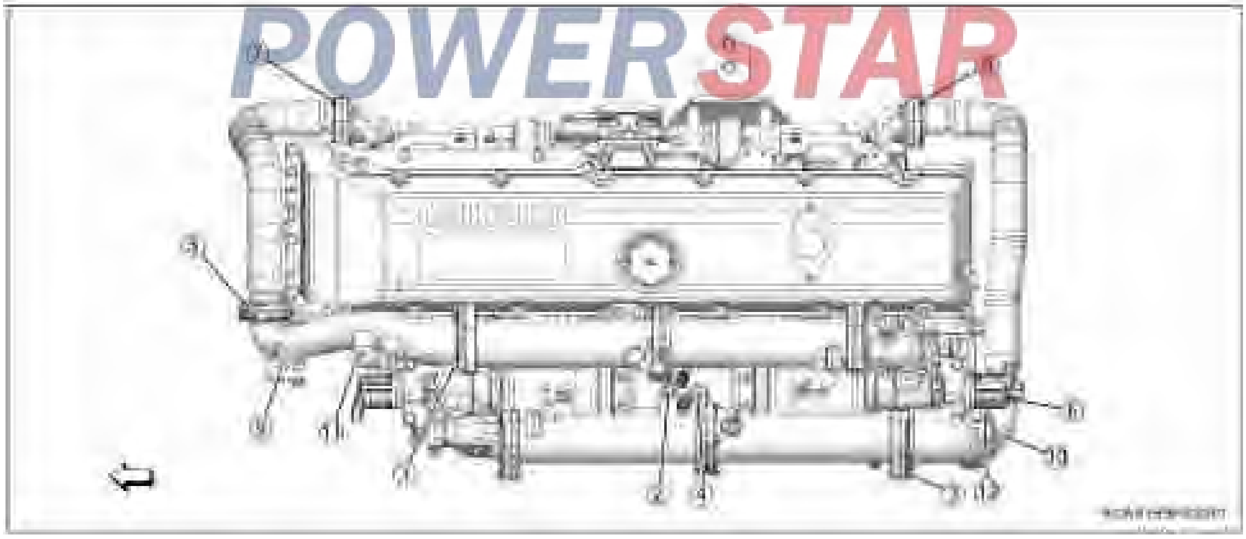
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft} 5,6 (M8), 7,8 (M8), 9 (M8)

Tightening torque: 24.7 N • m {2.5 kgf • m / 18 lb • ft} 10 (M8)

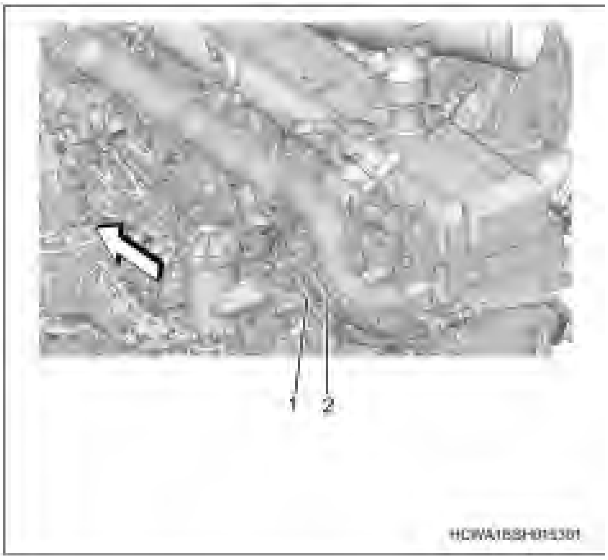
Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft} 11,12 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front water return pipe
2. Rear water return pipe

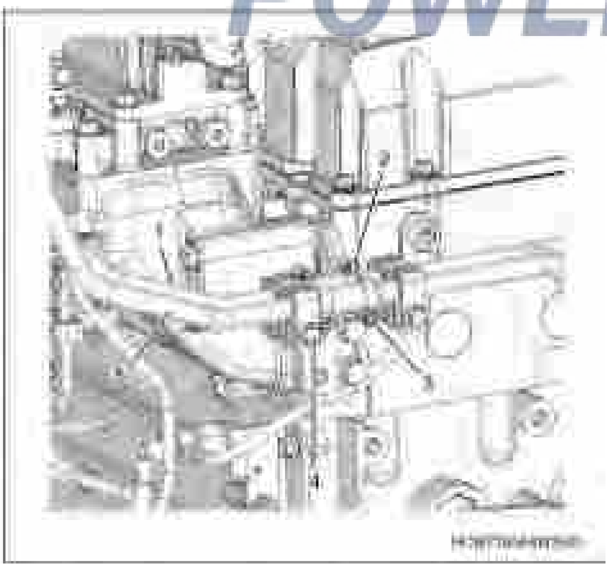
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

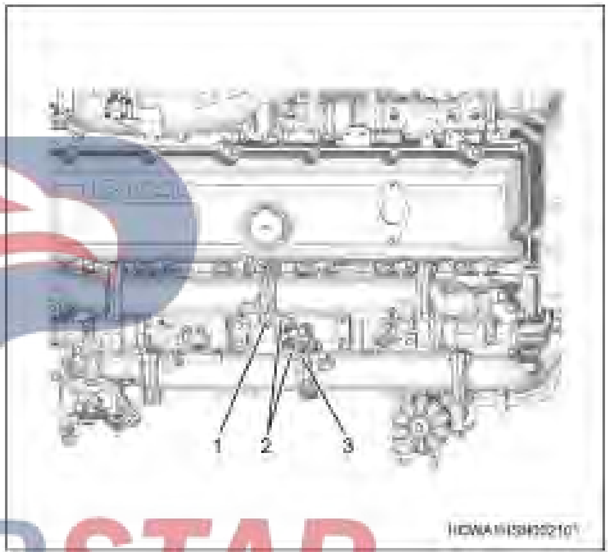


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp the bolt
5. Rear return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.



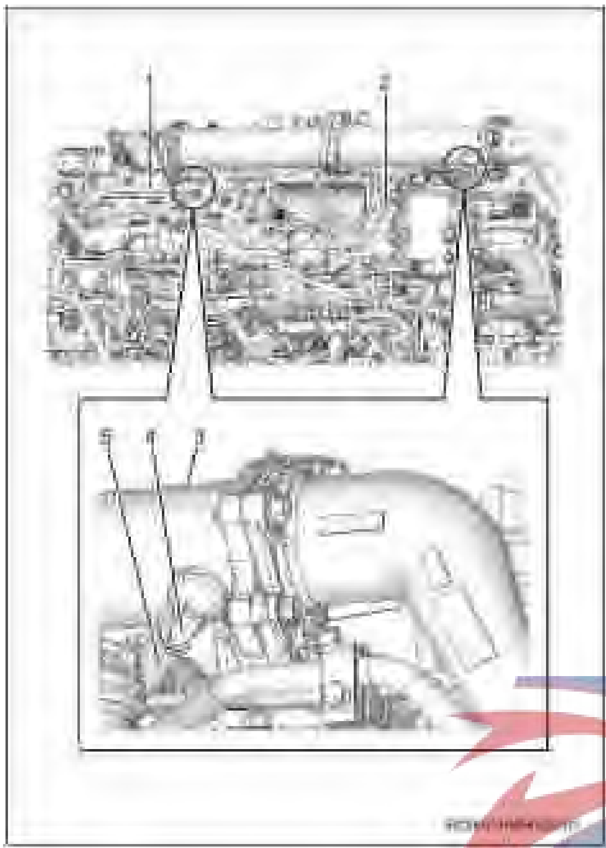
1. Hose clip
2. Water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

Caution:

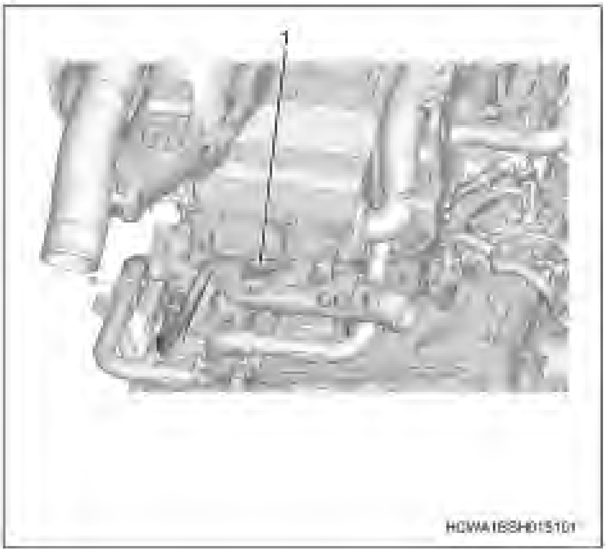
● During installation, care should also be taken to prevent the clamp from rotating.

POWERSTAR



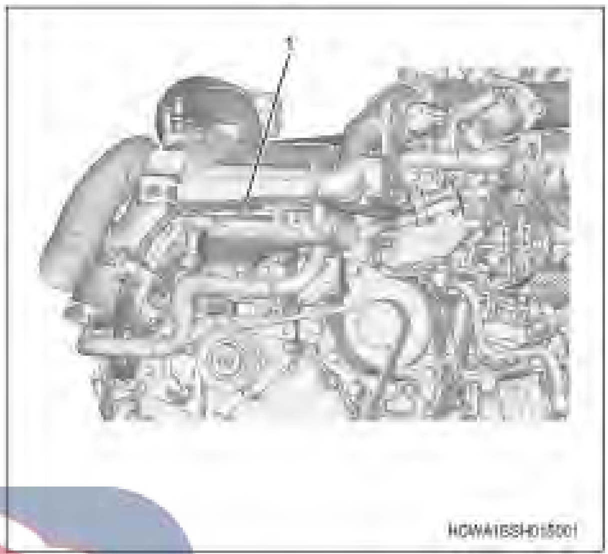
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

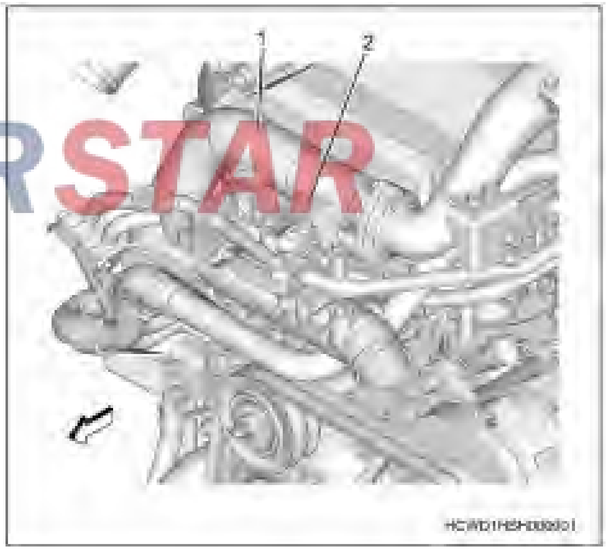
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

21. Suction pipe installation

1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction pipes to the air compressor.

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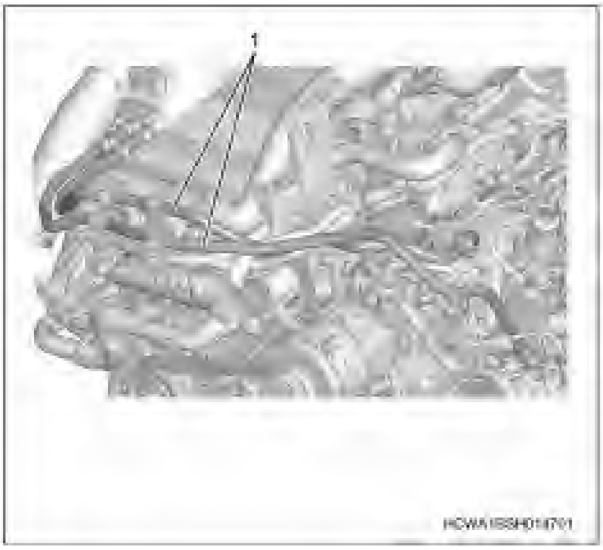
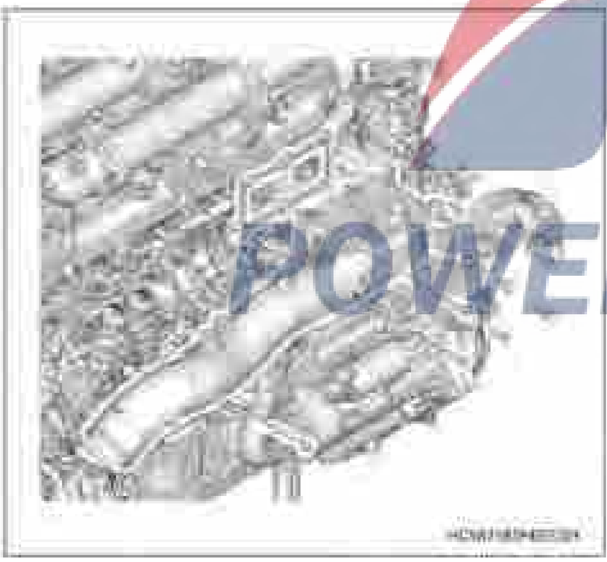


1. Exhaust pipe

22. Intake duct installation

1) Install the intake duct to the intake manifold.

Tightening torque: 43.8 N• m { 4.5 kgf • m / 14.51 kg • ft }



23. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

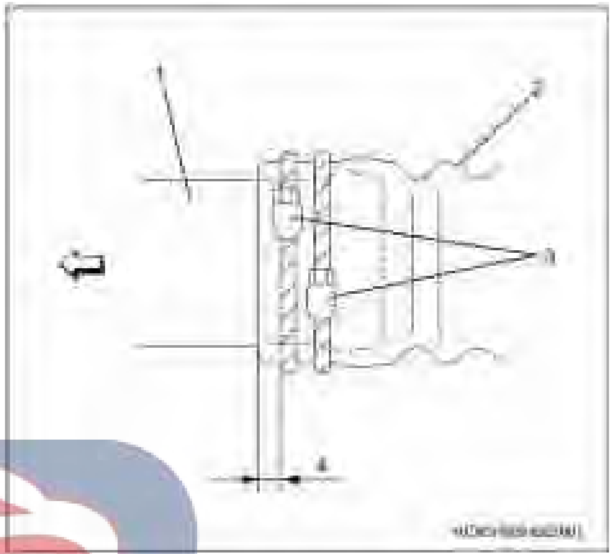
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been fixed installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30 ° or more.

Tightening torque: 6.4 N • m {0.7 kgf • m / 25.85 kg • in}



1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

24. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

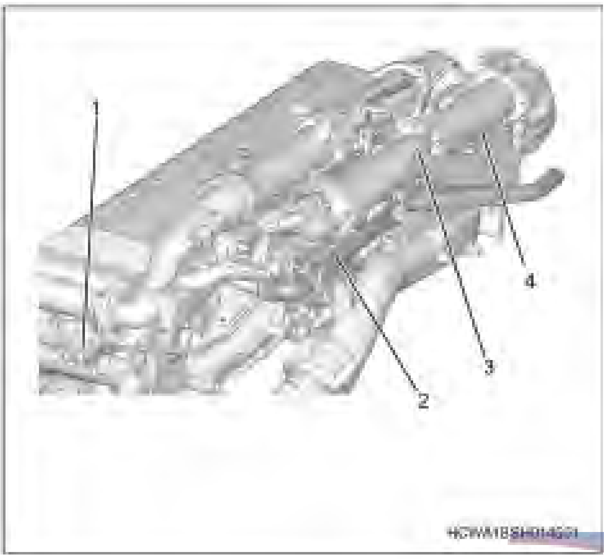
25. leakage pipe installation

1) Install the rear blow-by pipe to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the front blow-by pipe to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

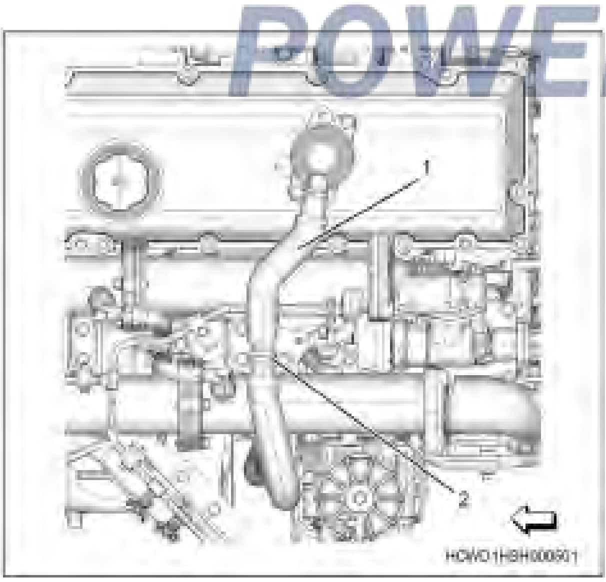
Eyebolt



1. Outlet pipe
2. Water charge pipe
3. Rear leakage pipe
4. Front leakage pipe

26. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

27. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

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● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

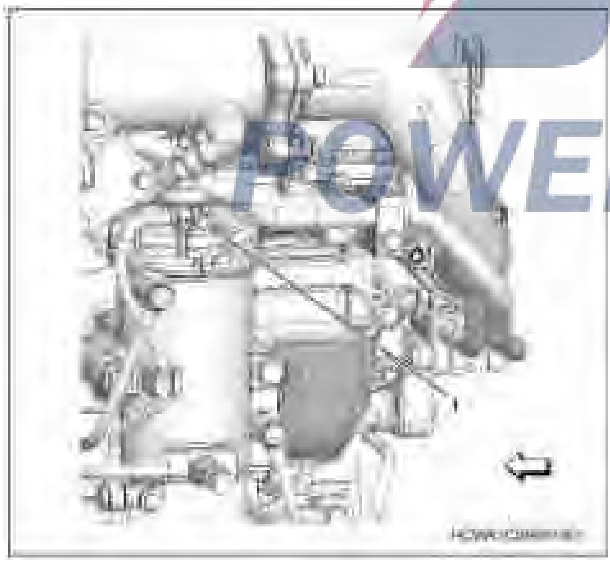
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

28. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 28.12 kg • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

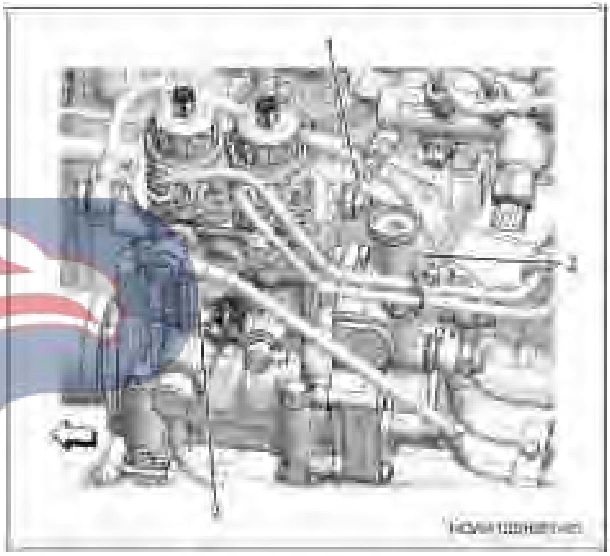
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N• m { 0.6 kgf• m / 24.04 kg• in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

29. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

30. Power steering fluid filling

1. Supplement (models not equipped with emergency auxiliary steering system)

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1) Jack up the front of the vehicle and attach a chassis stand.

2) Refill the oil tank with power steering fluid.

Note:

● Refill up to the level marked on the oil tank.

3) Repeatedly turn the steering wheel to the rightmost and leftmost positions with the engine stopped.

Note:

● In this state, the air from the power steering pipe will be released in the form of large bubbles.

4) Refill the oil tank with power steering fluid.

5) Start the engine.

6) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

7) Lower the vehicle.

8) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

9) Check for an abnormal sound.

Note:

● If no abnormal noise is heard, air removal is completed.

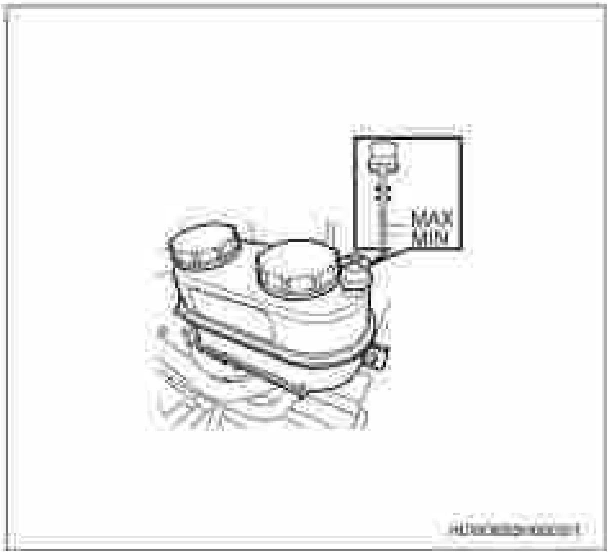
10) Inspect the fluid level of the oil tank and for oil leakage from each joint section.

2. Supplement (models equipped with emergency assistance steering system)

1) Tighten the oil supply hose connector.

2) Jack up the front of the vehicle and attach a chassis stand.

3) Refill the oil tank with power steering fluid.



Note:

● Refill up to the level marked on the oil tank.

4) Repeatedly turn the steering wheel to the rightmost and leftmost positions with the engine stopped.

Note:

● In this state, the air from the power steering pipe will be released in the form of large bubbles.

5) Refill the oil tank with power steering fluid.

6) Start the engine.

7) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

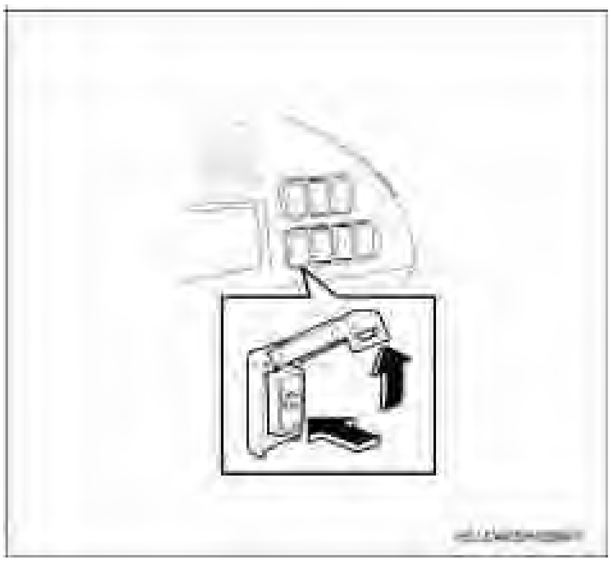
8) Lower the vehicle.

9) Turn the steering wheel to the rightmost and leftmost positions 5 times while idling.

Note:

● Do not leave the steering wheel at its turning limit.

10) Press the power steering check switch of the emergency assist steering system and stop the engine.



11) Start the emergency assist steering system and turn the steering wheel to the rightmost and leftmost 5 times.

12) After the exhaust operation is completed, press the power steering check button of the emergency assist steering system again to reset the button.

Note:

● Do not operate emergency assist steering system for a long time.

13) Check for an abnormal sound.

Note:

● If no abnormal noise is heard, air removal is completed.

14) Inspect the fluid level of the oil tank and for oil leakage from each joint section.

POWERSTAR

Exhaust manifold

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

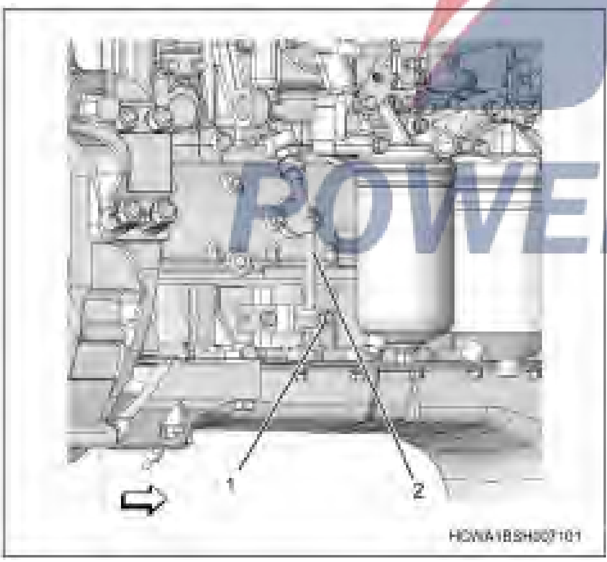
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

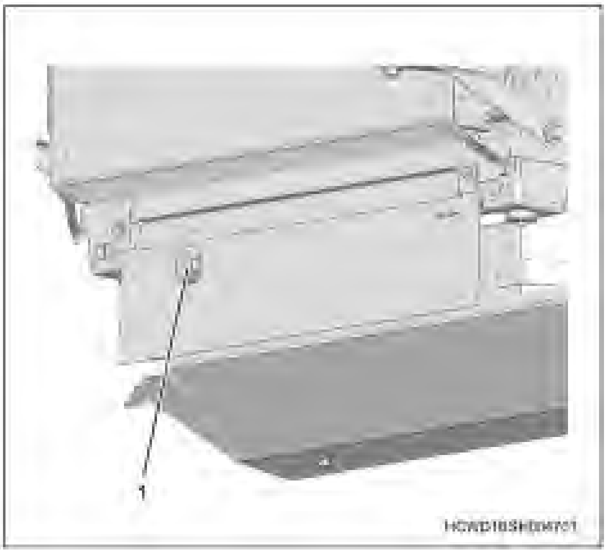
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

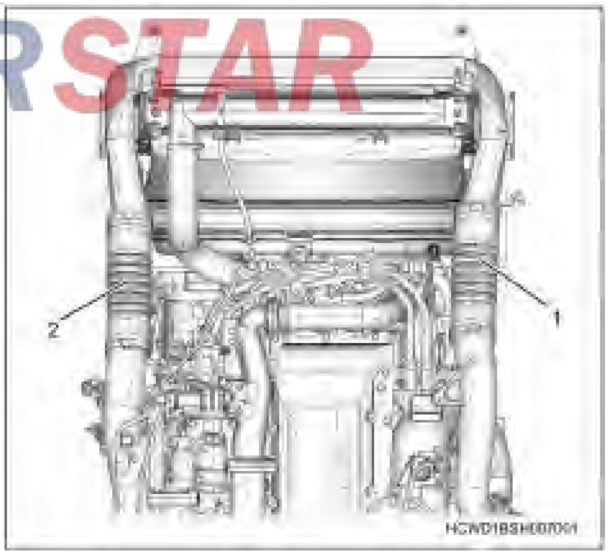
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side

2. Intercooler hose on the intercooler outlet side

2) Remove the intake duct from the turbocharger and the intake side of the intercooler hose.

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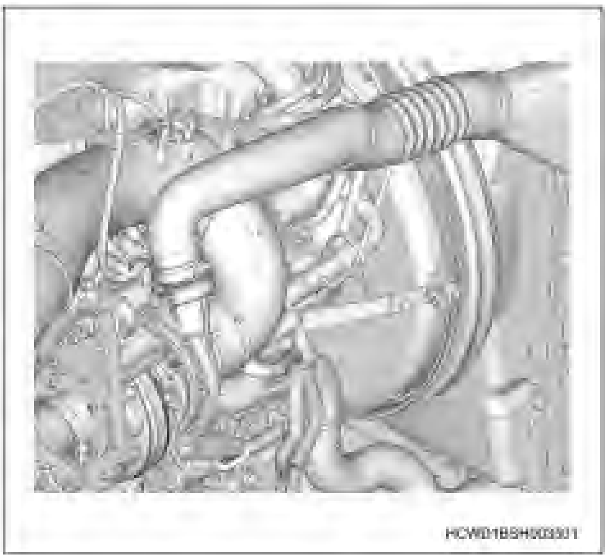
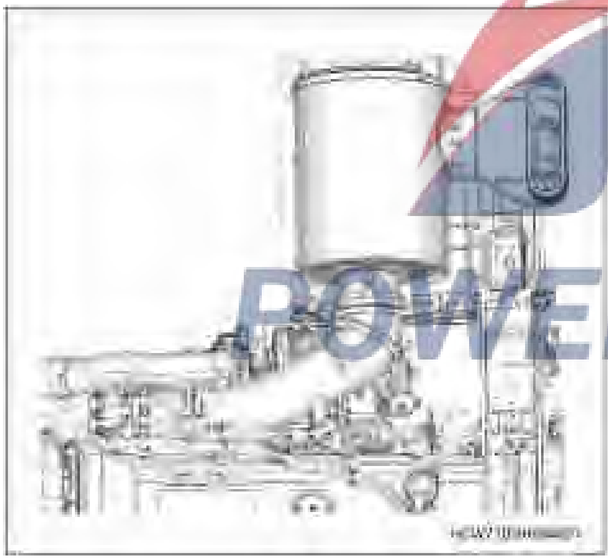


4. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

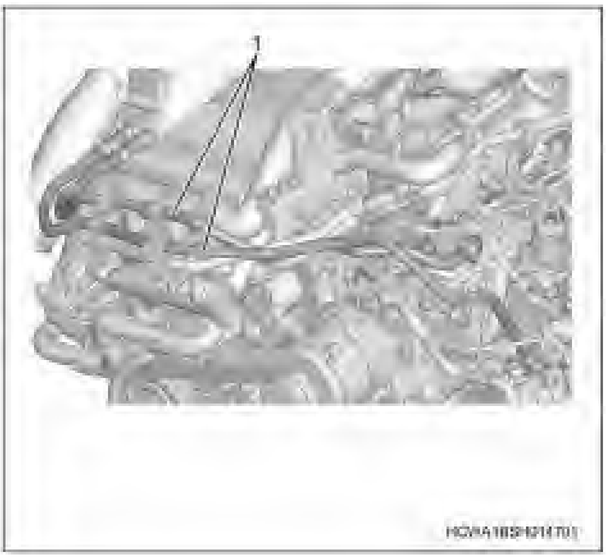
2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



5. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

2) Remove the heat shield from the air line.

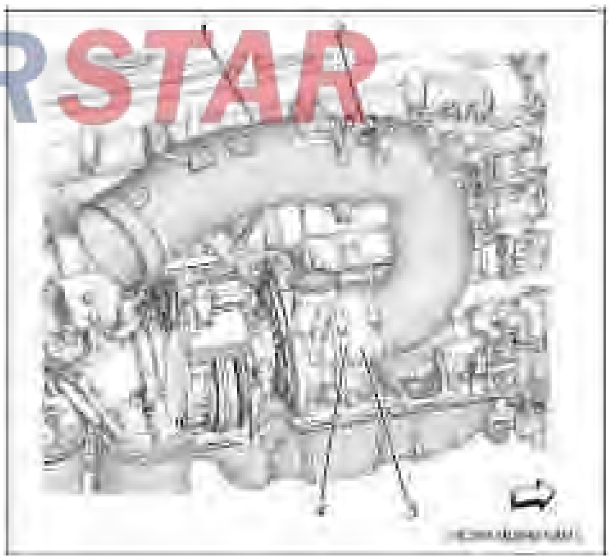
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

4. Hose clip

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6. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

7. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

8. Exhaust cover removal

1) Remove the exhaust cover from the frame.

9. Exhaust brake valve removal

1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

10. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.

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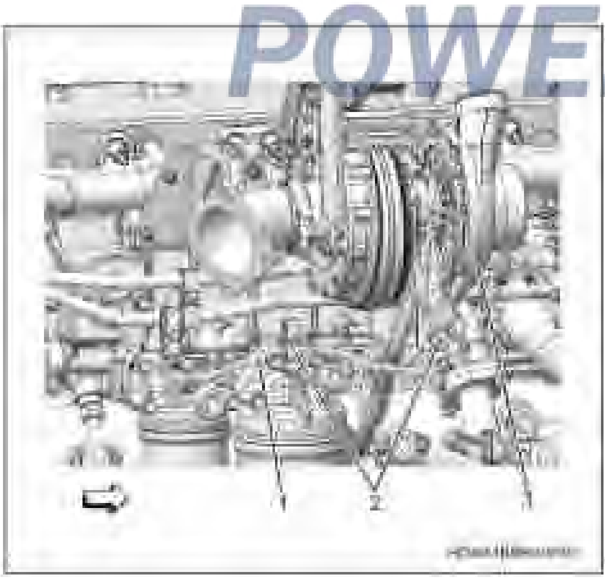


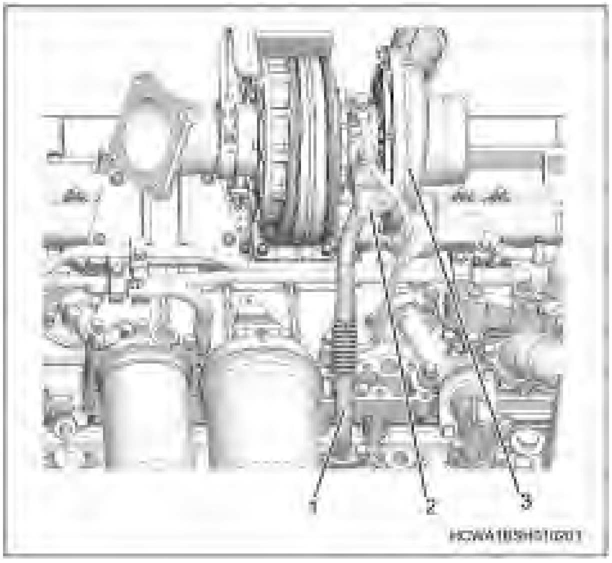
1. Turbocharger oil feed pipe

2. Pipe clamp

3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.



1. Turbocharger oil return pipe

2. Bracket

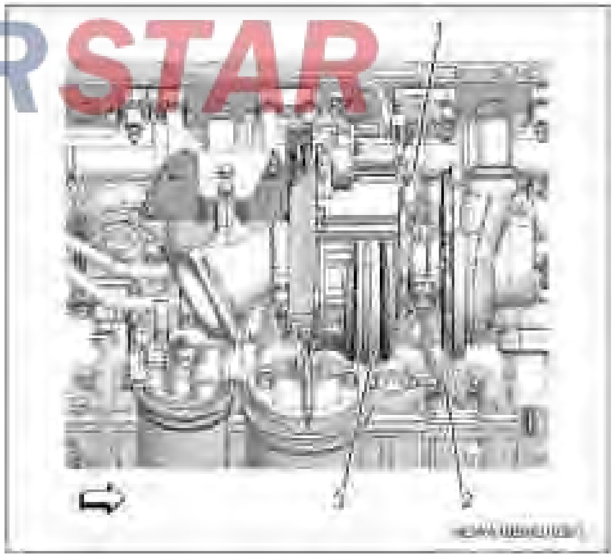
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.

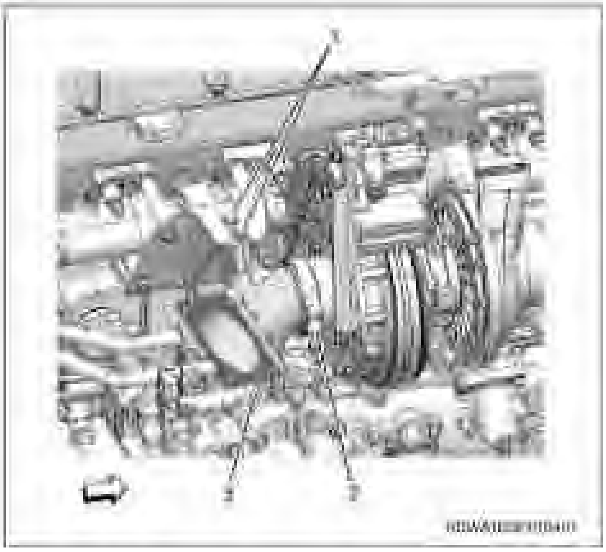


1. Water return pipe

2. Water feed pipe

3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe

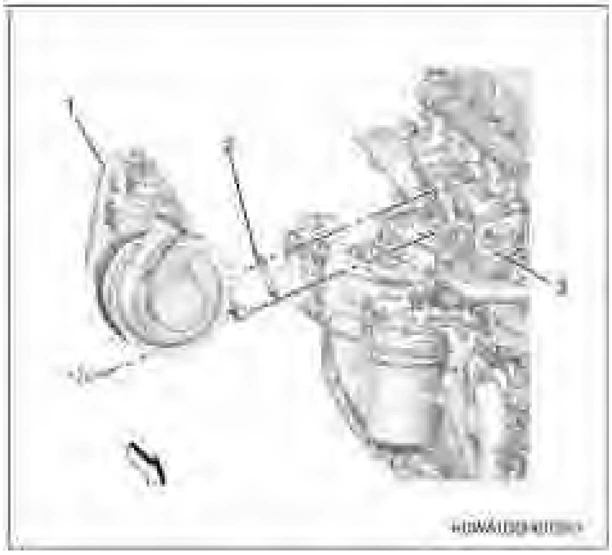
10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.



1. Turbocharger
2. Gasket
3. Exhaust manifold

11. Exhaust manifold removal

1) Remove the exhaust manifold from the cylinder head.

Note:

● Remove front, center, and rear sides simultaneously.

2) Remove the gasket from the cylinder head cover.

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Inspection

1. Exhaust manifold inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the exhaust manifold for cracks.

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Installation

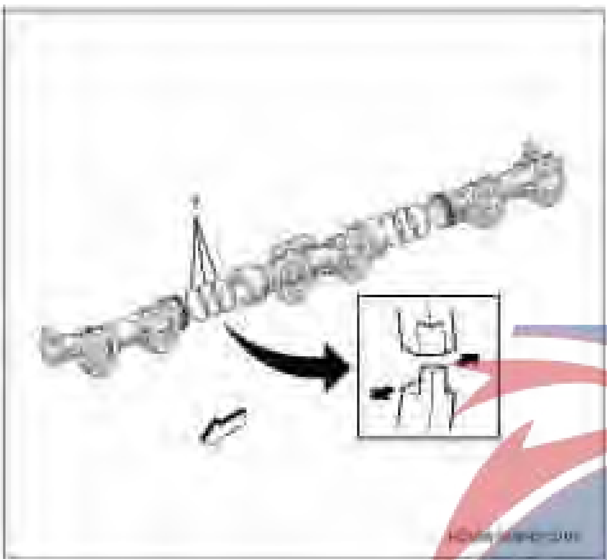
1. Exhaust manifold installation

1) Install the seal ring to the exhaust manifold.

Caution:

● Install the opening positions at intervals of 120°.

● Check and install the seal ring because it has directionality.



1. Seal ring

2) Assemble the exhaust manifold.

3) Install the gasket to the cylinder head.

Caution:

● Install in such a way that the mark is to the right of the bottom.

4) Install the exhaust manifold to the cylinder head in numerical order in the figure.

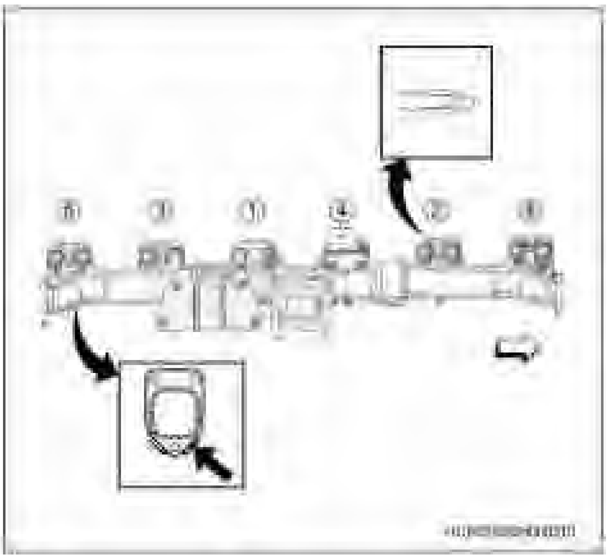
Note:

● Tighten and install the flange clockwise from the bottom.

Caution:

● Install the isolation ferrule with the isolation ferrule facing the nut.

Tightening torque: 48 N • m {4.9 kgf • m / 15.88 kg • ft}



2. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

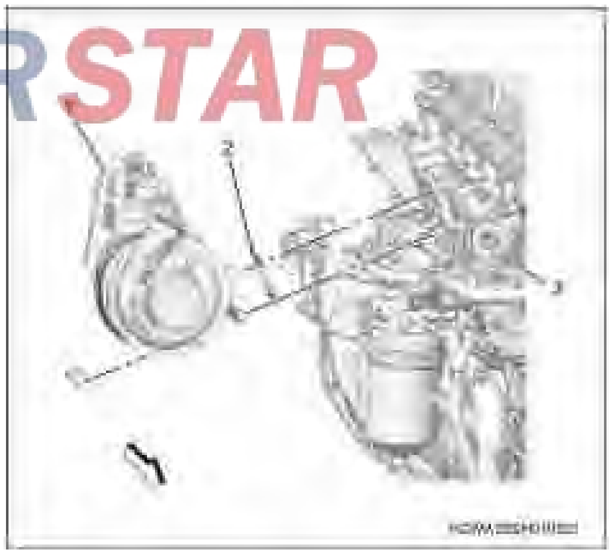
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 14.97 kg • ft}



1. Turbocharger

2. Gasket

3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

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Tightening torque: 41 N• m { 4.2 kgf• m / 13.61 kg • ft }

6) Connect the water return pipe to the turbocharger.

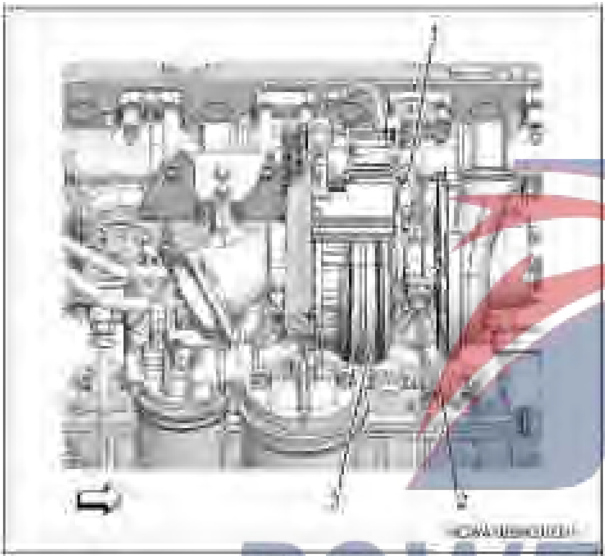
Tightening torque: 50 N• m { 5.1 kgf• m / 16.78 kg • ft }

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m { 4.2 kgf • m / 13.61 kg • ft }

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N• m { 5.1 kgf • m / 16.78 kg • ft }



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

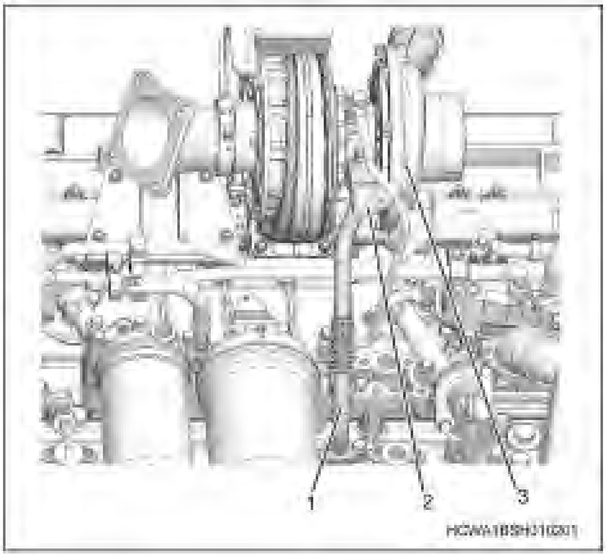
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 7.26 kg • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 14.51 kg • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

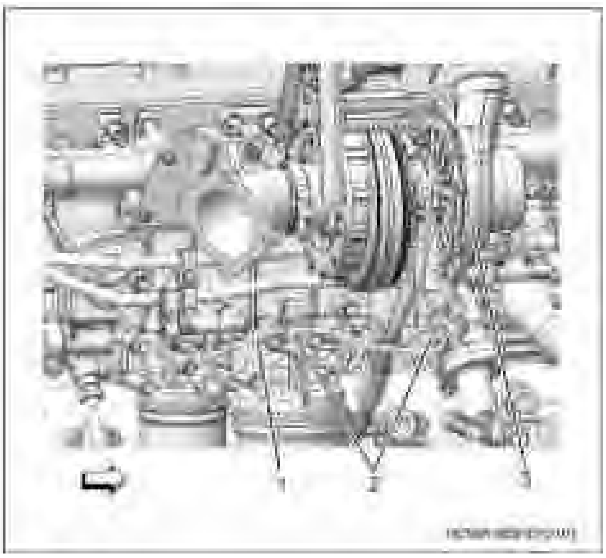
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the fuel filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 11.34 kg • ft}

17) Tighten the turbocharger fuel supply tube to the fuel filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 11.34 kg • ft}



POWERSTAR

1. Turbocharger oil feed pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N• m { 1.0 kgf• m / 40.37 kg• in }

3. Exhaust cover installation

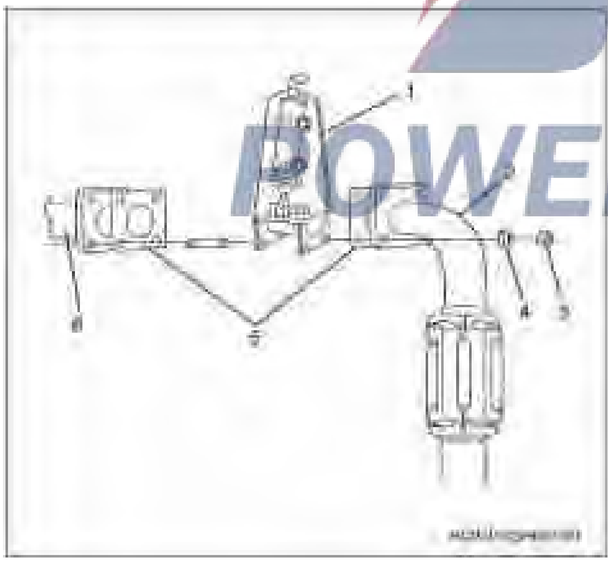
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

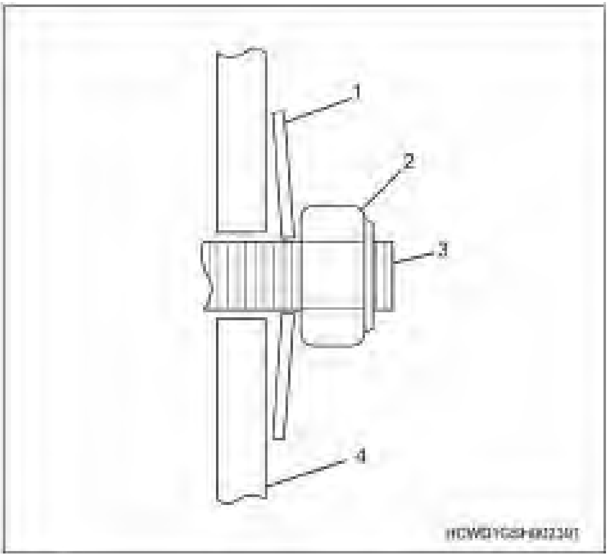
● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N• m { 6.0 kgf• m / 19.96 kg• ft }



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

Exhaust cover installation

1) Install the exhaust cover to the frame.

5. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

6. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

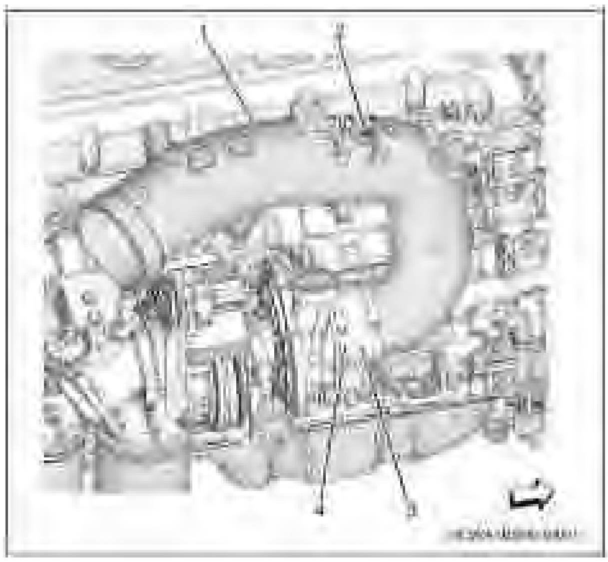
7. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft} M10

POWERSTAR



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

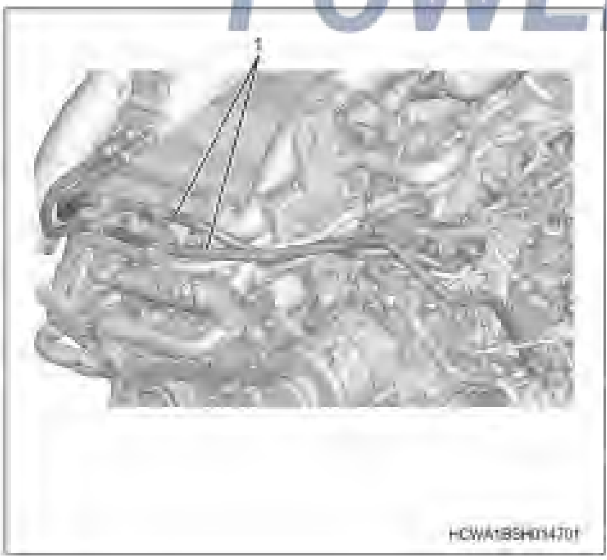
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

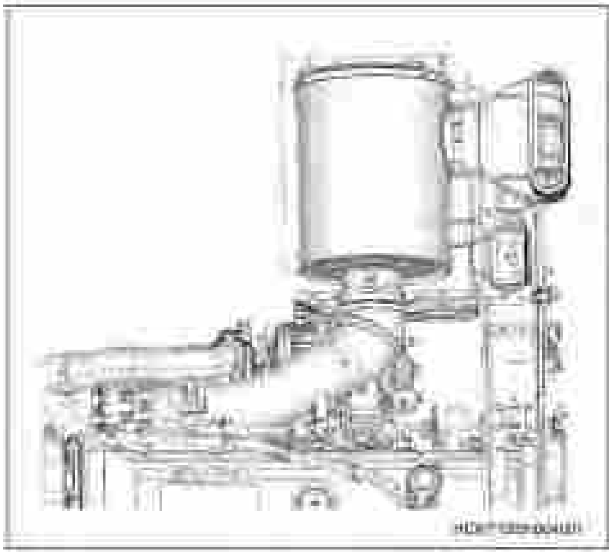
8. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



9. Intercooler hose installation

1) Install the air intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft} M10

Tightening torque: 8 N • m {0.8 kgf • m / 32.21 kg • in}

Turbocharger side clamp

2) Connect the intercooler hose inlet to the intercooler.

1. Intercooler hose installation precautions

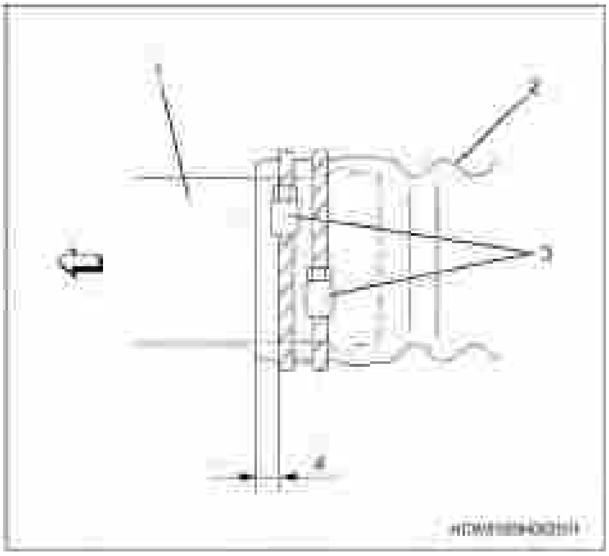
Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N• m { 0.7 kgf• m / 25.85 kg• in }

POWERSTAR



1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

10. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

11. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

POWERSTAR

Cylinder head cover

Removal

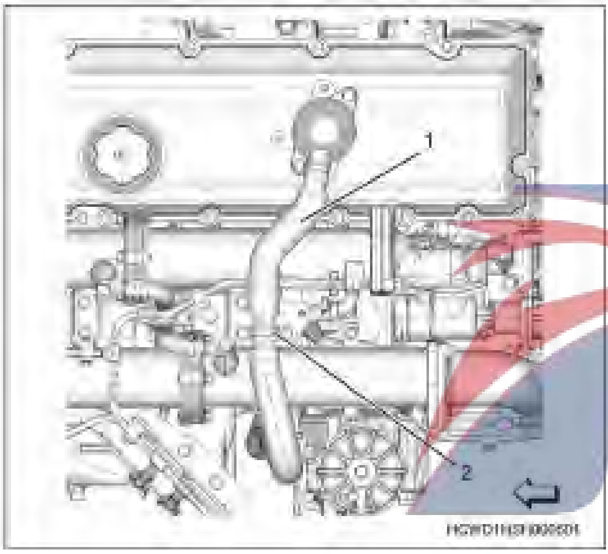
1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



1. Ventilation hose

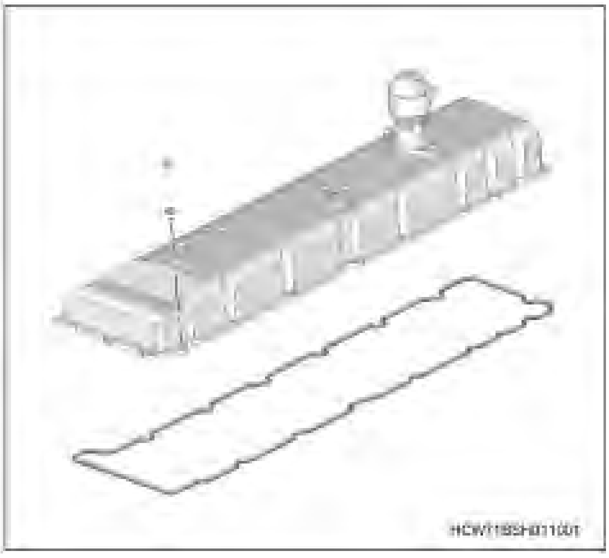
2. Ventilation hose clip

POWERSTAR

3. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



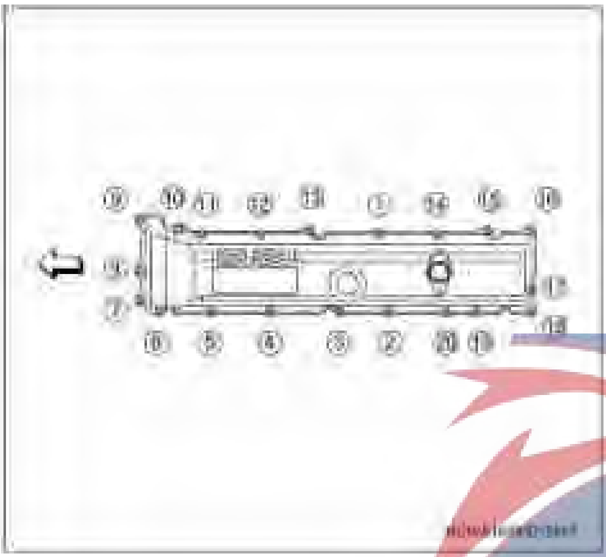
Installation

1. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

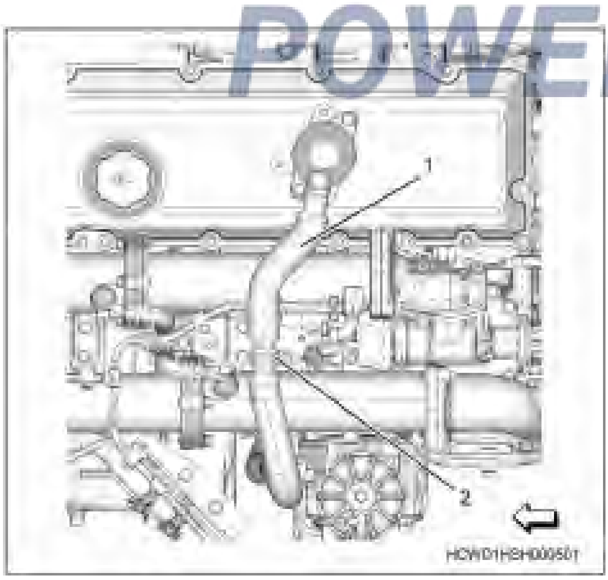
2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m { 1.5 kgf • m / 4.99 kg • ft }



2. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose

2. Ventilation hose clip

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

POWERSTAR

Rocker arm shaft

Removal

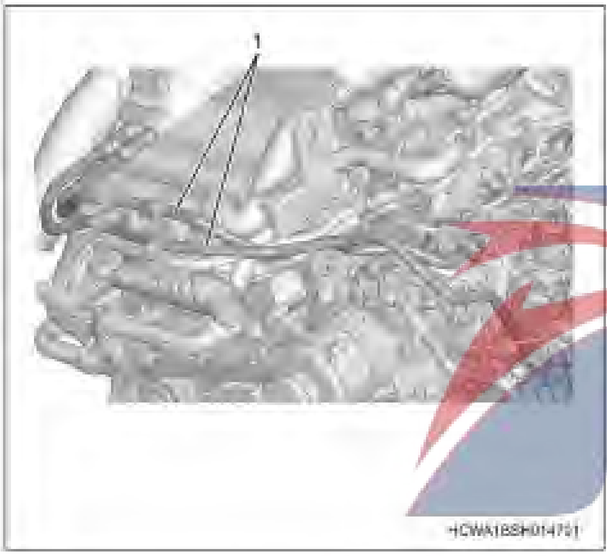
1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

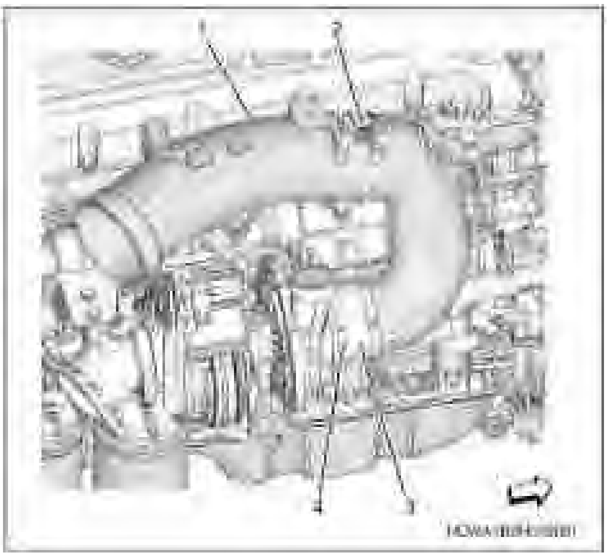
2) Remove the heat shield from the air line.

3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

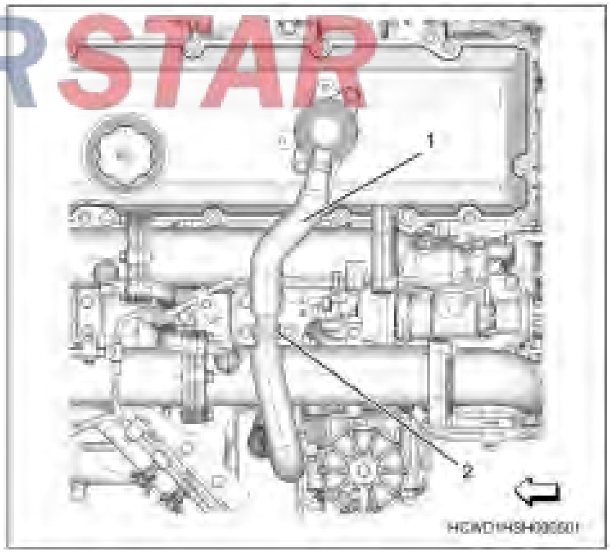
5) Remove the air line from the turbocharger.



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



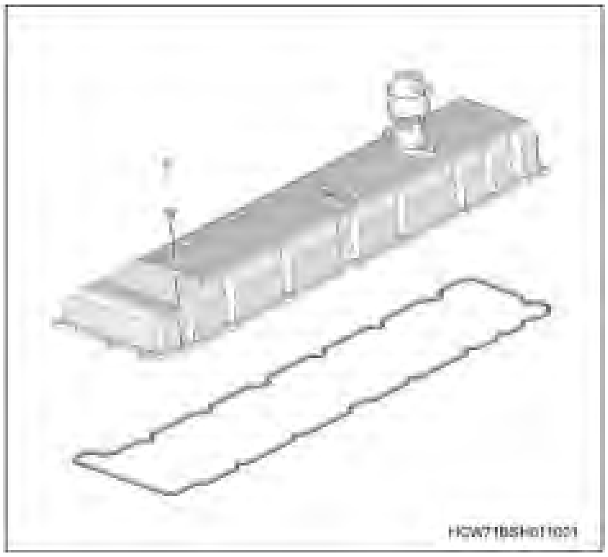
1. Ventilation hose
2. Ventilation hose clip

4. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.

POWERSTAR



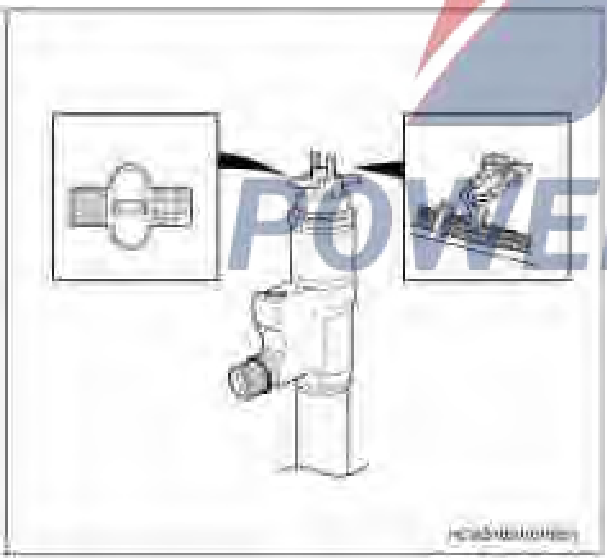
5. Injector harness removal

1) Remove the injector nut

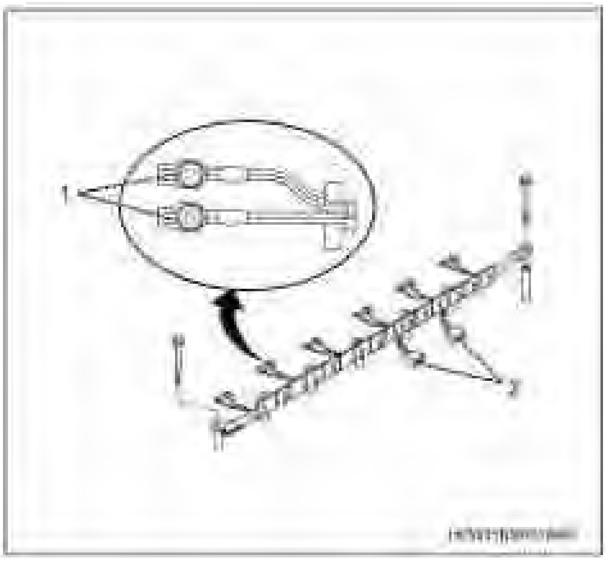
2) Remove the injector harness

Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.



3) Remove the bolts on the injector harness.



1. Injector terminal nut

2. Connector

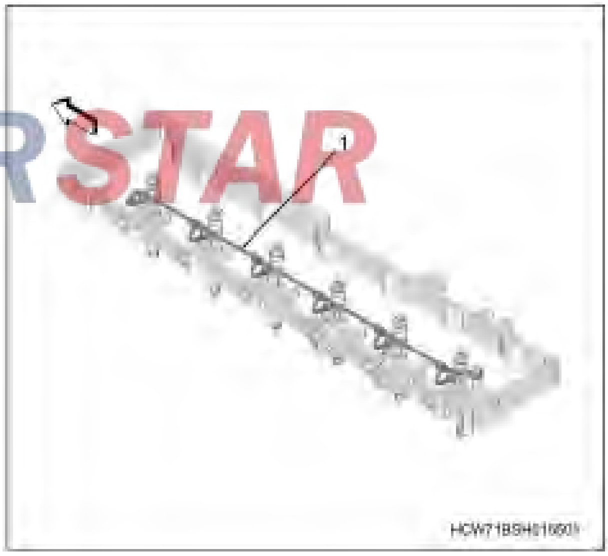
6. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

● Do not reuse the gasket.

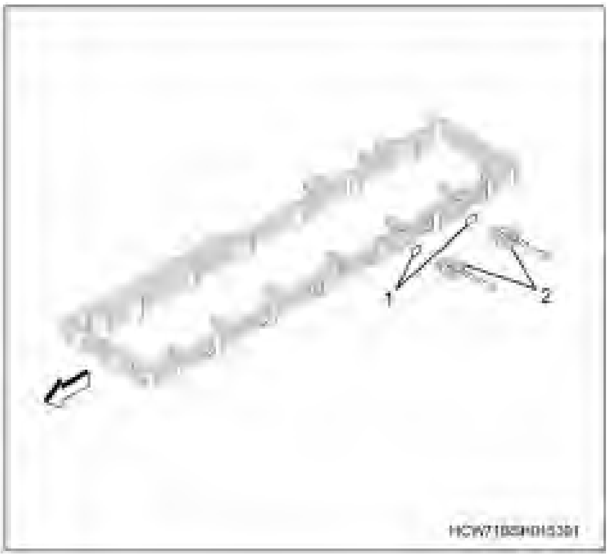


1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.

POWERSTAR



1. O-ring

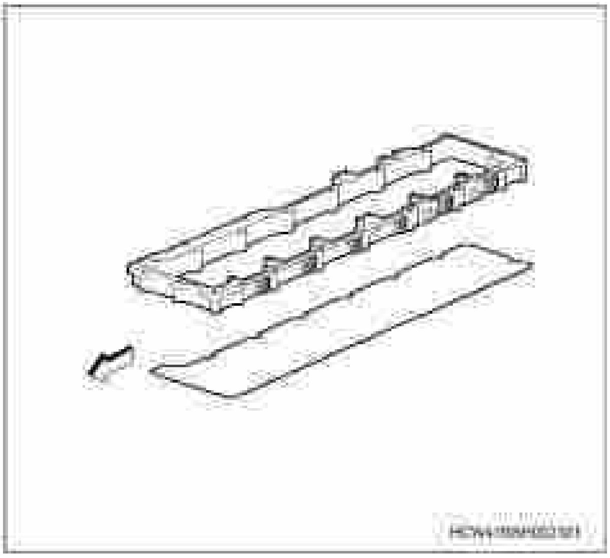
2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.

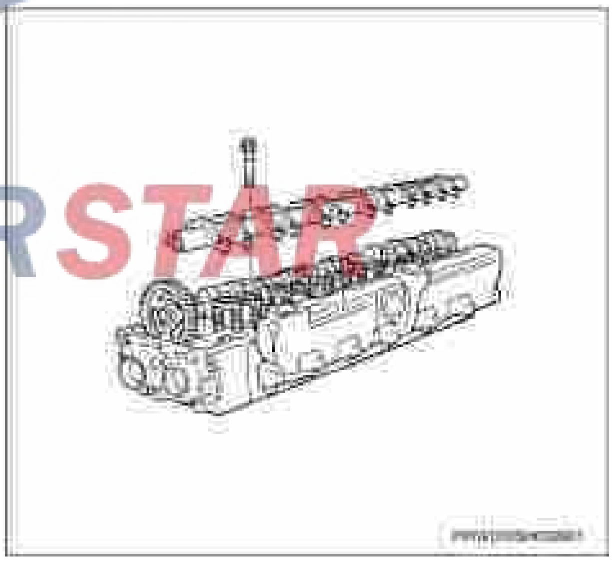


7. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



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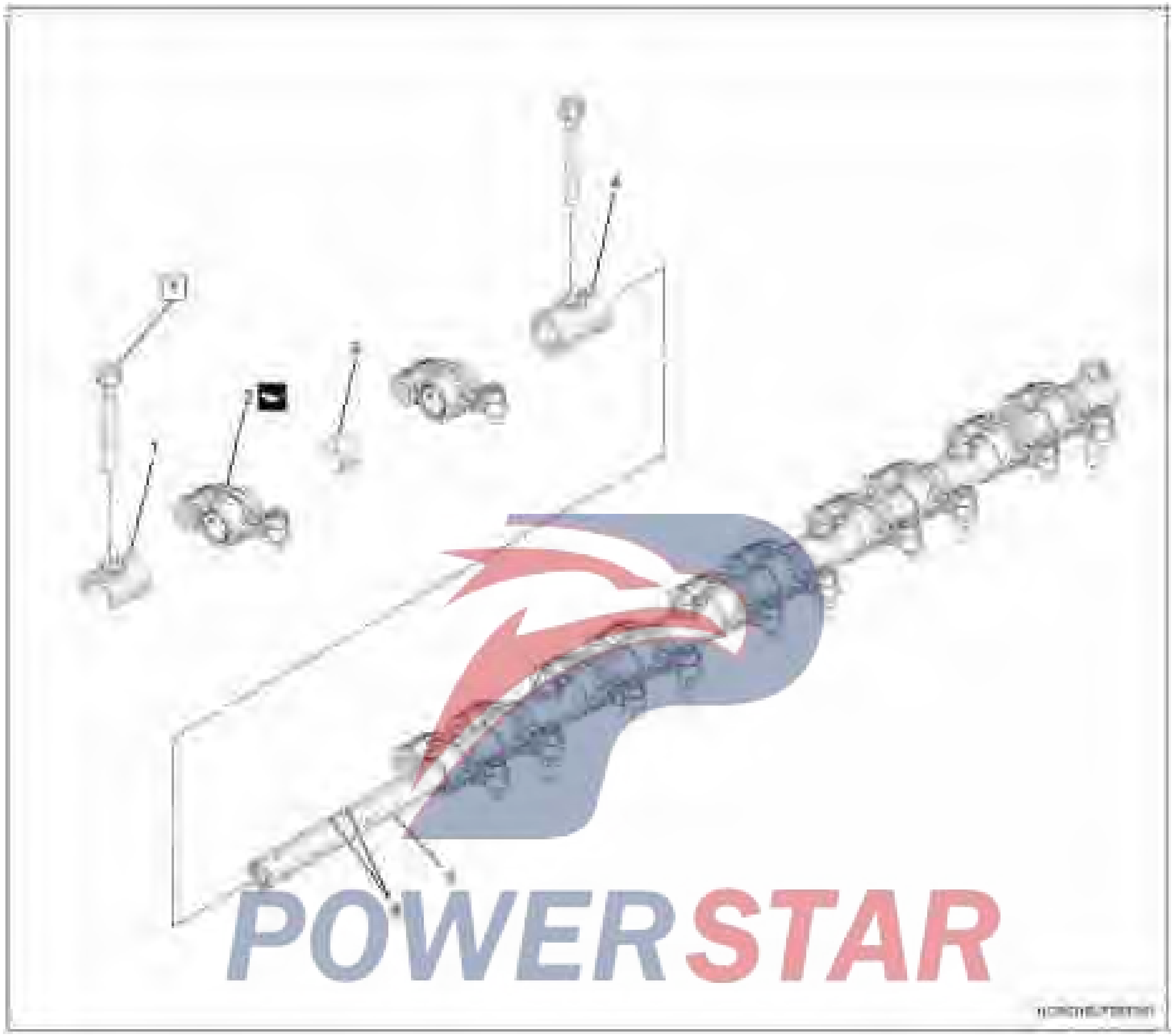
Removal

1. Component Views

Rocker arm shaft



Part name

1. Front bracket
2. Rocker arm
3. Spring
4. Center bracket
5. Rocker arm shaft
6. Front mark

Tightening torque

1: 90 N • m {9.2 kgf • m / 29.94 kg • ft}

2. Rocker arm shaft disassembly

1) Remove the bracket from the rocker shaft.

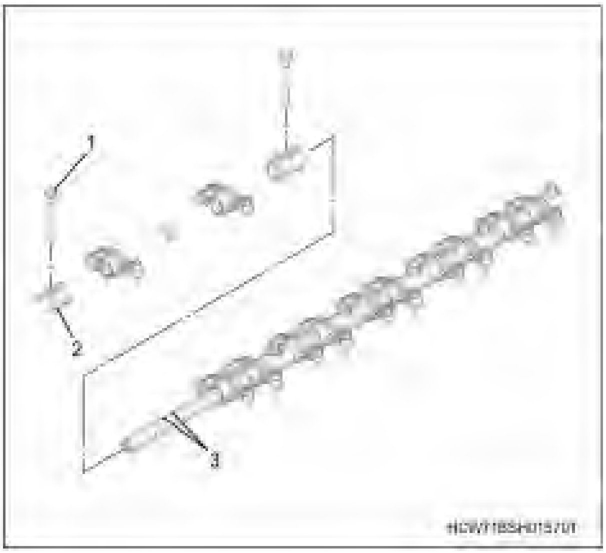
2) Remove the rocker arm from the rocker arm shaft.

3) Remove the spring from the rocker shaft.

4) Remove the rocker arm from the rocker arm shaft.

Caution:

● Loosen all the bolts a little at a time.



1. Bolt

2. Bracket

3. Front mark

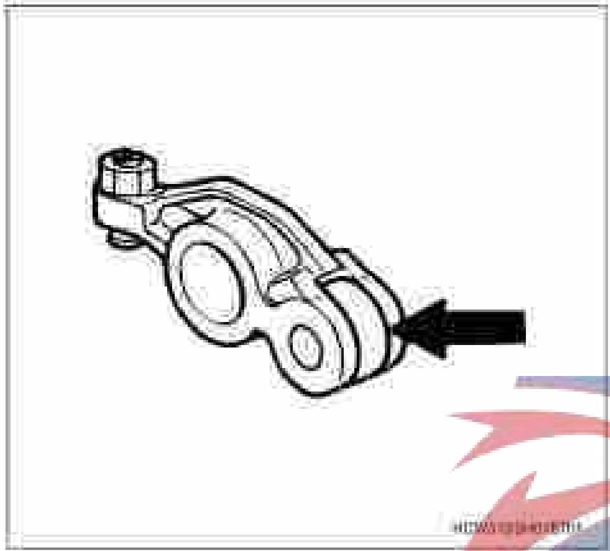
POWERSTAR

Inspection

1. Rocker arm inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the roller surface for wear and damage.



2) Push the roller from the top, and mark the measuring point.

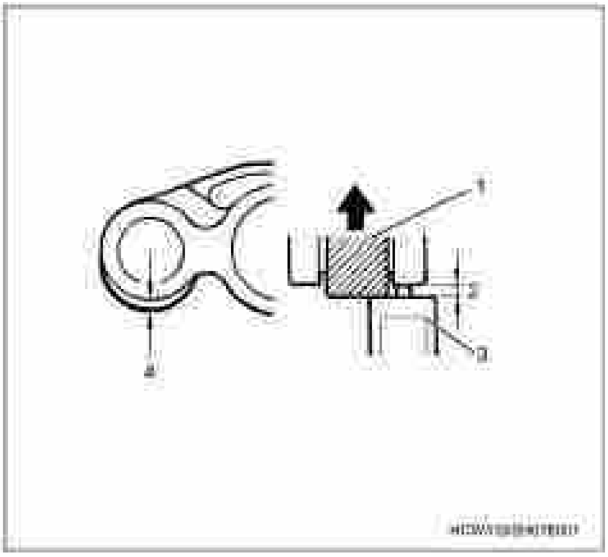
3) Measure the level difference between the rocker arm and the roller while pushing the roller from the top.

4) Measure the level difference at the marked positions of the measuring point while pushing the roller from the bottom.

5) Calculate the clearance between the roller pin and the roller from the level difference between the rocker arm and the roller and the level difference at the marked position of the measuring points.

Standard: 0.036 to 0.069mm { 0.00142 to 0.00272mm }

Limit: 0.15 mm { 0.0059 mm }



1. Roller
2. Size (b)
3. Vernier calipers
4. Size (a)

2. Rocker arm inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the oil hole for clogging.

2) Put the rocker arm shaft on the V-block.

3) Inspect the rocker arm shaft bends using a dial gauge.

Limit: 0.3 mm { 0.012 mm }

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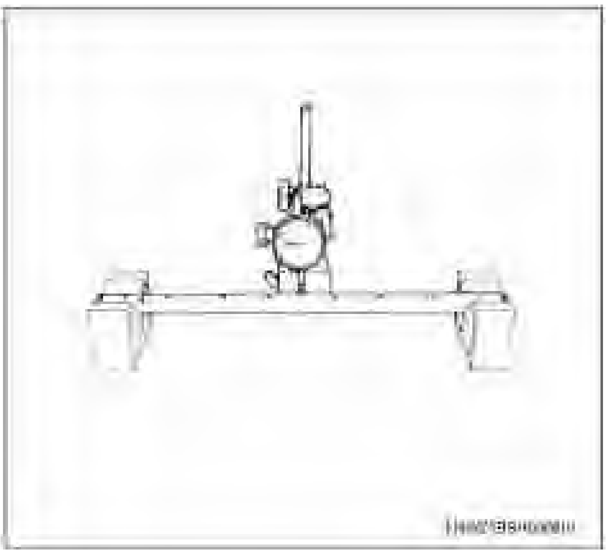


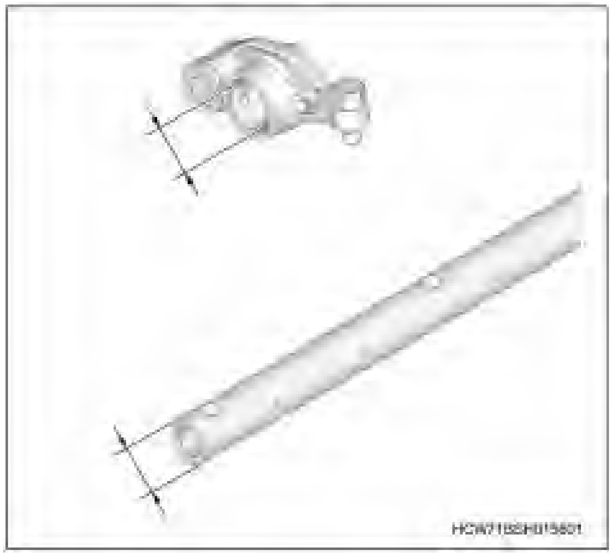
4) Measure the outer diameter of the rocker arm shaft and the inner diameter of the rocker arm.

5) Calculate the clearance from the outer diameter of the rocker arm shaft and the inner diameter of the rocker arm.

Clearance between rocker arm shaft and rocker arm

	Clearance	Shaft outer diameter
Dimensions	-	: 28 mm { 1.10 cm }
Specified value	: 0.041 to 0.141mm { 0.00161 to 0.00555in }	-

Limit	: 0.20 mm {0.0079 mm }	: 27.85 mm { 1.0965 cm }



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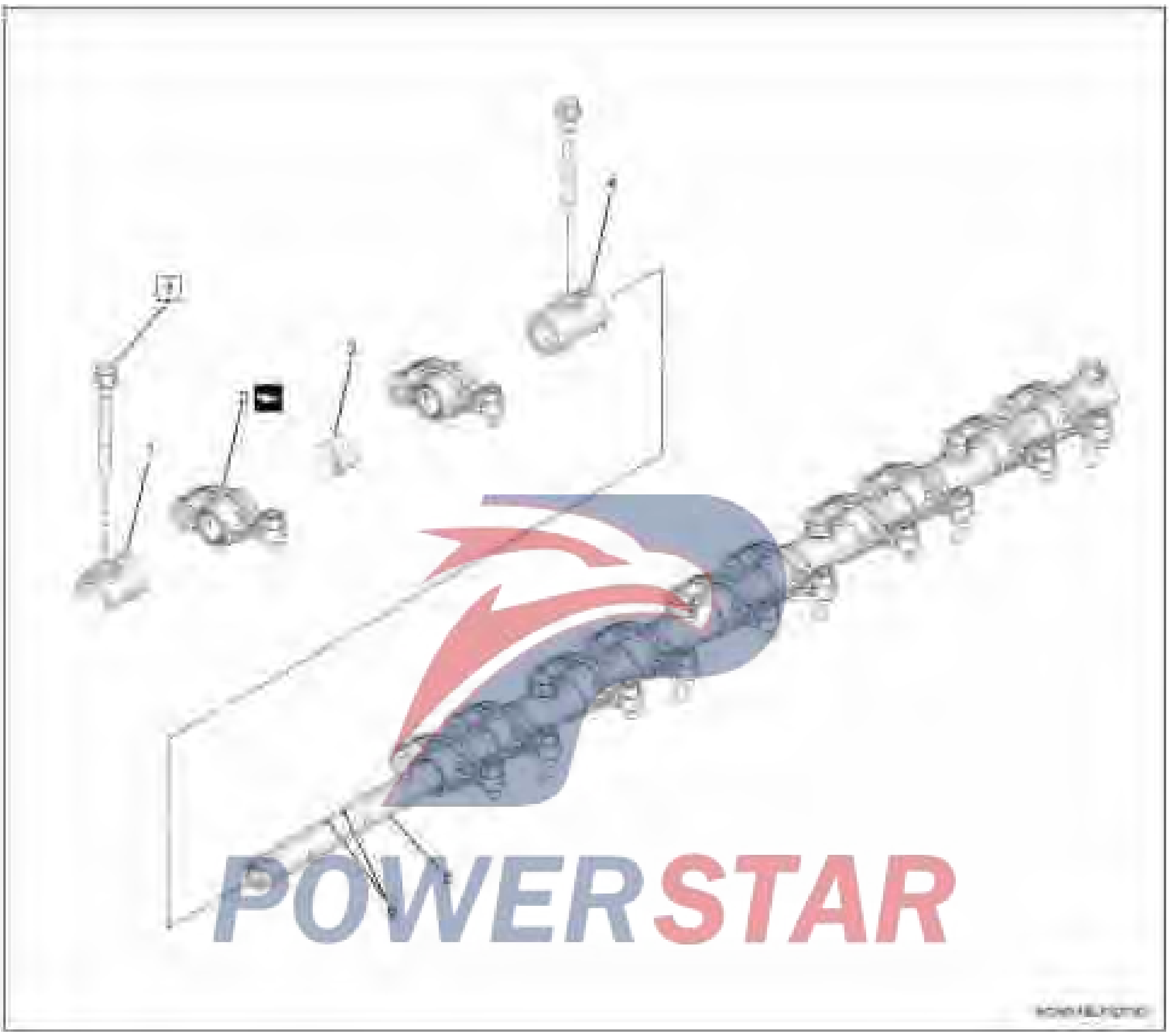
Reassembly

1. Component Views

Rocker arm shaft



Part name

1. Front bracket
2. Rocker arm
3. Spring
4. Center bracket
5. Rocker arm shaft
6. Front mark

Tightening torque

1: 90 N • m {9.2 kgf • m / 29.94 kg • ft}

2. Rocker arm shaft reassembly

Caution:

● After checking the front mark of the rocker arm shaft, start the procedure.

1) Apply engine oil to rocker arm.

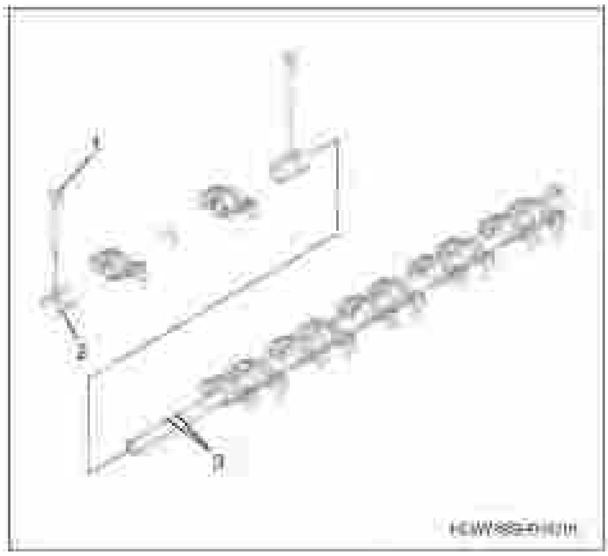
2) Install the rocker arm to the rocker arm shaft.

3) Mount the spring onto the rocker shaft.

4) Install the rocker arm to the rocker arm shaft.

Caution:

● Verify that the inlet rocker arm is assembled to the front side.



1. Bolt
2. Bracket
3. Front mark

POWERSTAR

Installation

1. Rocker arm shaft installation

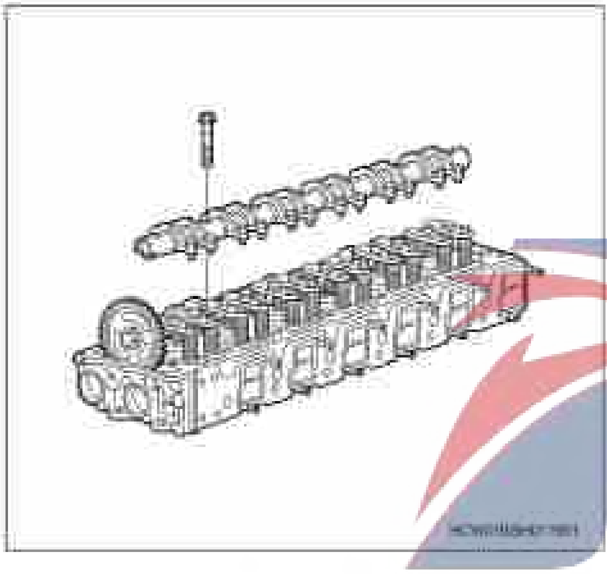
1) Lubricate the roller arm and adjusting screw lip with engine oil

2) Loosen the adjust screw.

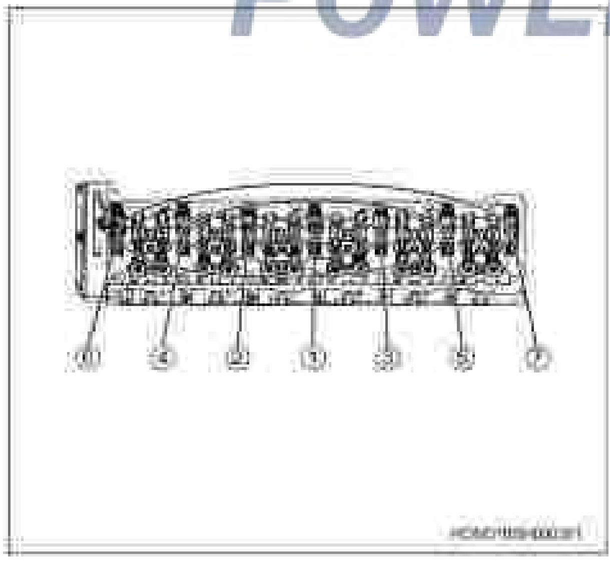
Caution:

● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



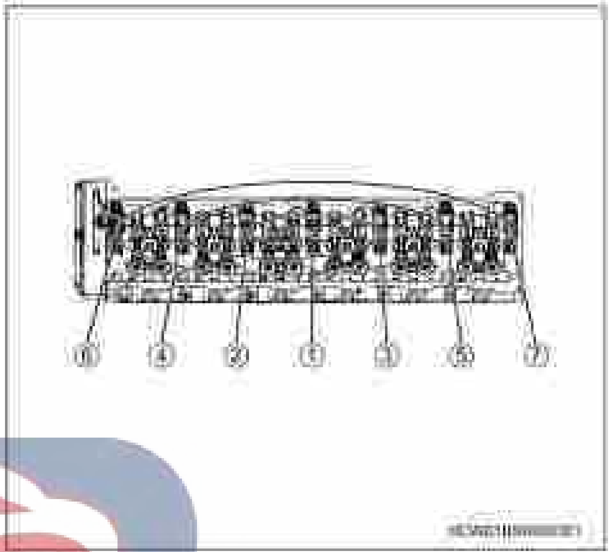
Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

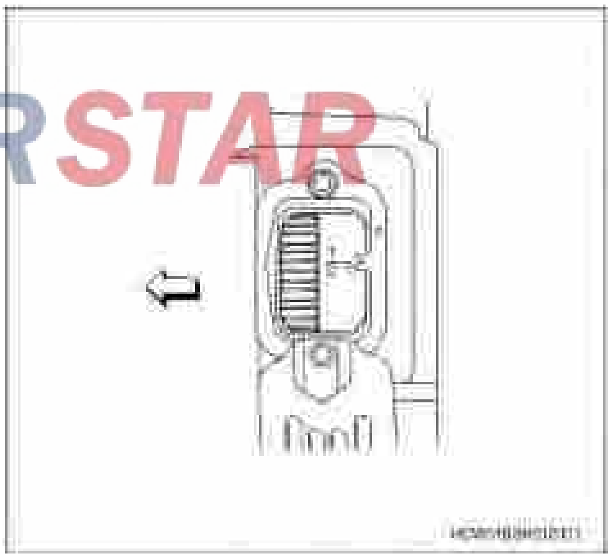
5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 29.94 kg • ft}



2. Rocker arm adjustment

1) Align cylinders 1 and 6 to the top dead center of the compressor.



2) Confirm that all adjusting screws are fully loosen.

3) Insert the feeler gauge between the rocker arm and the camshaft.

4) Tighten the rocker end adjustment screw and adjust the valve clearance to the specified value.

Standard: 0.4 mm {0.406 mm}

5) Use the lock nut to tighten the arm side

adjustment screw.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

6) Insert the gap gauge, gently screw into the side axle adjustment screw.

7) Confirm that the end of the axle and the end of the adjusting screw are in contact with each other, and the gap gauge adopts the rigid movement mode.

8) Gently loosen the axle side adjustment screw to move the feeler gauge.

9) Tighten the axle side adjustment screw with the locknut.

Tightening torque: 54 N• m { 5.5 kgf• m / 18.14 kg• ft }

Measurable valve position

Cylinder No.	#1		#2		#3		#4		#5		#6	
	Intake	EX	Intake	EX	Intake	EX	Intake	EX	Intake	EX	Intake	EX
When the No. 1 cylinder is at the compression top dead center	○	○	○			○	○			○		
When the No. 6 cylinder is at the compression top dead center				○	○			○	○		○	○

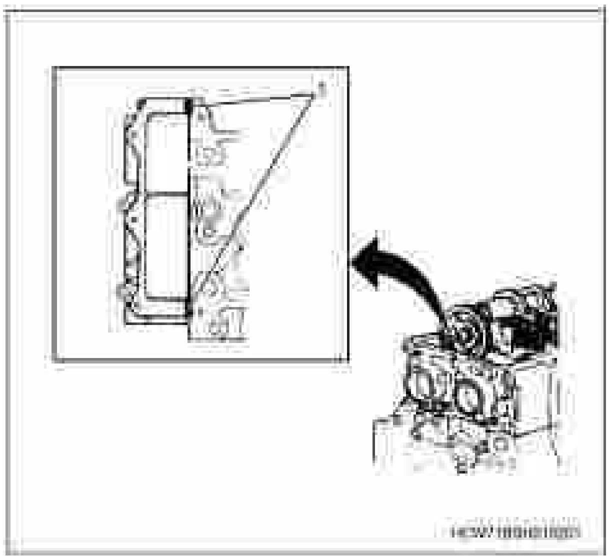
10) Rotate the crankshaft one revolution and adjust the remaining valve clearance.

3. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

3) Install the lower end cap onto the cylinder head.

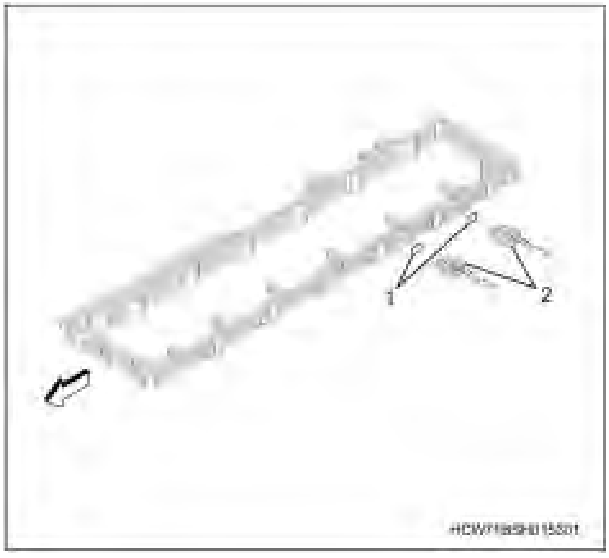
Tightening torque: 15 N • m {1.5 kgf • m / 4.99 kg • ft}

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 6.80 kg • ft}

POWERSTAR



1. O-ring

2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N• m { 4.2 kgf• m / 13.61 kg• ft }

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

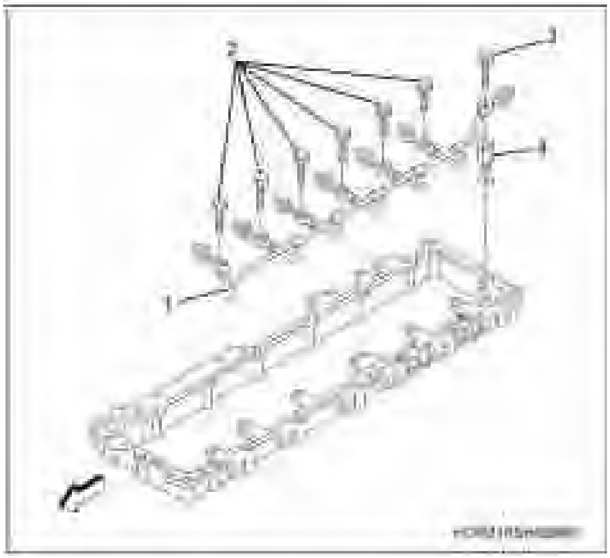
● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 4.99 kg • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 11.34 kg • ft}



1. Nozzle spout

2. Eyebolt

3. Eyebolt

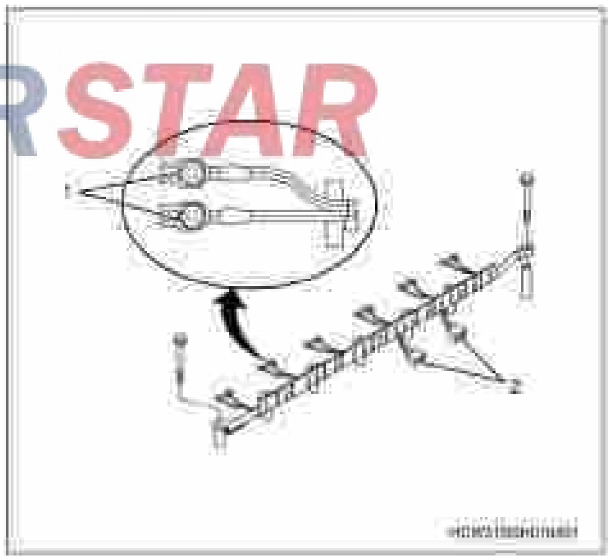
4. Adapter

4. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut

2. connector

2) Install the injector harness onto the cylinder head.

Tightening torque: 22 N • m {2.24 kgf • m / 7.26 kg • ft}

3) Connect the injector terminal nut to the injector.

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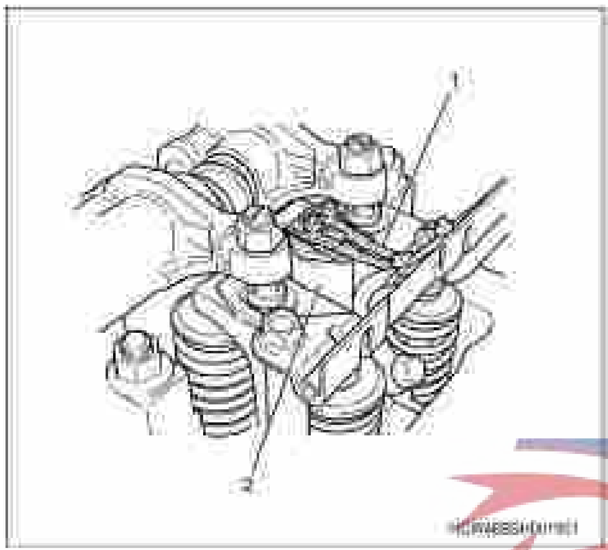
Tightening torque: 2 N • m {0.2 kgf • m / 8.16 kg • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



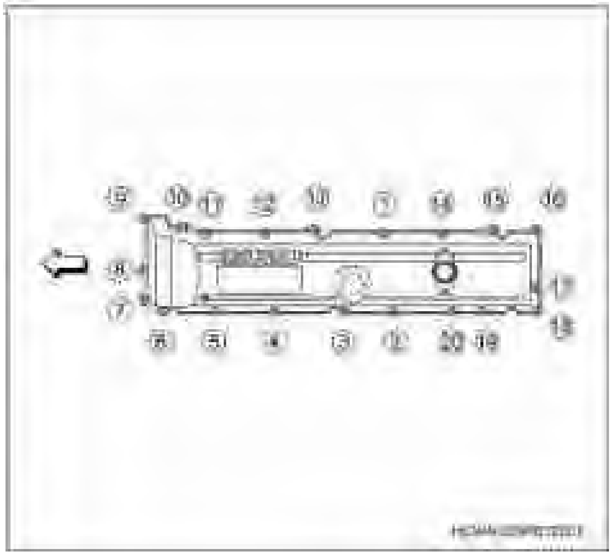
1. Injector harness
2. Injector

5. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

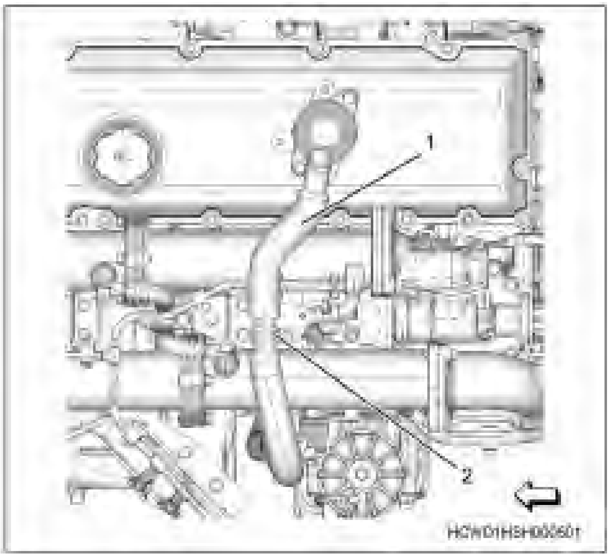
2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N• m { 1.5 kgf• m / 4.99 kg• ft }



6. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



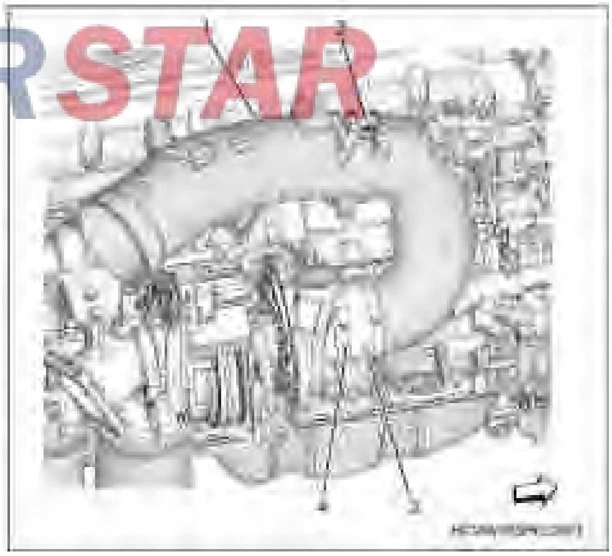
1. Ventilation hose
2. Ventilation hose clip

7. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29Ib • ft} M10



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

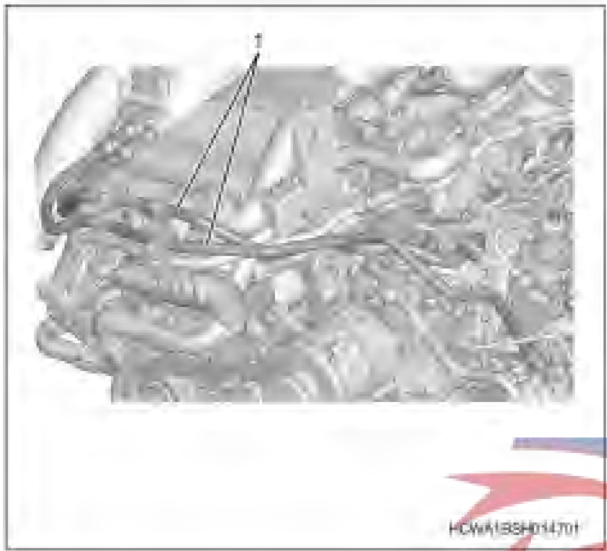
3) Connect the air cleaner duct to the air cleaner and turbocharger.

POWERSTAR

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

8. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

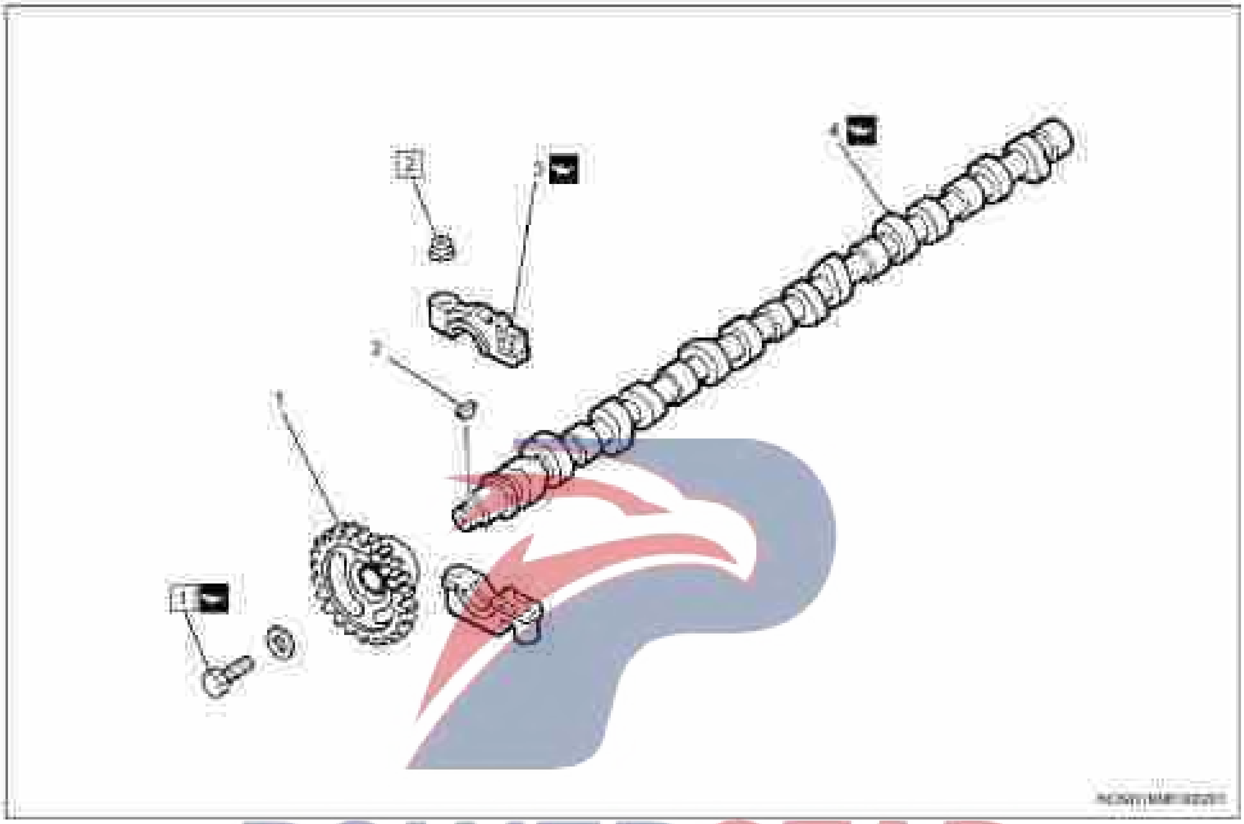
POWERSTAR

Camshaft

Removal

1. Component Views

Camshaft



Part name

1. Camshaft gear
2. Key
3. Camshaft bracket
4. Camshaft

Tightening torque

1: 137 N • m {14.0 kgf • m / 45.81 kg • ft}

2: 76 N • m {7.7 kgf • m / 25.40 kg • ft}

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.

1. Air compressor suction pipe

2) Remove the heat shield from the air line.

3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

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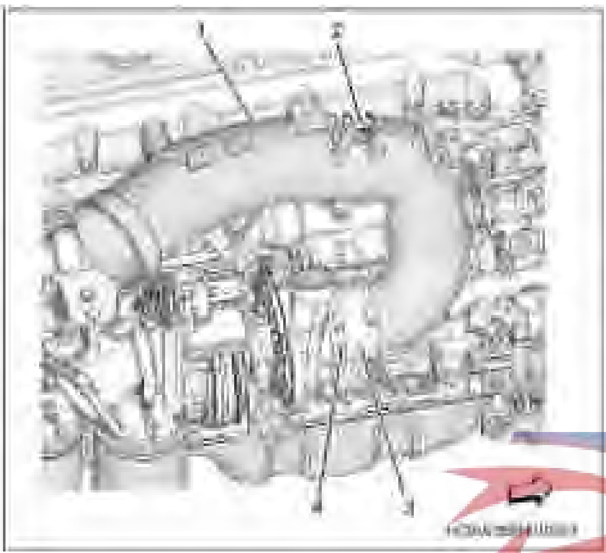
Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

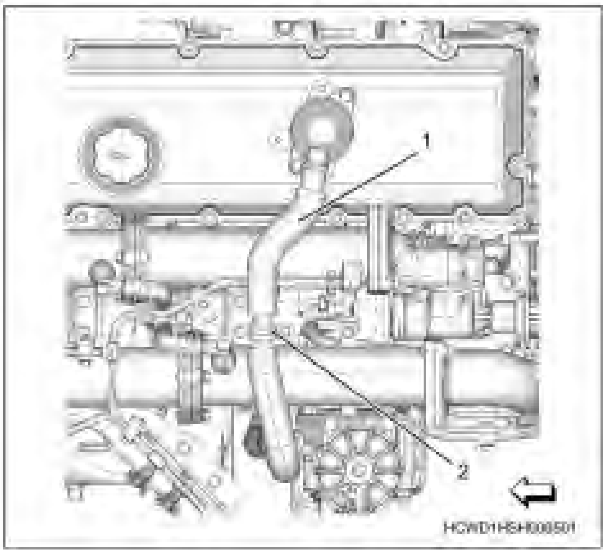
5) Remove the air line from the turbocharger.



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

4. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

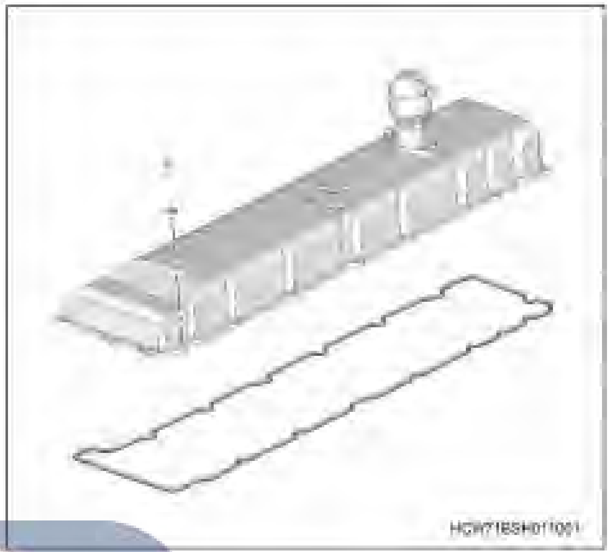


1. Ventilation hose
2. Ventilation hose clip

5. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



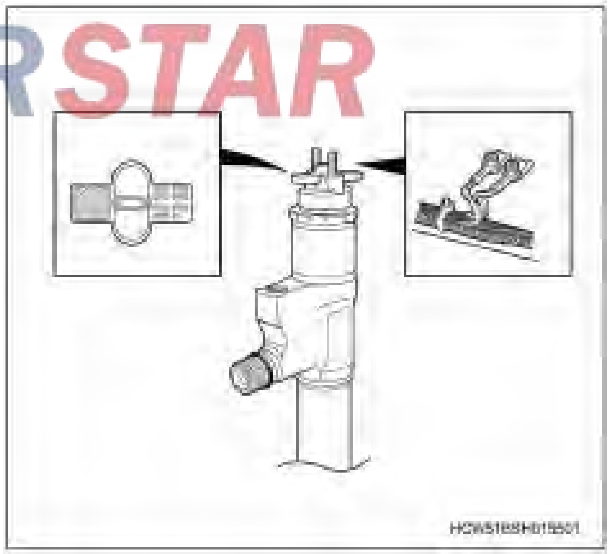
6. Injector harness removal

1) Remove the injector nut

2) Remove the injector harness

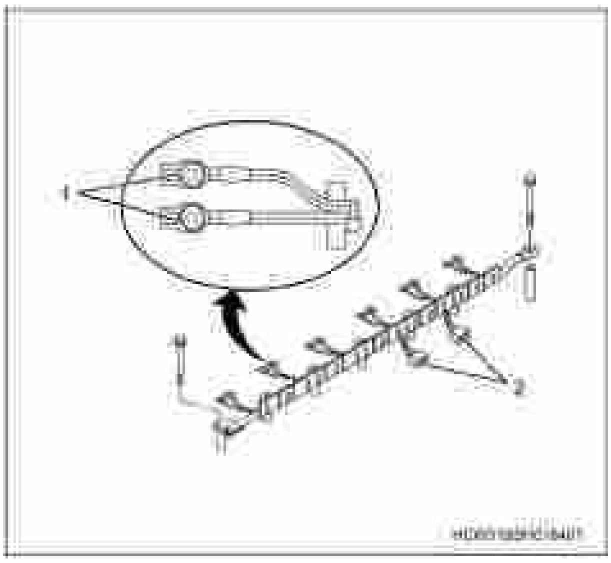
Caution:

● Because the injector ID code plate comes off, do not mix with other injector ID code plates.

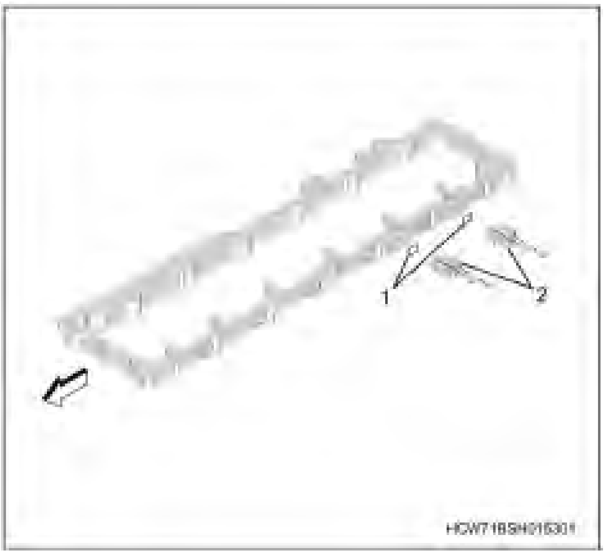


3) Remove the bolts on the injector harness.

POWERSTAR



1. Injector terminal nut
2. Connector



1. O-ring
2. Connector

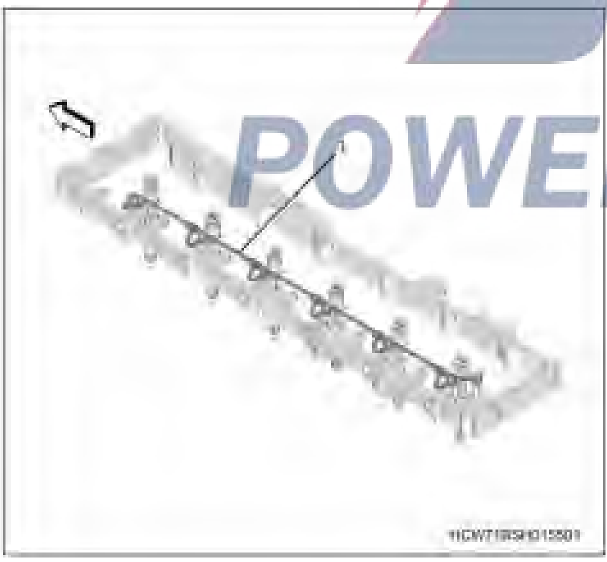
7. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

● Do not reuse the gasket.



1. Fuel leak-off pipe

3) Remove the lower cover adapter.

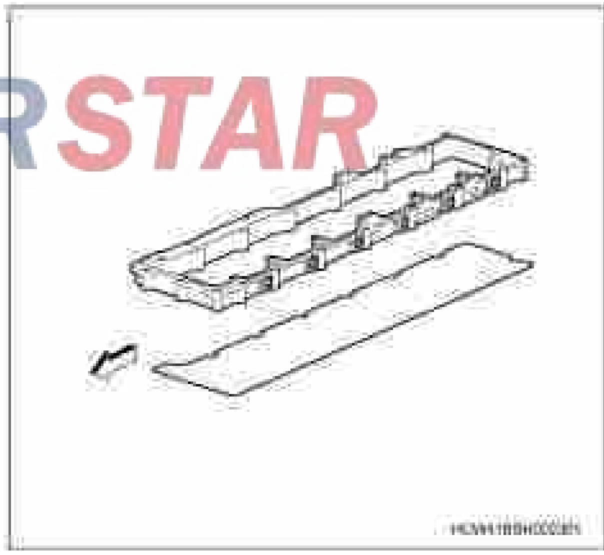
4) Remove the connector from the bottom cover.

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.



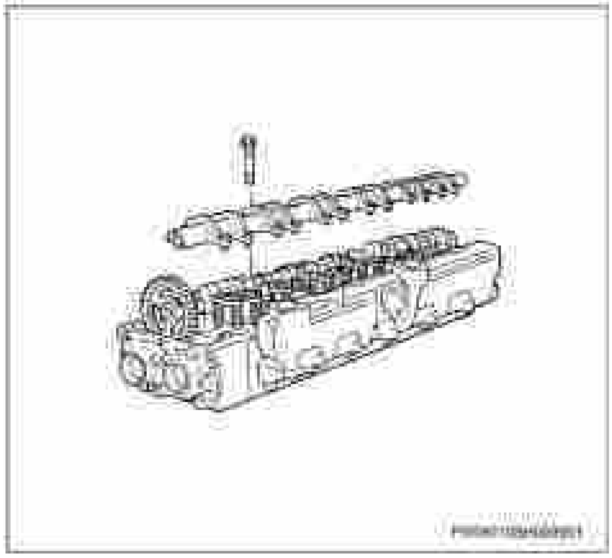
8. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.

POWERSTAR



9. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

1. Bridge

10. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170mm { 0.00335 to 0.00669mm }

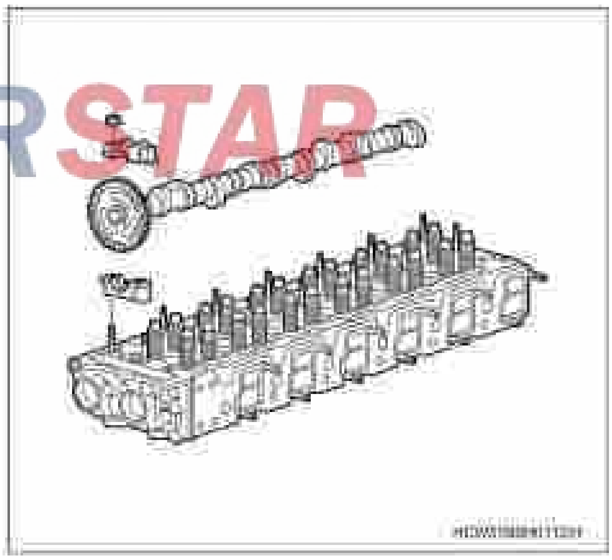
Limit: 0.25 mm { 0.0098 mm }

2) Remove nuts from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.



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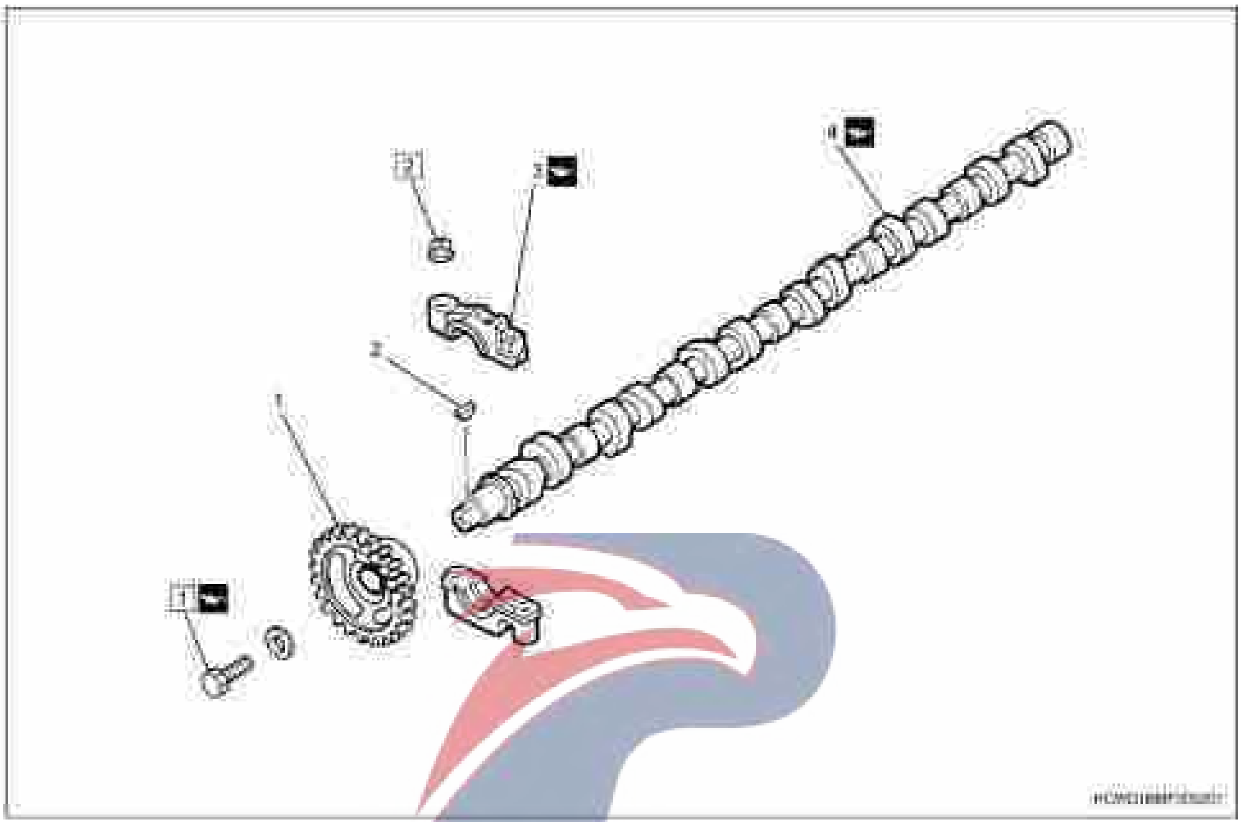
Removal

1. Component Views

Camshaft



Part name

1. Camshaft gear
2. Key
3. Camshaft bracket
4. Camshaft

Tightening torque

1: 137 N • m {14.0 kgf • m / 101 Ib • ft}

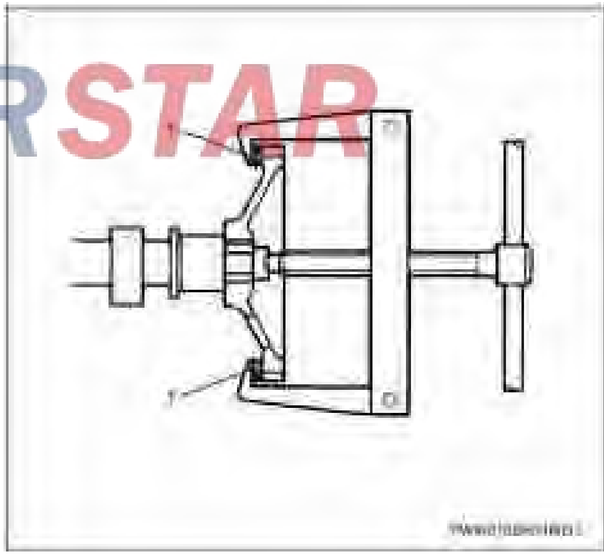
2: 76 N • m {7.7 kgf • m / 56 Ib • ft}

2. Camshaft removal

1) Remove the bolts on the camshaft gear.

2) Use a puller to remove the camshaft gear from the camshaft.

3) Attach the wooden block to the camshaft gear to prevent it from being damaged.



1. Wood

4) Remove the key from the camshaft.

Caution:

● Be careful not to lose the keys.

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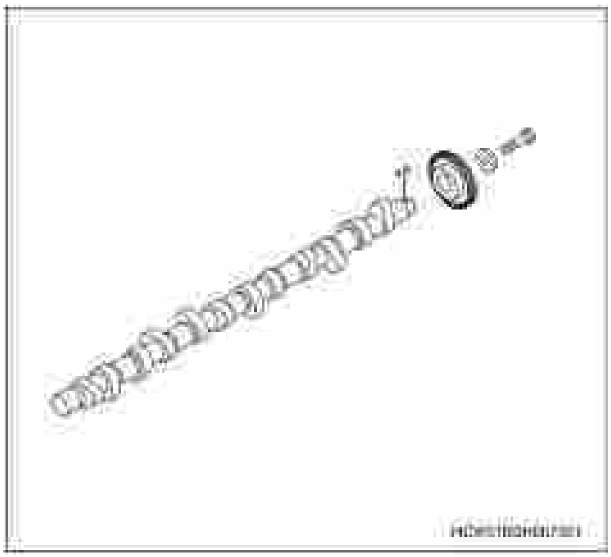

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Inspection

1. Camshaft gear inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the tooth surface for pitching and damage.

2. Camshaft inspection

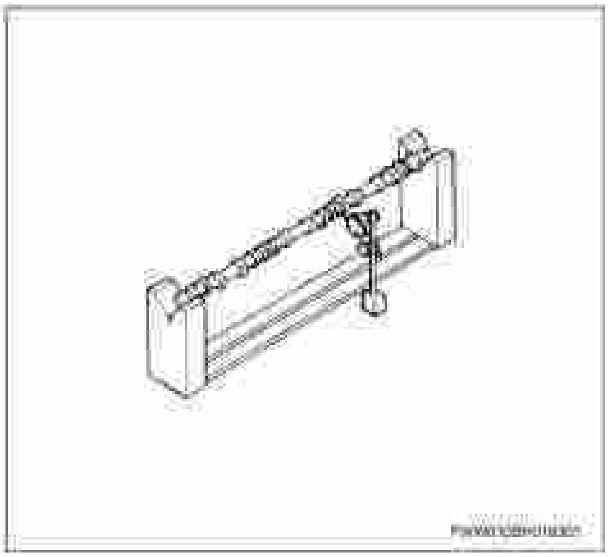
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Place the No. 1 and the No. 7 journals on the V-block.

2) With the dial gauge in contact with the No. 4 journal section, rotate the camshaft for one turn and measure the runout.

Standard: 0.08 mm { 0.0031 in}

Limit: 0.1 mm { 0.004 in}

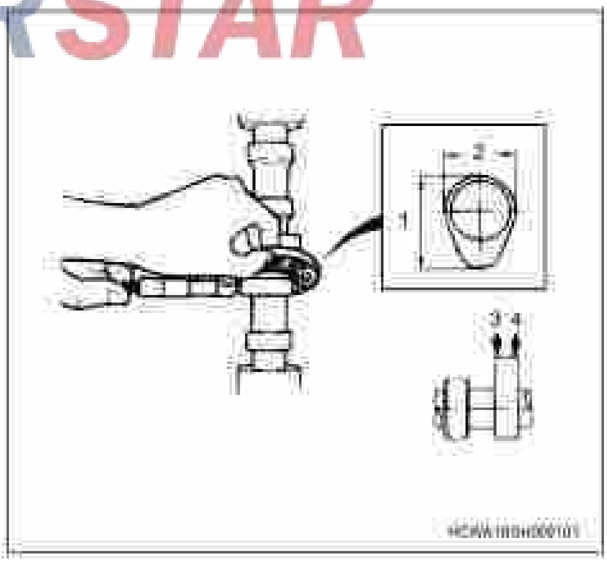


3) Refer to the diagram, measure the camshaft, and calculate the lift amount.

Caution:

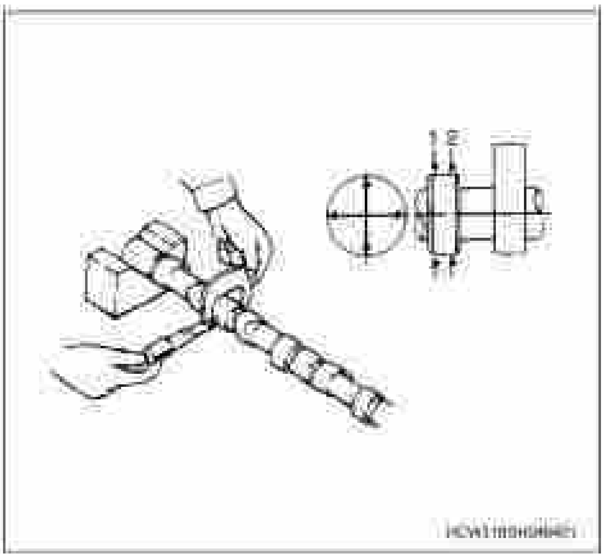
● Before measuring, repair minor cam surface damage and wear using an oil stone.

	Specified value	Limit
IN	: 9.4 mm {0.370 mm }	: 8.85 mm { 0.3484 mm }
Exhaust	: 10.4 mm { 0.409 mm }	: 9.75 mm {0.3839 mm }



1. Measurement position
2. Measurement position
3. Measurement position
4. Measurement position

4) Measure the outside diameter of the camshaft journal section.



1. Measurement position

2. Measurement position

Standard: 40 mm { 1.57 in}

Limit: 39.89 mm { 1.5705 in}

5) Install the camshaft bracket on the cylinder head.

Tightening torque: 76 N • m {7.7 kgf • m / 56 Ib • ft}

6) Install the rocker shaft on the camshaft holder.

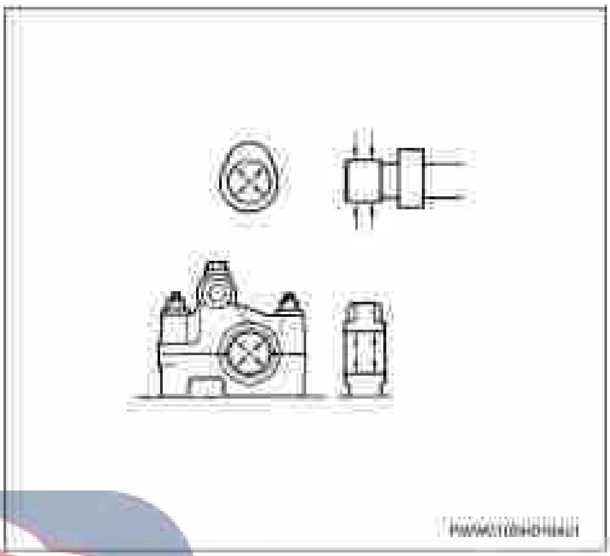
Tightening torque: 90 N • m {9.2 kgf • m / 66 Ib • ft}

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Note that the camshaft bracket side marks the non-journal number.

7) Measure the inner diameter of the camshaft journal section using a cylinder gauge.



8) According to the measured value to calculate the gap.

Note:

● It is also possible to measure the gap using a plastic gap strip.

Standard: 0.075 to 0.125mm { 0.00295 to 0.00492 in}

Limit: 0.15 mm { 0.0059 in}

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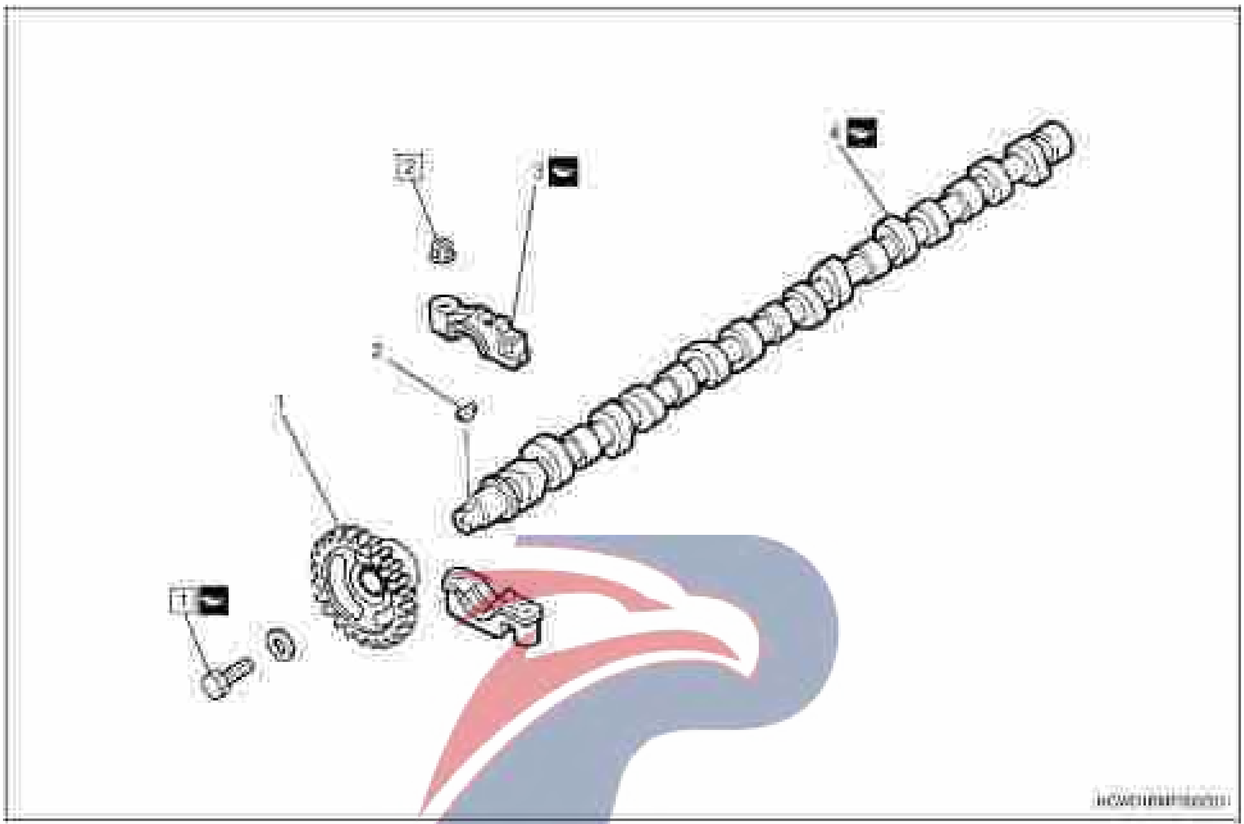
Reassembly

1. Component Views

Camshaft



Part name

1. Camshaft gear
2. Key
3. Camshaft bracket
4. Camshaft

Tightening torque

1: 137 N• m { 14.0 kgf• m / 101 Ib• ft }

2: 76 N• m { 7.7 kgf• m / 56 Ib • ft }

2. Camshaft reassembly

1) Install the key to the camshaft.

2) Install the camshaft gear to the camshaft.

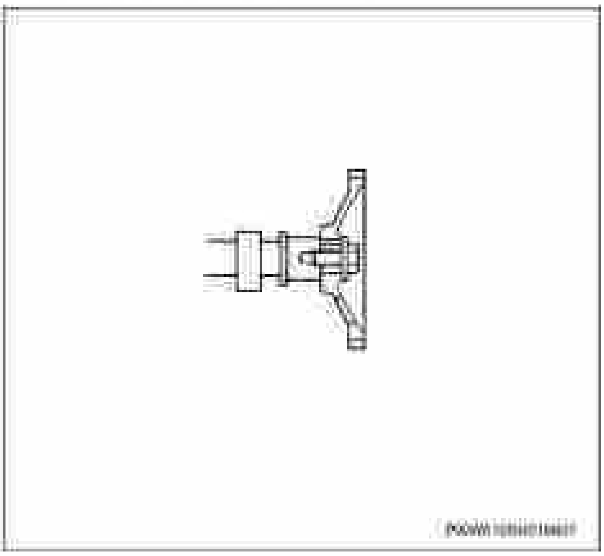
Note:

● Using a press, install with the larger gear center boss section facing toward the camshaft side.

3) Apply engine oil to the threaded portion and the seat surface of the bolt.

4) Install the bolt to the camshaft gear.

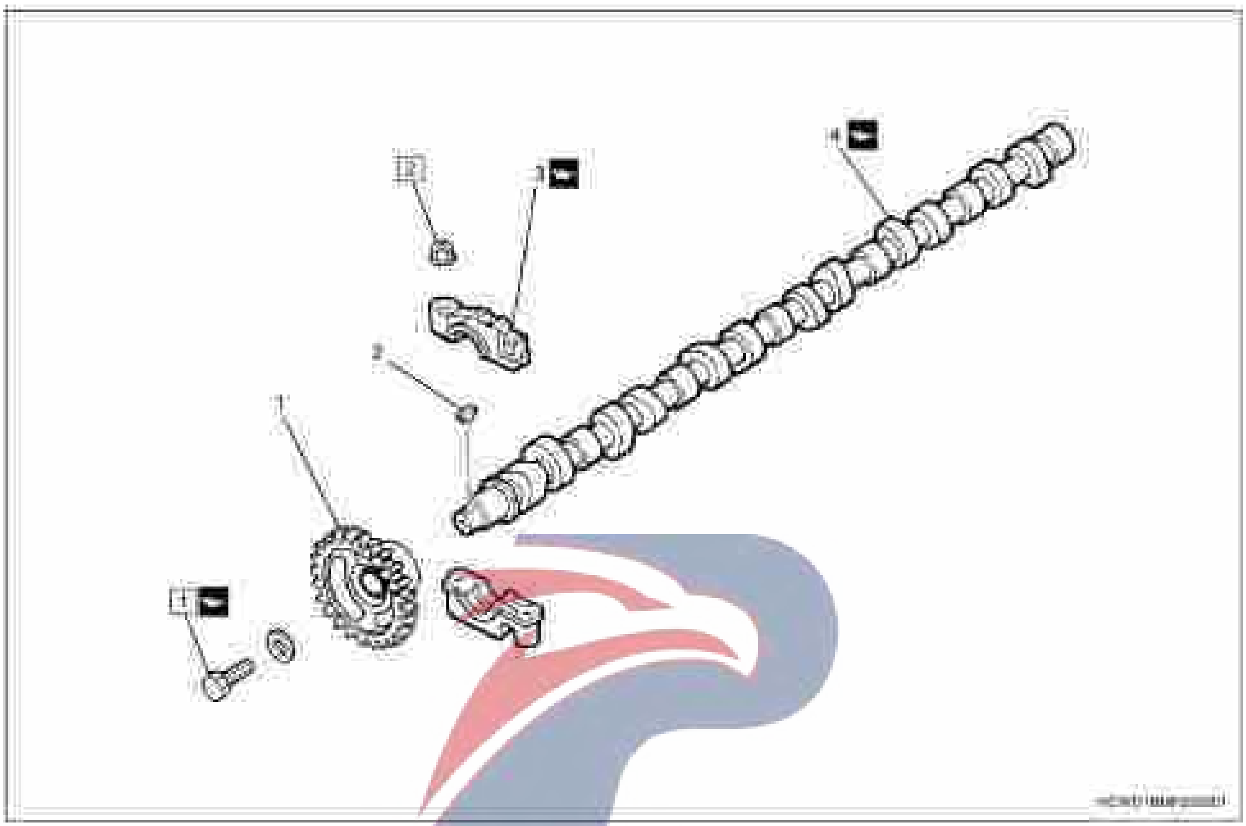
Tightening torque: 137 N• m { 14.0 kgf• m / 101 Ib • ft }



Installation

1. Component Views

Camshaft



Part name

1. Camshaft gear
2. Key
3. Camshaft bracket
4. Camshaft

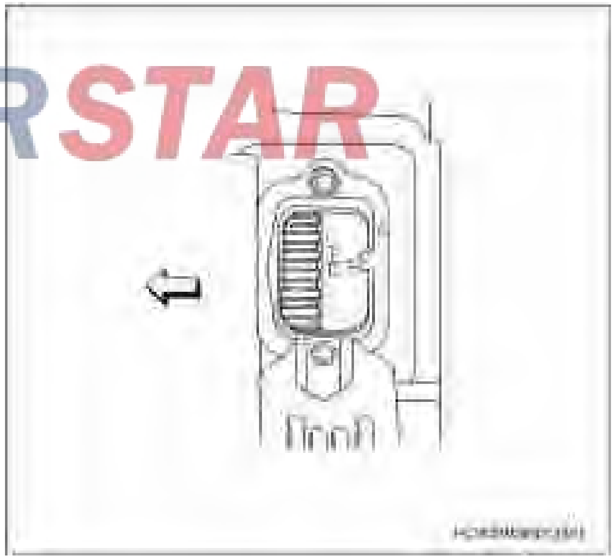
Tightening torque

1: 137 N • m {14.0 kgf • m / 101 Ib • ft}

2: 76 N • m {7.7 kgf • m / 56 Ib • ft}

2. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.



2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.

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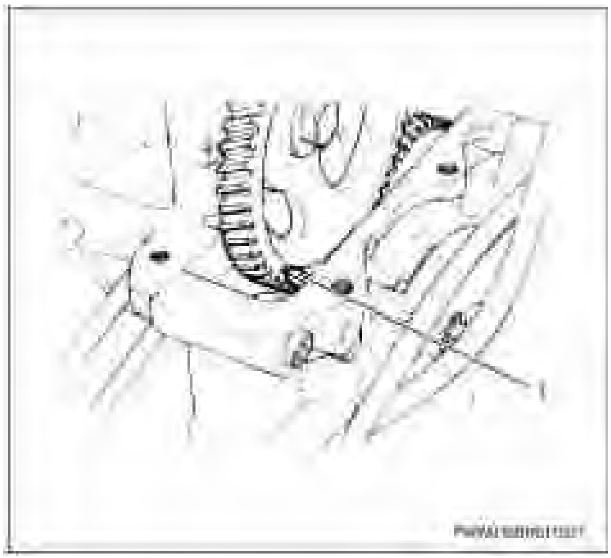


1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

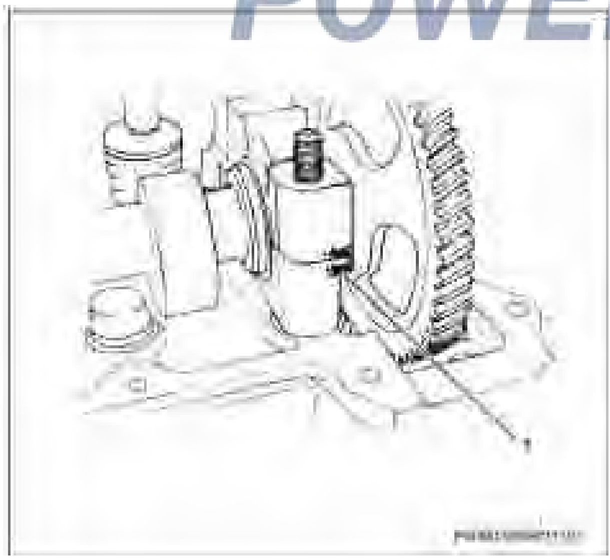
Note:

Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.



1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m {7.7 kgf • m / 56 Ib • ft}

3. Bridge installation

1) Apply the engine oil to the bridge guide.

2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.

1. Bridge

4. Rocker arm shaft installation

1) Lubricate the roller arm and adjusting screw lip with engine oil

2) Loosen the adjust screw.

Note:

● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.

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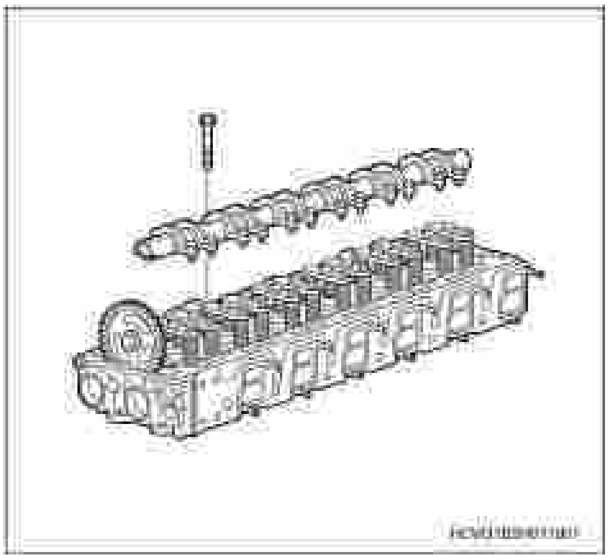
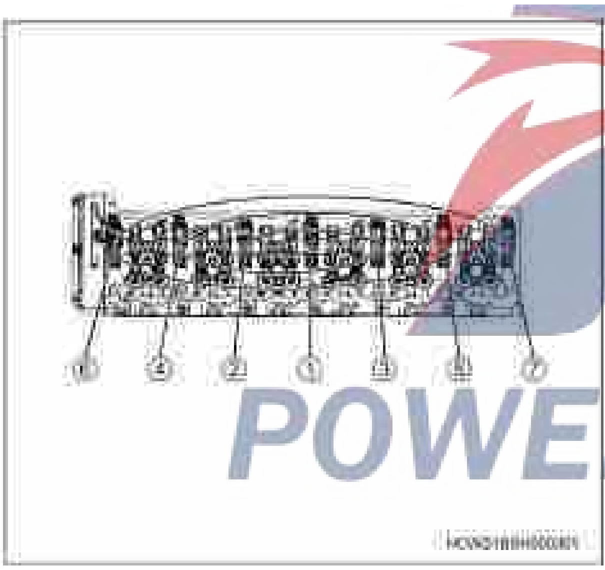


4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



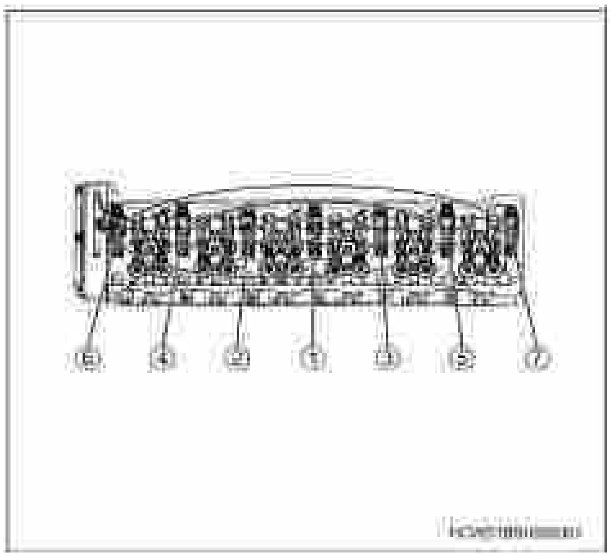
Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

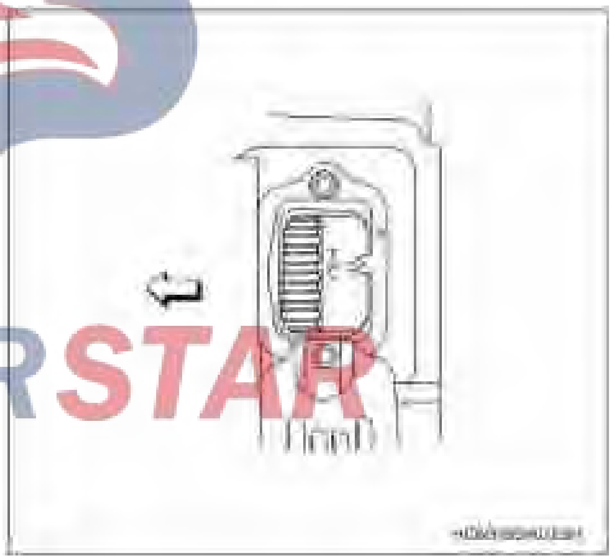
5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 Ib • ft}



5. Rocker arm adjustment

1) Align cylinders 1 and 6 to the top dead center of the compressor.



2) Confirm that all adjusting screws are fully loosen.

3) Insert the feeler gauge between the rocker arm and the camshaft.

4) Tighten the rocker end adjustment screw and adjust the valve clearance to the specified value.

Standard: 0.4 mm {0.016 mm}

5) Use the lock nut to tighten the arm side adjustment screw.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

6) Insert the gap gauge, gently screw into the side axle adjustment screw.

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7) Confirm that the end of the axle and the end of the adjusting screw are in contact with each other, and the gap gauge adopts the rigid movement mode.

8) Gently loosen the axle side adjustment screw to move the feeler gauge.

Measurable valve position

Cylinder No.	#1		#2		#3		#4		#5		#6	
	Intake	EX	Intake	EX	Intake	EX	Intake	EX	Intake	EX	Intake	EX
When the No. 1 cylinder is at the compression top dead center	○	○	○			○	○			○		
When the No. 6 cylinder is at the compression top dead center				○	○			○	○		○	○

9) Tighten the axle side adjustment screw with the locknut.

Tightening torque: 54 N • m {5.5 kgf • m / 18.14 kg • ft}

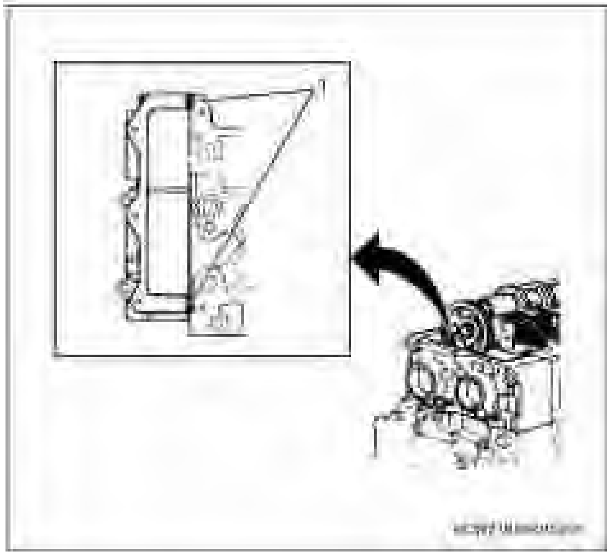
10) Rotate the crankshaft one revolution and adjust the remaining valve clearance.

6. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

3) Install the lower end cap onto the cylinder head.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}

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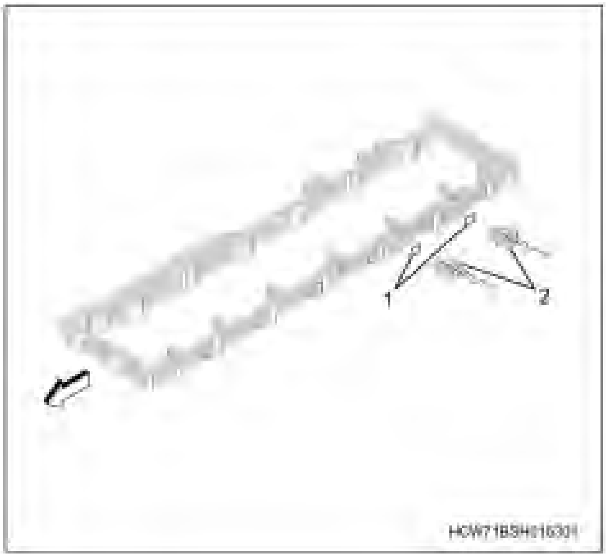


1. O-ring

2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

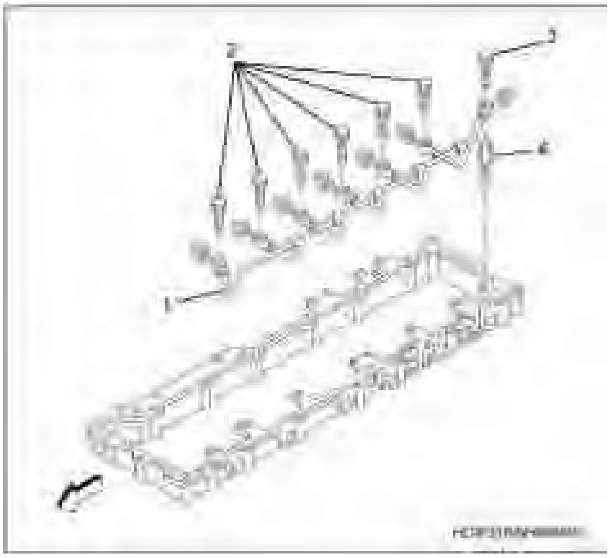
● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m /11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N• m { 3.5 kgf• m / 25 lb• ft }



1. Nozzle spout

2. Eyebolt

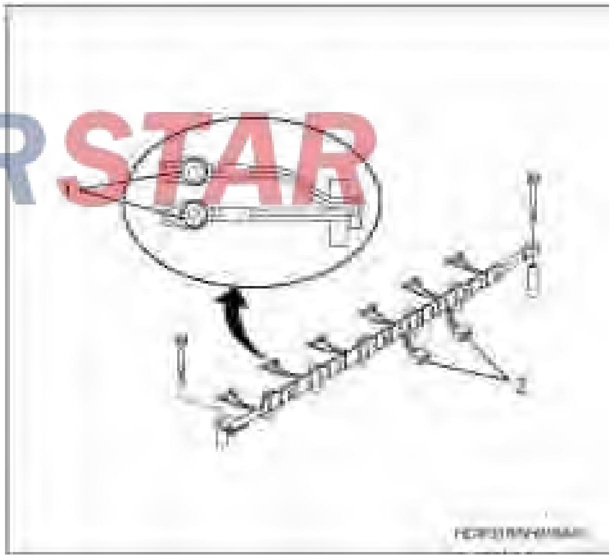
3. Eyebolt

4. Adapter

7. Injector harness installation

1) Install the connector on the lower cover.

● Securely lock the harness side connector.



1. Injector terminal nut

2. Connector

2) Install the injector harness onto the cylinder head.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

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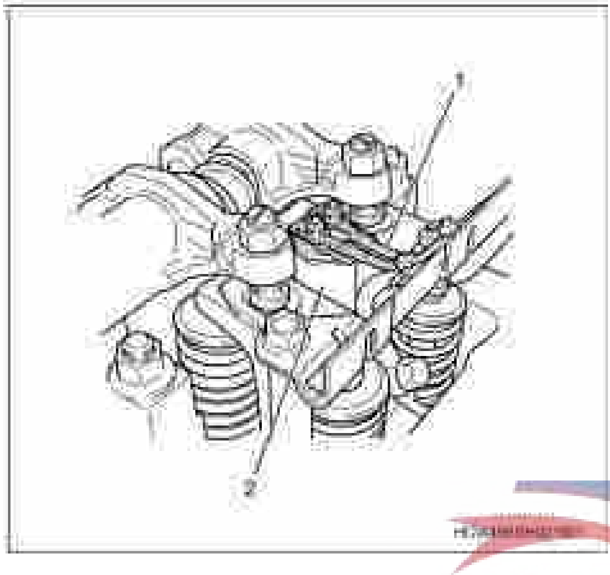
Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



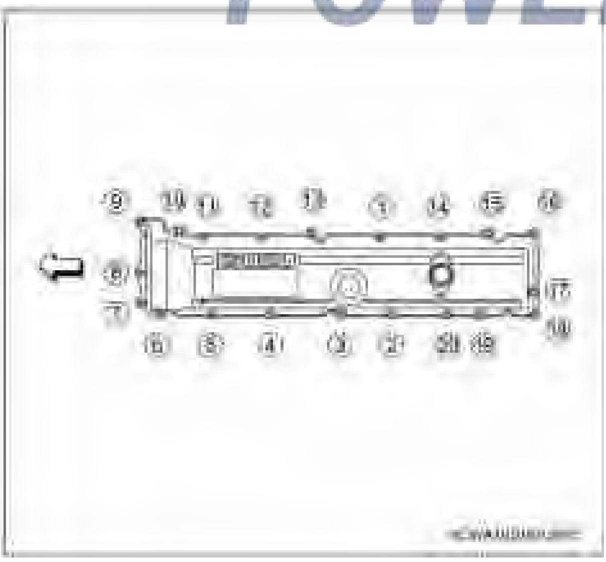
1. Injector harness
2. Injector

8. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

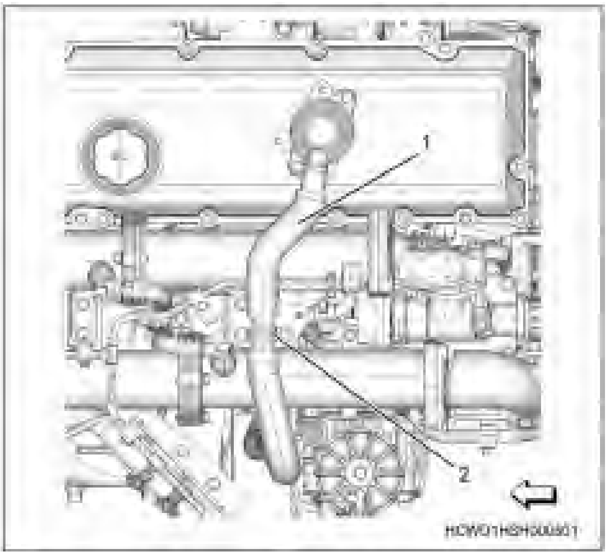
2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N• m { 1.5 kgf• m / 11 lb• ft }



9. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

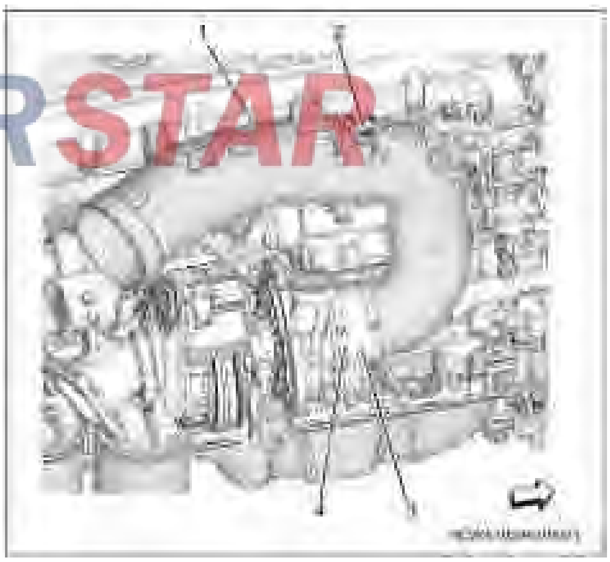
10. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

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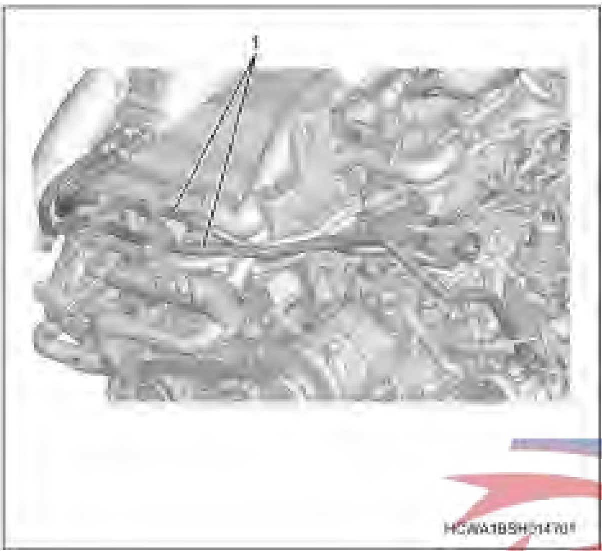
4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

11. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

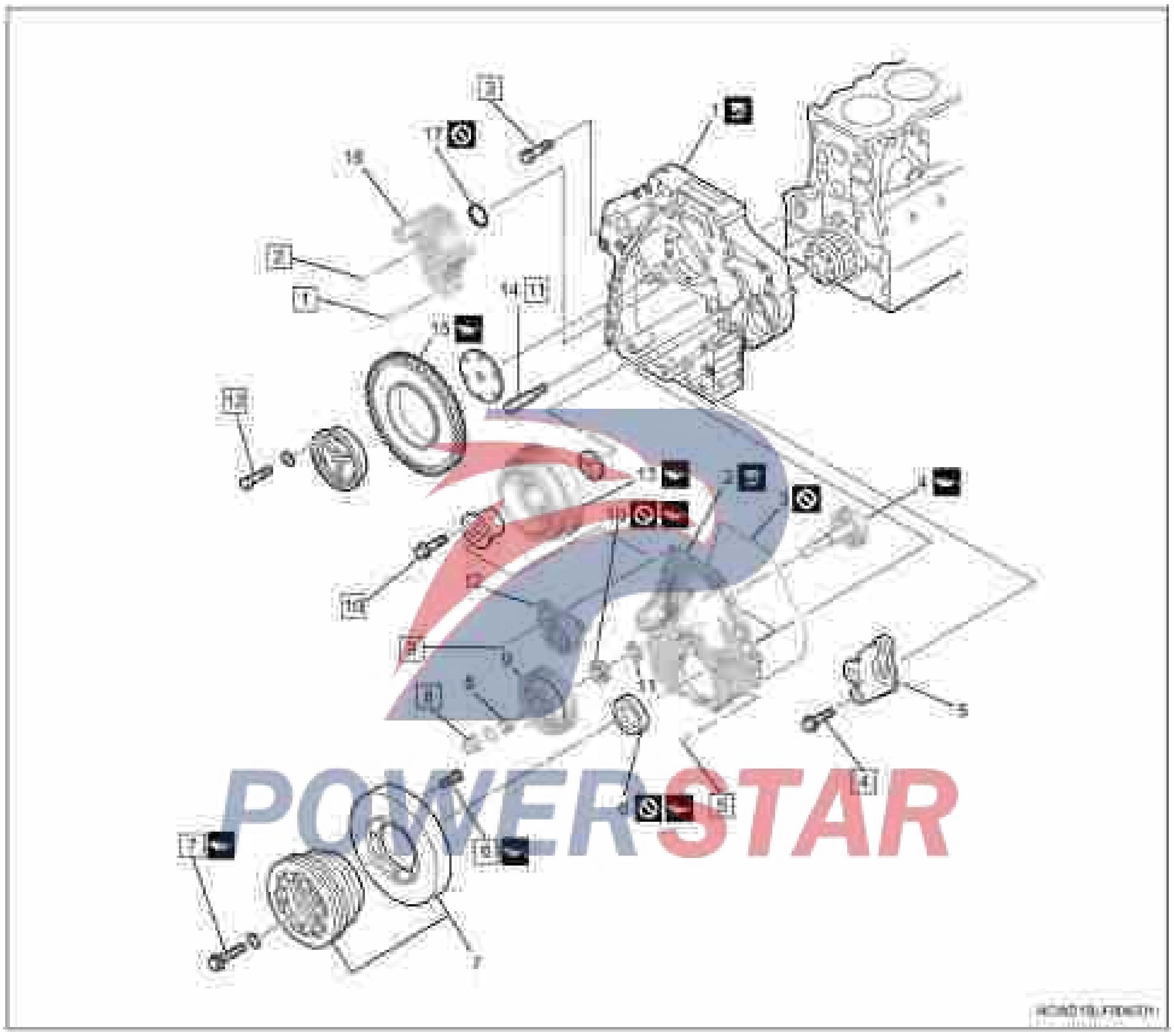
2) Lower the cab, and close the front lid.

Idle gear

Removal

1. Component Views

Idling gear



Part name

1. Timing gearbox
2. gear box cover
3. Gasket
4. Fan shaft
5. A / C compressor bracket
6. Crankshaft front oil seal
7. Crankshaft pulley
8. Tapered bushing
9. Fan pulley
10. Oil seal
11. Gasket
12. Idler
13. Idle gear A
14. Tightening bolts
15. Idle gear B
16. Oil pump
17. O-ring

Tightening torque

1: 49 N • m { 5.0 kgf • m /36 lb • ft }

2: 39 N • m { 4.0 kgf • m / 29 lb • ft }

3: 135 N • m { 13.8 kgf • m / 100 lb • ft } M14

3: 43 N • m { 4.4 kgf • m / 32 lb• ft } M10

4: 135 N • m { 13.8 kgf • m / 100 lb • ft }

5: 26 N • m { 2.7 kgf • m / 19 lb • ft } M8

5: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

6: 96 N • m { 9.8 kgf • m / 71 lb • ft }

7: 267 N • m { 27.2 kgf • m / 197 lb • ft }

8: 539 N • m { 55.0 kgf • m / 398 lb • ft }

9: 43 N • m { 4.4 kgf • m /32 lb • ft }

10: 108 N • m { 11.0 kgf • m / 80 lb • ft }

11: 39 N • m { 4.0 kgf • m / 29 lb • ft }

12: 40 N • m { 4.1 kgf • m / 30 lb • ft }

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

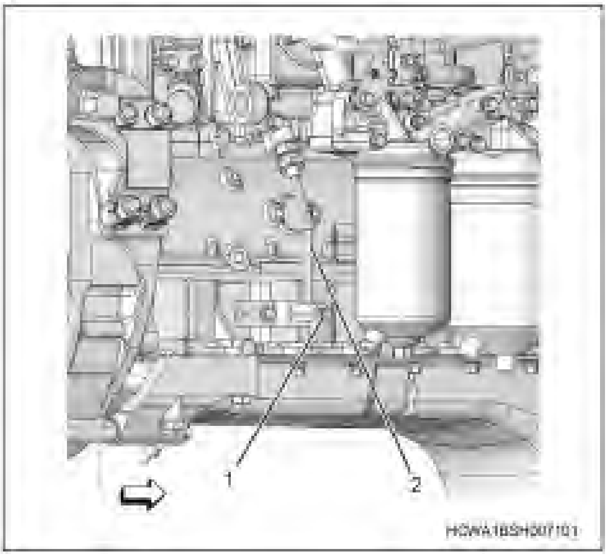
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.

1. Drain plug

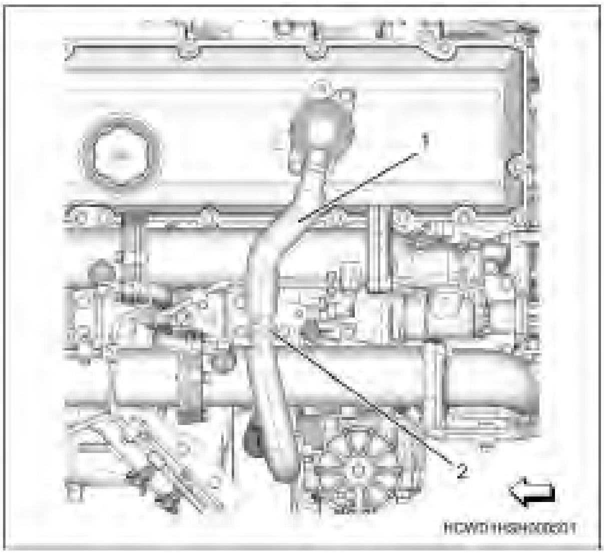
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

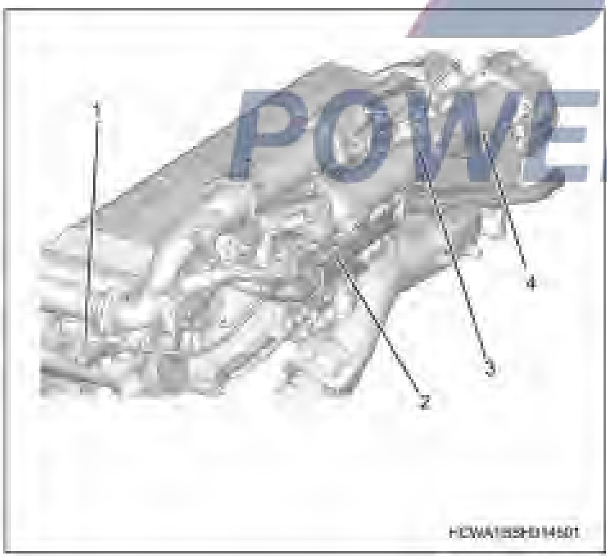


1. Ventilation hose
2. Ventilation hose clip

5. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

6. Water charge pipe removal

1) Remove the water charge pipe from the water charge pipe bracket.

2) Remove the water charge bracket from the inlet pipe.

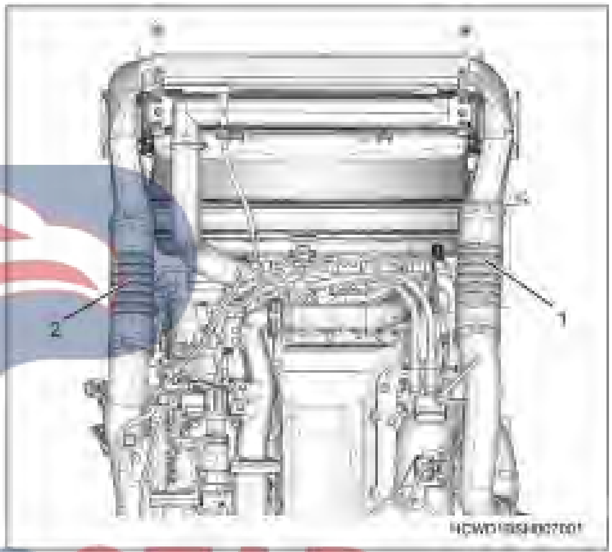
3) Remove the water charge bracket from exhaust gas recirculation valve line A.

7. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

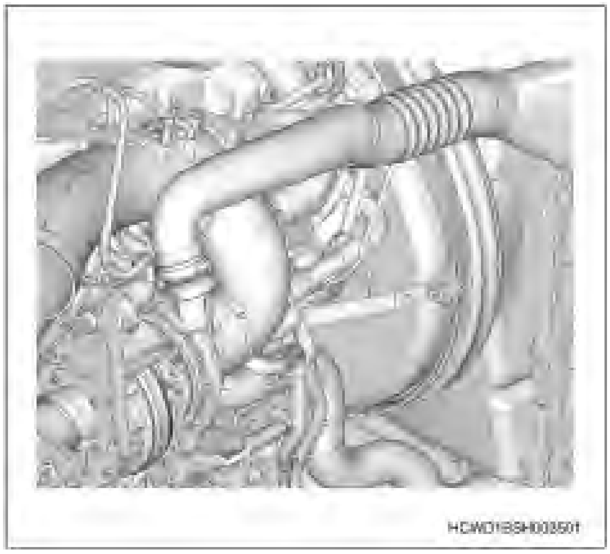
2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



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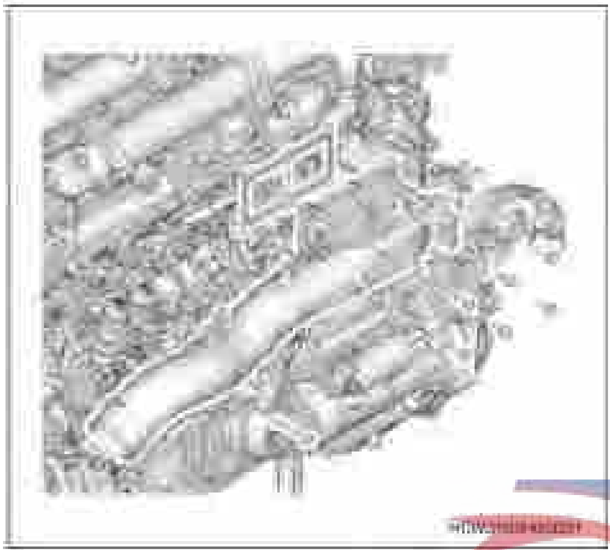
8. Intake duct removal

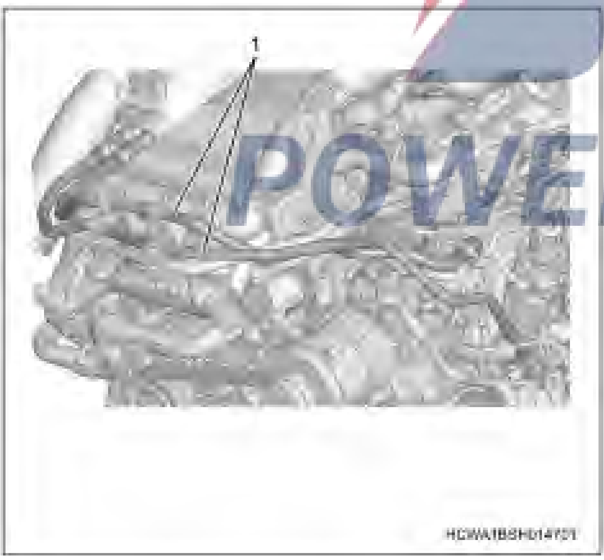
1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



9. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

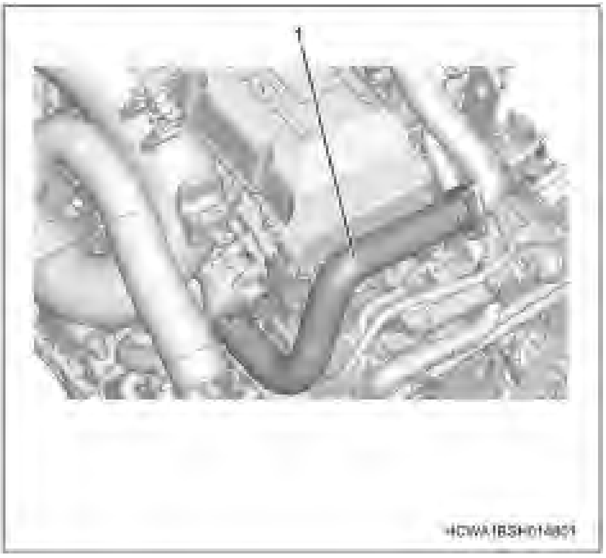


1. Exhaust pipe

10. EGR cooler removal

1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

1. Standard bolt
2. Exhaust gas recirculation line B
3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.

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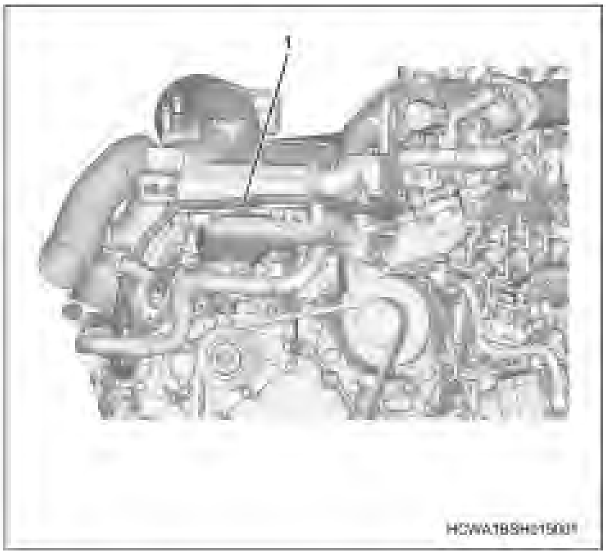
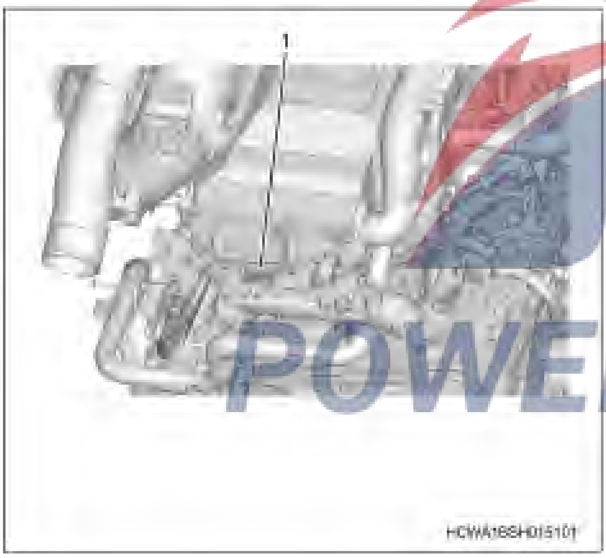


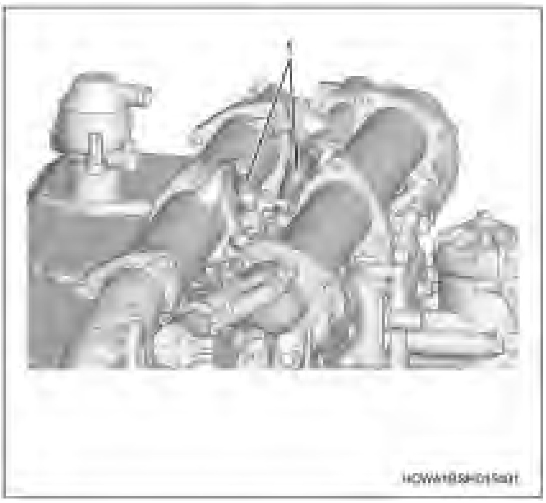
1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.



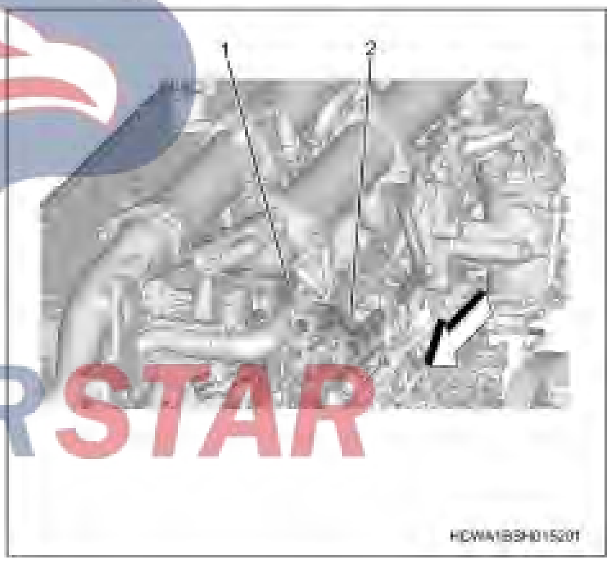
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. Water feed hose

7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe

2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

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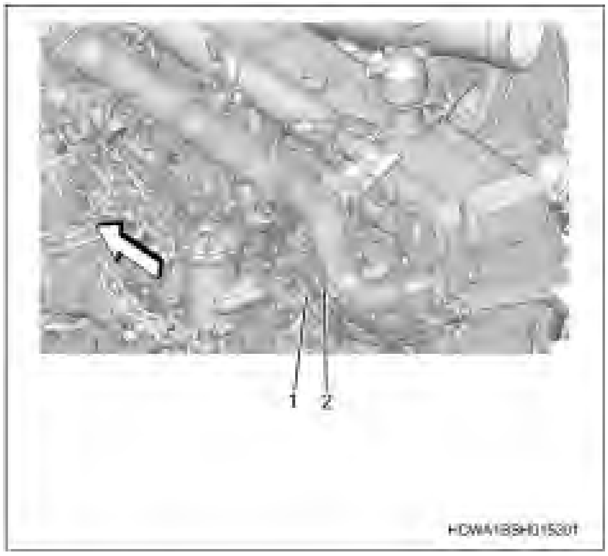
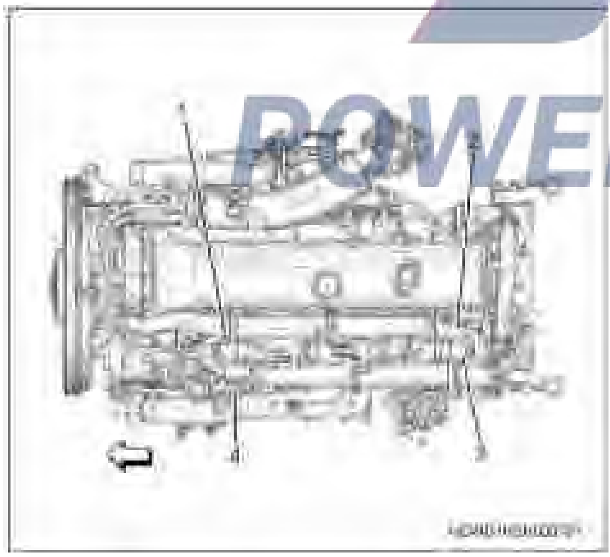


1. Front return pipe
2. Rear return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.



1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.

1. Exhaust gas recirculation cooler duct

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.

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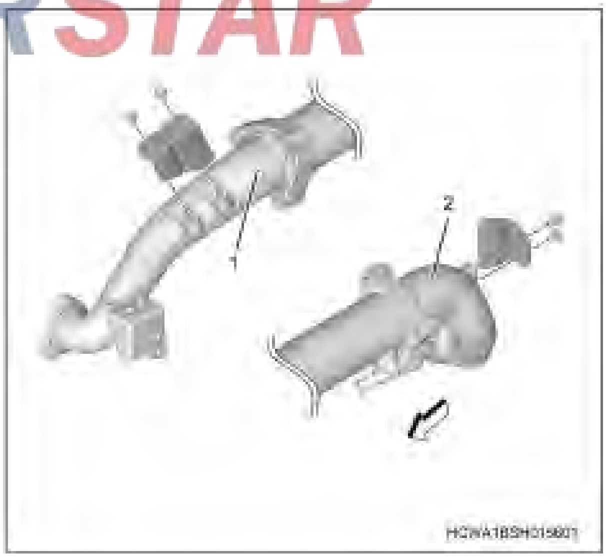
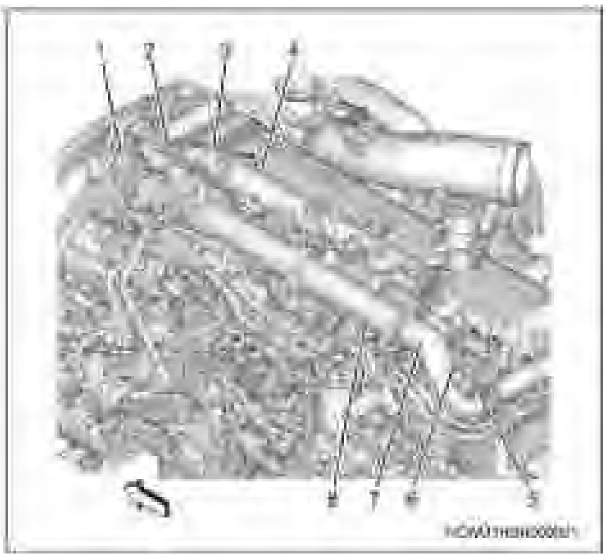


1. Exhaust gas recirculation cooler duct A
2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.

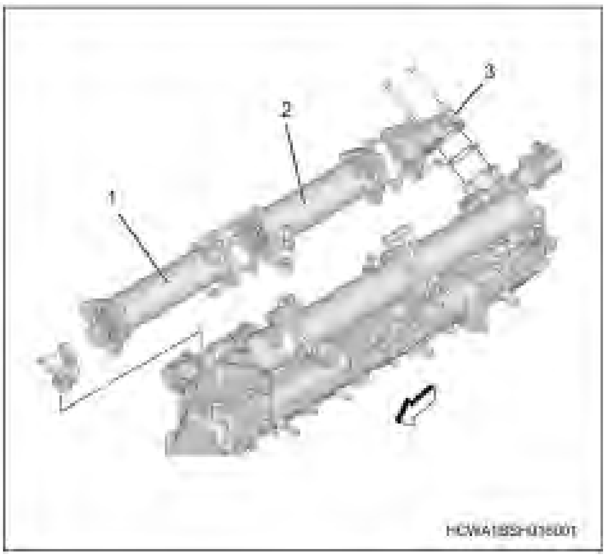


1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. Exhaust Gas Recirculation Cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket
6. Exhaust gas recirculation valve thermal protection device
7. Exhaust Gas Recirculation Cooler duct C
8. EGR cooler C

17) Remove the EGR cooler bracket on the EGR cooler.

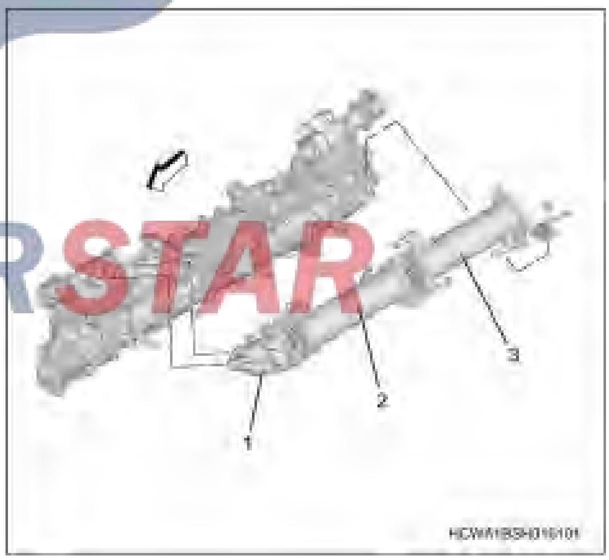
18) Remove the exhaust gas recirculation cooler bracket on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.



1. EGR cooler A
2. EGR cooler B
3. Exhaust Gas Recirculation Cooler duct B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



1. Exhaust gas recirculation cooler duct D
2. EGR cooler D
3. EGR cooler C

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.

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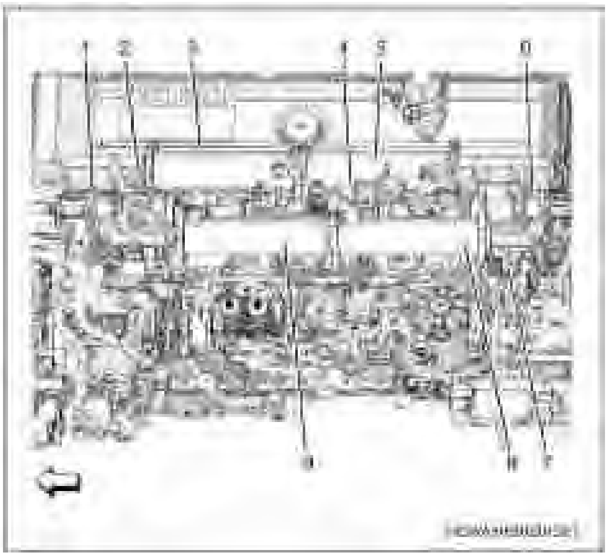
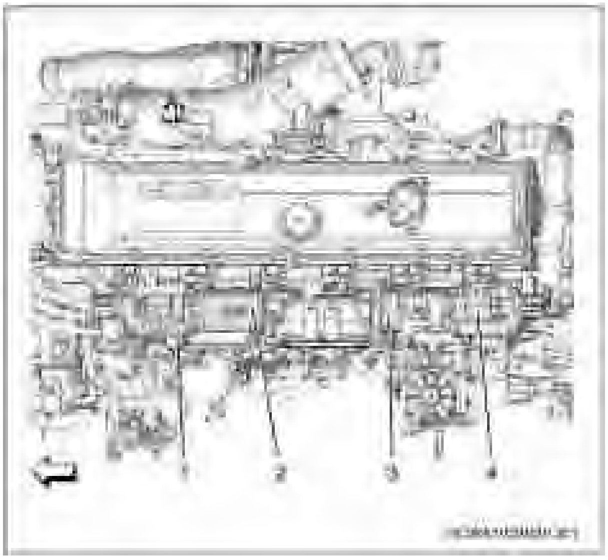


1. EGR valve 2
2. Exhaust gas recirculation cooler bracket
3. EGR cooler A.
4. Leakage pipe bracket
5. EGR cooler B.
6. EGR valve 1
7. Exhaust gas recirculation cooler bracket
8. EGR cooler C
9. EGR cooler D

11. Exhaust gas recirculation valve removal

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve duct A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve duct A.



1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

12. Pilot valve to remove

1) Remove pilot valve from EGR valve A.

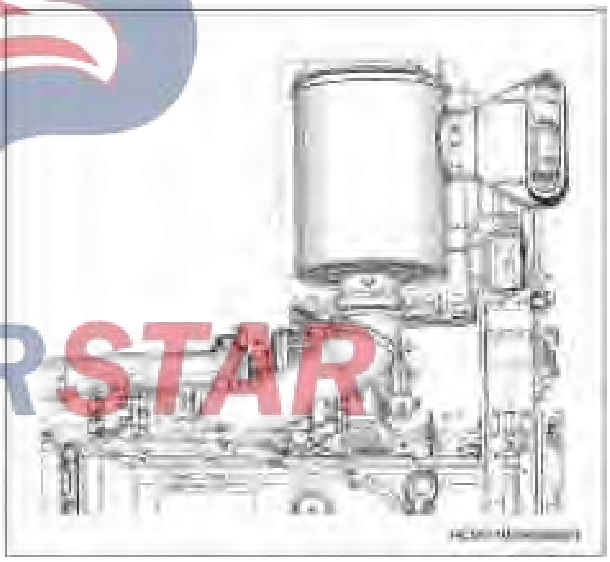
2) Remove pilot valve from EGR valve B.

13. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



14. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.

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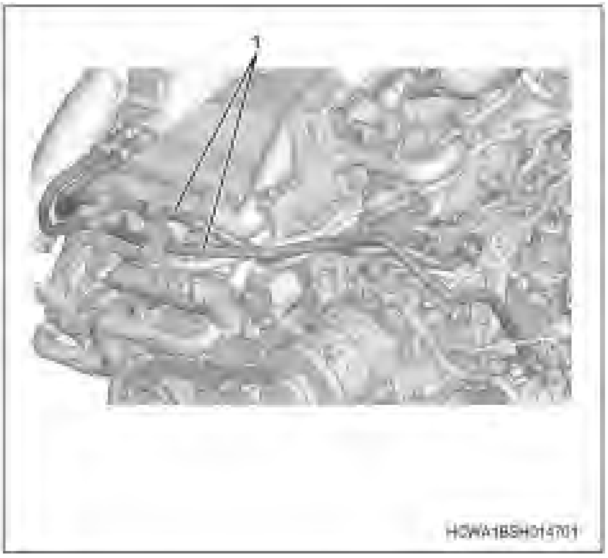


1. Air compressor suction pipe

2) Remove the heat shield from the air line.

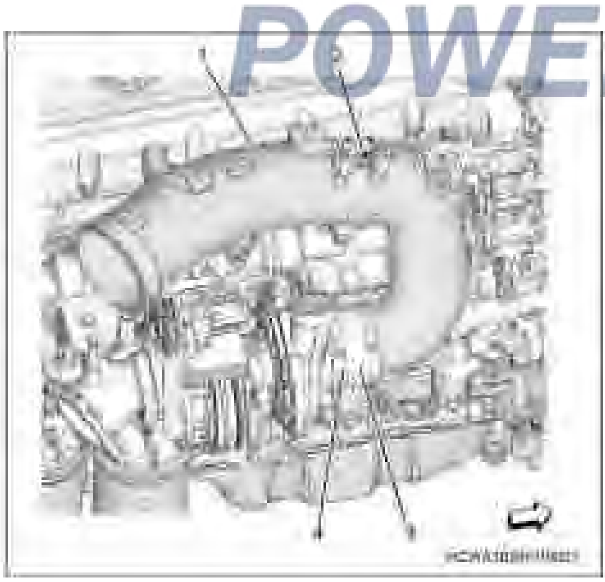
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

4. Hose clip

15. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

16. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

17. Exhaust cover removal

1) Remove the exhaust cover from the frame.

18. Exhaust brake valve removal

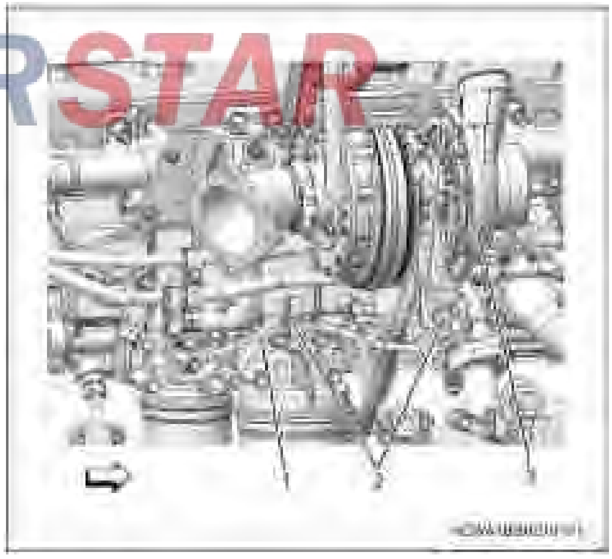
1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

19. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.



1. Turbocharger oil feed pipe

2. Pipe clamp

3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.

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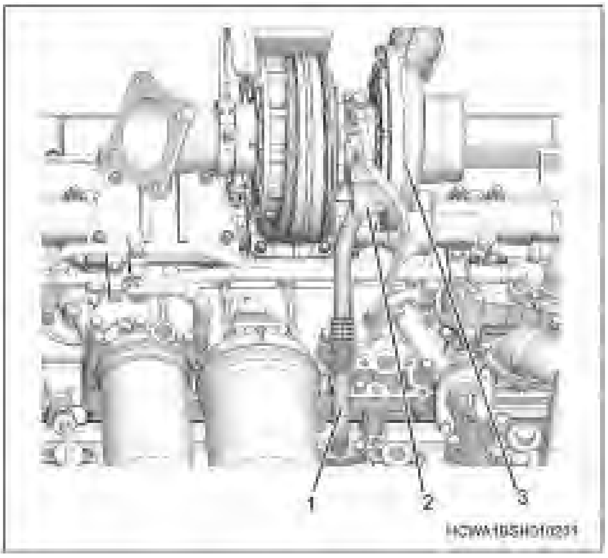


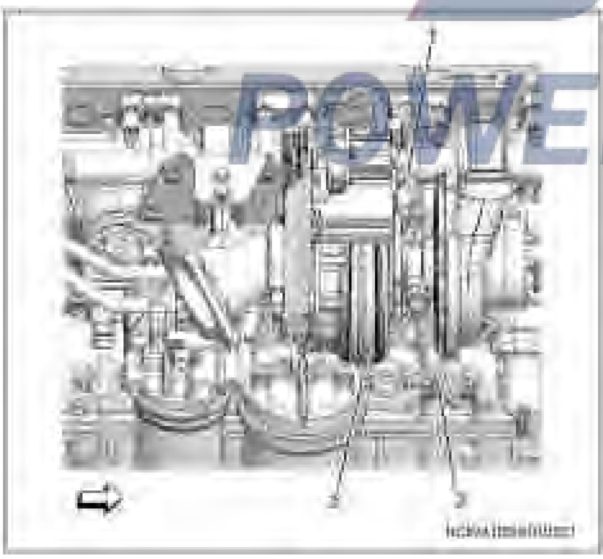
1. Turbocharger return pipe
2. Bracket
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

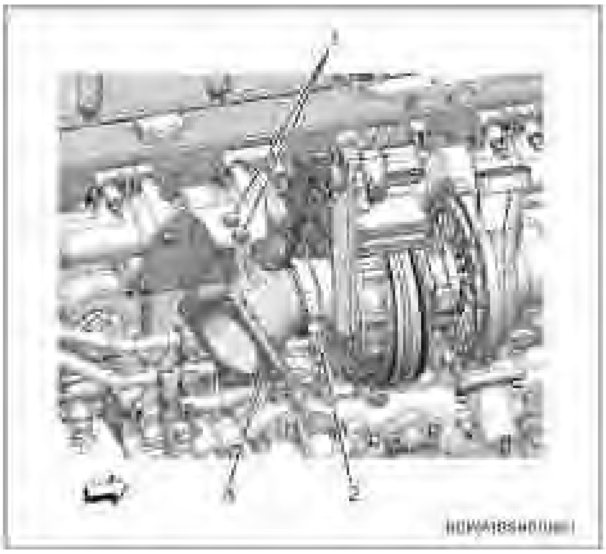
7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe

10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.

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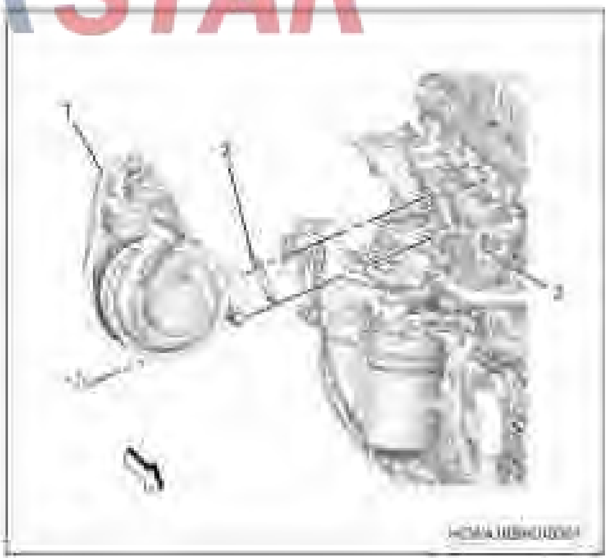


1. Turbocharger
2. Gasket
3. Exhaust manifold

20. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

21. Fuel drain pipe removed

1) Disconnect the fuel drain pipe from the fuel supply pump.

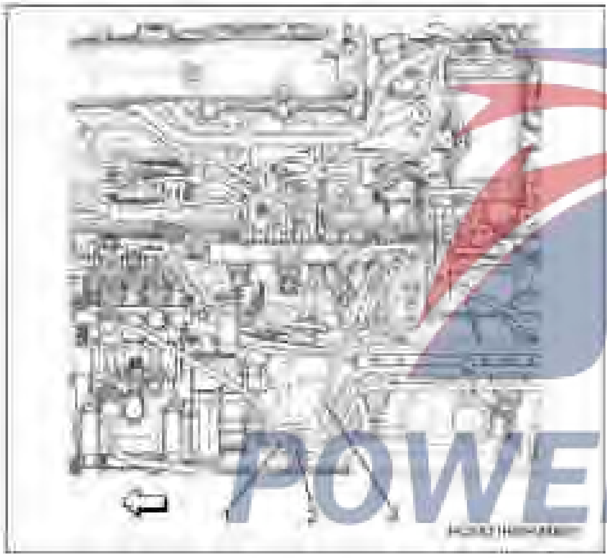
2) Disconnect the fuel drain pipe from the fuel filter.

22. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter from fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

23. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

3) Remove the fuel pipe from the fuel supply pump.

24. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.

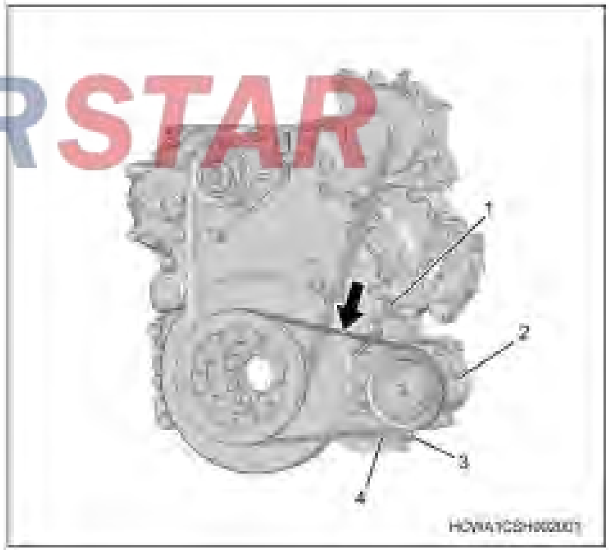
1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

25. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



1. Bolt

2. A/C compressor

3. Adjust bolt

4. Nut (back end)

26. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator

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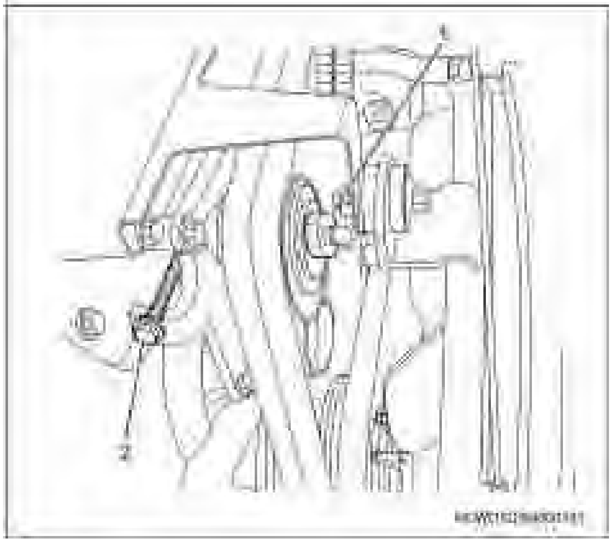
and crankshaft pulley.



1. Lock nut
2. Adjust bolt

27. Generator removal

1) Disconnect the harness connector from the generator.

2) Disconnect the generator from the ground and B-terminal harness.

3) Remove the generator from the bracket.

28. Generator bracket removal

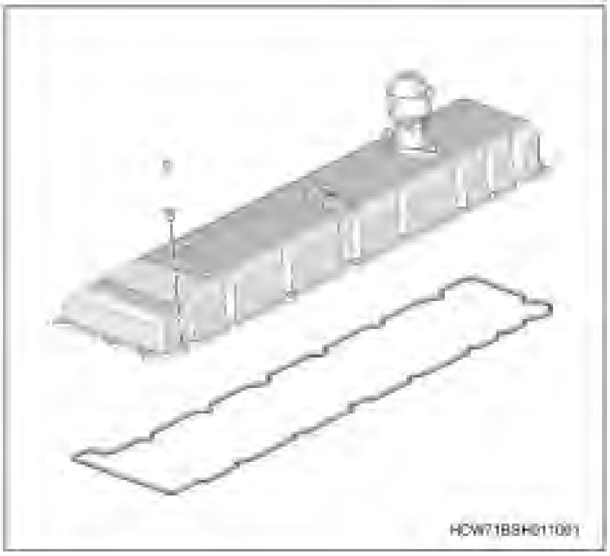
1) Remove the generator bracket from the cylinder head.

2) Remove the generator bracket from the timing gearbox.

29. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



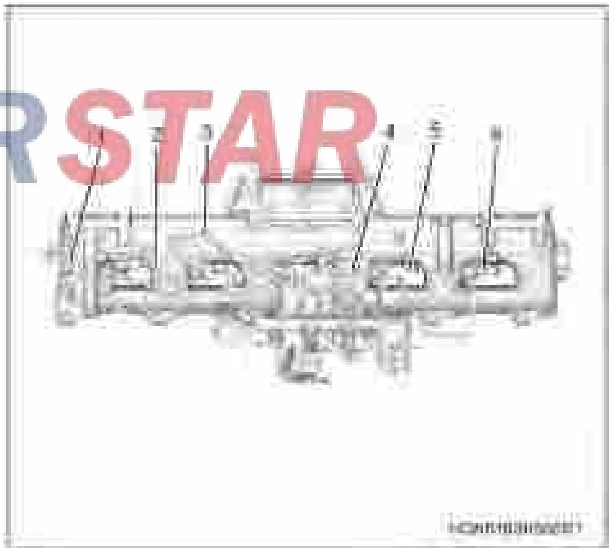
30. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

31. Injector harness removal

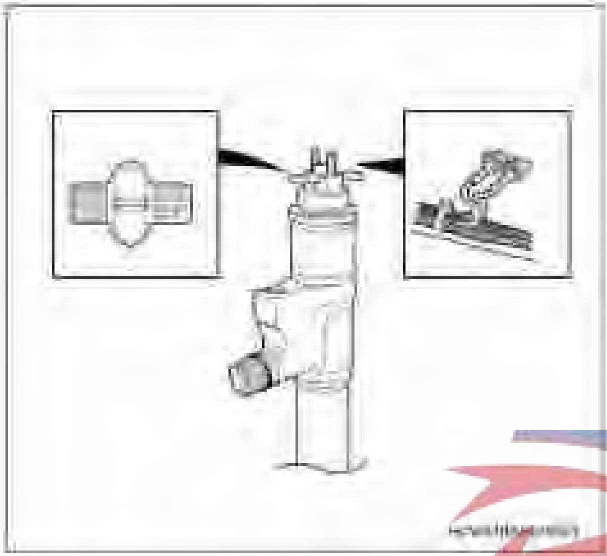
POWERSTAR

1) Remove the injector nut

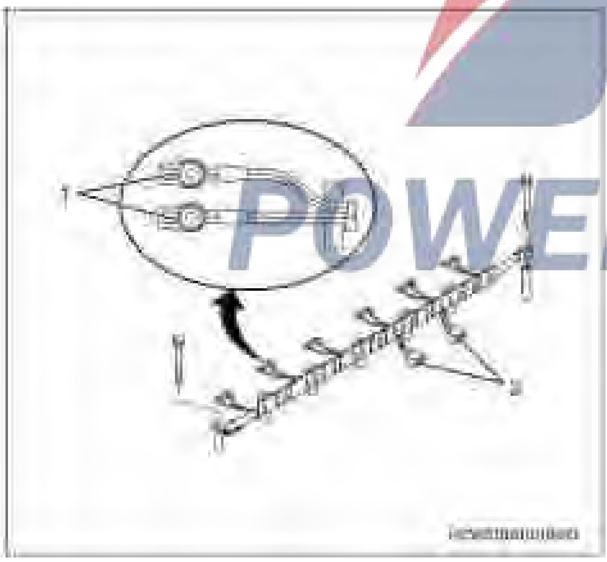
2) Remove the injector harness

Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.



3) Remove the bolts on the injector harness.



1. Injector terminal nut

2. Connector

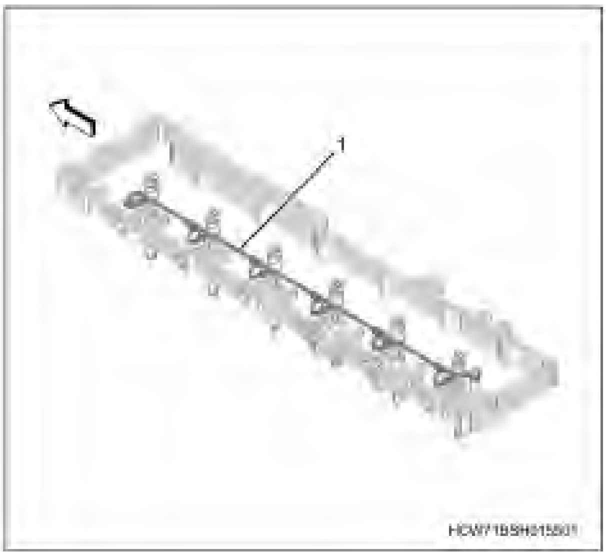
32. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

● Do not reuse the gasket.



1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.

1. O-ring

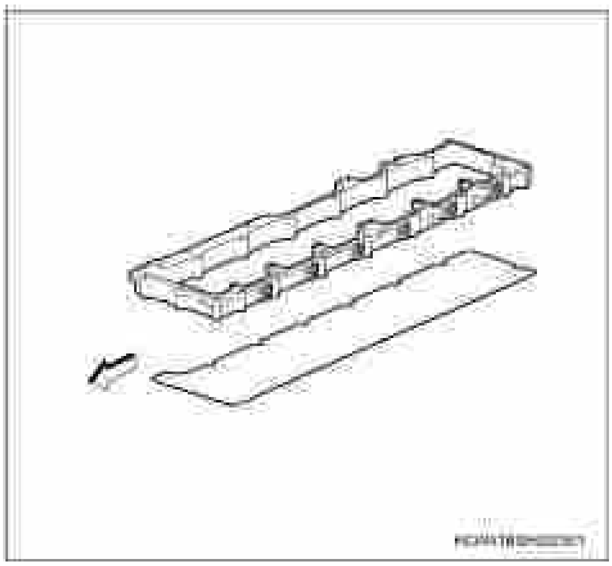
2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.



33. Injector removal

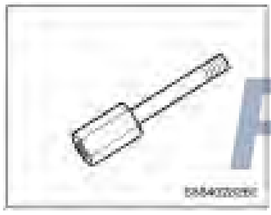
1) Remove the clamp from the cylinder head.

2) Remove the injector from the cylinder head with special tools.

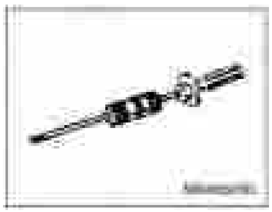
Caution:

● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

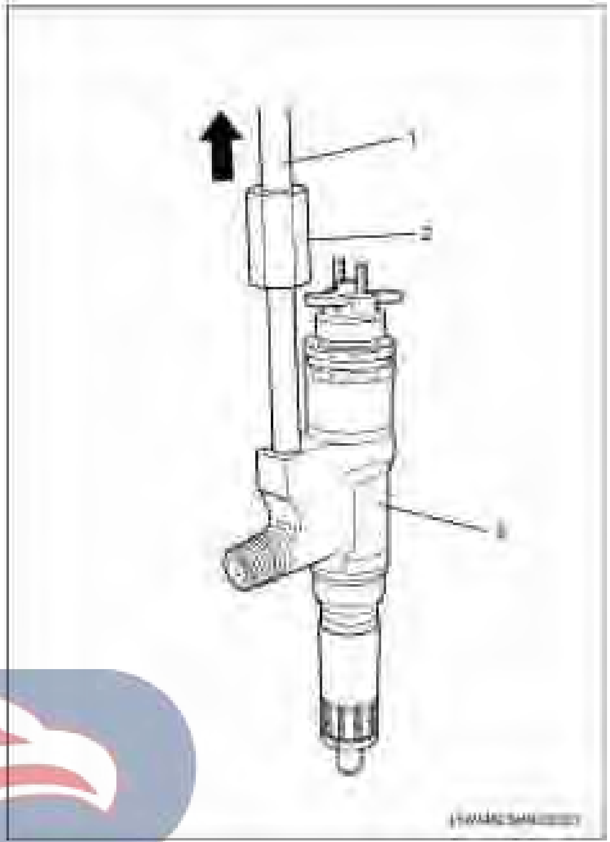
● Do not remove the injector ID code plate.



SST: 5-8840-2826-0 - injector remover



SST: 5-8840-0019-0 - sliding hammer



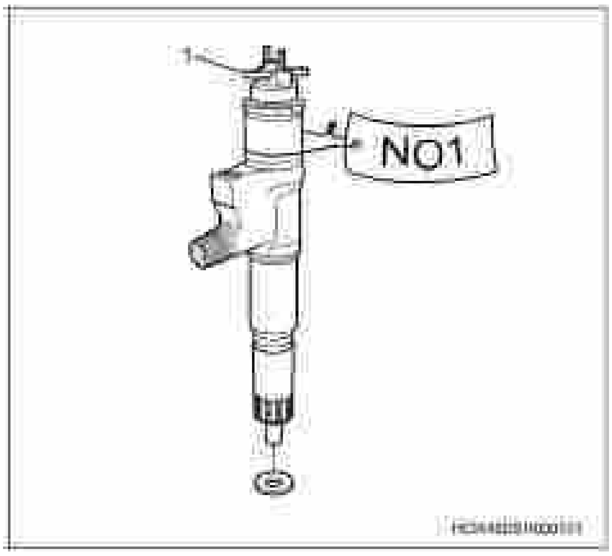
1. 5-8840-0019-0
2. 5-8840-2826-0
3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.



1. Injector

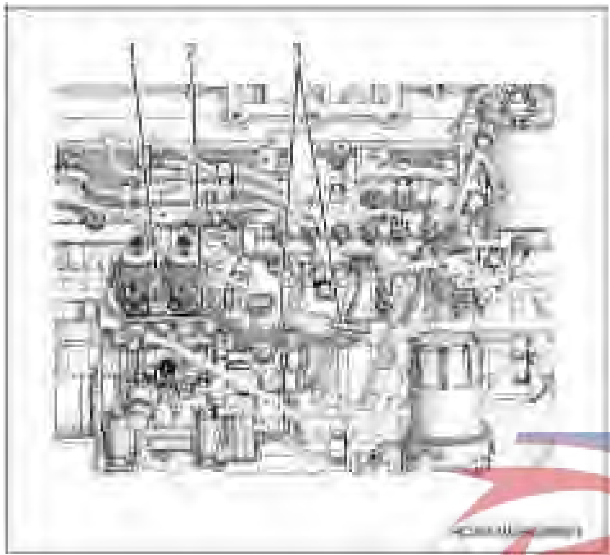
POWERSTAR

34. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.



1. Fuel pipe

2. Fuel pipe

3. Clip

35. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

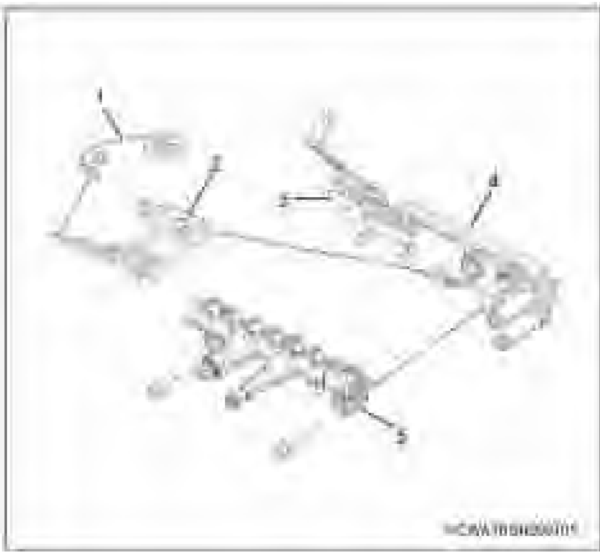
2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.



1. Injection pipe clamp bracket

2. Injection pipe clamp bracket

3. Fuel pipeline bracket

4. Common rail (fuel rail) bracket

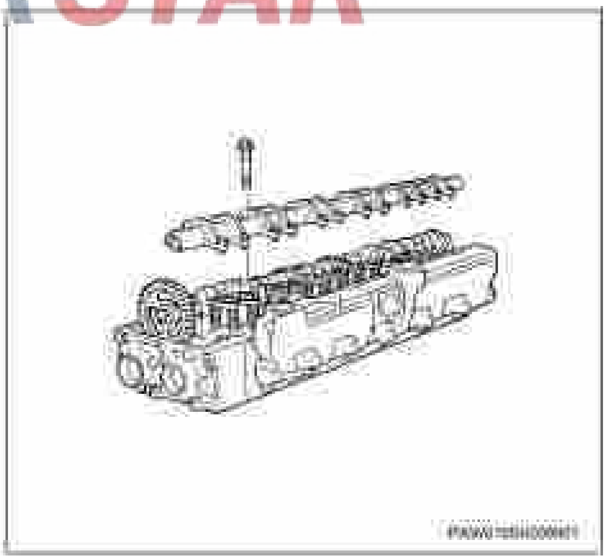
5. Common rail (fuel rail)

36. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



37. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

POWERSTAR

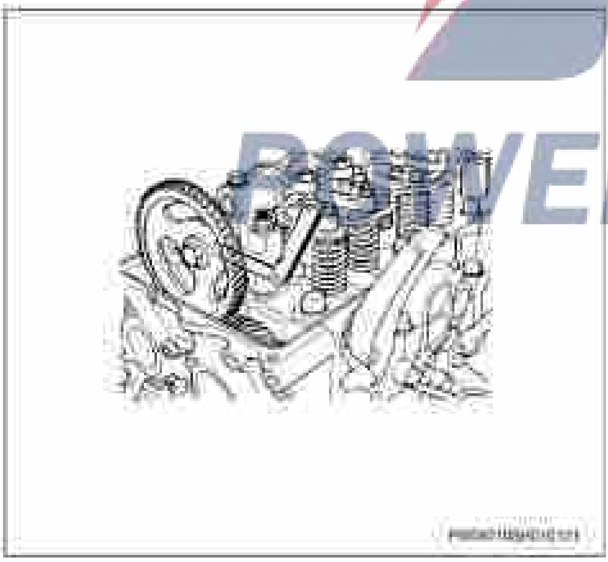
1. Bridge

38. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170 mm {0.00335 to 0.00669 mm}

Limit: 0.25 mm {0.0098 mm}

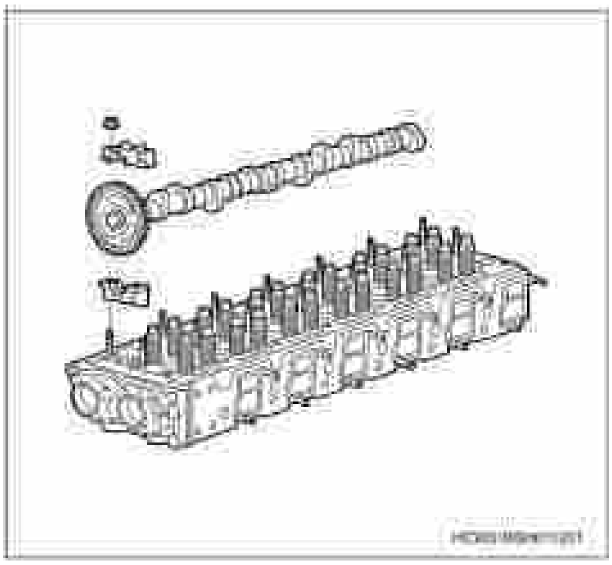


2) Remove the cam holder from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.



39. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

2) Remove the glow plug from the cylinder head.

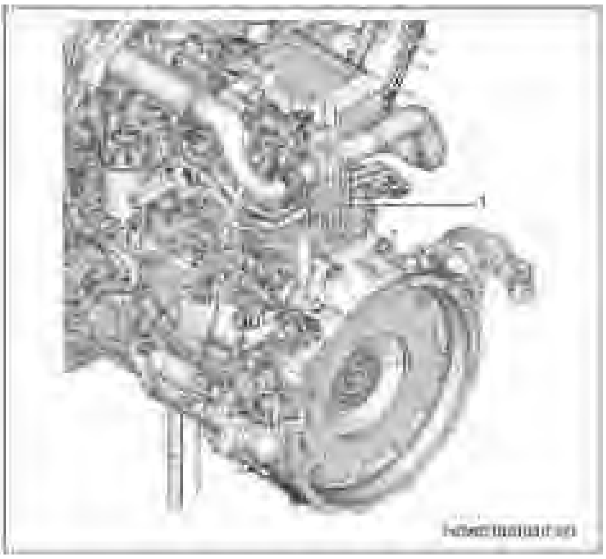
40. Cylinder head cover removal

1) Install special tool to the cylinder head.

SST: 8-9761-4276-0 - engine hanger

Tightening torque: 117.5 N• m { 12.0 kgf• m /87 lb• ft }

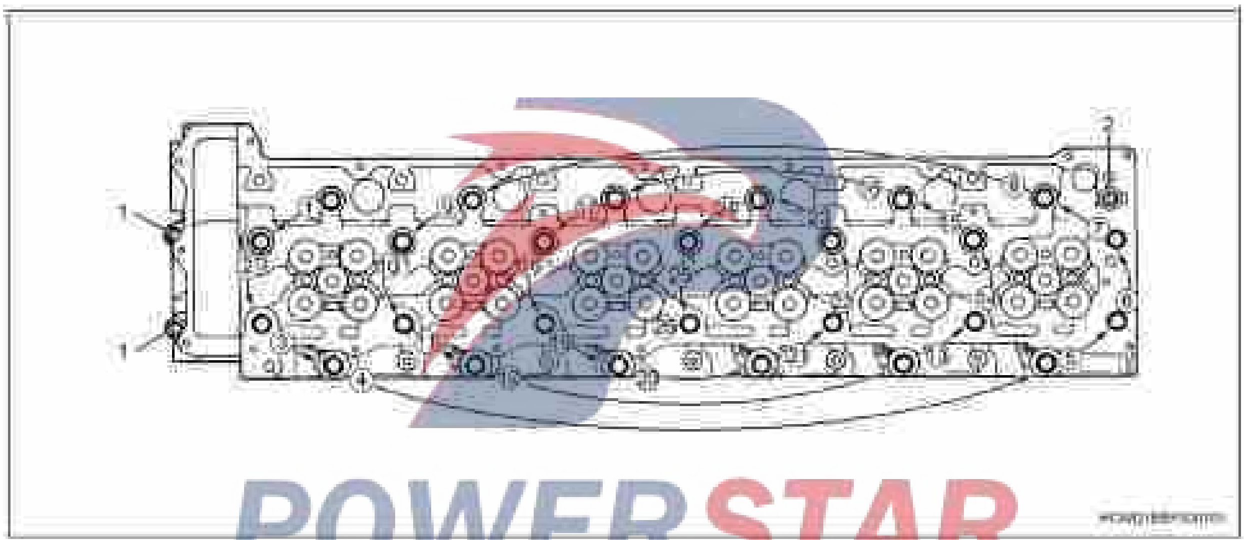
POWERSTAR



1. 8-9761-4276-0

2) Remove the M10 and M12 bolts from the cylinder head.

3) Remove the cylinder head bolts from the cylinder head in the order shown.



POWERSTAR

1. M10 bolt
2. M12 bolt

4) Remove the cylinder head from the cylinder block.

5) Remove the cylinder head gasket from the cylinder block.

Caution:

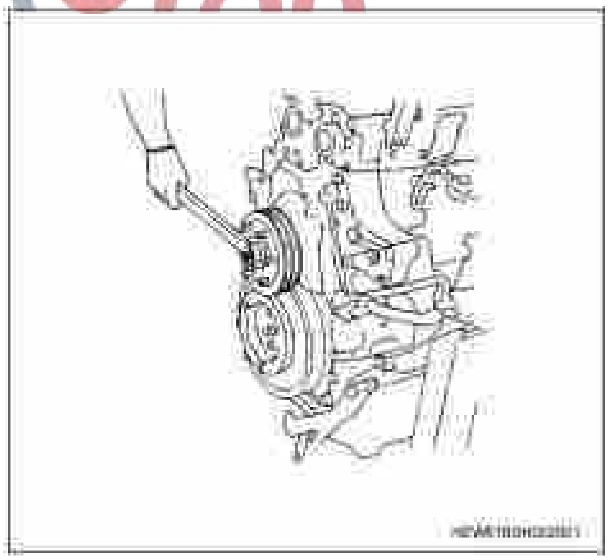
● Do not reuse the cylinder head gasket.

6) When removing, inspect for water leakage, exhaust gas leakage, etc.

41. Crankshaft pulley removal

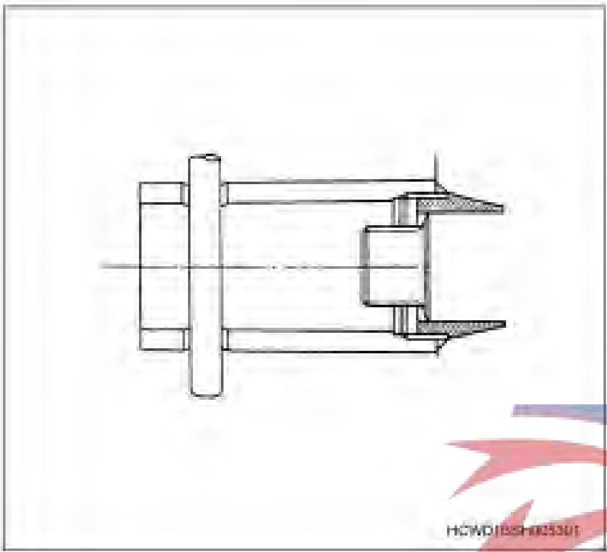
1) Wedge the crankshaft with a wooden block to prevent the fan pulley from rotating.

2) Remove the crankshaft pulley nut from the crankshaft pulley.



3) Use a special tool to remove the fan pulley cone bushing.

SST: 1-8521-0063-0 - Tapered bushing puller



4) Remove the fan pulley from the fan shaft.

5) Remove the crankshaft pulley from the crankshaft.

Caution:

● Do not damage the sealing surface or excessive force on the pump body.

42. Idle gear removal

1) Remove the idler gear from the gearbox cover.

43. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

44. Gearbox cover removed

1) Remove the gearbox cover from the timing gearbox.

2) Remove the gasket from the gearbox cover.

45. Crankshaft oil seal removed

1) Remove the crankshaft front oil seal from the gearbox cover.

Caution:

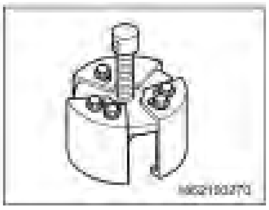
● Do not damage the oil seal pressure mounting surface.

● Do not reuse the slinger or oil seal.

2) Use a special tool to remove the oil deflector from the crankshaft.

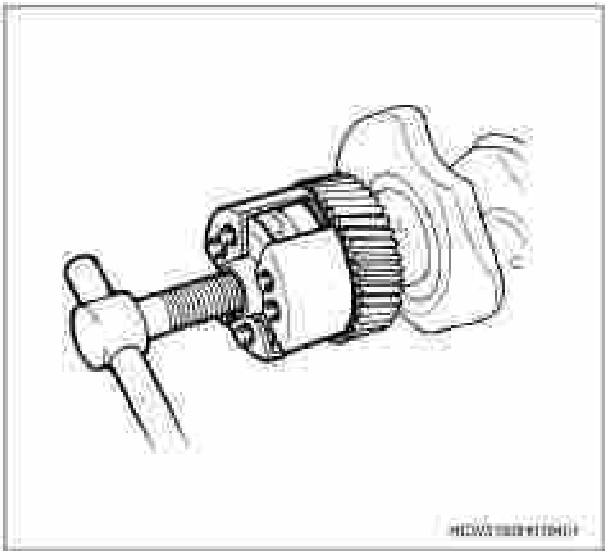
Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.



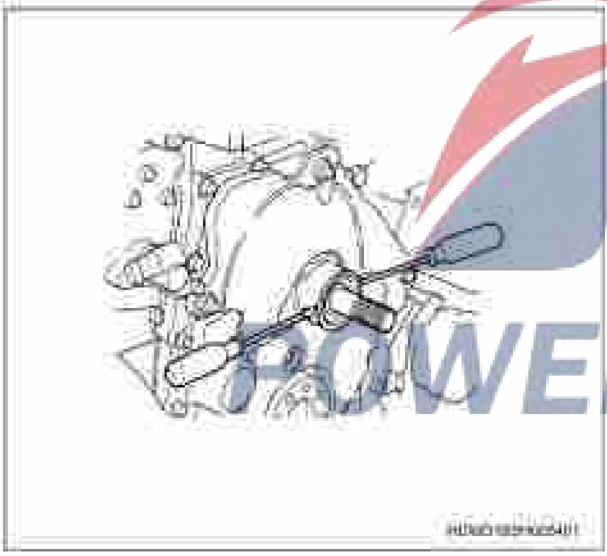
SST: 1-8521-0027-0 - Sleeve Removal Unit

POWERSTAR



46. Fan shaft removed

1) Use a screwdriver to remove the oil seal on the fan shaft.



2) Remove the gasket from the fan shaft.

3) Remove the fan shaft from the gearbox cover.

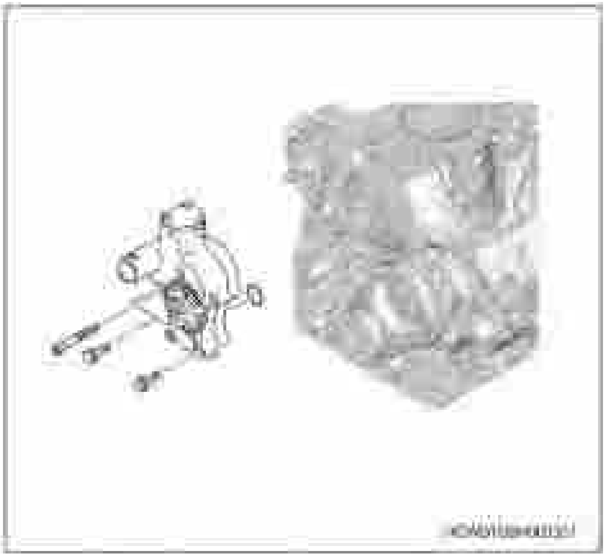
47. Oil pump removal

1) Remove the oil pump from the cylinder block.

Caution:

● Do not remove the bolt with the yellow mark on the top.

2) Remove the O-ring from the oil pump.



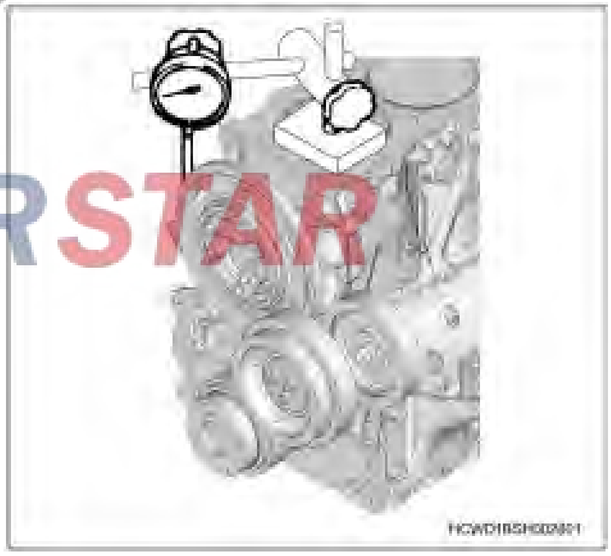
48. Idle gear removal

Caution:

● Before removing each idler gear, measure the backlash and axial clearance.

1) Measure idle gear clearance.

Standard: 0.03 to 0.13mm {0.0012 to 0.0051 in}



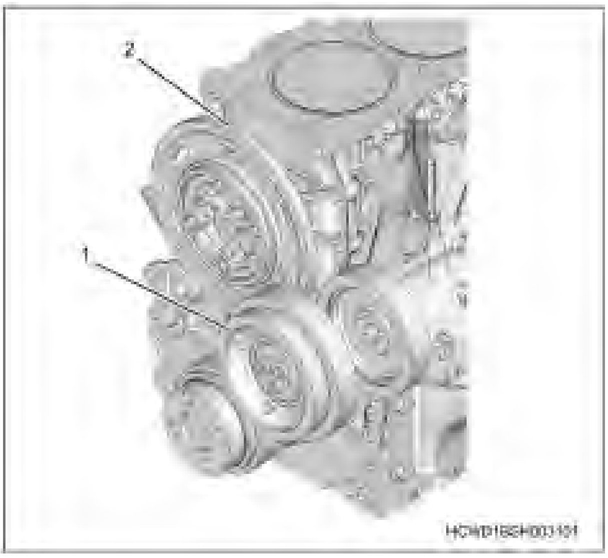
2) Measure the axial clearance of the idler gear.

Standard: 0.165 to 0.230mm {0.00650 to 0.00906in} Idler Gear A

Limit: 0.35 mm {0.0138 in} Idler gear A

Standard: 0.075 to 0.154mm {0.00295 to 0.00606in} Idler gear B.

Limit: 0.25 mm {0.0098 in} idler gear B



1. Idling Gear A
2. Idling gear B

3) Remove the distance bolt from the cylinder block.

4) Remove the idler gear A from the cylinder block.

Caution:

● During the disassembly, mark the idler gear and thrust plate to ensure the installation direction is facing front and back.

5) Remove idler gear B-axis from cylinder block.

6) Remove idler gear B from idler gear B axle.

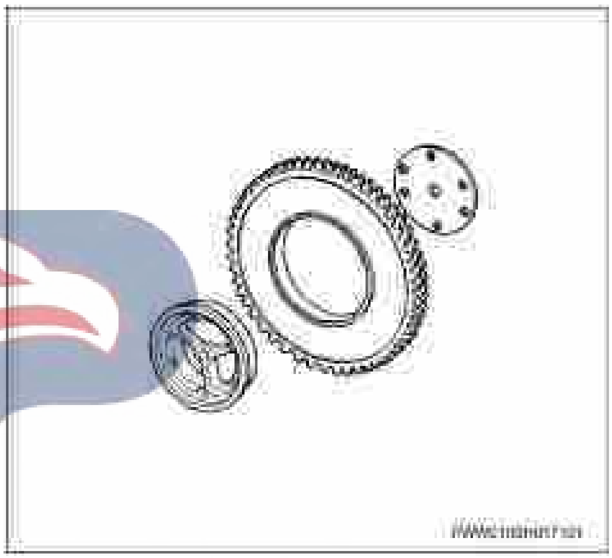
Caution:

● Remove idler gear B during marking to ensure that the mounting orientation is toward the front and back.

7) Remove thrust plate from cylinder body.

Caution:

● Thrust plates are marked during disassembly to ensure that the mounting orientation is toward the front and back.



POWERSTAR

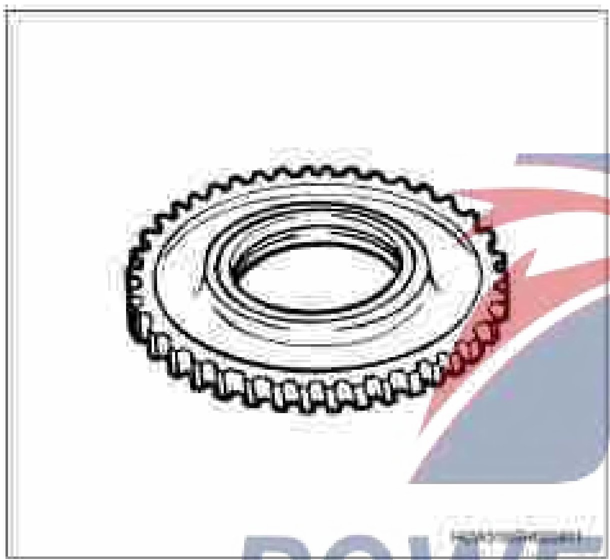
Inspection

1. Idler check

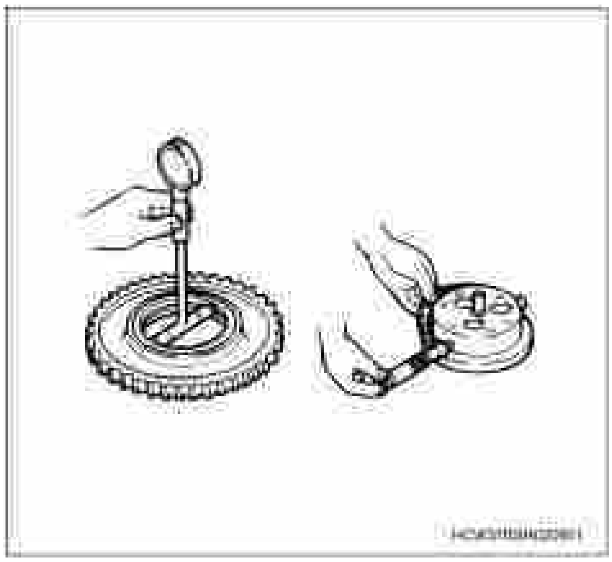
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check each of the following idler gear components.

- Wear
- Tooth contact
- Exfoliation
- Tilt



2) Measure the idler gear shaft outer diameter and idler gear inner diameter.



3) Calculate the clearance value based on the measured values of idler gear shaft outer diameter and idler gear inner diameter.

Idler gear shaft outer diameter

Idling gear	Prescribed value	Limit value
A	: 78.00 mm { 3.0709 in }	: 77.65 mm { 3.0571 in }
	: 57.00 mm {2.2441 in }	: 56.85 mm {2.2382 in }
B	: 142.00 mm {5.5905 in }	: 141.85 mm {5.5846 in }

Clearance between idler gear shaft and idler gear

Prescribed value	Limit value
: 0.040 to 0.105mm { 0.0016 to 0.0041 in }	: 0.20 mm { 0.0079 in }

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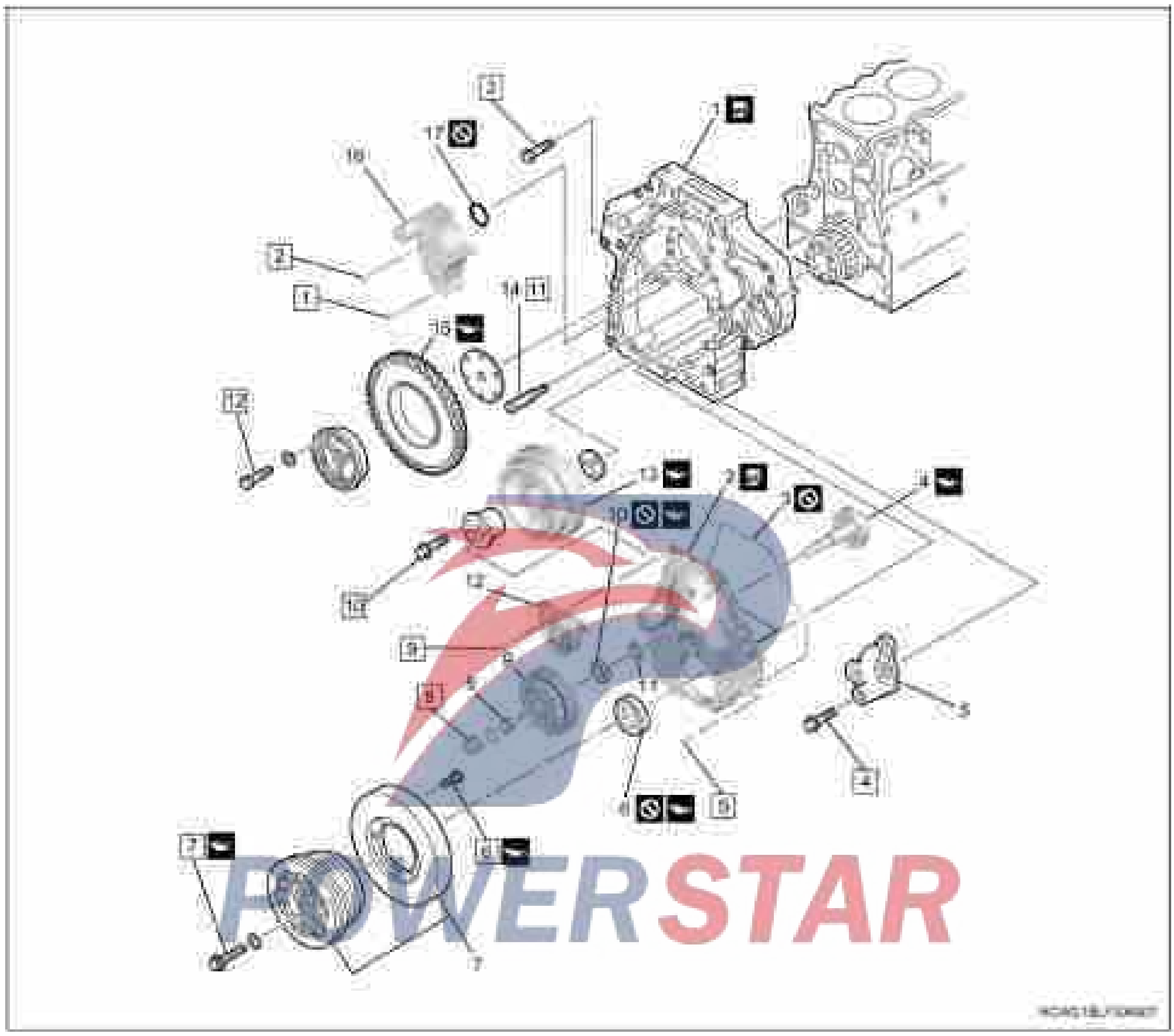
Installation

1. Component Views

Idling gear



Part name

1. Timing gearbox
2. Gear box cover
3. Gasket
4. Fan shaft
5. A / C compressor bracket
6. Crankshaft front oil seal
7. Crankshaft pulley
8. Tapered bushing
9. Fan pulley
10. Oil seal
11. Gasket
12. Idler
13. Idling Gear A
14. Tightening bolts
15. Idling Gear B
16. Oil pump
17. O-ring

Tightening torque

1: 49 N• m { 5.0 kgf• m / 36 lb ft }

2: 39 N•m { 4.0 kgf• m /29 lb• ft }

3: 135 N• m { 13.8 kgf• m / 100 lb• ft } M14

3: 43 N• m { 4.4 kgf• m / 32 lb• ft } M10

4: 135 N• m { 13.8 kgf• m / 100 lb• ft }

5: 26 N• m { 2.7 kgf• m / 19 lb• ft } M8

5: 43 N• m { 4.4 kgf• m / 32 lb● ft } M10

6: 96 N• m { 9.8 kgf• m / 71 lb• ft }

7: 267 N• m { 27.2 kgf• m / 197 lb• ft }

8: 539 N• m { 55.0 kgf• m / 398 lb• ft }

9: 43 N• m { 4.4 kgf• m / 32 lb• ft }

10: 108 N• m { 11.0 kgf• m / 80 lb• ft }

11: 39 N• m { 4.0 kgf• m / 29 lb• ft }

12: 40 N• m { 4.1 kgf• m / 30 1n• ft }

2. Idle gear installation

1) Apply the B-axis surface of the idler gear with engine oil.

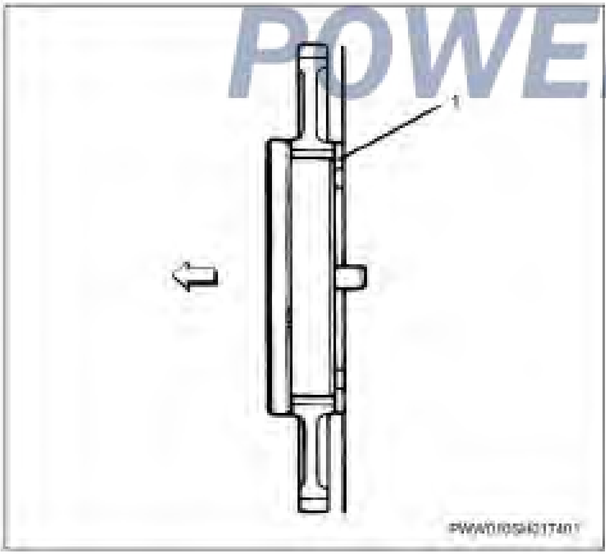
2) Apply idler gear B inner diameter and bearing surface with engine oil.

3) Install the idler gear B-axis onto the cylinder block.

Caution:

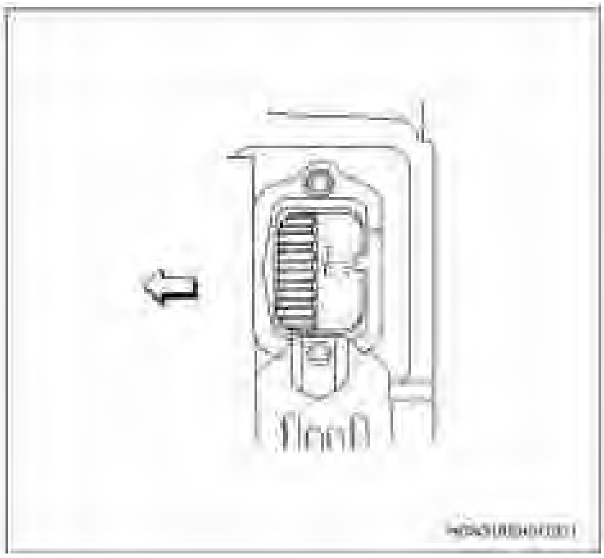
● During disassembly, check the front / rear markings on the idler gear B and the thrust plate repeatedly.

● Remember to remove the installed temporary fastening bolts.



1. Thrust piece

4) Align the No.1 cylinder to compression top dead center.



5) Apply idler gear A inner diameter to engine oil.

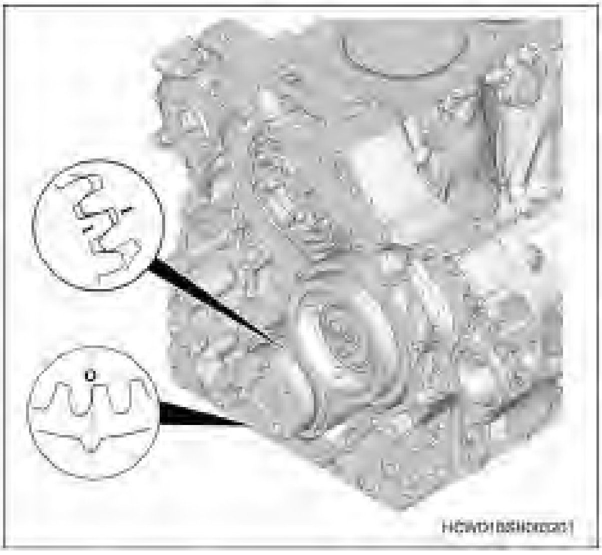
6) Install the sleeve on idler gear A.

7) Align thrust ring with idler gear A

8) Refer to the illustration, mark the O-mark between crankshaft gear and timing gearbox with I mark between crankshaft gear and idler gear A Align, and then install idler gear A onto the cylinder block.

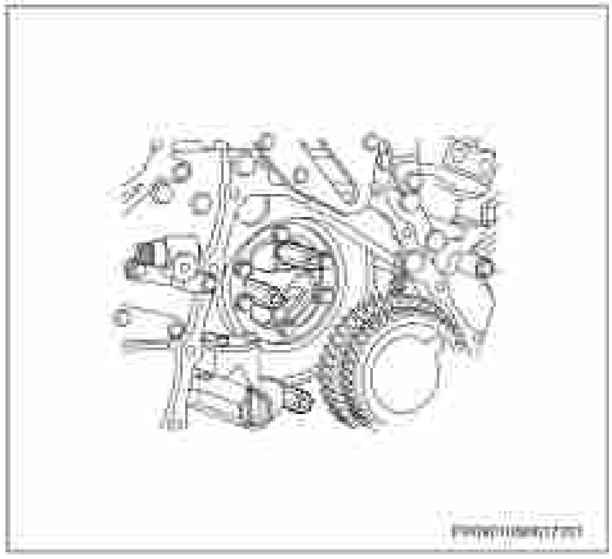
9) Referring to the figure, the I-mark between the crankshaft gear and the timing gear box and the I mark between the crankshaft gear and the idler gear A Align, and then install idler gear A onto the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}



10) Install the three distance bolts to the cylinder block.

Tightening torque: 39 N• m { 4.0 kgf• m / 29 lb• ft }



3. Oil pump installation

1) Install the O-ring to the pump.

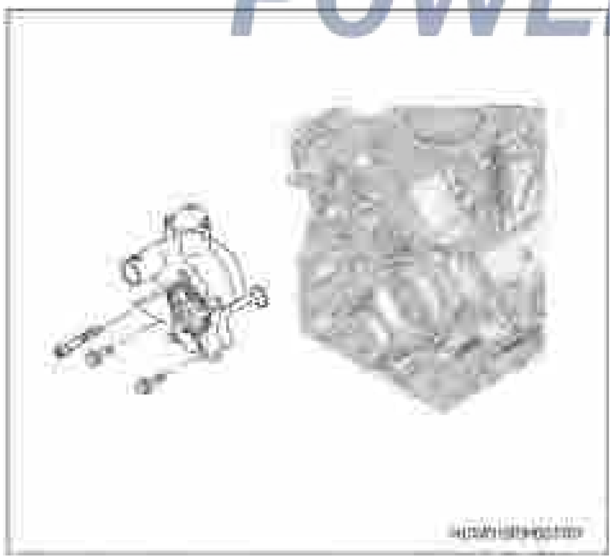
2) Install the pump to the cylinder block.

Caution:

● Do not tighten the screws marked with yellow on the top.

Tightening torque: 49 N • m {5 kgf • m / 36 lb • ft} hex bolts

Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft} Socket head cap screws

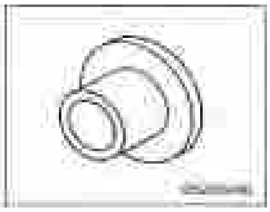


4. Fan shaft installation

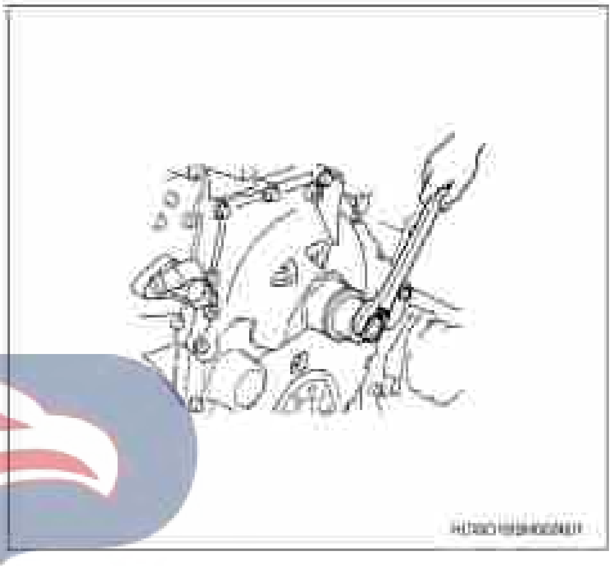
1) Mount the fan shaft to the gearbox cover.

2) Install the spacer on the fan shaft.

3) Use a special tool to install the fan shaft oil seal to the fan shaft.

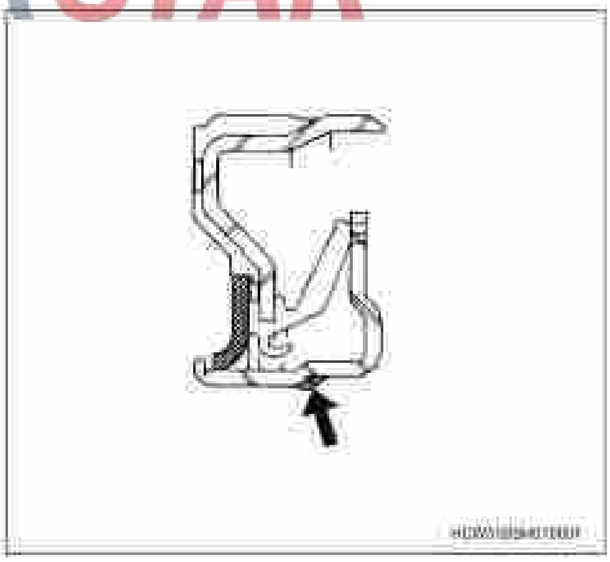


SST: 1-8522-0049-0 - Seal installation tool



Note:

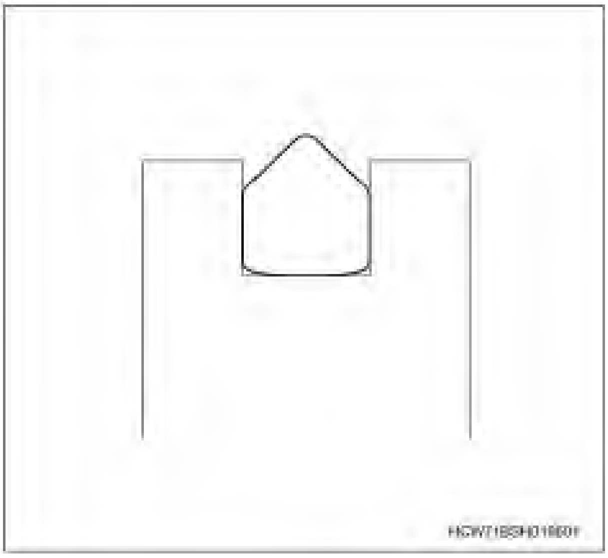
● If scratches are present in the shaft area after removing the oil deflector, apply San-Jian 1207C to the inner surface of the oil deflector shown in the illustration and attach it.



5. Gear box cover installed

1) Install the gasket on the gear box cover.

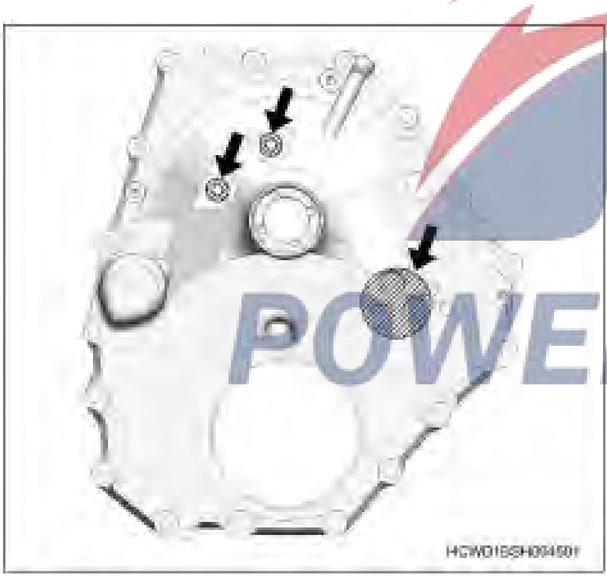
POWERSTAR



2) Use a liquid seal on the gearbox cover.

Note:

● Apply FMD127 to the back of the diagonally marked gearbox cover in the chart.



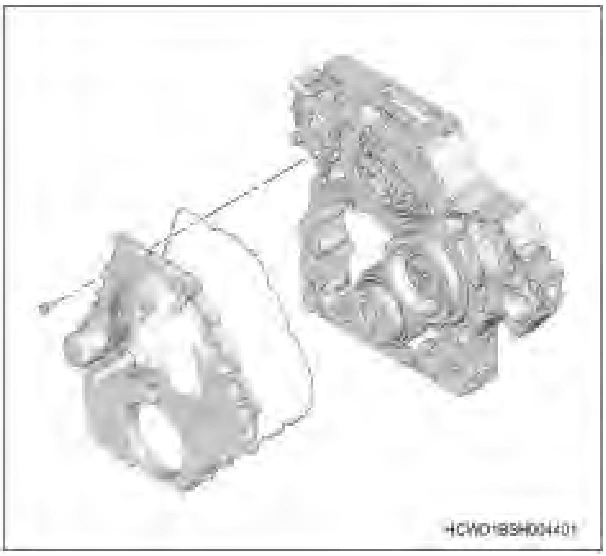
3) Install the gearbox cover onto the timing gearbox.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft}

M10

Tightening torque: 26 N • m {2.7 kgf • m / 19 lb • ft}

M8



6. Crankshaft front oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft front oil seal.

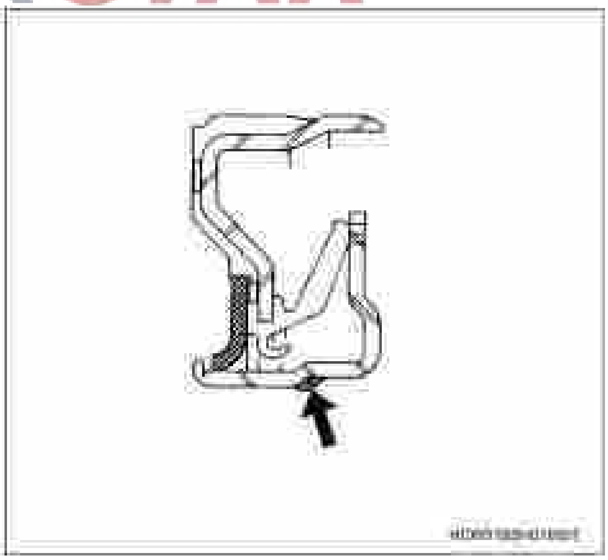
2) Install the crankshaft front oil seal to the front cover with the slinger as a set using the special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

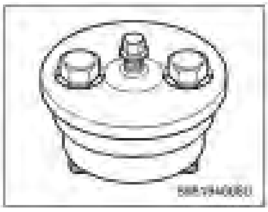
● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



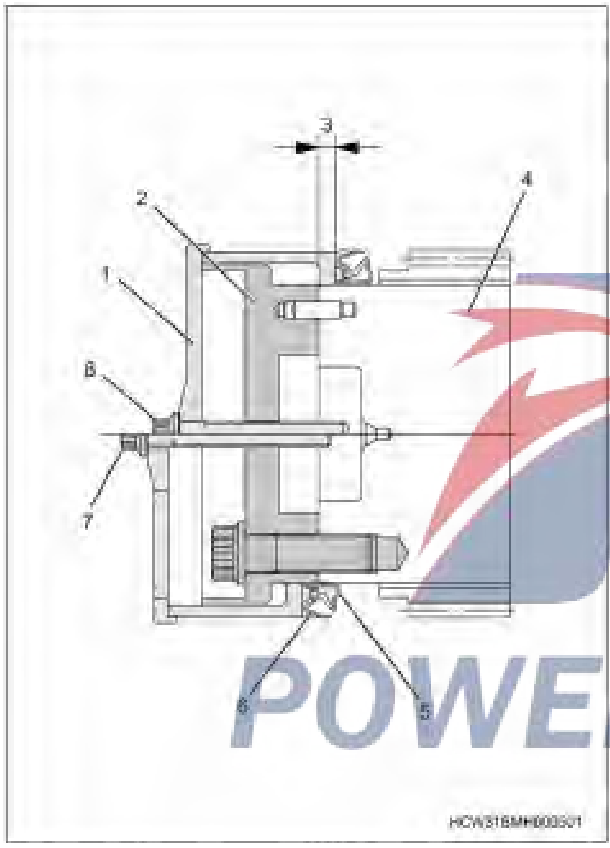
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) After the oil seal is installed by pressing assembly method, measure the size between the crankshaft end surface and the oil seal surface.

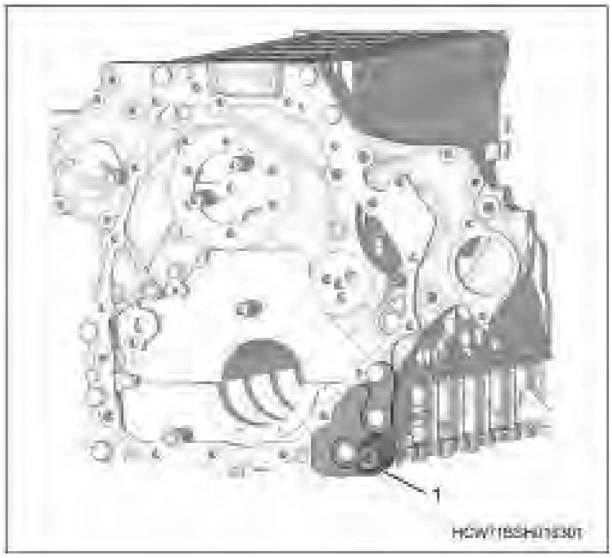


1. 8-9819-4608-0 (Sleeve)
2. 8-9819-4608-0 (Adapter)
3. 6.7 - 7.3 mm {0.264 - 0.287 in}
4. Crankshaft
5. Slinger (silver)
6. Oil seal
7. Oil seal
8. Finish pressing the position of the special tool after assembly

7. A / C compressor bracket installation

1) Install the air conditioner compressor bracket to the timing gearbox.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft}



1. Air conditioner compressor bracket

8. Idle gear installation

1) Install the idler gear to the gear cover.

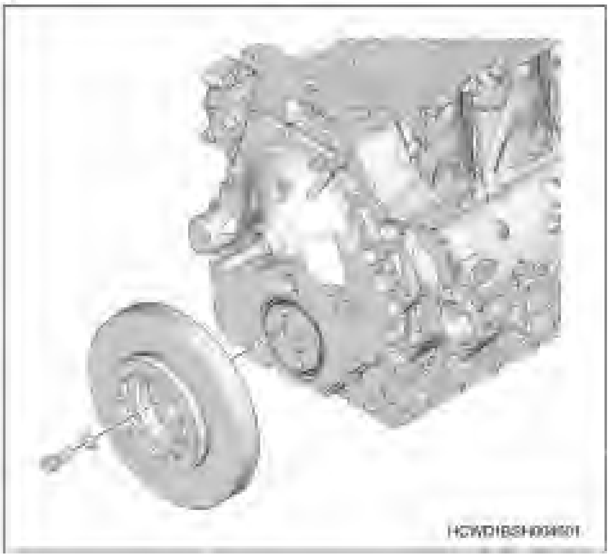
Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft}

9. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}

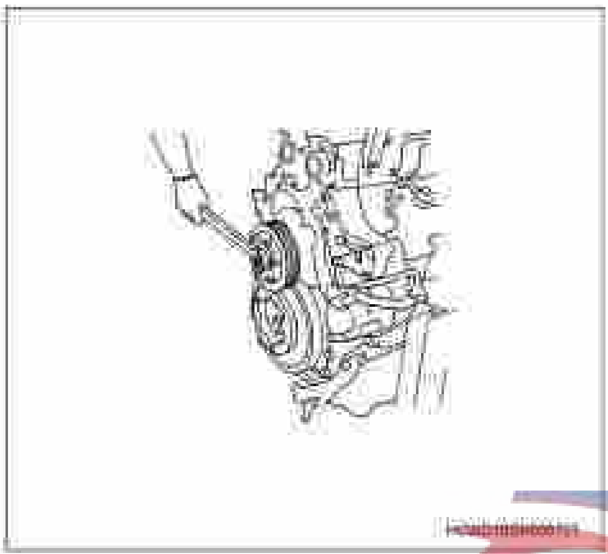


3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N• m { 55 kgf• m / 398 lb• ft }



10. Cylinder head installation

1) Use a squeegee to clean the upper surface of the cylinder block and the lower surface of the cylinder head.

Caution:

● Carefully clean the cylinder block upper surface and the cylinder head lower surface, taking care not to damage the components.

2) Refer to the diagram and the table, and apply the liquid gasket to the cylinder block.

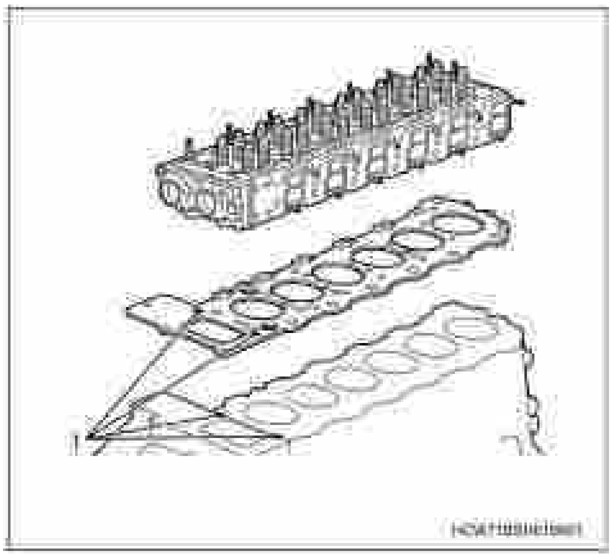
Caution:

● Strictly adhere to the liquid gasket application thickness and application width guidelines.

● After applying the liquid gasket, immediately install the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: 2 mm {0.08 in }
	Coating width	: 5 mm {0.20 in }



1. Liquid gasket application area

3) Install the cylinder head gasket to the cylinder block.

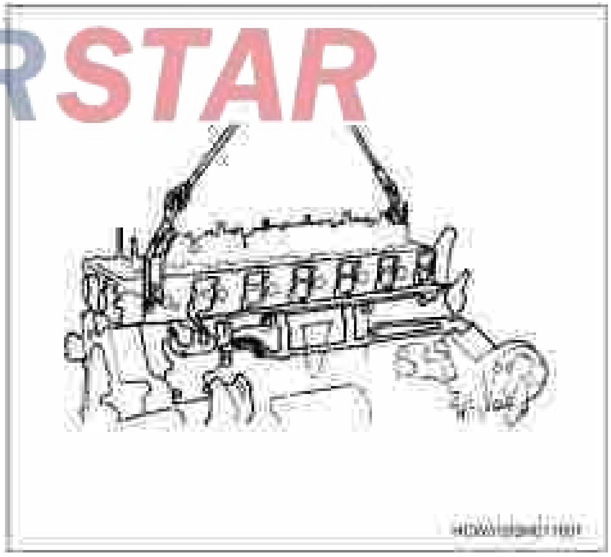
Caution:

● Do not reuse the cylinder head gasket.

4) Carefully align the knock pin positions, and place the cylinder head on the cylinder block.

Caution:

● Check the engagement of the idle gears.



5) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

Caution:

● Never use M12 bolts or M10 bolts.

6) Mount the cylinder head mounting bolts to the cylinder head in the order shown in the figure.

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Caution:

● Do not drip foreign matters into the timing gear hole.

● Cylinder head mounting bolts can be used up to 4 times.

Tightening torque: 177 N • m {18.0 kgf • m / 131 lb • ft} 1st (M18)

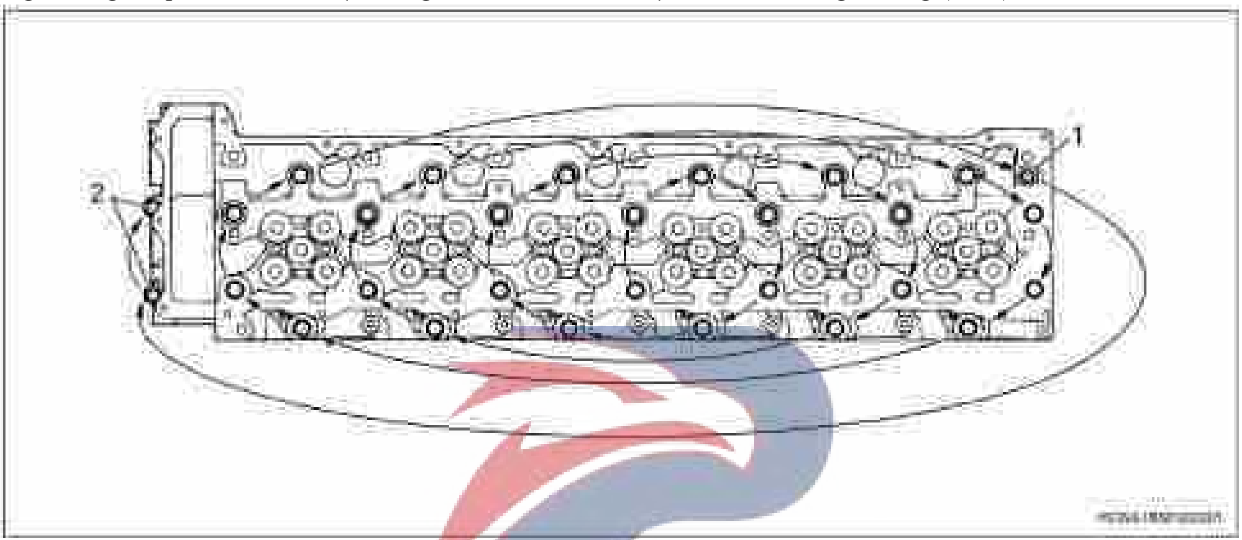
Tightening torque: 245 N • m {25.0 kgf • m / 181 lb • ft} 2nd (M18)

Tightening angle: 60 to 90 ° Third time (M18)

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft} 4th (M12)

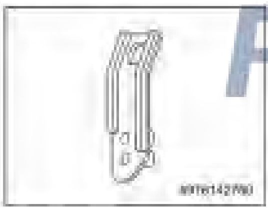
Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft} 5th (M10)

Tightening torque: 324 N • m {33.0 kgf • m / 239 lb • ft} Confirm the tightening (M18)

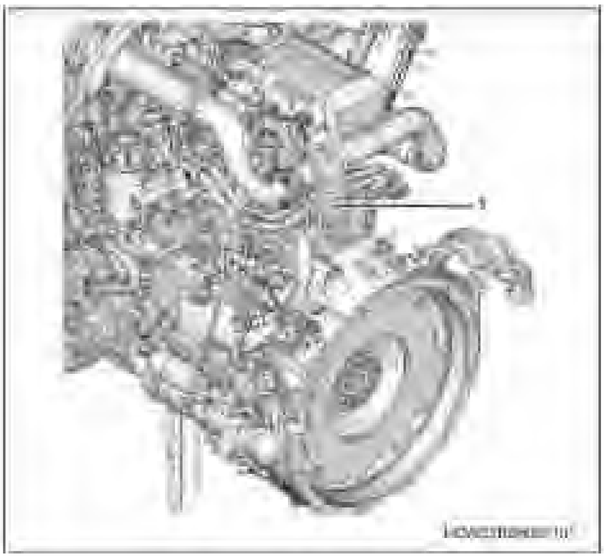


1. M12 bolt
2. M10 bolt

7) Remove special tool from the cylinder head.



SST: 8-9761-4276-0 - engine hanger



1. 8-9761-4276-0

11. Glow plug installation

1) Install the glow plug to the cylinder head.

Tightening torque: 25 N • m {2.5 kgf • m /18 lb • ft}

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m {0.15 kgf • m / 13 lb • in}

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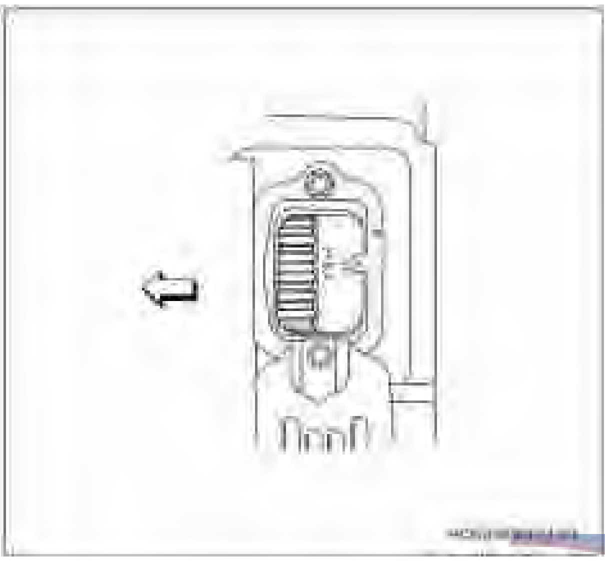
12. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.

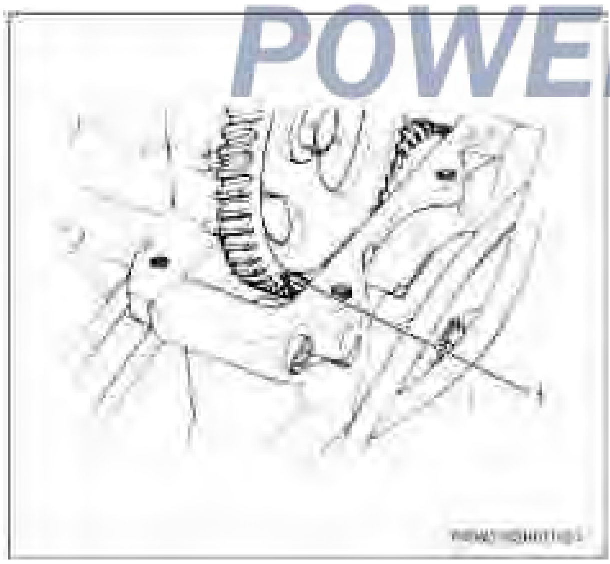


2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.



1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

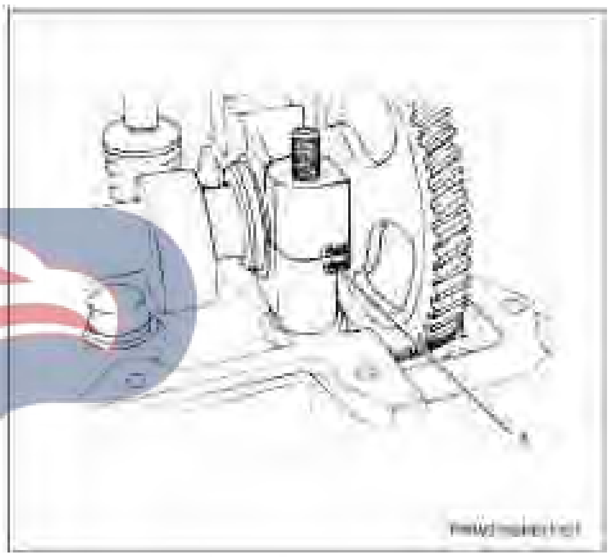
Note:

● Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.



1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m {7.7 kgf • m /56 lb • ft}

13. Bridge installation

1) Apply the engine oil to the bridge guide.

2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.

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1. Bridge

14. Rocker arm shaft installation

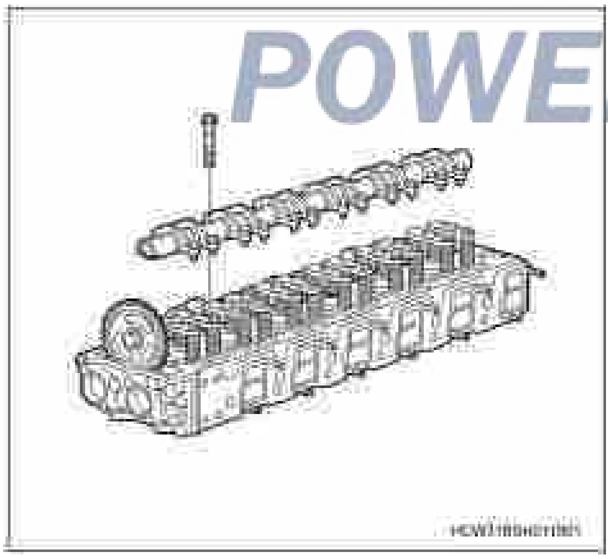
1) Lubricate the roller arm and adjusting screw lip with engine oil

2) Loosen the adjust screw.

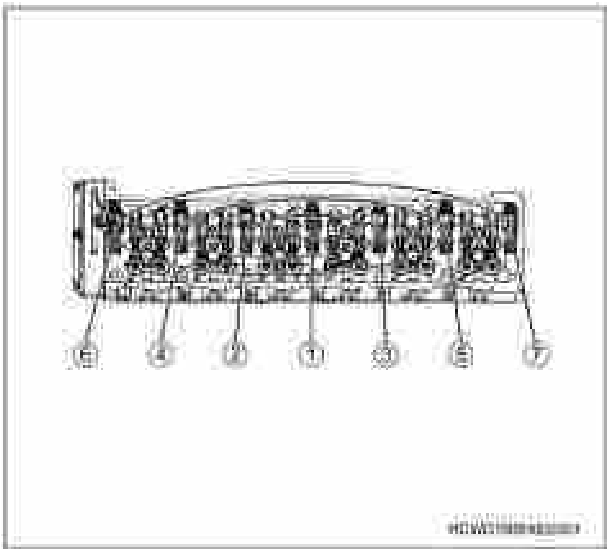
Note:

● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



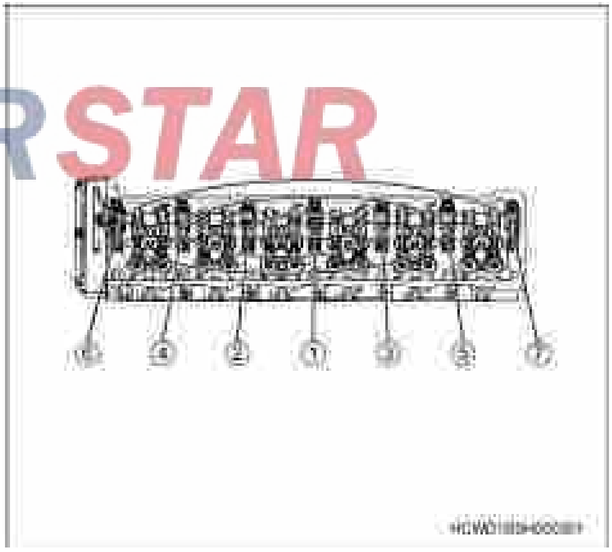
Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 lb • ft}



15. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m /30 lb • ft}

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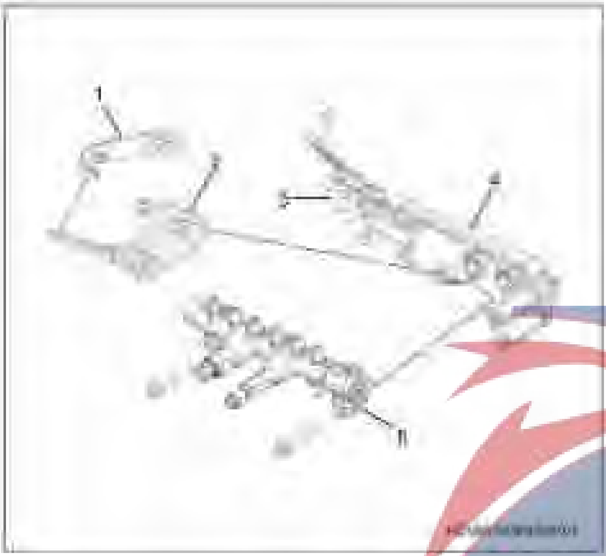
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipe line bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

---

4) Connect the harness connector to the fuel rail position sensor.

16. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

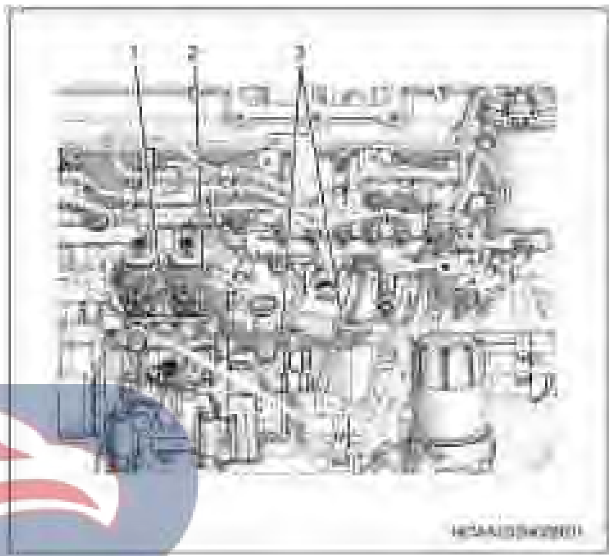
5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.



1. Fuel pipe
2. Fuel pipe
3. Clip

---

17. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

Note:

● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.

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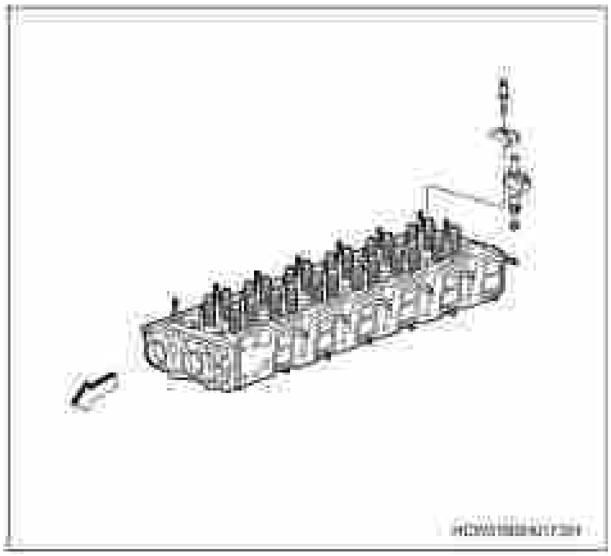

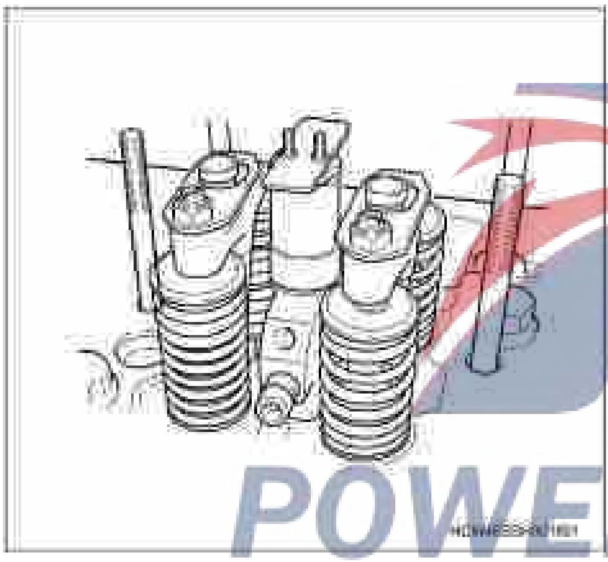

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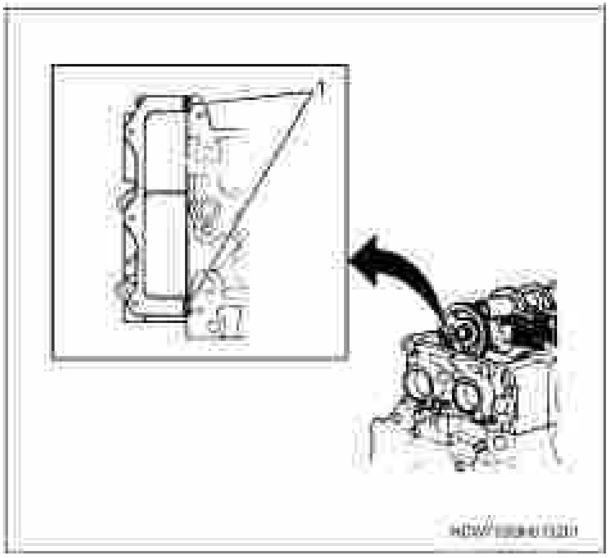
3) Temporarily fasten the injector clamp on the injector.

18. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

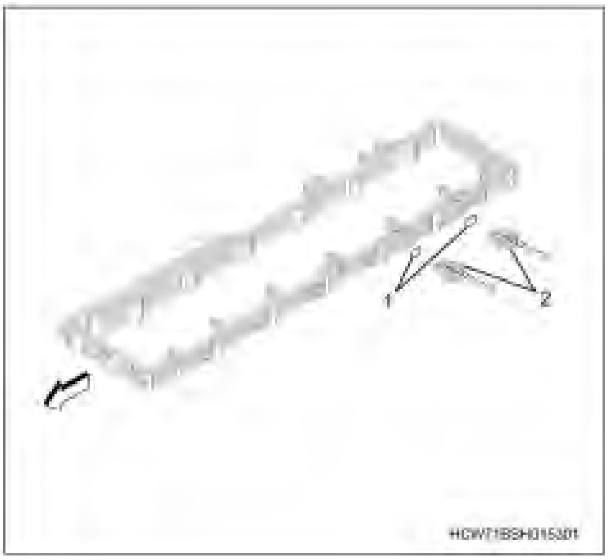
3) Install the lower end cap onto the cylinder head.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}



1. O-ring

2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

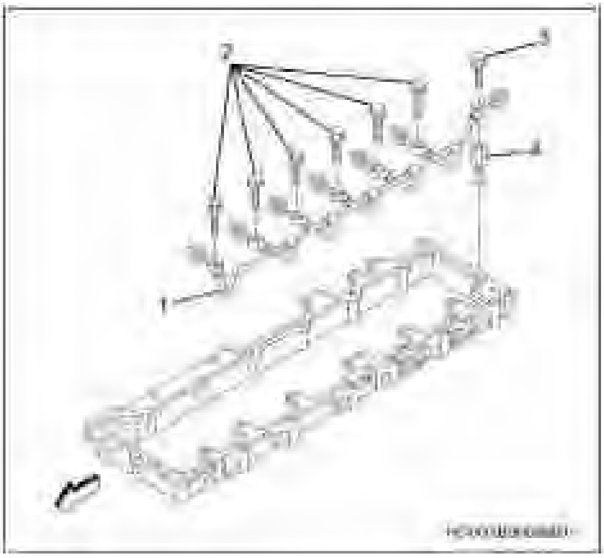
● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 25 lb • ft}



1. Nozzle spout

2. Eyebolt

3. Eyebolt

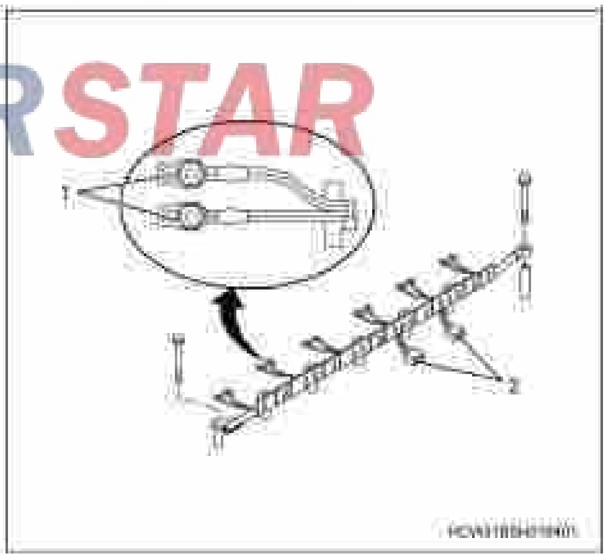
4. Adapter

19. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut

2. Connector

2) Install the injector harness onto the cylinder head.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

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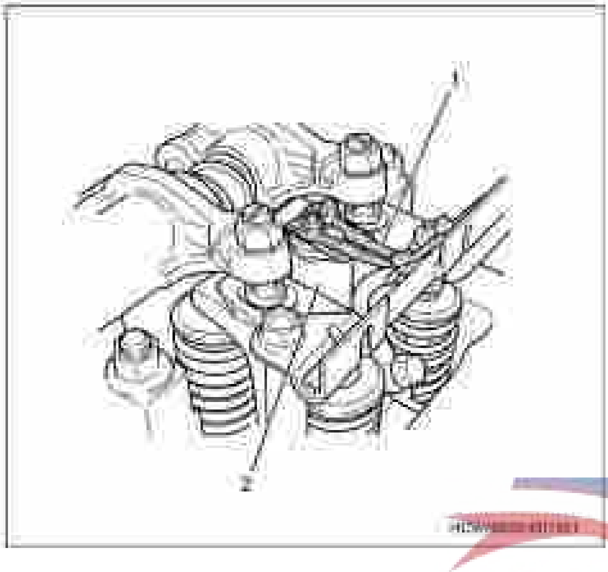
Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



1. Injector harness
2. Injector

20. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

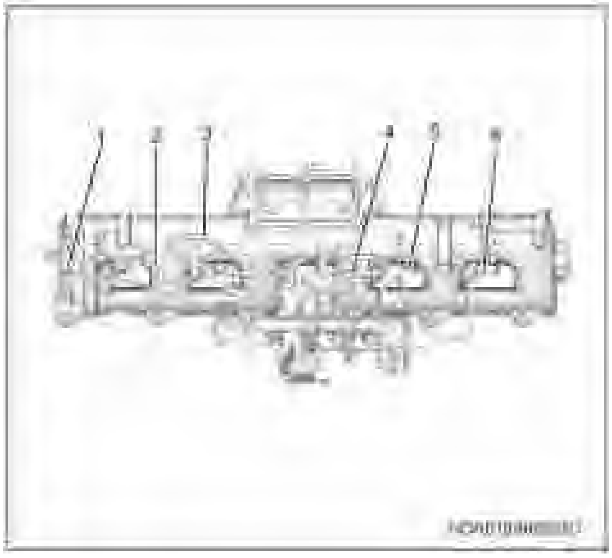
Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



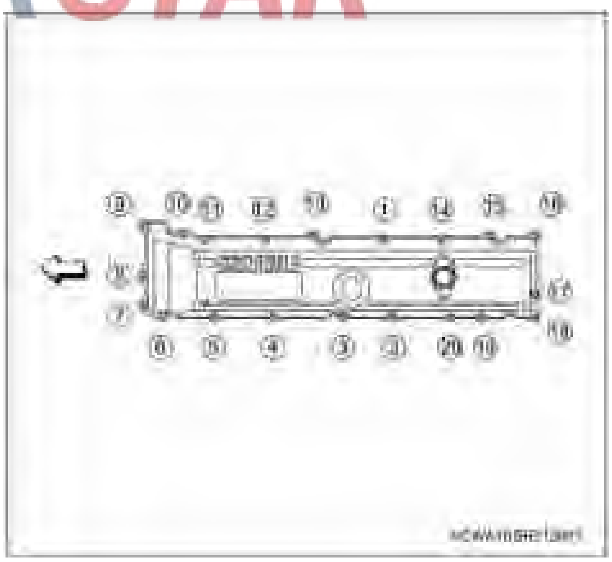
1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

21. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



22. Generator bracket Installation

1. 50 A and 60 A specifications

1) Install the generator bracket on the timing

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gearbox.

2) Install the generator bracket on the cylinder head.

2. 90 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

Note:

● When installing, make the right side of the oval hole area of the bracket contact with the bolt.

23. Generator installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground cable and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m /61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground cable and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

24. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

25. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

26. Cooling fan belt adjustment

As the cooling fan belt V-ribbed belt, therefore,

Compared to conventional V-belts, more precise tension adjustment is required.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

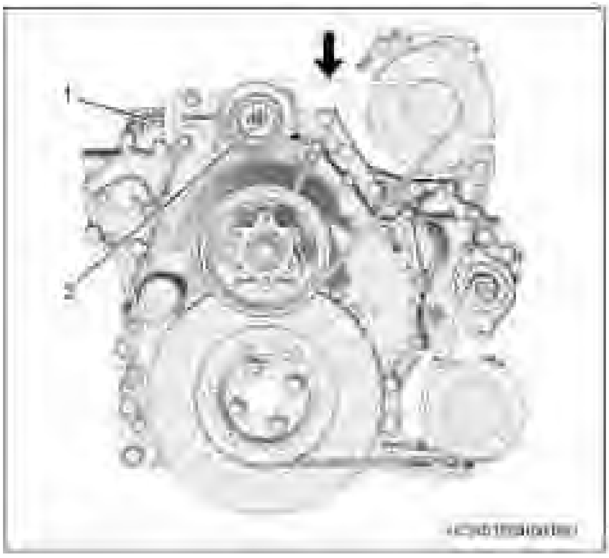
Cleaning fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394 to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551 to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394 to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512 to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

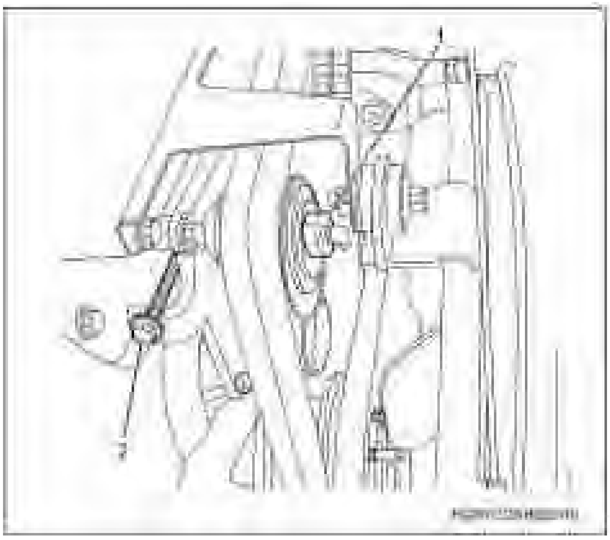
Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N• m { 15.0 kgf• m / 108 lb• ft }



1. Lock nut
2. Adjust bolt

27. A/C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A/C compressor pulley and crankshaft pulley to the specified value.

If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A/C compressor pulley and the crankshaft pulley.

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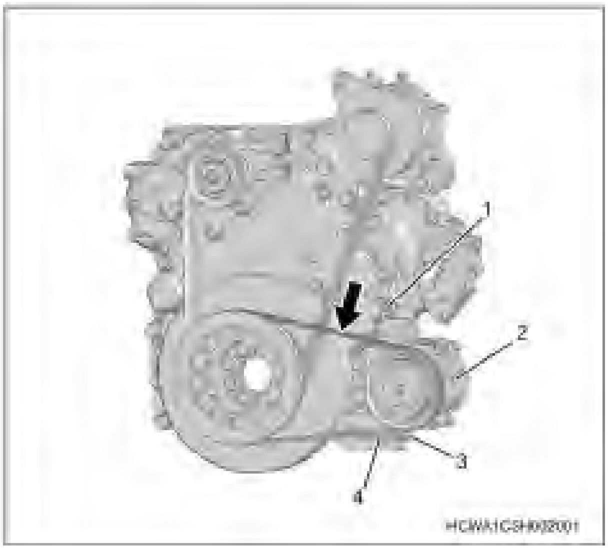
Air conditioner compressor belt tension specified value

Adjustment conditions	When new	When adjusting tension
tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0 to 40.0kg }
deviation	: 11 to 14mm { 0.4 to 0.6in }	: 15 to 17mm { 0.6 to 0.7 in }
vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

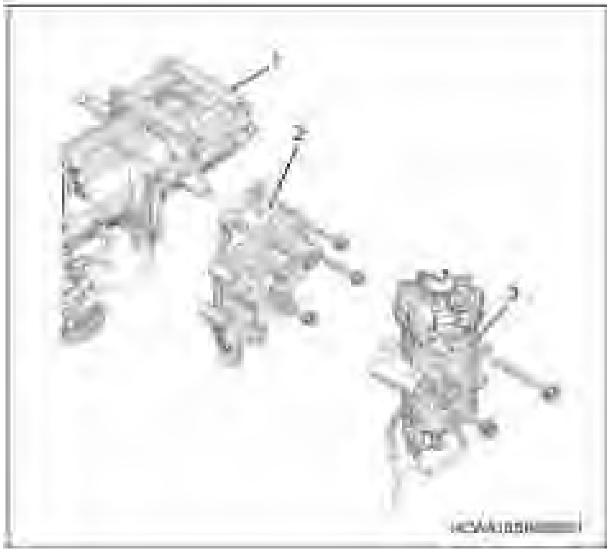
28. Fuel filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

29. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

30.Oil feed pipe installation

1) Temporarily fasten the fuel drain pipe to the cylinder head.

2) Tighten the fuel drain pipe to the cylinder head.

Eyebolt tightening torque list

Dimensions	Tightening torque
M8	: 15 N• m { 1.5 kgf• m / 11 lb• ft }
M10	: 27 N• m { 2.8 kgf• m / 20 lb• ft }
M12	: 34 N• m { 3.5 kgf• m /25 lb• ft }
M14	: 41 N• m { 4.2 kgf• m / 30 lb• ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

31. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

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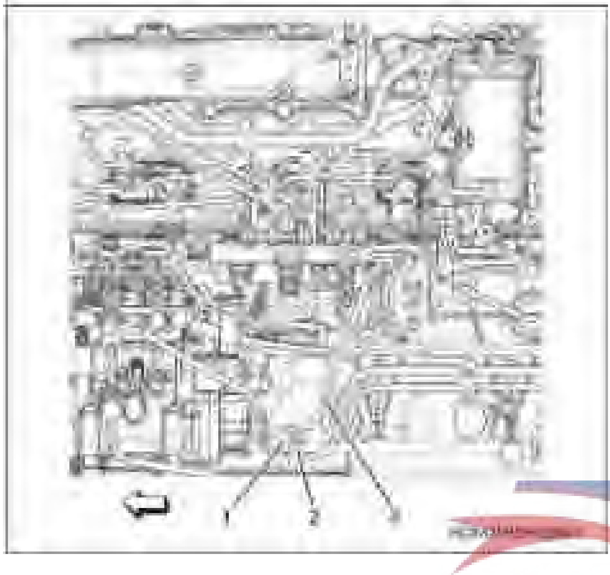
32. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

33. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

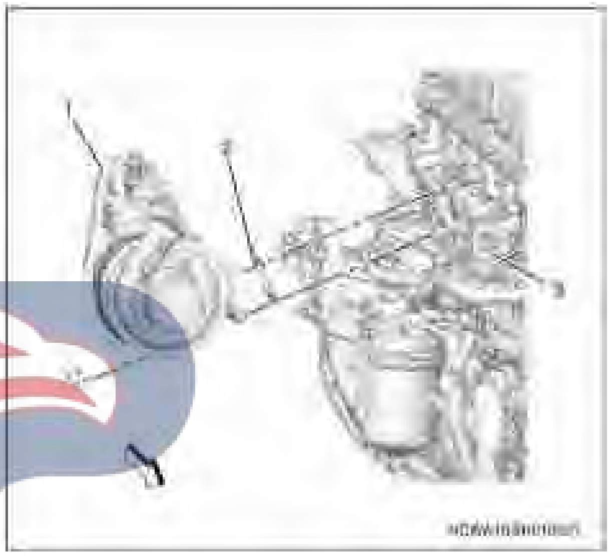
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb• ft}



1. Turbocharger
2. Gasket
3. Exhaust manifold

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4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N• m { 4.2 kgf• m / 30 lb• ft }

6) Connect the water return pipe to the turbocharger.

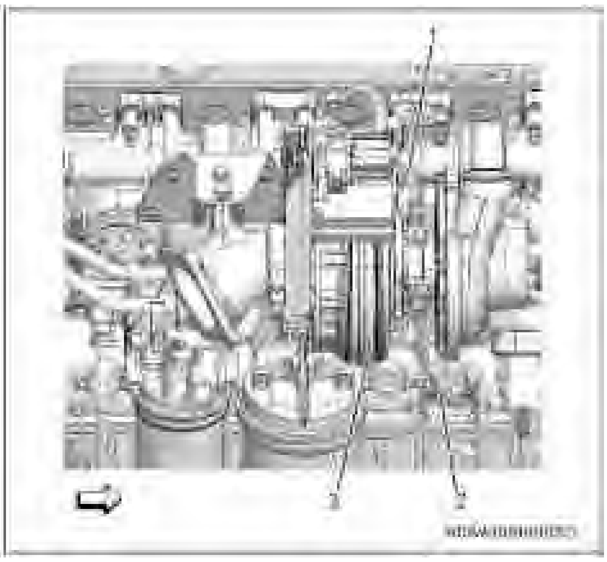
Tightening torque: 50 N• m { 5.1 kgf• m / 37 lb• ft }

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N• m { 4.2 kgf• m /30 lb• ft }

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N• m { 5.1 kgf• m / 37 lb• ft }



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

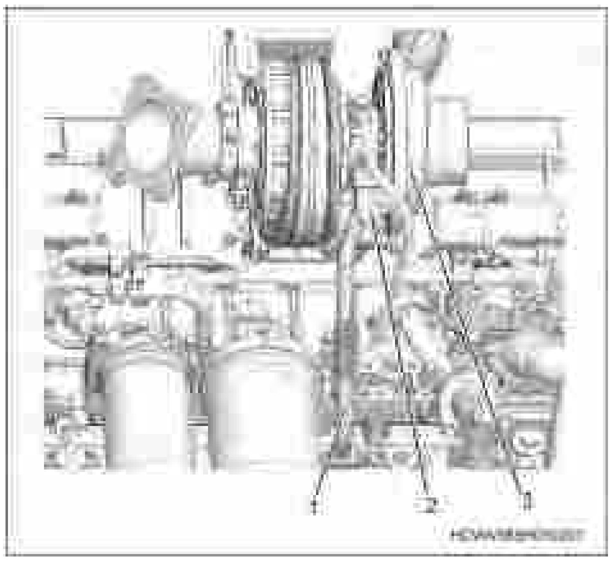
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

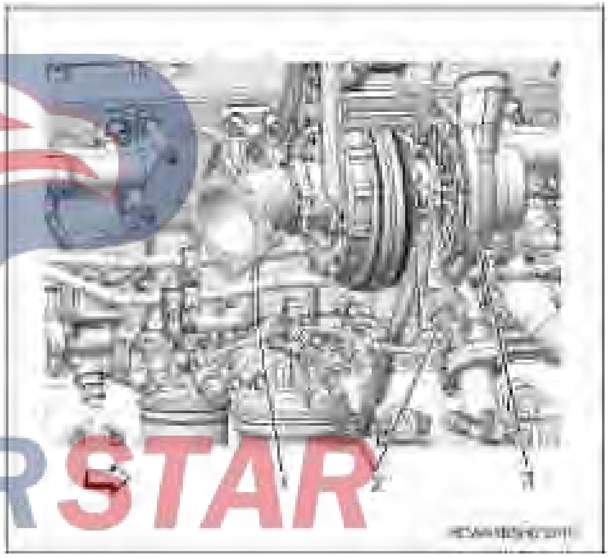
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the fuel filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the fuel filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}



1. Turbocharger oil feed pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m { 1.0 kgf • m / 89 lb • in }

34. Exhaust cover installation

1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

● Uniformly tighten the mounting nuts and bolts of

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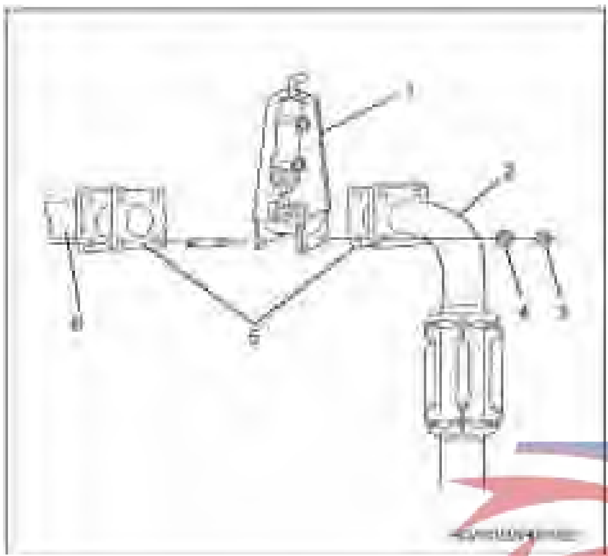
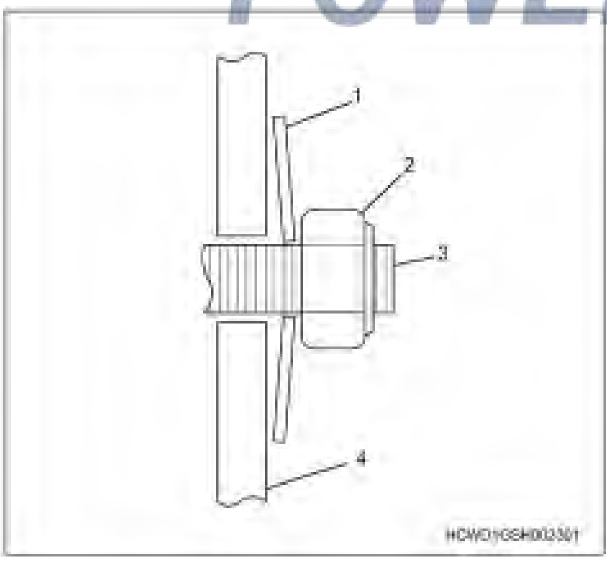
the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N• m { 6.0 kgf•m / 44 lb • ft }



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

35. Exhaust cover installation

1) Install the exhaust cover to the frame.

36. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

37. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

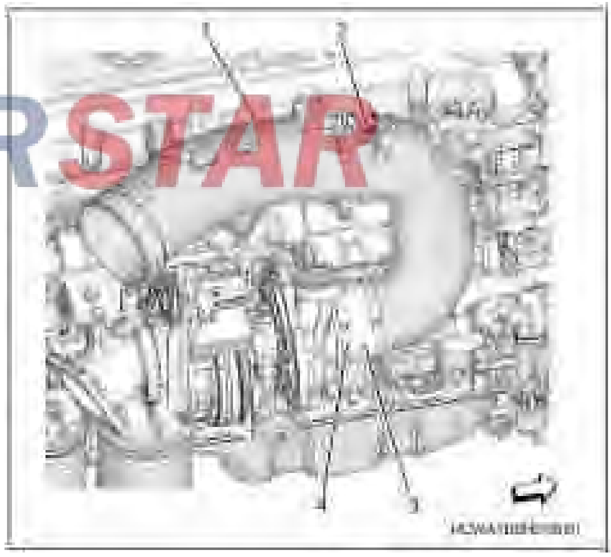
2) Install the mudguard on the left side of the vehicle to the bracket.

38. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m /29 lb • ft} M10



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air

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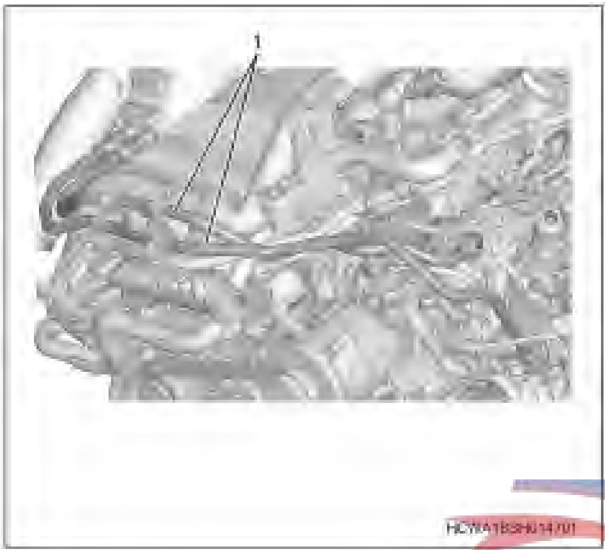
flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

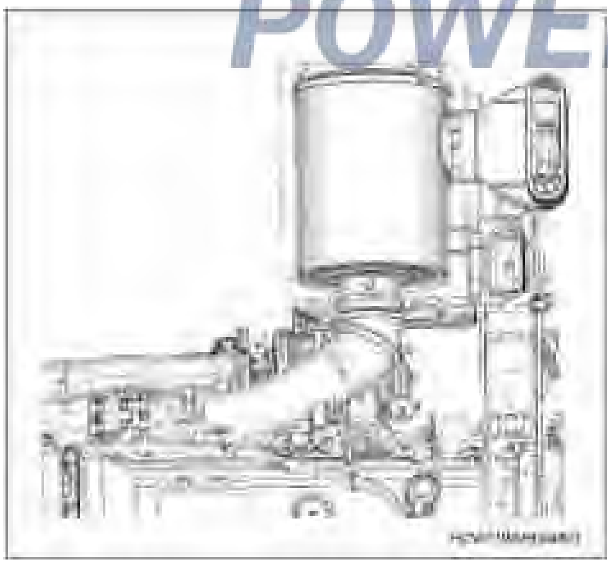
39. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



40. Pilot valve installed

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

41. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

- Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf •m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

- Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

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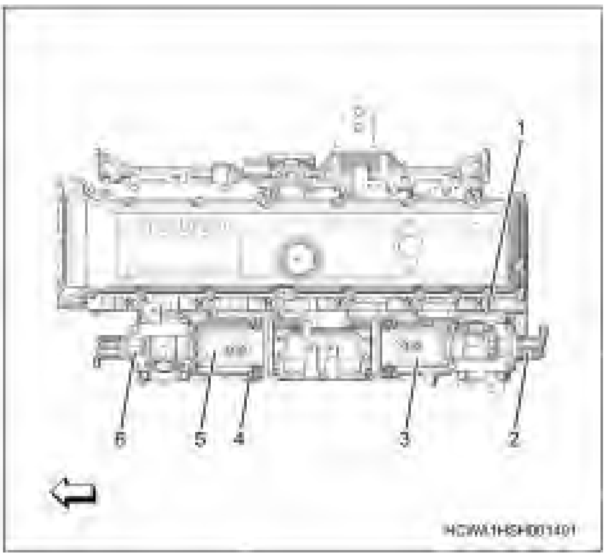


1. Harness bracket
2. EGR valve 1
3. EGR valve B
4. Pipe bracket
5. EGR Valve A
6. EGR valve 1

5) Final Tighten the EGR valve conduit A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb• ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

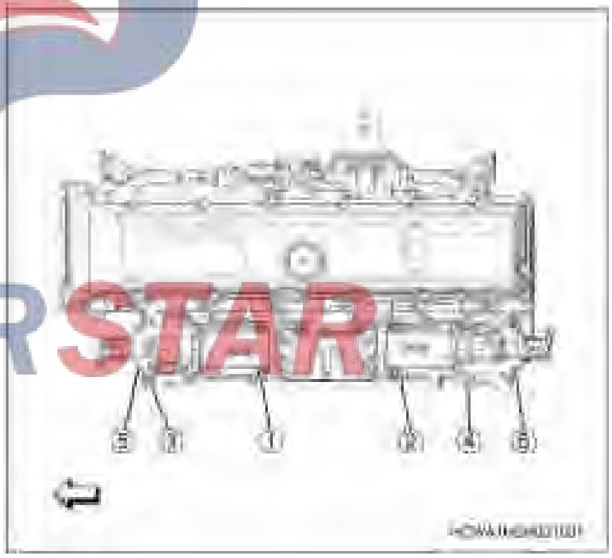
Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



42. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

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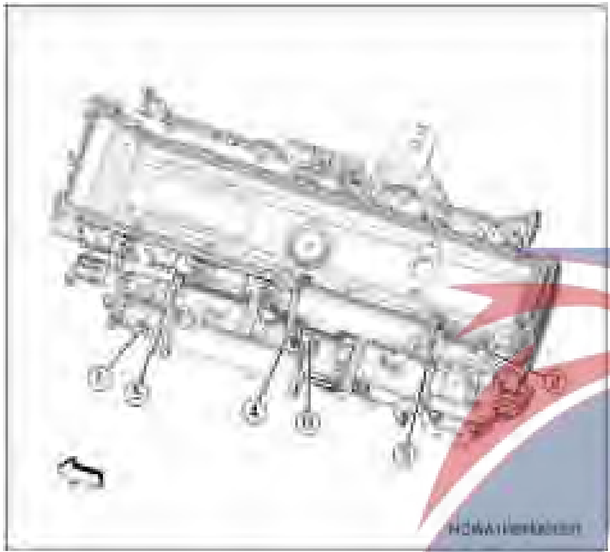
1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

- ● EGR cooler duct D.
- ● EGR cooler duct B
- ● EGR cooler B
- ● EGR cooler D

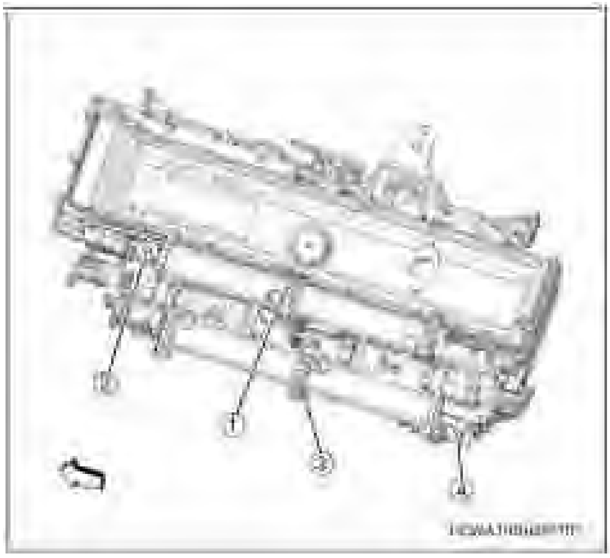
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

- ● EGR cooler A.
- ● EGR cooler bracket
- ● EGR cooler C
- ● EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

- ● EGR cooler duct D
- ● EGR cooler duct B
- ● EGR cooler B
- ● EGR cooler D
- ● EGR cooler A
- ● EGR cooler bracket
- ● EGR cooler C
- ● EGR cooler bracket

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5 (M10), 6(M10)

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5(M8), 6(M8)

Note:

● The number behind the tightening torque indicates the diagram number.

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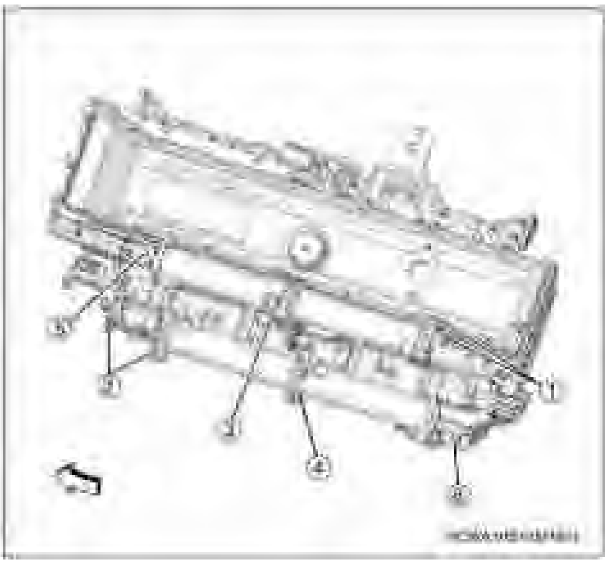


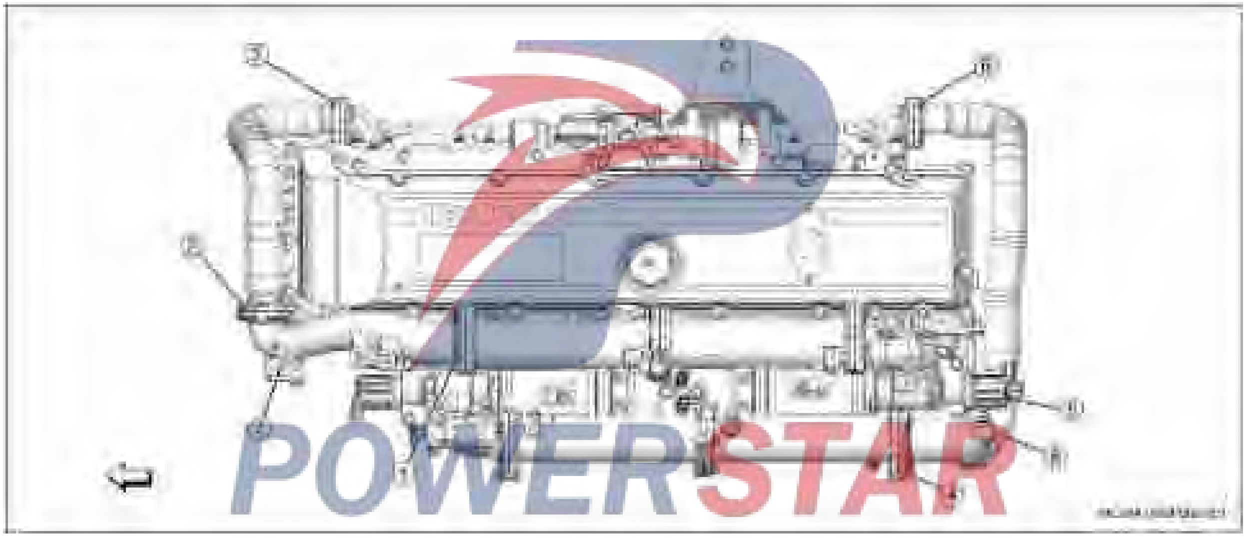
4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

- EGR cooler duct A.
- EGR duct A
- EGR cooler duct C.
- EGR duct B.
- Bracket

Caution:

- Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

- EGR cooler duct A
- EGR duct A
- EGR cooler duct C
- EGR duct B
- Bracket

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 1 (M10), 2, 3, 9 (M10), 10 (M10)

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 4

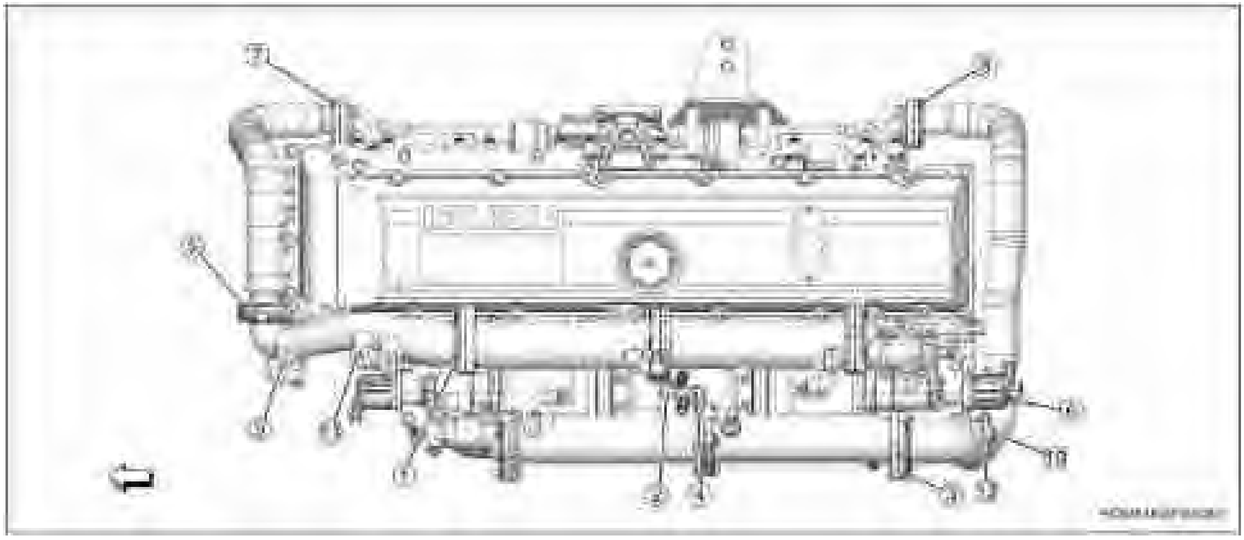
Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft } 5, 6 (M8), 7, 8 (M8), 9 (M8)

Tightening torque: 24.7 N • m { 2.5 kgf • m / 18 lb • ft } 10 (M8)

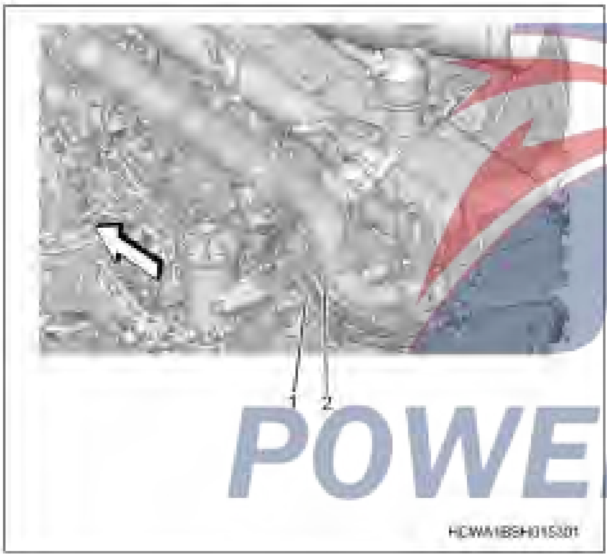
Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft } 11, 12 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front return pipe
2. Rear return pipe

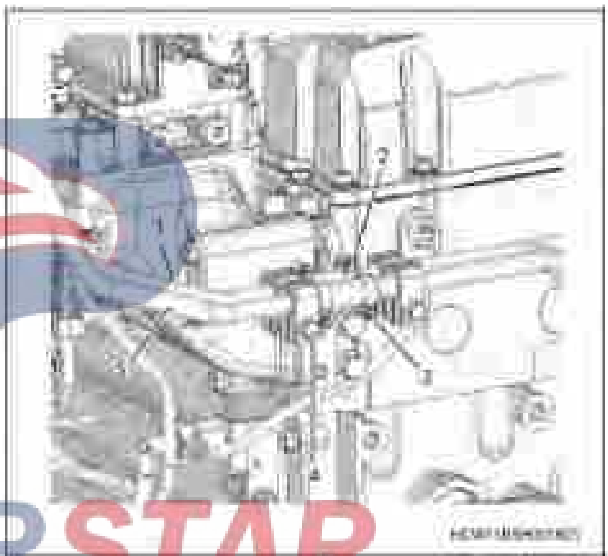
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.



1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp the bolt
5. Rear return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.

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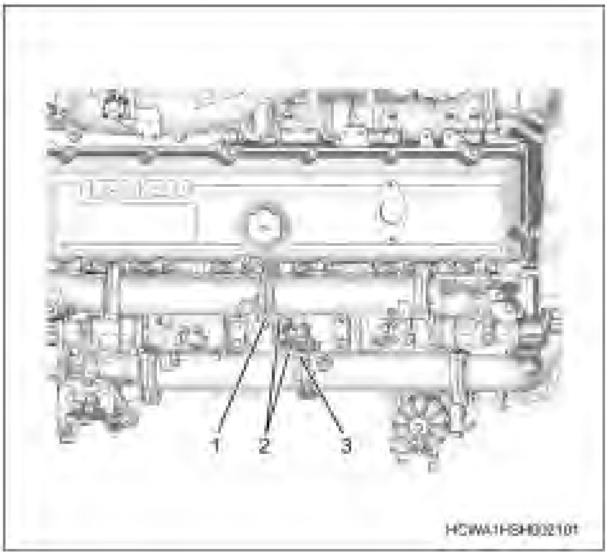


1. Hose clip

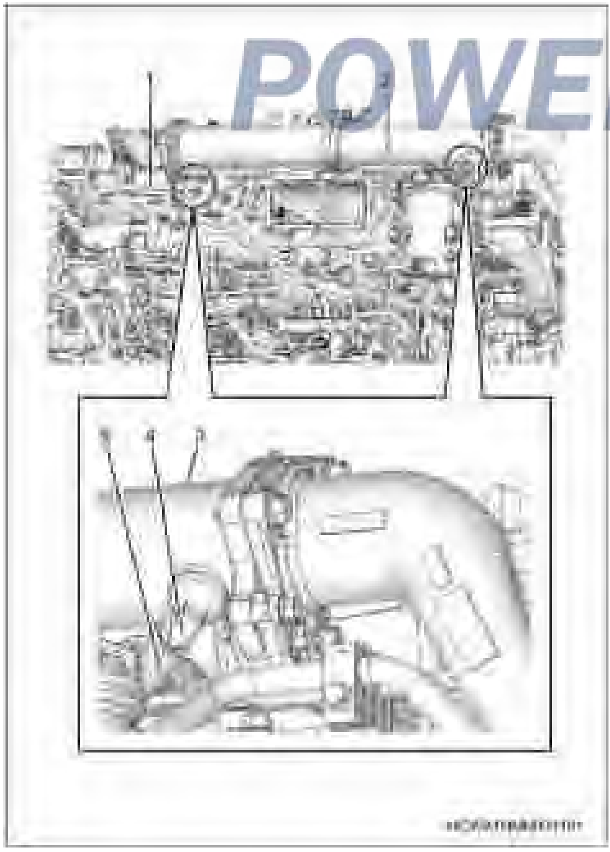
2. Water feed hose

3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



1. Front-end water supply pipe

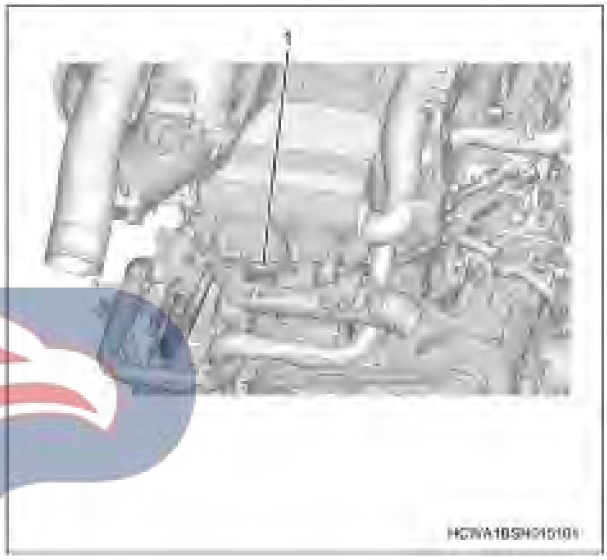
2. Back-end water pipe

3. EGR cooler.

4. Raised part of the tip

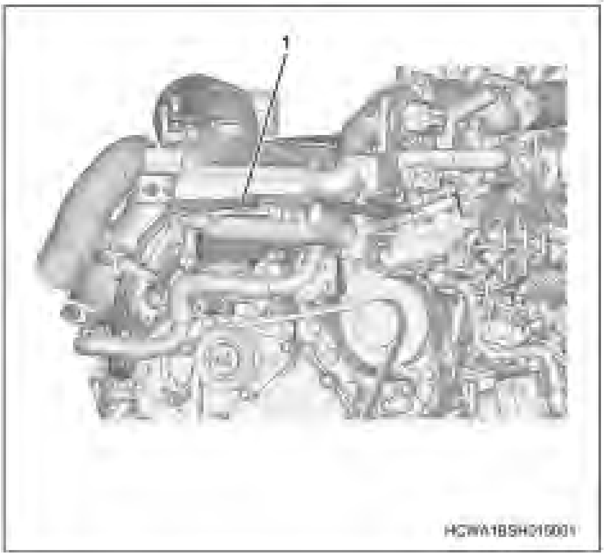
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

43. Suction pipe installation

1) Install the bracket on the drain.

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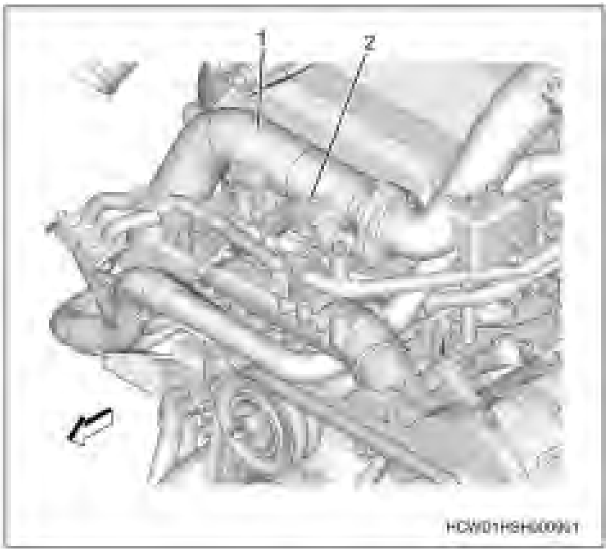
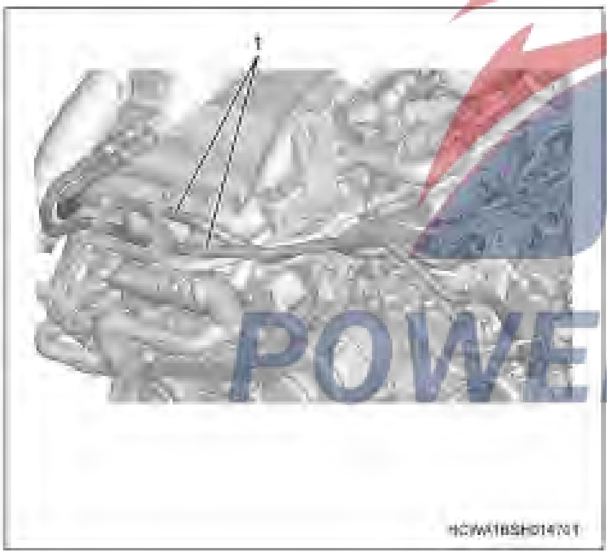


1. Front exhaust gas recirculation line

2. Bracket

2) Install 2 air suction tubes to the air compressor.

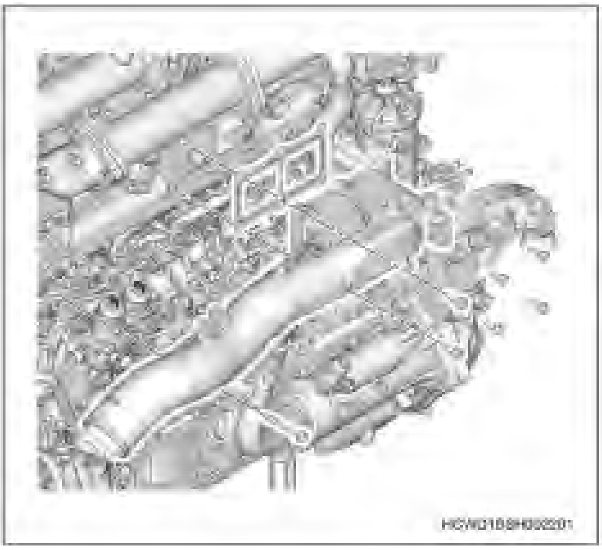


1. Exhaust pipe

44. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}



45. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }

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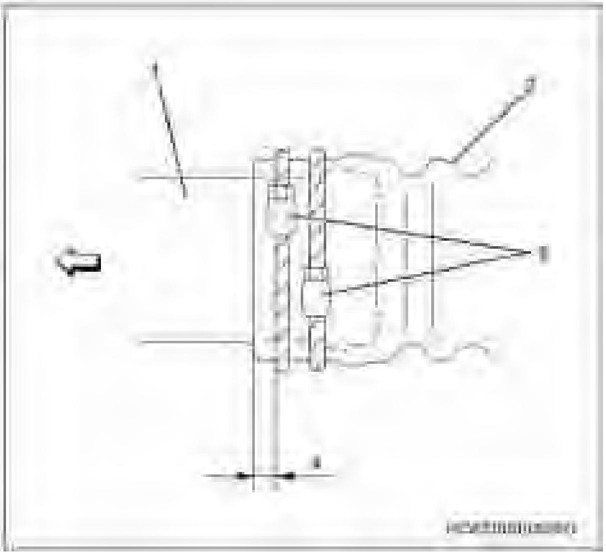


1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

46. Water charge pipe installation

1) Install the water charge pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water charge line bracket on the exhaust gas recirculation valve duct A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

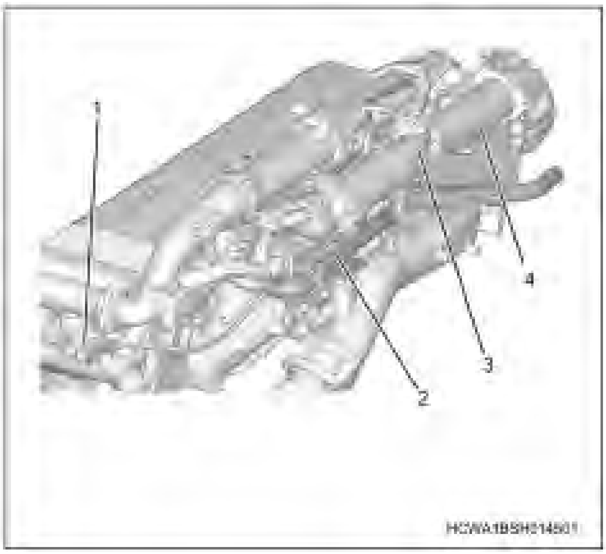
47. Air leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb• ft}

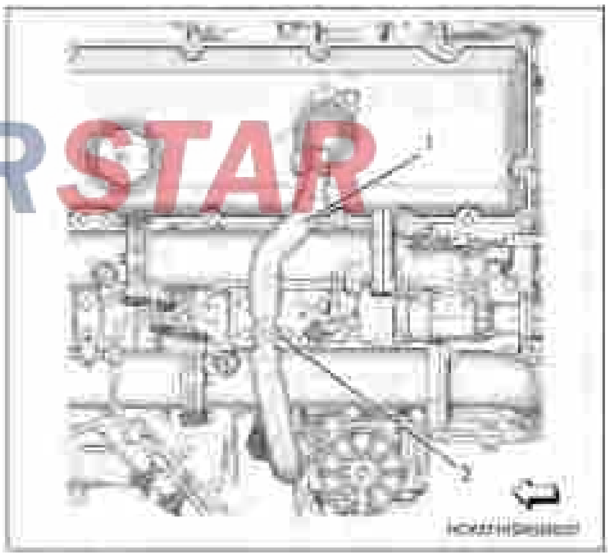
Eyebolt



1. Outlet pipe
2. Water charge pipe
3. Back-end trachea
4. Front leakage tube

48. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

49. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

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2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

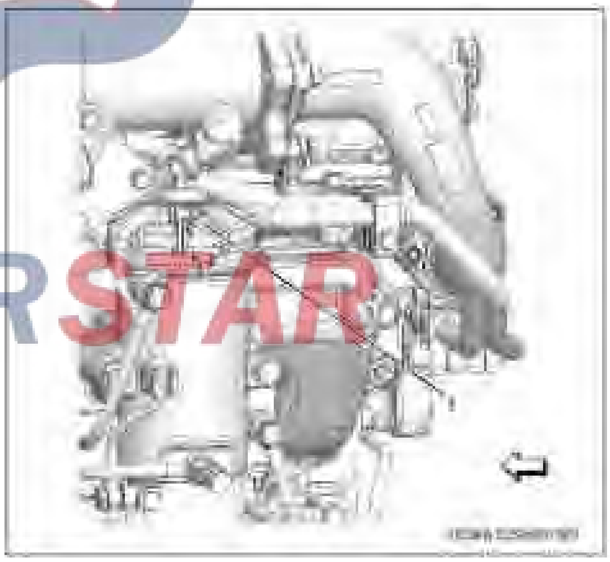
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

50. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N•m { 0.7 kgf•m / 62 lb•in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

6) Operate the priming pump until large bubbles are no longer formed.

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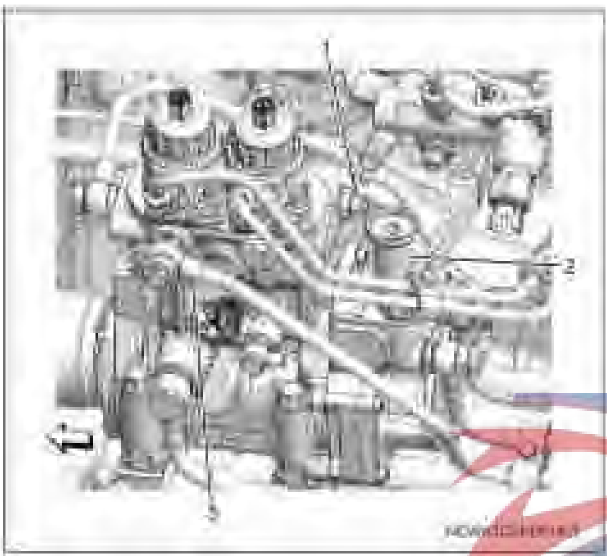
7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

51. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

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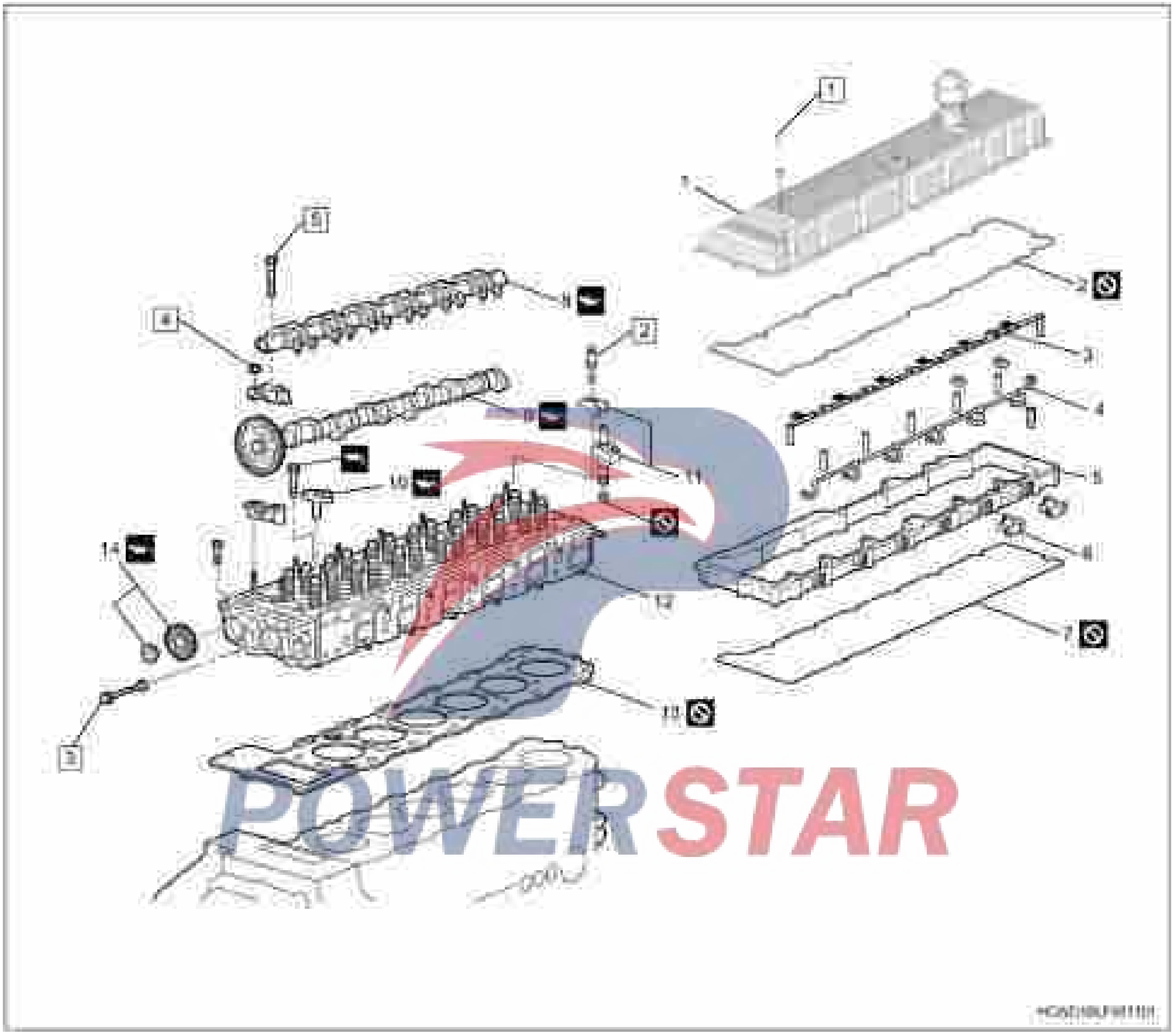
Cylinder head

Removal

1. Component Views

Cylinder top



Part name

1. Cylinder head cover
2. Cover gasket
3. Injector harness
4. Fuel leak-off pipe
5. Lower cover
6. Harness connector
7. Lower cap gasket
8. Rocker
9. Camshaft
10. Bridge
11. Injector, clamp
12. Cylinder top
13. Cylinder head gasket
14. Idling gear C

Tightening torque

1: 15 N• m { 1.5 kgf • m / 11 lb • ft }

2: 49 N•m { 5.0 kgf • m / 36 lb • ft }

3: 40 N•m { 4.1 kgf • m / 30 lb • ft }

4: 76 N•m { 7.7 kgf • m / 56 lb • ft }

5: 90 N•m { 9.2 kgf • m / 66 lb • ft }

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

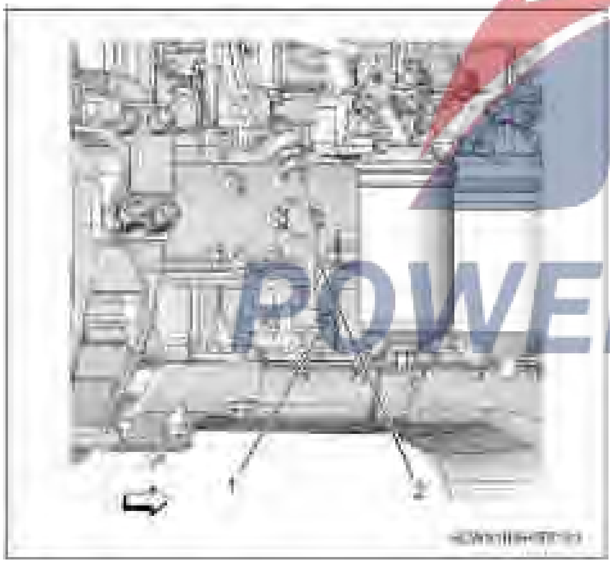
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.

1. Drain plug

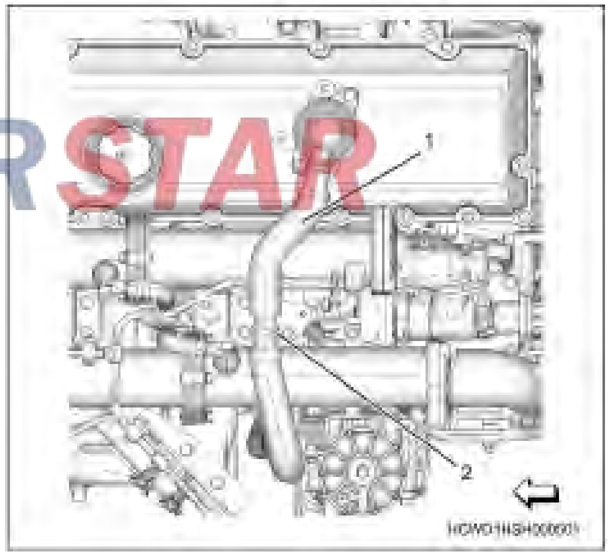
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



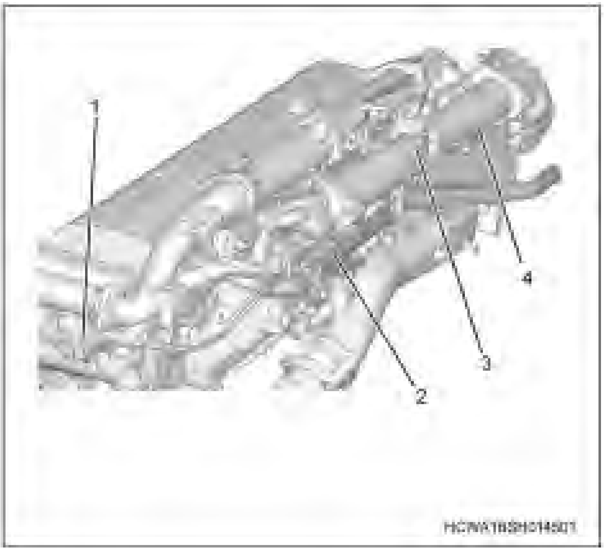
1. Ventilation hose

2. Ventilation hose clip

5. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

6. Water charge pipe removal

1) Remove the charge pipe from the filling pipe holder.

2) Remove the water charge bracket from the inlet pipe.

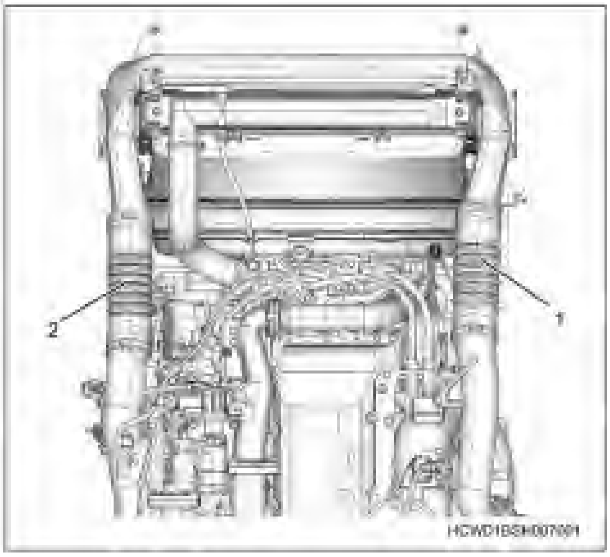
3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

7. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

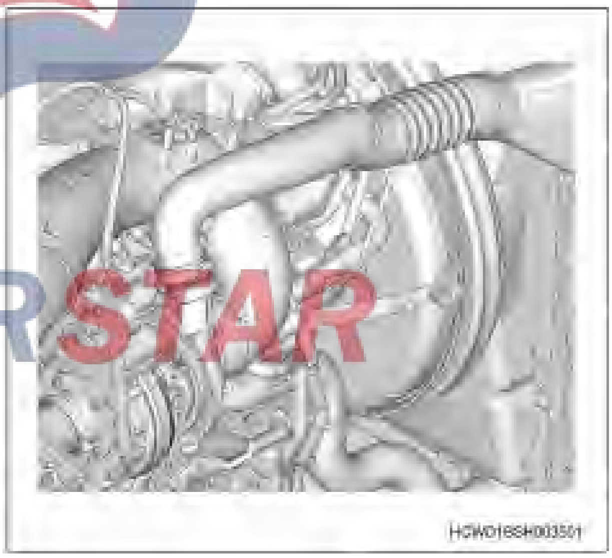
2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



8. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.

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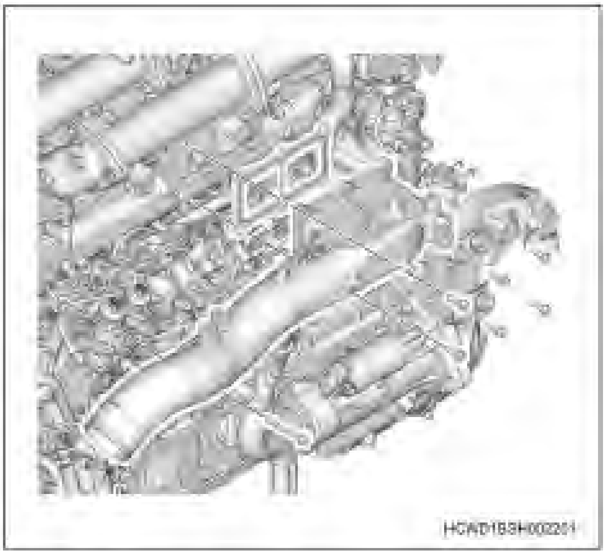
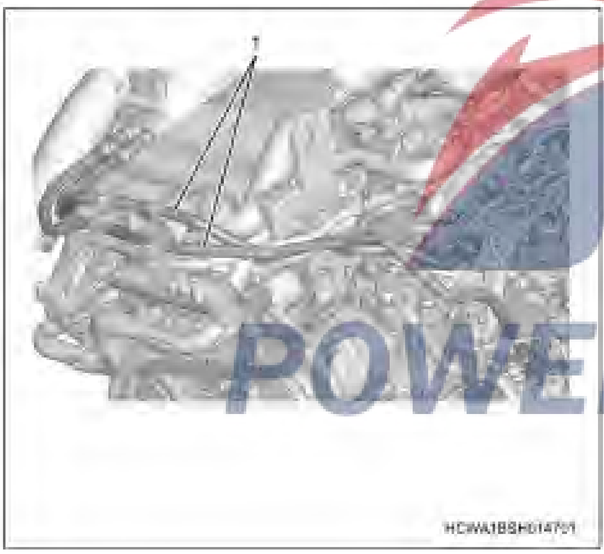


9. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

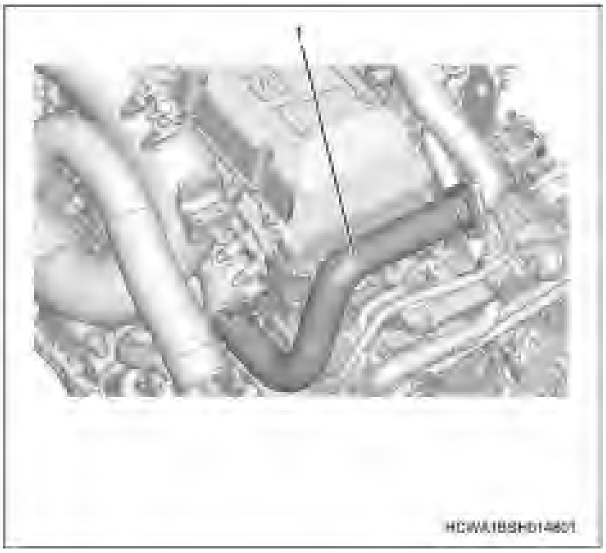


1. Exhaust pipe

10. EGR cooler removal

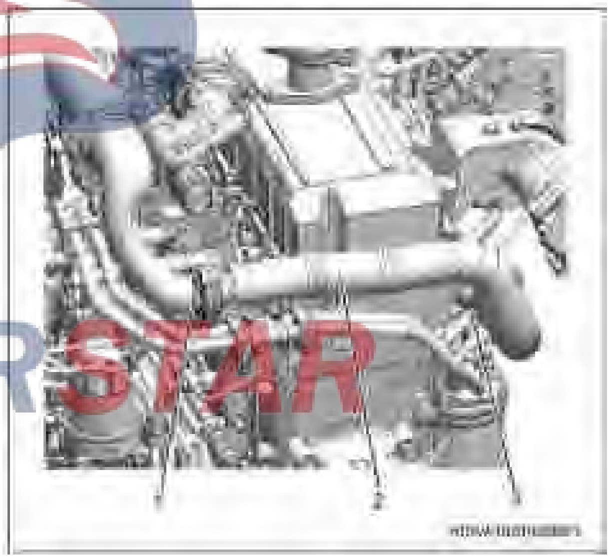
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



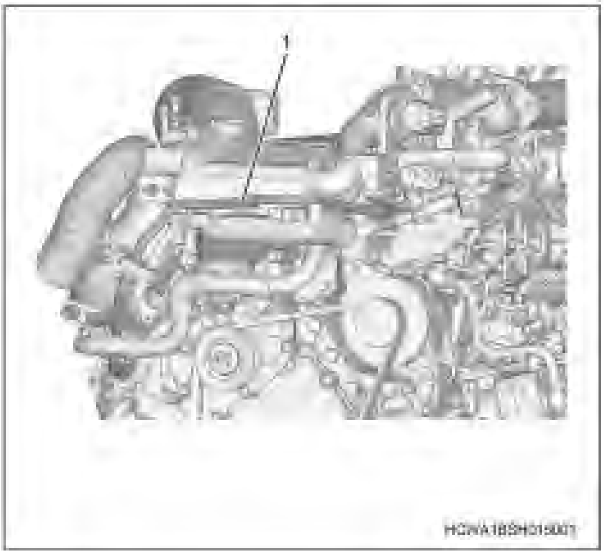
1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on theexhaust gas recirculation cooler line C.



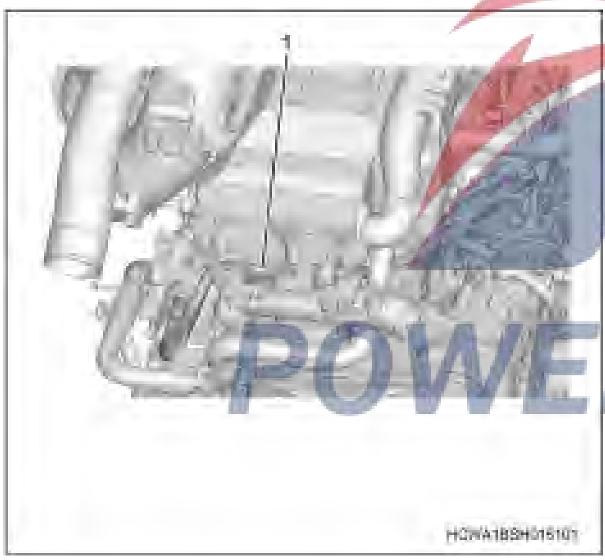
1. Standard bolt
2. Exhaust gas recirculation line B
3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.



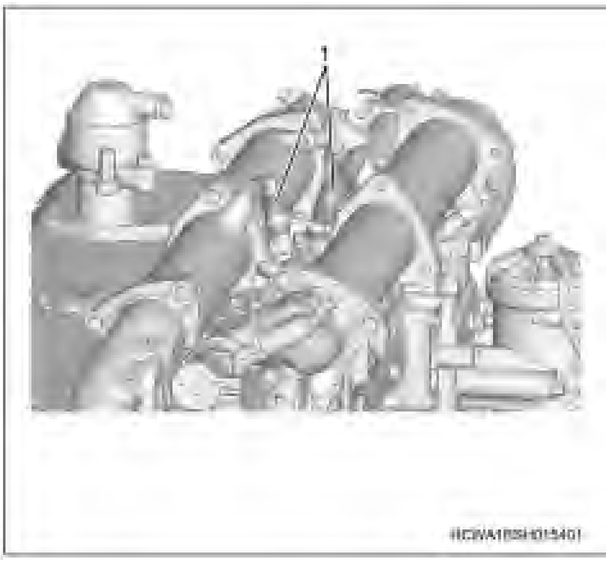
1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.



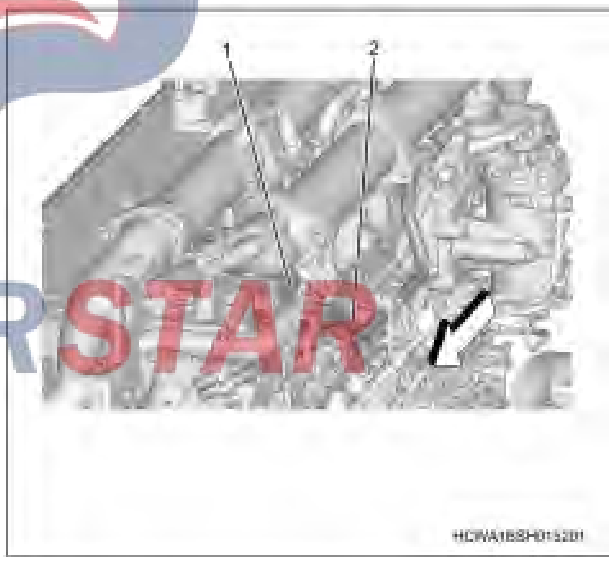
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. Water feed hose

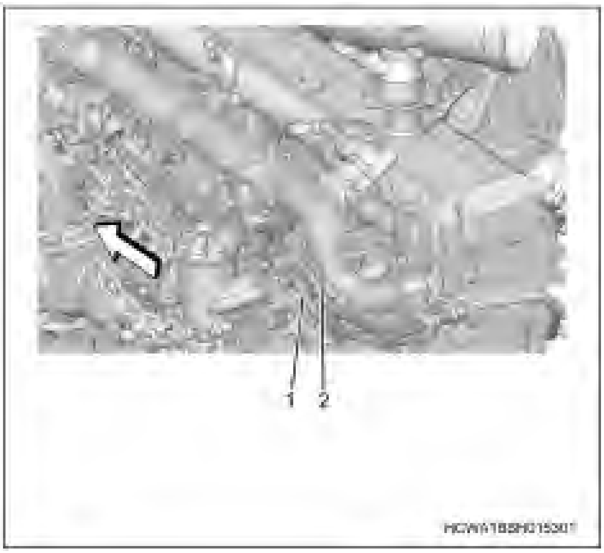
7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe
2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

POWERSTAR

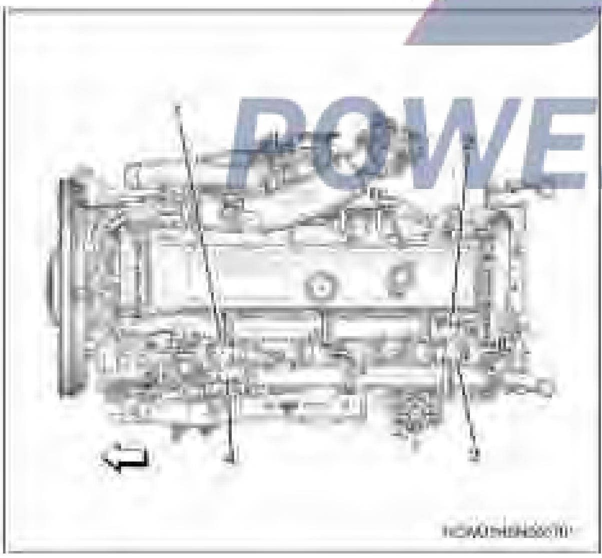


1. Front return pipe

2. Rear return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.



1. EGR valve 2

2. EGR cooler duct B

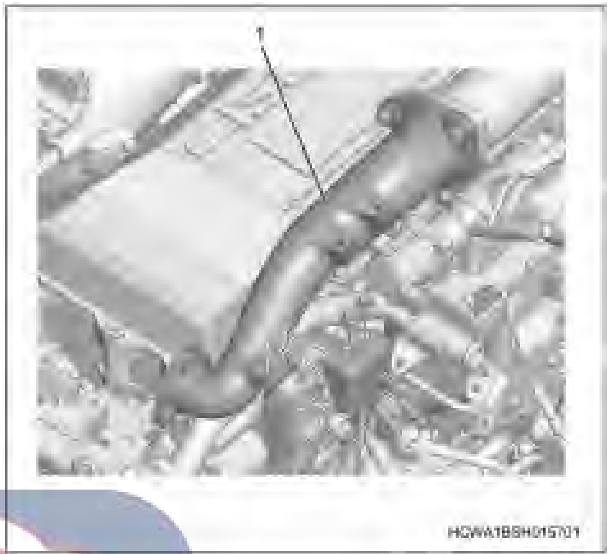
3. EGR valve 1

4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

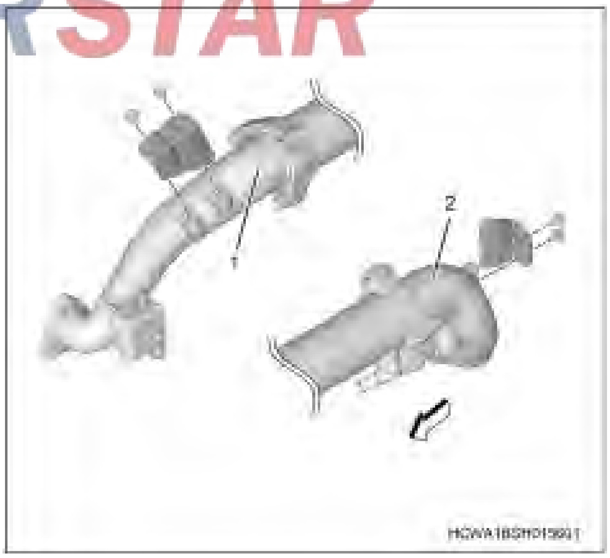
13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.



1. Exhaust gas recirculation cooler duct A

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A

2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.

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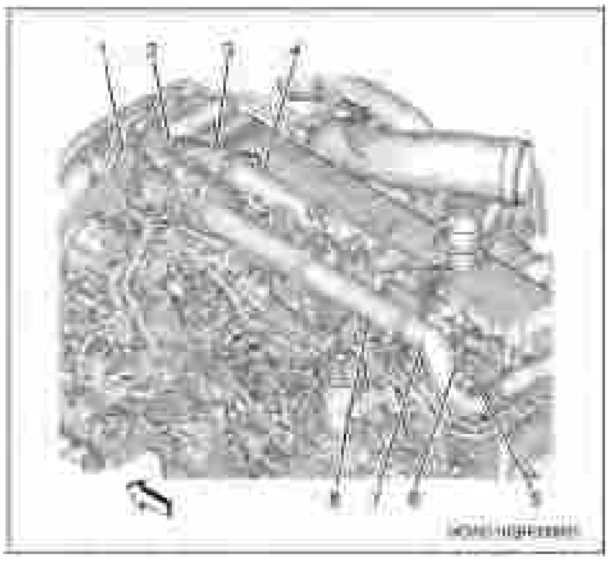


1. Front-end exhaust gas recirculation conduit bracket

2. Exhaust gas recirculation valve thermal protection device

3. Exhaust Gas Recirculation Cooler duct A.

4. EGR cooler A.

5. Back-end exhaust gas recirculation duct bracket

6. Exhaust gas recirculation valve thermal protection device

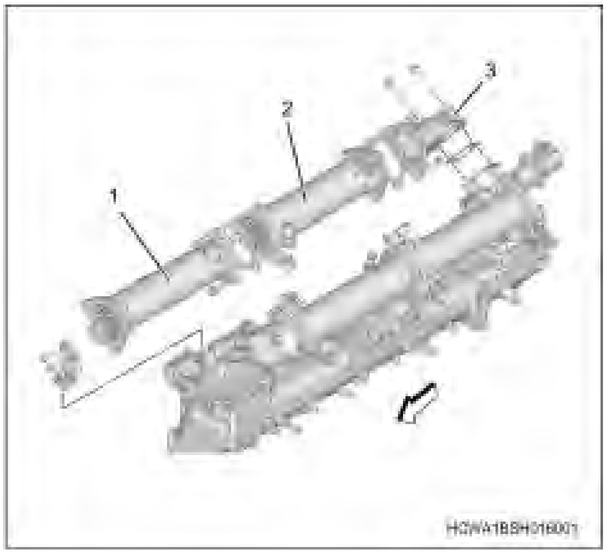
7. Exhaust Gas Recirculation Cooler duct C

8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler bracket on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

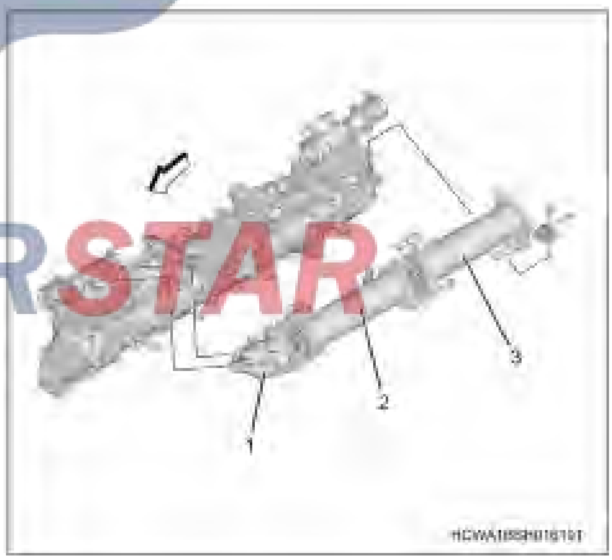


1. EGR cooler A.

2. EGR cooler B

3. Exhaust Gas Recirculation Cooler duct B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



1. Exhaust gas recirculation cooler duct D

2. EGR cooler D

3. EGR cooler C.

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.

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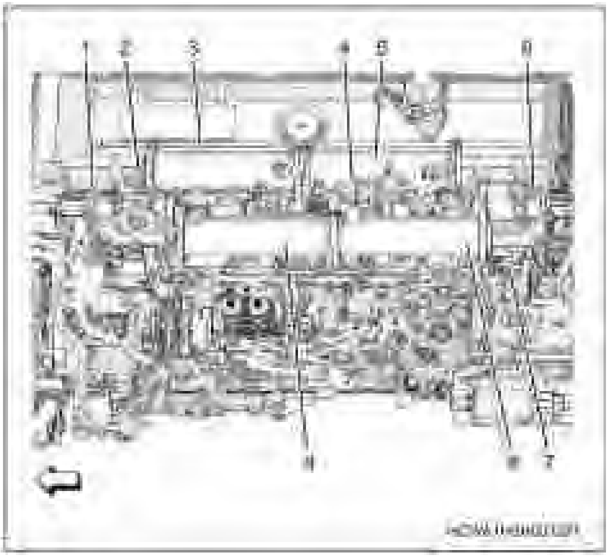
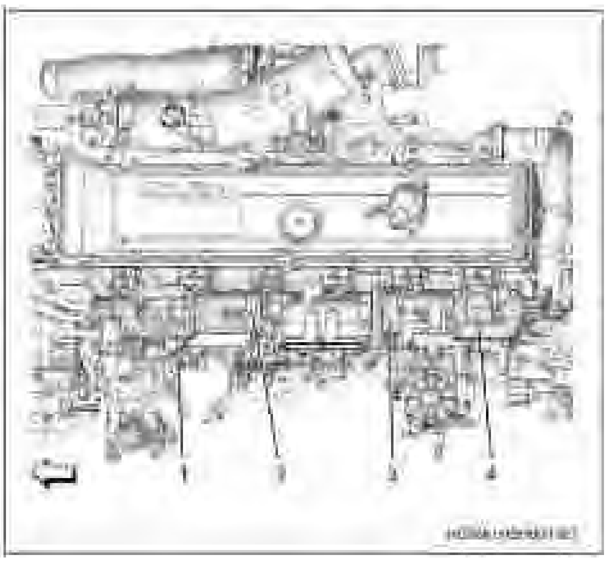


1. EGR valve 2
2. Exhaust gas recirculation cooler bracket
3. EGR cooler A.
4. leakage tube bracket
5. EGR cooler B.
6. EGR valve 1
7. Exhaust gas recirculation cooler bracket
8. EGR cooler C
9. EGR cooler D

11. Exhaust gas recirculation valve removed

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve duct A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve duct A.



1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

12. Pilot valve to remove

1) Remove pilot valve from EGR valve A.

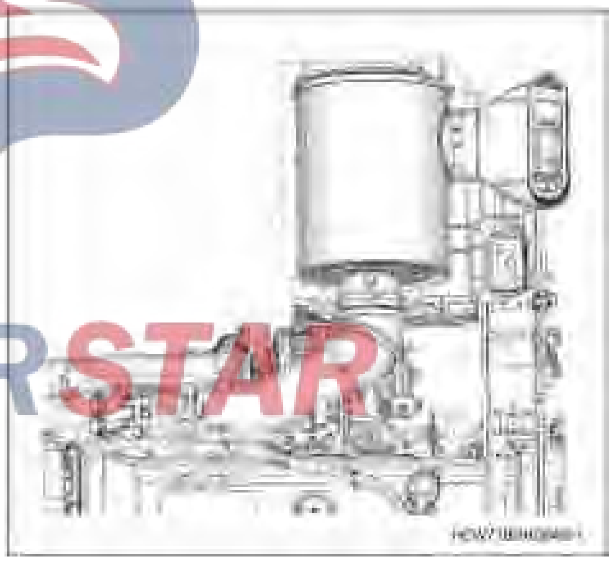
2) Remove pilot valve from EGR valve B.

13. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



14. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.

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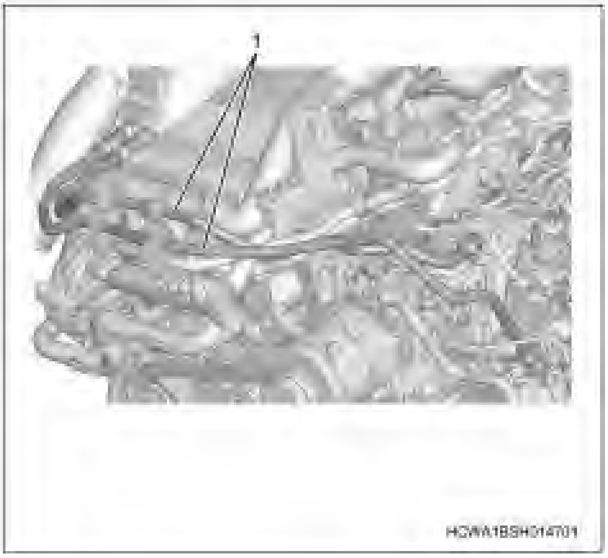


1. Air compressor suction pipe

2) Remove the heat shield from the air line.

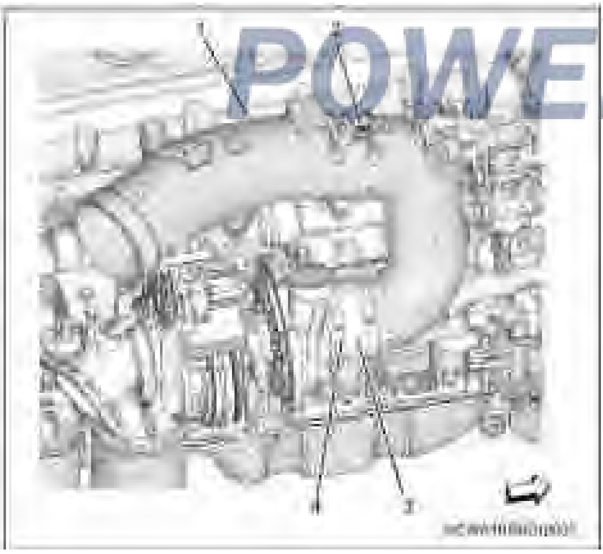
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

15. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

16. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

17. Exhaust cover removal

1) Remove the exhaust cover from the frame.

18. Exhaust brake valve removal

1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

19. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.

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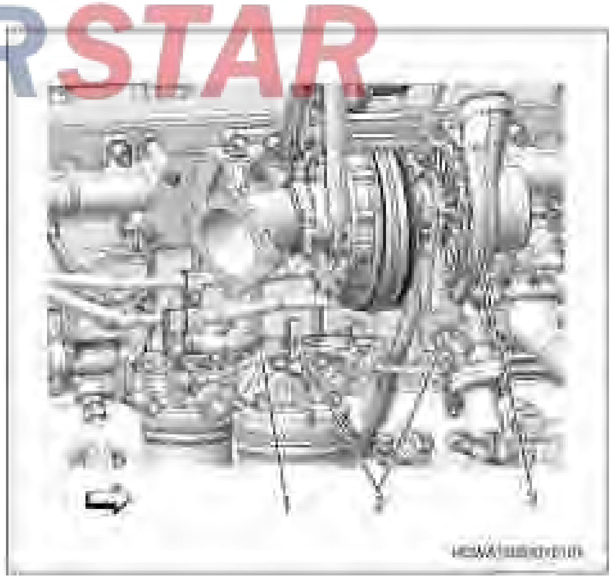
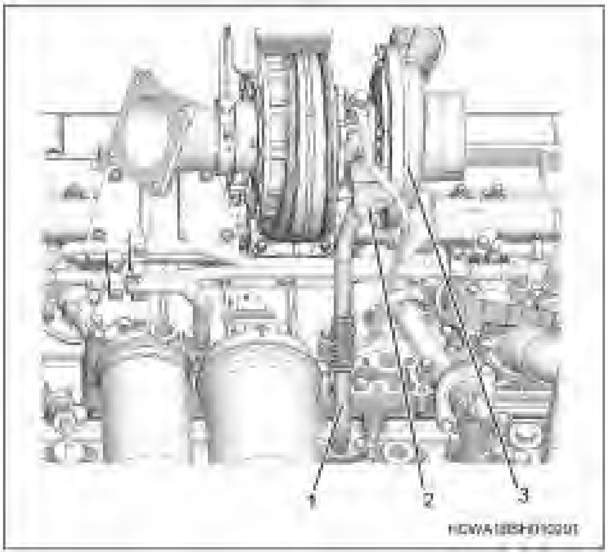


1. Turbocharger oil feed pipe
2. Pipe clamp
3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.



1. Turbocharger return pipe

2. Bracket

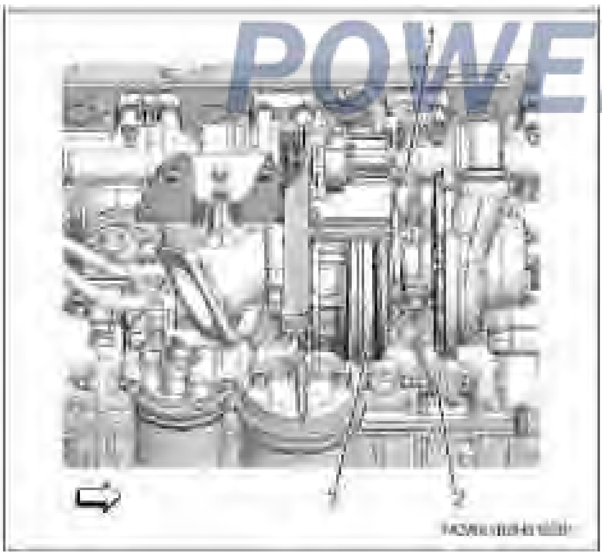
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.

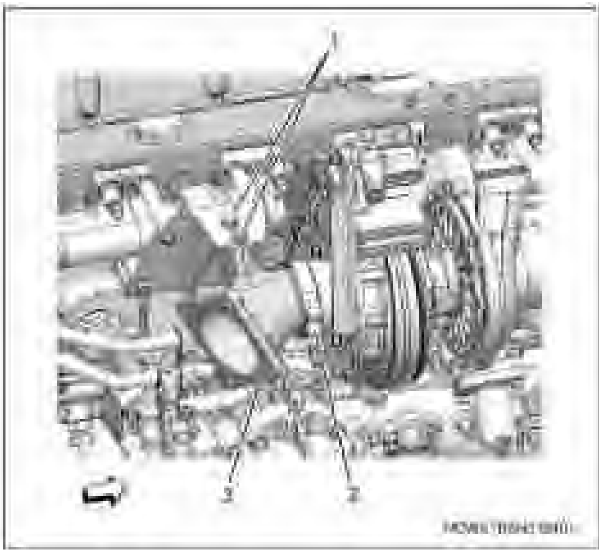


1. Water return pipe

2. Water feed pipe

3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt

2. V-belt

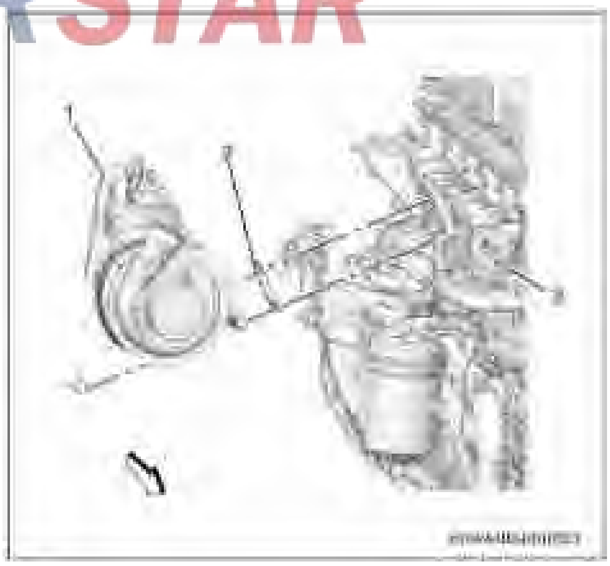
3. Turbocharger exhaust pipe

10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.



1. Turbocharger

2. Gasket

3. Exhaust manifold

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20. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

21. Fuel drain pipe removed

1) Disconnect the fuel drain pipe from the fuel supply pump.

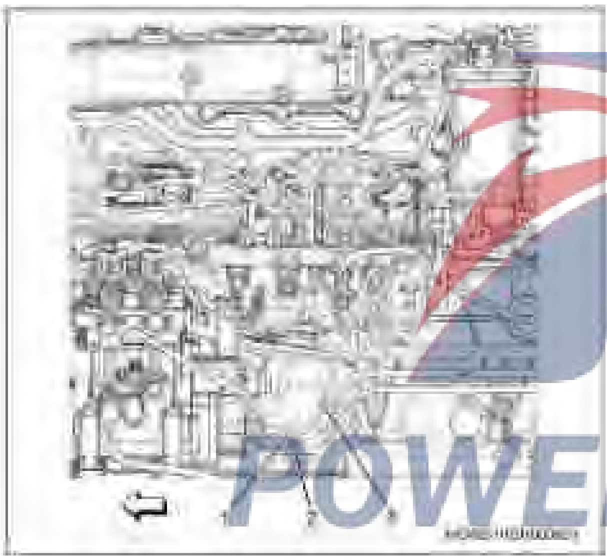
2) Disconnect the fuel drain pipe from the fuel filter.

22. Oil feed pipe removal

1) Remove the clip from the fuel supply line.

2) Disconnect fuel supply line from the fuel filter.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

23. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

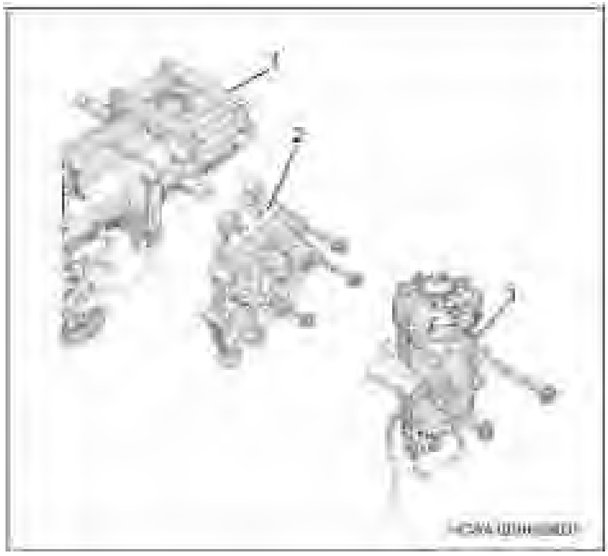
3) Remove the fuel pipe from the fuel supply pump.

24. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.



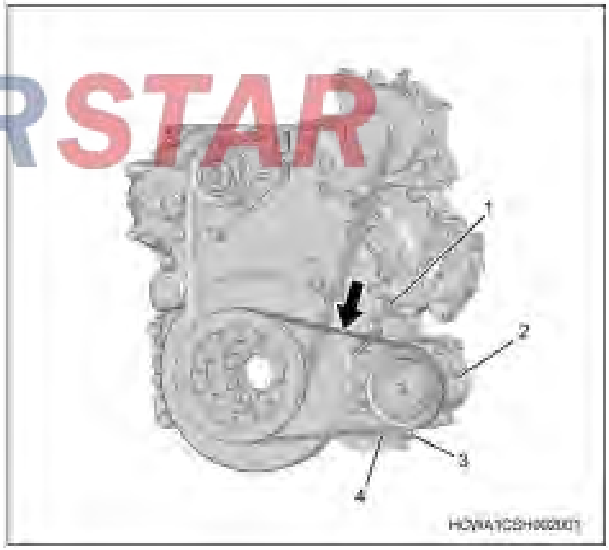
1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

25. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



1. Bolt

2. A/C compressor

3. Adjust bolt

4. Nut (back end)

26. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator

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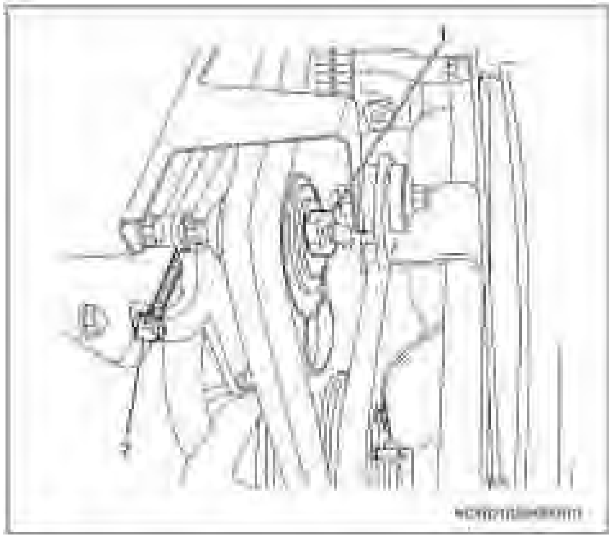
and crankshaft pulley.



1. Lock nut
2. Adjust bolt

27. Generator removal

1) Disconnect the harness connector from the generator.

2) Disconnect the generator from the ground cable and B-terminal harness.

3) Remove the generator from the bracket.

28. Generator bracket removal

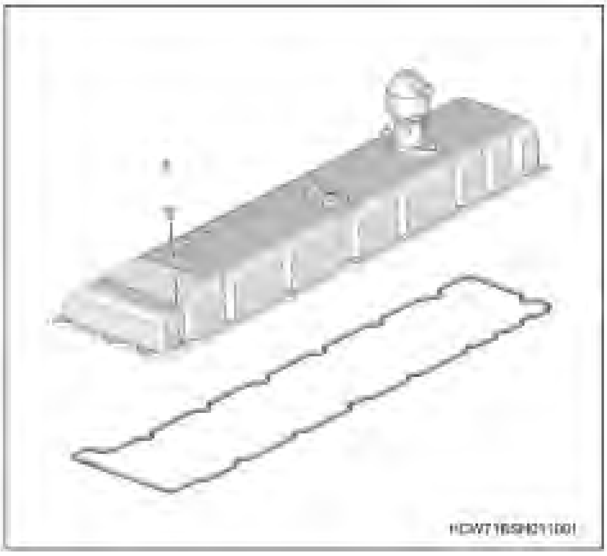
1) Remove the generator bracket from the cylinder head.

2) Remove the generator bracket from the timing gearbox.

29. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



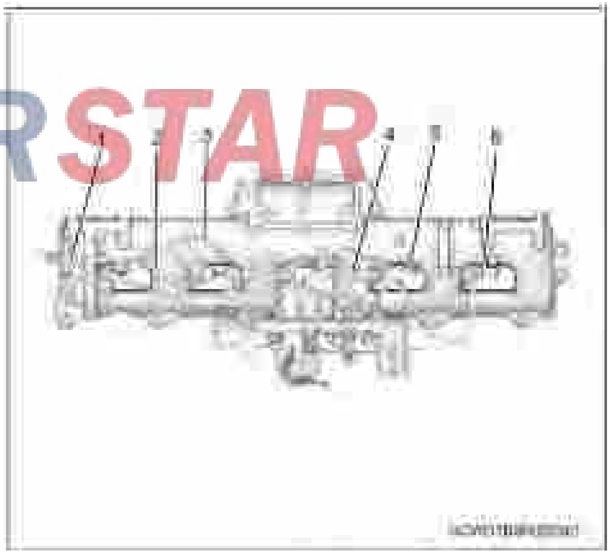
30. Injector removal

1) Remove the injector pipe from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

31. Injector harness removal

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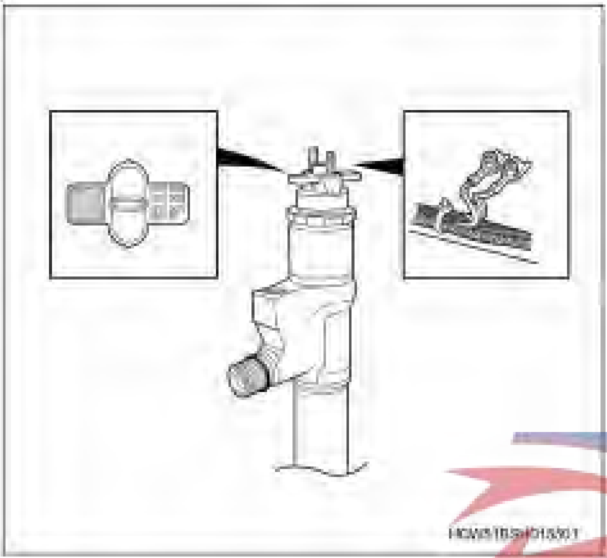
1) Remove the injector nut

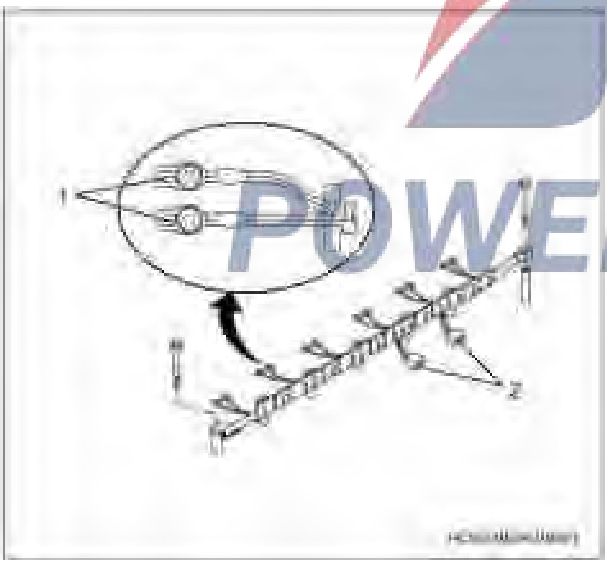
2) Remove the injector harness

Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.



3) Remove the bolts on the injector harness.



1. Injector terminal nut

2. connector

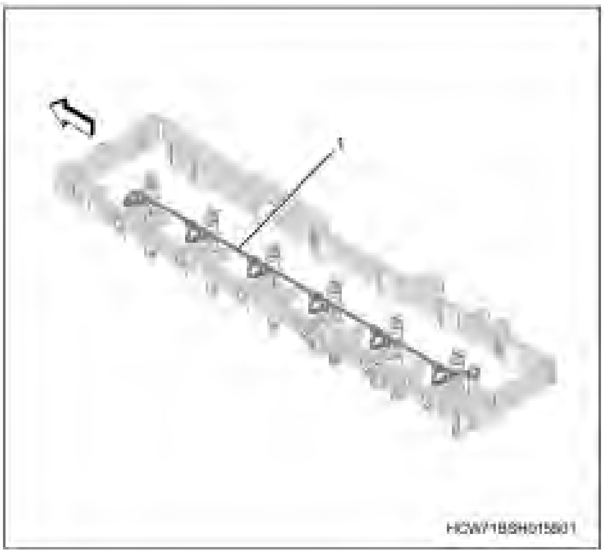
32. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

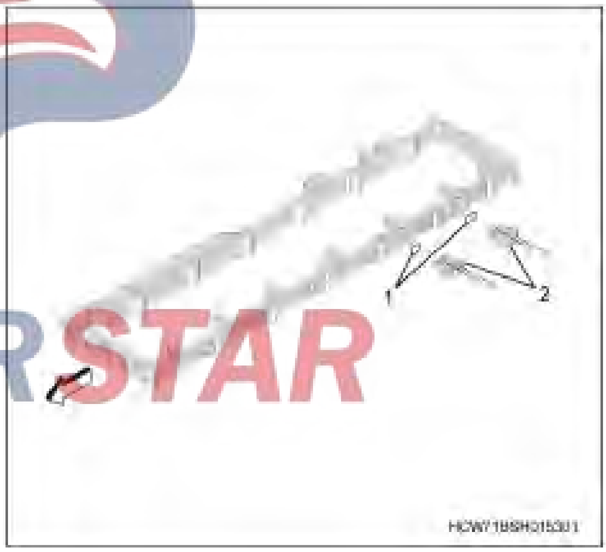
● Do not reuse the gasket.



1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.



1. O-ring

2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.

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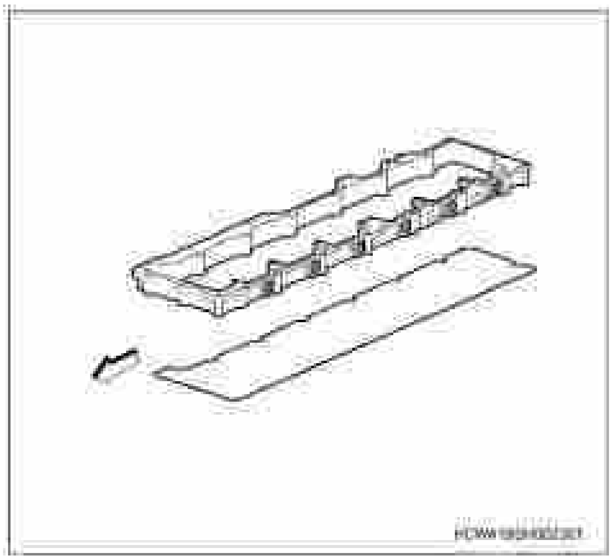


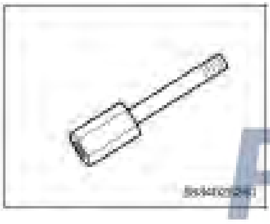
33. Injector removal

1) Remove the clamp from the cylinder head.

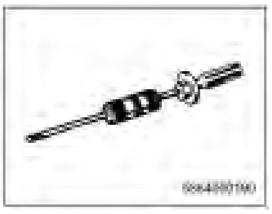
2) Remove the injector from the cylinder head with special tools.

● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

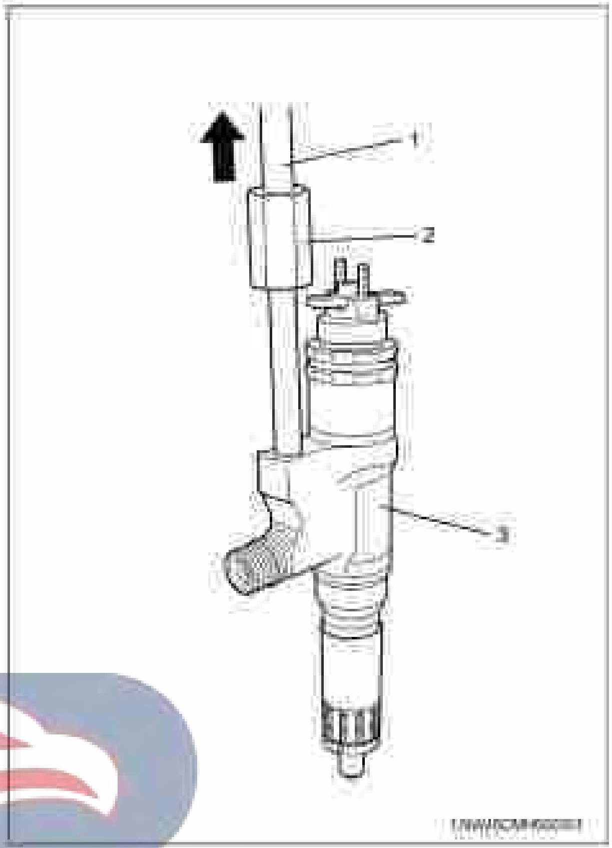
● Do not remove the injector ID code plate.



SST: 5-8840-2826-0 - injector remover



SST: 5-8840-0019-0 - sliding hammer



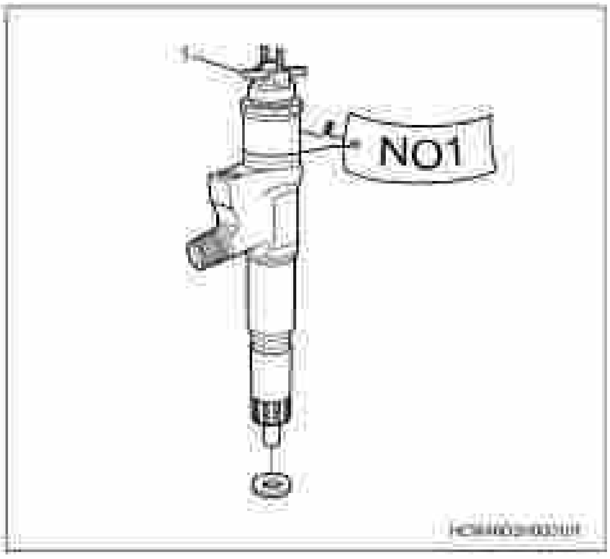
1. 5-8840-0019-0
2. 5-8840-2826-0
3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.



1. Injector

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34. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.

1. Fuel pipe
2. Fuel pipe
3. Clip

35. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

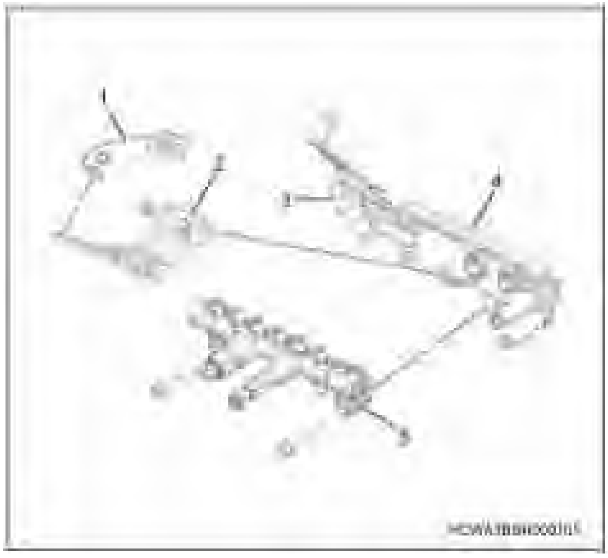
2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.



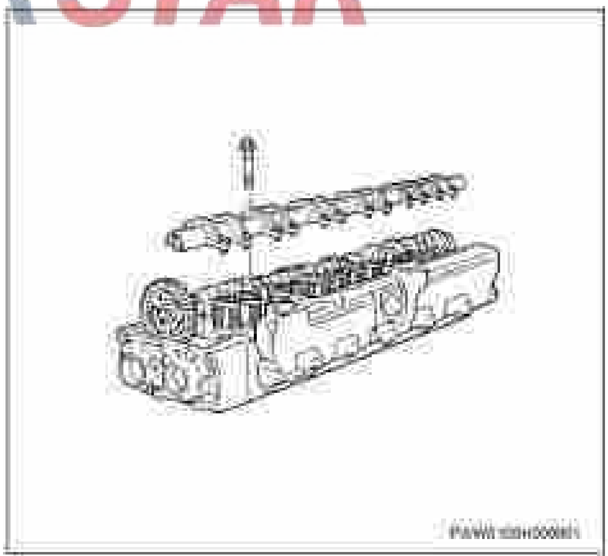
1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

36. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



37. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

POWERSTAR

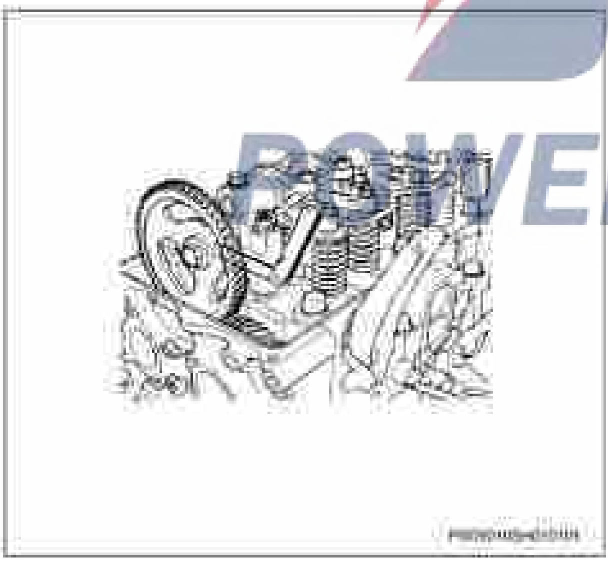
1. Bridge

38. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170 mm {0.00335 to 0.00669 in}

Limit: 0.25 mm {0.0098 mm}

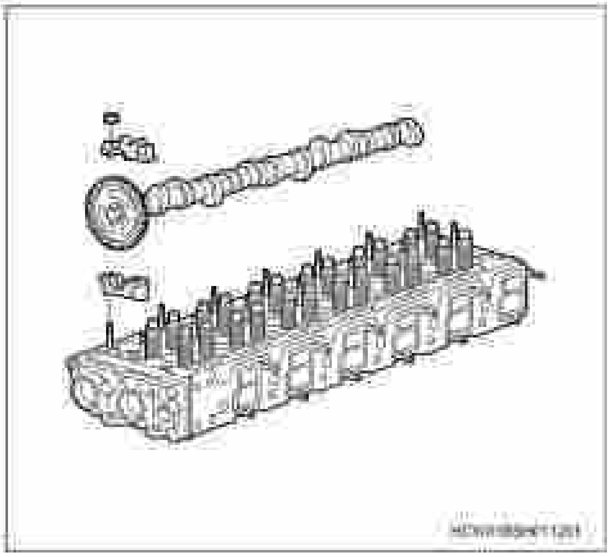


2) Remove the cam holder from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.



39. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

2) Remove the glow plug from the cylinder head.

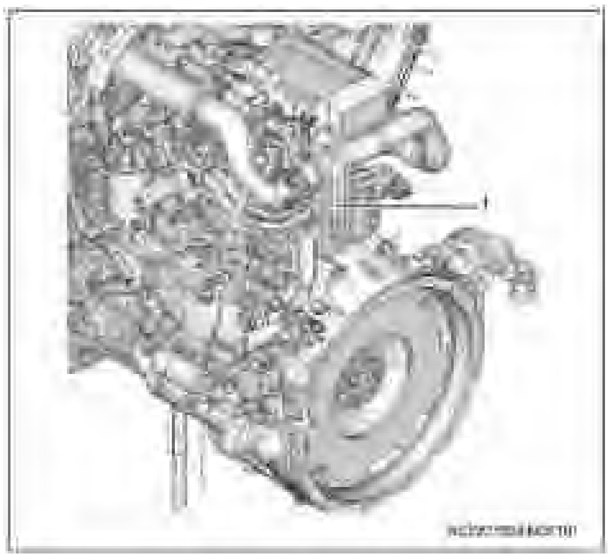
40. Cylinder head cover removal

1) Install special tool to the cylinder head.

SST: 8-9761-4276-0 - engine hanger

Tightening torque: 117.5 N • m { 12.0 kgf • m / 87 lb • ft }

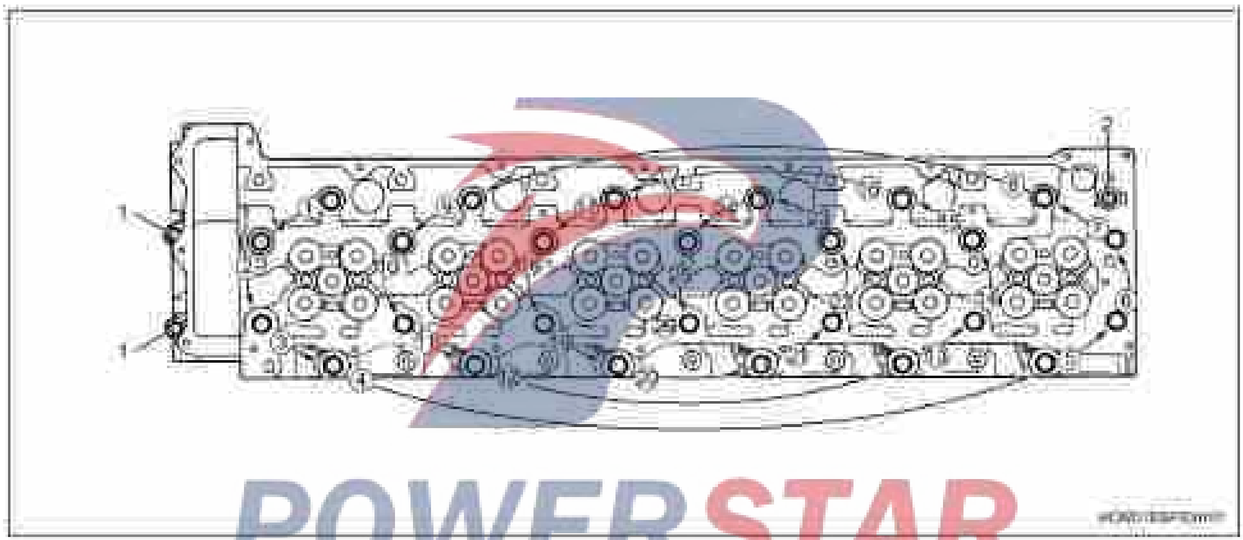
POWERSTAR



1. 8-9761-4276-0

2) Remove the M10 and M12 bolts from the cylinder head.

3) Remove the cylinder head bolts from the cylinder head in the order shown.



POWERSTAR

1. M10 bolt

2. M12 bolts

4) Remove the cylinder head from the cylinder block.

5) Remove the cylinder head gasket from the cylinder block.

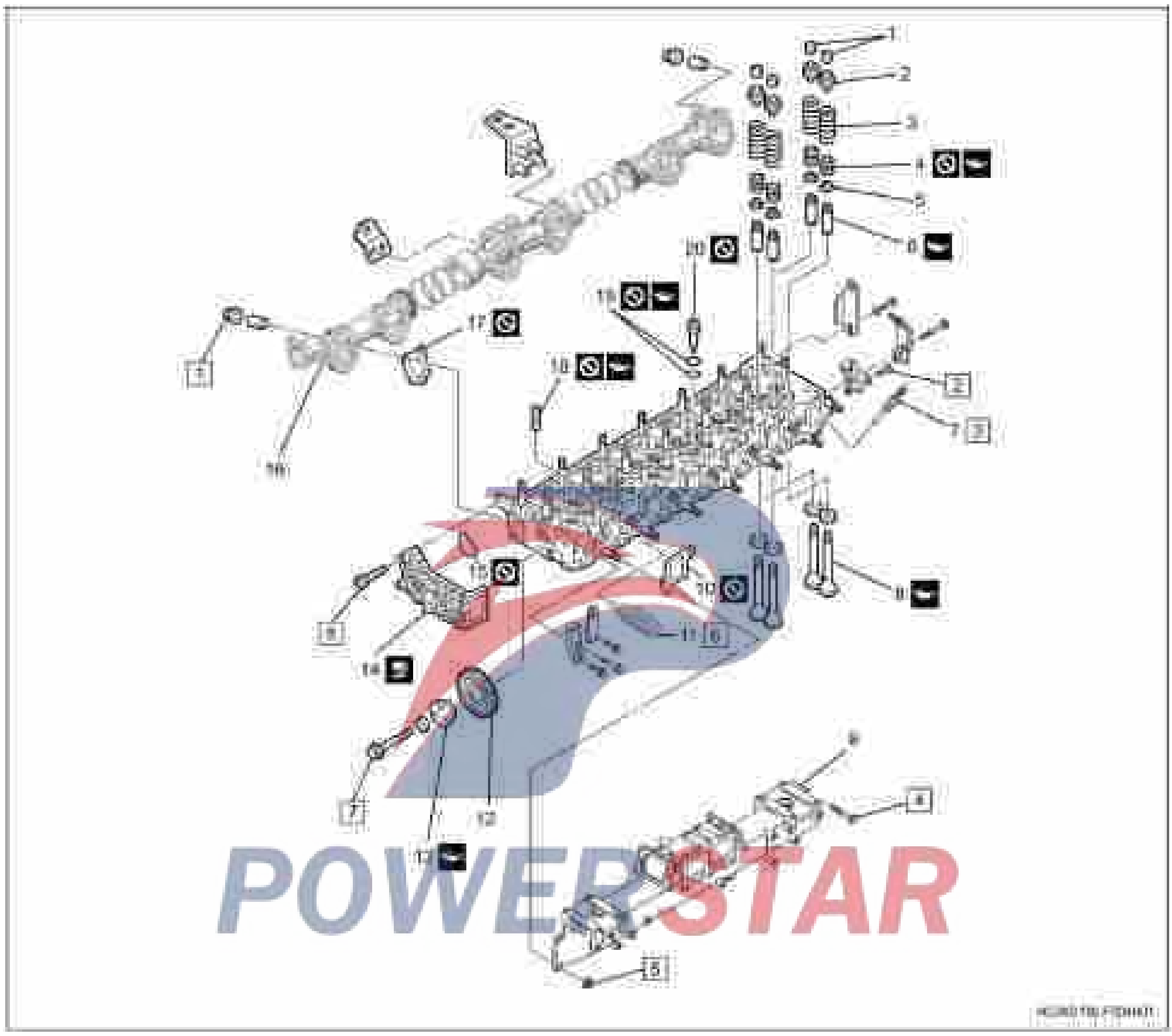
● Do not reuse the cylinder head gasket.

6) When removing, inspect for water leakage, exhaust gas leakage, etc.

Removal

1. Component Views

Cylinder top



Part name

1. Snap ring
2. Spring seat
3. Valve spring
4. Valve stem oil seal
5. spring seat
6. Valve guide
7. Glow plug
8. Valve
9. Intake manifold
10. Gasket
11. Engine coolant temperature sensor
12. Idling gear C
13. Idler gear shaft
14. Cylinder head gear box
15. O-ring
16. Exhaust manifold
17.Gasket
18. Axle guide
19. O-ring
20. Injector sleeve

Tightening torque

1: 48 N • m { 4.9 kgf • m / 35 lb• ft }

2: 117 N • m { 11.9 kgf • m / 86 lb • ft }

3: 25 N • m { 2.5 kgf • m / 18 lb • ft }

4: 45 N • m { 4.6 kgf • m / 33 lb • ft }

5: 45 N • m { 4.6 kgf • m / 33 lb • ft }

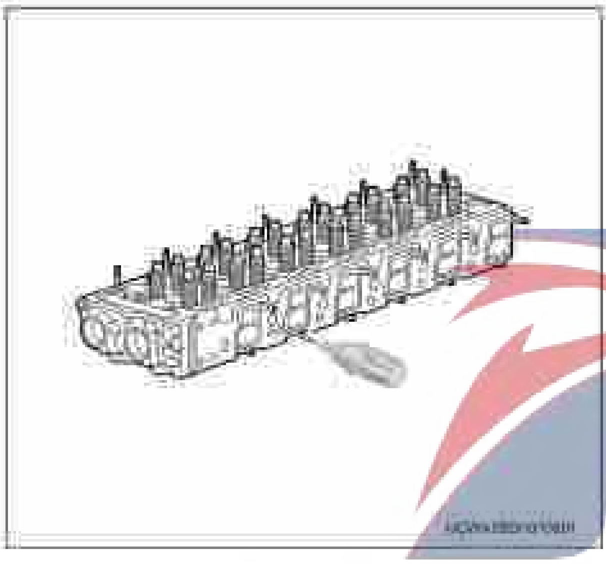
6: 25 N • m { 2.5 kgf • m / 18 lb • ft }

7: 40 N • m { 4.1 kgf • m / 30 lb • ft }

8: 38 N • m { 3.9 kgf • m / 28 lb • ft }

2. Engine coolant temperature sensor removal

1) Remove the engine coolant temperature sensor from the cylinder head.

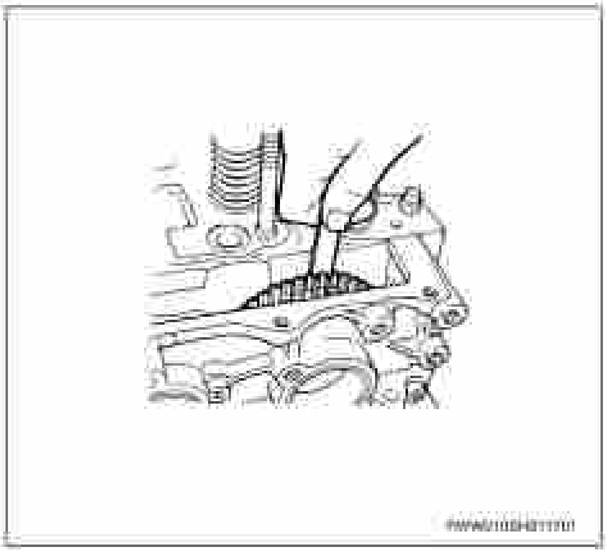


3. Idler C removed

1) Use a feeler gauge to measure the axial clearance of idler gear C.

Standard: 0.050 to 0.012 mm {0.00197 to 0.00045 in}

Limit: 0.25 mm {0.0098 in}

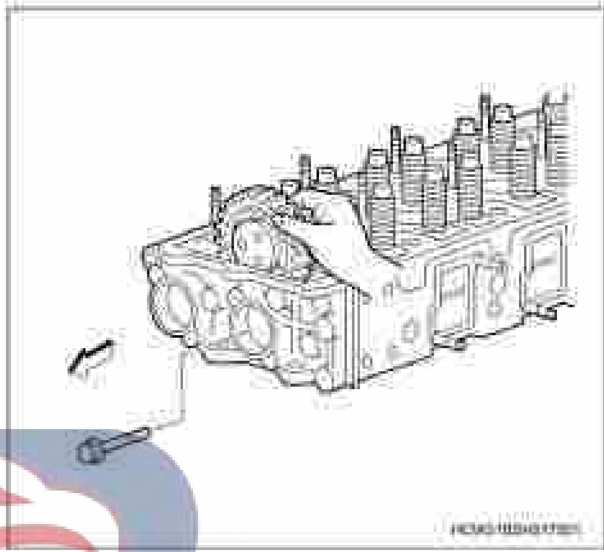


2) Remove the idler gear shaft from the cylinder head.

3) Remove the idler gear C from the cylinder head.

Caution:

● Do not scratch the idler gear shaft sleeve.



4. Cylinder head gear box removed

1) Remove the cylinder head gear box from the cylinder head cover.

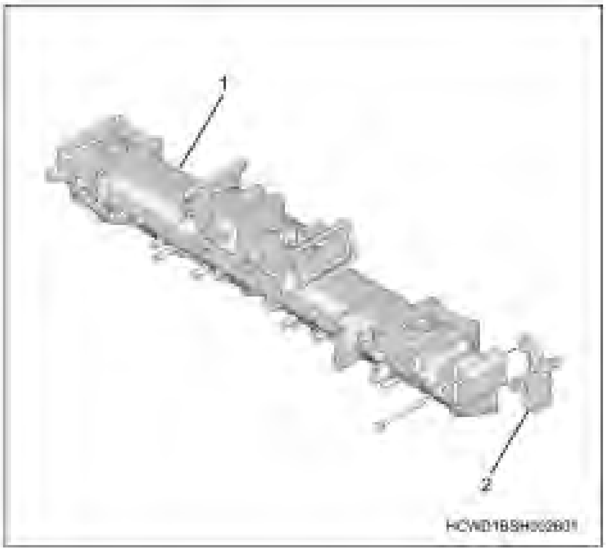
2) Remove the O-ring from the cylinder head gear box.

5. Intake manifold removal

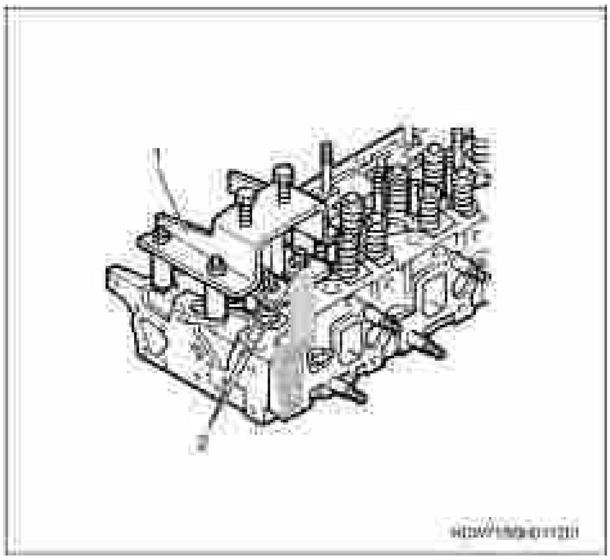
1) Remove the front and rear brackets on the intake manifold.

2) Remove the intake manifold from the cylinder head.

3) Remove the gasket from the cylinder head cover.



1. Intake manifold
2. Bracket



1. 1-8523-5013-0
2. Snap ring

6. Exhaust manifold removal

1) Remove the exhaust manifold from the cylinder head.

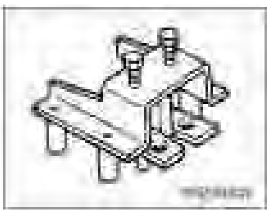
Note:

● Remove front, center, and rear sides simultaneously.

2) Remove the gasket from the cylinder head cover.

7. Valve spring removal

1) Use a special tool to remove the split washer from the spring retainer.



SST: 1-8523-5013-0 - Valve spring compressor

2) Remove special tool from the cylinder head.

3) Remove the spring seat from the valve spring.

4) Remove the following parts from the cylinder head.

● Intake valve spring

● Exhaust side outer leaf spring

● Exhaust side valve spring

Note:

● Store the removed valve spring and label it with a number.

5) Remove the spring seat from the cylinder head.

8. Valve removal

1) Remove the intake and exhaust valves from the cylinder head.

Note:

● Store the removed valve and label it with a number.

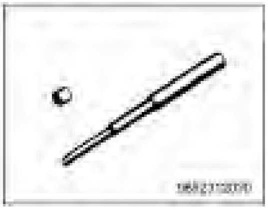
9. Valve stem oil seal removed

1) Remove the valve stem seal from the valve guide.

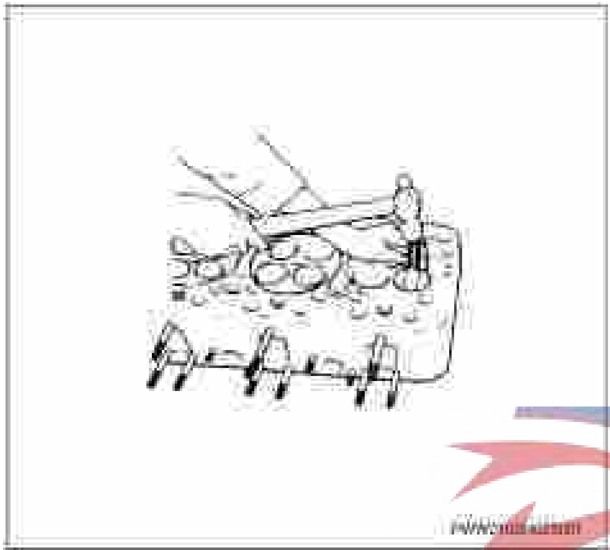
10. Valve guide removal

1) Using a special tool, remove the valve guide from the cylinder head.

POWERSTAR



SST: 9-8523-1202-0 - Valve guide reduction tool



11. Axle guide removal

1) The nut is welded to the axle guide by means of electric welding.

2) Using a slide hammer, remove the axle guide from the cylinder head.

Note:

● Install the slide hammer to the weld nut to be removed.

12. Valve seat removed

1) Use the gas burner to heat the two inner surfaces of the seat ring.

Heating temperature: 600 to 700 ℃ {1,112 to 1,292 ℉}

2) Cooling seat ring.

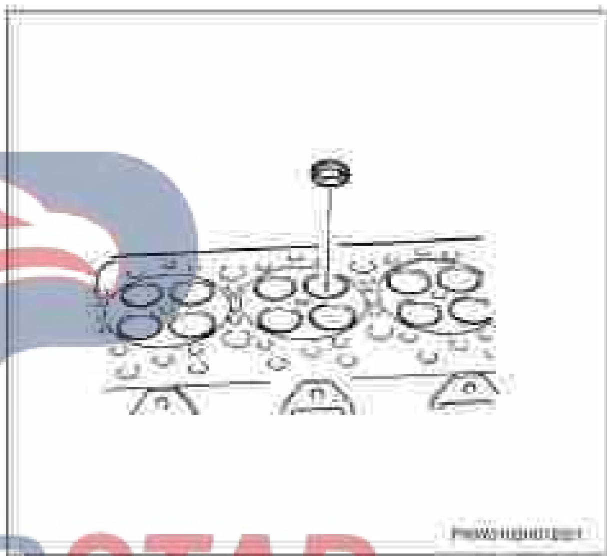
Note:

● Naturally cool for about 5 minutes.

Caution:

● Do not cool quickly.

3) Using a screwdriver, remove the insert valve seat from the cylinder head.



13. Injector sleeve removed

1) Remove the injector sleeve from the cylinder head.

Note:

● Place a lever on the injector sleeve and tap gently from the bottom of the cylinder head to remove it.

POWERSTAR

Inspection

1. Idler C inspection

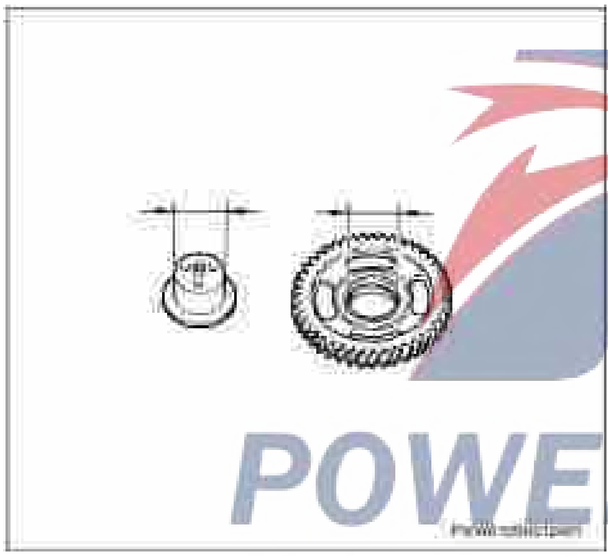
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Check each of the following idler gear components.

- Wear
- Tooth contact
- Exfoliation
- Tilt

2) Measure the idler gear shaft outer diameter and idler gear inner diameter.



3) Calculate the clearance value based on the measured values of idler gear shaft outer diameter and idler gear inner diameter.

Idler gear shaft outer diameter

Idling gear	Prescribed value	Limit value
C	: 49.00 mm {1.9291 in }	: 48.85 mm {1.9232 in }

Clearance between idler gear shaft and idler gear

Prescribed value	Limit value
: 0.040 to 0.105mm { 0.0016 to 0.0041 in }	: 0.20 mm { 0.0079 in }

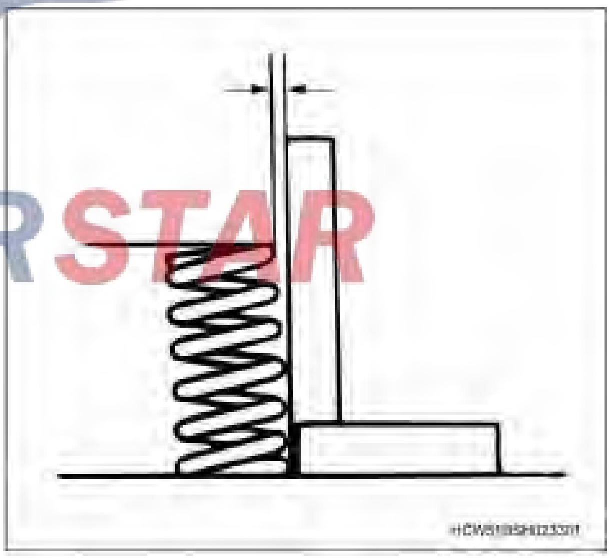
2. Valve spring inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Measure the squareness of the valve spring with a square ruler.

Part	Measured value	
Intake side	Prescribed value	: 2.8 mm {0.110 in }
	Limit value	: 4.1 mm { 0.161 in}
Exhaust outside	Prescribed value	: 4.5 mm {0.177 in }
	Limit value	: 6.2 mm { 0.244 in }
Exhaust inside	Prescribed value	: 4.2 mm { 0.165 in }
	Limit value	: 5.9 mm { 0.232 in }



2) Use vernier caliper to measure the free length of the valve spring.

Part	Measured value	
Intake side	Prescribed value	: 79.3 mm { 3.122 in }
	Limit value	: 75.3 mm { 2.965 in }

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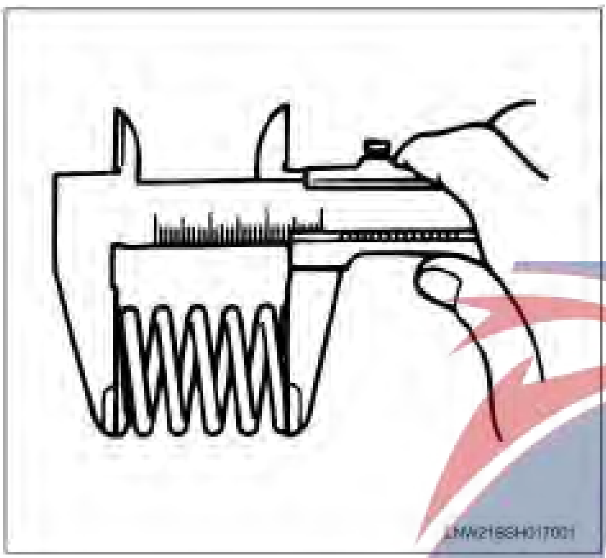
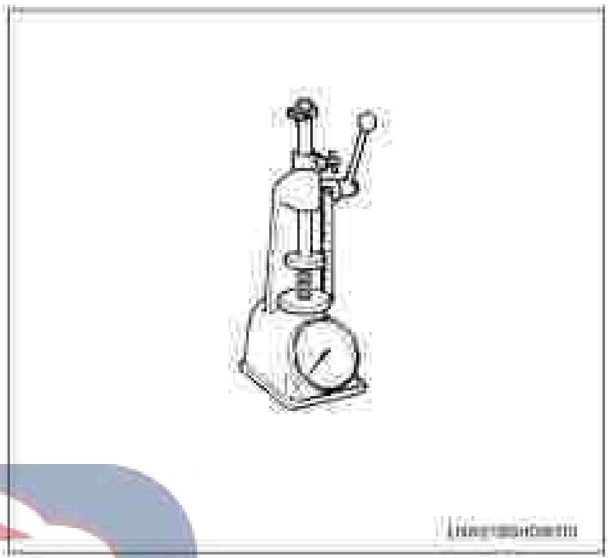
Exhaust outside	Prescribed value	: 102.7 mm {4.043 in }
	Limit value	: 97.6 mm {3.843 in }
Exhaust inside	Prescribed value	: 96.5 mm { 3.799 in }
	Limit value	: 91.7 mm { 3.610 in }



3) Using a load test device, measure the tension when installing the valve spring.

Part		Prescribed value
Intake side	Installation length	: 64 mm { 2.52 in }
	load	: 392 N { 40.0 kg / 88 lb }
	Limit value	: 372 N { 37.9 kg / 84 lb}
Exhaust outside	Installation length	: 69 mm {2.72 in }
	load	: 610 N { 62.2 kg /137 lb }
	Limit value	: 578 N { 58.9 kg / 130 lb }
Exhaust inside	Installation length	: 66 mm { 2.60 in }
	load	: 223 N { 22.7 kg / 50 lb }
	Limit value	: 213 N { 21.7 kg / 48 lb }



3. Valve inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the rod end is worn.

Note:

● Use whetstone to repair minor wear.

2) Micrometer rod diameter measurement.

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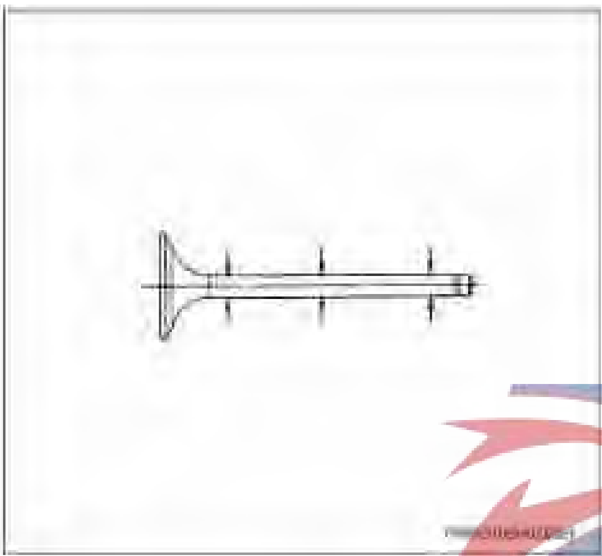
Note:

● 3 points marked with arrows in the measurement chart.

Standard: 10.0 mm {0.394 in}

Limit: 9.92 mm {0.3906 in} Inlet valve

Limit: 9.90 mm {0.3898 in} Vent valve

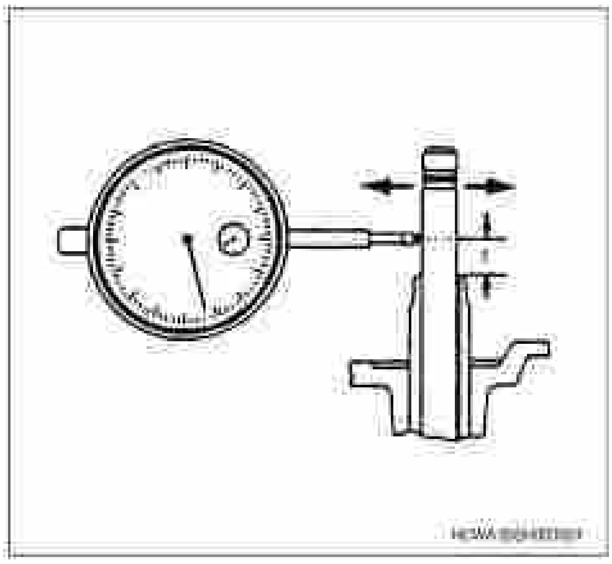


3) Use a dial gauge to measure the gap between the valve guide and the valve stem.

Note:

● Measure at 10 mm {0.394 in} or higher from the upper end of the valve guide.

	Intake valve	Vent
Prescribed value	: 0.040 to 0.077mm { 0.00157 to0.00303 in }	: 0.065 to 0.102mm { 0.00256 to 0.00402 in }
Limit value	: 0.15 mm {0.0059 in}	: 0.25 mm { 0.0098 in }



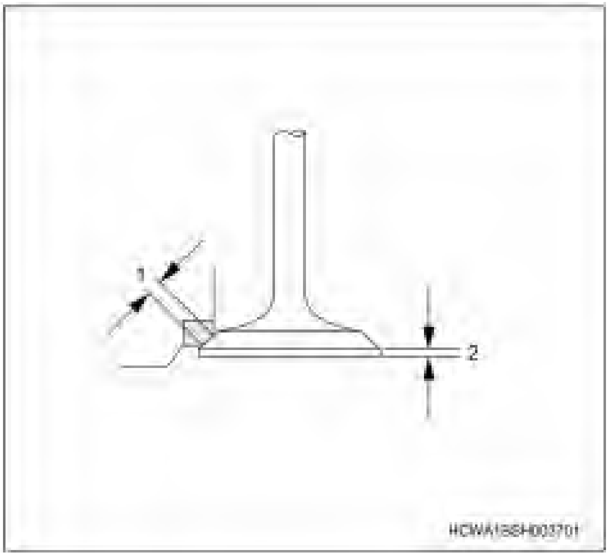
1. 10.0 mm {0.394 in}

4) Use a micrometer to measure the contact width of the seat surface.

	Intake valve	Vent
Prescribed value	: 3.3 mm {0.130 in }	: 2.6 mm {0.102 in }
Limit value	: 3.7 mm {0.146 in}	: 3.0 mm {0.118 in }

5) Use a micrometer to measure the valve thickness.

	Intake valve	Vent
Prescribed value	: 2.10 mm { 0.0827 in }	: 2.56 mm {0.1008 in}
Limit value	: 1.60 mm { 0.0630 in }	: 2.06 mm {0.0811 in }



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1. Valve seat surface contact width measurement area

2. Valve thickness measurement area

6) using dial indicator valve sinking.

	Intake valve	Vent
Prescribed value	: 0.3 mm {0.012 in }	: 0.2 mm {0.008 in }
Limit value	: 1.3 mm {0.051 in}	: 1.2 mm {0.047 in }

7) The use of red lead primer check valve contact position and contact surface leakage.

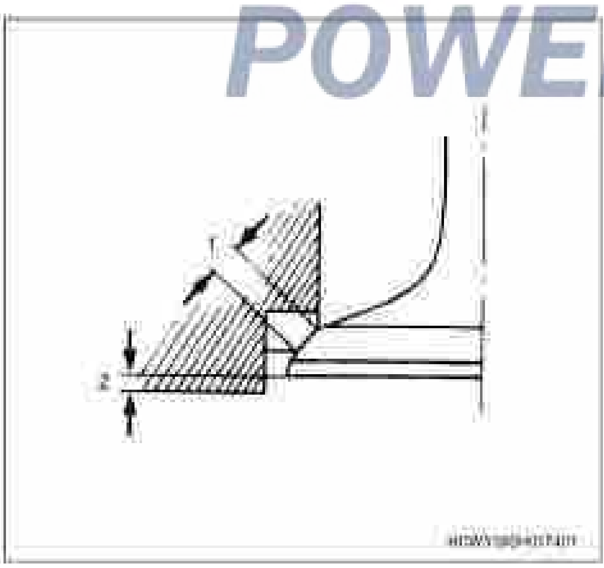
Caution:

● If the valve contact width and the valve contact surface are abnormal, use the seat dressing tool to correct the abnormal condition.

● When using the valve seat correction tool correction, perform each measurement again.

	Intake valve	Vent
Prescribed value	: 3.3 mm { 0.130 in }	: 2.6 mm { 0.102 in }
Limit value	: 3.7 mm { 0.146 in }	: 3.0 mm {0.118 in }

POWERSTAR



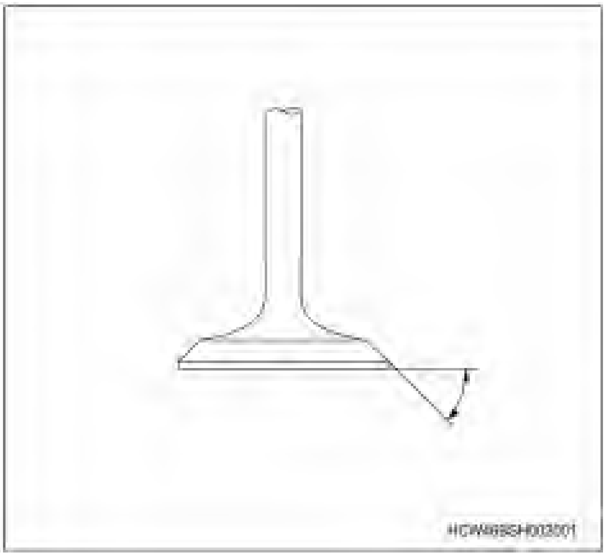
1. Contact width

2. The amount of sinking

8) Check the valve seat taper angle using the indexer.

Standard: 30 ° Intake valve

Standard: 45 ° Vent



9) The valve grinding tool used to grind the valve.

Caution:

● After finishing the assembly, conduct a thorough cleaning.

● If the valves overlap each other, measure them separately.

4. Axle inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the contact surface for wear and damage.

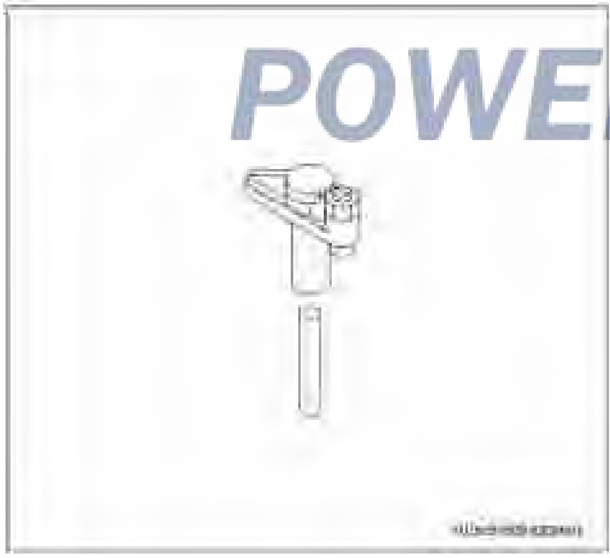
5. Axle guide check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Use a micrometer to measure the gap between the arm and the arm.

Standard: 0.020 to 0.056 mm {0.00079 to 0.00220 in}

Limit: 0.10 mm { 0.0039 in }



6 cylinder head inspection

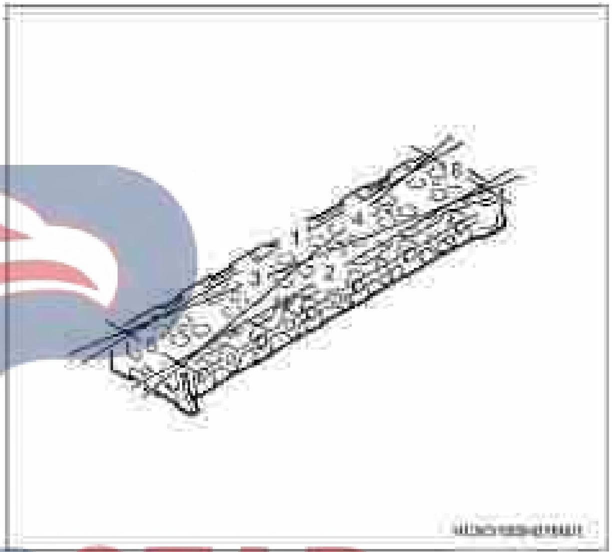
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Measure the deformation of the cylinder head with a feeler gauge.

Note:

● Measure the area No. 1 to No. 4 in the picture with a simple ruler and measure the cylinder head deformation.

Limit: 0.2 mm or less {0.008 in or less}



POWERSTAR

2) Check cylinder head for cracks and damage.

Note:

● If necessary, use magnetic detection method or dye permeate inspection method to check.

3) Use water pressure tester to check water jacket for rupture.

Note:

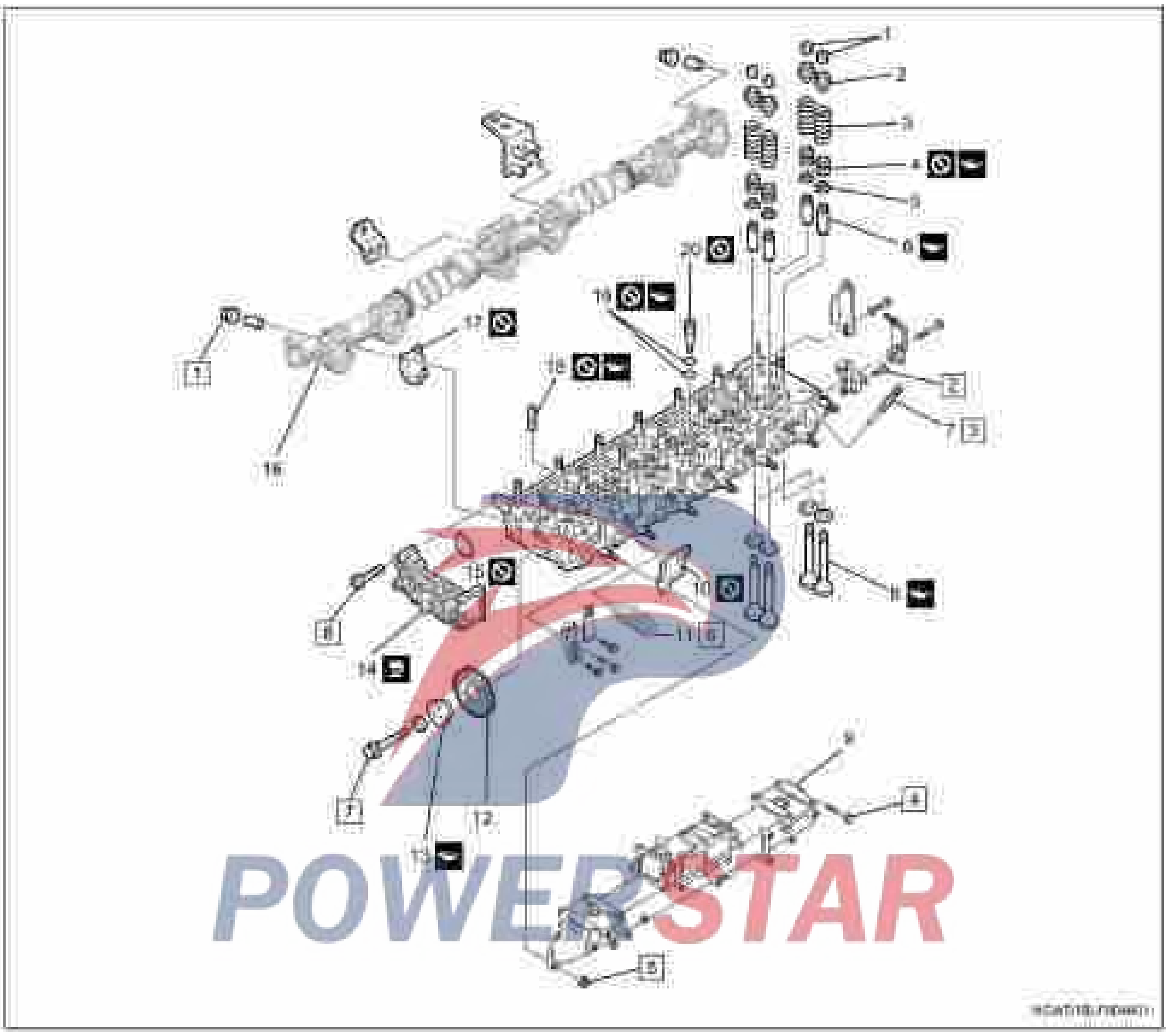
● Apply specified water pressure and hold for 3 minutes, then check for leaks in all parts of cylinder head.

Standard: 490 kPa { 5.0 kgf/cm2 / 71 psi }

Reassemble

1. Component Views

Cylinder top



Part name

1. Snap ring
2. Spring seat
3. Valve spring
4. Valve stem oil seal
5. spring seat
6. Valve guide
7. Glow plug
8. Valve
9. Intake manifold
10.Gasket
11. Engine coolant temperature sensor
12. Idling gear C
13. Idler gear shaft
14. Cylinder head gear box
15. O-ring
16. Exhaust manifold
17.Gasket
18. Axle guide
19. O-ring
20. Injector sleeve

Tightening torque

1: 48 N • m { 4.9 kgf • m / 35 lb • ft }

2: 117 N • m { 11.9 kgf • m / 86 lb • ft }

3: 25 N • m { 2.5 kgf • m /18 lb • ft }

4: 45 N • m { 4.6 kgf • m / 33 lb • ft }

5: 45 N • m { 4.6 kgf • m / 33 lb • ft }

6: 25 N • m { 2.5 kgf • m / 18 lb • ft }

7: 40 N • m { 4.1 kgf • m / 30 lb • ft }

8: 38 N • m { 3.9 kgf • m / 28 lb • ft }

2. Injector sleeve installation

1) Apply engine oil to the O-ring.

2) Install the O-ring onto the injector sleeve.

Caution:

● Install a red O-ring on the upper side of the injector sleeve recess and a black O-ring on the underside of the injector sleeve recess.

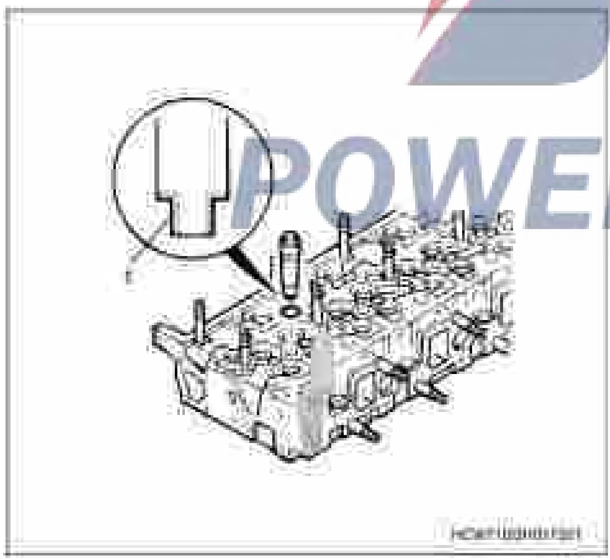
3) Apply Loctite 290 Glue to the following parts of the injector sleeve.

● Lower part

● Peripheral surface

● Seat side

4) Install the injector sleeve onto the cylinder head.



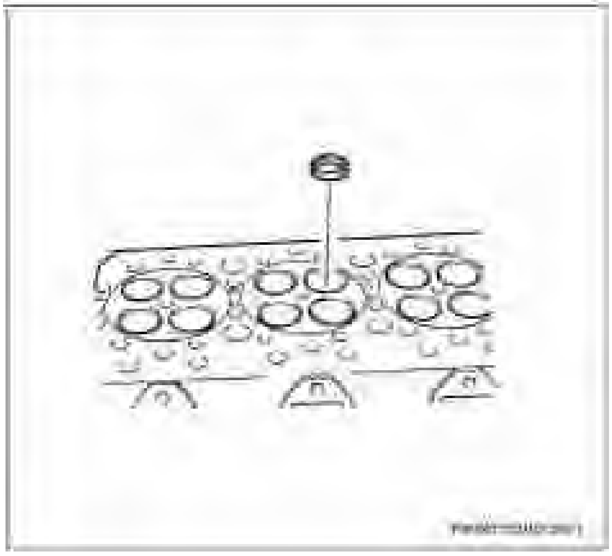
1. Loctite application area

3. Valve seat installation

1) Press the valve seat to the cylinder head.

Caution:

● Carefully remove the rust and carbon from the seating surface of the seat ring and install it by pressing.



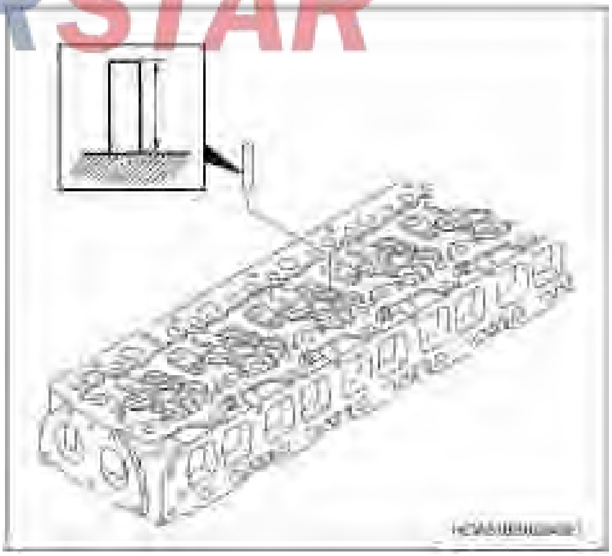
4. Axle guide installation

1) Apply the engine oil to the bridge guide.

2) Using a special tool, push the axle guide into the cylinder head.

SST: 9-8522-1324-0 - Axle-guide positioning tool

Standard: 49 mm {1.93 in}



5. Valve guide installation

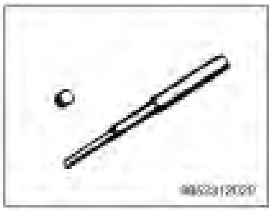
1) Apply engine oil to valve guide.

2) Install the valve guide to the cylinder head using special tools.

POWERSTAR

Caution:

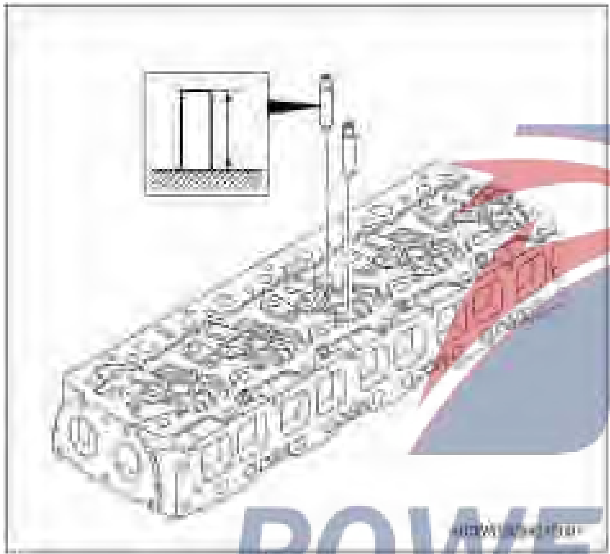
● Install the valve guide so that the amount of protrusion is within the specified range.



SST: 9-8523-1202-0 - Valve guide reduction tool

Standard: 27.0 mm {1.063 in} Intake side

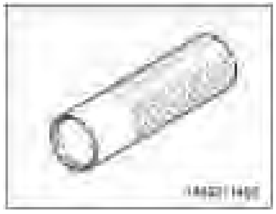
Standard: 29.0 mm {1.142 in} Exhaust side



6. Valve rod seal installation

1) Apply engine oil to valve stem oil seal.

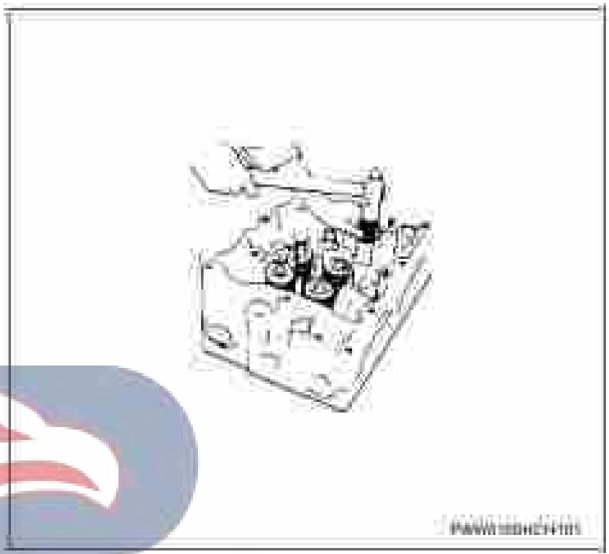
2) Use a special tool to install the intake end valve stem oil seal to the valve guide.



SST: 1-8522-1140-0 - Valve Seal Installer

3) Use a special tool to install the exhaust end valve stem oil seal to the valve guide.

SST: 1-8522-1184-0 - Valve Seal Installation Tool



Caution:

● After the pressing is completed, make sure the spring does not come off and the seal will not be deformed.

7. Valve installation

1) Apply engine oil to valve stem oil seal.

2) Insert Intake valve and Vent onto the cylinder head.

8. Valve spring installation

1) Mount the spring seat to the cylinder head.

2) Mount the following parts on the cylinder head.

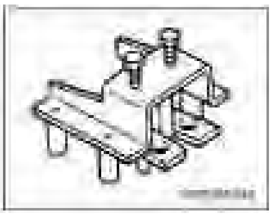
Intake valve spring

Exhaust side outer leaf spring

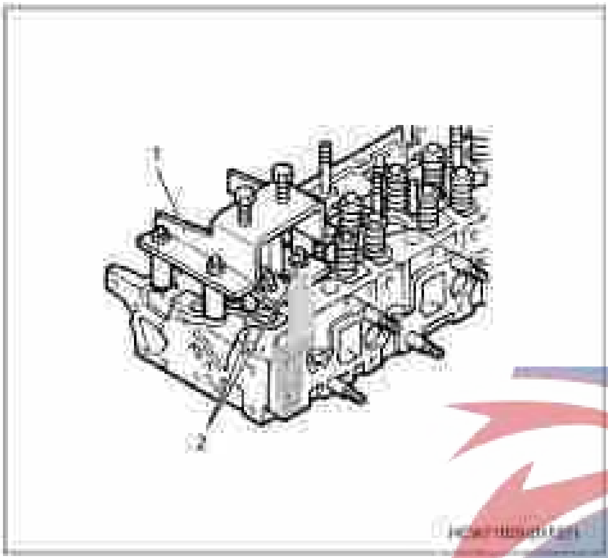
Exhaust side valve spring

3) Install the spring seat on the valve spring.

4) Use special tools to install the open washer onto the spring seat.



SST: 1-8523-5013-0 - Valve spring compressor



1. 1-8523-5013-0
2. Snap ring

5) Remove special tool from the cylinder head.

6) Gently tap the stem head.

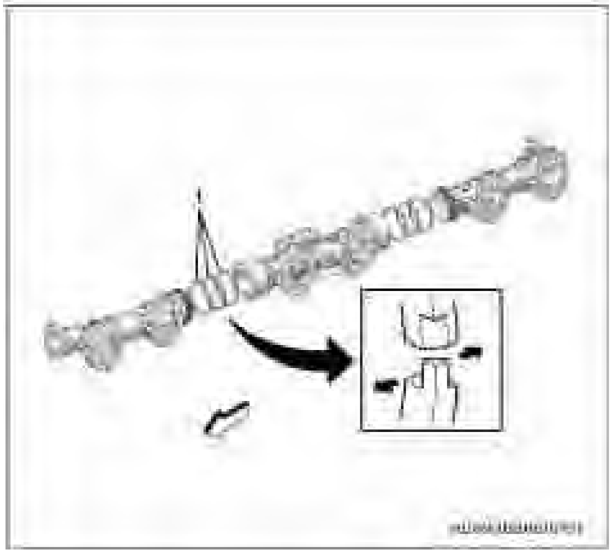
9. Exhaust manifold installation

1) Install the seal ring to the exhaust manifold.

Caution:

● Install the opening positions at intervals of 120 °.

● Check and install the seal ring because it has directionality.



1. Seal ring

2) Assemble the exhaust manifold.

3) Install the gasket to the cylinder head.

Caution:

● Install in such a way that the mark is to the right of the bottom.

4) Install the exhaust manifold to the cylinder head in numerical order in the figure.

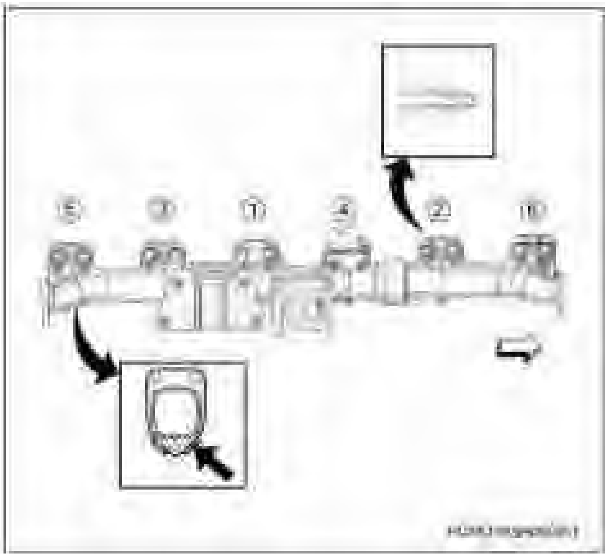
Note:

● Tighten and install the flange clockwise from the bottom.

Caution:

● Install the isolation ferrule with the isolation ferrule facing the nut.

Tightening torque: 48 N • m {4.9 kgf • m / 35 lb • ft}



POWERSTAR

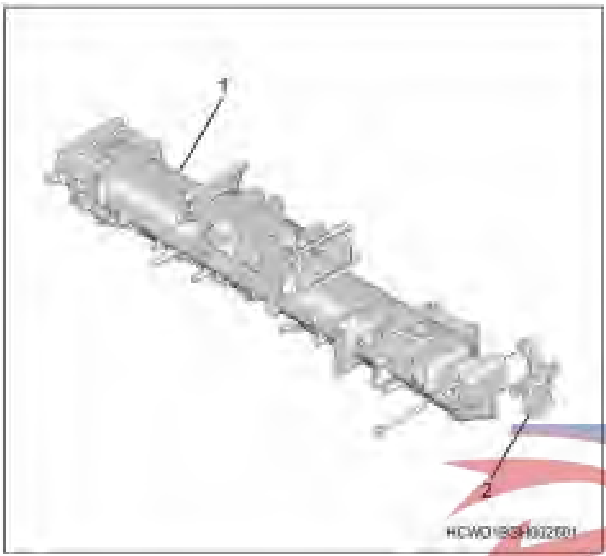
10. Intake manifold installation

1) Install the gasket to the cylinder head.

2) Install the intake manifold to the cylinder head.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Mount the bracket to the intake manifold.



1. Intake manifold
2. Bracket

11. Cylinder head gear box installation

1) Install the O-ring onto the cylinder head gearbox.

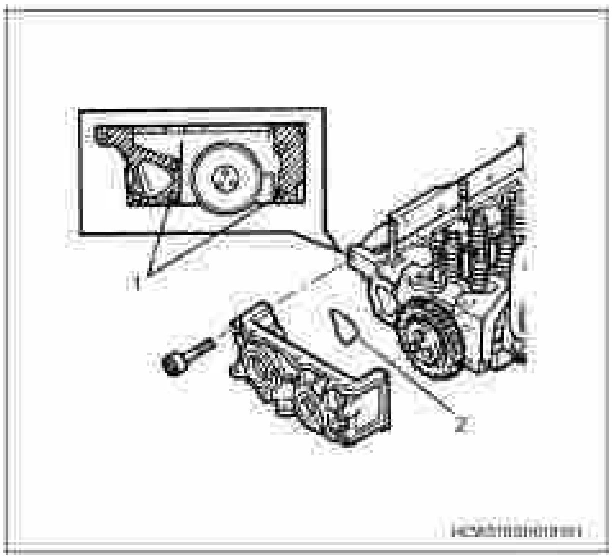
2) Refer to the corresponding chart and apply the liquid gasket to the cylinder head gear box.

Caution:

● Do not allow liquid gasket to drip into bolt hole.

Liquid gasket application procedure

Liquid gasket used	FMD127
Coating width	: about5 mm { about 0.2 in }
Coating thickness	: about0.3 mm { about 0.012 in }



1. Liquid gasket application area
2. O-ring

3) Install the cylinder head gear box to the cylinder head.

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}

12. Idler C installed

1) Apply the engine oil to the idler gear shaft.

2) Align the idler gear shaft with idler gear C.

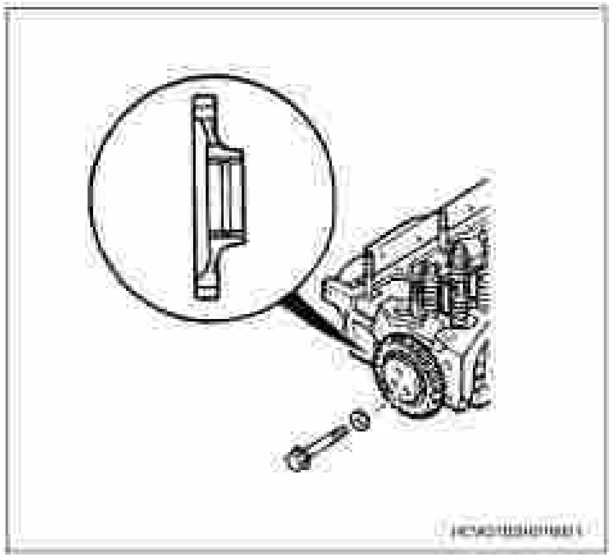
3) Install idler gear C to the cylinder head.

Caution:

● Confirm that the gear runs smoothly.

● As the gear extends from the cylinder head, avoid it from being damaged.

Tightening torque: 40 N • m {4.1 kgf • m / 30 lb • ft}



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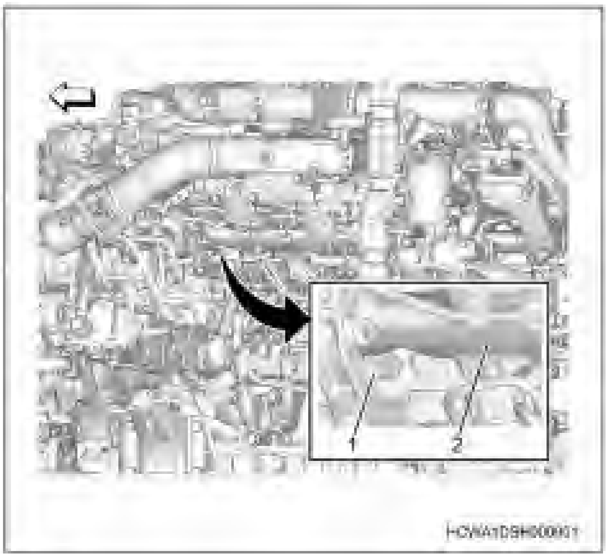
13. Engine coolant temperature sensor installation

1) Apply Loctite 262 or 962 to the threads of the engine coolant temperature sensor.

2) Install the engine coolant temperature sensor on the cylinder head.

Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft}



1. Engine coolant temperature sensor

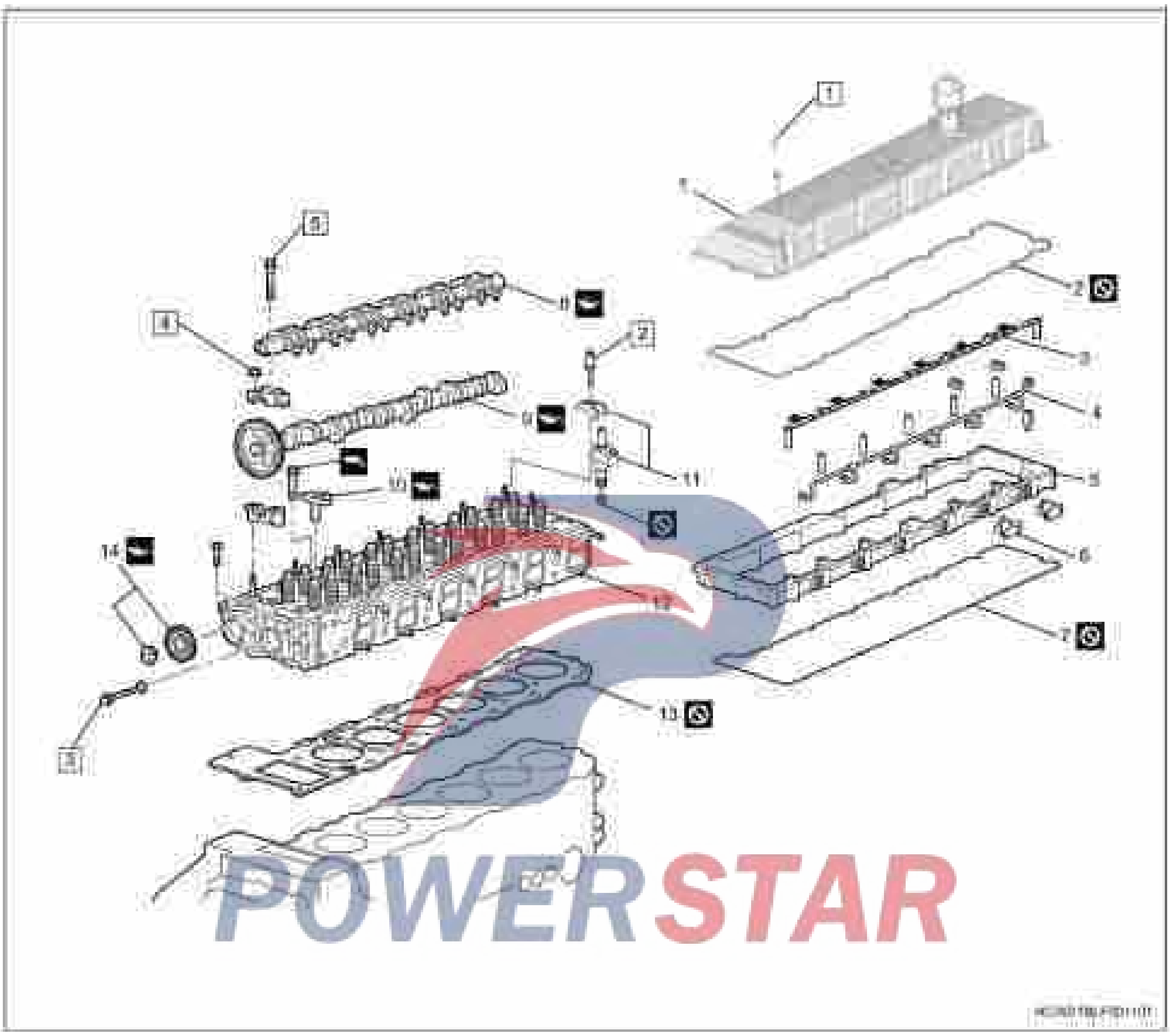
2. Intake manifold

POWERSTAR

Installation

1. Component Views

Cylinder top



Part name

1. Cylinder head cover
2. Cover gasket
3. Injector harness
4. Fuel leak-off pipe
5. Lower cover
6. Harness connector
7. Lower cap gasket
8. Rocker
9. Camshaft
10. Bridge
11. Injector, clamp
12. Cylinder top
13. Cylinder head gasket
14. Idling gear C

Tightening torque

1: 15 N • m {1.5 kgf • m / 11 lb • ft}

2: 49 N • m {5.0 kgf • m / 36 lb • ft}

3: 40 N • m {4.1 kgf • m / 30 lb • ft}

4: 76 N • m {7.7 kgf • m / 56 lb • ft}

5: 90 N • m {9.2 kgf • m / 66 lb • ft}

2. Cylinder head installation

1) Use a squeegee to clean the upper surface of the cylinder block and the lower surface of the cylinder

head.

Caution:

● Carefully clean the cylinder block upper surface and the cylinder head lower surface, taking care not to damage the components.

2) Refer to the diagram and the table, and apply the liquid gasket to the cylinder block.

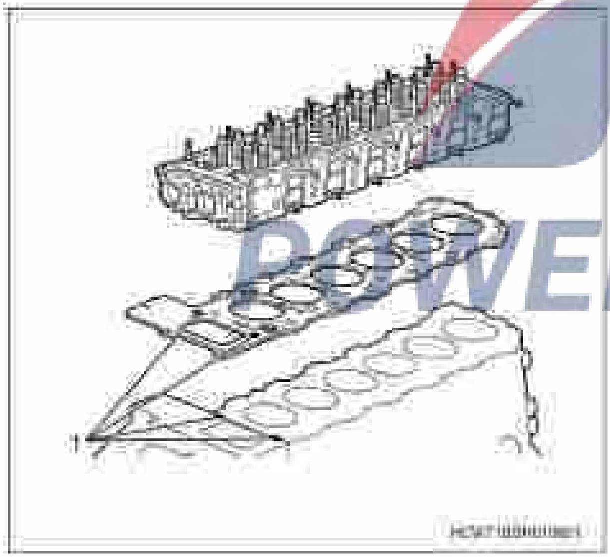
Caution:

● Strictly adhere to the liquid gasket application thickness and application width guidelines.

● After applying the liquid gasket, immediately install the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: 2 mm { 0.08 in }
	Coating width	: 5 mm {0.20 in }



1. Liquid gasket application area

3) Install the cylinder head gasket to the cylinder block.

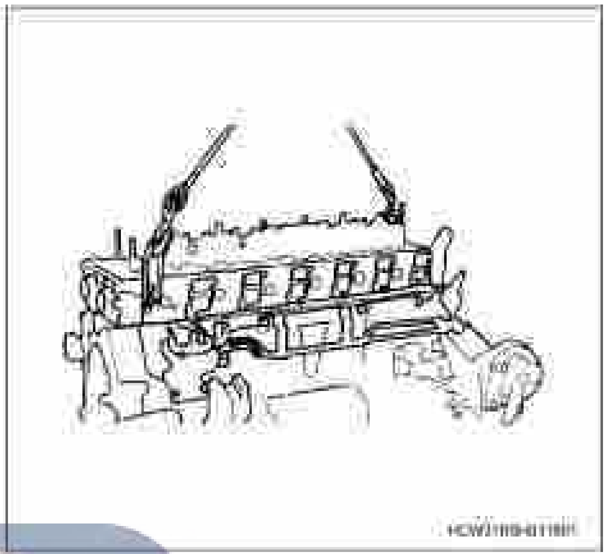
Caution:

● Do not reuse the cylinder head gasket.

4) Carefully align the knock pin positions, and place the cylinder head on the cylinder block.

Caution:

● Check the engagement of the idle gears.



5) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

Caution:

● Never use M12 bolts or M10 bolts.

6) Mount the cylinder head mounting bolts to the cylinder head in the order shown in the figure.

Caution:

● Do not drip foreign matters into the timing gear hole.

● Cylinder head mounting bolts can be used up to 4 times.

Tightening torque: 177 N • m {18.0 kgf • m / 131 lb • ft} 1st (M18)

Tightening torque: 245 N • m {25.0 kgf • m / 82.10 kg • ft} 2nd (M18)

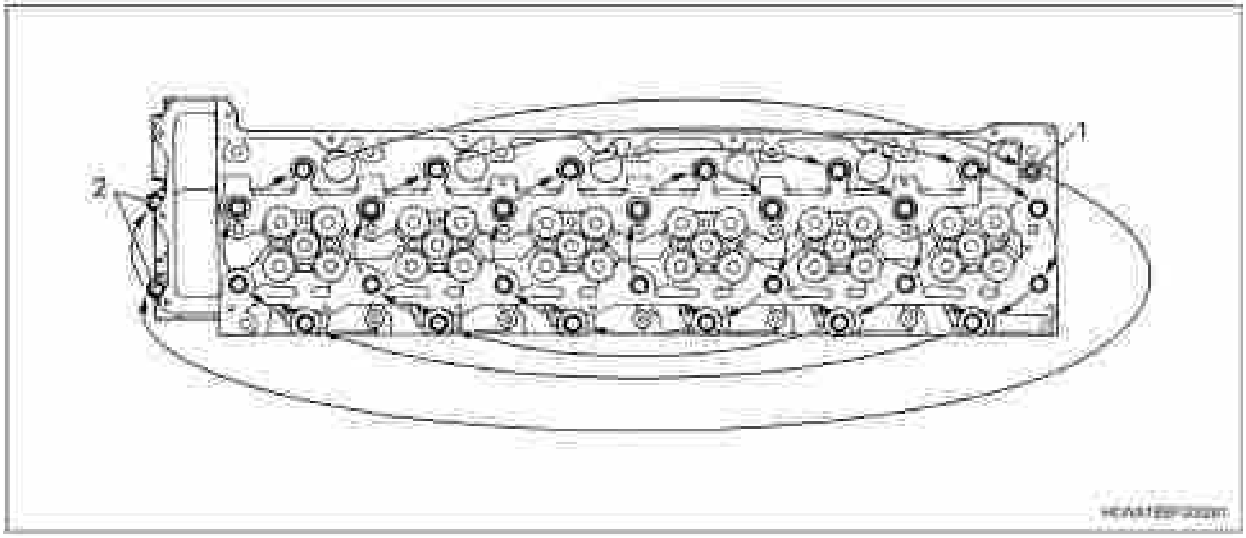
Tightening angle: 60 to 90 ° Third time (M18)

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft} 4th (M12)

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft} 5th (M10)

Tightening torque: 324 N • m {33.0 kgf • m / 239 lb • ft} Confirm the tightening (M18)

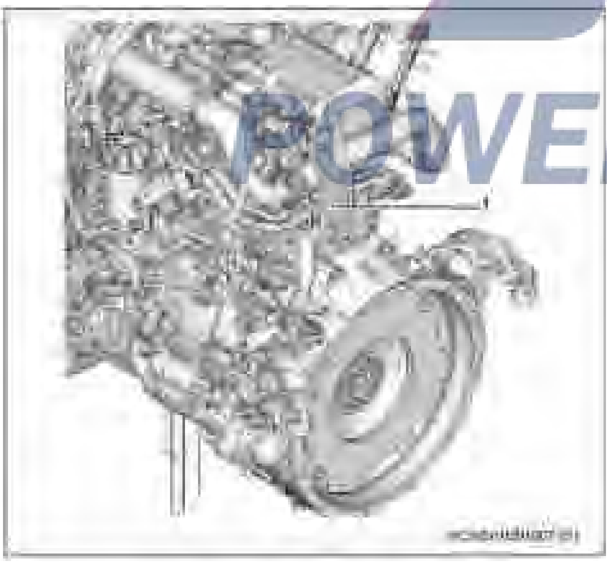
POWERSTAR



1. M12 bolt
2. M10 bolt

7) Remove special tool from the cylinder head.

SST: 8-9761-4276-0 - engine hanger



1. 8-9761-4276-0

3. Glow plug installation

1) Install the glow plug to the cylinder head.

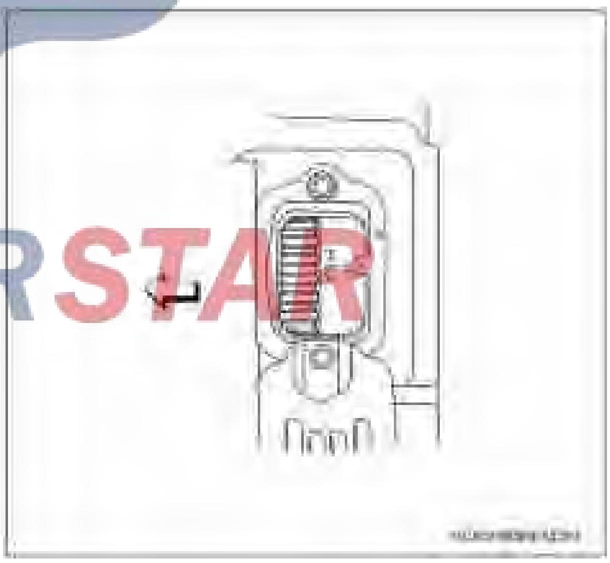
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft}

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m {0.15 kgf • m / 13 lb • in}

4. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.

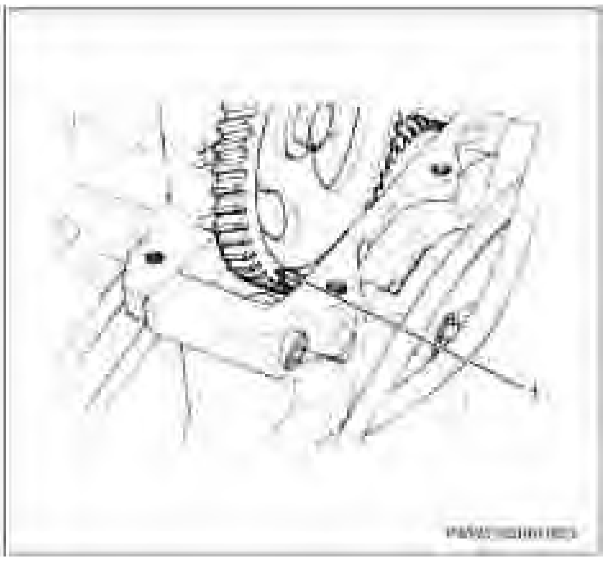


2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.



1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

Note:

● Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.

1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m {7.7 kgf • m / 56 lb • ft}

5. Bridge installation

1) Apply the engine oil to the bridge guide.

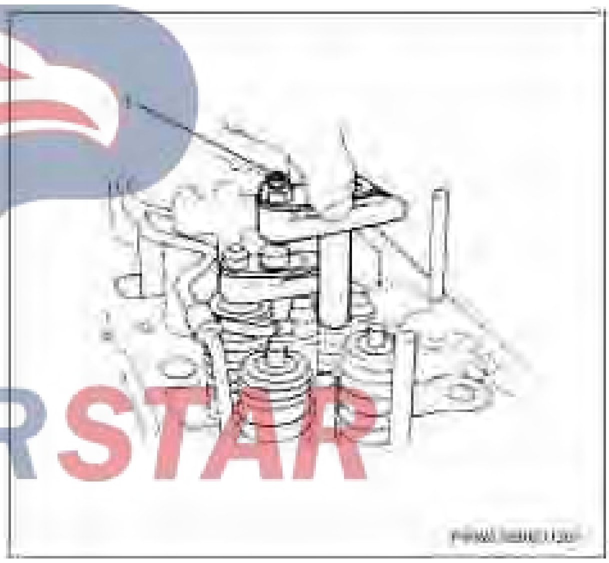
2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.



1. Bridge

6. Rocker arm shaft installation

1) Lubricate the roller arm and adjusting screw lip with engine oil

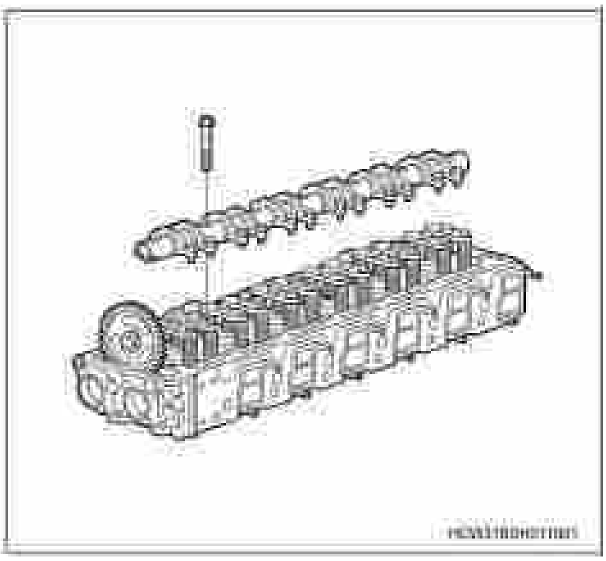
2) Loosen the adjust screw.

Note:

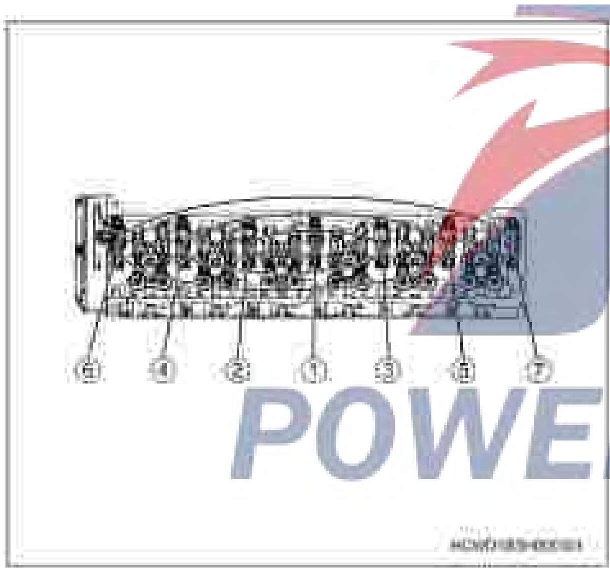
● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.

POWERSTAR



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.

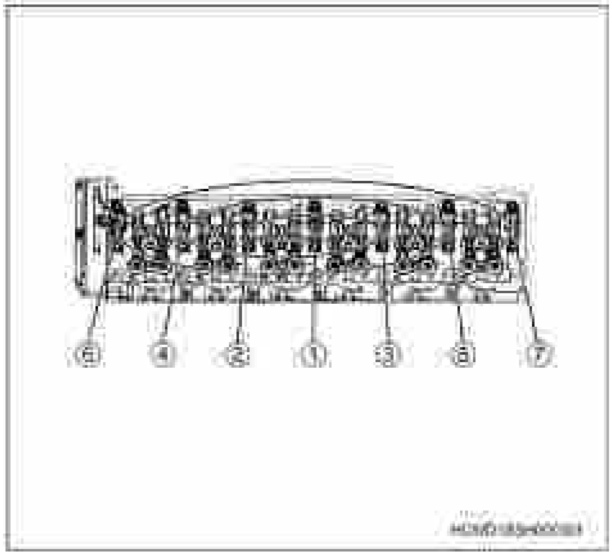


● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 lb • ft}



7. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

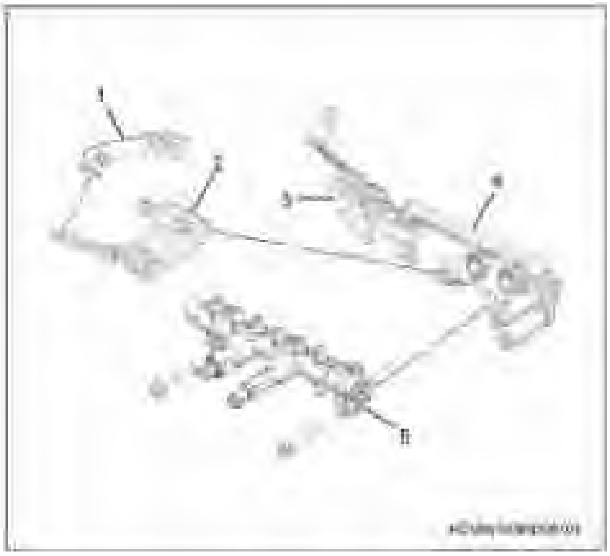
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



POWERSTAR

1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipe bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

4) Connect the harness connector to the fuel rail position sensor.

8. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

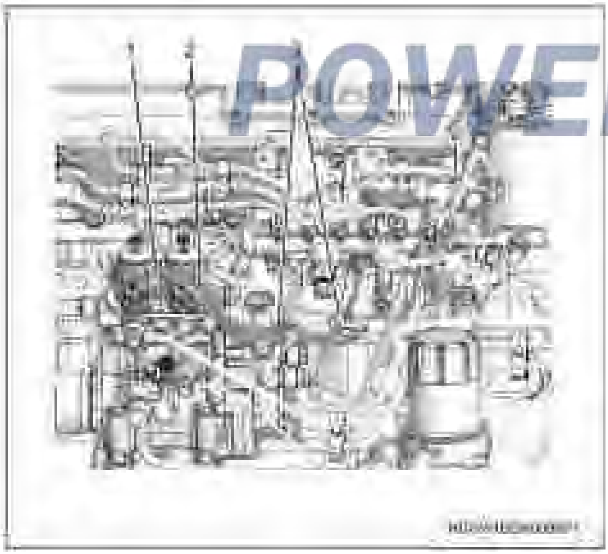
5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.



1. Fuel pipe
2. Fuel pipe
3. Clip

9. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

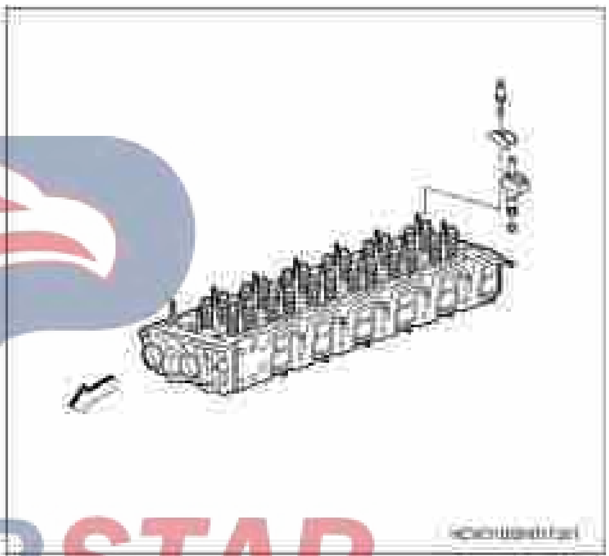
Note:

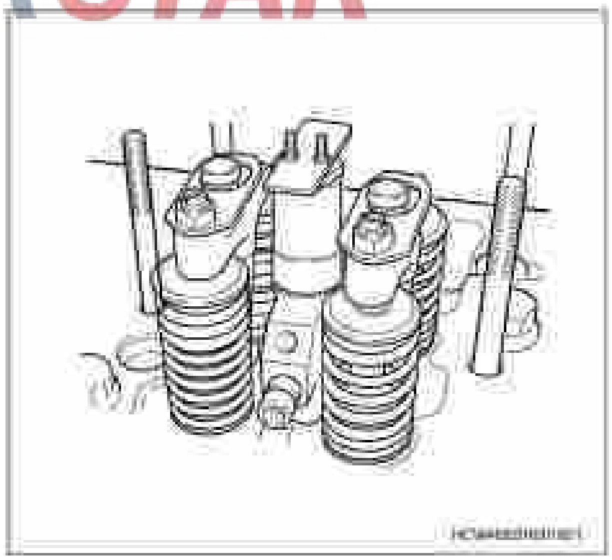
● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.





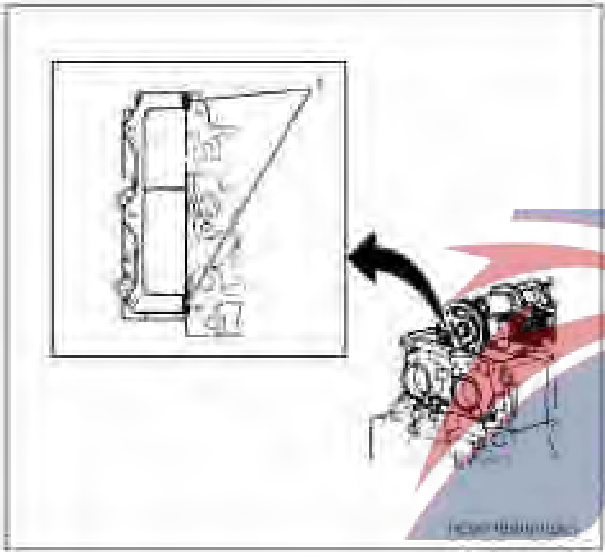
3) Temporarily fasten the injector clamp on the injector.

10. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}

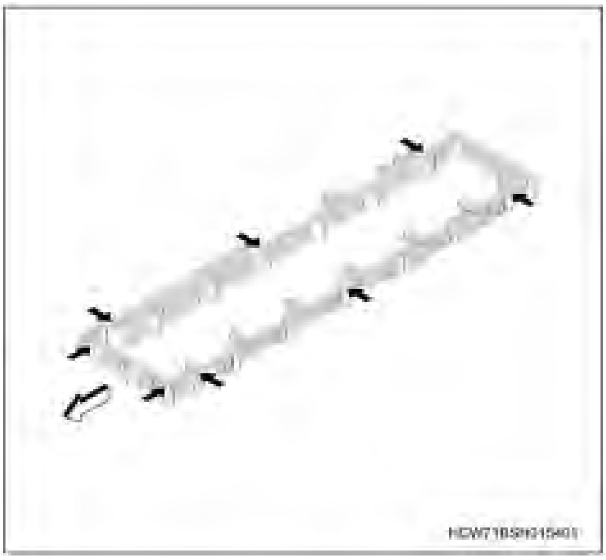


1. Liquid gasket application area

2) Install the gasket on the lower end cap.

3) Install the lower end cap onto the cylinder head.

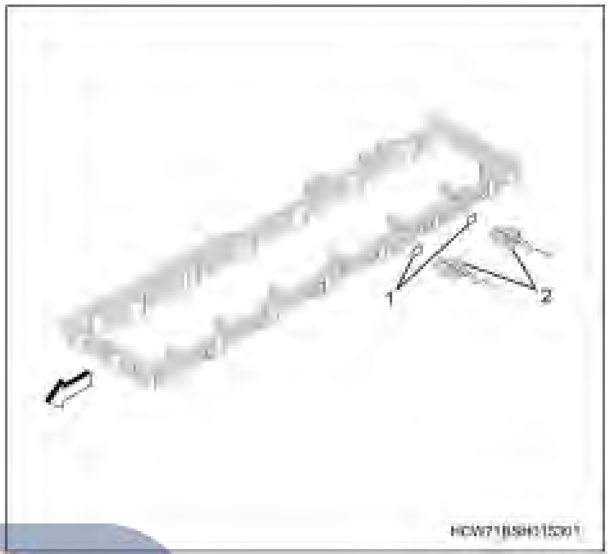
Tightening torque: 15 N • m { 1.5 kgf • m / 11 lb • ft }



4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}



1. O-ring
2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

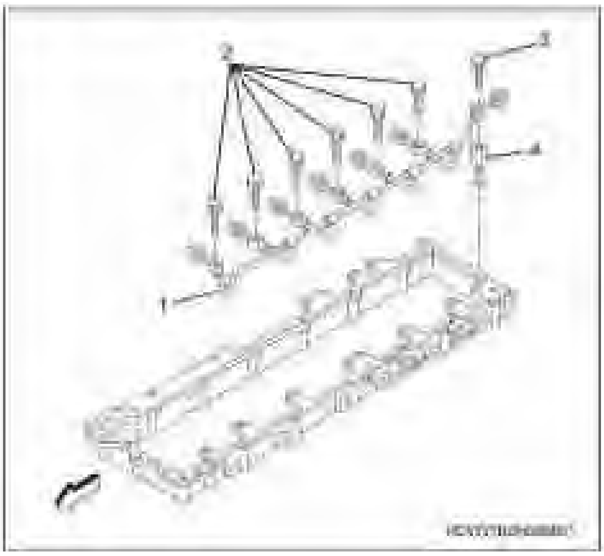
● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 25 lb • ft}



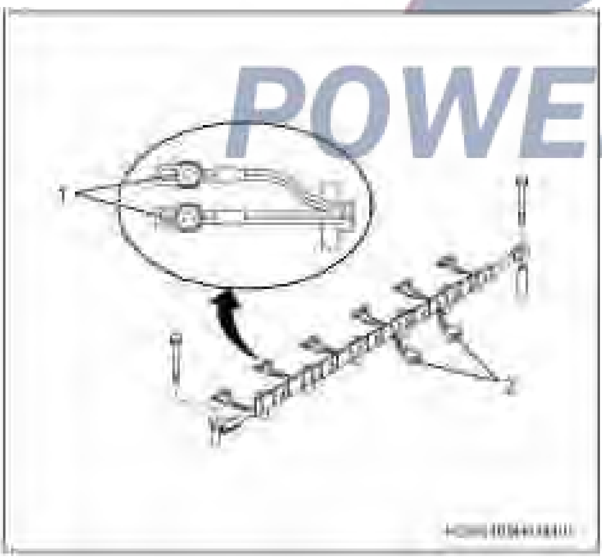
1. Nozzle spout
2. Eyebolt
3. Eyebolt
4. Adapter

11. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut
2. Connector

2) Install the injector harness onto the cylinder head.

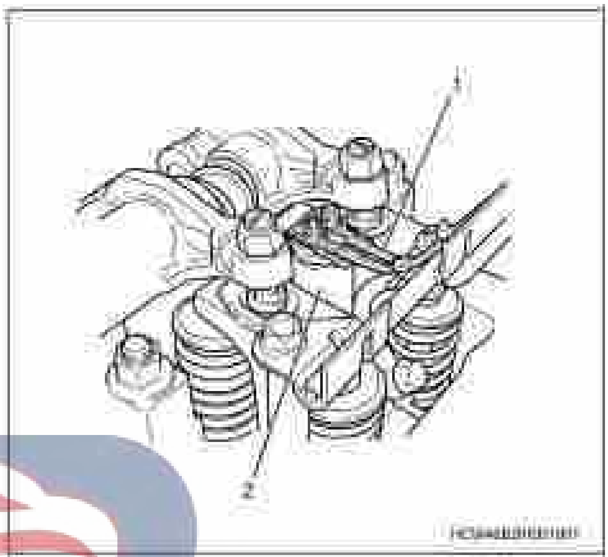
Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



1. Injector harness
2. Injector

12. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb• in}

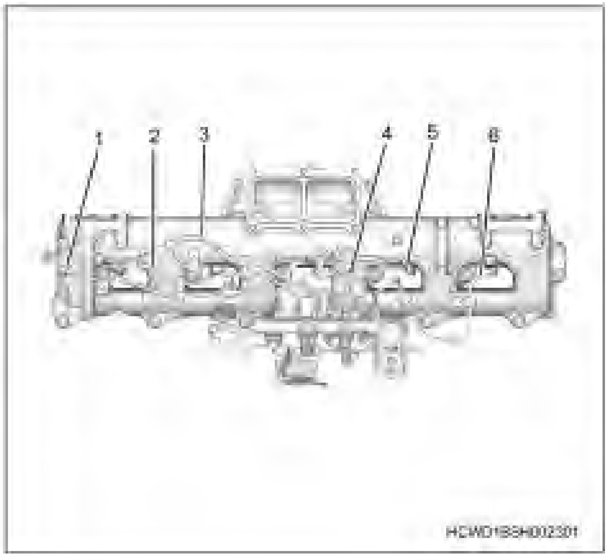
4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

POWERSTAR



1. Injection pipe No. 1

2. Injection pipe No. 2

3. Injection pipe No. 3

4. Injection pipe No. 4

5. Injection pipe No. 5

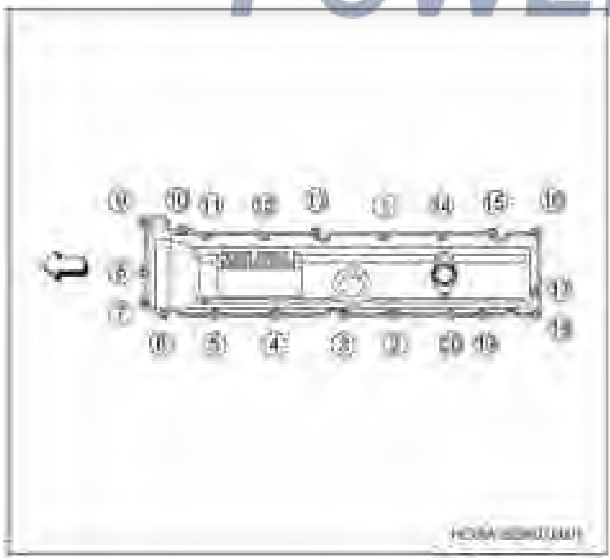
6. Injection pipe No. 6

13. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



14. Generator bracket Installation

1. 50 A and 60 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

2. 90 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

Note:

● When installing, make the right side of the oval hole area of the bracket contact with the bolt.

15. Generator installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground cable and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m / 61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground cable and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

16. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

17. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

18. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

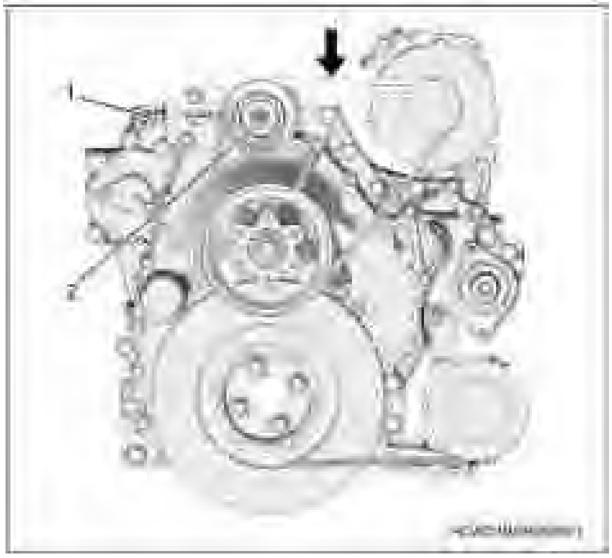
Cleaning fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551to 0.630 in}	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

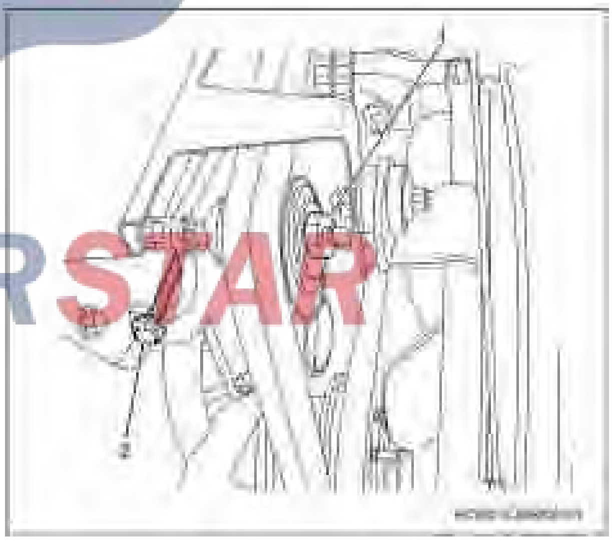
Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m { 15.0 kgf • m / 108 lb • ft }



1. Lock nut
2. Adjust bolt

19. A/C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A/C compressor pulley and crankshaft pulley to the specified value.

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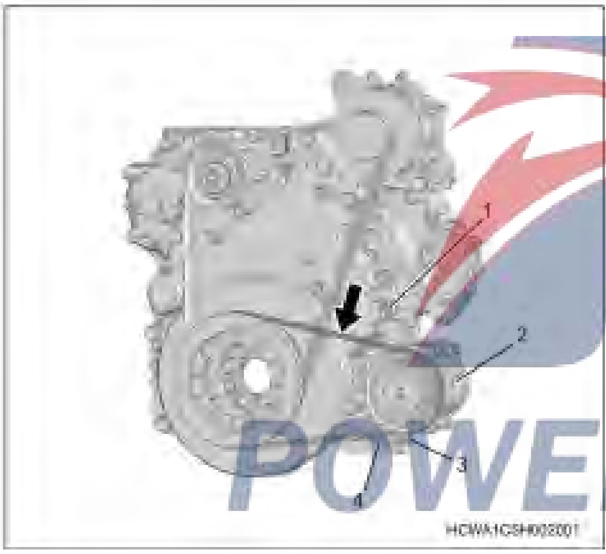
If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A/C compressor pulley and the crankshaft pulley.

Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
tension	: 392 to 588N { 40.0to 60.0kg }	: 294 to 392N { 30.0to 40.0kg }
deviation	: 11 to 14mm { 0.4to 15.24mm }	: 15 to 17mm { 0.6to 17.78mm }
vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

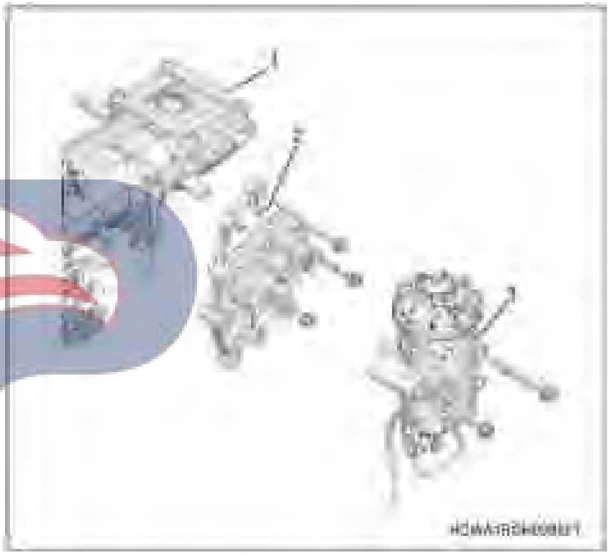
20. Fuel filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

21. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

22.Oil feed pipe installation

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1) Temporarily fasten the fuel drain pipe to the cylinder head.

2) Tighten the fuel drain pipe to the cylinder head.

Eyebolt tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

23. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

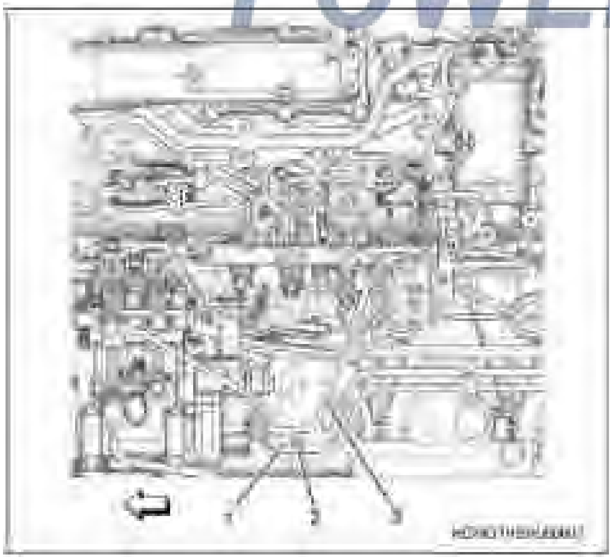
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

24. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

25. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

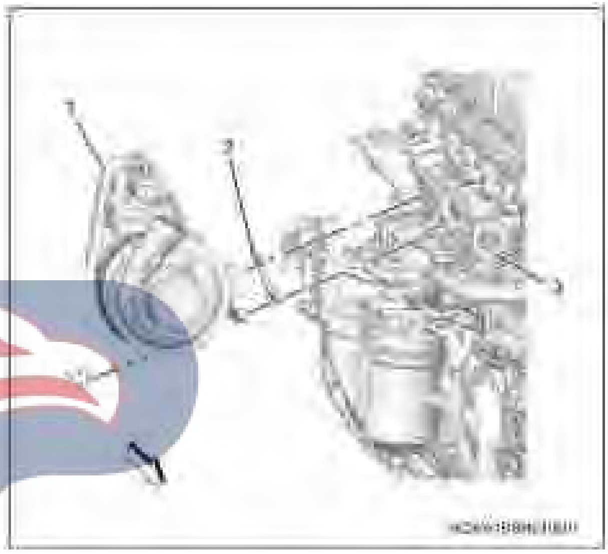
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}



1. Turbocharger
2. Gasket
3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

6) Connect the water return pipe to the turbocharger.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

8) Connect the water feed pipe to the turbocharger.

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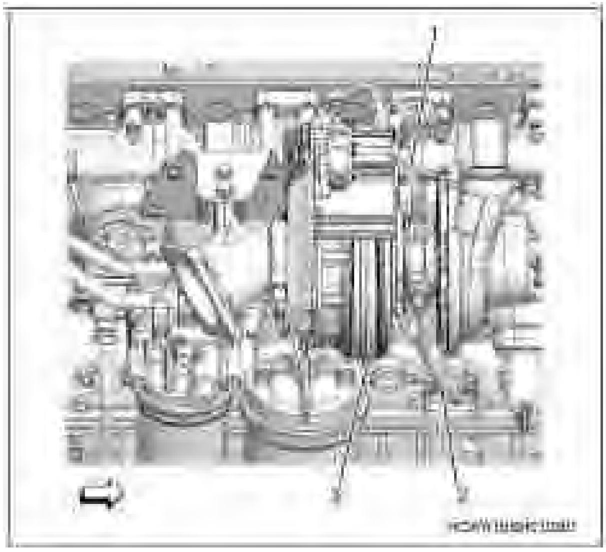
Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

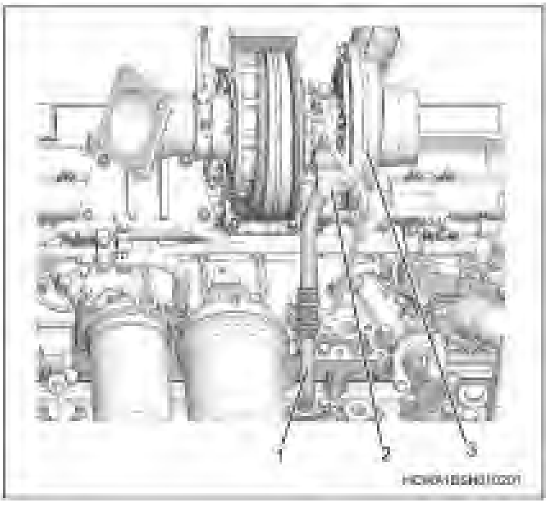
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

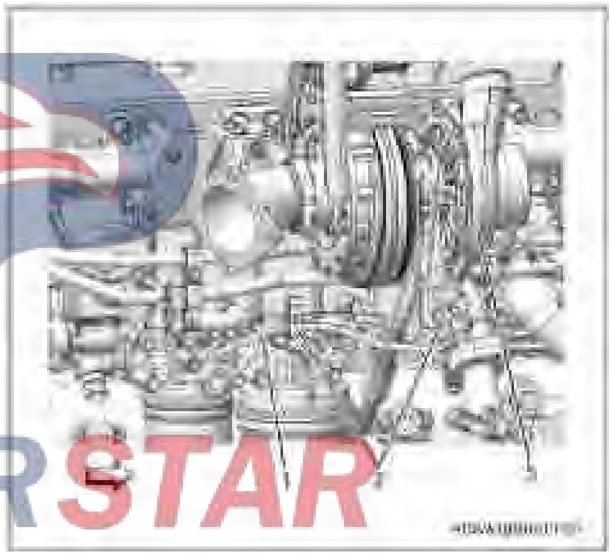
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the fuel filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the fuel filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}



1. Turbocharger feed oil pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m { 1.0 kgf • m / 89 lb • in }

26. Exhaust cover installation

1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

● Uniformly tighten the mounting nuts and bolts of

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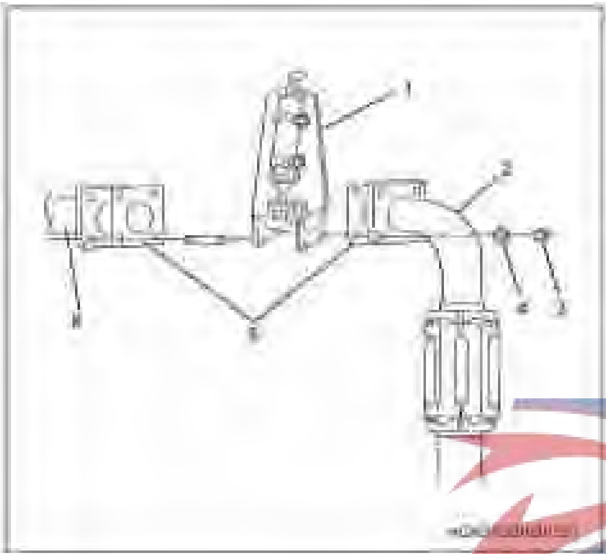
the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m { 6.0 kgf • m / 44 lb • ft }



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. washer
5. Gasket
6. Turbocharger exhaust pipe

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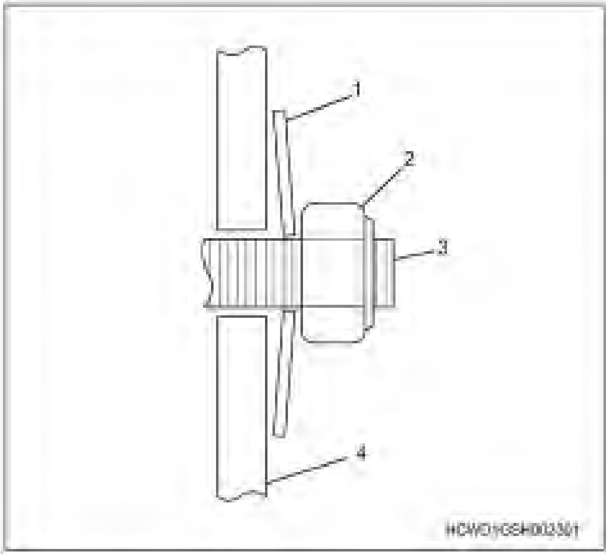


1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

27. Exhaust cover installation

1) Install the exhaust cover to the frame.

28. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

29. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

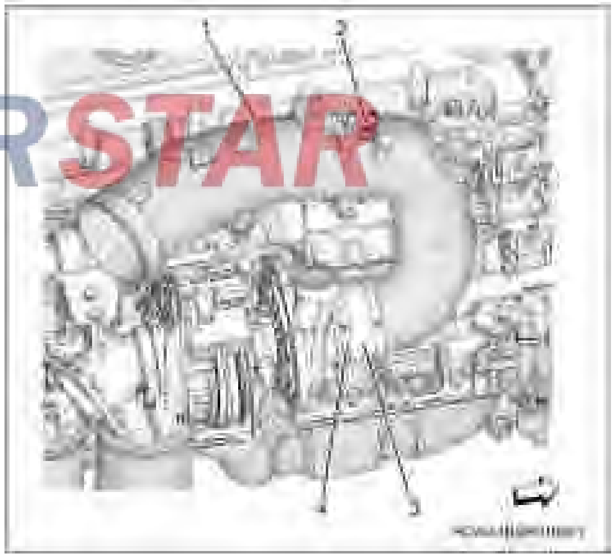
2) Install the mudguard on the left side of the vehicle to the bracket.

30. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb• ft} M10



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

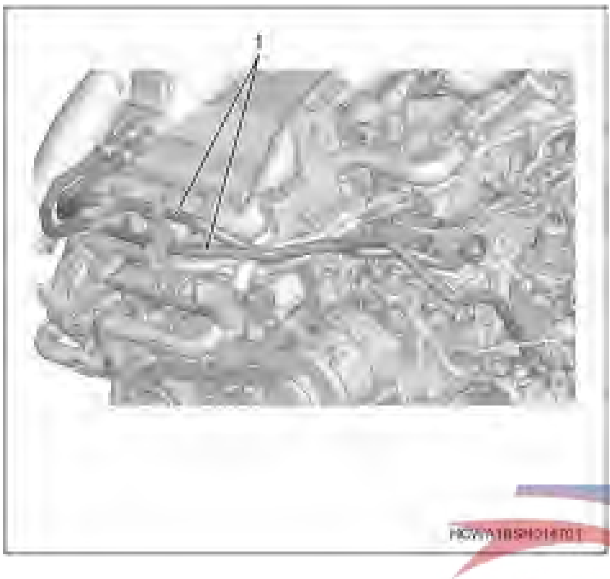
3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air

flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

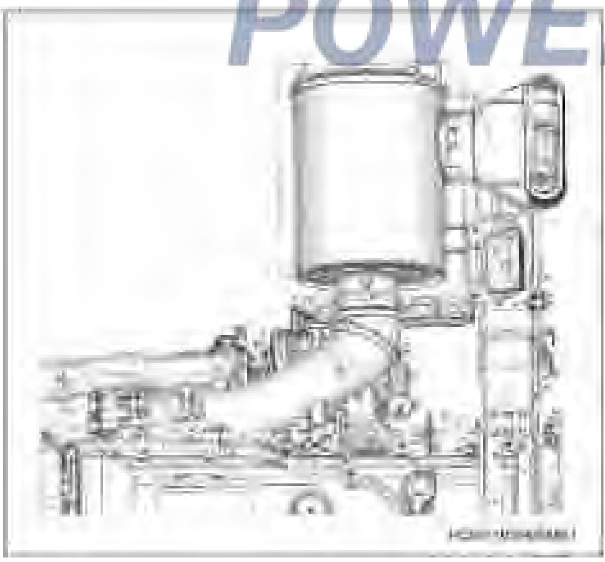
31. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



32. Polit valve installation

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb• in}

33. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

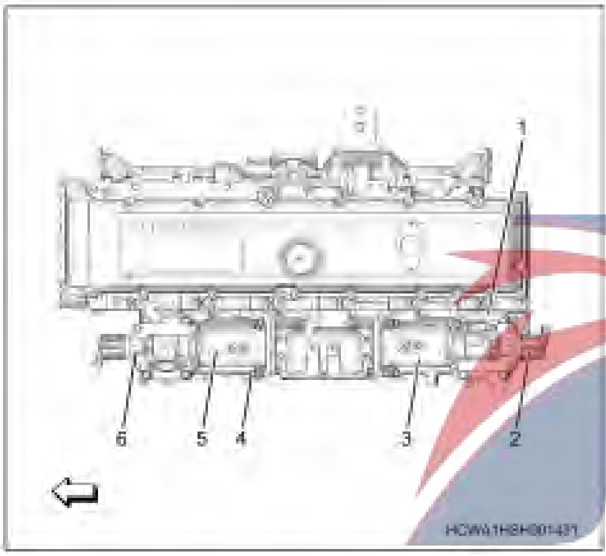
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb• in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe bracket
5. EGR Valve duct A
6. EGR valve 1

5) Final Tighten the EGR valve conduit A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

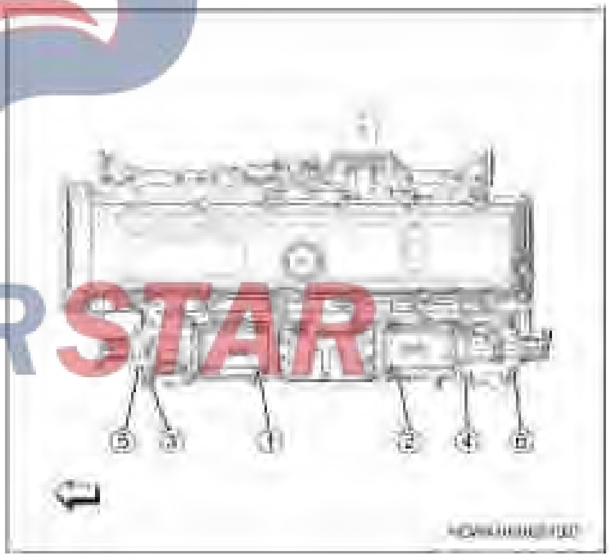
Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



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34. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

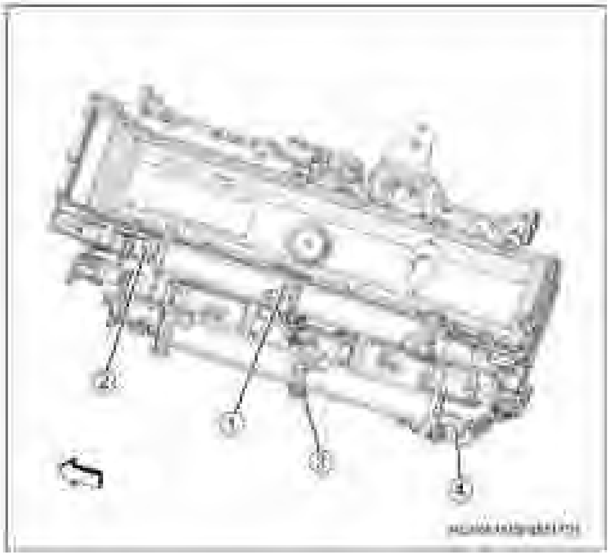
● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

- ● EGR cooler duct D.
- ● EGR cooler duct B
- ● EGR cooler B
- ● EGR cooler D

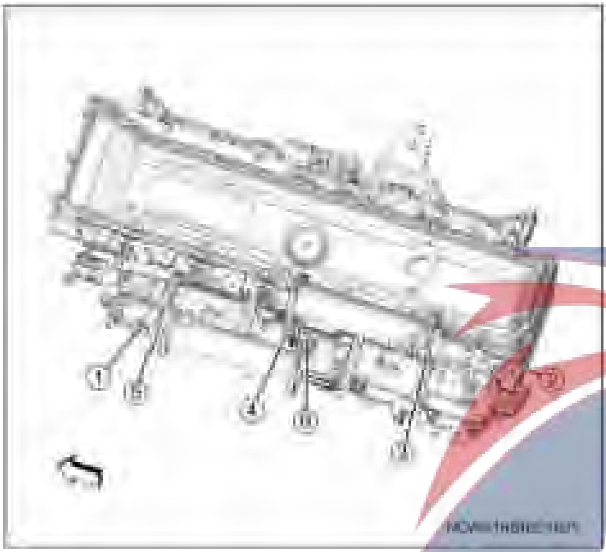
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

- ● EGR cooler A
- ● EGR cooler bracket
- ● EGR cooler C
- ● EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

- ● EGR cooler duct D
- ● EGR cooler duct B
- ● EGR cooler B
- ● EGR cooler D
- ● EGR cooler A
- ● EGR cooler bracket
- ● EGR cooler C
- ● EGR cooler bracket

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5 (M10), 6 (M10)

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5 (M8), 6 (M8)

Note:

- ● The number behind the tightening torque indicates the diagram number.

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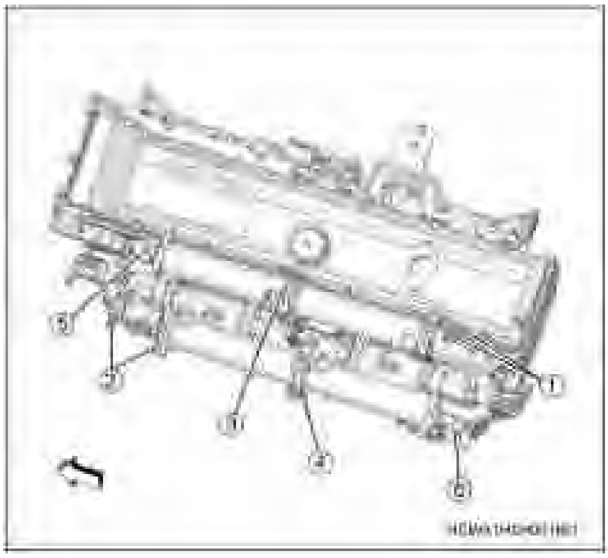


4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

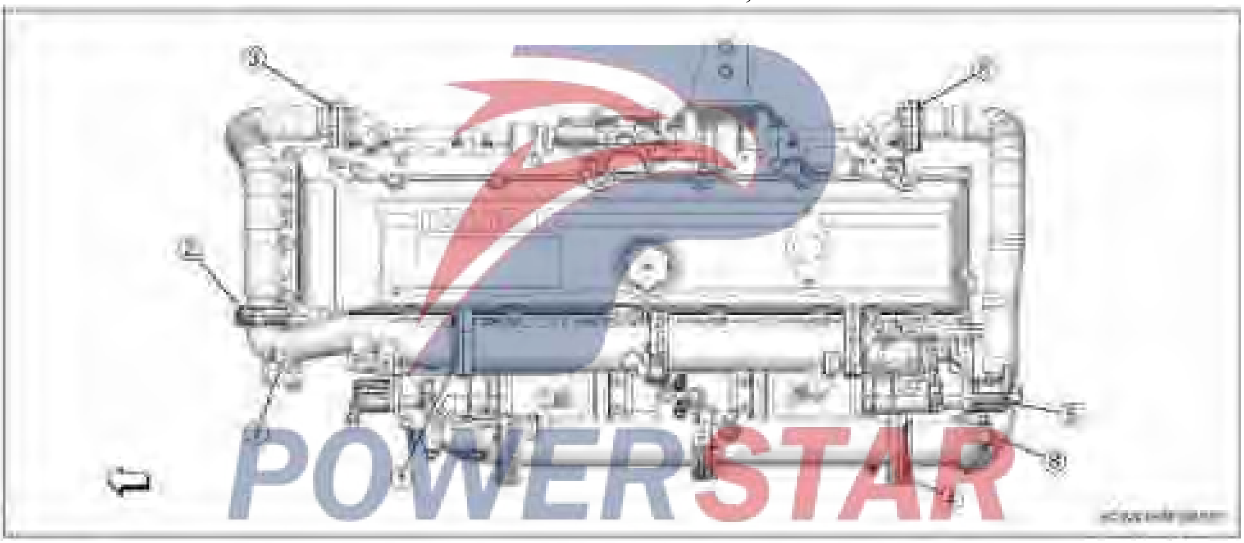
● EGR duct B.

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C

● EGR duct B

● Bracket

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 1 (M10), 2, 3, 9 (M10), 10 (M10)

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 4

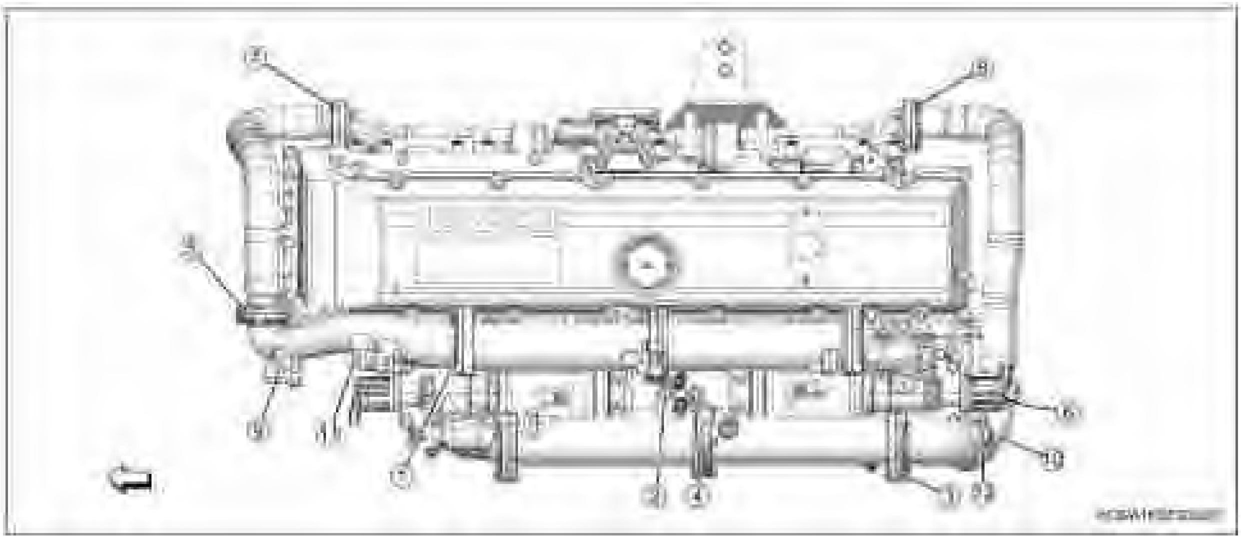
Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft } 5, 6 (M8), 7, 8 (M8), 9 (M8)

Tightening torque: 24.7 N • m { 2.5 kgf • m / 18 lb • ft } 10 (M8)

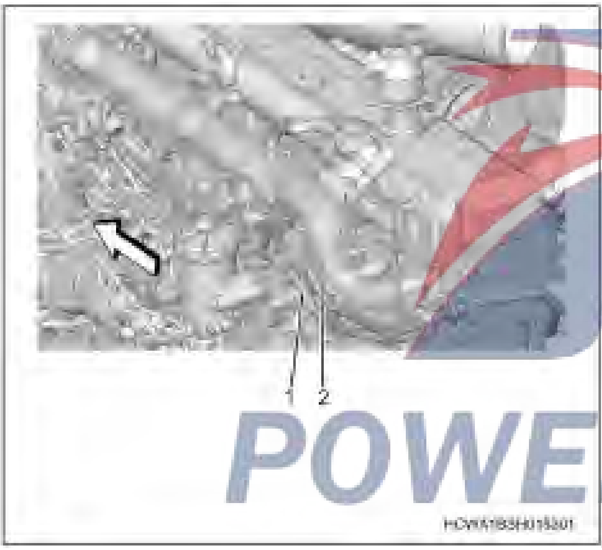
Tightening torque: 20 N • m { 2.0 kg • m / 15 lb • ft } 11, 12 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front return pipe
2. Rear return pipe

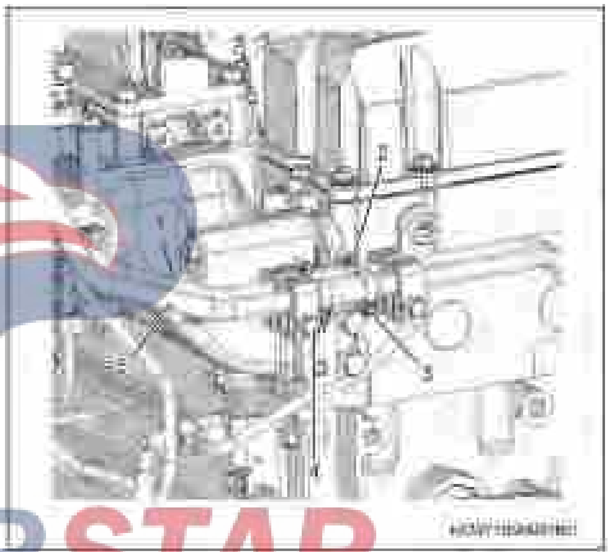
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.



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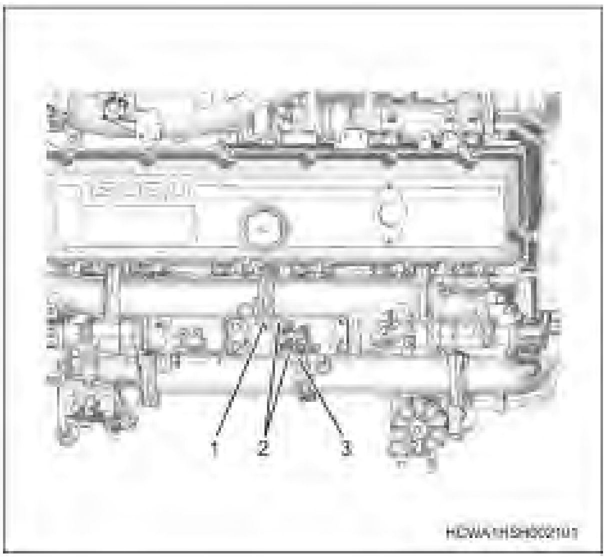
1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Rear return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.

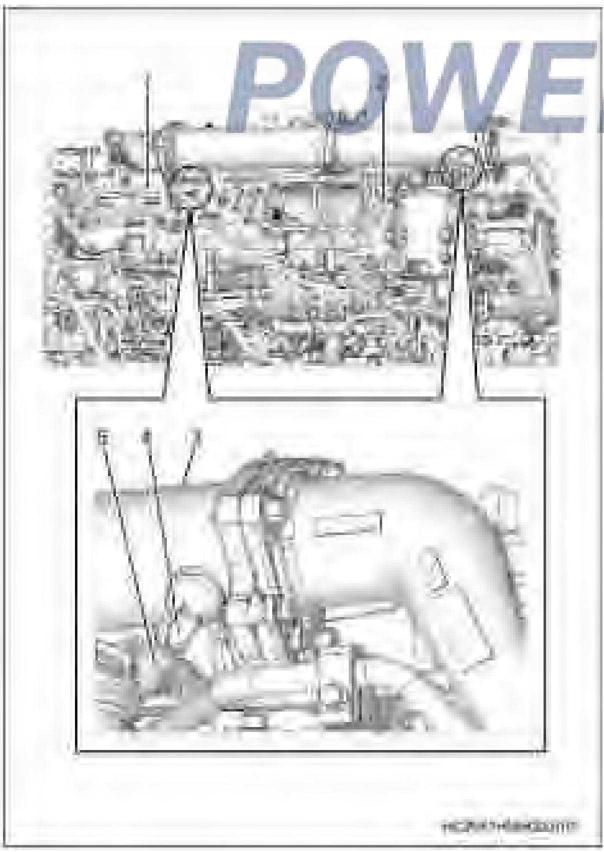


1. Hose clip
2. Water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

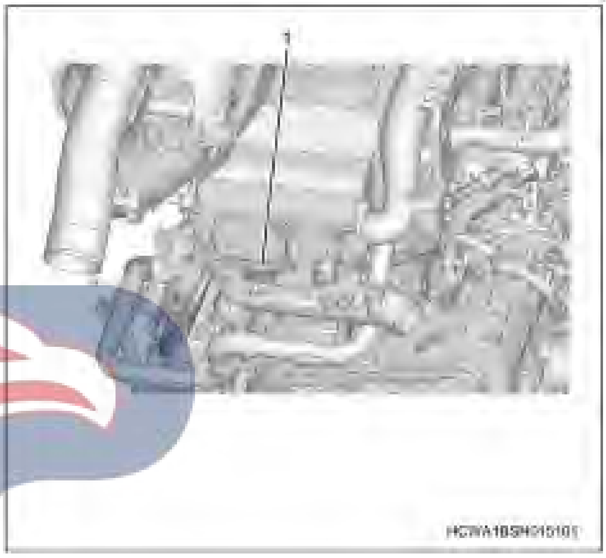
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



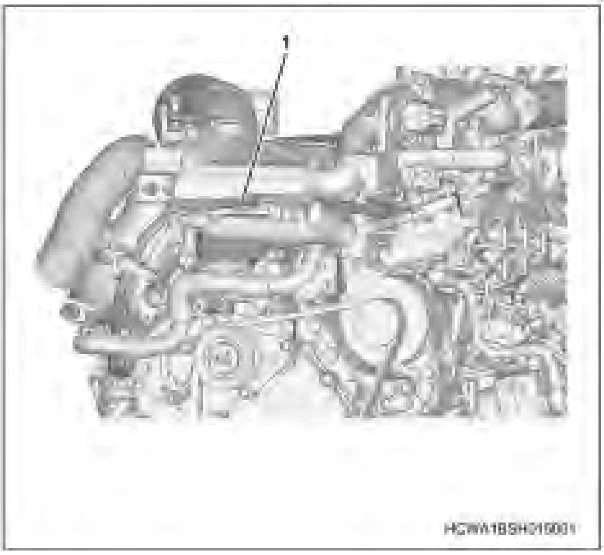
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

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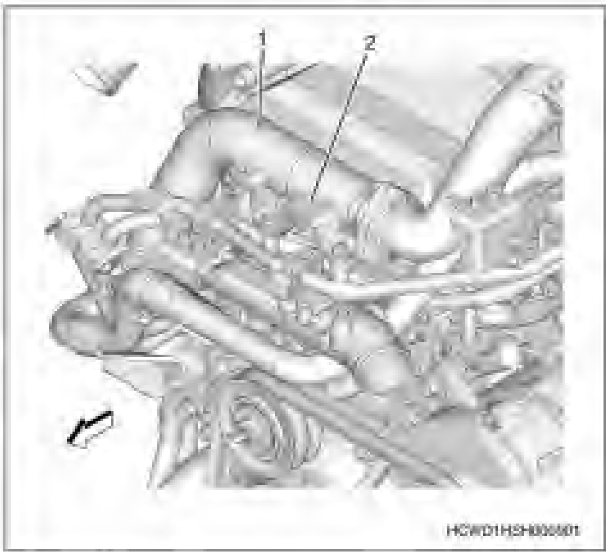
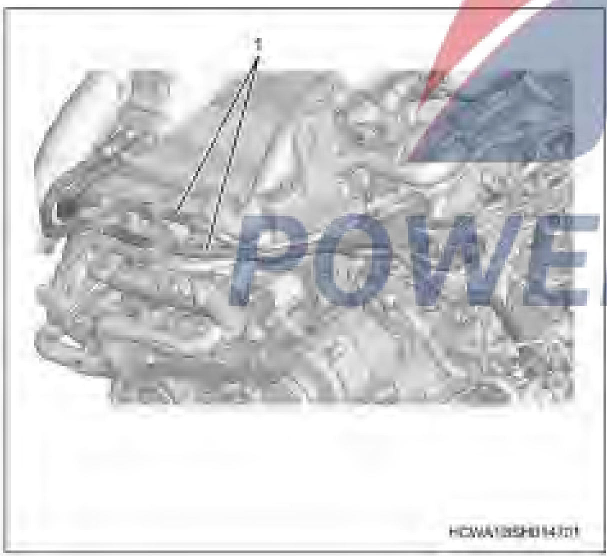
35. Suction pipe installation

1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction pipes to the air compressor.

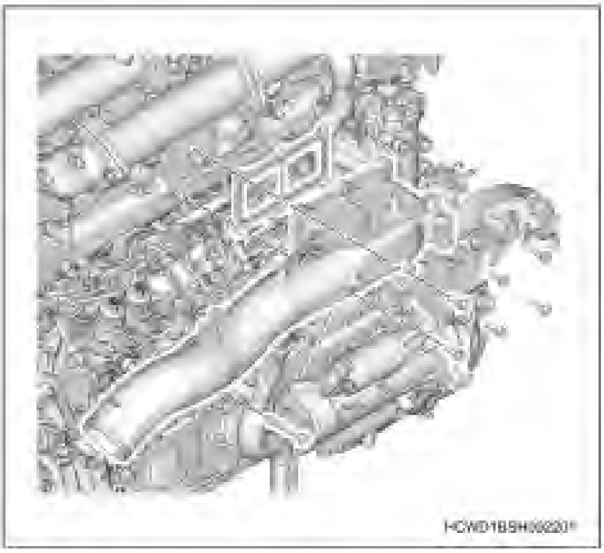


1. Exhaust pipe

36. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}



37. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }

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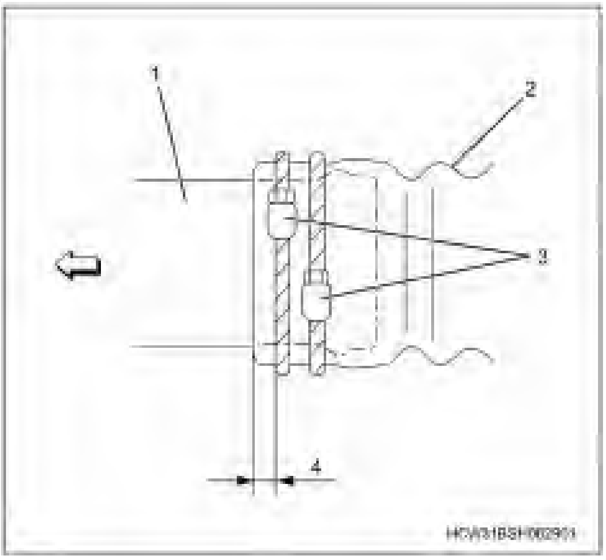


1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

38. Water charge pipe installation

1) Install the water charge pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

2) Install the water charge pipe bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

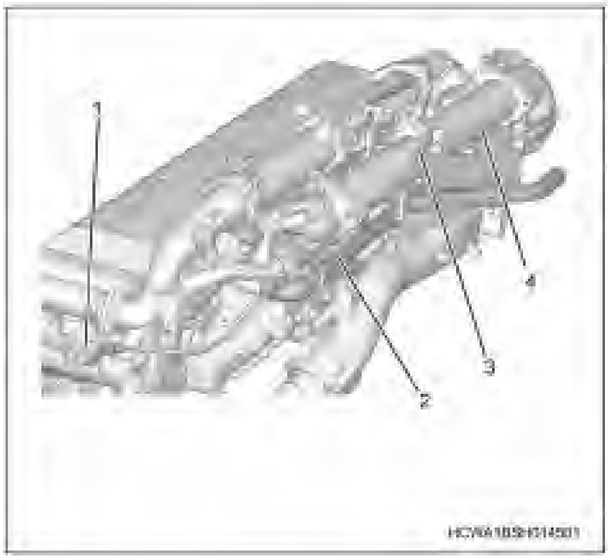
39. Air leakage pipe installation

1) Install the rear blow-by pipe to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the front blow-by pipe to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 13.61 kg • ft}

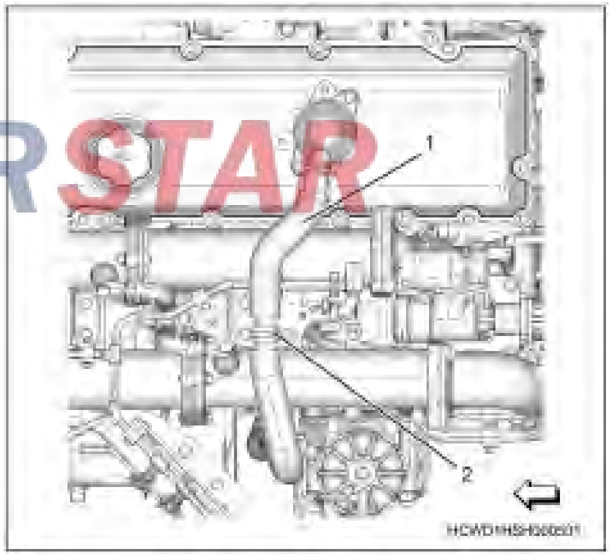
Eyebolt



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

40. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

41. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

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2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15)Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

42. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.

1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m /62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

6) Operate the priming pump until large bubbles are no longer formed.

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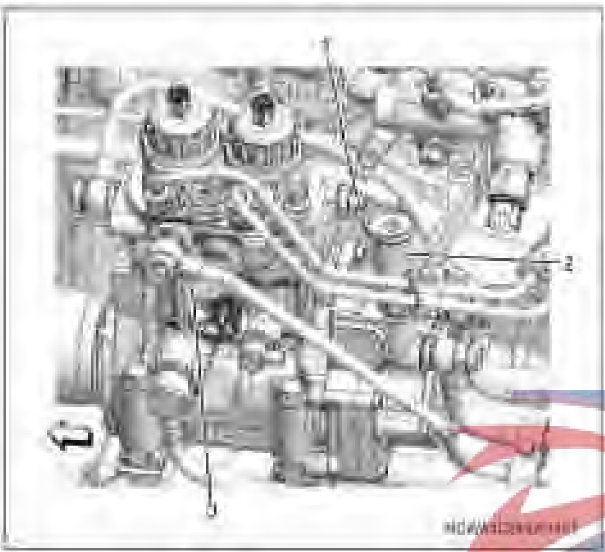
7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

43. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

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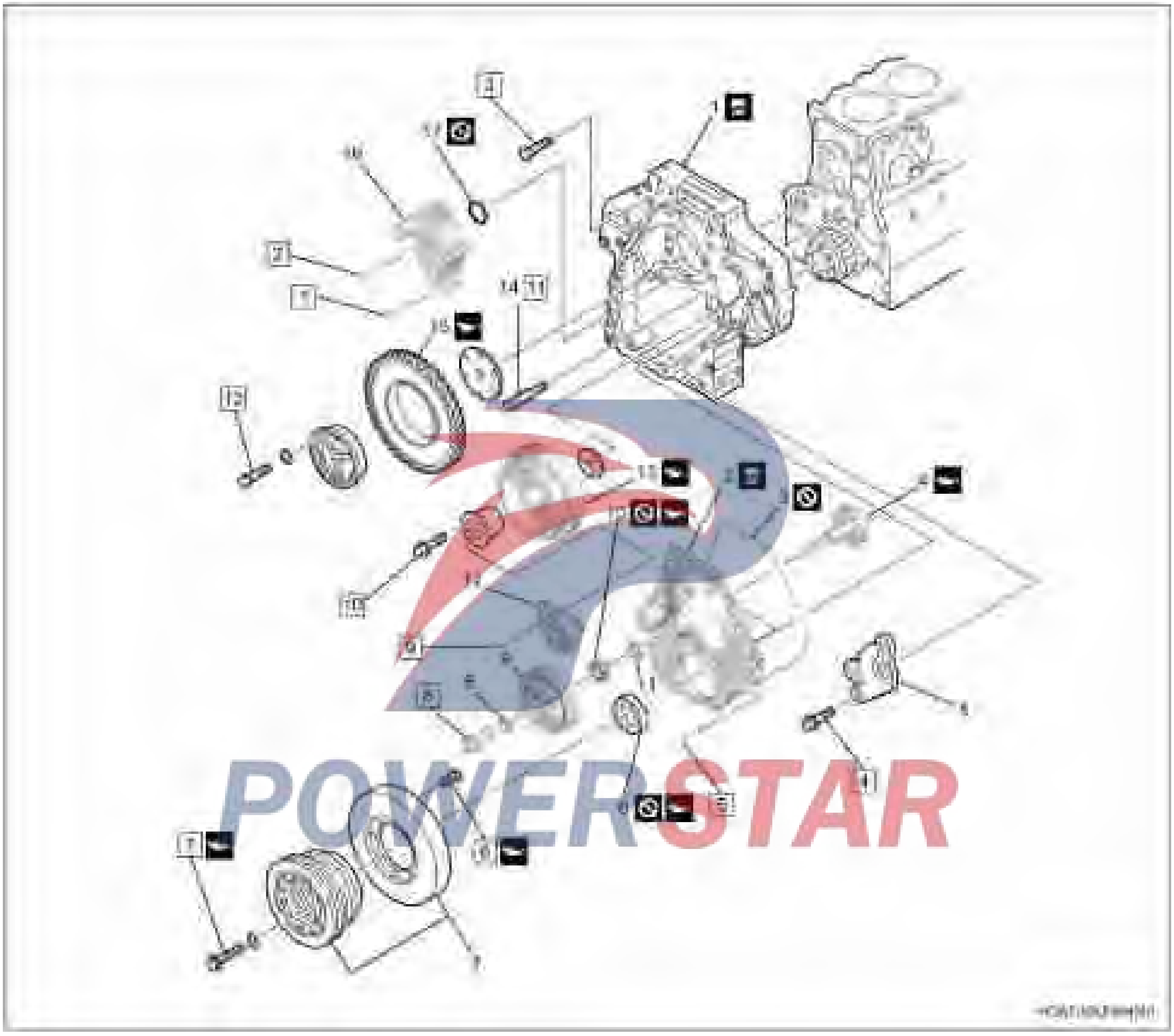
Timing gearbox

Removal

1. Component Views

Timing gearbox



Part name

1. Timing gear box
2. Gear box cover
3. Gasket
4. Fan shaft
5. A / C compressor bracket
6. Crankshaft front oil seal
7. Crankshaft pulley
8. Tapered bushing
9. Fan pulley
10. Oil seal
11. Gasket
12. Idler
13. Idling Gear A
14. Tightening bolts
15. Idling Gear B
16. Oil pump
17. O-ring

Tightening torque

1: 49 N • m { 5.0 kgf • m / 36 lb • ft }

2: 39 N • m { 4.0 kgf • m / 29 lb • ft }

3: 135 N • m { 13.8 kgf • m / 100 lb • ft } M14

3: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

4: 135 N • m { 13.8 kgf • m / 100 lb • ft }

5: 26 N • m { 2.7 kgf • m / 19 lb • ft } M8

5: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

6: 96 N • m { 9.8 kgf • m / 71 lb • ft }

7: 267 N • m { 27.2 kgf • m / 197 lb • ft }

8: 539 N • m { 55.0 kgf • m / 398 lb • ft }

9: 43 N • m { 4.4 kgf • m / 32 lb • ft }

10: 108 N • m { 11.0 kgf • m / 80 lb • ft }

11: 39 N • m { 4.0 kgf • m / 29 lb • ft }

12: 40 N • m { 4.1 kgf • m / 30 lb • ft }

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

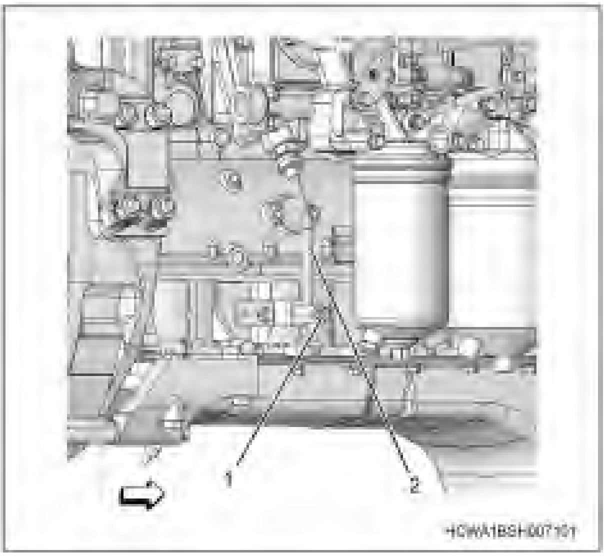
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.

1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

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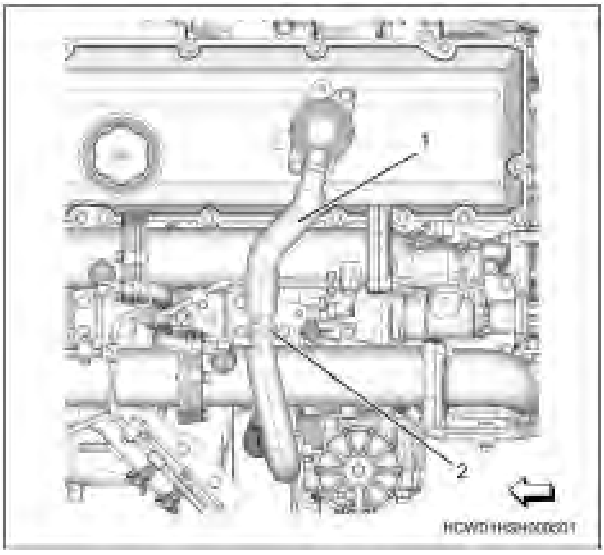
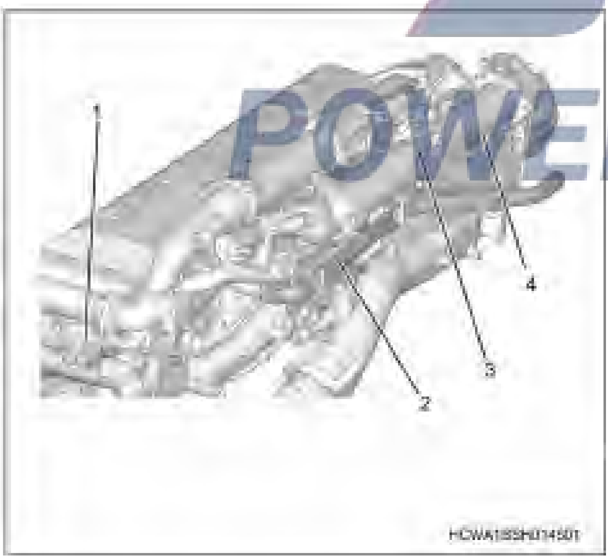


1. Ventilation hose
2. Ventilation hose clip

5. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

6. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

2) Remove the water-filled bracket from the inlet pipe.

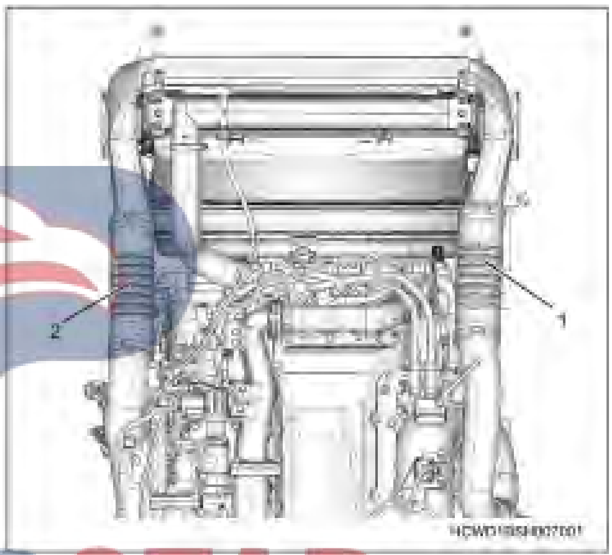
3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

7. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

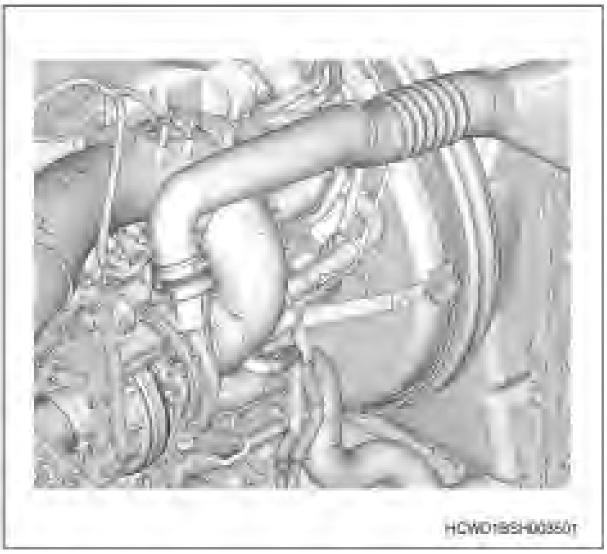
2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



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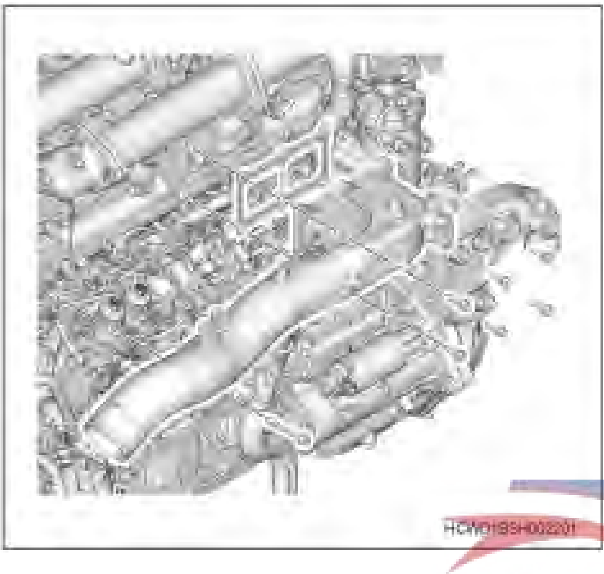
8. Intake duct removal

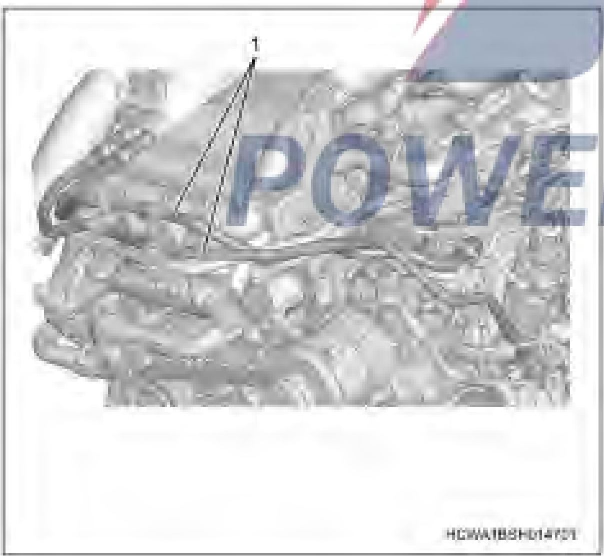
1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



9. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

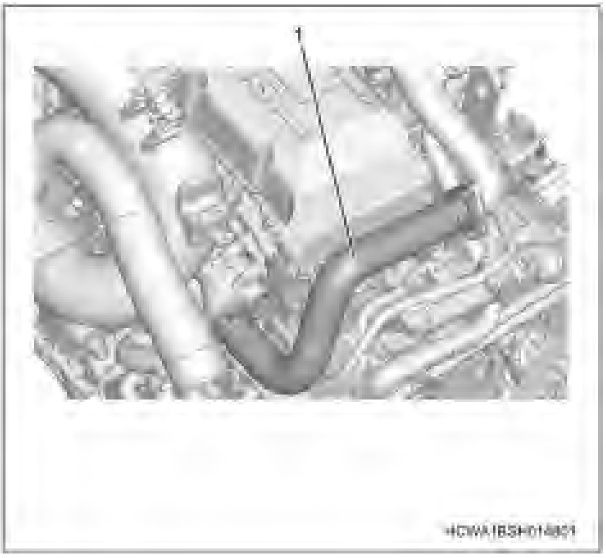


1. Exhaust pipe

10. EGR cooler removal

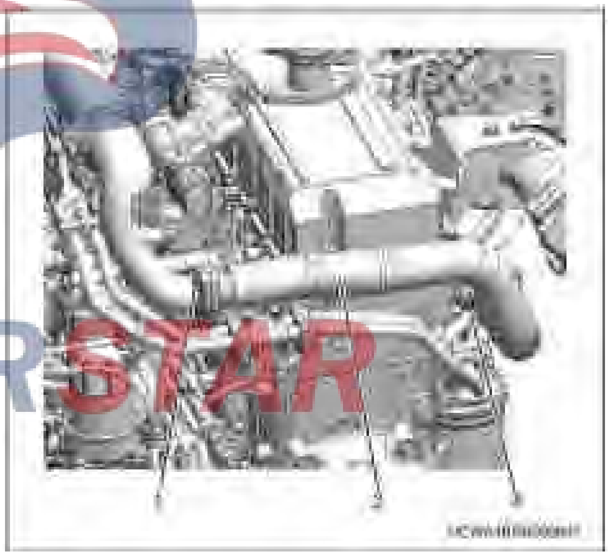
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the recirculation cooler line C.



1. Standard bolt
2. Exhaust gas recirculation line B
3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.

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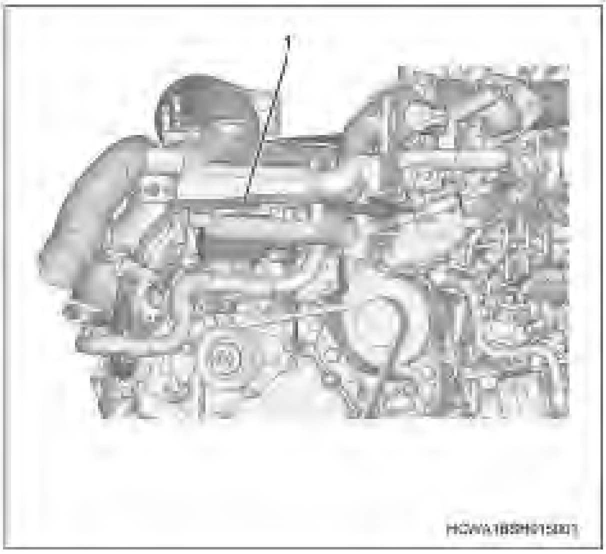
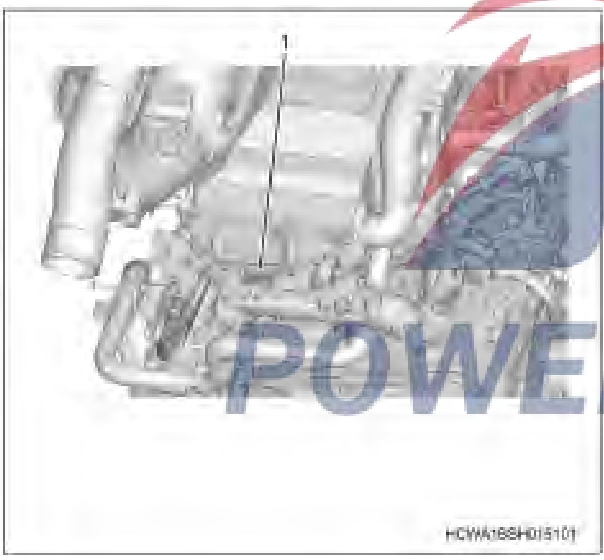


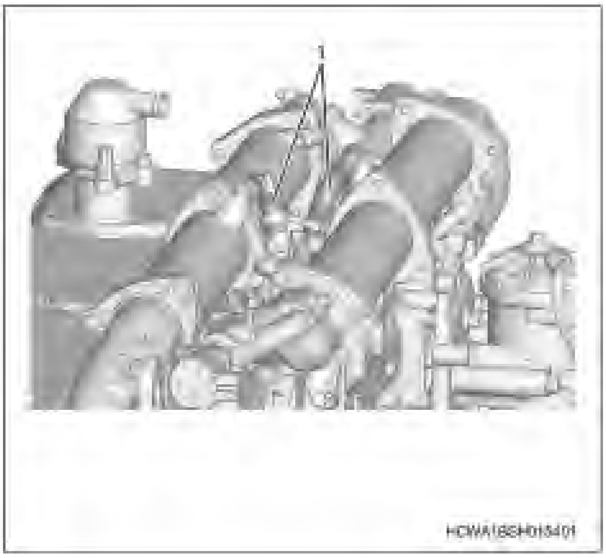
1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.



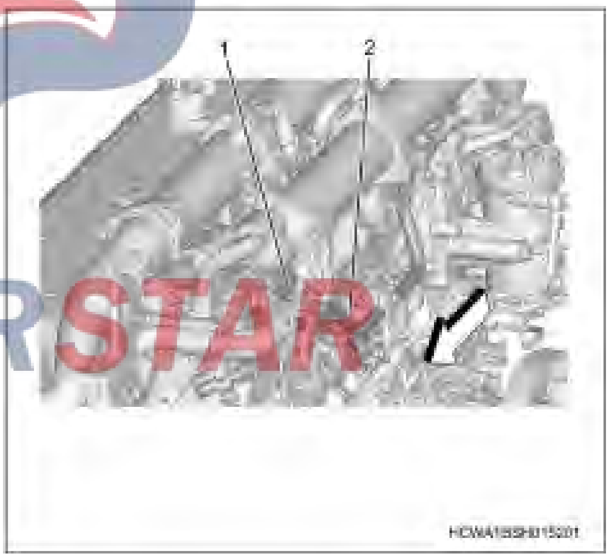
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. Water feed hose

7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe
2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

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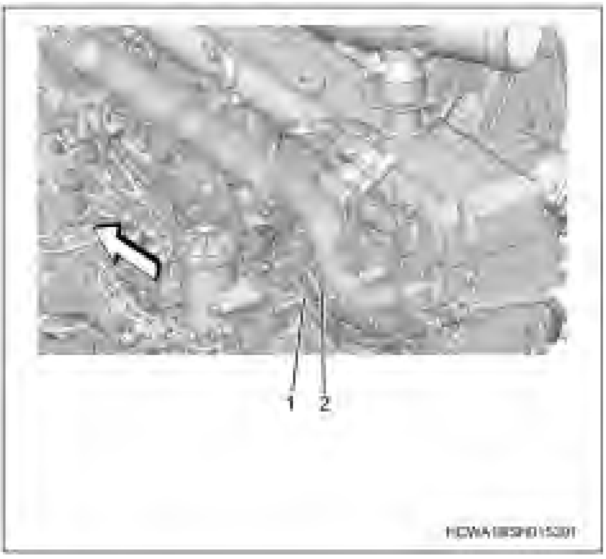
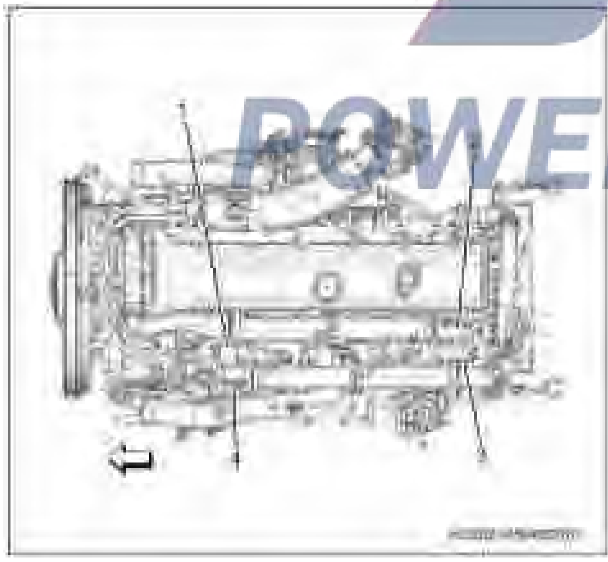


1. Front return pipe

2. Back-end return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.



1. EGR valve 2

2. EGR cooler duct B

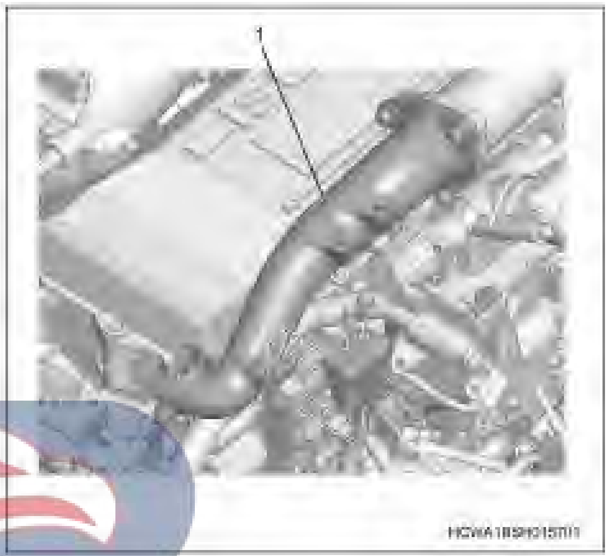
3. EGR valve 1

4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

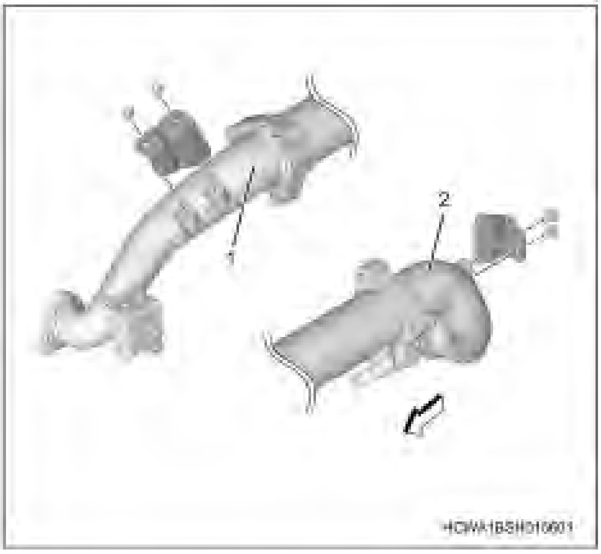
13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.



1. Exhaust gas recirculation cooler duct

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A

2. Exhaust Gas Recirculation Cooler duct C

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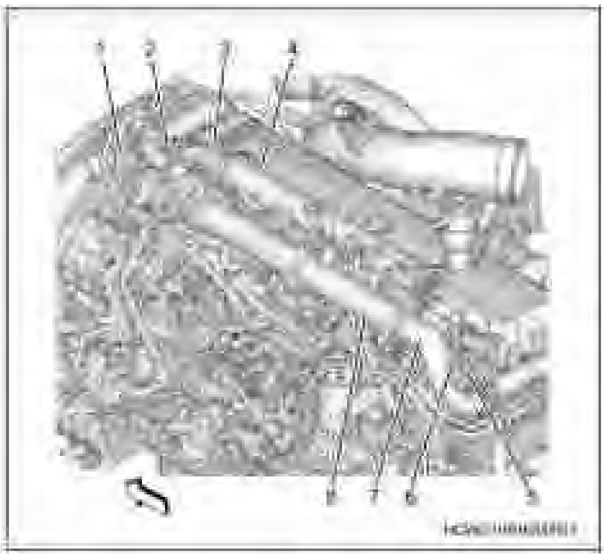
16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.



1. Front-end exhaust gas recirculation conduit bracket

2. Exhaust gas recirculation valve thermal protection device

3. Exhaust Gas Recirculation Cooler duct A.

4. EGR cooler A.

5. Back-end exhaust gas recirculation duct bracket

6. Exhaust gas recirculation valve thermal protection device

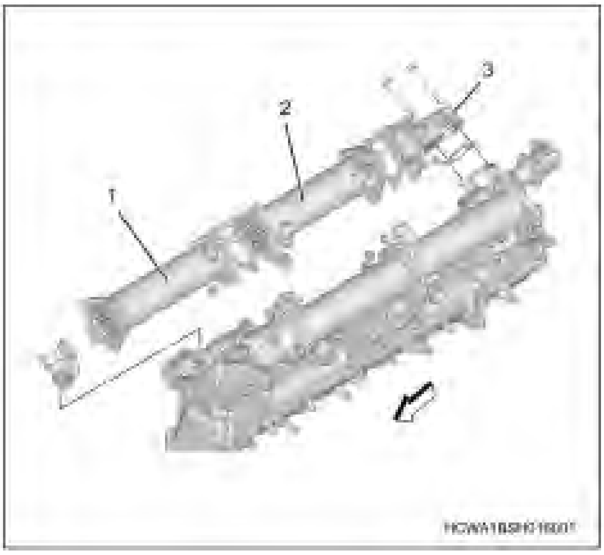
7. Exhaust Gas Recirculation Cooler duct C

8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler support on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

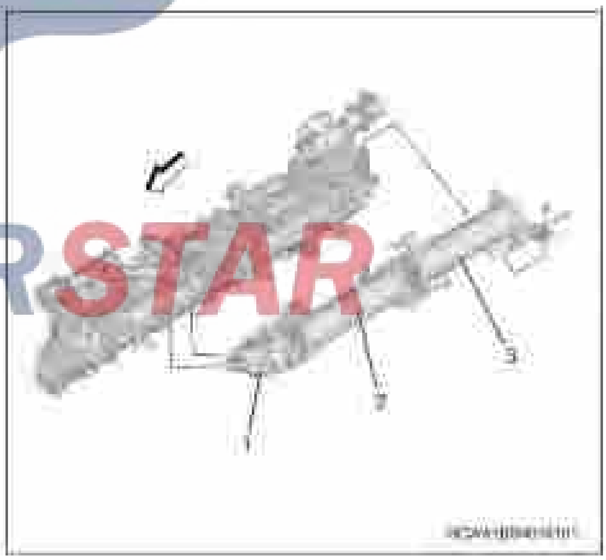


1. EGR cooler A

2. EGR cooler B

3. EGR cooler duct B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



1. Exhaust gas recirculation cooler duct D

2. EGR cooler D

3. EGR cooler C

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.

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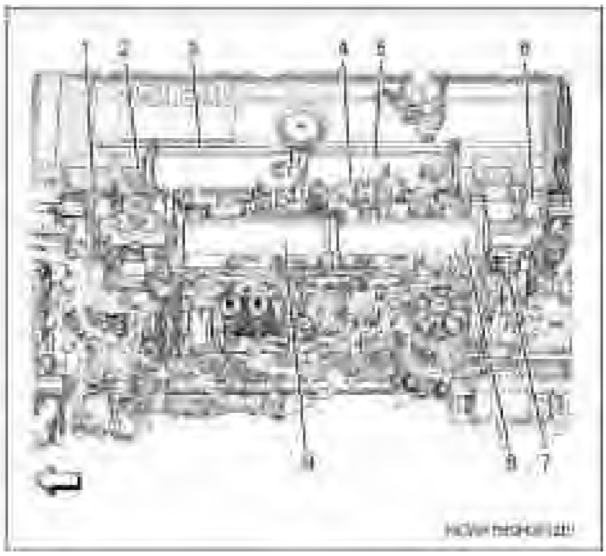
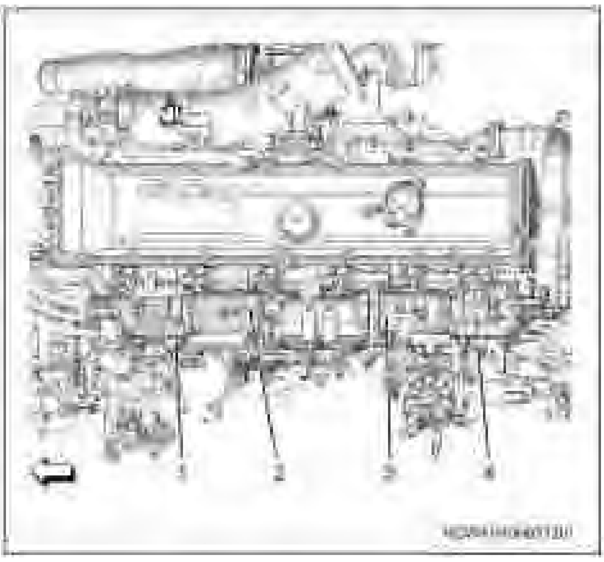


1. EGR valve 2
2. Exhaust gas recirculation cooler bracket
3. EGR cooler A
4. Leakage pipe bracket
5. EGR cooler B
6. EGR valve 1
7. Exhaust gas recirculation cooler bracket
8. EGR cooler C
9. EGR cooler D

11. Exhaust gas recirculation valve removed

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve duct A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve duct A.



1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

12. Pilot valve to remove

1) Remove pilot valve from EGR valve A.

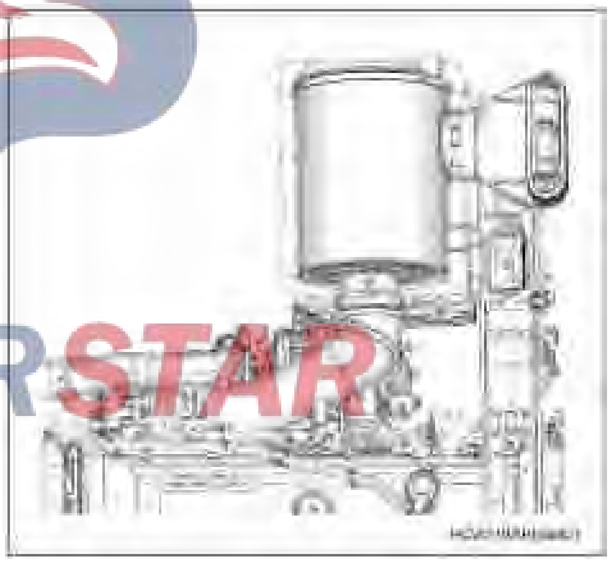
2) Remove pilot valve from EGR valve B.

13. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



14. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.

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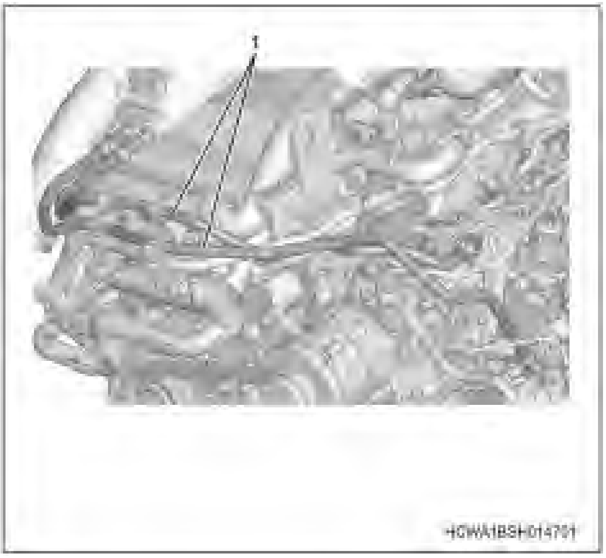


1. Air compressor suction pipe

2) Remove the heat shield from the air line.

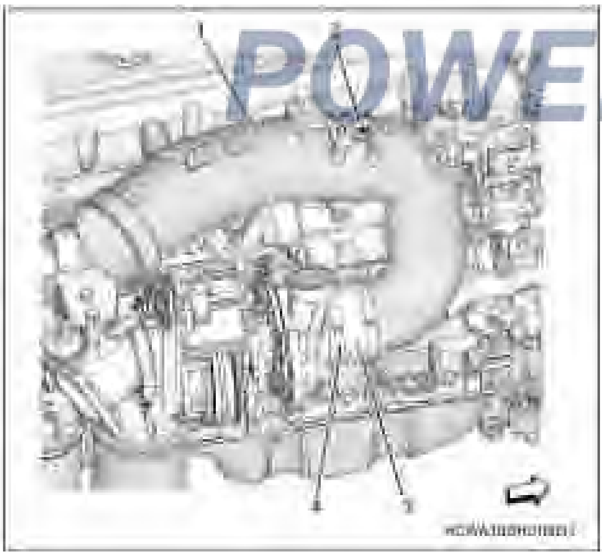
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

15. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

16. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

17. Exhaust cover removal

1) Remove the exhaust cover from the frame.

18. Exhaust brake valve removal

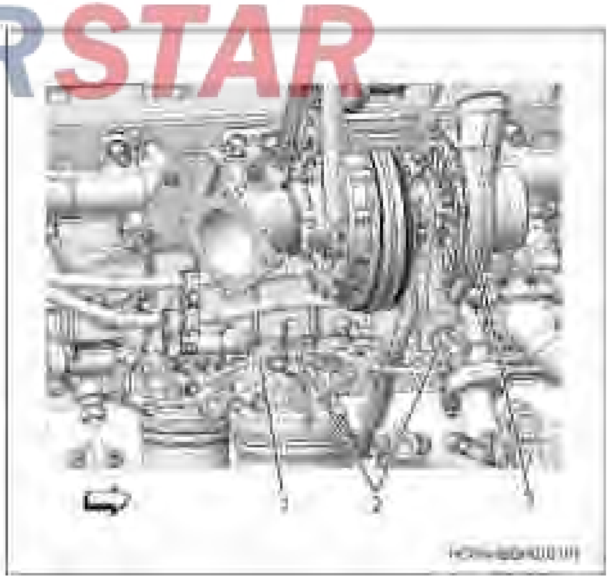
1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

19. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.



1. Turbocharger oil feed pipe
2. Pipe clamp
3. Turbocharger

3) Disconnect turbocharger oil return line.

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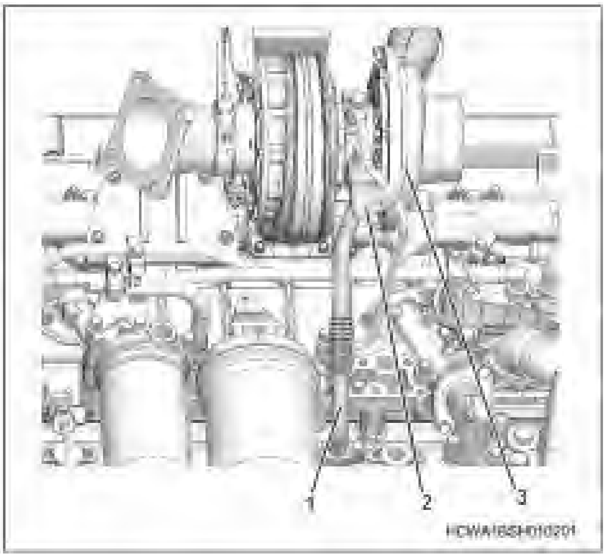
4) Remove the return pipe from the cylinder block.



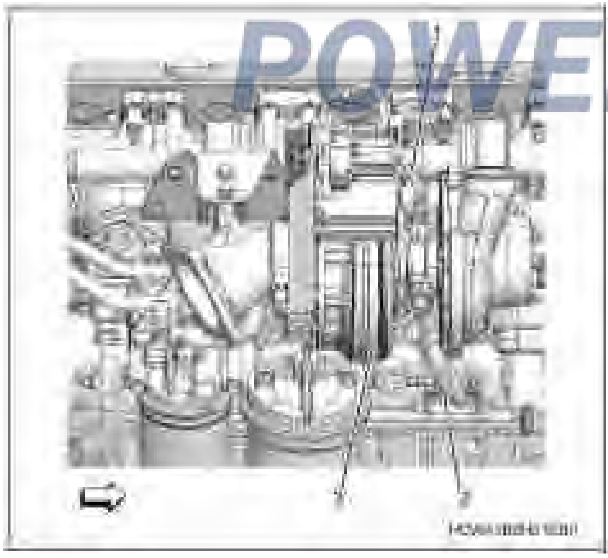
1. Turbocharger return pipe
2. Bracket
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

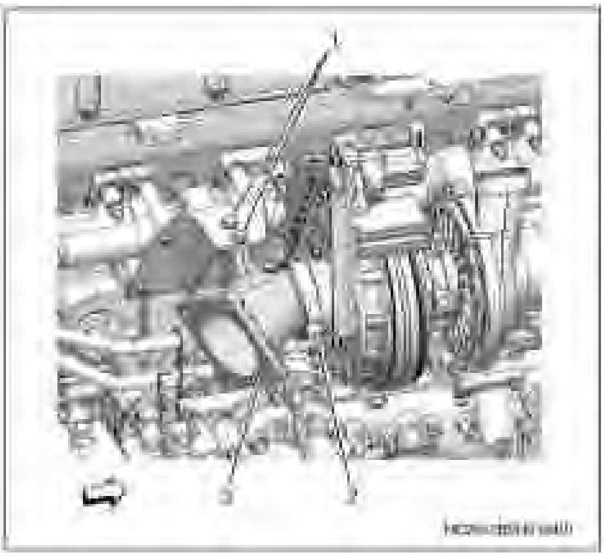
7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe

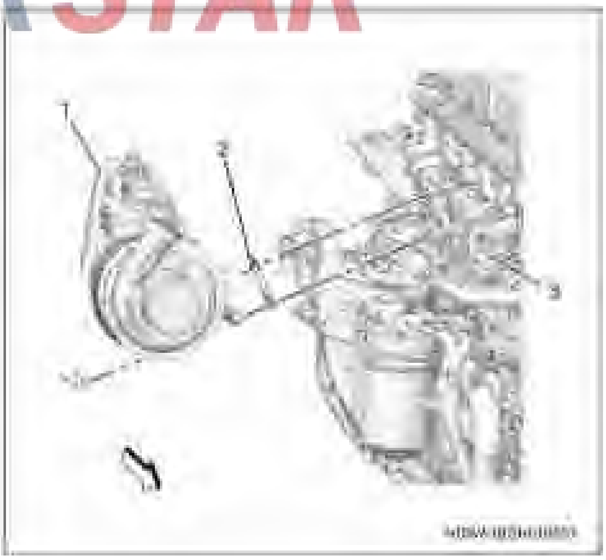
10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.



1. Turbocharger
2. Gasket
3. Exhaust manifold

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20. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

21. Fuel drain pipe removed

1) Disconnect the fuel drain on the fuel supply pump.

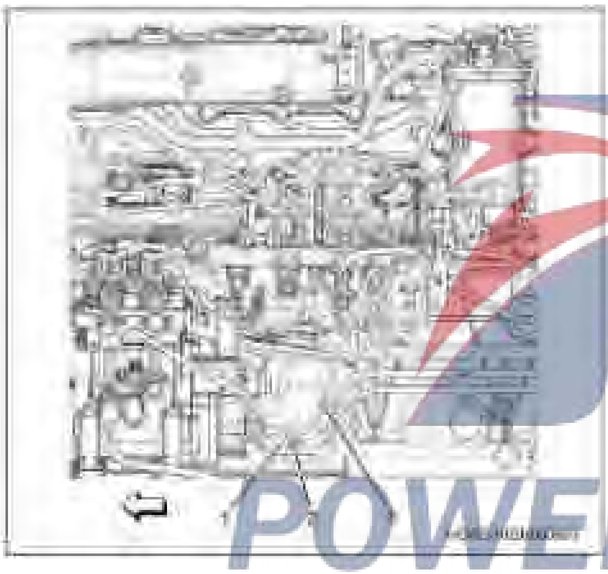
2) Disconnect the fuel drain hose from the fuel filter.

22. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

23. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

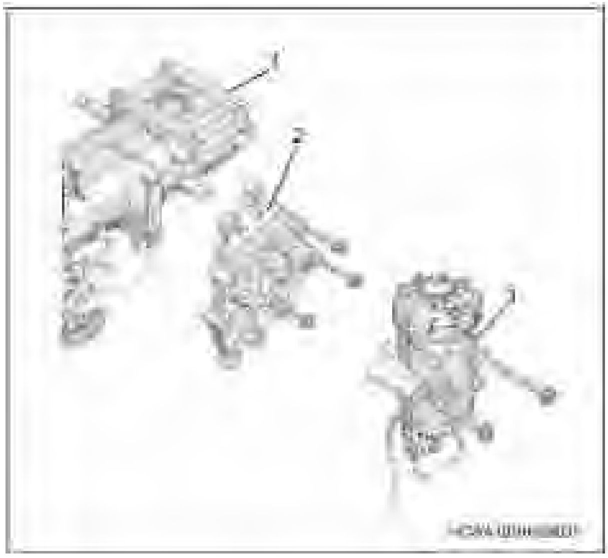
3) Remove the fuel pipe from the fuel supply pump.

24. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.



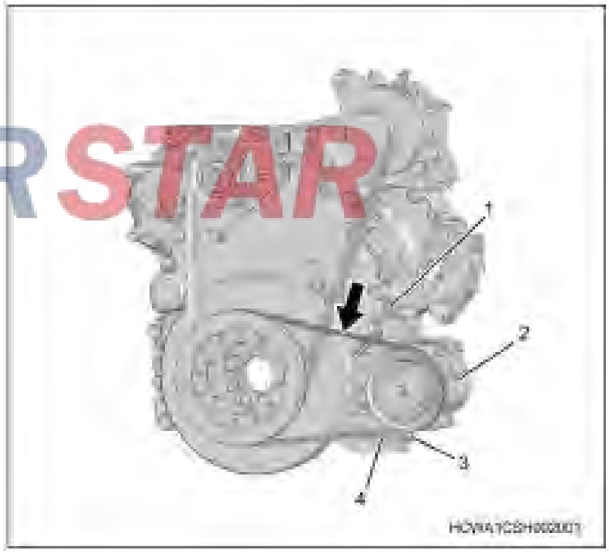
1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

25. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



1. Bolt

2. A/C compressor

3. Adjust bolt

4. Nut (back end)

26. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.

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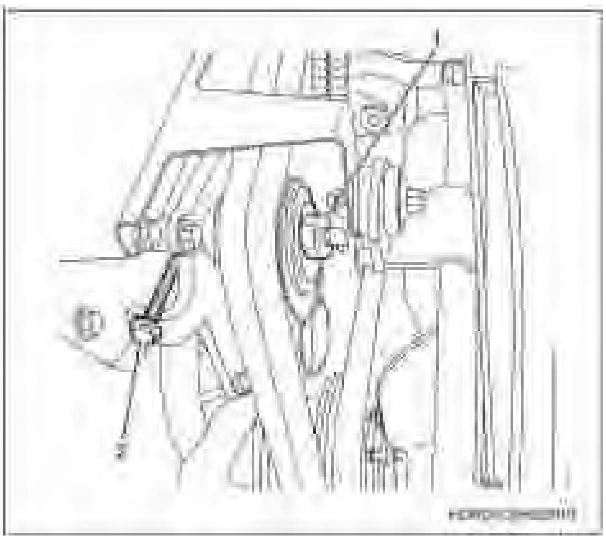


1. Lock nut
2. Adjust bolt

27. Generator removal

1) Disconnect the harness connector from the generator.

2) Disconnect the generator from the ground and B-terminal harness.

3) Remove the generator from the bracket.

28. Generator bracket removal

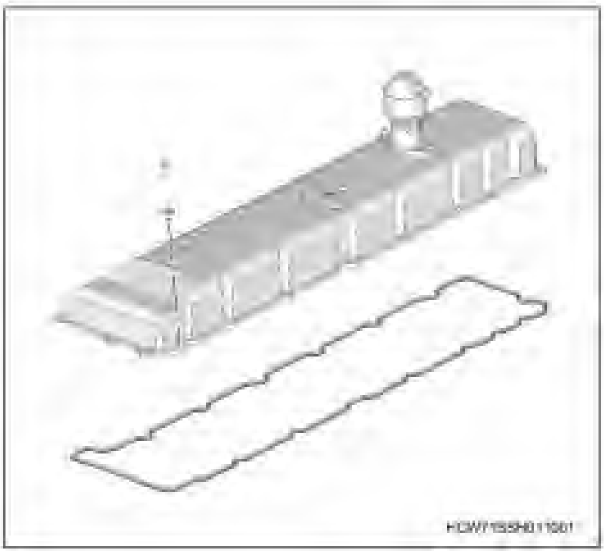
1) Remove the generator bracket from the cylinder head.

2) Remove the generator bracket from the timing gearbox.

29. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



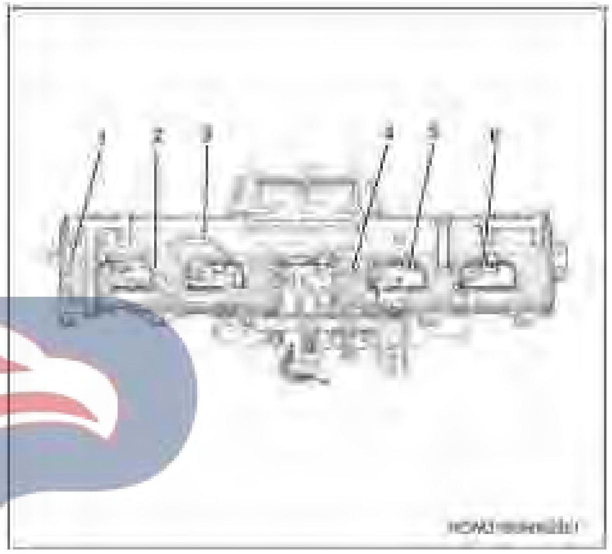
30. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

31. Injector harness removal

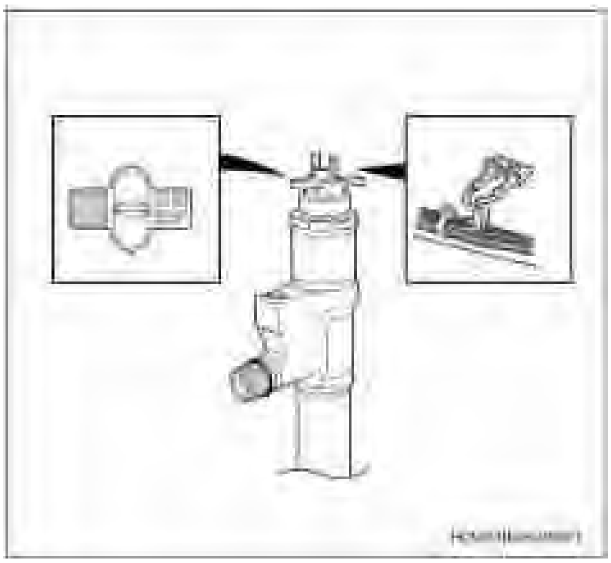
1) Remove the injector nut

2) Remove the injector harness

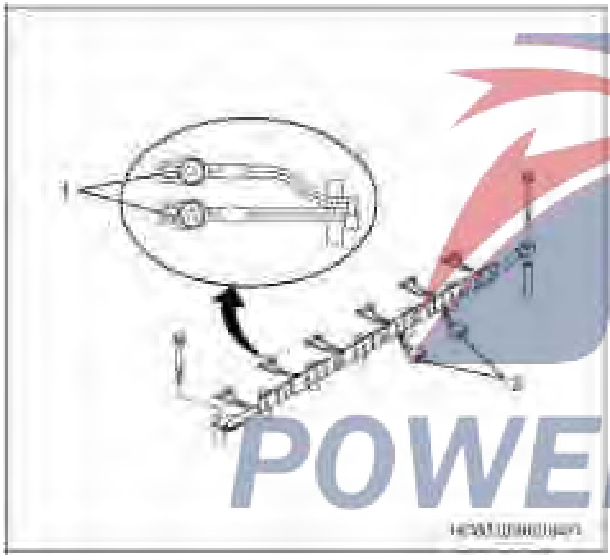
Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.

POWERSTAR



3) Remove the bolts on the injector harness.



1. Injector terminal nut

2. Connector

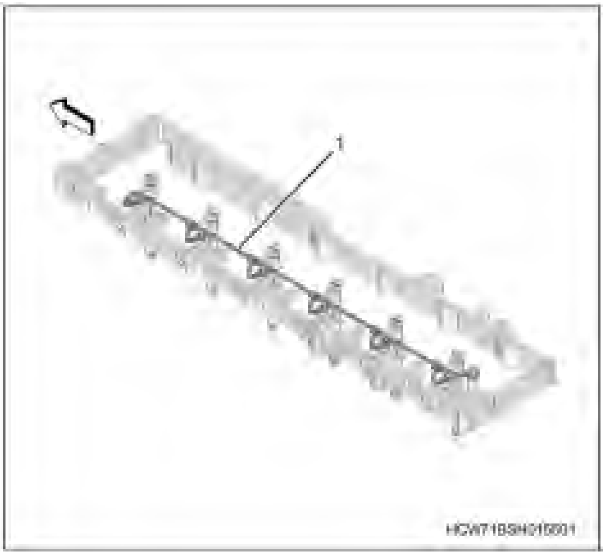
32. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

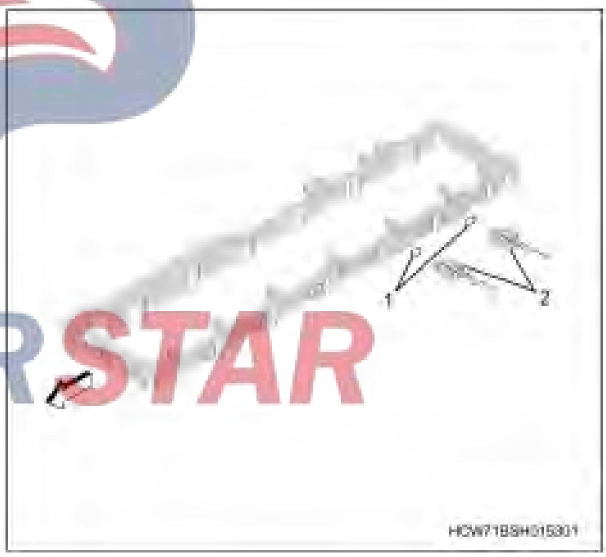
● Do not reuse the gasket.



1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.



1. O-ring

2. Connector

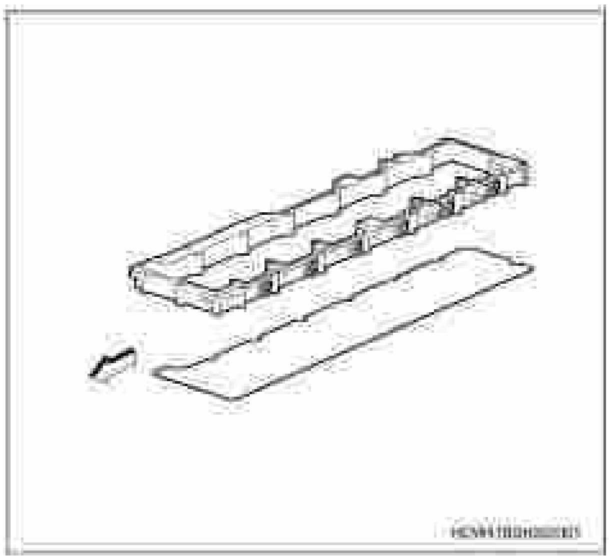
5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.

POWERSTAR



33.Injector removal

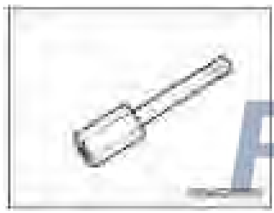
1) Remove the clamp from the cylinder head.

2) Remove the injector from the cylinder head with special tools.

Caution:

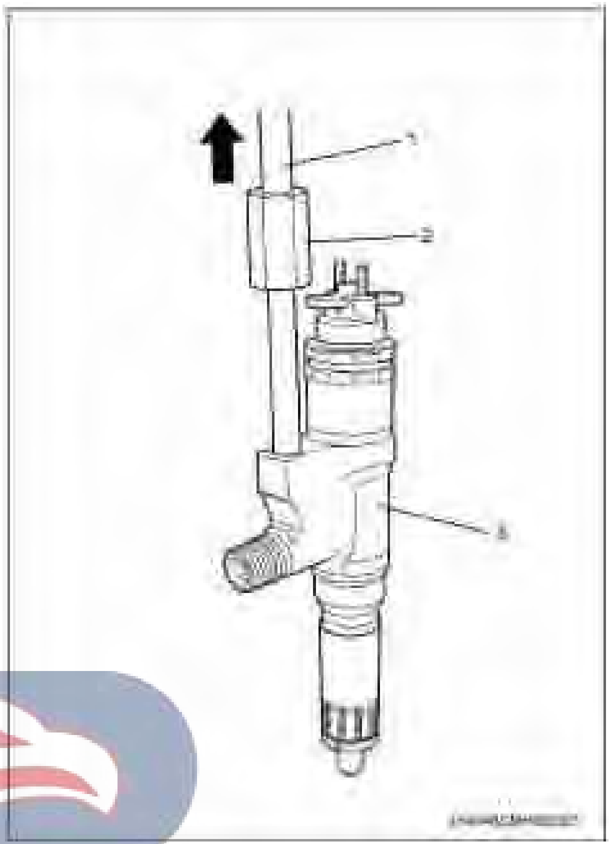
● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

● Do not remove the injector ID code plate.



SST: 5-8840-2826-0 - injector remover

SST: 5-8840-0019-0 - sliding hammer



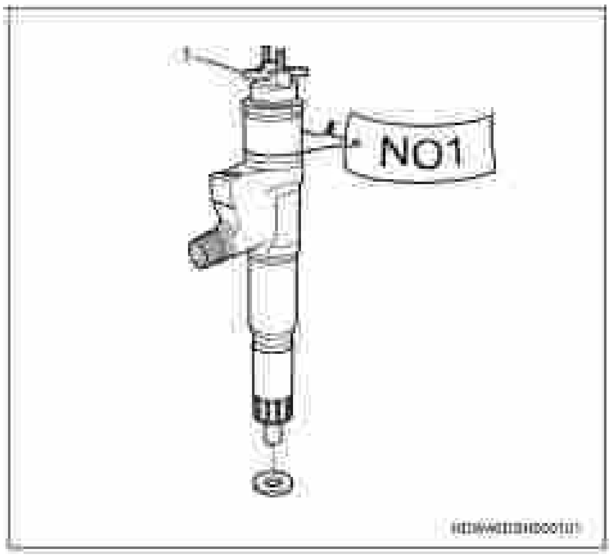
1. 5-8840-0019-0
2. 5-8840-2826-0
3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.



1. Injector

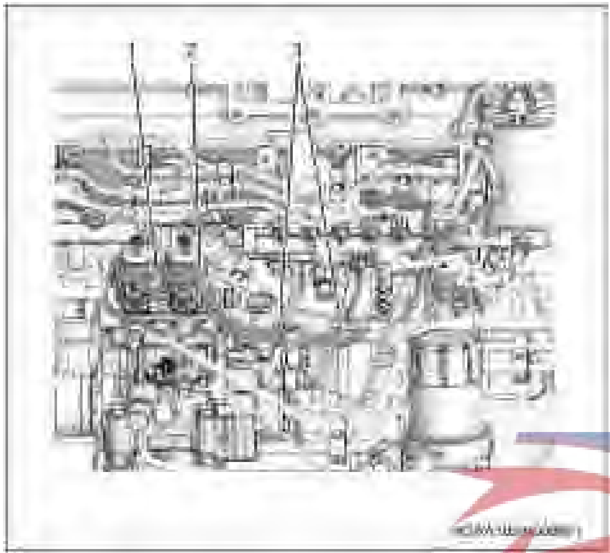
POWERSTAR

34. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.



1. Fuel pipe
2. Fuel pipe
3. Clip

35. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

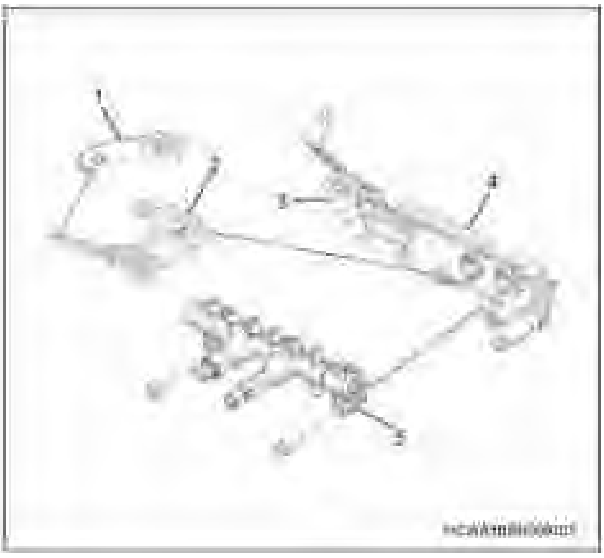
2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.



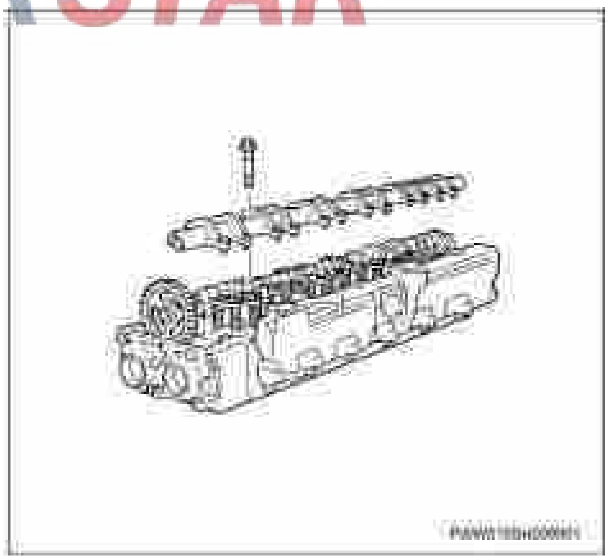
1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipe bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

36. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



37. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

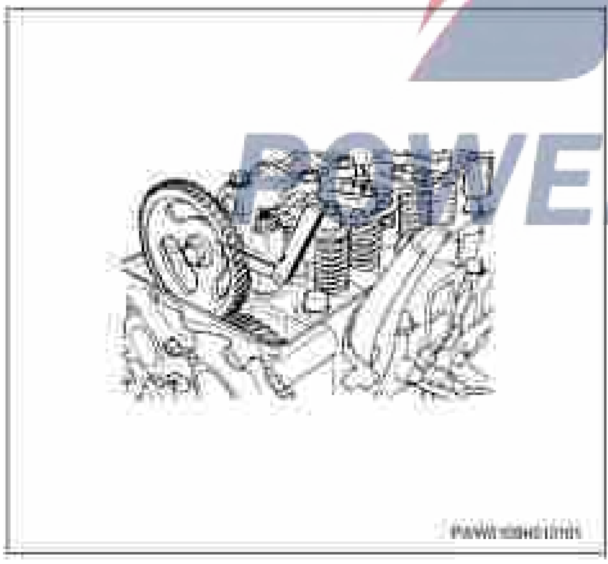
1. Bridge

38. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170 mm {0.00335 to 0.00669 mm}

Limit: 0.25 mm {0.0098 mm}

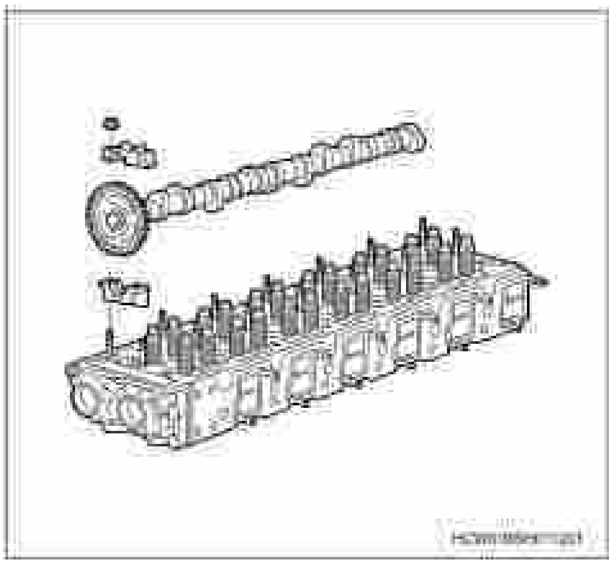


2) Remove the cam holder from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.



39. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

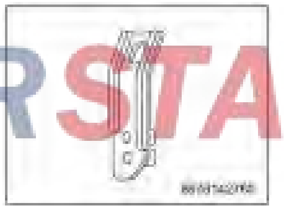
Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

2) Remove the glow plug from the cylinder head.

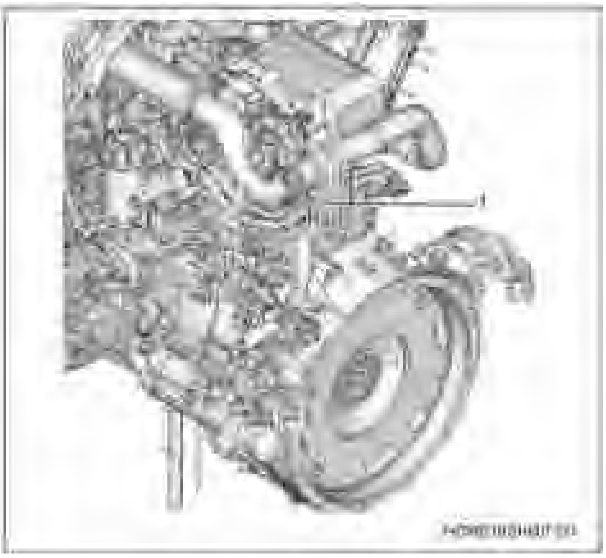
40. Cylinder head cover removal

1) Install special tool to the cylinder head.



SST: 8-9761-4276-0 - engine hanger

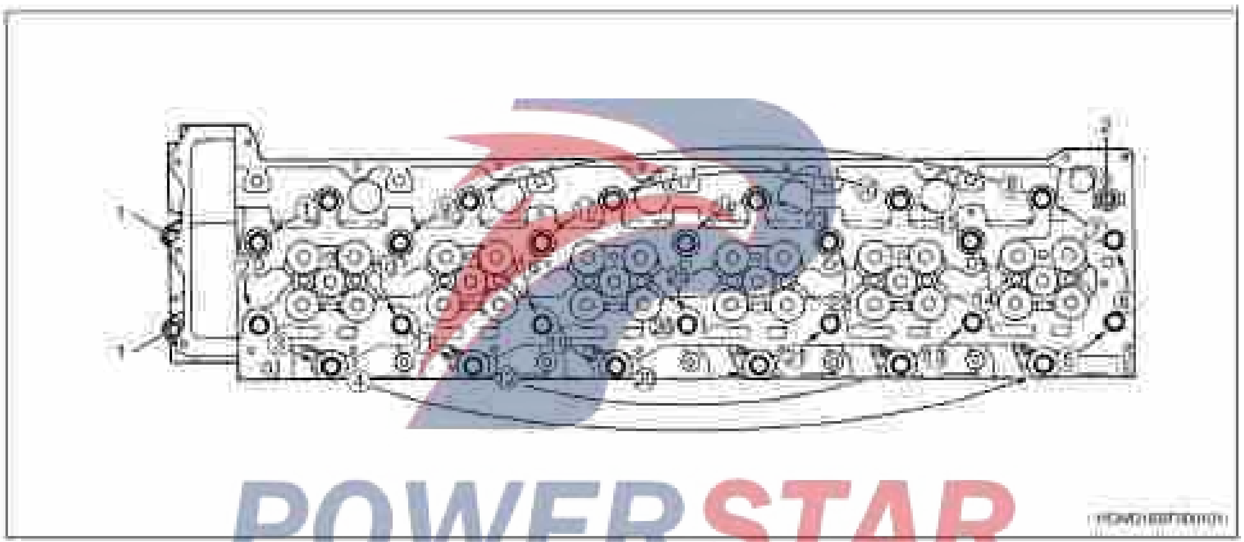
Tightening torque: 117.5 N • m { 12.0 kgf • m / 87 lb • ft }



1. 8-9761-4276-0

2) Remove the M10 and M12 bolts from the cylinder head.

3) Remove the cylinder head bolts from the cylinder head in the order shown.



POWERSTAR

1. M10 bolt

2. M12 bolt

4) Remove the cylinder head from the cylinder block.

5) Remove the cylinder head gasket from the cylinder block.

Caution:

● Do not reuse the cylinder head gasket.

6) When removing, inspect for water leakage, exhaust gas leakage, etc.

41. Fuel pump removal

1) Disconnect the harness connector connected to the camshaft position sensor.

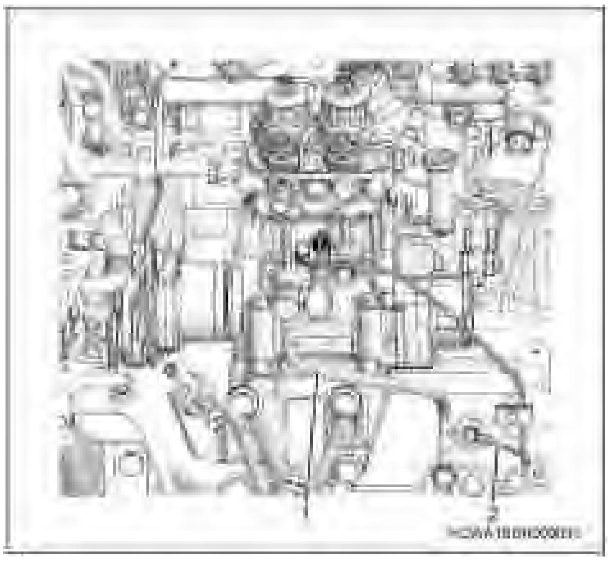
2) Disconnect PCV harness connector.

3) Disconnect the fuel supply pipe to the fuel supply pipe.

4) Remove the oil supply pipe from the cylinder block.

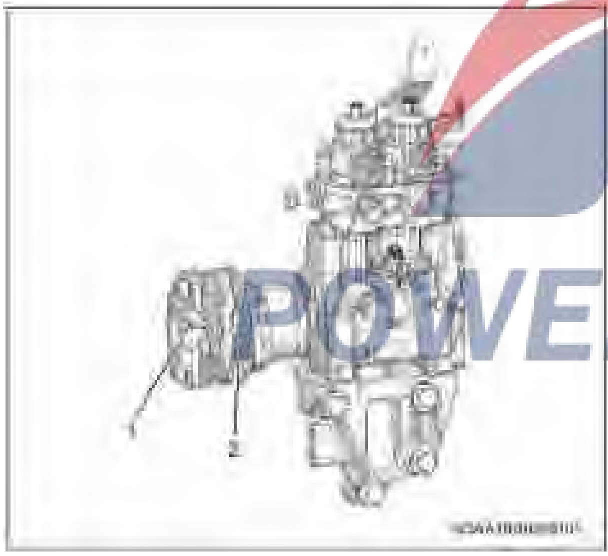
5) Disconnect the oil return pipe from the fuel supply pump.

6) Remove the oil return pipe from the cylinder block.



1. Oil return pipe
2. Oil feed pipe

7) Remove the pin bolts and coupling bolts on the coupling.



1. Cotter bolt
2. Coupling tightening bolt

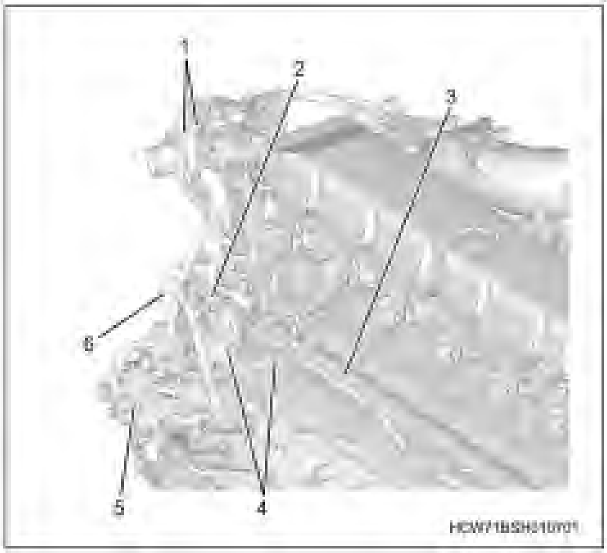
8) Remove fuel supply pump from supply pump bracket.

9) Remove the supply pump bracket from the cylinder block.

42. A / C compressor removal

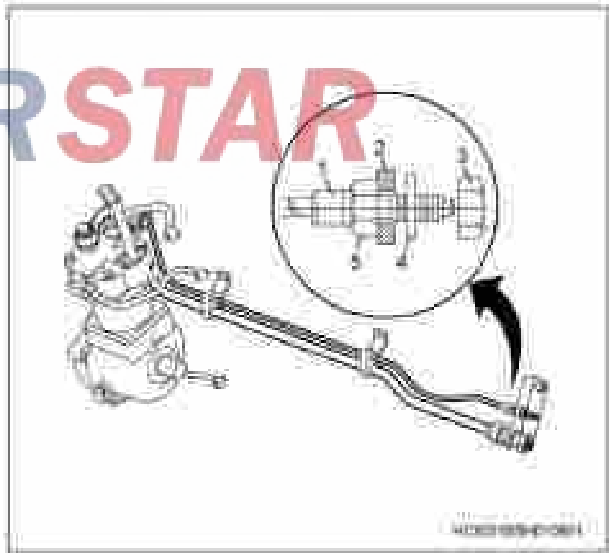
1) Remove the oil pipe from the cylinder block.

2) Remove the water pipe from the cylinder block.



1. Exhaust pipe
2. Water return pipe
3. Air compressor pressure pipe
4. Water feed pipe
5. Air compressor
6. Inflatable tube

3) Disconnect the inflation tube and air compressor pressure tube from the fitting.



1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

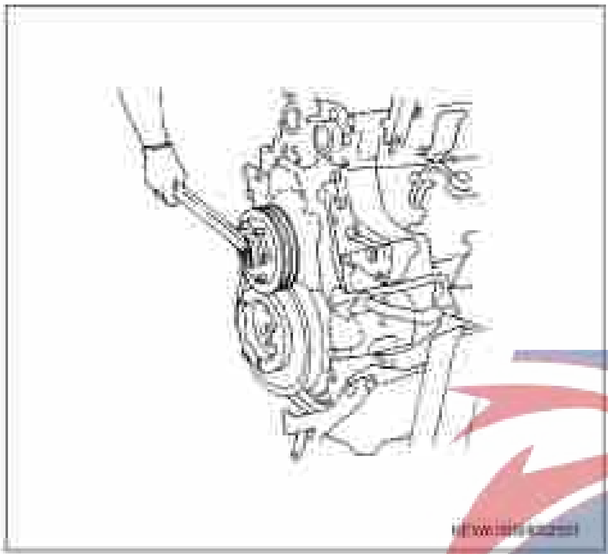
POWERSTAR

4) Remove the air compressor from the timing gearbox.

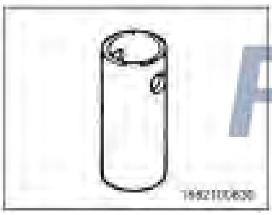
43. Crankshaft pulley removal

1) Wedge the crankshaft with a wooden block to prevent the fan pulley from rotating.

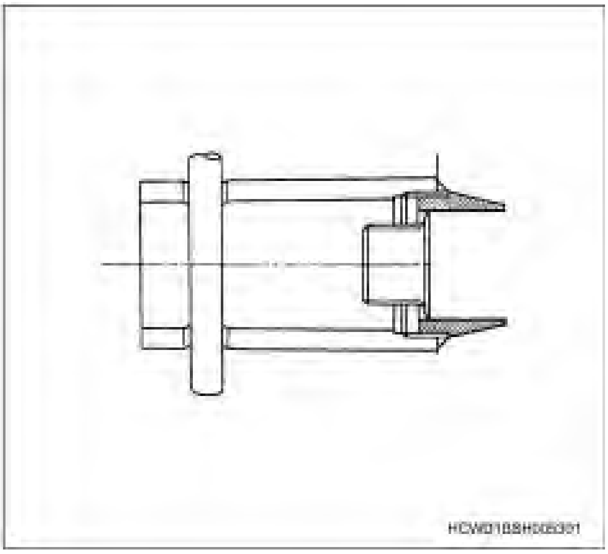
2) Remove the crankshaft pulley nut from the crankshaft pulley.



3) Use a special tool to remove the fan pulley cone bushing.



SST: 1-8521-0063-0 - Tapered bushing puller



4) Remove the fan pulley from the fan shaft.

5) Remove the crankshaft pulley from the crankshaft.

Caution:

● Do not damage the sealing surface or excessive force on the pump body.

44. Idle gear removal

1) Remove the idler gear from the gearbox cover.

45. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

46. Gear cover removed

1) Remove the gearbox cover from the timing gearbox.

2) Remove the gasket from the gearbox cover.

47. Crankshaft oil seal removed

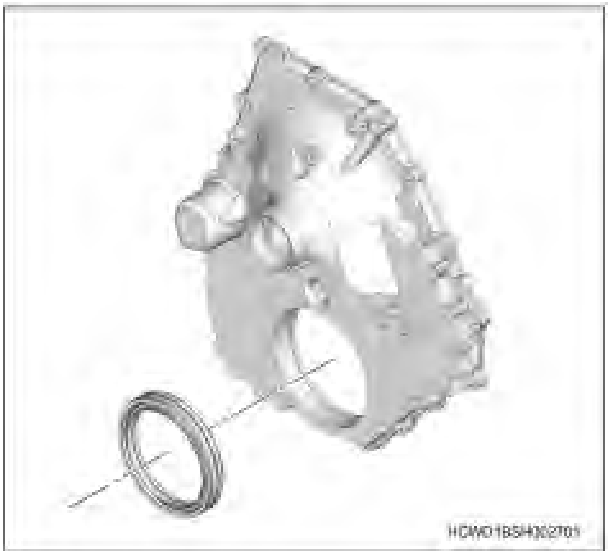
1) Remove the crankshaft front oil seal from the gearbox cover.

Caution:

● Do not damage the oil seal pressure mounting surface.

● Do not reuse the slinger or oil seal.

POWERSTAR

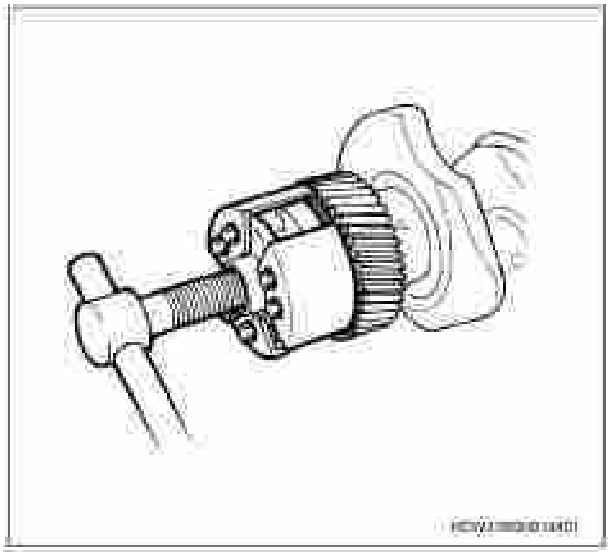


2) Use a special tool to remove the oil deflector from the crankshaft.

Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.

SST: 1-8521-0027-0 - Sleeve Removal Unit



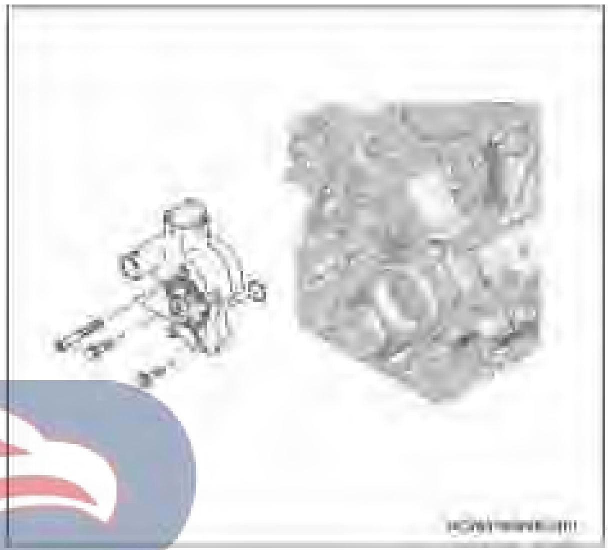
48. Oil pump removal

1) Remove the oil pump from the cylinder block.

Caution:

● Do not remove the bolt with the yellow mark on the top.

2) Remove the O-ring from the oil pump.



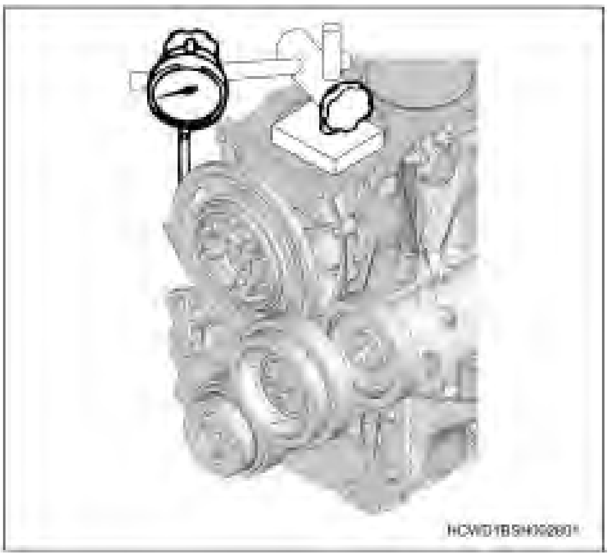
49. Idle gear removal

Caution:

● Before removing each idler gear, measure the backlash and axial clearance.

1) Measure idle gear clearance.

Standard: 0.03 to 0.13mm {0.0012 to 0.0051 in}



2) Measure the axial clearance of the idler gear.

Standard: 0.165 to 0.230mm {0.00650 to 0.00906in}

Idler Gear A

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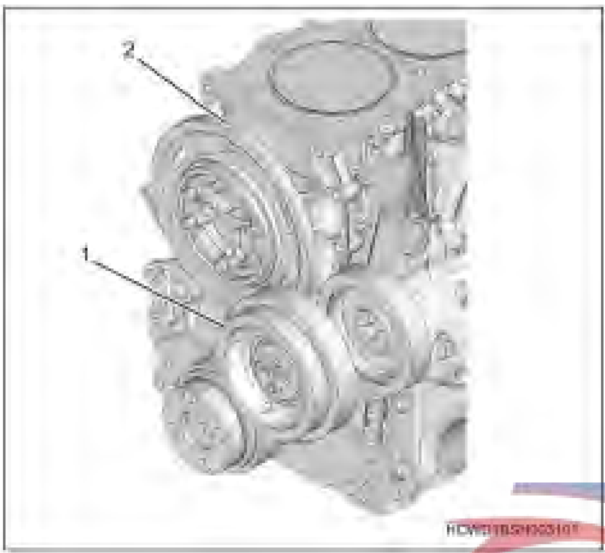
Limit: 0.35 mm {0.0138 in} Idler gear A

Standard: 0.075 to 0.154mm {0.00295 to 0.00606in} Idler gear B.

Limit: 0.25 mm {0.0098 in} idler gear B



1. Idling Gear A
2. Idling gear B

3) Remove the distance bolt from the cylinder block.

4) Remove the idler gear A from the cylinder block.

Caution:

● During the disassembly, mark the idler gear and thrust plate to ensure the installation direction is facing front and back.

5) Remove idler gear B-axis from cylinder block.

6) Remove idler gear B from idler gear B axle.

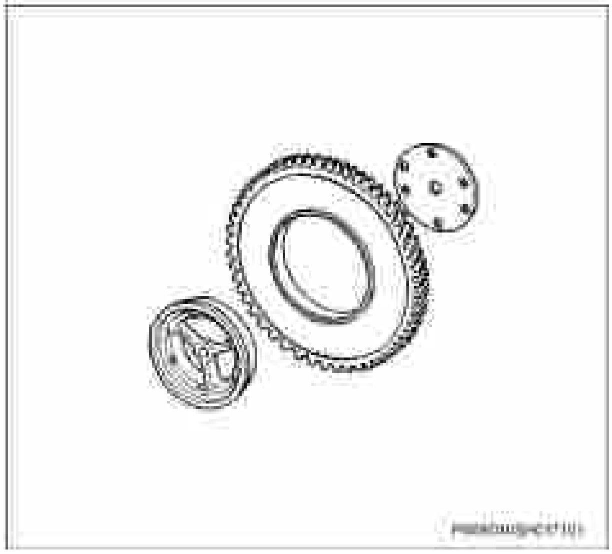
Caution:

● Remove idler gear B during marking to ensure that the mounting orientation is toward the front and back.

7) Remove thrust plate from Cylinder block.

Caution:

● Thrust plates are marked during disassembly to ensure that the mounting orientation is toward the front and back.



50. Oil pan removal

1) Remove the left and right flywheel housing brackets from the cylinder block and flywheel housing.

1. Flywheel housing
2. Flywheel housing bracket
3. Cylinder block

2) Remove the oil pan from the cylinder block.

51. Timing gearbox removed

1) Remove the timing gearbox from the cylinder block.

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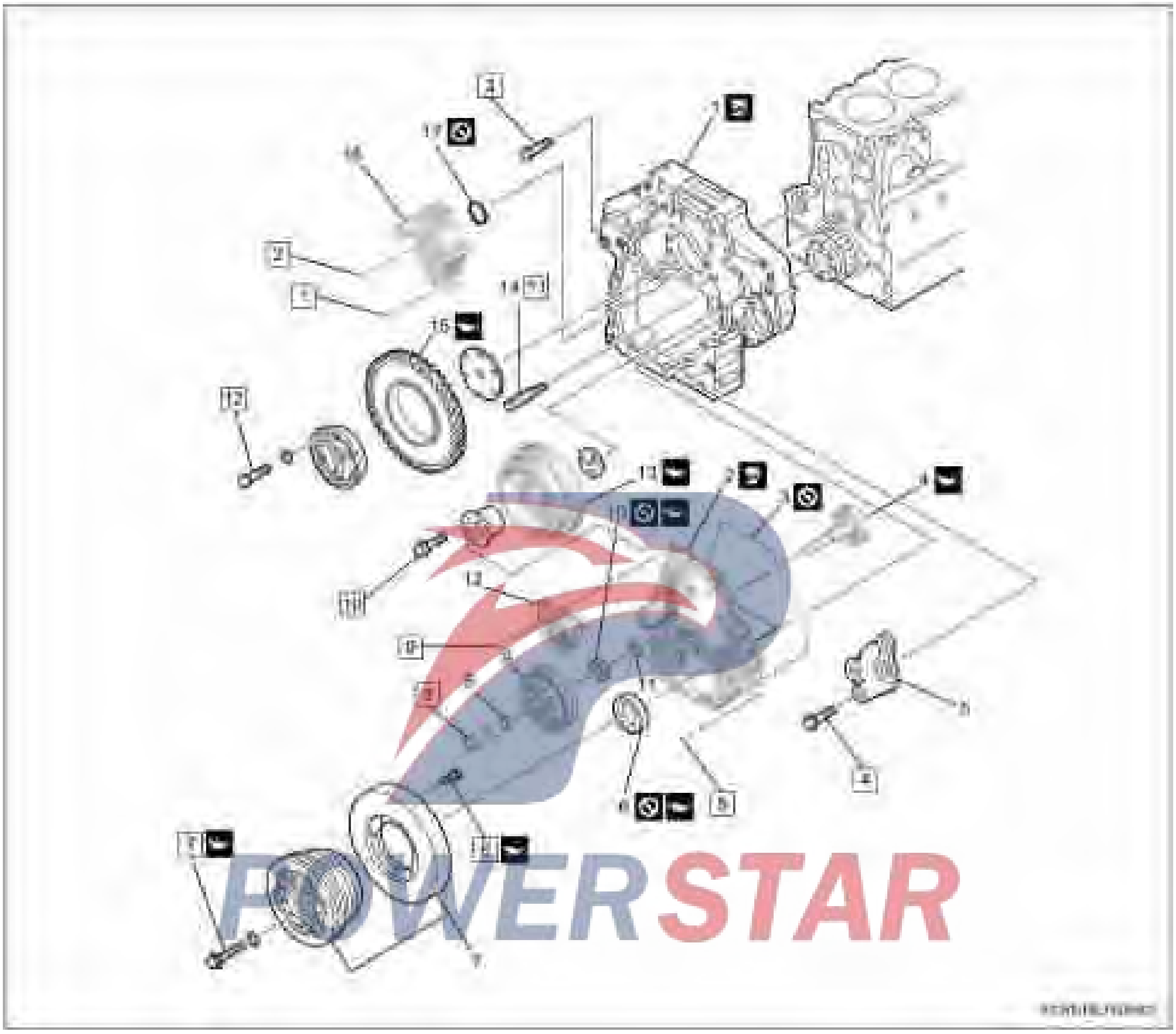
Installation

1. Component Views

Timing gearbox



Part name

1. Timing gearbox
2. Gear box cover
3. Gasket
4. Fan shaft
5. A / C compressor bracket
6. Crankshaft front oil seal
7. Crankshaft pulley
8. Tapered bushing
9. Fan pulley
10. Oil seal
11. Gasket
12. Idler
13. Idling Gear A
14. Tightening bolts
15. Idling Gear B
16. Oil pump
17. O-ring

Tightening torque

1: 49 N • m { 5.0 kgf • m / 36 lb • ft }

2: 39 N • m { 4.0 kgf • m / 29 lb • ft }

3: 135 N • m { 13.8 kgf • m / 100 lb • ft } M14

3: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

4: 135 N • m { 13.8 kgf • m / 100 lb • ft }

5: 26 N • m { 2.7 kgf • m / 19 lb • ft } M8

5: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

6: 96 N • m { 9.8 kgf • m / 71 lb • ft }

7: 267 N • m { 27.2 kgf • m / 197 lb • ft }

8: 539 N • m { 55.0 kgf • m / 398 lb • ft }

9: 43 N • m { 4.4 kgf • m / 32 lb • ft }

10: 108 N • m { 11.0 kgf • m / 80 lb • ft }

11: 39 N • m { 4.0 kgf • m / 29 lb • ft }

12: 40 N • m { 4.1 kgf • m / 30 lb • ft }

2. Timing gearbox installed

1) Refer to the corresponding chart and apply the liquid gasket to the timing gearbox.

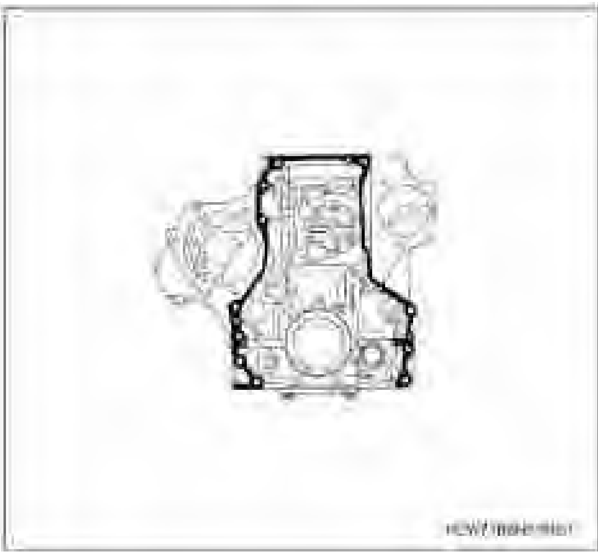
● In addition, the liquid seal can also be applied to the cylinder block and crankcase reference plane.

● Be careful not to allow the liquid gasket to enter the bolt hole.

● After the liquid gasket is assembled, the timing gearbox should be installed in time.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: about0.3 mm { about 0.012 in}
	Coating width	: about4 mm { about 0.16 in }



2) Install the timing gearbox to the cylinder block.

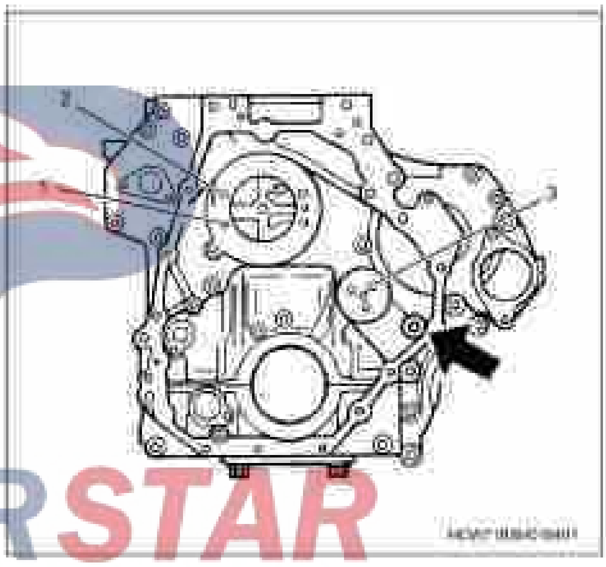
Caution:

● If you use the bolts indicated by the arrows in the figure again, apply the Loctite 271 glue to the threads.

● After the gear unit is installed, temporarily tighten the bolts M10 - 1.5 in the area shown in Figs. 1-3 with the specified torque and wait for 30 minutes or more before installing the idler gears A and B.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft} M14

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • t} M10



1. M10-1.5 bolts (temporary tightening)

2. M10-1.5 bolts (temporary tightening)

3. M10-1.5 bolts (temporary tightening)

3. Oil pan installation

1) apply the liquid gasket to the cylinder block.

Note:

● Three key 1207B with a coating thickness of 3 - 4 mm {0.118 - 0.157 in} and a width of 3-4 mm {0.118 - 0.157 in} on the locating surface of the flywheel housing, gearbox and cylinder block.

Caution:

● Clean the application surface of the gasket before applying the gasket.

POWERSTAR

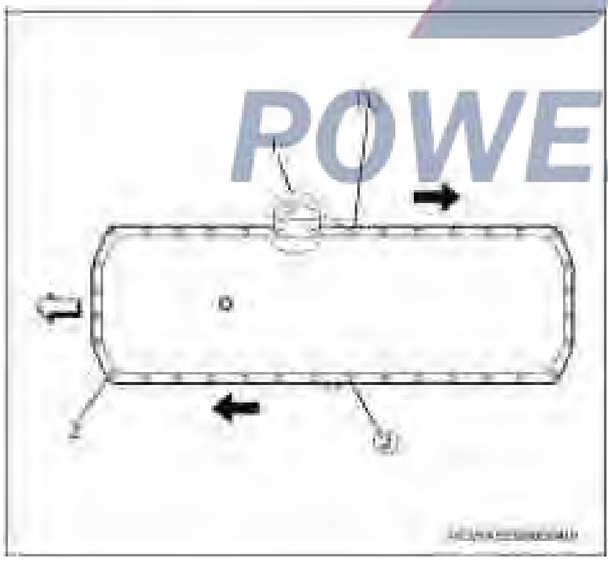
1. liquid gasket

2) Install the oil pan to the cylinder block in the order of numbers and arrows shown in the diagram.

Caution:

● After tightening all the bolts, tighten all the bolts again with the specified torque from the first tightened bolt.

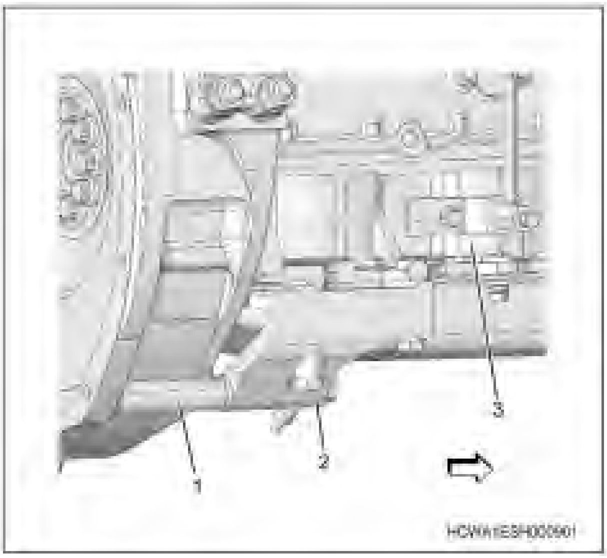
Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}



1. M10× 35
2. M10× 20

3) Install the left and right flywheel housing brackets onto the cylinder block and flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}



1. Flywheel housing
2. Flywheel housing bracket
3. Cylinder block

4. Idle gear installation

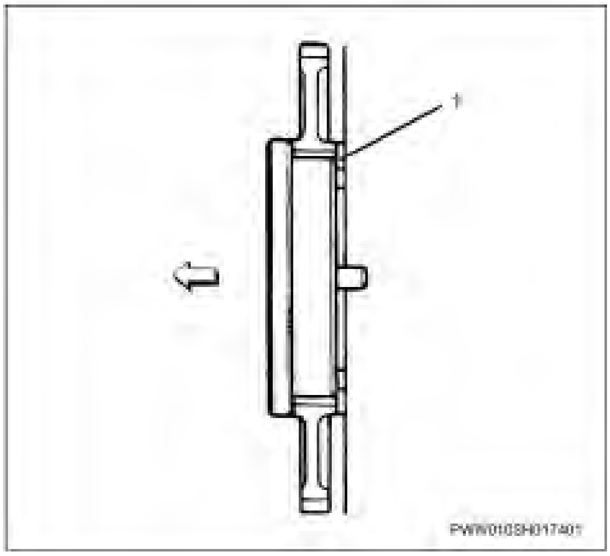
1) Bring the B-axis surface of the idler gear with engine oil.

2) Apply idler gear B inner diameter and bearing surface with engine oil.

3) Install the idler gear B-axis onto the cylinder block.

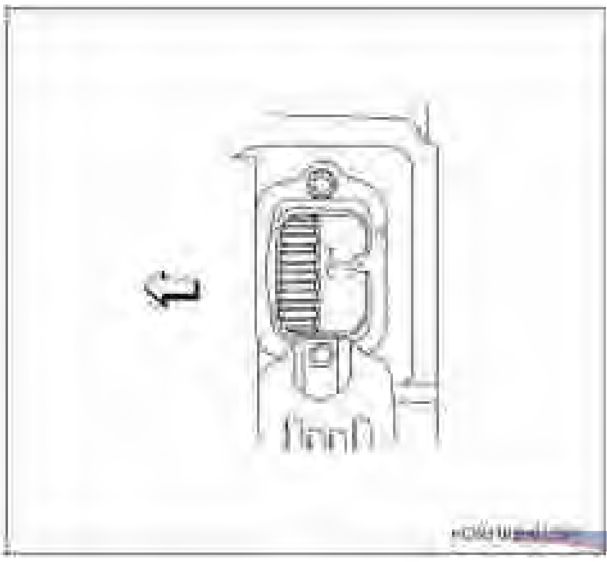
● During disassembly, check the front / rear markings on the idler gear B and the thrust plate repeatedly.

● Remember to remove the installed temporary fastening bolts.



1. Thrust piece

4) Align the No.1 cylinder to compression top dead center.



5) Apply engine oil to the idler gear A inner diameter.

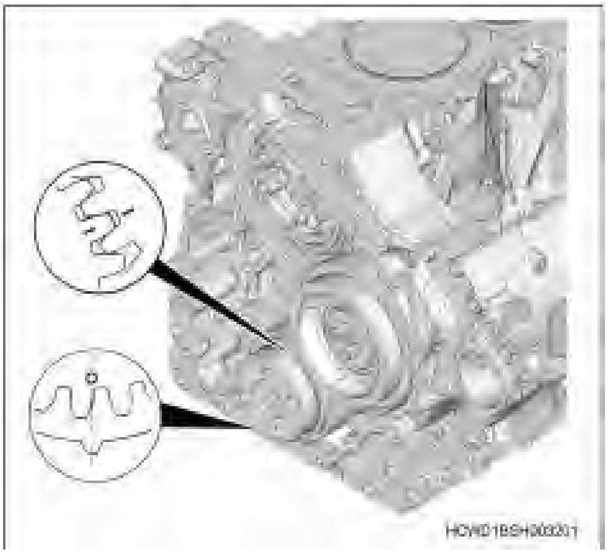
6) Install the sleeve on idler gear A.

7) Align thrust ring with idler gear A

8) Referring to the illustration, align the O mark between the crankshaft gear and the timing gear box with the I mark between the crankshaft gear and idler gear A, and install the idler gear A onto the cylinder block.

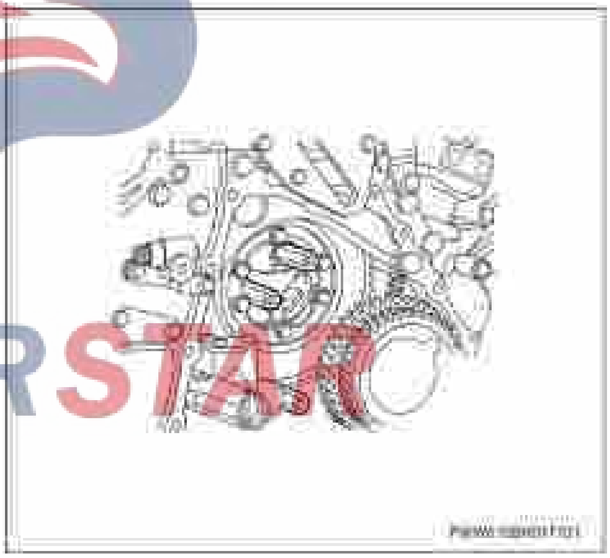
9) Referring to the illustration, align the O mark between the crankshaft gear and the timing gear box with the I mark between the crankshaft gear and idler gear A, and install the idler gear A onto the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}



10) Install the three distance bolts to the cylinder block.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}



5. Oil pump installation

1) Install the O-ring onto the pump.

2) Install the pump to the cylinder block.

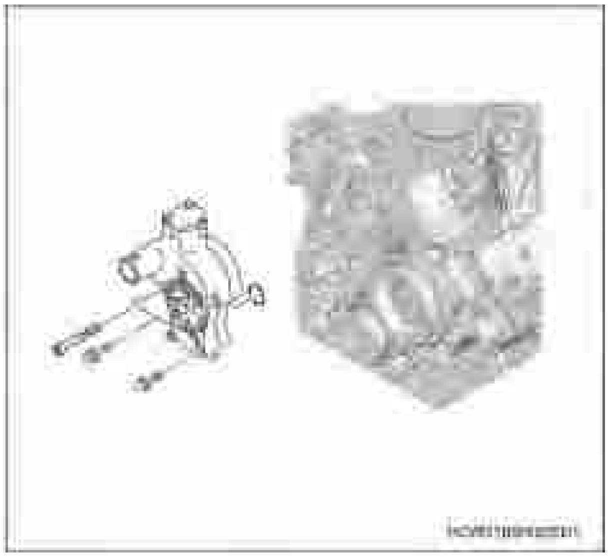
Caution:

● Do not tighten the screws marked with yellow on the top.

Tightening torque: 49 N • m {5 kgf • m / 36 lb • ft} hex bolts

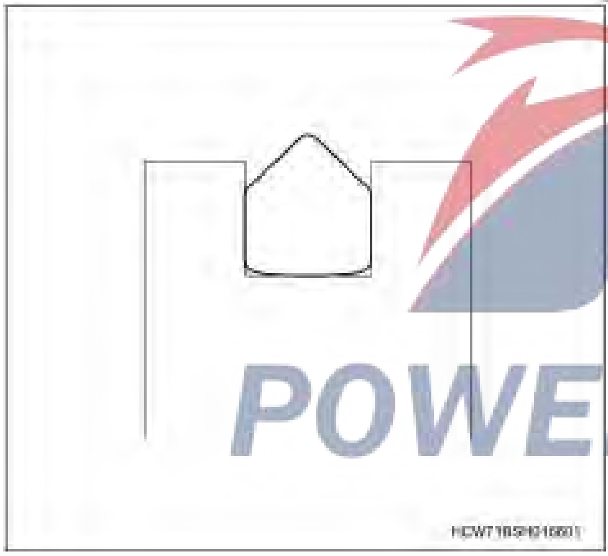
Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft} Socket head cap screws

POWERSTAR



6. Gear box cover installed

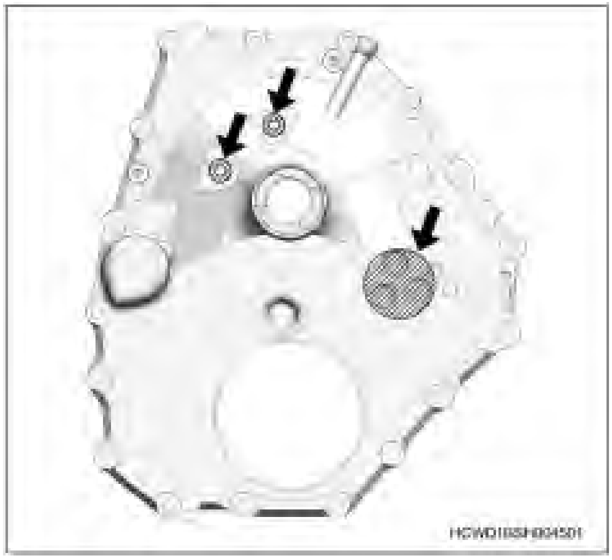
1) Install the gasket on the gear box cover.



2) Use a liquid seal on the gearbox cover.

Note:

● Apply FMD127 to the back of the diagonally marked gearbox cover in the chart.



3) Install the gearbox cover onto the timing gearbox.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft} M10

Tightening torque: 26 N • m {2.7 kgf • m / 19 lb • ft} M8

7. Crankshaft front oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft front oil seal.

2) Install the crankshaft front oil seal to the front cover with the slinger as a set using the special tool.

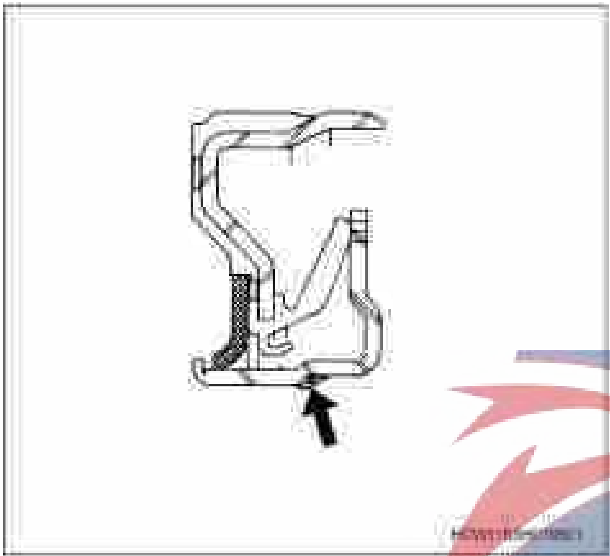
POWERSTAR

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

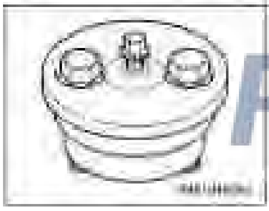
● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



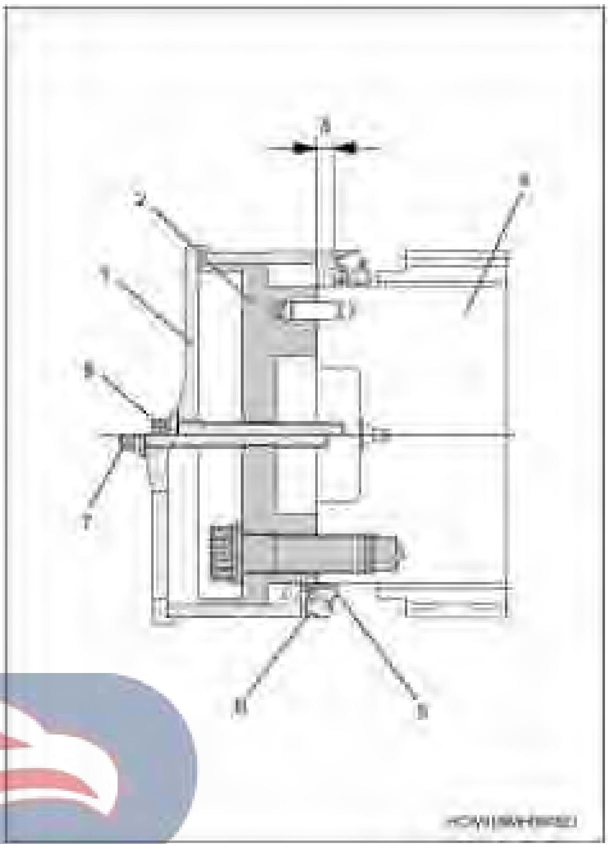
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) After the oil seal is installed by pressing assembly method, measure the size between the crankshaft end surface and the oil seal surface.



1. 8-9819-4608-0 (Sleeve)

1. 8-9819-4608-0 (Adapter)

3. 6.7 - 7.3 mm {0.264 - 0.287 in}

4. Crankshaft

5. Slinger (silver)

6. Oil seal

7. Oil seal

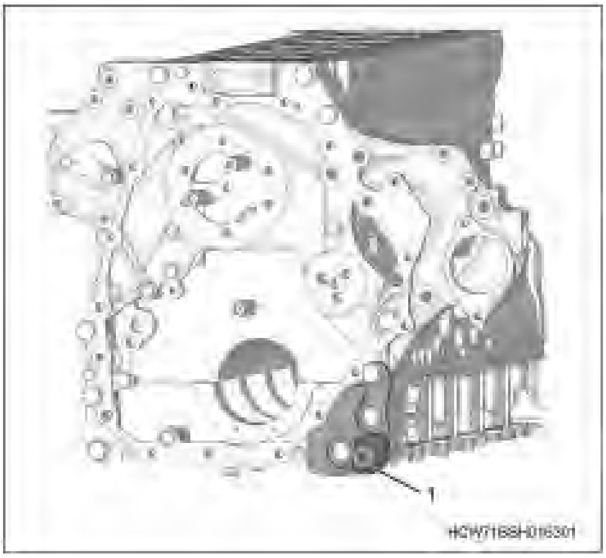
8. Finish pressing the position of the special tool after assembly

8. A / C compressor bracket installation

1) Install the air conditioner compressor bracket to the timing gearbox.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft}

POWERSTAR



1. Air conditioner compressor bracket

9. Idle gear installation

1) Install the idler gear to the gear cover.

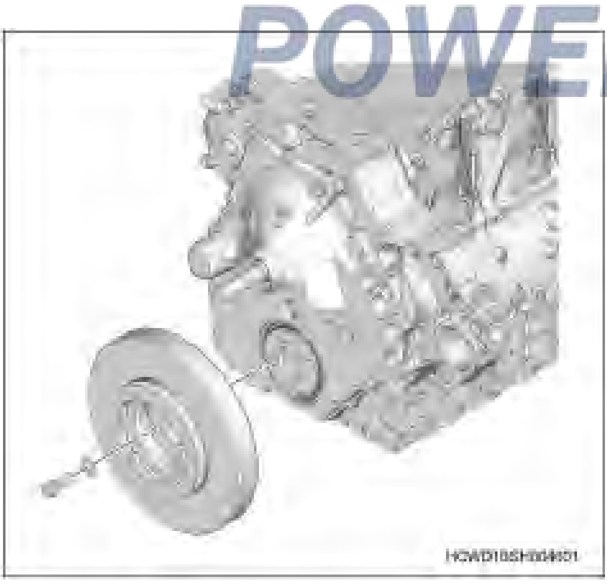
Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft}

10. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}

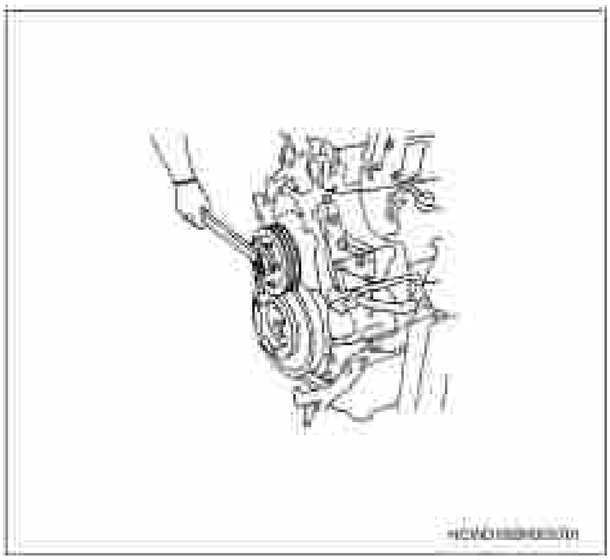


3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N • m { 55 kgf • m / 398 lb • ft }



11. Air compressor installation

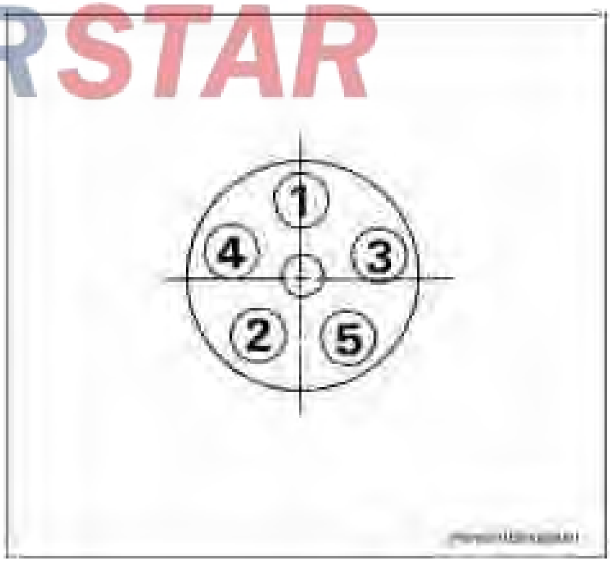
1) Apply molybdenum disulphide grease to the threaded surface of bearing surfaces and air compressor gear mounting bolts.

2) Install the gears on the air compressor according to the figures in numerical order.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

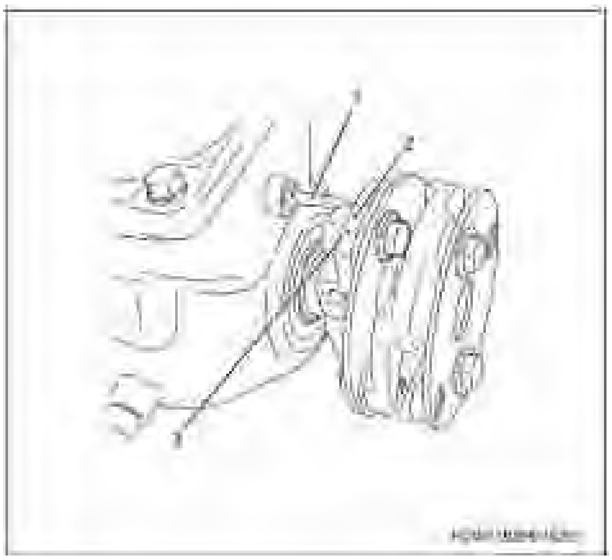
Prescribed angle: 90 to 120 ° second

POWERSTAR

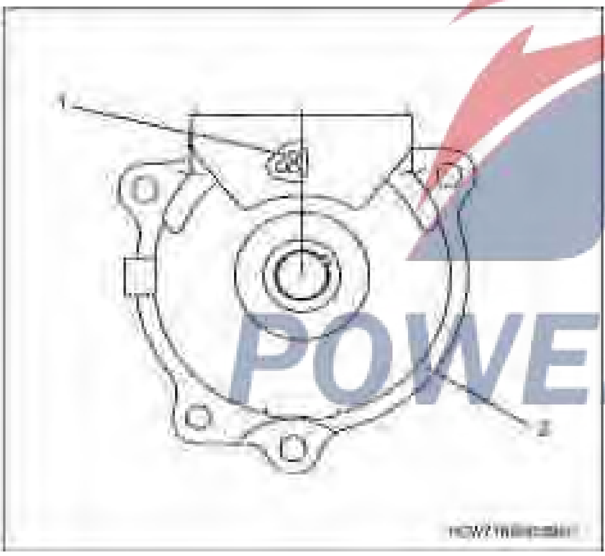


3) Install the O-ring onto the gearbox mounting flange area.

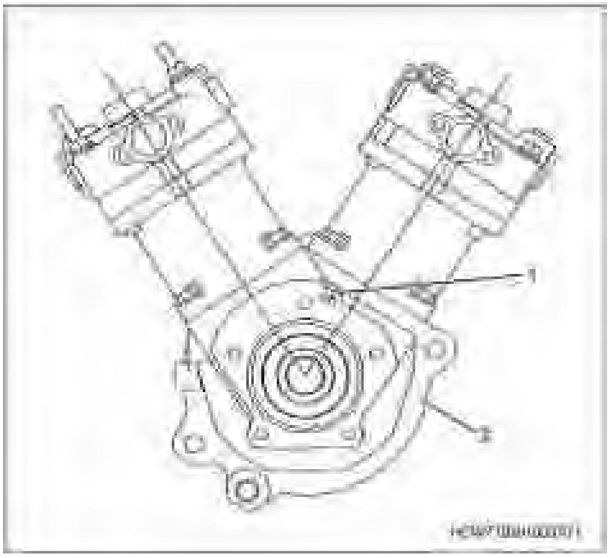
4) Referring to the illustration, align the pointer with the A mark.



1. Pointer
2. S mark
3. A mark

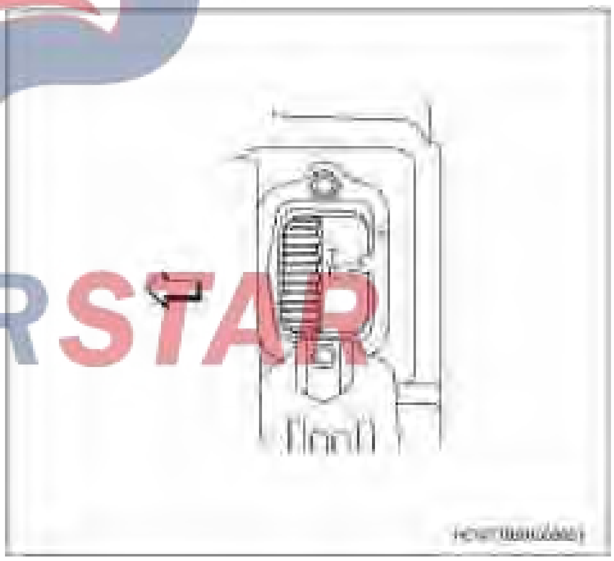


1. Pointer
2. Air compressor



1. Pointer
2. Air compressor

5) Align the No.1 cylinder to compression top dead center.



6) Install the air compressor on the timing gearbox.

● Insert the air compressor and make sure that the idle gear in the gear box is firmly installed.

Caution:

● After the installation is completed, if the pointer and the S mark are not aligned, it must be re-installed.

Tightening torque: 137 N • m {14.0 kgf • m / 101 lb • ft} M14 bolt

Tightening torque: 133 N • m {13.6 kgf • m / 98 lb • ft} M14 nut

1. Pointer
2. S mark
3. A mark

7) Connect the air compressor governor pipe to the air compressor.

Tightening torque: 41 N • m {4.2 kgf • m / 13 lb • ft}

8) Connect the inflation tube to the air compressor.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}

9) Connect the air compressor regulator to the fitting.

Note:

● Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 28 N • m {2.9 kgf • m / 21 lb • ft}

Flare nut

Tightening torque: 69 N • m {7.0 kgf • m / 51 lb • ft}

Nut

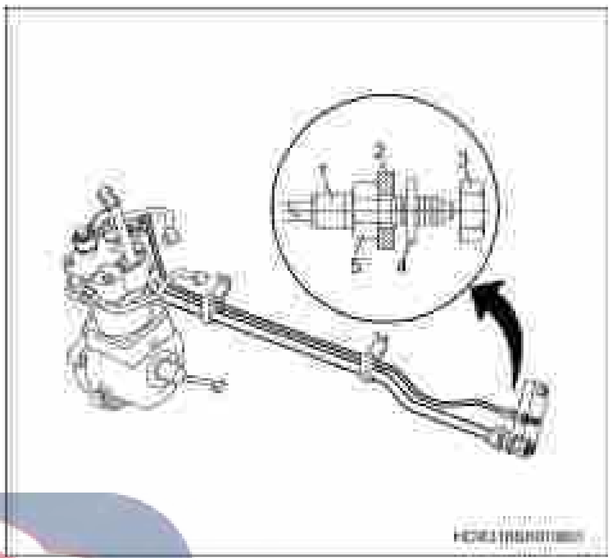
10) Connect the air charge pipe to the air compressor.

Note:

● Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 129 N • m {13.2 kgf • m / 95 lb • ft} Flare nut

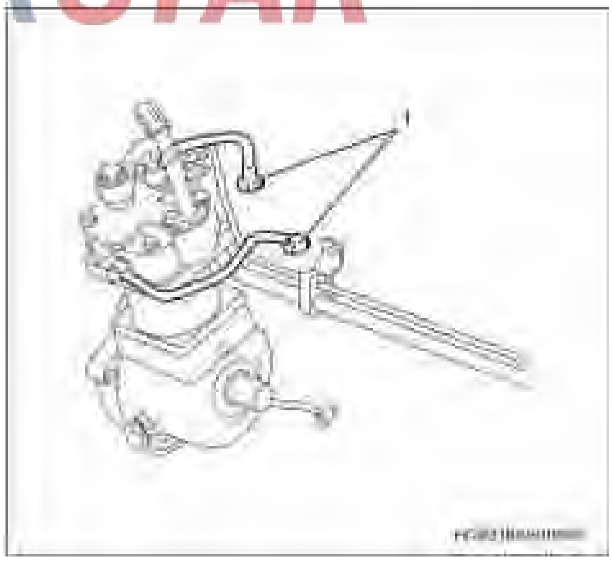
Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} nut



1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

11) Install two water pipes to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

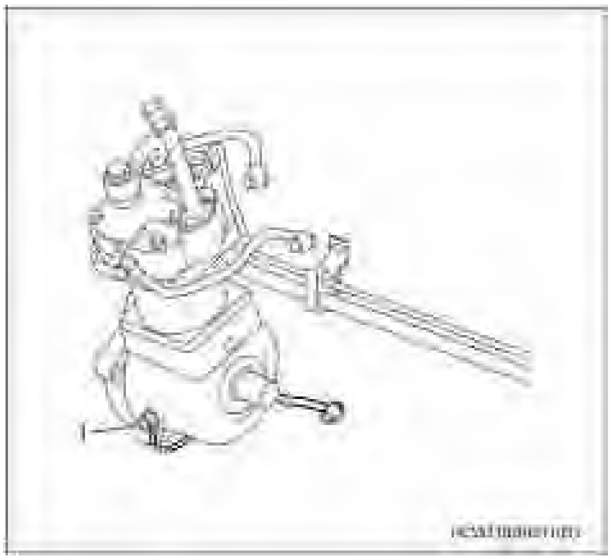


1. Water pipe

POWERSTAR

12) Install the oil pipe to the cylinder block.

Tightening torque: 27 N • m {2.8 kgf • m / 20 lb • ft}



1. Eyebolt

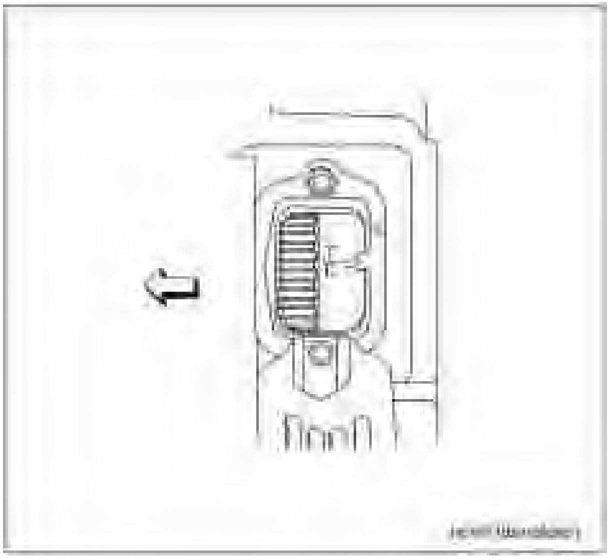
12. Fuel pump installed

1) Attach the feed pump bracket to the cylinder block.

Tightening torque: 108 N • m {11.0 kg • m / 80 lb • ft}

1. Fuel pump bracket

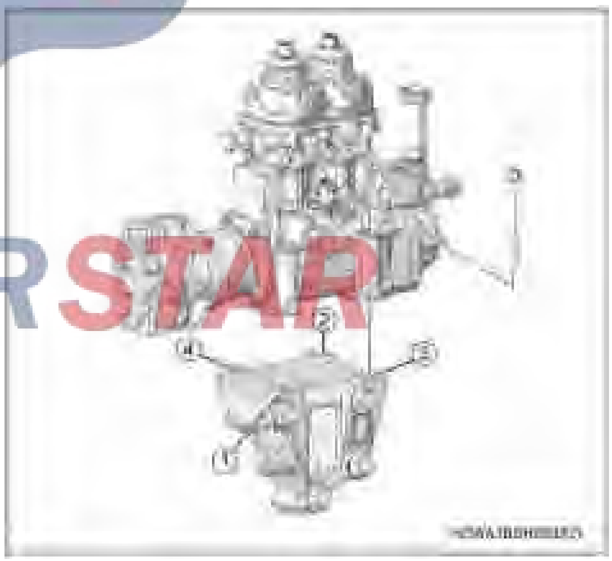
2) Align the No.1 cylinder to compression top dead center.



3) Align the pipe marked on the pipe with the marked pipe on the pump.

4) Install the fuel delivery pump in the order of numbers on the supply pump bracket.

Tightening torque: 57 N • m {5.8 kgf • m / 42 lb • ft}



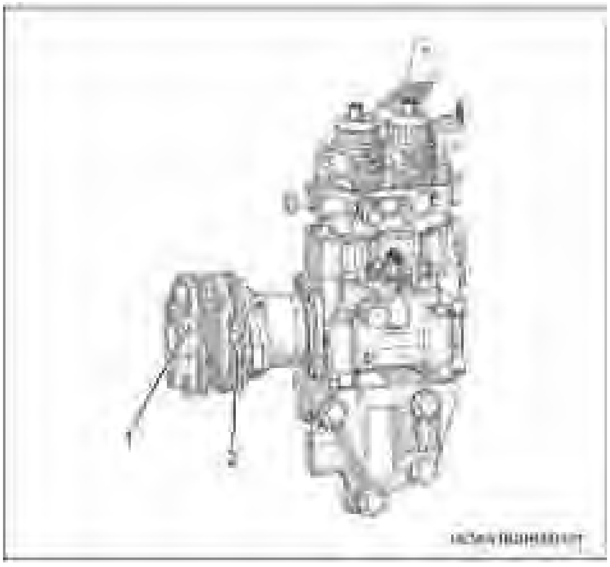
5) Slide the coupling to confirm firm contact with the feed pump and tighten the coupling bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

6) After checking and making sure that the coupling laminate is not bent, tighten the pin bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

POWERSTAR

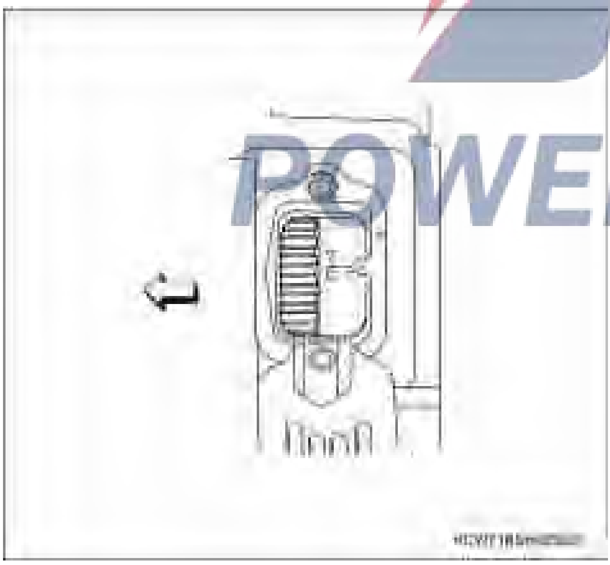


1. Cotter bolt
2. Coupling tightening bolt

7) Rotate the crankshaft forward to align cylinder # 1 to the top dead center of compression.

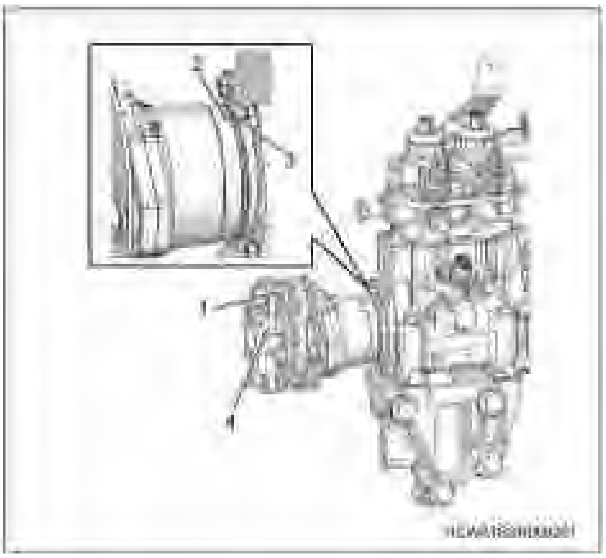
Note:

● Align with the center of the compression stop in a toothless state.



8) Verify that the marked pipe on the pipe fitting matches the marked pipe on the pump.

● If the marking line is out of service, use the 2 oval bolts on the coupling to readjust.



1. Coupling bolts
2. Coupling end marking line
3. Pump end marking line
4. Cotter bolt

9) Install the return line to the cylinder block.

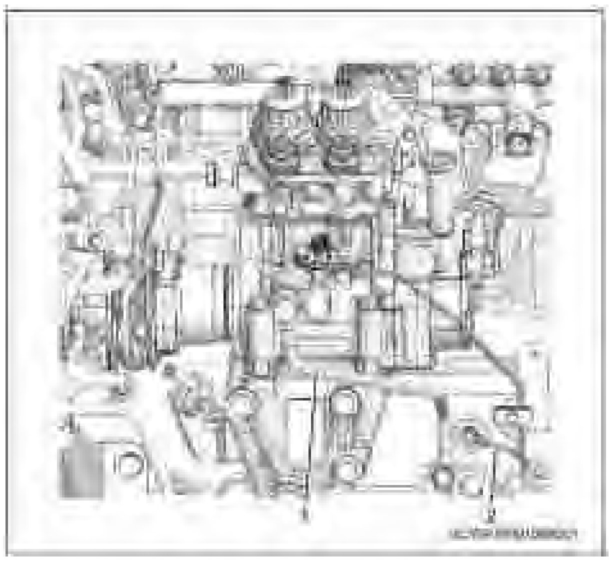
10) Install the oil return pipe to the fuel supply pump.

11) Install the tubing to the cylinder block.

12) Install the oil feed pipe to the fuel supply pump.

Tightening torque: 28 N • m {2.9 kgf • m / 21 lb • ft} M10

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft} M14



1. Oil return pipe

POWERSTAR

2. Oil feed pipe

13) Connect the harness connector to the PCV.

14) Connect the harness connector to the camshaft position sensor.

13. Cylinder head installation

1) Use a squeegee to clean the upper surface of the cylinder block and the lower surface of the cylinder head.

Caution:

● Carefully clean the cylinder block upper surface and the cylinder head lower surface, taking care not to damage the components.

2) Refer to the diagram and the table, and apply the liquid gasket to the cylinder block.

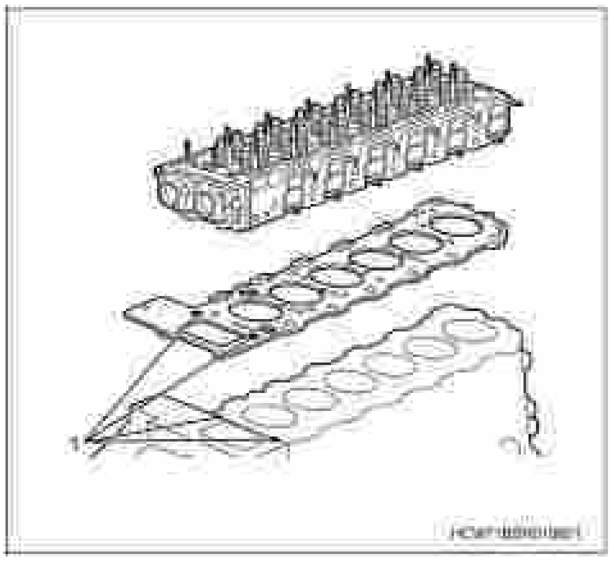
Caution:

● Strictly adhere to the liquid gasket application thickness and application width guidelines.

● After applying the liquid gasket, immediately install the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: 2 mm { 0.08 in }
	Coating width	: 5 mm { 0.20 in }



1. Liquid gasket application area

3) Install the cylinder head gasket to the cylinder block.

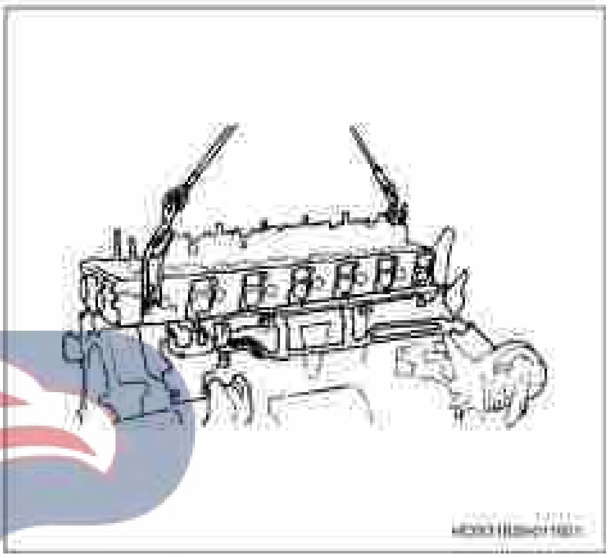
Caution:

● Do not reuse the cylinder head gasket.

4) Carefully align the knock pin positions, and place the cylinder head on the cylinder block.

Caution:

● Check the engagement of the idle gears.



5) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

Caution:

● Never use M12 bolts or M10 bolts.

6) Mount the cylinder head mounting bolts to the cylinder head in the order shown in the figure.

Caution:

● Do not drip foreign matters into the timing gear hole.

● Cylinder head mounting bolts can be used up to 4 times.

Tightening torque: 177 N • m {18.0 kgf • m / 131 lb • ft} 1st (M18)

Tightening torque: 245 N • m {25.0 kgf · m / 181 lb · ft} 2nd (M18)

Tightening angle: 60 to 90 ° Third time (M18)

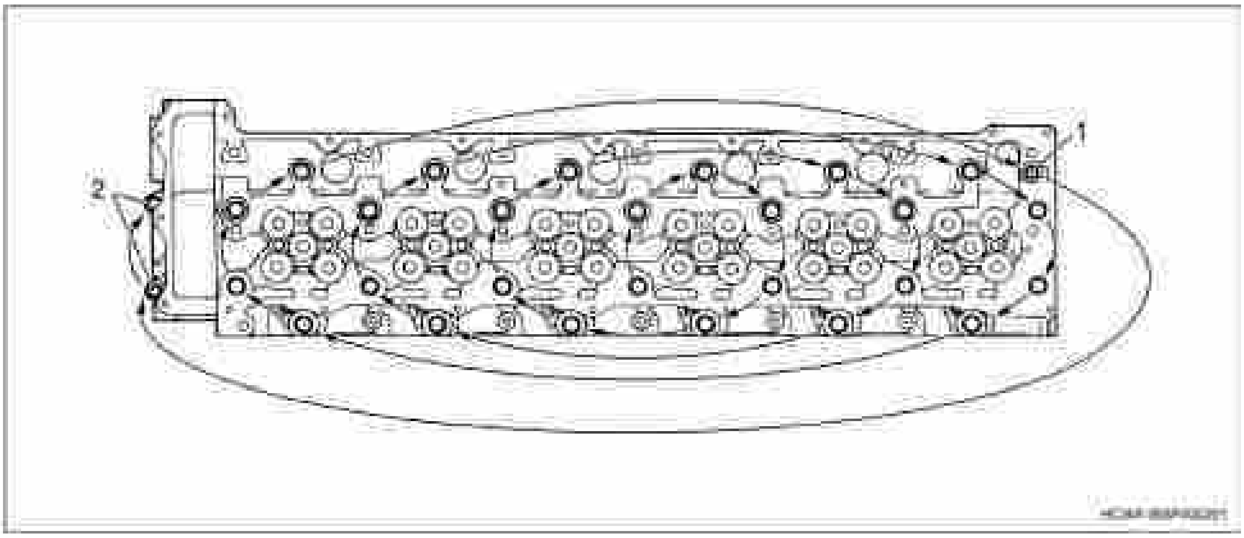
Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft} 4th (M12)

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft} 5th (M10)

Tightening torque: 324 N • m {33.0 kgf · m / 239 lb •

POWERSTAR

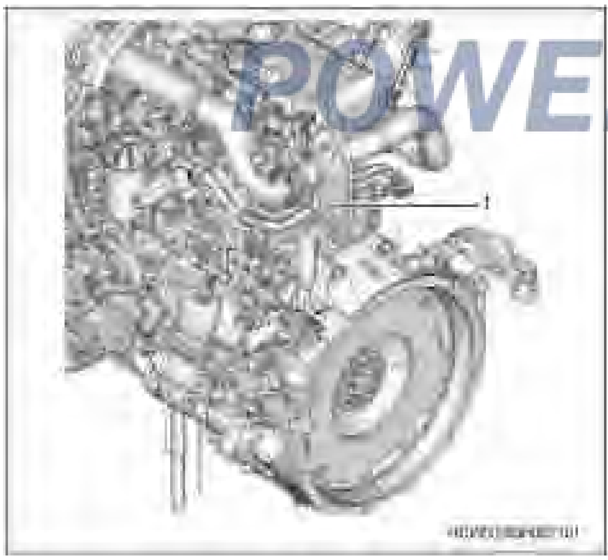
ft} Confirm the tightening (M18)



1. M12 bolt
2. M10 bolt

7) Remove special tool from the cylinder head.

SST: 8-9761-4276-0 - engine hanger



1. 8-9761-4276-0

14. Glow plug installation

1) Install the glow plug to the cylinder head.

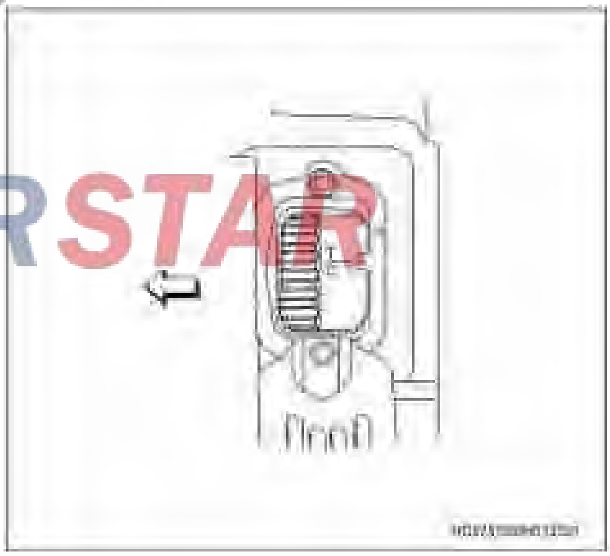
Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft }

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m { 0.15 kgf • m / 13 lb • in }

15. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.



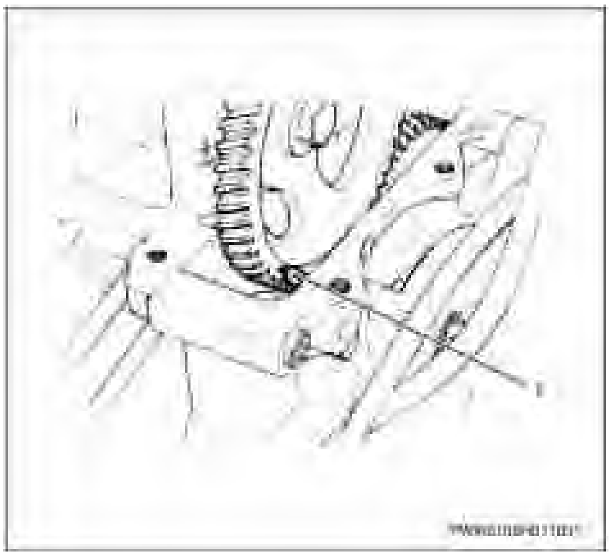
2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.

POWERSTAR



1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

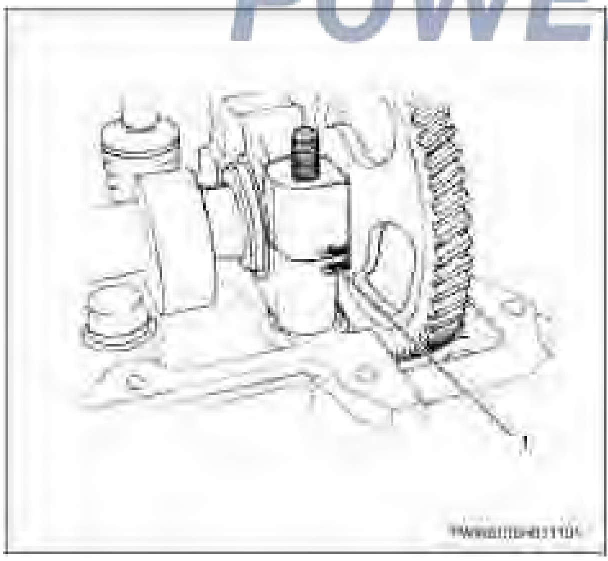
Note:

● Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.



1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m { 7.7 kgf • m / 56 lb • ft }

16. Bridge installation

1) Apply the engine oil to the bridge guide.

2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.

1. Bridge

17. Rocker arm shaft installation

1) Lubricate the roller arm and adjusting screw lip with engine oil

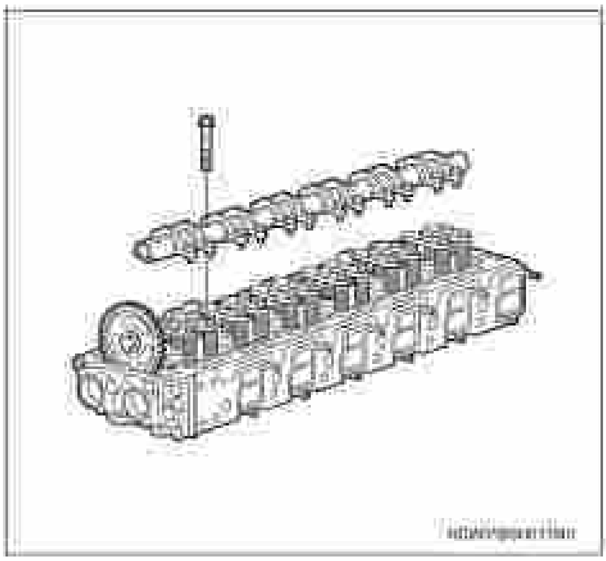
2) Loosen the adjust screw.

Note:

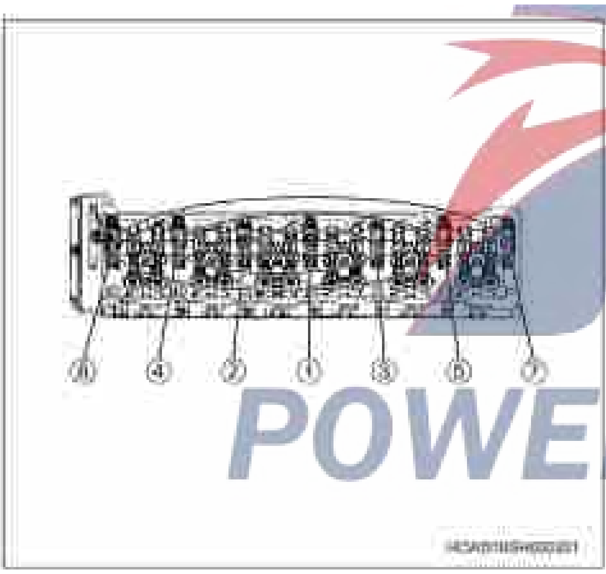
● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.

POWERSTAR



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



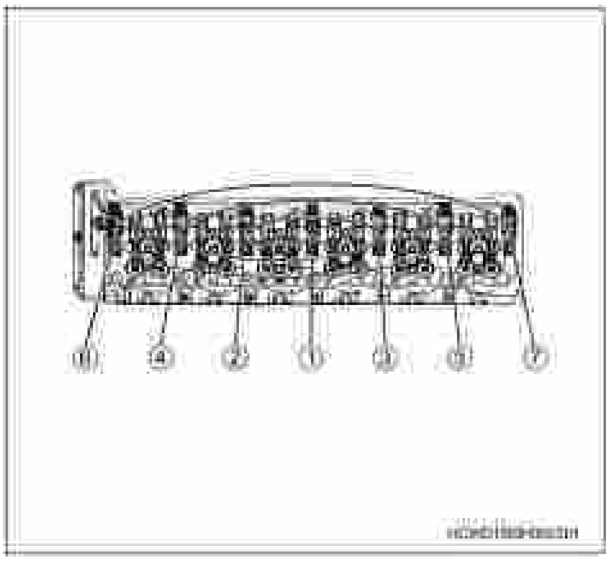
Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 lb • ft}



18. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

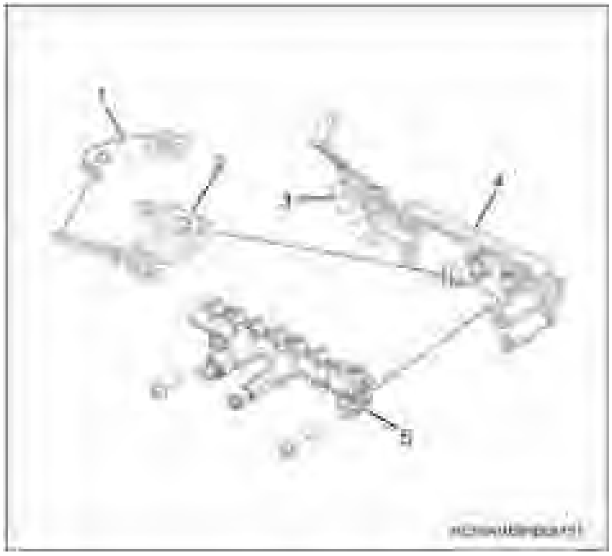
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



POWERSTAR

1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipe bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

---

4) Connect the harness connector to the fuel rail position sensor.

19. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

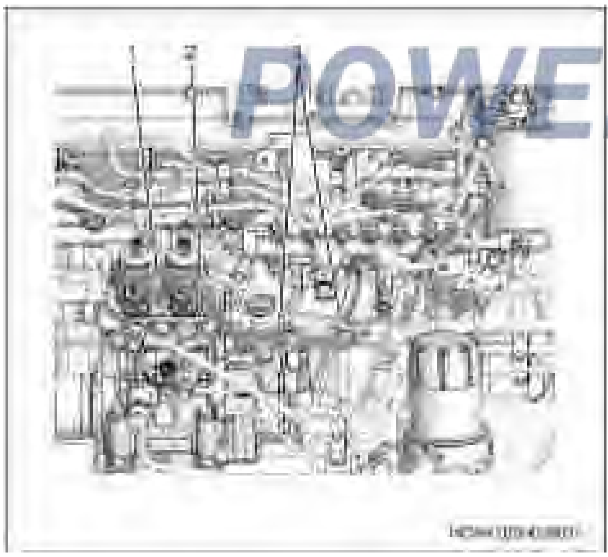
5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.



1. Fuel pipe
2. Fuel pipe
3. Clip

---

20. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

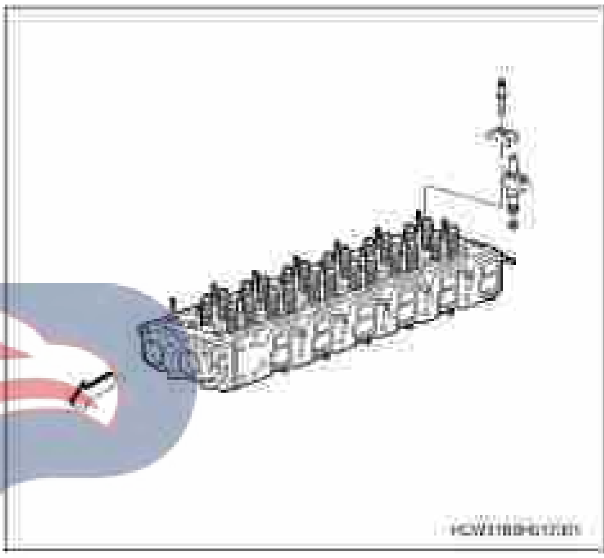
Note:

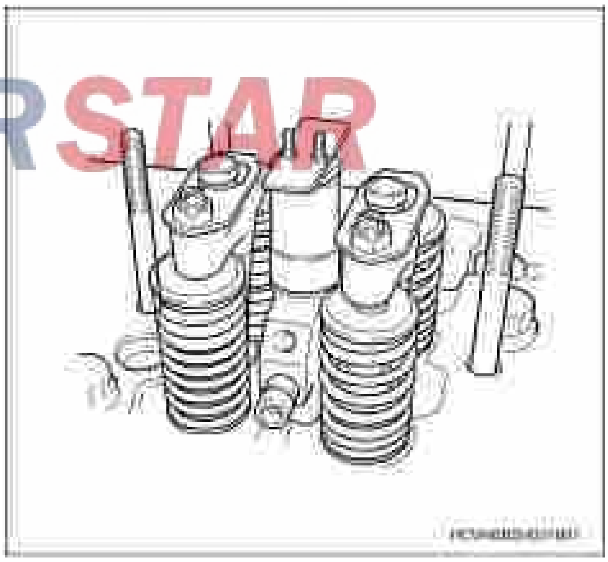
● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.





3) Temporarily fasten the injector clamp on the injector.

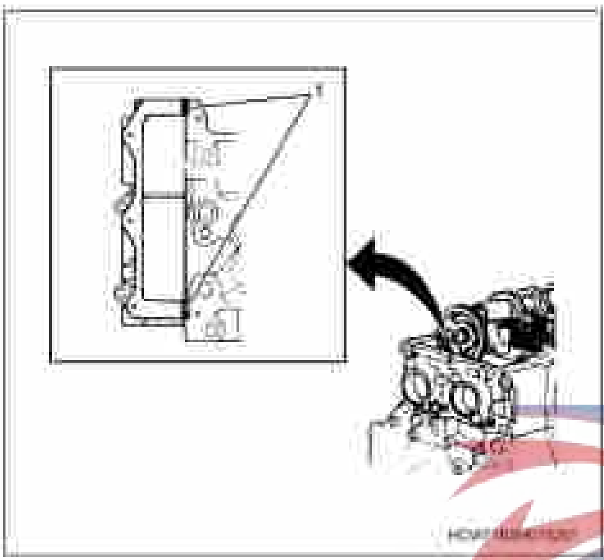
21. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

POWERSTAR

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}

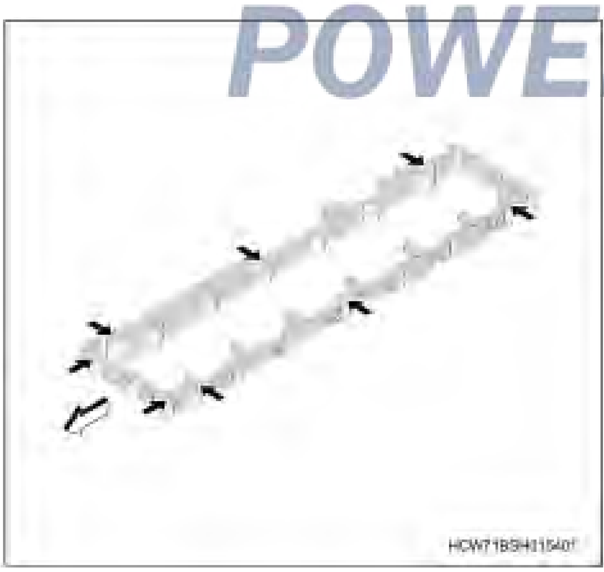


1. Liquid gasket application area

2) Install the gasket on the lower end cap.

3) Install the lower end cap onto the cylinder head.

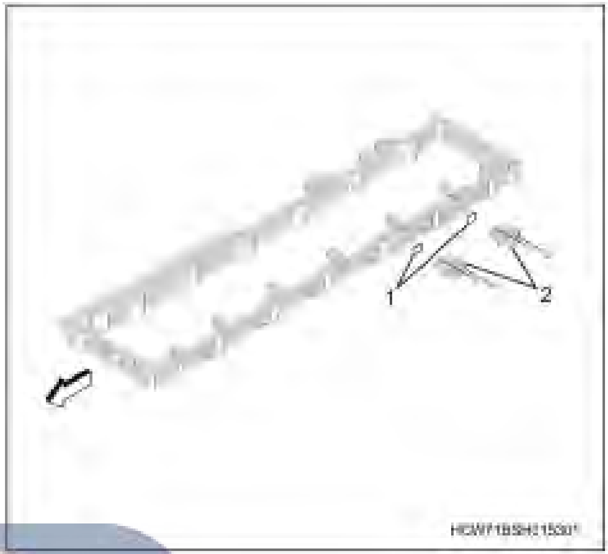
Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}



1. O-ring
2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

● Install the gasket firmly.

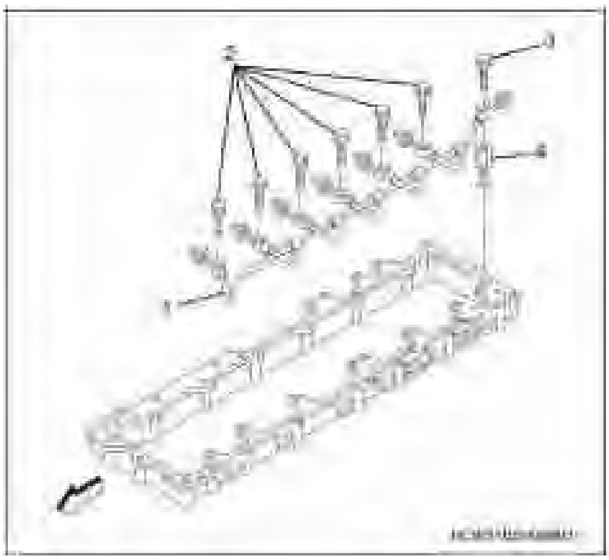
9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 25 lb • ft}

POWERSTAR

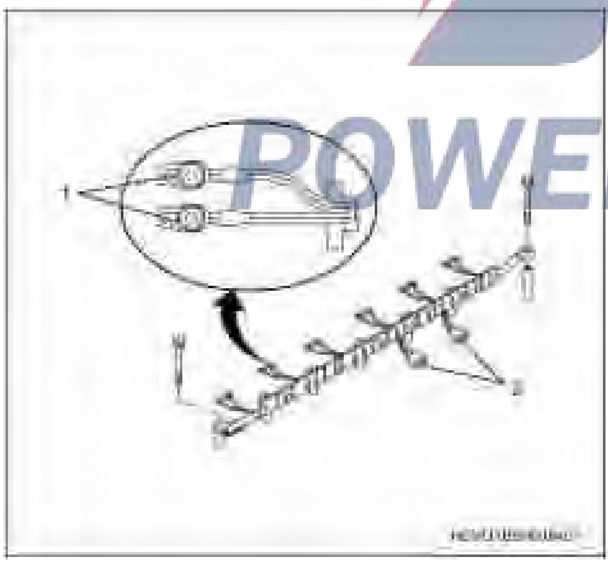


1. Nozzle spout
2. Eyebolt
3. Eyebolt
4. Adapter

22. Injector harness installation

1) Install the connector on the lower cover.

● Securely lock the harness side connector.



1. Injector terminal nut
2. Connector

2) Install the injector harness onto the cylinder head.

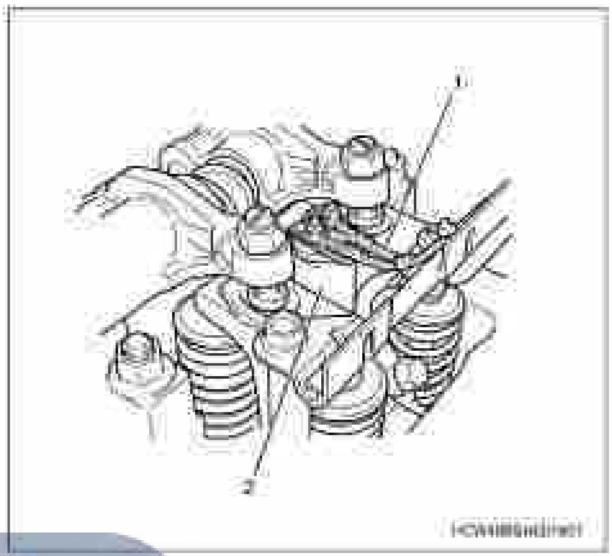
Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



1. Injector harness
2. Injector

23. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

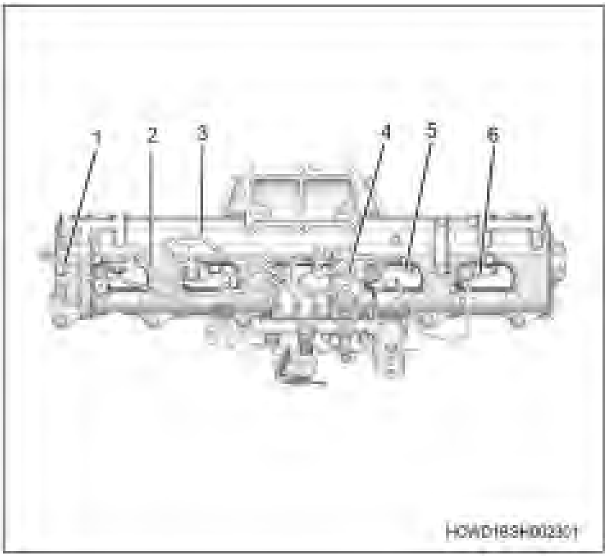
4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft }

POWERSTAR



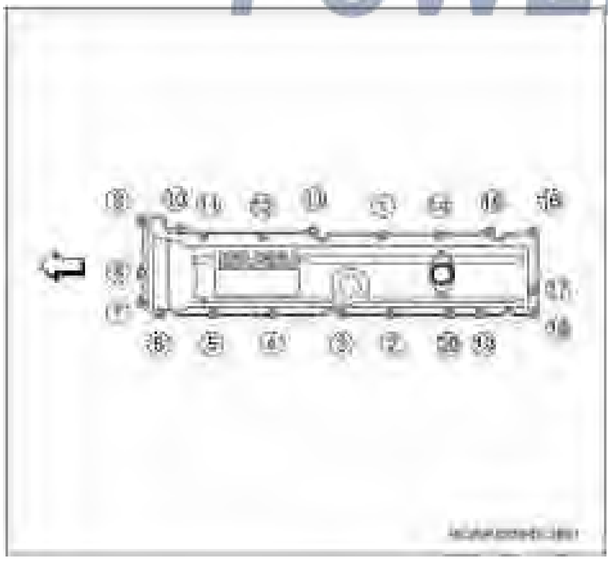
1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

24. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



25. Generator Bracket Installation

1. 50 A and 60 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

2. 90 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

● When installing, make the right side of the oval hole area of the bracket contact with the bolt.

26. Starter motor installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m / 61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

27. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

28. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

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29. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

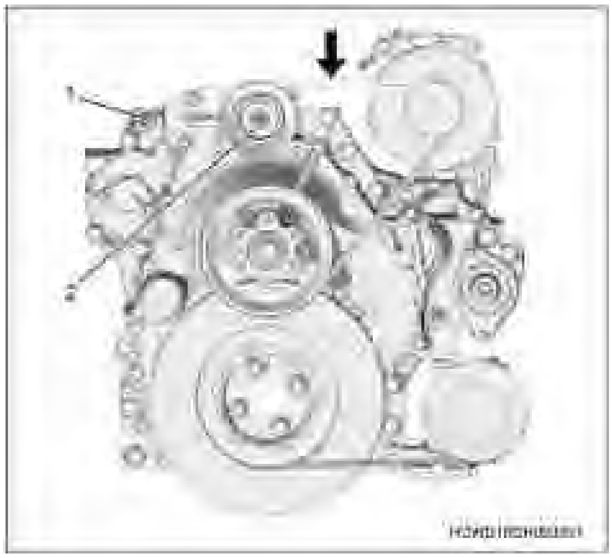
Cooling fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394to 0.472 in}	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

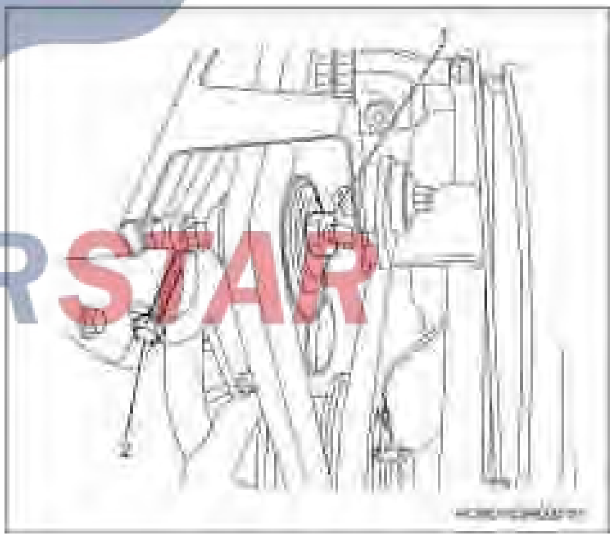
Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}



1. Lock nut
2. Adjust bolt

30. A / C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

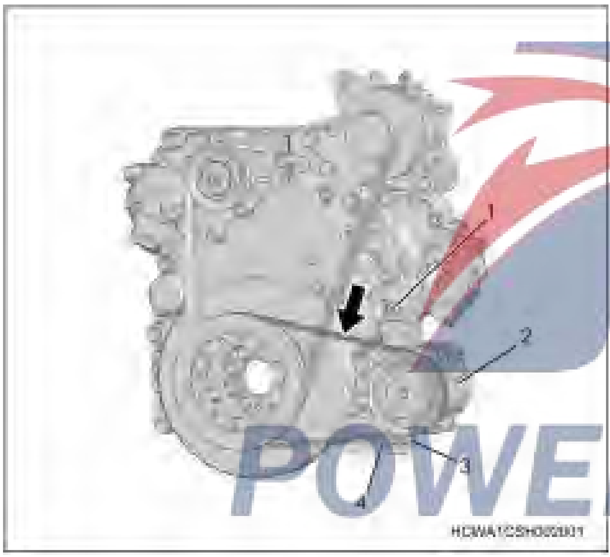
If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A / C compressor pulley and the crankshaft pulley.

Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
tension	: 392 to 588N { 40.0to 60.0kg }	: 294 to 392N { 30.0to 40.0kg }
deviation	: 11 to 14mm { 0.4to 0.6 in }	: 15 to 17mm { 0.6to 0.7 in }
vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

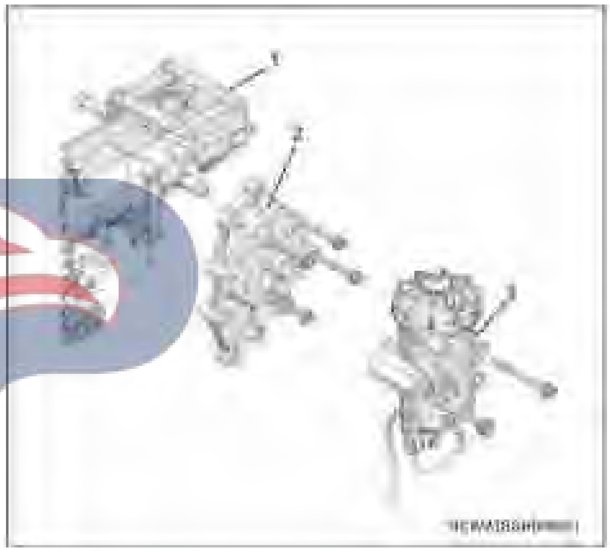
31. Fuel filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

32. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb •in}

33. Oil feed pipe installation

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1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Eyebolt Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb• ft }
M10	: 27 N • m { 2.8 kgf • m /20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

34. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

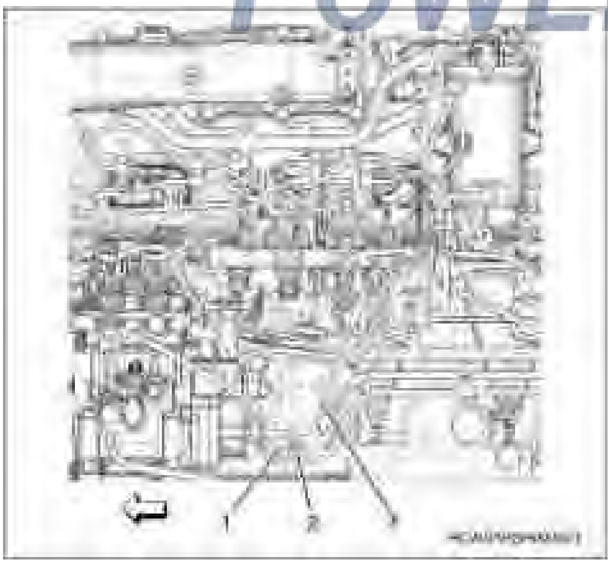
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

35. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

36. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

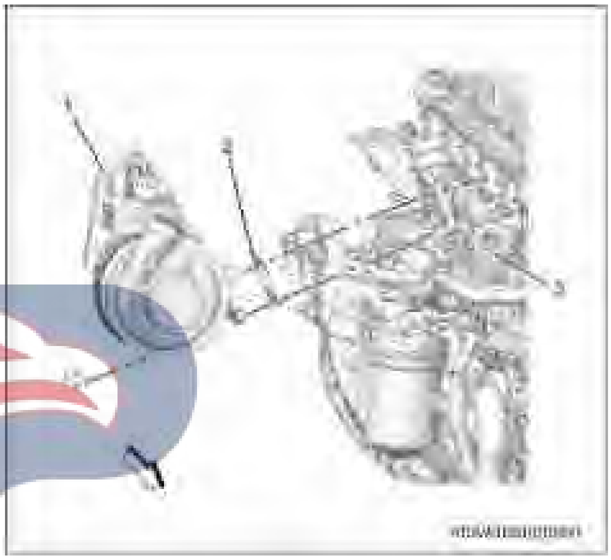
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}



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1. Turbocharger
2. Gasket
3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

6) Connect the water return pipe to the turbocharger.

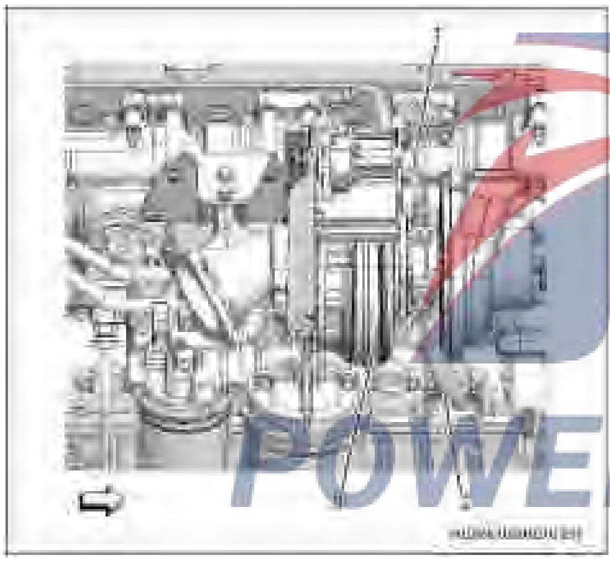
Tightening torque: 50 N • m {5.1 kgf · m / 37 lb • ft}

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf · m / 30 lb • ft}

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

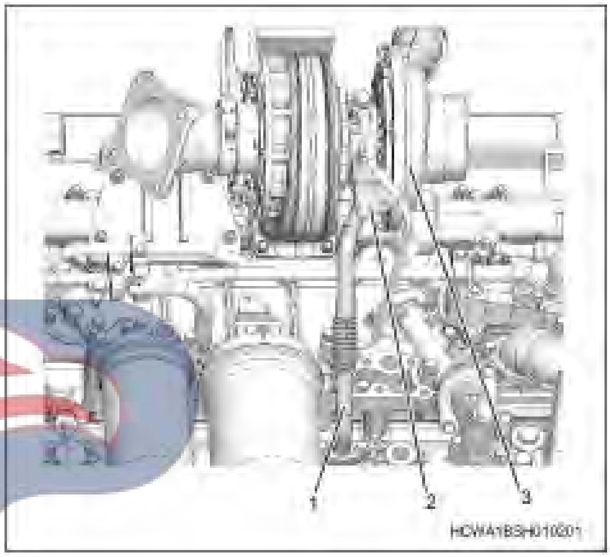
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

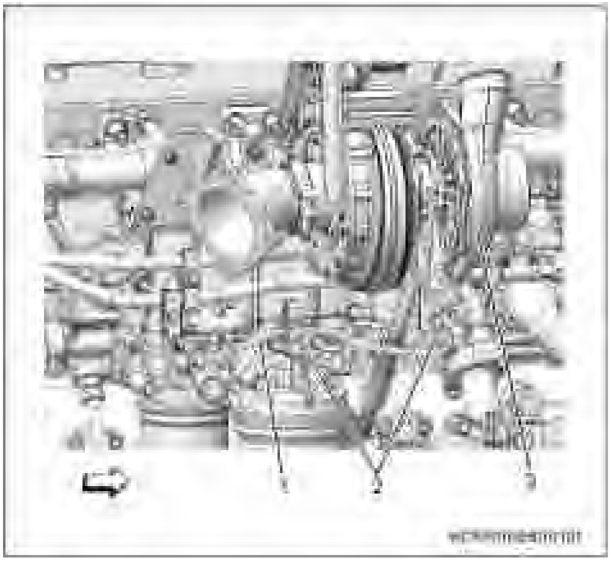
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the oil filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the oil filter body finally.

Tightening torque: 34 N • m { 3.5 kgf • m / 25 lb • ft }



1. Turbocharger oil feed pipe

2. Clip

3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

37. Exhaust brake valve installation

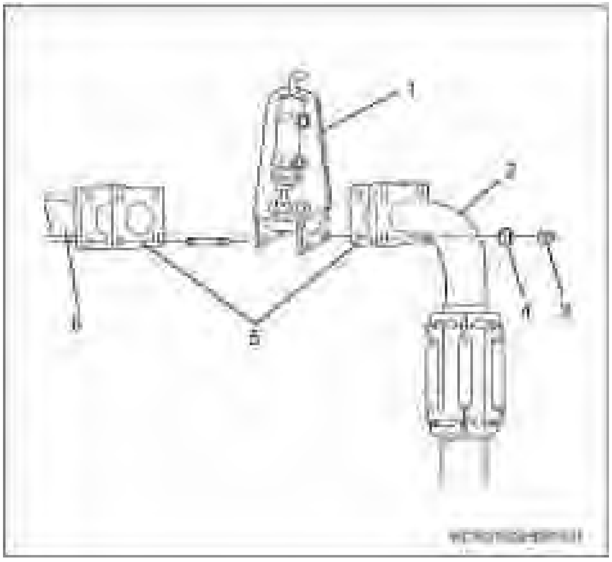
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m {6.0 kgf • m / 19.96 kg • ft}



1. Exhaust brake valve

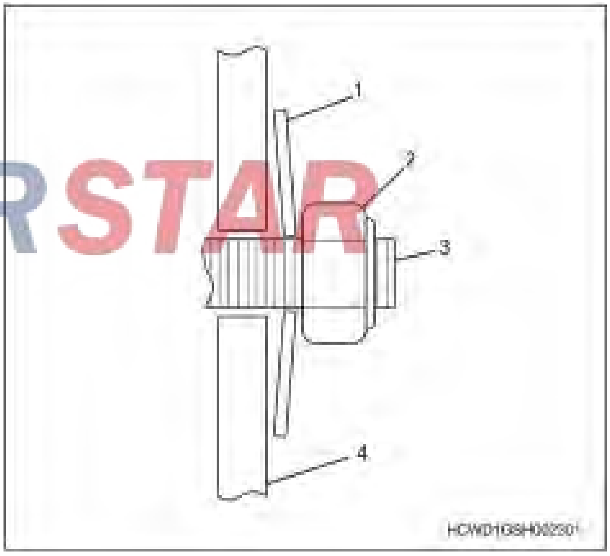
2. Front exhaust pipe A

3. Nut

4. Washer

5. Gasket

6. Turbocharger exhaust pipe



1. Washer

2. Nut

3. Stud

4. Flange

2) Connect the air hose to the exhaust brake valve.

38. Exhaust cover installation

1) Install the exhaust cover to the frame.

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39. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

40. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

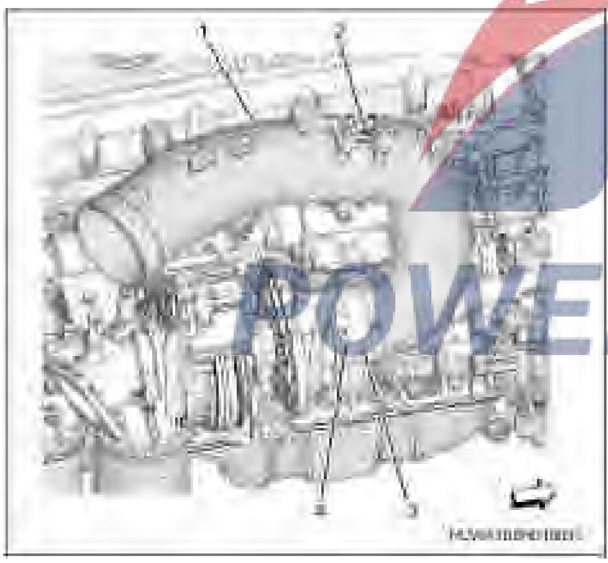
41. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb• ft }

M10



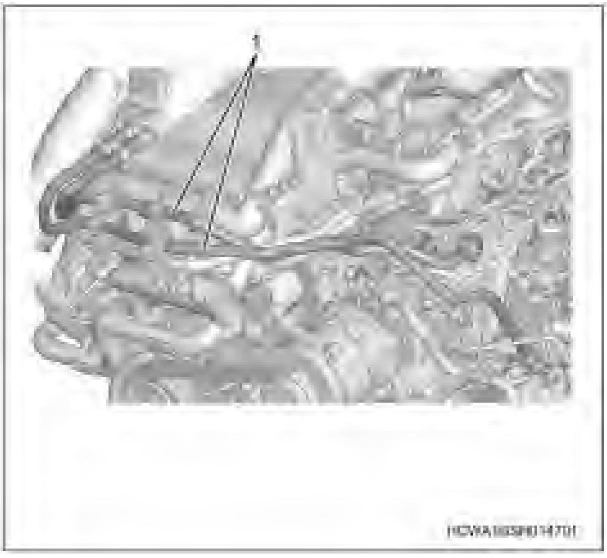
1. Air duct.
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

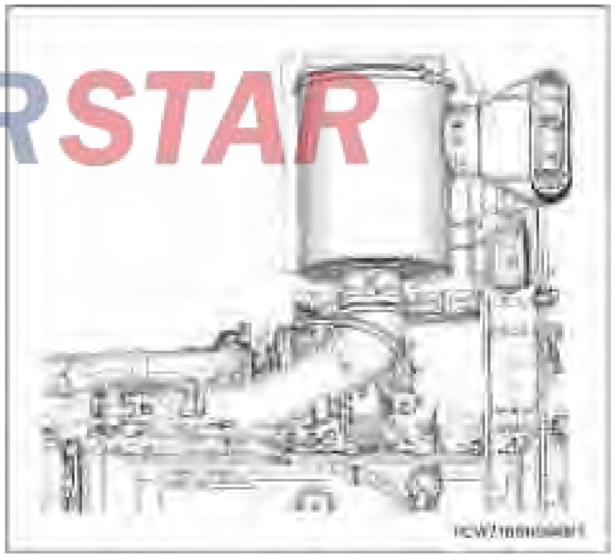
42. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



43. Pilot valve installed

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

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Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

44. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

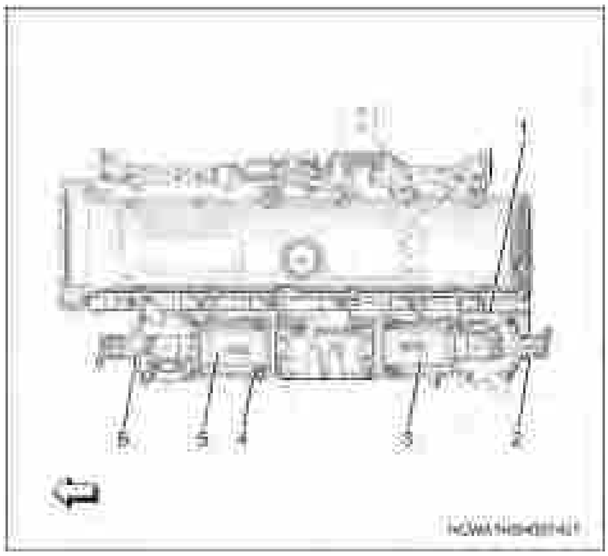
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe bracket
5. EGR Valve duct A
6. EGR valve 1

5) Final Tighten the EGR valve conduit A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

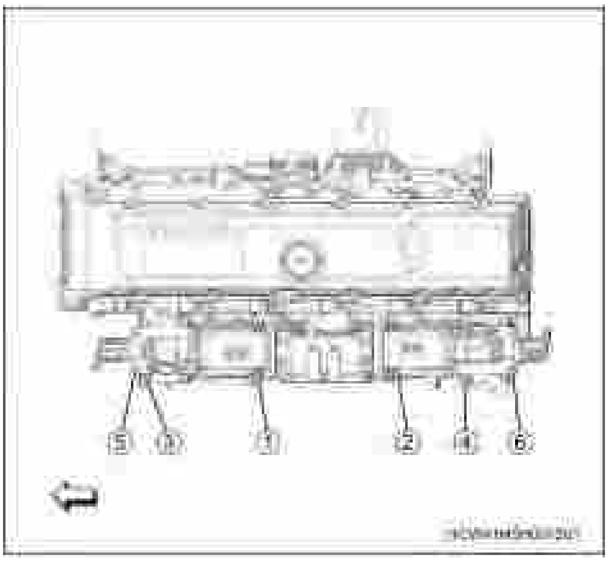
Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

POWERSTAR



45. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gas kets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

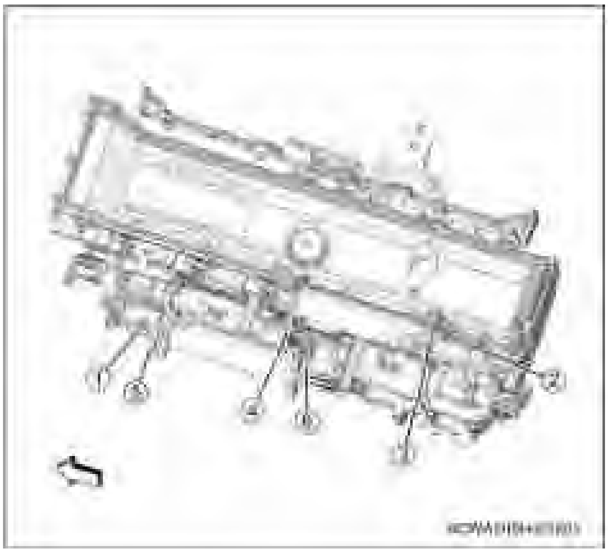
● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

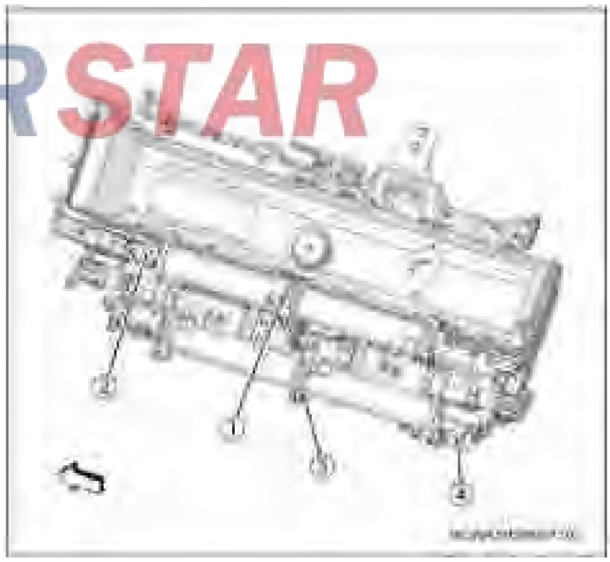
● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

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● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

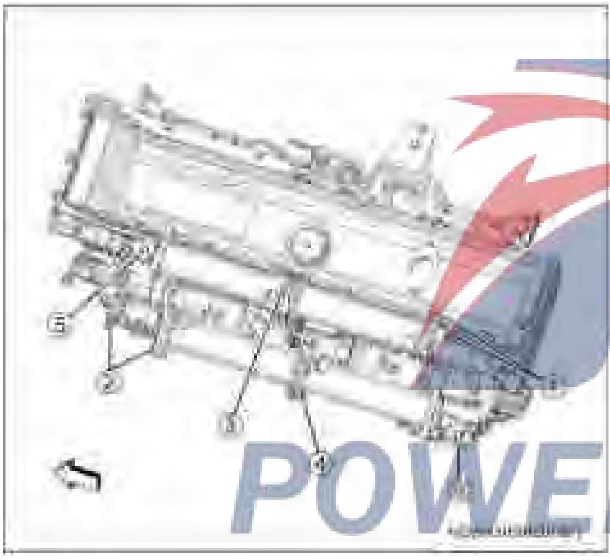
Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5 (M10), 6 (M10)

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5 (M8), 6 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

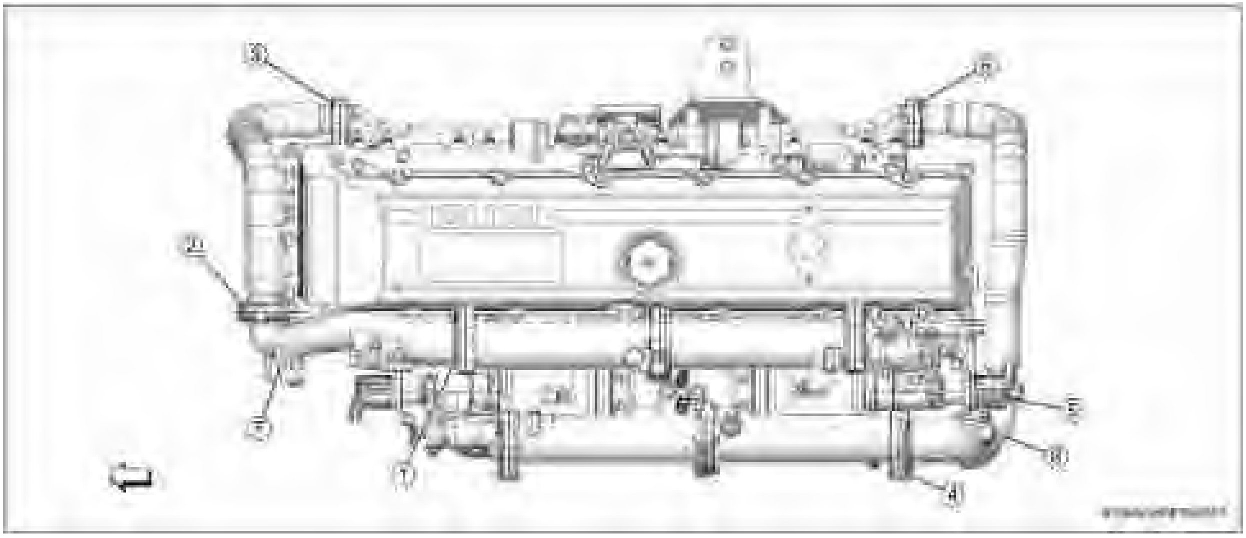
● EGR duct B.

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

- EGR duct B.
- Bracket

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 1 (M10), 2,3,9 (M10), 10 (M10)

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 4

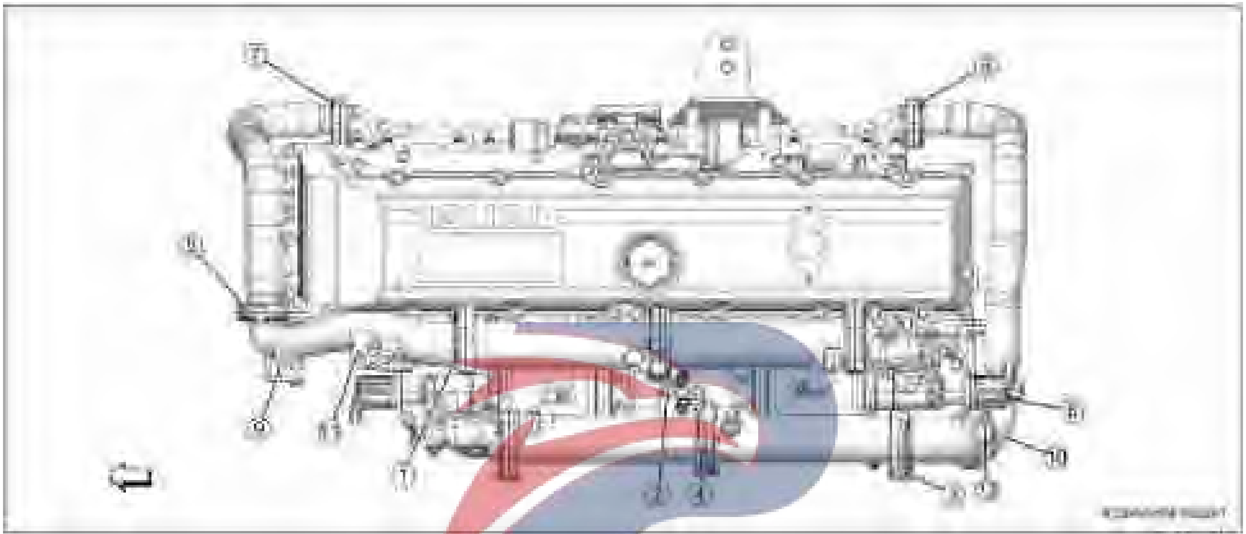
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft} 5,6 (M8), 7,8 (M8), 9 (M8)

Tightening torque: 24.7 N • m {2.5 kgf • m / 18 lb • ft} 10 (M8)

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft} 11,12 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.



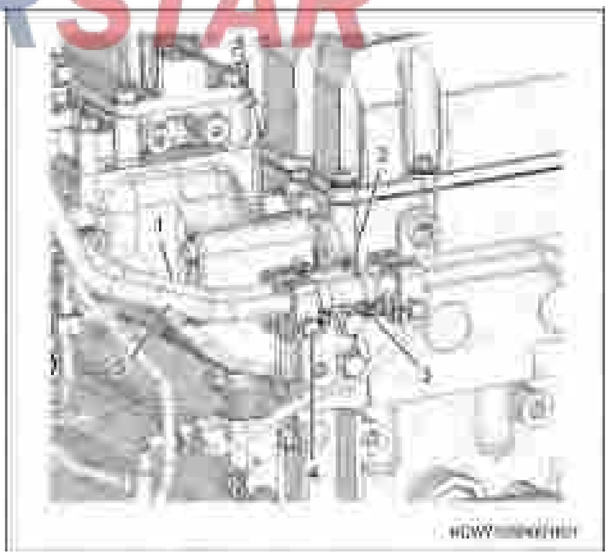
6) Install the front and rear return lines to the exhaust gas recirculation cooler.

1. Front return pipe
2. Back-end return pipe

7) Install the clip on the return pipe.

Caution:

- During installation, care should also be taken to prevent the clamp from rotating.
- Install the water supply hose clamp to keep it horizontal.
- Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.



1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp the bolt

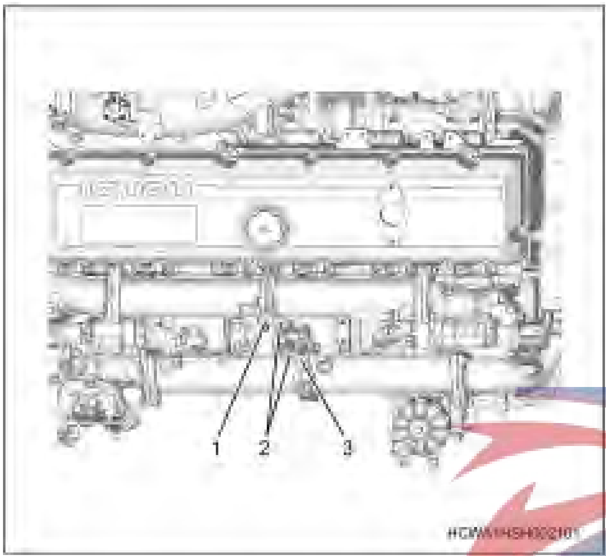
POWERSTAR

5. Back-end return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.



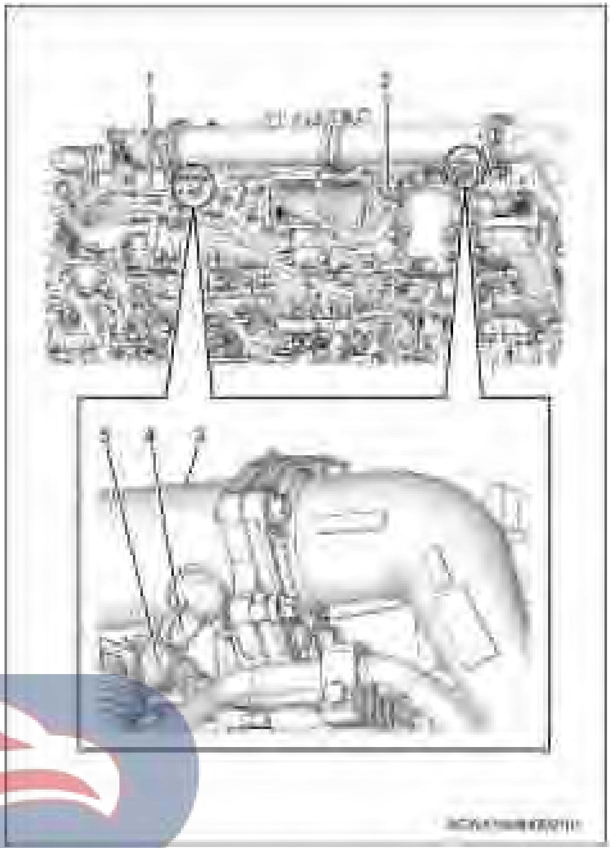
1. Hose clip
2. water feed hose
3. Hose clip

9) Recycle the raised tip on the cooler with the water supply hose

Align the markings on the exhaust gas recirculation cooler and install the front and rear water lines on the exhaust gas recirculation cooler.

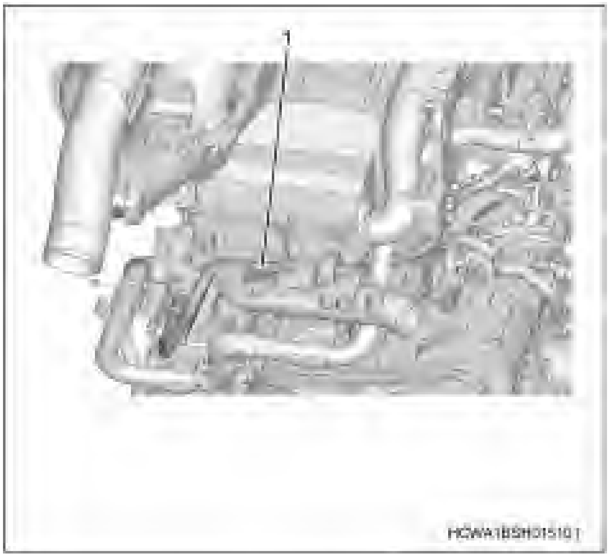
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

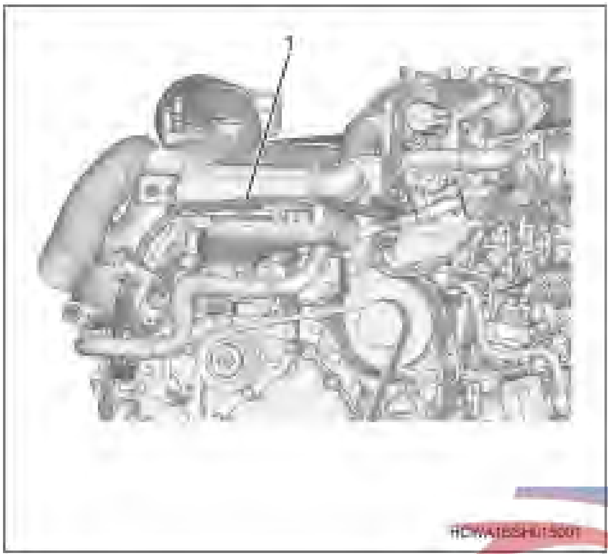
10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



POWERSTAR

1. Back-end water pipe

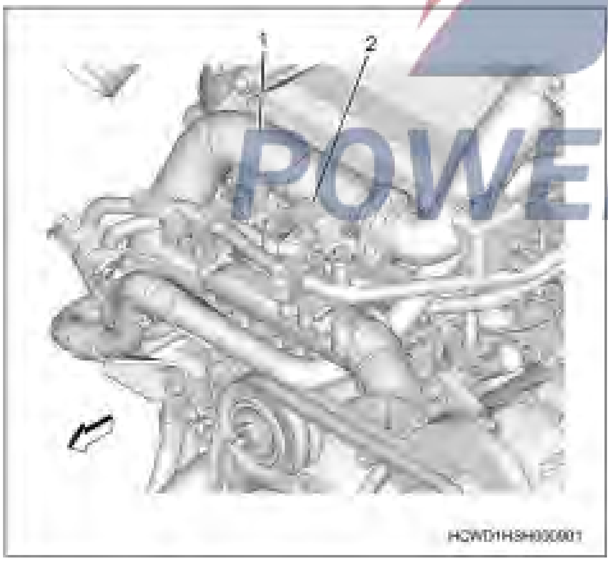
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

46. Suction pipe installation

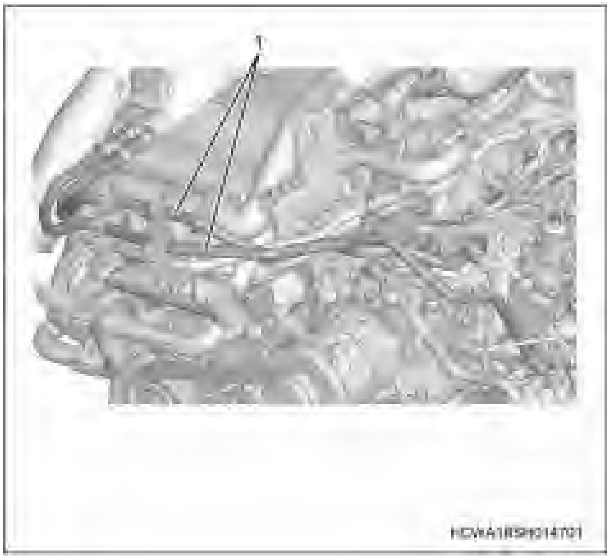
1) Install the bracket on the drain.



1. Front exhaust gas recirculation line

2. Bracket

2) Install 2 air suction tubes to the air compressor.



1. Exhaust pipe

47. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

48. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

POWERSTAR

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

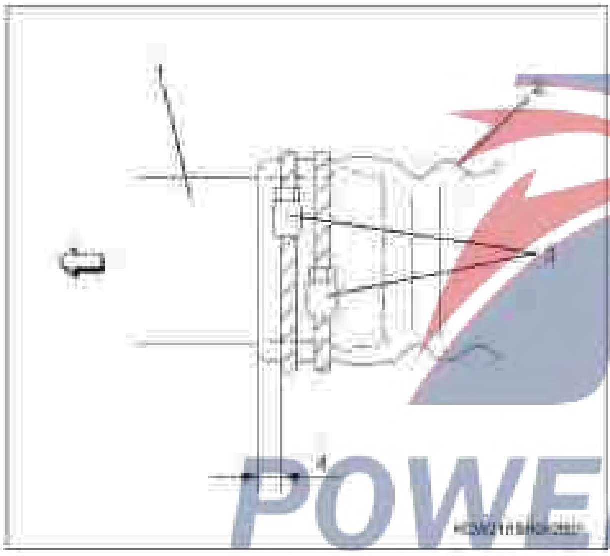
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been fixed installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30 ° or more.

Tightening torque: 6.4 N • m {0.7 kgf • m / 57 lb • in}



1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

49. Water charge pipe installation

1) Install the water charge pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water charge pipe bracket on the exhaust gas recirculation valve duct A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water charge pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

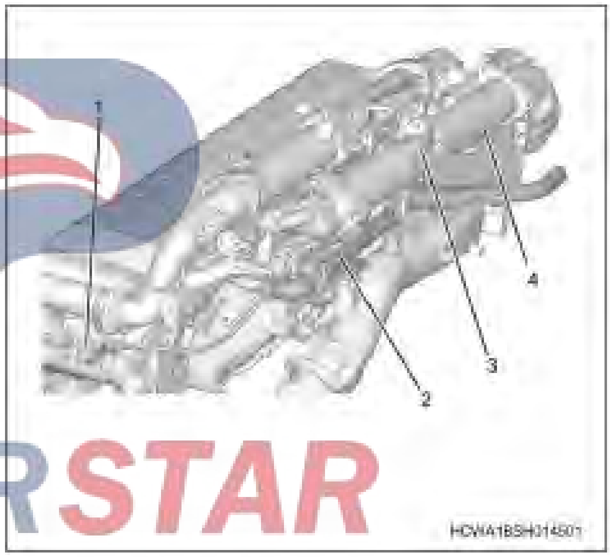
50. Leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Eyebolt

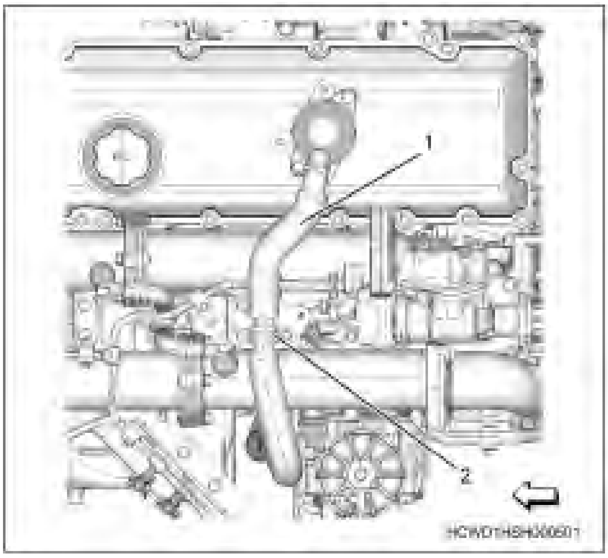


1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

51. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.

POWERSTAR



1. Ventilation hose
2. Ventilation hose clip

52. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15)Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

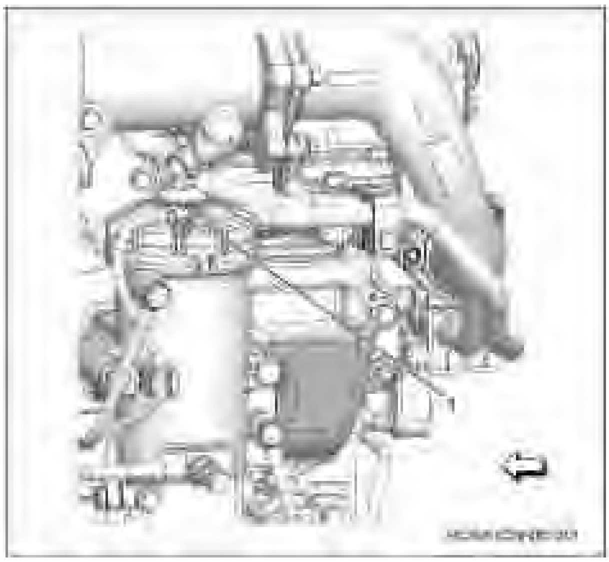
● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

53. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.

POWERSTAR



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

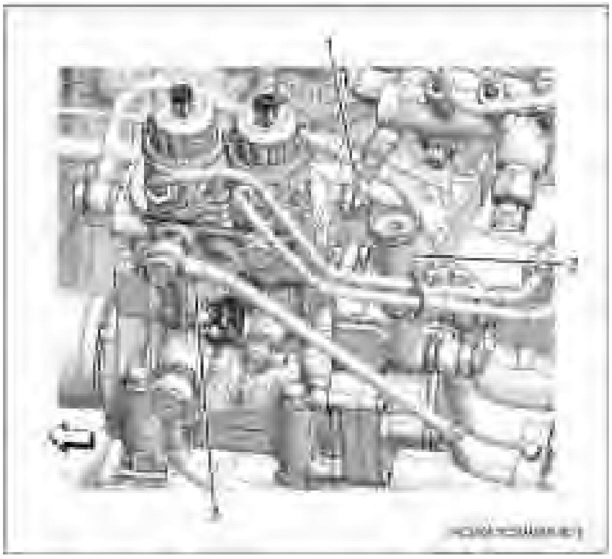
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

54. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

POWERSTAR

Crankshaft pulley

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

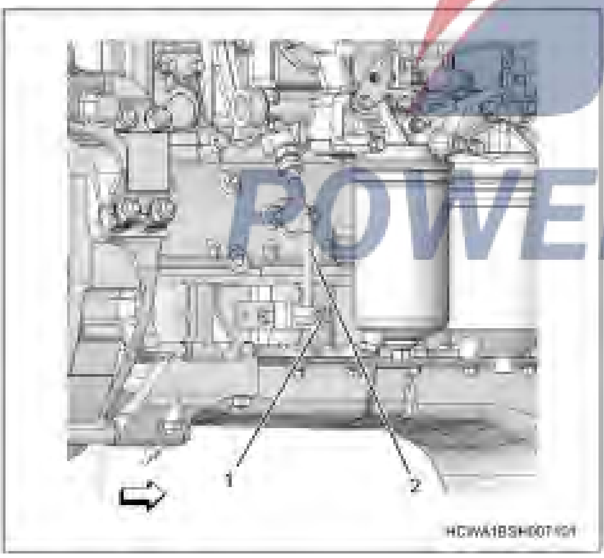
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug
2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.

1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

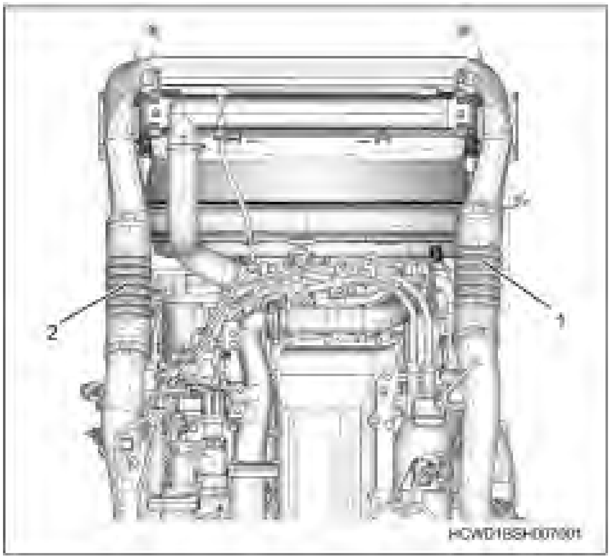
7) Install sub-tank cap to radiator.

3. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.

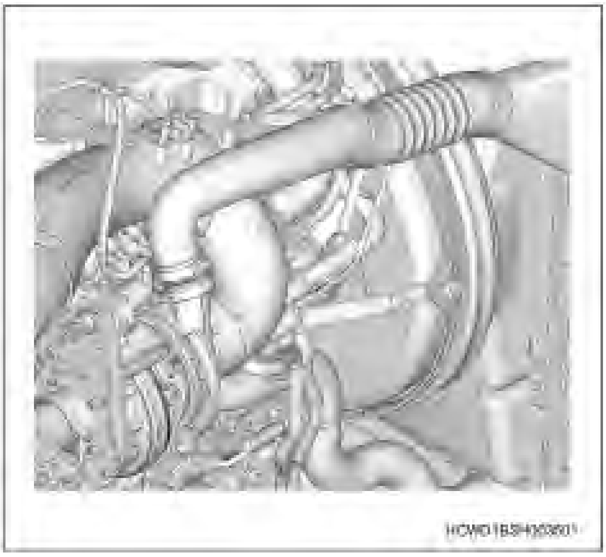
3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

POWERSTAR

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



4. Radiator upper hose removal

1) Remove the radiator upper hose from the water

2) Remove the radiator upper hose from the radiator.

3) Disconnect the radiator air leak hose from the radiator.

5. Radiator lower hose removal

1) Remove the radiator lower hose from the water intake pipe and the radiator.

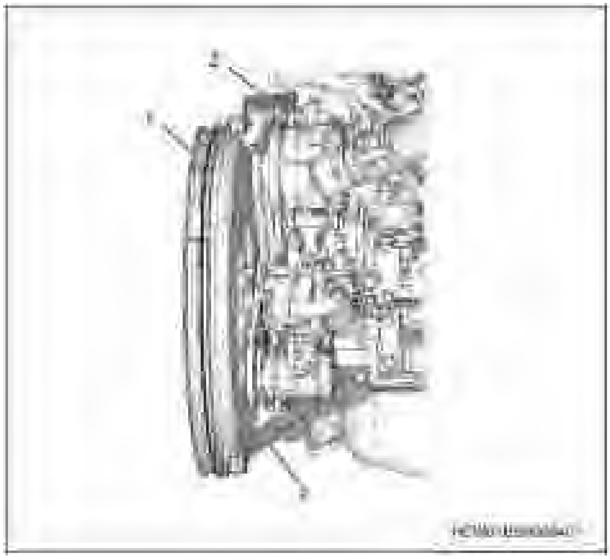
2) Remove the radiator lower hose from the radiator.

6. Radiator fan cover disconnect

1) Disconnect the fan guide bracket from the engine.

Caution:

● Do not remove the fan duct connected to the air duct bracket.



1. Fan guide

2. Fan guide bracket

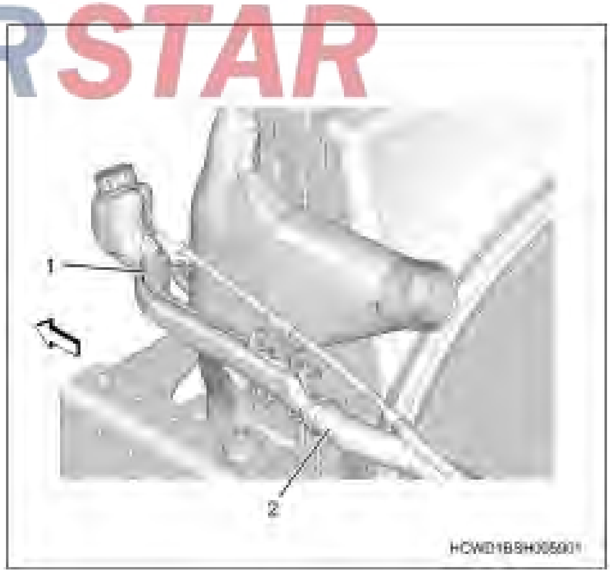
2) Disconnect the radiator fan cover from the fan guide cover.

7. Cooling fan removal

1) Remove the fan duct and cooling fan from the fan pulley.

8. Refueling pipe removal

1) Remove the fuel line and rubber hose from the timing gearbox.



1. Fuel pipeline

2. Rubber hose

POWERSTAR

9. Intercooler removal

1) Remove the intercooler from the radiator.

Caution:

● Remove the fin without damaging it.

10. Radiator removal

1) Remove the radiator stay from the radiator.

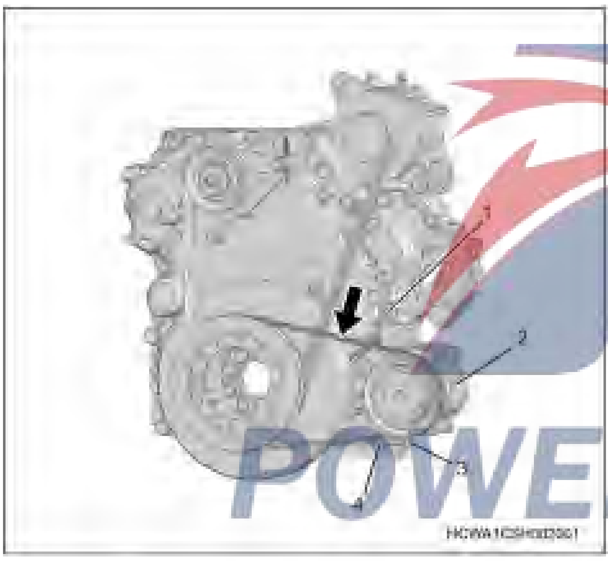
2) Remove the radiator from the frame.

Caution:

● Remove the fin without damaging it.

11. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



1. Bolt

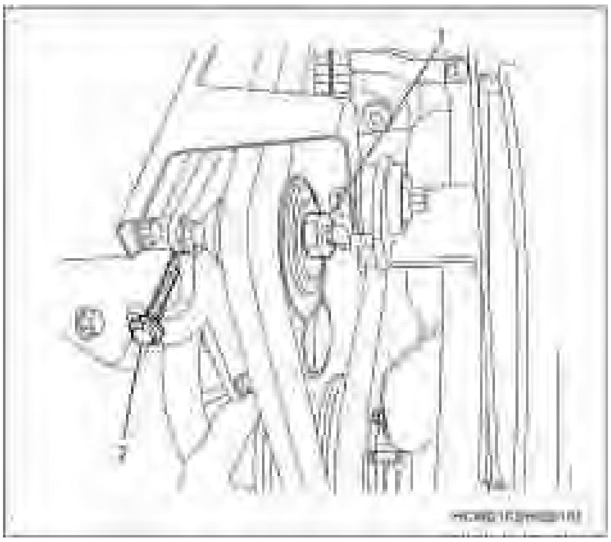
2. A/C compressor

3. Adjust bolt

4. Nut (back end)

12. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



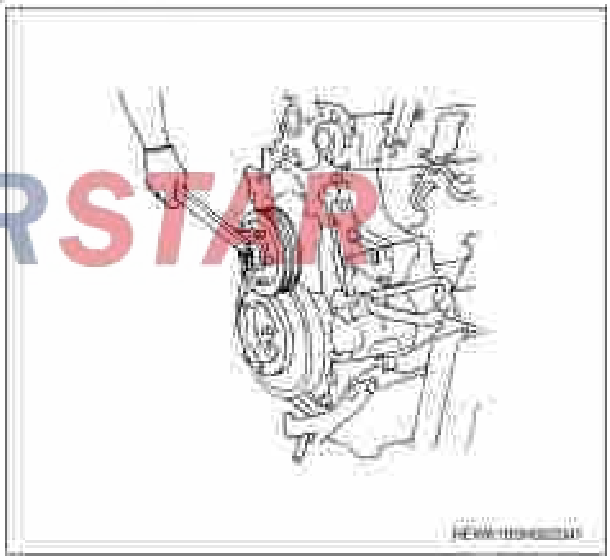
1. Lock nut

2. Adjust bolt

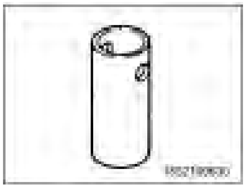
13. Crankshaft pulley removal

1) Wedge the crankshaft with a wooden block to prevent the fan pulley from rotating.

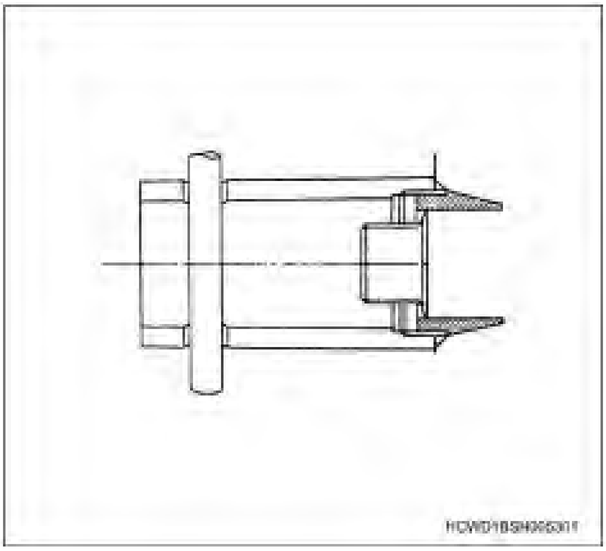
2) Remove the crankshaft pulley nut from the crankshaft pulley.



3) Use a special tool to remove the fan pulley cone bushing.



SST: 1-8521-0063-0 - Tapered bushing puller



4) Remove the fan pulley from the fan shaft.

5) Remove the crankshaft pulley from the crankshaft.

Caution:

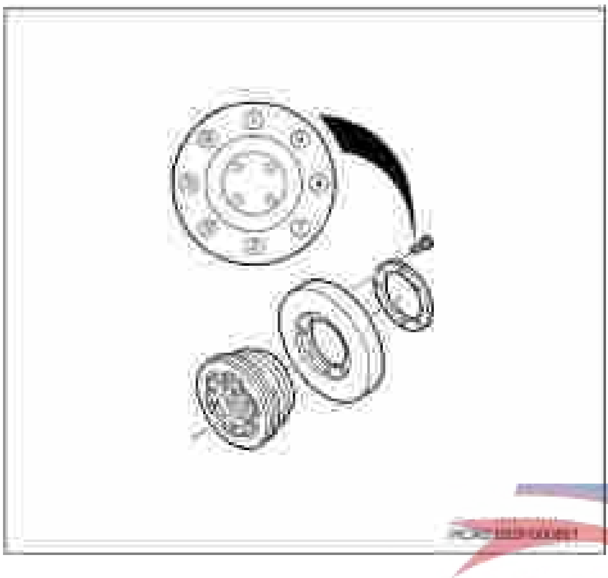
● Do not damage the sealing surface or excessive force on the pump body.

POWERSTAR

Removal

1. Crankshaft pulley disassembly

1) Remove the crankshaft damper from the crankshaft pulley.



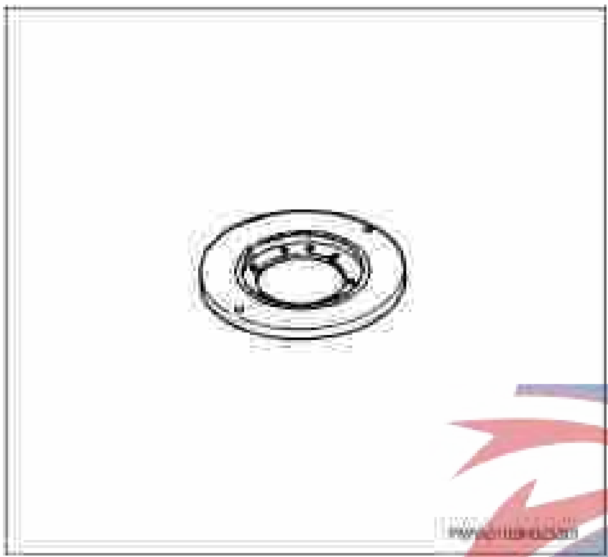
Inspection

1. Crankshaft pulley check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Check crankshaft shock absorber is broken.



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Reassembly

1. Crankshaft pulley reassembly

1) Install the crankshaft damper on the crankshaft pulley.

Note:

● Tighten the bolts diagonally.

Caution:

● Carefully label the front side.

Keep crankshaft shock absorbers away from oil and grease.

Tightening torque: 96 N • m { 9.8 kgf • m / 71 lb • ft }

POWERSTAR

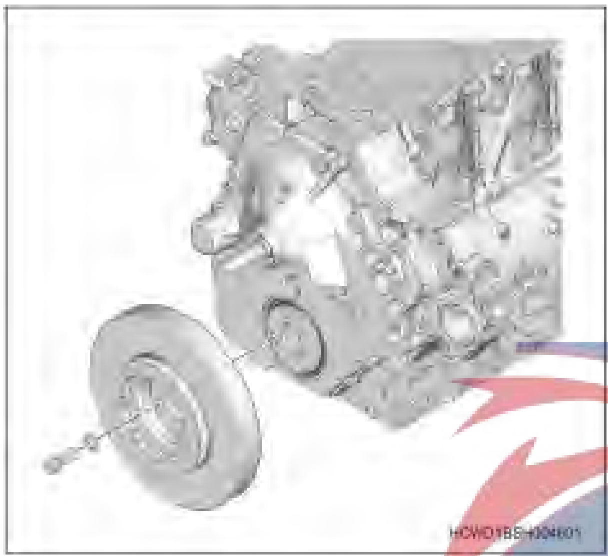
Installation

1. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}

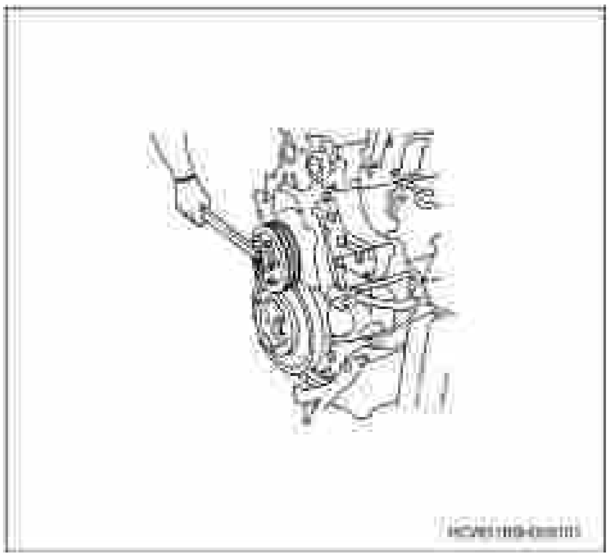


3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N • m {55 kgf • m / 398 lb • ft}



2. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

3. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

4. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

Cooling fan belt tension specified value

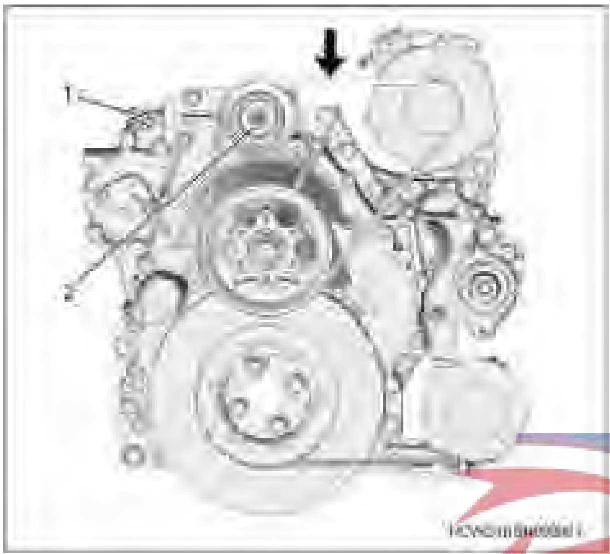
	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512to 0.591 in }	: 79 to 89Hz

POWERSTAR

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

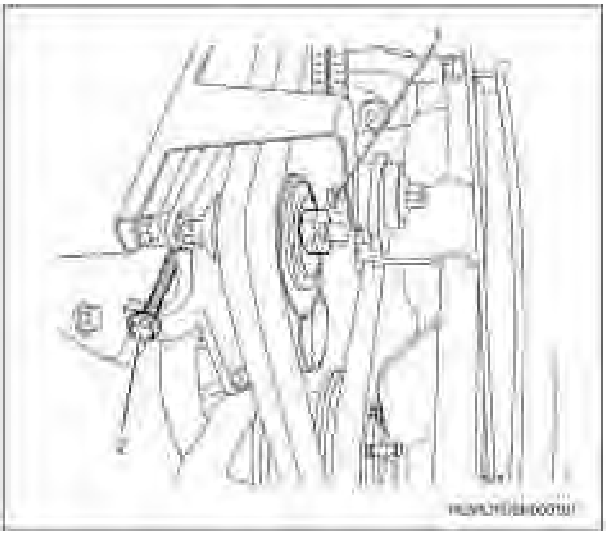
Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}



1. Lock nut
2. Adjust bolt

5. A / C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A / C compressor pulley and the crankshaft pulley.

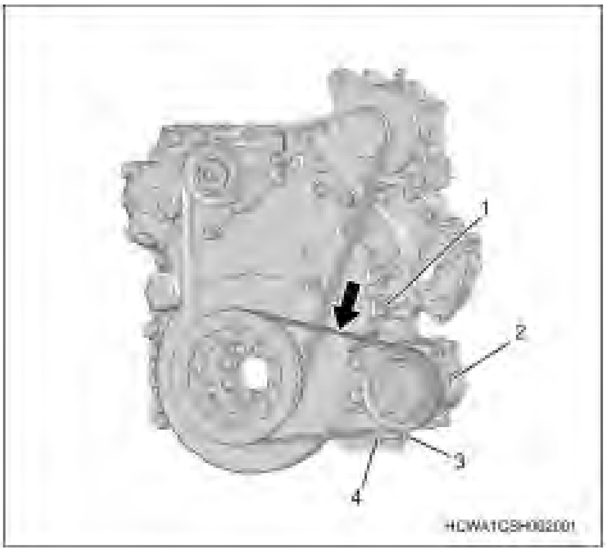
Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
Tension	: 392 to 588N { 40.0to 60.0kg }	: 294 to 392N { 30.0to 40.0kg }
Deviation	: 11 to 14mm { 0.4 to 0.6 in}	: 15 to 17mm { 0.6 to 0.7 in}
Vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.

POWERSTAR



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A/C compressor belt.

6. Radiator installation

1) Install the cushion rubber to the top and bottom of the radiator bracket.

2) Install the radiator to the frame.

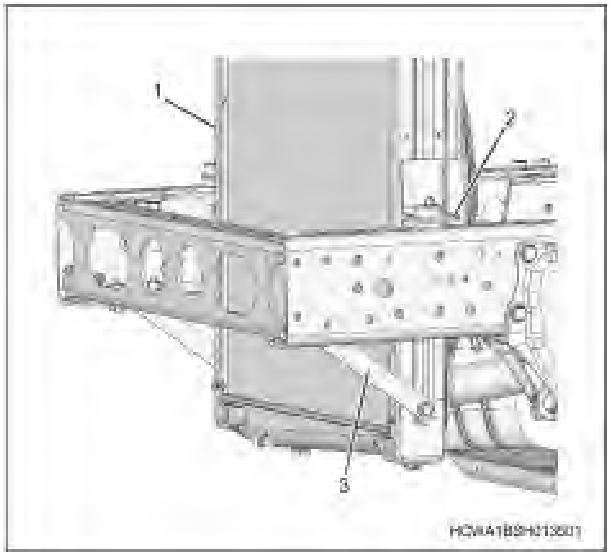
3) Install the washer to the topside of the cushion rubber.

4) Install the nut to the radiator.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

5) Install the radiator stay to the radiator and the frame.

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft }



1. Radiator
2. Bracket
3. Bracket

7. Intercooler installation

1) Install the intercooler to the radiator.

Caution:

● Remove dirt and other foreign objects.

● Do not damage the fins during installation or removal.

● When the intercooler fin deforms due to heat dissipation slow down, performance degradation, please carry out maintenance.

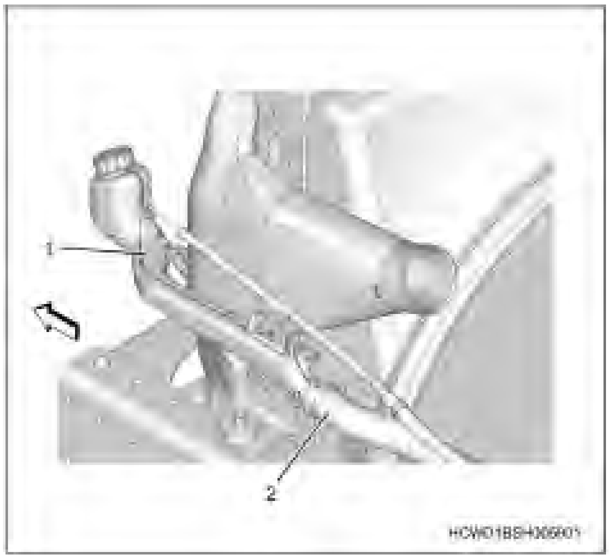
● Do not damage the fin base when repairing the fin.

● Do not use a high-pressure water jet on the radiator, intercooler, or the surrounding parts.

8. Refueling pipe installation

1) Install the refueling line and rubber hose to the timing gearbox.

POWERSTAR



1. Fuel pipeline

2. Rubber hose

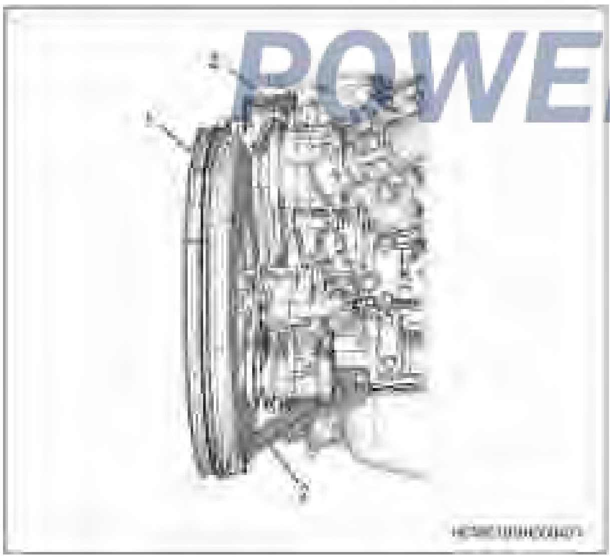
9. Cooling fan installation

1) Install the fan duct and cooling fan on the fan pulley.

Tightening torque: 67.5 N • m {6.9 kgf • m / 50 lb • ft}

10. Radiator fan cover connection

1) Install the fan guide bracket to the engine.



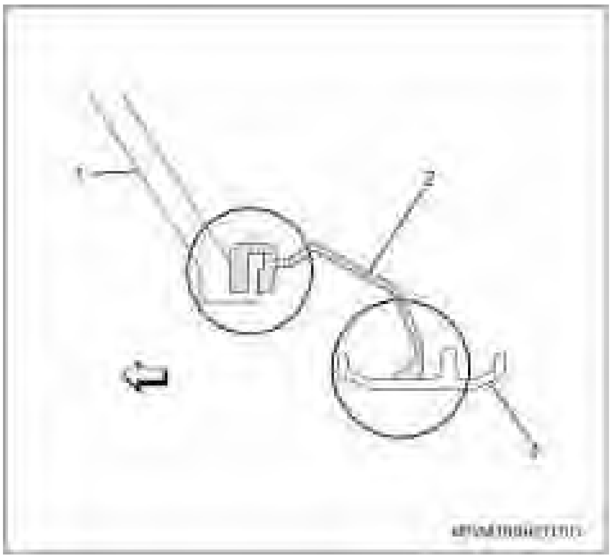
1. Fan guide

2. Fan guide bracket

2) Connect the fan guide to the radiator fan cover.

Caution:

● Verify that the entire circumference of the radiator fan cover is in contact with the fan guide.



1. Fan guide

2. Fan cover

3. Fan guide

11. Radiator lower hose installation

1) Install the radiator lower hose to the radiator and the water intake pipe.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

12. Radiator upper hose installation

1) Connect the radiator air leak hose to the radiator.

2) Install the radiator upper hose to the water outlet duct and the radiator.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

13. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 13.15 kg • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 32.21 kg • in}

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

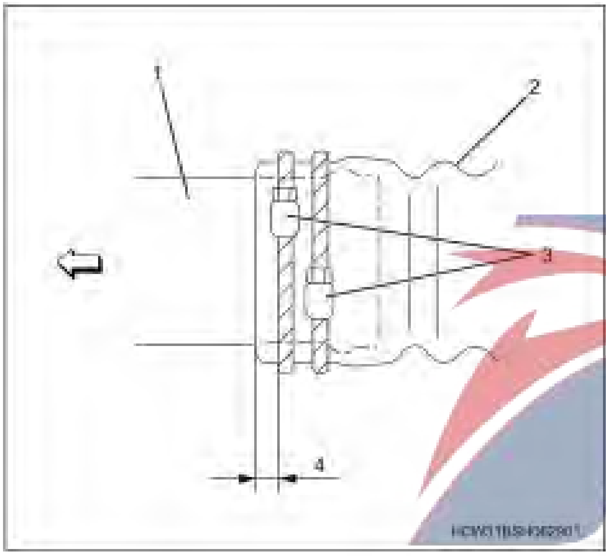
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }



1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

14. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15)Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

POWERSTAR

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

15. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

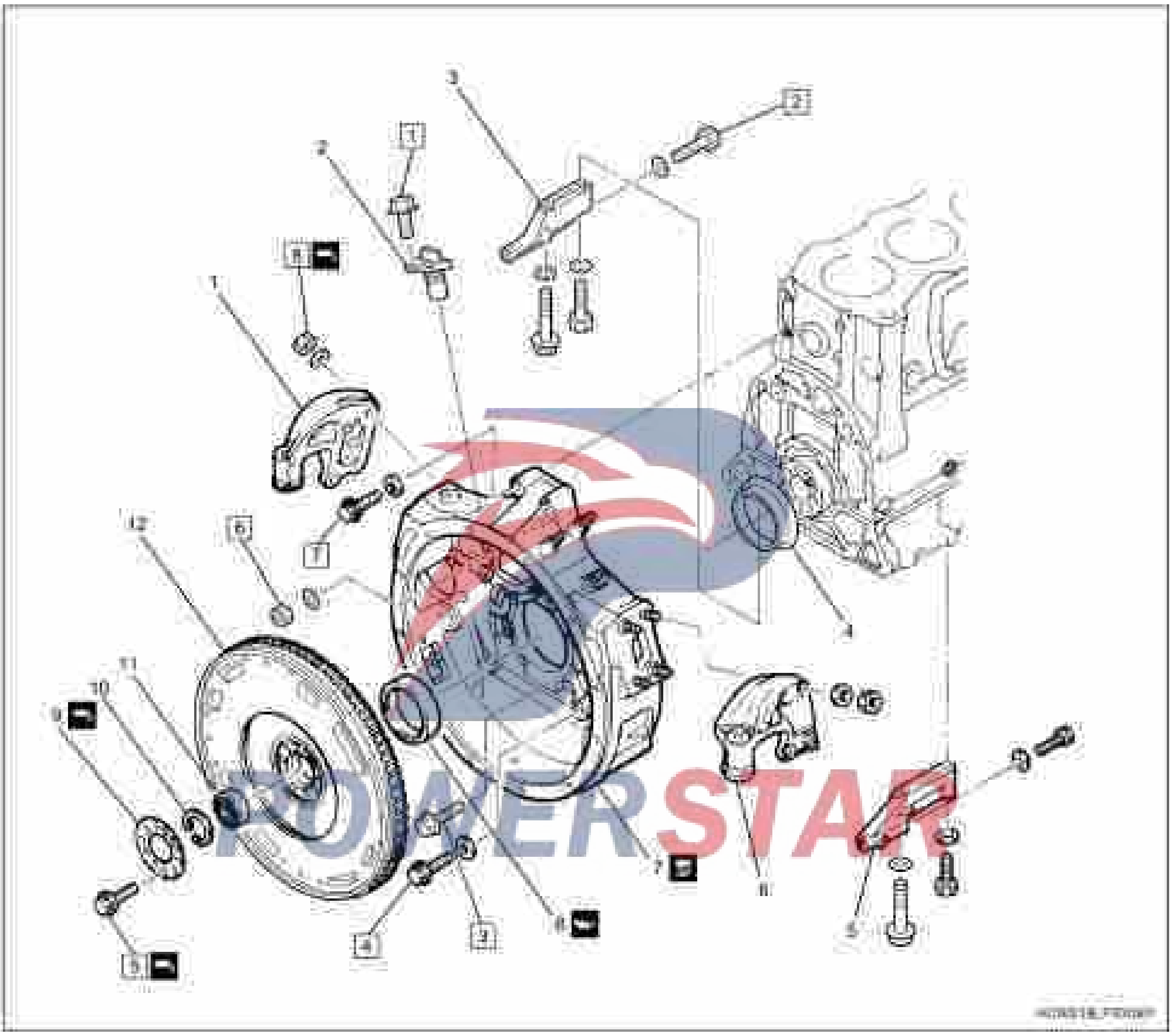
POWERSTAR

Flywheel

Removal

1. Component Views

Flywheel



Part name

1. Engine foot
2. CMP sensor
3. Flywheel housing bracket
4. Slinger
5. Flywheel housing bracket
6. Engine foot
7. Flywheel housing
8. Crankshaft rear oil seal
9. Washer
10. Snap ring
11. Guide bearing
12. Flywheel

Tightening torque

1: 8 N • m { 0.8 kgf • m / 71 lb • in }

2: 113 N • m { 11.5 kgf • m / 83 lb • ft }

3: 22 N • m { 2.2 kgf • m / 16 lb • ft }

4: 123 N • m { 12.5 kgf • m / 90 lb • ft }

5-1: 78.5 N • m { 8.0 kgf • m / 58 lb • ft }

5-2: 60 °

5-3: 30 °

6: 108 N • m { 11.0 kgf • m / 80 lb • ft }

7: 123 N • m { 12.5 kgf • m / 91 lb • ft }

8-1: 147 N • m { 15.0 kgf • m / 108 lb • ft }

8-2: 275 N • m { 28.0 kgf • m / 203 lb • ft }

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

4. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

5. Exhaust cover removal

1) Remove the exhaust cover from the frame.

6. Exhaust brake valve removal

1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

7. Transmission removed

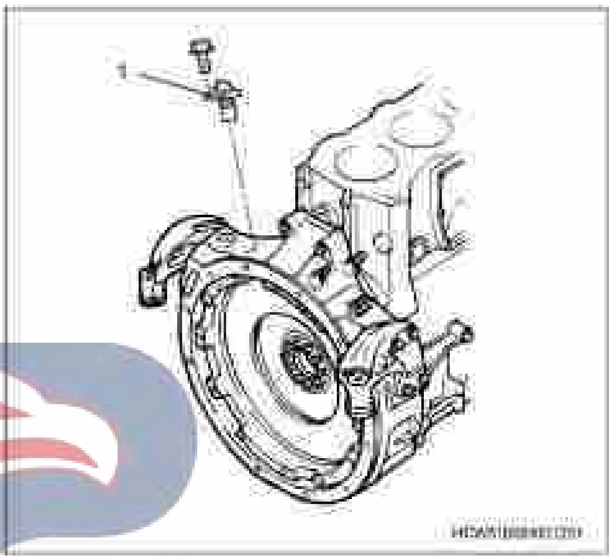
Refer to "*5.Transmission, Transaxle 5C.Manual (MJT) Transmission removal*".

Refer to "*5.Transmission, Transaxle 5C.Manual (MJX16) Transmission removal*".

8. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the crankshaft position sensor from the flywheel housing.



1. CMP sensor

9. Remove the clutch disc

Refer to "*5. TRANSMISSION, TRANSAXLE 5E. MJT CLUTCH (SINGLE PLATE DRIVE) REMOVAL*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Disassembly*".

10. Flywheel removal

1) Remove the flywheel from the crankshaft.

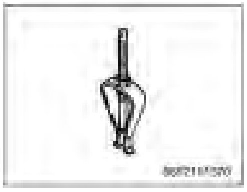
POWERSTAR

Removal

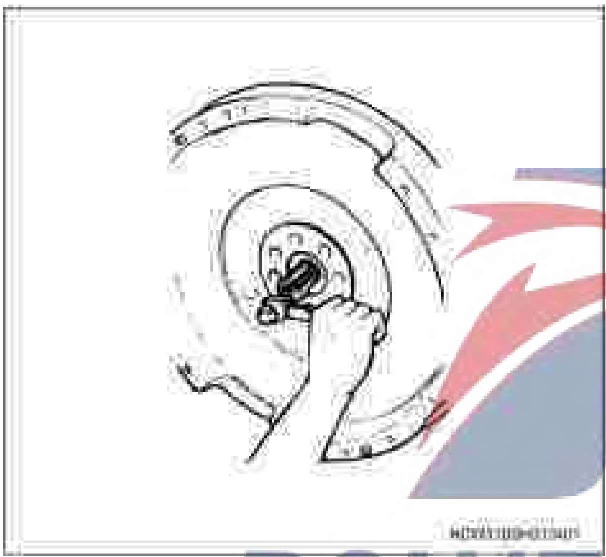
1. Flywheel removal

1) Remove the snap ring from the flywheel.

2) Use special tools to remove the guide bearing from the flywheel.



SST: 9-8521-0157-0 - Bearing puller

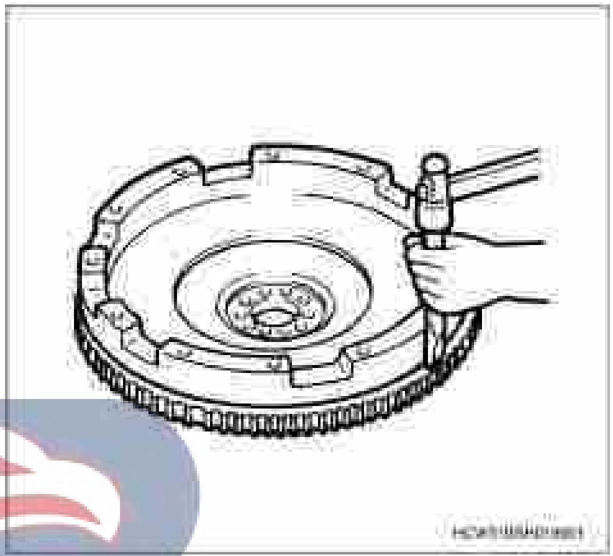


Note:

● Place the flywheel on a wooden strip, and then evenly knock the end face of the ring gear to remove it.

Caution:

● Do not remove the ring gear if no abnormalities are found during the ring gear damage inspection.



POWERSTAR

Inspection

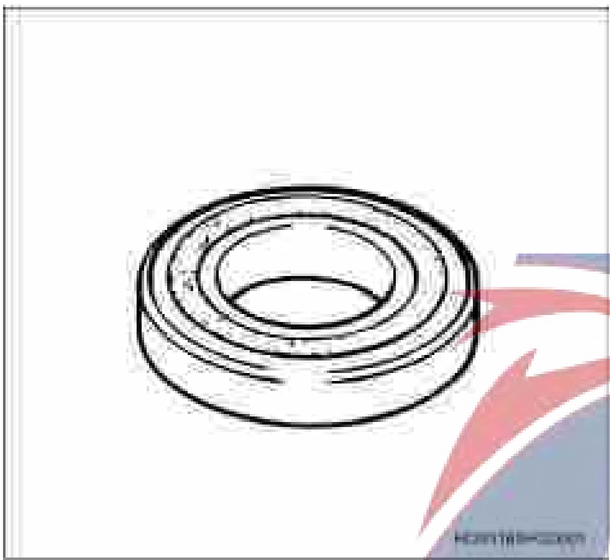
1.Pilot bearing inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the pilot bearing for wear and abnormal noise.

Caution:

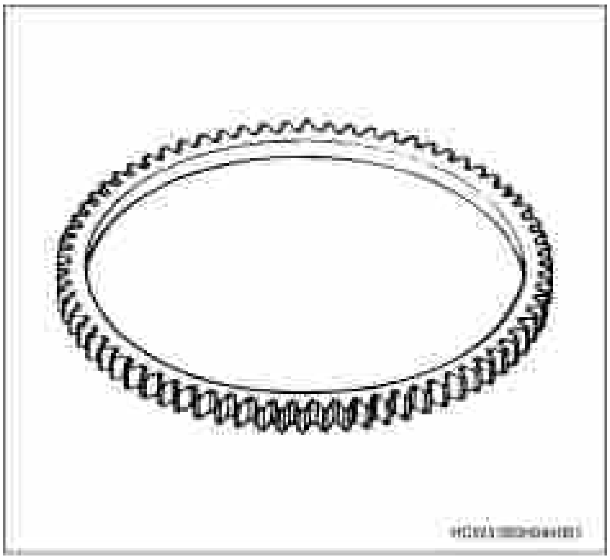
● Be careful not to clean as it is sealed with grease.



2. Flywheel inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the ring gear tooth surface for wear and damage.



2) Inspect the flywheel for cracking and streaking.

3) Measure the flywheel friction surface using a vernier caliper.

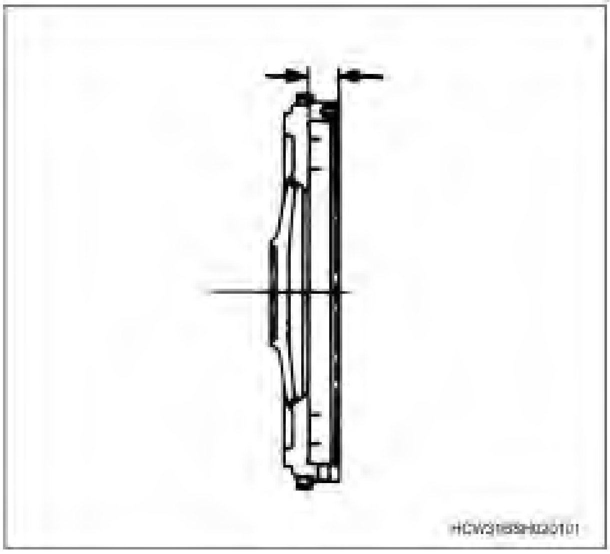
Note:

● Measure the depth from the installation surface of the clutch cover to the friction surface of the flywheel.

Standard: 20.0 mm {0.787 in} 15.5 inch Double Plate Push Style

Standard: 0.0 mm {0.000 in} 15.5 inch Double Plate Pull Specifications

Standard: 48.0 mm {1.890 in} 17 inch Single Board Specifications



POWERSTAR

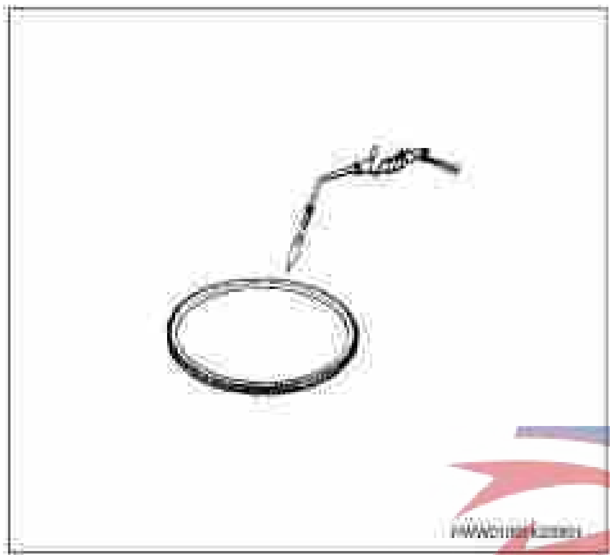
Reassembly

1. Flywheel reassembly

1) Heat the ring gear with the gas burner.

Caution:

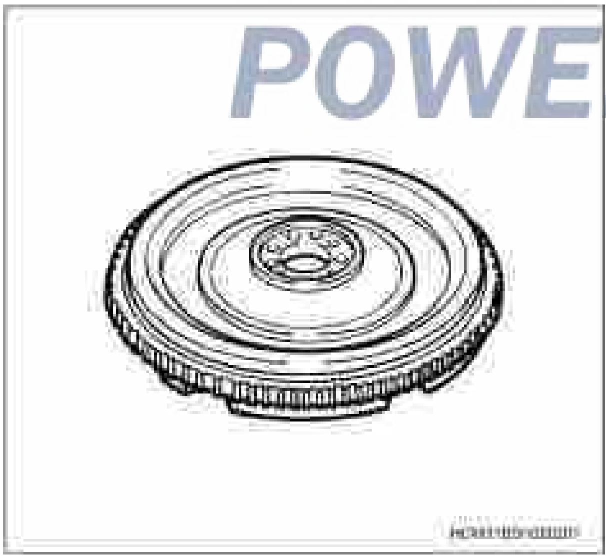
● Heat at 200℃ {392℉} or less.



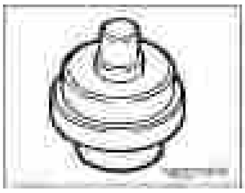
2) Install the ring gear to the flywheel.

Caution:

● Install with the larger chamfered side of the gear facing the front.

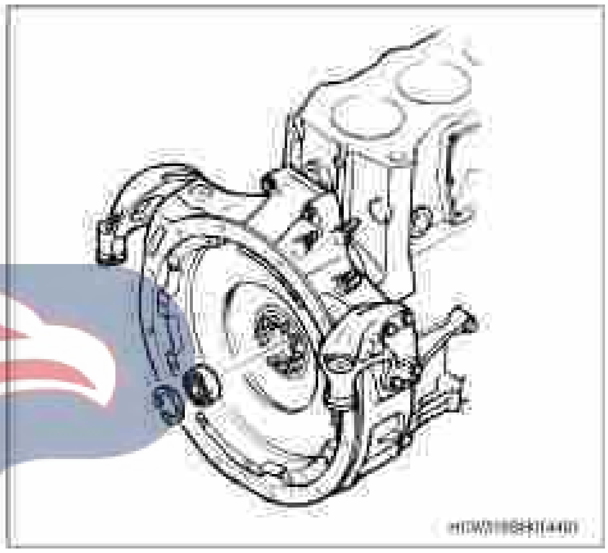


3) Use special tools to install the guide bearing on the flywheel.



SST: 1-8522-1057-0 - Bearing Mounting Tools

4) Install the snap ring onto the flywheel.

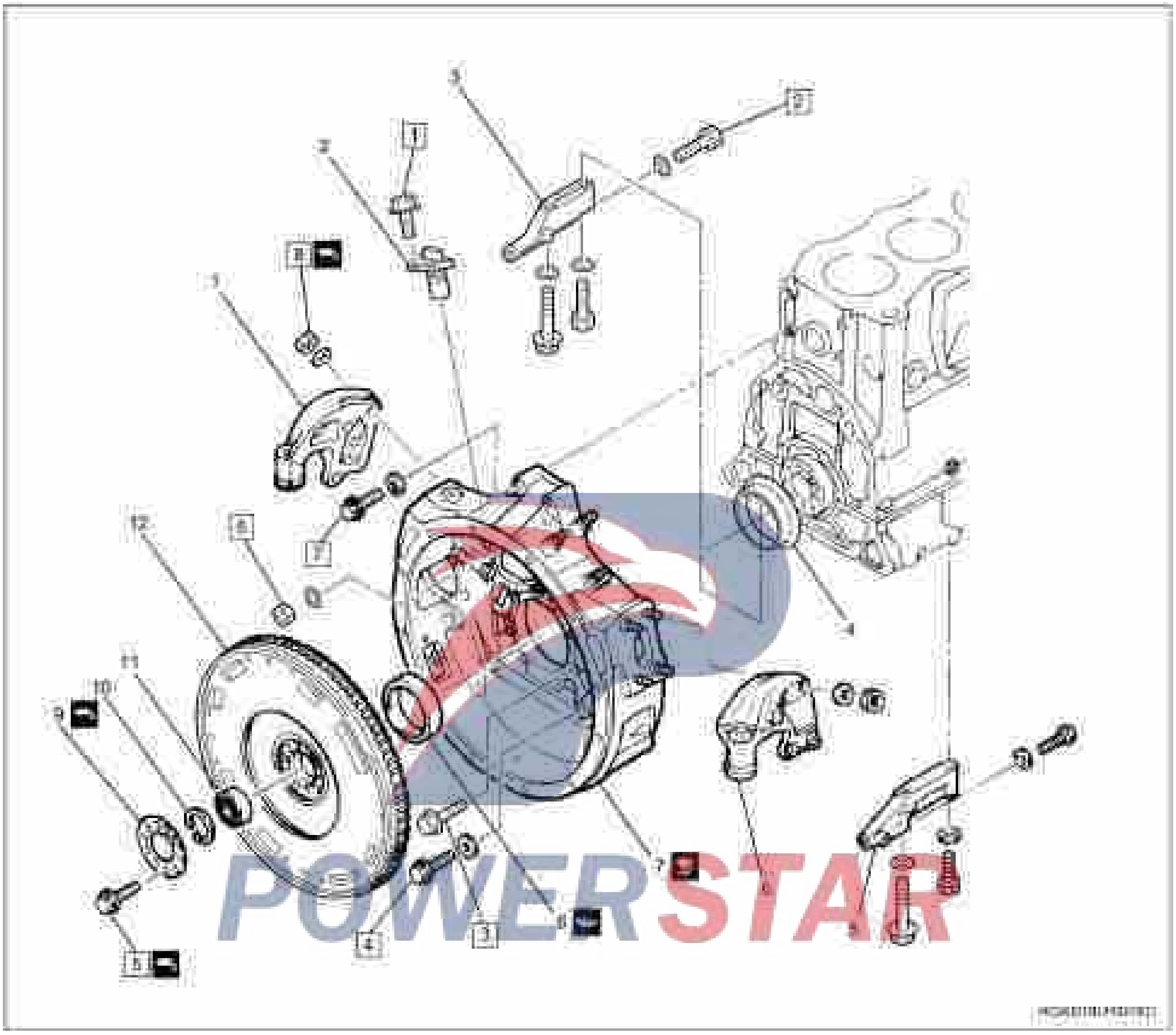


POWERSTAR

Installation

1. Component Views

Flywheel



Part name

1. Engine foot
2. CMP sensor
3. Flywheel housing bracket
4. Slinger
5. Flywheel housing bracket
6. Engine foot
7. Flywheel housing
8. Crankshaft rear oil seal
9. Washer
10. Snap ring
11. Guide bearing
12. Flywheel

Tightening torque

1: 8 N • m { 0.8 kgf • m / 71 lb• in }

2: 113 N • m { 11.5 kgf • m / 83 lb • ft }

3: 22 N • m { 2.2 kgf • m / 16 lb • ft }

4: 123 N • m { 12.5 kgf • m / 90 lb • ft }

5-1: 78.5 N • m { 8.0 kgf • m / 58 lb • ft }

5-2: 60 °

5-3: 30 °

6: 108 N • m { 11.0 kgf • m / 80 lb • ft }

7: 123 N • m { 12.5 kgf • m / 91 lb • ft }

8-1: 147 N • m { 15.0 kgf • m / 108 lb• ft }

8-2: 275 N • m { 28.0 kgf • m / 203 lb • ft }

2. Flywheel installation

1) Apply molybdenum disulfide to the threads and seat surface of the tightening bolt.

2) Install the flywheel to the crankshaft in the order shown in the diagram.

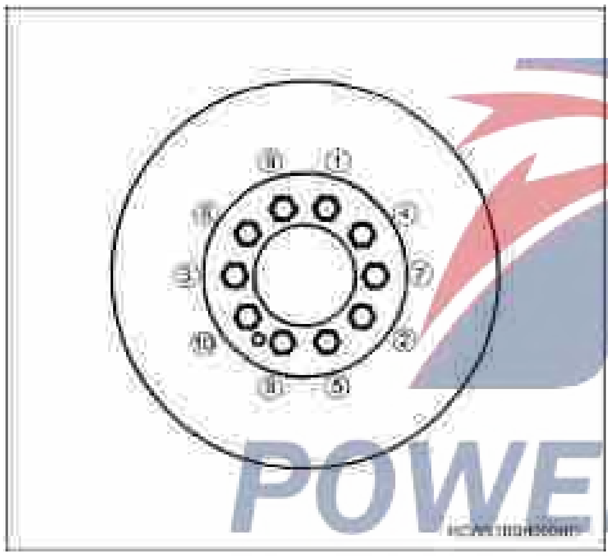
Tightening torque: 78.5 N • m {8.0 kgf • m / 58 lb • ft} 1st time

Prescribed angle: 60 ° second time

Prescribed angle: 30 ° the third time

Caution:

● The angular tolerance for tightening through angle control should be 90-120 °.



3. Clutch driven disk installation

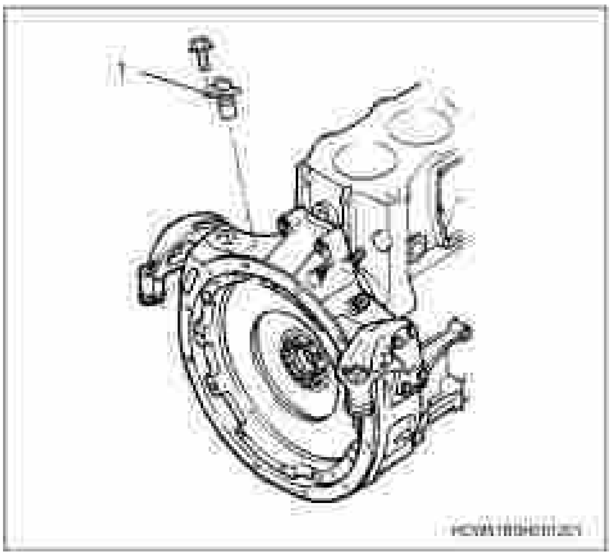
Refer to "*5. Transmission, Transaxle 5e. mjt Clutch (single plate drive) Mounting*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Installation*".

CMP sensor installation

1) Install the crankshaft position sensor to the flywheel housing.

Tightening torque: 8 N • m { 0.8 kgf • m / 71 lb • in }



1. CMP sensor

2) Connect the connector to the CMP sensor.

5. Transmission installation

Refer to "*5.Transmission, Transaxle 5C.Manual Transmission (MJT) installation*".

Refer to "*5.Transmission, Transaxle 5C.Manual Transmission (MJX16) installation*".

6. Exhaust brake valve installation

1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

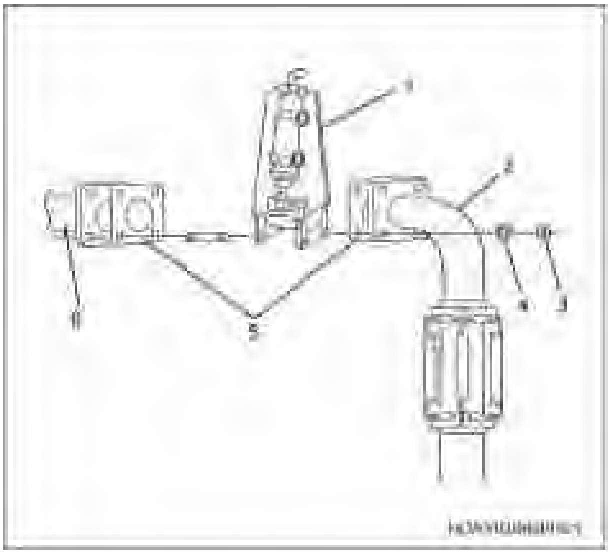
Caution:

● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

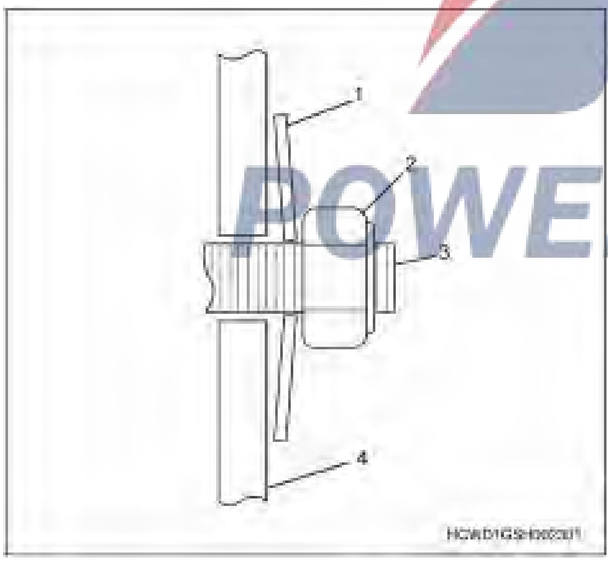
● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m { 6.0 kgf • m / 44 lb • ft }

POWERSTAR



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. Washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

7. Exhaust cover installation

1) Install the exhaust cover to the frame.

8. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

9. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

10. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

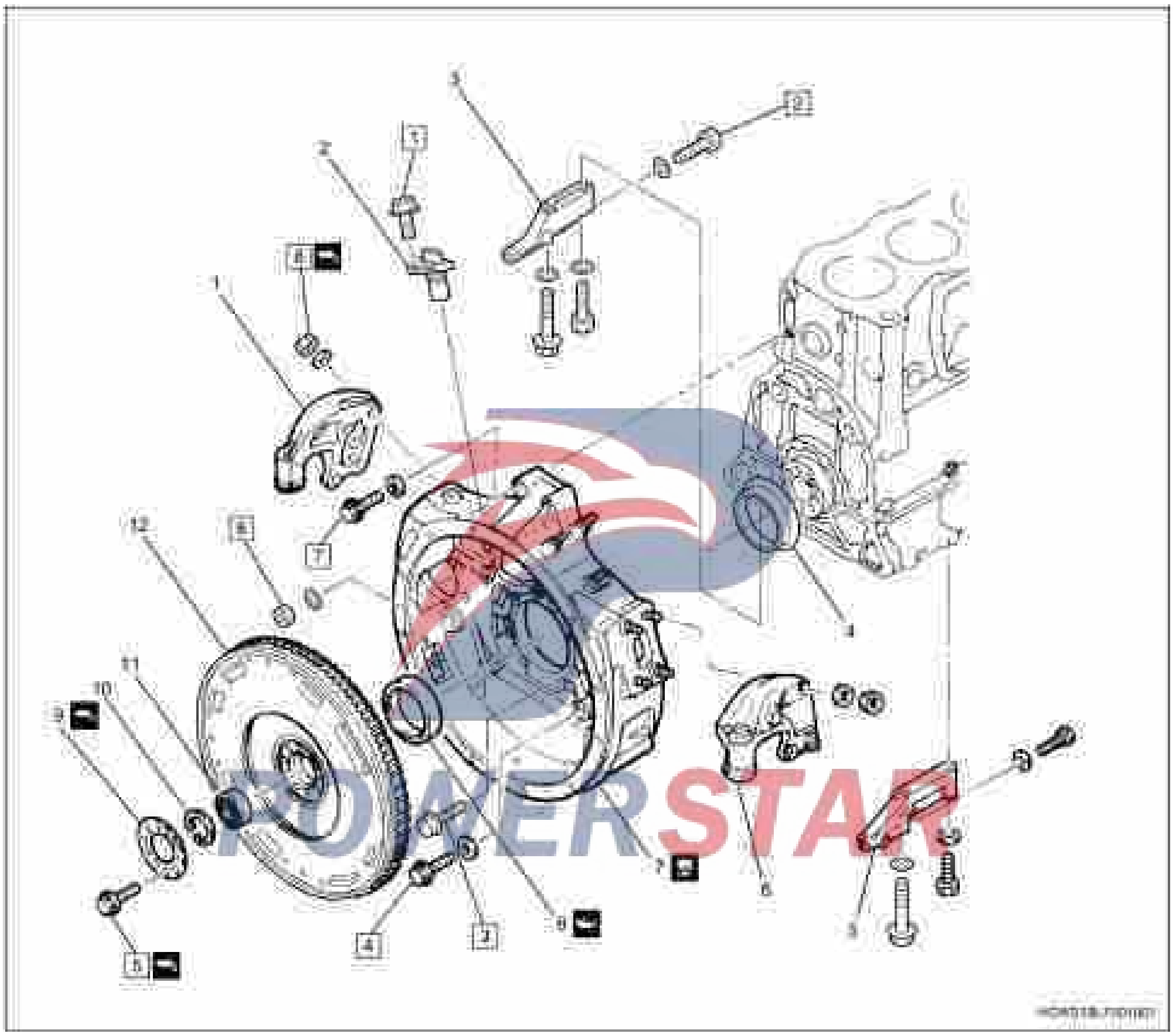
2) Lower the cab, and close the front lid.

Flywheel housing

Removal

1. Component Views

Flywheel housing



Part name

1. Engine foot
2. CMP sensor
3. Flywheel housing bracket
4. Slinger
5. Flywheel housing bracket
6. Engine foot
7. Flywheel housing
8. Crankshaft rear oil seal
9. Washer
10. Snap ring
11. Guide bearing
12. Flywheel

Tightening torque

1: 8 N • m { 0.8 kgf • m / 71 lb • in }

2: 113 N • m { 11.5 kgf • m / 83 lb • ft }

3: 22 N • m { 2.2 kgf • m / 16 lb • ft }

4: 123 N • m { 12.5 kgf • m / 90 lb • ft }

5-1: 78.5 N • m { 8.0 kgf • m / 58 lb • ft }

5-2: 60 °

5-3: 30 °

6: 108 N • m { 11.0 kgf • m / 80 lb • ft }

7: 123 N • m { 12.5 kgf • m / 91 lb • ft }

8-1: 147 N • m { 15.0 kgf • m / 108 lb • ft }

8-2: 275 N • m { 28.0 kgf • m /203 lb • ft }

2. Engine removal

Refer to "*Engine removal*".

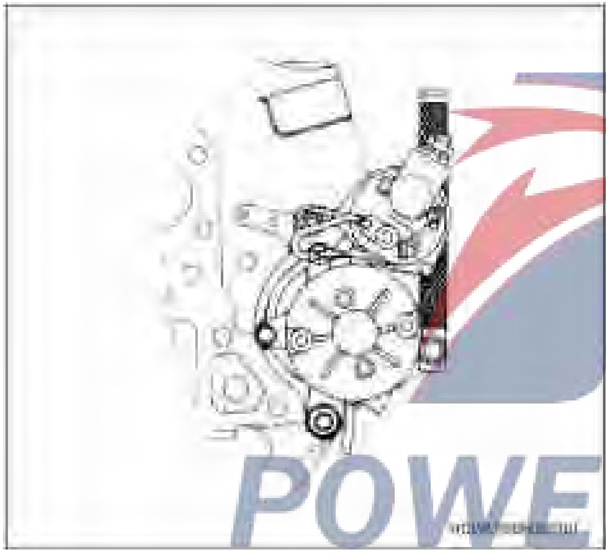
3. Starter motor removal

1) Disconnect the starter ground cable.

2) Disconnect starter B terminal.

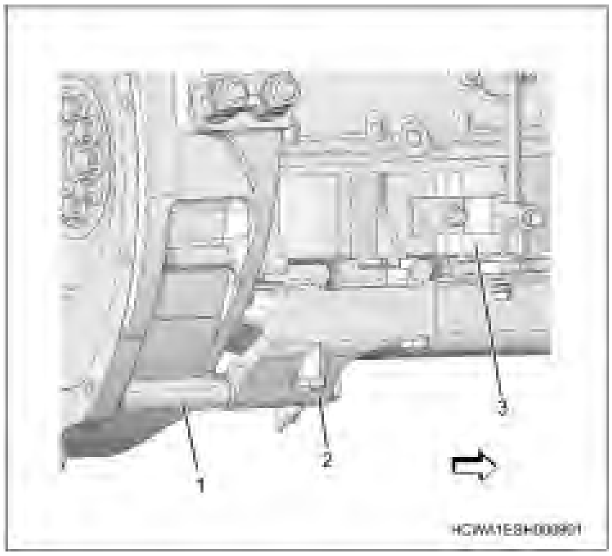
3) Disconnect starter S-terminal.

4) Remove the starter from the flywheel housing.



4. Oil pan removal

1) Remove the left and right flywheel housing brackets from the cylinder block and flywheel housing.



1. Flywheel housing

2. Flywheel housing bracket

3. Cylinder block

2) Remove the oil pan from the cylinder block.

5. Oil strainer removed

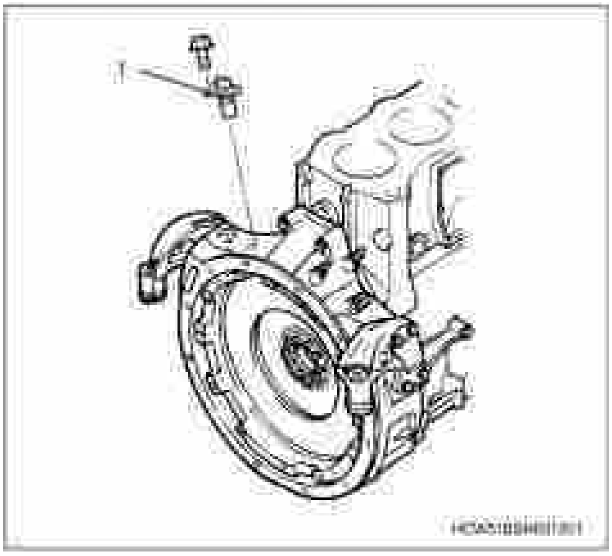
1) Remove the oil strainer and O-ring from the cylinder block.

2) Remove the bracket from the cylinder block.

6. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the crankshaft position sensor from the flywheel housing.



1. CMP sensor

POWERSTAR

7. Remove the clutch driven plate

Refer to "*5. transmission, transaxle 5e. mjt clutch (single plate drive) removal*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Disassembly*".

8. Flywheel removal

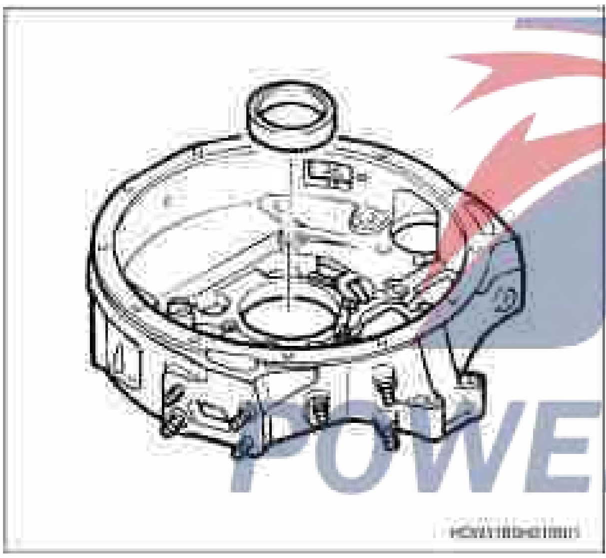
1) Remove the flywheel from the crankshaft.

9. Crankshaft rear oil seal removal

1) Remove the crankshaft rear oil seal from the flywheel housing

Caution:

● Do not damage the oil seal pressure mounting surface.



2) Use a special tool to remove the oil deflector from the crankshaft.

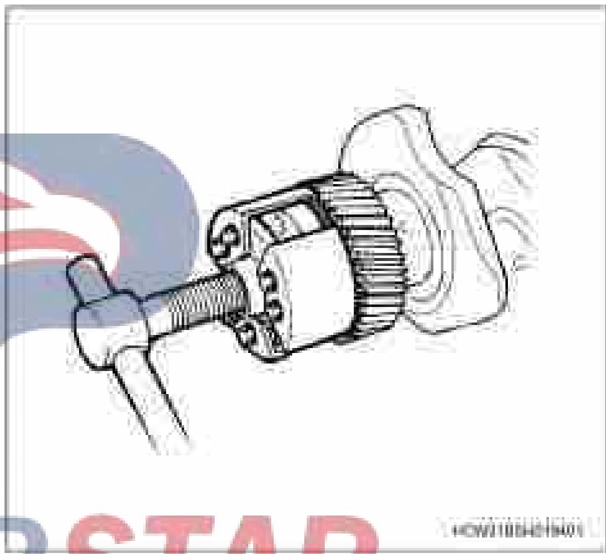
Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.

Caution:

● Do not reuse the oil seal or ram during replacement.

SST: 1-8521-0027-0 - Sleeve Removal Unit



POWERSTAR

10. Flywheel housing removal

1) Disconnect the flywheel housing bracket from the flywheel housing.

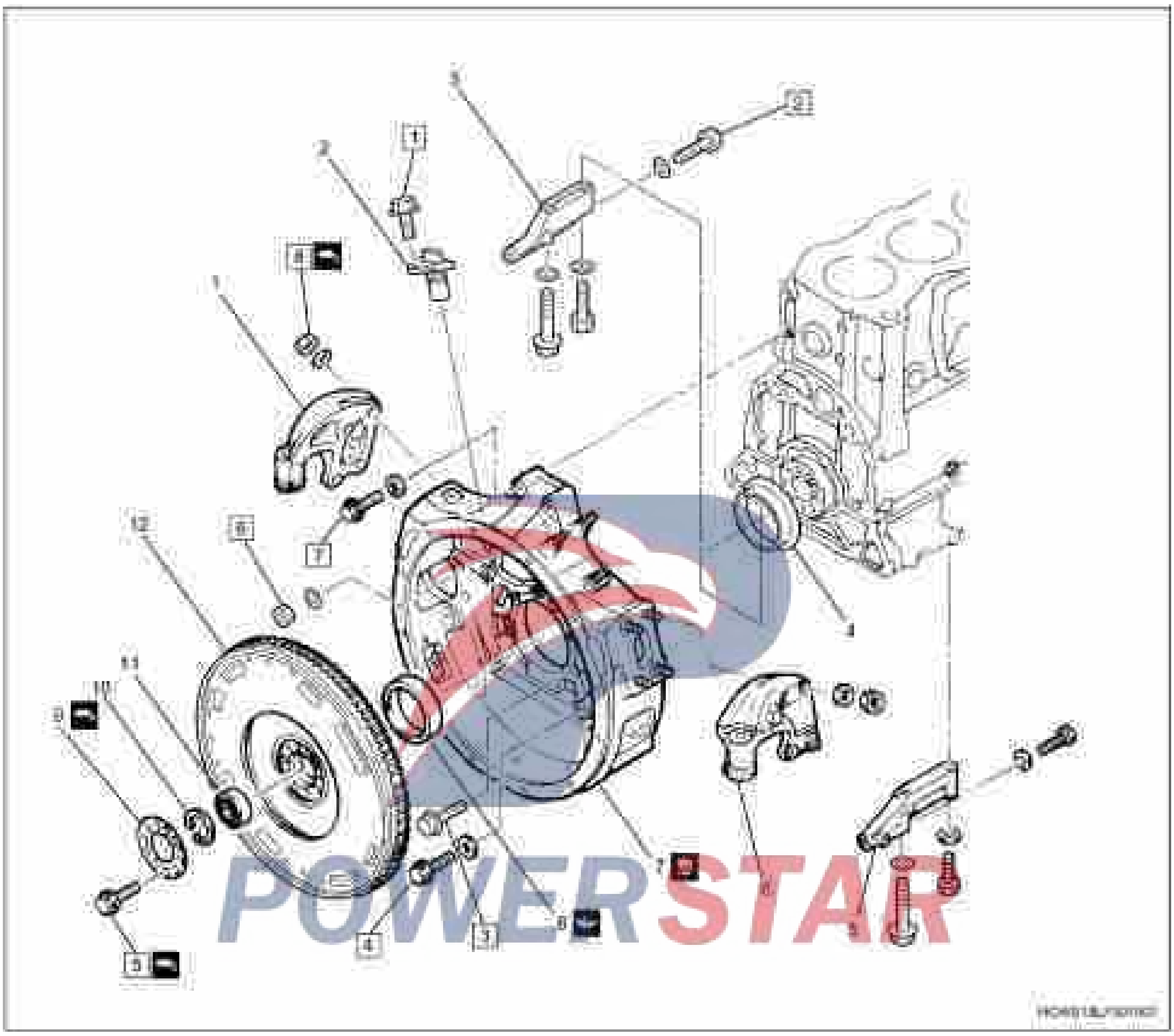
2) Remove the engine support foot from the flywheel housing.

3) Remove the flywheel housing from the cylinder block.

Installation

1. Component Views

Flywheel housing



Part name

1. Engine foot
2. CMP sensor
3. Flywheel housing bracket
4. Slinger
5. Flywheel housing bracket
6. Engine foot
7. Flywheel housing
8. Crankshaft rear oil seal
9. Washer
10. Snap ring
11. Guide bearing
12. Flywheel

Tightening torque

1: 8 N • m { 0.8 kgf • m / 71 lb • in }

2: 113 N • m { 11.5 kgf • m / 83 lb • ft }

3: 22 N • m { 2.2 kgf • m /16 lb • ft }

4: 123 N • m { 12.5 kgf • m / 90 lb • ft }

5-1: 78.5 N • m { 8.0 kgf • m / 58 lb • ft }

5-2: 60 °

5-3: 30 °

6: 108 N • m { 11.0 kgf • m / 80 lb • ft }

7: 123 N • m { 12.5 kgf • m / 91 lb • ft }

8-1: 147 N • m { 15.0 kgf • m / 108 lb • ft }

8-2: 275 N • m { 28.0 kgf • m /203 lb • ft }

2. Flywheel housing installation

1) Apply liquid gaskets to the positioning surfaces of the flywheel housing, cylinder block and crankcase.

Caution:

● Do not insert the liquid gasket into the bolt hole.

● After the liquid gasket assembly is completed, the flywheel housing should be installed in time.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: about0.3 mm { about 0.012 in }
	Coating width	: 4.0 mm { 0.157 in}

2) Attach the flywheel housing to the cylinder block.

Caution:

● First tighten the bolt near the dowel pin.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}

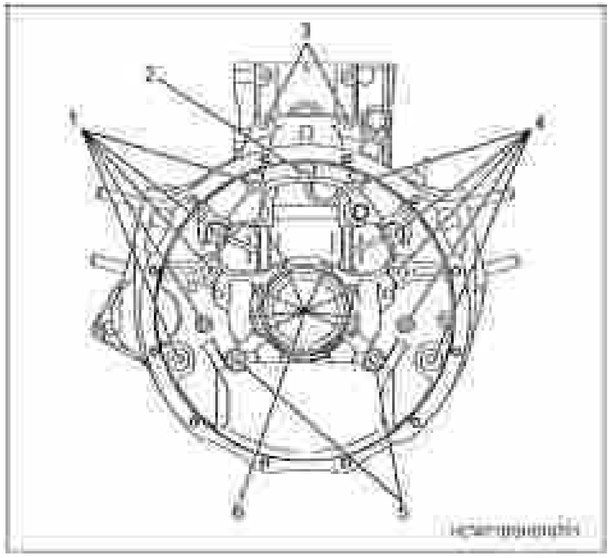
M14 nut

Tightening torque: 123 N • m {12.5 kgf • m / 91 lb• ft}

M14 bolt

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

M8 bolt



1. M14 bolt
2. M14 nut
3. M14 bolt
4. M14 bolt
5. M14 bolt
6. M8 bolt

3) Apply molybdenum disulphide grease to the threaded surface of the bearing surface and the engine mount mounting bolt.

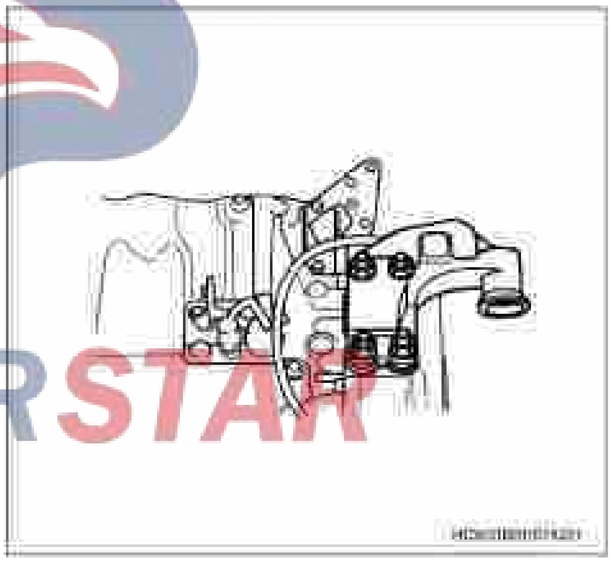
4) Install the engine bearing support foot to the flywheel housing.

Caution:

● Tighten from the pinned position.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} The first time

Tightening torque: 275 N • m {28.0 kgf • m / 203 lb • ft} 2nd time



POWERSTAR

5) Connect the flywheel housing bracket to the flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}

3. Crankshaft rear oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft rear oil seal.

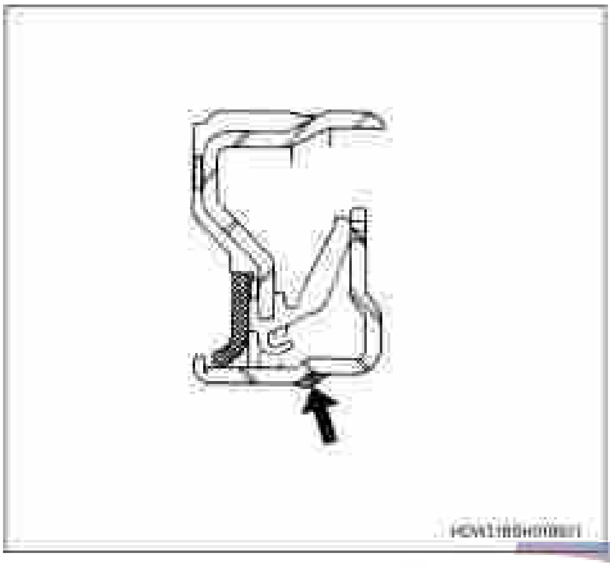
2) Install the crankshaft rear oil seal to the flywheel housing using special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

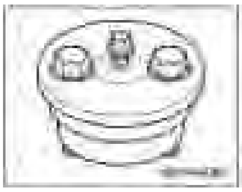
● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



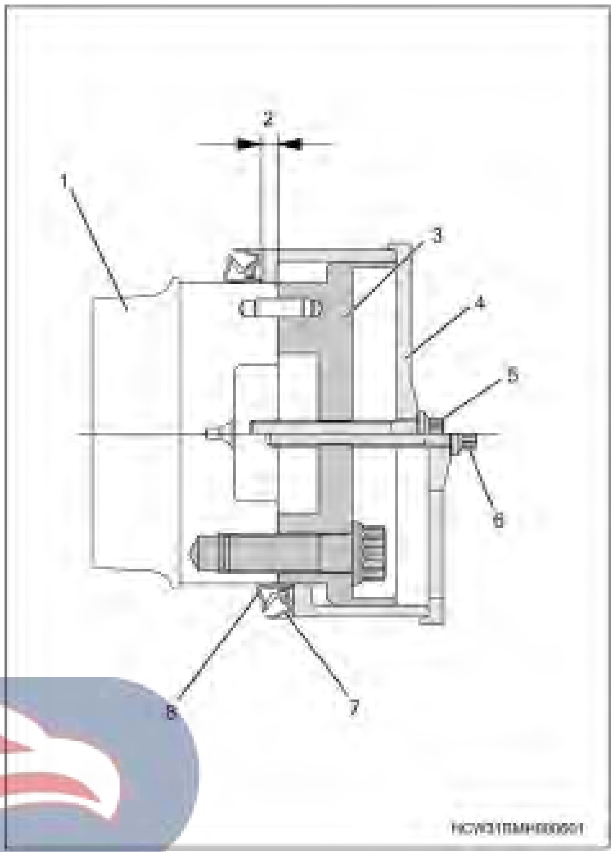
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) Measure the size of the crankshaft end face to the oil seal surface.



1. Crankshaft
2. 6.7 - 7.3 mm {0.264 - 0.287 in}
3. 1-8521-0027-0 (Adapter)
4. 1-8521-0027-0 (Sleeve)
5. Finish pressing the position of the special tool after assembly
6. Perform the position of the special tool before pressing the assembly
7. Oil seal
8. Slinger (gray)

4. Flywheel installation

1) Apply molybdenum disulfide to the threads and seat surface of the tightening bolt.

2) Install the flywheel to the crankshaft in the order shown in the diagram.

Tightening torque: 78.5 N • m {8.0 kgf • m / 58 lb • ft} 1st time

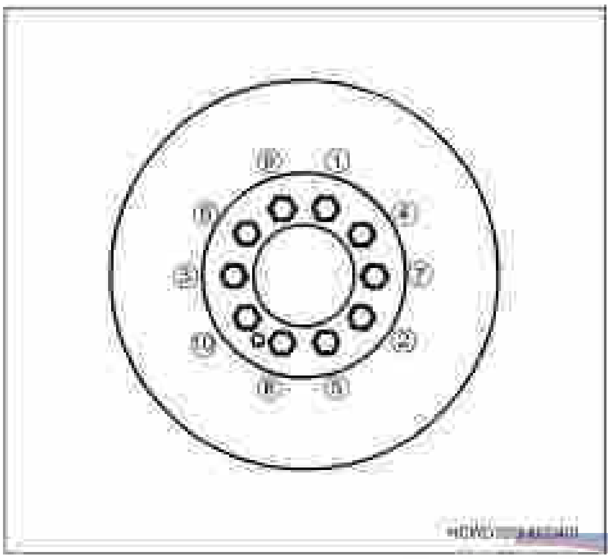
Prescribed angle: 60 ° second

Prescribed angle: 30 ° the third time

POWERSTAR

Caution:

● The angular tolerance for tightening through angle control should be 90-120 °.



5. Clutch driven disc installation

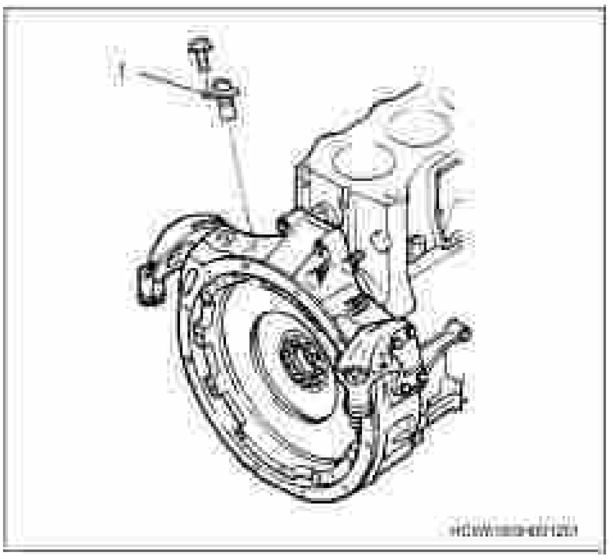
Refer to "*5. transmission, transaxle 5e. mjt clutch (single plate drive) mounting*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Installation*".

6. CMP sensor installation

1) Install the crankshaft position sensor to the flywheel housing.

Tightening torque: 8 N • m { 0.8 kgf • m / 71 lb • in }



1. CMP sensor

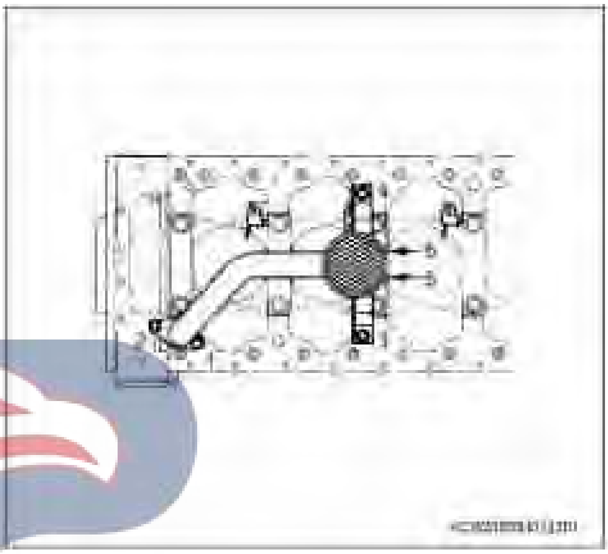
2) Connect the connector to the CMP sensor.

7. Oil strainer installed

1) Temporarily fasten the bracket to the cylinder block.

2) Install the oil strainer and O-ring onto the cylinder block in numerical order in the figure.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}



8. Oil pan installation

1) apply the liquid gasket to the cylinder block.

Note:

● Three key 1207B with a coating thickness of 3 - 4 mm {0.118 - 0.157 in} and a width of 3-4 mm {0.118 - 0.157 in} on the locating surface of the flywheel housing, gearbox and cylinder block.

Caution:

● Clean the application surface of the gasket before applying the gasket.

POWERSTAR

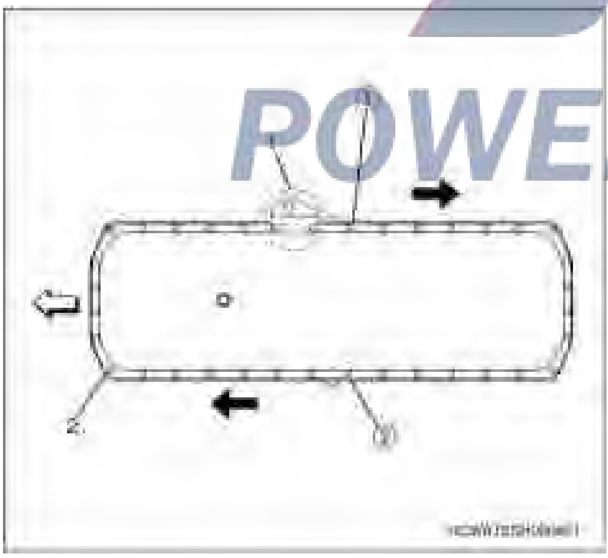
1. Liquid gasket

2) Install the oil pan to the cylinder block in the order of numbers and arrows shown in the diagram.

Caution:

● After tightening all the bolts, tighten all the bolts again with the specified torque from the first tightened bolt.

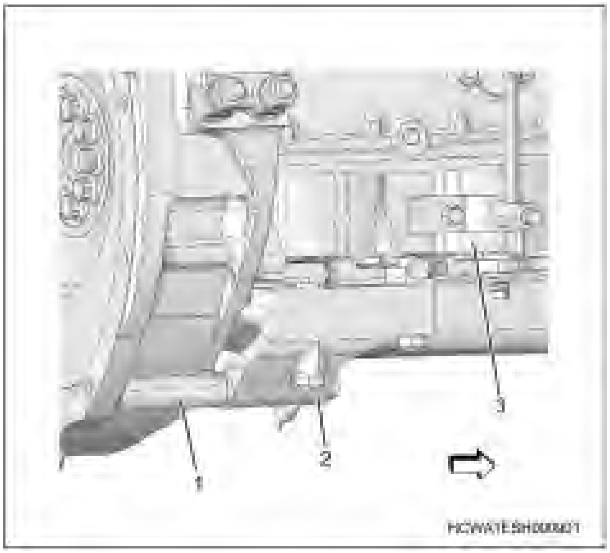
Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}



1. M10× 35
2. M10× 20

3) Install the left and right flywheel housing brackets onto the cylinder block and flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}



1. Flywheel housing
2. Flywheel housing bracket
3. Cylinder block

9. Starter motor installation

1) Install the starter to the flywheel housing.

Tightening torque: 103 N • m {10.5 kgf • m / 76 lb • ft}

2) Connect the S-terminal to the starter.

3) Connect the B-terminal to the starter.

4) Connect the grounding cable to the starter.

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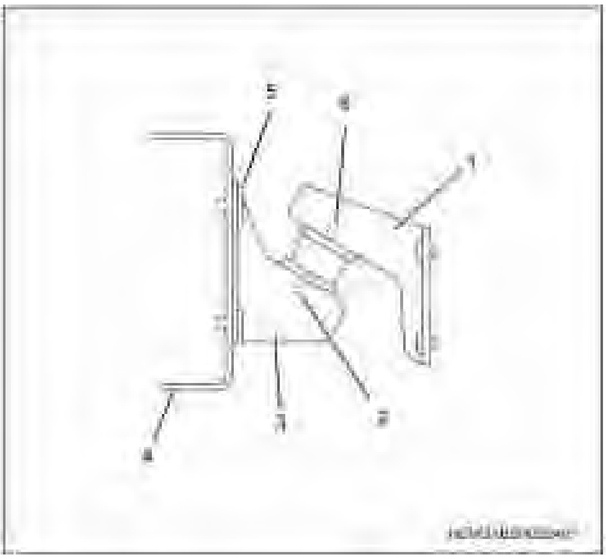
Engine mounting installation

1) Install the front side engine mounting to the frame.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft} Chassis side rubber nut

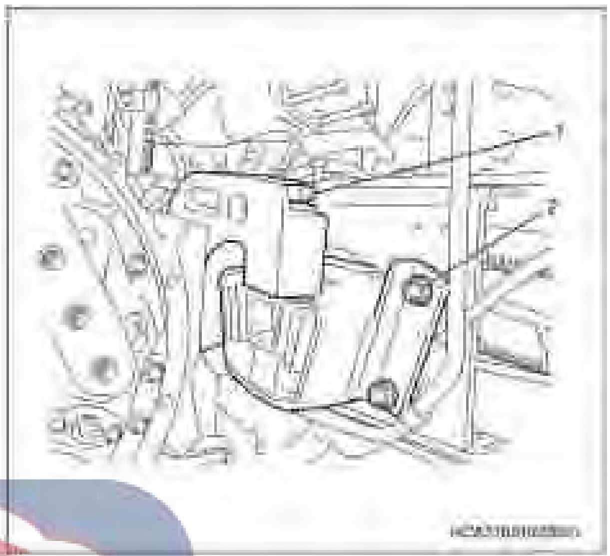
Tightening torque: 157 N • m {16.0 kgf • m / 116 lb • ft} Bolts



1. Engine foot
2. Chassis side rubber nut
3. Cushion rubber bracket
4. Frame
5. Bolt
6. Engine side rubber nut

2) Install the rear side engine mounting to the frame.

Tightening torque: 157 N • m { 16.0 kgf • m / 116 lb • ft } Chassis side bolt



1. Engine side bolt
2. Chassis side bolt

11. Engine installation

Refer to "*Engine installation*".

POWERSTAR

Crankshaft front oil seal

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

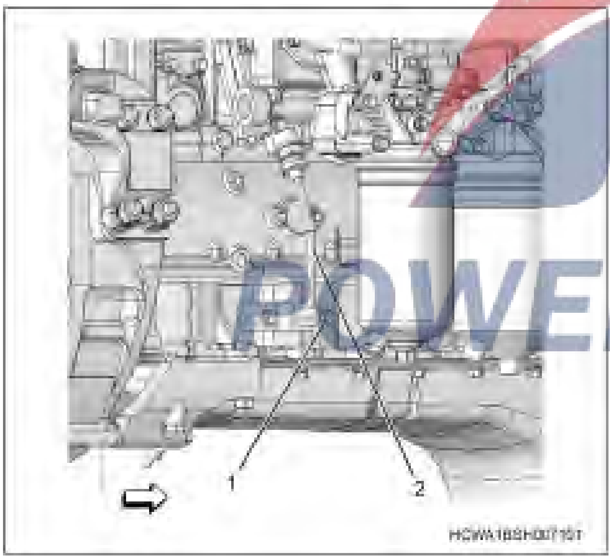
Warning:

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

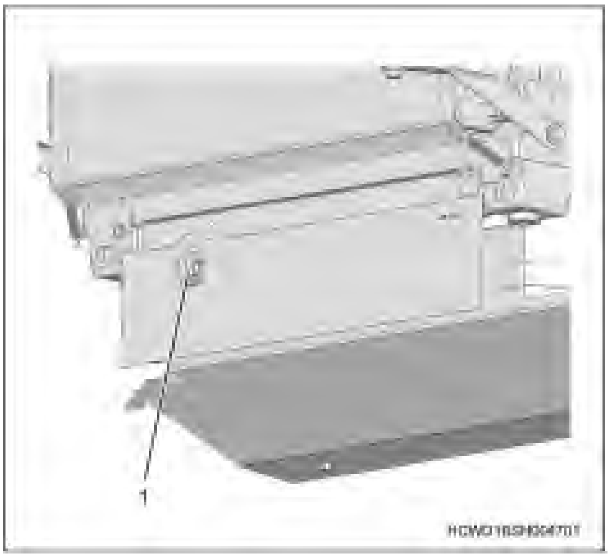
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

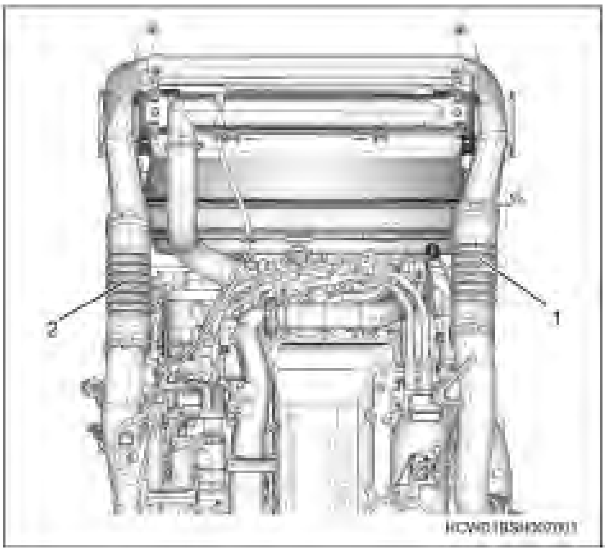
7) Install sub-tank cap to radiator.

3. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.

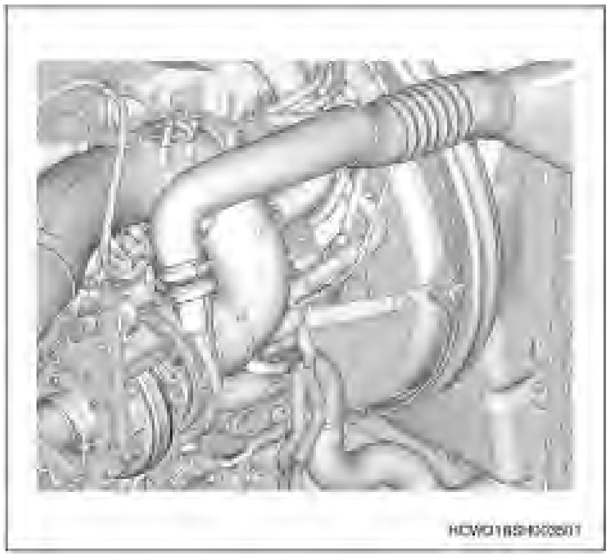


1. Intercooler hose on the intercooler inlet side

2. Intercooler hose on the intercooler outlet side

POWERSTAR

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



4. Radiator upper hose removal

1) Remove the radiator upper hose from the water

2) Remove the radiator upper hose from the radiator.

3) Disconnect the radiator air leak hose from the radiator.

5. Radiator lower hose removal

1) Remove the radiator lower hose from the water intake pipe and the radiator.

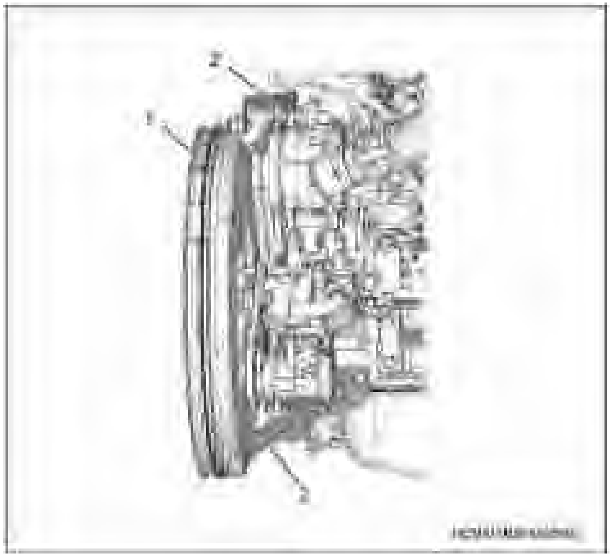
2) Remove the radiator lower hose from the radiator.

6. radiator fan cover disconnect

1) Disconnect the fan guide bracket from the engine.

Caution:

● Do not remove the fan duct connected to the air duct bracket.



1. Fan guide

2. Fan guide bracket

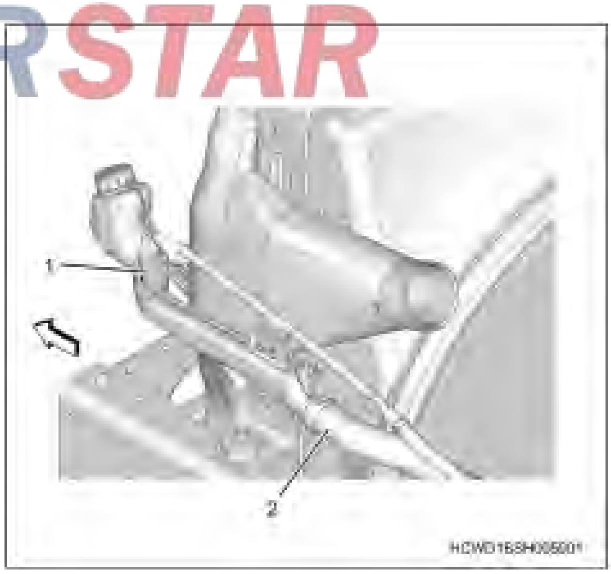
2) Disconnect the radiator fan cover from the fan guide cover.

7. Cooling fan removal

1) Remove the fan duct and cooling fan from the fan pulley.

8. refueling pipe removal

1) Remove the fuel line and rubber hose from the timing gearbox.



1. Fuel pipeline

2. Rubber hose

9. Intercooler removal

1) Remove the intercooler from the radiator.

Caution:

POWERSTAR

● Remove the fin without damaging it.

10. Radiator removal

1) Remove the radiator stay from the radiator.

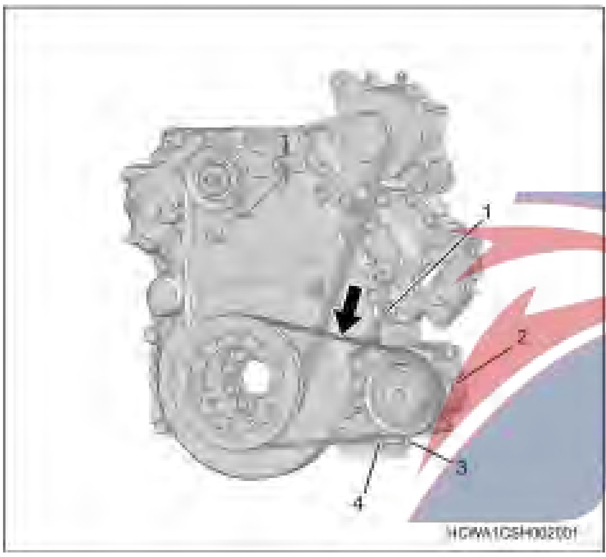
2) Remove the radiator from the frame.

Caution:

● Remove the fin without damaging it.

11. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



1. Bolt

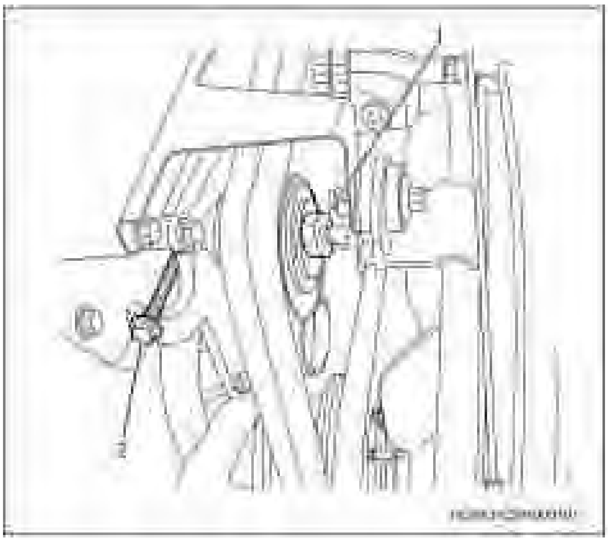
2. A/C compressor

3. Adjust bolt

4. Nut (back end)

12. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



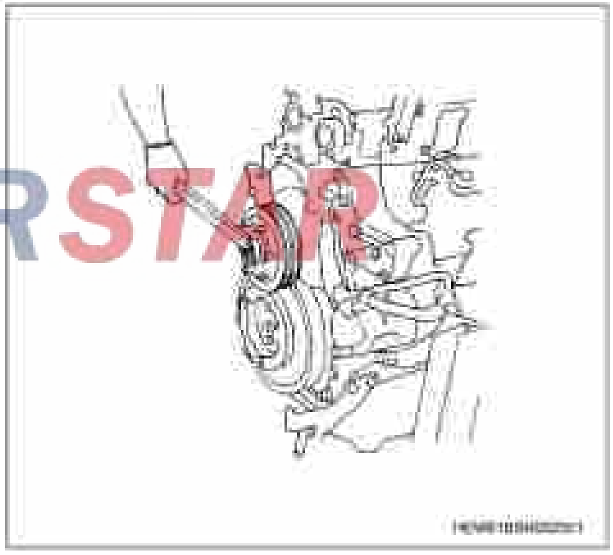
1. Lock nut

2. Adjust bolt

13. Crankshaft pulley removal

1) Wedge the crankshaft with a wooden block to prevent the fan pulley from rotating.

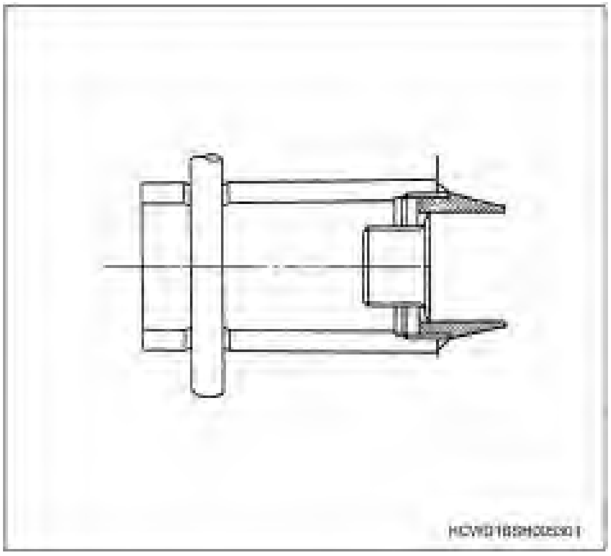
2) Remove the crankshaft pulley nut from the crankshaft pulley.



3) Use a special tool to remove the fan pulley cone bushing.

SST: 1-8521-0063-0 - Tapered bushing puller

POWERSTAR



4) Remove the fan pulley from the fan shaft.

5) Remove the crankshaft pulley from the crankshaft.

Caution:

● Do not damage the sealing surface or excessive force on the pump body.

14. Idle gear removal

1) Remove the idler gear from the gearbox cover.

15. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

16. Remove the gearbox cover

1) Remove the gearbox cover from the timing gearbox.

2) Remove the gasket from the gearbox cover.

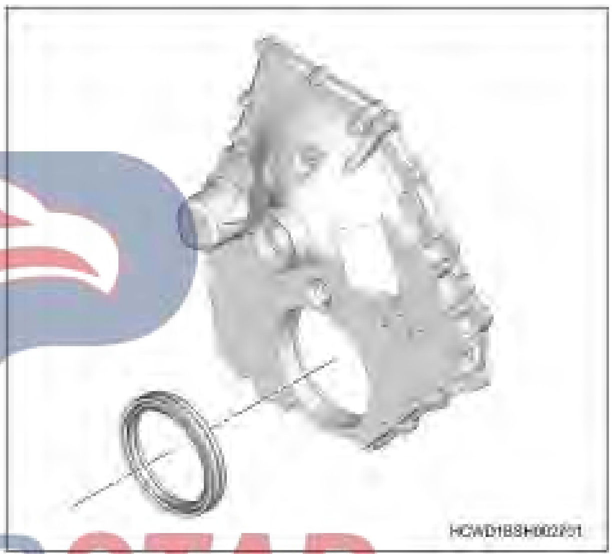
17. Crankshaft oil seal removed

1) Remove the crankshaft front oil seal from the gearbox cover.

Caution:

● Do not damage the oil seal pressure mounting surface.

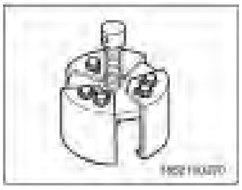
● Do not reuse the slinger or oil seal.



2) Use a special tool to remove the oil deflector from the crankshaft.

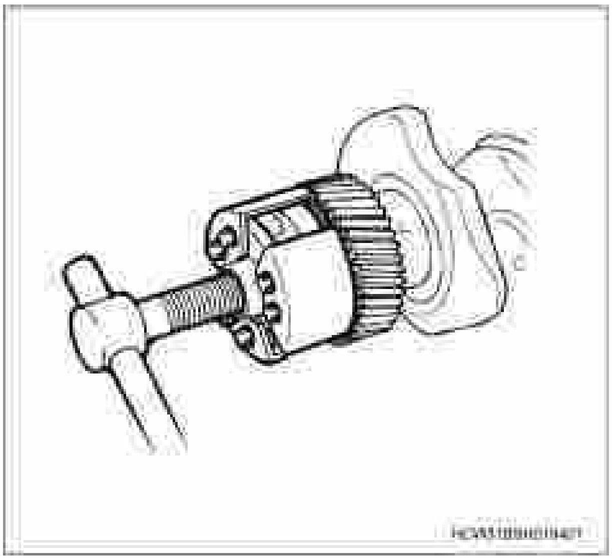
Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.



SST: 1-8521-0027-0 - Sleeve Removal Unit

POWERSTAR



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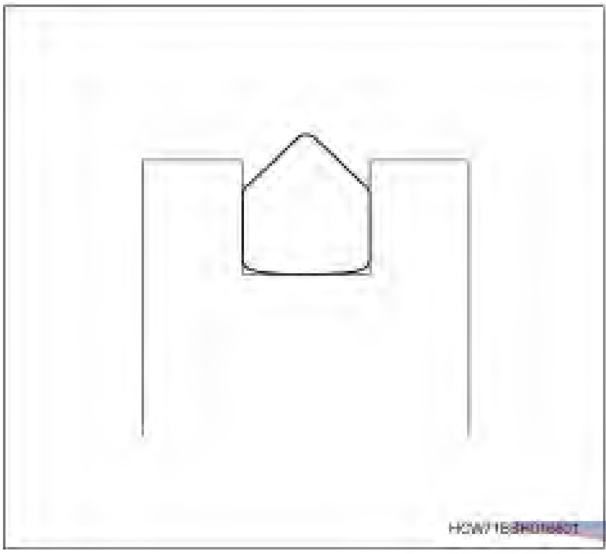
Installation

1. Gear box cover installed

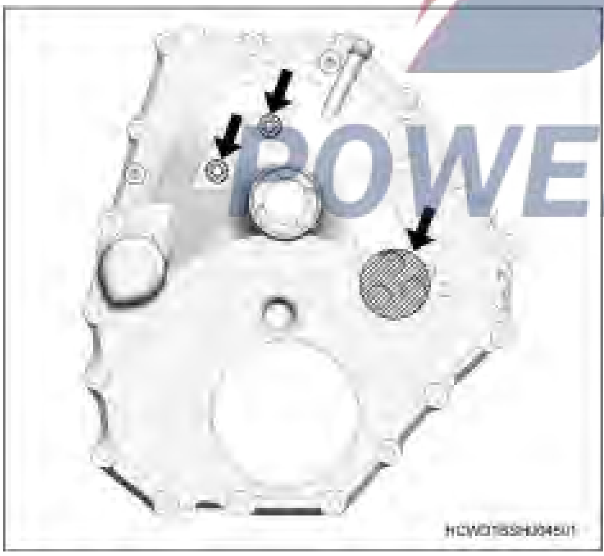
1) Install the gasket on the gear box cover.



2) Use a liquid seal on the gearbox cover.

Note:

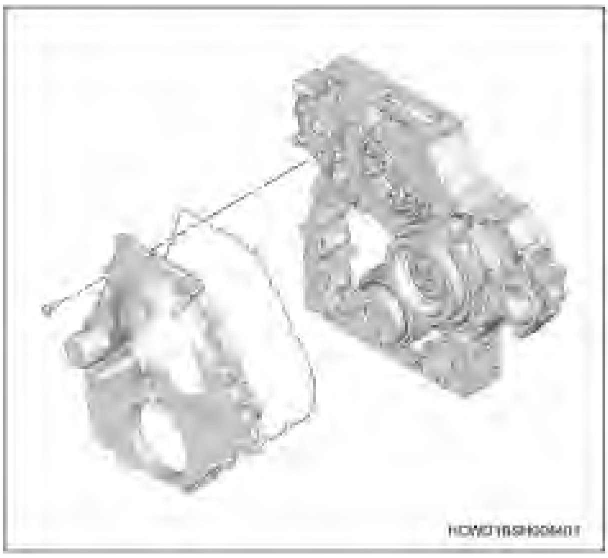
● Apply FMD127 to the back of the diagonally marked gearbox cover in the chart.



3) Install the gearbox cover onto the timing gearbox.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft} M10

Tightening torque: 26 N • m {2.7 kgf • m / 19 lb • ft} M8



2. Crankshaft front oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft front oil seal.

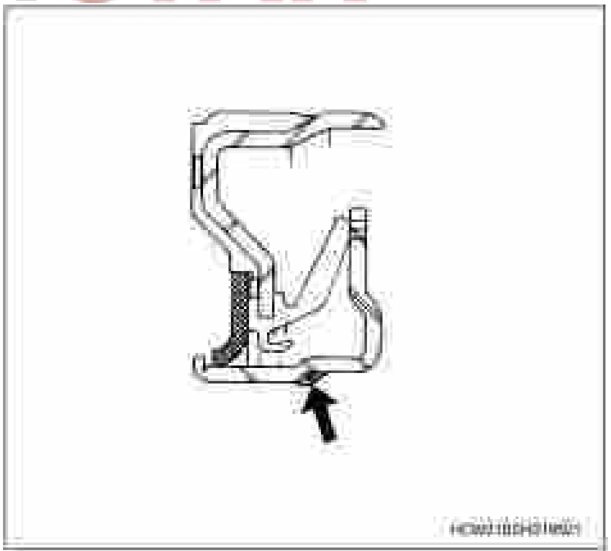
2) Install the crankshaft front oil seal to the front cover with the slinger as a set using the special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



Caution:

● Wipe off the leaked oil after pressing the oil seal.

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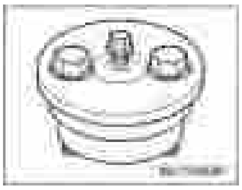
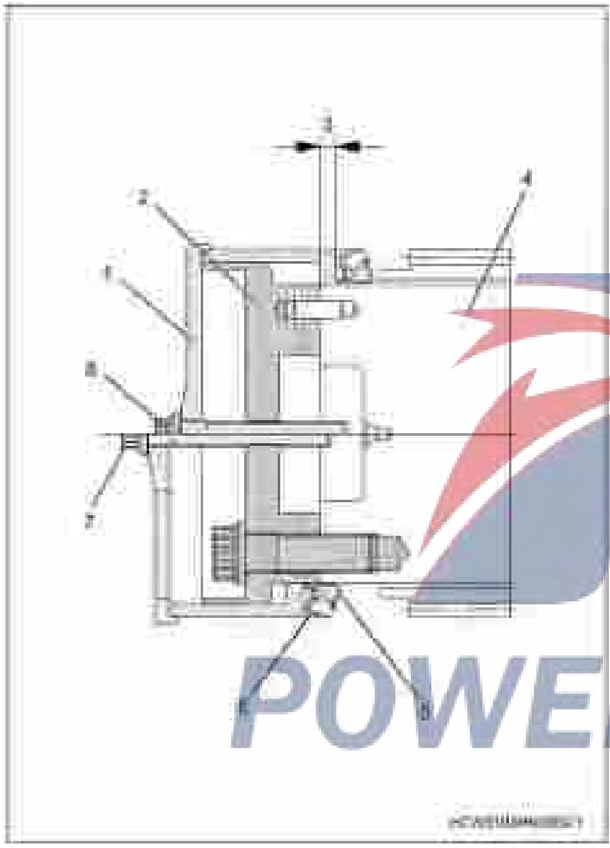


SST: 8-9819-4608-0 - Oil Seal Installer

3) After the oil seal is installed by pressing assembly method, measure the size between the crankshaft end surface and the oil seal surface.

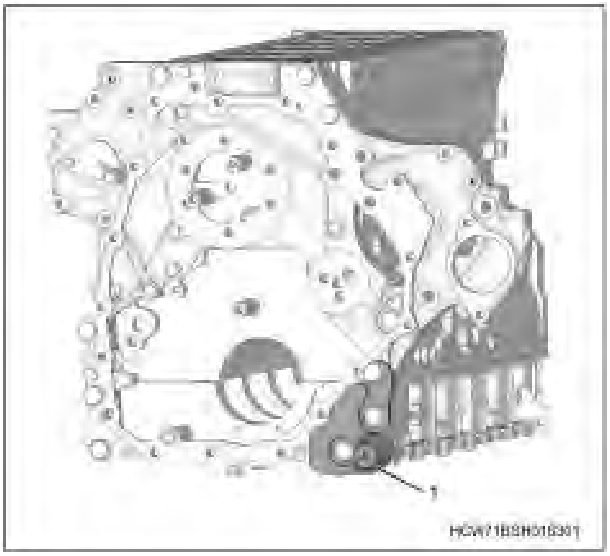


1. 8-9819-4608-0 (Sleeve)
2. 8-9819-4608-0 (Adapter)
3. 6.7 - 7.3 mm {0.264 - 0.287 in}
4. Crankshaft
5. Slinger (silver)
6. Oil seal
7. Oil seal
8. Finish pressing the position of the special tool after assembly

3. A / C compressor bracket installation

1) Install the air conditioner compressor bracket to the timing gearbox.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft}



1. Air conditioner compressor bracket

4. Idle gear installation

1) Install the idler gear to the gear cover.

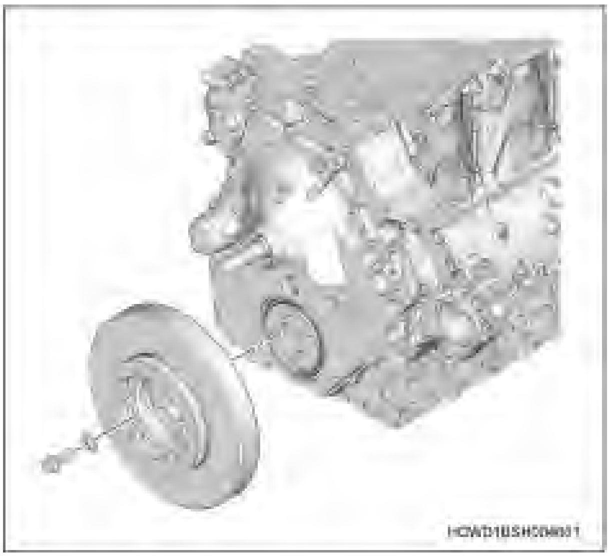
Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft}

5. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}



3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

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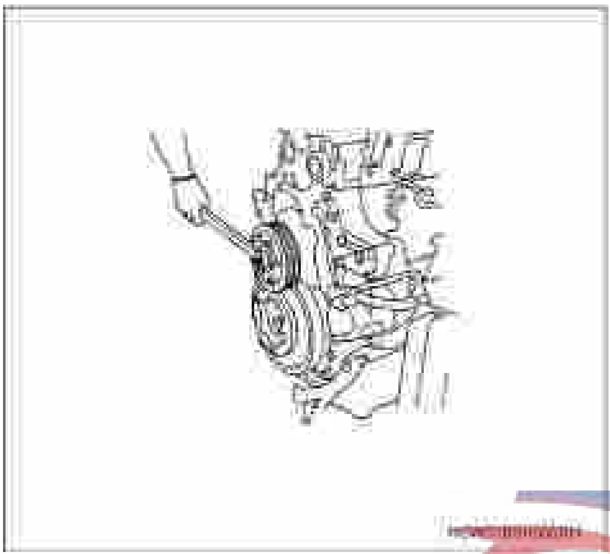
5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N • m { 55 kgf • m / 398 lb • ft }



6. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

7. A/C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

8. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

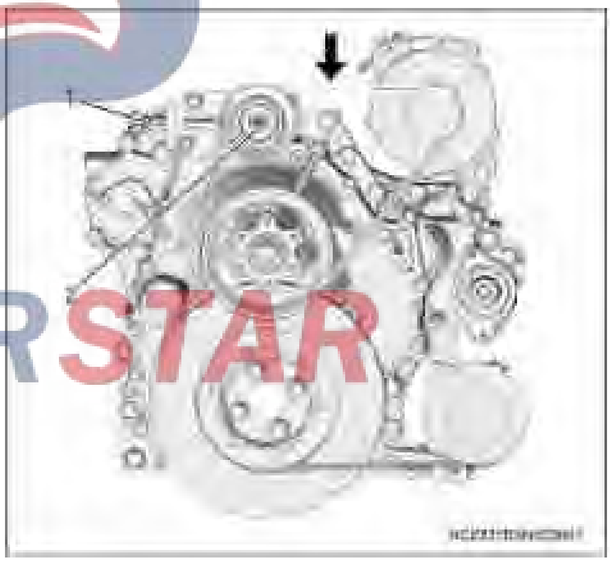
Cooling fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394 to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551 to 0.630 in }	: 75 to 85Hz

Caution:

・ When pushing the midpoint between the idler and the generator pulley by the specified value, the specified amount of deflection is the value shown below.

Standard:98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}

1. Lock nut
2. Adjust bolt

9. A / C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

POWERSTAR

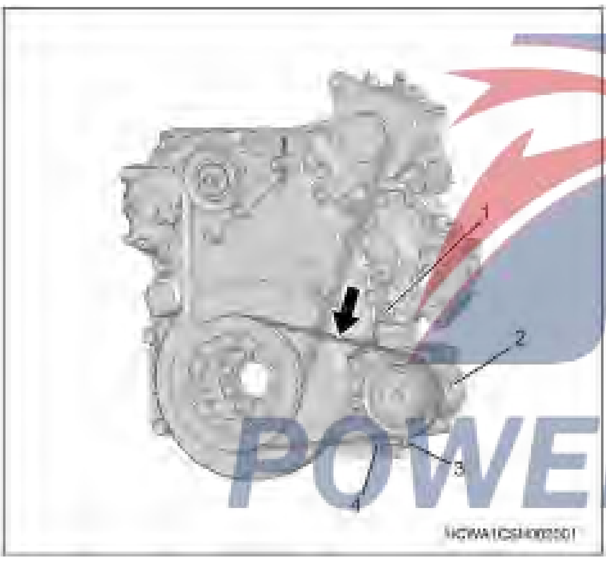
If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A / C compressor pulley and the crankshaft pulley.

Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0 to 40.0kg }
deviation	: 11 to 14mm { 0.4 to 15.24mm }	: 15 to 17mm { 0.6 to 17.78mm }
vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



1. Bolt

2. A/C compressor

3. Adjust bolt

4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

10. Radiator installation

1) Install the cushion rubber to the top and bottom of the radiator bracket.

2) Install the radiator to the frame.

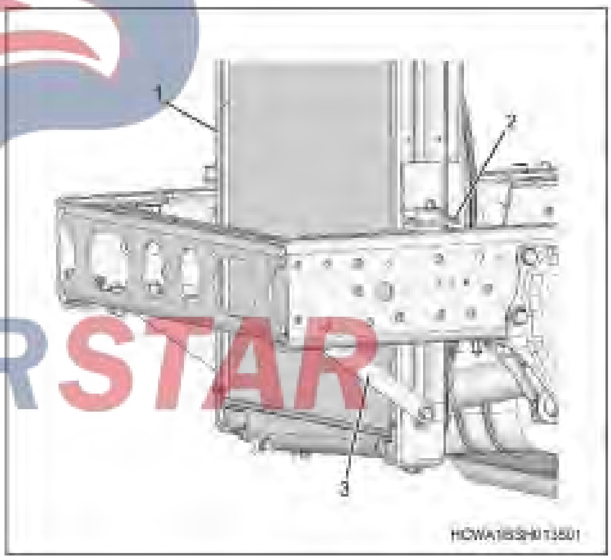
3) Install the washer to the topside of the cushion rubber.

4) Install the nut to the radiator.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

5) Install the radiator stay to the radiator and the frame.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}



1. Radiator

2. Bracket

3. Bracket

11. Intercooler installation

1) Install the intercooler to the radiator.

Caution:

● Remove dirt and other foreign objects.

● Do not damage the fins during installation or removal.

POWERSTAR

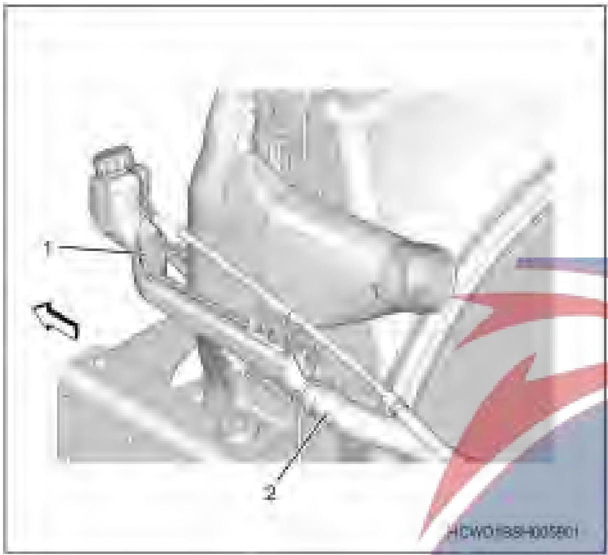
● When the intercooler fin deforms due to heat dissipation slow down, performance degradation, please carry out maintenance.

● Do not damage the fin base when repairing the fin.

● Do not use a high-pressure water jet on the radiator, intercooler, or the surrounding parts.

12. Refueling pipe installation

1) Install the refueling line and rubber hose to the timing gearbox.



1. Fuel pipeline

2. Rubber hose

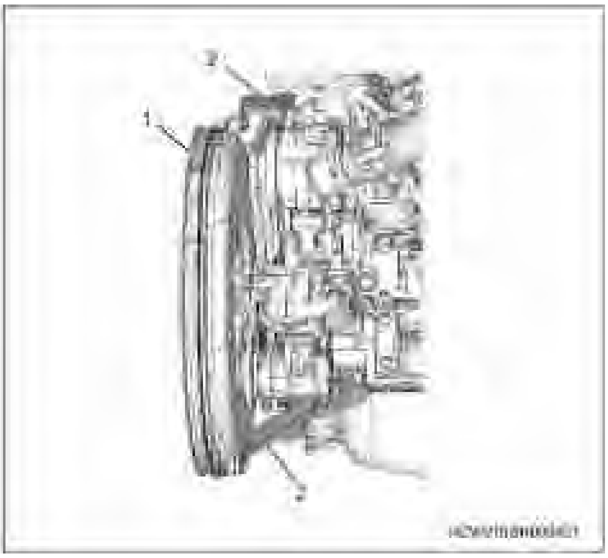
13. Cooling fan installation

1) Install the fan duct and cooling fan on the fan pulley.

Tightening torque: 67.5 N • m {6.9 kgf • m / 50 lb • ft}

14. Radiator fan cover connection

1) Install the fan guide bracket to the engine.



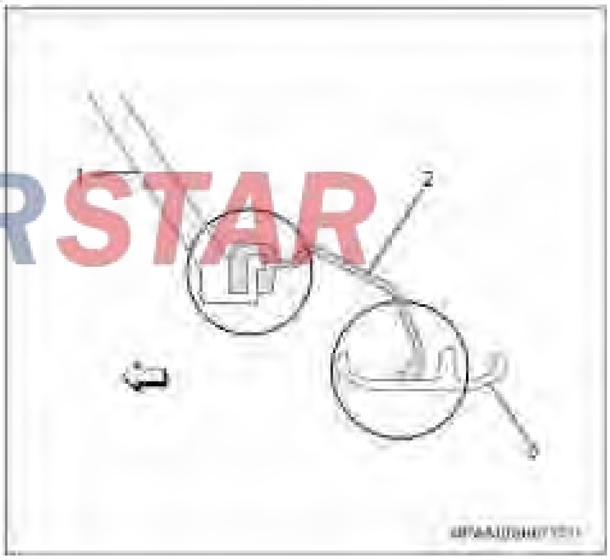
1. Fan guide

2. Fan guide bracket

2) Connect the fan guide to the radiator fan cover.

Caution:

● Verify that the entire circumference of the radiator fan cover is in contact with the fan guide.



1. Fan guide

2. Fan cover

3. Fan guide

15. Radiator lower hose installation

1) Install the radiator lower hose to the radiator and the water intake pipe.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

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16. Radiator upper hose installation

1) Connect the radiator air leak hose to the radiator.

2) Install the radiator upper hose to the water outlet duct and the radiator.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

17. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

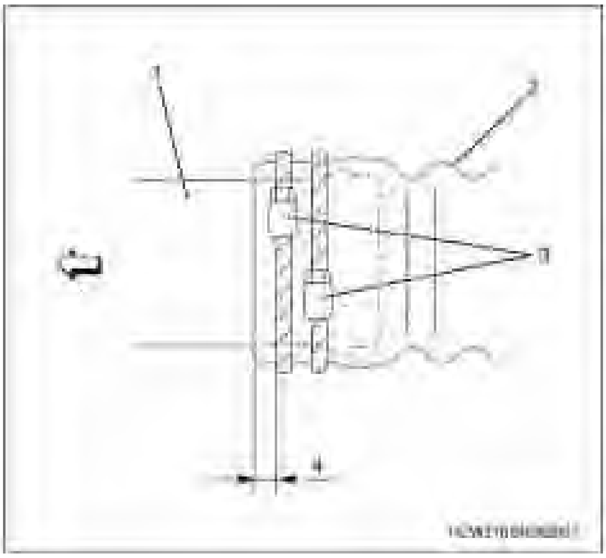
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }



1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

18. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm,

POWERSTAR

raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

19. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

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Crankshaft rear oil seal

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

3. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

4. Exhaust cover removal

1) Remove the exhaust cover from the frame.

5. Exhaust brake valve removal

1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

6. Transmission removed

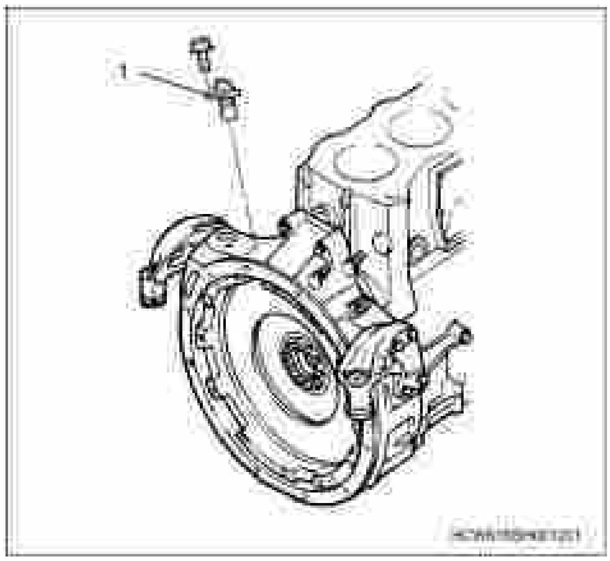
Refer to "*5.Transmission, Transaxle 5C.Manual (MJT) Transmission removal*".

Refer to "*5.Transmission, Transaxle 5C.Manual (MJX16) Transmission removal*".

7. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the crankshaft position sensor from the flywheel housing.



1. CMP sensor

8. Remove the clutch driven plate

Refer to "*5. transmission, transaxle 5e. mjt clutch (single plate drive) removal*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Disassembly*".

9. Flywheel removal

1) Remove the flywheel from the crankshaft.

10. Crankshaft rear oil seal removal

1) Remove the crankshaft rear oil seal from the flywheel housing

Caution:

● Do not damage the oil seal pressure mounting surface.

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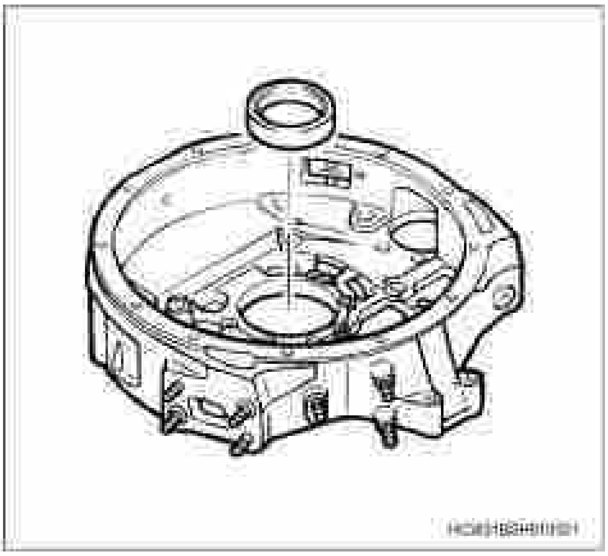
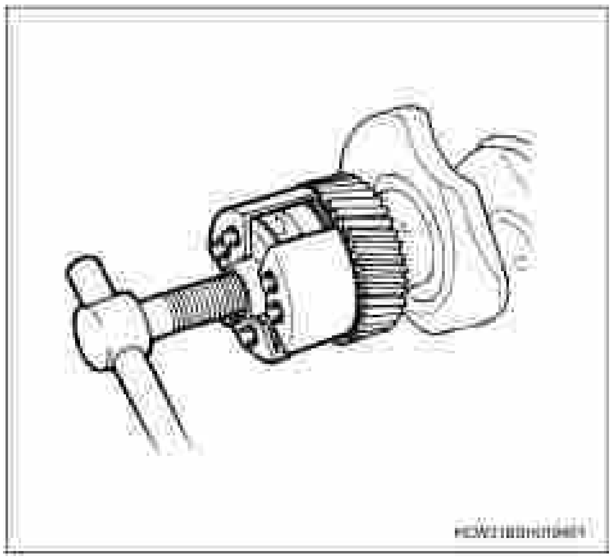


SST: 1-8521-0027-0 - Sleeve Removal Unit



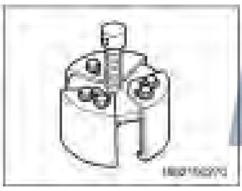
2) Use a special tool to remove the oil deflector from the crankshaft.

Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.

Caution:

● Do not reuse oil seal or ram when replacing.



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Installation

1. Crankshaft rear oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft rear oil seal.

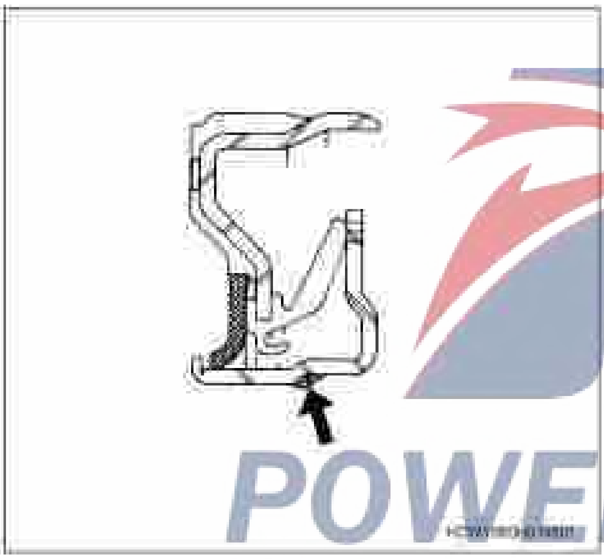
2) Install the crankshaft rear oil seal to the flywheel housing using special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

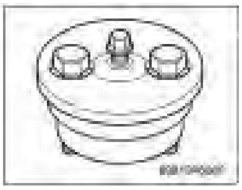
● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



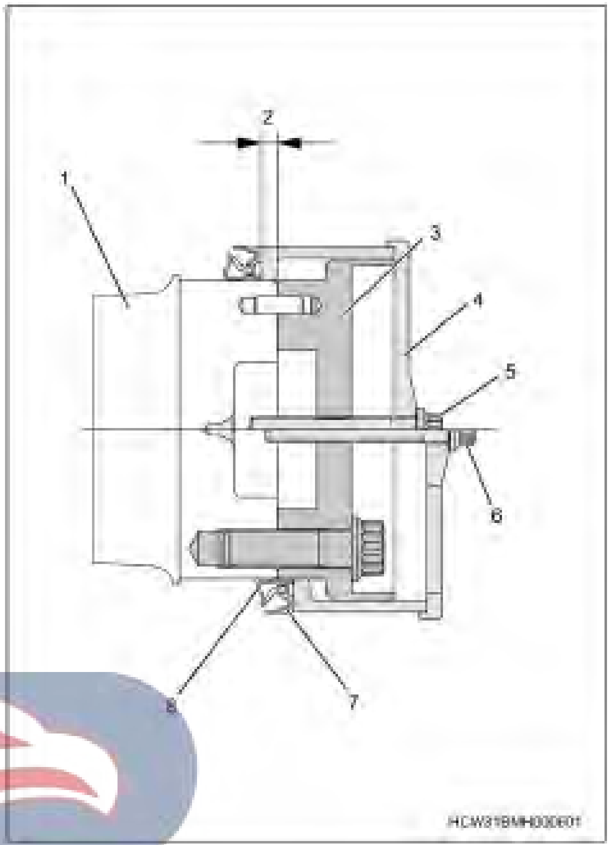
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) Measure the size of the crankshaft end face to the oil seal surface.



1. Crankshaft

2. 6.7 - 7.3 mm {0.264 - 0.287 in}

3. 1-8521-0027-0 (Adapter)

4. 1-8521-0027-0 (Sleeve)

5. Finish pressing the position of the special tool after assembly

6. Perform the position of the special tool before pressing the assembly

7. Oil seal

8. Slinger (gray)

2. Flywheel installation

1) Apply molybdenum disulfide to the threads and seat surface of the tightening bolt.

2) Install the flywheel to the crankshaft in the order shown in the diagram.

Tightening torque: 78.5 N • m {8.0 kgf • m / 58 lb • ft} 1st time

Prescribed angle: 60 ° second

Prescribed angle: 30 ° the third time

Caution:

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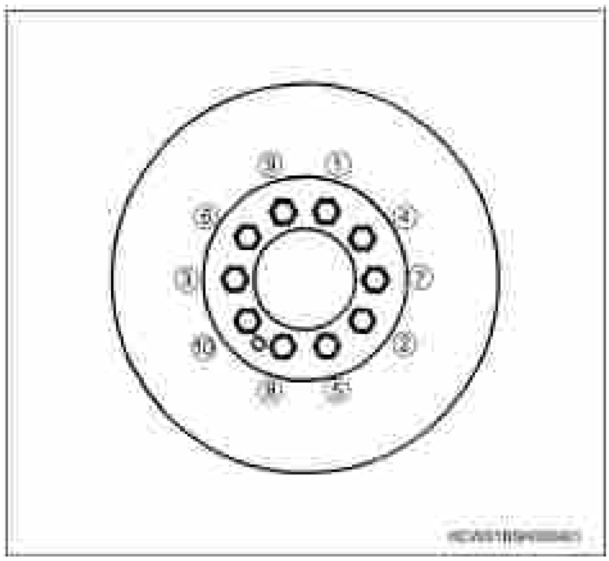
● The angular tolerance for tightening through angle control should be 90-120 °.



3. Clutch driven disk installation

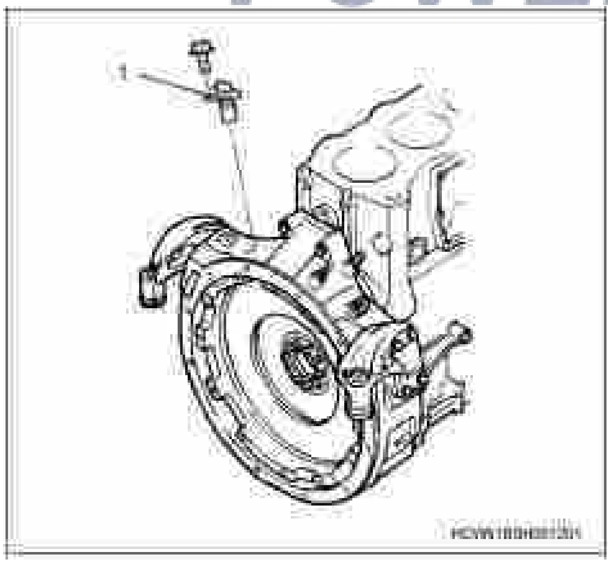
Refer to "*5. transmission, transaxle 5e. mjt clutch (single plate drive) mounting*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Installation*".

CMP sensor installation

1) Install the crankshaft position sensor to the flywheel housing.

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}



1. CMP sensor

2) Connect the connector to the CMP sensor.

5. Transmission installation

Refer to "*5.Transmission, Transaxle 5C.Manual Transmission (MJT) installation*".

Refer to "*5.Transmission, Transaxle 5C.Manual Transmission (MJX16) installation*".

6. Exhaust cover installation

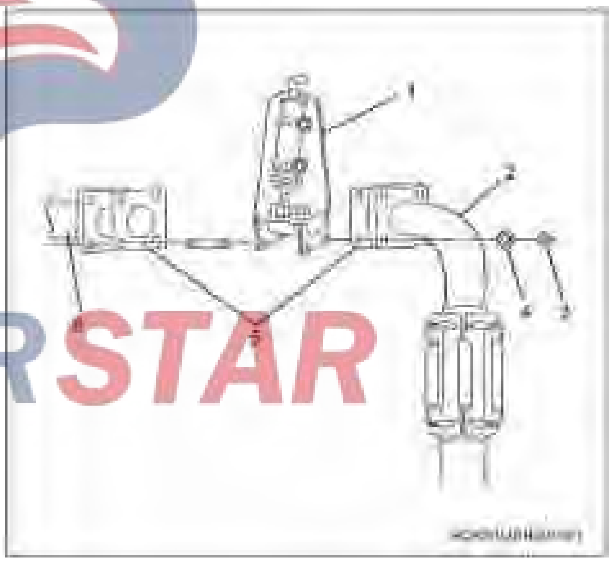
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m {6.0 kgf • m / 44 lb • ft}



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. Washer
5. Gasket
6. Turbocharger exhaust pipe

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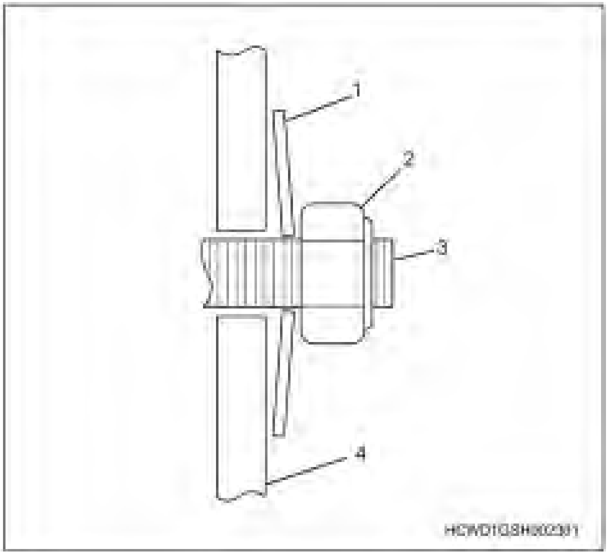

1. Washer

2. Nut

3. Stud

4. Flange

2) Connect the air hose to the exhaust brake valve.

7. Exhaust cover installation

1) Install the exhaust cover to the frame.

8. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

9. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

10. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

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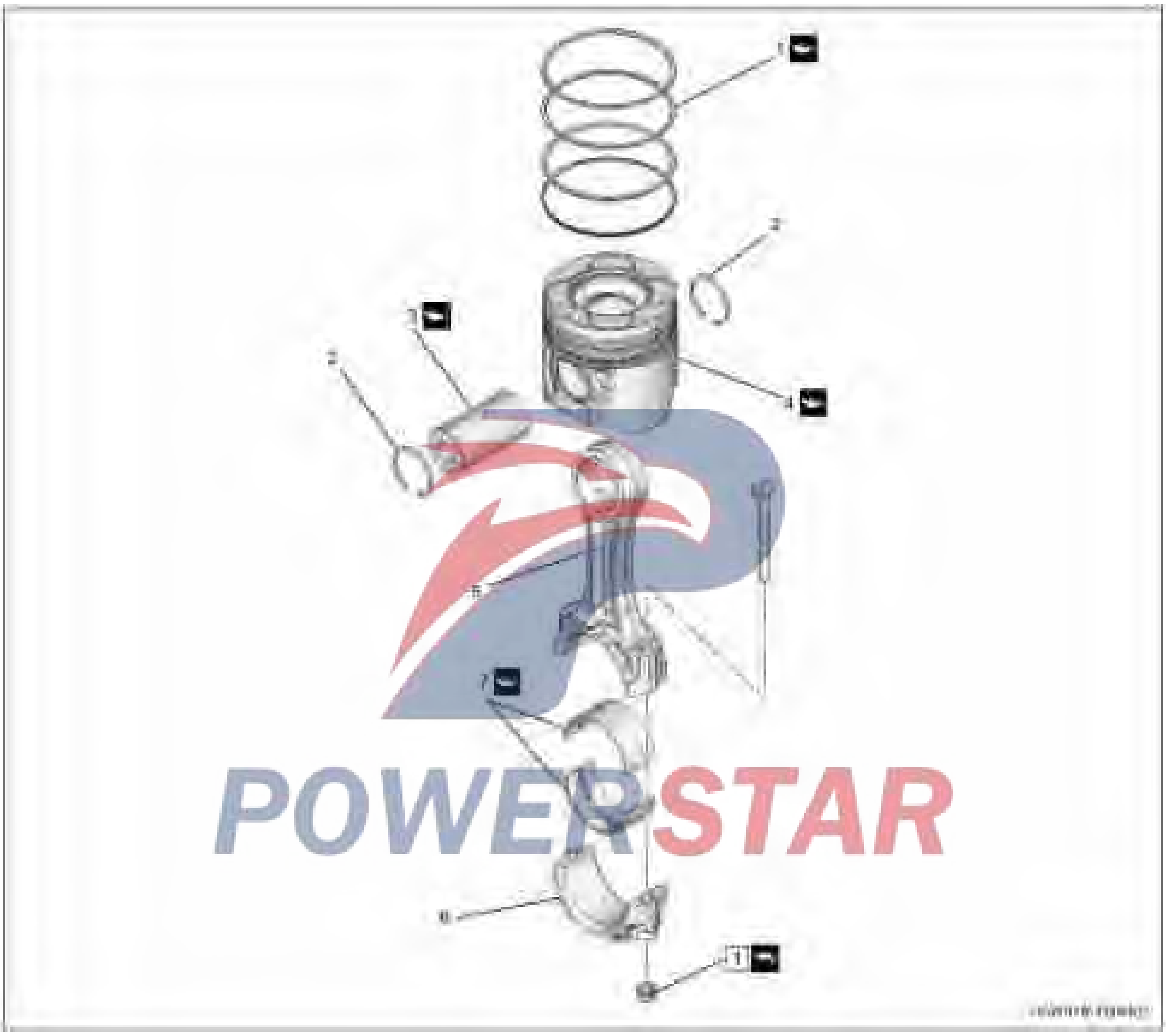
Piston

Removal

1. Component Views

Piston



Part name

1. Piston ring
2. Snap ring
3. Piston pin
4. Piston
5. Connecting rod.
6. Rod bearing cover
7. Connecting rod bearing

Tightening torque

1-1: 98 N • m { 10.0 kgf • m / 72 lb • ft }

1-2: 30 °

1-3: 30 °

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

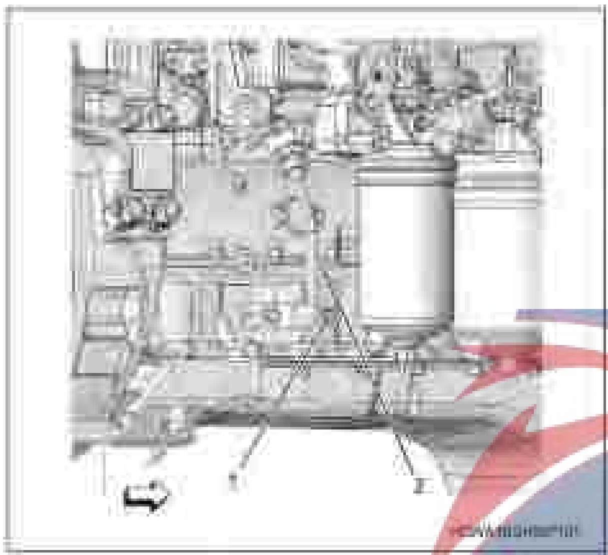
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

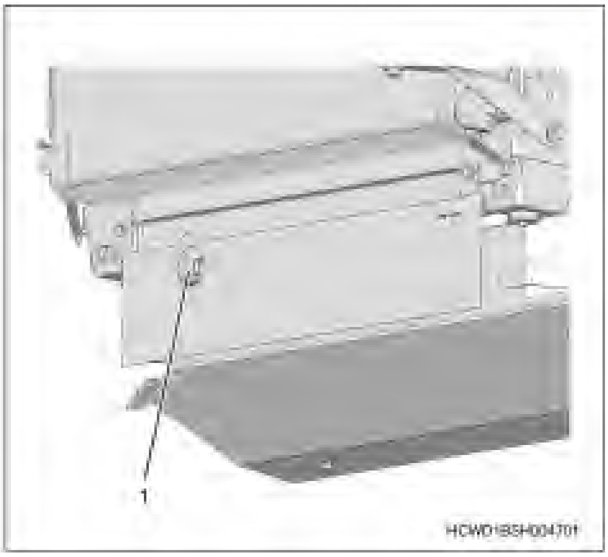
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

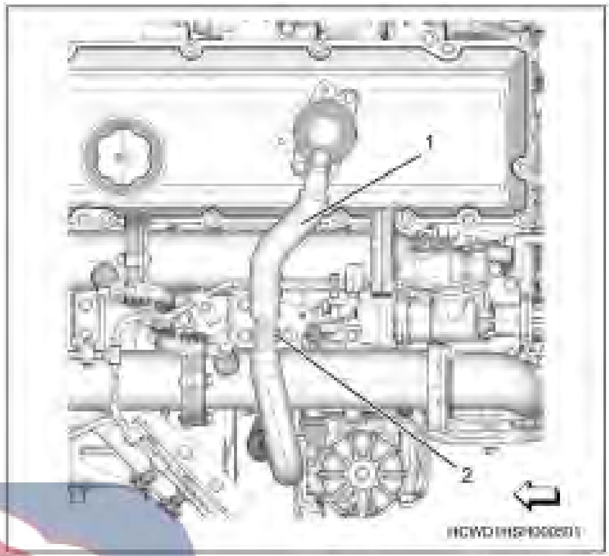
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



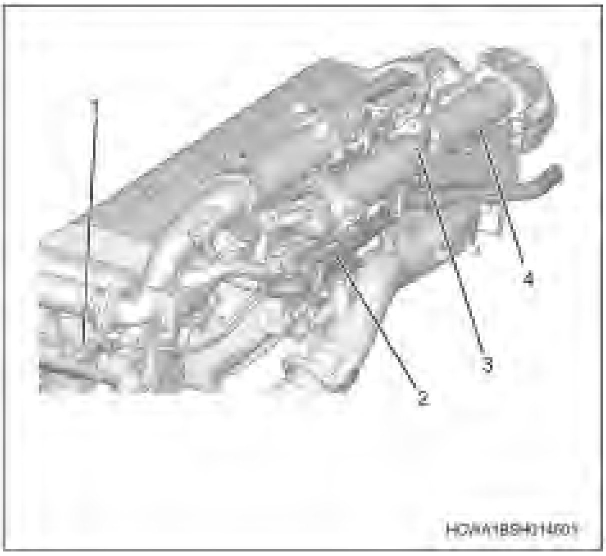
1. Ventilation hose

2. Ventilation hose clip

5. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe

2. Water charge pipe

3. Back-end trachea

4. Front leakage tube

6. Water charge pipe removal

1) Remove the water charge pipe from the filling pipe holder.

2) Remove the water charge bracket from the inlet pipe.

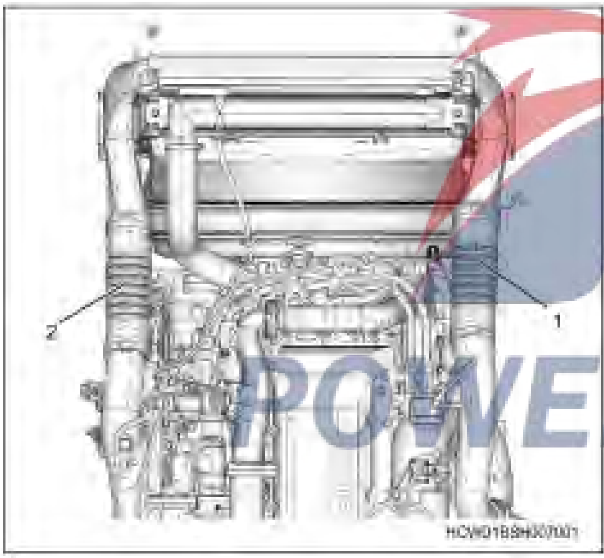
3) Remove the water charge bracket from exhaust gas recirculation valve line A.

7. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

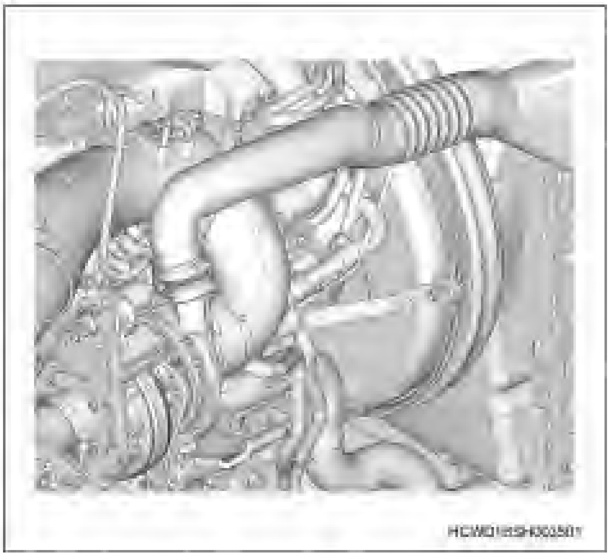
2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

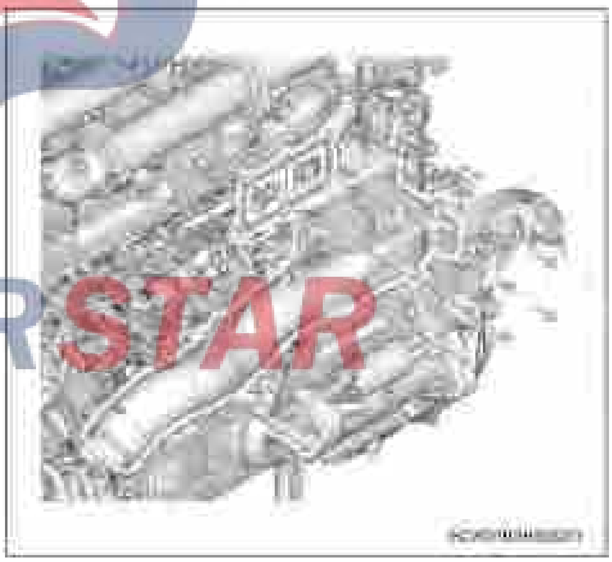
4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



8. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



9. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

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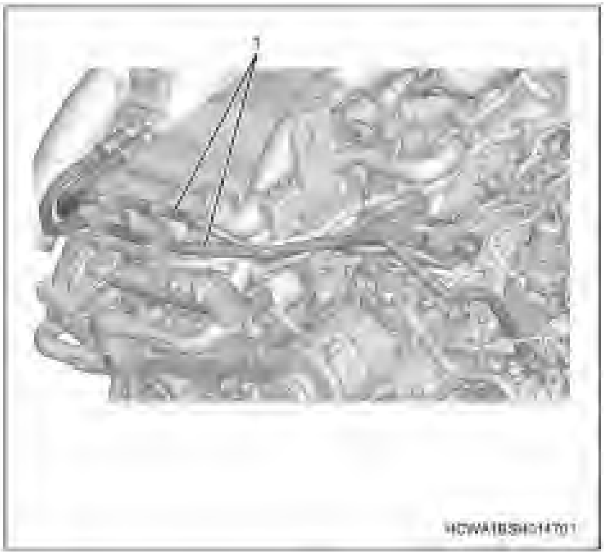
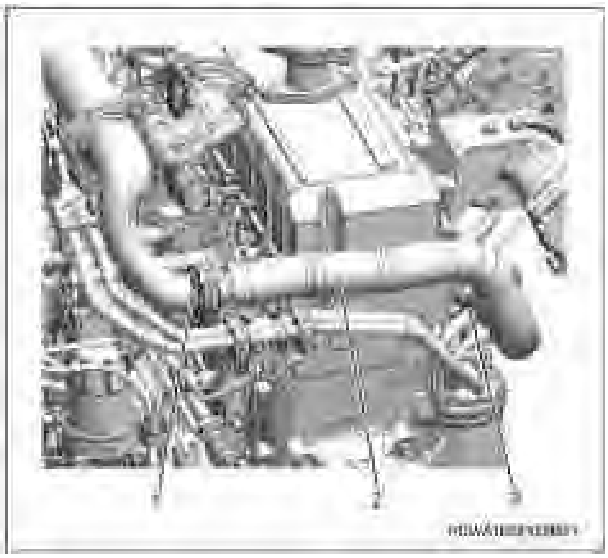


1. Exhaust pipe

10. EGR cooler removal

1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.

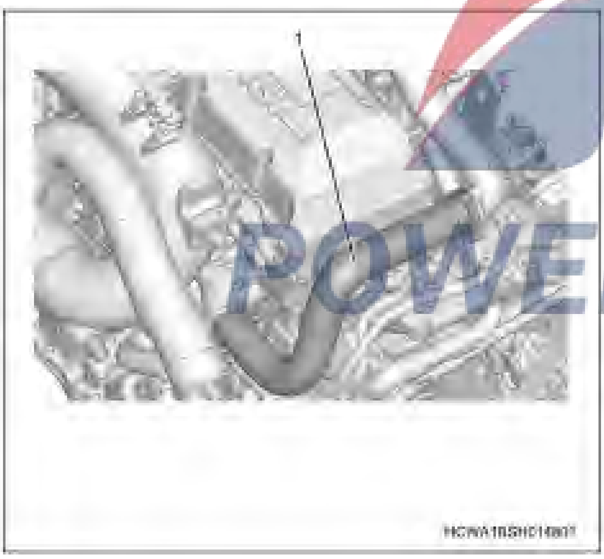


1. Standard bolt

2. Exhaust gas recirculation line B

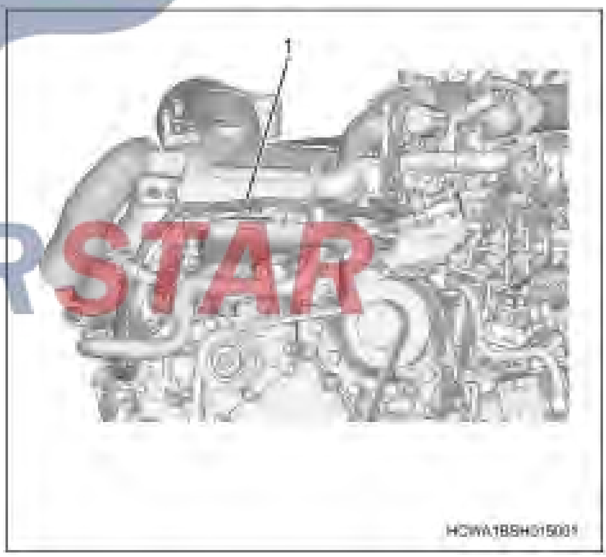
3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.



1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.

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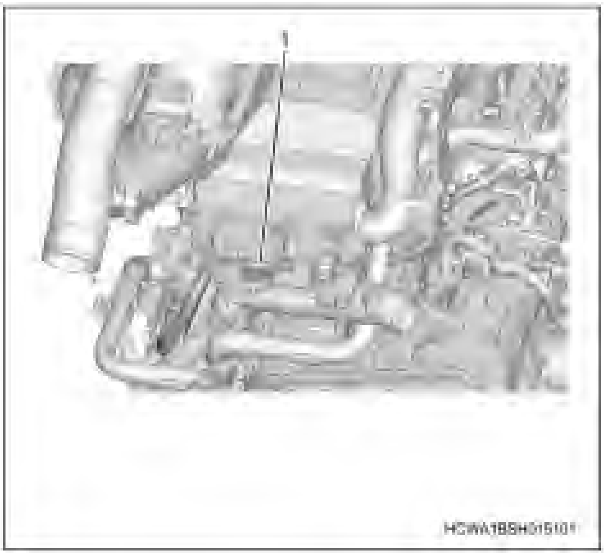
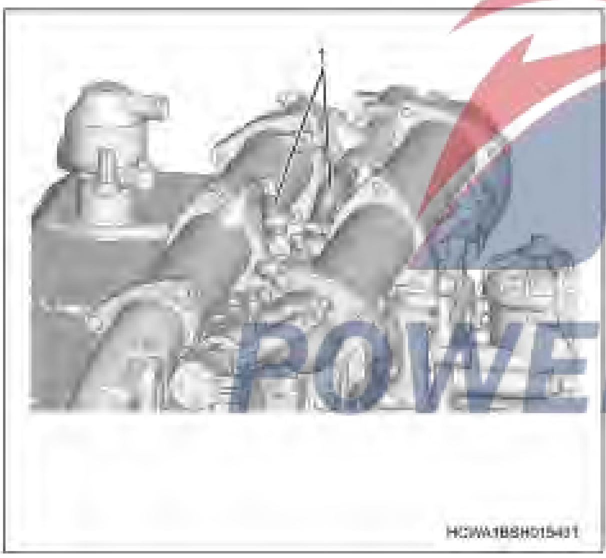


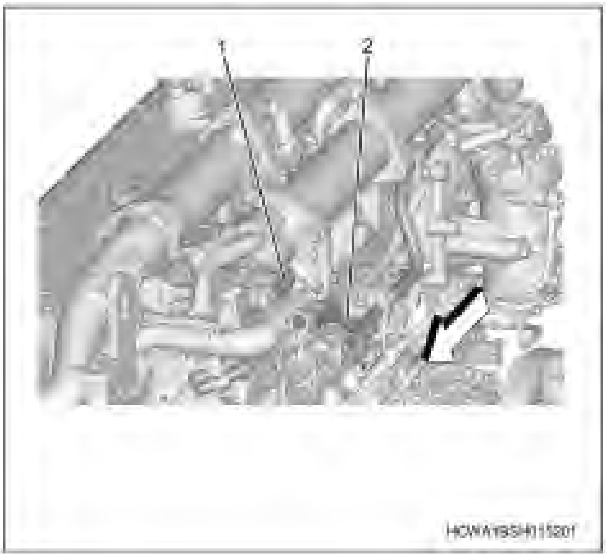
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. Water feed hose

7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe

2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

1. Front return pipe

2. Back-end return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.

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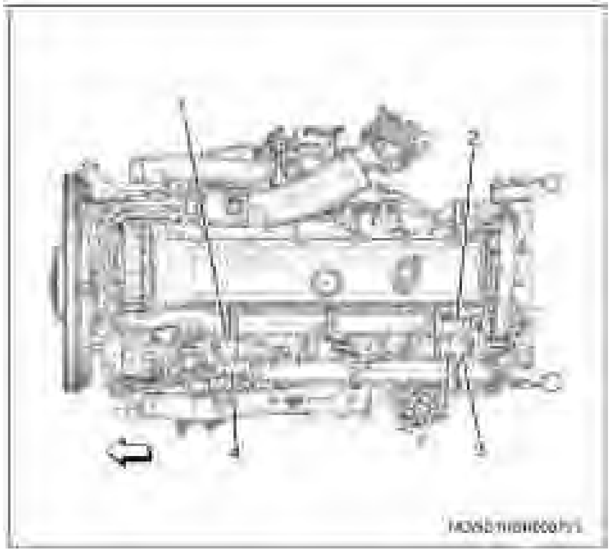


1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

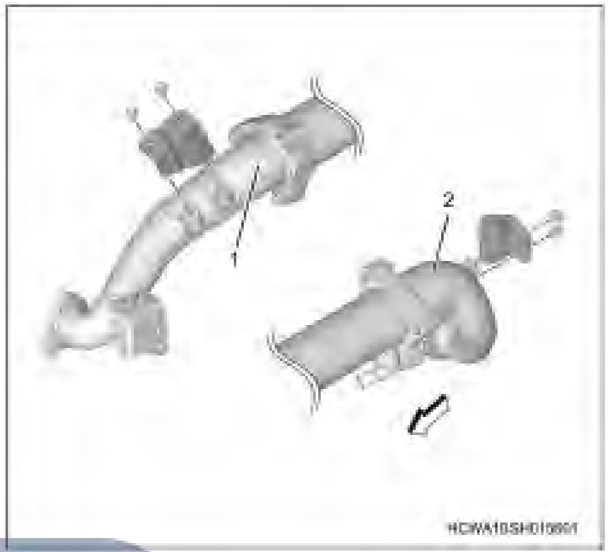
12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.

1. Exhaust gas recirculation cooler duct A

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A
2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.

1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. Exhaust Gas Recirculation Cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket

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6. Exhaust gas recirculation valve thermal protection device

7. Exhaust Gas Recirculation Cooler duct C

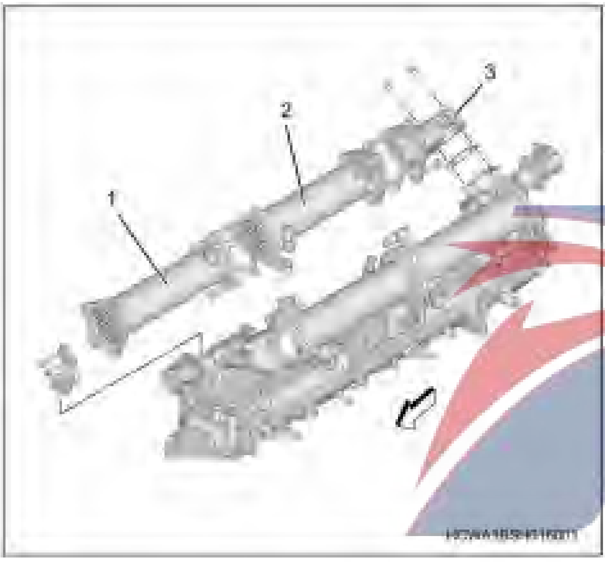
8. EGR cooler C

---

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler support on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.



1. EGR cooler A.

2. EGR cooler B

3. Exhaust Gas Recirculation Cooler duct B

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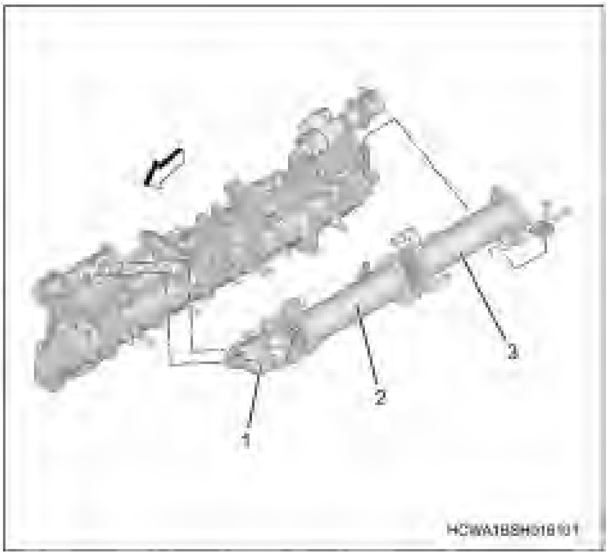
20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



1. Exhaust gas recirculation cooler duct D

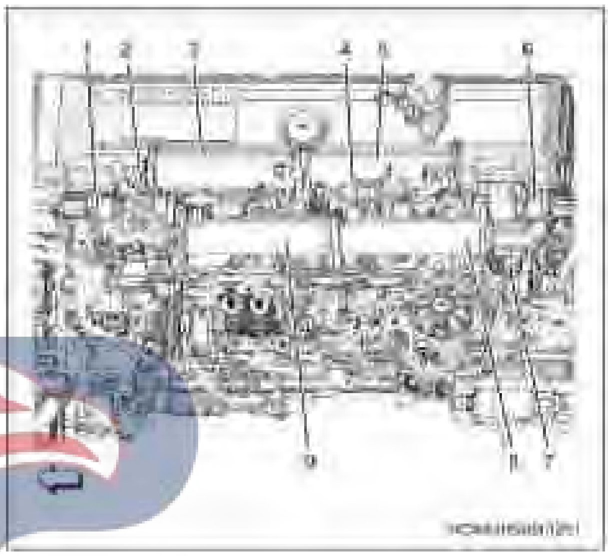
2. EGR cooler D

3. EGR cooler C.

---

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.



1. EGR valve 2

2. Exhaust gas recirculation cooler bracket

3. EGR cooler A.

4. Leakage pipe bracket

5. EGR cooler B.

6. EGR valve 1

7. Exhaust gas recirculation cooler bracket

8. EGR cooler C

9. EGR cooler D

---

11. Exhaust gas recirculation valve removed

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve conduit A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve conduit A.

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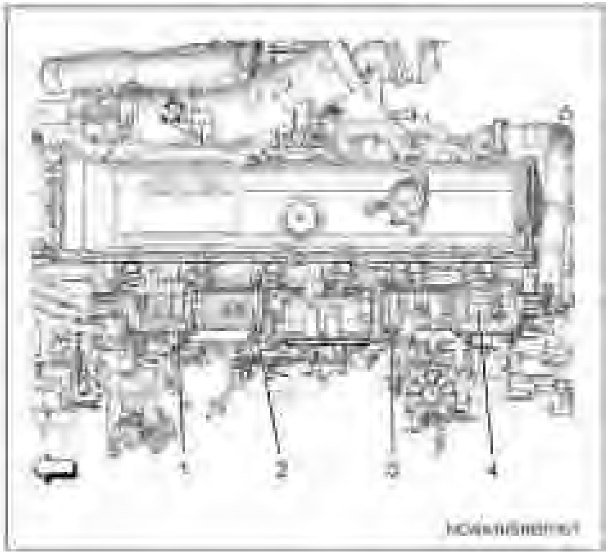


1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

12. Pilot valveto remove

1) Remove pilot valve from EGR valve A.

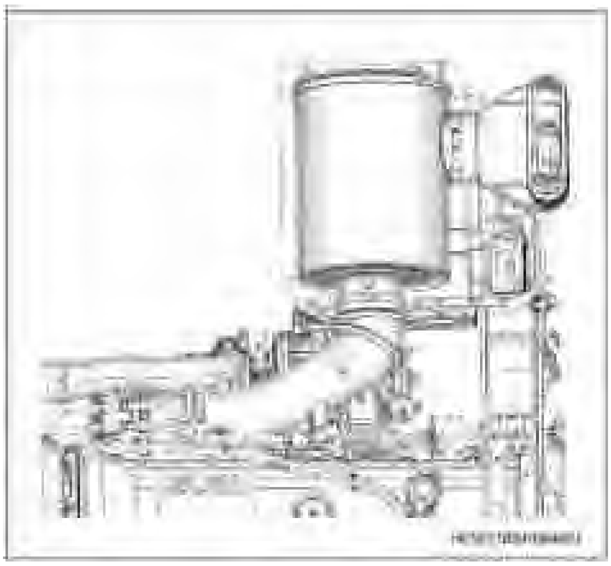
2) Remove pilot valve from EGR valve B.

13. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

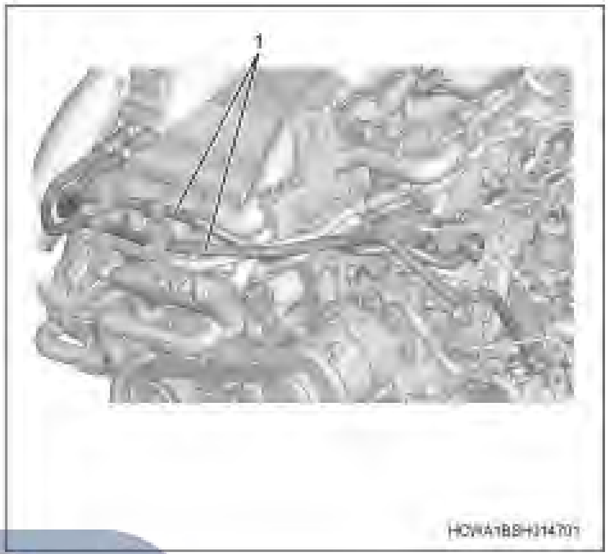
2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



14. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

2) Remove the heat shield from the air line.

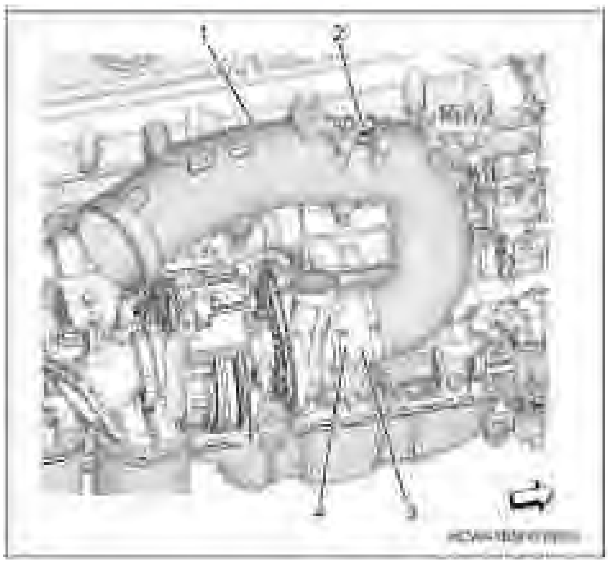
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose

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4. Hose clip

15. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

16. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

17. Exhaust cover removal

1) Remove the exhaust cover from the frame.

18. Exhaust brake valve removal

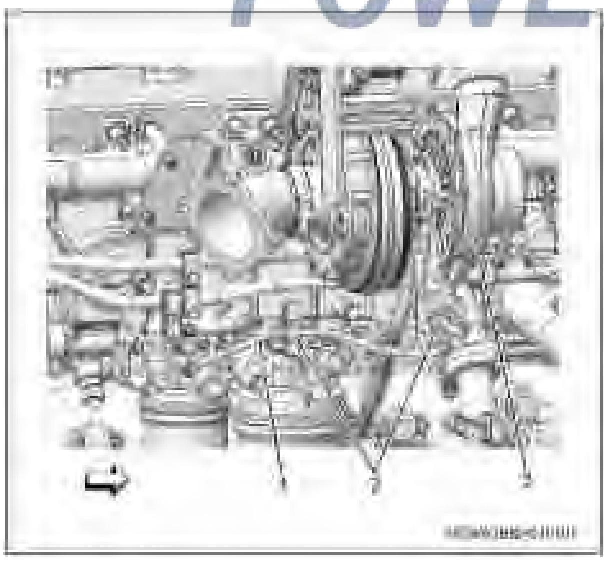
1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

19. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.



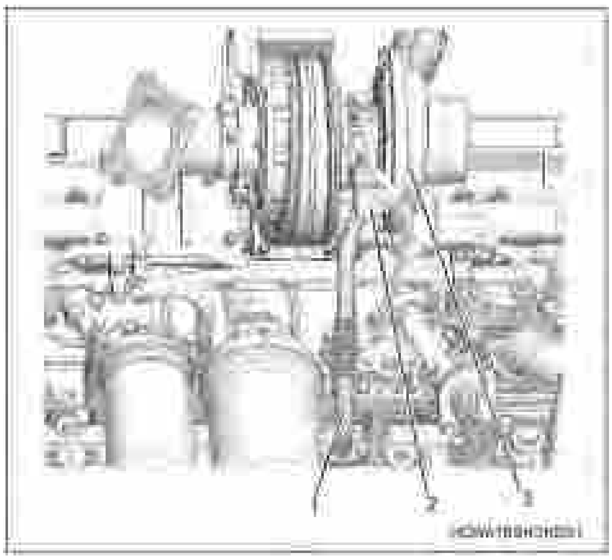
1. Turbocharger oil feed pipe

2. Pipe clamp

3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.



1. Turbocharger return pipe

2. Bracket

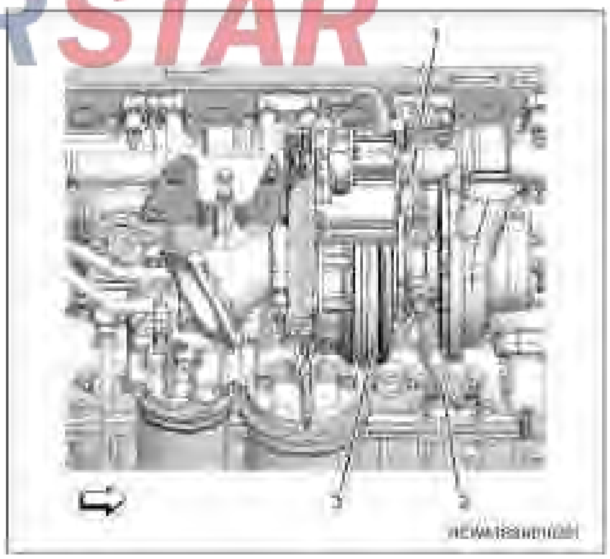
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.



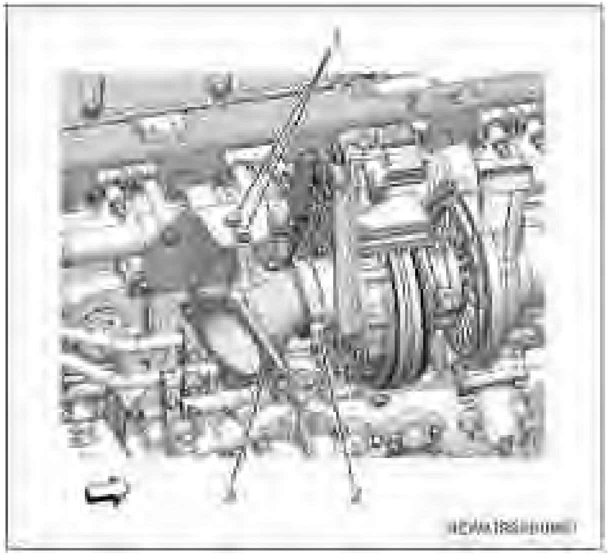
1. Water return pipe

2. Water feed pipe

3. Turbocharger

POWERSTAR

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt

2. V-belt

3. Turbocharger exhaust pipe

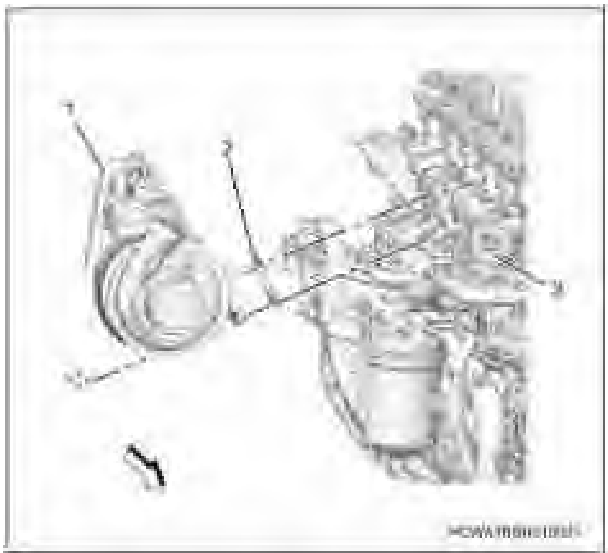
10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.



1. Turbocharger

2. Gasket

3. Exhaust manifold

20. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

21. Fuel drain pipe removed

1) Disconnect the fuel drain on the fuel supply pump.

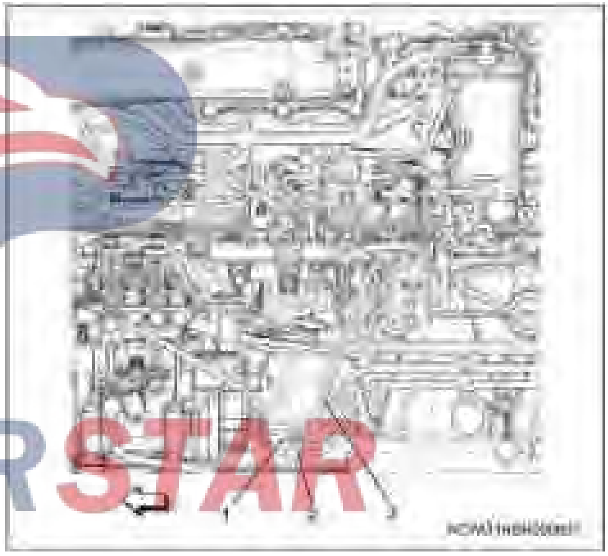
2) Disconnect the fuel drain hose from the fuel filter.

22. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

23. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

3) Remove the fuel pipe from the fuel supply pump.

24. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

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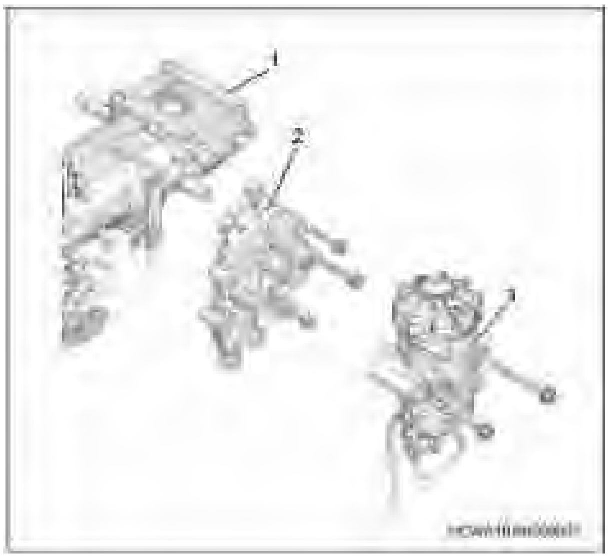
3) Remove the fuel filter bracket from the intake manifold.



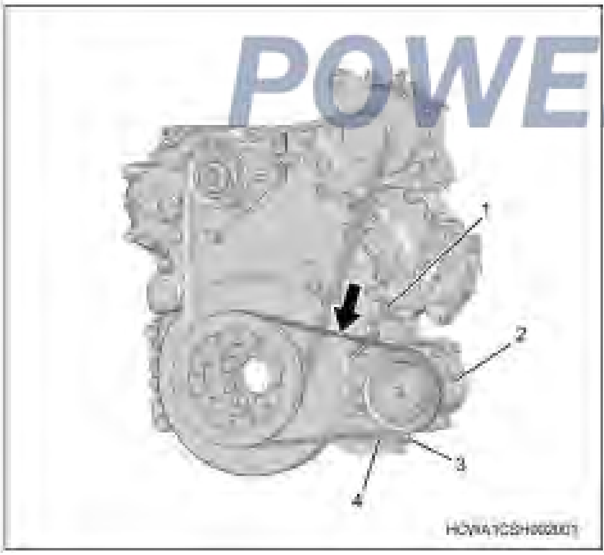
1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

25. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts, and then remove the A / C compressor drive belt for the A / C compressor and crankshaft pulley.



1. Bolt

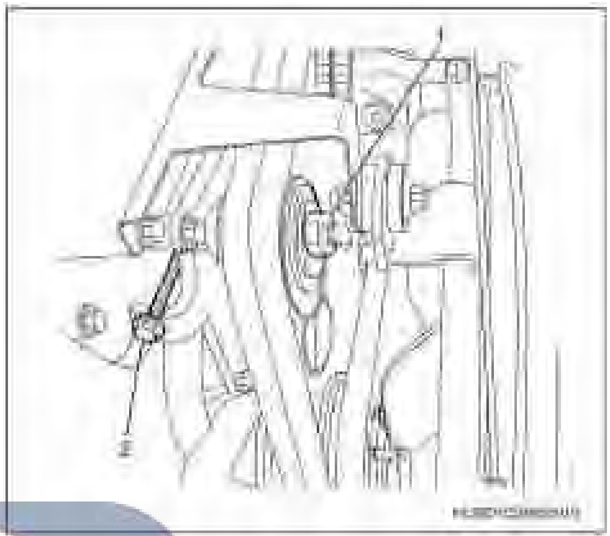
2. A/C compressor

3. Adjust bolt

4. Nut (back end)

26. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



1. Lock nut

2. Adjust bolt

27. Generator removal

1) Disconnect the harness connector from the generator.

2) Disconnect the generator from the ground and B-terminal harness.

3) Remove the generator from the bracket.

28. Generator bracket removal

1) Remove the generator bracket from the cylinder head.

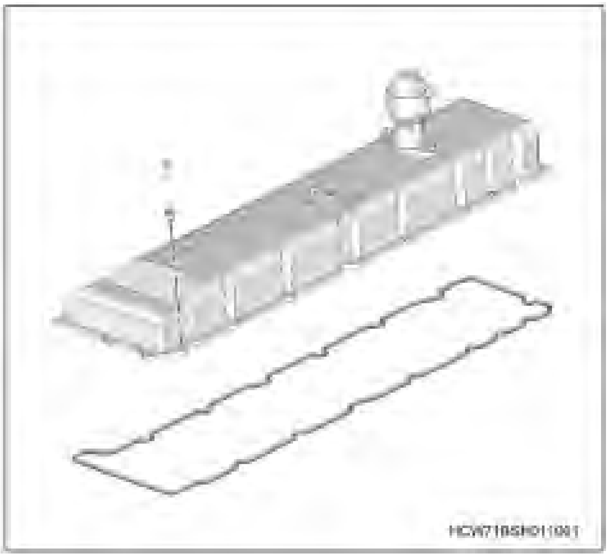
2) Remove the generator bracket from the timing gearbox.

29. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.

POWERSTAR



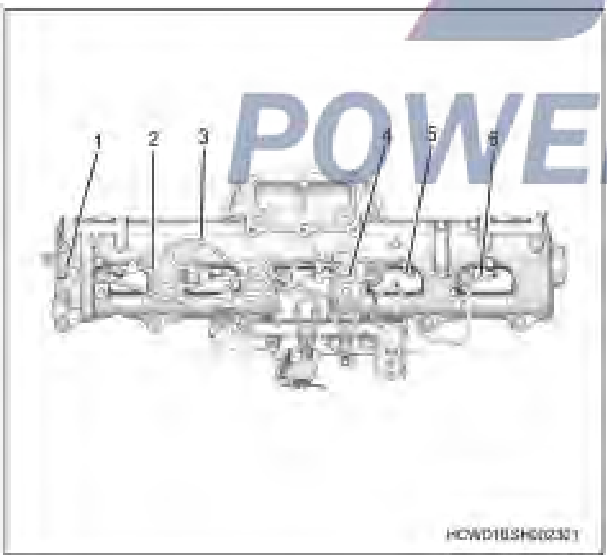
30. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

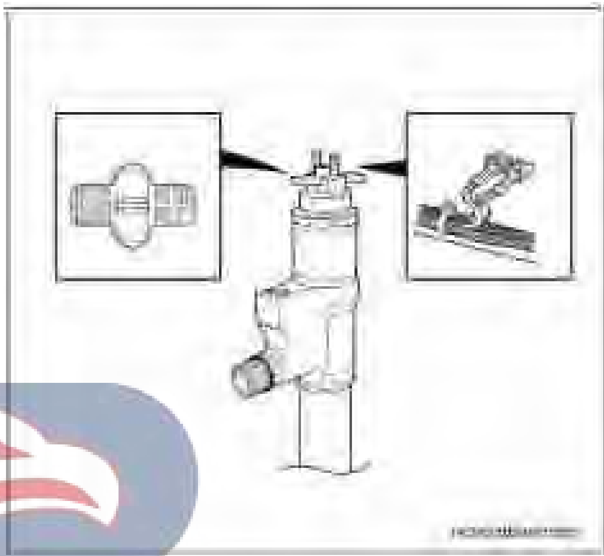
31. Injector harness removal

1) Remove the injector nut

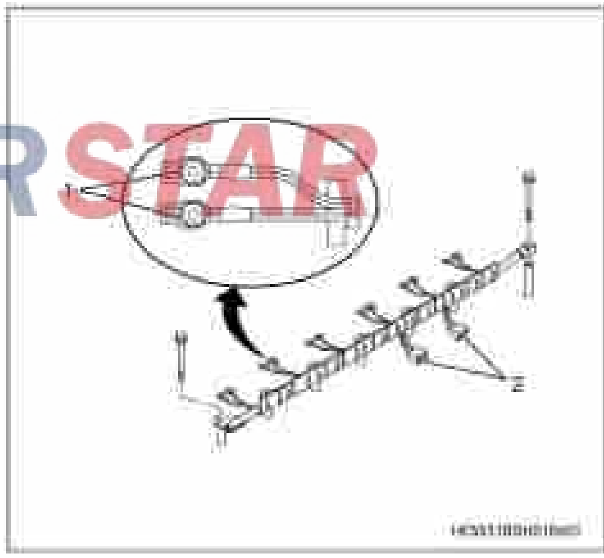
2) Remove the injector harness

Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.



3) Remove the bolts on the injector harness.



1. Injector terminal nut
2. Connector

32. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

● Do not reuse the gasket.

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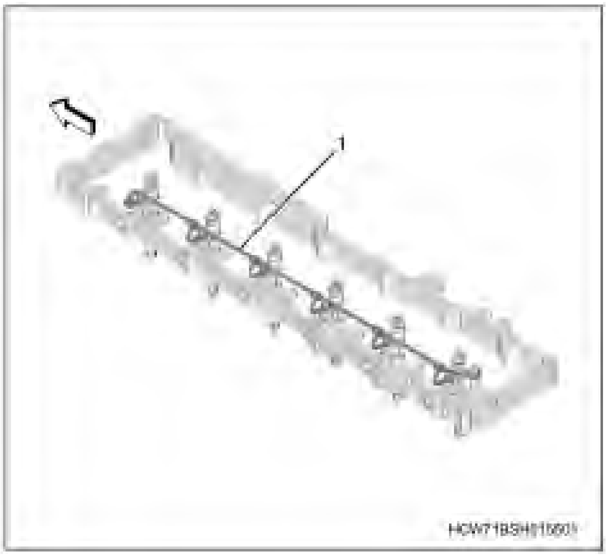
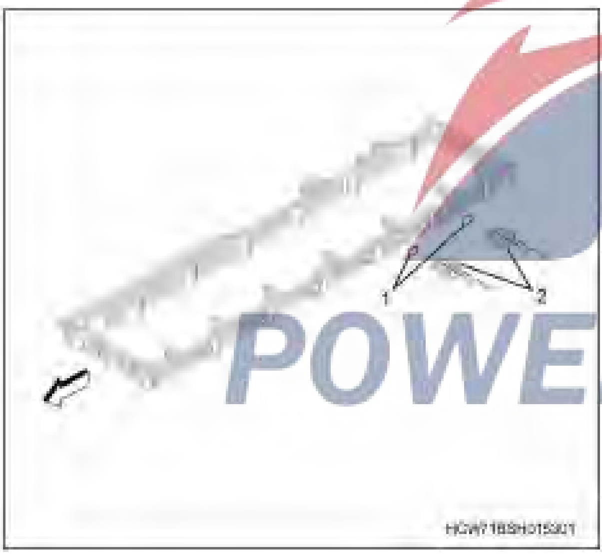


1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.



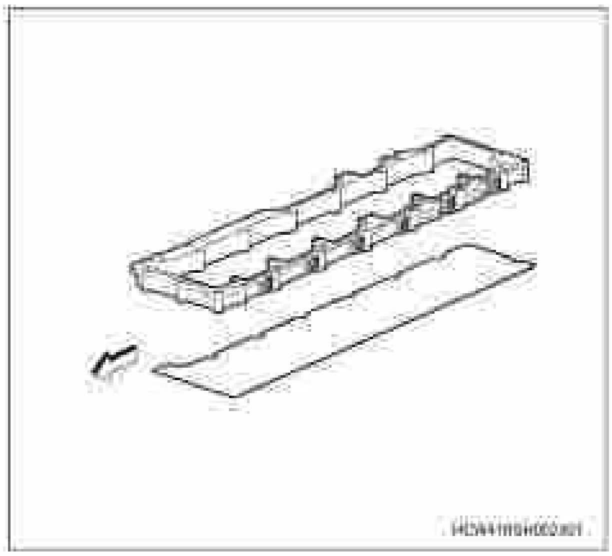
1. O-ring
2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.



33.injector removal

1) Remove the clamp from the cylinder head.

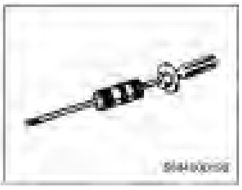
2) Remove the injector from the cylinder head with special tools.

Caution:

● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

● Do not remove the injector ID code plate.

SST: 5-8840-2826-0 - injector remover



SST: 5-8840-0019-0 - sliding hammer

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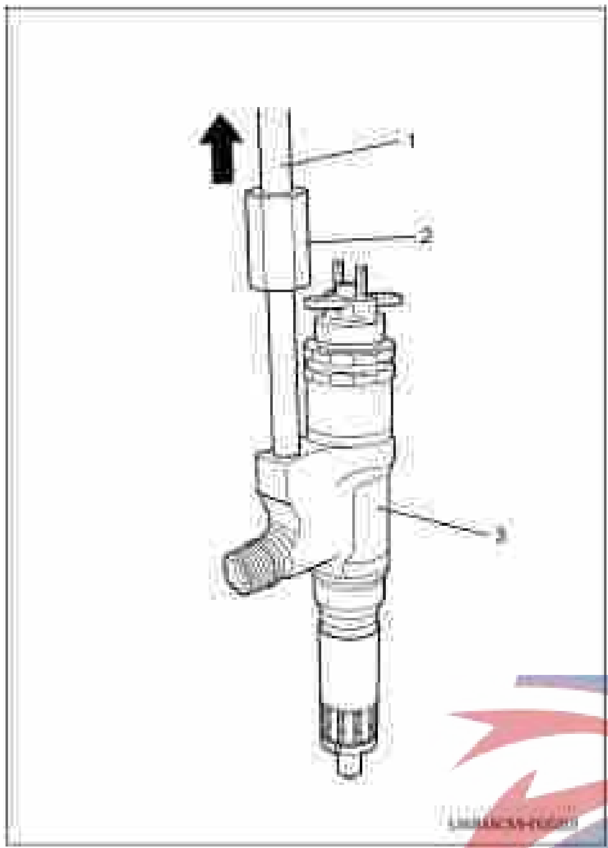


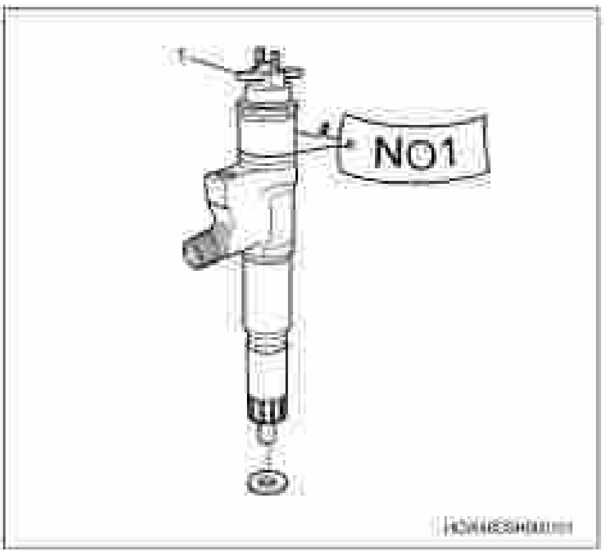
1. 5-8840-0019-0
2. 5-8840-2826-0
3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.



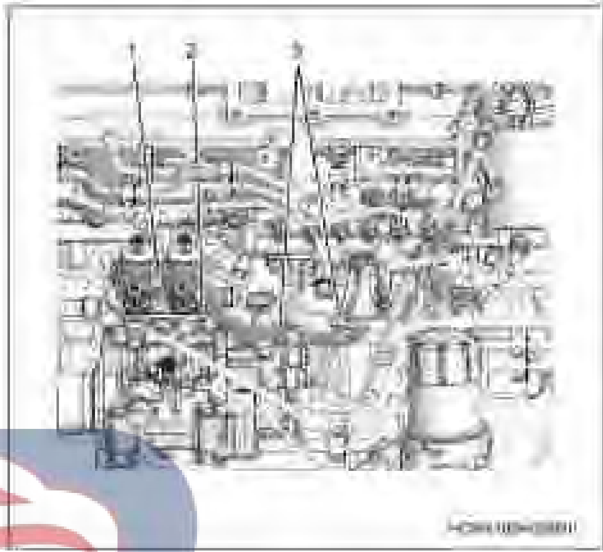
1. Injector

34. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.



1. Fuel pipe
2. Fuel pipe
3. Clip

35. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.

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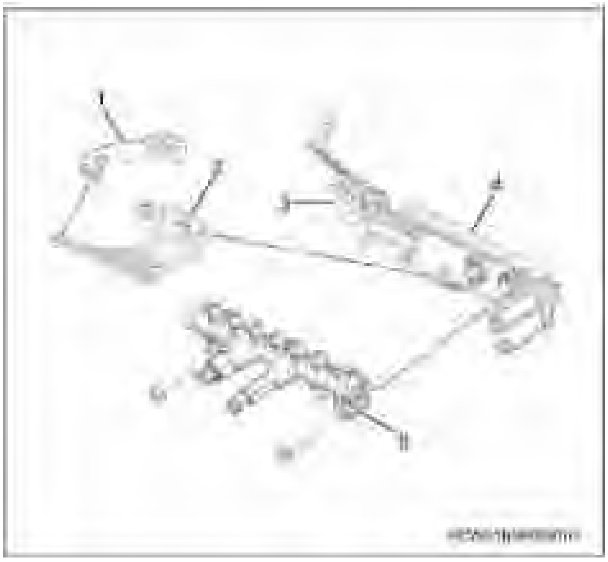


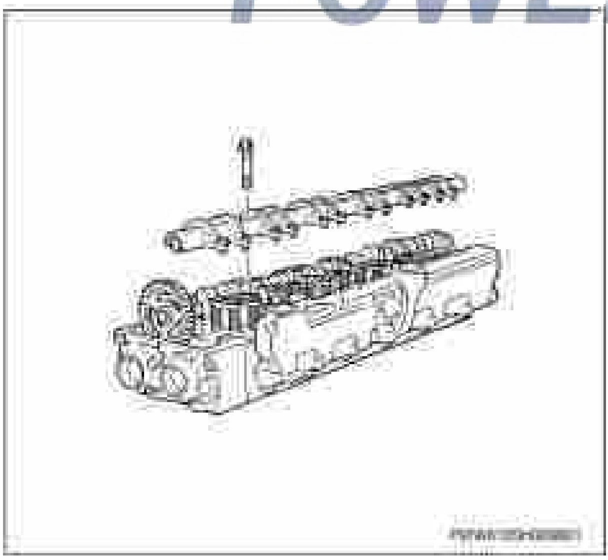
1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

36. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



37. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

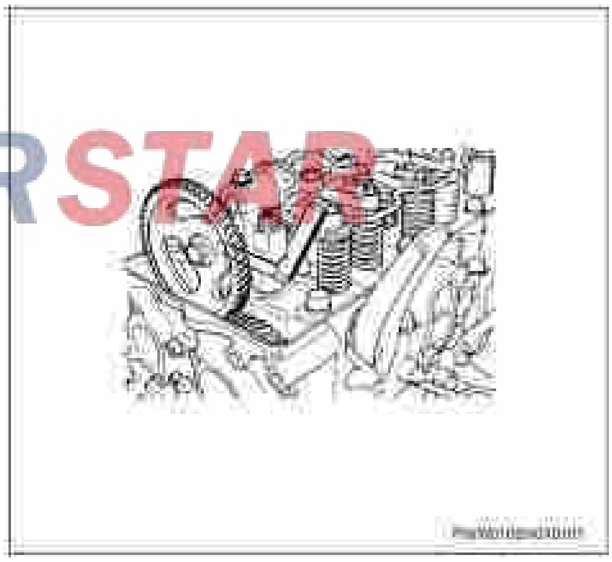
1. Bridge

38. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170mm { 0.00335 to 0.00669 in }

Limit: 0.25 mm { 0.0098 in }



2) Remove the cam holder from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.

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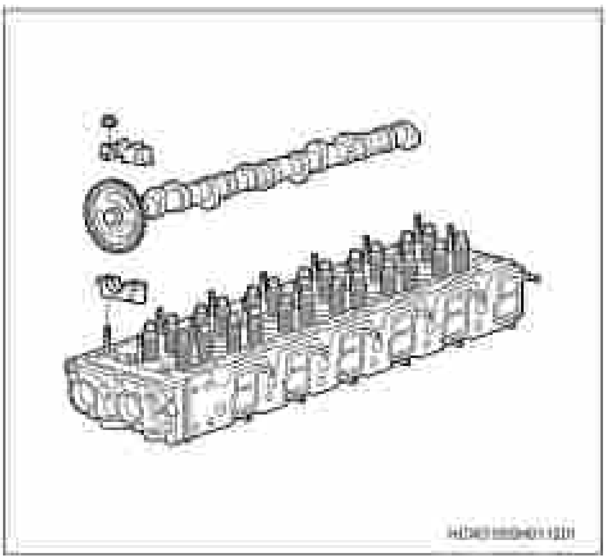


39. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

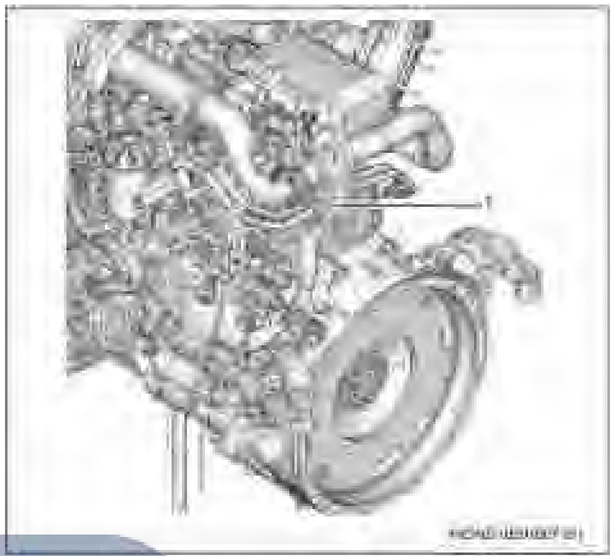
2) Remove the glow plug from the cylinder head.

40. Cylinder head cover removal

1) Install special tool to the cylinder head.

SST: 8-9761-4276-0 - engine hanger

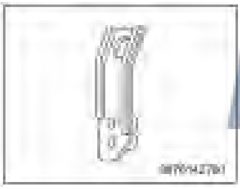
Tightening torque: 117.5 N • m { 12.0 kgf • m / 87 lb • ft }



1. 8-9761-4276-0

2) Remove the M10 and M12 bolts from the cylinder head.

3) Remove the cylinder head bolts from the cylinder head in the order shown.



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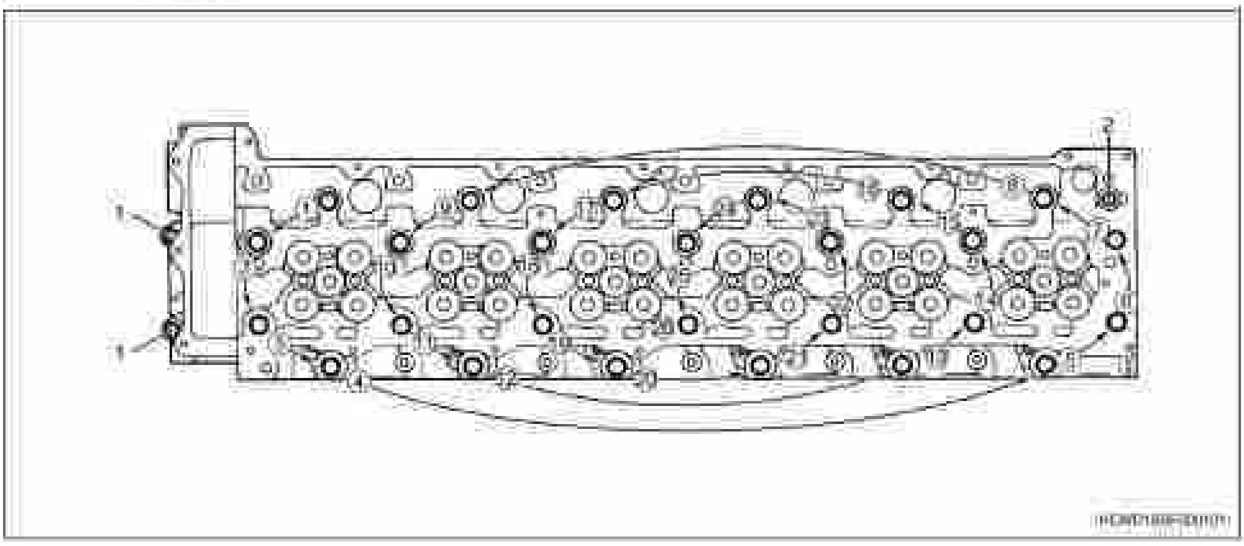


1. M10 bolt

2. M12 bolt

4) Remove the cylinder head from the cylinder block.

5) Remove the cylinder head gasket from the cylinder block.

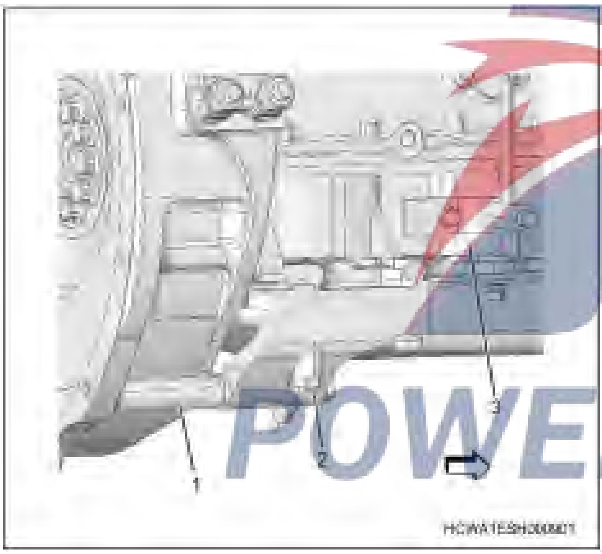
Caution:

● Do not reuse the cylinder head gasket.

6) When removing, inspect for water leakage, exhaust gas leakage, etc.

41. Oil pan removal

1) Remove the left and right flywheel housing brackets from the cylinder block and flywheel housing.



1. Flywheel housing

2. Flywheel housing bracket

3. Cylinder block

2) Remove the oil pan from the cylinder block.

42. Oil strainer removed

1) Remove the oil strainer and O-ring from the cylinder block.

2) Remove the bracket from the cylinder block.

43. Piston removal

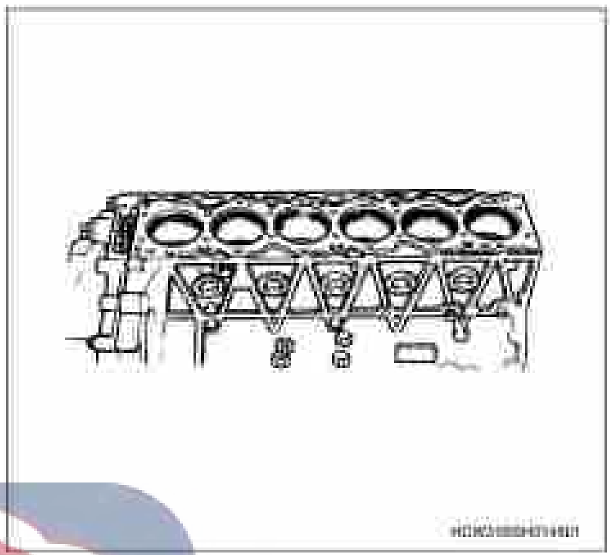
Caution:

● Connect stops to prevent the bushing from protruding during crankshaft rotation and piston removal.

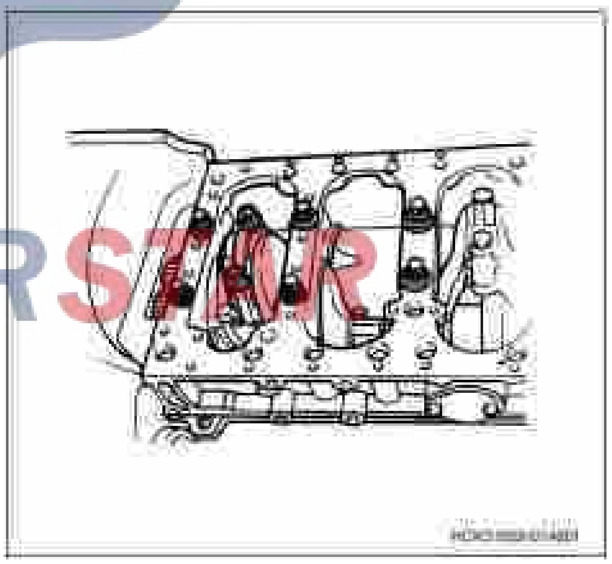
1) Scrape off all the carbon on the top of the cylinder liner with a scraper.

Caution:

● Do not damage the cylinder liner.



2) Remove the bearing cap from the connecting rod.



3) Remove the piston from the cylinder block.

Note:

● Remove the piston to the compression top dead center and push the lower end of the rod out using a hammer or the like.

Caution:

● Avoid interference between rod and cylinder liner.

● Do not damage the nozzle.

● Temporarily tighten the removed cap and bearing onto the connecting rod to avoid confusing parts.

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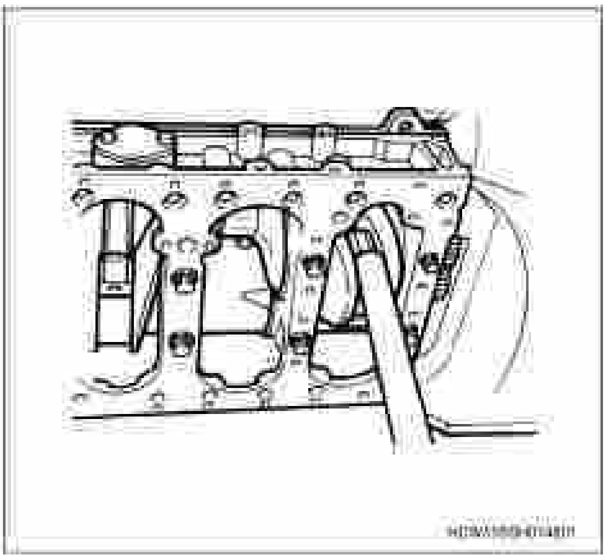

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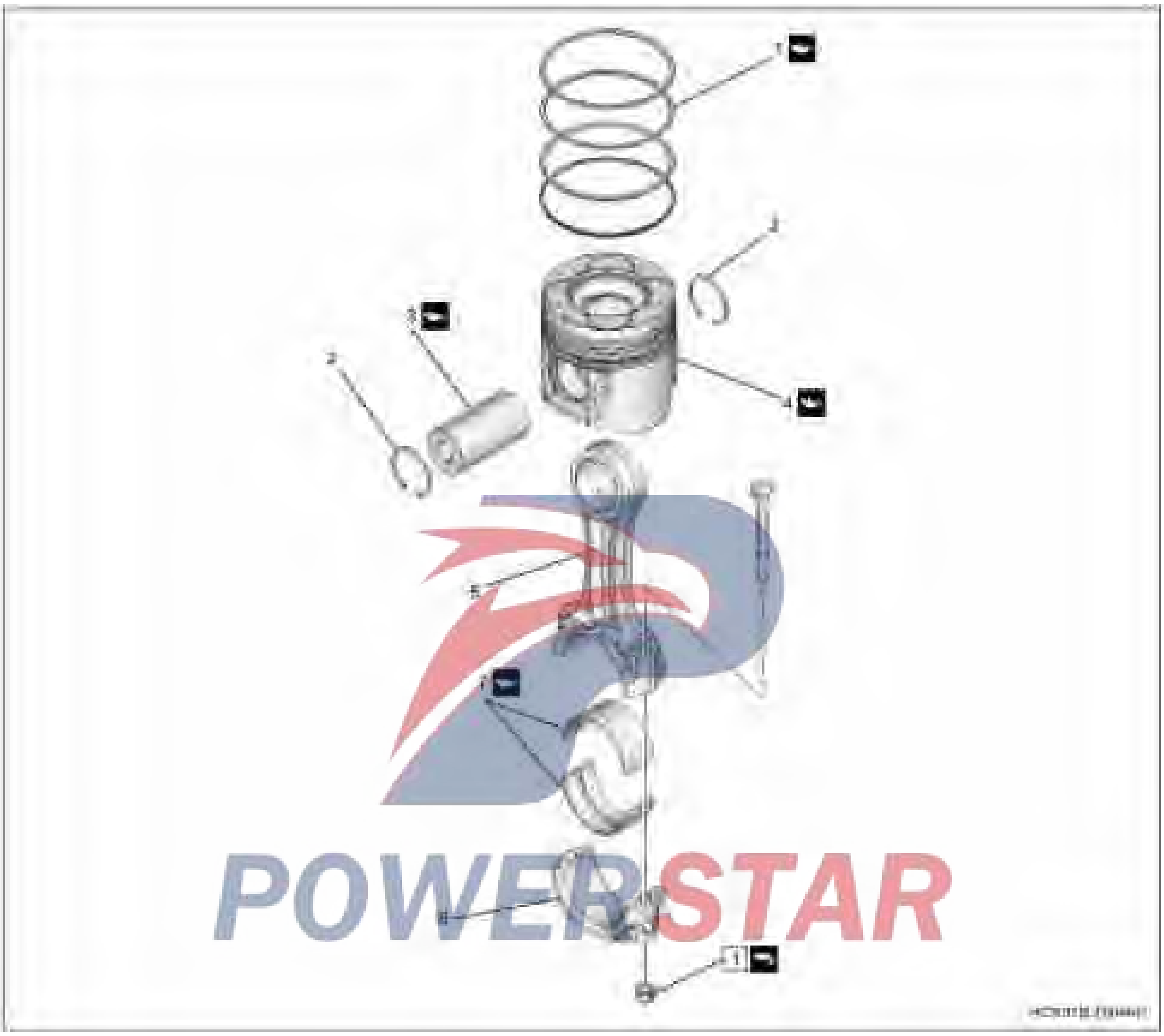
Removal

1. Component Views

Piston



Part name

1. Piston ring
2. Snap ring
3. Piston pin
4. Piston
5. Connecting rod.
6. Rod bearing cover
7. Connecting rod bearing

Tightening torque

1-1: 98 N • m {10.0 kgf • m / 72 lb • ft}

1-2: 30 °

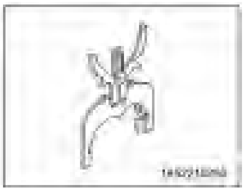
1-3: 30 °

2 piston removal

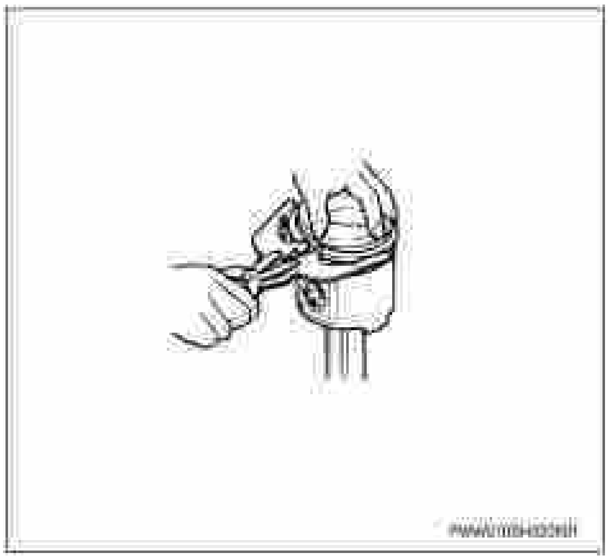
1) Using a special tool, remove the piston ring and oil ring from the piston.

Caution:

● Draw identification marks on the cylinder and on the top surface of the removed piston ring.

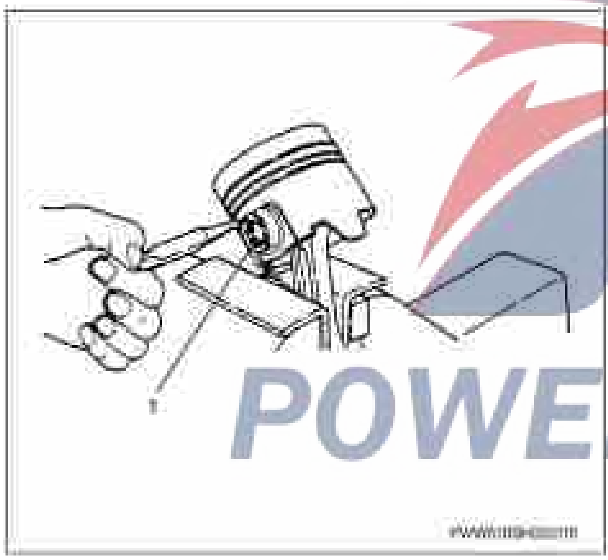


SST: 1-8522-1025-0 -. piston installer



2) Remove the snap ring from the piston.

3) Remove the snap ring from the piston.



1. Piston pin

4) Remove the piston from the connecting rod.

Caution:

● Piston and piston pins are labeled to show their corresponding cylinder numbers.

Inspection

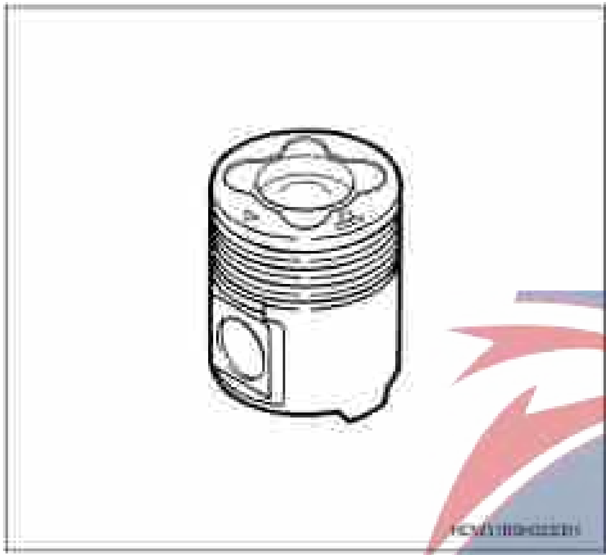
1. Piston inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the piston for scratches and cracks.

Note:

● Dye permeate inspection can also be performed.

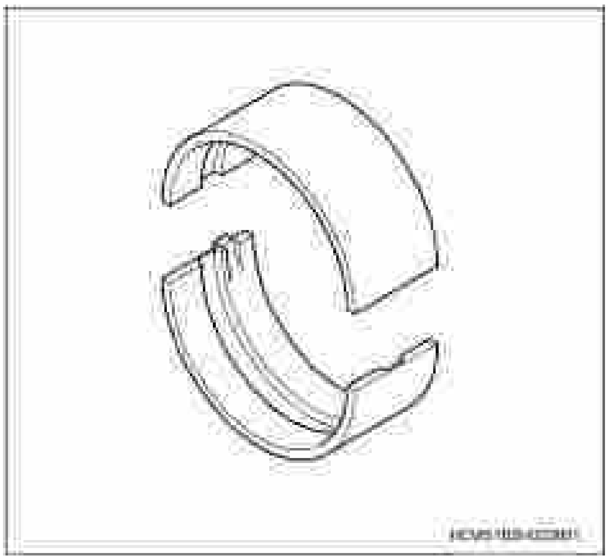


2) Check piston ring for defects, scratches and flaking.

3) Check whether the connecting rod bearing wear, damage or peeling.

Note:

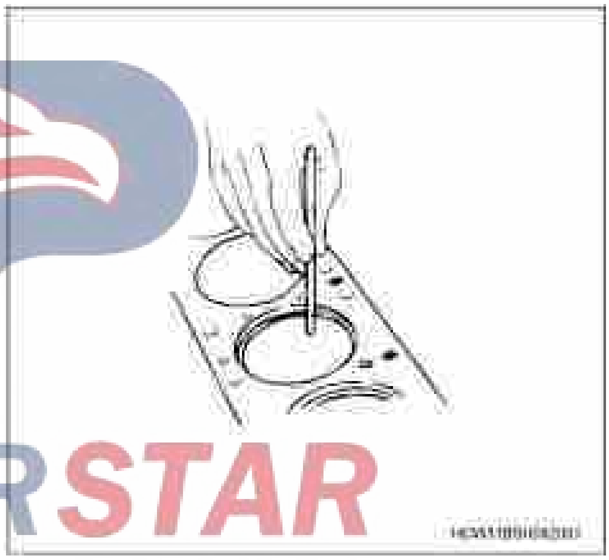
● When assembling, confirm that the bearing also has tension.



4) Using the piston head, push the piston ring down to the bottom of the cylinder liner.

5) Gap gauge measuring piston ring end clearance.

Parts	Specified value	Limit
Top ring	: 0.38 to 0.59mm { 0.0150 to 0.0232 in }	: 1.0 mm { 0.039 in }
Second ring	: 0.83 to 1.04mm { 0.0327 to 0.0409 in }	: 1.5 mm { 0.059 in }
Third ring	: 0.38 to 0.59mm { 0.0150 to 0.0232 in}	: 1.0 mm {0.039 in }
Oil ring	: 0.33 to 0.59mm { 0.0130 to 0.0232 in }	: 1.0 mm {0.039 in }



6) Clean the piston ring groove and the piston ring.

7) Install the piston ring to the piston.

8) Measure the clearance of the piston ring groove and the piston ring using a feeler gauge.

Note:

● Set the piston against the straight edge while using a feeler gauge to measure the top ring clearance.

Parts	Specified value	Limit
Top ring	: 0.077 to 0.117mm { 0.00303 to 0.00461 in}	-
Second ring	: 0.085 to 0.120mm { 0.00335 to 0.00472 in }	-

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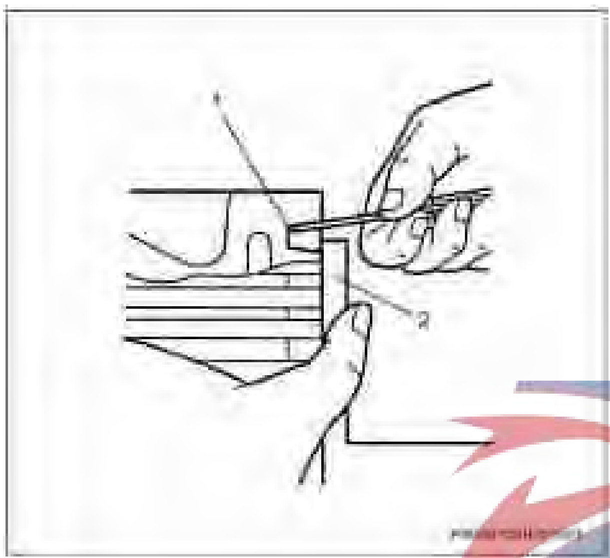
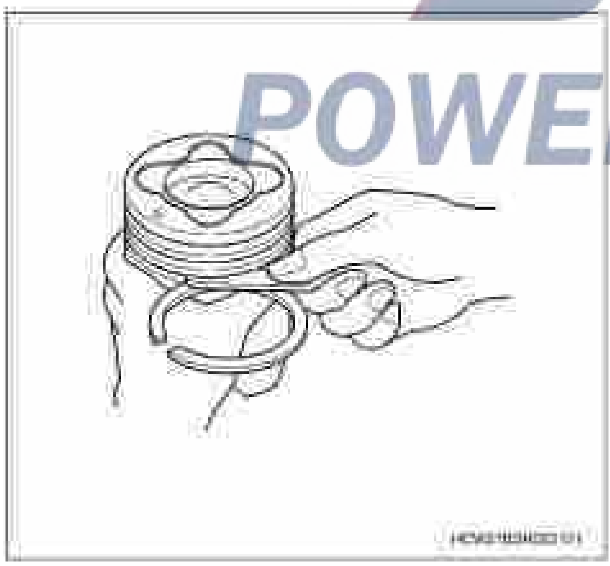
Third ring	: 0.085 to 0.120mm { 0.00335 to 0.00472 in }	-
Oil ring	: 0.025 to 0.065mm { 0.00098 to 0.00256 in }	: 0.15 mm { 0.0059 in }



1. Gauge rules
2. Straight edge

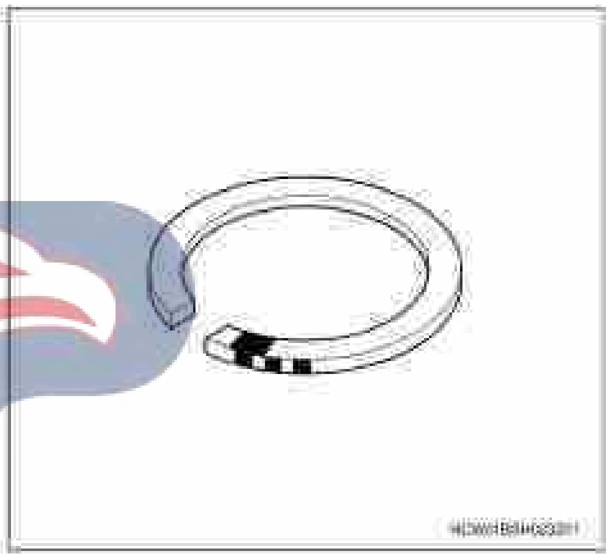


9) Tension meter measuring piston ring tension.

Note:

● Measure the oil ring after installing the coil stretcher.

Parts	Specified value	Limit
Top ring	: 27.5 to 41.2N { 2.8 to 4.2kg / 6 to 9lb }	: 24.5 N { 2 kg / 6 lb }
Second ring	: 22.8 to 34.1N { 2.3 to 3.5kg / 5 to 81 b }	: 19.6 N { 2 kg / 4 lb }
Third ring	: 28.1 to 36.6N { 2.9 to 3.7kg / 6 to 81 b}	: 19.6 N { 2 kg / 4 lb}
Oil ring	: 46.3 to 57.7N { 4.7 to 5.9kg / 10 to 131 b }	: 39.2 N { 4 kg / 9 lb }



10) Use a micrometer to measure the piston pin in the 6 positions shown in the figure.

Standard: 56 mm {2.205 in}

Limit: 55.97 mm {2.2035 in}

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11) Based on the measured values, calculate the clearance between the piston and the piston pin.

Parts	Specified value	Limit
Clearance between piston pin and pin hole	: 0.008 to 0.021mm { 0.00031 to 0.00083 in }	: 0.05 mm { 0.0020 in }
Clearance between piston pin and connecting rod bushing	: 0.020 to 0.037mm { 0.00079to 0.00146 in }	-

12) Measure the outer diameter of the piston at the measuring point.

Specified part: 30 mm {1.18 in} From the underside of the piston skirt in the direction of the larger diameter

Level code	Piston outer diameter
A	: 146.850 to 146.879mm { 5.78148to 5.78263 in }
B	: 146.860 to 146.890mm { 5.78188to 5.78306 in}
C	: 146.871 to 146.900mm { 5.78231to 5.78345 in}

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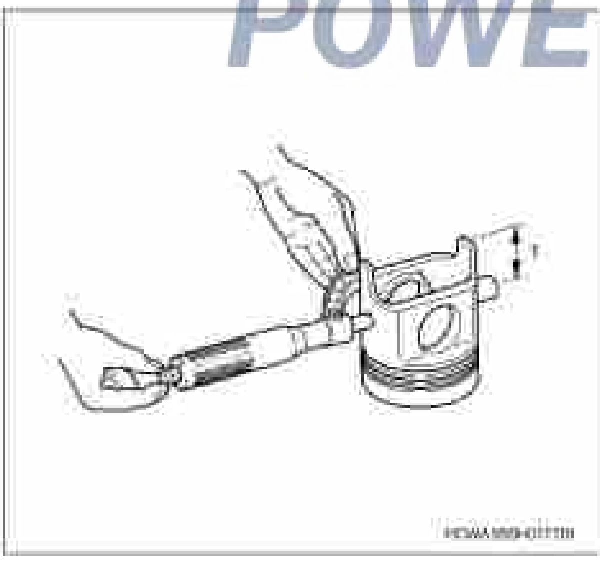


1. 30 mm {1.18 in} (from piston skirt bottom surface)

13) Remove any carbon adhering to the liner.

14) Measure the inner diameter of the bushing at the measuring position.

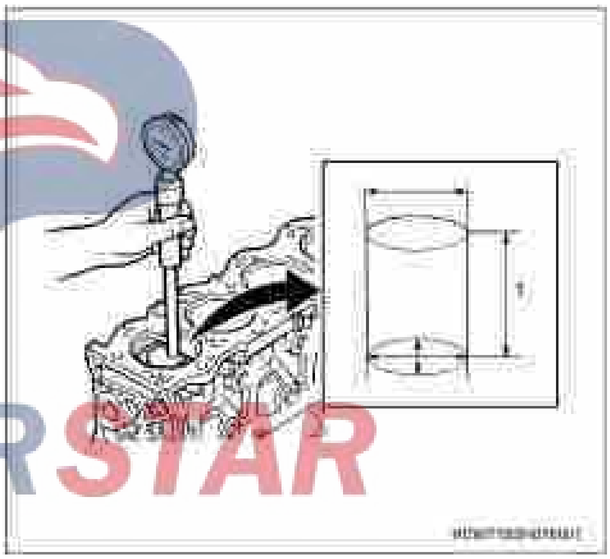
Note:

● Measure maximum and minimum averages.

● When replacing only the bushing, select it according to the grade.

Specified part: 130 mm {5.12 in} from top of cylinder liner

Level code	Pad diameter
A	: 147.000 to 147.010mm { 5.78739to 5.78778 in }
B	: 147.011 to 147.020mm { 5.78782to 5.78818 in }
C	: 147.021 to 147.030mm { 5.78822to 5.78857 in }



1. 130 mm {5.12 in}

15) Based on the measured values, calculate the clearance between the piston outer diameter and the liner inner diameter.

Standard: 0.121 to 0.160mm {0.00476 to 0.00630 in}

2. Rod inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Clean the bearing and bearing mounting surface.

2) Install the bearing on the connecting rod and connecting rod cover.

3) Apply molybdenum disulfide grease to the surface of the base and to the threaded portion of the mounting bolt.

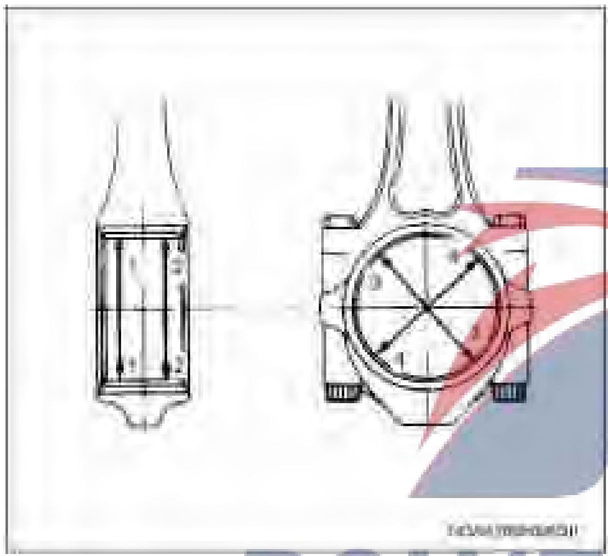
4) Install the bearing cap on the connecting rod.

Tightening torque: 98 N • m {10 kgf • m / 72 lb • ft} The first time

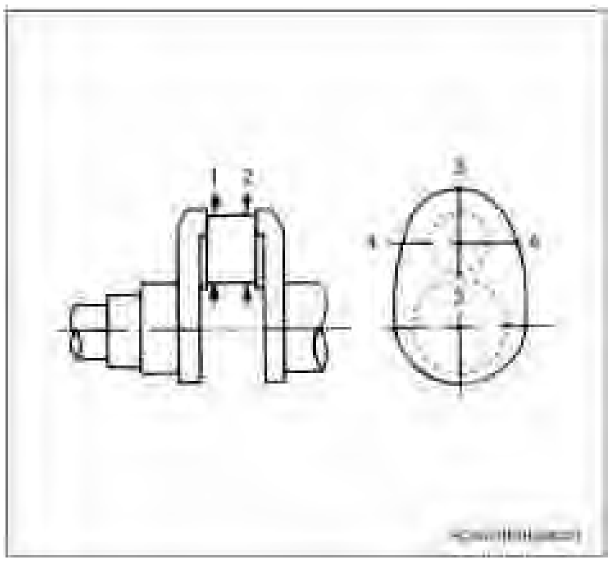
Prescribed angle: 30 ° second

Prescribed angle: 30 ° the third time

5) The bore diameter gauge is used to measure the inner diameter of the connecting rod in 4 positions as shown in the figure.



6) Using a micrometer, measure the outer diameter of the crankpin at the four positions shown in the figure.



7) Calculate the clearance between the connecting rod big end diameter and the crankpin diameter.

Note:

● It is also possible to measure with a plastic gap strip.

Caution:

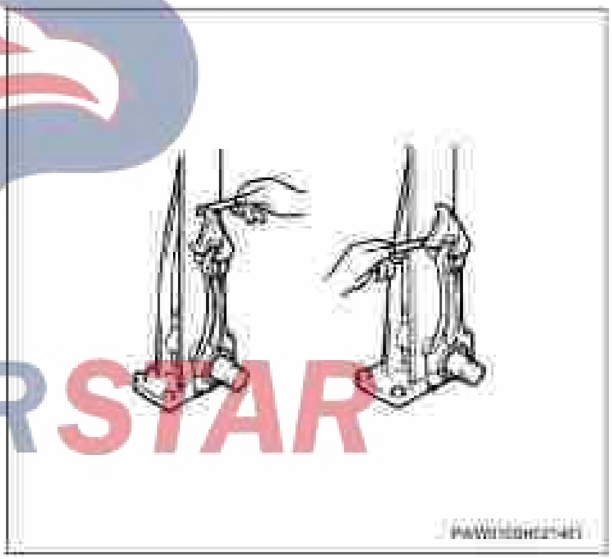
● Since the crankshaft has been nitrided, do not carry out repairs.

Standard: 0.033 to 0.103 mm {0.00130 to 0.00406 in}

8) Mount the unthreaded bearing on the connecting rod.

9) Connecting rod calibrator to measure the parallelism of connecting rod.

Standard: 0.05 mm {0.0020 in}



10) Clean the bearing and bearing mounting surface.

11) Install the bearing on the connecting rod and connecting rod cover.

12) Apply molybdenum disulfide grease to the base surface and the threaded part of the mounting bolt.

13) Install the connecting rod on the crankpin.

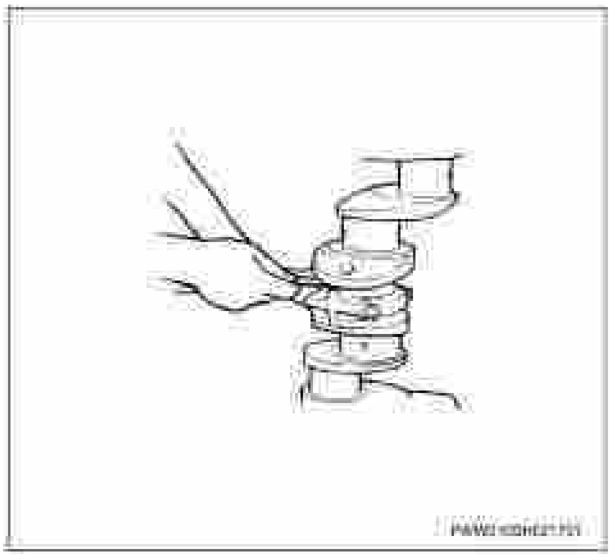
Tightening torque: 98 N • m {10 kgf • m / 72 lb• ft} The first time

Prescribed angle: 30 ° second

Prescribed angle: 30 ° the third time

14) Measure the axial clearance of connecting rod and crankshaft with feeler gauge.

Standard: 0.175 to 0.290 mm {0.00689 to 0.01142 in}



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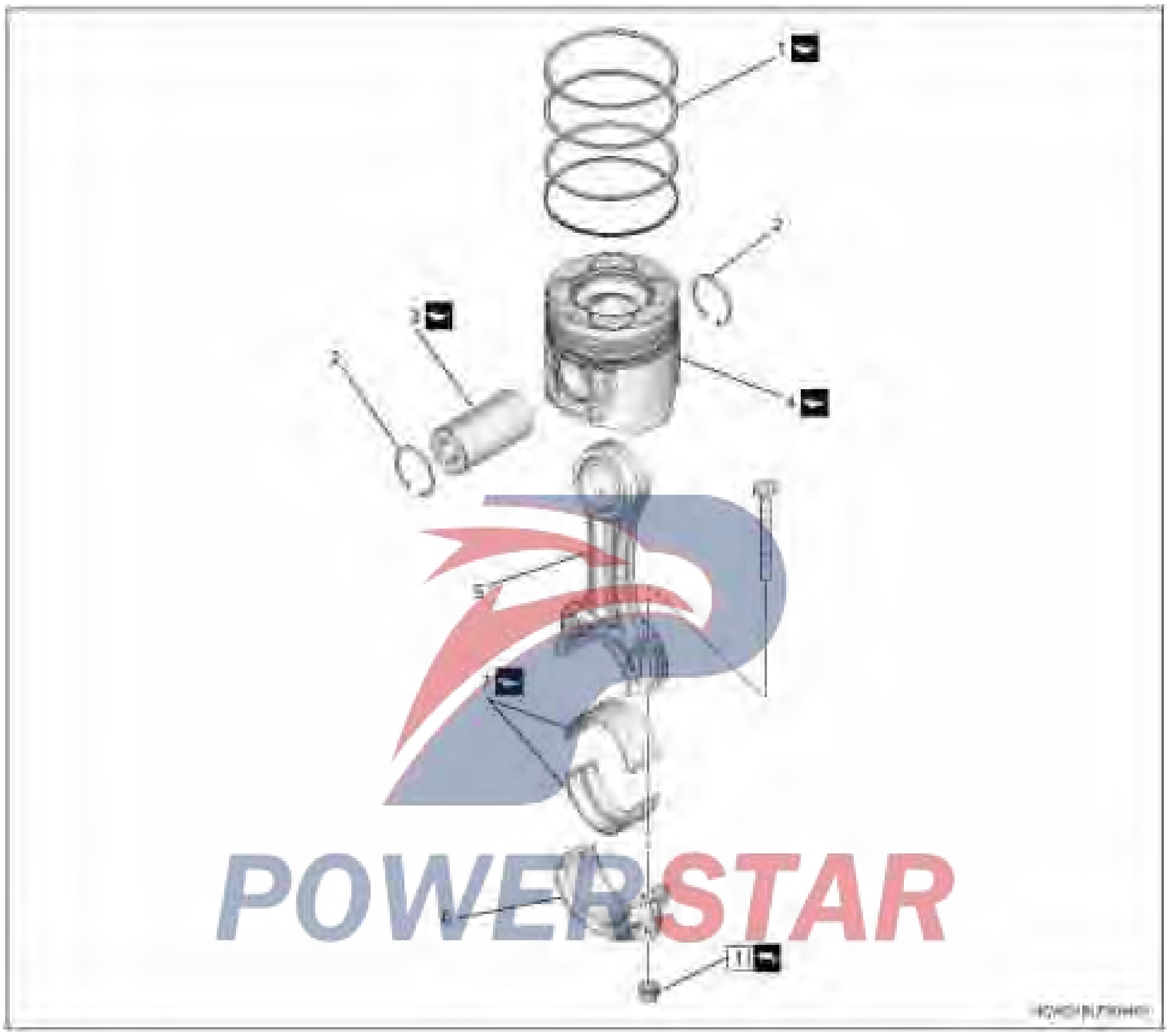
Reassembly

1. Component Views

Piston



Part name

1. Piston ring
2. Snap ring
3. Piston pin
4. Piston
5. Connecting rod.
6. Rod bearing cover
7. Connecting rod bearing

Tightening torque

1-1: 98 N • m {10.0 kgf • m / 72 lb • ft}

1-2: 30 °

1-3: 30 °

2. Piston reassembly

When using a new piston, be sure to use the specified replacement piston, regardless of the grade factor when replacing the piston.

1) Apply the engine oil to the piston pin.

2) Align the piston to the connecting rod.

Caution:

● Install the piston head arrow mark in the same orientation as the front face of the connecting rod.

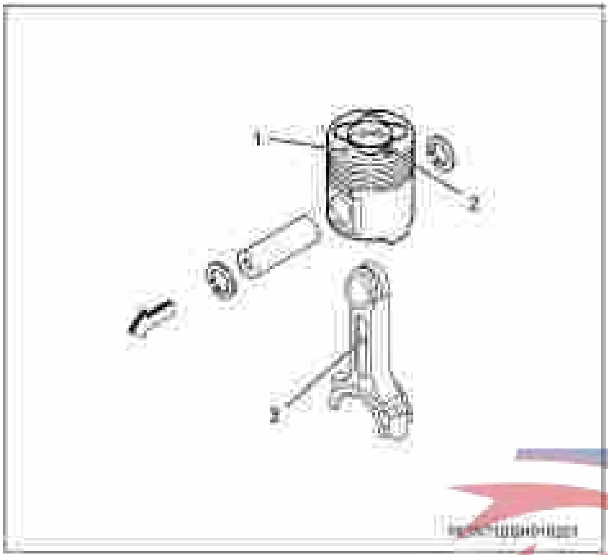
3) Install the piston pin to the piston and the connecting rod.

4) Install the snap ring to the piston.

Caution:

● Verify that the snap ring securely fits into the piston groove and that the piston and connecting rod move smoothly.

● Make sure the locking ring is open upward or downward.



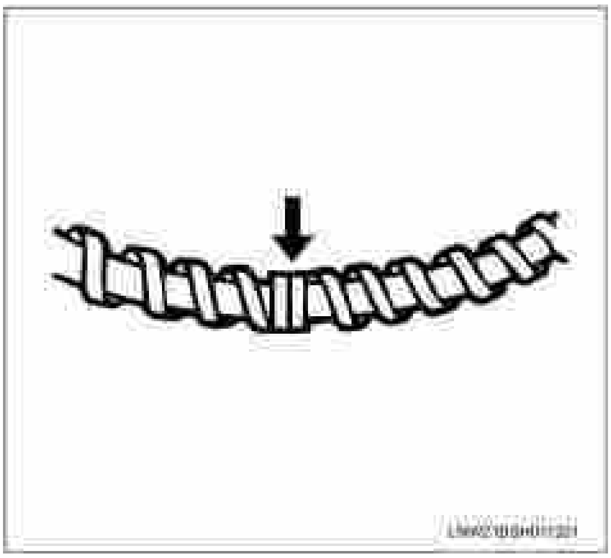
1. Arrow mark
2. Level classification
3. Front mark

5) Install the oil ring on the piston.

Caution:

● The angle between the end of the oil ring and the end of the coil should be 180 °, opposite each other.

● Install in such a way that there is no opening in the end ring section of the expansion ring.



6) Use special tools to install the following parts on the piston.

● Top ring

● Second ring

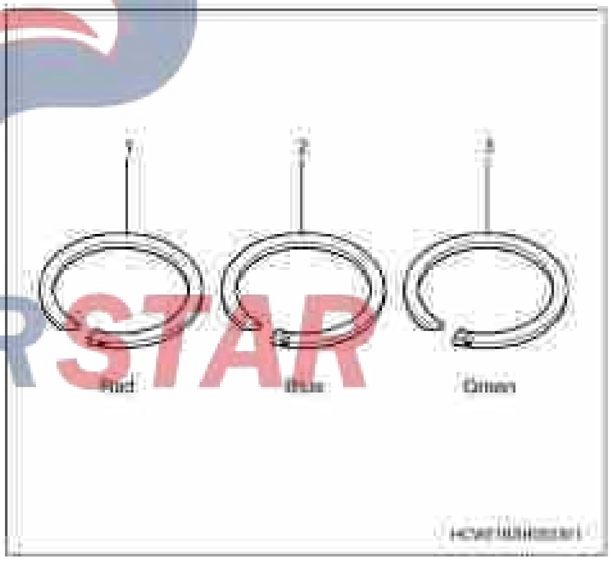
● Third ring

Note:

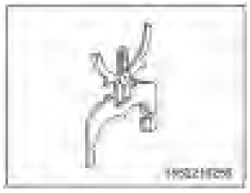
● Install the top ring, the second ring, and the third ring and place the end-of-segment identification color on the right.

● Mark the sides of each end gap to identify the top, second, and third rings.

	Logo	Top and bottom
Top ring	Red paint	No mark
Second ring	Blue paint	2 N
Third ring	Green spray paint	3 N



1. Top ring
2. Second ring
3. Third ring



SST: 1-8522-1025-0 -. piston installer

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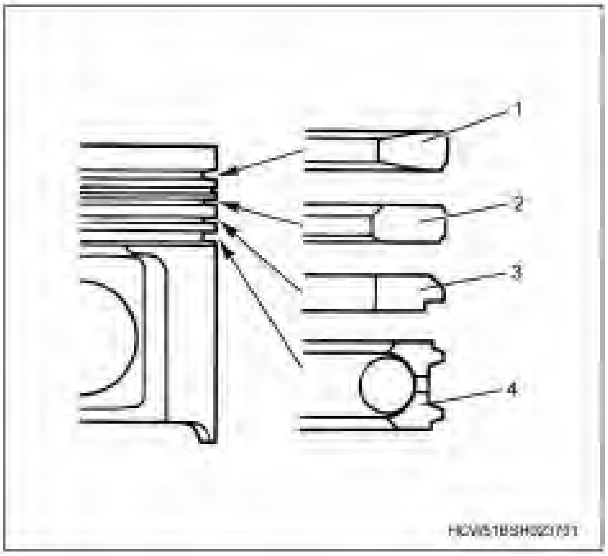


1. Top ring
2. Second ring
3. Third ring
4. Oil ring

7) Apply engine oil to the entire circumference of each seal ring and then rotate the seal ring.

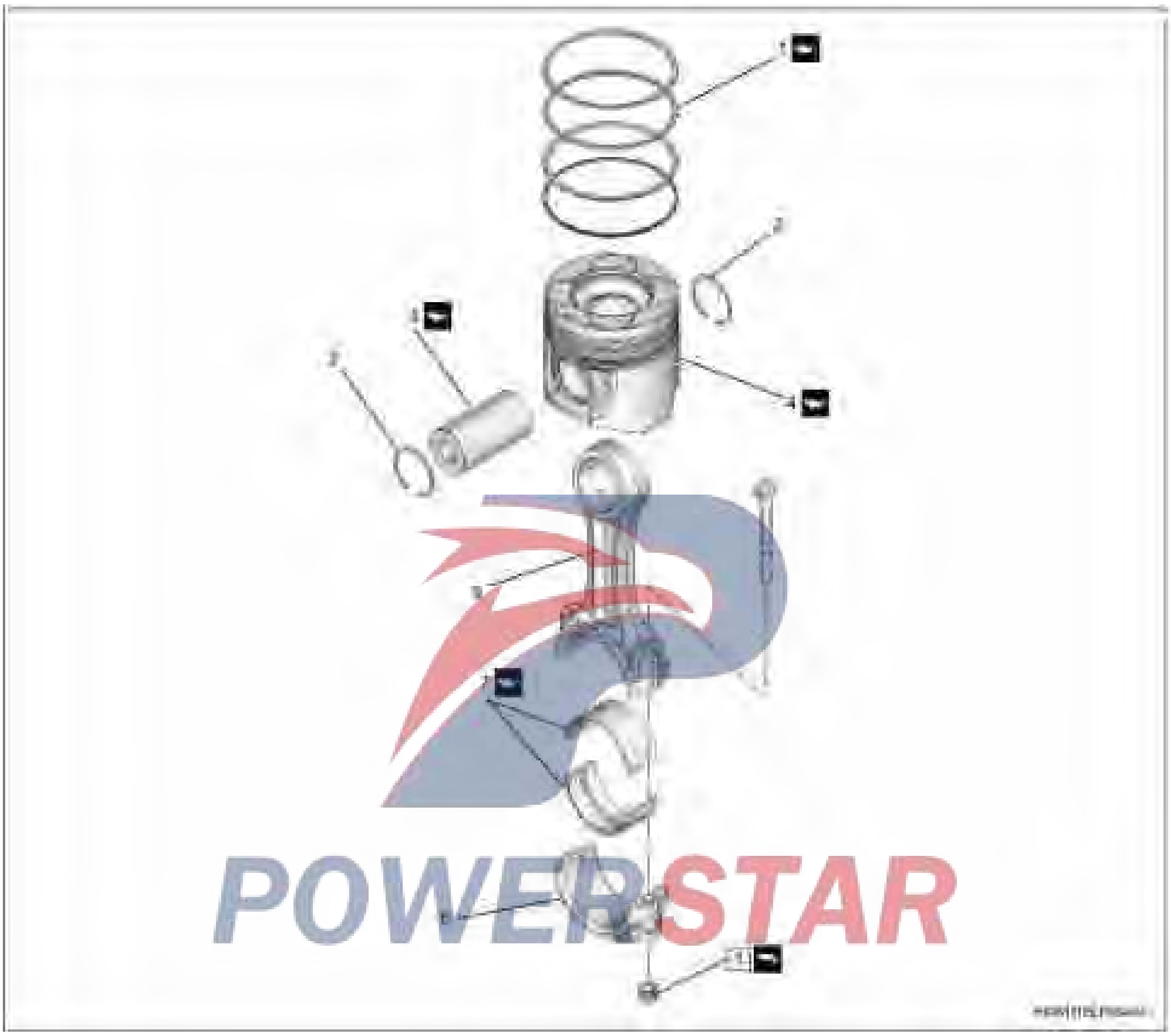
Caution:

● Check if the rotation is stable and unimpeded.

Installation

1. Component Views

Piston



Part name

1. Piston ring
2. Snap ring
3. Piston pin
4. Piston
5. Connecting rod.
6. Rod bearing cover
7. Connecting rod bearing

Tightening torque

1-1: 98 N • m {10.0 kgf • m / 72 lb • ft}

1-2: 30 °

1-3: 30 °

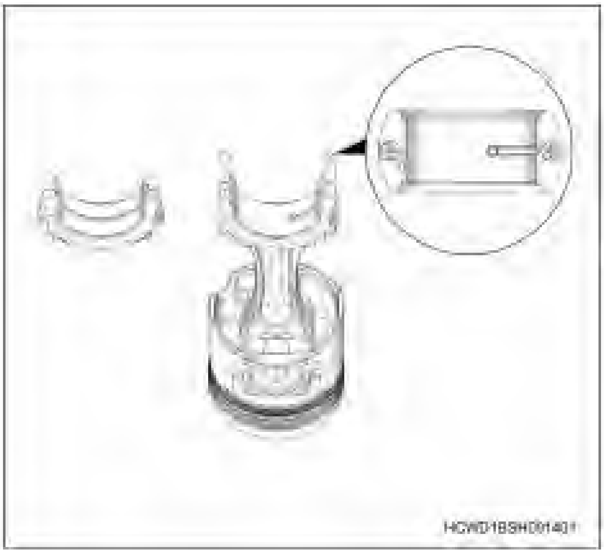
2. Piston installation

1) Clean the rod connecting rod bearing mounting surface and cover.

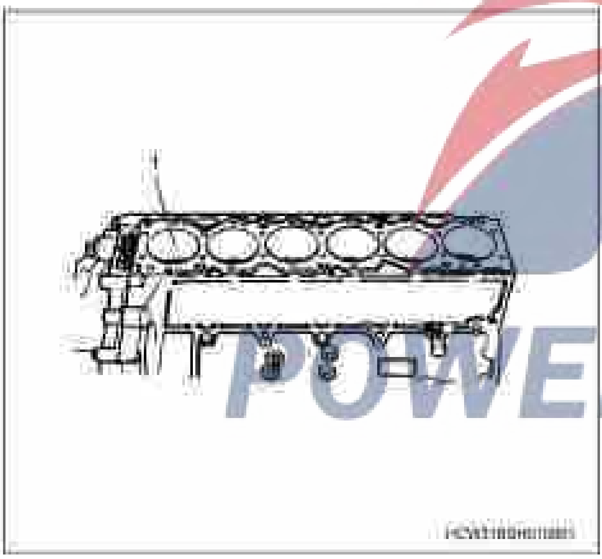
2) Inspect the entire outer edge of the bearing for oil grooves and attach the rod bearing to the end cap.

3) Check the bearing for the presence of local grooves and oil holes, and then install the connecting rod bearing on the connecting rod.

4) Coat the sliding surface of the rod bearing with engine oil.



5) Apply engine oil to cylinder liner.

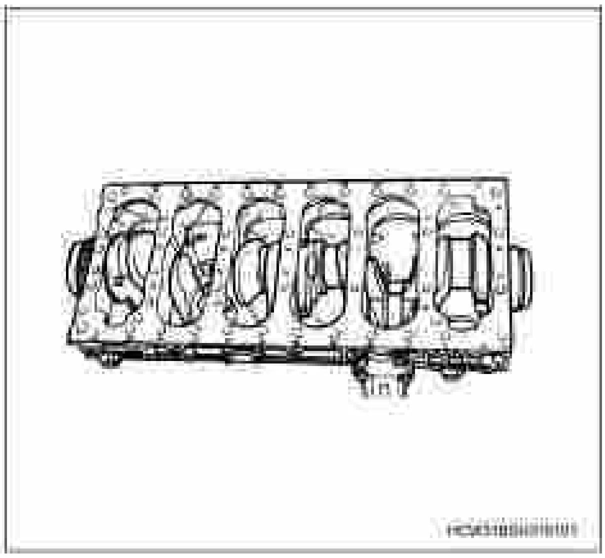


1. Cylinder liner

6) Align the cylinder piston pin of the fitted piston with the top dead center.

Caution:

● Attach stop to avoid bushing protrusion.



7) Avoid positioning the piston ring end clearance in the direction of the side pressure. Rotate the piston ring to create a 90 ° clearance on the cover.

Caution:

● Install the oil ring end cap on the opposite side of the expansion ring end cap.

8) Apply engine oil to the entire circumference of the piston and piston ring.

9) Use special tools to attach the piston to the cylinder block.

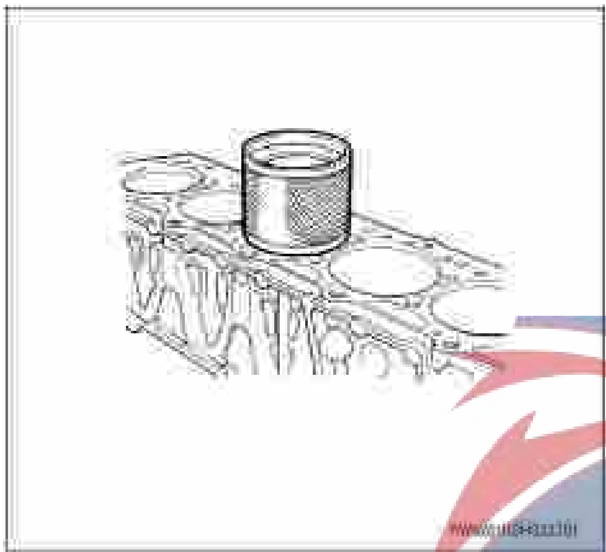
Caution:

● Carefully install the piston.

● Special tools are fastened to the cylinder block for ease of use.

● Do not damage the crankpin and nozzle when inserting the piston.

SST: 1-8522-0059-0 -. piston installer

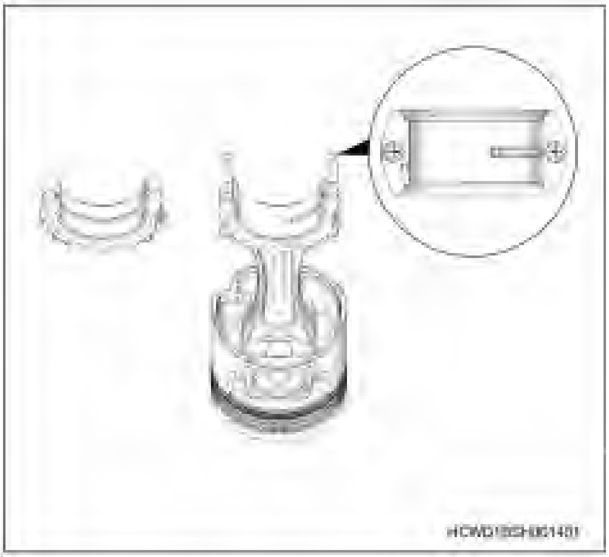


10) Align the connecting rod and cylinder head according to the number of cylinders, and then attach the connecting rod to the crankshaft.

Caution:

● Install in such a way that the mark faces the right side of the cylinder block.

11) Apply molybdenum disulphide grease to the screw thread on the base surface and the rod end cap mounting nut.



12) Install the rod bearing cap on the connecting rod.

Tightening torque: 98 N • m {10 kgf • m / 72 lb • ft} The first time

Prescribed angle: 30 ° second

Prescribed angle: 30 ° the third time

Tightening torque: 137 N • m {14 kgf • m / 101 lb • ft}

Confirm again

Caution:

● Angle tolerance should be 60 - 90 °.

13) Install the crankshaft.

Note:

● Confirm that the crankshaft is running smoothly.

Caution:

● Attach stop to avoid bushing protrusion.

14) Confirm that the piston nozzle is not deformed.

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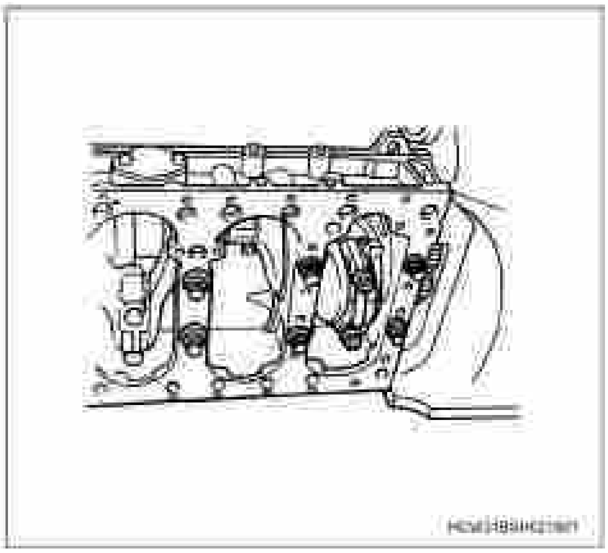
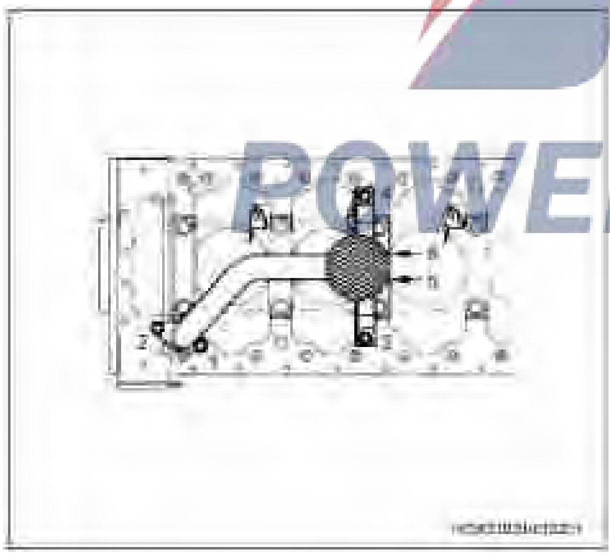


3. Oil strainer installed

1) Temporarily fasten the bracket to the cylinder block.

2) Install the oil strainer and O-ring onto the cylinder block in numerical order in the figure.

Tightening torque: 49 N • m { 5.0 kgf • m / 36 lb • ft }



4. Oil pan installation

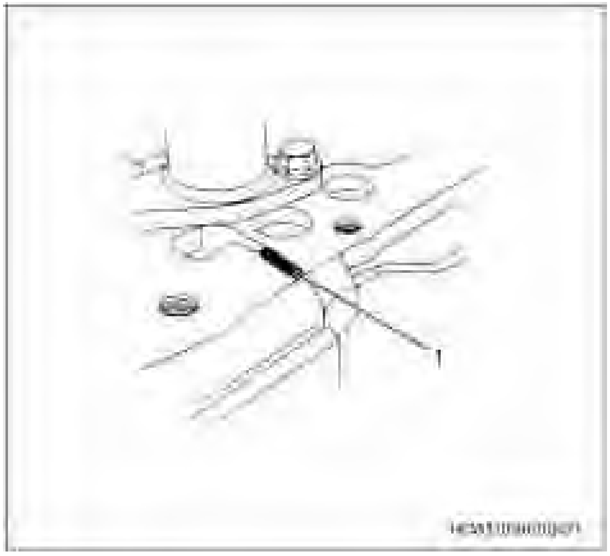
1) Apply the liquid gasket to the cylinder block.

Note:

● Three key 1207B with a coating thickness of 3 - 4 mm {0.118 - 0.157 in} and a width of 3-4 mm {0.118 - 0.157 in} on the locating surface of the flywheel housing, gearbox and cylinder block.

Caution:

● Clean the application surface of the gasket before applying the gasket.



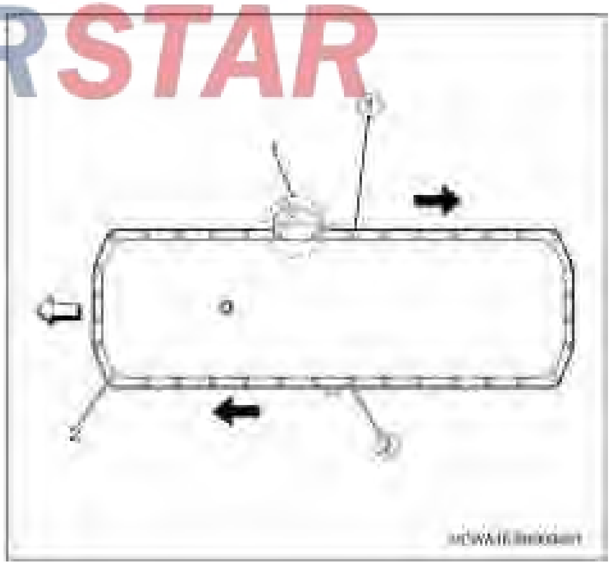
1. Liquid gasket

2) Install the oil pan to the cylinder block in the order of numbers and arrows shown in the diagram.

Caution:

● After tightening all the bolts, tighten all the bolts again with the specified torque from the first tightened bolt.

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}



1. M10×35

2. M10×20

3) Install the left and right flywheel housing brackets onto the cylinder block and flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb •

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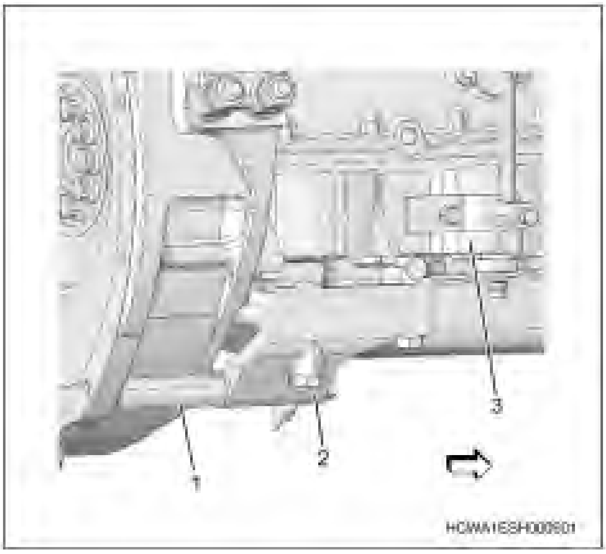
ft}



1. Flywheel housing
2. Flywheel housing bracket
3. Cylinder block

5. Cylinder head installation

1) Use a doctor blade to clean the cylinder block upper surface and cylinder head lower surface.

Caution:

● Carefully clean the cylinder block upper surface and the cylinder head lower surface, taking care not to damage the components.

2) Refer to the diagram and the table, and apply the liquid gasket to the cylinder block.

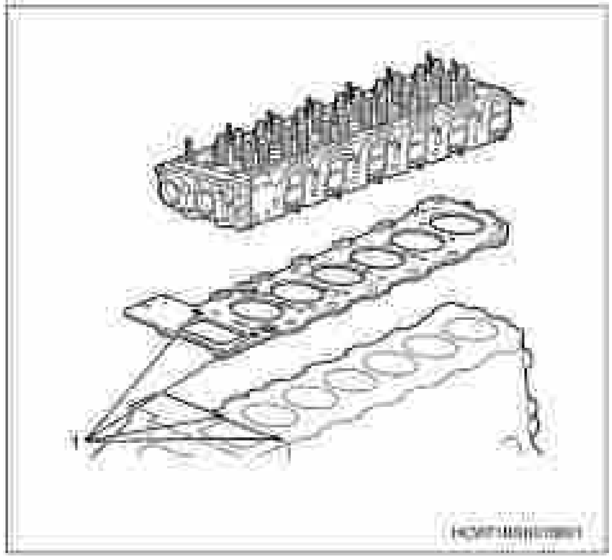
Caution:

● Strictly adhere to the liquid gasket application thickness and application width guidelines.

● After applying the liquid gasket, immediately install the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: 2 mm { 0.08 in}
	Coating width	: 5 mm { 0.20 in }



1. Liquid gasket application area

3) Install the cylinder head gasket to the cylinder block.

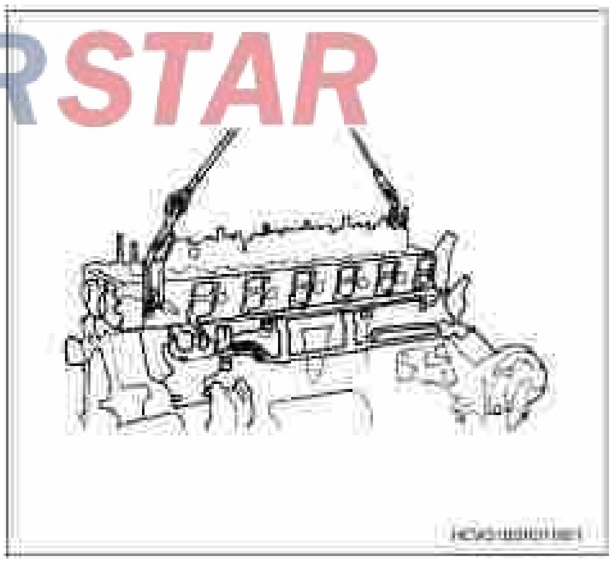
Caution:

● Do not reuse the cylinder head gasket.

4) Carefully align the knock pin positions, and place the cylinder head on the cylinder block.

Caution:

● Check the engagement of the idle gears.



5) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

Caution:

● Never use M12 bolts or M10 bolts.

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6) Mount the cylinder head mounting bolts to the cylinder head in the order shown in the figure.

Caution:

- Do not drip foreign matters into the timing gear hole.
- Cylinder head mounting bolts can be used up to 4 times.

Tightening torque: 177 N • m {18.0 kgf • m / 131 lb • ft} 1st (M18)

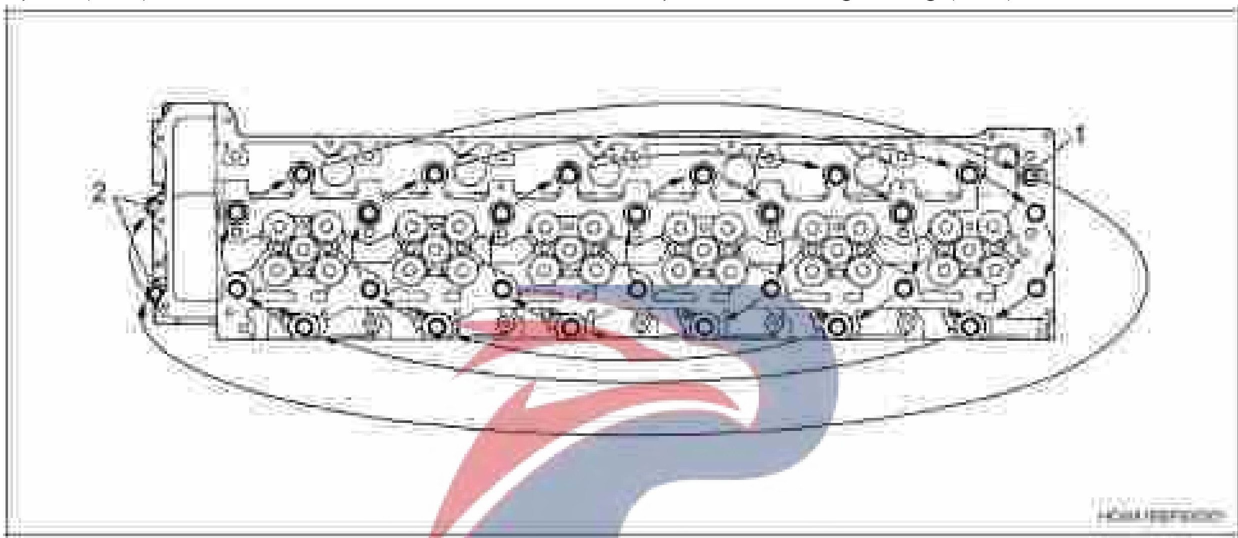
Tightening torque: 245 N • m {25.0 kgf • m / 181 lb • ft} 2nd (M18)

Tightening angle: 60 to 90 ° Third time (M18)

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft} 4th (M12)

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft} 5th (M10)

Tightening torque: 324 N • m {33.0 kgf • m / 239 lb • ft} Confirm the tightening (M18)



1. M12 bolt
2. M10 bolt

7) Remove special tool from the cylinder head.

SST: 8-9761-4276-0 - engine hanger

1. 8-9761-4276-0

6. Glow plug installation

1) Install the glow plug to the cylinder head.

Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft}

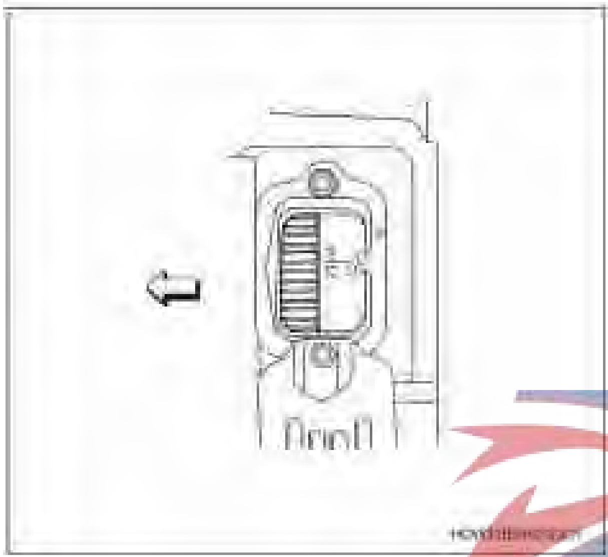
POWER STAR

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m {0.15 kgf • m / 13 lb • in}

7. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.

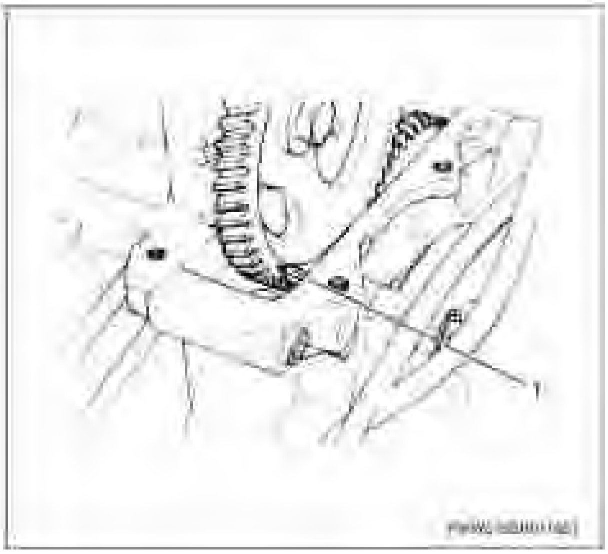


2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.



1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

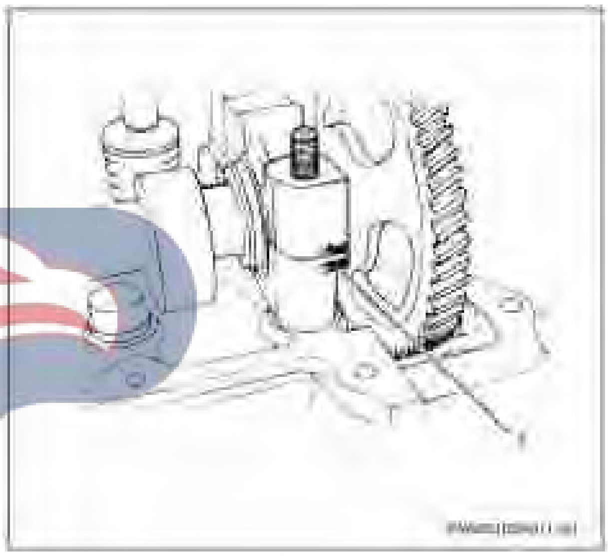
Note:

● Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.



1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m {7.7 kgf • m / 56 lb • ft}

8. Bridge installation

1) Apply the engine oil to the bridge guide.

2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.

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1. Bridge

9. Rocker arm shaft installation

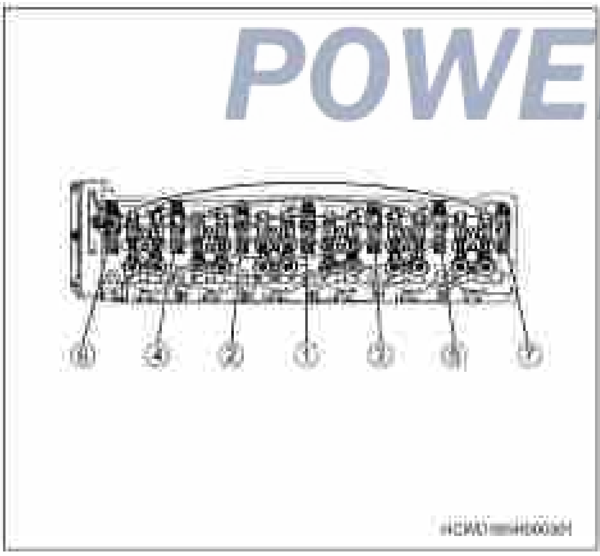
1) Lubricate the roller arm and adjusting screw lip with engine oil

2) Loosen the adjust screw.

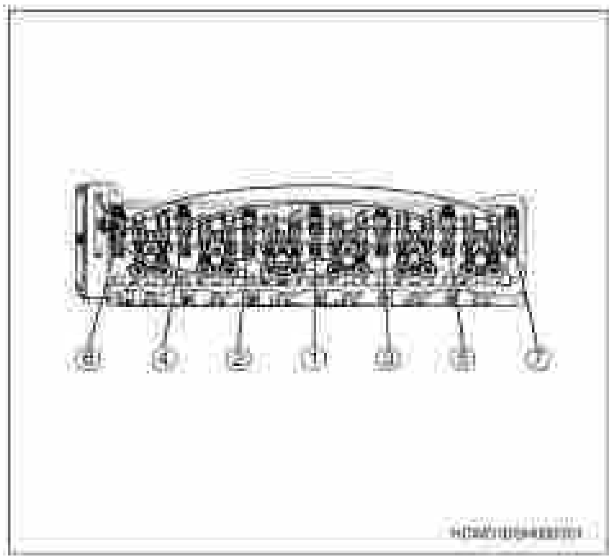
Note:

● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 lb • ft}

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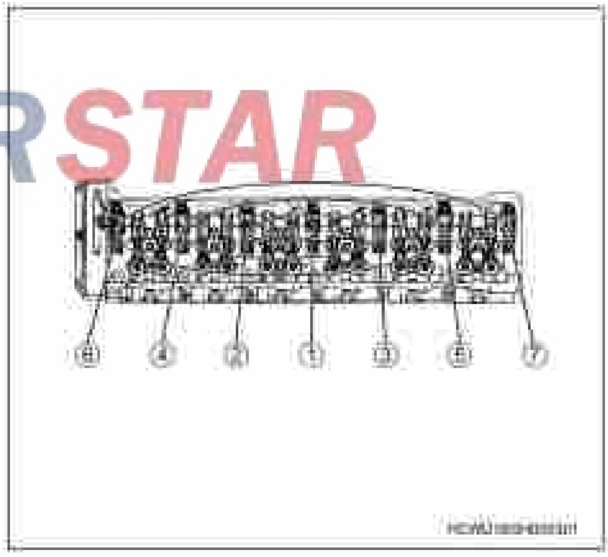


10. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

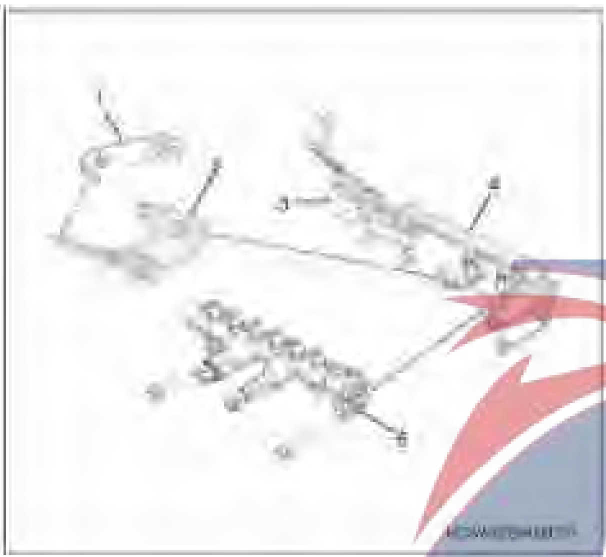
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

4) Connect the harness connector to the fuel rail position sensor.

11. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.

1. Fuel pipe
2. Fuel pipe
3. Clip

12. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

Note:

● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.

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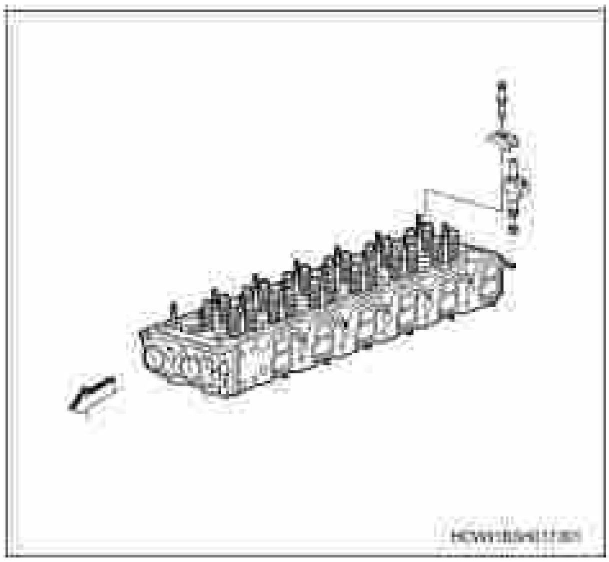
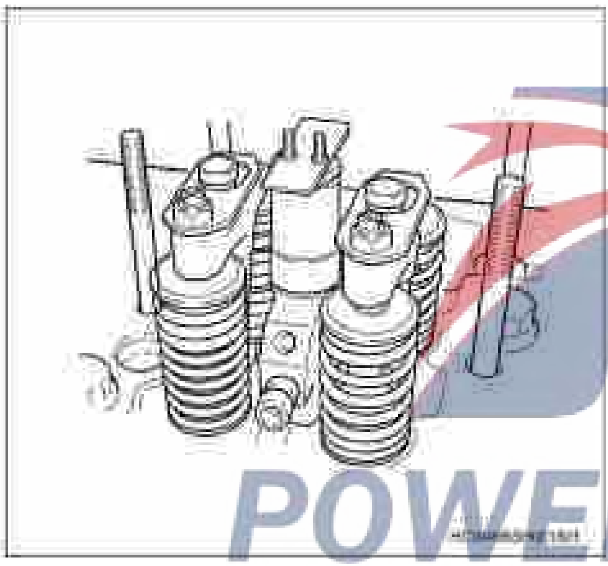




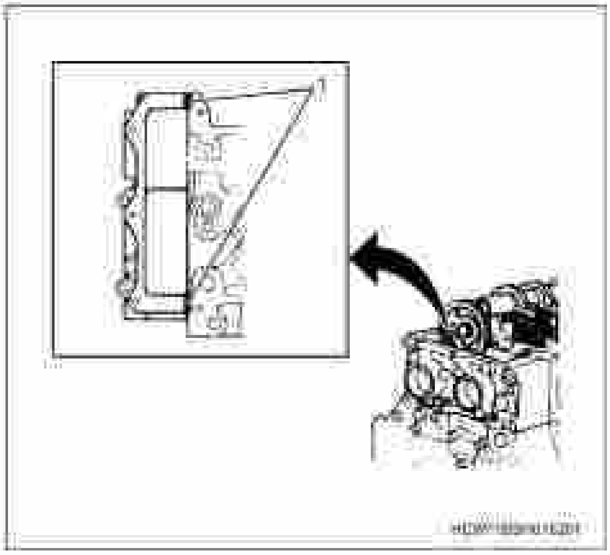
3) Temporarily fasten the injector clamp on the injector.

13. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

3) Install the lower end cap onto the cylinder head.

Tightening torque: 15 N • m { 1.5 kgf • m / 11 lb • ft }

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}

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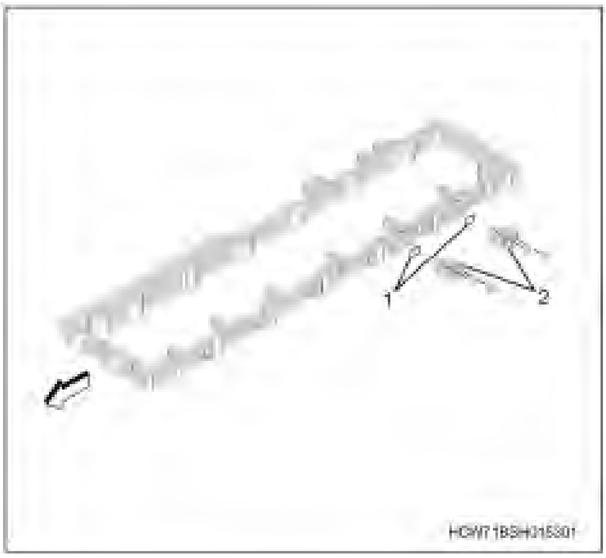


1. O-ring

2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

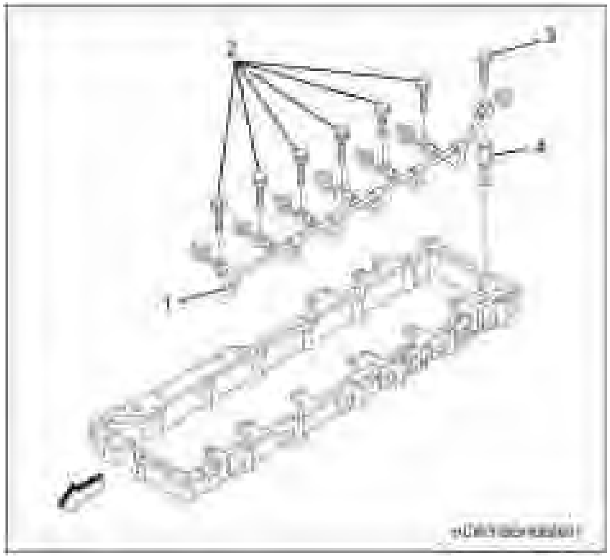
● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 25 lb • ft}



1. Nozzle spout

2. Eyebolt

3. Eyebolt

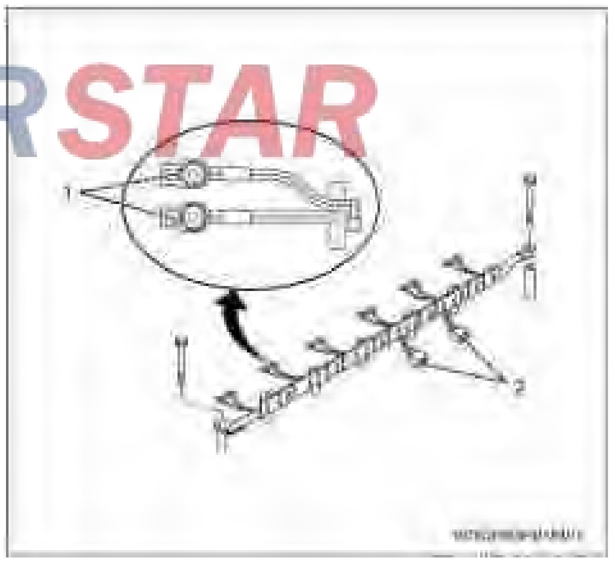
4. Adapter

14. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut

2. Connector

2) Install the injector harness onto the cylinder head.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

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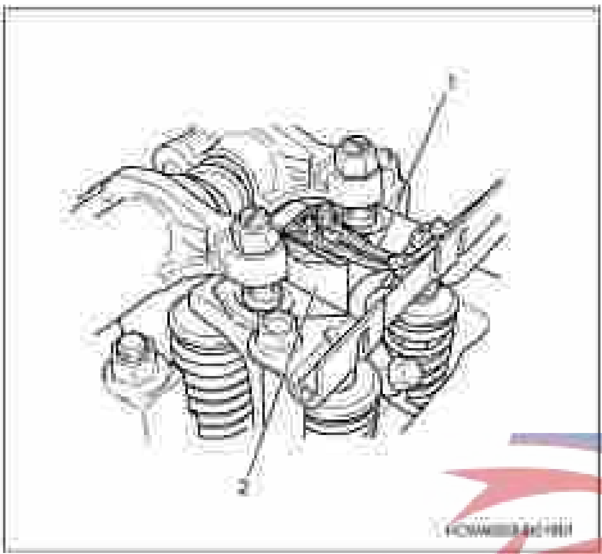
3) Connect the injector terminal nut to the injector.

Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



1. Injector harness
2. Injector

15. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

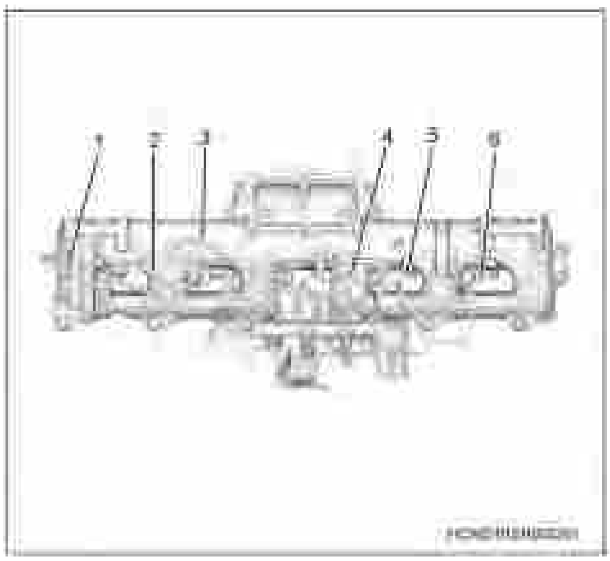
Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



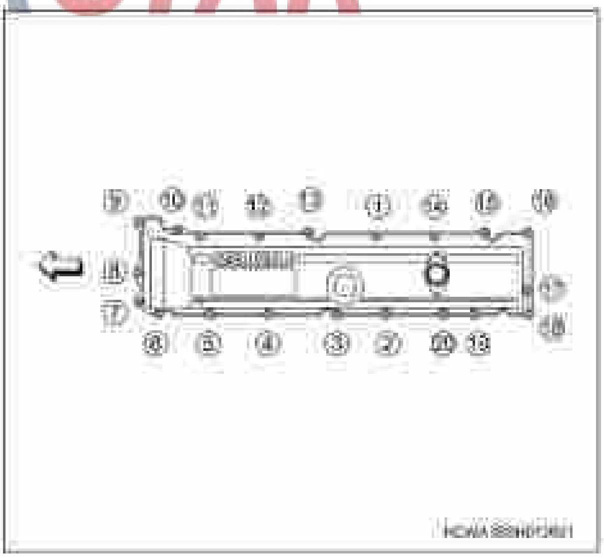
1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

16. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



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17. Generator Bracket Installation

1. 50 A and 60 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

2. 90 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

Note:

● When installing, make the right side of the oval hole area of the bracket contact with the bolt.

18. Starter motor installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m / 61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

19. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

20. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

21. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

Cooling fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394 to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551 to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394 to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512 to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

Standard: 98 N { 10.0 kg / 22 lb }

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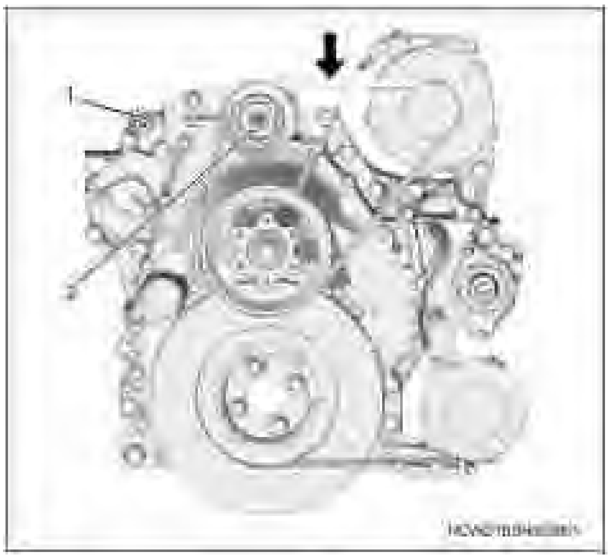
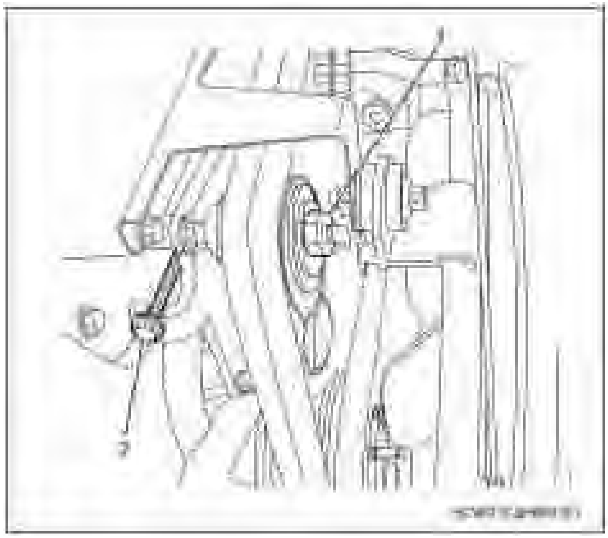


1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m { 15.0 kgf • m / 108 lb • ft }



1. Lock nut
2. Adjust bolt

22. A/C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A/C compressor pulley and crankshaft pulley to the specified value.

If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A/C compressor pulley and the crankshaft pulley.

Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0to 40.0kg }
deviation	: 11 to 14mm { 0.4 to 0.6 in }	: 15 to 17mm { 0.6to 0.7 in }
frequency	: 102 to 126Hz	: 90 to 102Hz

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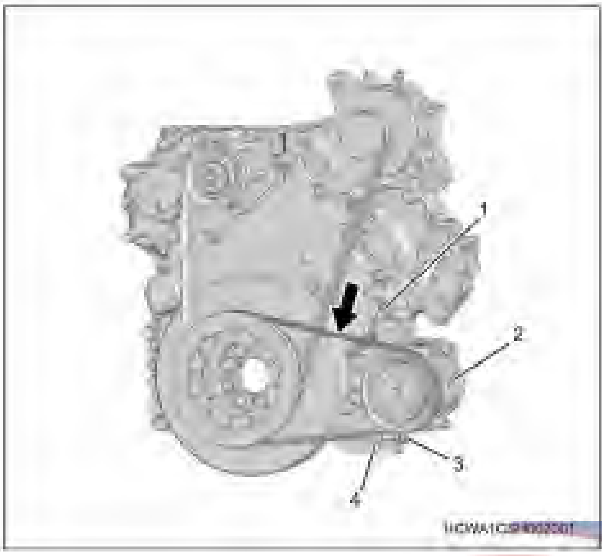
1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A / C compressor belt.

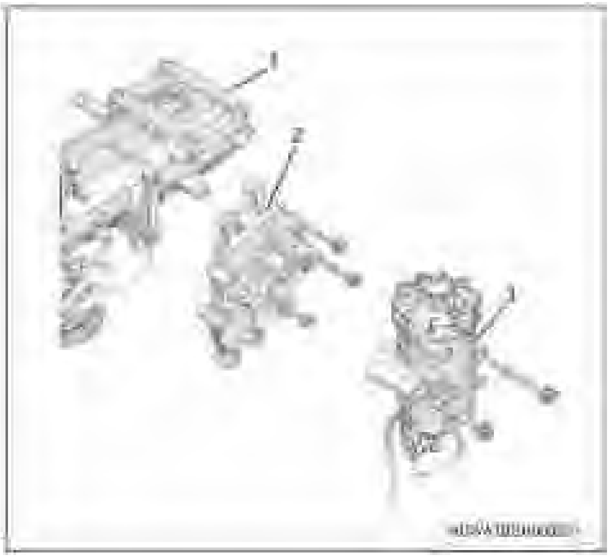
23. Oil filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

24. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

25. Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

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3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

26. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

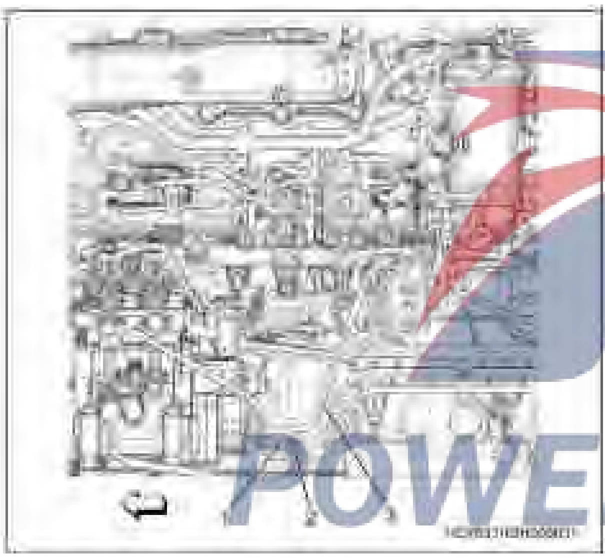
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

27. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

28. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

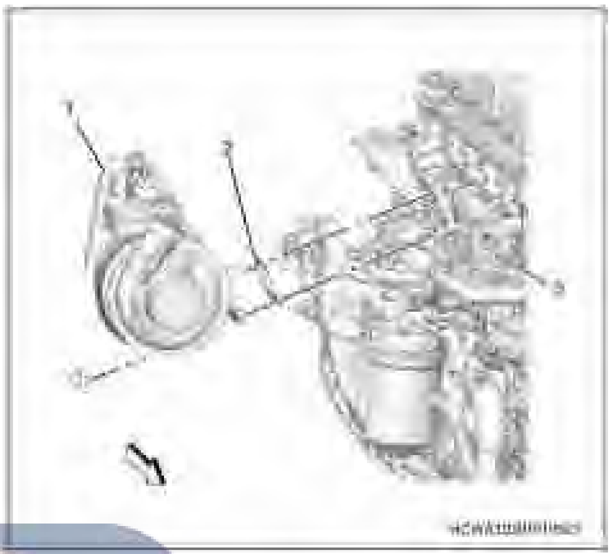
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}



1. Turbocharger
2. Gasket
3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

6) Connect the water return pipe to the turbocharger.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

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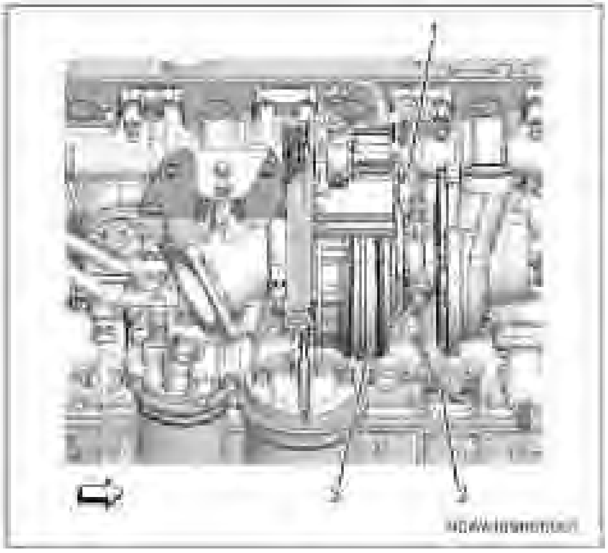


1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

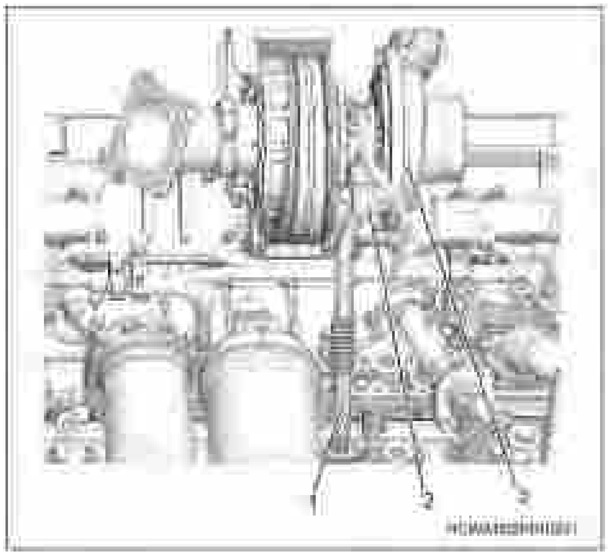
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

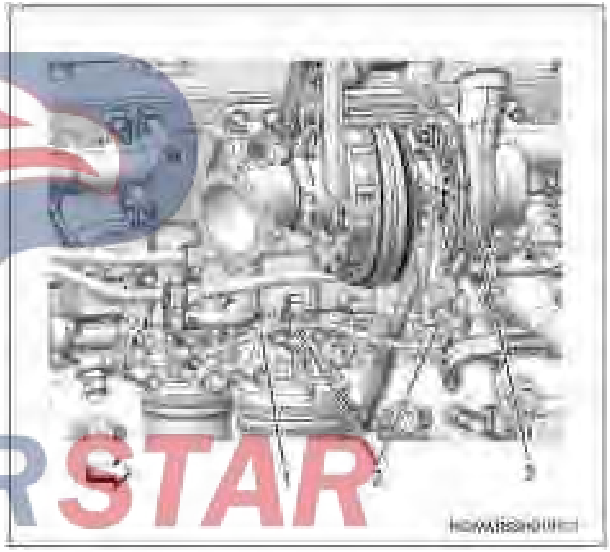
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the oil filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the oil filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}



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1. Turbocharger oil feed pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

29. Exhaust cover installation

1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

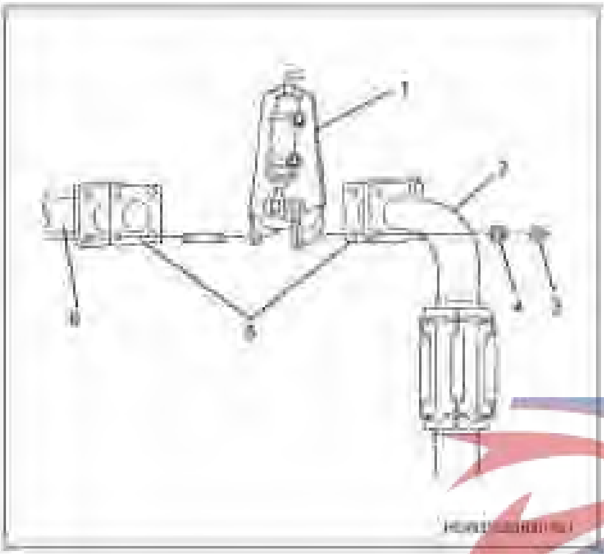
Caution:

● Uniformly tighten the mounting nuts and bolts of

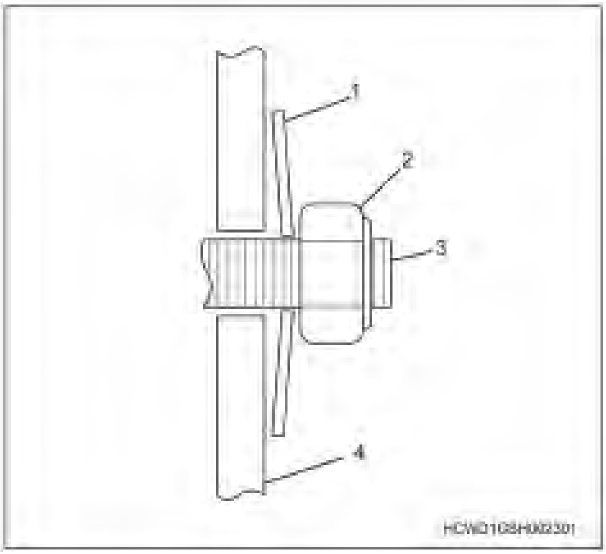
the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m { 6.0 kgf • m / 44 lb • ft }



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

30. Exhaust cover installation

1) Install the exhaust cover to the frame.

31. Noise shutter panel installation

1) Install the noise shutter panel for the right side of the vehicle to the frame.

2) Install the noise shutter panel for the left side of the vehicle to frame.

32. Mud guard installation

1) Install the mudguard for the right side of the vehicle to the bracket.

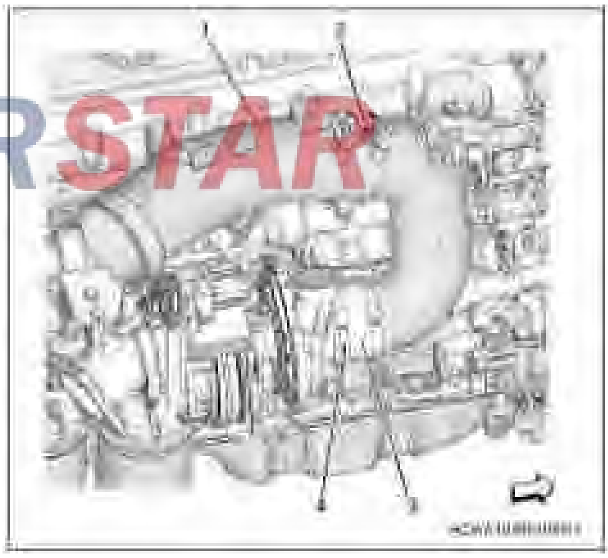
2) Install the mudguard for the left side of the vehicle to the bracket.

33. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb• ft} M10



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

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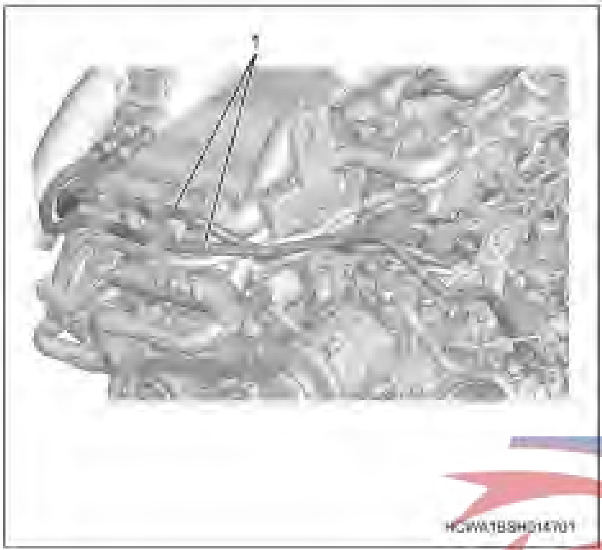
4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

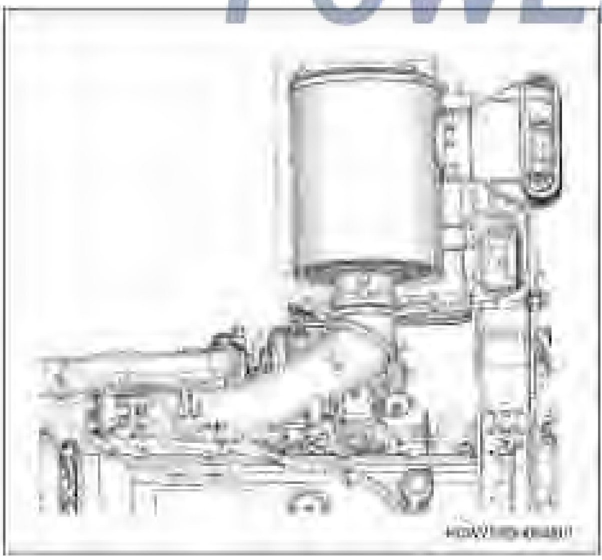
34. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



35. Pilot valve installation

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb •in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

36. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

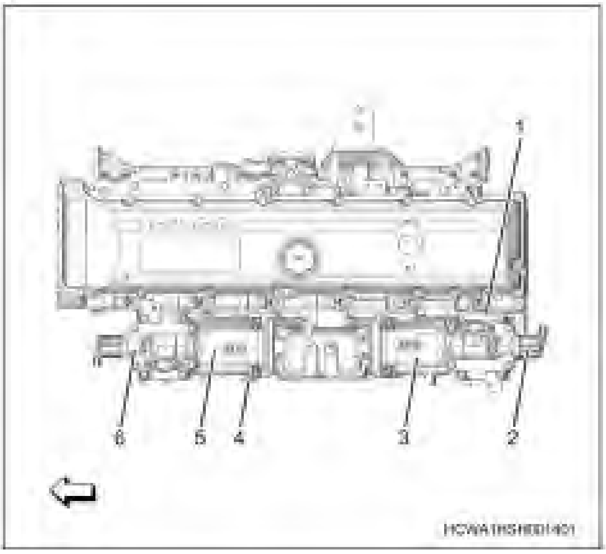
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe backet
5. EGR Valve duct A
6. EGR valve 1

5) Final Tighten the EGR valve conduit A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

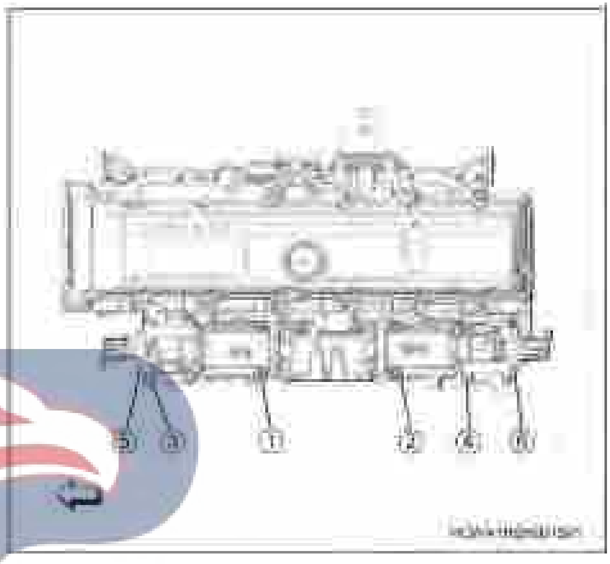
Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



37. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

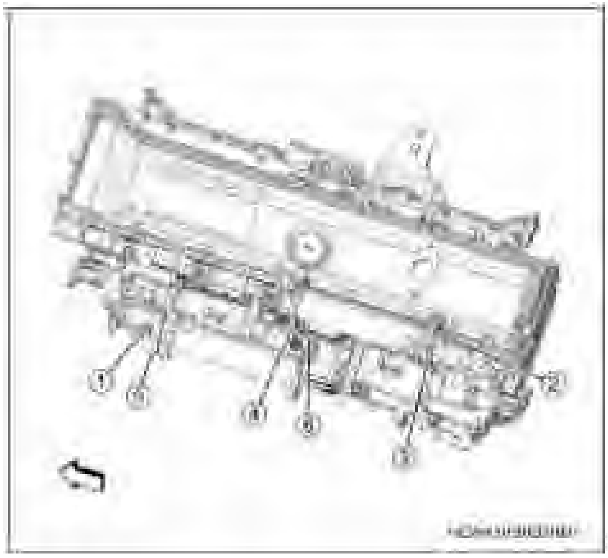
● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

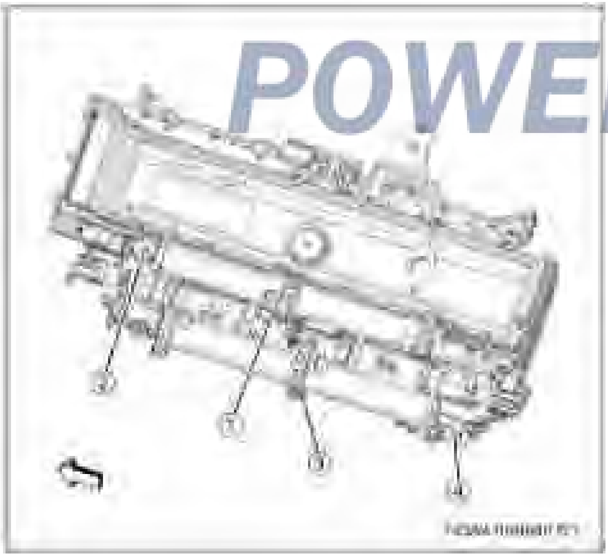
● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

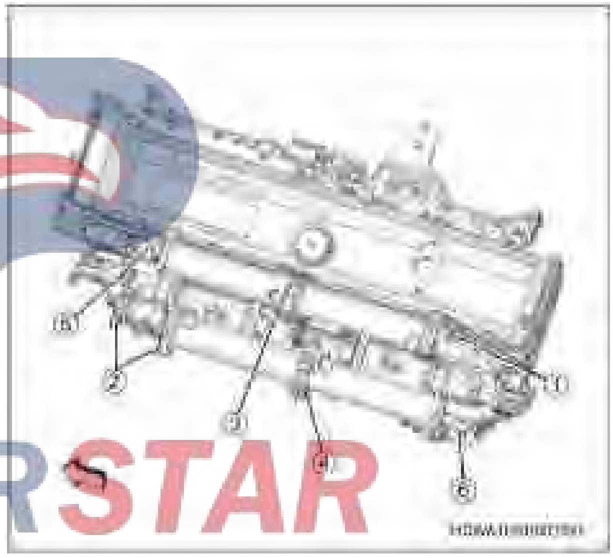
Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5 (M10), 6 (M10)

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5 (M8), 6 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

● EGR duct B.

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

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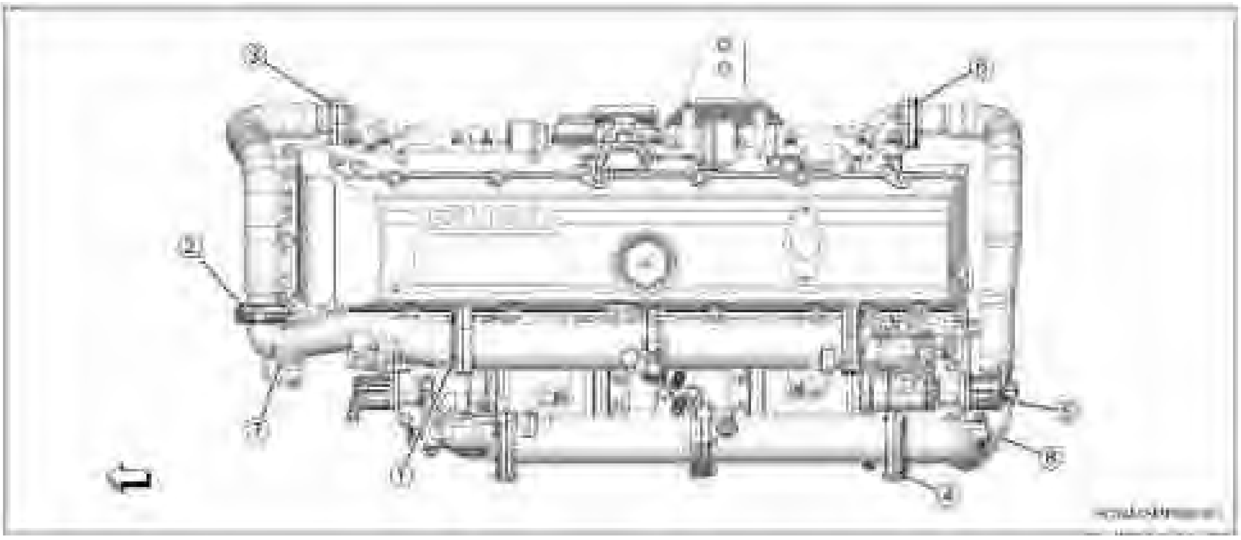

5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

- EGR cooler duct A.
- EGR duct A
- EGR cooler duct C
- EGR duct B
- Bracket

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 1 (M10), 2, 3, 9 (M10), 10 (M10)

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 4

Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft } 5, 6 (M8), 7, 8 (M8), 9 (M8)

Tightening torque: 24.7 N • m { 2.5 kgf • m / 18 lb • ft } 10 (M8)

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft } 11, 12 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.

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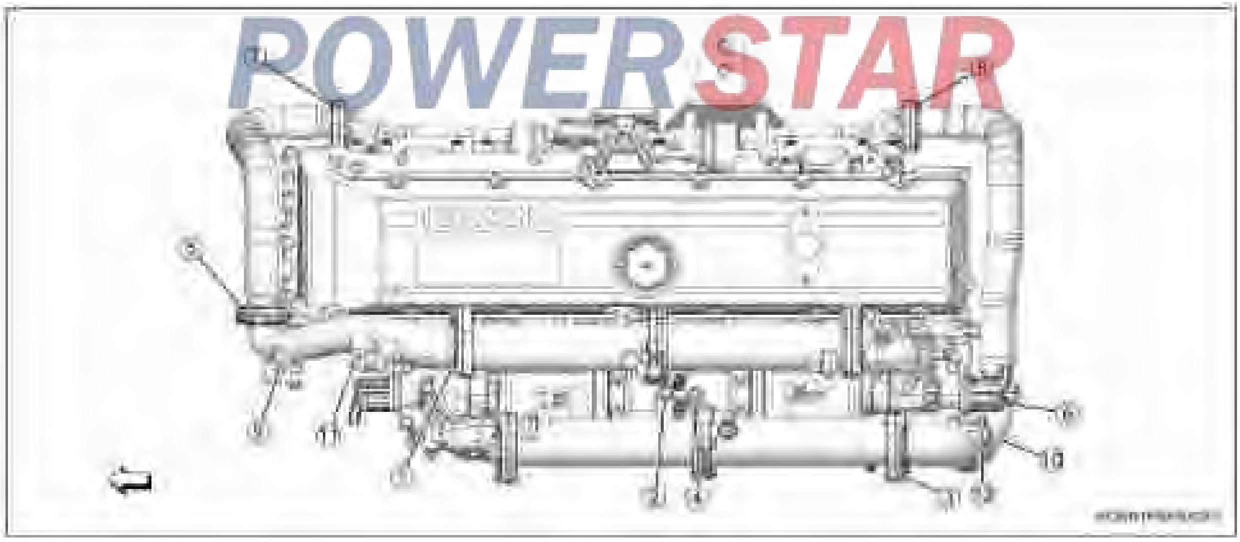
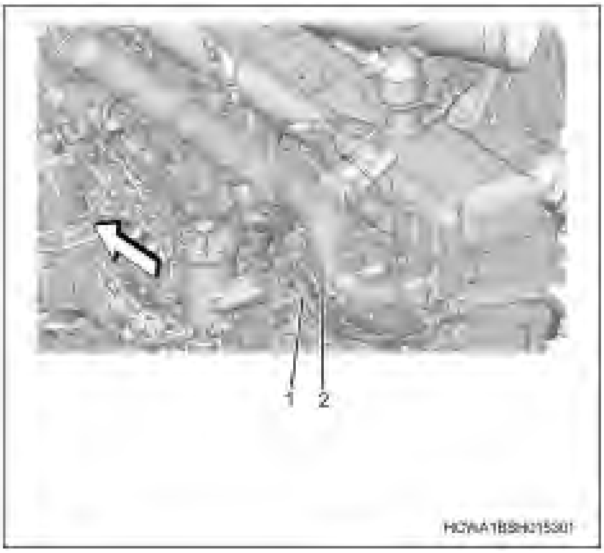


6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front return pipe
2. Back-end return pipe

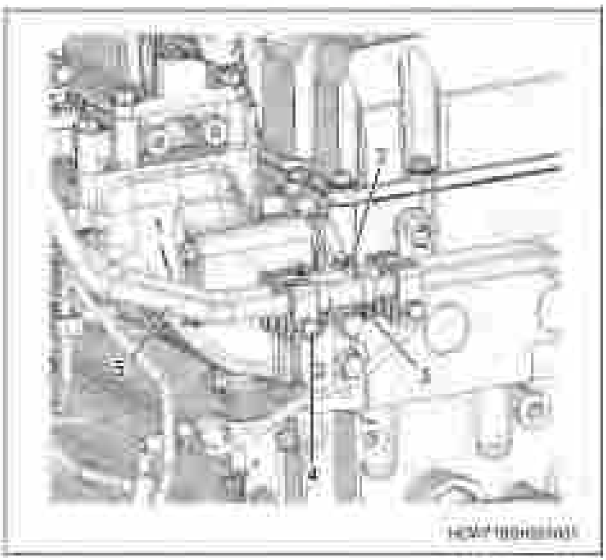
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

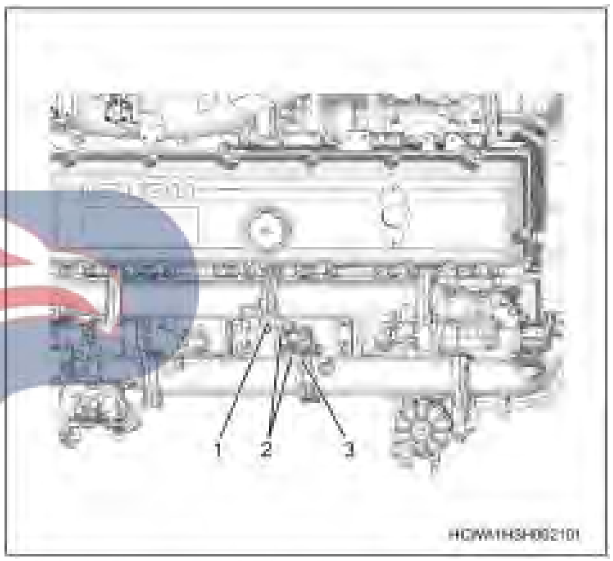


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.



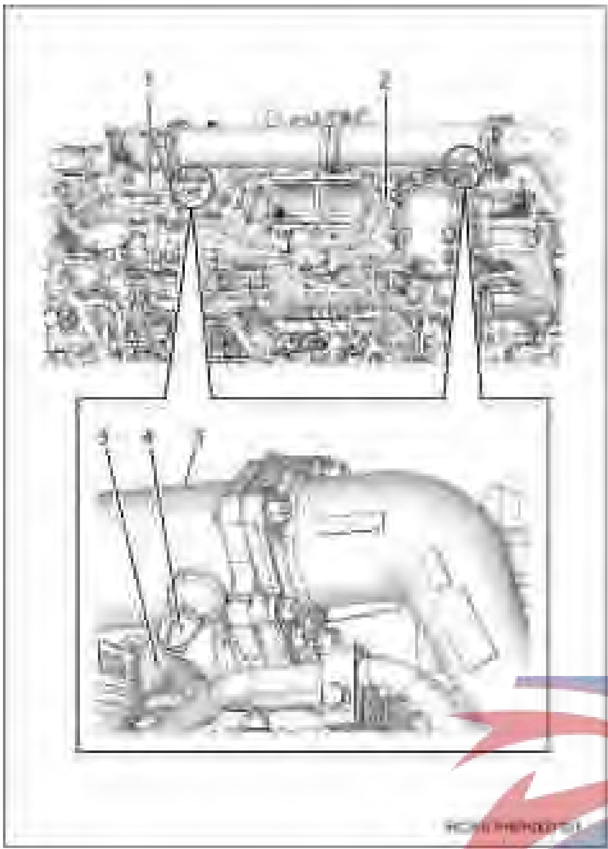
1. Hose clip
2. water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

Caution:

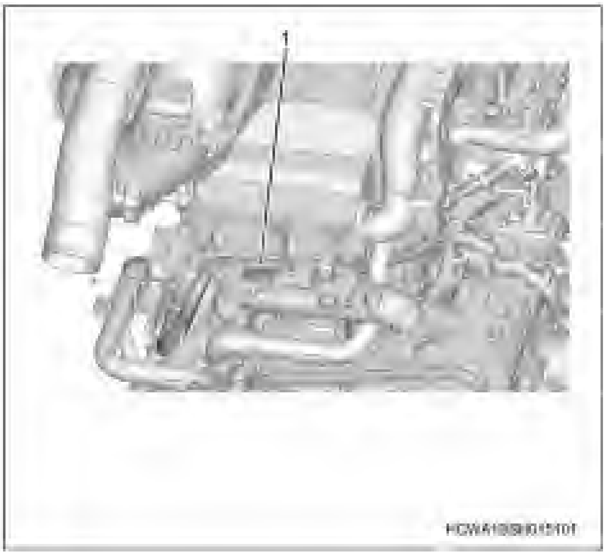
● During installation, care should also be taken to prevent the clamp from rotating.

POWERSTAR



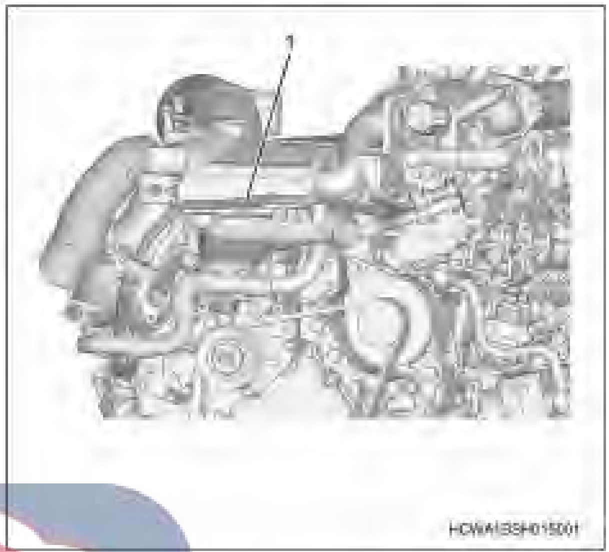
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

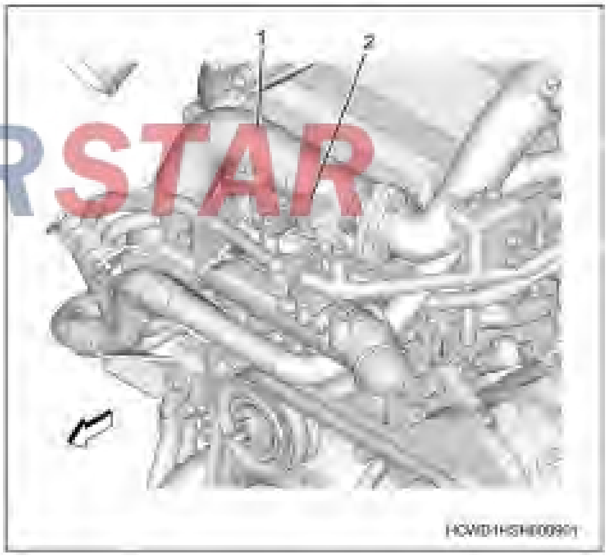
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

38. Suction pipe installation

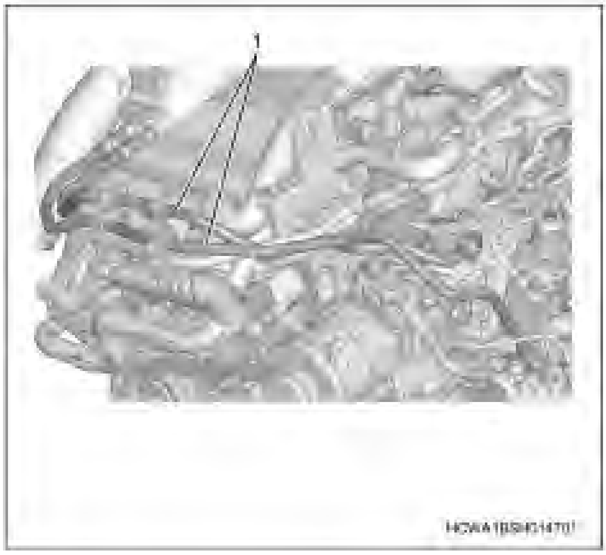
1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction tubes to the air compressor.

POWERSTAR

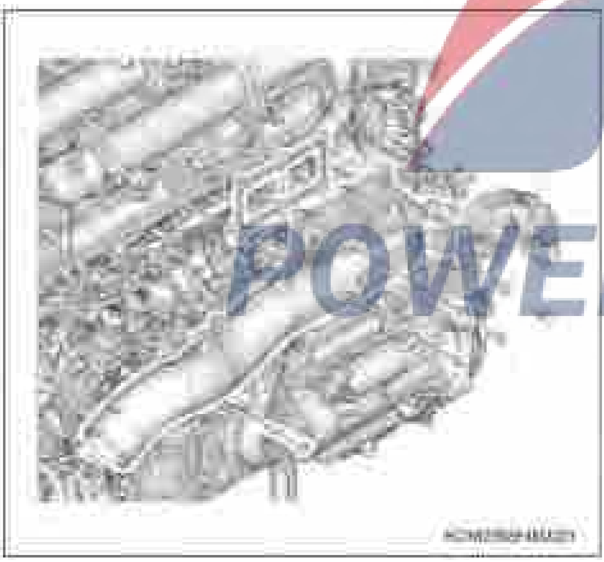


1. Exhaust pipe

39. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}



40. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

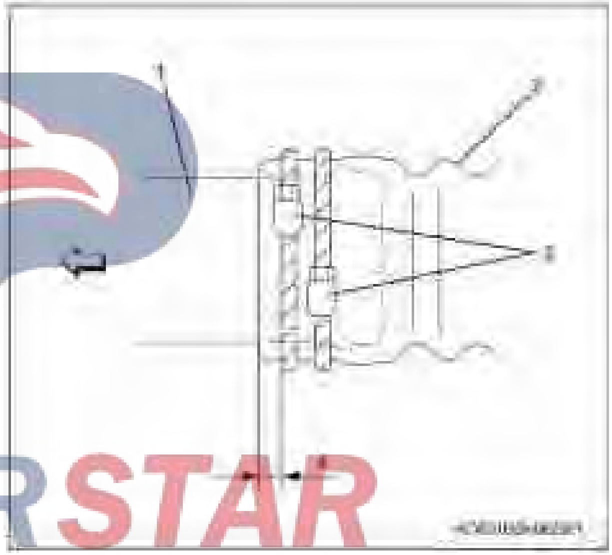
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30° or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }



1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

41. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

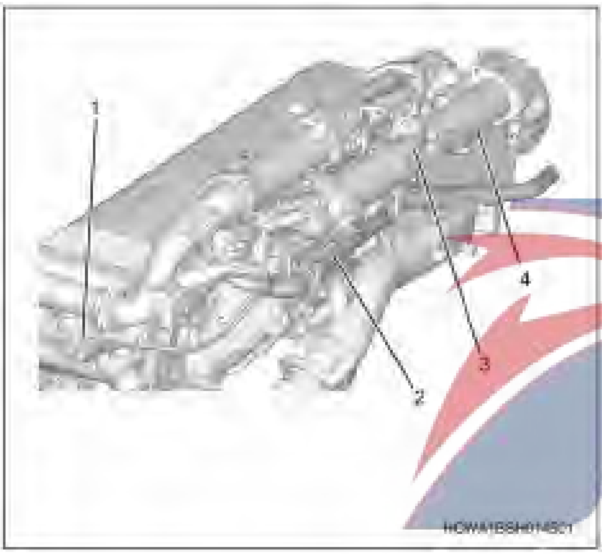
42. Air leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Eyebolt



1. Outlet pipe

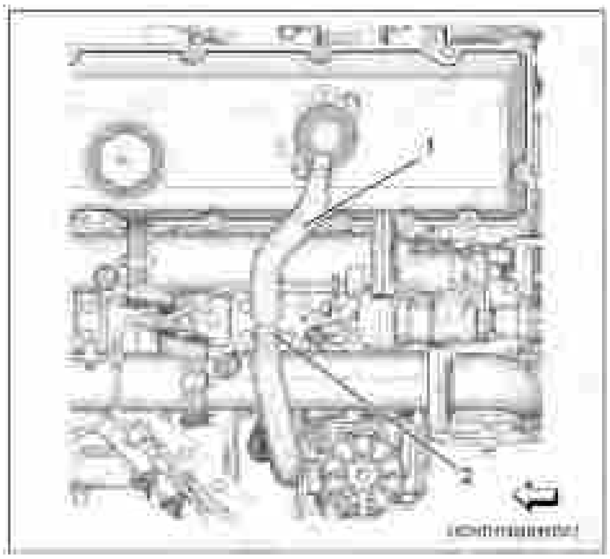
2. Water charge pipe

3. Back-end trachea

4. front leakage tube

43. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose

2. Ventilation hose clip

44. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

POWERSTAR

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Coolant is injected into radiator sub tank until the highest level is reached.

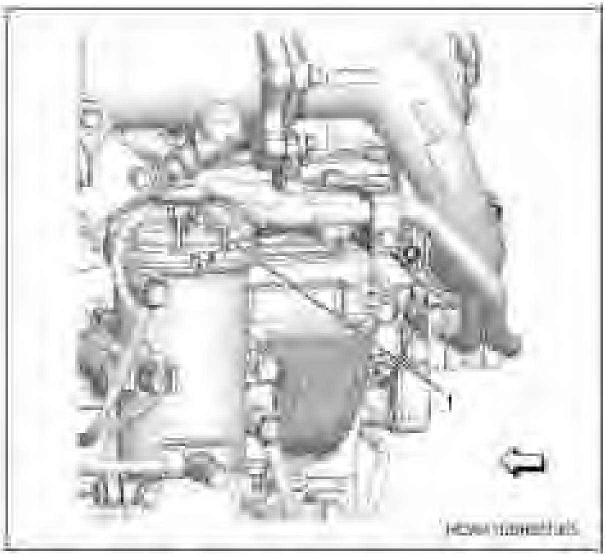
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

45. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

6) Operate the priming pump until large bubbles are no longer formed.

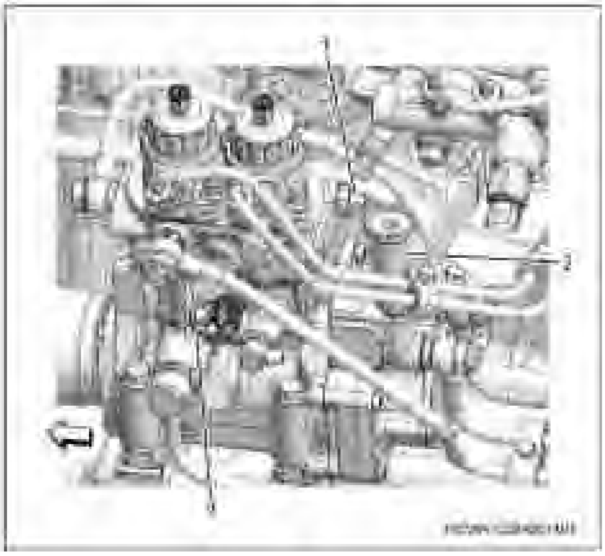
7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.

POWERSTAR



1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

46. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

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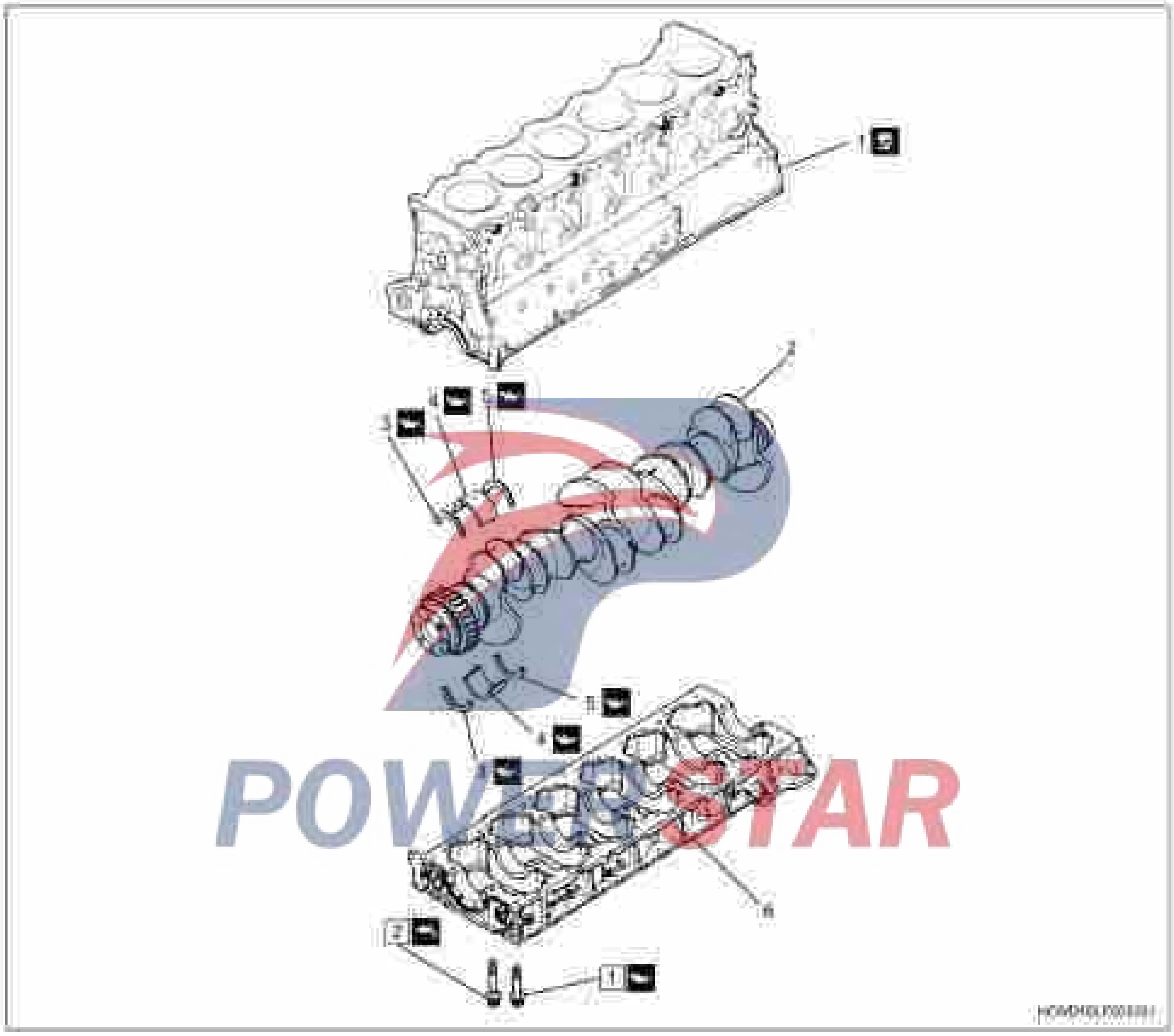
Crankshaft

Removal

1. Component Views

Crankshaft



Part name

1. Cylinder block
2. Crankshaft
3. Thrust bearings
4. Main bearing
5. Thrust bearing
6. Crankcase

Tightening torque

1: 96 N • m {9.8 kgf • m / 71 lb • ft} M12

2-1: 49 N • m {5.0 kgf • m / 36 lb • ft} M18

2-2: 88 N • m {9.0 kgf • m / 29.48 kg • ft} M18

2-3: 90 ° M18

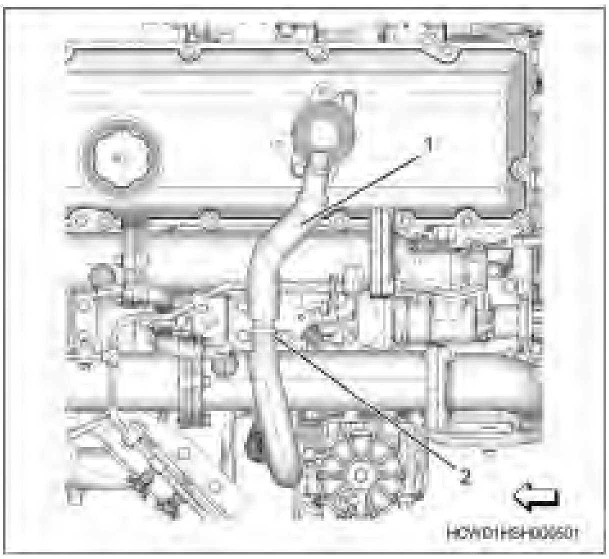
2-4: 294 N • m {30.0 kgf • m / 98.43 kg • ft} M18

2. Engine removal

Refer to "*Engine removal*".

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

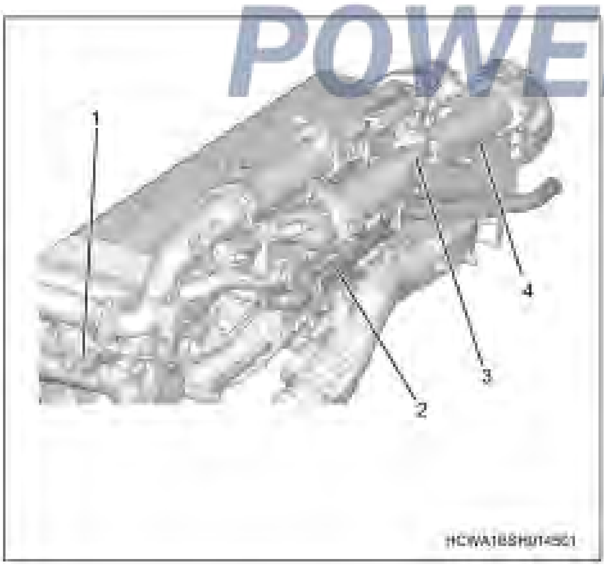


1. Ventilation hose
2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

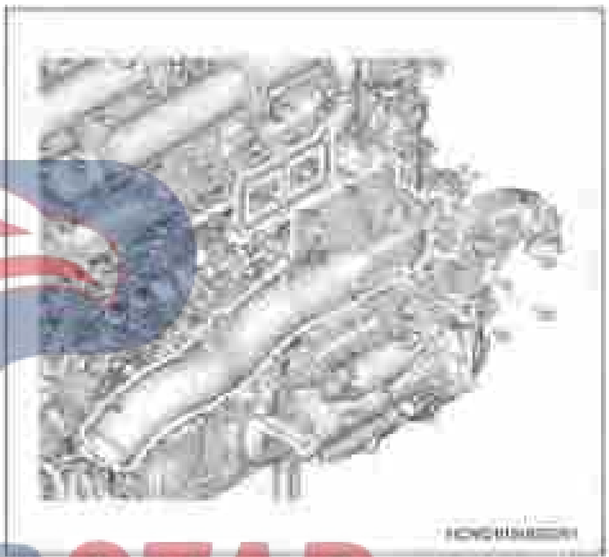
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



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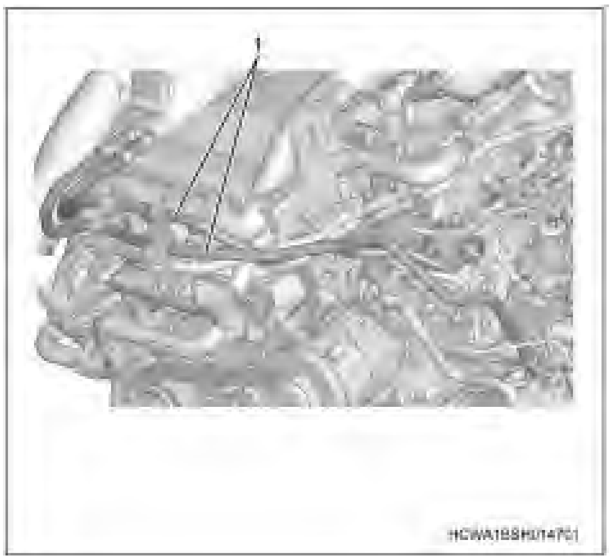
7. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

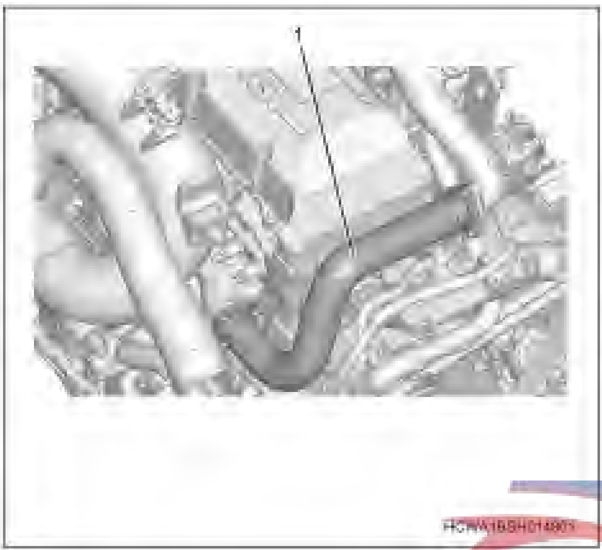


1. Exhaust pipe

8. EGR cooler removal

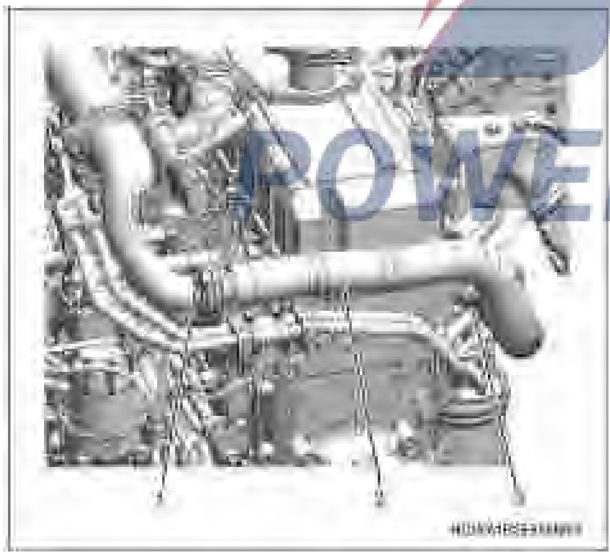
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



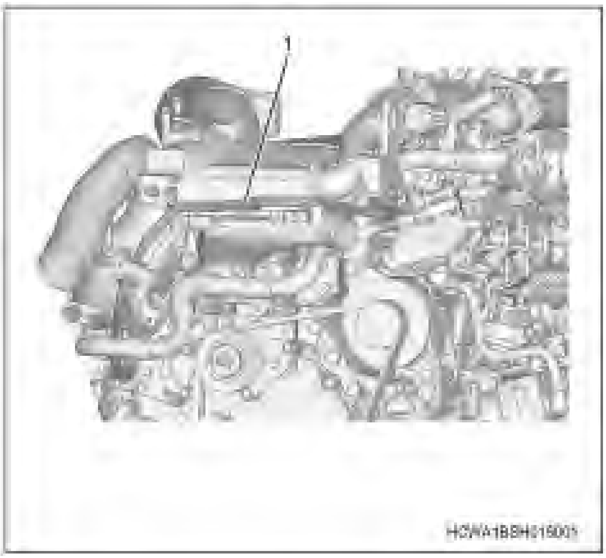
1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.



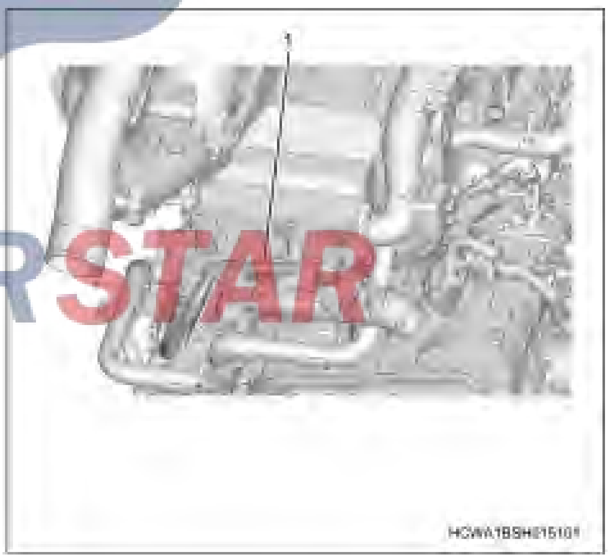
1. Standard bolt
2. Exhaust gas recirculation line B
3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.



1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.



1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.

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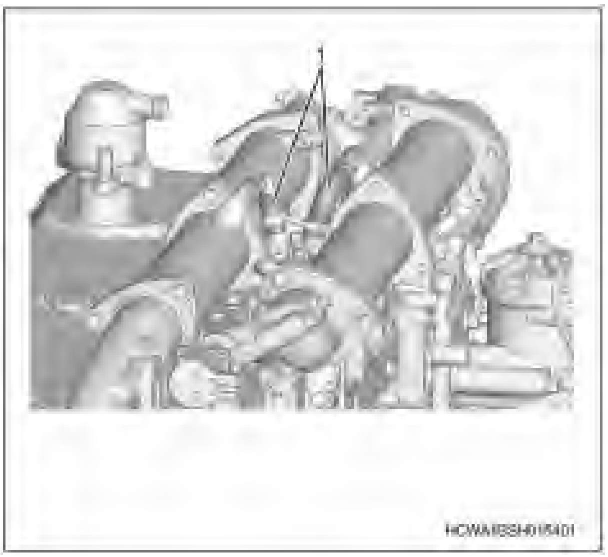
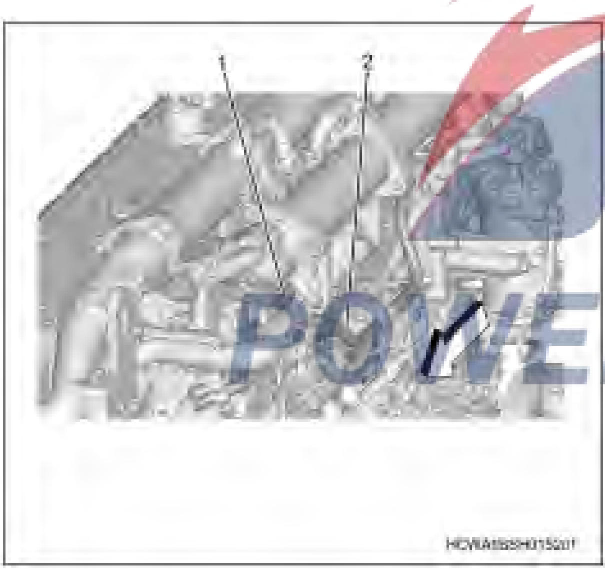


1. Water feed hose

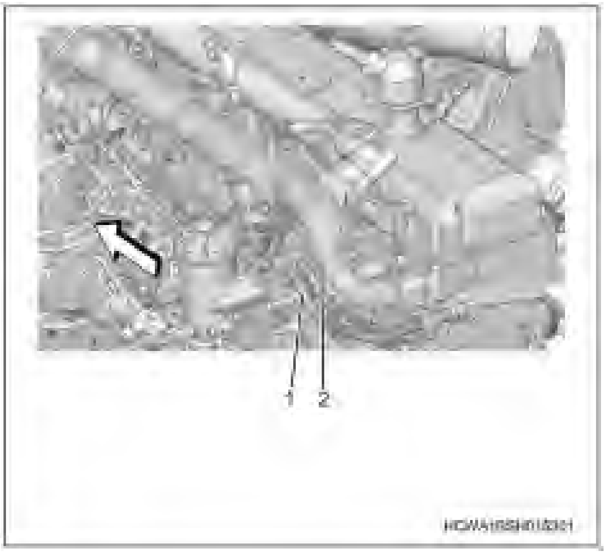
7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe

2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

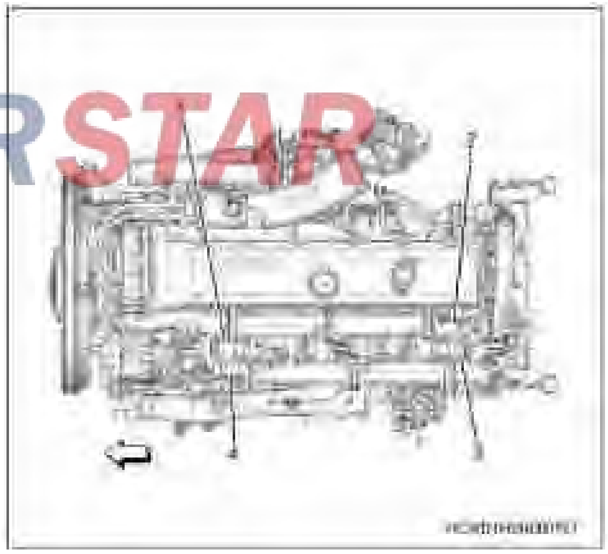


1. Front return pipe

2. Back-end return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.



1. EGR valve 2

2. EGR cooler duct B

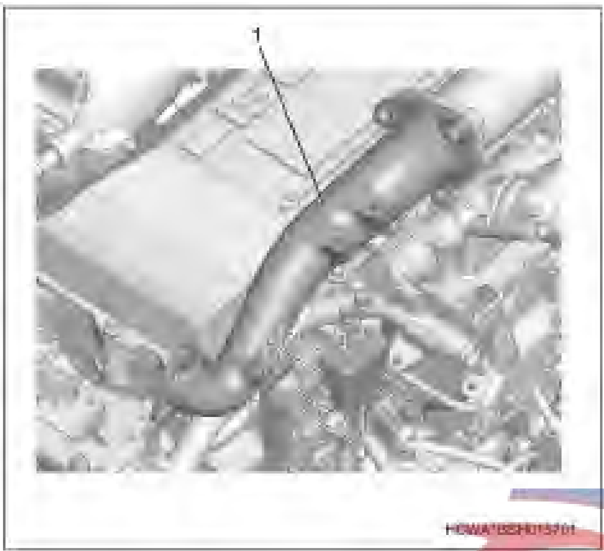
3. EGR valve 1

4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

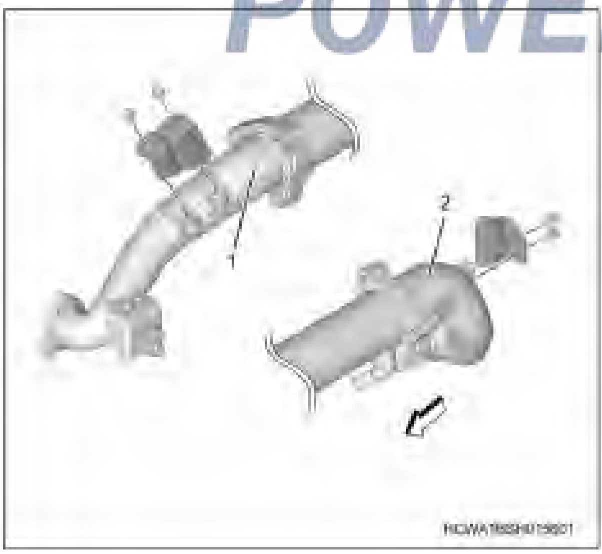
13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.



1. Exhaust gas recirculation cooler duct A

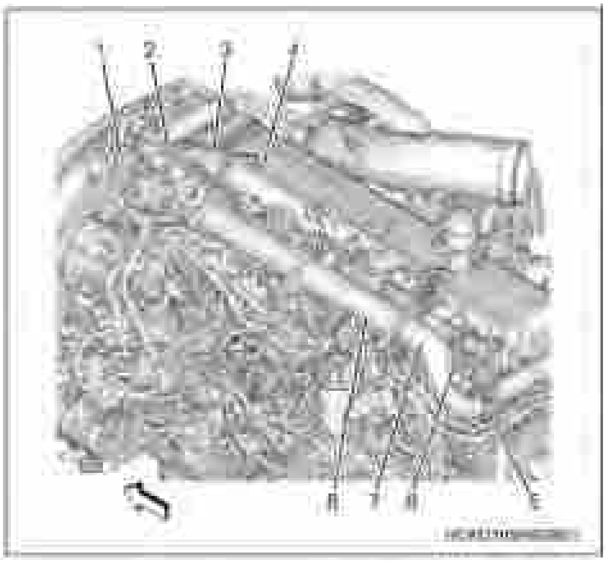
14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A
2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.



1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. Exhaust Gas Recirculation Cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket
6. Exhaust gas recirculation valve thermal protection device
7. Exhaust Gas Recirculation Cooler duct C
8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler support on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

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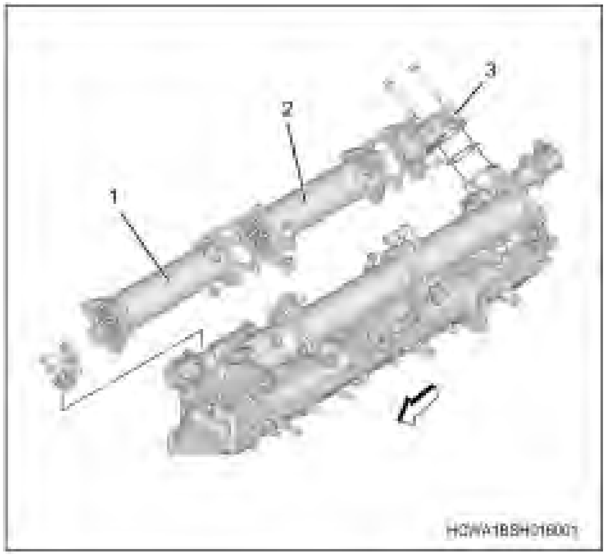
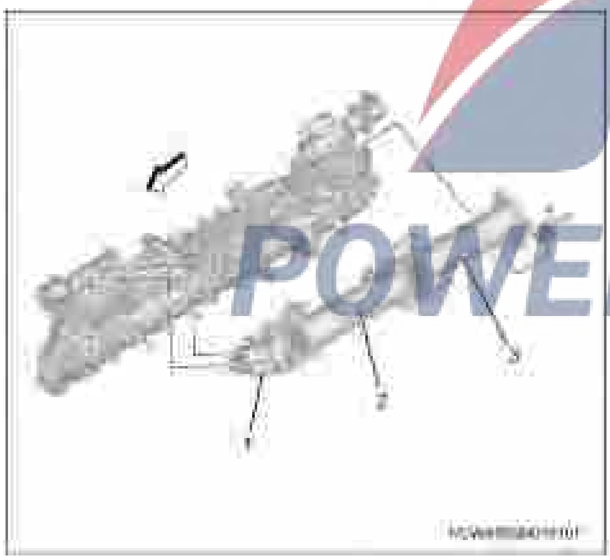


1. EGR cooler A.

2. EGR cooler B

3. Exhaust Gas Recirculation Cooler duct B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



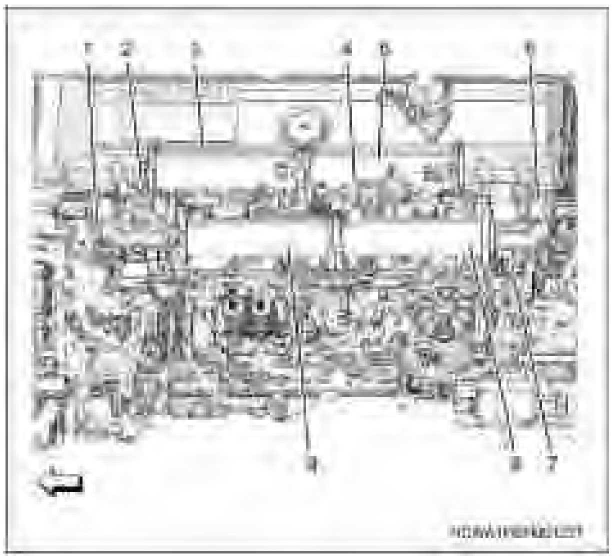
1. Exhaust gas recirculation cooler duct D

2. EGR cooler D

3. EGR cooler C.

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.



1. EGR valve 2

2. Exhaust gas recirculation cooler bracket

3. EGR cooler A.

4. Leakage pipe bracket

5. EGR cooler B.

6. EGR valve 1

7. Exhaust gas recirculation cooler bracket

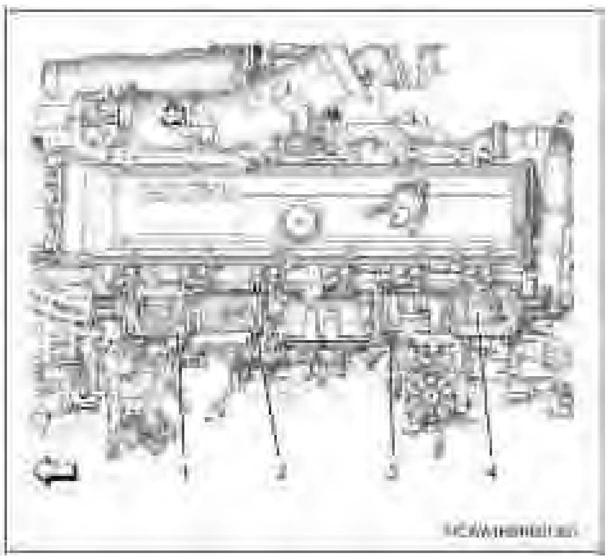
8. EGR cooler C

9. EGR cooler D

9. Exhaust gas recirculation valve removed

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve conduit A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve conduit A.



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1. EGR valve 2

2. EGR valve duct A

3. EGR valve duct B

4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

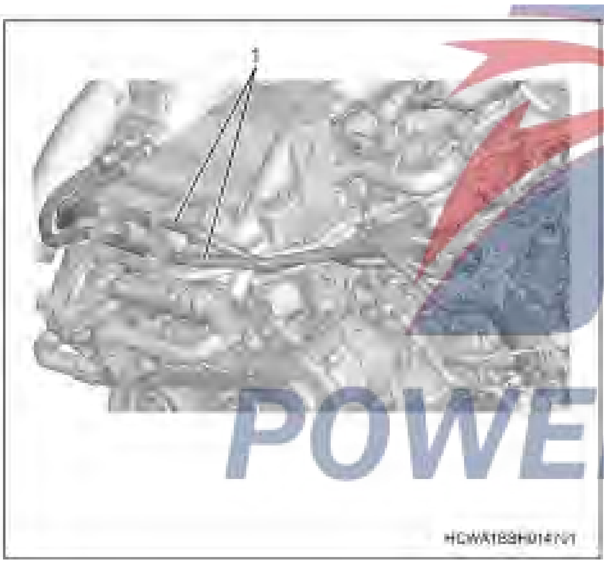
10. Pilot valve removed

1) Remove pilot valve from EGR valve A.

2) Remove pilot valve from EGR valve B.

11. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

2) Remove the heat shield from the air line.

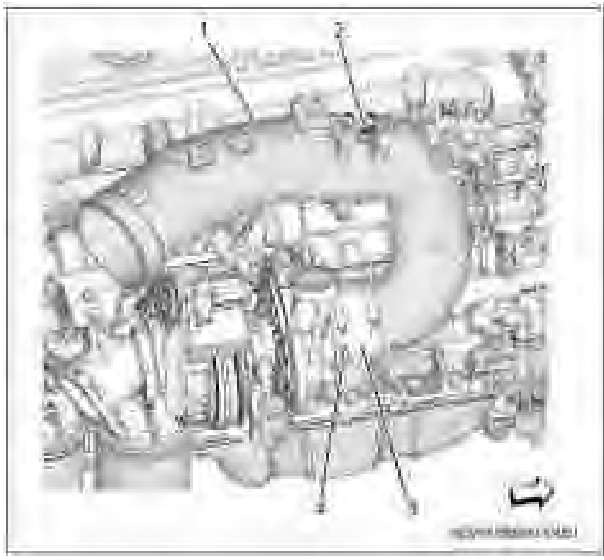
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct

2. Mass air flow and intake air temperature sensor

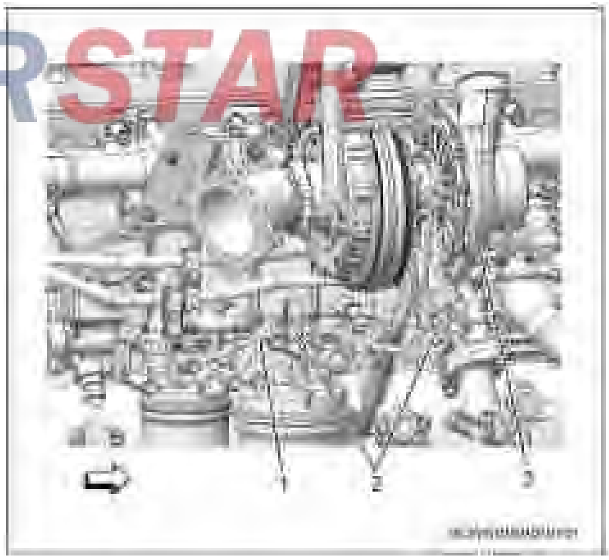
3. Rubber hose

4. Hose clip

12. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.



1. Turbocharger oil feed pipe

2. Pipe clamp

3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.

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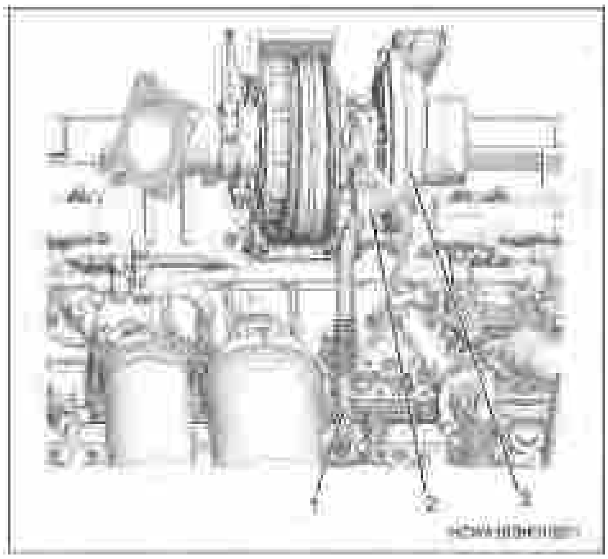


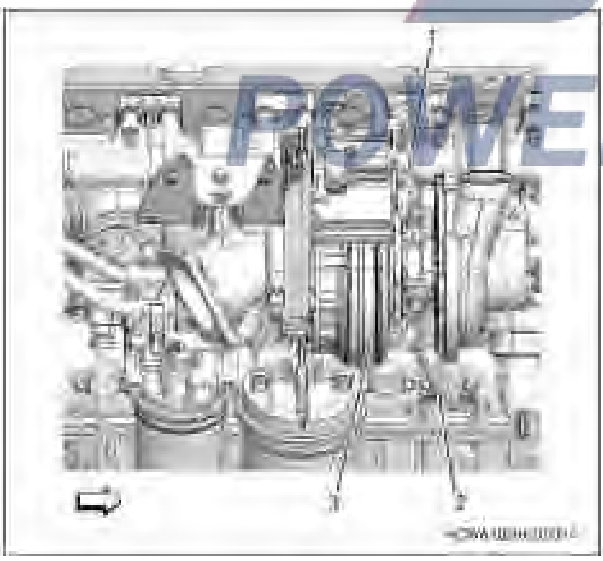
1. Turbocharger return pipe
2. Bracket
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

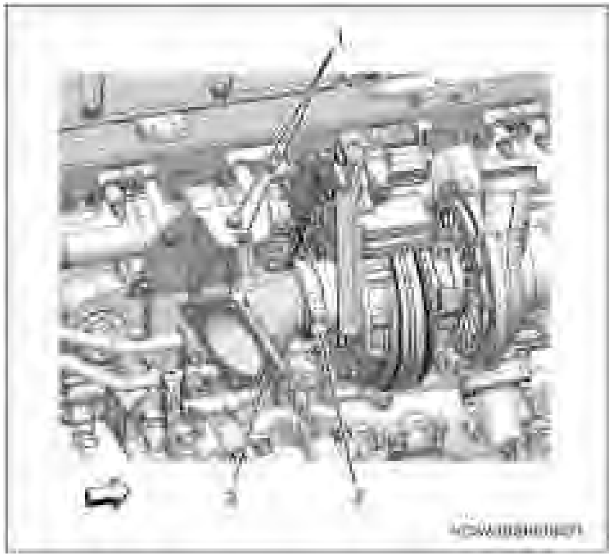
7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe

10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.

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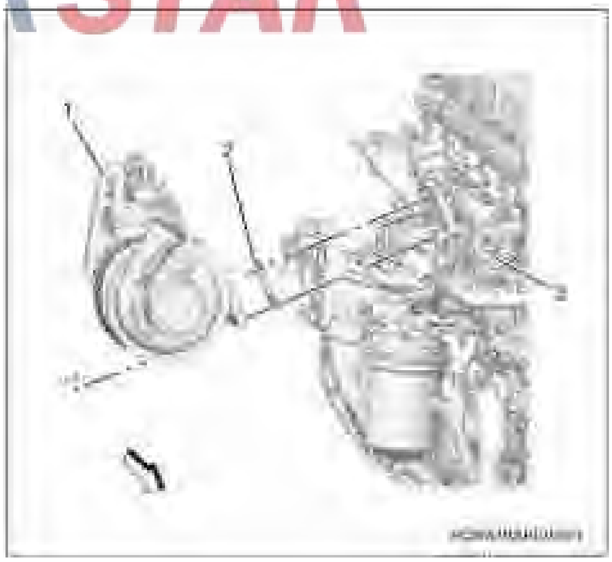


1. Turbocharger
2. Gasket
3. Exhaust manifold

13. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

14. Fuel drain pipe removed

1) Disconnect the fuel drain on the fuel supply pump.

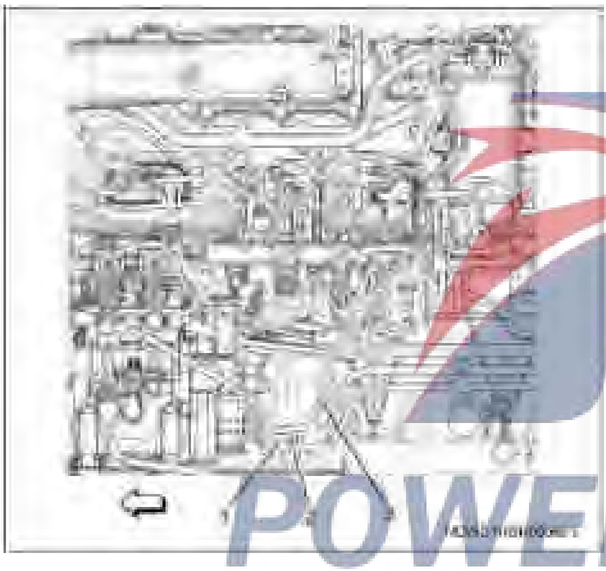
2) Disconnect the fuel drain hose from the fuel filter.

15. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

16. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

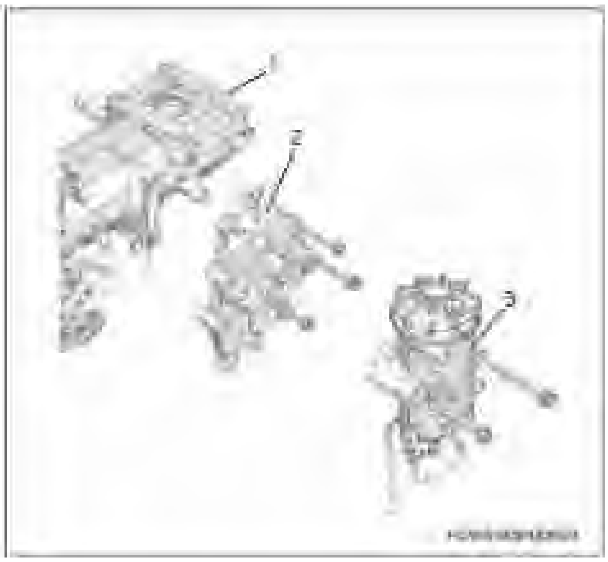
3) Remove the fuel pipe from the fuel supply pump.

17. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

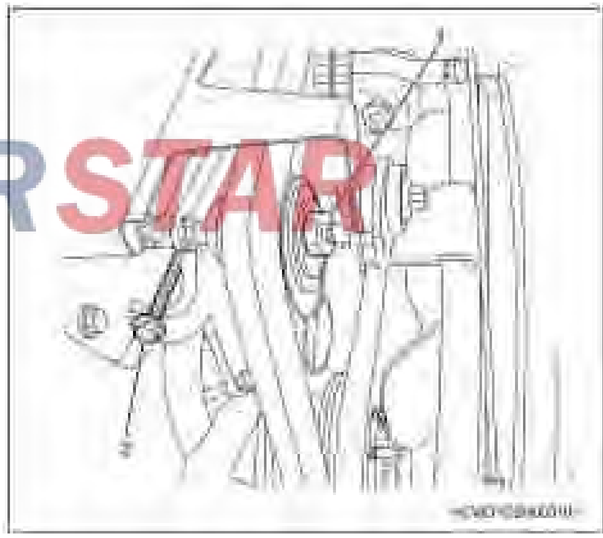
3) Remove the fuel filter bracket from the intake manifold.



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

18. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



1. Lock nut
2. Adjust bolt

19. Generator removal

1) Disconnect the harness connector from the generator.

2) Disconnect the generator from the ground and B-terminal harness.

3) Remove the generator from the bracket.

POWERSTAR

20. Generator bracket removal

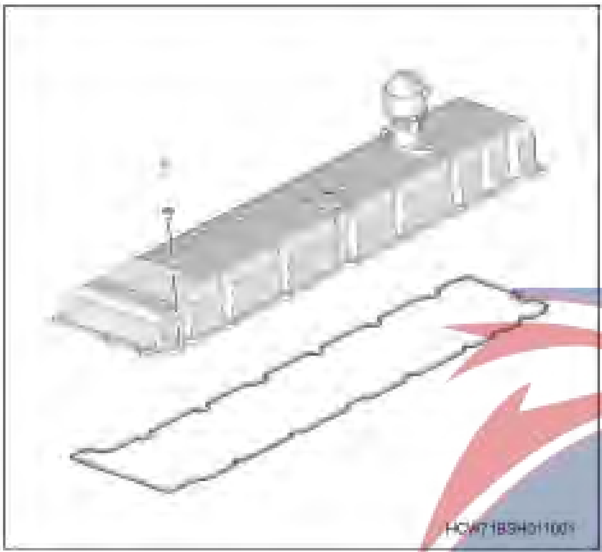
1) Remove the generator bracket from the cylinder head.

2) Remove the generator bracket from the timing gearbox.

21. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



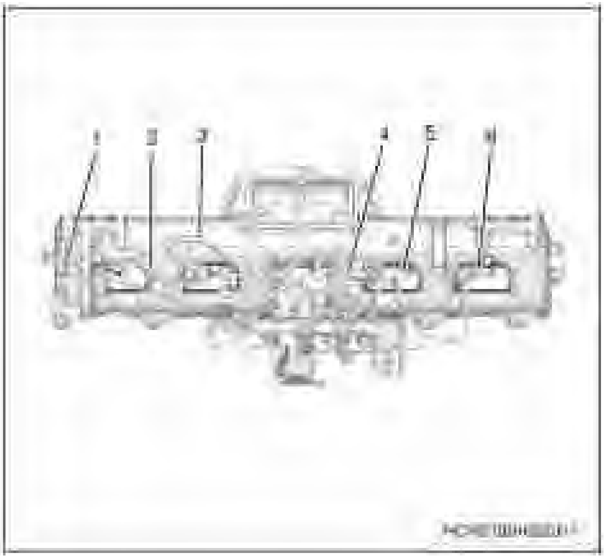
22. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

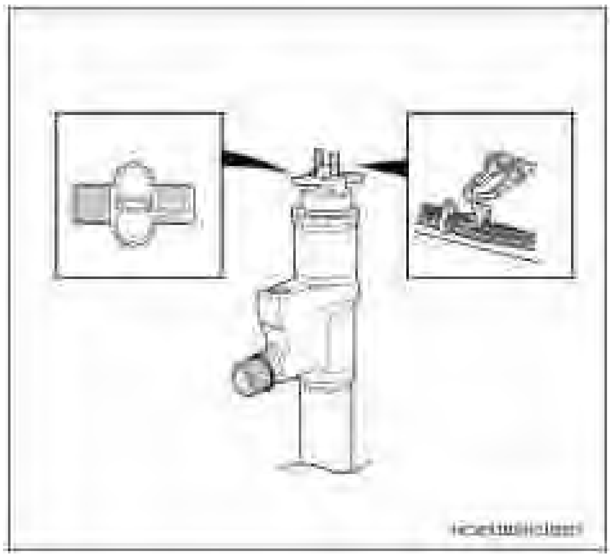
23. Injector harness removal

1) Remove the injector nut

2) Remove the injector harness

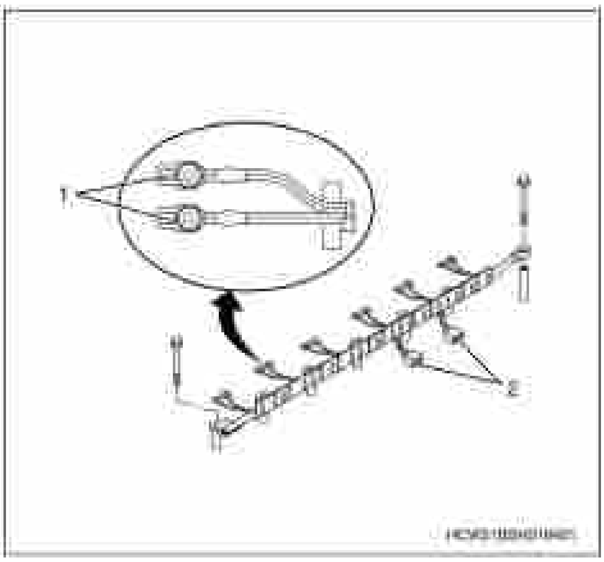
Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.



3) Remove the bolts on the injector harness.

POWERSTAR



1. Injector terminal nut

2. Connector

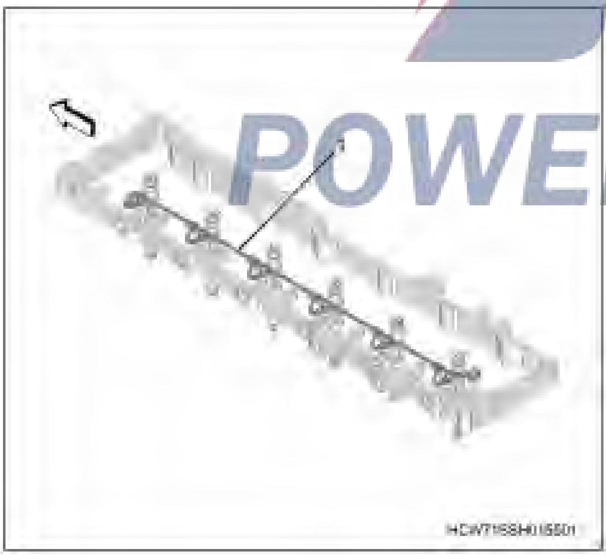
24. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

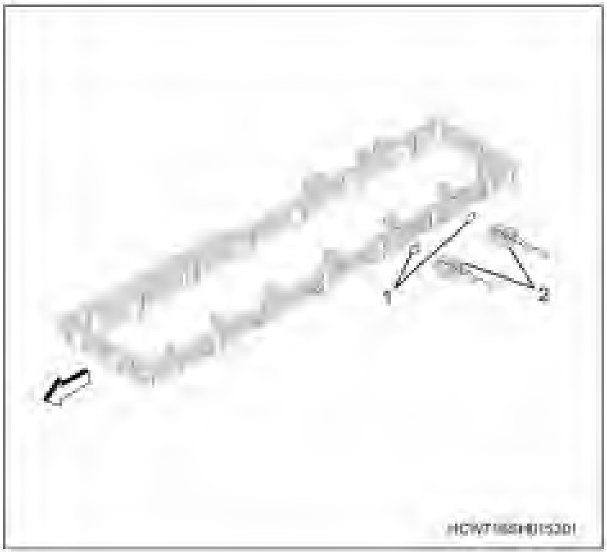
● Do not reuse the gasket.



1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.



1. O-ring

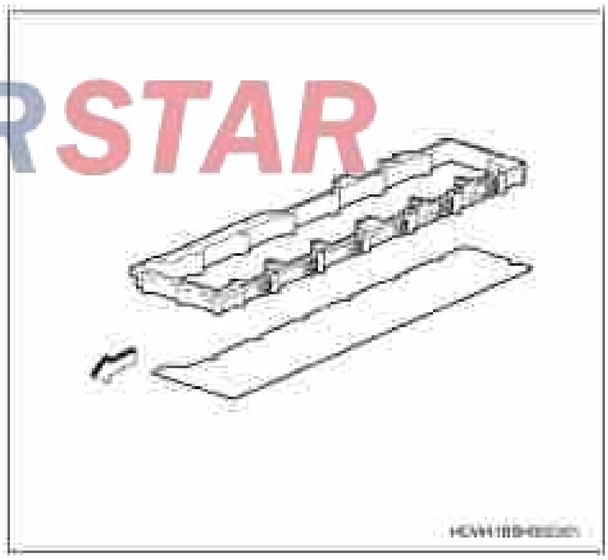
2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.



25.injector removal

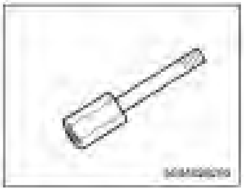
1) Remove the clamp from the cylinder head.

2) Remove the injector from the cylinder head with special tools.

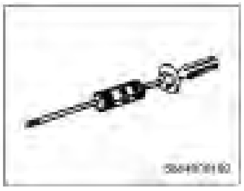
Caution:

● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

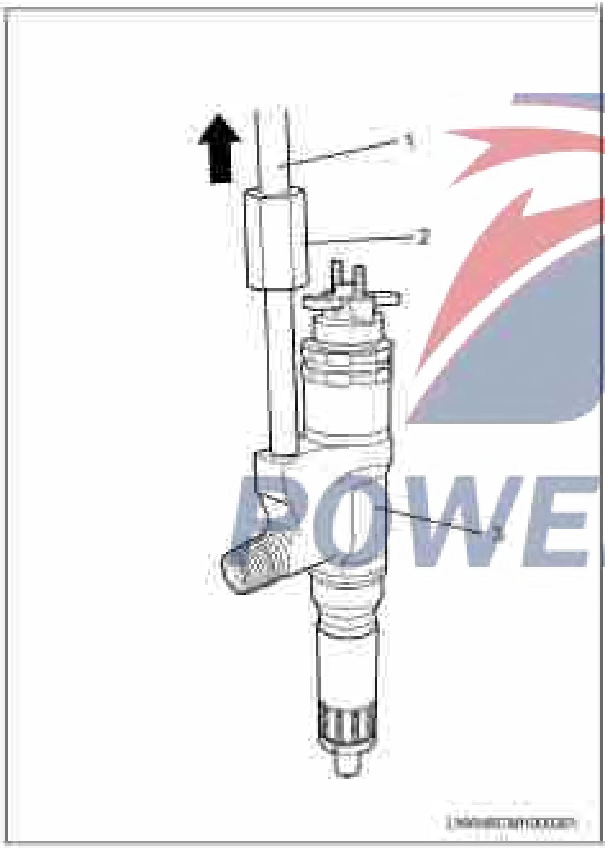
● Do not remove the injector ID code plate.



SST: 5-8840-2826-0 - injector remover



SST: 5-8840-0019-0 - sliding hammer



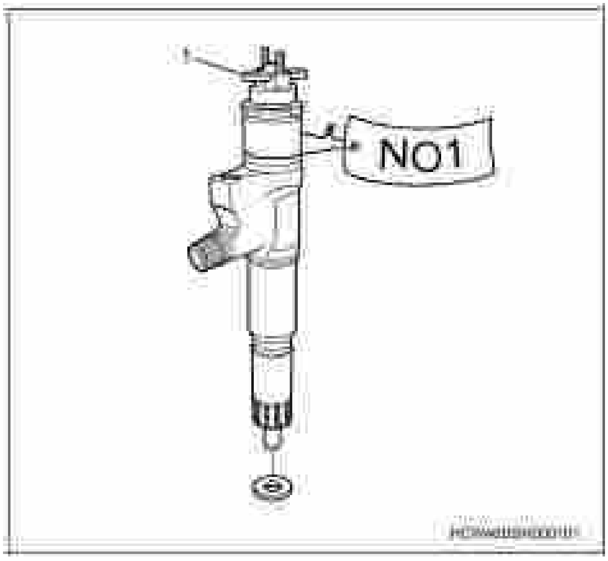
1. 5-8840-0019-0
2. 5-8840-2826-0
3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.



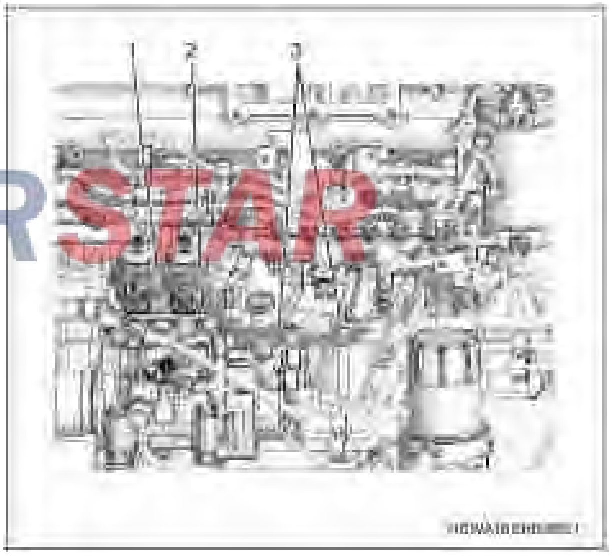
1. Injector

26. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.



1. Fuel pipe
2. Fuel pipe
3. Clip

27. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

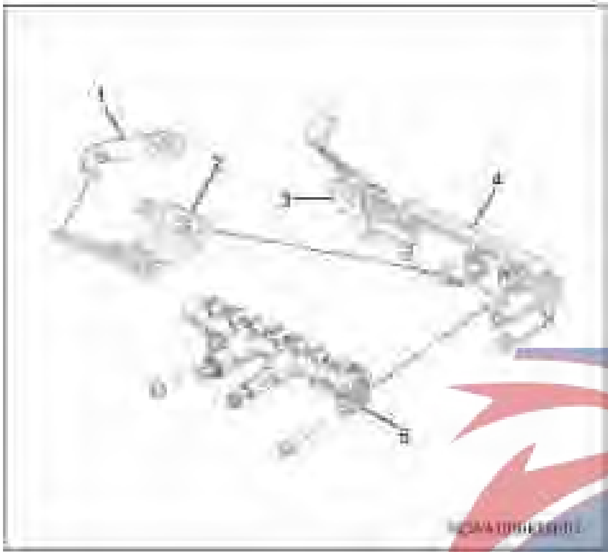
2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.



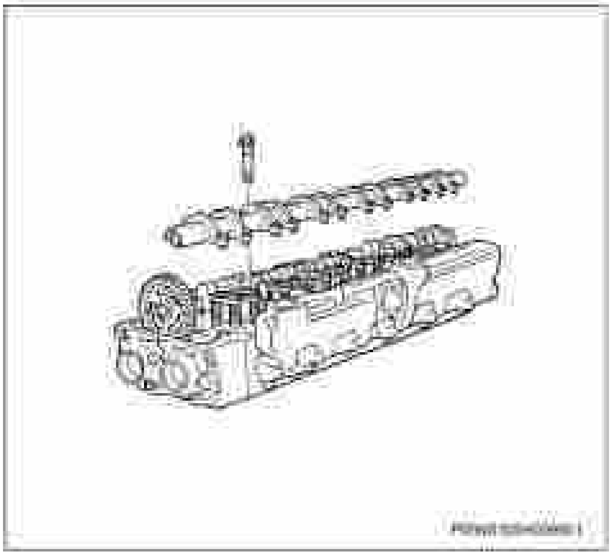
1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

28. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



29. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

1. Bridge

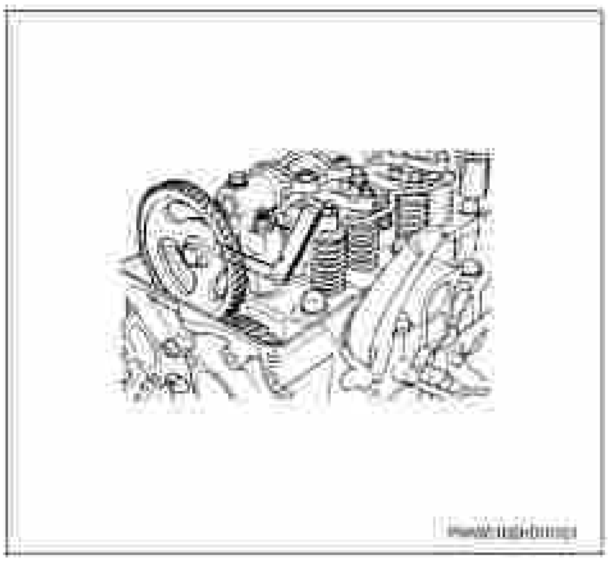
30. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170 mm {0.00335 to 0.00669 in}

Limit: 0.25 mm {0.0098 in}

POWERSTAR

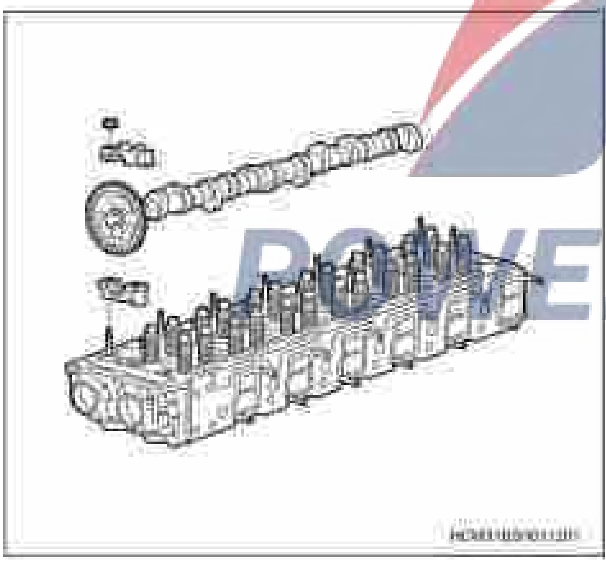


2) Remove the cam holder from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.



31. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

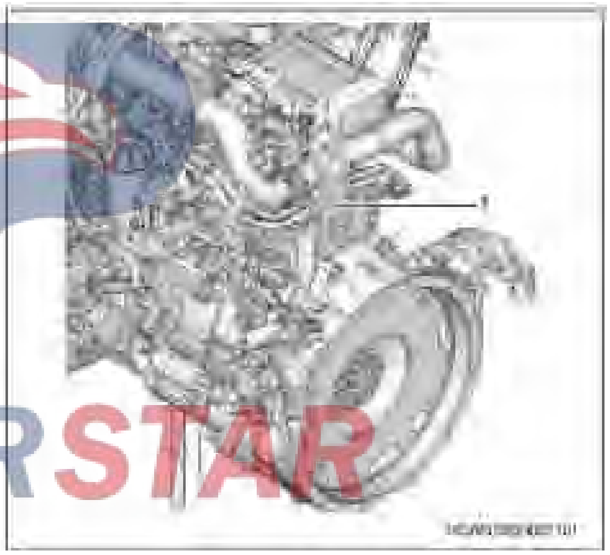
2) Remove the glow plug from the cylinder head.

32. Cylinder head cover removal

1) Install special tool to the cylinder head.

SST: 8-9761-4276-0 - engine hanger

Tightening torque: 117.5 N • m { 12.0 kgf • m / 87 lb • ft }

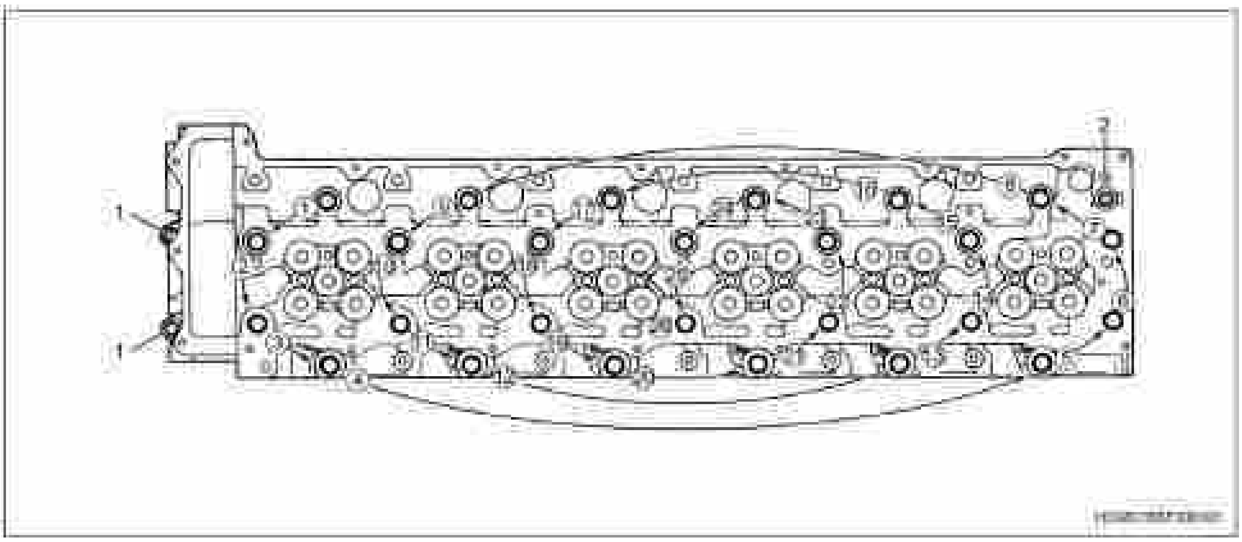


1. 8-9761-4276-0

2) Remove the M10 and M12 bolts from the cylinder head.

3) Remove the cylinder head bolts from the cylinder head in the order shown.

POWERSTAR



1. M10 bolt
2. M12 bolt

4) Remove the cylinder head from the cylinder block.

5) Remove the cylinder head gasket from the cylinder block.

Caution:

● Do not reuse the cylinder head gasket.

6) When removing, inspect for water leakage, exhaust gas leakage, etc.

33. Fuel pump removed

1) Disconnect the harness connector connected to the camshaft position sensor.

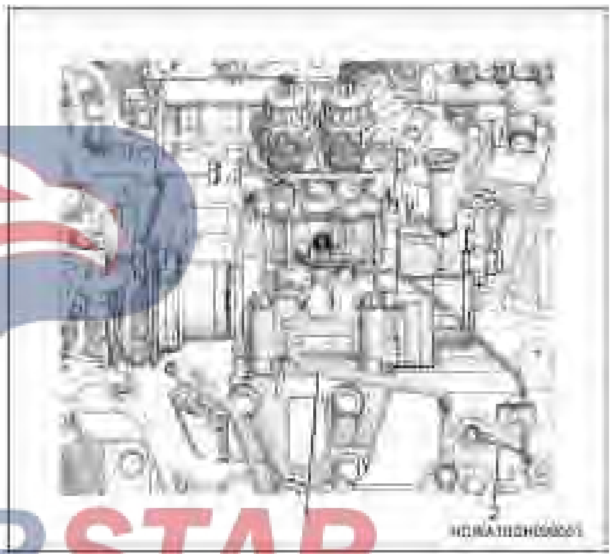
2) Disconnect PCV harness connector.

3) Disconnect the fuel supply pipe to the fuel supply pipe.

4) Remove the oil supply pipe from the cylinder block.

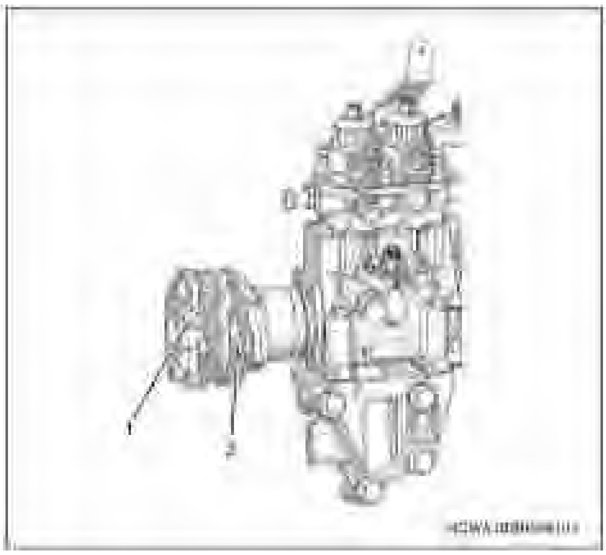
5) Disconnect the oil return pipe from the fuel supply pump.

6) Remove the oil return pipe from the cylinder block.



1. Oil return pipe
2. Oil feed pipe

7) Remove the pin bolts and coupling bolts on the coupling.



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1. Cotter bolt
2. Coupling tightening bolt

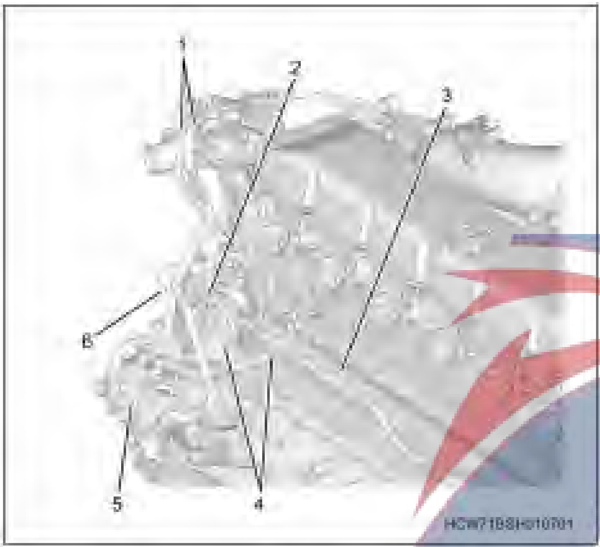
8) Remove fuel supply pump from supply pump bracket.

9) Remove the supply pump bracket from the cylinder block.

34. A / C compressor removal

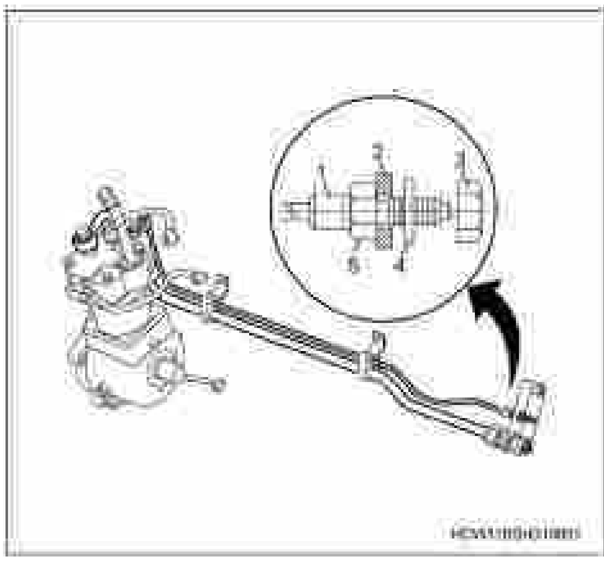
1) Remove the oil pipe from the cylinder block.

2) Remove the water pipe from the cylinder block.



1. Exhaust pipe
2. Water return pipe
3. Air compressor pressure pipe
4. Water feed pipe
5. Air compressor
6. Inflatable tube

3) Disconnect the inflation tube and air compressor pressure tube from the fitting.



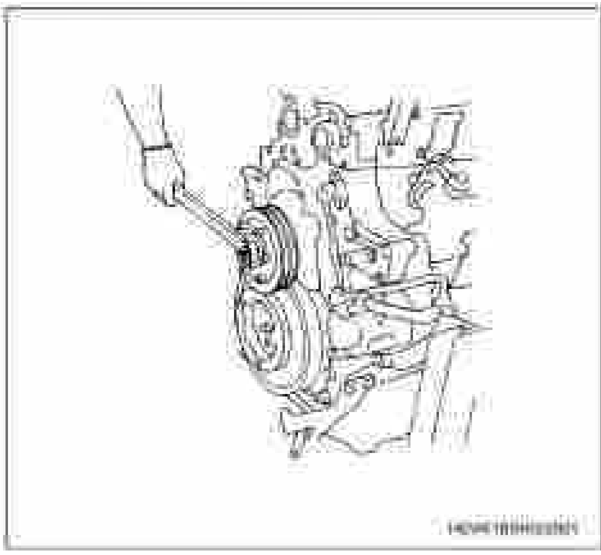
1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

4) Remove the air compressor from the timing gearbox.

35. Crankshaft pulley removal

1) Wedge the crankshaft with a wooden block to prevent the fan pulley from rotating.

2) Remove the crankshaft pulley nut from the crankshaft pulley.



3) Use a special tool to remove the fan pulley cone bushing.

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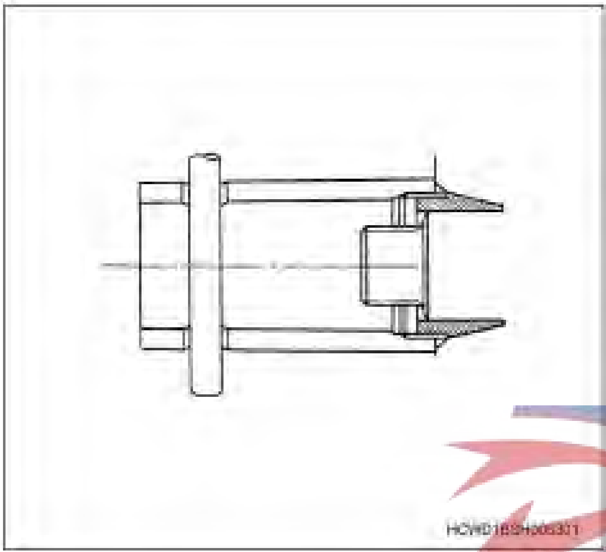
SST: 1-8521-0063-0 - Tapered bushing puller



4) Remove the fan pulley from the fan shaft.

5) Remove the crankshaft pulley from the crankshaft.

Caution:

● Do not damage the sealing surface or excessive force on the pump body.

36. Idle gear removal

1) Remove the idler gear from the gearbox cover.

37. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

38. Gear cover removed

1) Remove the gearbox cover from the timing gearbox.

2) Remove the gasket from the gearbox cover.

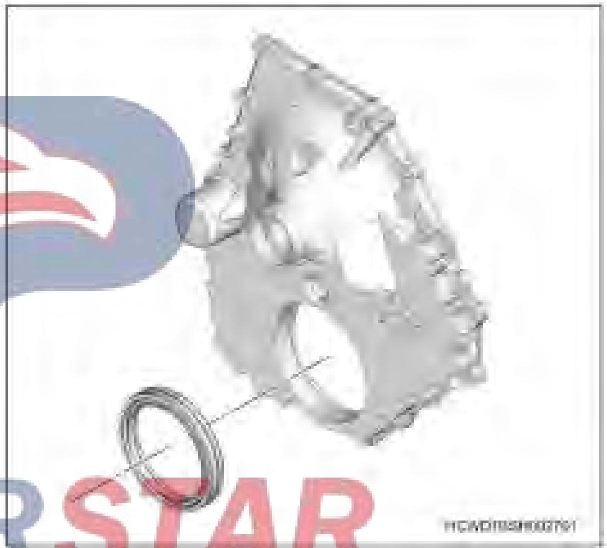
39. Crankshaft oil seal removed

1) Remove the crankshaft front oil seal from the gearbox cover.

Caution:

● Do not damage the oil seal pressure mounting surface.

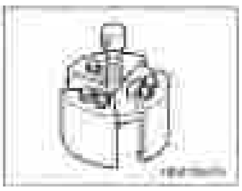
● Do not reuse the slinger or oil seal.



2) Use a special tool to remove the oil deflector from the crankshaft.

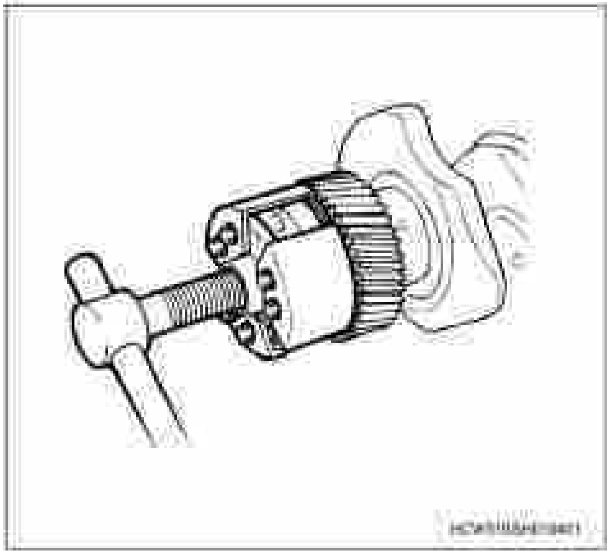
Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.



SST: 1-8521-0027-0 - Sleeve Removal Unit

POWERSTAR



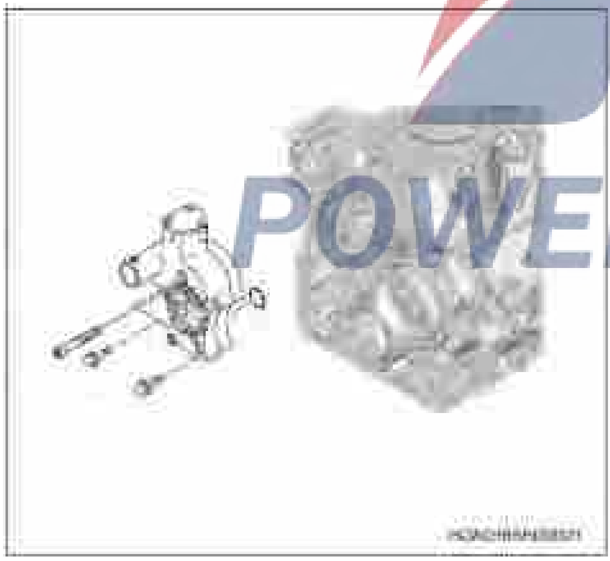
40. Oil pump removal

1) Remove the oil pump from the cylinder block.

Caution:

● Do not remove the bolt with the yellow mark on the top.

2) Remove the O-ring from the oil pump.



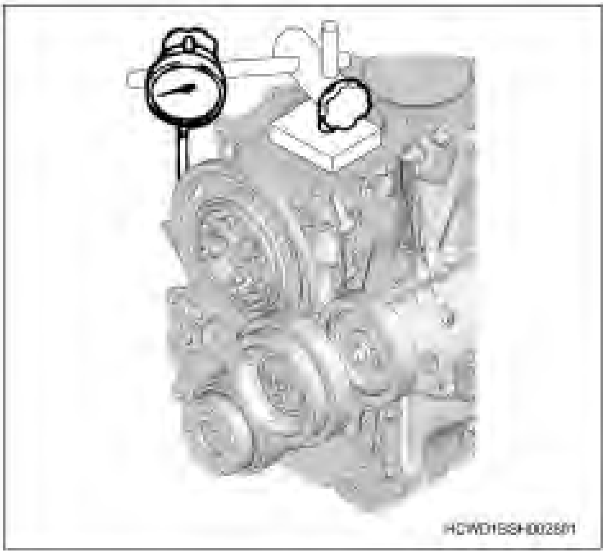
41. Idle gear removal

Caution:

● Before removing each idler gear, measure the backlash and axial clearance.

1) Measure idle gear clearance.

Standard: 0.03 to 0.13mm {0.0012 to 0.0051 in}



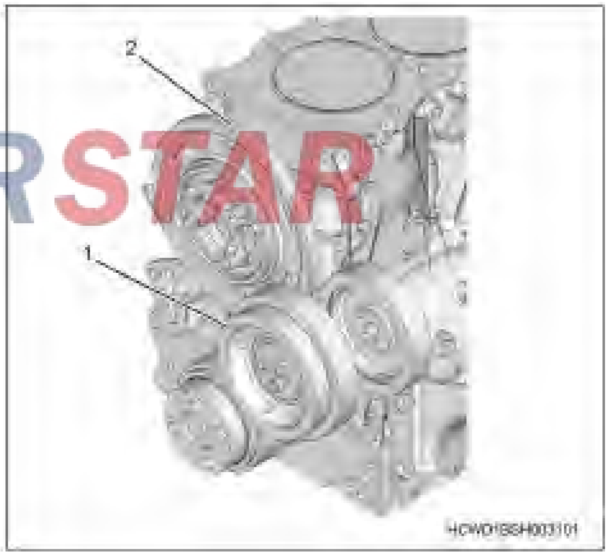
2) Measure the axial clearance of the idler gear.

Standard: 0.165 to 0.230mm {0.00650 to 0.00906in} Idler Gear A

Limit: 0.35 mm {0.0138 in} Idler gear A

Standard: 0.075 to 0.154mm {0.00295 to 0.00606in} Idler gear B.

Limit: 0.25 mm {0.0098 in} idler gear B



1. Idling Gear A

2. Idling gear B

3) Remove the distance bolt from the cylinder block.

4) Remove the idler gear A from the cylinder block.

Caution:

● During the disassembly, mark the idler gear and thrust plate to ensure the installation direction is facing front and back.

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5) Remove idler gear B-axis from cylinder block.

6) Remove idler gear B from idler gear B axle.

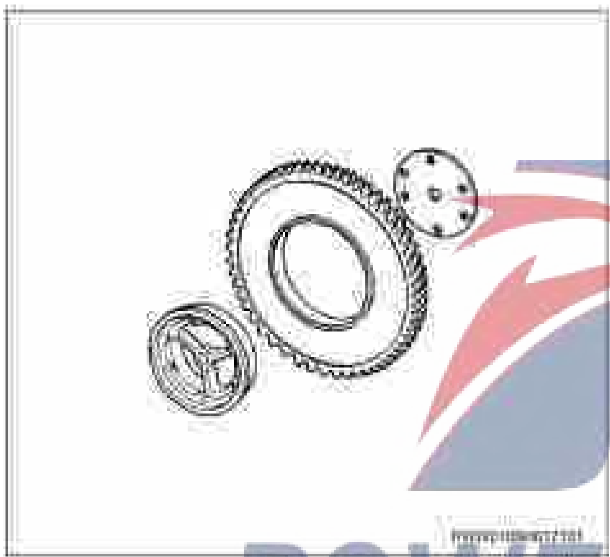
Caution:

● Remove idler gear B during marking to ensure that the mounting orientation is toward the front and back.

7) Remove thrust plate from Cylinder block.

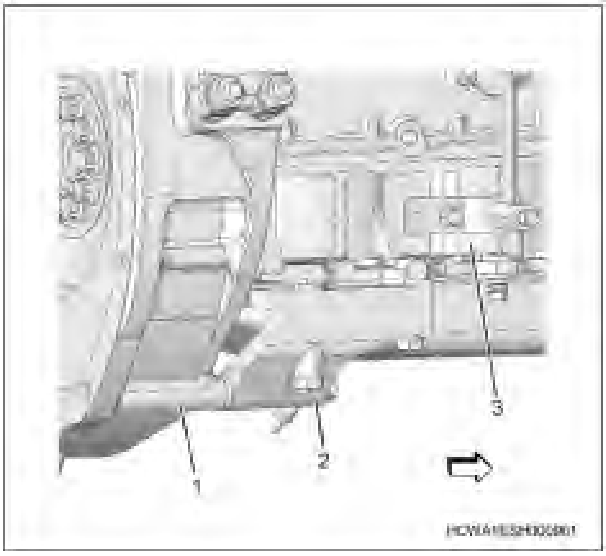
Caution:

● Thrust plates are marked during disassembly to ensure that the mounting orientation is toward the front and back.



42. Oil pan removal

1) Remove the left and right flywheel housing brackets from the cylinder block and flywheel housing.



1. Flywheel housing

2. Flywheel housing bracket

3. Cylinder block

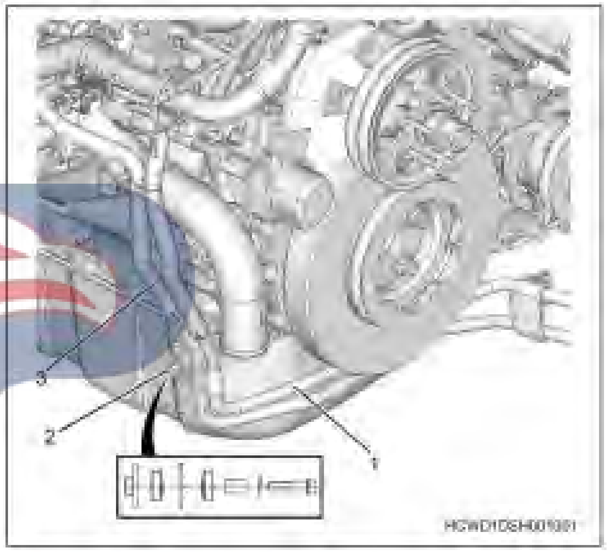
2) Remove the oil pan from the cylinder block.

43. Timing gearbox removed

1) Remove the timing gearbox from the cylinder block.

44. Heater hose removal

1) Remove the clip and then remove the heater hose from the thermostat housing.



1. Heater hose

2. Heater pipe bracket part

3. Heater pipe

45. Exhaust gas recirculation cooler water pipe removed

1) Remove the front and rear return lines from the thermostat housing.

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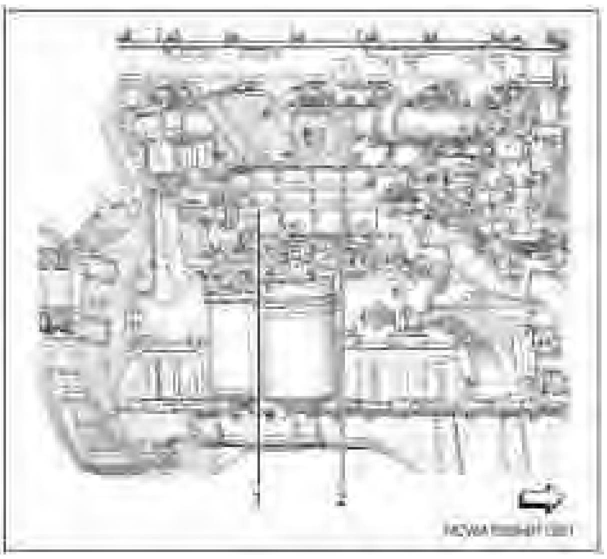
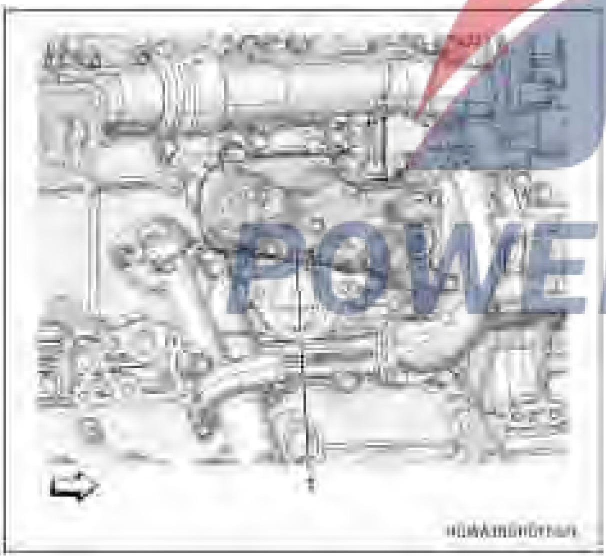


1. Back-end return pipe

2. Front return pipe

46. Thermostat housing removal

1) Remove the thermostat housing from the oil cooler.

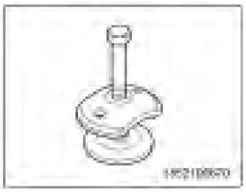


1. Thermostat housing

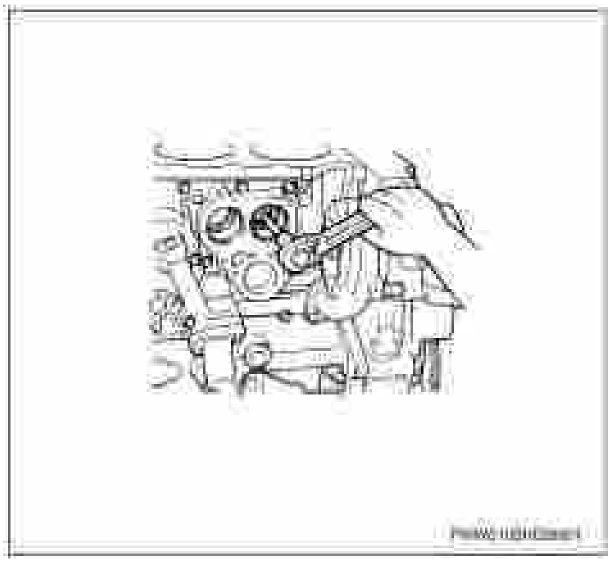
47. Thermostat removal

1) Remove the thermostat from the oil cooler.

2) Using a special tool, remove the thermostat seal ring from the oil cooler.

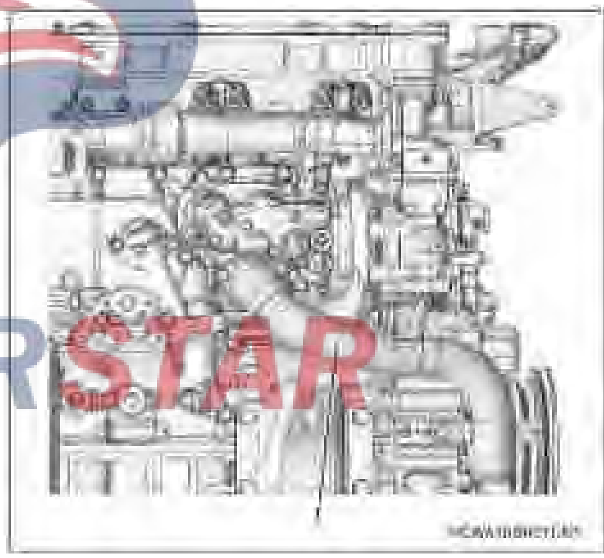


SST: 1-8521-0067-0 - thermostat seal remover



48. Intake pipe removed

1) Remove the inlet pipe from the oil cooler.



1. Water inlet

49. Water pump removal

1) Remove the pump from the oil cooler and gearbox.

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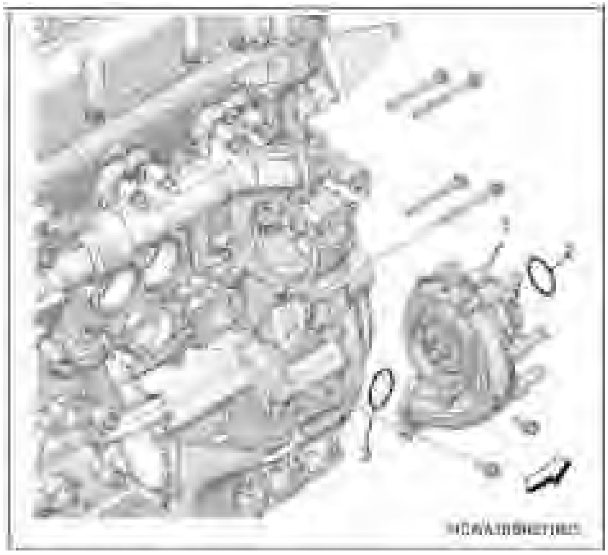


1. Water pump
2. O-ring
3. O-ring

50. oil filter warning switch removal

1) Disconnect the oil filter warning switch.

2) Remove the oil filter warning switch and valve from the oil filter body.

51. Oil filter removal

1) Remove the drain plug from the oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the oil filter case.

Caution:

● Do not reuse O-rings.

● Do not forget to tighten the drain plug.

Tightening torque: 45 N • m { 4.6 kgf • m / 33 lb • ft }

3) Disconnect the oil filter tubing.

4) Remove the hose clamp bracket from the oil filter.

5) Remove the oil filter from the oil cooler.

52. Partial oil filter removal

1) Remove the drain plug from the partial oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the partial oil filter.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Remove the clip from the oil pipe.

4) Remove the tubing holder from the splitter oil filter body.

5) Remove the partial oil filter from the oil cooler.

53. Oil cooler removal

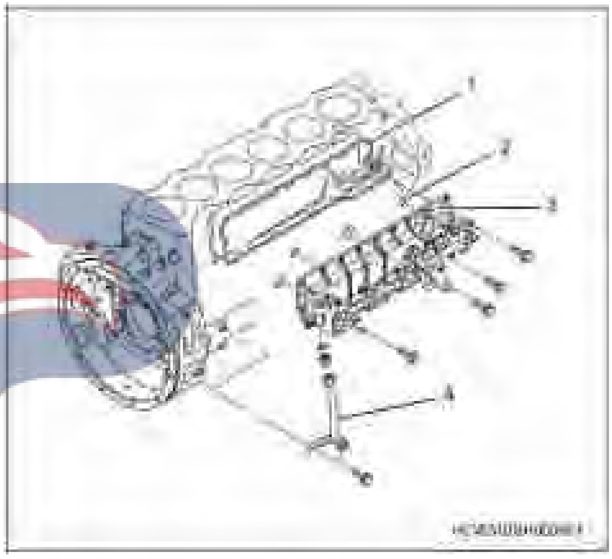
1) Remove the drain pipe from the oil cooler.

2) Remove the connector from the oil cooler.

3) Disconnect the water pipe from the oil cooler.

● Disconnect all hoses connected to the oil cooler.

4) Remove the oil cooler from the cylinder block.



1.Gasket
2. O-ring
3. Oil cooler
4. Drainage line

54. Starter motor removal

1) Disconnect the starter ground cable.

2) Disconnect starter B terminal.

3) Disconnect starter S-terminal.

4) Remove the starter from the flywheel housing.

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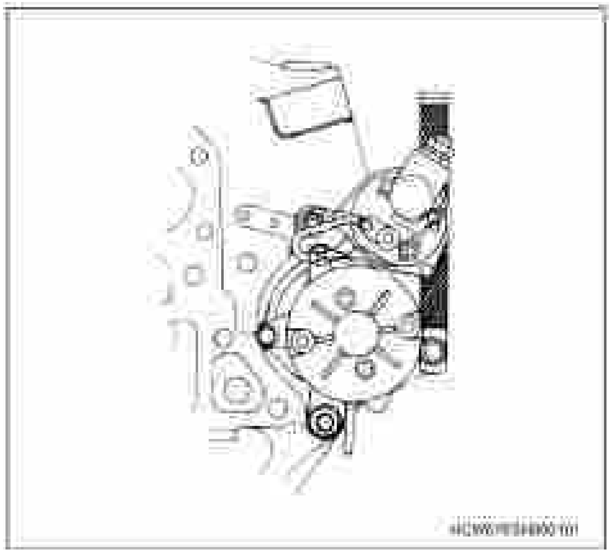


55. Oil strainer removed

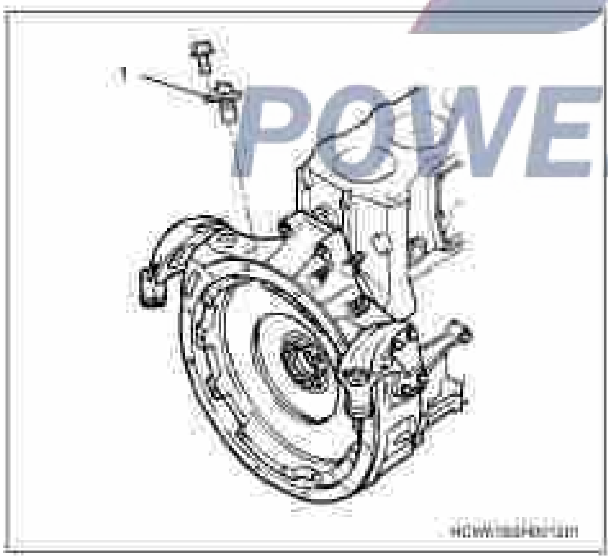
1) Remove the oil strainer and O-ring from the cylinder block.

2) Remove the bracket from the cylinder block.

56. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the crankshaft position sensor from the flywheel housing.



1. CMP sensor

57. Clutch disc removed

Refer to "*5. transmission, transaxle 5e. mjt clutch (single plate drive) removal*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Disassembly*".

58. Flywheel removal

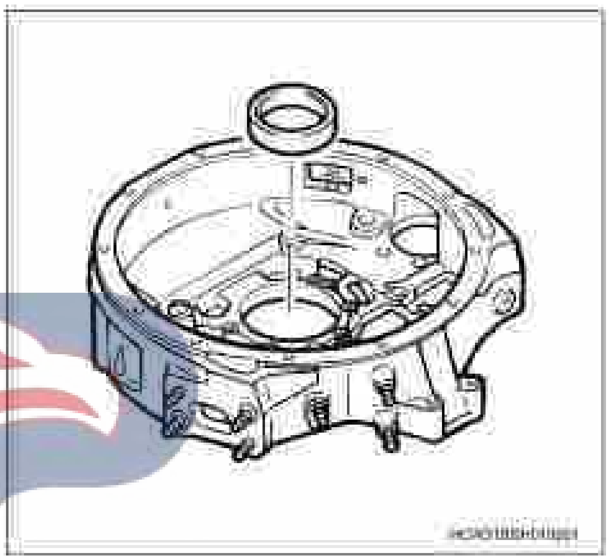
1) Remove the flywheel from the crankshaft.

59. Crankshaft rear oil seal removal

1) Remove the crankshaft rear oil seal from the flywheel housing

Caution:

● Do not damage the oil seal pressure mounting surface.



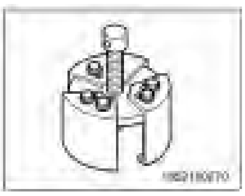
2) Use a special tool to remove the oil deflector from the crankshaft.

Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.

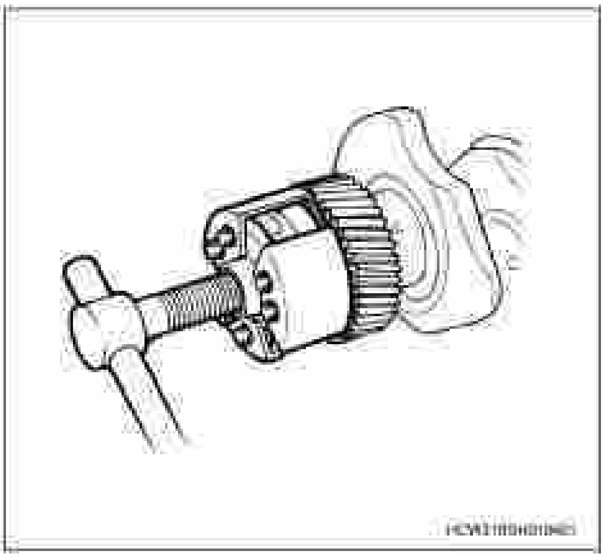
Caution:

● Do not reuse the oil seal or ram during replacement.



SST: 1-8521-0027-0 - Sleeve Removal Unit

POWERSTAR



60. Flywheel housing removal

1) Disconnect the flywheel housing bracket from the flywheel housing.

2) Remove the engine support foot from the flywheel housing.

3) Remove the flywheel housing from the cylinder block.

61. Piston removal

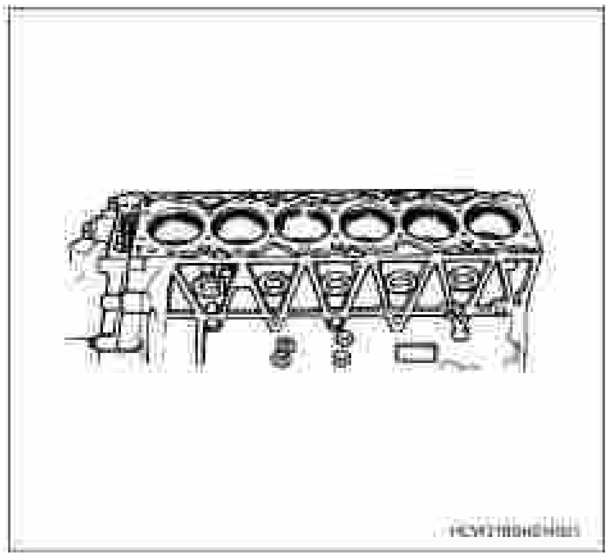
Caution:

● Connect stops to prevent the bushing from protruding during crankshaft rotation and piston removal.

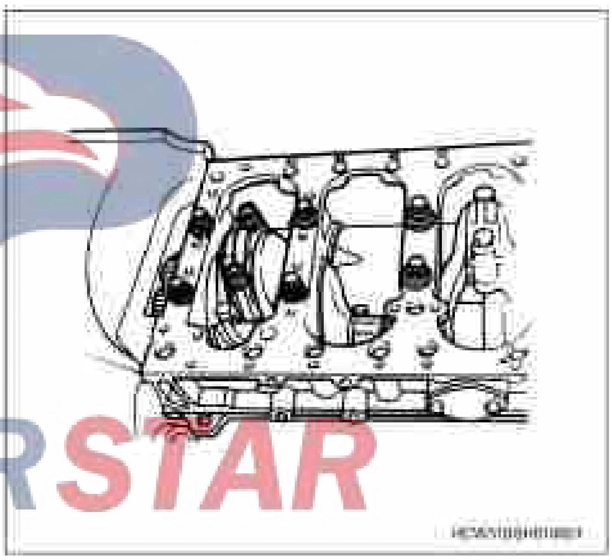
1) Scrape off all the carbon on the top of the cylinder liner with a scraper.

Caution:

Do not damage the cylinder liner.



2) Remove the bearing cap from the connecting rod.



3) Remove the piston from the cylinder block.

Note:

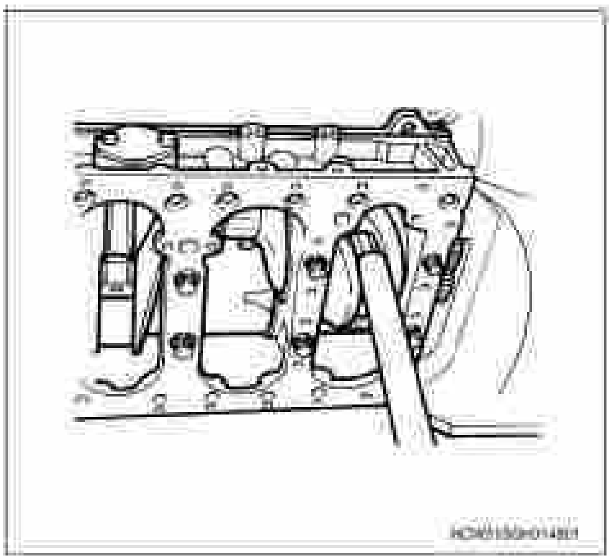
● Remove the piston to the compression top dead center and push the lower end of the rod out using a hammer or the like.

Caution:

● Avoid interference between rod and cylinder liner.

● Do not damage the nozzle.

● Temporarily tighten the removed cap and bearing onto the connecting rod to avoid confusing parts.



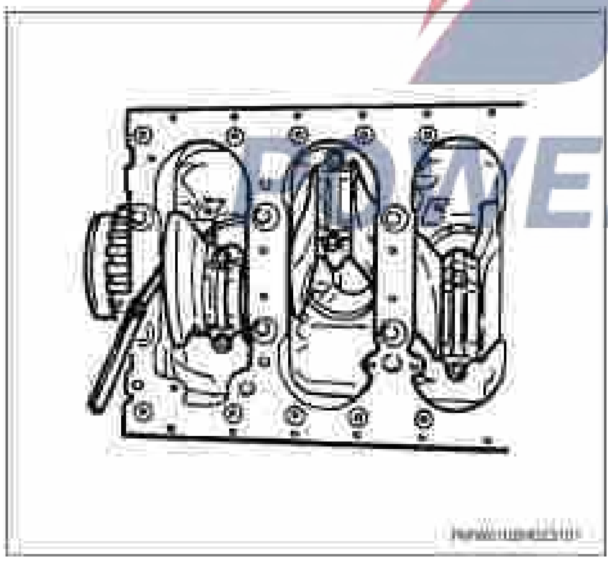
62. crankshaft removal

1) Insert the feeler gauge into the thrust surface of No. 1 bearing and measure the axial clearance.

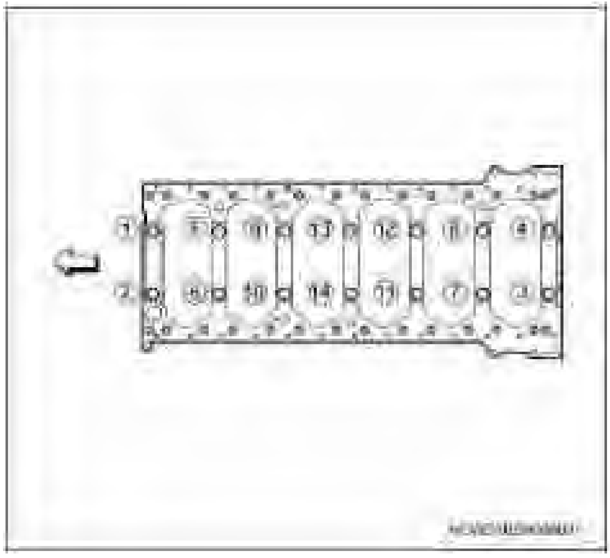
Caution:

If the measured value is not within the specified range, replace the thrust bearing.

Standard: 0.10 to 0.28 mm {0.004 to 0.011 in}



2) Loosen the bolts in the order shown and remove the crankcase from the cylinder block.



3) Remove the crankshaft from the cylinder block.

4) Remove the bearing from the crankcase.

Caution:

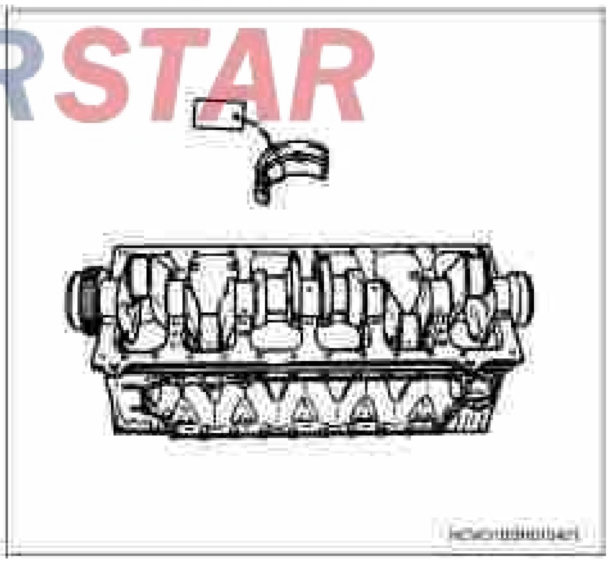
● Label the mounting location of the bearing.

5) Remove the bearing from the cylinder block.

Caution:

● Label the mounting location of the bearing.

● Do not damage the crankshaft bearing sliding parts.



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Removal

1. Crankshaft gear removal

Caution:

● Do not remove the crankshaft gear if no abnormalities are found during crankshaft gear damage.

1) If the oil deflector has been installed, please use special tools to remove the oil deflector from the crankshaft.

SST: 1-8521-0027-0 - Sleeve Removal Unit

2) Use a special tool to remove the crankshaft drive from the crankshaft.

SST: 1-8521-0064-0 - Crankshaft Gear Removal Tool

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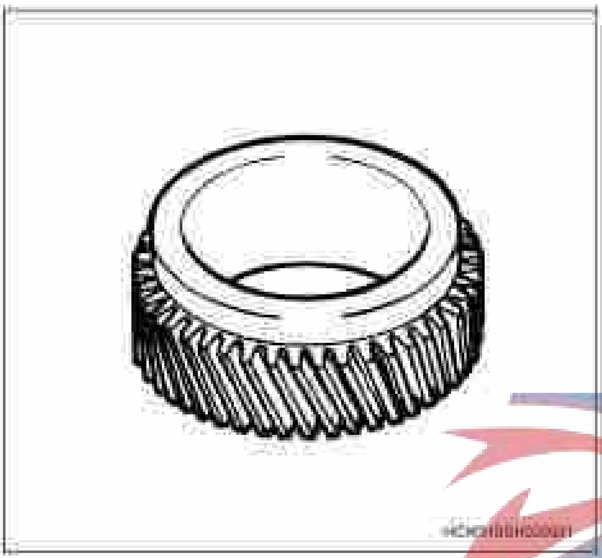
Inspection

1. Crankshaft gear inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check crankshaft gear for damage.



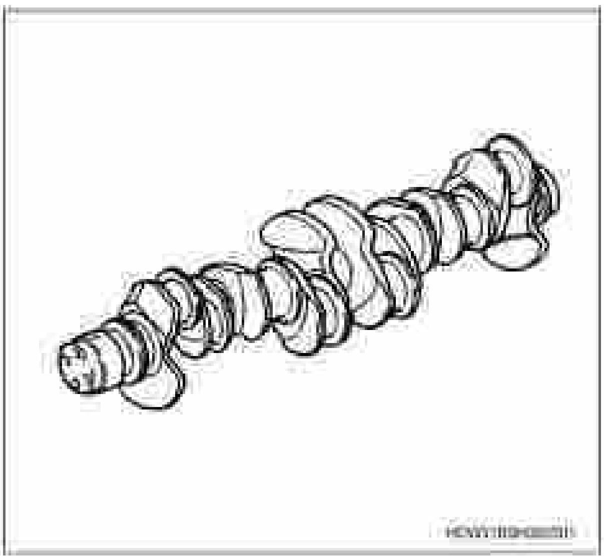
Crankshaft inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check shaft for cracks or damage.

Note:

● You can also use magnetic detection method or staining method to check the penetration of liquid.

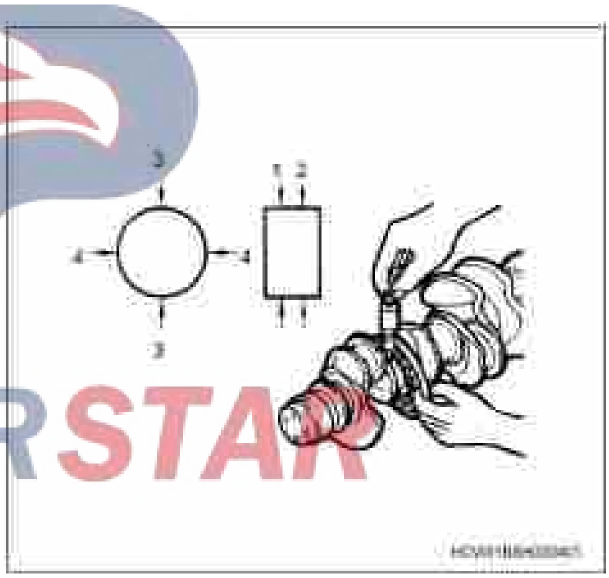


2) Use a micrometer to measure the journal outside diameter and the outside diameter of the pin at 4 locations shown in the figure.

Caution:

● Since the crankshaft has been nitrided, do not carry out repairs.

<table>
<tr><th colspan="2">Measuring point</th><th>Diameter</th><th>Prescribed value</th></tr>
<tr><td rowspan="2">Journal diameter</td><td>No. 4 journal</td><td rowspan="2">: 105 mm { 10.5001 cm }</td><td>: 104.850 to 104.875mm { 4.12794to 4.12893 in }</td></tr>
<tr><td>other</td><td>: 104.880 to 104.905mm { 4.12913to 4. 13011 in }</td></tr>
<tr><td colspan="2">Pin diameter</td><td>: 92 mm { 9.1999 cm }</td><td>: 91.895 to 91.925mm { 3.61791to 3. 61909 in }</td></tr>
</table>



1. Measuring point
2. Measuring point
3. Measuring point
4. Measuring point

3) Place No. 1 and No. 7 crankshaft journal on V-block.

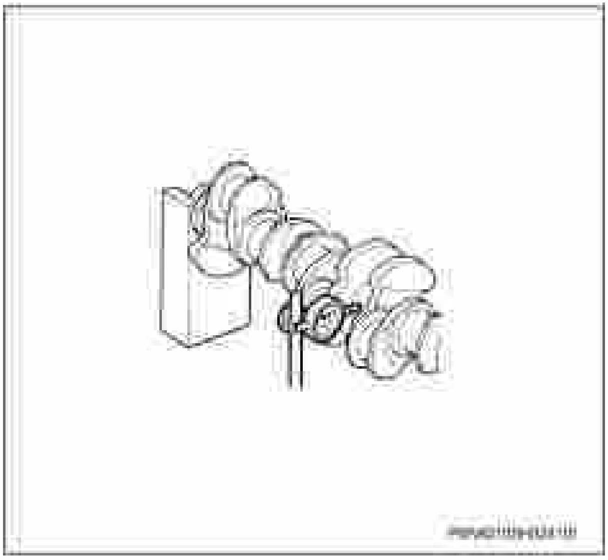
4) Dial gauge to measure the radial runout of the crankshaft.

Note:

● Fix the dial indicator on the No. 4 journal for easy measurement.

Limit: 0.12 mm {0.0047 in}

POWERSTAR



5) Install the bearing on the crankcase.

6) Install the bearing on the cylinder block.

7) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

8) Apply engine oil to bearing surfaces and M12 bolt threaded surfaces.

9) Install the crankcase to the cylinder block in numerical order in the figure.

Tightening torque: 96 N • m {9.8 kgf • m / 71 lb • ft}

4th (M18)

Tightening torque: 88 N • m {9.0 kgf • m / 65 lb • ft}

2nd (M18)

Specified angle: 90 ° Third time (M18)

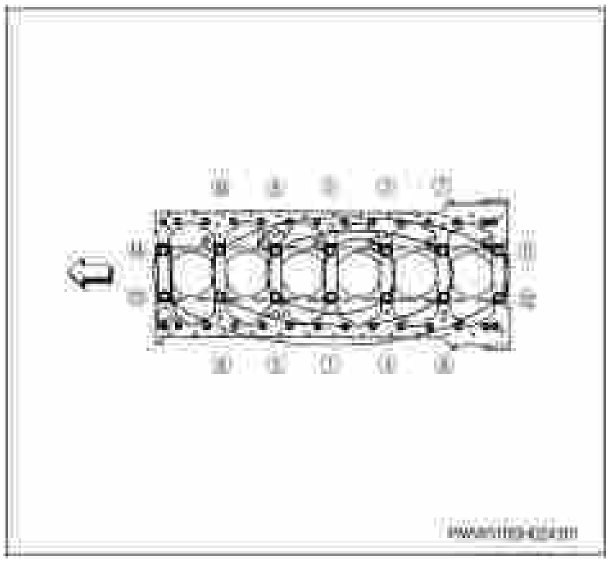
Note:

● Angular tolerances when tightening with angle control should be 90 - 120 °.

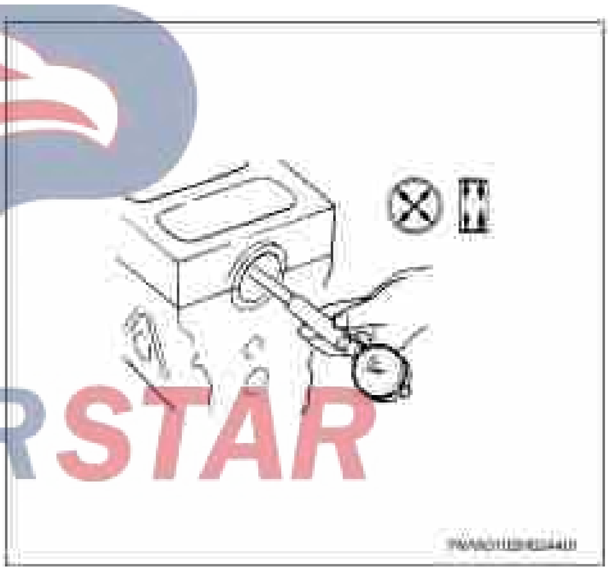
Tightening torque: 96 N • m {9.8 kgf • m / 71 lb • ft}

4th (M18)

Tightening torque: 294 N • m {30.0 kgf • m / 217 lb • ft} Confirm fastening again (M18)



10) Cylinder gauge is used to measure the cylinder block at 4 points shown in the figure.



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11) Calculate the clearance between crankshaft bearing inner diameter and crankshaft journal outer diameter.

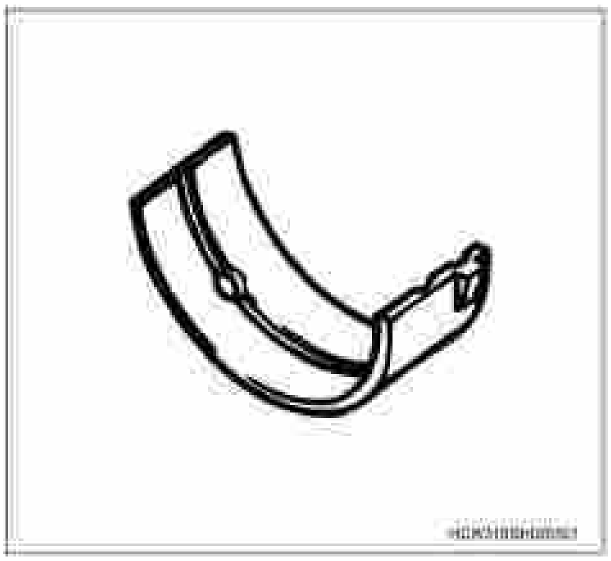
Measuring point	Prescribed value	Limit value
No. 4 journal	: 0.075 to 0.150mm { 0.00295to 0.00591 in }	: 0.16 mm {0.0063 in }
others	: 0.045 to 0.120mm { 0.00177to 0.00472 in}	

12) Check the following parts of the bearing.

● Wear

● Tooth contact

● Exfoliation



13) Clean the crankshaft with organic solvent.

14) Dissolve cupric ammonium chloride dihydrate in distilled water to prepare a test with a concentration of 5 to 10%.

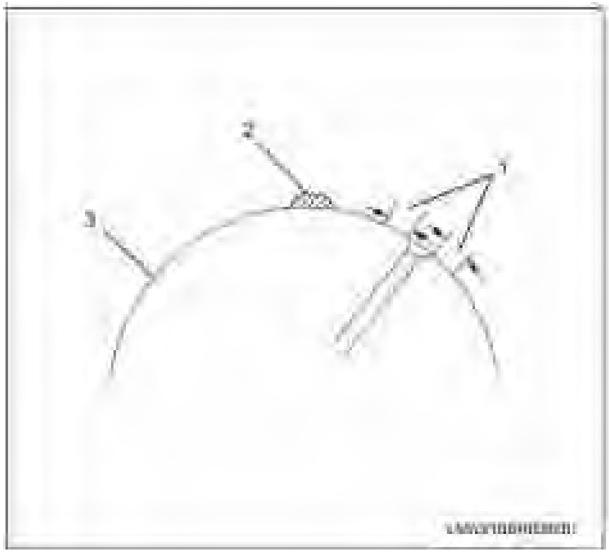
Warning:

● If the test solution used for the nitrocellulose test is splashed in the eyes, immediately wash with plenty of fresh water before proceeding with treatment.

Caution:

● Due to the strong corrosiveness of the test solution, the test solution should be erased immediately after inspection and cleaned with water or steam.

15) Drip check the crankshaft with a dropper.



1. No drip zone (oil hole 10 mm {0.39 in} radius)
2. Drip check solution location
3. Crankshaft

16) Wait for about 40 seconds, and then determine if it passes.

Usability testing	Conditions
May be reused	About 40 seconds after no change.
Impossible to re-use	After about 40 seconds, the drop position changes to a copper color.

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Reassembly

1. Crankshaft gear installation

1) Install the dowel pin to the crankshaft.

2) Heat the crank gear with the oil heater.

Heating temperature: 180 to 240℃ {356 to 464 ℉}

3) Use special tools to install the crankshaft drive on the crankshaft.

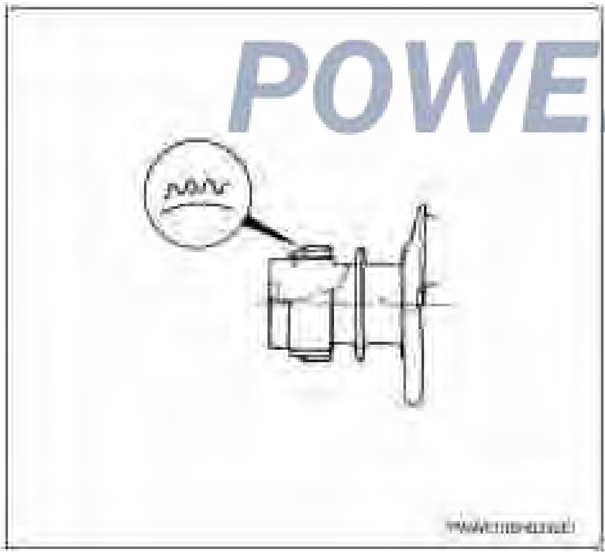
Note:

● Align the timing mark O with the front side, align the gear groove with the crankshaft alignment pin, and finally install with a depth of installation that ensures no gap between the crankshaft and the crankshaft drive.

Caution:

● Please pay attention to gear direction during installation.

SST: 1-8522-0045-0 - Gear installation tools



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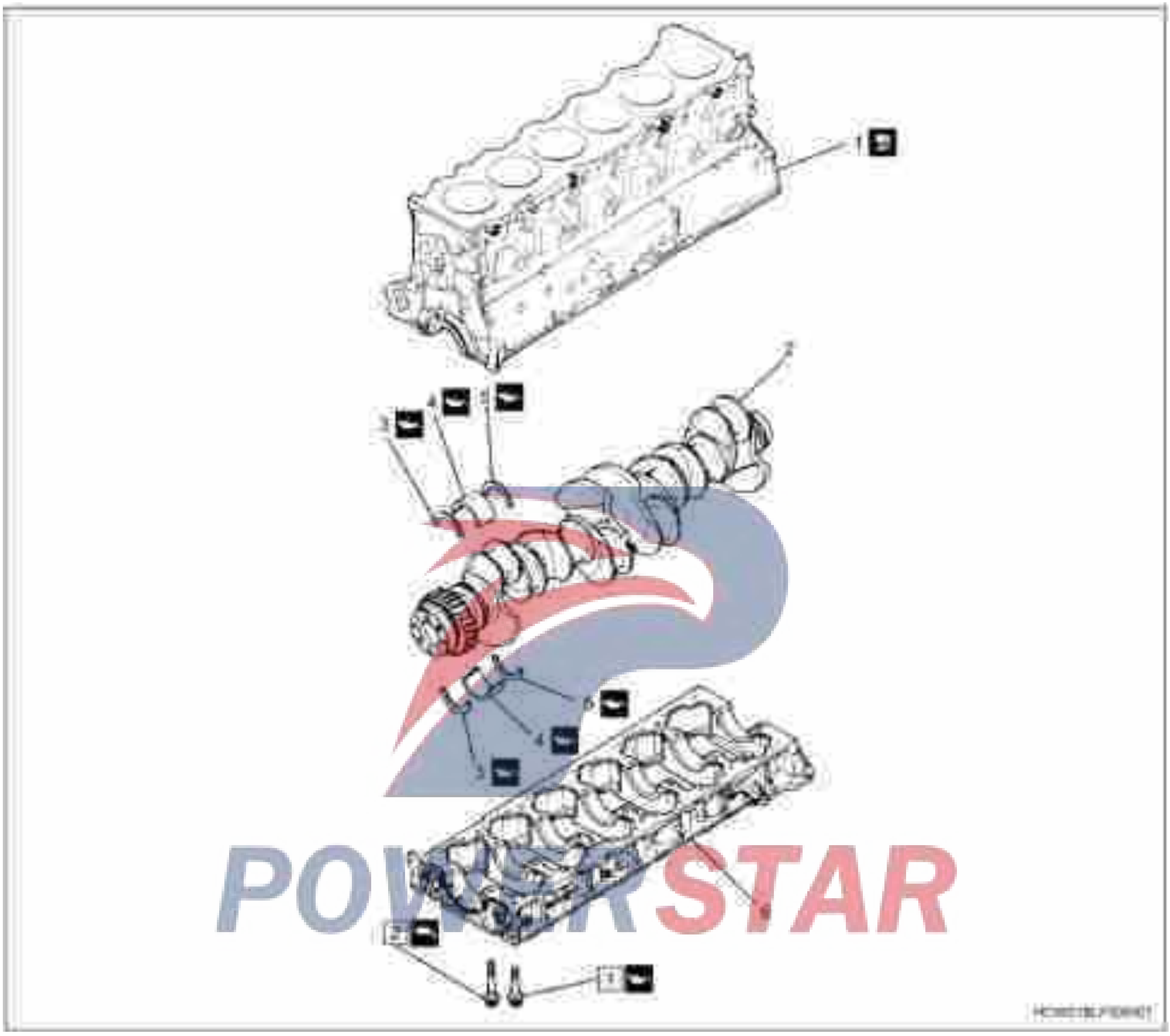
Installation

1. Component Views

Crankshaft



Part name

1. Cylinder block
2. Crankshaft
3. Thrust bearings
4. Main bearing
5. Thrust bearing
6. Crankcase

Tightening torque

1: 96 N • m {9.8 kgf • m / 71 lb • ft} M12

2-1: 49 N • m {5.0 kgf • m / 36 lb • ft} M18

2-2: 88 N • m {9.0 kgf • m / 66 lb • ft} M18

2-3: 90 °M18

2-4: 294 N • m {30.0 kgf • m / 217 lb • ft} M18

2. Crankshaft installation

1) Clean the bearing and bearing mounting surface.

Note:

● Carefully clean bearing and bearing mounting surfaces.

2) Install the crank bearing on the crankcase.

Caution:

● First confirm the bearing rating for the corresponding installation location, and then install.

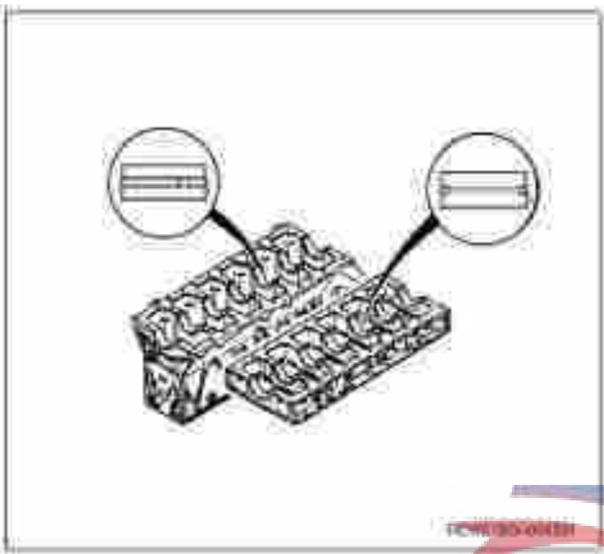
Confirm there is no oil hole in crankshaft bearing.

3) Install the crank bearing on the cylinder block.

Caution:

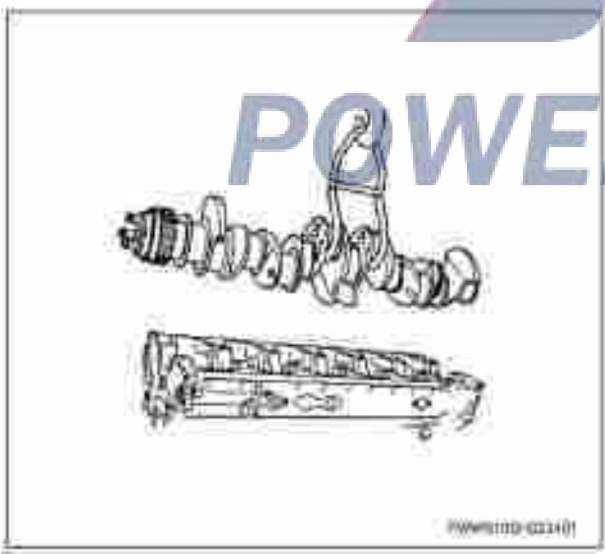
● First confirm the bearing rating for the corresponding installation location, and then install.

Confirm there is oil hole in crankshaft bearing.



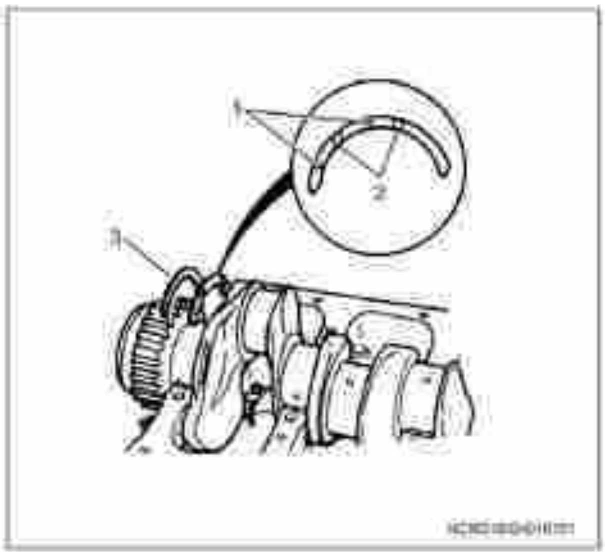
4) Apply the engine oil to the sliding surface of the crankshaft bearing.

5) Level the crankshaft and carefully align the crankshaft with the cylinder block.



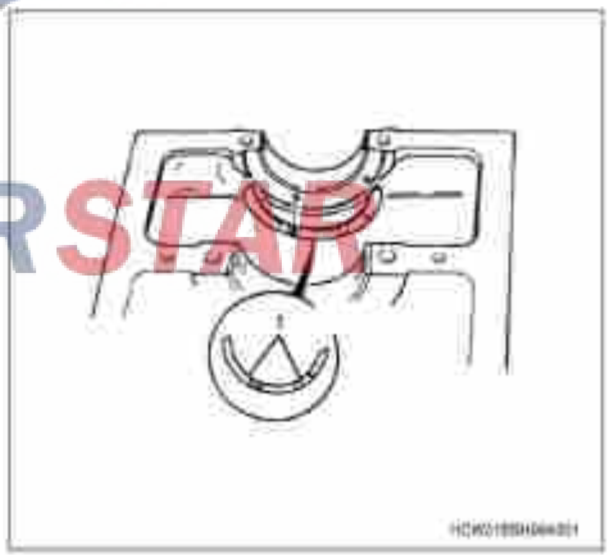
6) Apply the engine oil to the thrust bearing.

7) Install the thrust bearing on both sides of the No. 1 journal area of the cylinder block so that it faces the outside of the tank.



1. Align the dowel hole
2. Oil tank
3. Apply the oil

8) Align the thrust bearing with the raised area of the crankcase, and then insert the thrust bearing facing the outside of the sump.



1. Oil tank

9) Refer to the corresponding chart and apply the liquid gasket to the cylinder block.

Caution:

● After the liquid gasket assembly is completed, the crankcase should be installed in time.

Cylinder bottom dedicated liquid gasket application procedure

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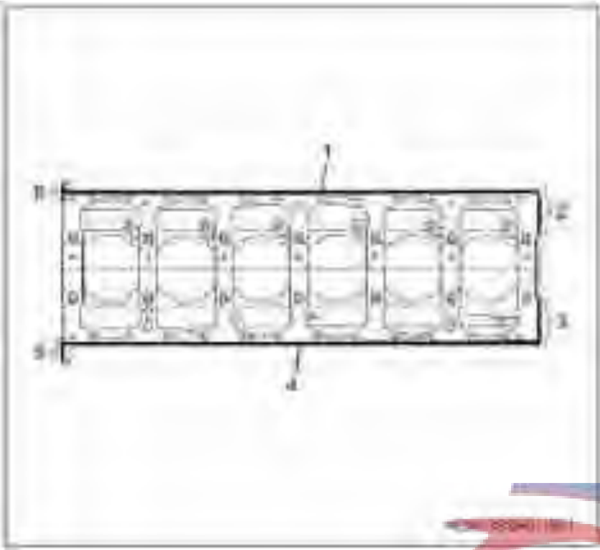
Liquid gasket used	FMD127
Coating width	: about4 mm { about 0.16 in }
Coating thickness	:0.3 mm or more {0.012 in or more}



1. Liquid gasket application location
2. Liquid gasket application location
3. Liquid gasket application location
4. Liquid gasket application location
5. Liquid gasket application location
6. Liquid gasket application location

10) Apply molybdenum disulphide grease to the surface of the base and to the threaded portion of the M18 bolt.

11) Apply engine oil to bearing surfaces and M12 bolt threaded surfaces.

12) Install the crankcase to the cylinder block in numerical order in the figure.

Tightening torque: 49 N • m {5.0 kgf • m / 16.33 kg • ft}1st (M18)

Tightening torque: 88 N • m {9.0 kgf • m / 29.48 kg • ft}2nd (M18)

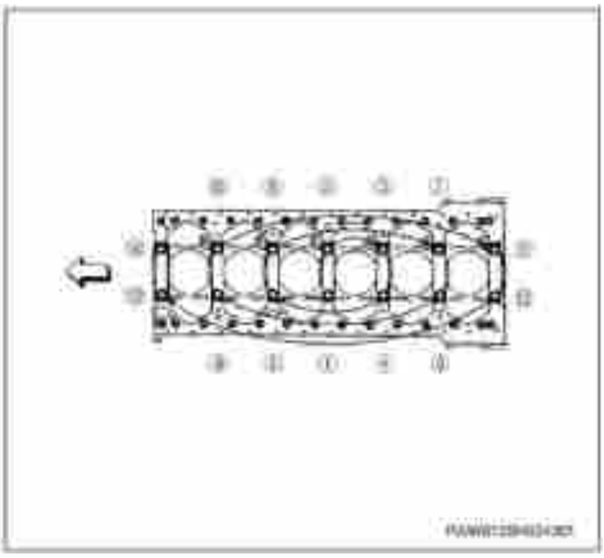
Specified angle: 90 °T hird time (M18)

Note:

● Angular tolerances when tightening with angle control should be 90 - 120 °.

Tightening torque: 96 N • m {9.8 kgf • m / 32.21 kg • ft}4th (M18)

Tightening torque: 294 N • m {30.0 kgf • m / 98.43 kg ft} Confirm again (M18)



3. Piston installation

1) Clean the rod connecting rod bearing mounting surface and cover.

2) Inspect the entire outer edge of the bearing for oil grooves and attach the rod bearing to the end cap.

3) Check the bearing for the presence of local grooves and oil holes, and then install the connecting rod bearing on the connecting rod.

4) Coat the sliding surface of the rod bearing with engine oil.

5) Apply engine oil to cylinder liner.

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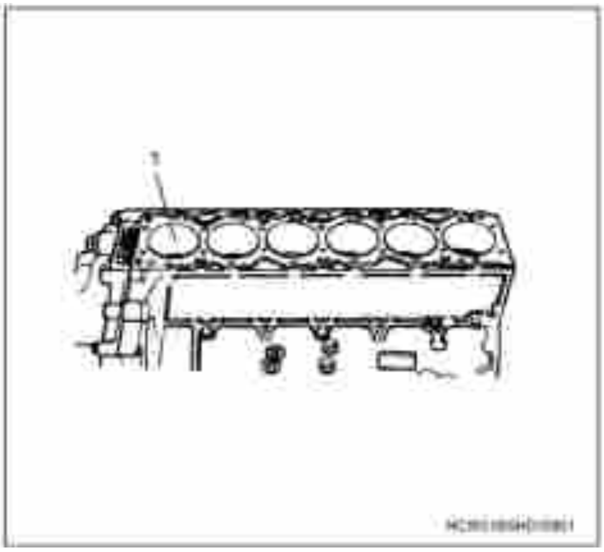
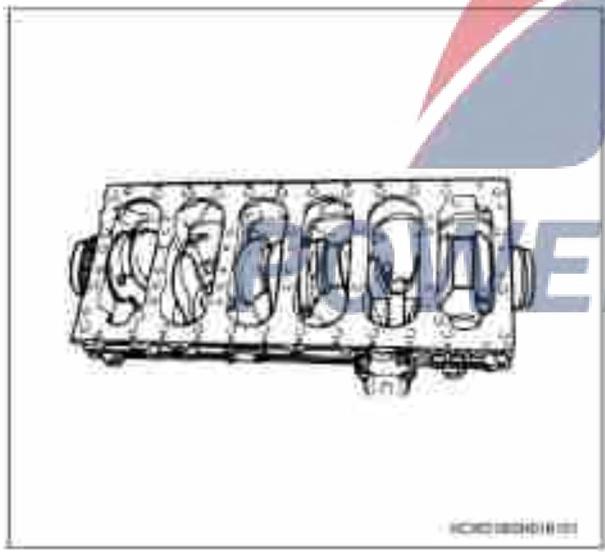


1. Cylinder liner

6) Align the cylinder piston pin of the fitted piston with the top dead center.

Caution:

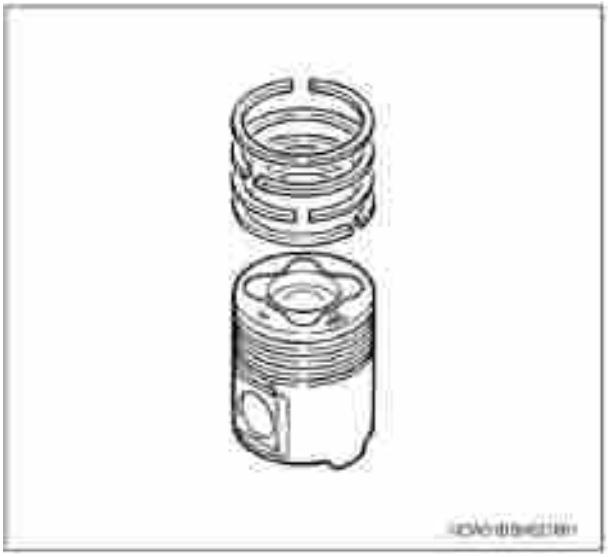
● Attach stop to avoid bushing protrusion.



7) Avoid positioning the piston ring end clearance in the direction of the side pressure. Rotate the piston ring to create a 90 °clearance on the cover.

Caution:

● Install the oil ring end cap on the opposite side of the expansion ring end cap.



8) Apply engine oil to the entire circumference of the piston and piston ring.

9) Use special tools to attach the piston to the cylinder block.

Caution:

● Carefully install the piston.

● Special tools are fastened to the cylinder block for ease of use.

● Do not damage the crankpin and nozzle when inserting the piston.

SST: 1-8522-0059-0 -. Piston installer

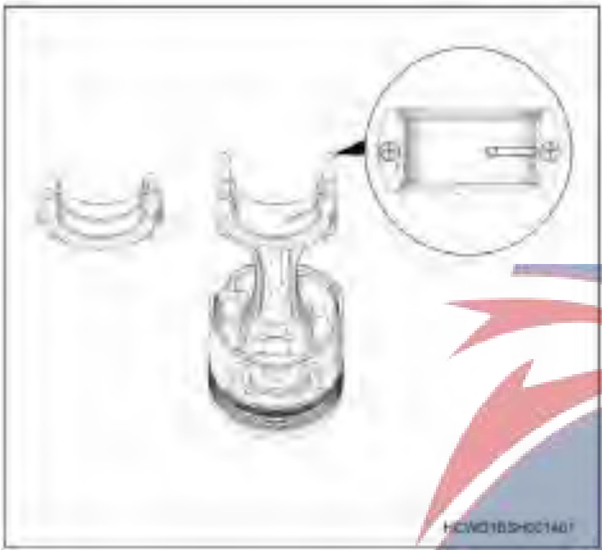
POWER STAR

10) Align the connecting rod and cylinder head according to the number of cylinders, and then attach the connecting rod to the crankshaft.

Caution:

● Install in such a way that the mark faces the right side of the cylinder block.

11) Apply to the screw thread on the base surface and connecting rod end cap mounting nut Cover molybdenum disulfide grease.



12) Install the rod bearing cap on the connecting rod.

Tightening torque: 98 N • m {10 kgf • m / 72 lb • ft} The first time

Prescribed angle: 30 °second

Prescribed angle: 30 °the third time

Tightening torque: 137 N • m {14 kgf • m / 101 lb• ft}

Confirm again

Caution:

● Angle tolerance should be 60 - 90 °

13) Install the crankshaft.

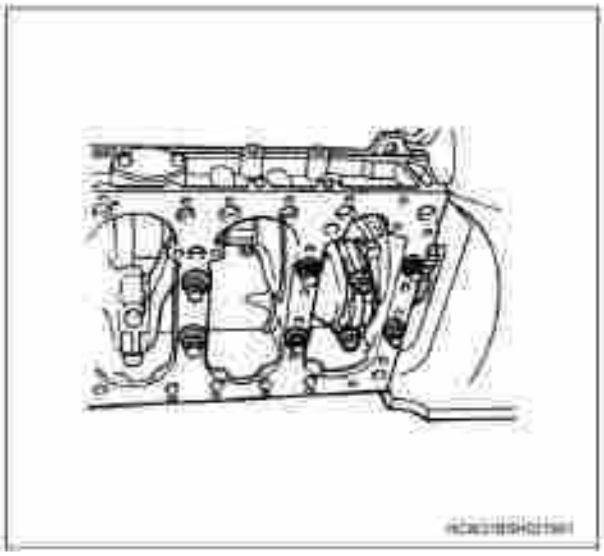
Note:

Confirm that the crankshaft is running smoothly.

Caution:

● Attach stop to avoid bushing protrusion.

14) Confirm that the piston nozzle is not deformed.



4. Flywheel housing installation

1) Apply liquid gaskets to the positioning surfaces of the flywheel housing, cylinder block and crankcase.

Caution:

● Do not insert the liquid gasket into the bolt hole.

● After the liquid gasket assembly is completed, the flywheel housing should be installed in time.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: about 0.3mm { 0.012 in }
	Coating width	: 4.0 mm {0.157 in }

2) Attach the flywheel housing to the cylinder block.

Caution:

● First tighten the bolt near the dowel pin.

Tightening torque: 108 N • m { 11.0 kgf • m /80 lb • ft }

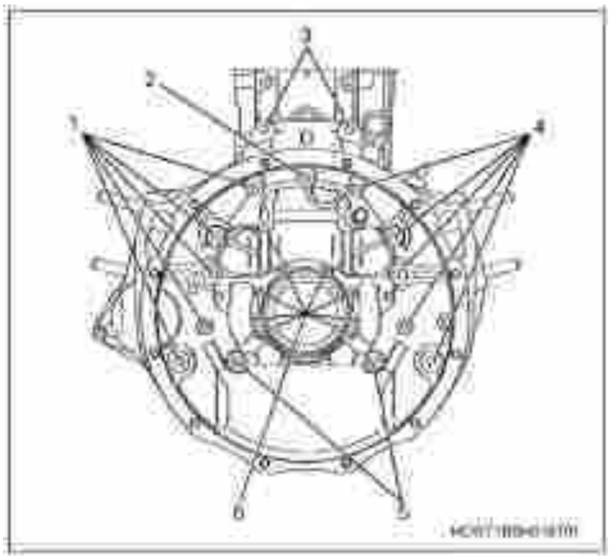
M14 nut

Tightening torque: 123 N • m { 12.5 kgf • m / 91 lb • ft }

M14 bolt

Tightening torque: 22 N • m { 2.2 kgf • m / 16 lb • ft }

M8 bolt



1. M14 bolt
2. M14 nut
3. M14 bolt
4. M14 bolt
5. M14 bolt
6. M8 bolt

3) Apply molybdenum disulphide grease to the threaded surface of the bearing surface and the engine mount mounting bolt.

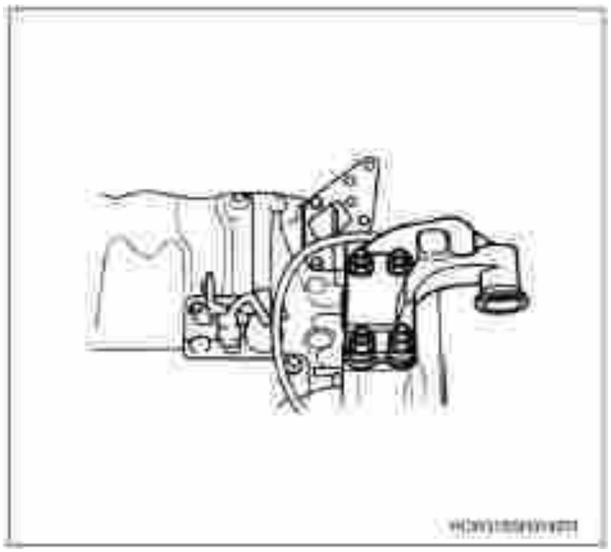
4) Install the engine bearing support foot to the flywheel housing.

Caution:

● Tighten from the pinned position.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} The first time

Tightening torque: 275 N • m {28.0 kgf • m /203 lb • ft} 2nd time



5) Connect the flywheel housing bracket to the flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}

5. Crankshaft rear oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft rear oil seal.

2) Install the crankshaft rear oil seal to the flywheel housing using special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.

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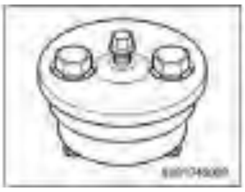
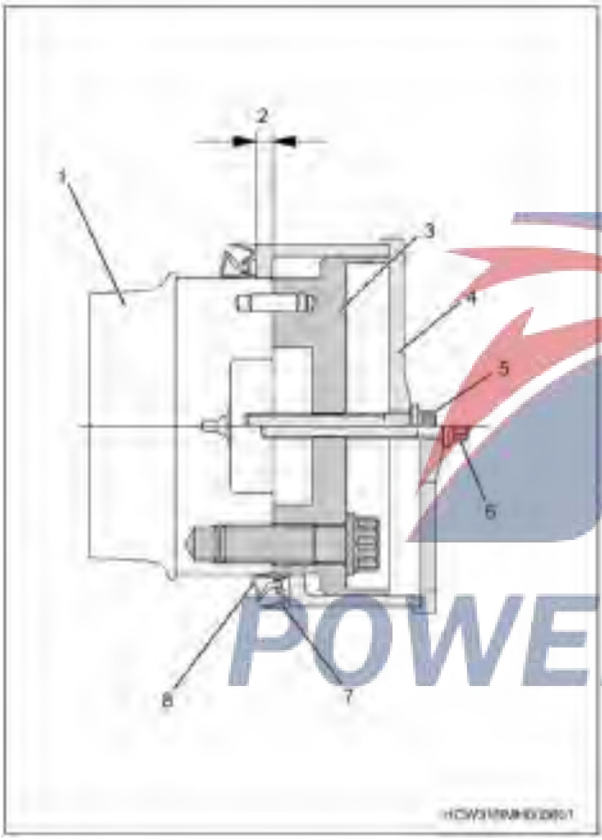
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) Measure the size of the crankshaft end face to the oil seal surface.



1. Crankshaft

2. 6.7 - 7.3 mm {0.264 - 0.287 in}

3. 1-8521-0027-0 (Adapter)

4. 1-8521-0027-0 (Sleeve)

5. Finish pressing the position of the special tool after assembly

6. Perform the position of the special tool before pressing the assembly

7. Oil seal

8. Slinger (gray)

6. Flywheel installation

1) Apply molybdenum disulfide to the threads and seat surface of the tightening bolt.

2) Install the flywheel to the crankshaft in the order shown in the diagram.

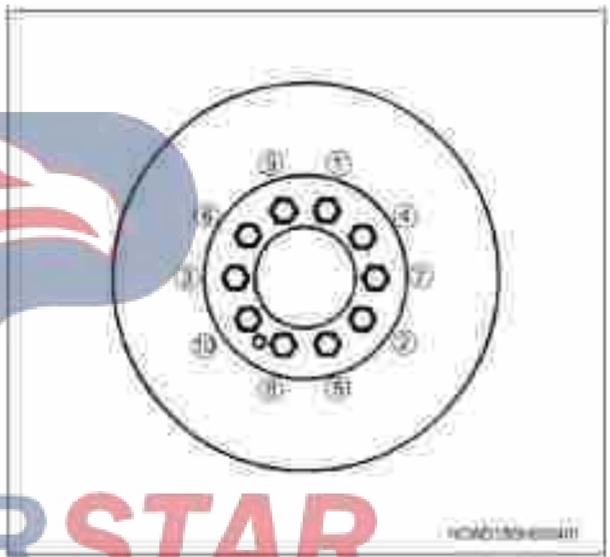
Tightening torque: 78.5 N • m {8.0 kgf • m / 58 lb • ft} 1st time

Prescribed angle: 60 °second

Prescribed angle: 30 °the third time

Caution:

● The angular tolerance for tightening through angle control should be 90-120 °



POWERSTAR

7. Clutch disk installed

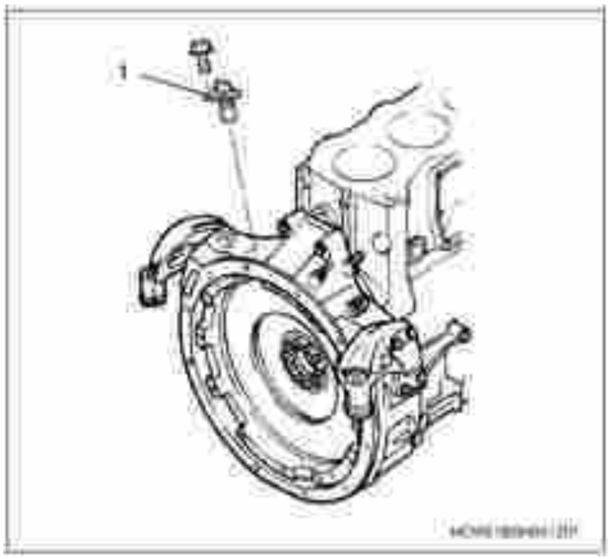
Refer to "*5. transmission, transaxle 5e. mjt clutch (single plate drive) mounting*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Installation*".

8. CMP sensor installation

1) Install the crankshaft position sensor to the flywheel housing.

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}



1. CMP sensor

2) Connect the connector to the CMP sensor.

9 oil strainer installed

1) Temporarily fasten the bracket to the cylinder block.

2) Install the oil strainer and O-ring onto the cylinder block in numerical order in the figure.

Tightening torque: 49 N • m { 5.0 kgf • m /36 lb • ft }

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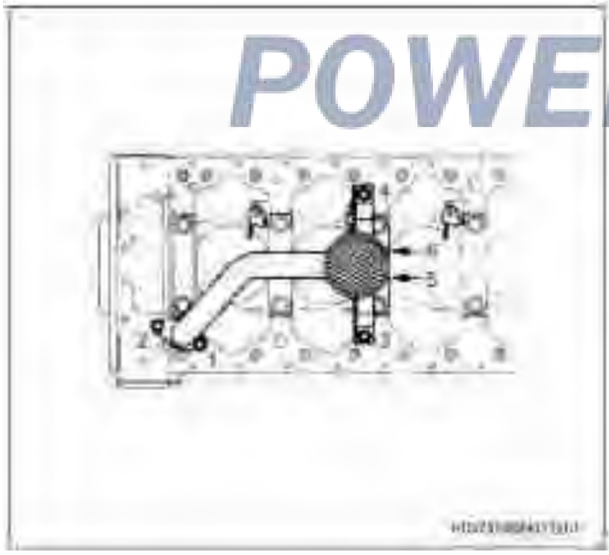


10. Starter motor installation

1) Install the starter to the flywheel housing.

Tightening torque: 103 N • m { 10.5 kgf • m / 76 lb • ft }

2) Connect the S-terminal to the starter.

3) Connect the B-terminal to the starter.

4) Connect the grounding cable to the starter.

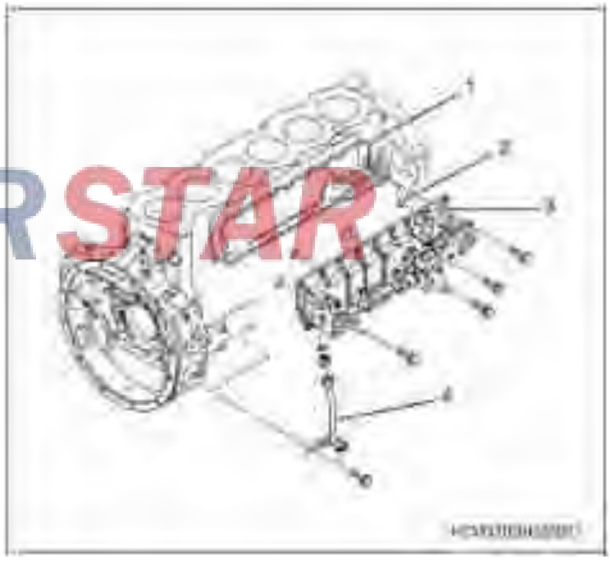
11. Oil cooler installation

1) install the gasket to the oil cooler.

2) install the O-ring to the oil cooler.

3) install the oil cooler to the cylinder block.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Gasket

2. O-ring

3. Oil cooler

4. Drainage line

4) Install the fitting on the oil cooler.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

5) Install the drain pipe to the connector.

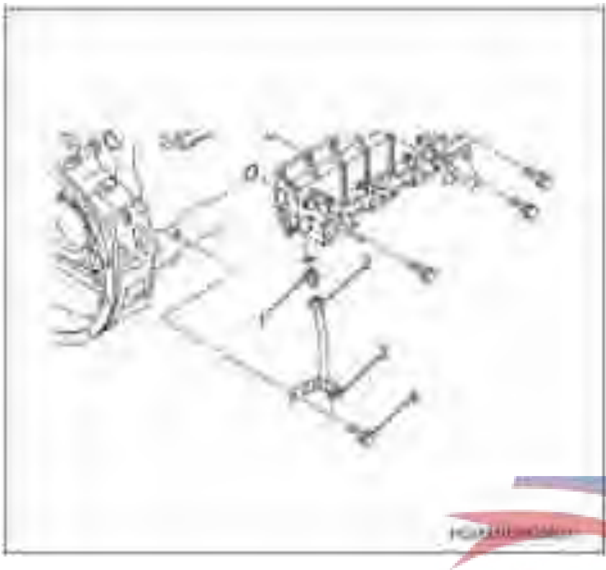
Tightening torque: 69 N • m {7.0 kgf • m / 51 lb • ft}

6) Install the bolt to the cylinder.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft}

7) Install the drain plug on the pipe.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}



1. Connector
2. Drainage line
3. Drain plug
4. Bolt

12. Partial oil filter installation

1) Install the O-ring to the partial oil filter.

2) Install the partial oil filter to the oil cooler as a set with the bracket.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3) Install the clip to the oil pipe.

13. Oil filter installation

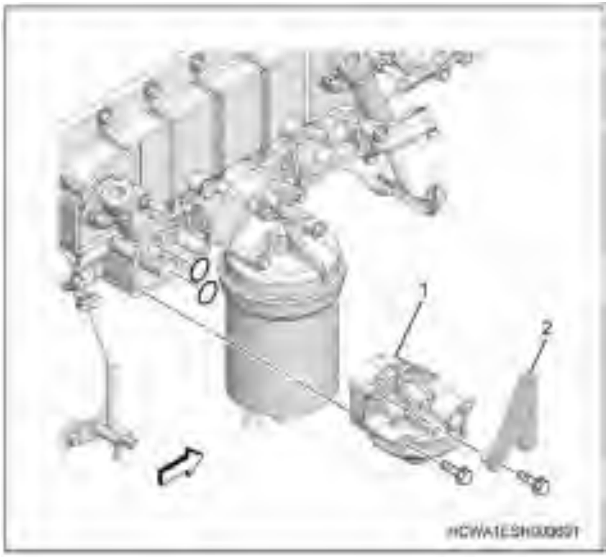
1) Install the O-ring to the oil filter case.

2) Install the oil filter to the oil cooler.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3) Install the pipe clamp bracket on the oil filter.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Oil filter case.
2. Hose clamp bracket

14. oil filter warning switch installation

1) Install the oil filter warning switch and valve to the oil filter body.

Tightening torque: 78 N • m {8 kgf • m / 58 lb • ft}

2) Connect the harness connector to the oil filter warning switch.

15. Water pump installation

1) Install the O-ring and pump to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

1. Water pump
2. O-ring
3. O-ring

POWERSTAR

16. Intake pipe installation

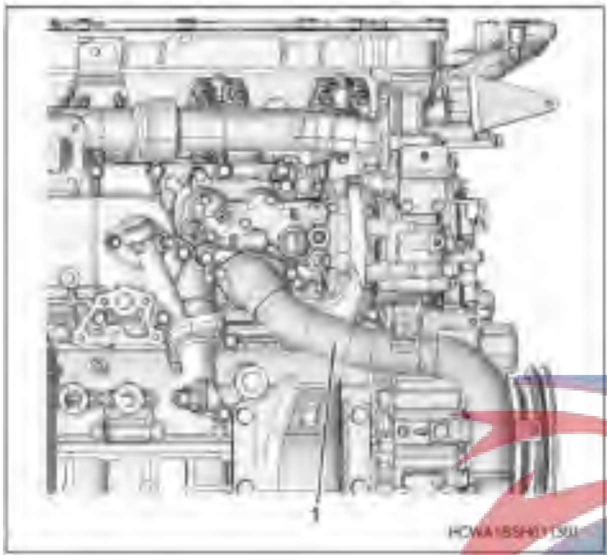
1) Install the water inlet pipe to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

Oil cooler side

Tightening torque: 88 N • m {9.0 kgf • m / 65 lb • ft}

Gearbox side



1. Water inlet

17. Thermostat installation

1) Install the thermostat seal ring on the oil cooler using a special tool.

SST: 1-8522-1034-0 - thermostat seal ring Installer

2) Mount the thermostat to the oil cooler.

Caution:

● Care should be taken when installing the seal ring to avoid damaging the seal ring.

18. Thermostat housing installation

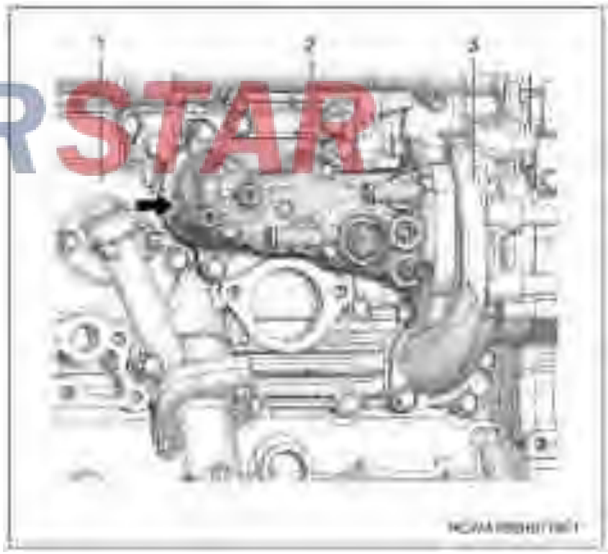
1) Install the o-rings and washers, and then install the thermostat housing on the oil cooler.

Note:

● While tightening the thermostat housing against the oil cooler, tighten the pump end bolts.

● Tighten the oil cooling bolt.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}



1. Oil cooler

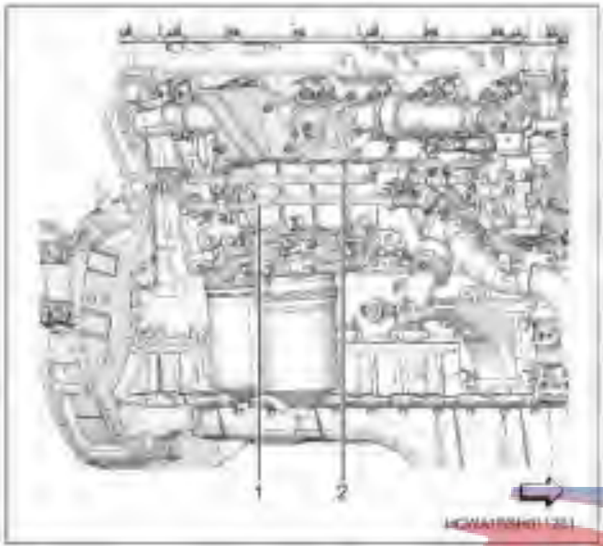
2. Thermostat housing

3. Water pump

POWERSTAR

19. Exhaust gas recirculation cooler water pipe installation

1) Install the front and rear exhaust gas recirculation cooler pipes on the thermostat housing.



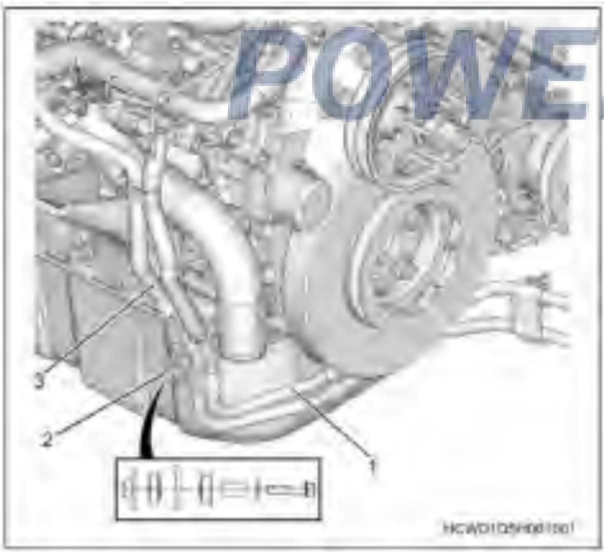
1. Back-end exhaust gas recirculation cooler hose

2. Exhaust gas recirculation cooler hose

20. Heater hose installation

1) Mount the heater hose to the thermostat housing.

2) Install the clip on the heater hose.



1. Heater hose

2. Heater pipe bracket part

3. Heater pipe

21. Timing gearbox installed

1) Refer to the corresponding chart and apply the liquid gasket to the timing gearbox.

Caution:

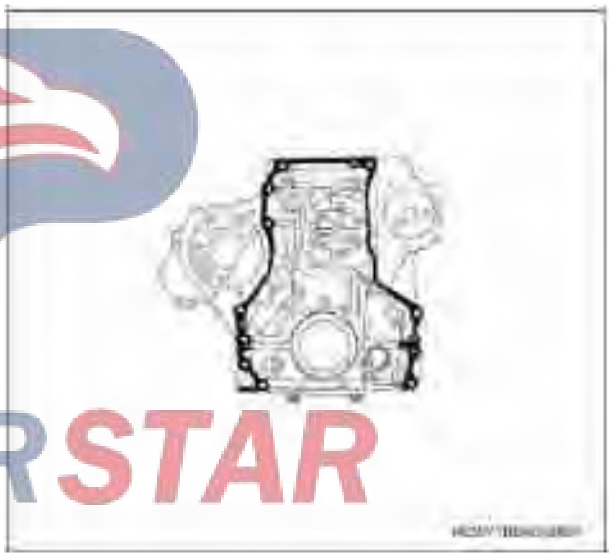
● In addition, the liquid seal can also be applied to the cylinder block and crankcase reference plane.

● Be careful not to allow the liquid gasket to enter the bolt hole.

● After the liquid gasket is assembled, the timing gearbox should be installed in time.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: about0.3mm { about 0.012 in }
	Coating width	: about4 mm { about 0.16 in }



2) Install the timing gearbox to the cylinder block.

Caution:

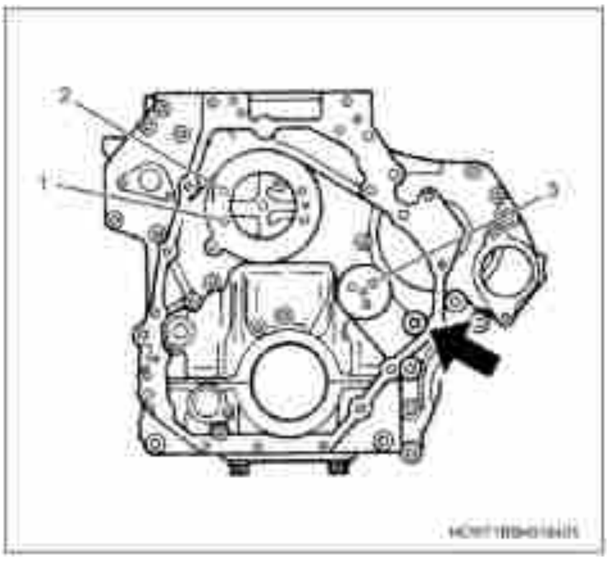
● If you use the bolts indicated by the arrows in the figure again, apply the Loctite 271 glue to the threads.

● After the gear unit is installed, temporarily tighten the bolts M10 - 1.5 in the area shown in Figs. 1-3 with the specified torque and wait for 30 minutes or more before installing the idler gears A and B.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft} M14

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft} M10

POWERSTAR



1. M10-1.5 bolts (temporary tightening)
2. M10-1.5 bolts (temporary tightening)
3. M10-1.5 bolts (temporary tightening)

22. Oil pan installation

1) apply the liquid gasket to the cylinder block.

Note:

● Three key 1207B with a coating thickness of 3 - 4 mm {0.118 - 0.157 in} and a width of 3-4 mm {0.118 - 0.157 in} on the locating surface of the flywheel housing, gearbox and cylinder block.

Caution:

● Clean the application surface of the gasket before applying the gasket.

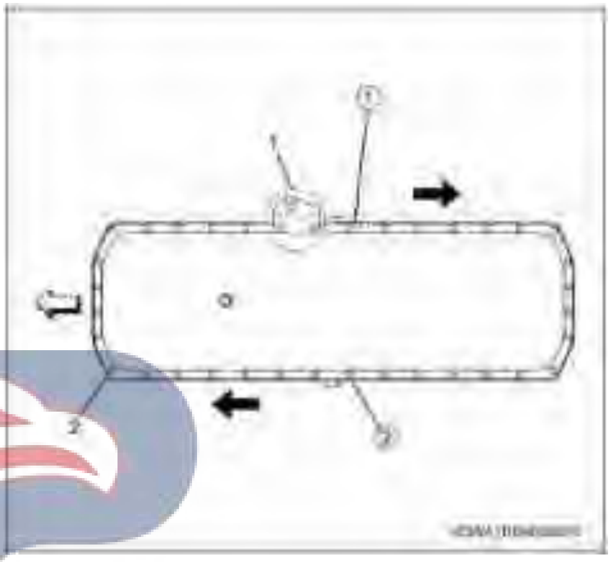
1. Liquid gasket

2) Install the oil pan to the cylinder block in the order of numbers and arrows shown in the diagram.

Caution:

● After tightening all the bolts, tighten all the bolts again with the specified torque from the first tightened bolt.

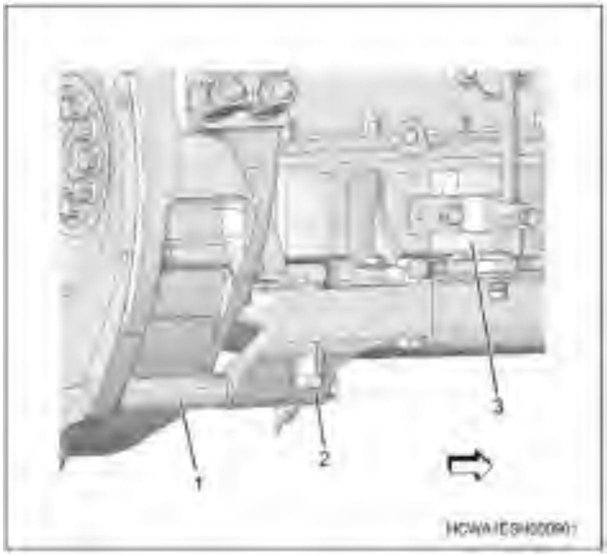
Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}



1. M10×35
2. M10×20

3) Install the left and right flywheel housing brackets onto the cylinder block and flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}



1. Flywheel housing
2. Flywheel housing bracket

POWERSTAR

3. Cylinder block

23. Idle gear installation

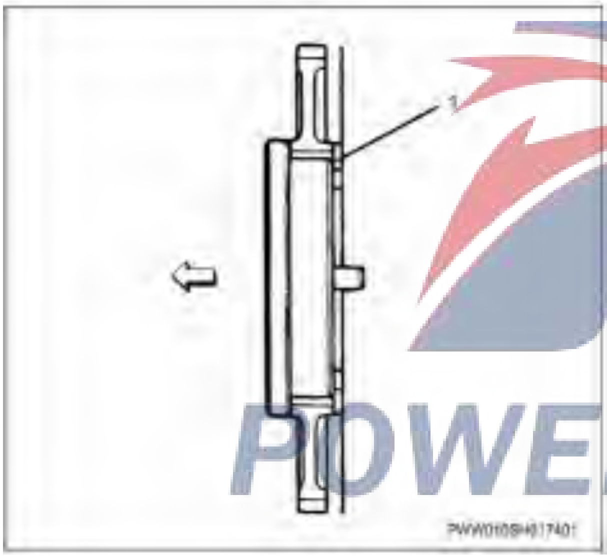
1) Bring the B-axis surface of the idler gear with engine oil.

2) Apply idler gear B inner diameter and bearing surface with engine oil.

3) Install the idler gear B-axis onto the cylinder block.

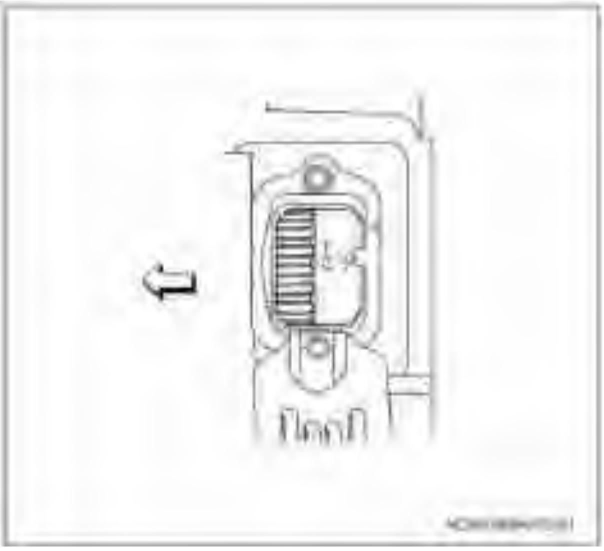
Caution:

- During disassembly, check the front / rear markings on the idler gear B and the thrust plate repeatedly.
- Remember to remove the installed temporary fastening bolts.



1. Thrust piece

4) Align the No.1 cylinder to compression top dead center.



5) Apply idler gear A inner diameter to engine oil.

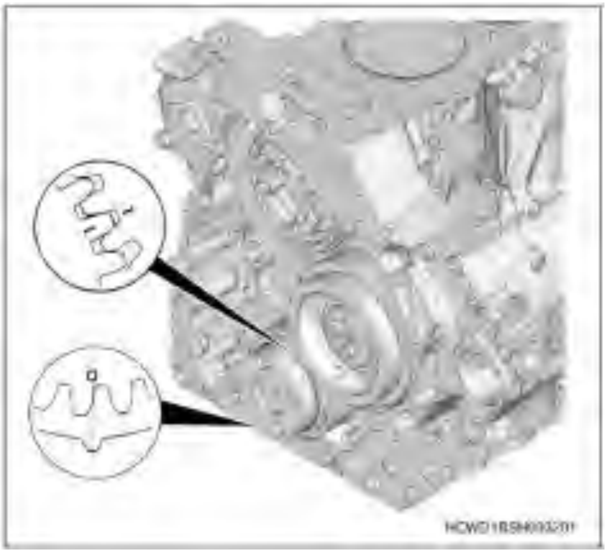
6) Install the sleeve on idler gear A.

7) Align thrust ring with idler gear A

8) Referring to the illustration, align the O mark between the crankshaft gear and the timing gear box with the I mark between the crankshaft gear and idler gear A, and install the idler gear A onto the cylinder block.

9) Referring to the illustration, align the O mark between the crankshaft gear and the timing gear box with the I mark between the crankshaft gear and idler gear A, and install the idler gear A onto the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}



10) Install the three distance bolts to the cylinder block.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

24. Oil pump installation

1) Install the O-ring onto the pump.

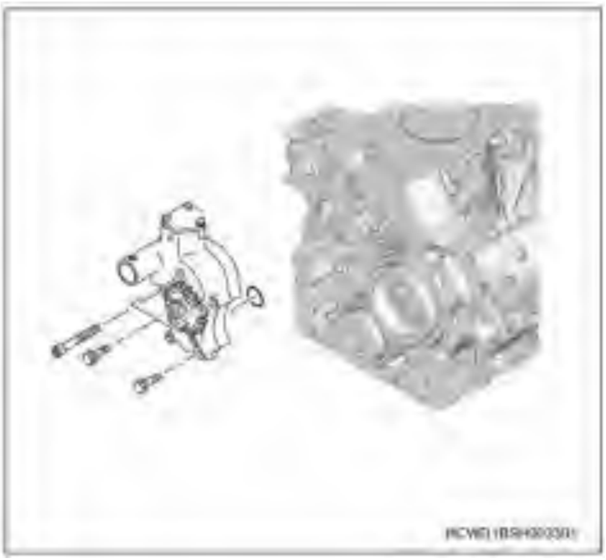
2) Install the pump to the cylinder block.

Caution:

● Do not tighten the screws marked with yellow on the top.

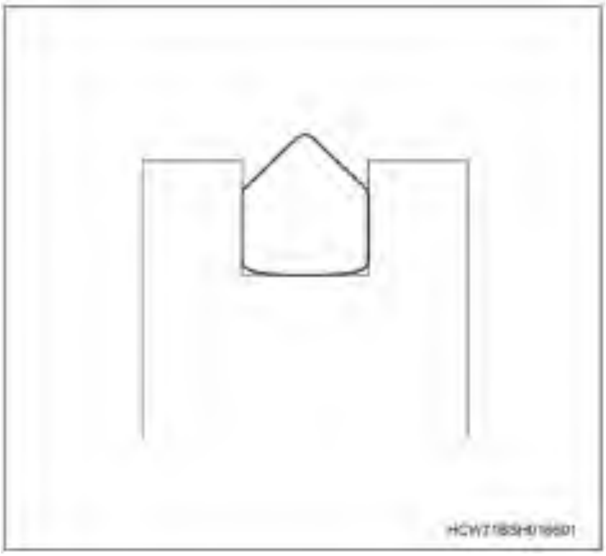
Tightening torque: 49 N • m {5 kgf • m / 36 lb • ft} hex bolts

Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft} Socket head cap screws



25. Gear box cover installed

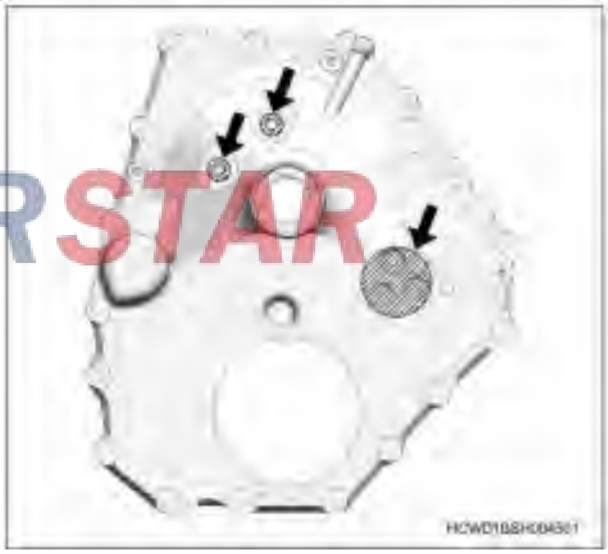
1) Install the gasket on the gear box cover.



2) Use a liquid seal on the gearbox cover.

Note:

● Apply FMD127 to the back of the diagonally marked gearbox cover in the chart.

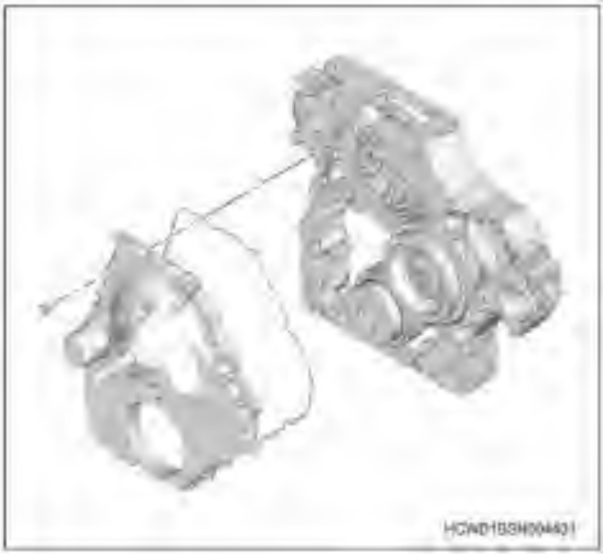


3) Install the gearbox cover onto the timing gearbox.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft} M10

Tightening torque: 26 N • m {2.7 kgf • m / 19 lb • ft} M8

POWERSTAR



26. Crankshaft front oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft front oil seal.

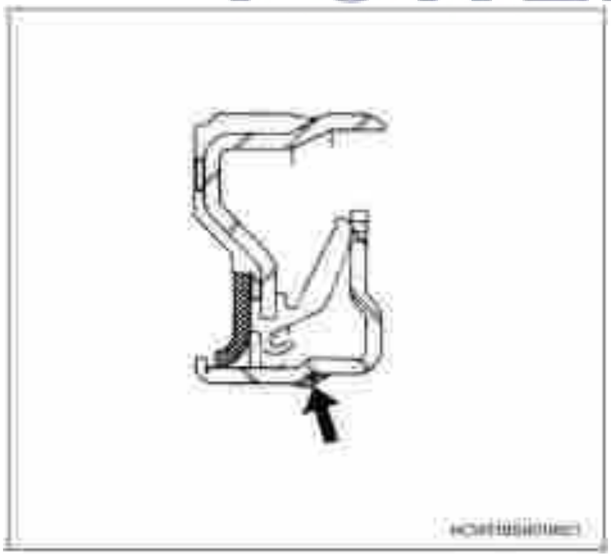
2) Install the crankshaft front oil seal to the front cover with the slinger as a set using the special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.

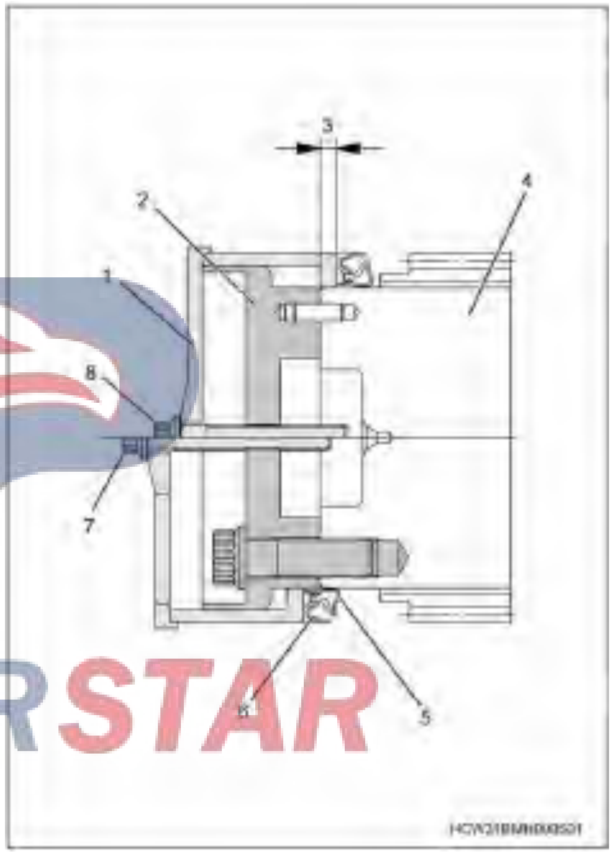


Caution:

● Wipe off the leaked oil after pressing the oil seal.

SST: 8-9819-4608-0 - Oil Seal Installer

3) After the oil seal is installed by pressing assembly method, measure the size between the crankshaft end surface and the oil seal surface.



1. 8-9819-4608-0 (Sleeve)

2. 8-9819-4608-0 (Adapter)

3. 6.7 - 7.3 mm {0.264 - 0.287 in}

4. Crankshaft

5. Slinger (silver)

6. Oil seal

7. Oil seal

8. Finish pressing the position of the special tool after assembly

27. A / C compressor bracket installation

1) Install the air conditioner compressor bracket to the timing gearbox.

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Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft}

1. Air conditioner compressor bracket

28. Idle gear installation

1) Install the idler gear to the gear cover.

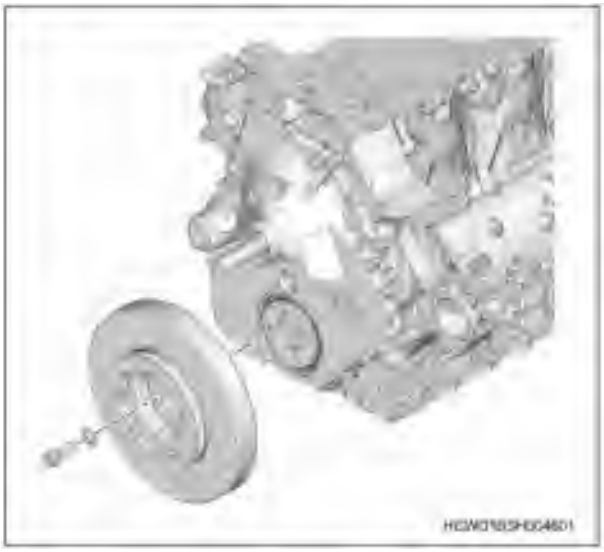
Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft}

29. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}

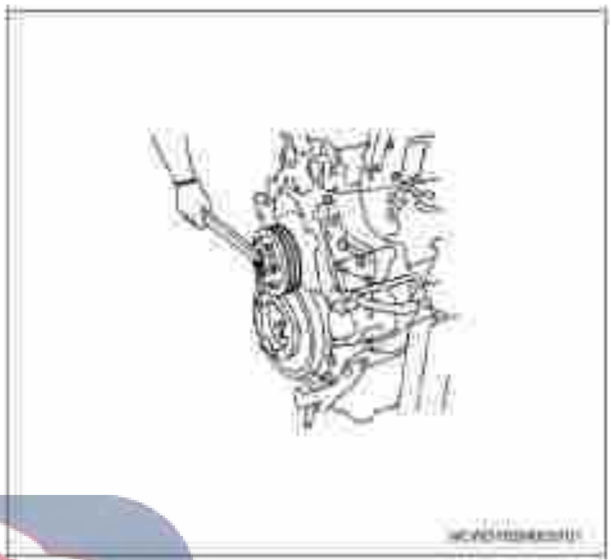


3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N • m { 55 kgf • m / 398 lb • ft }



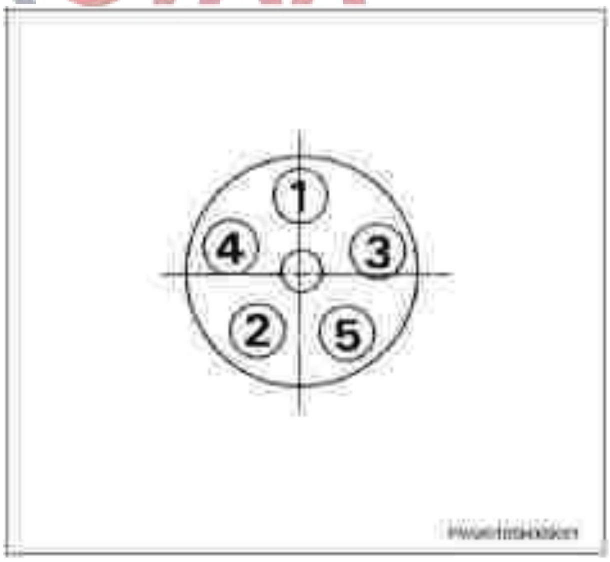
30. Air compressor installation

1) Apply molybdenum disulphide grease to the threaded surface of bearing surfaces and air compressor gear mounting bolts.

2) Install the gears on the air compressor according to the figures in numerical order.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

Prescribed angle: 90 to 120 °second



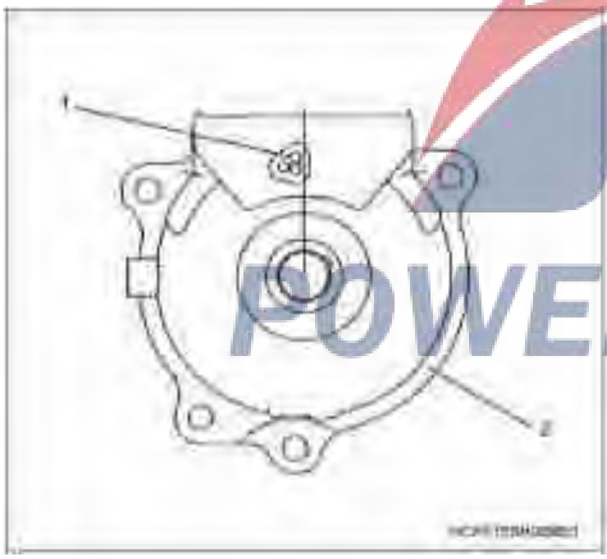
3) Install the O-ring onto the gearbox mounting flange area.

4) Referring to the illustration, align the pointer with

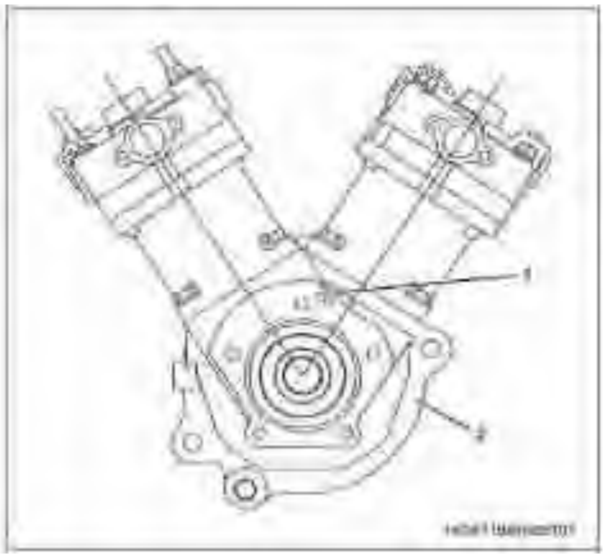
POWERSTAR

the A mark.

1. Pointer
2. S mark
3. A mark

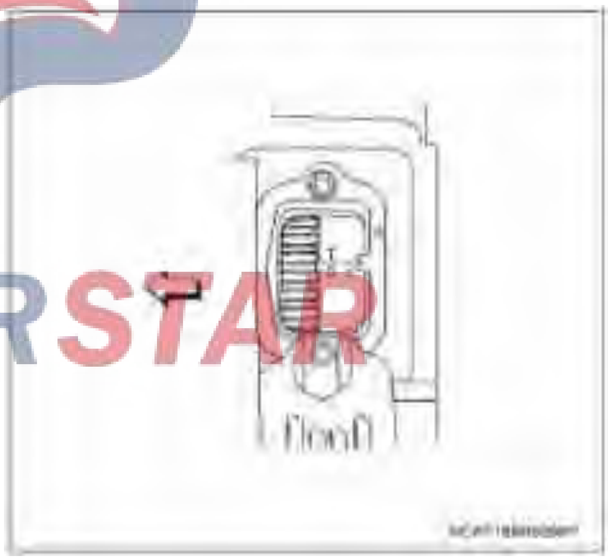


1. Pointer
2. Air compressor



1. Pointer
2. Air compressor

5) Align the No.1 cylinder to compression top dead center.



6) Install the air compressor on the timing gearbox.

Note:

● Insert the air compressor and make sure that the idle gear in the gear box is firmly installed.

Caution:

● After the installation is completed, if the pointer and the S mark are not aligned, it must be re-installed.

Tightening torque: 137 N • m {14.0 kgf • m / 101 lb • ft} M14 bolt

POWERSTAR

Tightening torque: 133 N • m {13.6 kgf • m / 98 lb • ft} M14 nut

1. Pointer
2. S mark
3. A mark

7) Connect the air compressor governor pipe to the air compressor.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

8) Connect the inflation tube to the air compressor.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}

9) Connect the air compressor regulator to the fitting.

Note:

Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 28 N • m {2.9 kgf • m / 21 lb • ft}

Flare nut

Tightening torque: 69 N • m {7.0 kgf • m / 51 lb • ft}

Nut

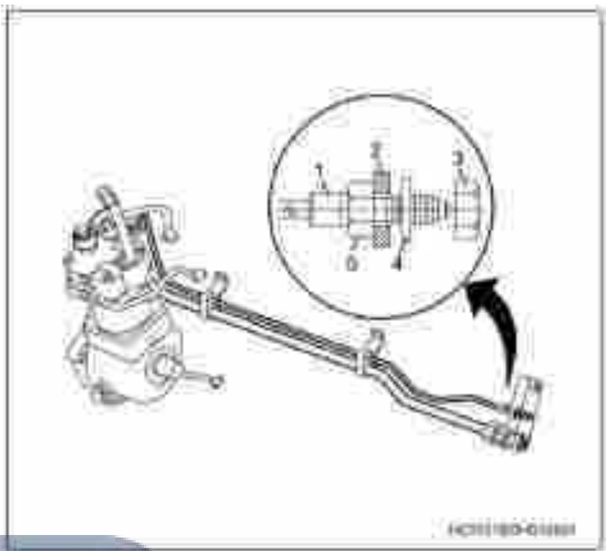
10) Connect the air charge pipe to the air compressor.

Note:

Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 129 N • m {13.2 kgf • m / 95 lb • ft} Flare nut

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} nut

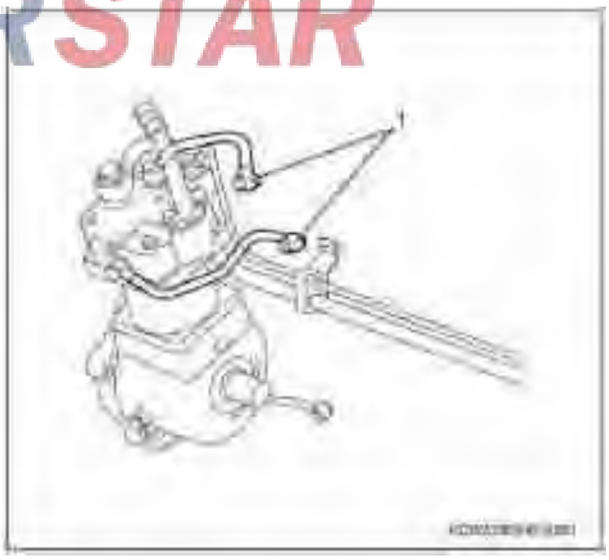


1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

11) Install two water pipes to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

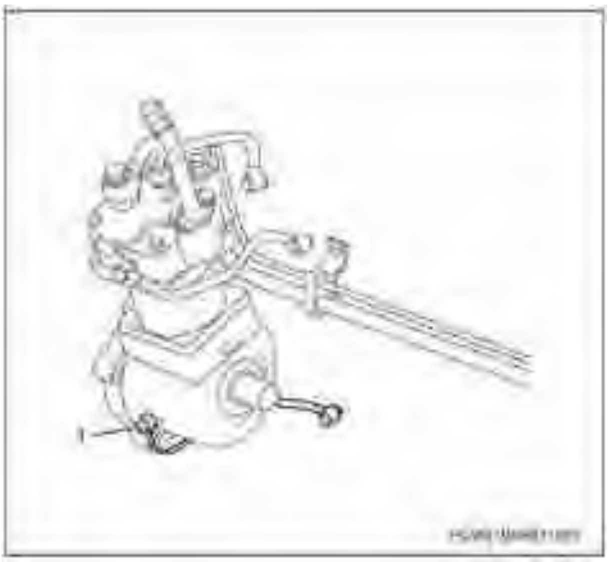
POWERSTAR



1. Water pipe

12) Install the oil pipe to the cylinder block.

Tightening torque: 27 N • m {2.8 kgf • m / 20 lb • ft}



1. Eyebolt

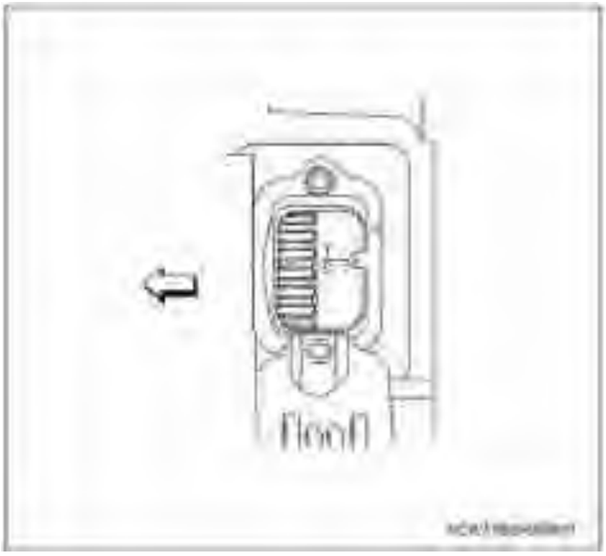
31. Fuel pump installed

1) Attach the feed pump bracket to the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}

1. Fuel pump bracket

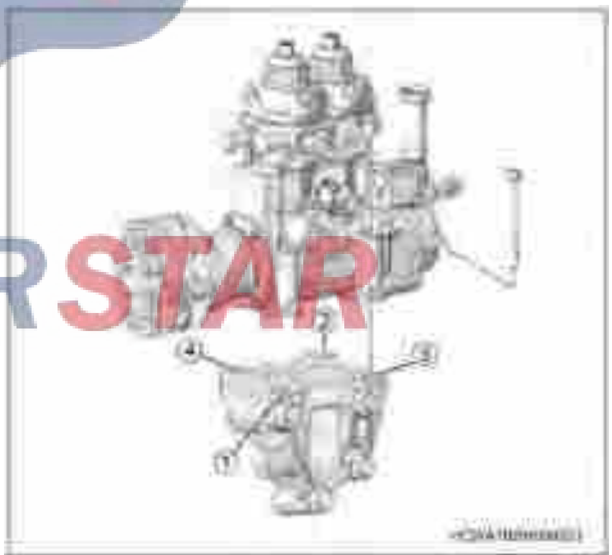
2) Align the No.1 cylinder to compression top dead center.



3) Align the pipe marked on the pipe with the marked pipe on the pump.

4) Install the fuel delivery pump in the order of numbers on the supply pump bracket.

Tightening torque: 57 N • m {5.8 kgf • m / 42 lb • ft}



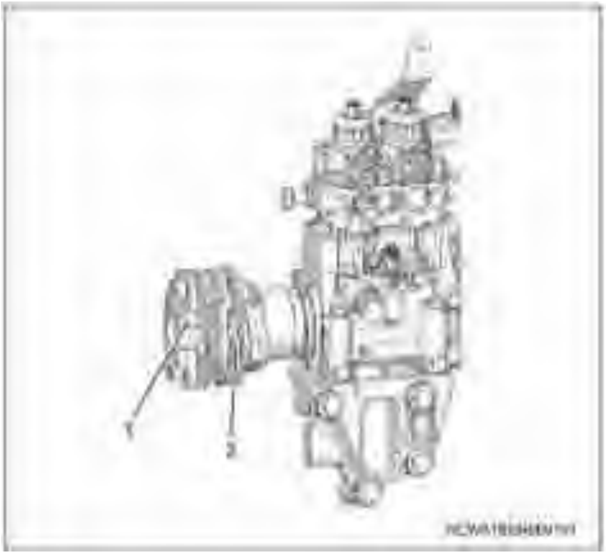
5) Slide the coupling to confirm firm contact with the feed pump and tighten the coupling bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

6) After checking and making sure that the coupling laminate is not bent, tighten the pin bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

POWERSTAR



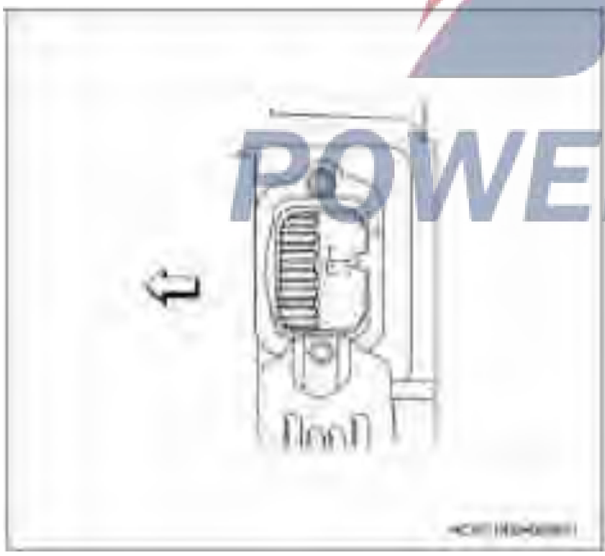
1. Cotter bolt

2. Coupling tightening bolt

7) Rotate the crankshaft forward to align cylinder # 1 to the top dead center of compression.

Note:

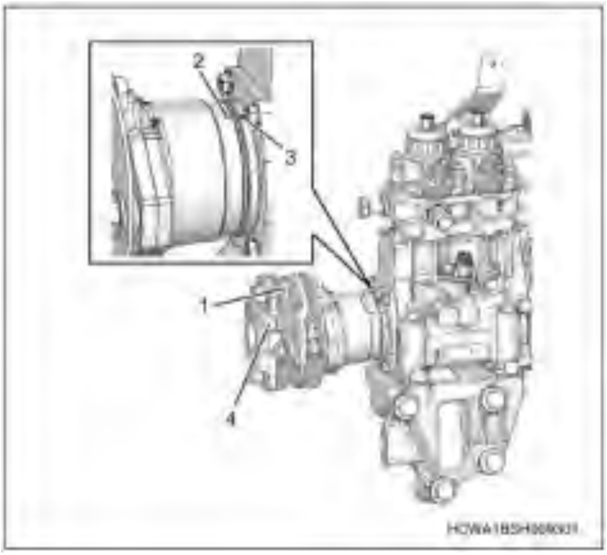
● Align with the center of the compression stop in a toothless state.



8) Verify that the marked pipe on the pipe fitting matches the marked pipe on the pump.

Caution:

● If the marking line is out of service, use the 2 oval bolts on the coupling to readjust.



1. Coupling bolts

2. Coupling end marking line

3. Pump end marking line

4. Cotter bolt

9) Install the return line to the cylinder block.

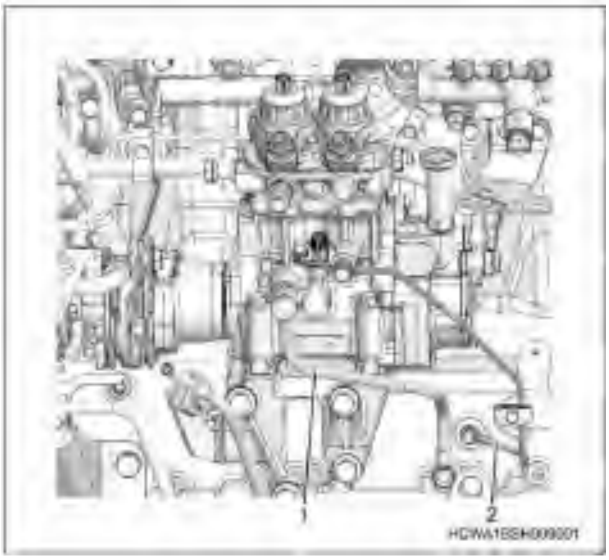
10) Install the oil return pipe to the fuel supply pump.

11) Install the tubing to the cylinder block.

12) Install the oil feed pipe to the fuel supply pump.

Tightening torque: 28 N • m {2.9 kgf • m / 21 lb • ft} M10

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft} M14



1. Oil return pipe

POWERSTAR

2. Oil feed pipe

13) Connect the harness connector to the PCV.

14) Connect the harness connector to the camshaft position sensor.

32. Cylinder head installation

1) Use a squeegee to clean the upper surface of the cylinder block and the lower surface of the cylinder head.

Caution:

● Carefully clean the cylinder block upper surface and the cylinder head lower surface, taking care not to damage the components.

2) Refer to the diagram and the table, and apply the liquid gasket to the cylinder block.

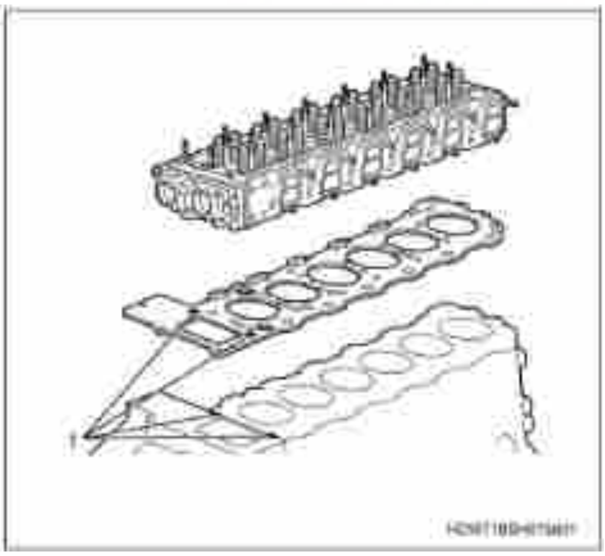
Caution:

● Strictly adhere to the liquid gasket application thickness and application width guidelines.

● After applying the liquid gasket, immediately install the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: 2 mm {0.08 in}
	Coating width	: 5 mm { 0.20 in }



1. Liquid gasket application area

3) Install the cylinder head gasket to the cylinder block.

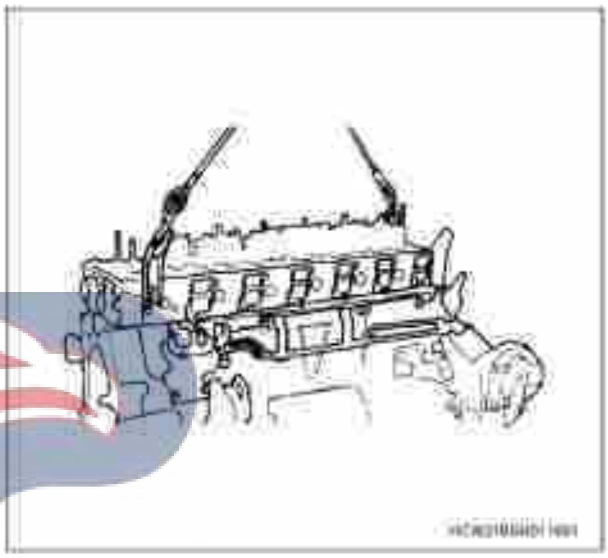
Caution:

● Do not reuse the cylinder head gasket.

4) Carefully align the knock pin positions, and place the cylinder head on the cylinder block.

Caution:

● Check the engagement of the idle gears.



5) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

Caution:

● Never use M12 bolts or M10 bolts.

6) Mount the cylinder head mounting bolts to the cylinder head in the order shown in the figure.

Caution:

● Do not drip foreign matters into the timing gear hole.

● Cylinder head mounting bolts can be used up to 4 times.

Tightening torque: 177 N • m {18.0 kgf • m / 131 lb • ft} 1st (M18)

Tightening torque: 245 N • m {25.0 kgf • m /181 lb • ft} 2nd (M18)

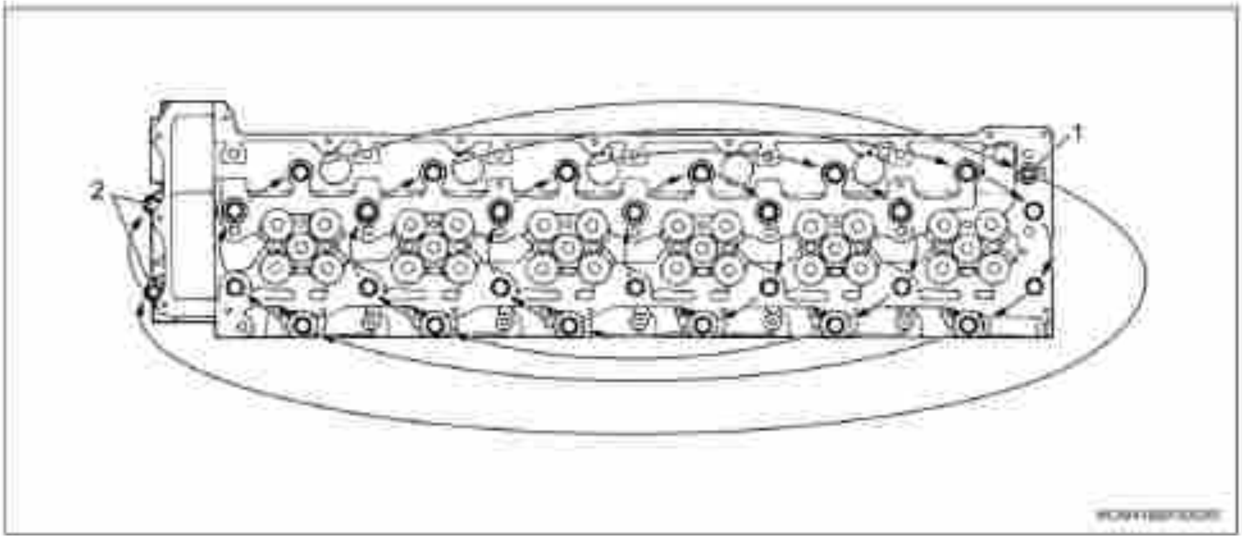
Tightening angle: 60 to 90 °Third time (M18)

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft} 4th (M12)

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft} 5th (M10)

POWERSTAR

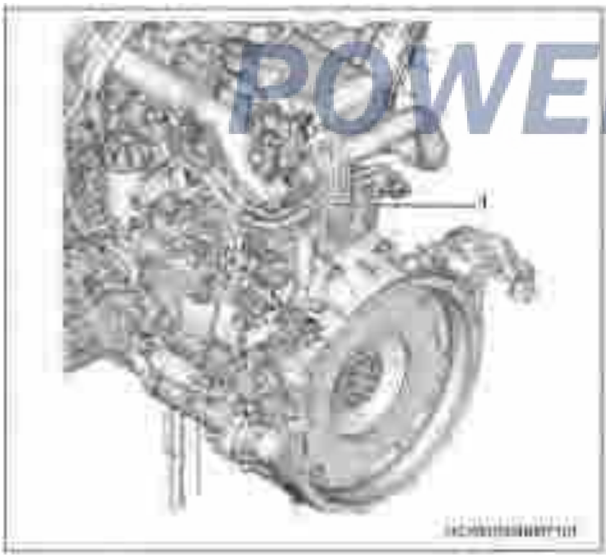
Tightening torque: 324 N • m {33.0 kgf • m / 239 lb • ft} Confirm the tightening (M18)



1. M12 bolt
2. M10 bolt

7) Remove special tool from the cylinder head.

SST: 8-9761-4276-0 - engine hanger



1. 8-9761-4276-0

33. Glow plug installation

1) Install the glow plug to the cylinder head.

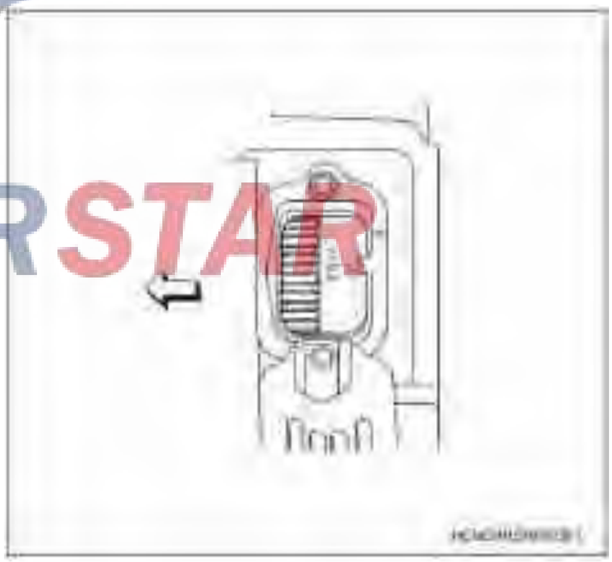
Tightening torque: 25 N • m { 2.5 kgf • m /18 lb • ft }

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m { 0.15 kgf • m / 13 lb • in }

34. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.



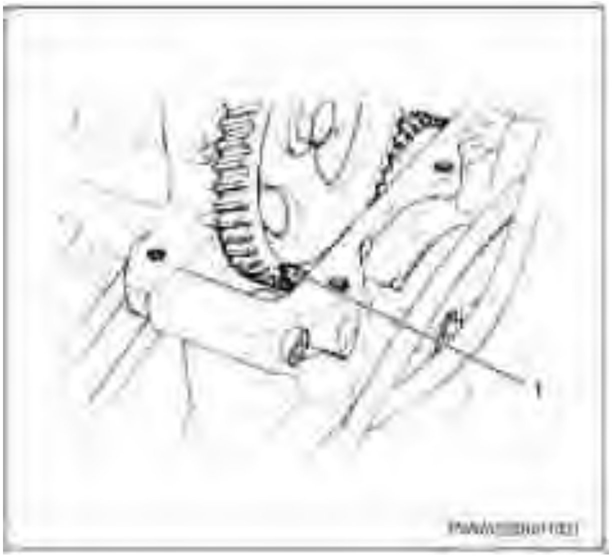
2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.

POWERSTAR



1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

Note:

● Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

• Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.

1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m { 7.7 kgf • m / 56 lb • ft }

35. Bridge installation

1) Apply the engine oil to the bridge guide.

2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.

1. Bridge

36. Rocker arm shaft installation

1) Lubricate the roller arm and adjusting screw lip with engine oil

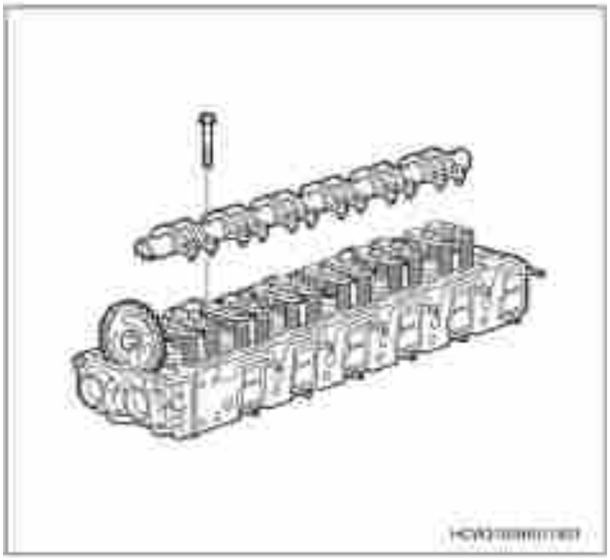
2) Loosen the adjust screw.

Note:

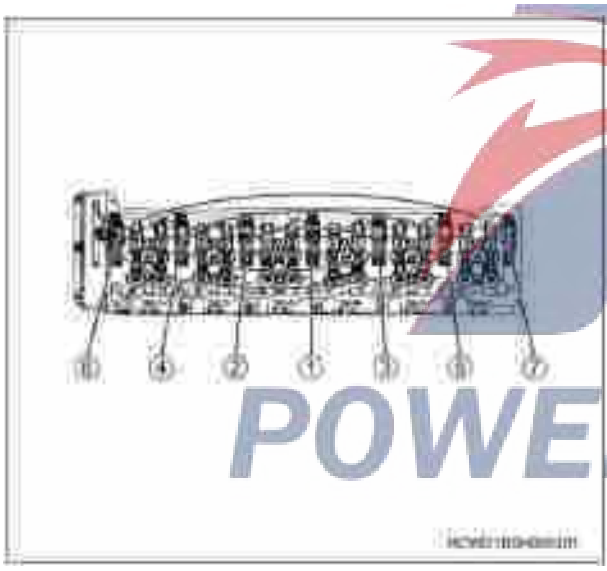
● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.

POWERSTAR



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



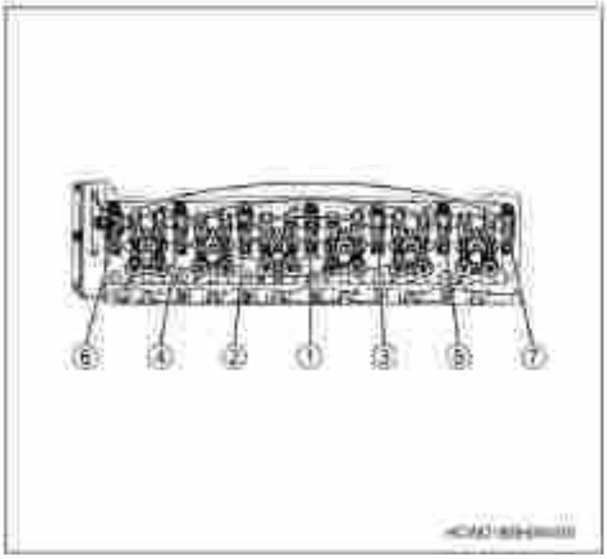
Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 lb • ft}



37. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

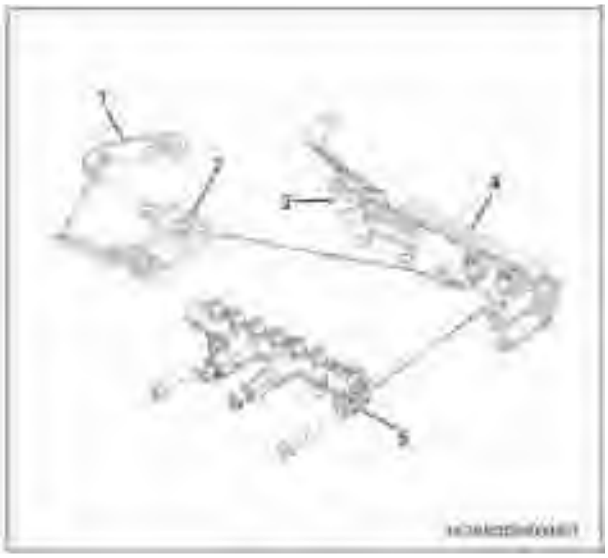
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



1. Injection pipe clamp bracket

2 injection pipe clamp bracket

3. Fuel pipeline bracket

4. Common rail (fuel rail) bracket

5. Common rail (fuel rail)

4) Connect the harness connector to the fuel rail position sensor.

38. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.

1. Fuel pipe

2. Fuel pipe

3. Clip

39. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

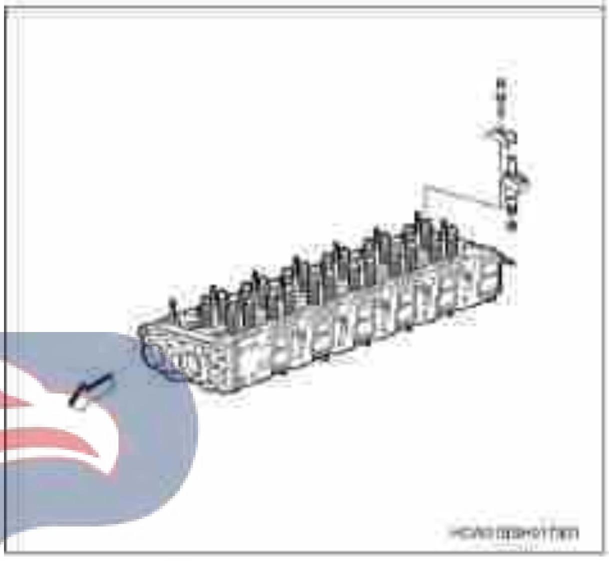
Note:

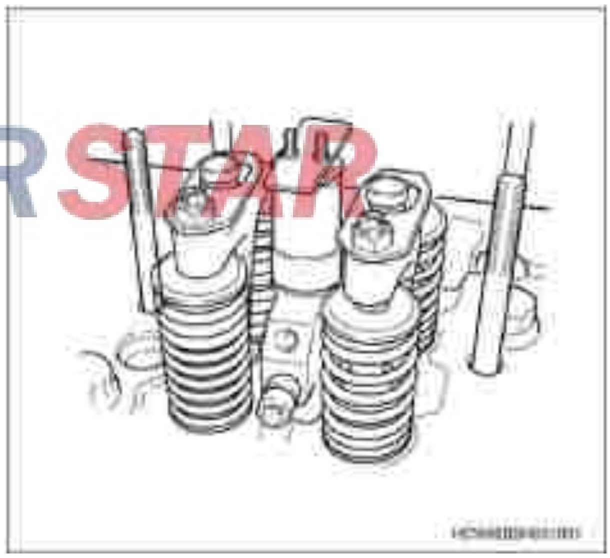
● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.





3) Temporarily fasten the injector clamp on the injector.

40. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

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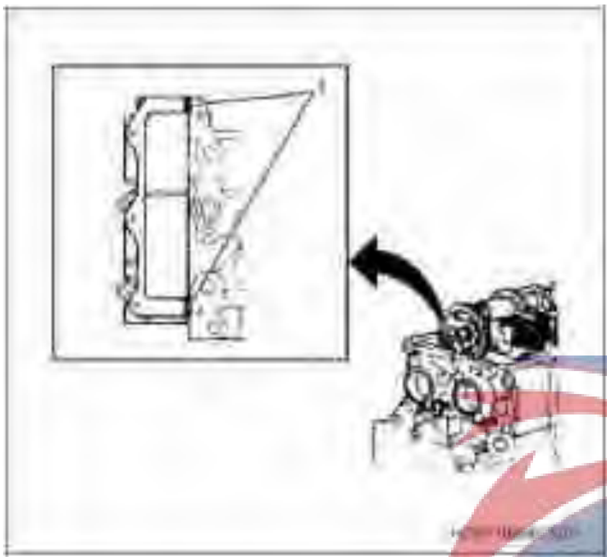
Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

3) Install the lower end cap onto the cylinder head.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}

1. O-ring
2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 25 lb • ft}

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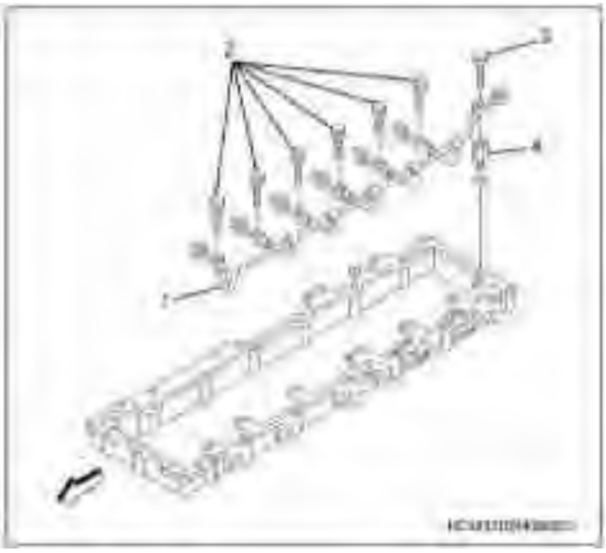


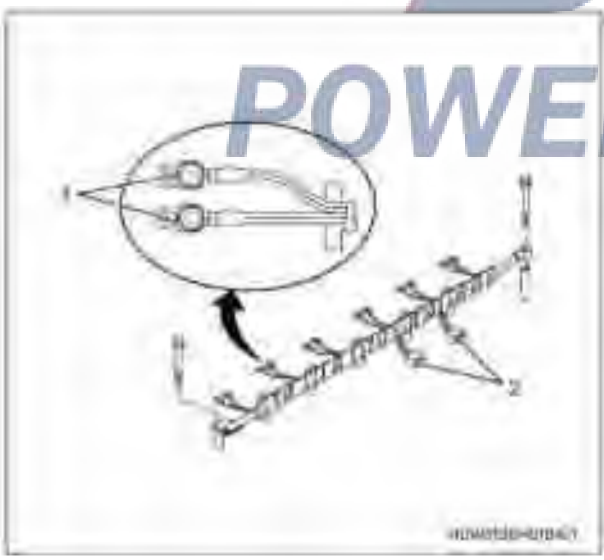
1. Nozzle spout
2. Eyebolt
3. Eyebolt
4. Adapter

41. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut
2. Connector

2) Install the injector harness onto the cylinder head.

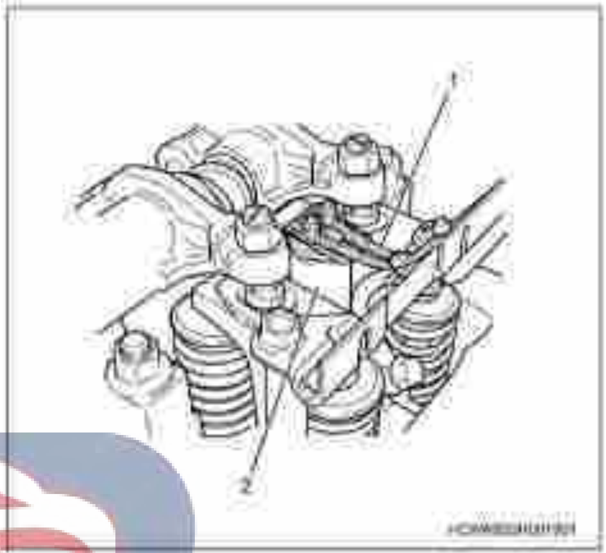
Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



1. Injector harness
2. Injector

42. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft }

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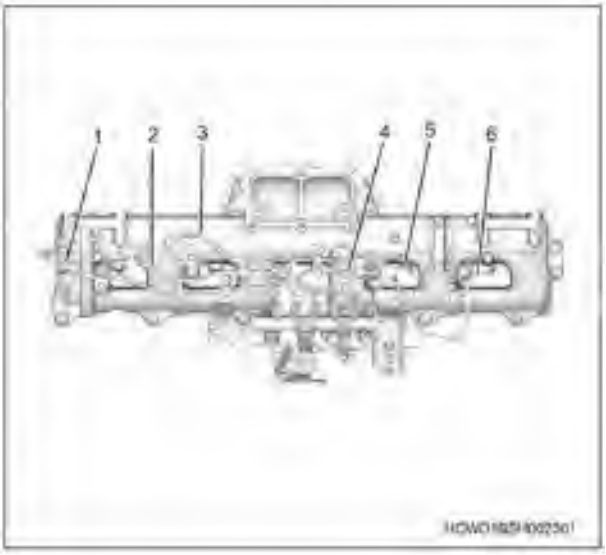

1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

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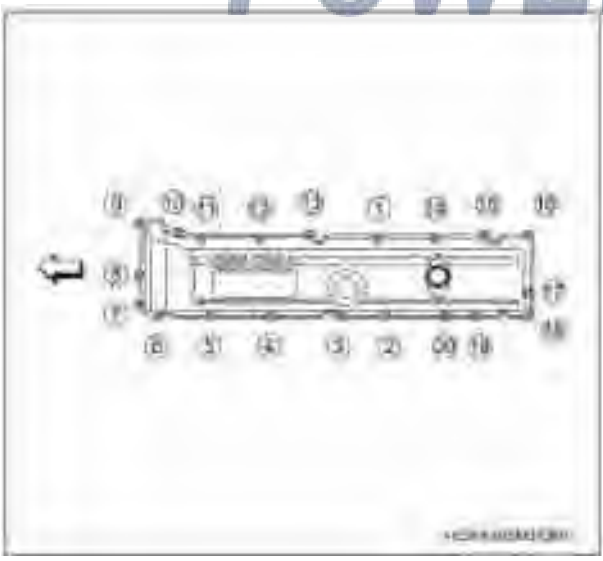
43. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



44. Generator Bracket Installation

1. 50 A and 60 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

2. 90 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

Note:

● When installing, make the right side of the oval hole area of the bracket contact with the bolt.

45. Starter motor installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m / 61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

46. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

47. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

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In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

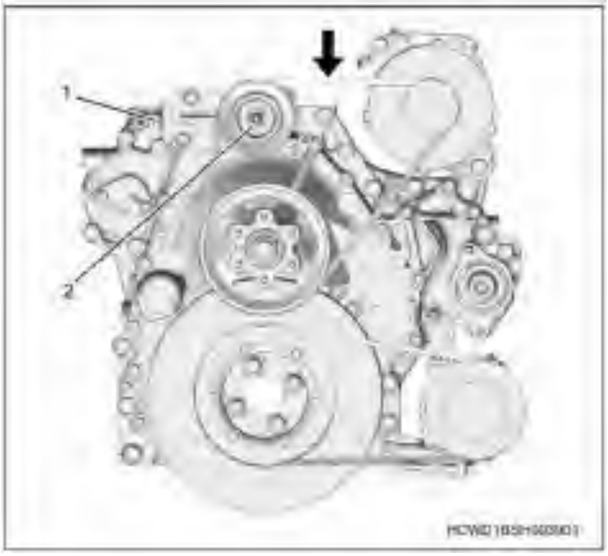
Cooling fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394to 11.989mm }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512to 15.011mm }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}

1. Lock nut
2. Adjust bolt

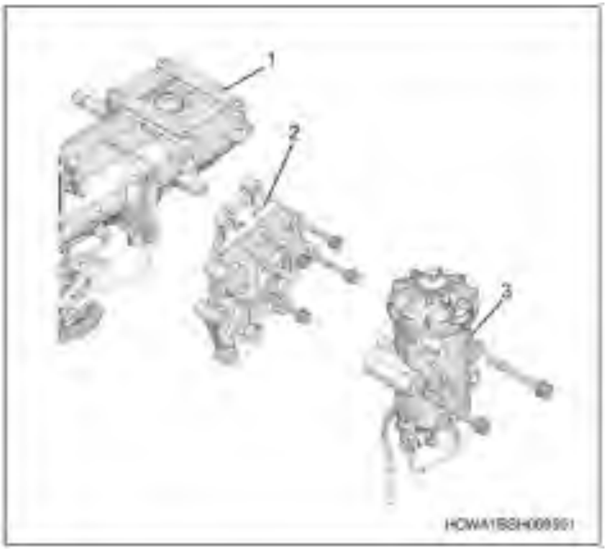
48. Oil filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

49. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

50.Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Eyebolt Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m /20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

51. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

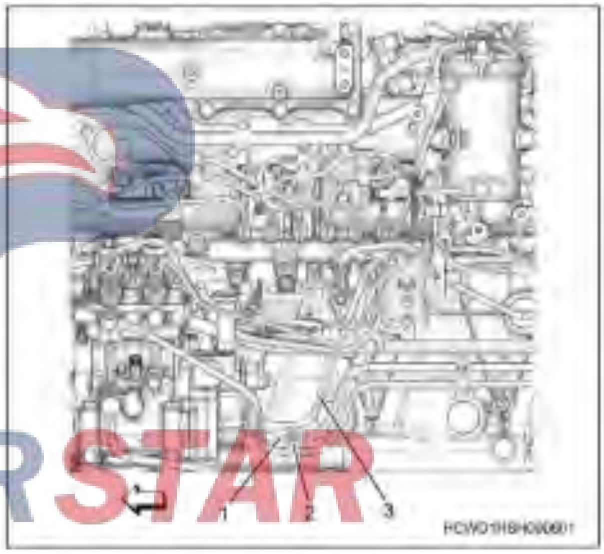
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

52. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

53. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

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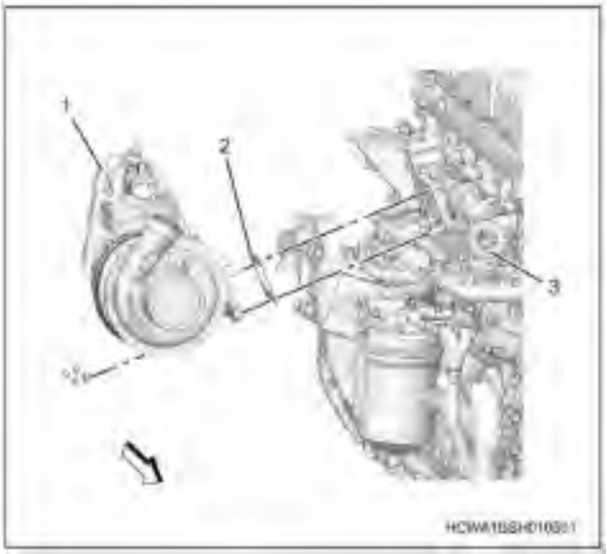
Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}



1. Turbocharger
2. Gasket
3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

6) Connect the water return pipe to the turbocharger.

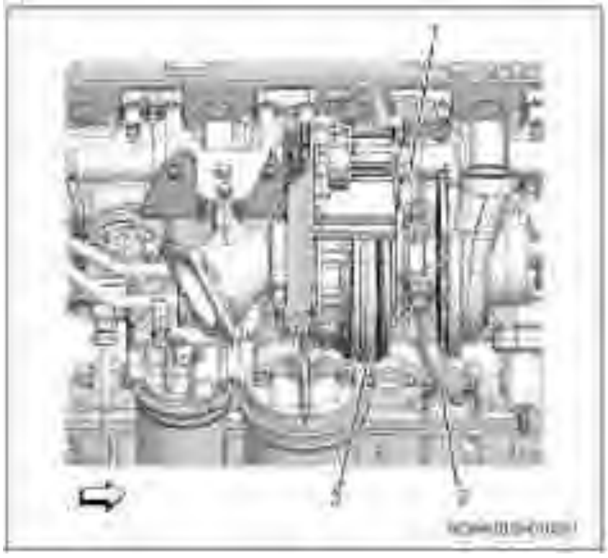
Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

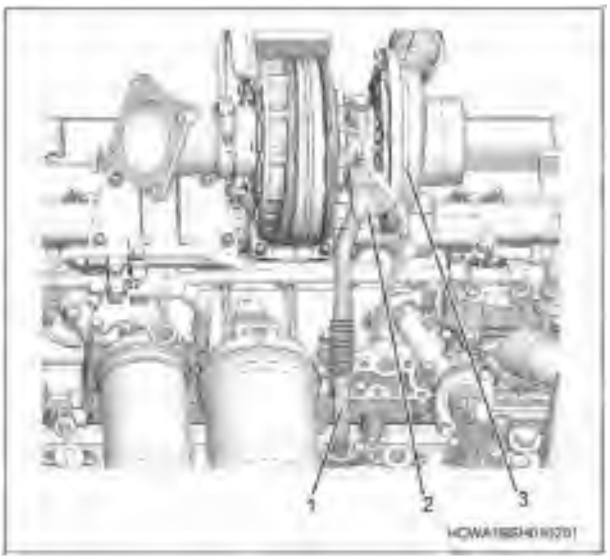
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



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1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

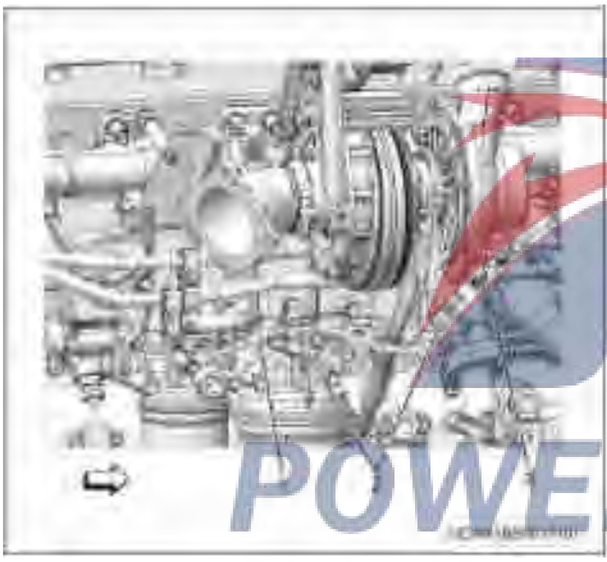
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the oil filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the oil filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}



1. Turbocharger oil feed pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

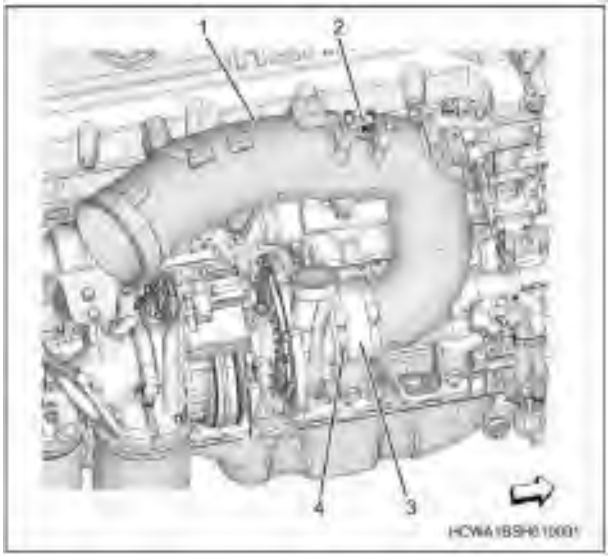
54. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10



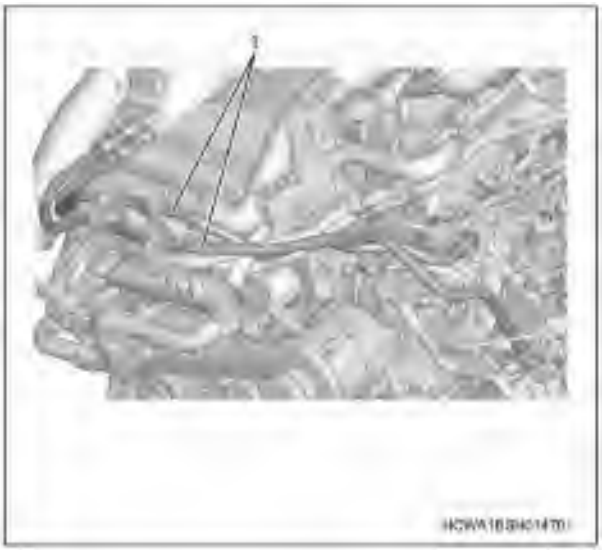
1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

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55. Guide the valve installed

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb• in}

56. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

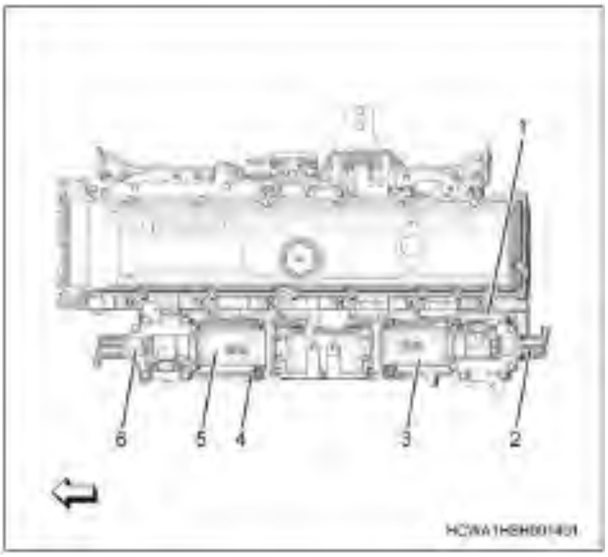
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe bracket
5. EGR valve duct A
6. EGR valve 1

5) Final tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

POWERSTAR

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

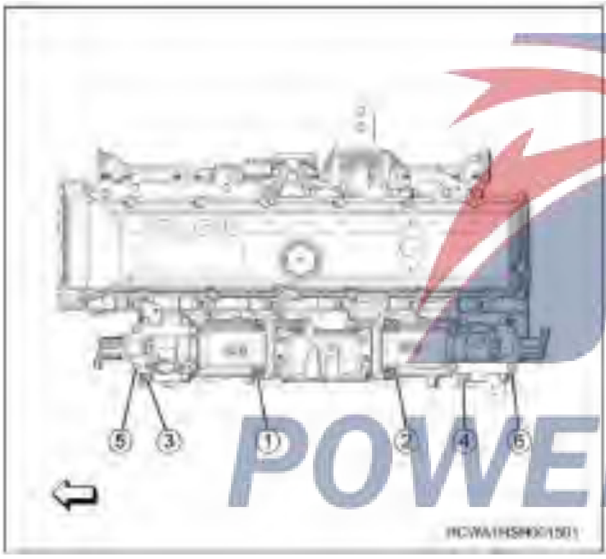
Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



57. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

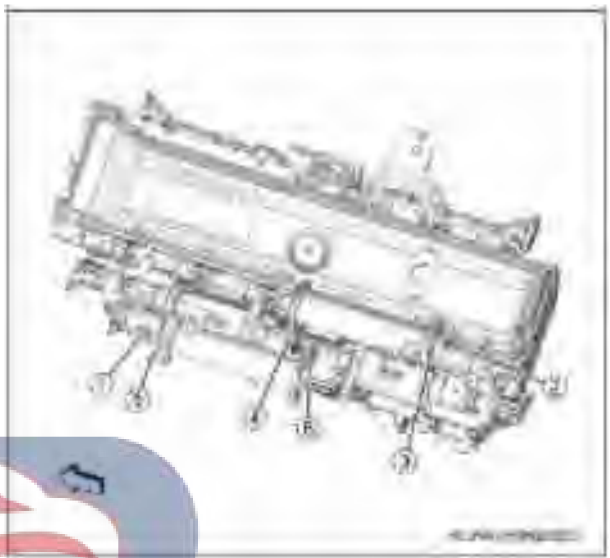
● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

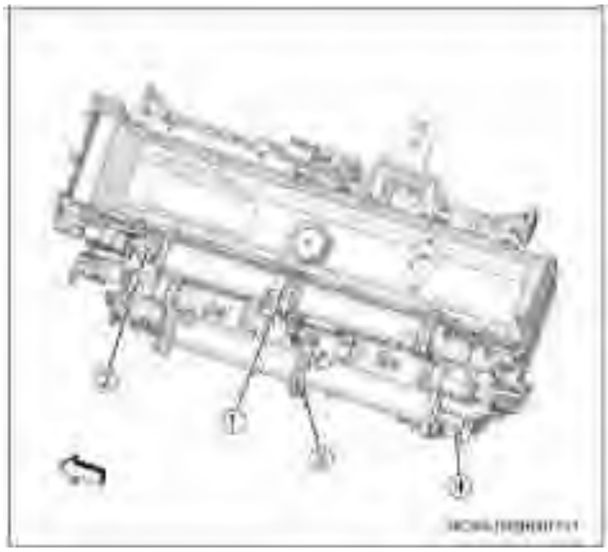
● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



POWERSTAR

3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

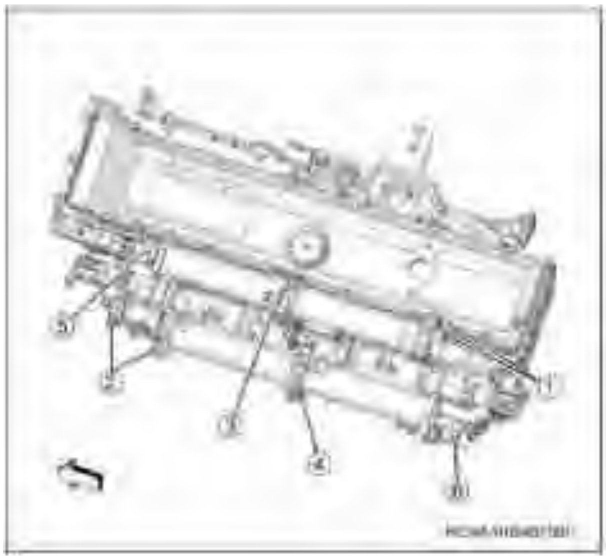
Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5(M10), 6(M10)

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5(M8), 6(M8)

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A

● EGR duct A

● EGR cooler duct C

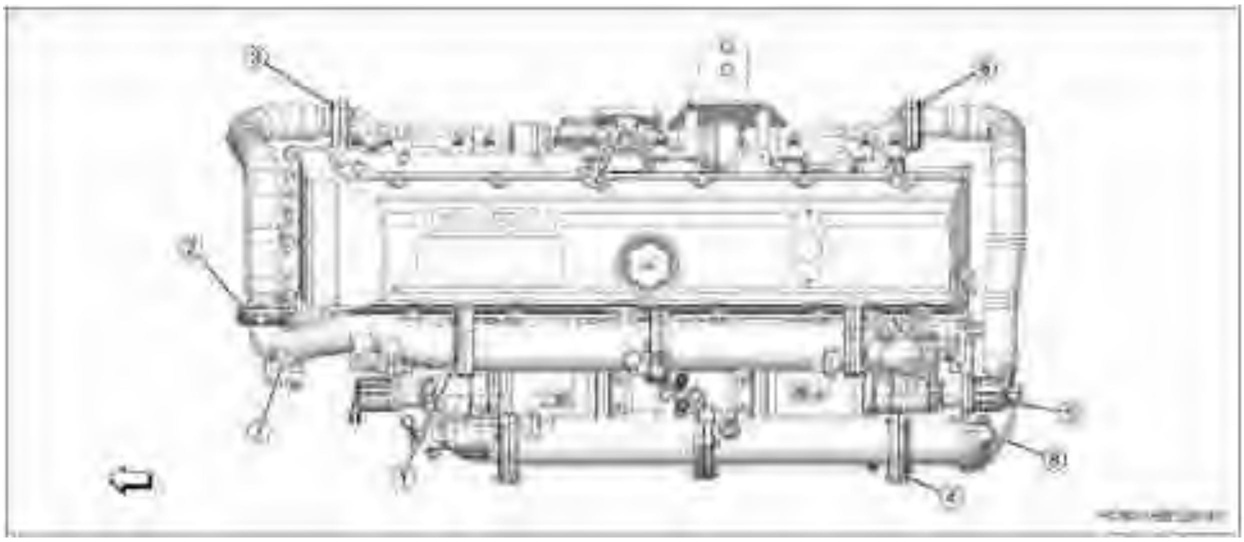
● EGR duct B.

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



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5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C

● EGR duct B

● bracket

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 1(M10), 2, 3, 9(M10), 10(M10)

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 4

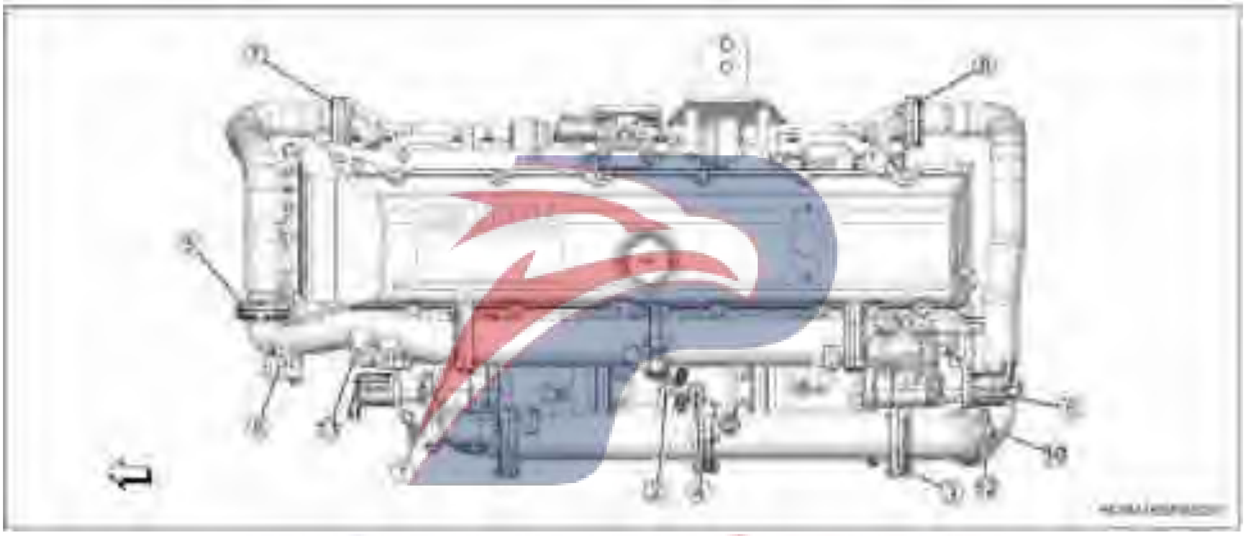
Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft } 5, 6(M8), 7, 8(M8), 9(M8)

Tightening torque: 24.7 N • m { 2.5 kgf • m / 18 lb • ft } 10(M8)

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft } 11, 12(M8)

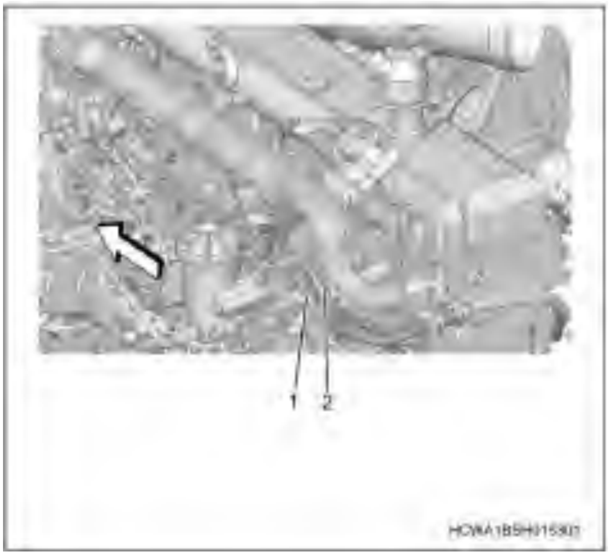
Note:

● The number behind the tightening torque indicates the diagram number.



POWERSTAR

6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front return pipe

2. Back-end return pipe

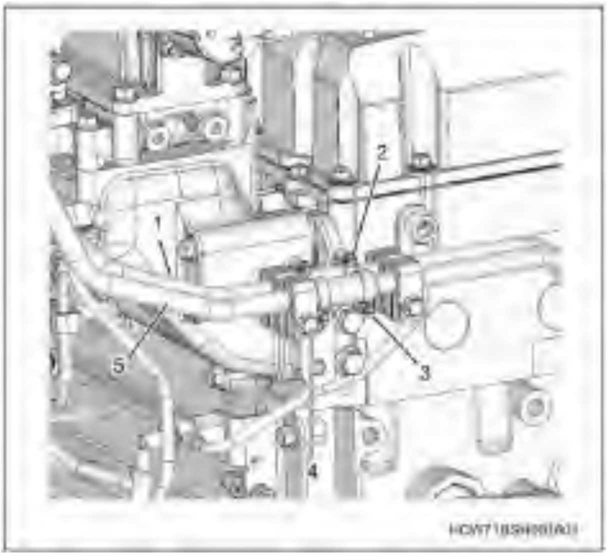
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

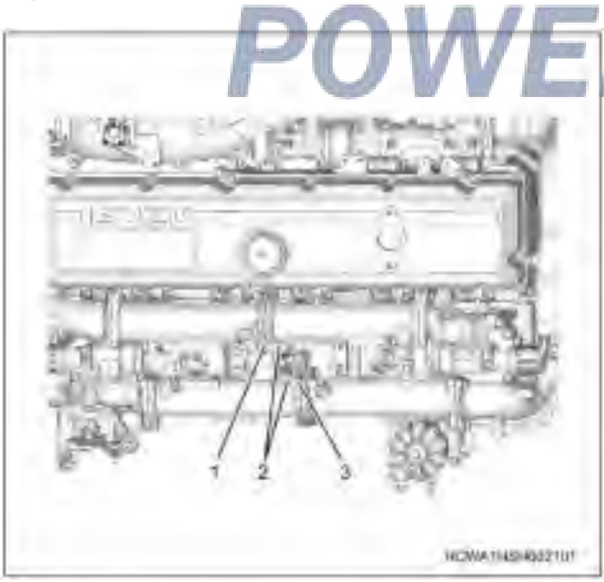


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.

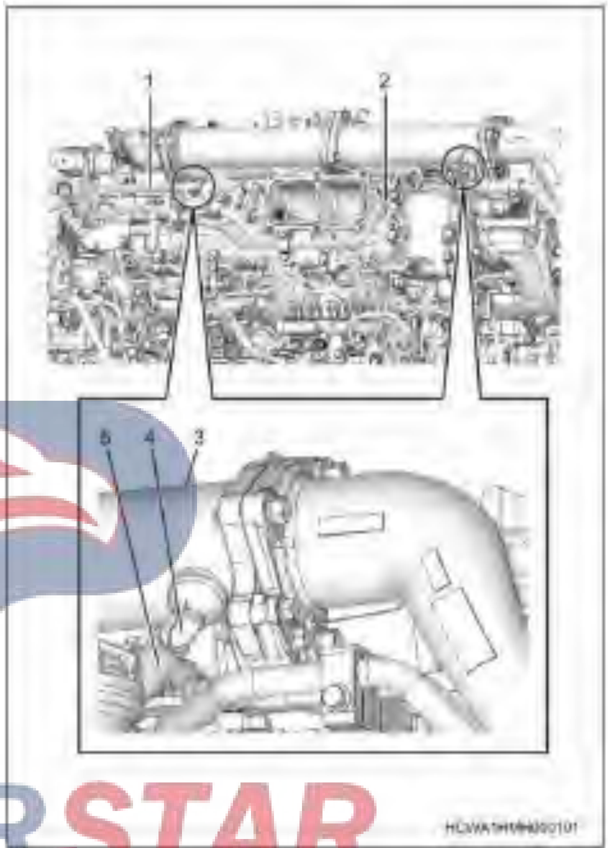


1.Hose clip
2. water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

Caution:

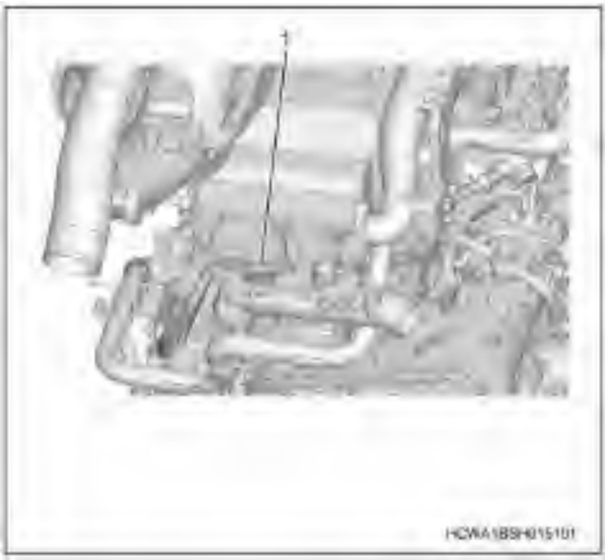
● During installation, care should also be taken to prevent the clamp from rotating.



1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.

POWERSTAR



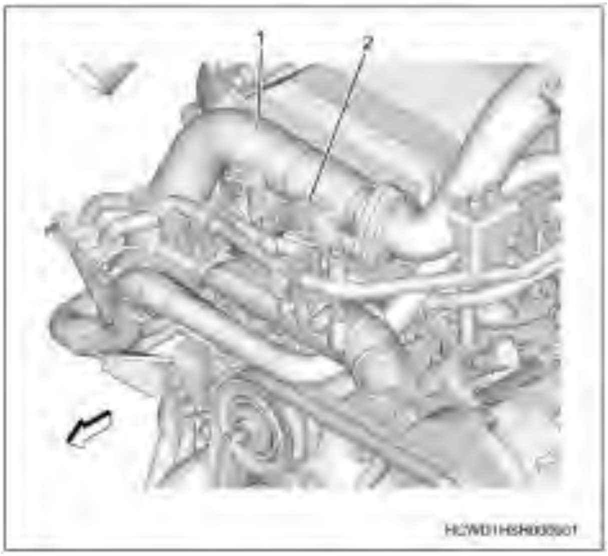
1. Back-end water pipe

11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.

1. Front-end water supply pipe

58. Suction pipe installation

1) Install the bracket on the drain.



1. Front exhaust gas recirculation line

2. Bracket

2) Install 2 air suction tubes to the air compressor.

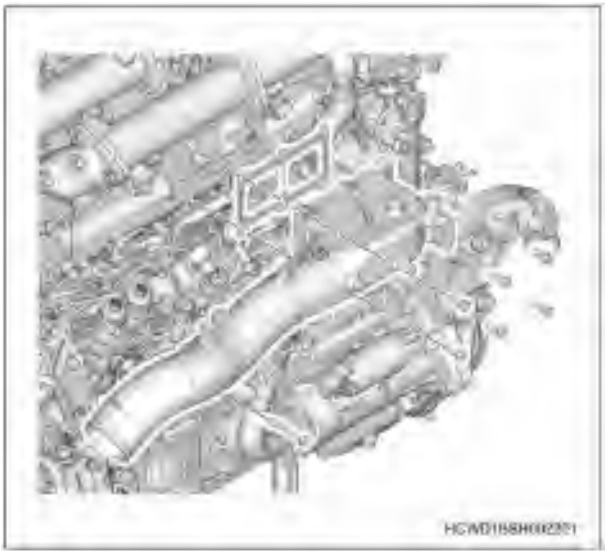
1. Exhaust pipe

59. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

POWERSTAR



60. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

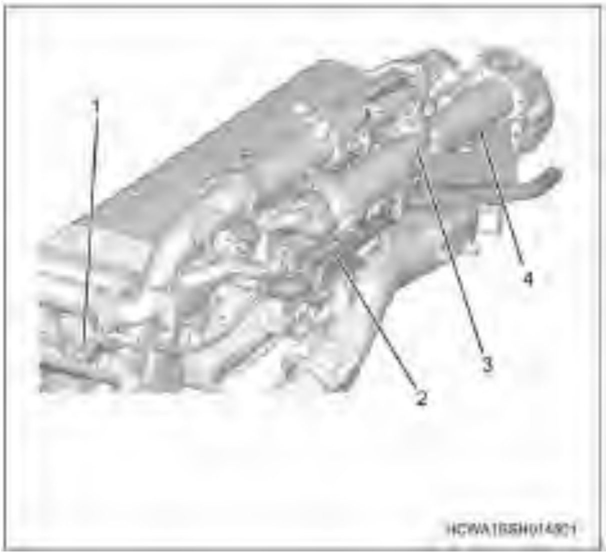
61. Air leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

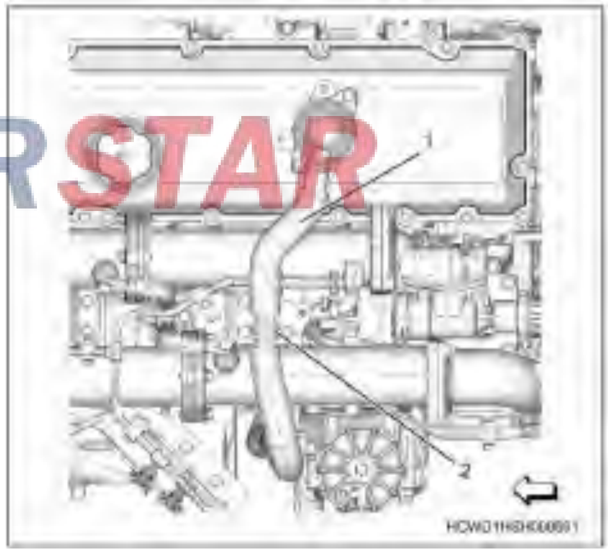
Eyebolt



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

62. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

63. Engine installation

Refer to "*Engine installation*".

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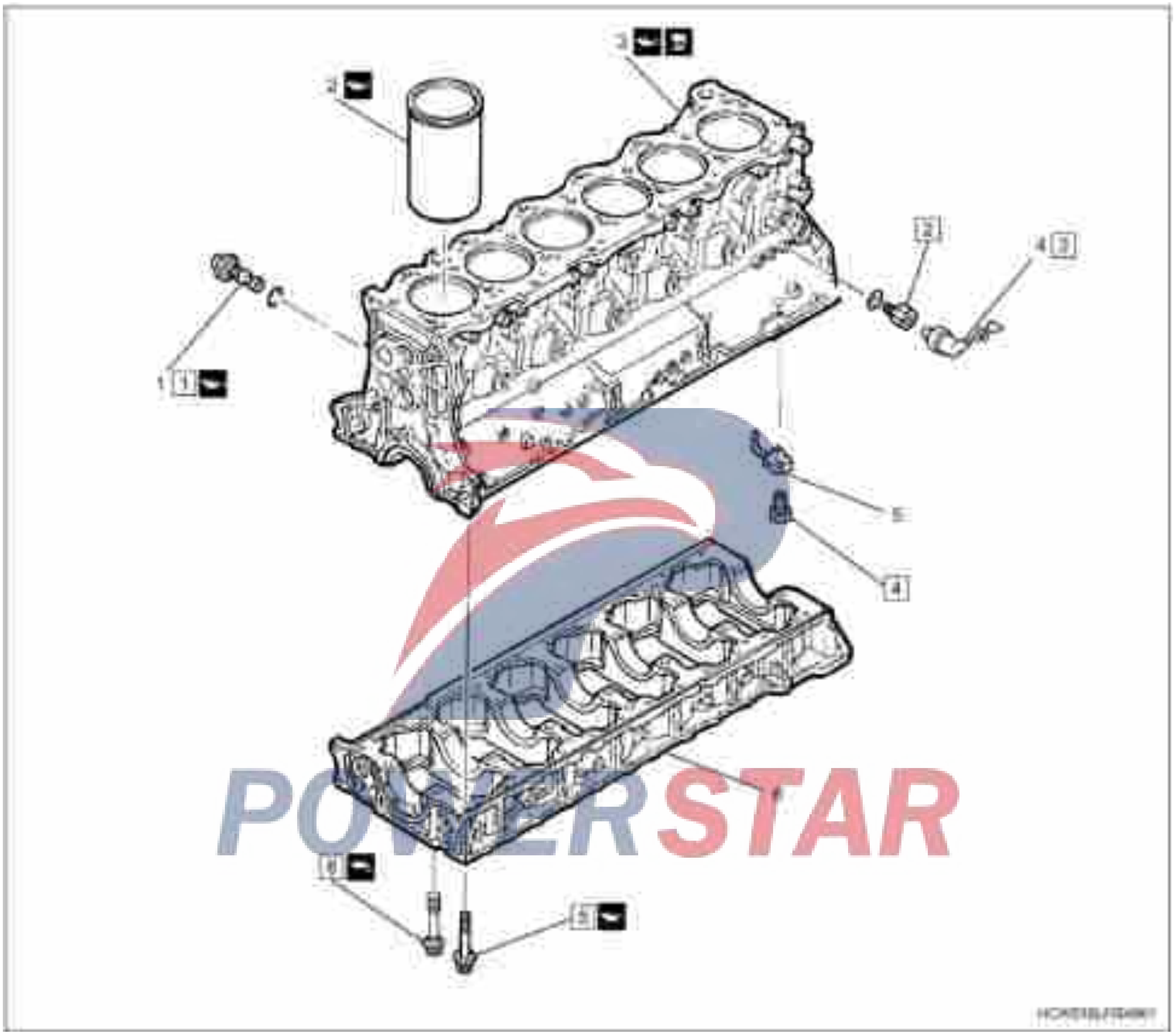
Cylinder block

Removal

1. Component Views

Cylinder block



Part name

1. Drain valve
2. Cylinder liner
3. Cylinder block
4. Hydraulic switch
5. Oil nozzle
6. Crankcase

Tightening torque

1: 20 N • m { 2.0 kgf • m / 15 lb • ft }

2: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3: 18 N • m { 1.8 kgf • m / 13 lb • ft }

4: 69 N • m { 7.0 kgf • m / 51 lb • ft }

5: 96 N • m { 9.8 kgf • m / 71 lb • ft } M12

6-1: 49 N • m { 5.0 kgf • m / 36 lb • ft } M18

6-2: 88 N • m { 9.0 kgf • m / 65 lb • ft } M18

6-3: 90 °M18

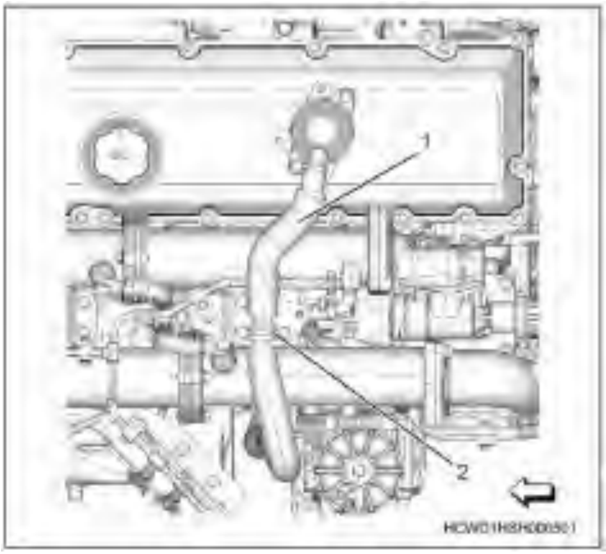
6-4: 294 N • m { 30.0 kgf • m / 217 lb • ft } M18

2. Engine removal

Refer to "*Engine removal*".

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

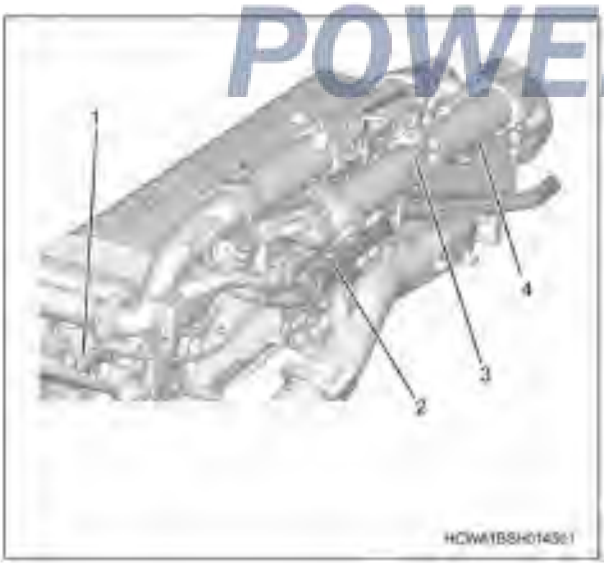


1. Ventilation hose
2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

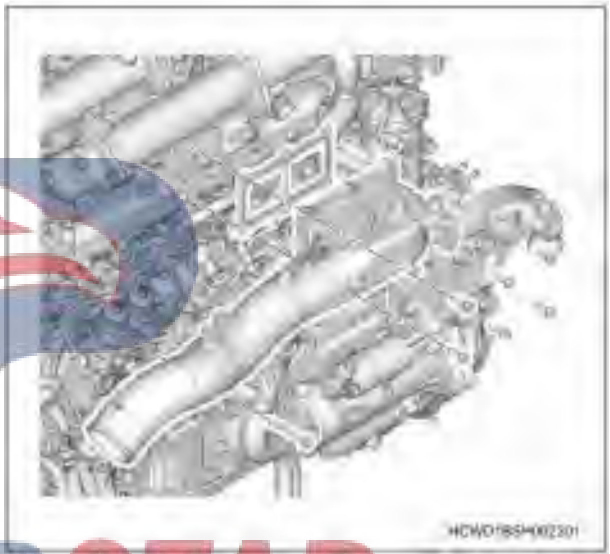
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



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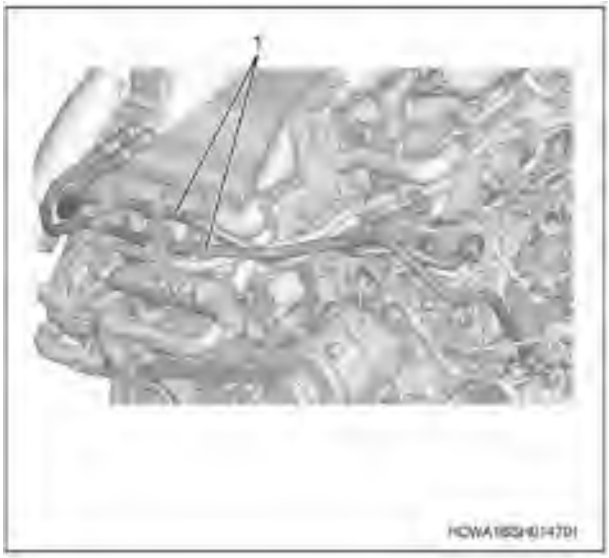
7. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

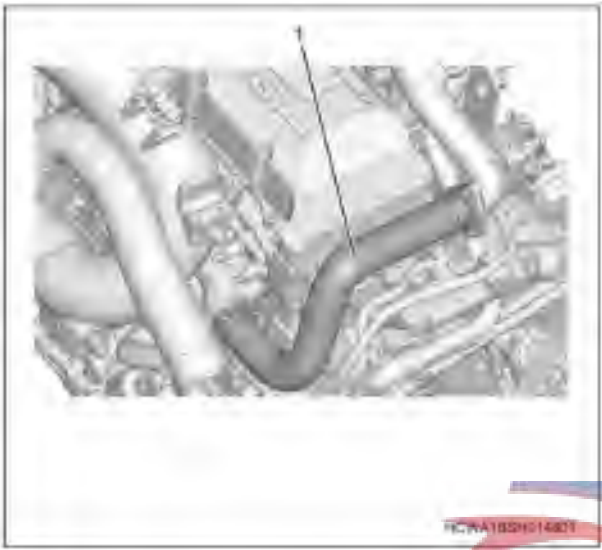


1. Exhaust pipe

8. EGR cooler removal

1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.

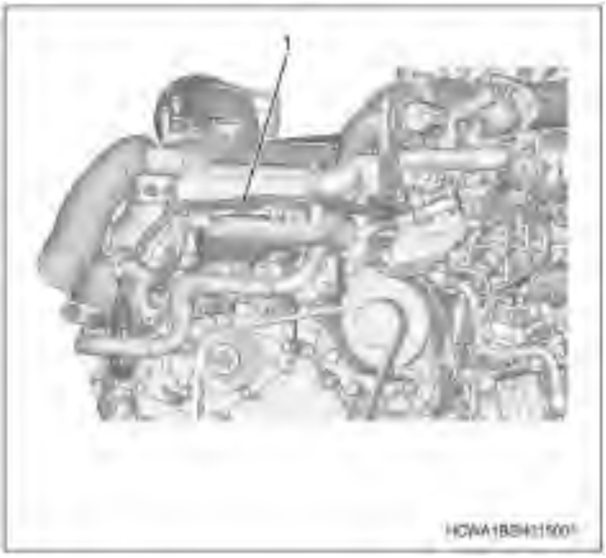


1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

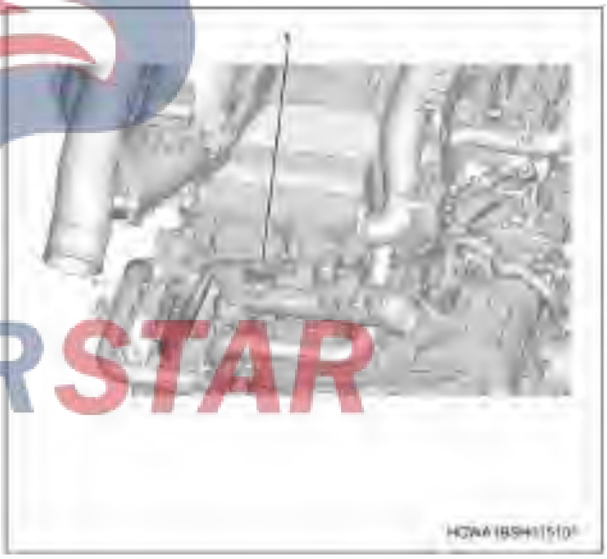
1. Standard bolt
2. Exhaust gas recirculation line B
3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.



1. Front exhaust gas recirculation cooler hose

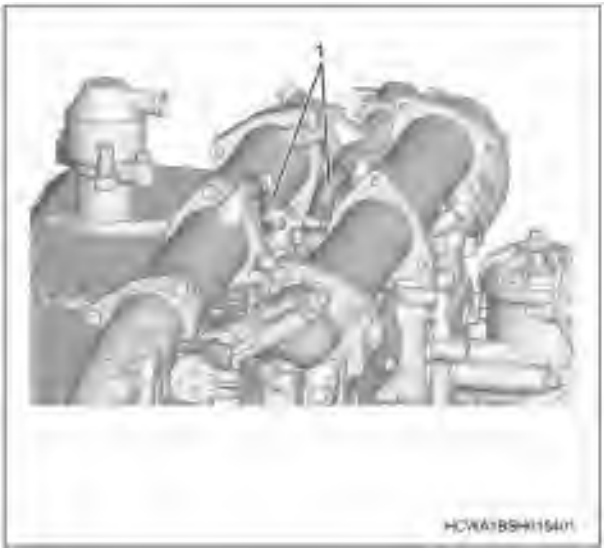
5) The back-end water supply pipe removed from the pump.



1. Back-end water pipe

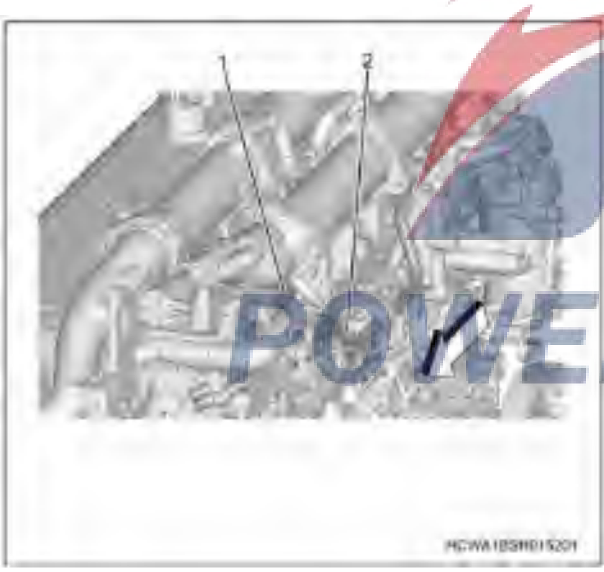
6) Remove the water supply hose from the exhaust gas recirculation cooler.

POWERSTAR



1. Water feed hose

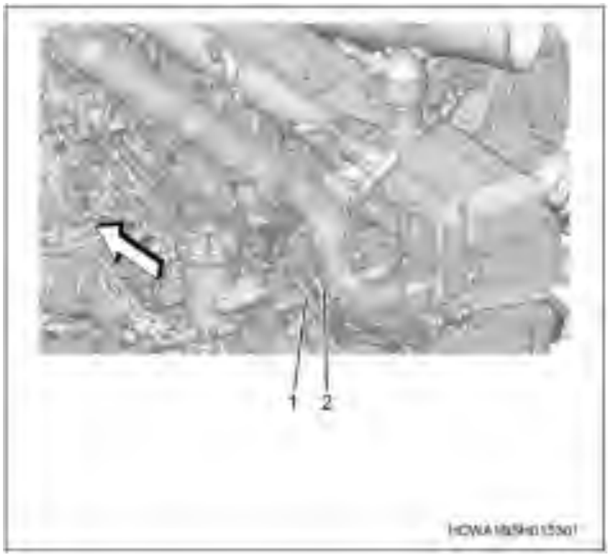
7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe

2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

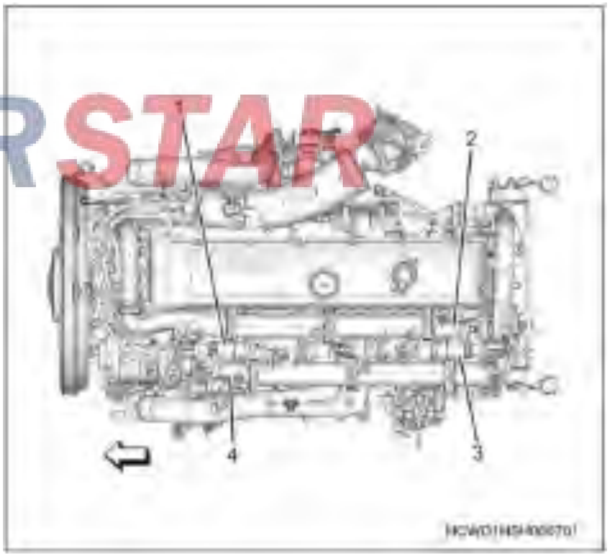


1. Front return pipe

2. Back-end return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.



1. EGR valve 2

2. EGR cooler duct B

3. EGR valve 1

4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

POWERSTAR

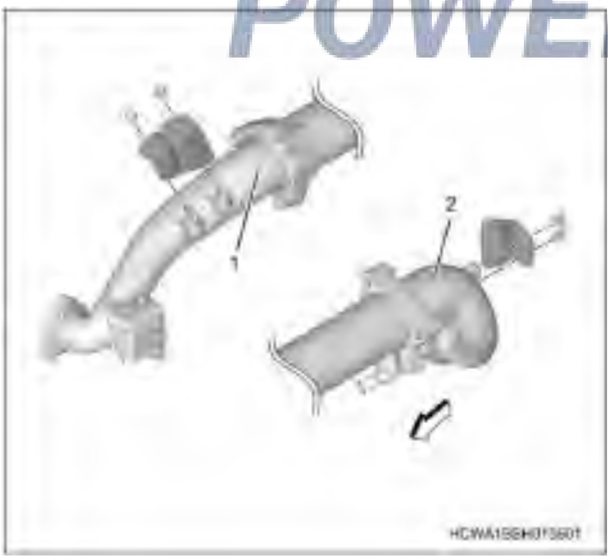
12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.

1. Exhaust gas recirculation cooler duct A

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

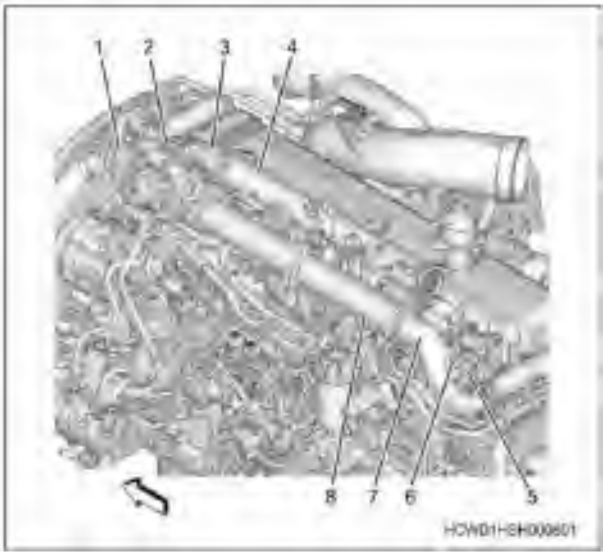
15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A

2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.



1. Front-end exhaust gas recirculation duct bracket

2. Exhaust gas recirculation valve thermal protection device

3. Exhaust Gas Recirculation Cooler duct A.

4. EGR cooler A.

5. Back-end exhaust gas recirculation duct holder

6. Exhaust gas recirculation valve thermal protection device

7. Exhaust Gas Recirculation Cooler duct C

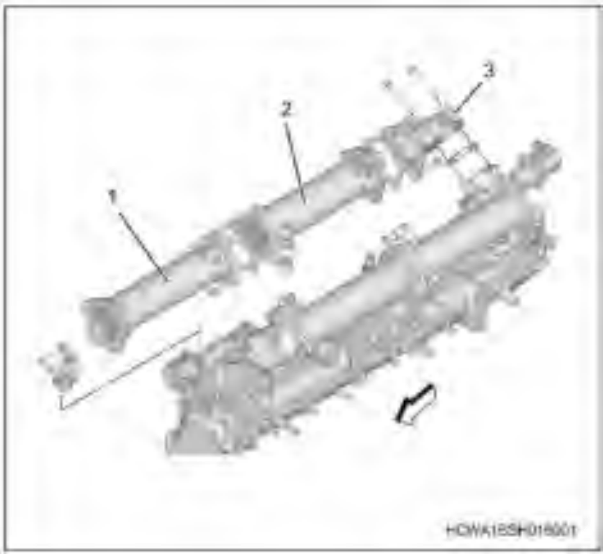
8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler support on exhaust gas recirculation cooler C.

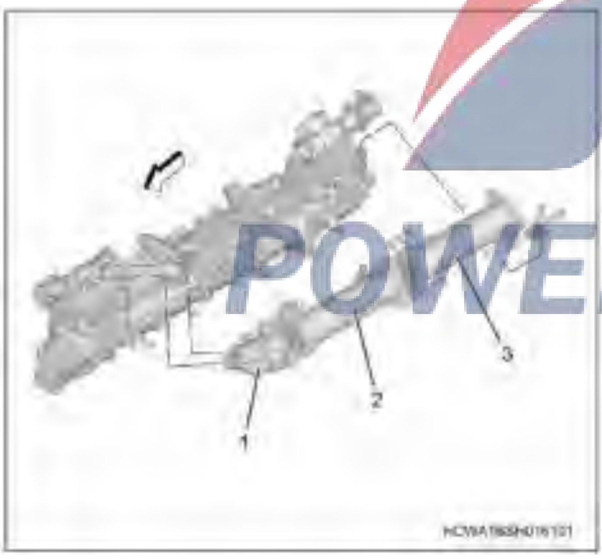
19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

POWERSTAR



1. EGR cooler A.
2. EGR cooler B
3. Exhaust Gas Recirculation Cooler B

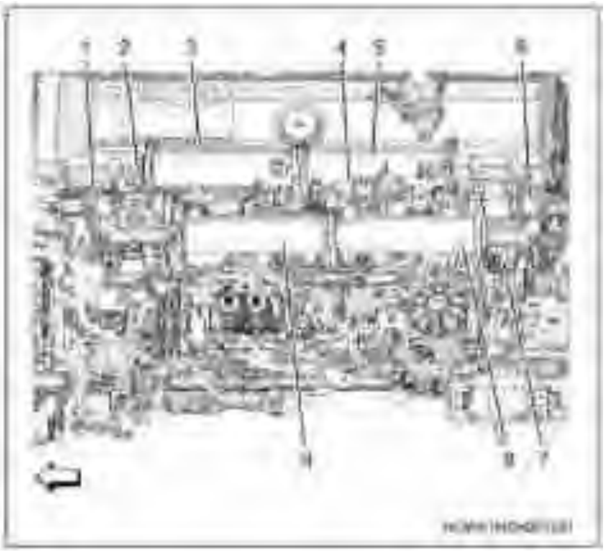
20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



1. Exhaust gas recirculation cooler duct A
2. EGR cooler D
3. EGR cooler C.

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.

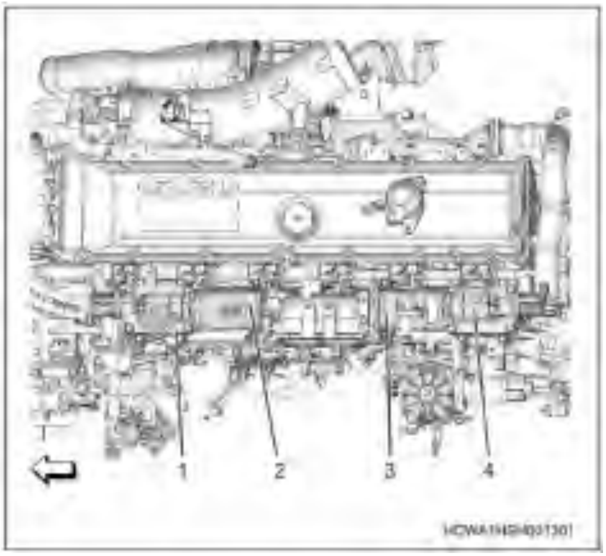


1. EGR valve 2
2. Exhaust gas recirculation cooler bracket
3. EGR cooler A.
4. Leakage tube stent
5. EGR cooler B.
6. EGR valve 1
7. Exhaust gas recirculation cooler bracket
8. EGR cooler C
9. EGR cooler D

9. Exhaust gas recirculation valve removed

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve conduit A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve conduit A.



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1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

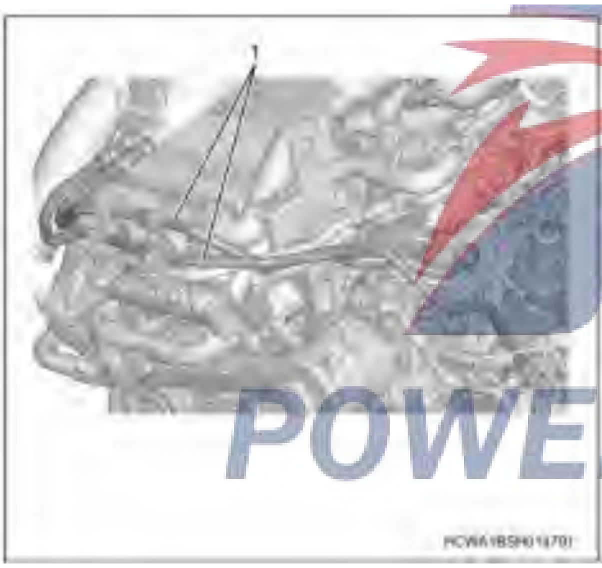
10. Guide the valve removed

1) Remove pilot valve from EGR valve A.

2) Remove pilot valve from EGR valve B.

11. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

2) Remove the heat shield from the air line.

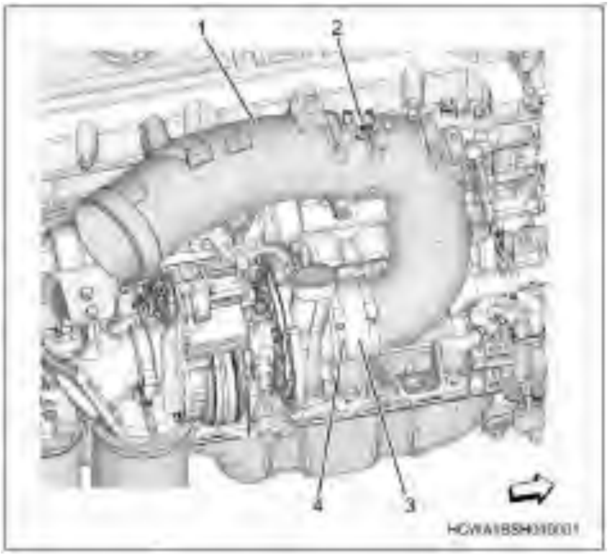
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.

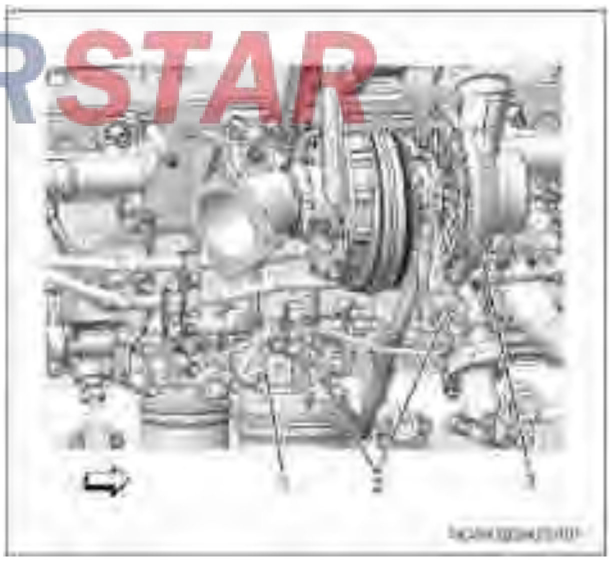


1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

12. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

2) Remove the turbocharger fuel supply pipe from the filter body.

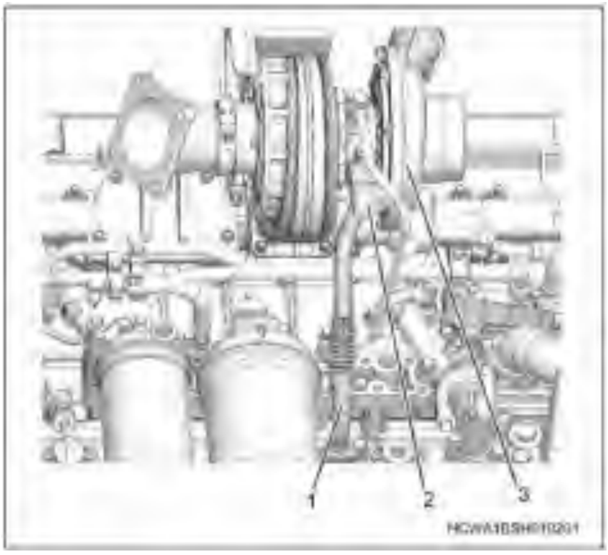


1. Turbocharger oil feed pipe
2. Pipe clamp
3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.

POWERSTAR



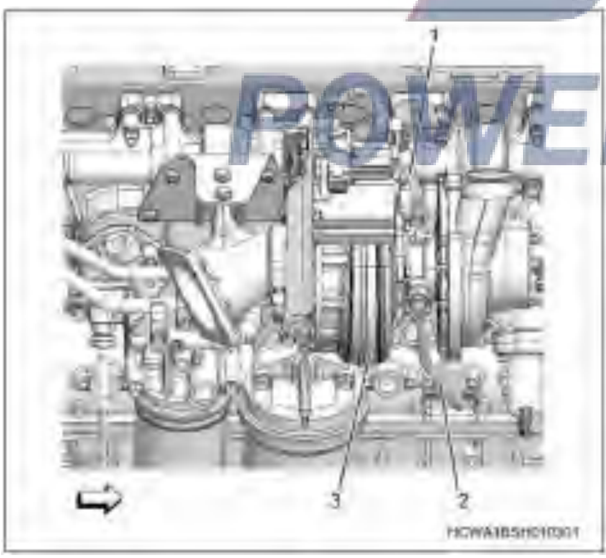
1. Turbocharger return pipe
2. Bracket
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

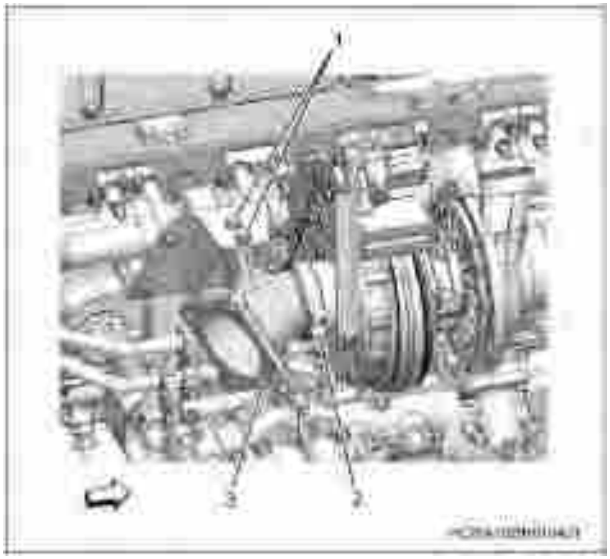
7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe

10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.

1. Turbocharger
2. Gasket
3. Exhaust manifold

POWERSTAR

13. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

14. Fuel drain pipe removed

1) Disconnect the fuel drain on the fuel supply pump.

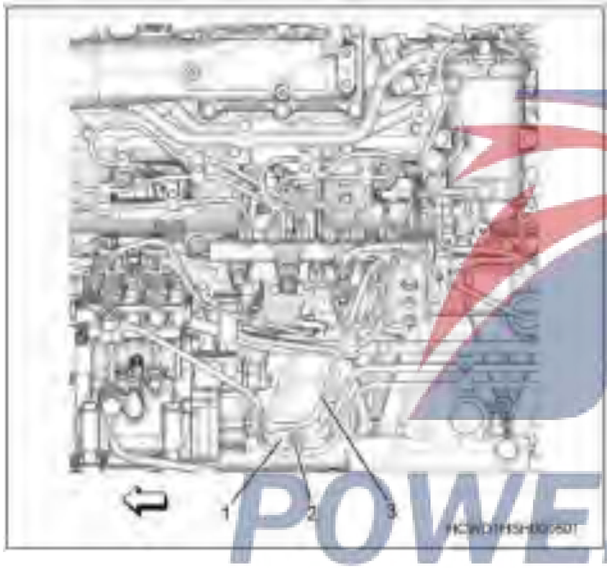
2) Disconnect the fuel drain hose from the fuel filter.

15. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

16. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

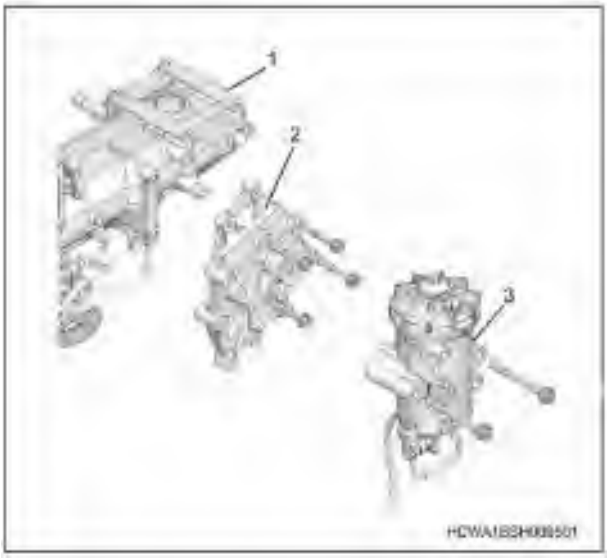
3) Remove the fuel pipe from the fuel supply pump.

17. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

18. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.

1. Lock nut
2. Adjust bolt

19. Generator removal

1) Disconnect the harness connector from the generator.

2) Disconnect the generator from the ground and B-terminal harness.

3) Remove the generator from the bracket.

POWERSTAR

20. Generator bracket removal

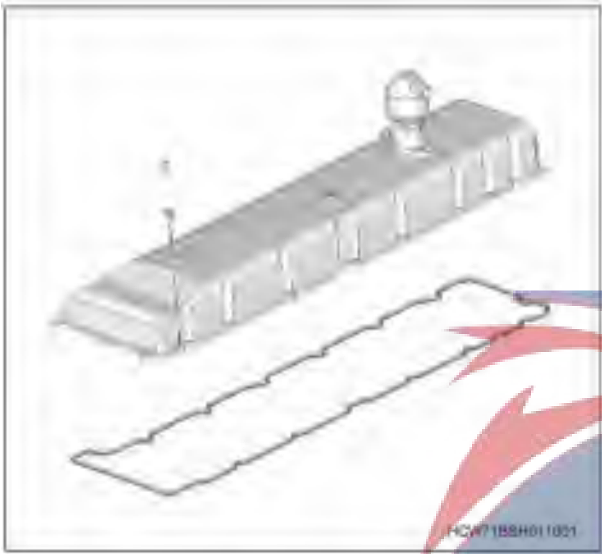
1) Remove the generator bracket from the cylinder head.

2) Remove the generator bracket from the timing gearbox.

21. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



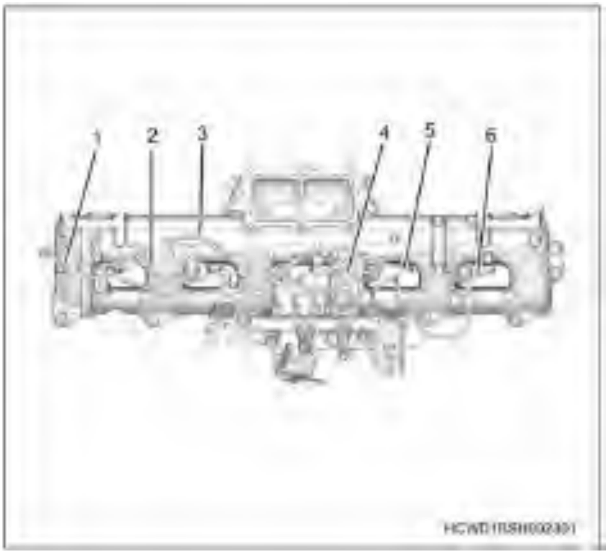
22. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.



1. Injection pipe No. 1

2. Injection pipe No. 2

3. Injection pipe No. 3

4. Injection pipe No. 4

5. Injection pipe No. 5

6. Injection pipe No. 6

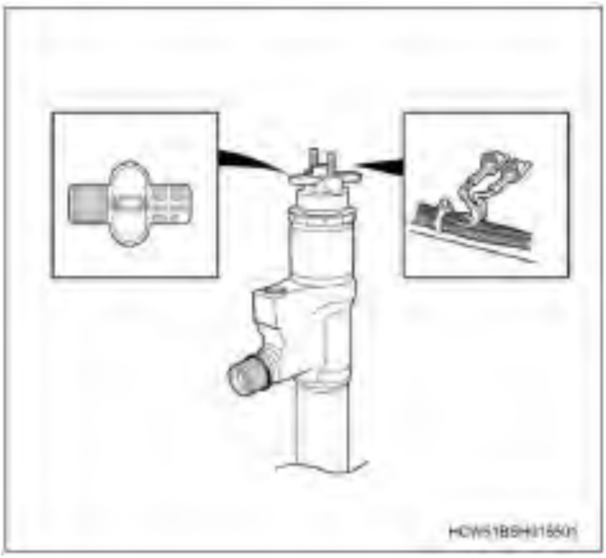
23. Injector harness removal

1) Remove the injector nut

2) Remove the injector harness

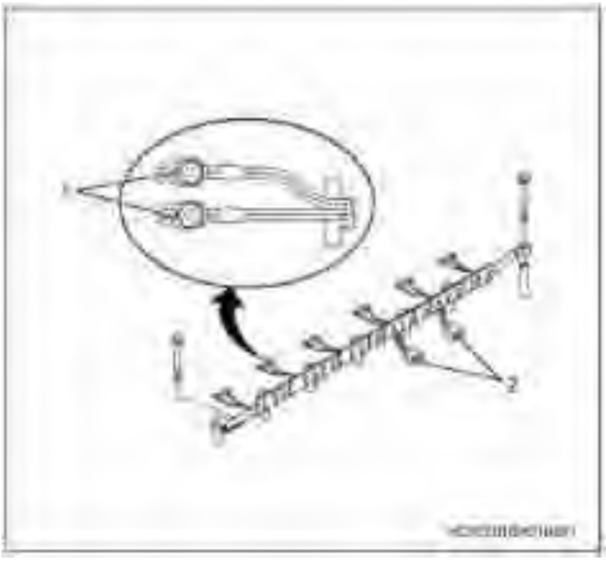
Caution:

● Because the injector ID code plate comes off,do not mix with other injector ID code plates.



3) Remove the bolts on the injector harness.

POWERSTAR



1. Injector terminal nut

2. Connector

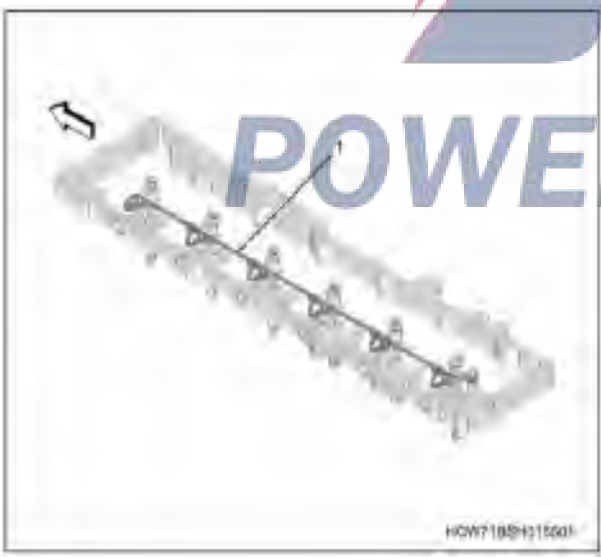
24. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

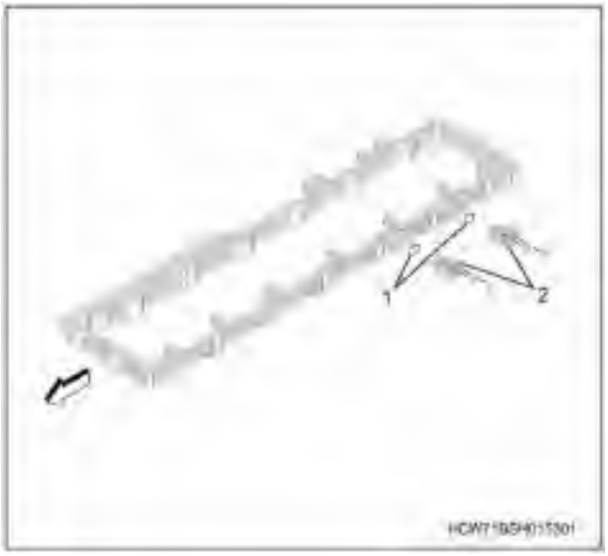
● Do not reuse the gasket.



1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.



1. O-ring

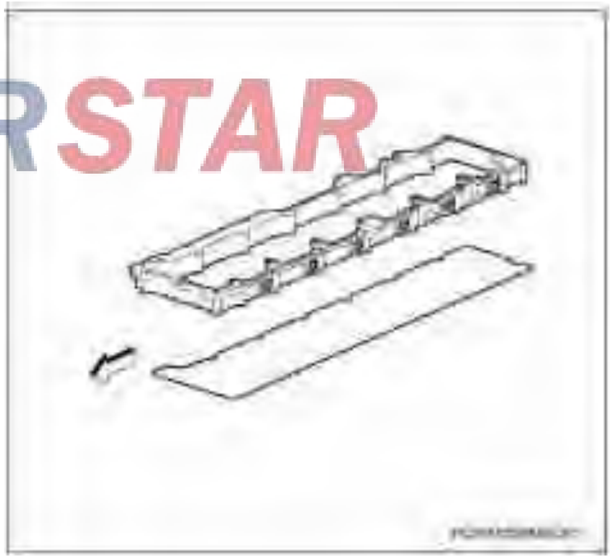
2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.



25. Injector removal

1) Remove the clamp from the cylinder head.

2) Remove the injector from the cylinder head with special tools.

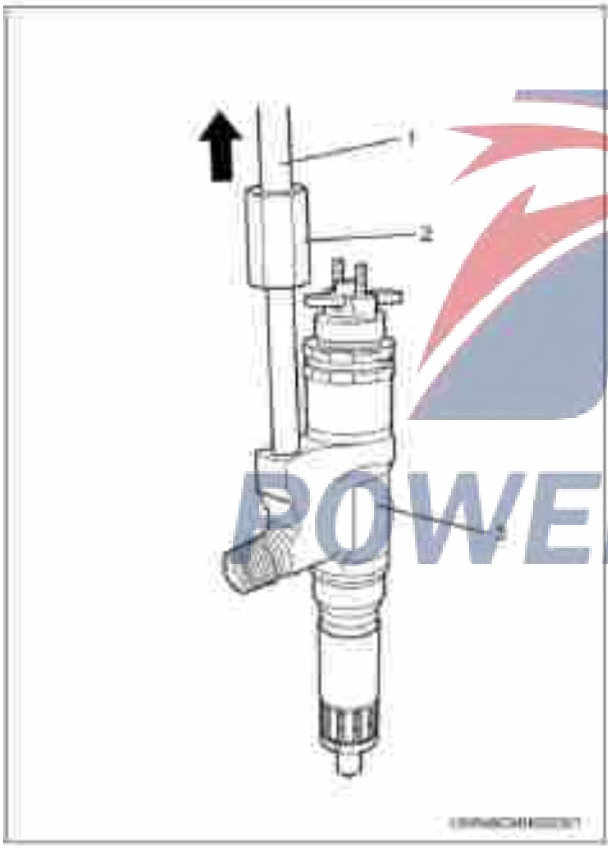
Caution:

● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

● Do not remove the injector ID code plate.

SST: 5-8840-2826-0 - injector remover

SST: 5-8840-0019-0 - sliding hammer



1. 5-8840-0019-0

2. 5-8840-2826-0

3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.

1. Injector

26. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.

1. Fuel pipe

2. Fuel pipe

3. Clip

27. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

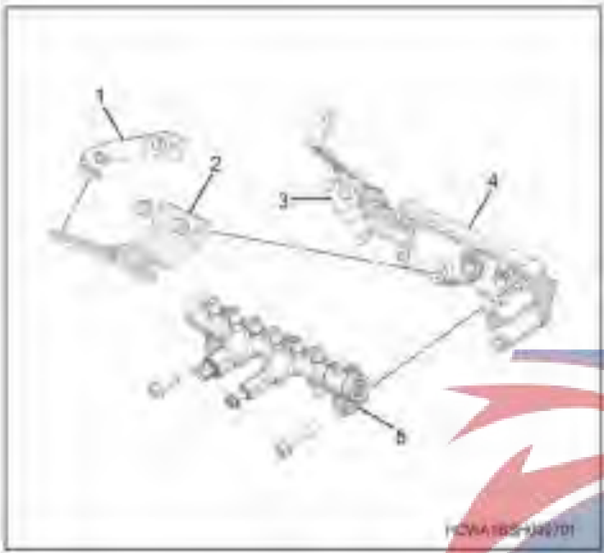
POWERSTAR

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.



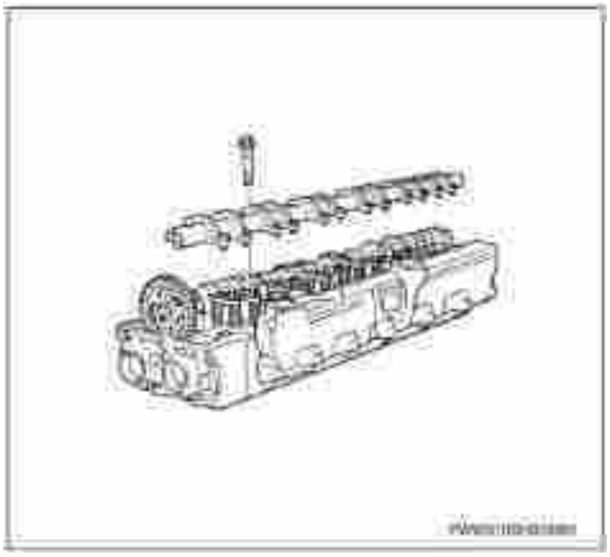
1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

28. Rocker arm shaft removal

1) Remove the rocker arm shaft from the cylinder head.

Caution:

● Evenly loosen the rocker arm shaft mounting bolt at both ends and remove.



29. Bridge removal

1) Remove the bridge from the bridge guide.

2) Store the removed bridges in numerical order.

1. Bridge

30. Camshaft removal

1) Measure the axial direction clearance of the camshaft.

Standard: 0.085 to 0.170 mm {0.00335 to 0.00669 in}

Limit: 0.25 mm {0.0098 in}

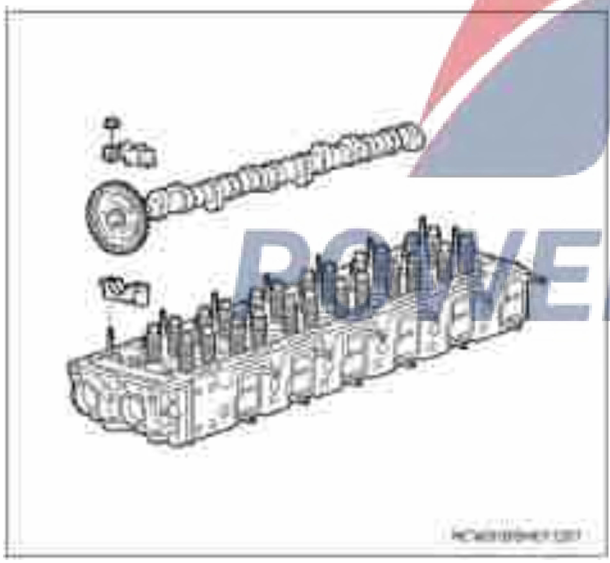
POWERSTAR

2) Remove the cam holder from the camshaft carrier.

Caution:

● Evenly loosen both ends, and remove.

3) Remove the camshaft and camshaft bracket from the cylinder head.



31. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

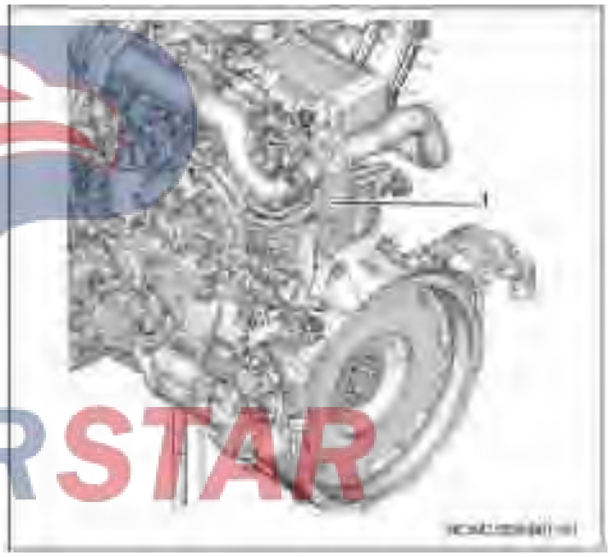
2) Remove the glow plug from the cylinder head.

32. Cylinder head cover removal

1) Install special tool to the cylinder head.

SST: 8-9761-4276-0 - engine hanger

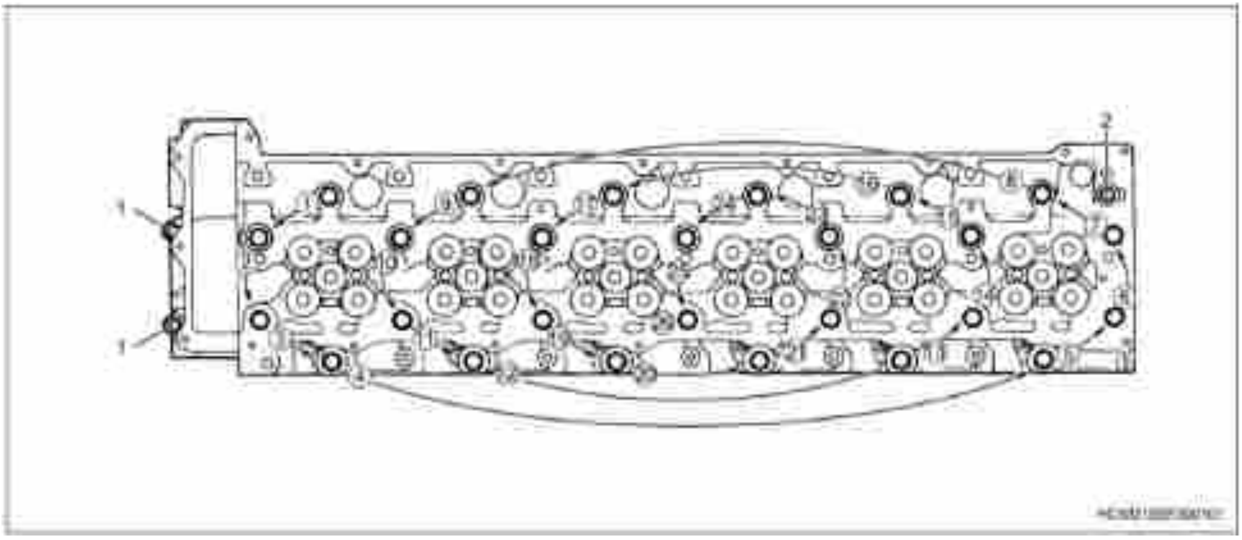
Tightening torque: 117.5 N • m { 12.0 kgf • m / 87 lb • ft }



1. 8-9761-4276-0

2) Remove the M10 and M12 bolts from the cylinder head.

3) Remove the cylinder head bolts from the cylinder head in the order shown.



1. M10 bolt

2. M12 bolt

4) Remove the cylinder head from the cylinder block.

5) Remove the cylinder head gasket from the cylinder block.

Caution:

● Do not reuse the cylinder head gasket.

6) When removing, inspect for water leakage, exhaust gas leakage, etc.

33. Fuel pump removed

1) Disconnect the harness connector connected to the camshaft position sensor.

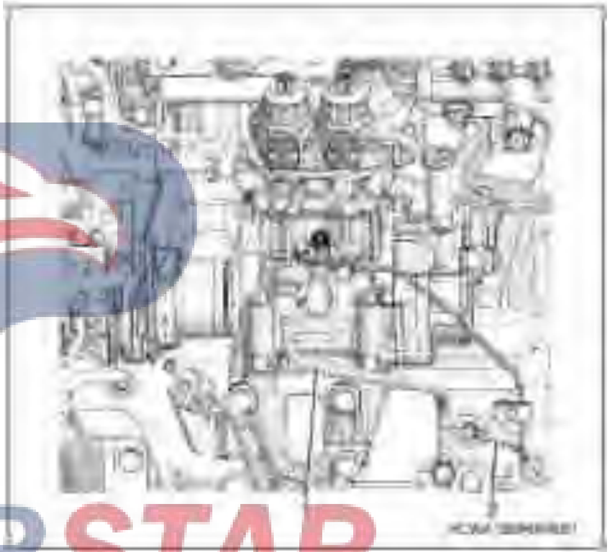
2) Disconnect PCV harness connector.

3) Disconnect the fuel supply pipe to the fuel supply pipe.

4) Remove the oil supply pipe from the cylinder block.

5) Disconnect the oil return pipe from the fuel supply pump.

6) Remove the oil return pipe from the cylinder block.

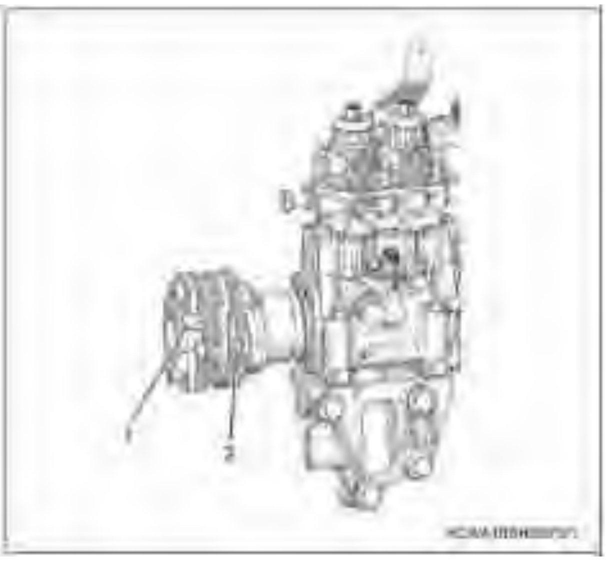


1. Oil return pipe

2. Oil feed pipe

7) Remove the pin bolts and coupling bolts on the coupling.

POWERSTAR



1. Cotter bolt
2. Coupling tightening bolt

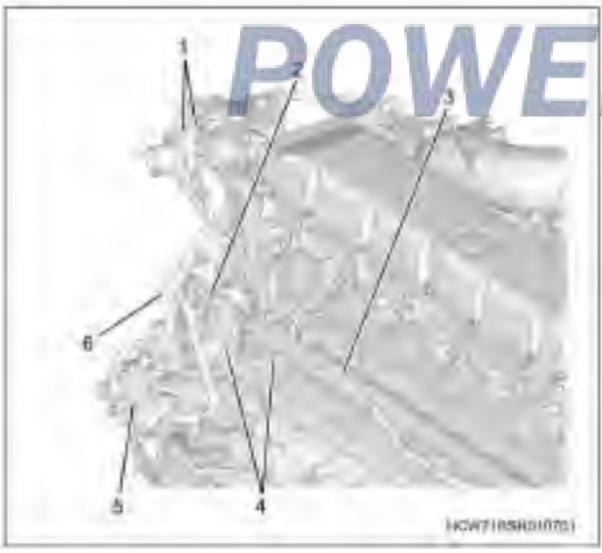
8) Remove fuel supply pump from supply pump bracket.

9) Remove the supply pump bracket from the cylinder block.

34. A / C compressor removal

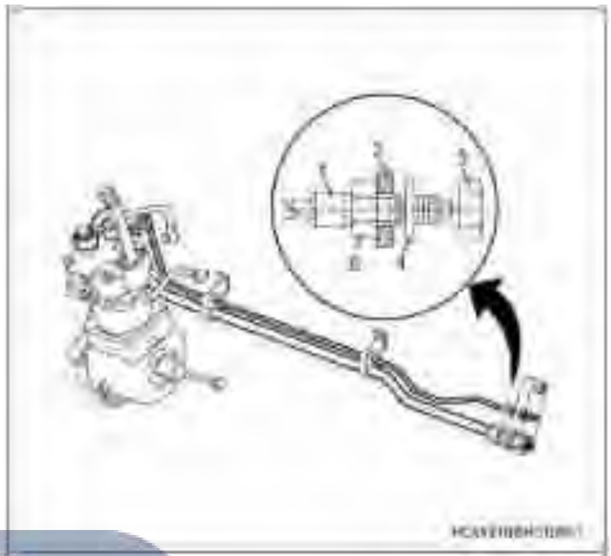
1) Remove the oil pipe from the cylinder block.

2) Remove the water pipe from the cylinder block.



1. Exhaust pipe
2. Water return pipe
3. Air compressor pressure pipe
4. Water feed pipe
5. Air compressor
6. Inflatable tube

3) Disconnect the inflation tube and air compressor pressure tube from the fitting.



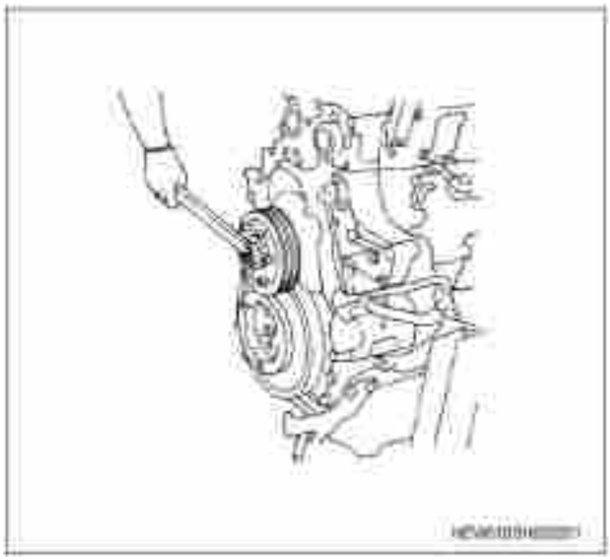
1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

4) Remove the air compressor from the timing gearbox.

35. Crankshaft pulley removal

1) Wedge the crankshaft with a wooden block to prevent the fan pulley from rotating.

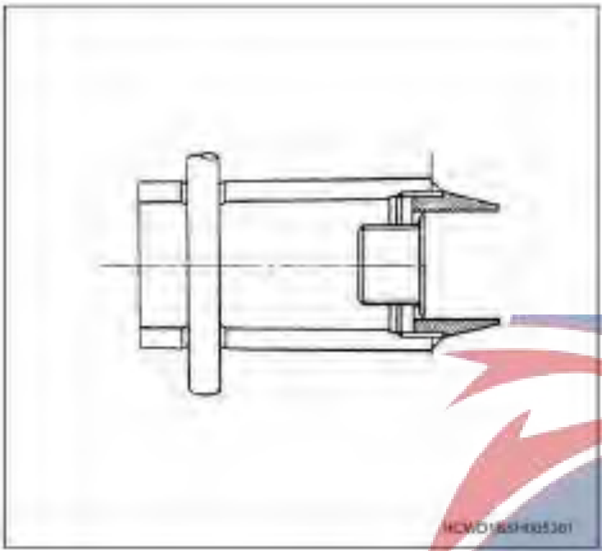
2) Remove the crankshaft pulley nut from the crankshaft pulley.



POWERSTAR

3) Use a special tool to remove the fan pulley cone bushing.

SST: 1-8521-0063-0 - Tapered bushing puller



4) Remove the fan pulley from the fan shaft.

5) Remove the crankshaft pulley from the crankshaft.

Caution:

● Do not damage the sealing surface or excessive force on the pump body.

36. Idle gear removal

1) Remove the idler gear from the gearbox cover.

37. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

38. Gear cover removed

1) Remove the gearbox cover from the timing gearbox.

2) Remove the gasket from the gearbox cover.

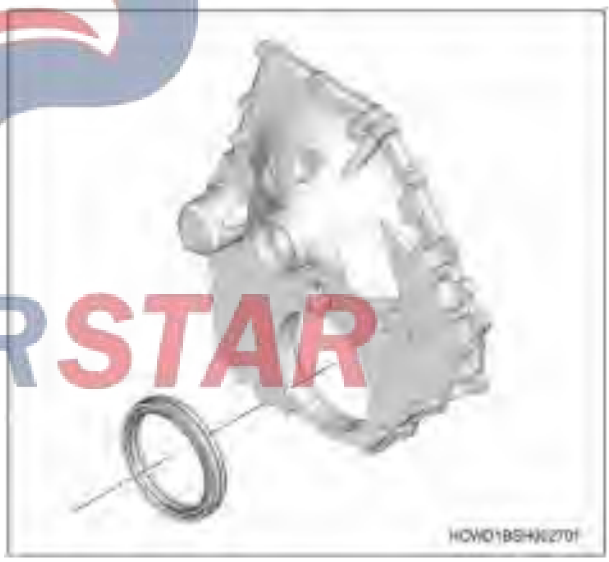
39. Crankshaft oil seal removed

1) Remove the crankshaft front oil seal from the gearbox cover.

Caution:

● Do not damage the oil seal pressure mounting surface.

● Do not reuse the slinger or oil seal.



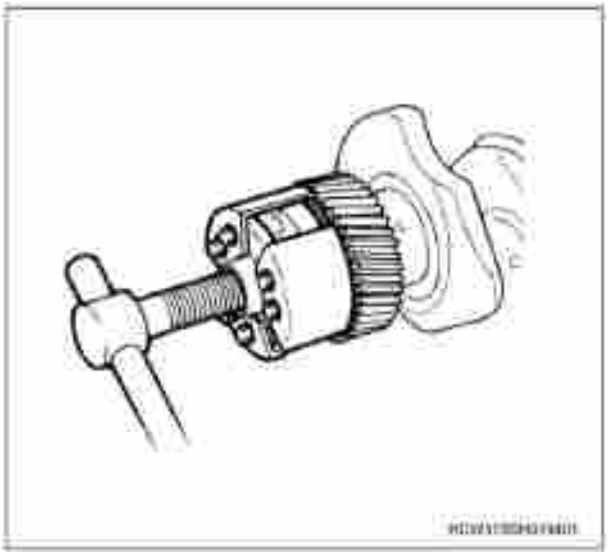
2) Use a special tool to remove the oil deflector from the crankshaft.

Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.

POWERSTAR

SST: 1-8521-0027-0 - Sleeve Removal Unit



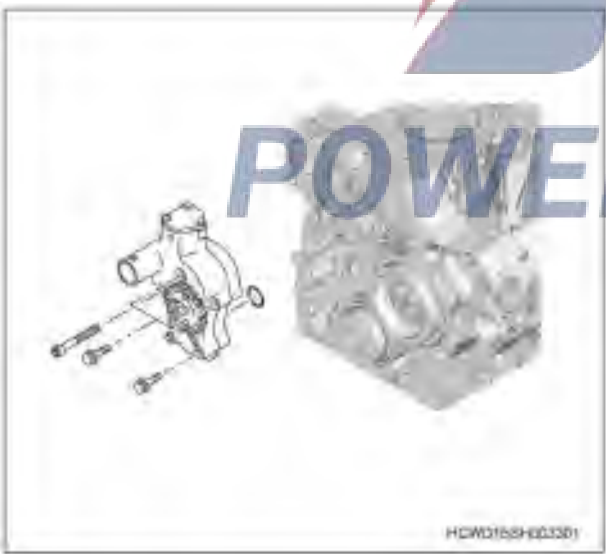
40. Oil pump removal

1) Remove the oil pump from the cylinder block.

Caution:

● Do not remove the bolt with the yellow mark on the top.

2) Remove the O-ring from the oil pump.



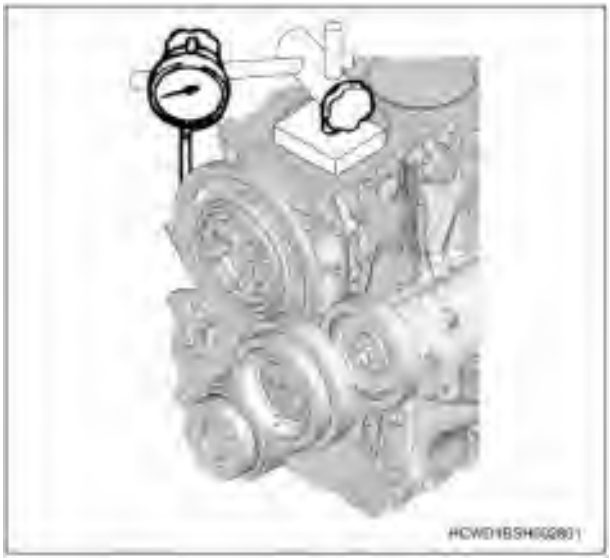
41. Idle gear removal

Caution:

● Before removing each idler gear, measure the backlash and axial clearance.

1) Measure idle gear clearance.

Standard: 0.03 to 0.13mm {0.0012 to 0.0051 in}



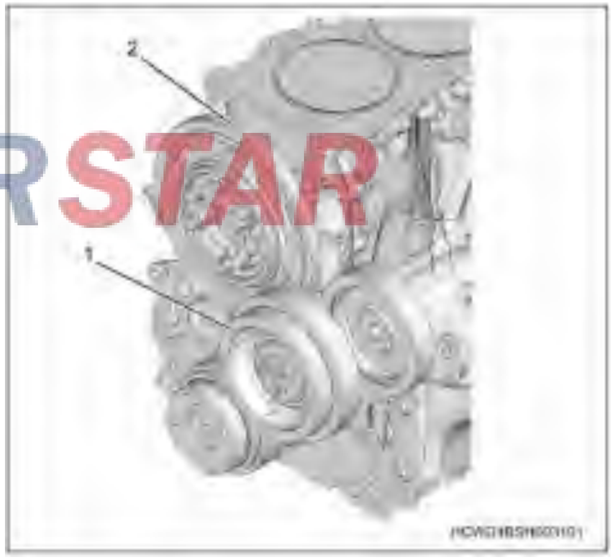
2) Measure the axial clearance of the idler gear.

Standard: 0.165 to 0.230mm {0.00650 to 0.00906in} Idler Gear A

Limit: 0.35 mm {0.0138 in} Idler gear A

Standard: 0.075 to 0.154mm {0.00295 to 0.00606in} Idler gear B.

Limit: 0.25 mm {0.0098 in} idler gear B



1. Idling Gear A
2. Idling gear B

3) Remove the distance bolt from the cylinder block.

4) Remove the idler gear A from the cylinder block.

Caution:

● During the disassembly, mark the idler gear and thrust plate to ensure the installation direction is facing front and back.

POWERSTAR

5) Remove idler gear B-axis from cylinder block.

6) Remove idler gear B from idler gear B axle.

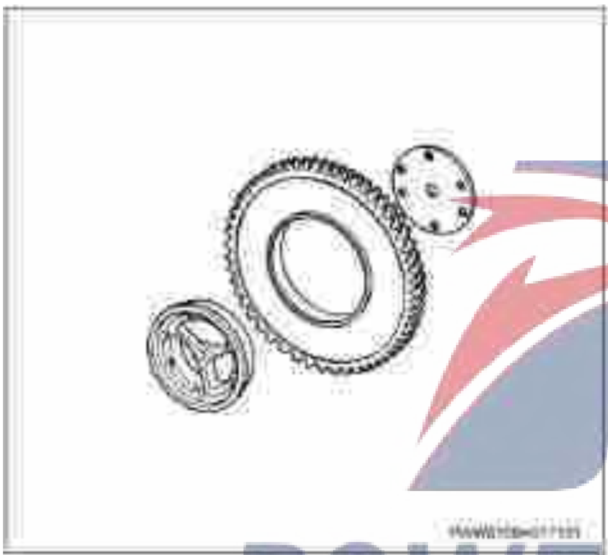
Caution:

● Remove idler gear B during marking to ensure that the mounting orientation is toward the front and back.

7) Remove thrust plate from Cylinder block.

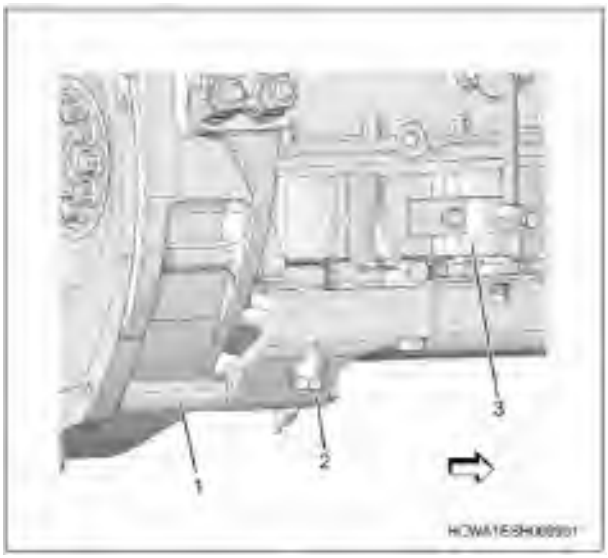
Caution:

● Thrust plates are marked during disassembly to ensure that the mounting orientation is toward the front and back.



42. Oil pan removal

1) Remove the left and right flywheel housing brackets from the cylinder block and flywheel housing.



1. Flywheel housing

2. Flywheel housing bracket

3. Cylinder block

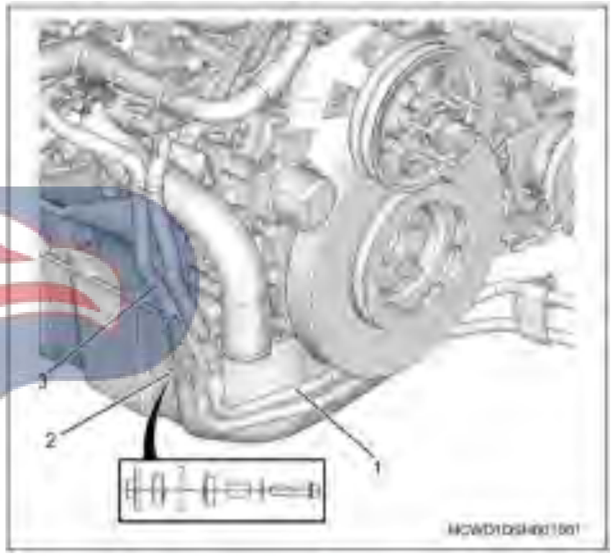
2) Remove the oil pan from the cylinder block.

43. Timing gearbox removed

1) Remove the timing gearbox from the cylinder block.

44. Heater hose removal

1) Remove the clip and then remove the heater hose from the thermostat housing.



1. Heater hose

2. Heater pipe bracket part

3. Heater pipe

45. Exhaust gas recirculation cooler water pipe removed

1) Remove the front and rear return lines from the thermostat housing.

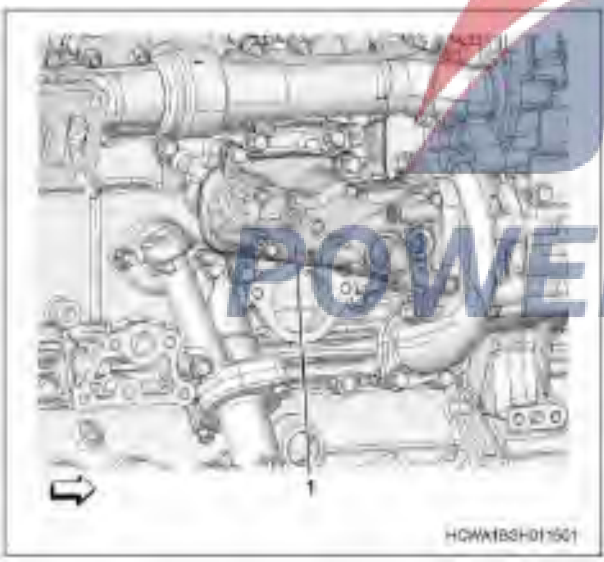
POWERSTAR

1. Back-end return pipe

2. Front return pipe

46. Thermostat housing removal

1) Remove the thermostat housing from the oil cooler.



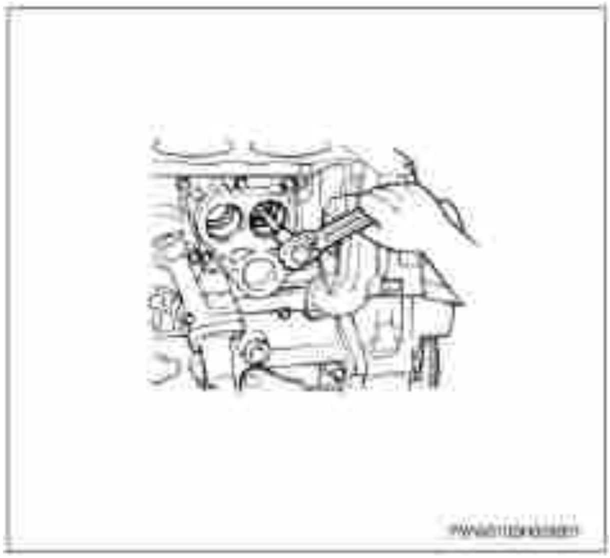
1. Thermostat housing

47. Thermostat removal

1) Remove the thermostat from the oil cooler.

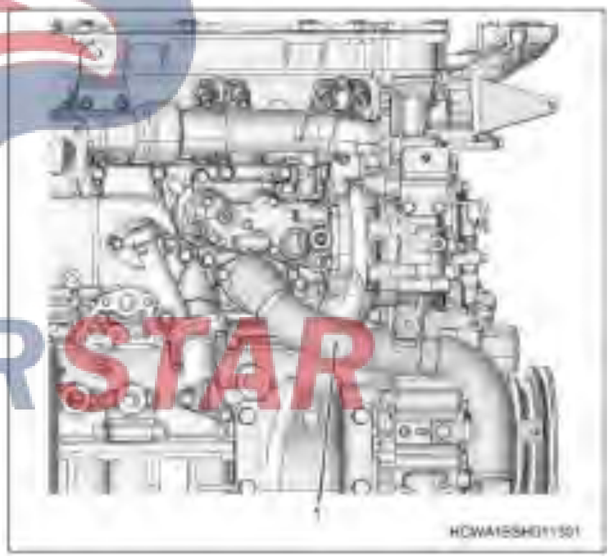
2) Using a special tool, remove the thermostat seal ring from the oil cooler.

SST: 1-8521-0067-0 - thermostat seal remover



48. Intake pipe removed

1) Remove the inlet pipe from the oil cooler.

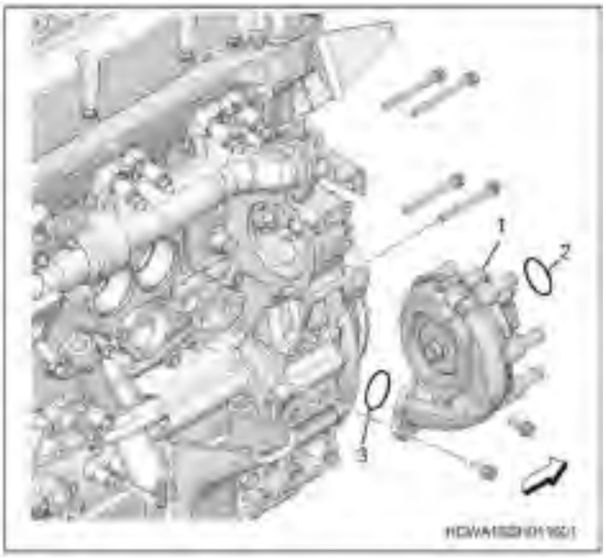


1. Water inlet

49. Water pump removal

1) Remove the pump from the oil cooler and gearbox.

POWERSTAR



1. Water pump
2. O-ring
3. O-ring

50. Oil filter warning switch removal

1) Disconnect the oil filter warning switch.

2) Remove the oil filter warning switch and valve from the oil filter body.

51. Oil filter removal

1) Remove the drain plug from the oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the oil filter case.

Caution:

● Do not reuse O-rings.

● Do not forget to tighten the drain plug.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Disconnect the oil filter tubing.

4) Remove the hose clamp bracket from the oil filter.

5) Remove the oil filter from the oil cooler.

52. Partial oil filter removal

1) Remove the drain plug from the partial oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the partial oil filter.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Remove the clip from the oil pipe.

4) Remove the tubing holder from the splitter oil filter body.

5) Remove the partial oil filter from the oil cooler.

53. Oil cooler removal

1) Remove the drain pipe from the oil cooler.

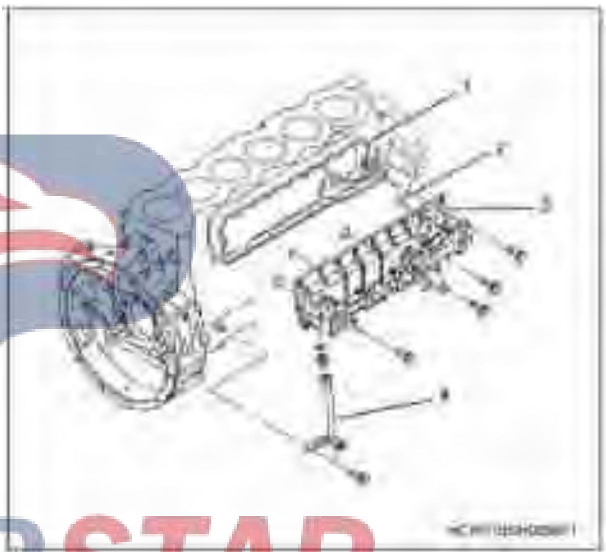
2) Remove the connector from the oil cooler.

3) Disconnect the water pipe from the oil cooler.

Note:

● Disconnect all hoses connected to the oil cooler.

4) Remove the oil cooler from the cylinder block.



1. Gasket
2. O-ring
3. Oil cooler
4. Drainage line

54. Starter motor removal

1) Disconnect the starter ground cable.

2) Disconnect starter B terminal.

3) Disconnect starter S-terminal.

4) Remove the starter from the flywheel housing.

POWERSTAR

55. Oil strainer removed

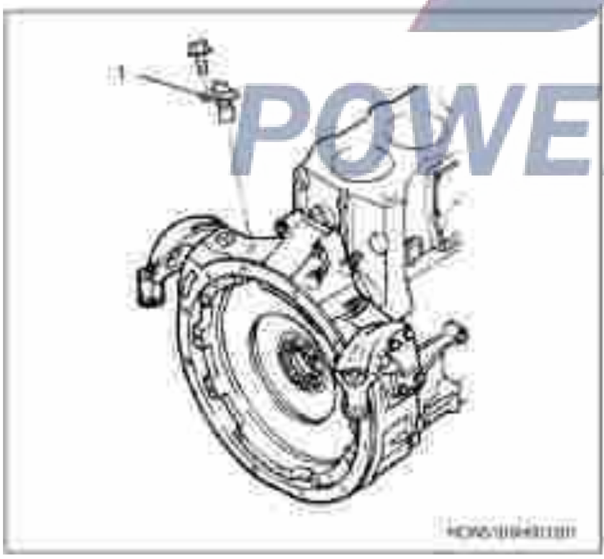
1) Remove the oil strainer and O-ring from the cylinder block.

2) Remove the bracket from the cylinder block.

56. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the crankshaft position sensor from the flywheel housing.



1. CMP sensor

57. Clutch disc removed

Refer to "*5. TRANSMISSION, TRANSAXLE 5E. MJT CLUTCH (SINGLE PLATE DRIVE) REMOVAL*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Disassembly*".

58. Flywheel removal

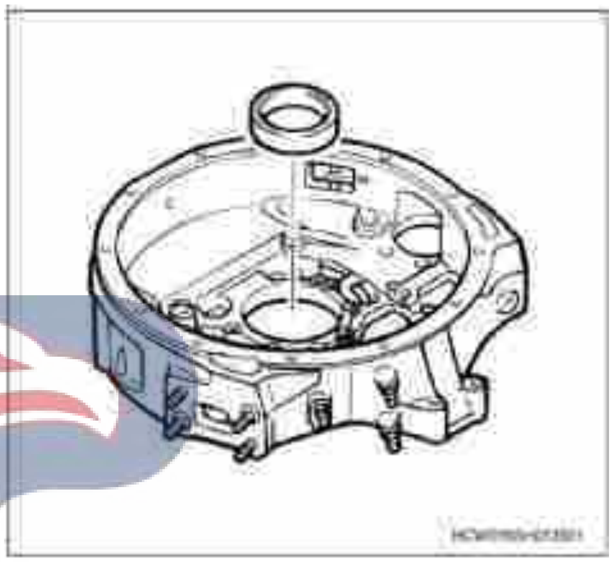
1) Remove the flywheel from the crankshaft.

59. Crankshaft rear oil seal removal

1) Remove the crankshaft rear oil seal from the flywheel housing

Caution:

● Do not damage the oil seal pressure mounting surface.



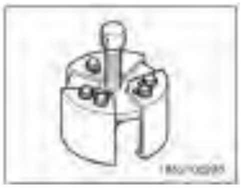
2) Use a special tool to remove the oil deflector from the crankshaft.

Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.

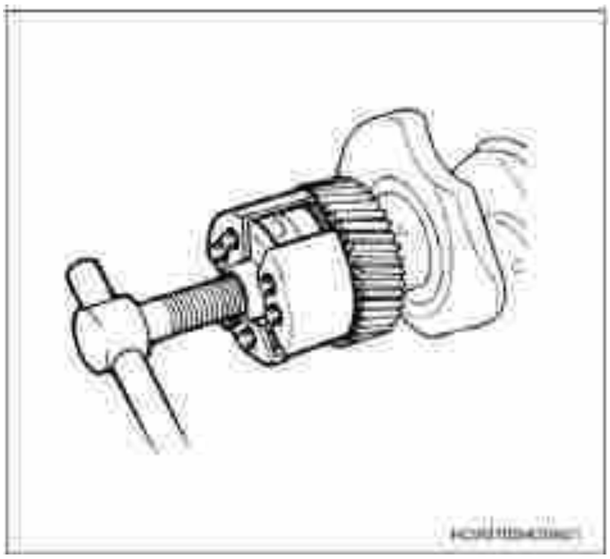
Caution:

● Do not reuse the oil seal or ram during replacement.



SST: 1-8521-0027-0 - Sleeve Removal Unit

POWERSTAR



60. Flywheel housing removal

1) Disconnect the flywheel housing bracket from the flywheel housing.

2) Remove the engine support foot from the flywheel housing.

3) Remove the flywheel housing from the cylinder block.

61. Engine support feet removed

1) Remove the engine support leg from the cylinder block.

62. Piston removal

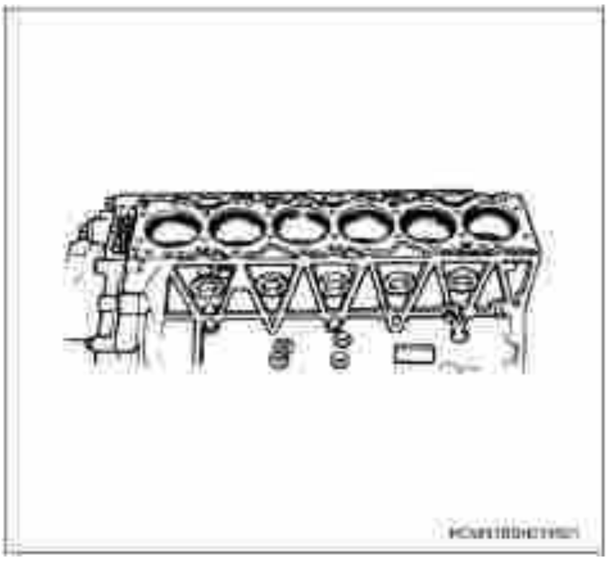
Caution:

● Connect stops to prevent the bushing from protruding during crankshaft rotation and piston removal.

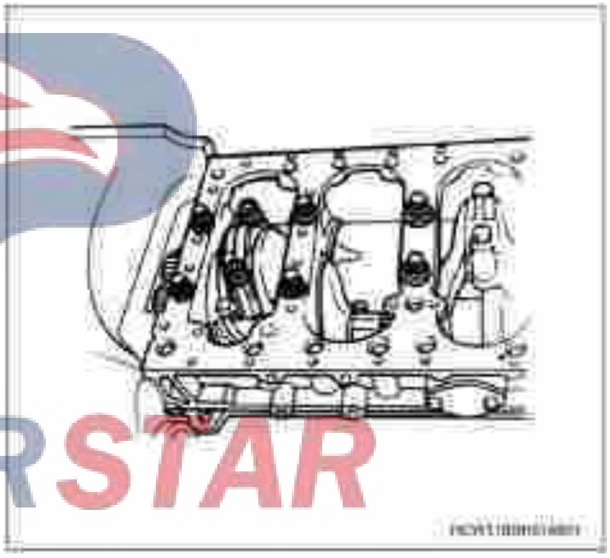
1) Scrape off all the carbon on the top of the cylinder liner with a scraper.

Caution:

● Do not damage the cylinder liner.



2) Remove the bearing cap from the connecting rod.



POWERSTAR

3) Remove the piston from the cylinder block.

Note:

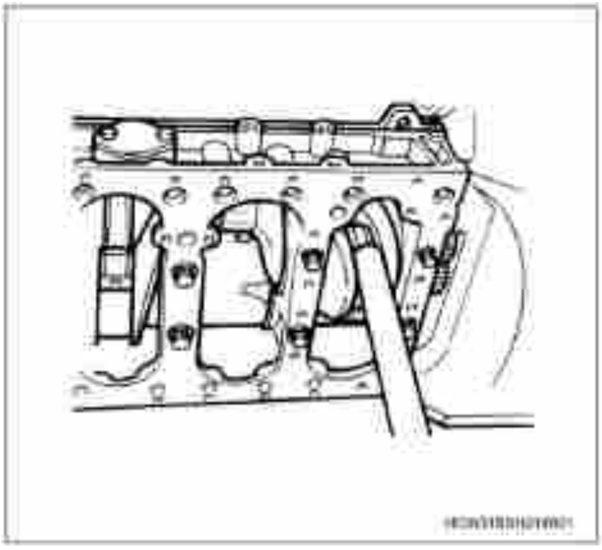
● Remove the piston to the compression top dead center and push the lower end of the rod out using a hammer or the like.

Caution:

● Avoid interference between rod and cylinder liner.

● Do not damage the nozzle.

● Temporarily tighten the removed cap and bearing onto the connecting rod to avoid confusing parts.



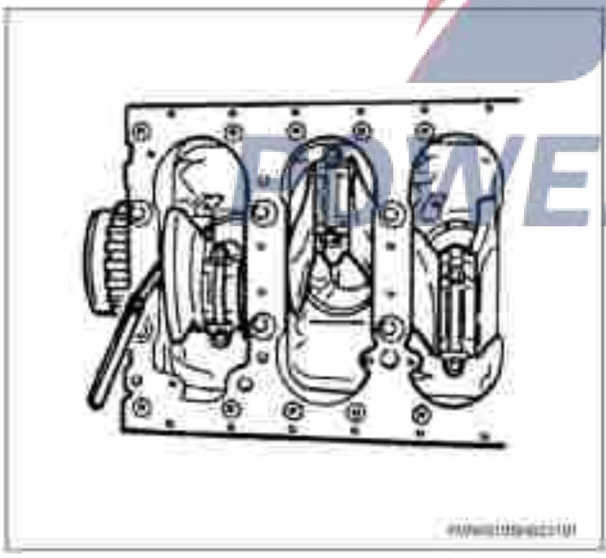
63. crankshaft removal

1) Insert the feeler gauge into the thrust surface of No. 1 bearing and measure the axial clearance.

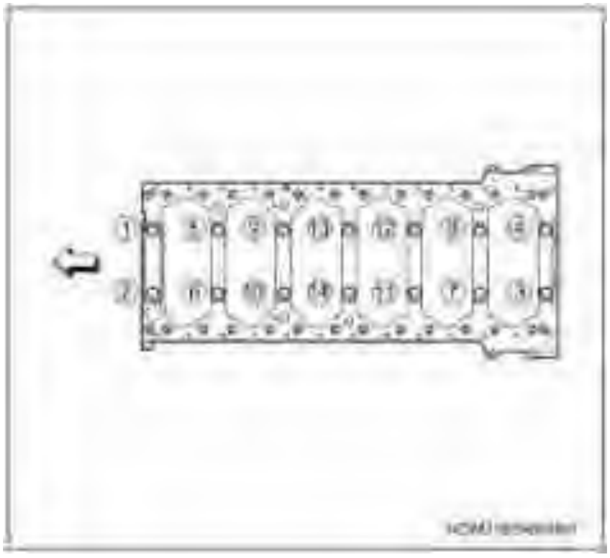
Caution:

● If the measured value is not within the specified range, replace the thrust bearing.

Standard: 0.10 to 0.28 mm {0.004 to 0.011 in}



2) Loosen the bolts in the order shown and remove the crankcase from the cylinder block.



3) Remove the crankshaft from the cylinder block.

4) Remove the bearing from the crankcase.

Caution:

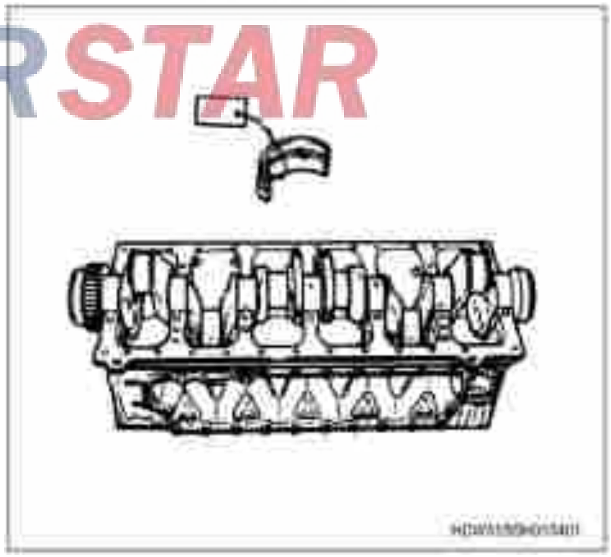
● Label the mounting location of the bearing.

5) Remove the bearing from the cylinder block.

Caution:

● Label the mounting location of the bearing.

● Do not damage the crankshaft bearing sliding parts.



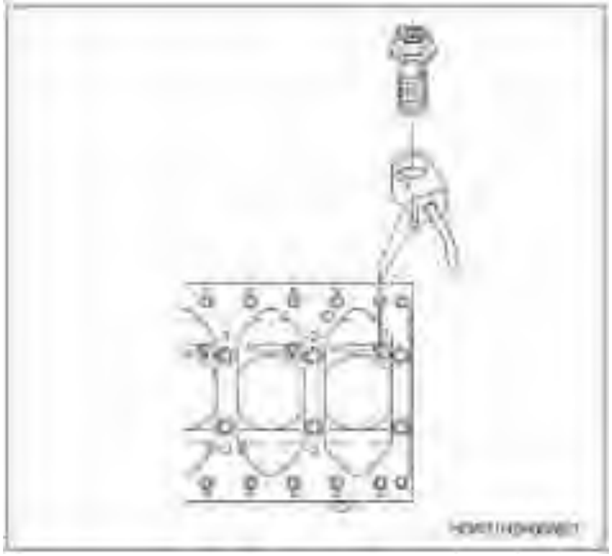
64. Hydraulic switch removed

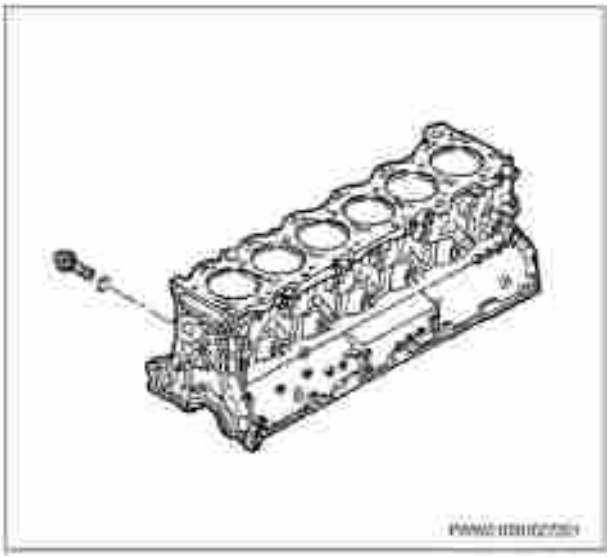
1) Remove the oil pressure switch from the adapter.

2) Remove the adapter from the cylinder block.

65. Piston oil nozzle removed

1) Remove the piston nozzle from the cylinder block.





66. drain valve removed

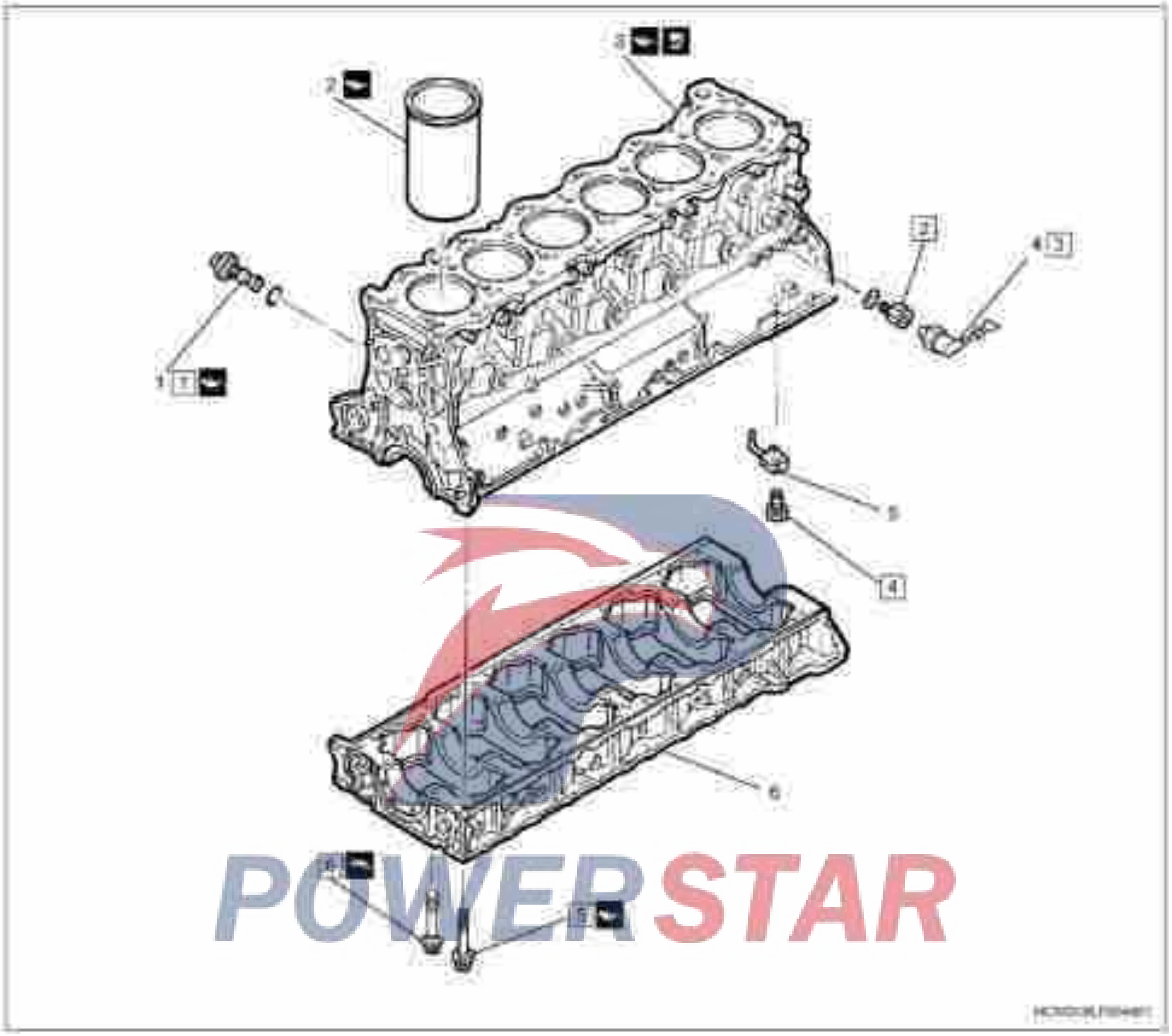
1) Remove the drain valve from the cylinder block.

POWERSTAR

Removal

1. Component Views

Cylinder block



Part name

1. Drain valve
2. Cylinder liner
3. Cylinder block
4. Hydraulic switch
5. Oil nozzle
6. Crankcase

Tightening torque

1: 20 N • m {2.0 kgf • m / 15 lb • ft}

2: 41 N • m {4.2 kgf • m / 30 lb • ft}

3: 18 N • m {1.8 kgf • m / 13 lb • ft}

4: 69 N • m {7.0 kgf • m / 51 lb • ft}

5: 96 N • m {9.8 kgf • m / 71 lb • ft} M12

6-1: 49 N • m {5.0 kgf • m / 36 lb • ft} M18

6-2: 88 N • m {9.0 kgf • m / 65 lb • ft} M18

6-3: 90 °M18

6-4: 294 N • m {30.0 kgf • m / 217 lb • ft} M18

2. Cylinder liner removed

1) Refer to the illustration to measure the inside diameter of the cylinder liner.

Note:

● Measure the maximum amount of wear at a depth of 130 mm (5.1181 in) from the top of the cylinder block.

Caution:

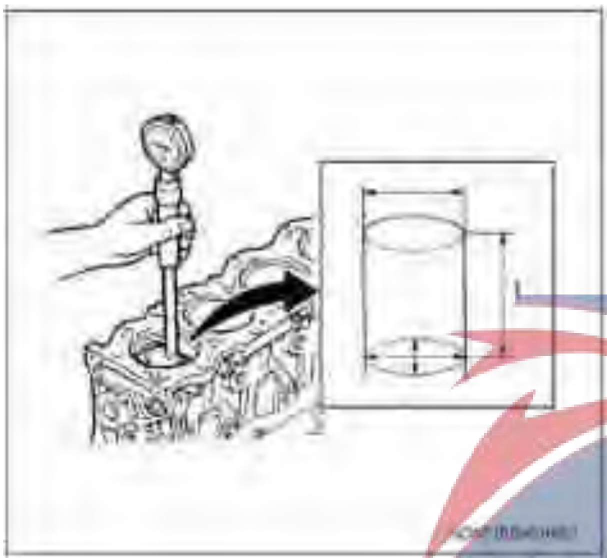
● If the measured value exceeds the specified Limit value, replace the cylinder liner.

● Do not punch or hone the liner during maintenance.

● Attach stop to cylinder liner.

Standard: 147 mm {5.79 in}

Limit: 147.3 mm {5.799 in}



1. 130 mm {5.1181 in}

2) Remove the cylinder liner from the cylinder block.

POWERSTAR

Inspection

1. Cylinder block inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the cylinder block oil and water channels for corrosion and blockage.

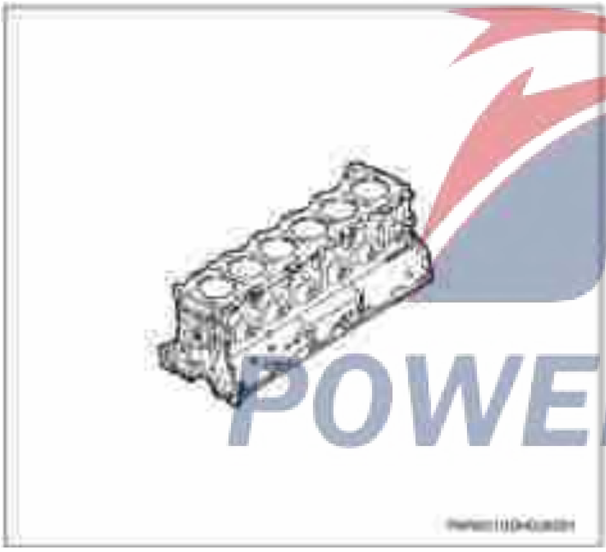
2) Use water pressure tester to check water jacket for rupture.

Note:

● Apply specified water pressure and hold for 3 minutes and check for leaks in all areas.

Standard: 490 kPa {5.0 kgf / cm2 / 71 psi}

3) Check the cylinder block for cracks and damage using magnetic flaw detection or dye permeate.

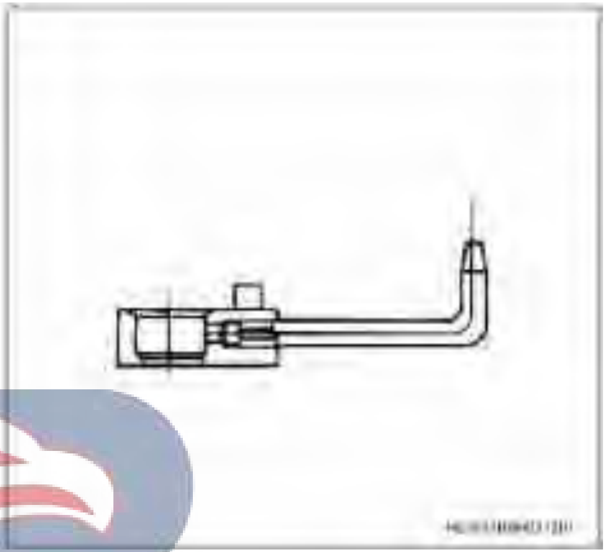


2. Piston oil nozzle check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Check the piston oil nozzle is bent, the oil hole is blocked.



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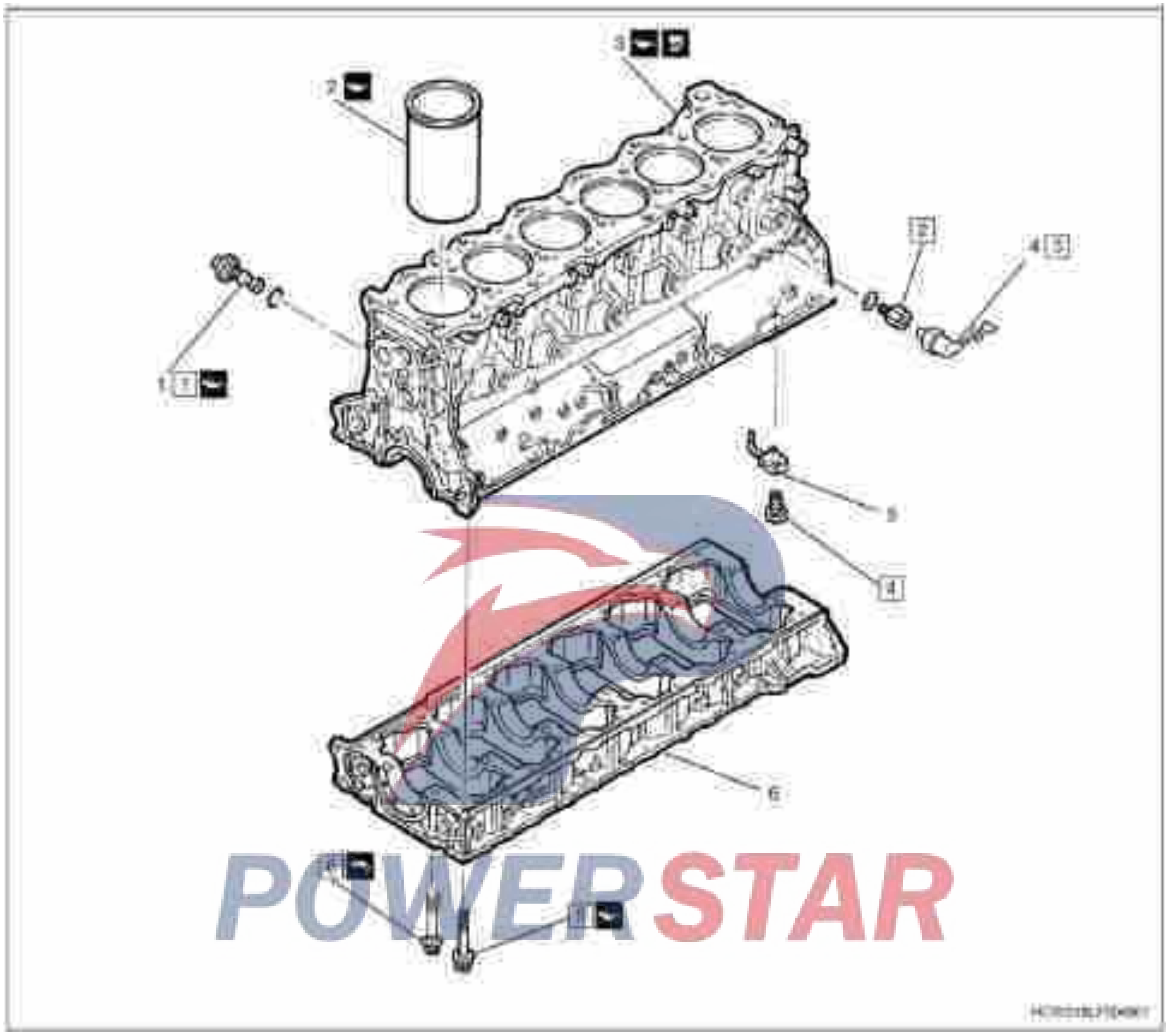
Reassemble

1. Component Views

Cylinder block



Part name

1. Drain valve
2. Cylinder liner
3. Cylinder block
4. Hydraulic switch
5. Oil nozzle
6. Crankcase

Tightening torque

1: 20 N • m {2.0 kgf • m / 15 lb • ft}

2: 41 N • m {4.2 kgf • m / 30 lb • ft}

3: 18 N • m {1.8 kgf • m / 13 lb • ft}

4: 69 N • m {7.0 kgf • m / 51 lb • ft}

5: 96 N • m {9.8 kgf • m / 71 lb • ft} M12

6-1: 49 N • m {5.0 kgf • m / 36 lb • ft} M18

6-2: 88 N • m {9.0 kgf • m / 65 lb • ft} M18

6-3: 90 °M18

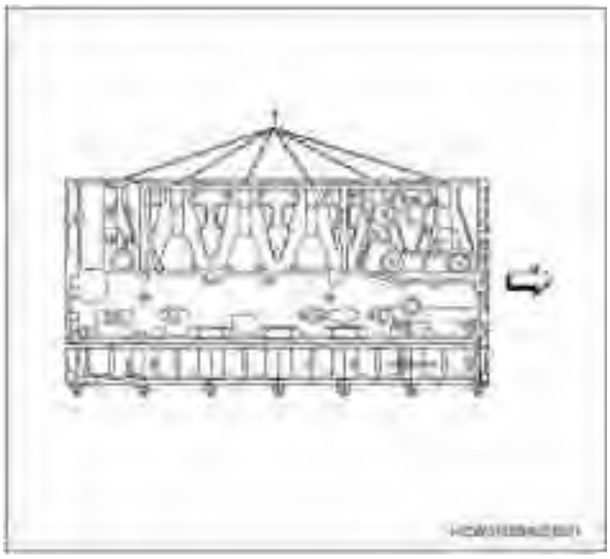
6-4: 294 N • m {30.0 kgf • m / 217 lb • ft} M18

2. Cylinder liner installation

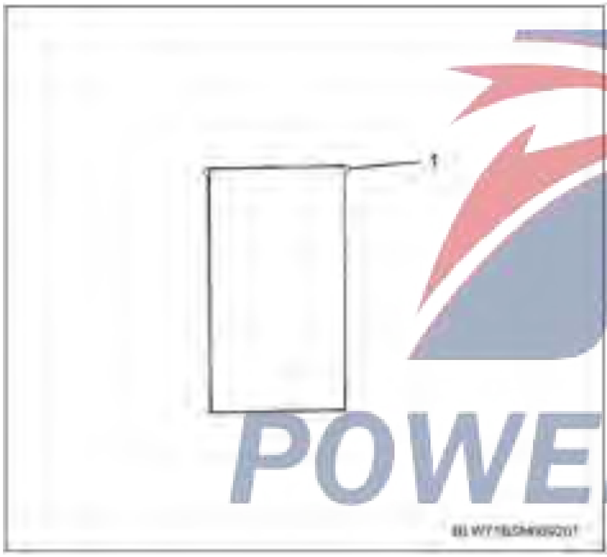
Caution:

● Prior to installing the cylinder liner, select the cylinder liner rating.

1) Refer to the corresponding chart to select the liner according to the mark number on the cylinder block.



1. Cylinder block diameter mark



1. Cylinder liner outer diameter mark

Cylinder liner level selection

Mark the location	level		
	1	2	3
Cylinder block diameter	: 151.600 to 151.610mm { 5.96849 to 5.96889 in }	: 151.611 to 151.620mm { 5.96893 to 5.96928 in }	: 151.621 to 151.630mm { 5.96932 to 5.96967 in }
Cylinder liner outer diameter	1X	3X	
	: 151.590 to 151.599mm { 5.96810 to 5.96845 in }	: 151.600 to 151.610mm { 5.96849 to 5.96889 in }	

Clearance between cylinder liner and cylinder block

Assemble standard value	: 0.006 to 0.025mm { 0.00024 to 0.00098 in }

2) Apply the engine oil to the outer circumference of the cylinder liner.

3) Install the cylinder liner onto the cylinder block.

Note:

● Mount to cylinder block vertically.

Caution:

● Do not apply excessive force when installing bushings.

● After installing the bushing, invert the cylinder block to prevent the bushing from slipping out.

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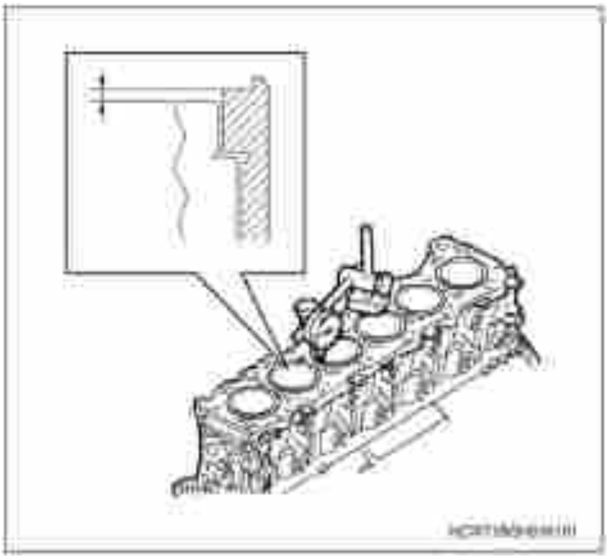
4) Using a dial gauge cylinder liner out of volume.

The amount of cylinder liner protrusion	: 0.05 to 0.09 mm {0.0020 to 0.0035 in}
Adjacent cylinder differences	: 0.020 mm or less {0.00079 in or less}



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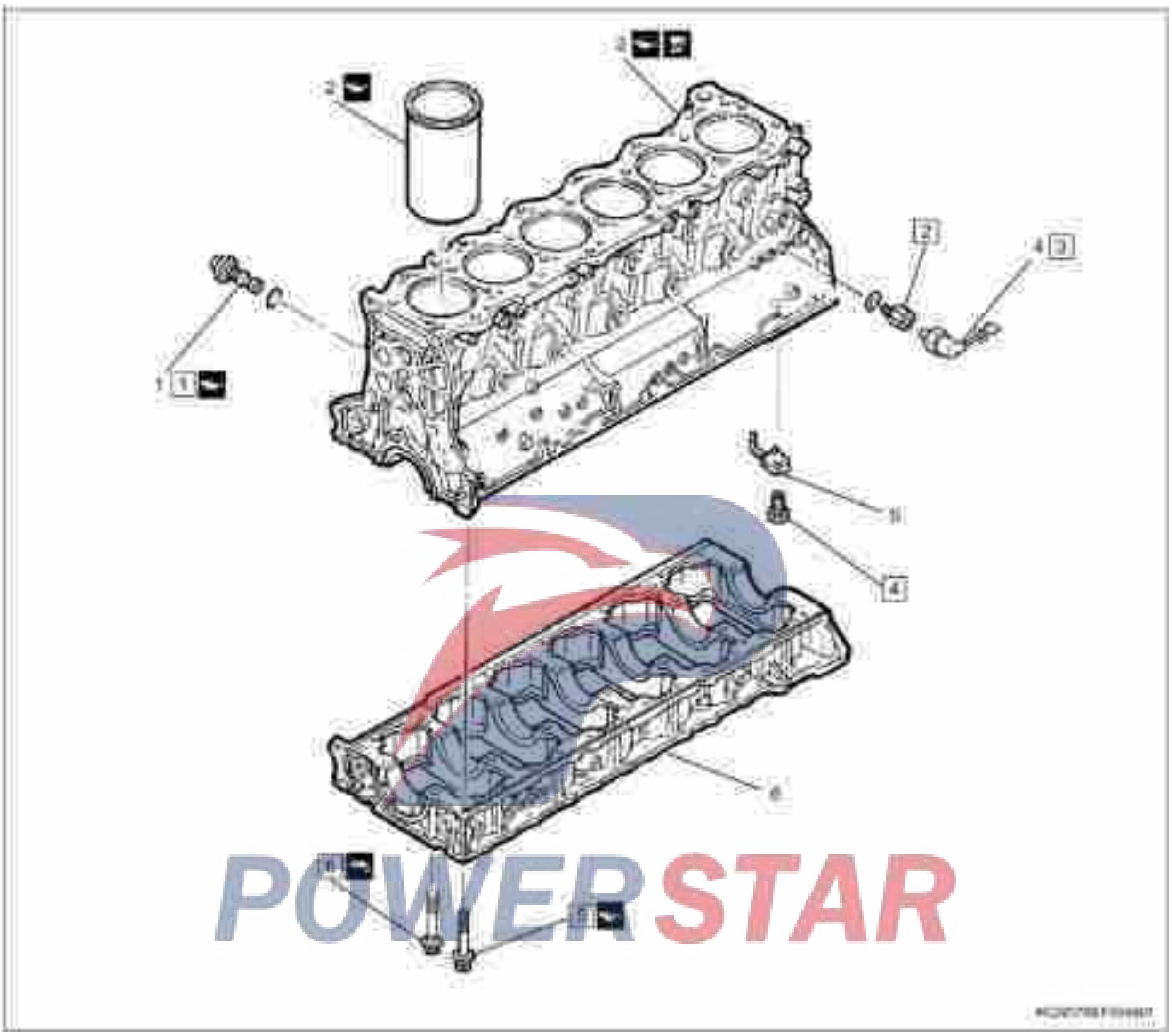
Installation

1. Component Views

Cylinder block



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Part name

1. Drain valve
2. Cylinder liner
3. Cylinder block
4. Hydraulic switch
5. Oil nozzle
6. Crankcase

Tightening torque

1: 20 N • m {2.0 kgf • m / 15 lb • ft}

2: 41 N • m {4.2 kgf • m / 30 lb • ft}

3: 18 N • m {1.8 kgf • m / 13 lb • ft}

4: 69 N • m {7.0 kgf • m / 51 lb • ft}

5: 96 N • m {9.8 kgf • m / 71 lb • ft} M12

6-1: 49 N • m {5.0 kgf • m / 36 lb • ft} M18

6-2: 88 N • m {9.0 kgf • m / 65 lb • ft} M18

6-3: 90 °M1 8

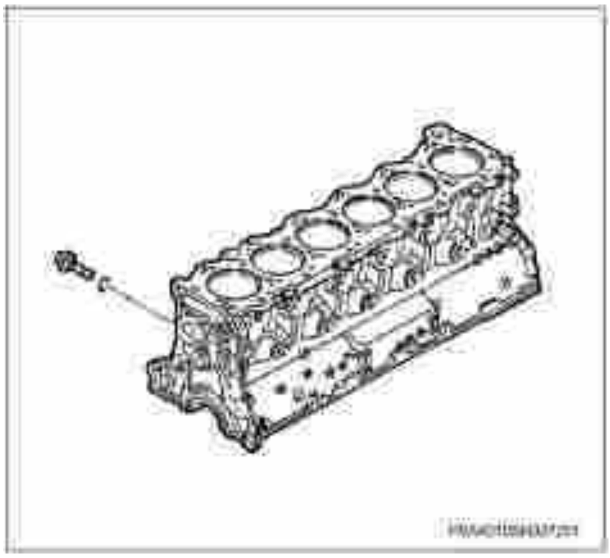
6-4: 294 N • m {30.0 kgf • m / 217 lb • ft} M18

2. Oil drain valve installed

1) Apply engine oil to the threaded part of the oil pressure relief valve.

2) Install the drain valve to the cylinder block.

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft }



3. Piston oil nozzle installed

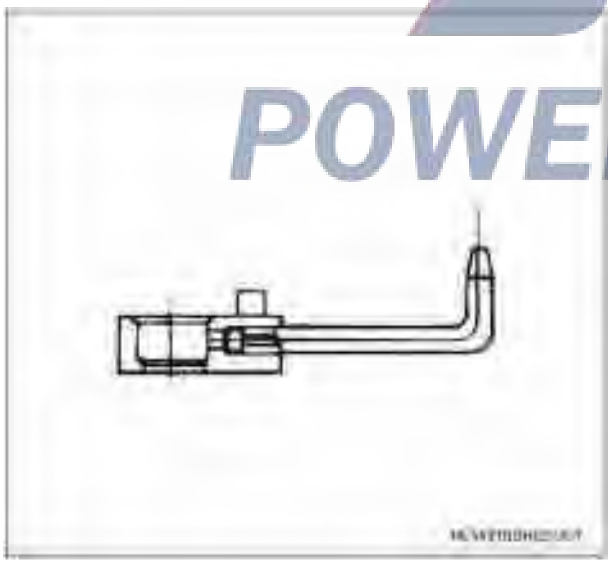
1) Install the piston nozzle onto the cylinder block.

Caution:

● Check if the tip of the oil nozzle is facing the piston cooling inlet.

● Be careful not to deform the tip of the piston nozzle.

Tightening torque: 69 N • m {7.0 kgf • m / 51 lb • ft}



4. Hydraulic switch installation

1) Mount the adapter to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

2) Install the oil pressure switch to the connector.

Tightening torque: 18 N • m {1.8 kgf • m / 13 lb • ft}

5. Crankshaft installation

1) Clean the bearing and bearing mounting surface.

Note:

● Carefully clean bearing and bearing mounting surfaces.

2) Install the crank bearing on the crankcase.

Caution:

● First confirm the bearing rating for the corresponding installation location, and then install.

● Confirm there is no oil hole in crankshaft bearing.

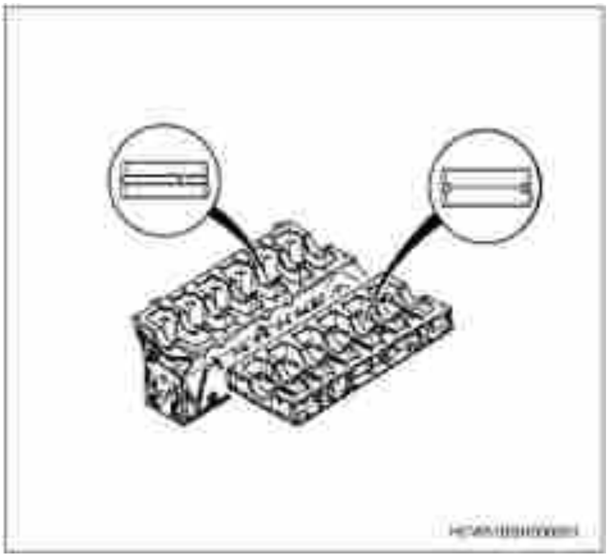
3) Install the crank bearing on the cylinder block.

Caution:

● First confirm the bearing rating for the corresponding installation location, and then install.

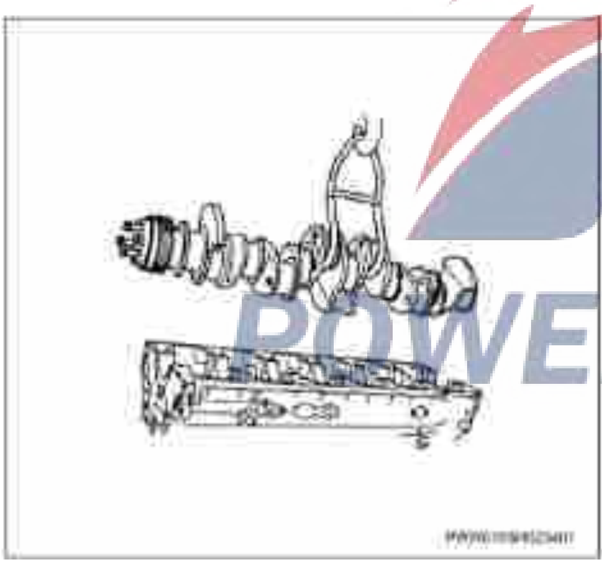
● Confirm there is oil hole in crankshaft bearing.

POWERSTAR



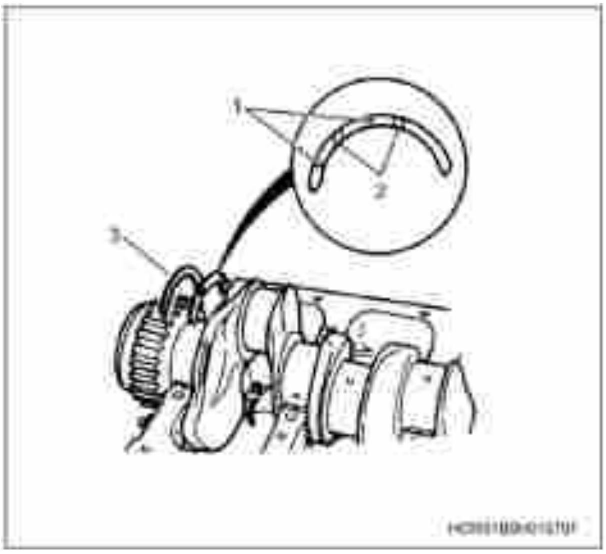
4) Apply the engine oil to the sliding surface of the crankshaft bearing.

5) Level the crankshaft and carefully align the crankshaft with the cylinder block.



6) Apply the engine oil to the thrust bearing.

7) Install the thrust bearing on both sides of the No. 1 journal area of the cylinder block so that it faces the outside of the tank.

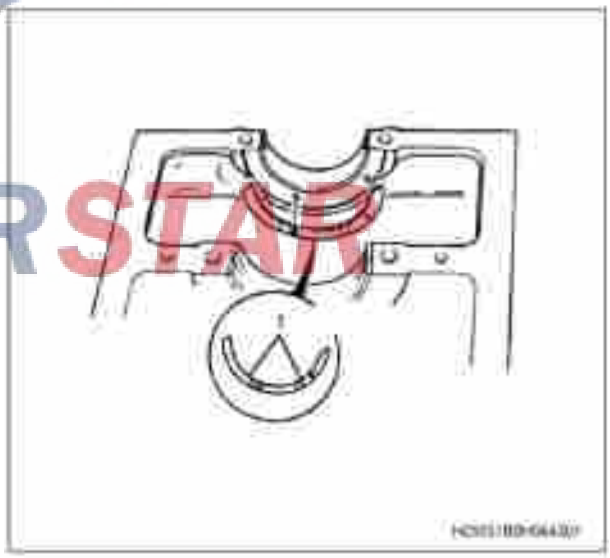


1. Align the dowel hole

2. Oil tank

3. Apply the oil

8) Align the thrust bearing with the raised area of the crankcase, and then insert the thrust bearing facing the outside of the sump.



1. Oil tank

9) Refer to the corresponding chart and apply the liquid gasket to the cylinder block.

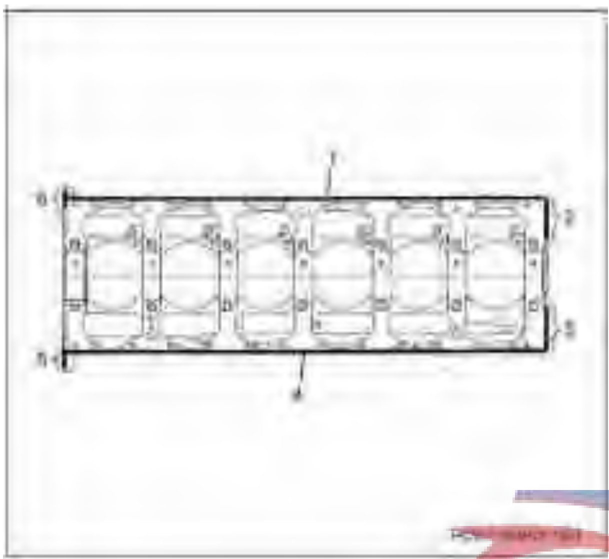
Caution:

● After the liquid gasket assembly is completed, the crankcase should be installed in time.

Cylinder bottom dedicated Liquid gasket application procedure

POWERSTAR

Liquid gasket used	FMD127
Coating width	: about4 mm { about 0.16 in }
Coating thickness	:0.3 mm or more {0.012 in or more}



1. The location of the liquid gasket
2. liquid seal position
3. The location of the liquid seal
4. Liquid gasket use location
5. liquid seal position
6. liquid seal position

10) Apply molybdenum disulphide grease to the surface of the base and to the threaded portion of the M18 bolt.

11) Apply engine oil to bearing surfaces and M12 bolt threaded surfaces.

12) Install the crankcase to the cylinder block in numerical order in the figure.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft} 1st (M18)

Tightening torque: 88 N • m {9.0 kgf • m / 65 lb • ft} 2nd (M18)

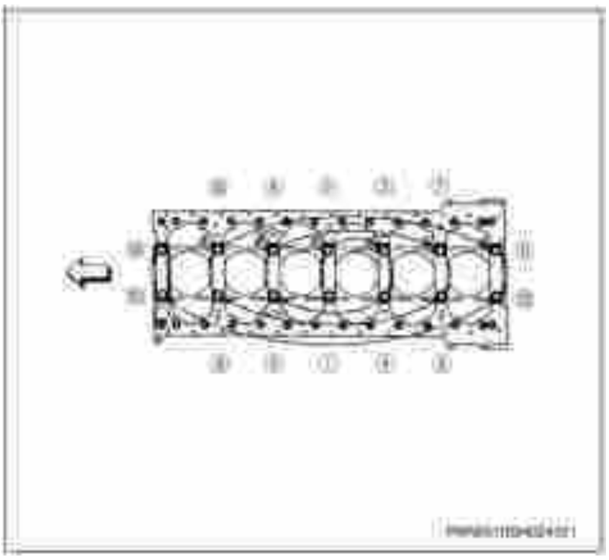
Specified angle: 90 °Third time (M18)

Note:

Angular tolerances when tightening with angle control should be 90 - 120 °

Tightening torque: 96 N • m {9.8 kgf • m / 71 lb • ft} 4th (M18)

Tightening torque: 294 N • m {30.0 kgf • m / 217 lb • ft} Confirm fastening again (M18)



6. Piston installation

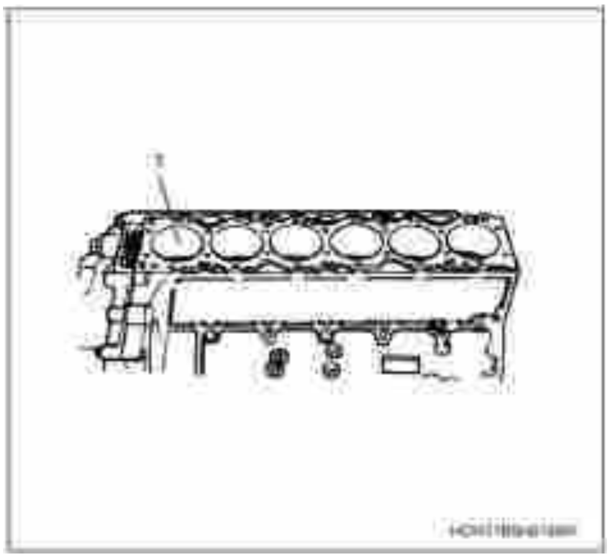
1) Clean the rod connecting rod bearing mounting surface and cover.

2) Inspect the entire outer edge of the bearing for oil grooves and attach the rod bearing to the end cap.

3) Check the bearing for the presence of local grooves and oil holes, and then install the connecting rod bearing on the connecting rod.

4) Coat the sliding surface of the rod bearing with engine oil.

5) Apply engine oil to cylinder liner.

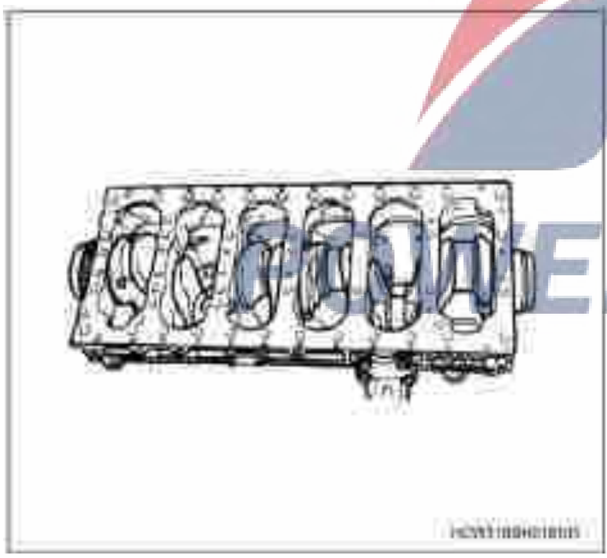


1. Cylinder liner

6) Align the cylinder piston pin of the fitted piston with the top dead center.

Caution:

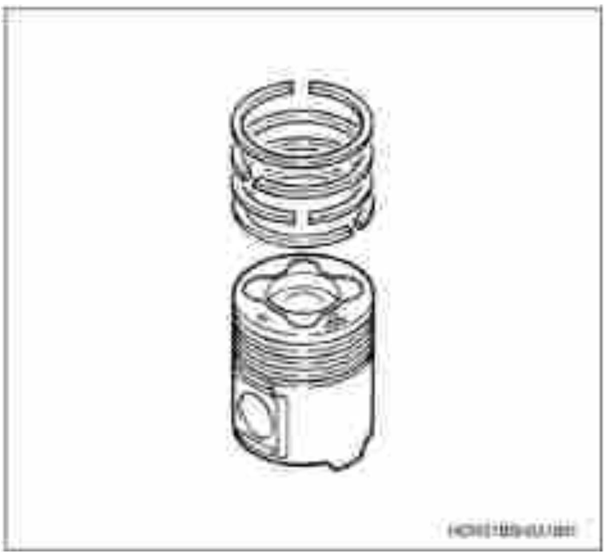
● Attach stop to avoid bushing protrusion.



7) Avoid positioning the piston ring end clearance in the direction of the side pressure. Rotate the piston ring to create a 90 °clearance on the cover.

Caution:

● Install the oil ring end cap on the opposite side of the expansion ring end cap.



8) Apply engine oil to the entire circumference of the piston and piston ring.

9) Use special tools to attach the piston to the cylinder block.

Caution:

● Carefully install the piston.

● Special tools are fastened to the cylinder block for ease of use.

● Do not damage the crankpin and nozzle when inserting the piston.

SST: 1-8522-0059-0 -. Piston installer

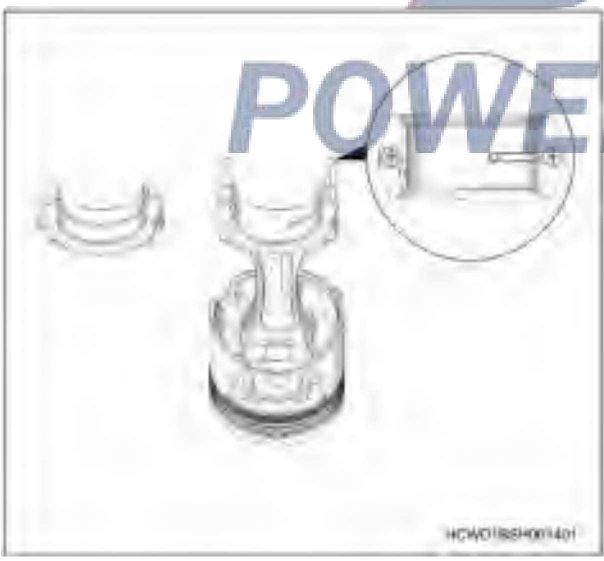
POWERSTAR

10) Align the connecting rod and cylinder head according to the number of cylinders, and then attach the connecting rod to the crankshaft.

Caution:

● Install in such a way that the mark faces the right side of the cylinder block.

11) Apply molybdenum disulphide grease to the screw thread on the base surface and the rod end cap mounting nut.



12) Install the rod bearing cap on the connecting rod.

Tightening torque: 98 N • m {10 kgf • m / 72 lb • ft} The first time

Prescribed angle: 30 °second

Prescribed angle: 30 °the third time

Tightening torque: 137 N • m {14 kgf • m / 101 lb • ft}

Confirm again

Caution:

● Angle tolerance should be 60 - 90 °

13) Install the crankshaft.

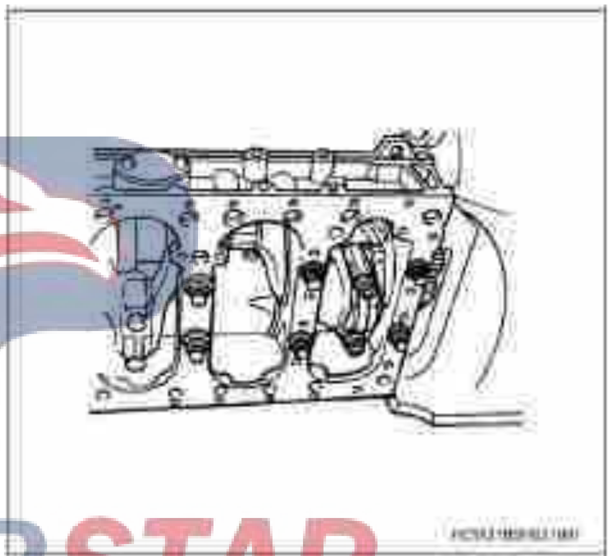
Note:

● Confirm that the crankshaft is running smoothly.

Caution:

● Attach stop to avoid bushing protrusion.

14) Confirm that the piston nozzle is not deformed.



7. Engine support foot installation

1) Mount the engine support foot to the cylinder block.

Tightening torque: 157 N • m {16.0 kgf • m / 116 lb • ft}

8. Flywheel housing installation

1) Apply liquid gaskets to the positioning surfaces of the flywheel housing, cylinder block and crankcase.

Caution:

● Do not insert the liquid gasket into the bolt hole.

● After the liquid gasket assembly is completed, the flywheel housing should be installed in time.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: about 0.3 mm { about 0.012 in }
	Coating width	: 4.0 mm {0.157 in}

2) Attach the flywheel housing to the cylinder block.

Caution:

● First tighten the bolt near the dowel pin.

Tightening torque: 108 N • m { 11.0 kgf • m / 80 lb • ft }

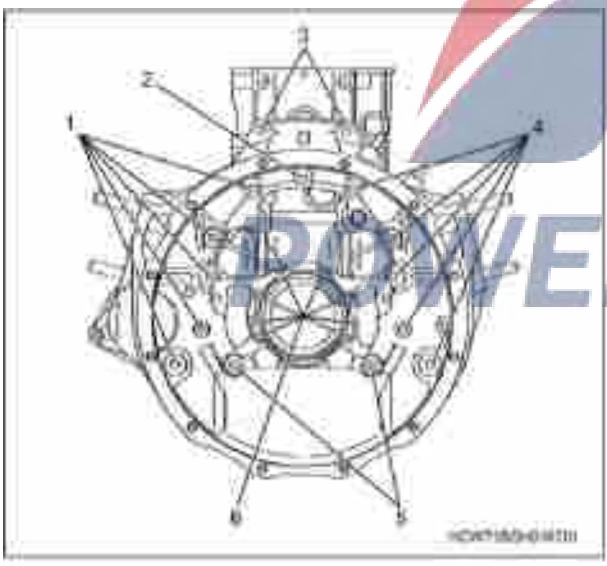
M14 nut

Tightening torque: 123 N • m { 12.5 kgf • m / 91 lb • ft }

M14 bolt

Tightening torque: 22 N • m { 2.2 kgf • m / 16 lb • ft }

M8 bolt



1. M14 bolt
2. M14 nut
3. M14 bolt
4. M14 bolt
5. M14 bolt
6. M8 bolt

3) Apply molybdenum disulphide grease to the threaded surface of the bearing surface and the engine mount mounting bolt.

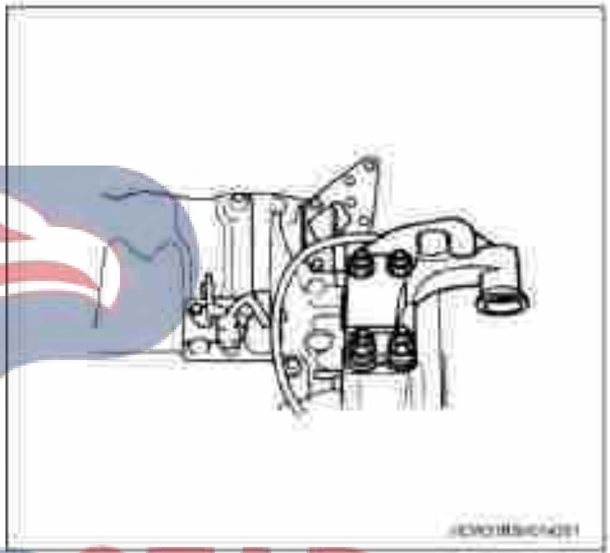
4) Install the engine bearing support foot to the flywheel housing.

Caution:

● Tighten from the pinned position.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} The first time

Tightening torque: 275 N • m {28.0 kgf • m / 203 lb • ft} 2nd time



5) Connect the flywheel housing bracket to the flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}

9. Crankshaft rear oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft rear oil seal.

2) Install the crankshaft rear oil seal to the flywheel housing using special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

● Do not damage the oil seal.

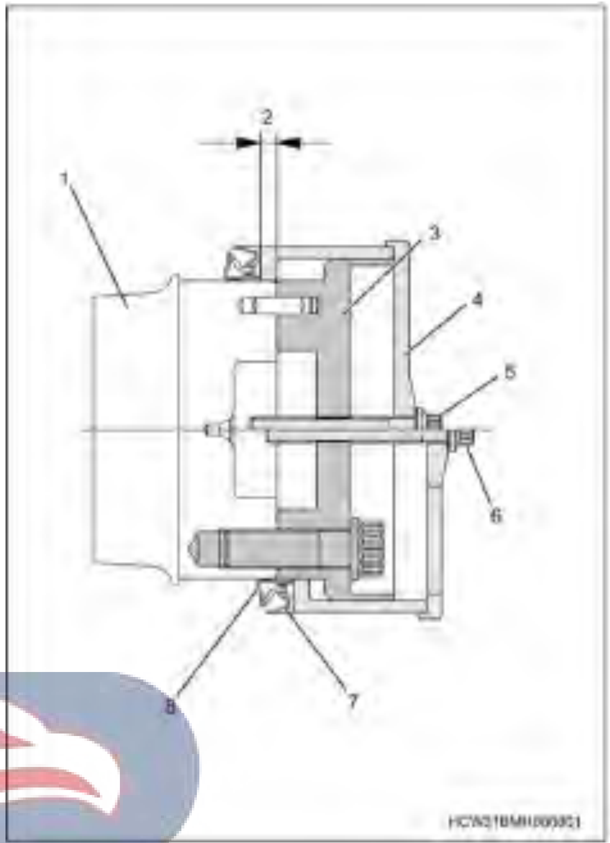
● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.

Caution:

● Wipe off the leaked oil after pressing the oil seal.

SST: 8-9819-4608-0 - Oil Seal Installer

3) Measure the size of the crankshaft end face to the oil seal surface.



1. Crankshaft

2. 6.7 - 7.3 mm {0.264 - 0.287 in}

3. 1-8521-0027-0 (Adapter)

4. 1-8521-0027-0 (Sleeve)

5. Finish pressing the position of the special tool after assembly

6. Perform the position of the special tool before pressing the assembly

7. Oil seal

8. Slinger (gray)

10. Flywheel installation

1) Apply molybdenum disulfide to the threads and seat surface of the tightening bolt.

2) Install the flywheel to the crankshaft in the order shown in the diagram.

Tightening torque: 78.5 N • m {8.0 kgf • m / 58 lb • ft} 1st time

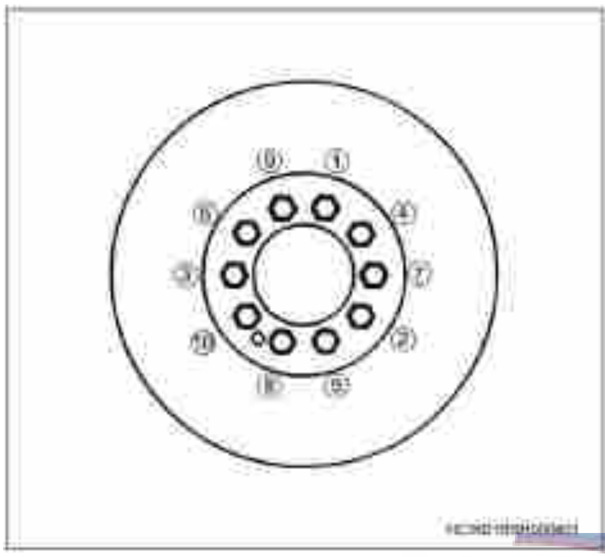
Prescribed angle: 60 °second

Prescribed angle: 30 °the third time

POWERSTAR

Caution:

● The angular tolerance for tightening through angle control should be 90-120 ?



11. Clutch driven disc installation

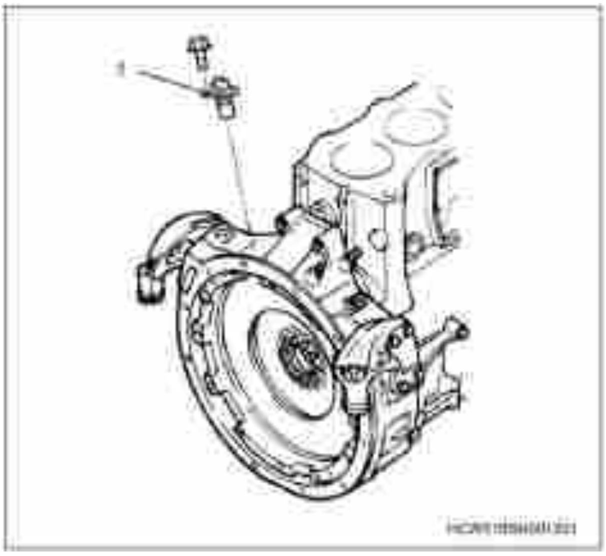
Refer to "*5. TRANSMISSION, TRANSAXLE 5E. MJT CLUTCH (SINGLE PLATE DRIVE) MOUNTING*".

Refer to "*5. Transmission, Transaxle 5E. Clutch System (MJX16) Clutch (Double Plate Pull) Installation*".

12. CMP sensor installation

1) Install the crankshaft position sensor to the flywheel housing.

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}



1. CMP sensor

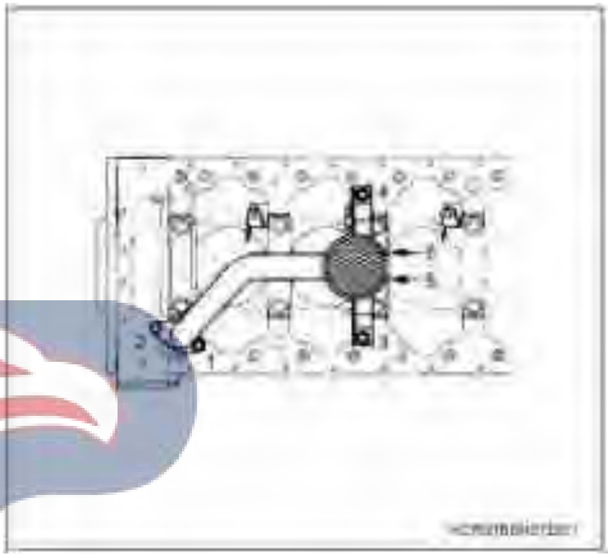
2) Connect the connector to the CMP sensor.

13. Oil strainer installed

1) Temporarily fasten the bracket to the cylinder block.

2) Install the oil strainer and O-ring onto the cylinder block in numerical order in the figure.

Tightening torque: 49 N • m { 5.0 kgf • m / 36 lb • ft }



14. Starter motor installation

1) Install the starter to the flywheel housing.

Tightening torque: 103 N • m { 10.5 kgf • m / 76 lb • ft }

2) Connect the S-terminal to the starter.

3) Connect the B-terminal to the starter.

4) Connect the grounding cable to the starter.

POWERSTAR

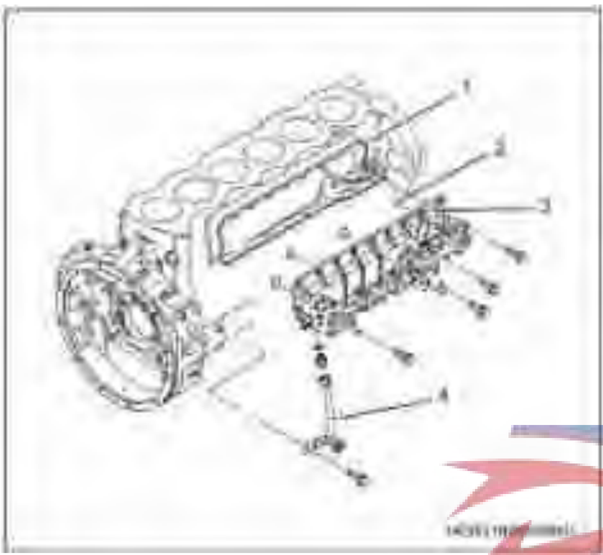
15. Oil cooler installation

1) install the gasket to the oil cooler.

2) install the O-ring to the oil cooler.

3) install the oil cooler to the cylinder block.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Gasket
2. O-ring
3. Oil cooler
4. Drainage line

4) Install the fitting on the oil cooler.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

5) Install the drain pipe to the connector.

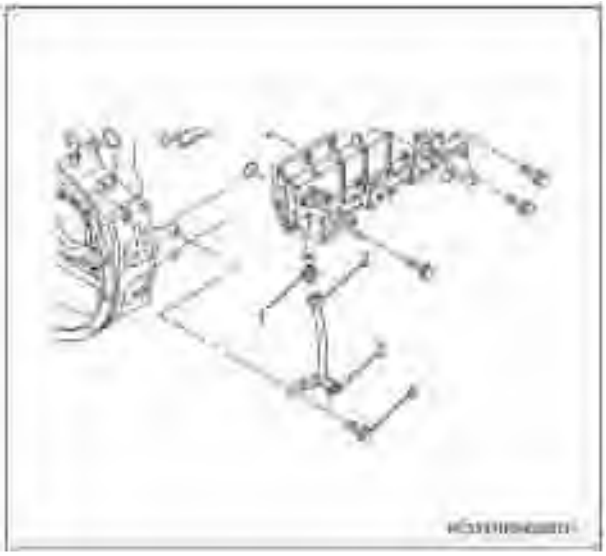
Tightening torque: 69 N • m {7.0 kgf • m / 51 lb • ft}

6) Install the bolt to the cylinder.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft}

7) Install the drain plug on the pipe.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}



1. Connector
2. Drainage line
3. Drain plug
4. Bolt

16. Partial oil filter installation

1) Install the O-ring to the partial oil filter.

2) Install the partial oil filter to the oil cooler as a set with the bracket.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3) Install the clip to the oil pipe.

17. Oil filter installation

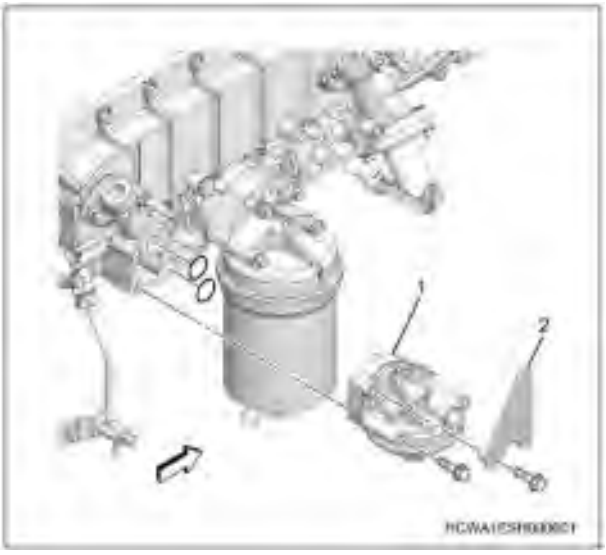
1) Install the O-ring to the oil filter case.

2) Install the oil filter to the oil cooler.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3) Install the pipe clamp bracket on the oil filter.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. oil filter case.

2. Hose clamp bracket

18. oil filter warning switch installation

1) Install the oil filter warning switch and valve to the oil filter body.

Tightening torque: 78 N • m {8 kgf • m / 58 lb • ft}

2) Connect the harness connector to the oil filter warning switch.

19. Water pump installation

1) Install the O-ring and pump to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

1. Water pump

2. O-ring

3. O-ring

20. Intake pipe installation

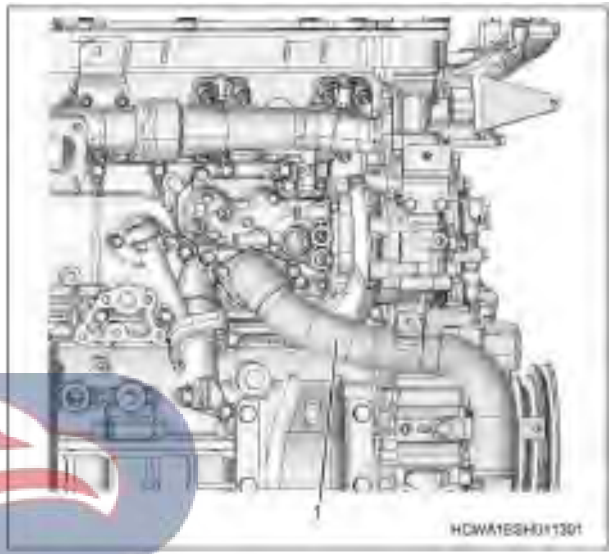
1) Install the water inlet pipe to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

Oil cooler side

Tightening torque: 88 N • m {9.0 kgf • m / 65 lb • ft}

Gearbox side



1. Water inlet

21. Thermostat installation

1) Install the thermostat seal ring on the oil cooler using a special tool.

SST: 1-8522-1034-0 - thermostat seal ring Installer

2) Mount the thermostat to the oil cooler.

Caution:

● Care should be taken when installing the seal ring to avoid damaging the seal ring.

POWERSTAR

22. Thermostat housing installation

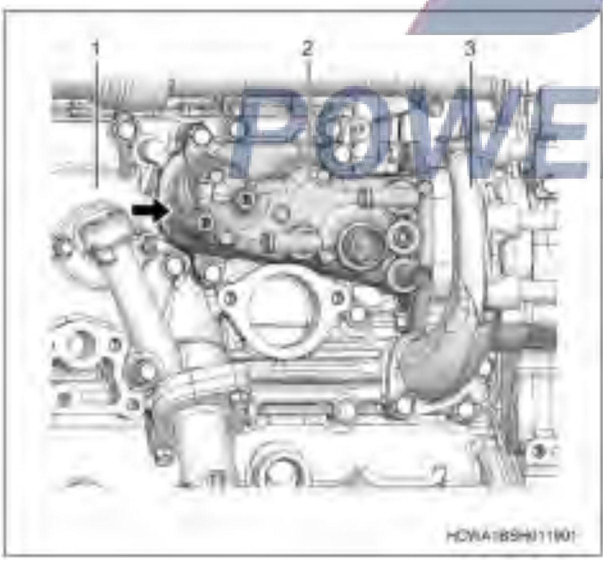
1) Install the o-rings and washers, and then install the thermostat housing on the oil cooler.

Note:

● While tightening the thermostat housing against the oil cooler, tighten the pump end bolts.

● Tighten the oil cooling bolt.

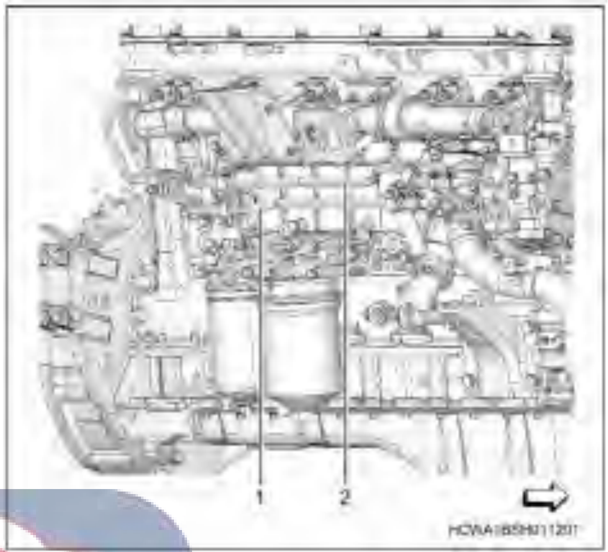
Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}



1. Oil cooler
2. Thermostat housing
3. Water pump

23. Exhaust gas recirculation cooler water pipe installation

1) Install the front and rear exhaust gas recirculation cooler pipes on the thermostat housing.

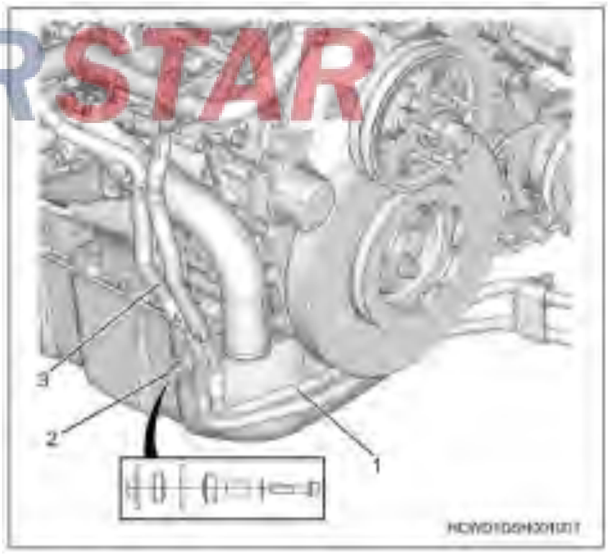


1. Back-end exhaust gas recirculation cooler hose
2. Exhaust gas recirculation cooler hose

24. Heater hose installation

1) Mount the heater hose to the thermostat housing.

2) Install the clip on the heater hose.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

POWERSTAR

25. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

26. Timing gearbox installed

1) Refer to the corresponding chart and apply the liquid gasket to the timing gearbox.

Caution:

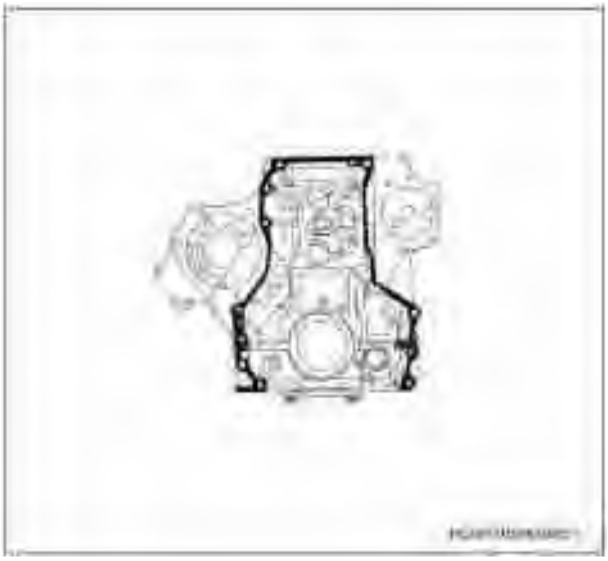
● In addition, the liquid seal can also be applied to the cylinder block and crankcase reference plane.

● Be careful not to allow the liquid gasket to enter the bolt hole.

● After the liquid gasket is assembled, the timing gearbox should be installed in time.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: about0.3 mm { about 0.012 in}
	Coating width	: about4 mm { about 0.16 in }



2) Install the timing gearbox to the cylinder block.

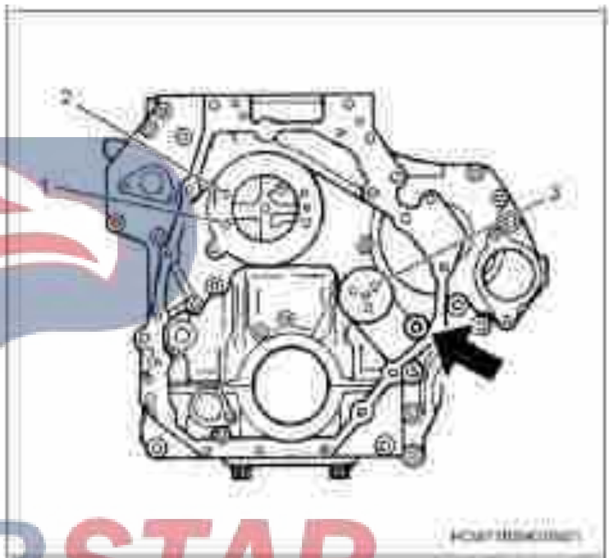
Caution:

● If you use the bolts indicated by the arrows in the figure again, apply the Loctite 271 glue to the threads.

● After the gear unit is installed, temporarily tighten the bolts M10 - 1.5 in the area shown in Figs. 1-3 with the specified torque and wait for 30 minutes or more before installing the idler gears A and B.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft} M14

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft} M10



1. M10-1.5 bolts (temporary tightening)

2. M10-1.5 bolts (temporary tightening)

3. M10-1.5 bolts (temporary tightening)

27. Oil pan installation

1) apply the liquid gasket to the cylinder block.

Note:

● Three key 1207B with a coating thickness of 3 - 4 mm {0.118 - 0.157 in} and a width of 3-4 mm {0.118 - 0.157 in} on the locating surface of the flywheel housing, gearbox and cylinder block.

Caution:

● Clean the application surface of the gasket before applying the gasket.

POWERSTAR

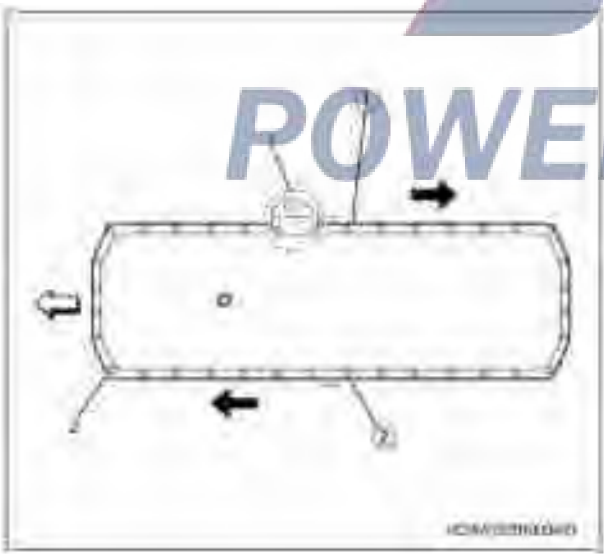
1. Liquid gasket

2) Install the oil pan to the cylinder block in the order of numbers and arrows shown in the diagram.

Caution:

● After tightening all the bolts, tighten all the bolts again with the specified torque from the first tightened bolt.

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}



1. M10×35
2. M10×20

3) Install the left and right flywheel housing brackets onto the cylinder block and flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}

1. Flywheel housing
2. Flywheel housing bracket
3. Cylinder block

28. Idle gear installation

1) Bring the B-axis surface of the idler gear with engine oil.

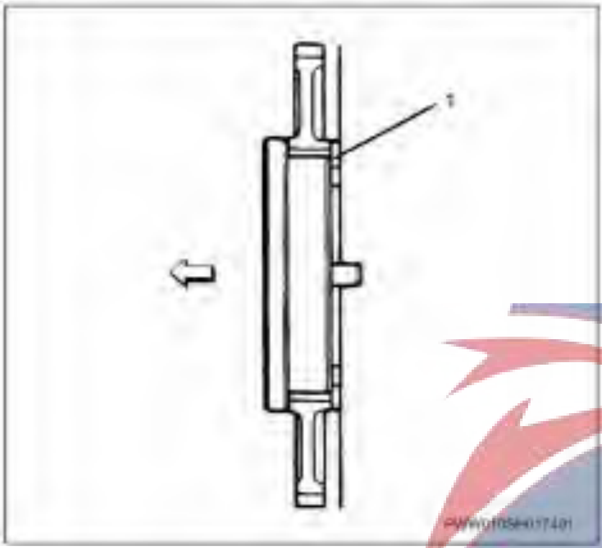
2) Apply idler gear B inner diameter and bearing surface with engine oil.

POWERSTAR

3) Install the idler gear B-axis onto the cylinder block.

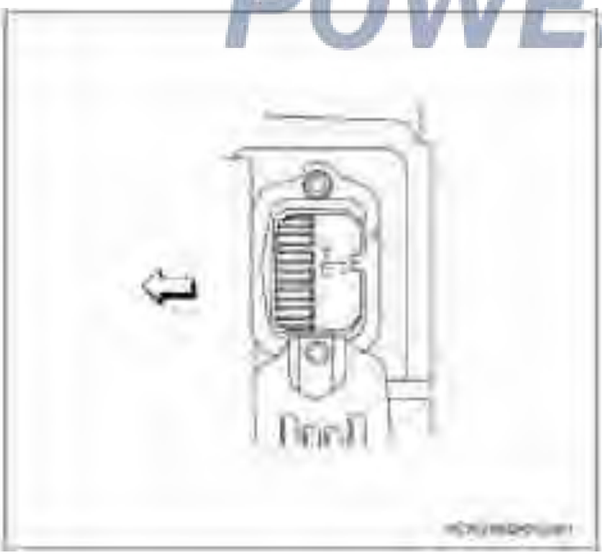
Caution:

- During disassembly, check the front / rear markings on the idler gear B and the thrust plate repeatedly.
- Remember to remove the installed temporary fastening bolts.



1. Thrust piece

4) Align the No.1 cylinder to compression top dead center.



5) Apply idler gear A inner diameter to engine oil.

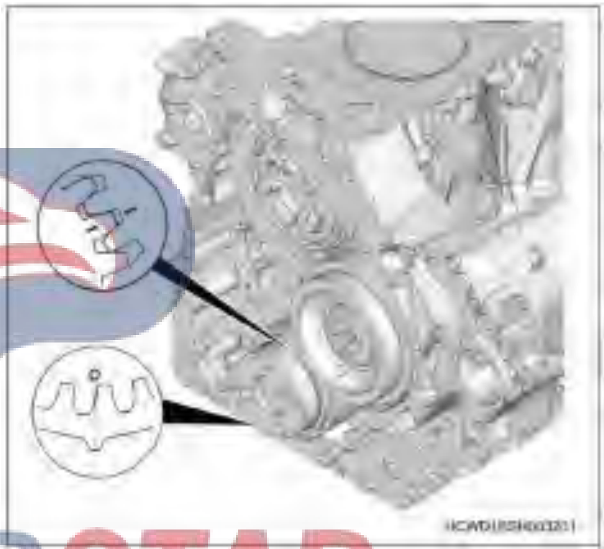
6) Install the sleeve on idler gear A.

7) Align thrust ring with idler gear A

8) Referring to the illustration, align the O mark between the crankshaft gear and the timing gear box with the I mark between the crankshaft gear and idler gear A, and install the idler gear A onto the cylinder block.

9) Referring to the illustration, align the O mark between the crankshaft gear and the timing gear box with the I mark between the crankshaft gear and idler gear A, and install the idler gear A onto the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}



POWERSTAR

10) Install the three distance bolts to the cylinder block.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

29. Oil pump installation

1) Install the O-ring onto the pump.

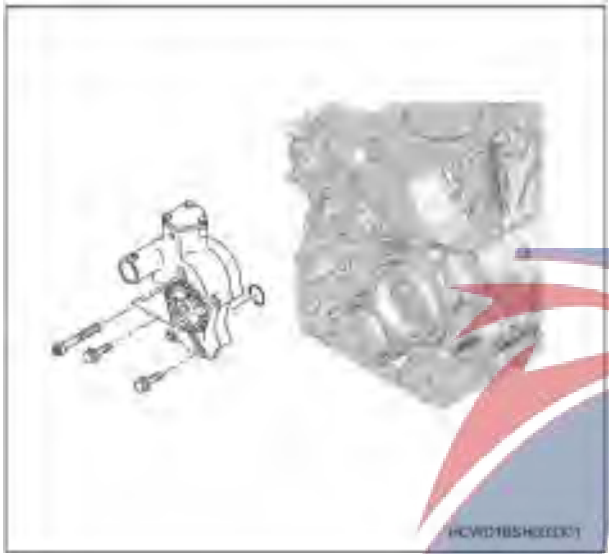
2) Install the pump to the cylinder block.

Caution:

● Do not tighten the screws marked with yellow on the top.

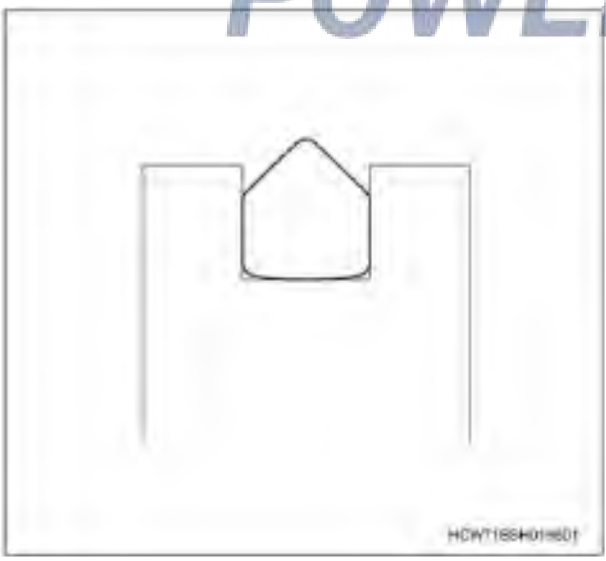
Tightening torque: 49 N • m {5 kgf • m / 36 lb • ft} hex bolts

Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft} Socket head cap screws



30. Gear box cover installed

1) Install the gasket on the gear box cover.



2) Use a liquid seal on the gearbox cover.

Note:

● Apply FMD127 to the back of the diagonally marked gearbox cover in the chart.

3) Install the gearbox cover onto the timing gearbox.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft} M10

Tightening torque: 26 N • m {2.7 kgf • m / 19 lb • ft} M8

31. Crankshaft front oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft front oil seal.

2) Install the crankshaft front oil seal to the front cover with the slinger as a set using the special tool.

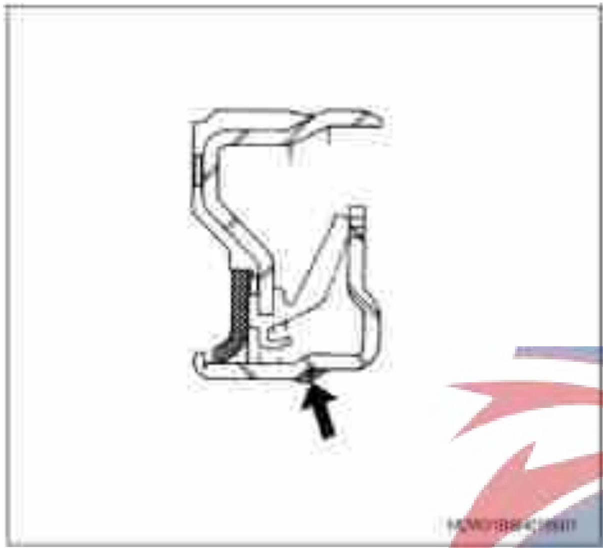
POWERSTAR

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

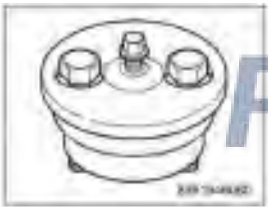
● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



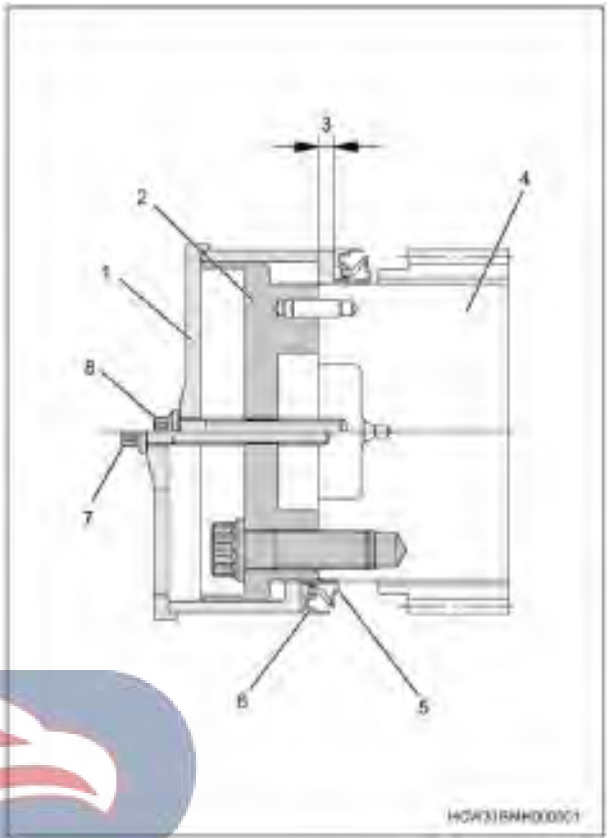
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) After the oil seal is installed by pressing assembly method, measure the size between the crankshaft end surface and the oil seal surface.



1. 8-9819-4608-0 (Sleeve)
2. 8-9819-4608-0 (Adapter)
3. 6.7 - 7.3 mm {0.264 - 0.287 in}
4. Crankshaft
5. Slinger (silver)
6. Oil seal
7. Oil seal
8. Finish pressing the position of the special tool after assembly

32. A / C compressor bracket mounting

1) Install the air conditioner compressor bracket to the timing gearbox.

Tightening torque: 135 N • m {13.8 kgf • m / 100 lb • ft}

POWERSTAR

1. Air conditioner compressor bracket

33. Idle gear installation

1) Install the idler gear to the gear cover.

Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft}

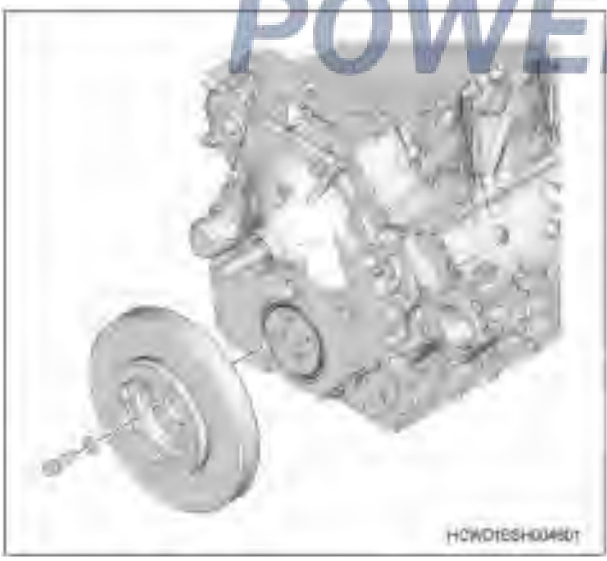
34. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}

POWERSTAR

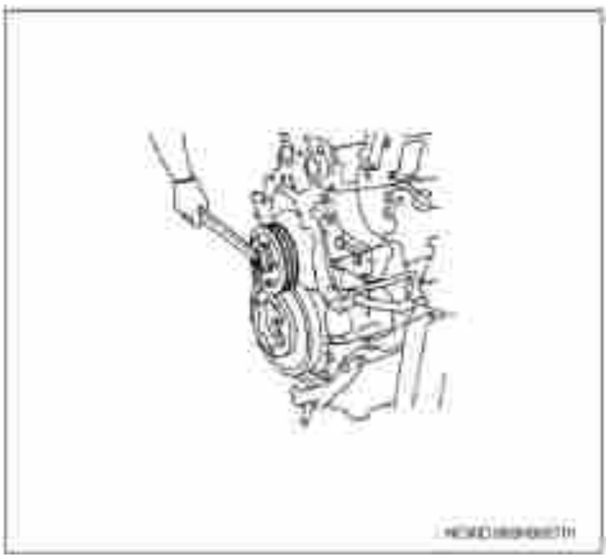


3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N • m { 55 kgf • m / 398 lb • ft }



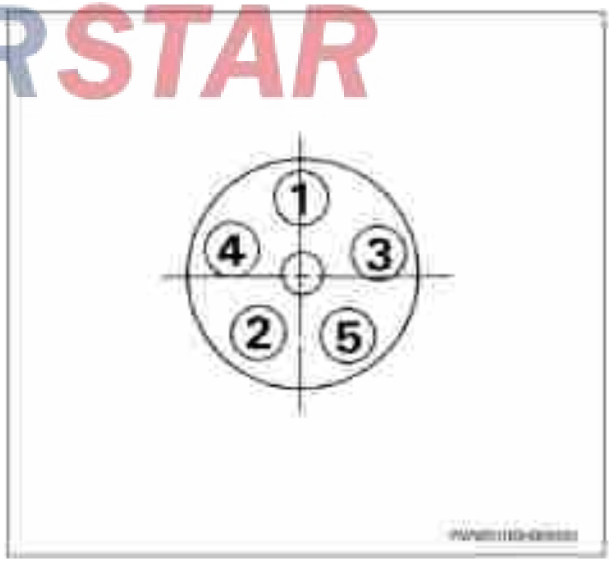
35. Air compressor installation

1) Apply molybdenum disulphide grease to the threaded surface of bearing surfaces and air compressor gear mounting bolts.

2) Install the gears on the air compressor according to the figures in numerical order.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

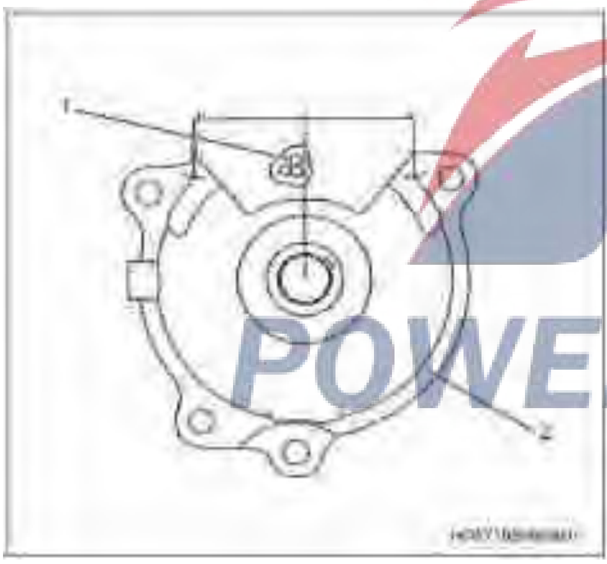
Prescribed angle: 90 to 120 °second



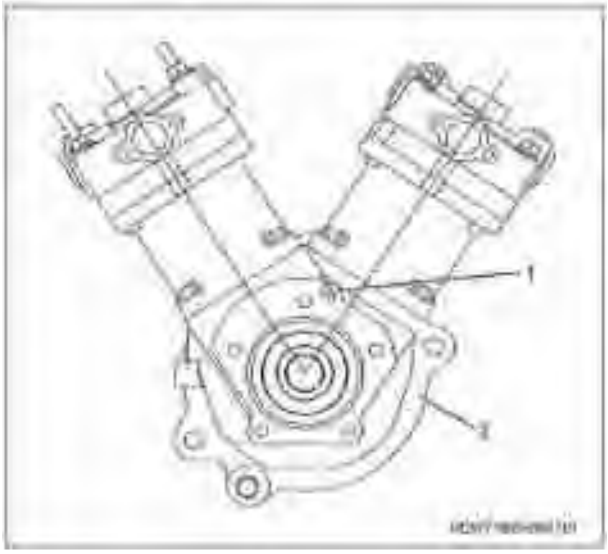
3) Install the O-ring onto the gearbox mounting flange area.

4) Referring to the illustration, align the pointer with the A mark.

1. Pointer
2. S mark
3. A mark

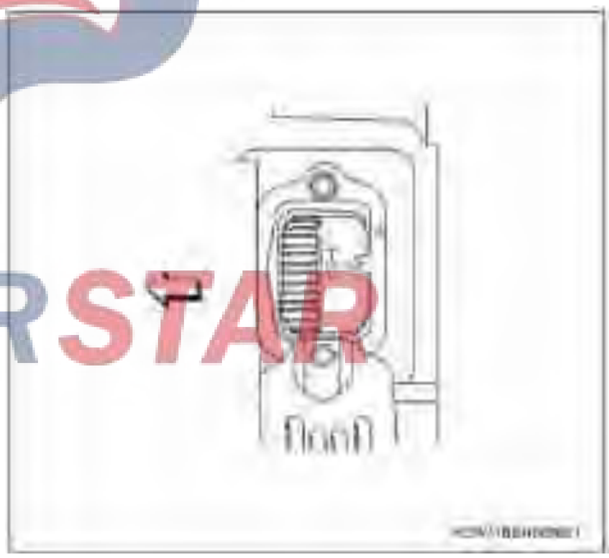


1. Pointer
2. Air compressor



1. Pointer
2. Air compressor

5) Align the No.1 cylinder to compression top dead center.



6) Install the air compressor on the timing gearbox.

Note:

● Insert the air compressor and make sure that the idle gear in the gear box is firmly installed.

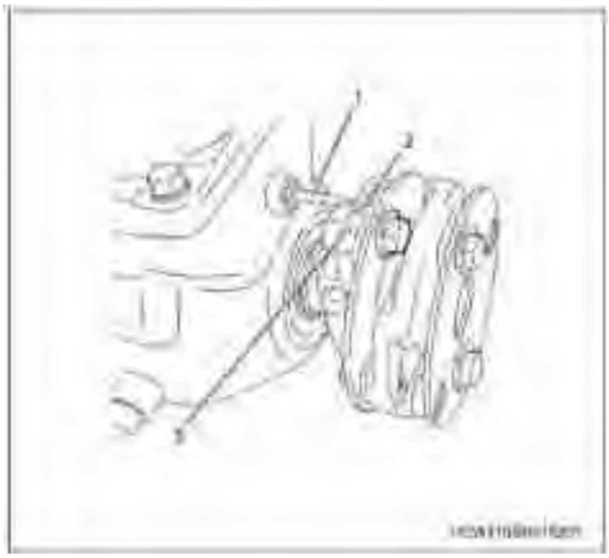
Caution:

● After the installation is completed, if the pointer and the S mark are not aligned, it must be re-installed.

Tightening torque: 137 N • m {14.0 kgf • m / 101 lb • ft} M14 bolt

POWERSTAR

Tightening torque: 133 N • m {13.6 kgf • m / 98 lb • ft} M14 nut



1. Pointer
2. S mark
3. A mark

7) Connect the air compressor governor pipe to the air compressor.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

8) Connect the inflation tube to the air compressor.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}

9) Connect the air compressor regulator to the fitting.

Note:

● Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 28 N • m {2.9 kgf • m / 95 lb • ft}

Flare nut

Tightening torque: 69 N • m {7.0 kgf • m / 108 lb • ft}

Nut

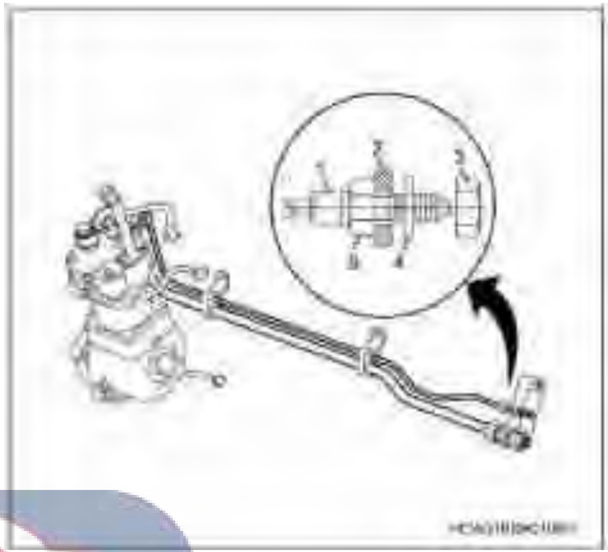
10) Connect the air charge pipe to the air compressor.

Note:

● Hold one end of the pipe fitting with an open-ended wrench and tighten the flare nut to avoid twisting the pipe.

Tightening torque: 129 N • m {13.2 kgf • m / 95 lb • ft} Flare nut

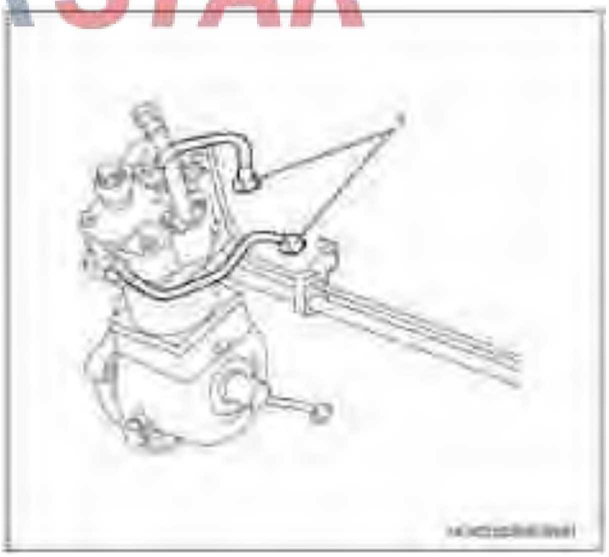
Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft} nut



1. Flare nut
2. Bracket
3. Nut
4. Spring washer
5. Union

11) Install two water pipes to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

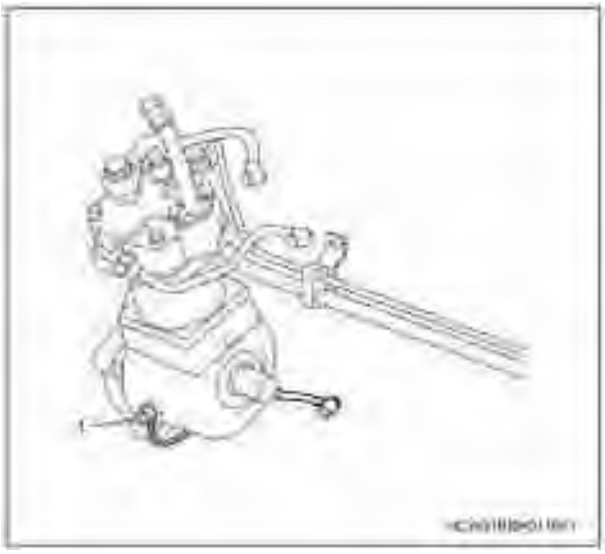


1. Water pipe

POWERSTAR

12) Install the oil pipe to the cylinder block.

Tightening torque: 27 N • m {2.8 kgf • m / 20 lb • ft}



1. Eyebolt

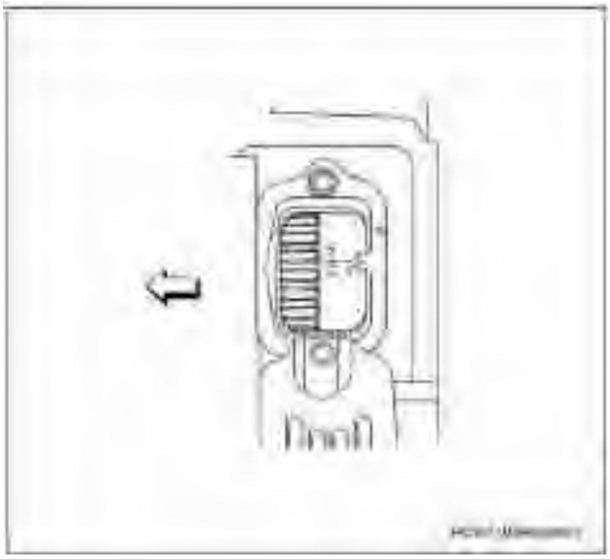
36. Fuel pump installed

1) Attach the feed pump bracket to the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}

1. Fuel pump bracket

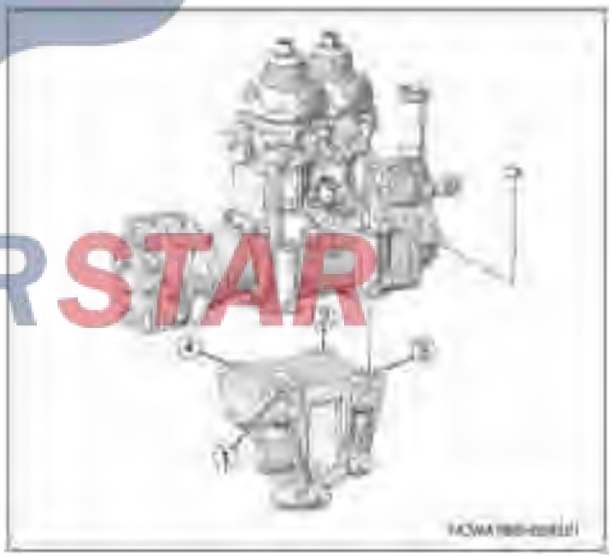
2) Align the No.1 cylinder to compression top dead center.



3) Align the pipe marked on the pipe with the marked pipe on the pump.

4) Install the fuel delivery pump in the order of numbers on the supply pump bracket.

Tightening torque: 57 N • m {5.8 kgf • m / 42 lb • ft}



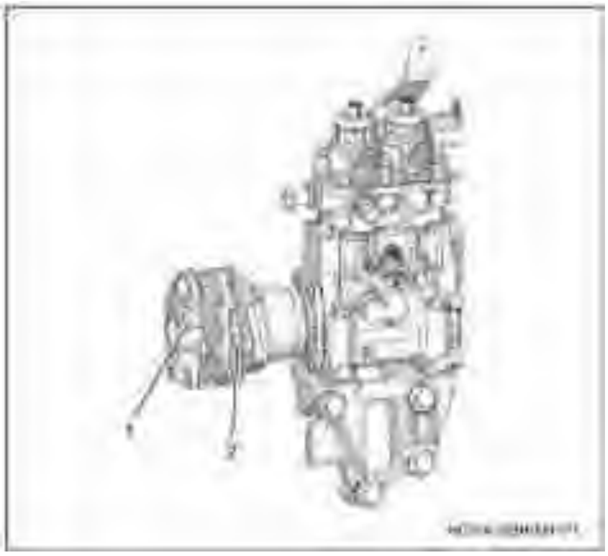
5) Slide the coupling to confirm firm contact with the feed pump and tighten the coupling bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

6) After checking and making sure that the coupling laminate is not bent, tighten the pin bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

POWERSTAR



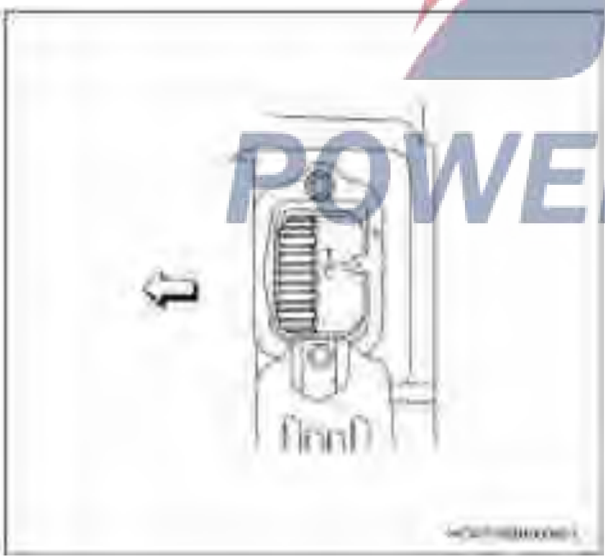
1. Cotter bolt

2. Coupling tightening bolt

7) Rotate the crankshaft forward to align cylinder # 1 to the top dead center of compression.

Note:

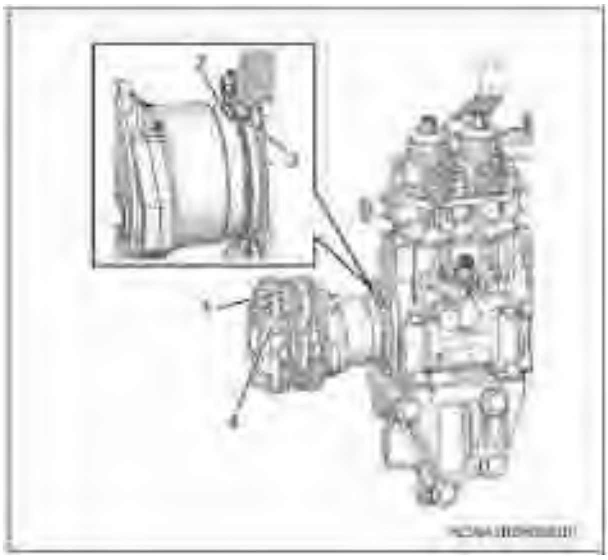
● Align with the center of the compression stop in a toothless state.



8) Verify that the marked pipe on the pipe fitting matches the marked pipe on the pump.

Caution:

● If the marking line is out of service, use the 2 oval bolts on the coupling to readjust.



1. Coupling bolts

2. Coupling end marking line

3. Pump end marking line

4. Cotter bolt

9) Install the return line to the cylinder block.

10) Install the oil return pipe to the fuel supply pump.

11) Install the tubing to the cylinder block.

12) Install the oil feed pipe to the fuel supply pump.

Tightening torque: 28 N • m {2.9 kgf • m / 21 lb • ft}

M10

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

M14

POWERSTAR

1. Oil return pipe

2. Oil feed pipe

13) Connect the harness connector to the PCV.

14) Connect the harness connector to the camshaft position sensor.

37. Cylinder head installation

1) Use a squeegee to clean the upper surface of the cylinder block and the lower surface of the cylinder head.

Caution:

● Carefully clean the cylinder block upper surface and the cylinder head lower surface, taking care not to damage the components.

2) Refer to the diagram and the table, and apply the liquid gasket to the cylinder block.

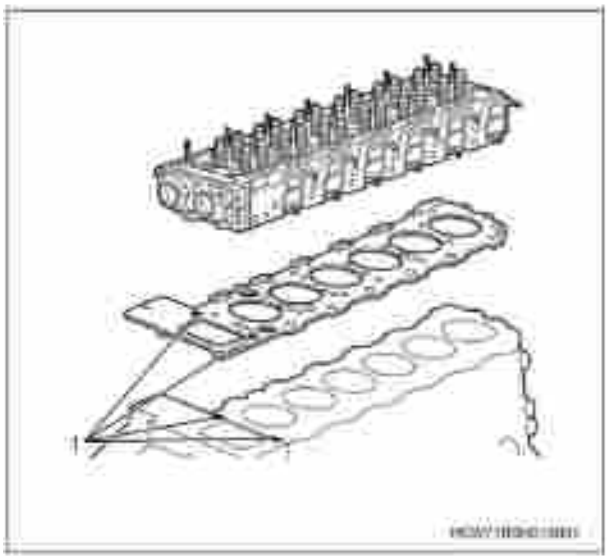
Caution:

● Strictly adhere to the liquid gasket application thickness and application width guidelines.

● After applying the liquid gasket, immediately install the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions	
FMD127	Coating thickness	: 2 mm {0.08 in }
	Coating width	: 5 mm { 0.20 in }



1. Liquid gasket application area

3) Install the cylinder head gasket to the cylinder block.

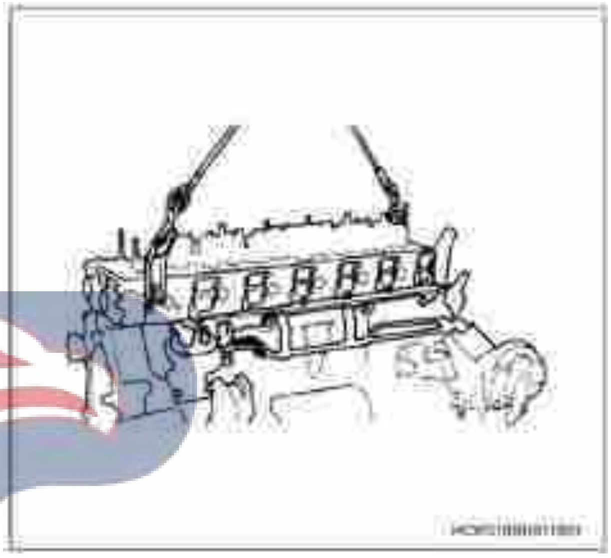
Caution:

● Do not reuse the cylinder head gasket.

4) Carefully align the knock pin positions, and place the cylinder head on the cylinder block.

Caution:

● Check the engagement of the idle gears.



5) Apply molybdenum disulfide grease to the base surface and the threaded portion of the M18 bolt.

Caution:

● Never use M12 bolts or M10 bolts.

6) Mount the cylinder head mounting bolts to the cylinder head in the order shown in the figure.

Caution:

● Do not drip foreign matters into the timing gear hole.

● Cylinder head mounting bolts can be used up to 4 times.

Tightening torque: 177 N • m {18.0 kgf • m / 131 lb • ft} 1st (M18)

Tightening torque: 245 N • m {25.0 kgf • m / 181 lb • ft} 2nd (M18)

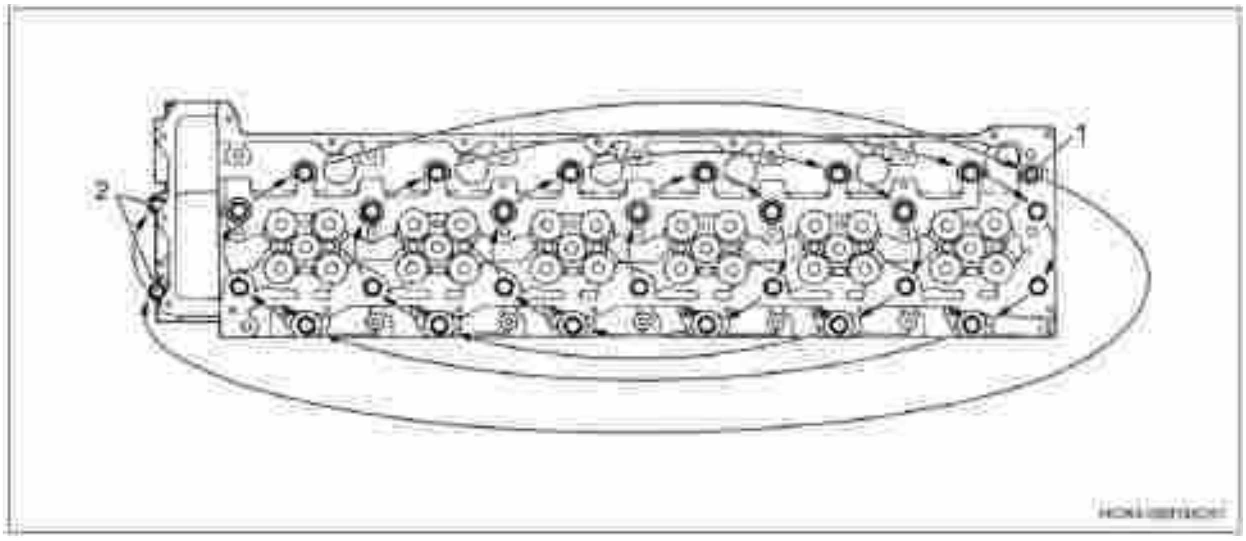
Tightening angle: 60 to 90 °Third time (M18)

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft} 4th (M12)

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft} 5th (M10)

POWERSTAR

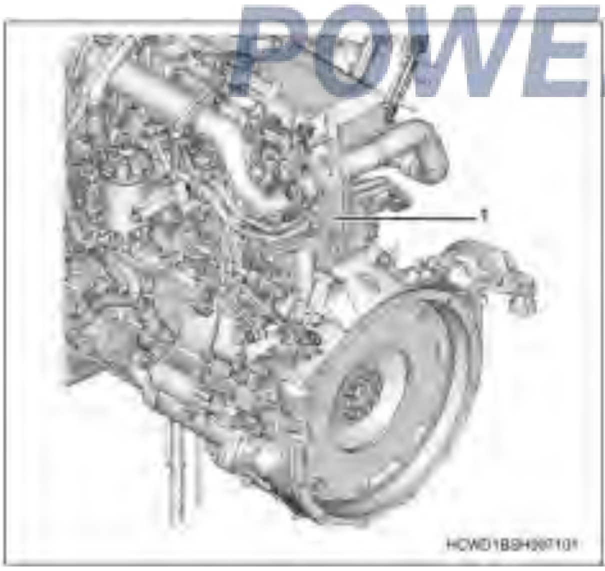
Tightening torque: 324 N • m {33.0 kgf • m / 239 lb • ft} Confirm the tightening (M18)



1. M12 bolt
2. M10 bolt

7) Remove special tool from the cylinder head.

SST: 8-9761-4276-0 - engine hanger



1. 8-9761-4276-0

38. Glow plug installation

1) Install the glow plug to the cylinder head.

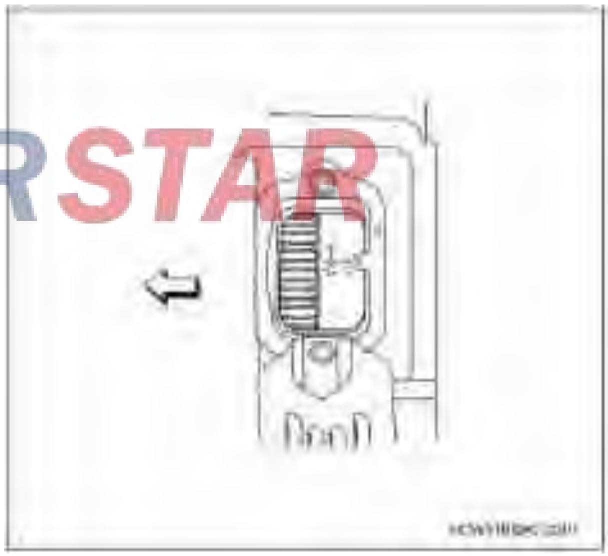
Tightening torque: 25 N • m { 2.5 kgf • m / 8.16 kg • ft }

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m { 0.15 kgf • m / 5.90 kg • in }

39. Camshaft Installation

1) Align the No.1 cylinder to compression top dead center.



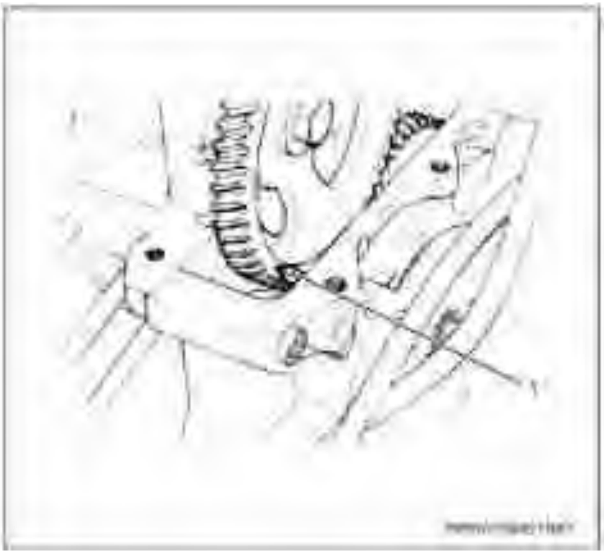
2) Apply engine oil to camshaft cam surface and cam gear tooth surface.

3) Apply the engine oil to the camshaft carrier.

4) Install the lower camshaft bracket to the cylinder head.

5) Align the mark on the camshaft gear with the arrow and place the camshaft on the shaft bracket.

POWERSTAR



1. Pointer

6) Temporarily fasten the camshaft upper bracket to the cylinder head cover.

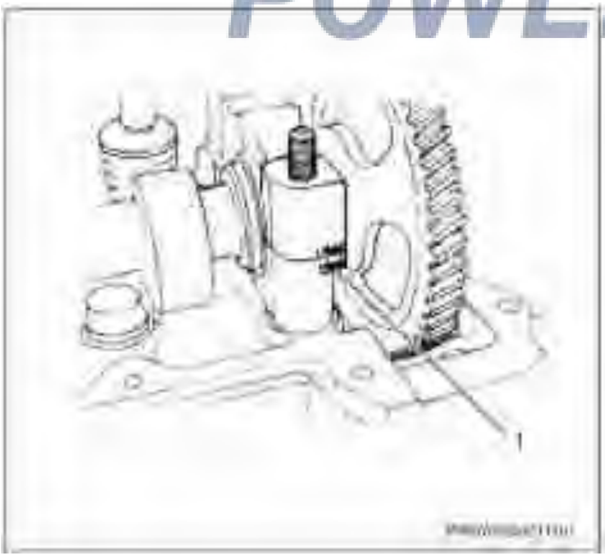
Note:

● Install the camshaft bracket with the mark number on the side of the camshaft bracket.

Caution:

● Fit the No. 1 camshaft bracket to No. 1 piston while ensuring secure mounting.

● Make sure the marking lines on the rear end of the camshafts are aligned horizontally and vertically.



1. Mark number

7) Final camshaft upper bracket is finally fastened to the cylinder head.

Caution:

● Perform final tightening one by one from the camshaft gear side.

Tightening torque: 76 N • m { 7.7 kgf • m / 56 lb • ft }

40. Bridge installation

1) Apply the engine oil to the bridge guide.

2) Loosen the adjust screw.

3) Install the bridge to the bridge guide.

Caution:

● Install to the same position as when removed.

● Install the adjusting screw so that it faces the intake manifold side.

1. Bridge

41. Rocker arm shaft installation

1) Lubricate the roller arm and adjusting screw lip with engine oil

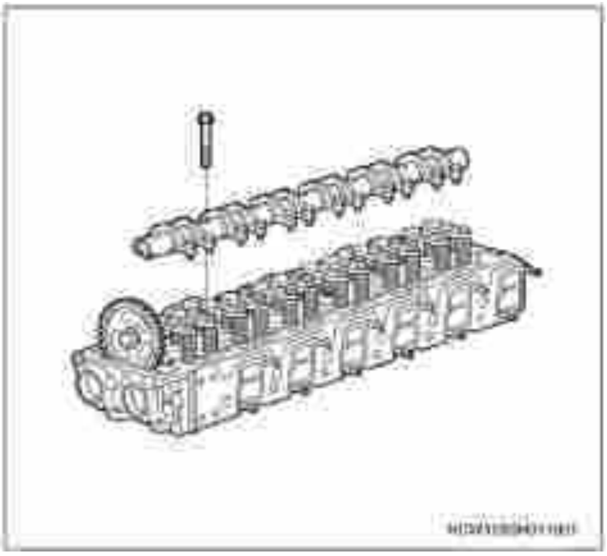
2) Loosen the adjust screw.

Note:

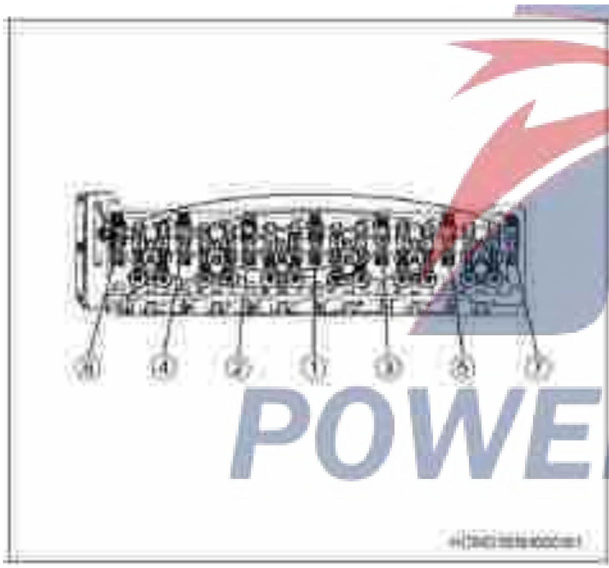
● Completely loosen the rocker arm side adjust screw.

3) Mount the rocker shaft to the cylinder head.

POWERSTAR



4) Temporarily fasten the rocker arm shaft to the cylinder head in the order shown.



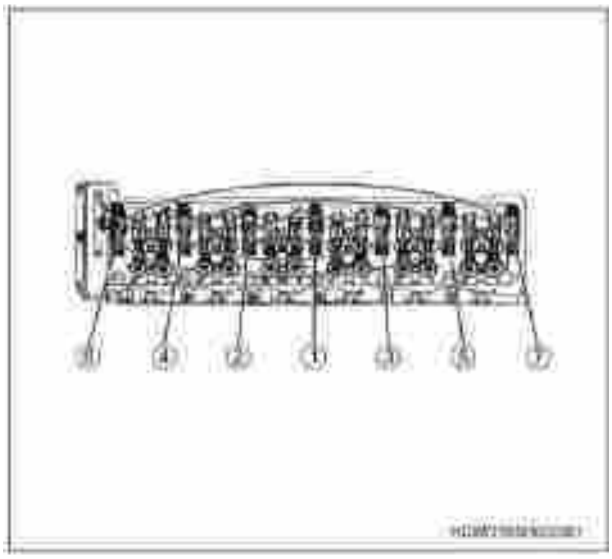
Caution:

● Assemble according to the cylinder numbers recorded during disassembly.

● Install the adjusting screw so that it faces the intake manifold side.

5) Fasten the rocker shaft to the cylinder head in the order shown.

Tightening torque: 90 N • m {9.2 kgf • m / 66 lb • ft}



42. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

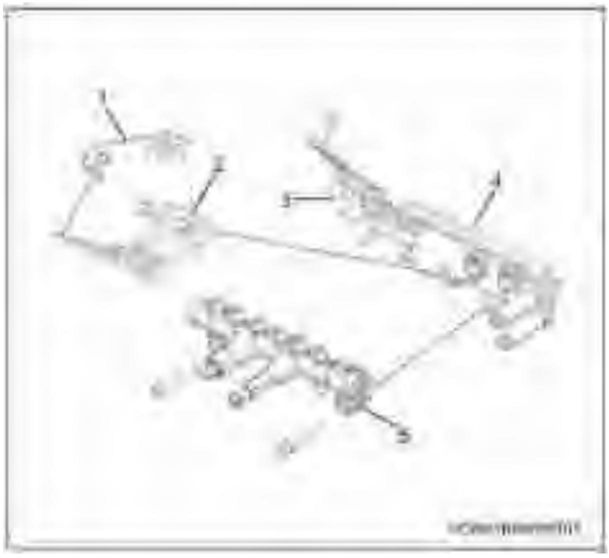
Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.

POWERSTAR



1. Injection pipe clamp bracket

2. Injection pipe clamp bracket

3. Fuel pipeline bracket

4. Common rail (fuel rail) bracket

5. Common rail (fuel rail)

4) Connect the harness connector to the fuel rail position sensor.

43. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

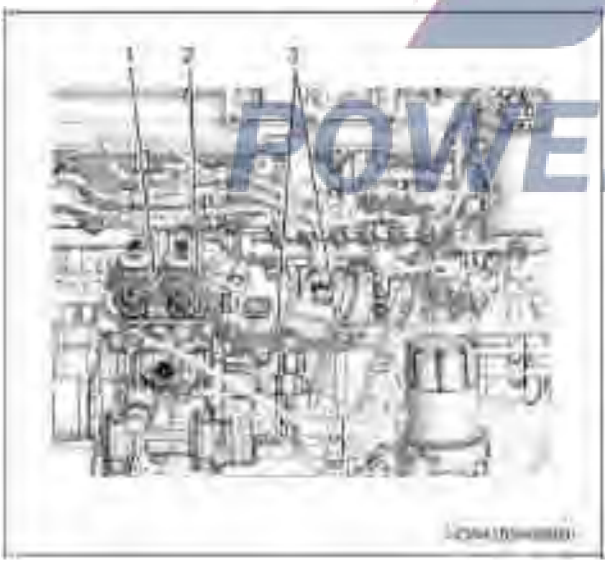
5) Tighten the fuel line to the fuel supply pump.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.



1. Fuel pipe

2. Fuel pipe

3. Clip

44. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

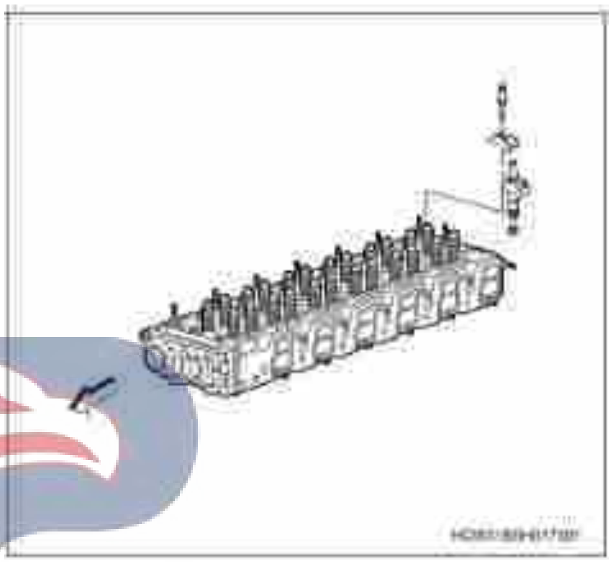
Note:

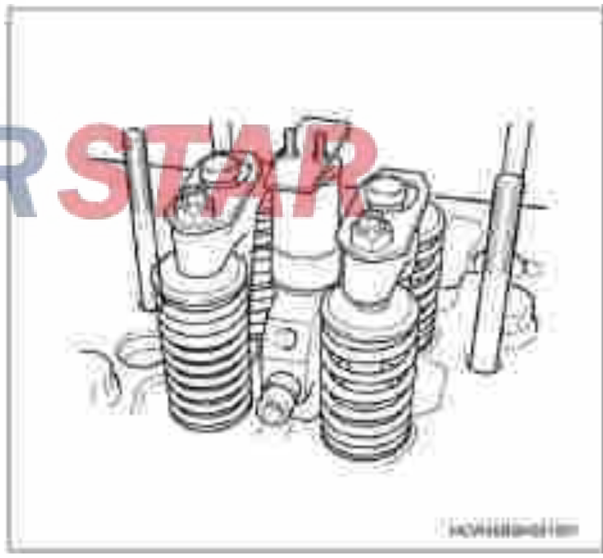
● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.





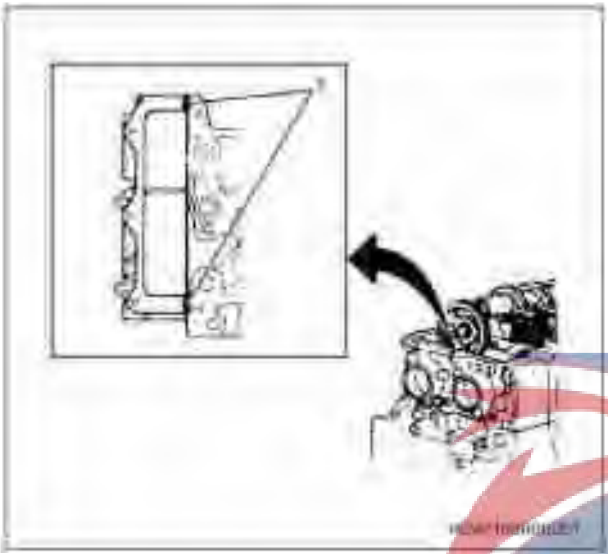
3) Temporarily fasten the injector clamp on the injector.

45. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

Liquid gasket used	Instructions
ThreeBond 1207 or equivalent	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

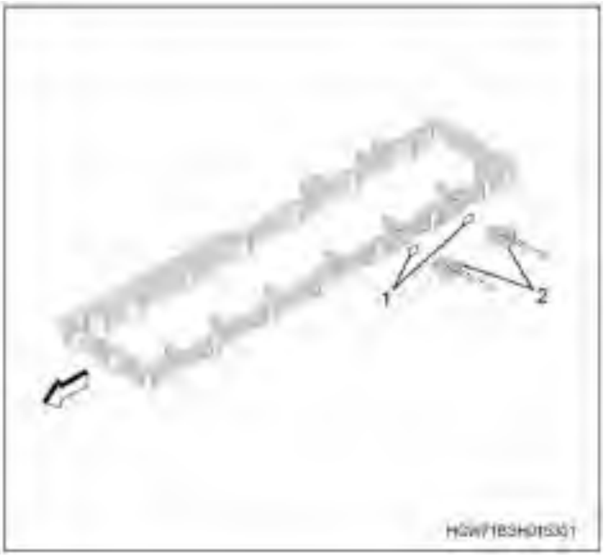
3) Install the lower end cap onto the cylinder head.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}



1. O-ring
2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m {3.5 kgf • m / 25 lb • ft}

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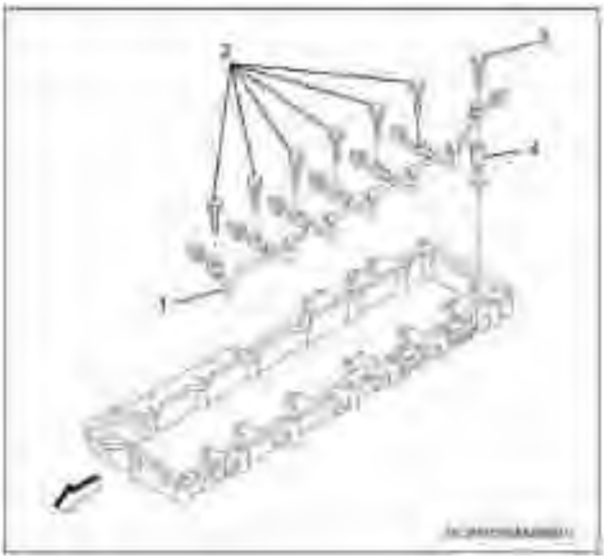


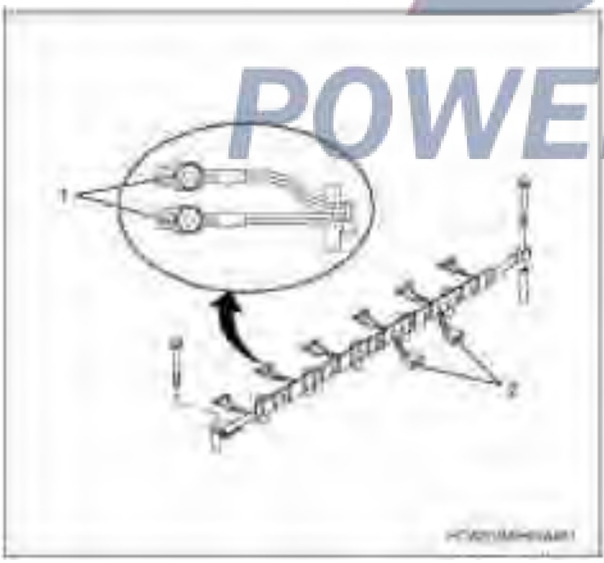
1. Nozzle spout
2. Eyebolt
3. Eyebolt
4. Adapter

46. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut
2. Connector

2) Install the injector harness onto the cylinder head.

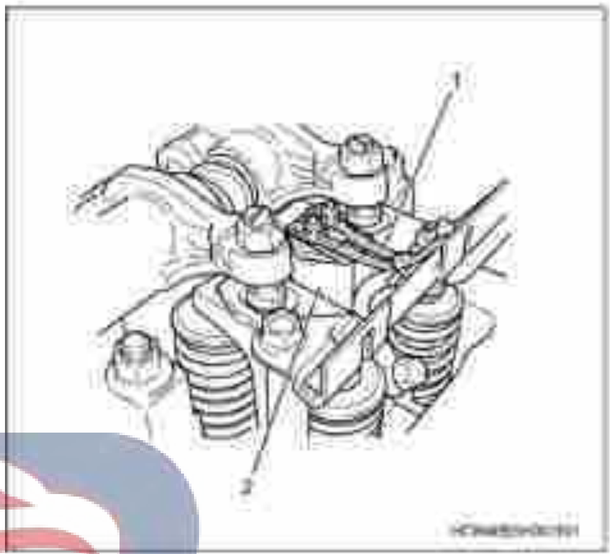
Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



1. Injector harness
2. Injector

47. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft }

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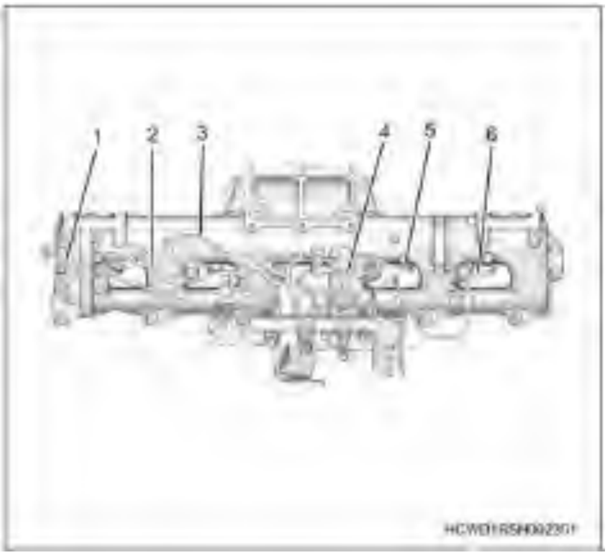


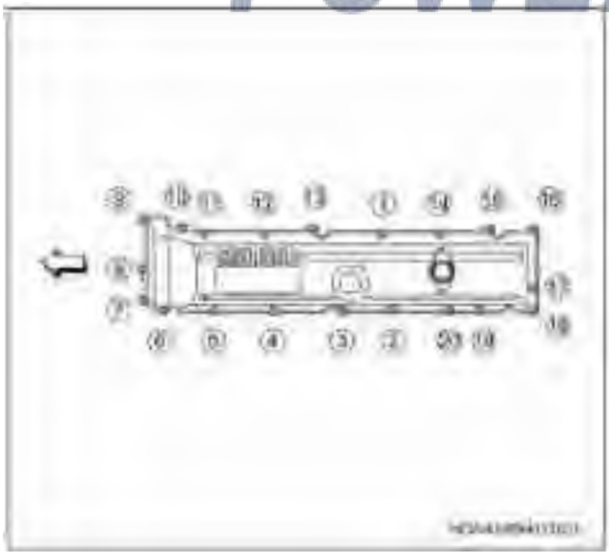
1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

48. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



49. Generator Bracket Installation

1. 50 A and 60 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

2. 90 A specifications

1) Install the generator bracket on the timing gearbox.

2) Install the generator bracket on the cylinder head.

Note:

● When installing, make the right side of the oval hole area of the bracket contact with the bolt.

50. Starter motor installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m / 61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

51. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

52. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

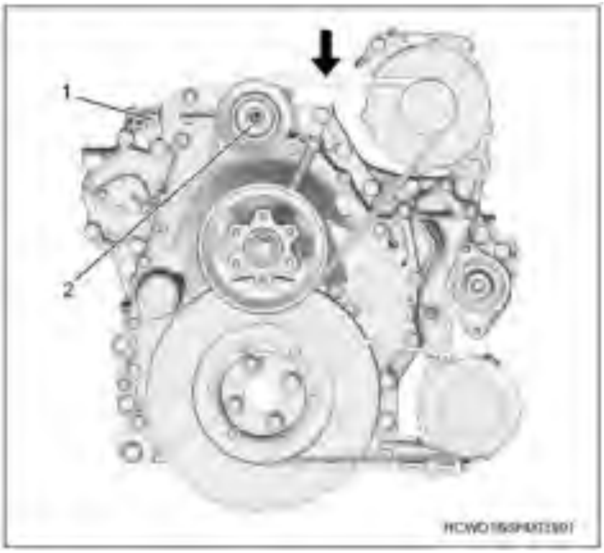
Cooling fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

Standard: 98 N { 10.0 kg / 22 lb }

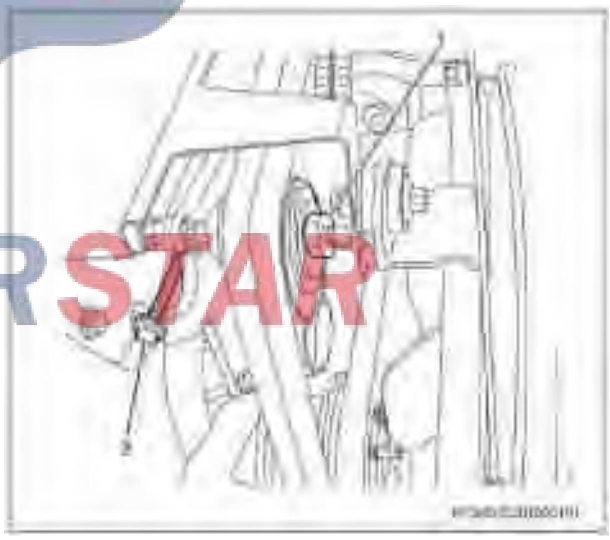


1. Adjust bolt

2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108lb • ft}



1. Lock nut

2. Adjust bolt

53. Oil filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}

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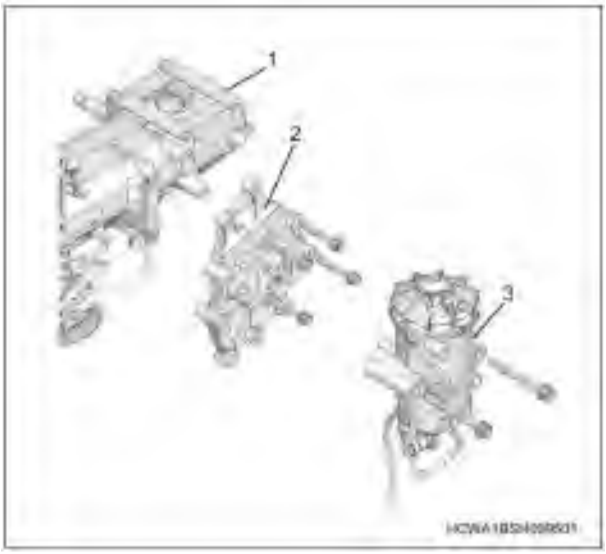


1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

55.Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

56. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

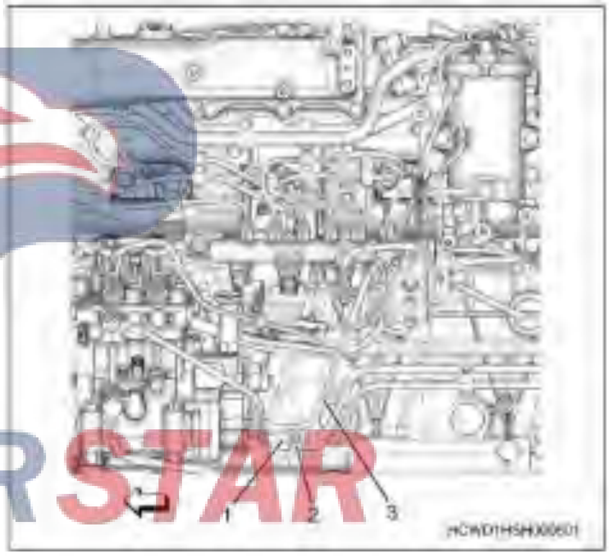
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

57. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

58. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

2) Install the gasket to the exhaust manifold.

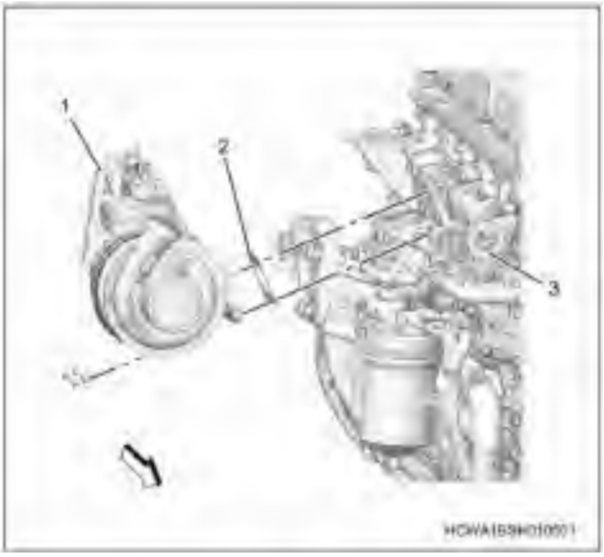
3) Install the turbocharger to the exhaust manifold.

Note:

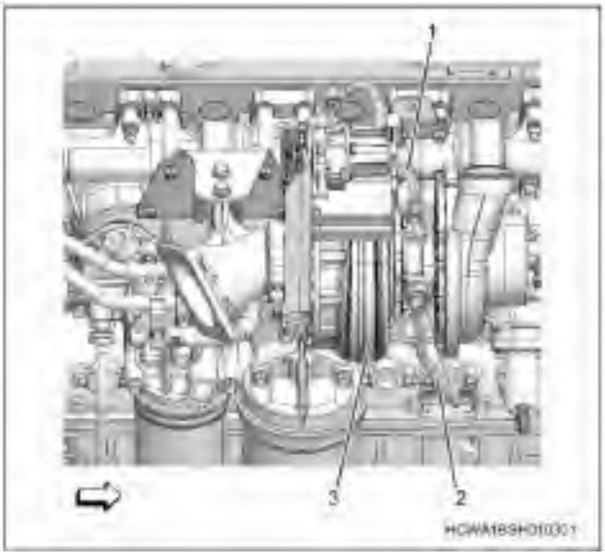
Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

POWERSTAR



1. Turbocharger
2. Gasket
3. Exhaust manifold



1. Water return pipe
2. Water feed pipe
3. Turbocharger

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

6) Connect the water return pipe to the turbocharger.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

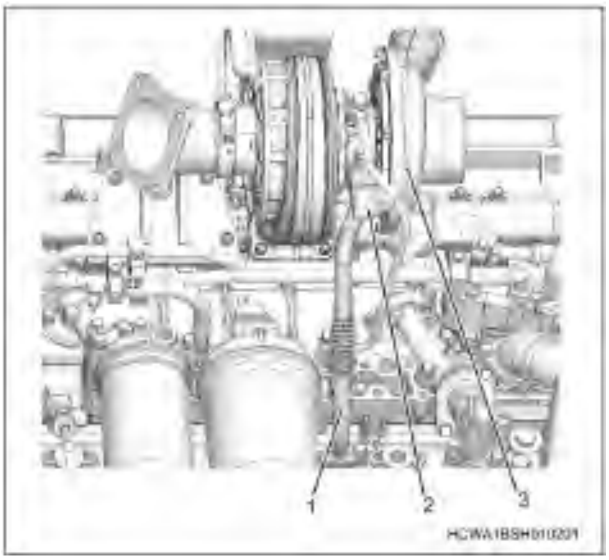
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



POWERSTAR

1. Oil return pipe

2. Bracket

3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

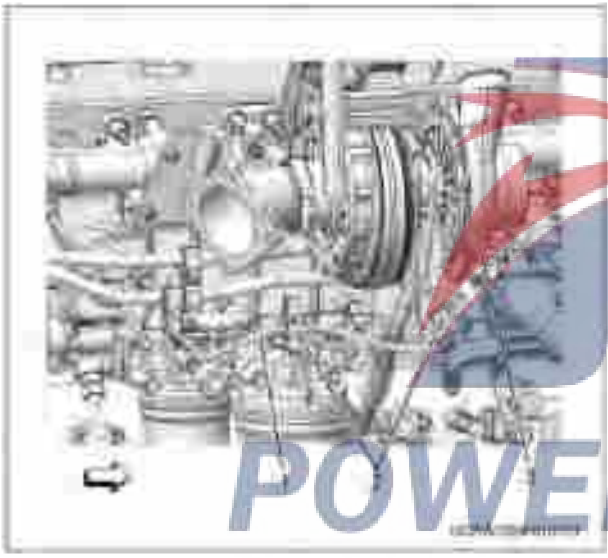
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the oil filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the oil filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}



1. Turbocharger oil feed pipe

2. Clip

3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

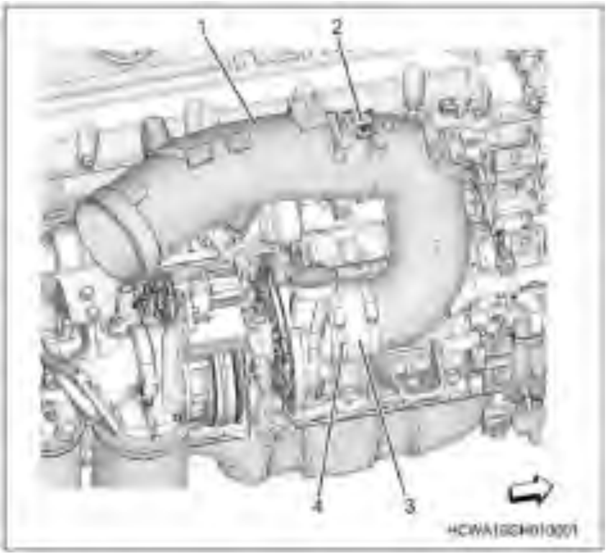
59. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

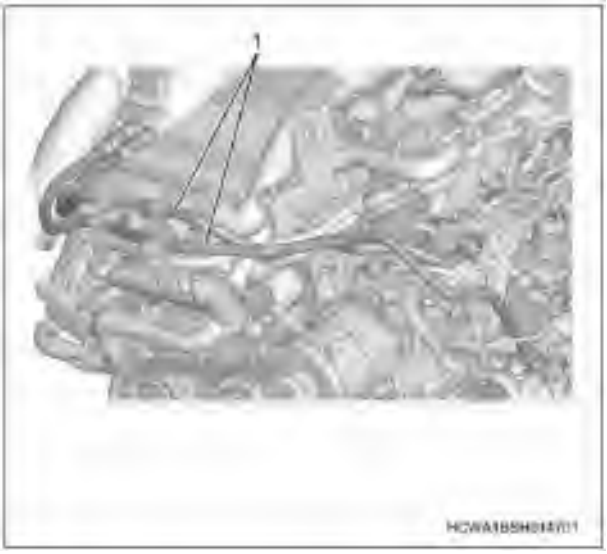
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

POWERSTAR

60. Guide the valve installation

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

61. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

POWERSTAR

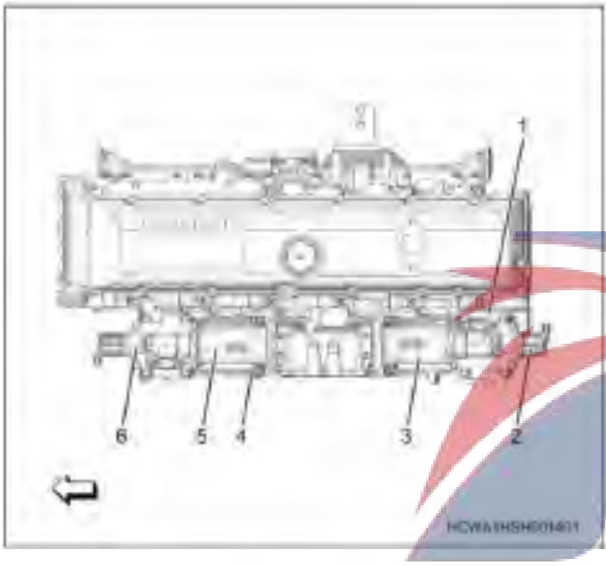
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe bracket
5. EGR valve duct A
6. EGR valve 1

5) Final Tighten the EGR valve conduit A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

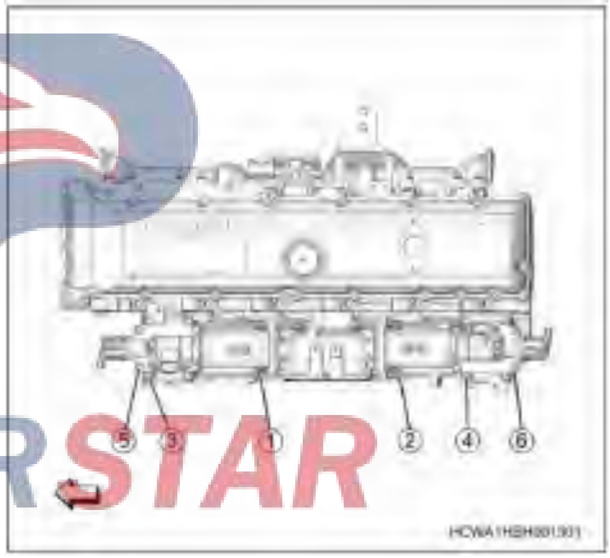
Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



62. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

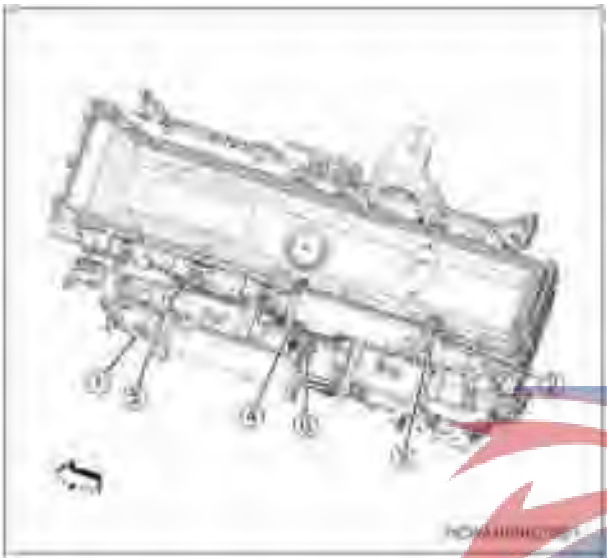
● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

POWERSTAR

- EGR cooler duct D.
- EGR cooler duct B
- EGR cooler B
- EGR cooler D

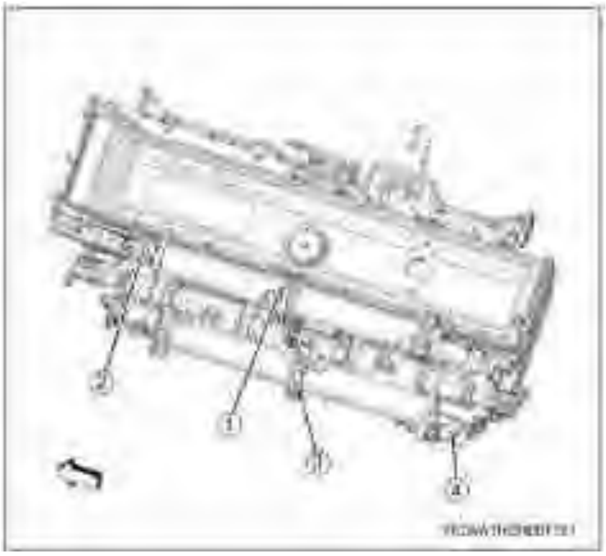
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

- EGR cooler A.
- EGR cooler bracket
- EGR cooler C
- EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

- EGR cooler duct D
- EGR cooler duct B
- EGR cooler B
- EGR cooler D
- EGR cooler A
- EGR cooler bracket
- EGR cooler C
- EGR cooler bracket

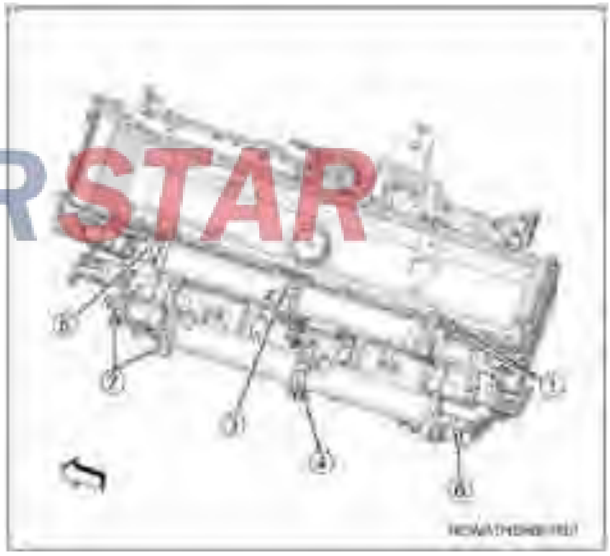
Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5 (M10), 6(M10)

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5(M8), 6(M8)

Note:

- The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

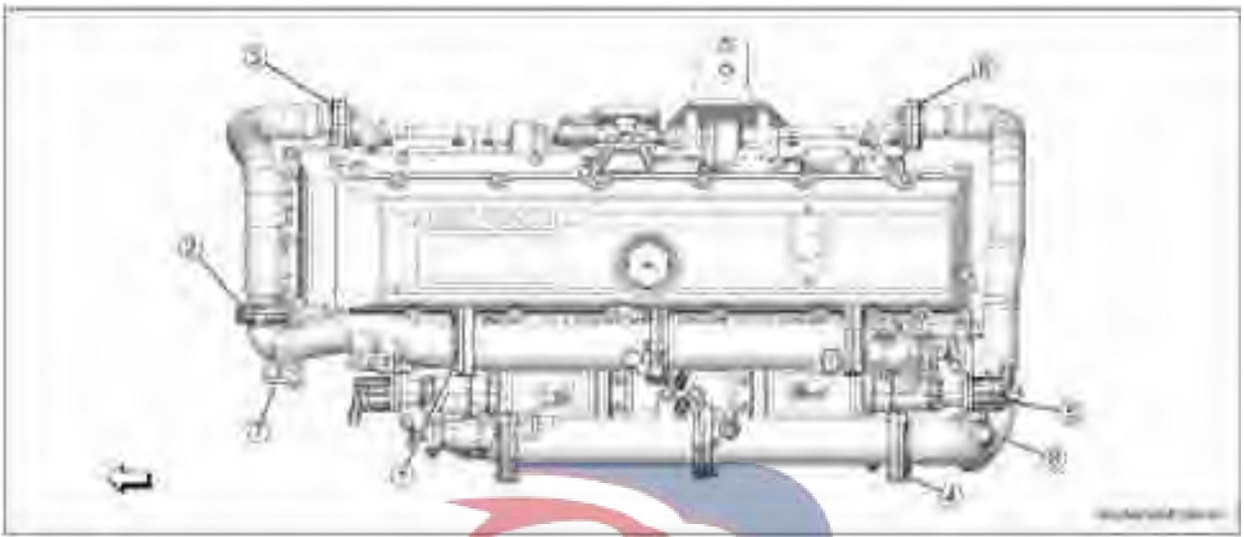
- EGR cooler duct A.
- EGR duct A
- EGR cooler duct C.
- EGR duct B.
- Bracket

POWERSTAR

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C

● EGR duct B

● bracket

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 1(M10), 2, 3, 9(M10), 10(M10)

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 4

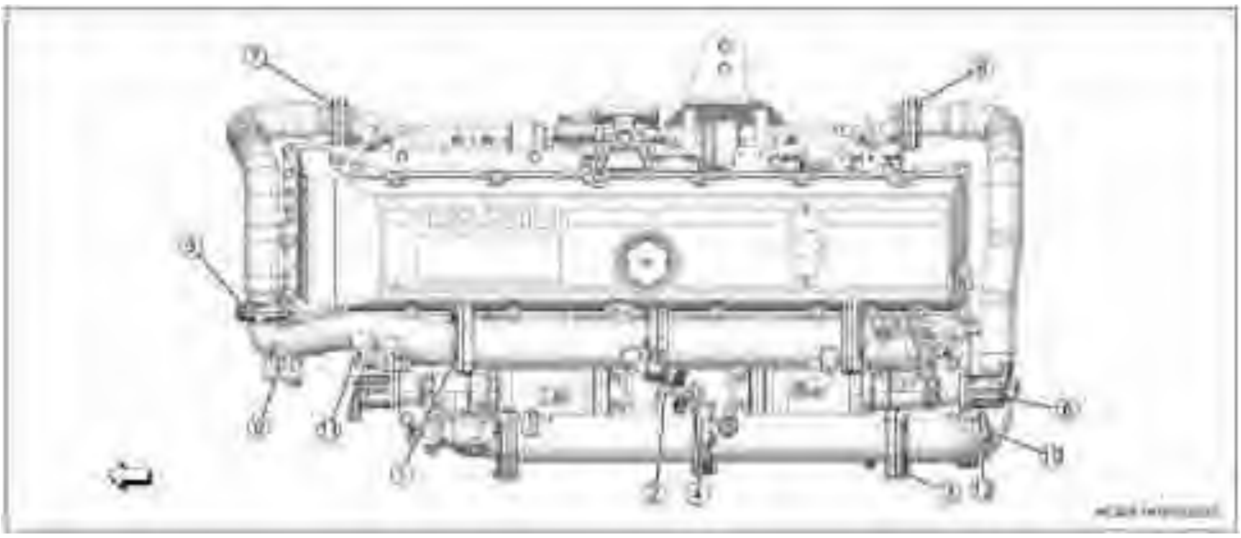
Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft } 5, 6(M8), 7, 8(M8), 9(M8)

Tightening torque: 24.7 N • m { 2.5 kgf • m / 18 lb • ft } 10(M8)

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft } 11, 12(M8)

Note:

● The number behind the tightening torque indicates the diagram number.



POWERSTAR

6) Install the front and rear return lines to the exhaust gas recirculation cooler.

1. Front return pipe
2. Back-end return pipe

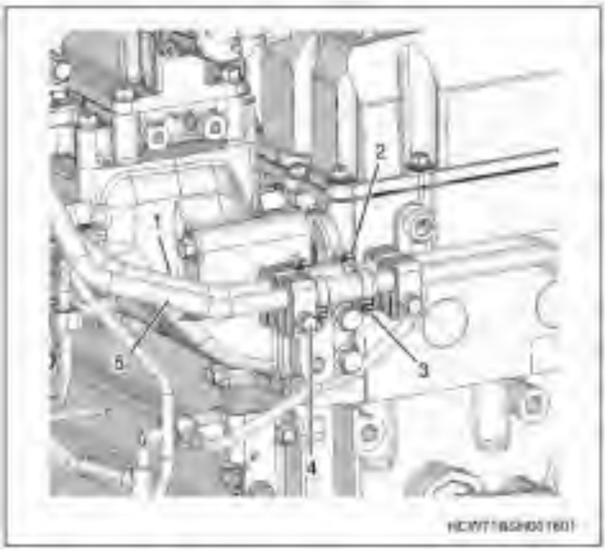
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

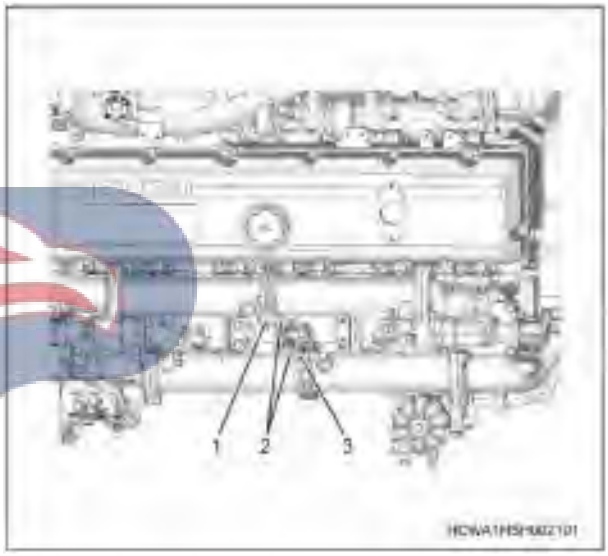


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.



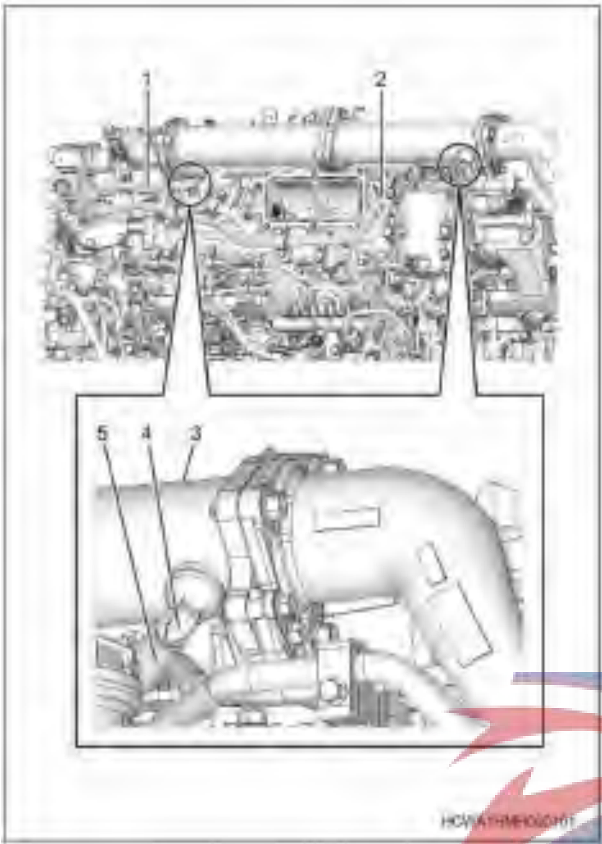
1. Hose clip
2. water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

Caution:

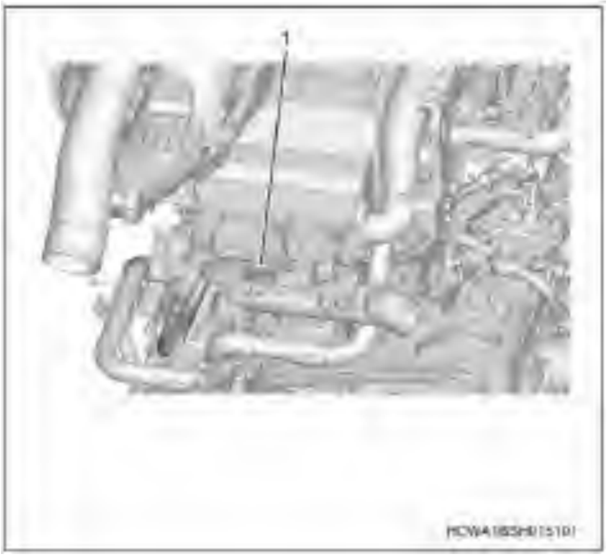
● During installation, care should also be taken to prevent the clamp from rotating.

POWERSTAR



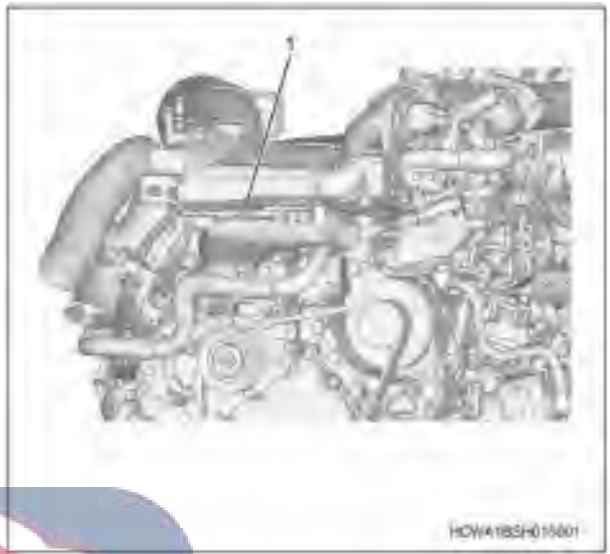
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

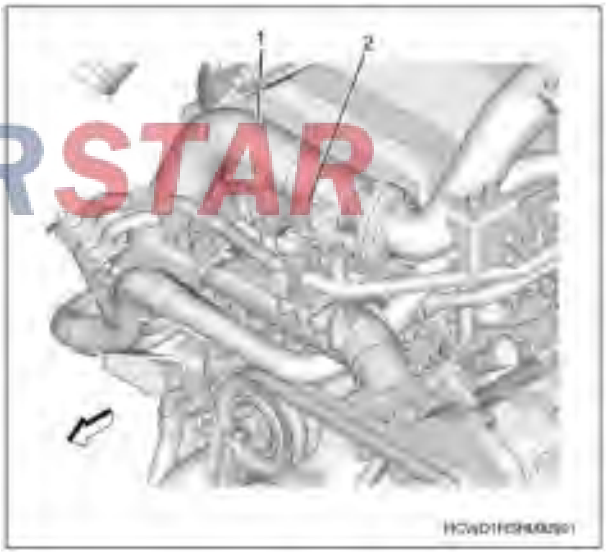
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

63. Suction pipe installation

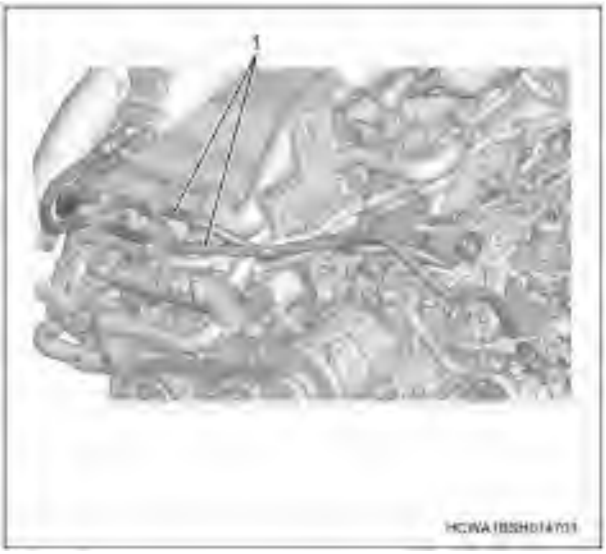
1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction tubes to the air compressor.

POWERSTAR

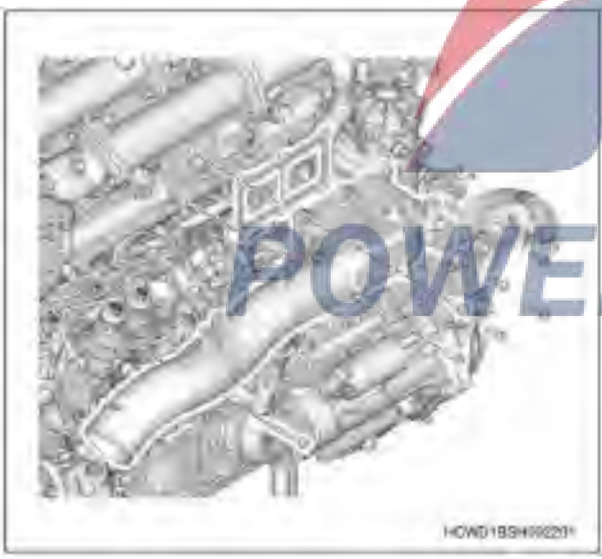


1. Exhaust pipe

64. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}



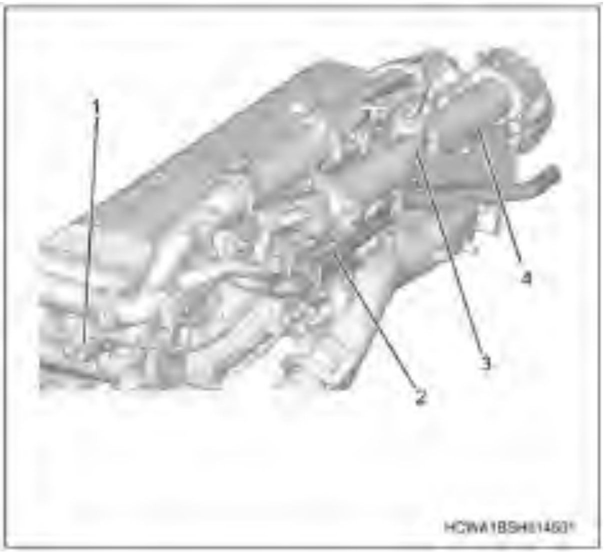
65. Air leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

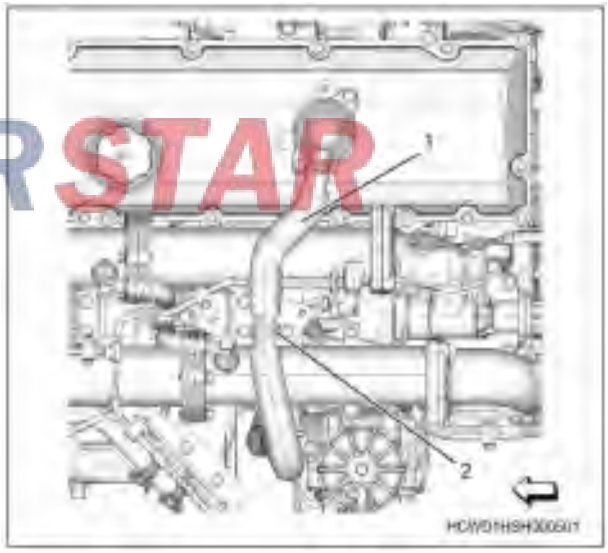
Eyebolt



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

66. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

67. Engine installation

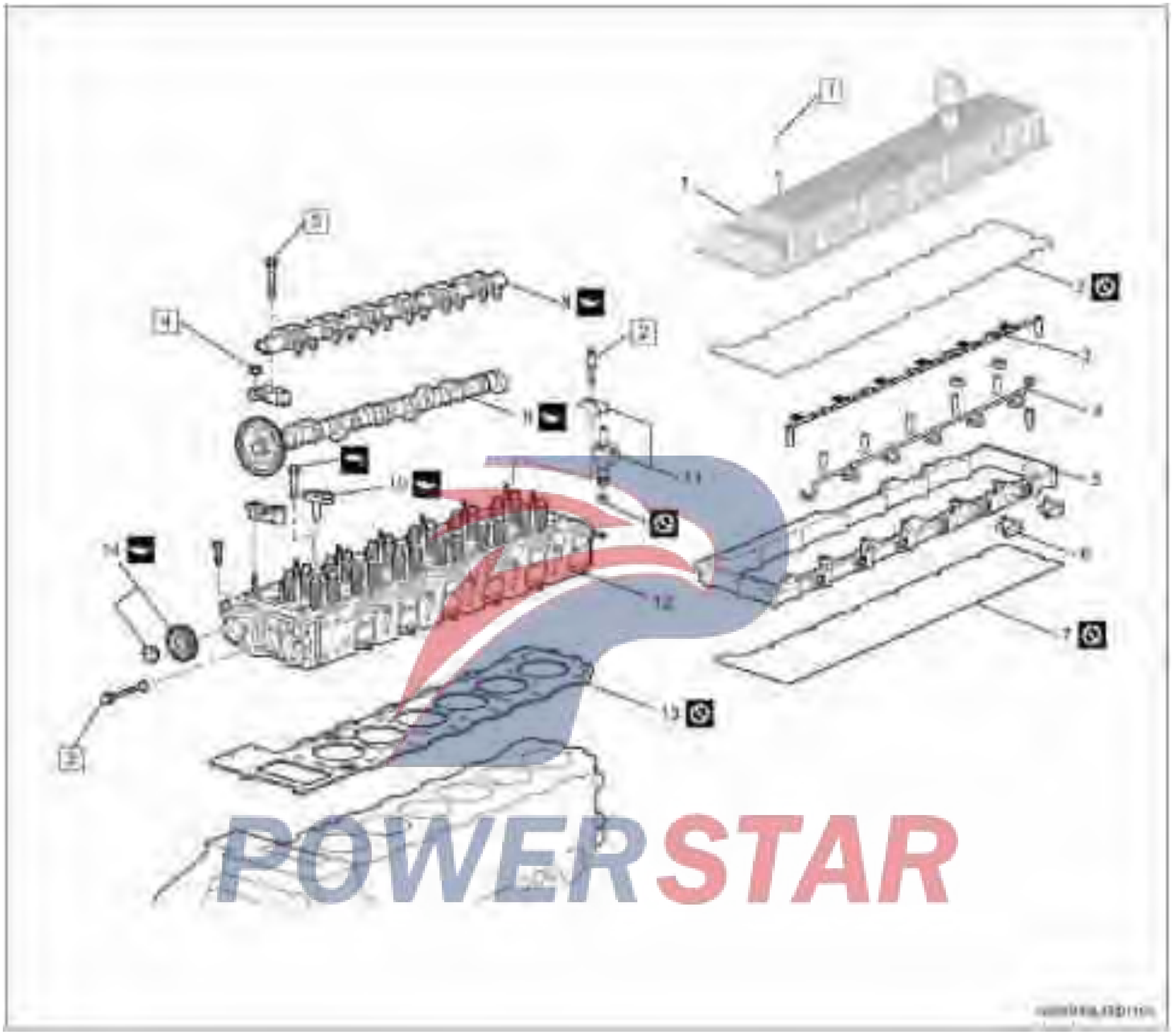
Refer to "*Engine installation*".

POWERSTAR

Additional information

1. Component Views

Cylinder top



Part name

1. Cylinder head cover
2. Cover gasket
3. Injector harness
4. Fuel leak-off pipe
5. Lower cover
6. Harness connector
7. Lower cap gasket
8. Rocker
9. Camshaft
10. Bridge
11. Injector, clamp
12. Cylinder top
13. Cylinder head gasket
14. Idling gear C

Tightening torque

1: 15 N・m { 1.5 kgf • m / 11 lb • ft }

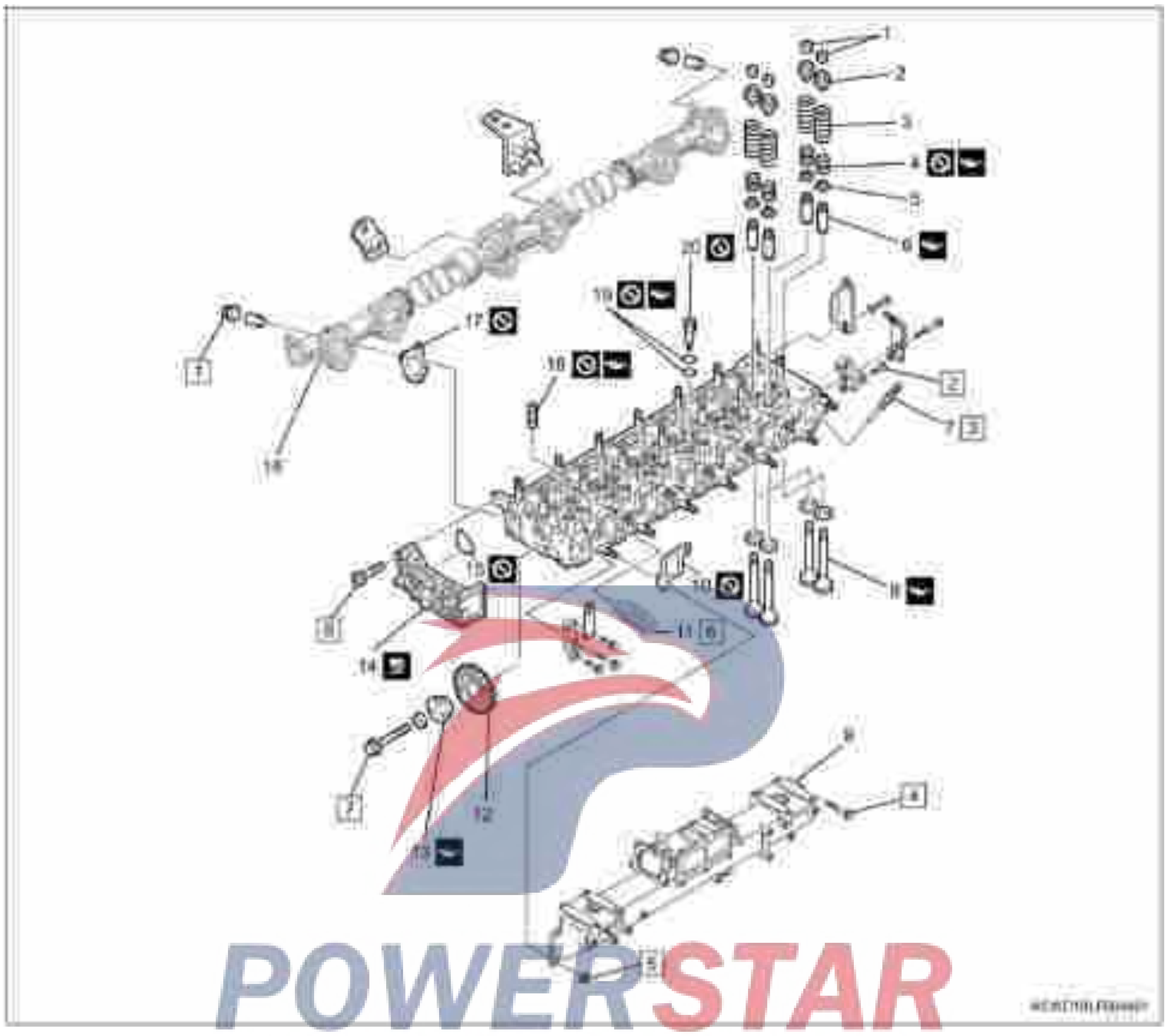
2: 49 N • m { 5.0 kgf • m / 36 lb • ft }

3: 40 N • m { 4.1 kgf • m / 30 lb • ft }

4: 76 N • m { 7.7 kgf • m / 56 lb • ft }

5: 90 N • m { 9.2 kgf • m / 66 lb • ft }

Cylinder top



POWERSTAR

Part name

1. Open ring
2. Spring seat
3. Valve spring
4. Valve stem oil seal
5. Spring seat
6. Valve guide
7. Glow plug
8. Valve
9. Intake manifold
10. Gasket
11. Engine coolant temperature sensor
12. Idling gear C
13. Idler gear shaft
14. Cylinder head gear box
15. O-ring
16. Exhaust manifold
17.Gasket
18. Axle guide
19. O-ring
20. Injector sleeve

Tightening torque

1: 48 N • m { 4.9 kgf • m / 35 lb • ft }

2: 117 N • m { 11.9 kgf • m / 86 lb • ft }

3: 25 N • m { 2.5 kgf • m / 18 lb • ft }

4: 45 N • m { 4.6 kgf • m / 33 lb • ft }

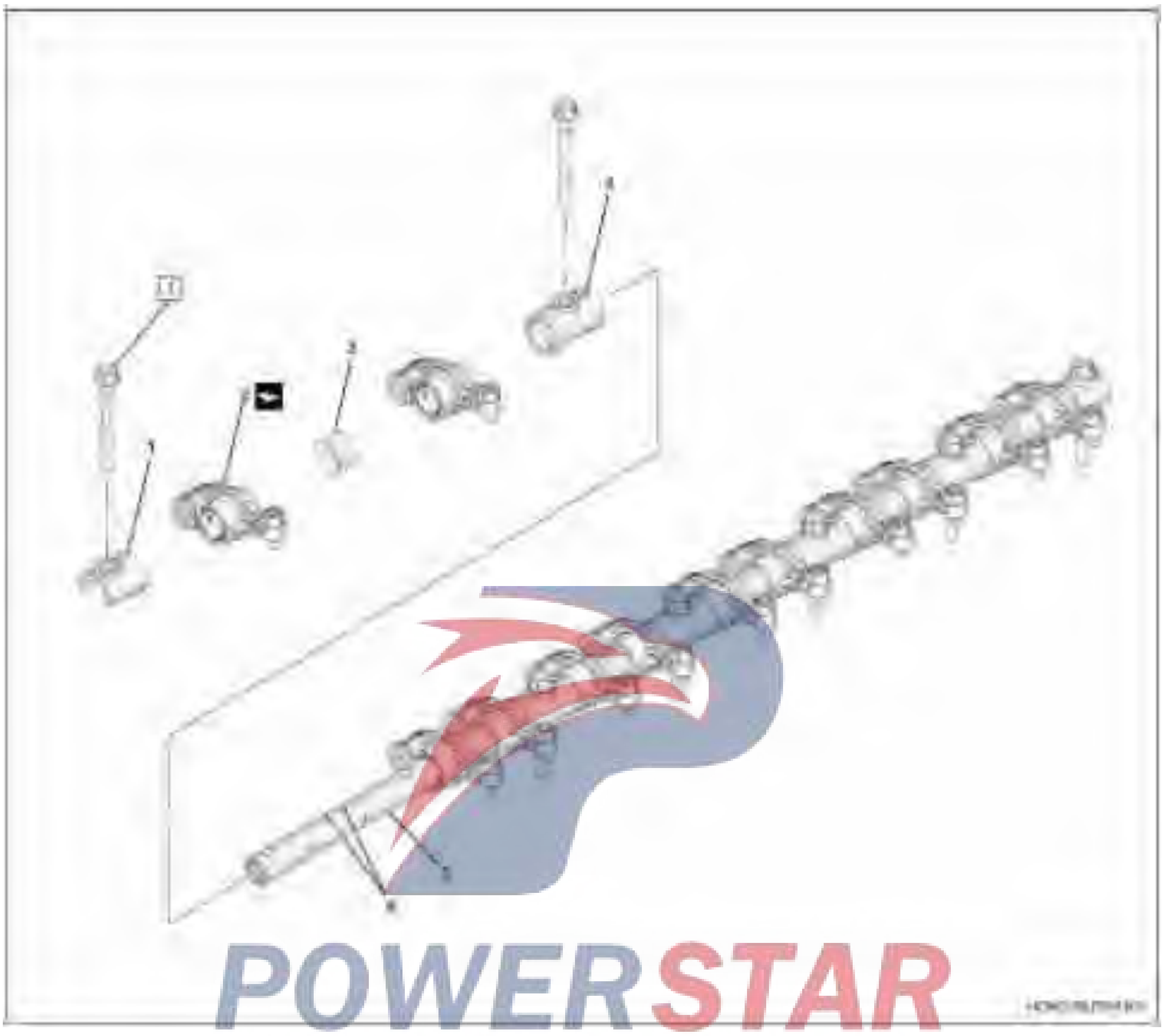
5: 45 N • m { 4.6 kgf • m / 33 lb • ft }

6: 25 N • m { 2.5 kgf • m / 18 lb • ft }

7: 40 N • m { 4.1 kgf • m / 30 lb • ft }

8: 38 N • m { 3.9 kgf • m / 28 lb • ft }

Rocker shaft



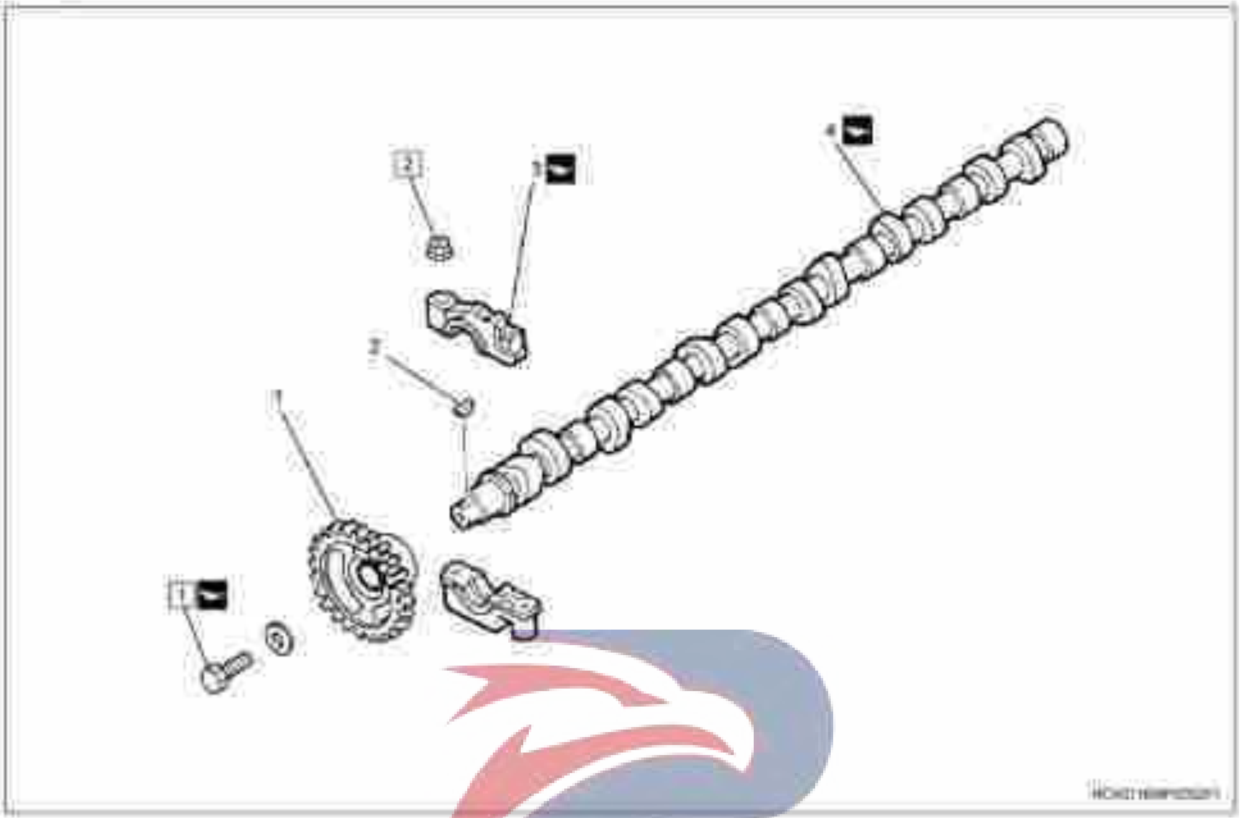
Part name

1. Front bracket
2. Rocker arm
3. Spring
4. Center bracket
5. Rocker shaft
6. Front mark

Tightening torque

1: 90 N • m { 9.2 kgf • m / 66 lb • ft }

Part name



1. Camshaft gear
2. Key
3. Camshaft bracket
4. Camshaft

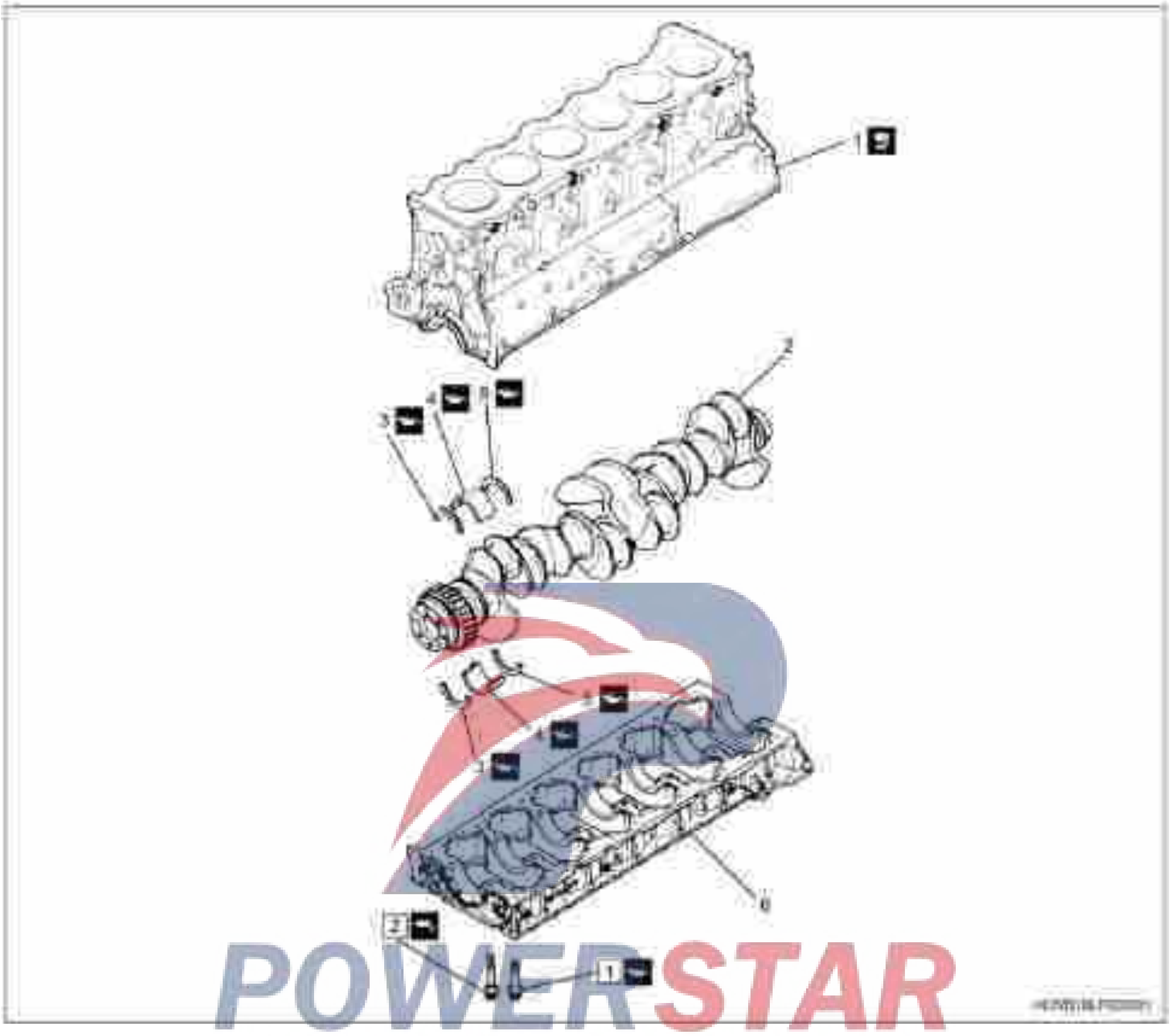
Tightening torque

1: 137 N • m { 14.0 kgf • m / 101 lb • ft }

2: 76 N • m { 7.7 kgf • m / 56 lb • ft }

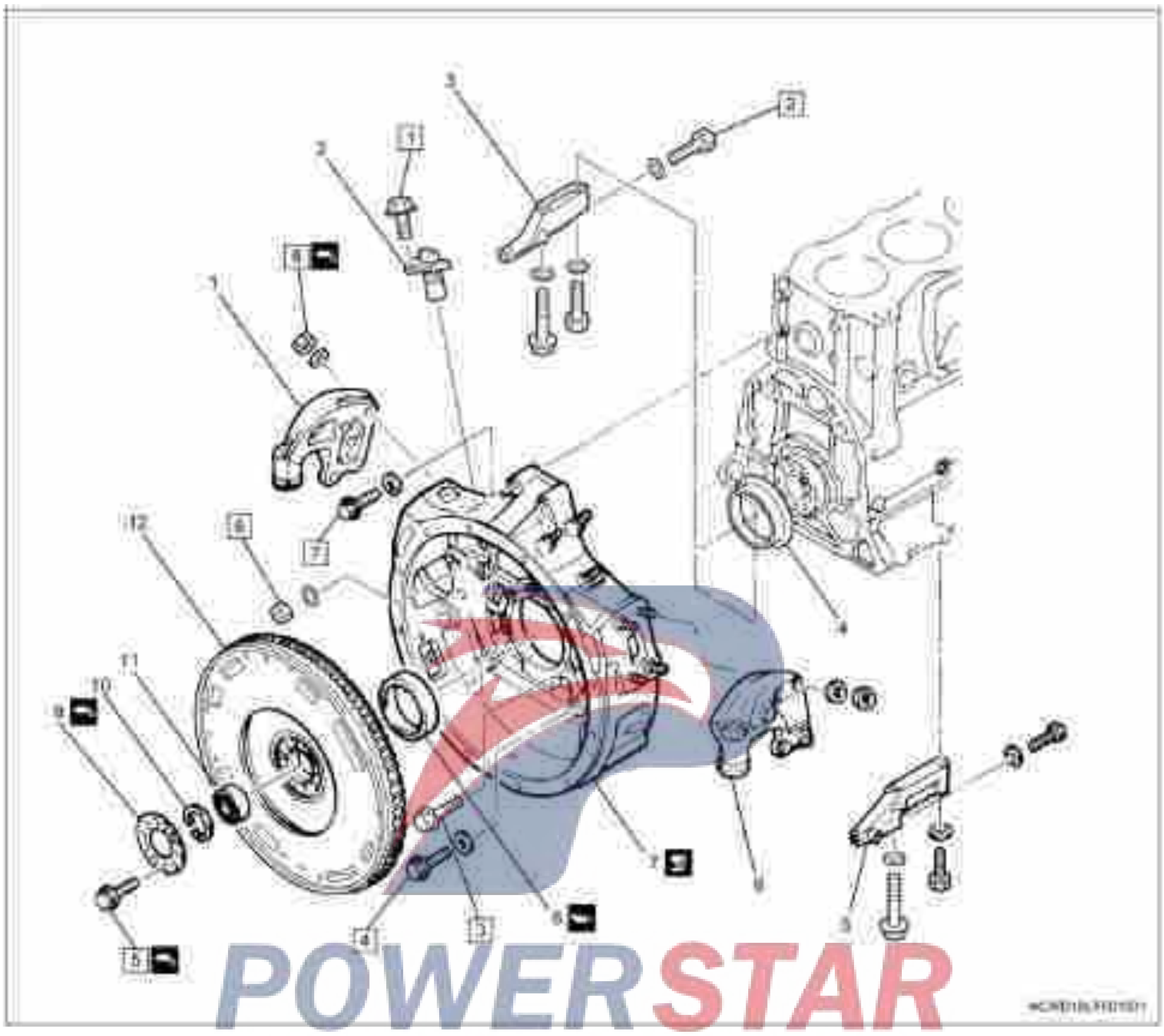
POWERSTAR

Crankshaft



Part name	Tightening torque
1. Cylinder block	1: 96 N • m { 9.8 kgf • m / 71 lb • ft } M12
2. Crankshaft	2-1: 49 N • m { 5.0 kgf • m / 36 lb • ft } M18
3. Thrust bearings	2-2: 88 N • m { 9.0 kgf • m / 65 lb • ft } M18
4. Main bearing	2-3: 90 °M18
5. Thrust bearing	2-4: 294 N • m { 30.0 kgf • m / 217 lb • ft } M18
6. Crankcase	

Flywheel housing



Part name

1. Engine foot
2. CMP sensor
3. Flywheel housing bracket
4. Slinger
5. Flywheel housing bracket
6. Engine foot
7. Flywheel housing
8. Crankshaft rear oil seal
9. Washer
10. Snap ring
11. Guide bearing
12. Flywheel

Tightening torque

1: 8 N • m { 0.8 kgf • m / 71 lb • in }

2: 113 N • m { 11.5 kgf • m / 83 lb • ft }

3: 22 N • m { 2.2 kgf • m / 16 lb • ft }

4: 123 N • m { 12.5 kgf • m / 90 lb • ft }

5-1: 78.5 N • m { 8.0 kgf • m / 58 lb • ft }

5-2: 60 °

5-3: 30 °

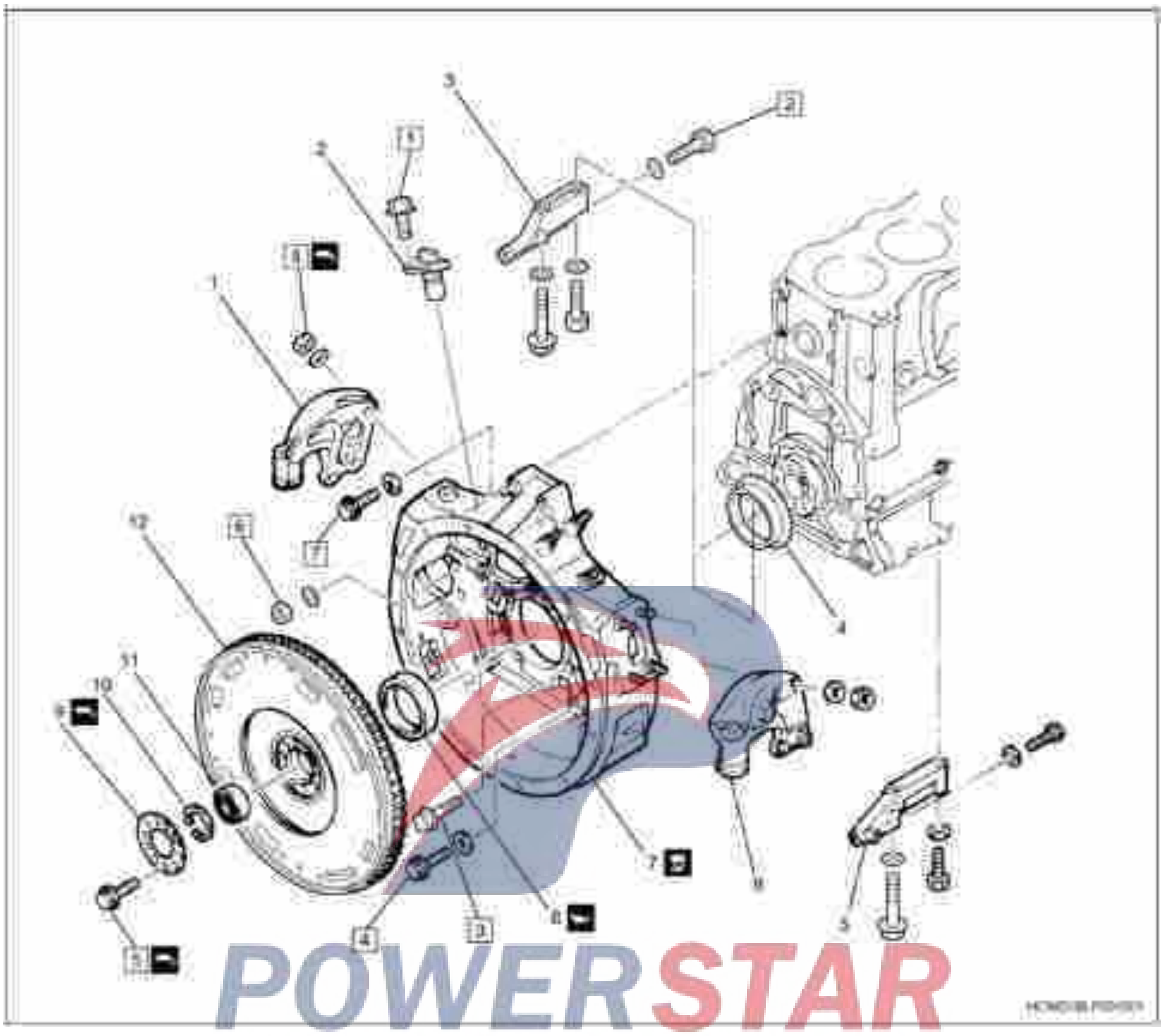
6: 108 N • m { 11.0 kgf • m / 80 lb • ft }

7: 123 N • m { 12.5 kgf • m / 91 lb • ft }

8-1: 147 N • m { 15.0 kgf • m / 108 lb • ft }

8-2: 275 N • m { 28.0 kgf • m / 203 lb • ft }

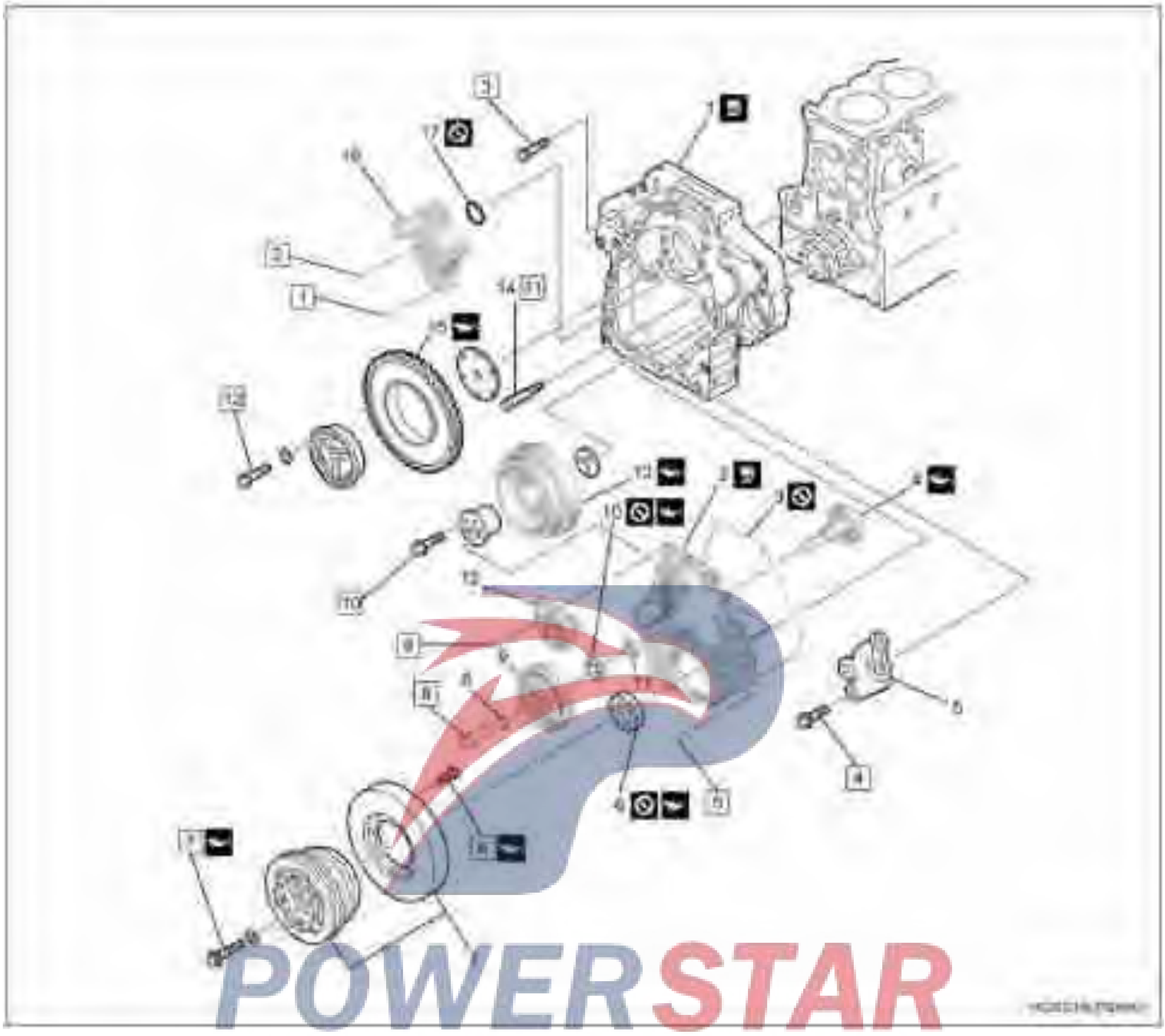
Flywheel



POWERSTAR

Part name	Tightening torque
1. Engine foot	1: 8 N • m { 0.8 kgf • m / 71 lb • in }
2. CMP sensor	2: 113 N • m { 11.5 kgf • m / 83 lb • ft }
3. Flywheel housing bracket	3: 22 N • m { 2.2 kgf • m / 16 lb • ft }
4. Slinger	4: 123 N • m { 12.5 kgf • m / 90 lb • ft }
5. Flywheel housing bracket	5-1: 78.5 N • m { 8.0 kgf • m / 58 lb • ft }
6. Engine foot	5-2: 60 °
7. Flywheel housing	5-3: 30 °
8. Crankshaft rear oil seal	6: 108 N • m { 11.0 kgf • m / 80 lb • ft }
9. Washer	7: 123 N • m { 12.5 kgf • m / 91 lb • ft }
10. Snap ring	8-1: 147 N • m { 15.0 kgf • m / 108 lb • ft }
11. Guide bearing	8-2: 275 N • m { 28.0 kgf • m / 203 lb • ft }
12. Flywheel	

Idling gear



Part name

1. Timing gearbox
2. Gear box cover
3. Gasket
4. Fan shaft
5. A / C compressor bracket
6. Crankshaft front oil seal
7. Crankshaft pulley
8. Tapered bushing
9. Fan pulley
10. Oil seal
11. Gasket
12. Idler
13. Idling Gear A
14. Tightening bolts
15. Idling Gear B
16. Oil pump
17. O-ring

Tightening torque

1: 49 N • m { 5.0 kgf • m / 36 lb • ft }

2: 39 N • m { 4.0 kgf • m / 29 lb • ft }

3: 135 N • m { 13.8 kgf • m / 100 lb • ft } M14

3: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

4: 135 N • m { 13.8 kgf • m / 100 lb • ft }

5: 26 N • m { 2.7 kgf • m / 19 lb • ft } M8

5: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

6: 96 N • m { 9.8 kgf • m / 71 lb • ft }

7: 267 N • m { 27.2 kgf • m / 197 lb • ft }

8: 539 N • m { 55.0 kgf • m / 398 lb • ft }

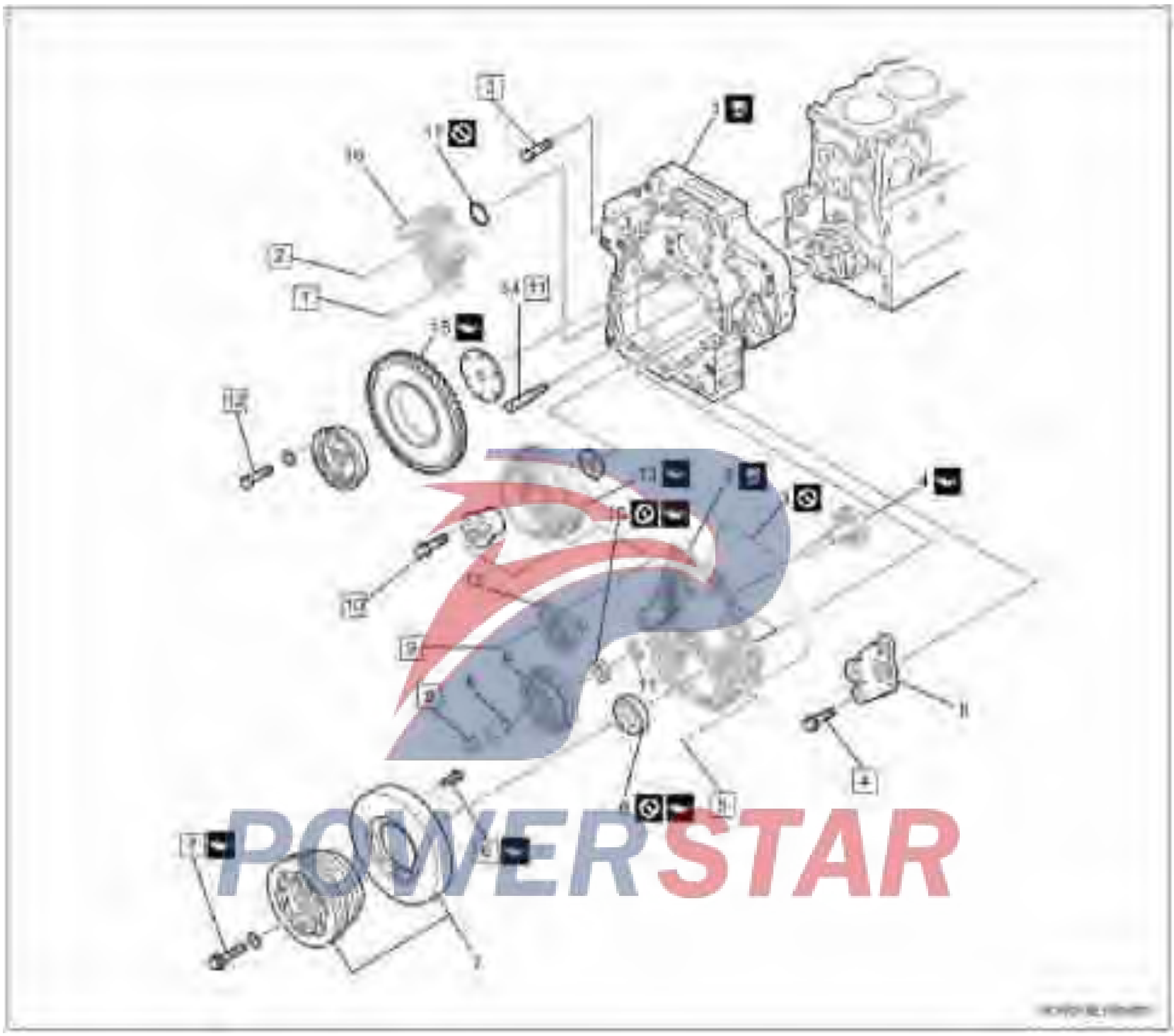
9: 43 N • m { 4.4 kgf • m / 32 lb • ft }

10: 108 N • m { 11.0 kgf • m / 80 lb • ft }

11: 39 N • m { 4.0 kgf • m / 29 lb • ft }

12: 40 N • m { 4.1 kgf • m / 30 lb • ft }

Timing gearbox



Part name

1. Timing gearbox
2. Gear box cover
3. Gasket
4. Fan shaft
5. A / C compressor bracket
6. Crankshaft front oil seal
7. Crankshaft pulley
8. Tapered bushing
9. Fan pulley
10. Oil seal
11. Gasket
12. Idler
13. Idling Gear A
14. Tightening bolts
15. Idling Gear B
16. Oil pump
17. O-ring

Tightening torque

1: 49 N • m { 5.0 kgf • m / 36 lb • ft }

2: 39 N • m { 4.0 kgf • m / 29 lb • ft }

3: 135 N • m { 13.8 kgf • m / 100 lb • ft } M14

3: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

4: 135 N • m { 13.8 kgf • m / 100 lb • ft }

5: 26 N • m { 2.7 kgf • m / 19 lb • ft } M8

5: 43 N • m { 4.4 kgf • m / 32 lb • ft } M10

6: 96 N • m { 9.8 kgf • m / 71 lb • ft }

7: 267 N • m { 27.2 kgf • m / 197 lb • ft }

8: 539 N • m { 55.0 kgf • m / 398 lb • ft }

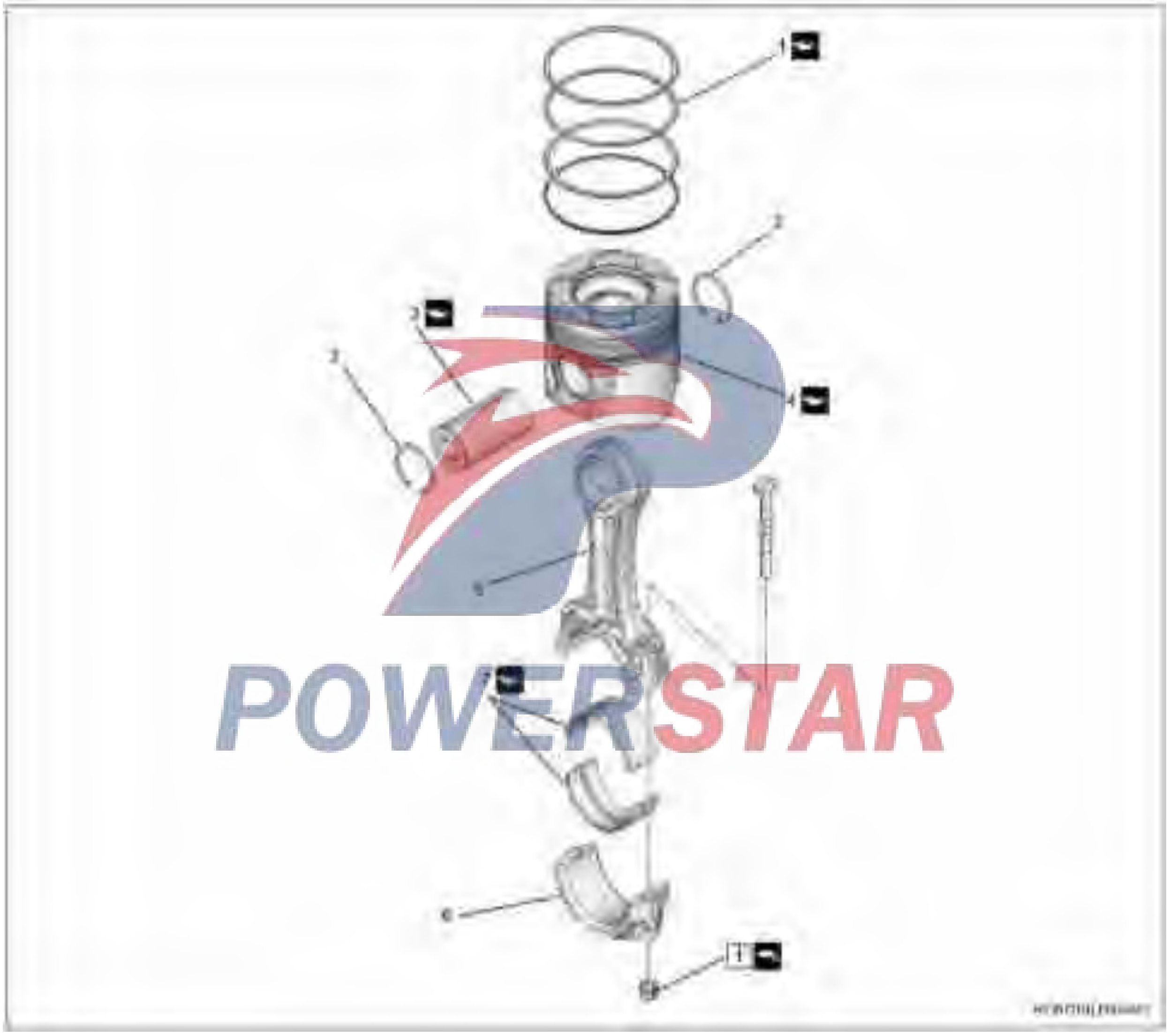
9: 43 N • m { 4.4 kgf • m / 32 lb • ft }

10: 108 N • m { 11.0 kgf • m / 80 lb • ft }

11: 39 N • m { 4.0 kgf • m / 29 lb • ft }

12: 40 N • m { 4.1 kgf • m / 30 lb • ft }

Piston



Part name

1. Piston ring
2. Snap ring
3. Piston pin
4. Piston
5. Connecting rod.
6. Rod bearing cover
7. Connecting rod bearing

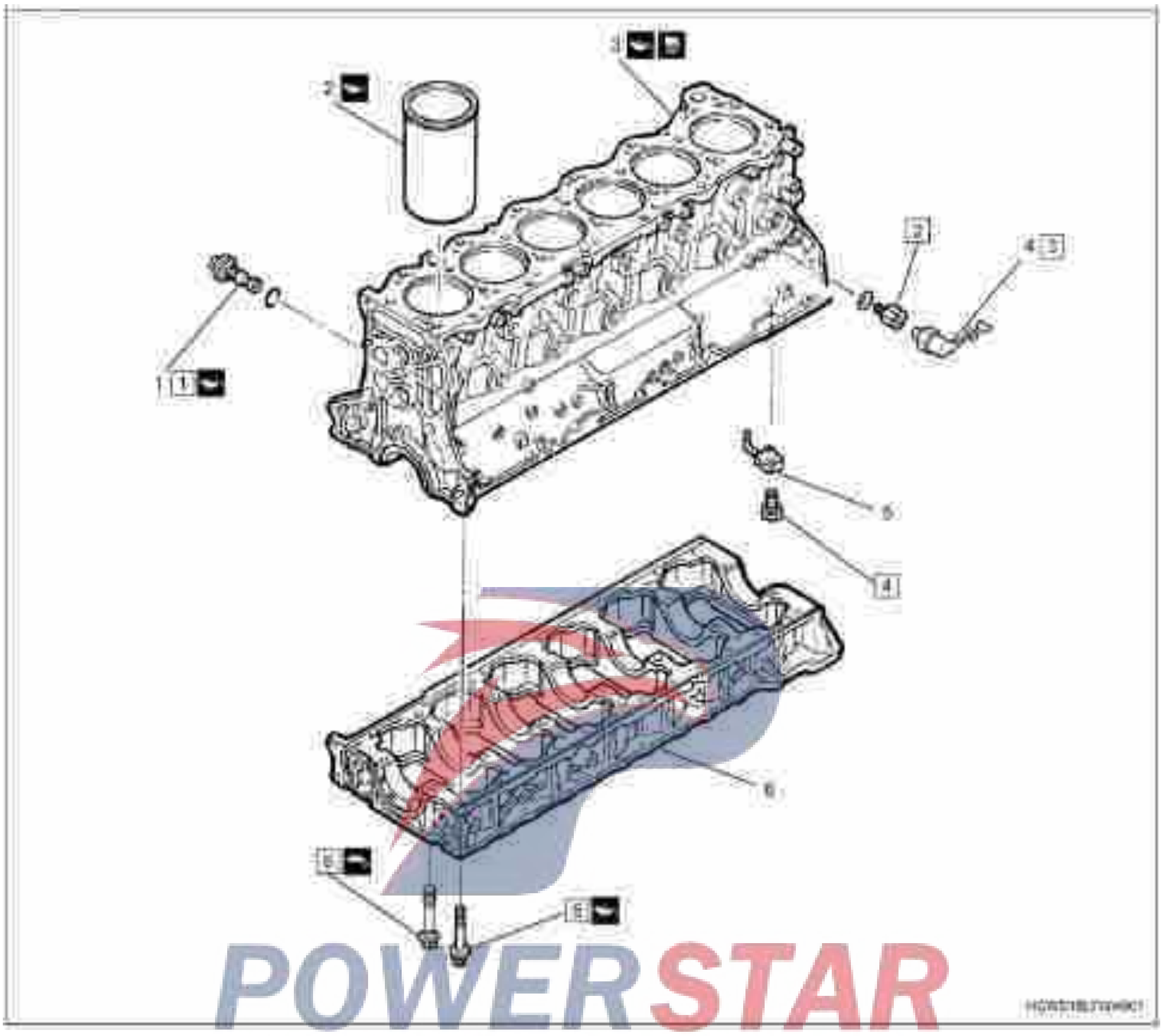
Tightening torque

1-1: 98 N • m { 10.0 kgf • m / 72 lb • ft }

1-2: 30 °

1-3: 30 °

Cylinder block



Part name

1. Drain valve
2. Cylinder liner
3. Cylinder block
4. Hydraulic switch
5. Oil nozzle
6. Crankcase

Tightening torque

1: 20 N • m { 2.0 kgf • m / 15 lb • ft }

2: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3: 18 N • m { 1.8 kgf • m / 13 lb • ft }

4: 69 N • m { 7.0 kgf • m / 51 lb • ft }

5: 96 N • m { 9.8 kgf • m / 71 lb • ft } M12

6-1: 49 N • m { 5.0 kgf • m / 36 lb • ft } M18

6-2: 88 N • m { 9.0 kgf • m / 65 lb • ft } M18

6-3: 90 °M18

6-4: 294 N • m { 30.0 kgf • m / 217 lb • ft } M18

Engine

Fuel system

(6WG1)

Table of contents

POWERSTAR

Fuel

Inspection

1. Fuel safety information

Caution:

● Add cleaning agent to the steam cleaner and thoroughly clean the sensor and common rail areas.

● Completely remove moisture with an air blower.

● Verify that foreign material has been completely removed, and start the work.

● After replacing the various sensors, clear the trouble code, and verify the replaced sensors operate normally.

● Because fuel leakage may lead to fire, wipe off the leaked fuel after completing the work and after the inspection, and be sure to check for fuel leaks after starting the engine.

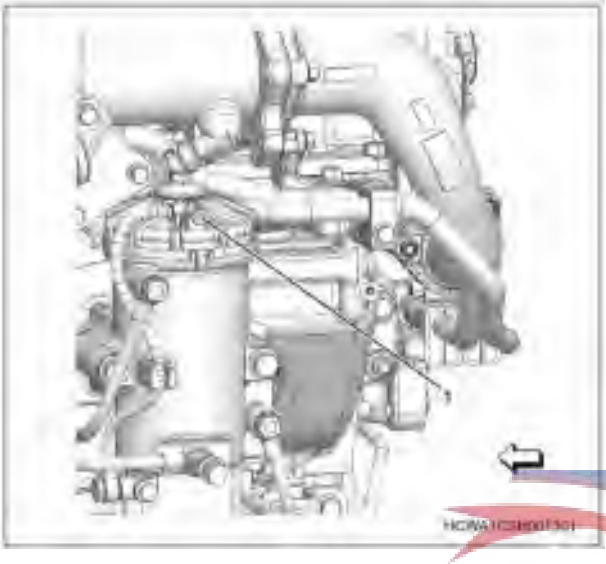
POWERSTAR

Deflation

1. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

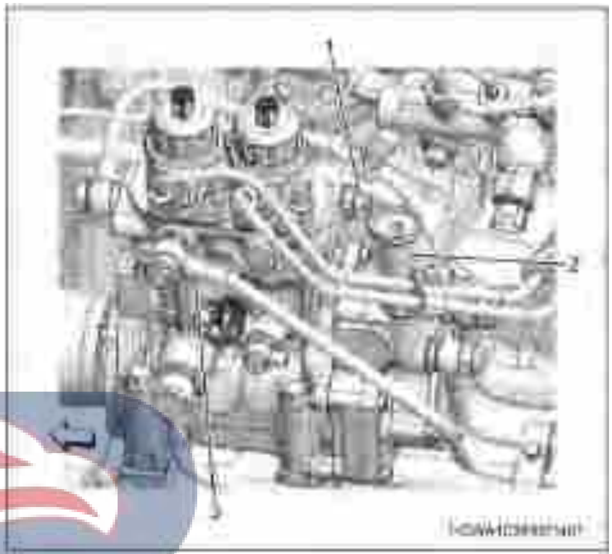
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

POWERSTAR

Wastewater

1. Fuel oil

1) Loosen the exhaust plug.

2) Loosen the drain plug to remove moisture and deposits.

3) Tighten the drain plug.

Tightening torque: 7 N • m {0.7 kgf • m / 62 lb • in}

4) Tighten the vent plug.

Tightening torque: 7 N • m {0.7 kgf • m / 62 lb • in}

2. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.

1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m {0.7 kgf • m / 62 lb • in}

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

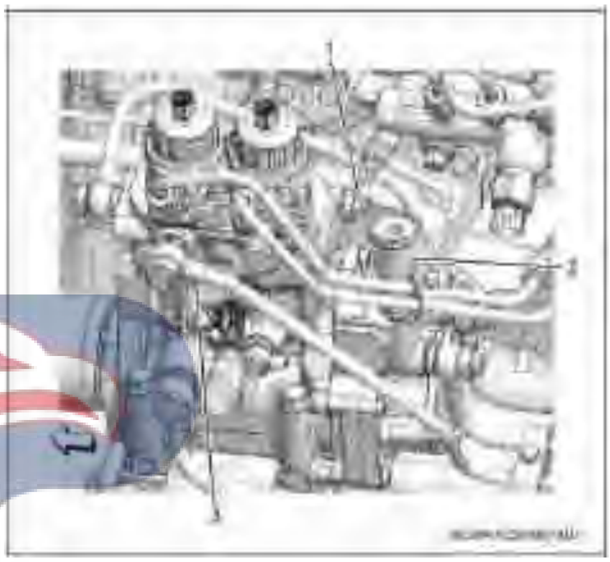
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m {0.6 kgf • m / 53 lb • in}

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

POWERSTAR

Fuel filter

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Fuel drain pipe removed

1) Disconnect the fuel drain on the fuel supply pump.

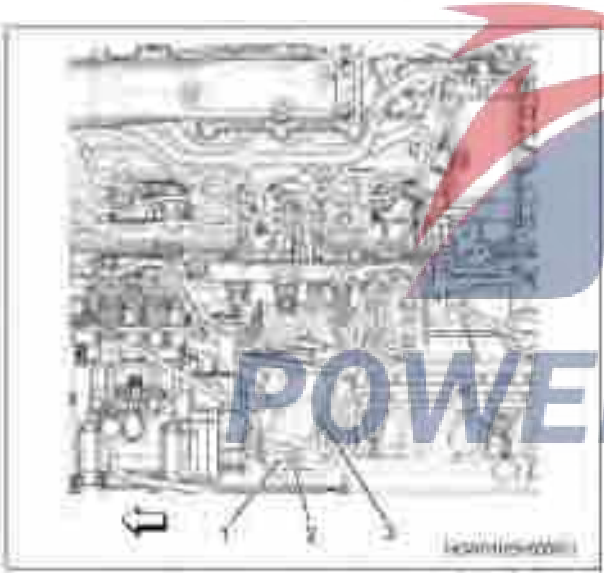
2) Disconnect the fuel drain hose from the fuel filter.

3. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

4. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

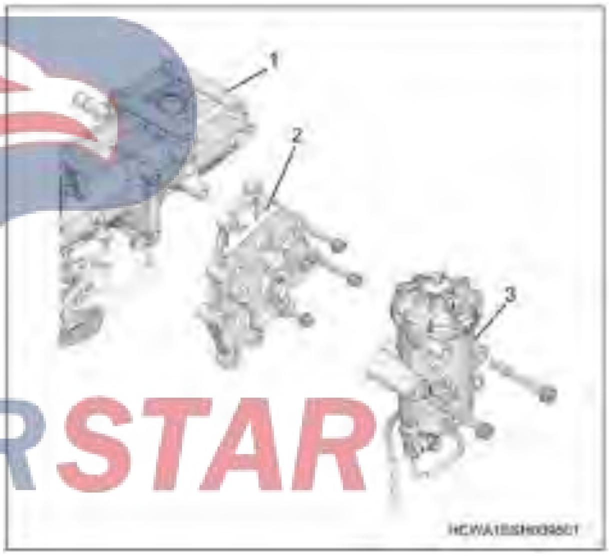
3) Remove the fuel pipe from the fuel supply pump.

5. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.



1. Intake manifold

2. Fuel filter bracket

3. Fuel filter

POWERSTAR

Installation

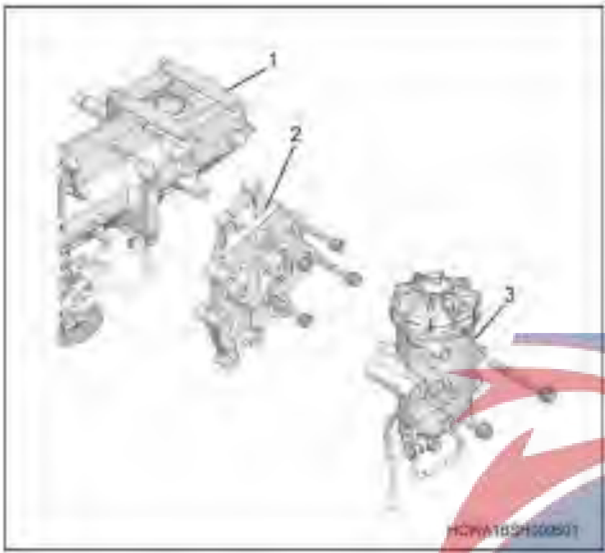
1. Oil filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

2. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

3. Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m /11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

4. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

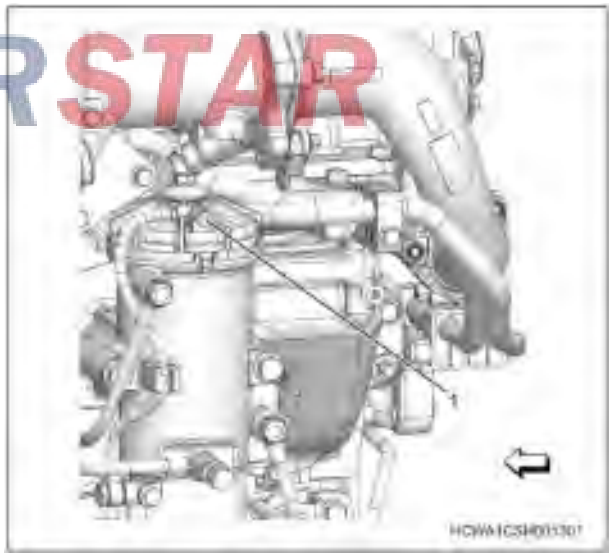
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

5. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

POWERSTAR

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

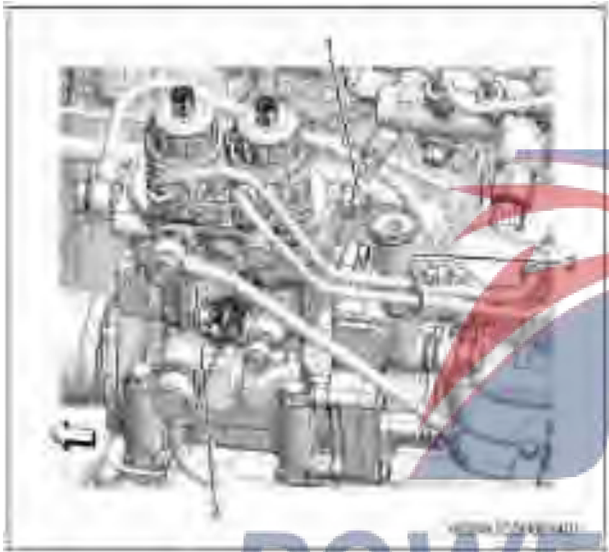
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

6. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

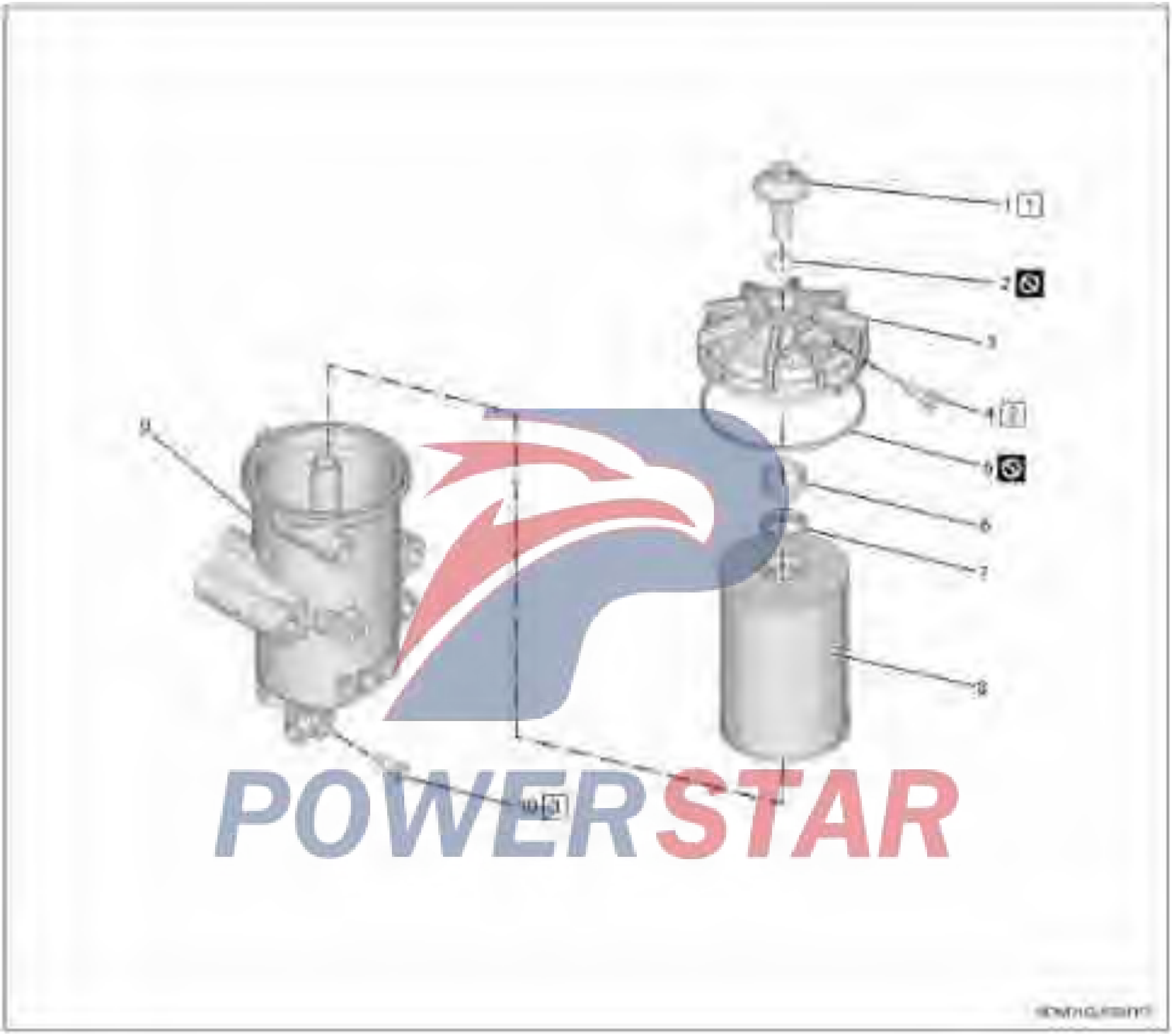
POWERSTAR

Fuel filtre element

Removal

1. Component Views

Fuel filtre element



Part name

1. Center bolt
2. O-ring
3. Cover
4. Deflate valve plug
5. O-ring
6. Spring
7. Bracket
8. Fuel filter cartridge
9. Fuel filter body
10. Drain plug

Tightening torque

1: 29.4 N • m {3.0 kgf • m / 22 lb • ft}

2: 7 N • m {0.7 kgf • m / 62 lb • in}

3: 7 N • m {0.7 kgf • m / 62 lb • in}

4: 2.5 N • m {0.3 kgf • m / 22 lb • in}

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3 Fuel oil

1) Loosen the exhaust plug.

2) Loosen drain plug to drain moisture and deposits.

3) Tighten the drain plug.

Tightening torque:7 N • m { 0.7 kgf • m / 62 lb • in }

4) Tighten the vent plug.

Tightening torque:7 N • m { 0.7 kgf • m / 62 lb • in }

4. Fuel filter cartridge removed

1) Loosen the center bolt and remove the cover from the main body of the fuel filter.

2) Remove the spring and cage from the main body of the fuel filter.

3) Remove the filter cartridge from the fuel filter body.

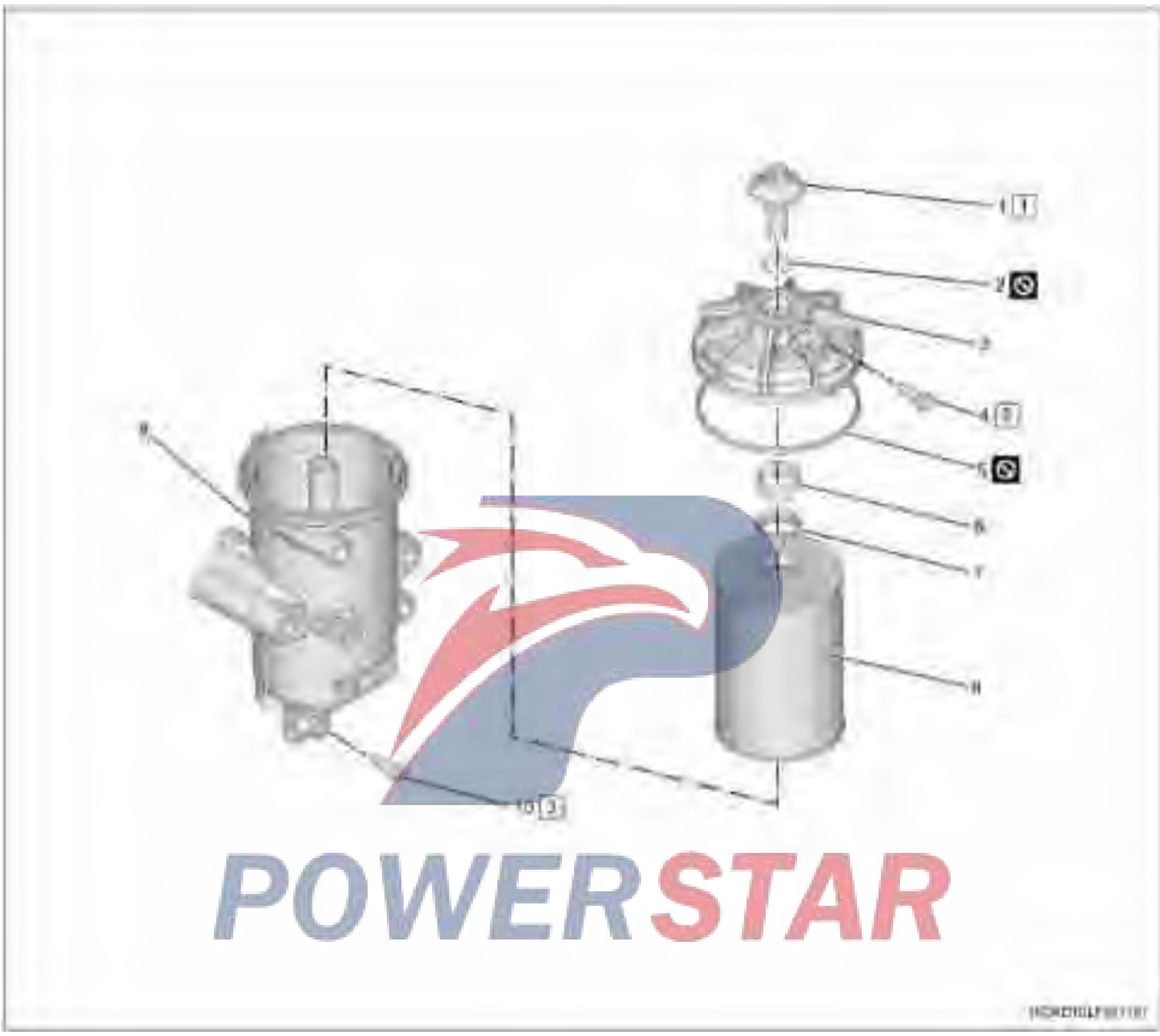
4) Clean the fuel filter body.

POWERSTAR

Installation

1. Component Views

Fuel filter element



POWERSTAR

Part name

1. Center bolt
2. O-ring
3. Cover
4. Deflate valve plug
5. O-ring
6. Spring
7. Bracket
8. Fuel filter cartridge
9. Fuel filter body
10. Drain plug

Tightening torque

1: 29.4 N • m {3.0 kgf • m / 22 lb • ft}

2: 7 N • m {0.7 kgf • m / 62 lb • in}

3: 7 N • m {0.7 kgf • m / 62 lb • in}

4: 2.5 N • m {0.3 kgf • m / 22 lb • in}

2. Fuel filter cartridge installed

1) Install the filter on the fuel filter body.

2) Mount the spring and cage to the fuel filter body.

3) Install the O-ring onto the upper cover groove.

4) Install the upper cover on the fuel filter body and tighten the center bolt.

Caution:

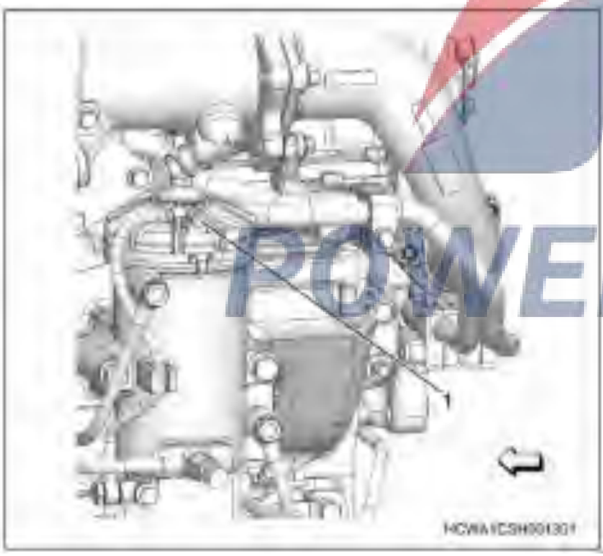
● Do not tighten the center bolt excessively.

Tightening torque: 29 N • m { 3.0 kgf • m / 22 lb • ft }

3. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

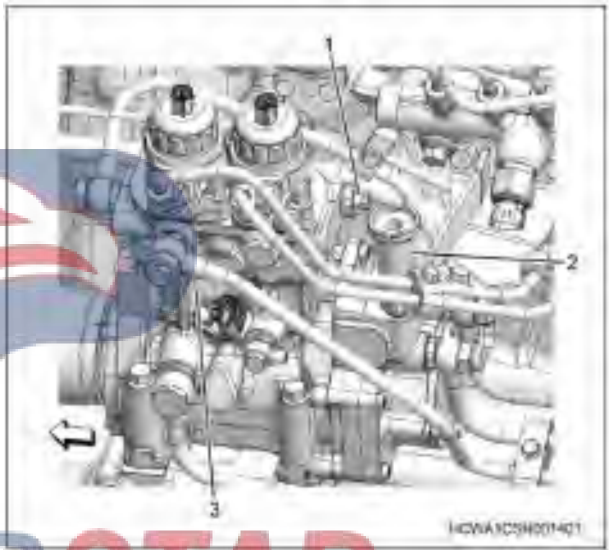
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

4. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

POWERSTAR

Fuel precleaner

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Fuel emissions

1) Remove the tank filler cap from the fuel tank.

2) Pull out the oil drain plug to allow the fuel to drain out of the fuel tank.

3) Install the drain plug on the fuel tank.

Tightening torque: 29 N • m {3.0 kgf • m / 21 lb • ft}

3. Fuel pre-filter removed

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Disconnect the fuel pre-cleaner's fuel supply hose.

3) Disconnect the fuel pre-cleaner fuel return hose connection.

4) Remove the fuel precleaner from the frame.

POWERSTAR

Installation

1. Fuel pre-filter installation

1) Install the fuel precleaner on the frame.

2) Install the return hose to the fuel prefilter.

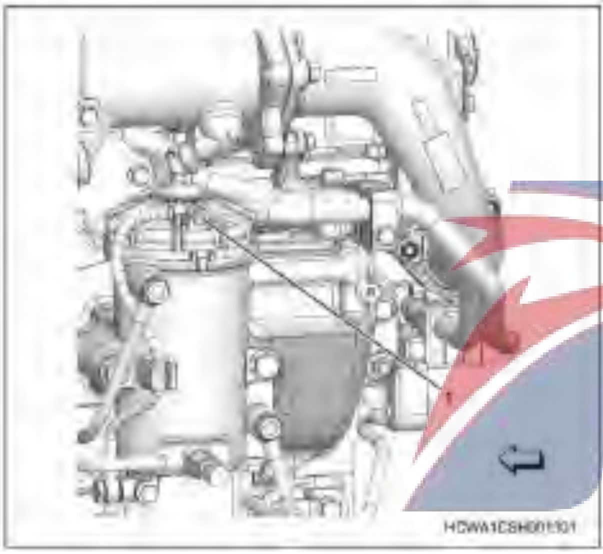
3) Install the fuel supply hose to the fuel precleaner.

4) Connect the connector to the water sedimentation separator switch.

2. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m {0.7 kgf • m / 62 lb • in}

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

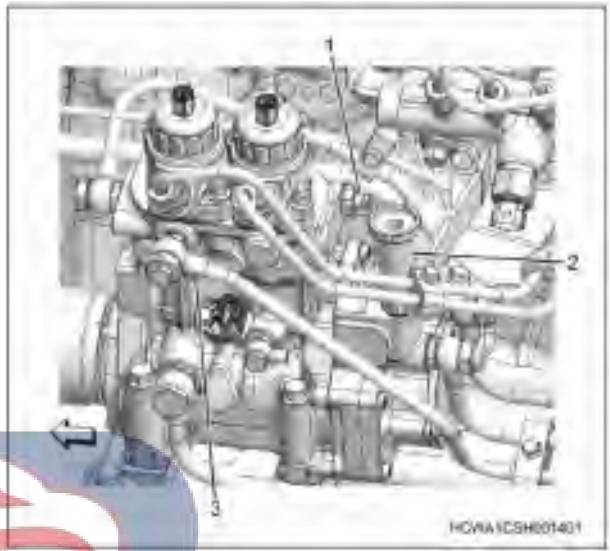
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m {0.6 kgf • m / 53 lb • in}

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

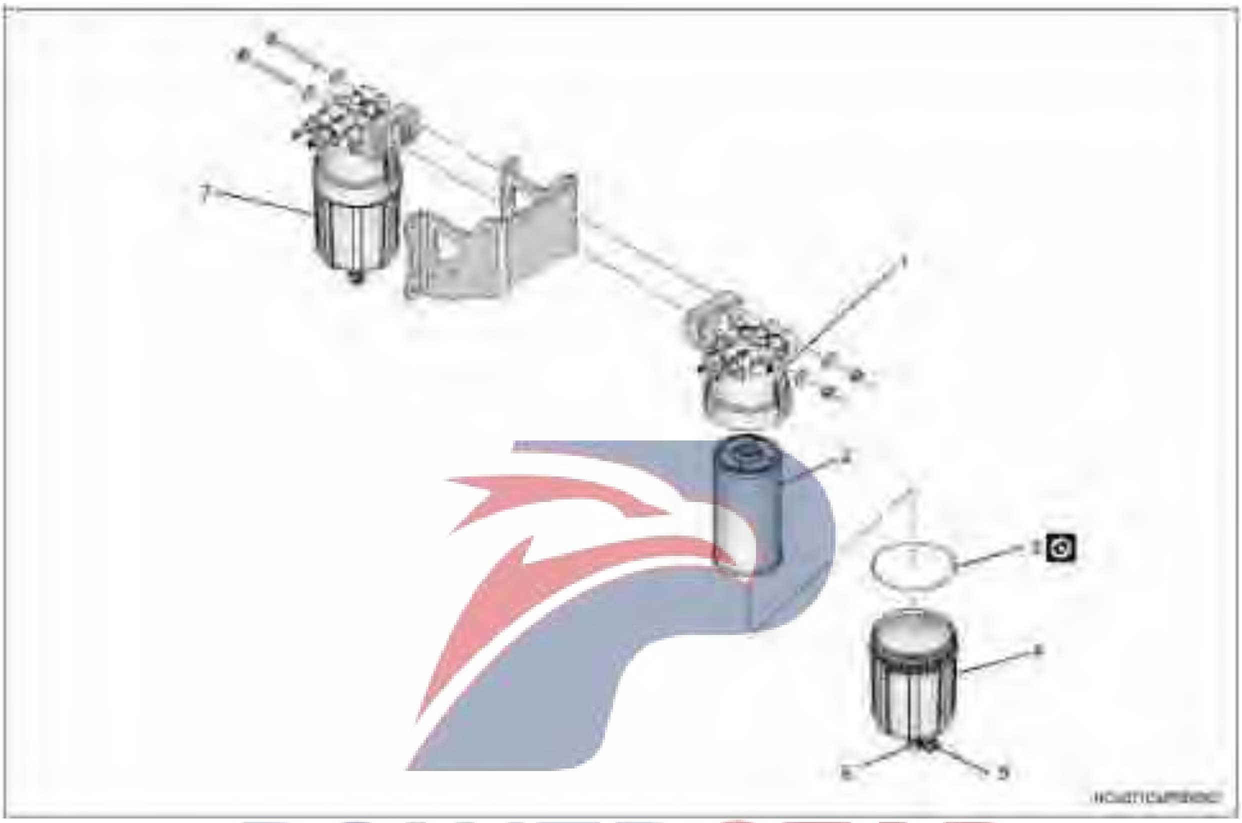
POWERSTAR

Fuel precleaner filter

Removal

1. Component Views

Fuel precleaner filter



POWERSTAR

Part name

1. Fuel filter body
2. Fuel pre-filter element
3. O-ring
4. Component housing
5. Drain plug
6. Precipitator switch connector
7. Fuel pre-filter

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Fuel pre-filter cartridge removed

1) Loosen the drain plug to drain the fuel from the fuel precleaner.

2) Disconnect the harness connector of the water settler separator switch.

3) Remove the filter housing from the fuel filter body.

Caution:

● Slowly rotate the cartridge housing counterclockwise to remove it.

4) Remove the fuel filter from the fuel filter body.

5) Remove the O-ring from the cartridge housing.

Inspection

1. Fuel pre-filter check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check component box for damage.

2) Check if the fuel filter body is clogged.

1. Check the sedimentation separator float switch.

1) Fill the fuel prefilter with distilled water.

Note:

● Injection 80 - 120 cc {0.0176 - 0.0264 Imp.

gal} Distilled water and removed float.

2) Check the warning indicator work.

POWERSTAR

Installation

1. Fuel filter pre-filter installation

Caution:

● If the fuel filter is covered with water, drain the water.

● Do not operate the vehicle without emptying the water to avoid damage to the fuel injection system.

1) Apply new gasoline or engine oil to new o-rings.

2) Install the O-ring on the component case.

Caution:

● Use caution when installing the O-ring to avoid damaging the O-ring.

3) Install the fuel prefilter element on the component box.

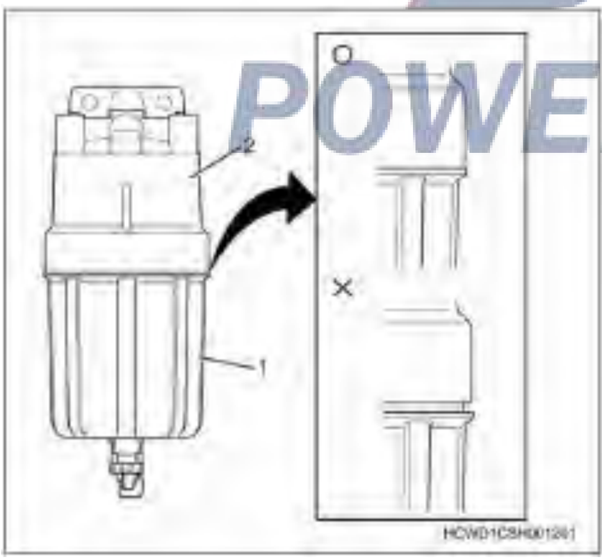
4) Install the fuel pre-filter element and component case on the fuel filter.

Note:

● Turn clockwise until it contacts the main body of the fuel filter and install it.

Caution:

● Do not block the O-ring.



1. Component housing
2. Fuel filter body

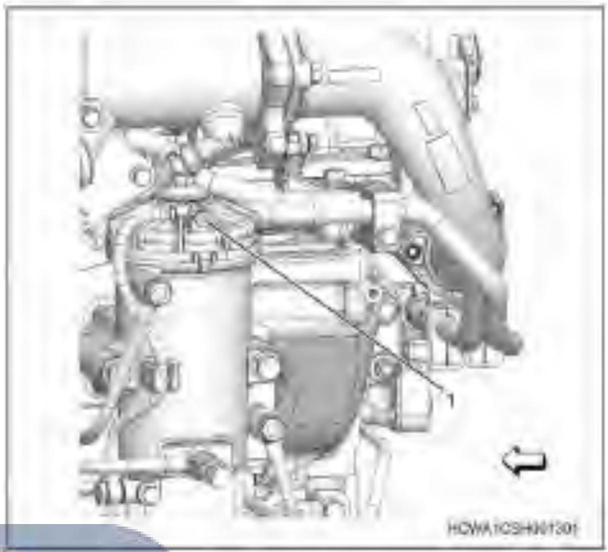
5) Connect the connector to the water sedimentation separator switch.

6) Install the oil drain plug on the fuel precleaner.

2. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m {0.7 kgf • m / 62 lb • in}

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

6) Operate the priming pump until large bubbles are no longer formed.

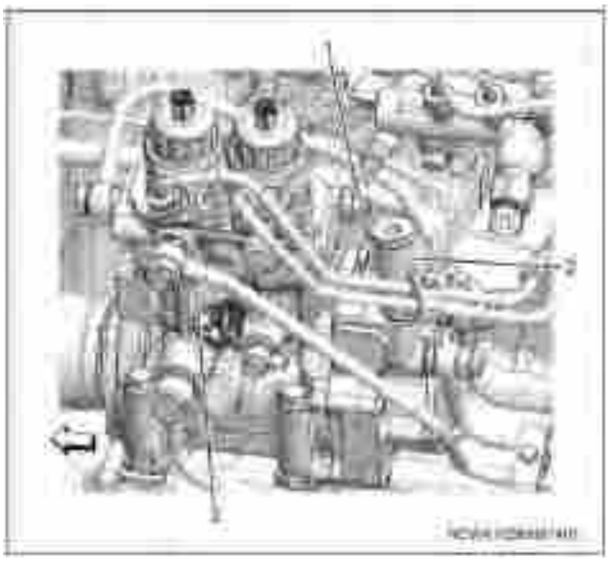
7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m {0.6 kgf • m / 53 lb • in}

Caution:

● Do not excessively tighten the bleeder screw.

POWERSTAR



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

Tighten the cover.

Carefully clean the spilled fuel.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

POWERSTAR

Fuel injector

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

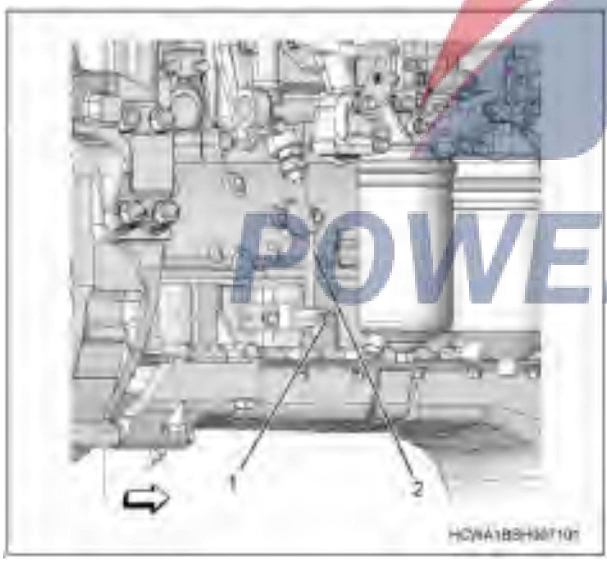
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is may of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.

1. Drain plug

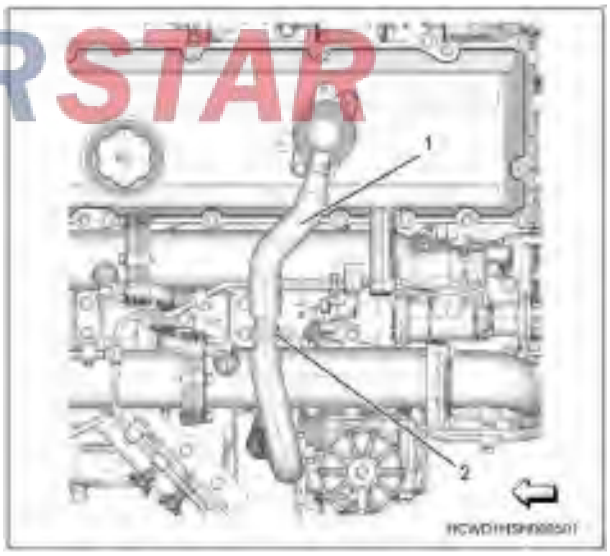
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



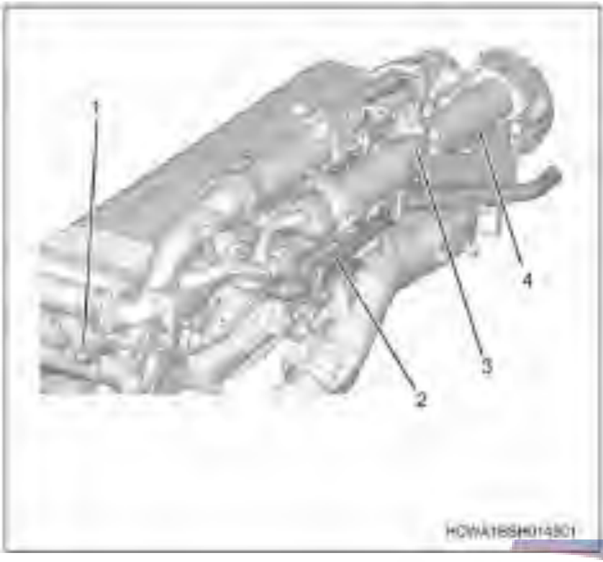
1. Ventilation hose

2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

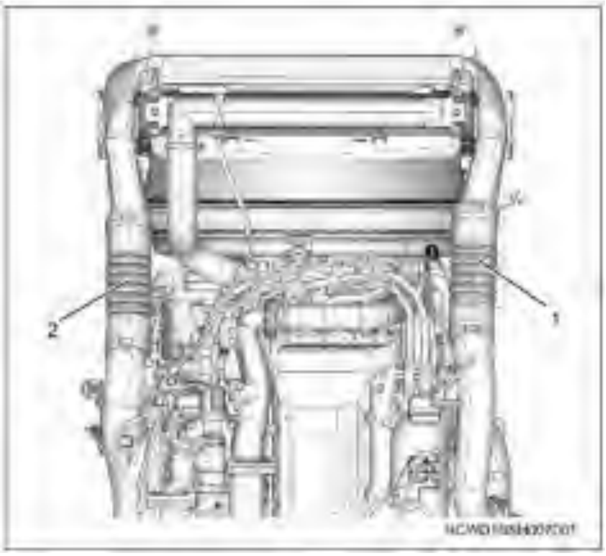
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

7. Intake duct removal

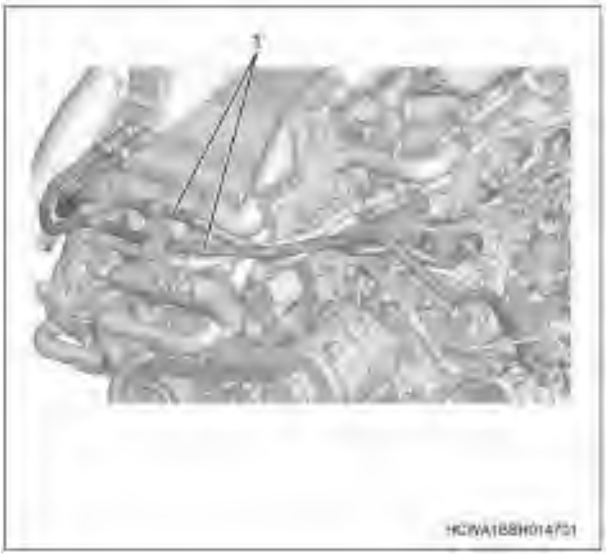
1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.

8. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

POWERSTAR

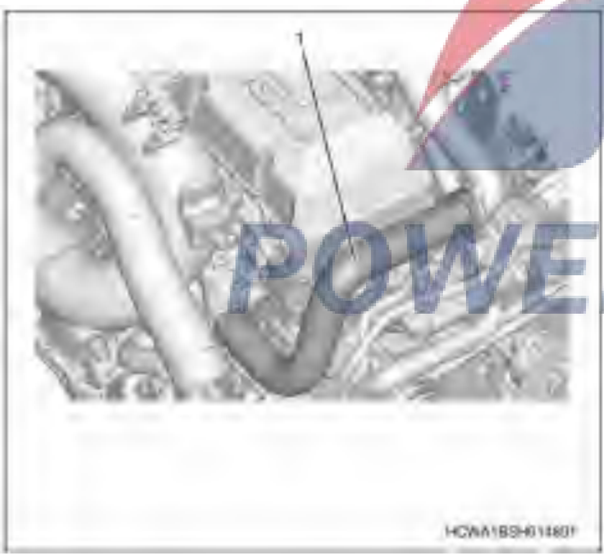


1. Exhaust pipe

9. EGR cooler removal

1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



1. Exhaust gas recirculation line A

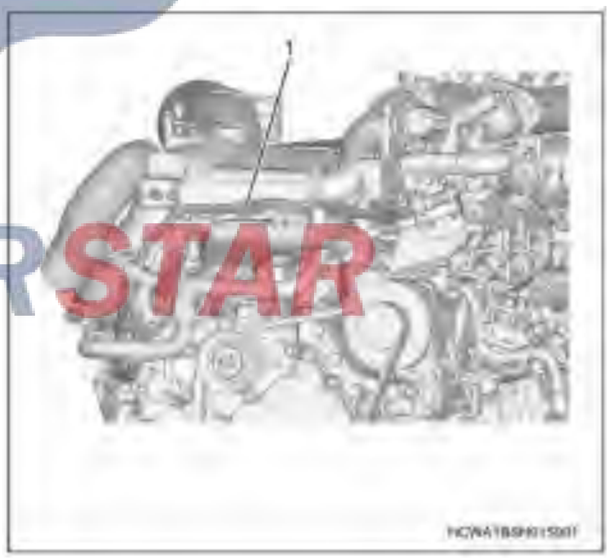
3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

1. Standard bolt

2. Exhaust gas recirculation line B

3. High temperature steel flange bolts

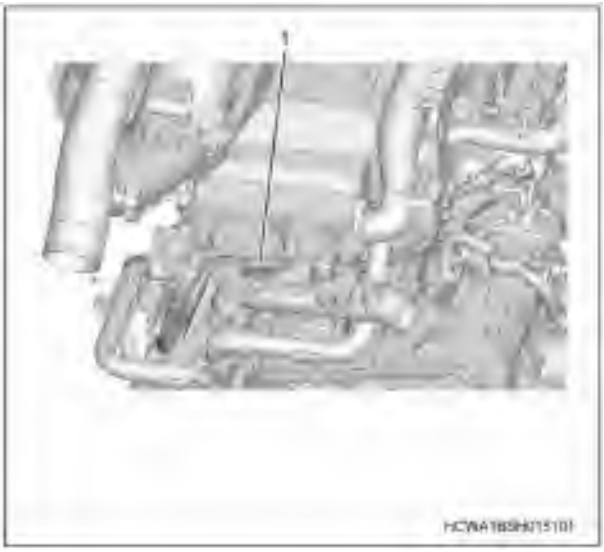
4) Remove the front exhaust gas recirculation cooler hose on the pump.



1. Front exhaust gas recirculation cooler hose

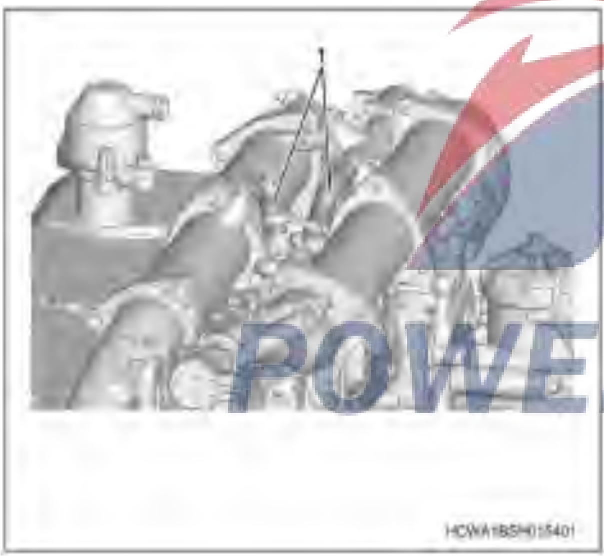
5) The back-end water supply pipe removed from the pump.

POWERSTAR



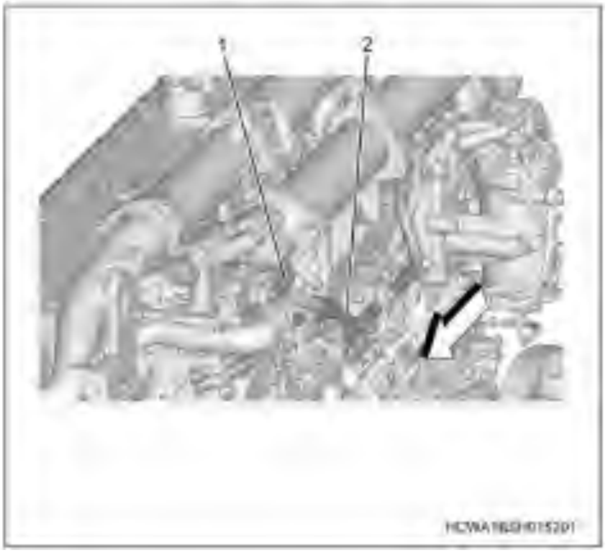
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. water feed hose

7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe

2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

1. Front return pipe

2. Back-end return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.

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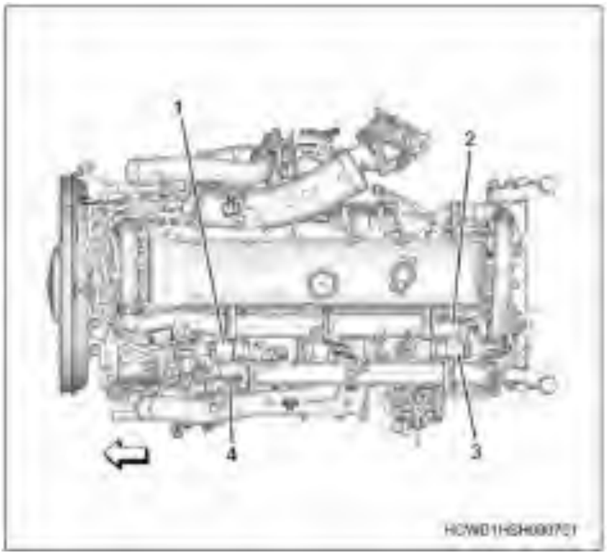


1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

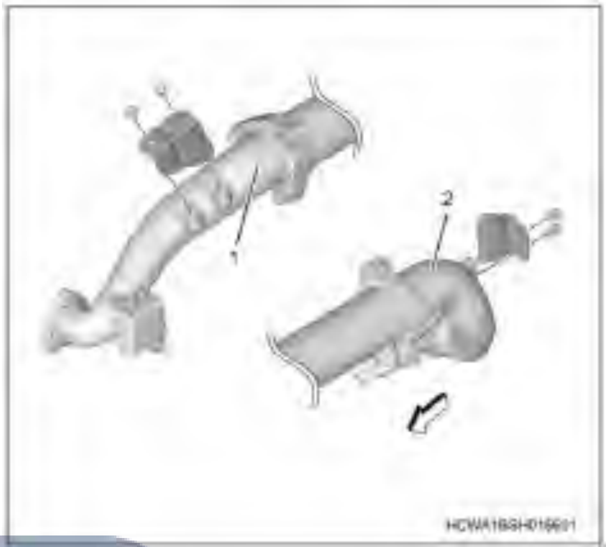
12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.

1. Exhaust gas recirculation cooler duct A

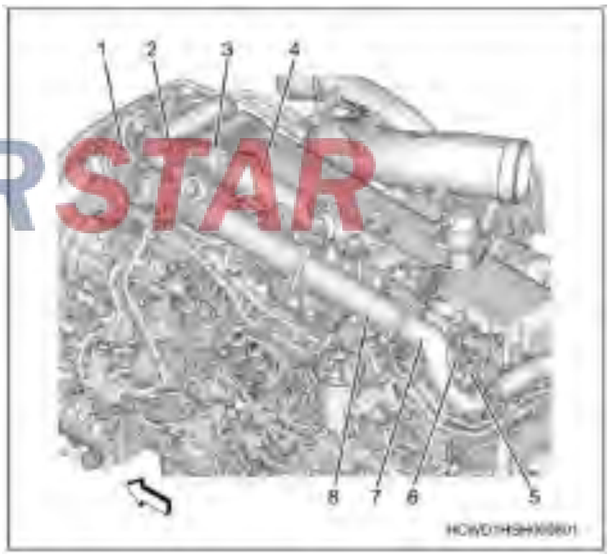
14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A
2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.



1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. Exhaust Gas Recirculation Cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket

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6. Exhaust gas recirculation valve thermal protection device

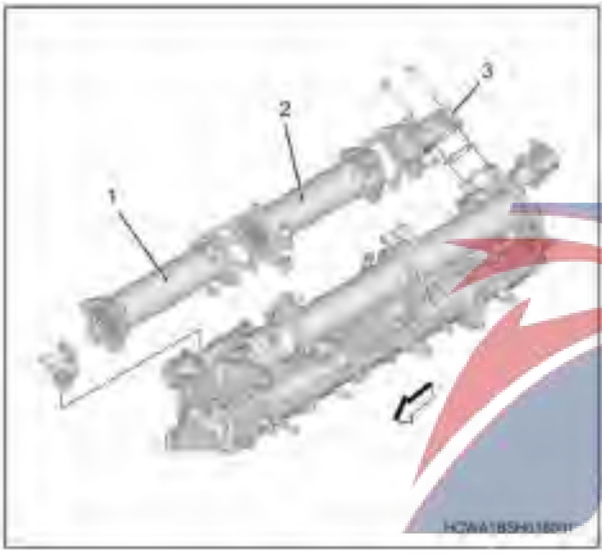
7. Exhaust Gas Recirculation Cooler duct C

8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler support on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

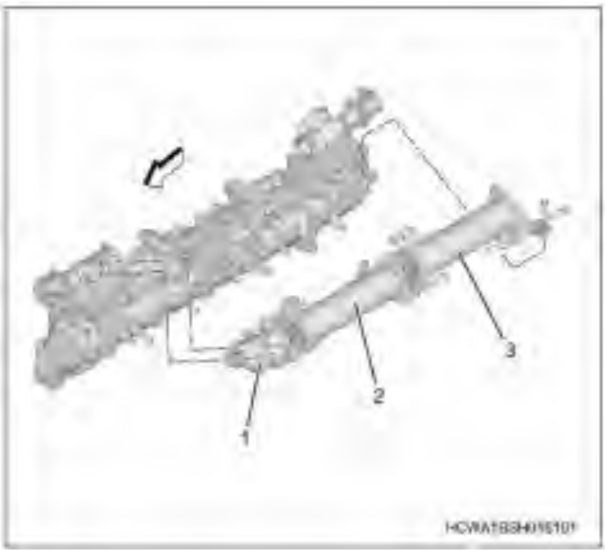


1. EGR cooler A.

2. EGR cooler B

3. Exhaust Gas Recirculation Cooler B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



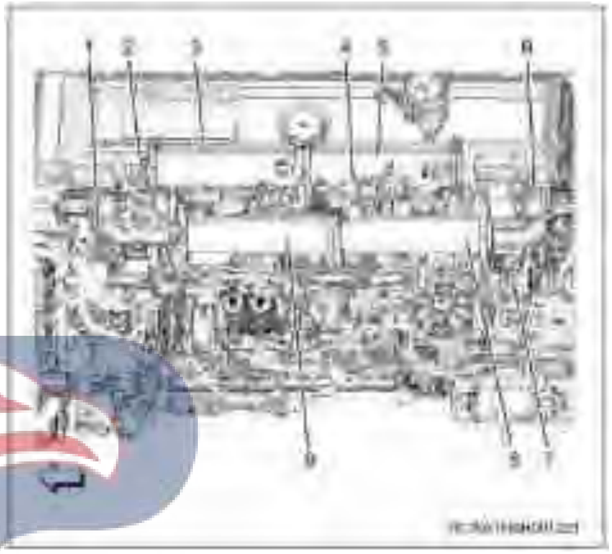
1. Exhaust gas recirculation cooler duct D

2. EGR cooler D

3. EGR cooler C.

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.



1. EGR valve 2

2. Exhaust gas recirculation cooler bracket

3. EGR cooler A.

4. Leakage bracket

5. EGR cooler B.

6. EGR valve 1

7. Exhaust gas recirculation cooler bracket

8. EGR cooler C

9. EGR cooler D

10. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

11. Discharge oil drain pipe

1) Disconnect the fuel drain on the fuel supply pump.

2) Disconnect the fuel drain hose from the fuel filter.

12. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

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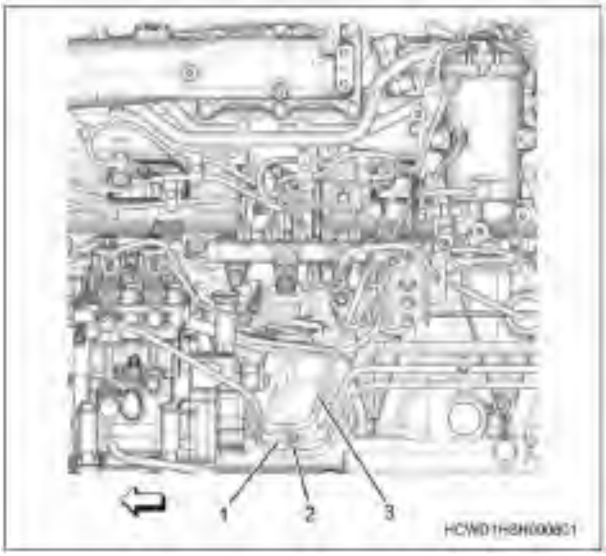
3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

13. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

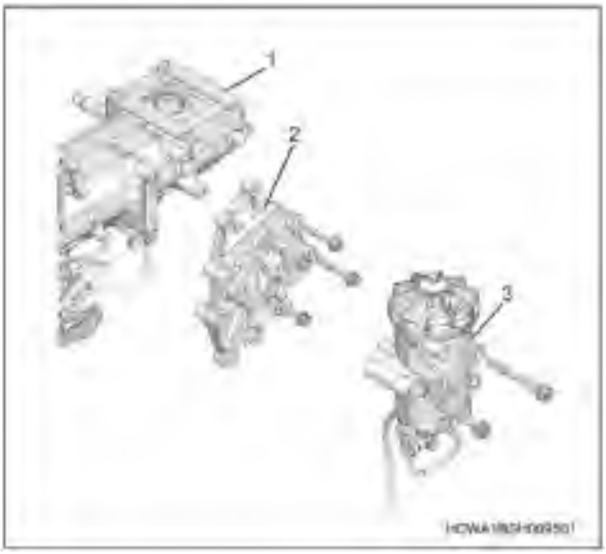
3) Remove the fuel pipe from the fuel supply pump.

14. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.

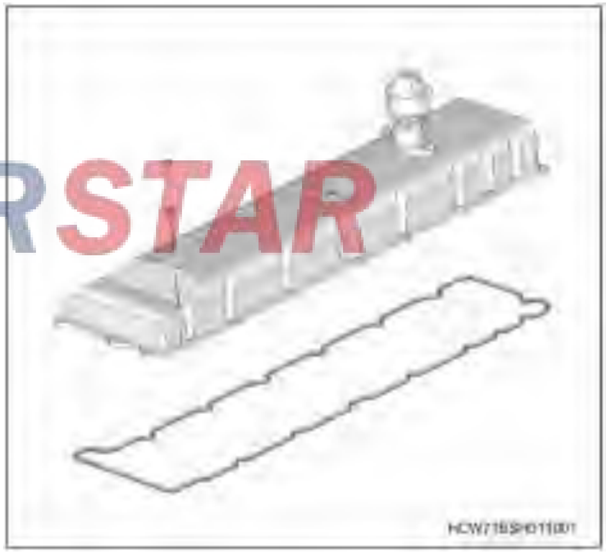


1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

15. Cylinder head cover removal

1) Remove the cylinder head from the lower cover.

2) Remove the gasket from the cylinder head cover.



16. Injector removal

1) Remove the injector tube from the injector and common rail (fuel rail).

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.

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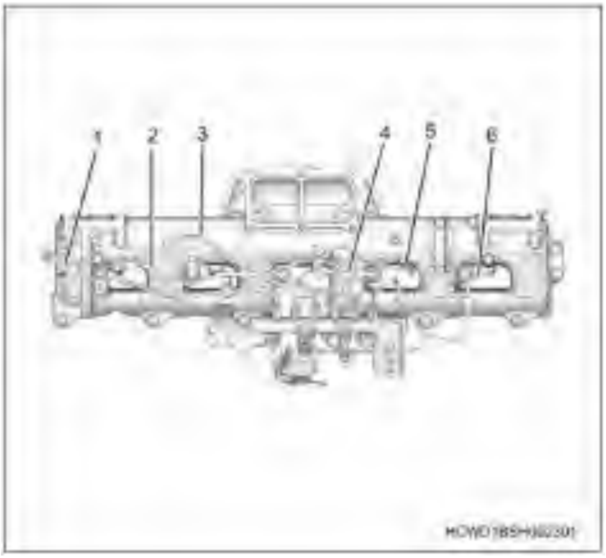


1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

17. Injector harness removal

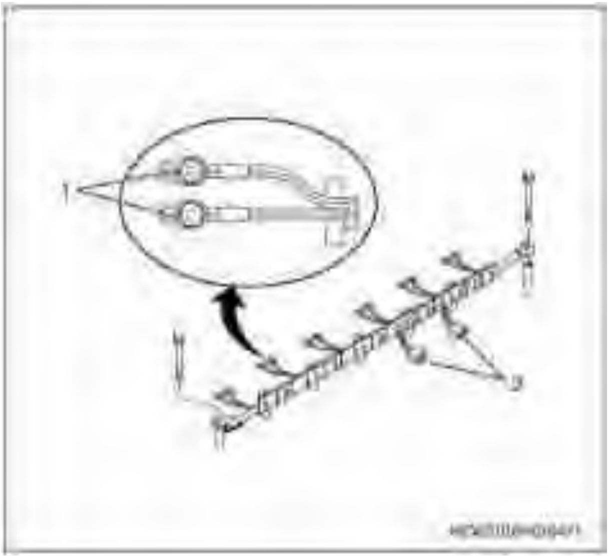
1) Remove the injector nut

2) Remove the injector harness

Caution:

● Because the injector ID code plate comes off, do not mix with other injector ID code plates.

3) Remove the bolts on the injector harness.



1. Injector terminal nut
2. Connector

18. Fuel leak-off pipe removal

1) Disconnect the adapter from the leak line.

2) Remove the leak line from the fuel injector.

Caution:

● Do not reuse the gasket.

1. Fuel leak-off pipe

3) Remove the lower cover adapter.

4) Remove the connector from the bottom cover.

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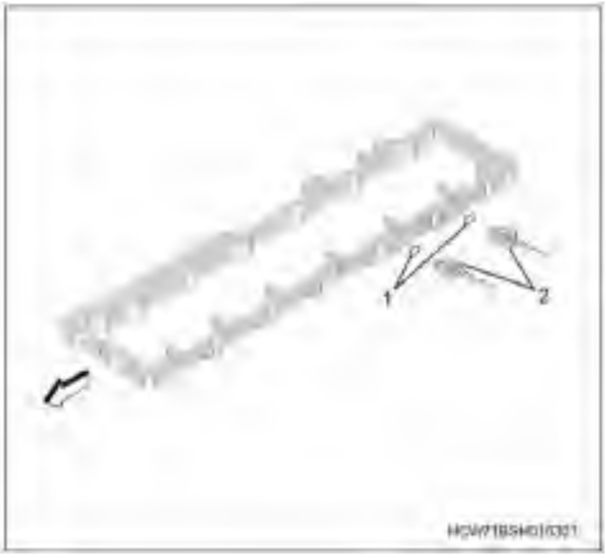


1. O-ring

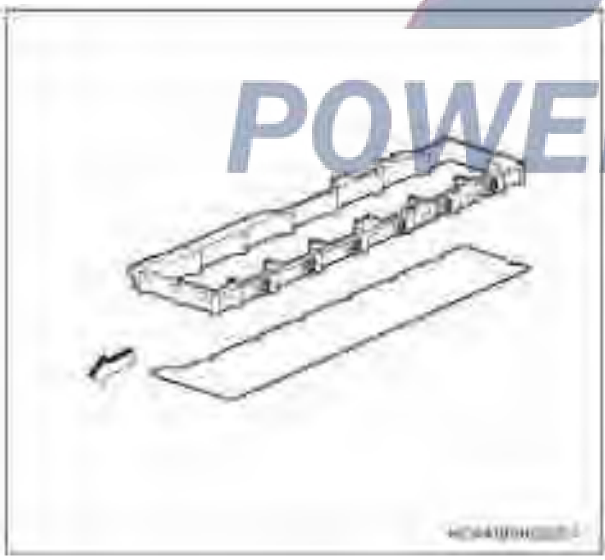
2. Connector

5) Remove the lower cover from the cylinder head.

Caution:

● If the engine leaks a small amount of oil during disassembly, wipe it with the industrial cloth for the workshop.

6) Remove the gasket from the lower end cap.



19.injector removal

1) Remove the clamp from the cylinder head.

2) Remove the injector from the cylinder head with special tools.

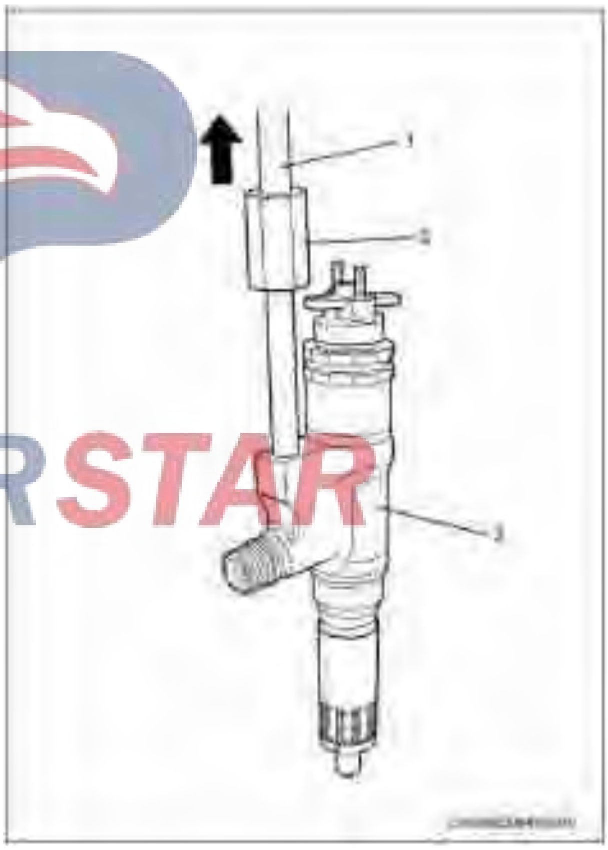
Caution:

● Do not touch the injector's electromagnetic area to prevent performance degradation and damage.

● Do not remove the injector ID code plate.

SST: 5-8840-2826-0 - injector remover

SST: 5-8840-0019-0 - sliding hammer



1. 5-8840-0019-0

2. 5-8840-2826-0

3. Injector

3) Remove the gasket from the cylinder head cover.

Caution:

● Do not reuse the gasket.

4) Place the numbered label on the injector.

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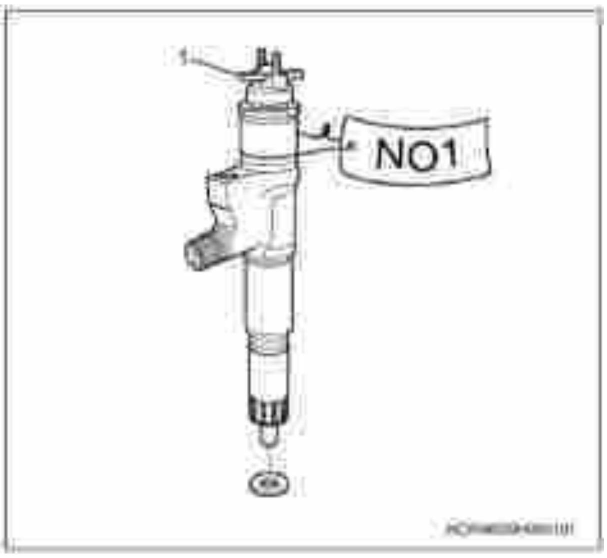

1. Injector

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Inspection

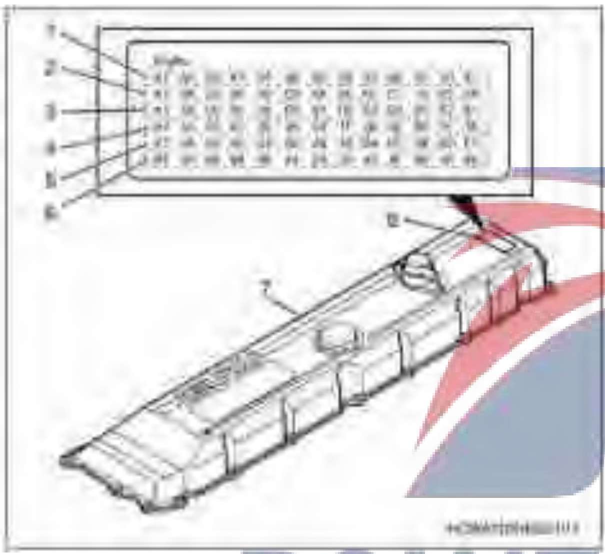
1. Injector check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check injector for dirt or damage.

Caution:

● If a fuel injector has been replaced, use a black marker to erase the replacement cylinder identification number attached to the Injector ID Code label on the cylinder head.



1. Cylinder No.1 Injector ID Code
2. Cylinder No.2 Injector ID Code
3. Cylinder No.3 Injector ID Code
4. Cylinder No.4 Injector ID Code
5. Cylinder No.5 Injector ID Code
6. Cylinder No.6 Injector ID Code
7. Cylinder head cover
8. Injector ID Code label

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Installation

1. Injector installation

1) Install the gasket to the injector.

Caution:

● Do not reuse the gasket.

2) Install the injector to the cylinder head.

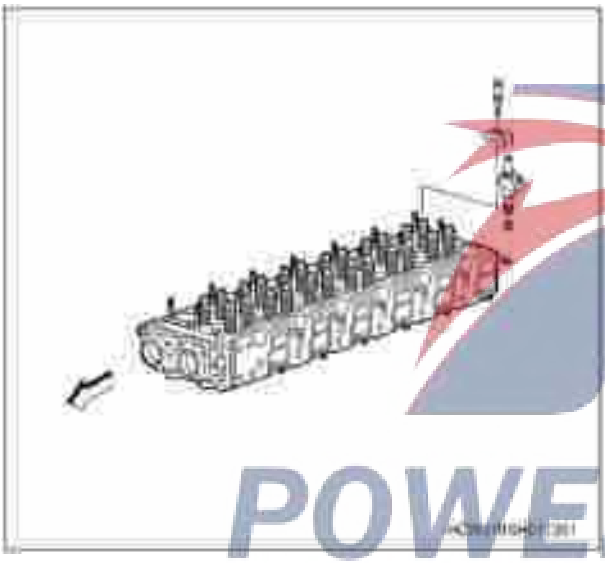
Note:

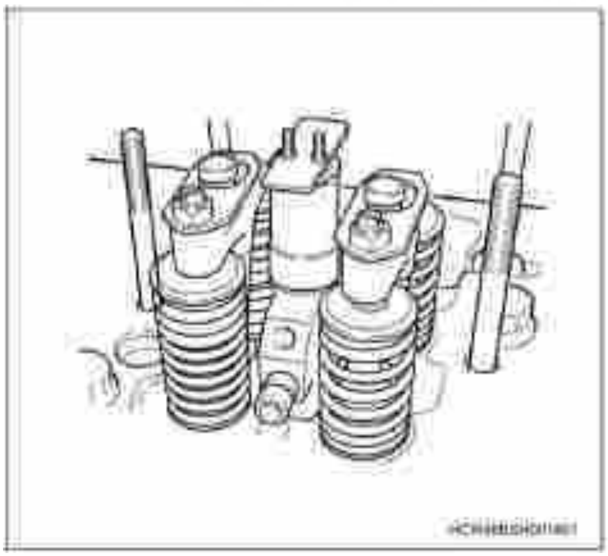
● Temporarily tighten the injector and finally tighten the injection line after installation.

Caution:

● Do not remove the injector ID code plate.

● Carefully remove carbon in the sleeve.





3) Temporarily fasten the injector clamp on the injector.

2. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

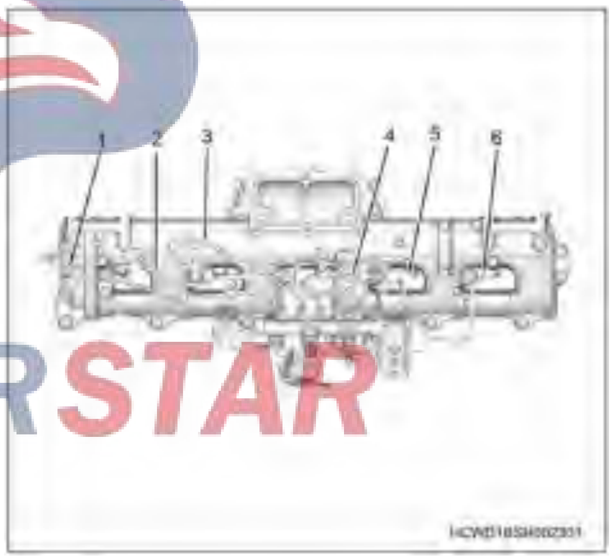
Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

4) Fasten the injector clamp on the injector.

Tightening torque: 49 N • m {5.0 kgf • m / 36 lb • ft}

5) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

3. Injector leak-off pipe installation

1) Refer to the corresponding chart and apply the liquid gasket to the top of the cylinder head.

Liquid gasket application procedure

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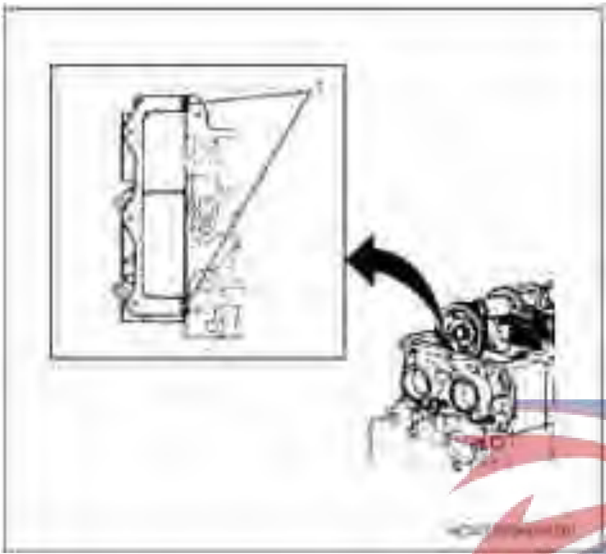
Liquid gasket used	Instructions
Three keys 1207 or similar glue	Application thickness: 2 mm {0.079 in}
	Application width: 5 mm {0.197 in}



1. Liquid gasket application area

2) Install the gasket on the lower end cap.

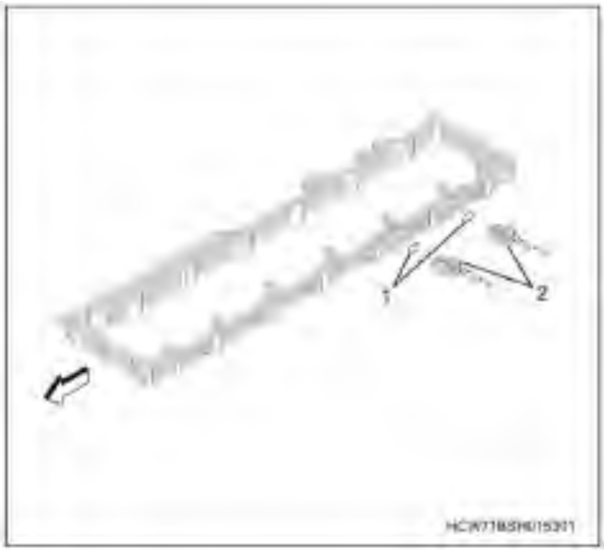
3) Install the lower end cap onto the cylinder head.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

4) Install the O-ring onto the connector.

5) Install the connector on the lower cover.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}



1. O-ring

2. Connector

6) Install the adapter on the lower cover.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

7) Temporarily fasten the drain hose to the fuel injector.

Caution:

● Install the gasket firmly.

● Do not reuse the gasket.

8) Temporarily fasten the drain tubing to the adapter.

Caution:

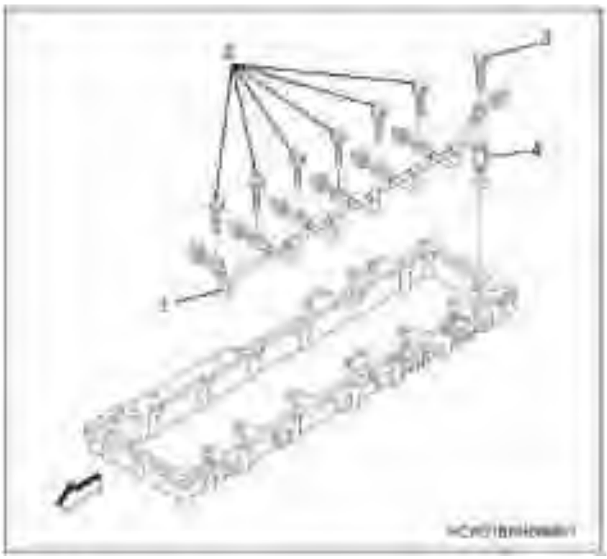
● Install the gasket firmly.

9) Fasten the drain pipe to the fuel injector.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}

10) Fasten the drain pipe to the adapter.

Tightening torque: 34.5 N • m { 3.5 kgf • m / 25 lb • ft }



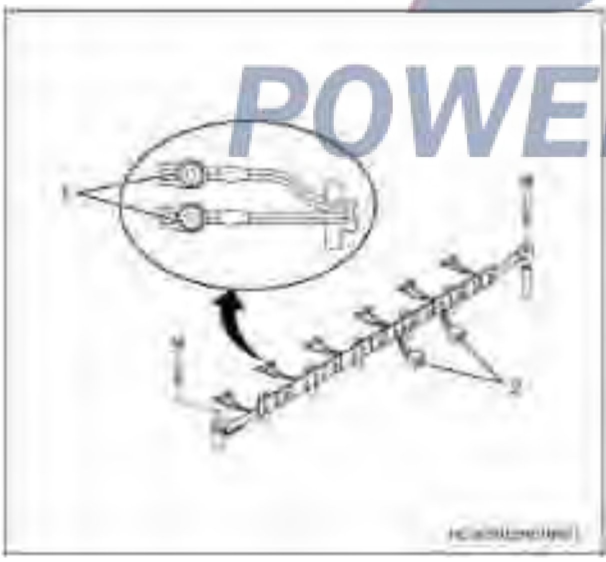
1. Nozzle spout
2. Eyebolt
3. Eyebolt
4. Adapter

4. Injector harness installation

1) Install the connector on the lower cover.

Caution:

● Securely lock the harness side connector.



1. Injector terminal nut
2. connector

2) Install the injector harness onto the cylinder head.

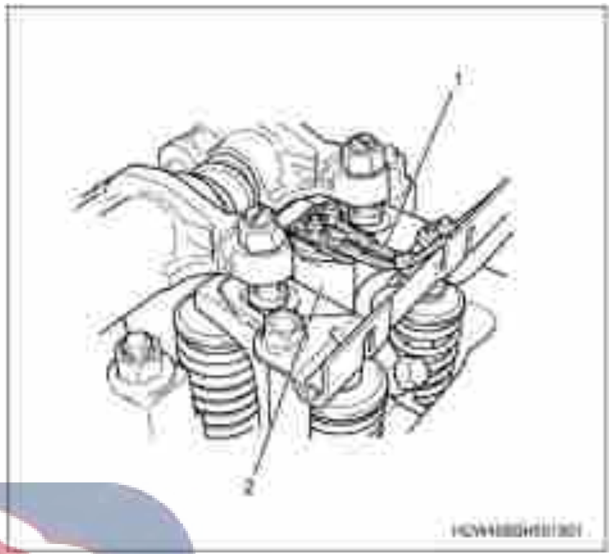
Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

3) Connect the injector terminal nut to the injector.

Tightening torque: 2 N • m {0.2 kgf • m / 16 lb • in}

Caution:

● Because overtightening the nuts may result in damage, strictly adhere to the specified torque.



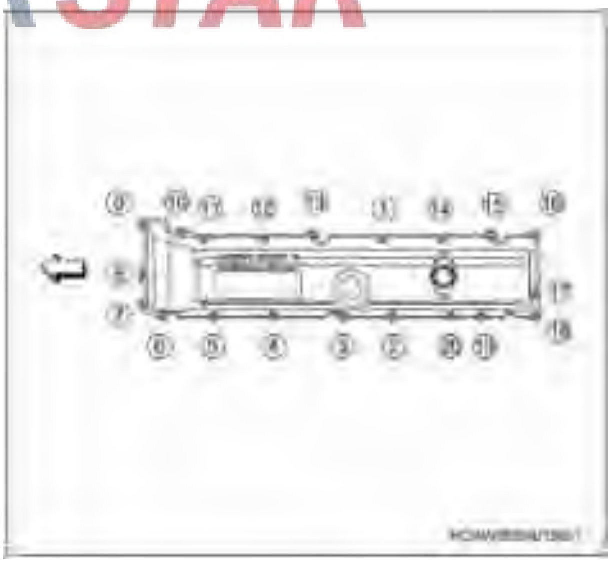
1. Injector harness
2. Injector

5. Cylinder head cover installation

1) Install the gasket to the cylinder head cover.

2) Install the cylinder head cover to the lower cover in numerical order in the figure.

Tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft}



6. Oil filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

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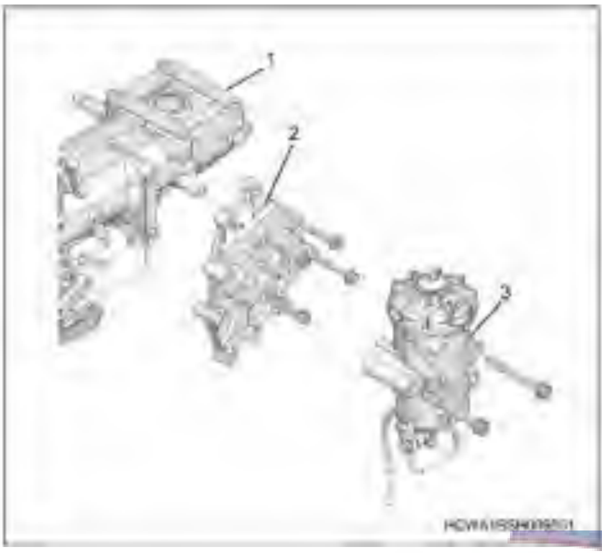
2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m { 9.9 kgf • m / 72 lb • ft }



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

7. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

8. Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb• ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

9. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

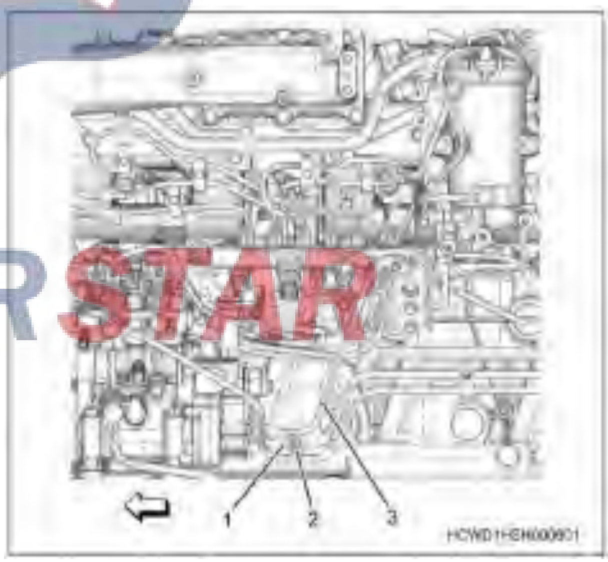
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

10. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

11. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

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● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

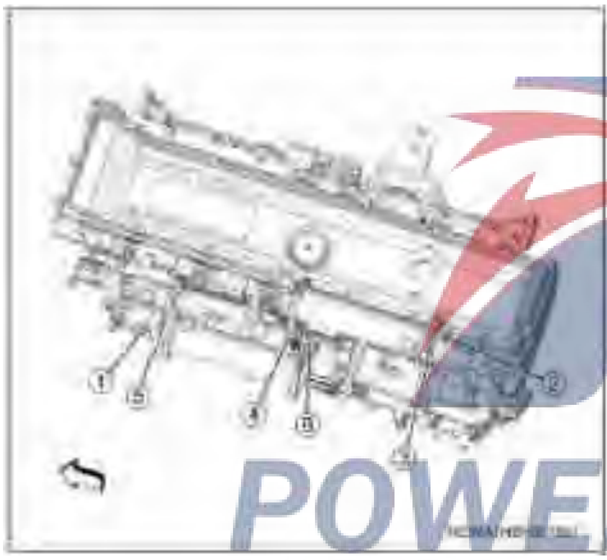
● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

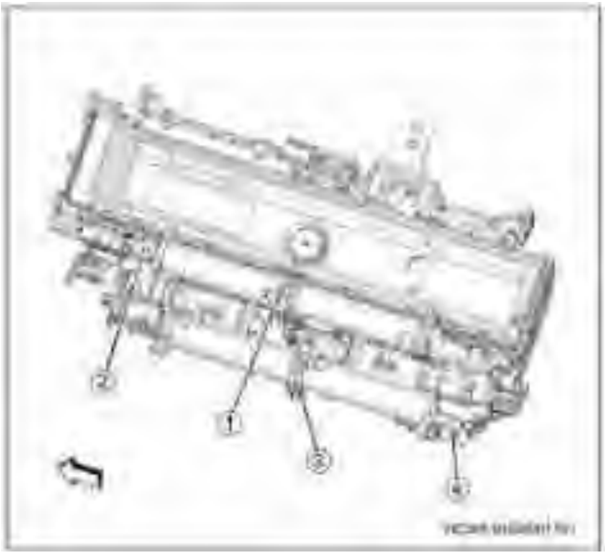
● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

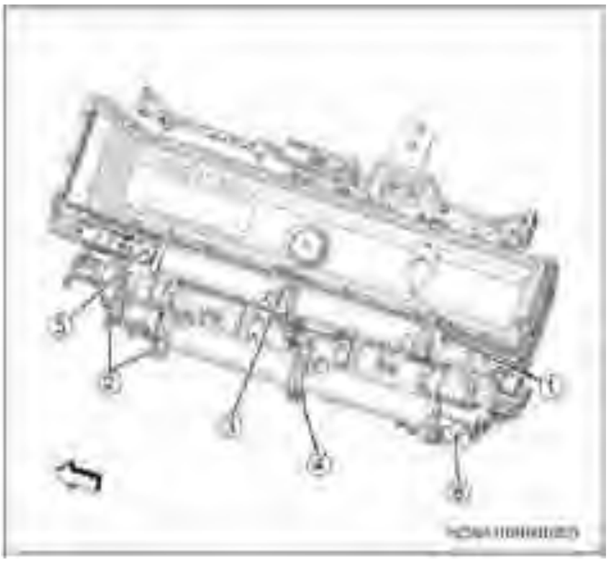
Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 1,2

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 3,4,5 (M10), 6 (M10)

Tightening torque: 25 N • m {3 kgf • m / 18 lb • ft} 5 (M8), 6 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



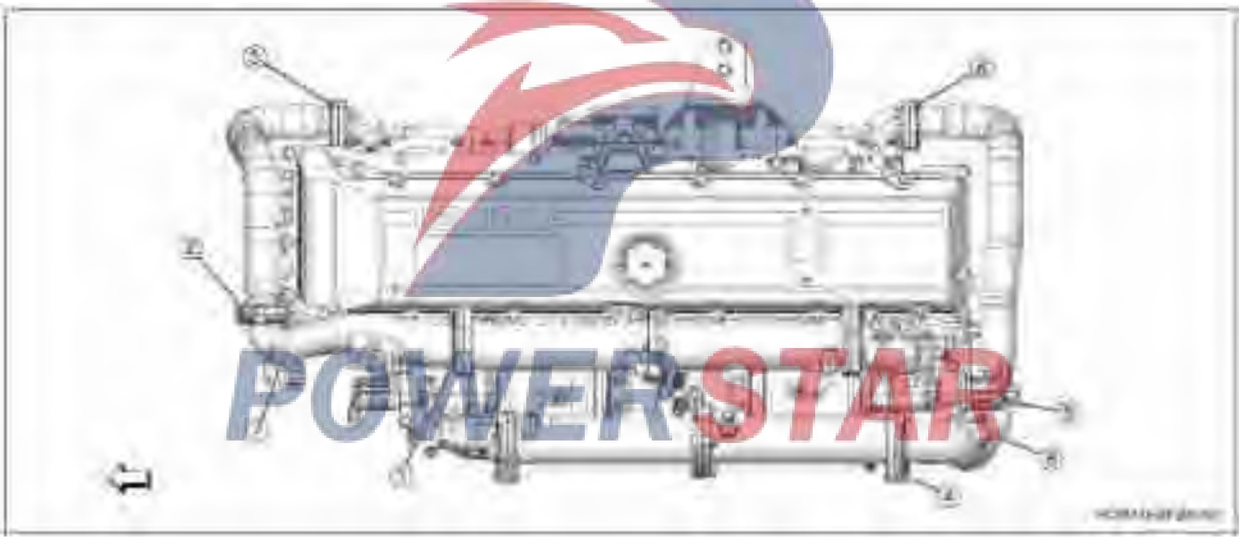
4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

- ● EGR cooler duct A.
- ● EGR duct A
- ● EGR cooler duct C.
- ● EGR duct B.
- ● Bracket

Caution:

- ● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

- ● EGR cooler duct A.
- ● EGR duct A
- ● EGR cooler duct C.
- ● EGR duct B.
- ● Bracket

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 1 (M10), 2,3,9 (M10), 10 (M10)

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 4

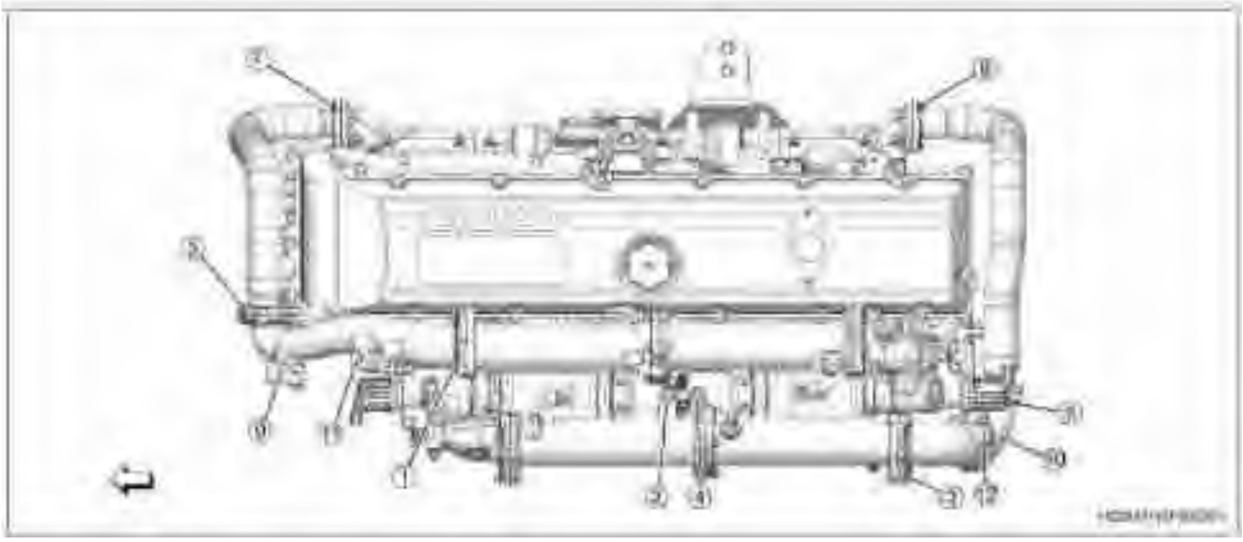
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft} 5,6 (M8), 7,8 (M8), 9 (M8)

Tightening torque: 24.7 N • m {2.5 kgf • m / 18 lb • ft} 10 (M8)

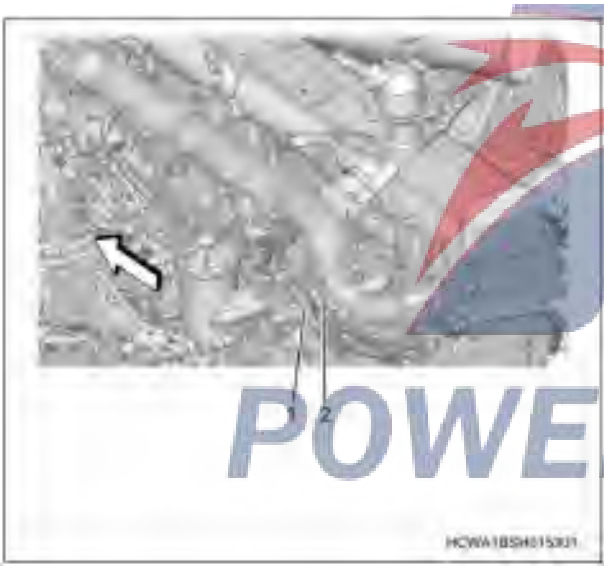
Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft} 11,12 (M8)

Note:

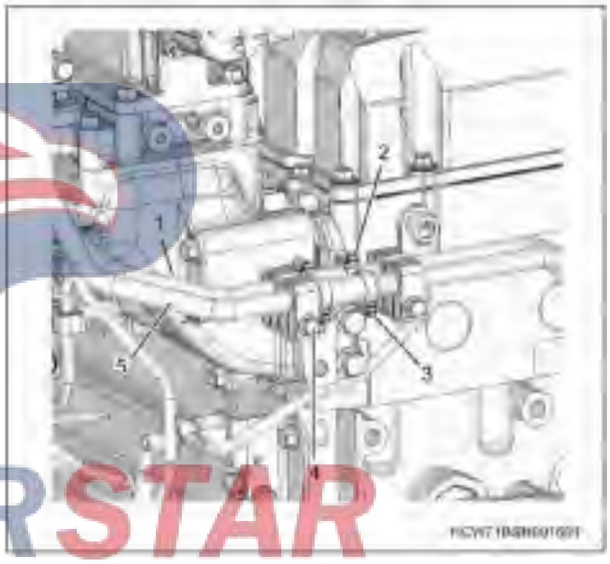
- ● The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front return pipe
2. Back-end return pipe



1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.

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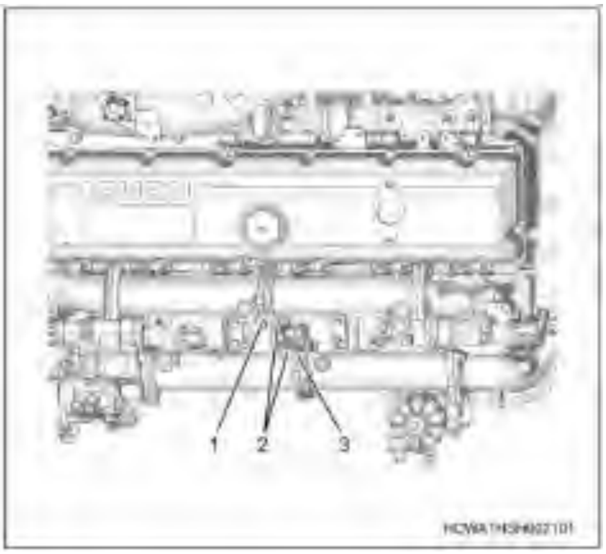
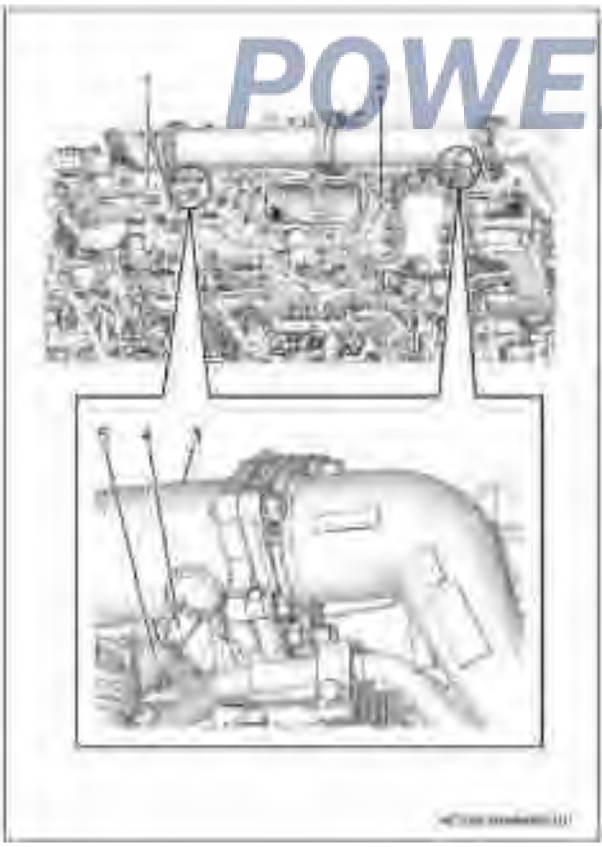


1. Hose clip
2. Water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

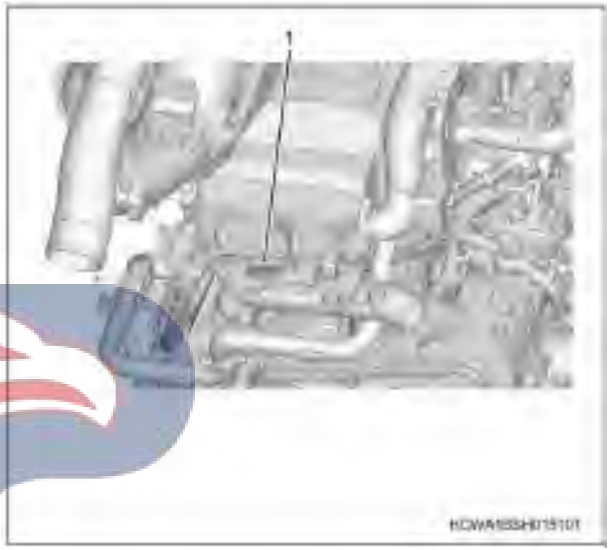
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



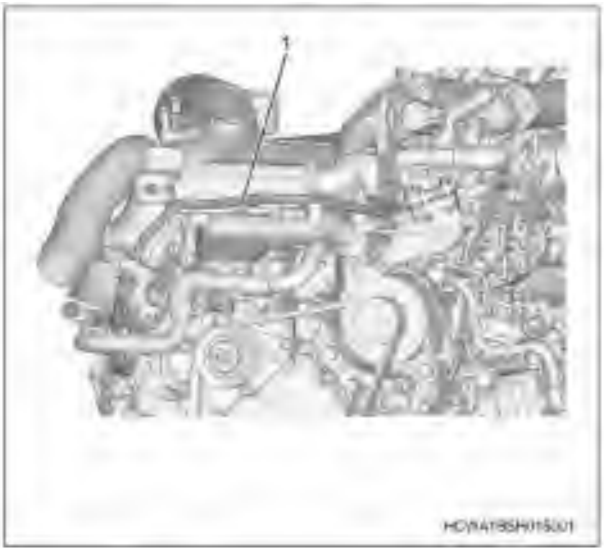
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.

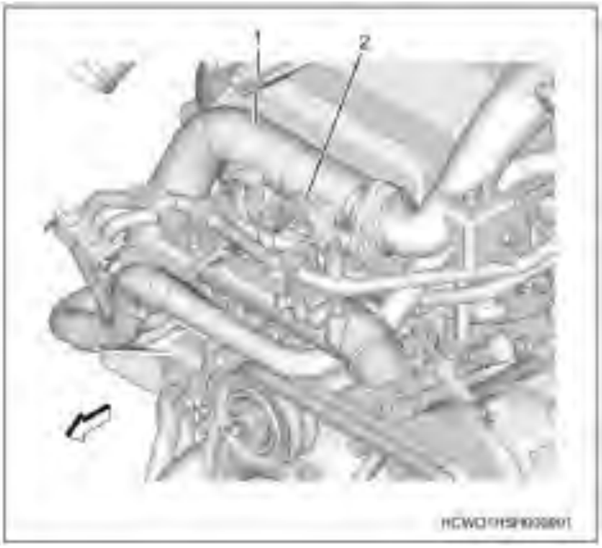


1. Front-end water supply pipe

12. Suction pipe installation

1) Install the bracket on the drain.

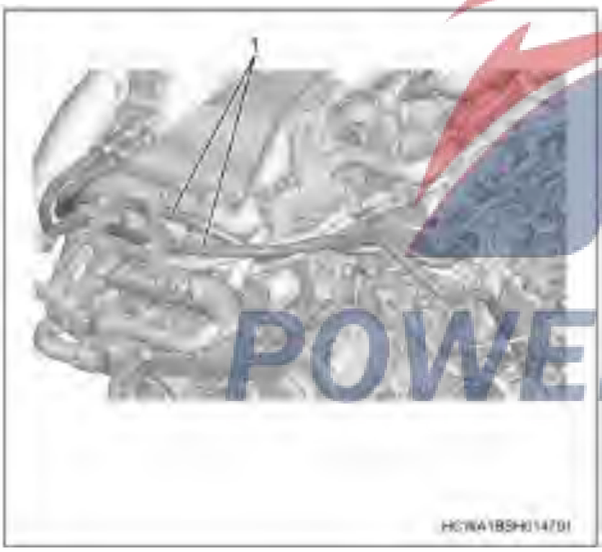
POWERSTAR



1. Front exhaust gas recirculation line

2. Bracket

2) Install 2 air suction tubes to the air compressor.



1. Exhaust pipe

13. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

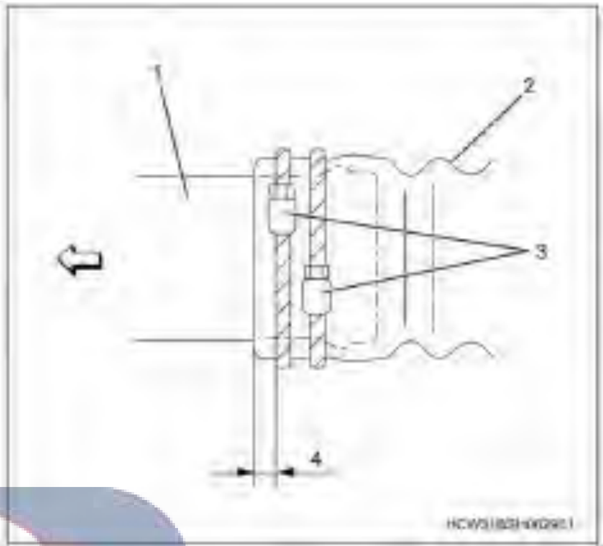
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30°or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb in }



1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

14. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

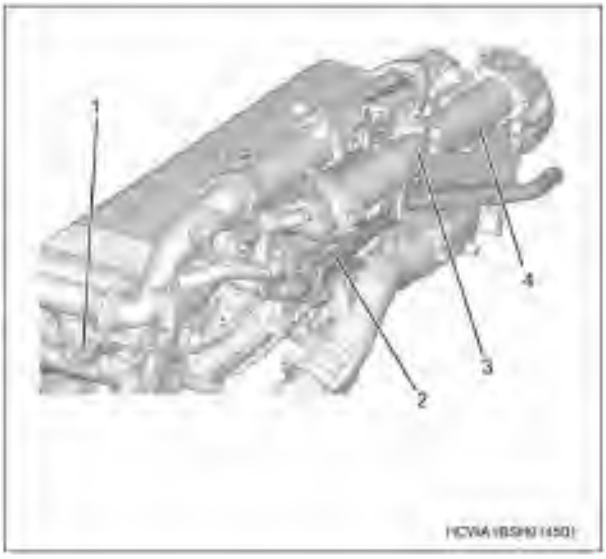
15 leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Eyebolt



1. Outlet pipe

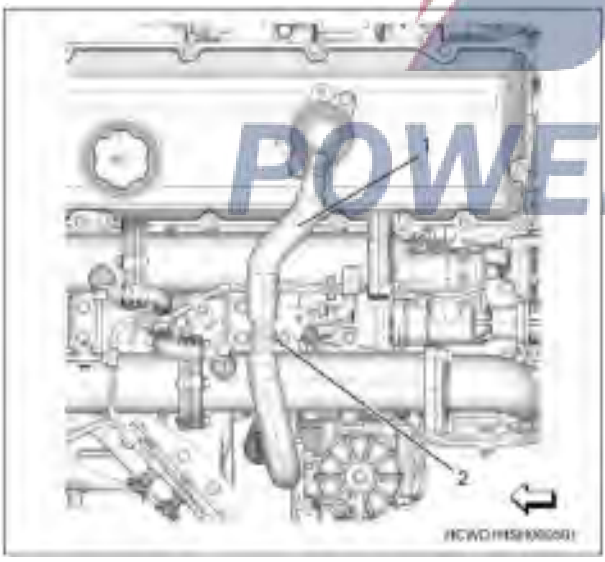
2. Water charge pipe

3. Back-end leakage pipe

4. Front leakage pipe

16. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose

2. Ventilation hose clip

17. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

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14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

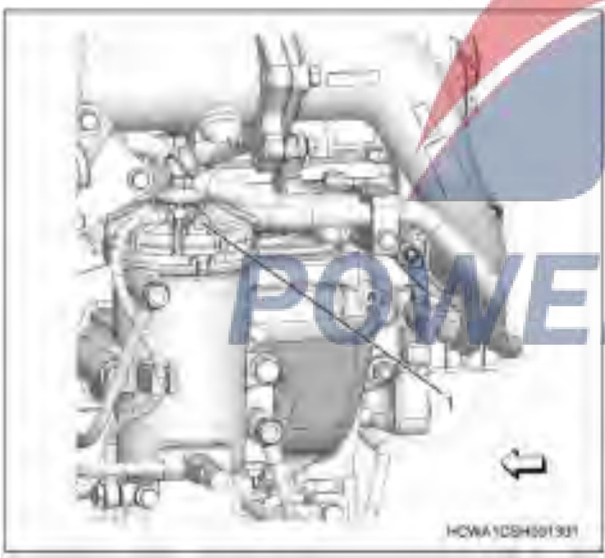
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

18. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

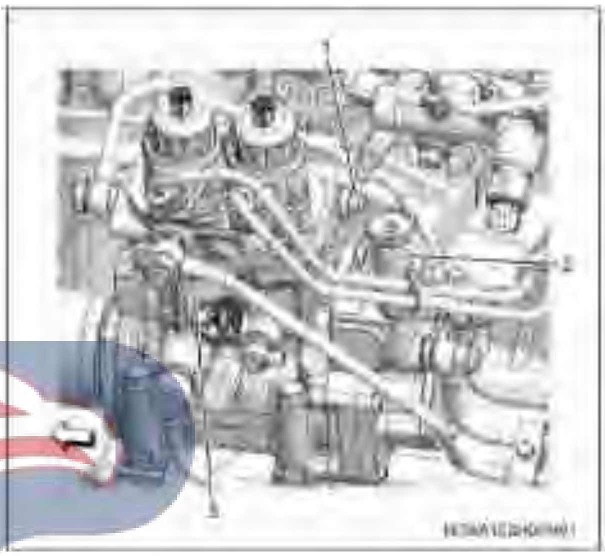
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

19. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

20. ECM setting

1. Write injector ID

Note:

● If you replace the injector, implement injector ID programming.

1) Connect the scanning tool to the data communication link connector.

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2) Turn ON the ignition switch.

3) Select the scan tool item.

- Diagnosis
- Engine
- Engine model
- Programming
- Injector ID Code
- Write the injector identification code

4) Program the Injector ID Code into the ECM by following the instructions on the screen.

5) After the programming is completed, turn OFF the ignition switch.

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Common rail (fuel rail)

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

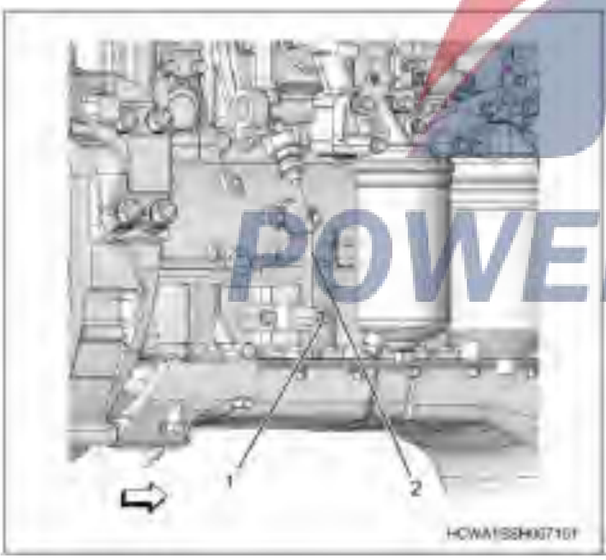
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is may of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.

1. Drain plug

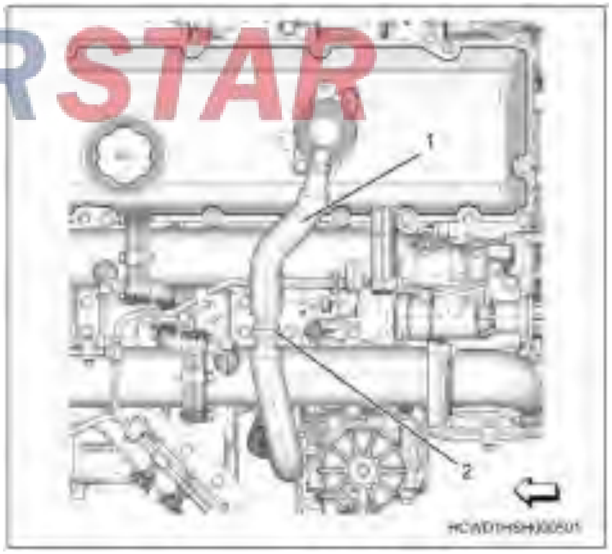
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



1. Ventilation hose

2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

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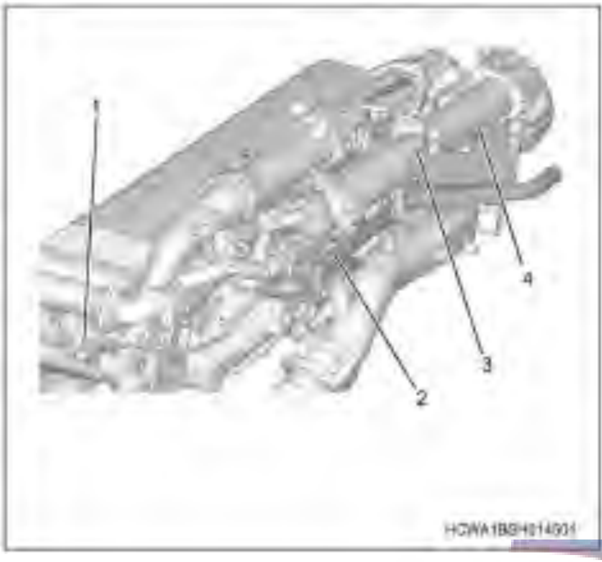
2) Remove the two clips and then remove the rear blow-by tube on the exhaust gas recirculation cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

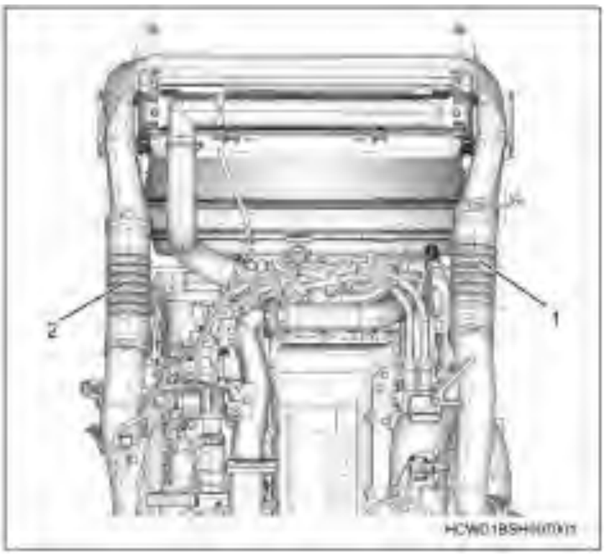
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

7. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.

8. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

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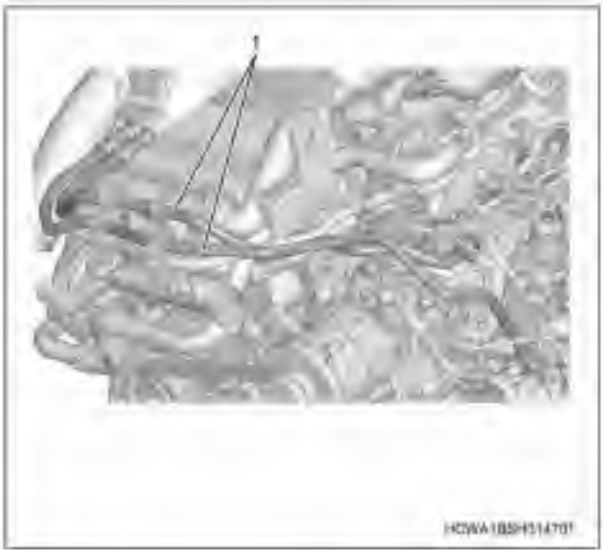
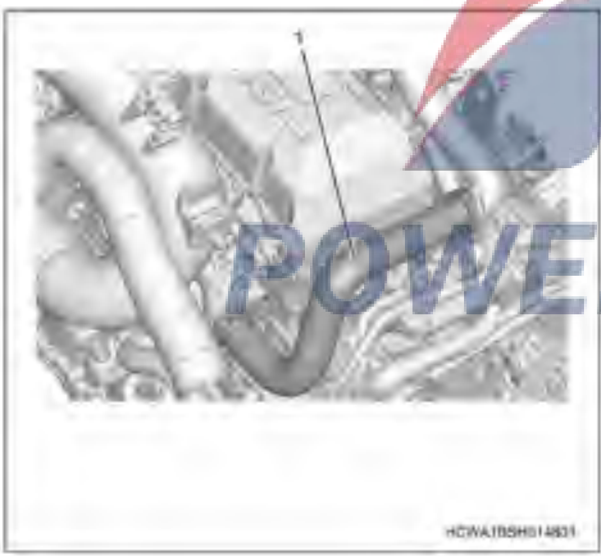


1. Exhaust pipe

9. EGR cooler removal

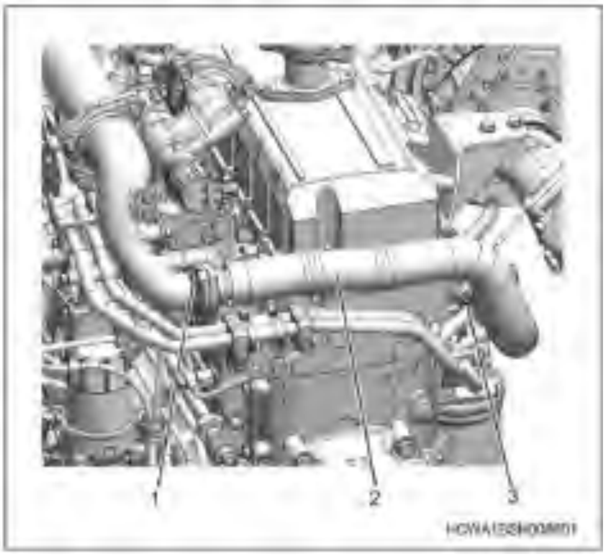
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the exhaust gas recirculation cooler line A.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

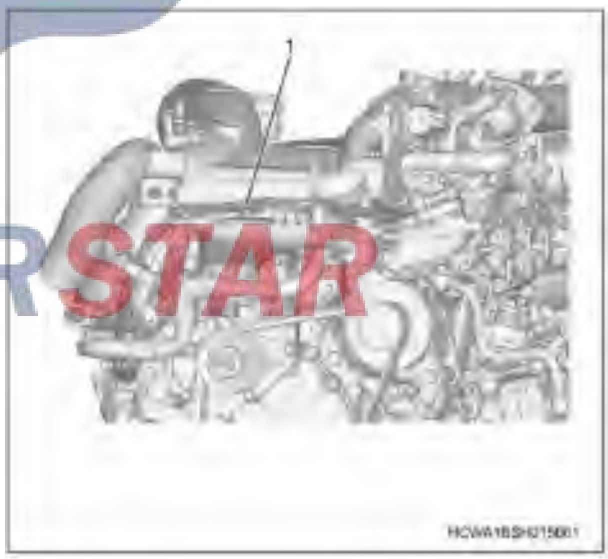


1. Standard bolt

2. Exhaust gas recirculation line B

3. High temperature steel flange bolts

4) Remove the front exhaust gas recirculation cooler hose on the pump.



1. Front exhaust gas recirculation cooler hose

5) The back-end water supply pipe removed from the pump.

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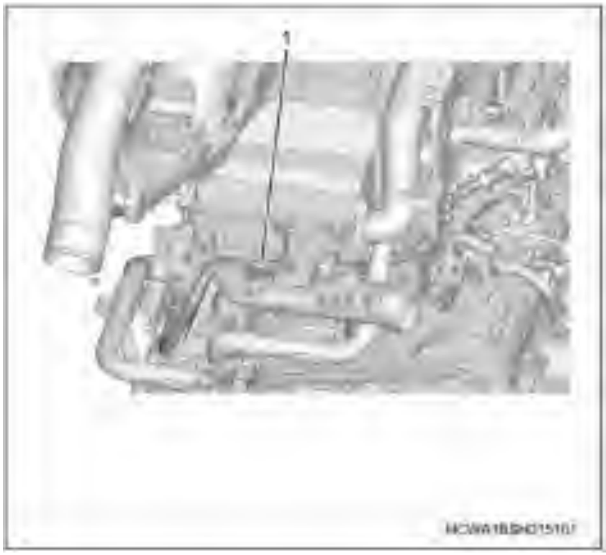
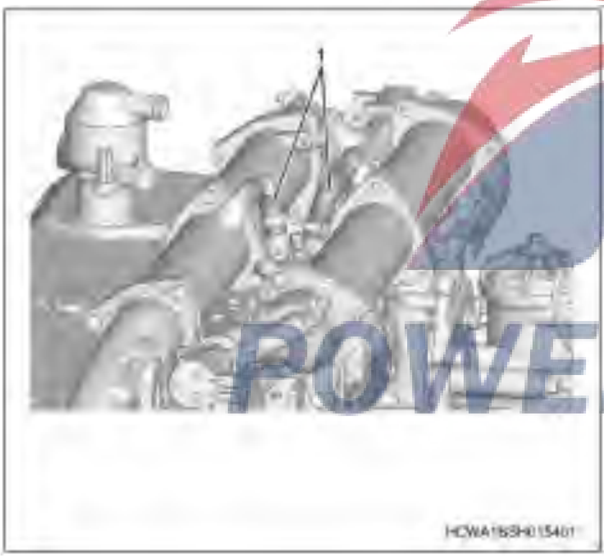


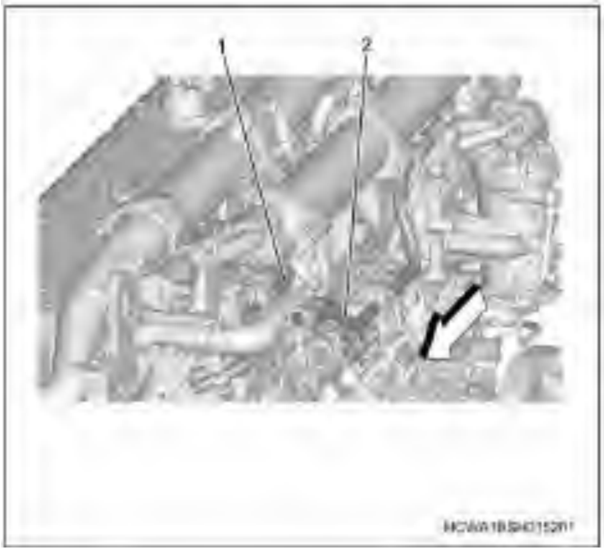
1. Back-end water pipe

6) Remove the water supply hose from the exhaust gas recirculation cooler.



1. water feed hose

7) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.



1. Front-end water supply pipe
2. Back-end water pipe

8) Remove the front and rear exhaust gas recirculation cooler pipes from the exhaust gas recirculation cooler.

1. Front return pipe
2. Back-end return pipe

9) Remove the exhaust gas recirculation cooler duct D from the exhaust gas recirculation valve 2 and the exhaust gas recirculation cooler D.

10) Remove the exhaust gas recirculation cooler duct B from the exhaust gas recirculation valve 1 and the exhaust gas recirculation cooler B.

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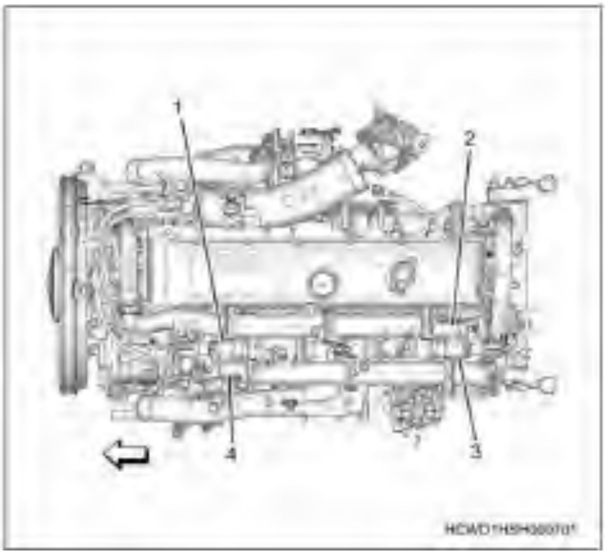


1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. Exhaust Gas Recirculation Cooler duct D

11) Remove front exhaust gas recirculation line bracket of exhaust gas recirculation cooler line A.

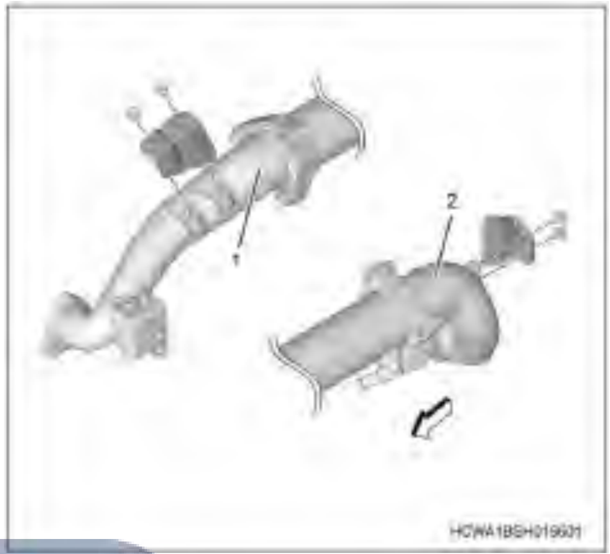
12) Remove the exhaust gas recirculation valve heat shield on the exhaust gas recirculation cooler line A.

13) Remove Exhaust Gas Recirculation Cooler Line A from Exhaust Gas Recirculation Cooler A.

1. Exhaust gas recirculation cooler duct A

14) Remove the back-end exhaust gas recirculation line bracket of exhaust gas recirculation cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on exhaust gas recirculation cooler C.



1. Exhaust gas recirculation cooler duct A
2. Exhaust Gas Recirculation Cooler duct C

16) Remove Exhaust Gas Recirculation Cooler Line C on Exhaust Gas Recirculation Cooler C.

1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. Exhaust Gas Recirculation Cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket
6. Exhaust gas recirculation valve thermal protection device

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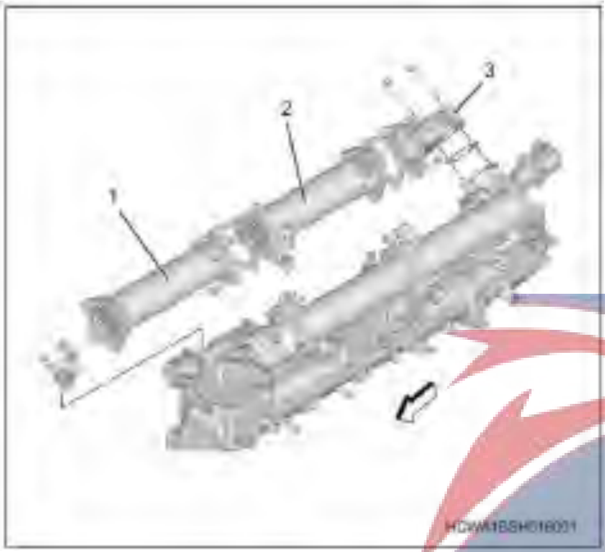
7. Exhaust Gas Recirculation Cooler duct C

8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the exhaust gas recirculation cooler support on exhaust gas recirculation cooler C.

19) Remove the exhaust gas recirculation cooler A on the exhaust gas recirculation cooler B.

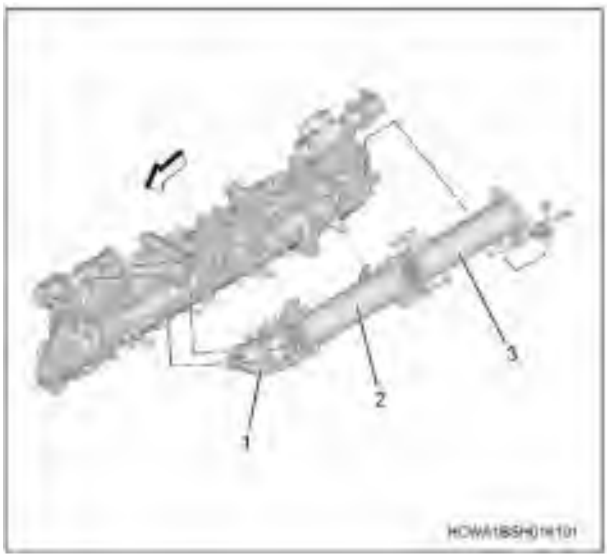


1. EGR cooler A.

2. EGR cooler B

3. Exhaust Gas Recirculation Cooler duct B

20) Remove the exhaust gas recirculation cooler C on the exhaust gas recirculation cooler D.



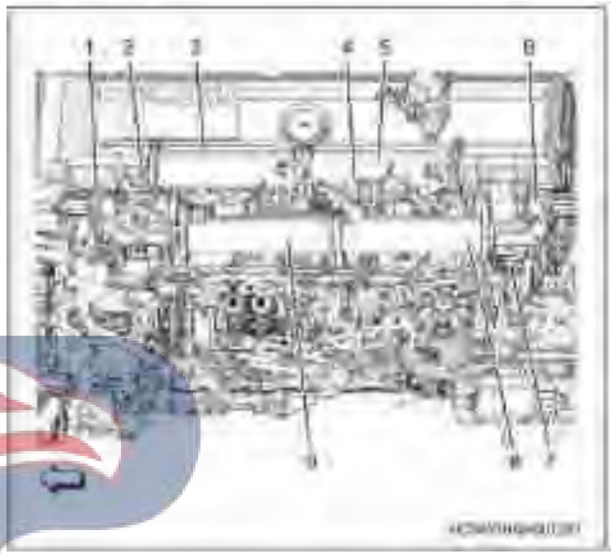
1. Exhaust gas recirculation cooler duct D

2. EGR cooler D

3. EGR cooler C.

21) Remove the exhaust gas recirculation cooler B on the intake manifold.

22) Remove the exhaust gas recirculation cooler D on the intake manifold.



1. EGR valve 2

2. Exhaust gas recirculation cooler bracket

3. EGR cooler A.

4. Leakage tube stent

5. EGR cooler B.

6. EGR valve 1

7. Exhaust gas recirculation cooler bracket

8. EGR cooler C

9. EGR cooler D

10. Discharge oil drain pipe

1) Disconnect the fuel drain on the fuel supply pump.

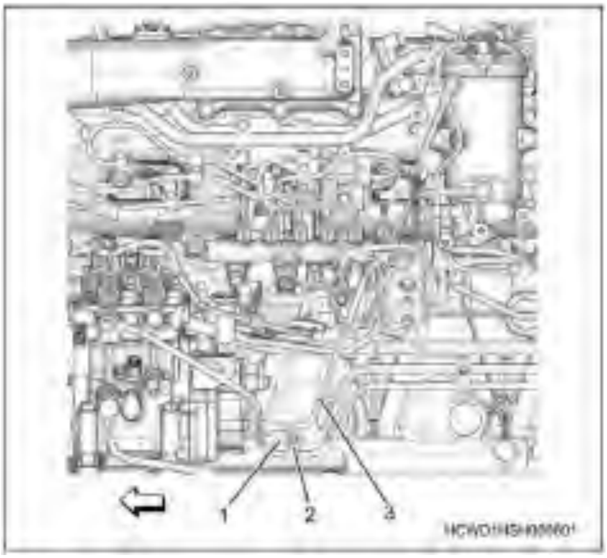
2) Disconnect the fuel drain hose from the fuel filter.

11. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

12. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

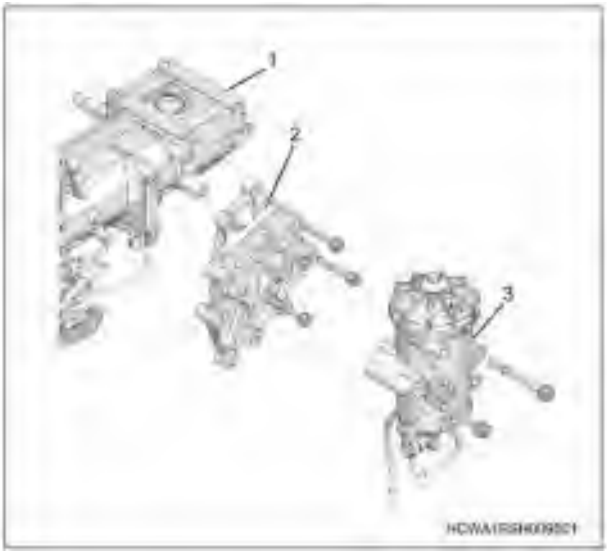
3) Remove the fuel pipe from the fuel supply pump.

13. Fuel filter removal

1) Disconnect the harness connector of the water sedimentation separator switch.

2) Remove the fuel filter from the fuel filter holder.

3) Remove the fuel filter bracket from the intake manifold.



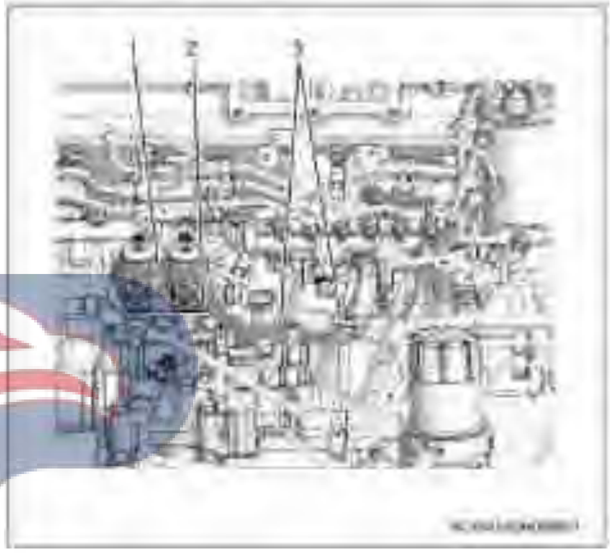
1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

14. Fuel pipe removal

1) Remove the clip on the fuel line.

2) Disconnect the fuel rail from the common rail (common fuel rail).

3) Remove the fuel pipe from the fuel supply pump.



1. Fuel pipe
2. Fuel pipe
3. Clip

15. Injector removal

1) Remove injector tube from injector and common rail (fuel rail)

except.

Caution:

● Prevent dust and dirt from adhering to the sleeve nut.

2) Seal the common rail (fuel rail) pipe mounting hole to prevent dirt from adhering to the hole.

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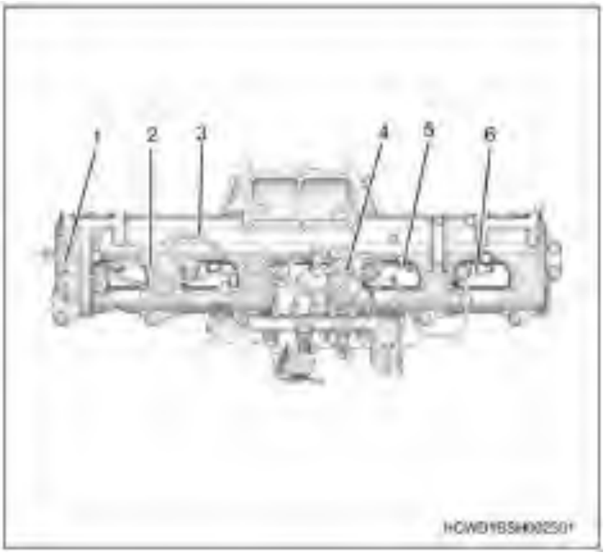


1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

16. Common rail (fuel rail) removal

1) Disconnect the harness connector from the FRP sensor.

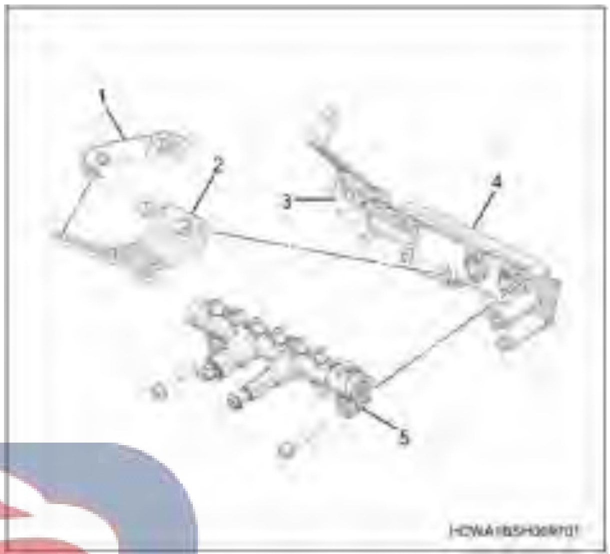
2) Remove the injector tube clamp bracket on the common rail (fuel rail) bracket.

3) Remove the common rail (fuel rail) from the bracket.

Caution:

● Seal each fuel opening to prevent foreign material from entering.

4) Remove the two common rail (fuel rail) brackets from the cylinder block.



1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

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Installation

1. Common rail (fuel rail) installation

1) Mount the common rail (fuel rail) bracket to the cylinder block.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

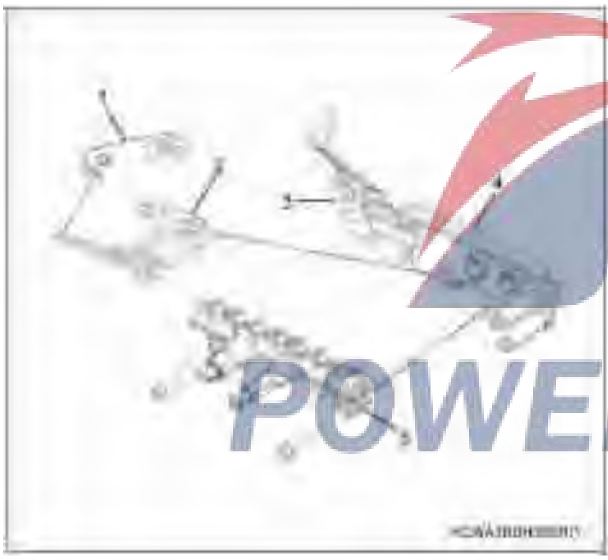
2) Install the common rail (fuel rail) on the common rail (fuel rail) bracket.

Tightening torque: 40.3 N • m {4.1 kgf • m / 30 lb • ft}

3) Temporarily fasten the 2 injector pipe clamp brackets to the common rail (fuel rail) bracket.

Note:

● After the injector line clamps are installed, finalize the injection tube clamp bracket.



1. Injection pipe clamp bracket
2. Injection pipe clamp bracket
3. Fuel pipeline bracket
4. Common rail (fuel rail) bracket
5. Common rail (fuel rail)

4) Connect the harness connector to the fuel rail position sensor.

2. Fuel injection pipe installation

1) Apply a small amount of engine oil to the injector side sleeve nut on the injector line.

2) Temporarily tighten the injection line for the injector and common rail (fuel rail) assembly.

Caution:

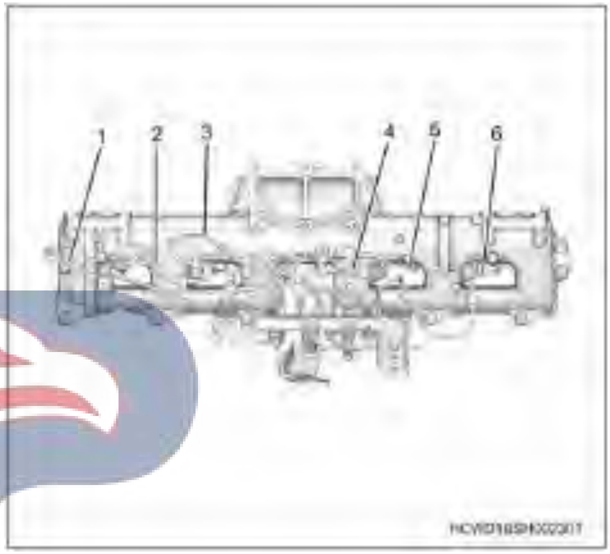
● When installing the injector line, first assemble lines 4 and 3.

3) Install the clip on the injector tube.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

4) Final tightening of fuel injector and common rail (fuel rail) assembly of the injection pipeline.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Injection pipe No. 1
2. Injection pipe No. 2
3. Injection pipe No. 3
4. Injection pipe No. 4
5. Injection pipe No. 5
6. Injection pipe No. 6

3. Fuel pipe installation

1) Mount the bracket to the common rail (fuel rail) bracket.

2) Temporarily fasten the fuel line to the fuel supply pump.

3) Temporarily fasten the fuel pipe to the common rail (fuel rail).

4) Temporarily fasten the clip to the fuel tube.

5) Tighten the fuel line to the fuel supply pump.

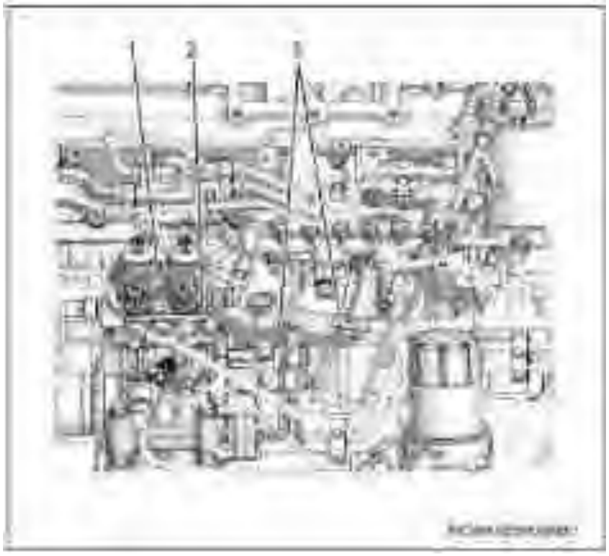
Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the fuel pipe to the common rail (fuel rail).

POWERSTAR

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}

7) Fasten the clip to the fuel tube.



1. Fuel pipe
2. Fuel pipe
3. Clip

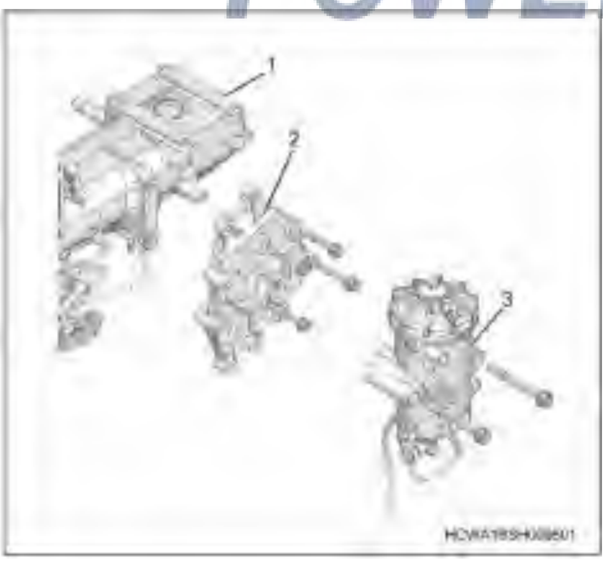
4. Oil filter installation

1) Mount the fuel filter bracket to the intake manifold.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

2) Install the fuel filter to the fuel filter bracket.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}



1. Intake manifold
2. Fuel filter bracket
3. Fuel filter

3) Connect the connector to the water sedimentation separator switch.

5. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

6.Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Eyebolt Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m /11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

POWERSTAR

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

7. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

8. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

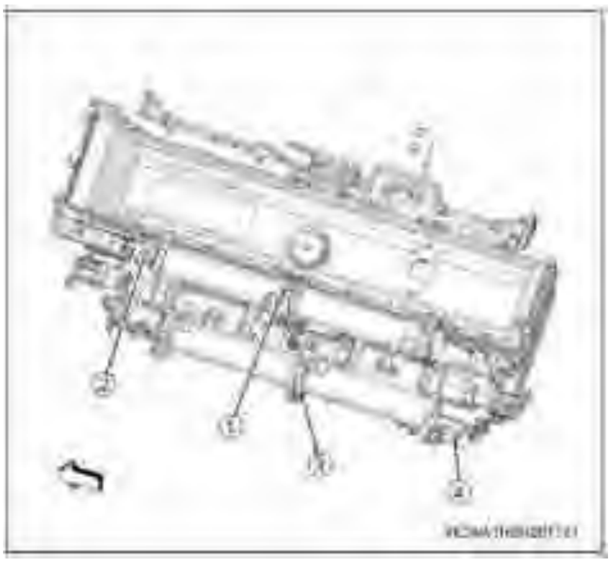
● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



2) Temporarily tighten the following exhaust gas recirculation cooler components according to the figure in numerical order.

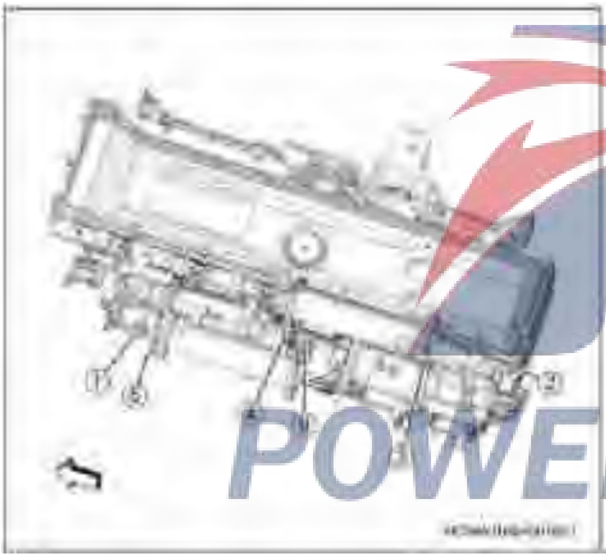
● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A.

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

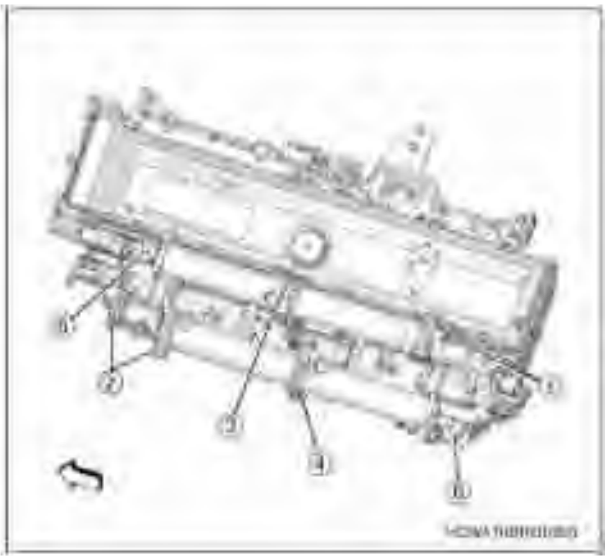
Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 1,2

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 3,4,5 (M10), 6 (M10)

Tightening torque: 25 N • m {3 kgf • m / 18 lb • ft} 5 (M8), 6 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following exhaust gas recirculation cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

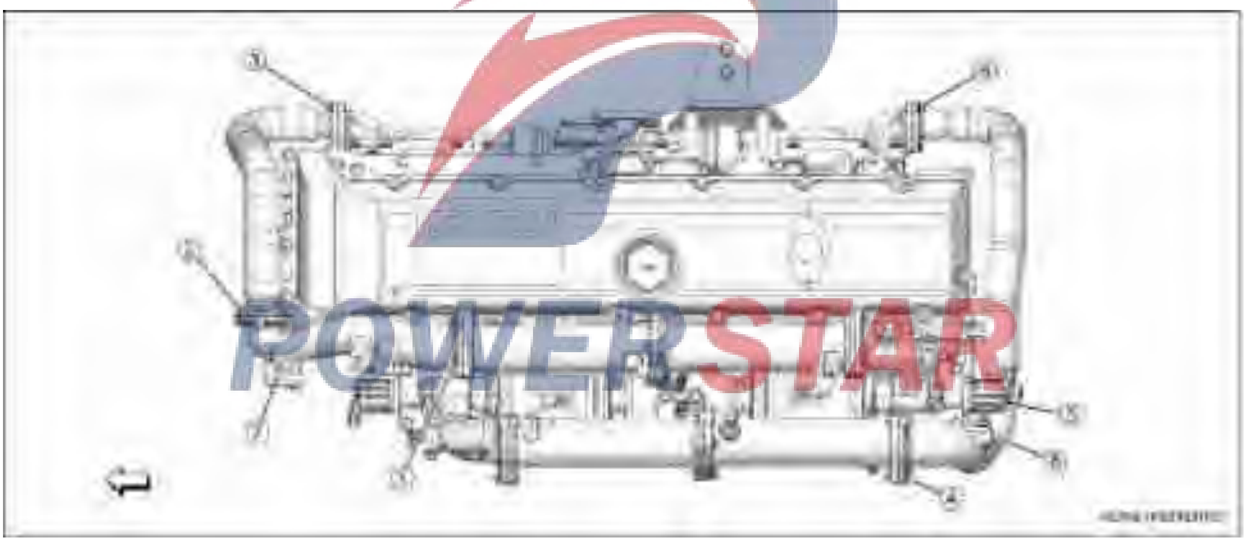
● EGR duct B.

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



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5) Final tightening of the following exhaust gas recirculation cooler components and final tightening of the exhaust manifold in the numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

● EGR duct B.

● Bracket

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 1 (M10), 2,3,9 (M10), 10 (M10)

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 4

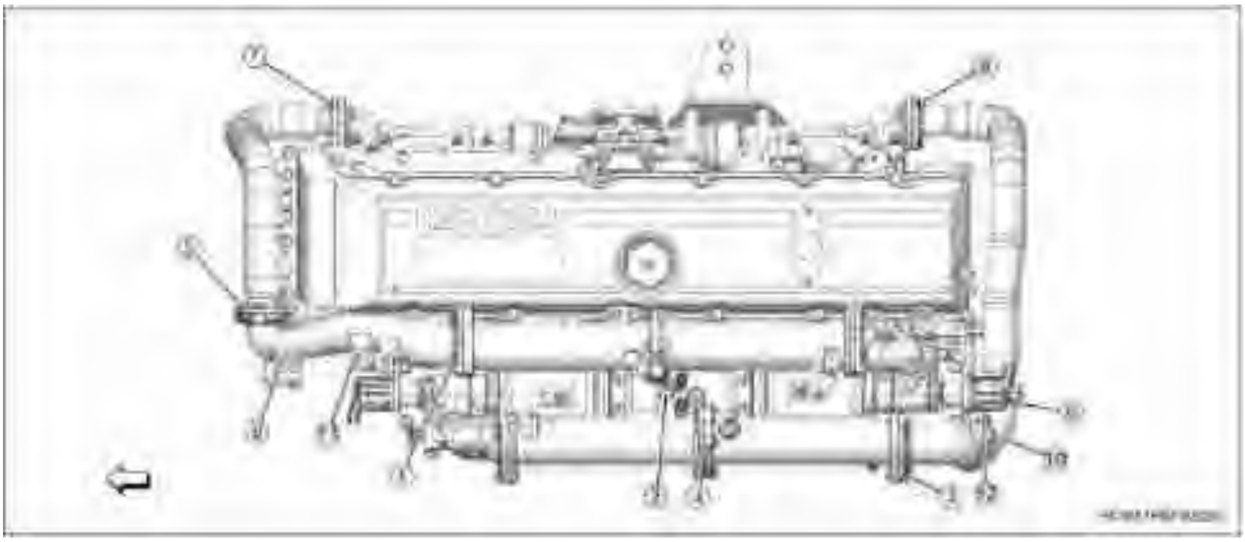
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft} 5,6 (M8), 7,8 (M8), 9 (M8)

Tightening torque: 24.7 N • m {2.5 kgf • m / 18 lb • ft} 10 (M8)

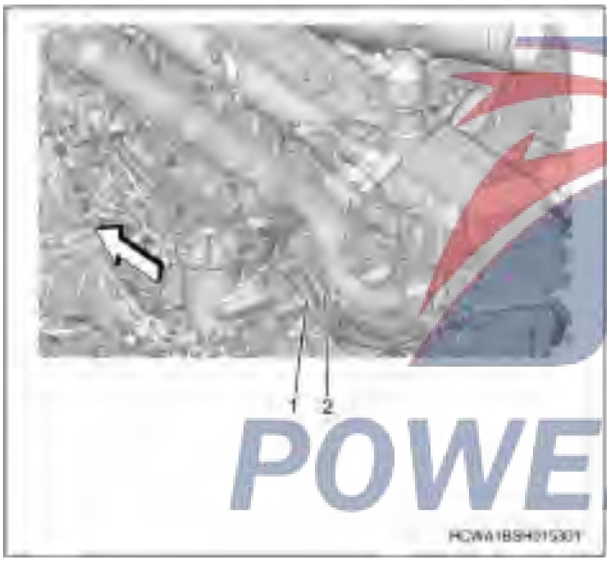
Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft} 11,12 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the exhaust gas recirculation cooler.



1. Front return pipe
2. Back-end return pipe

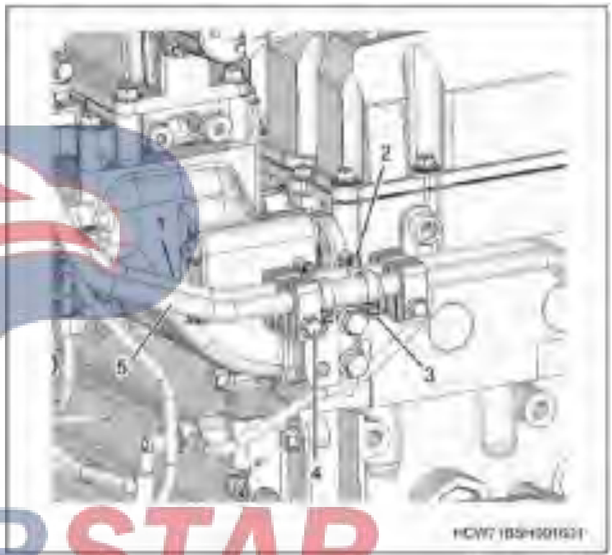
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.



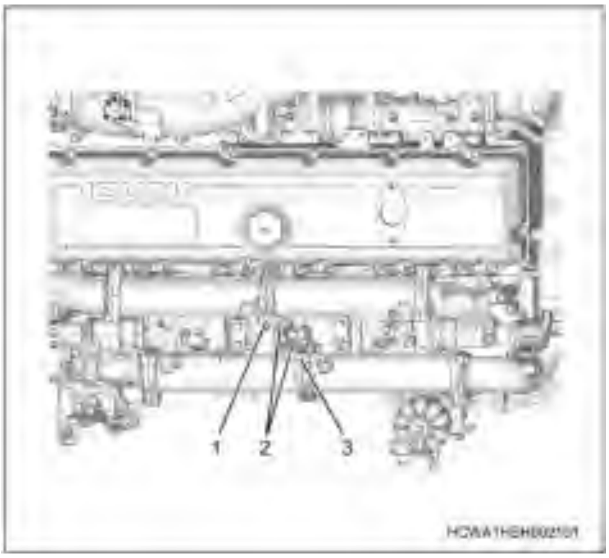
POWERSTAR

1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the exhaust gas recirculation cooler.

Caution:

● Hose clamps should be toward the top of the engine.

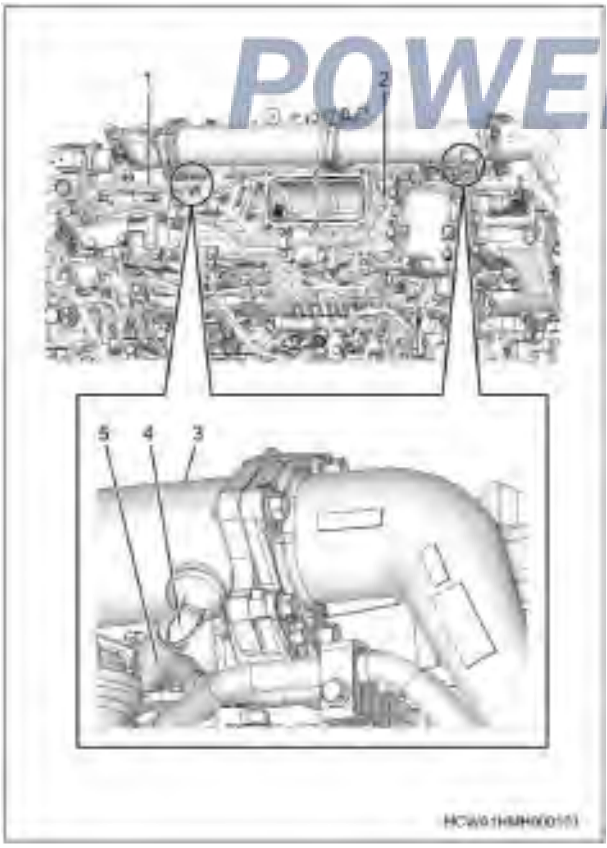


1. Hose clip
2. water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

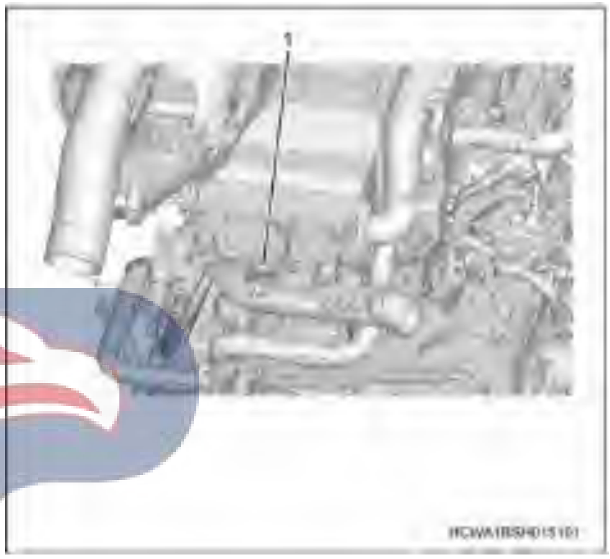
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



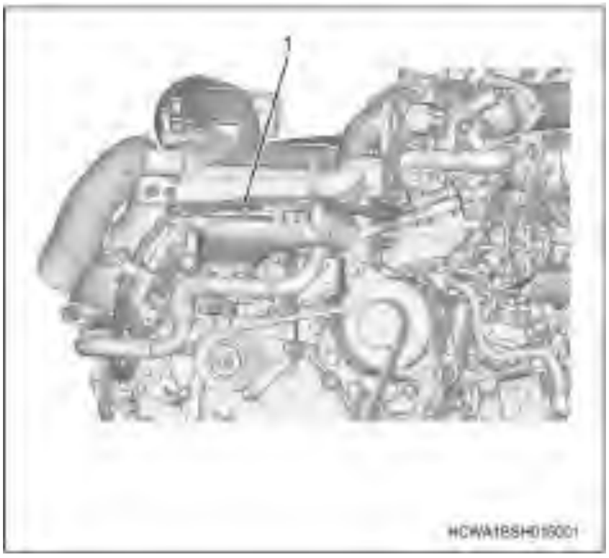
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

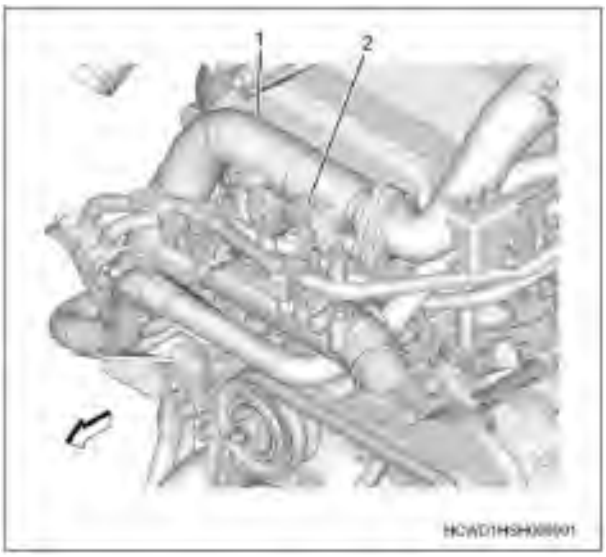
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

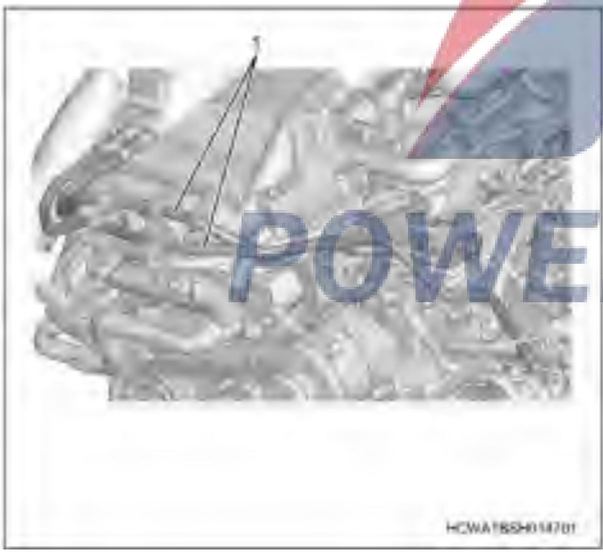
9. Suction pipe installation

1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction tubes to the air compressor.

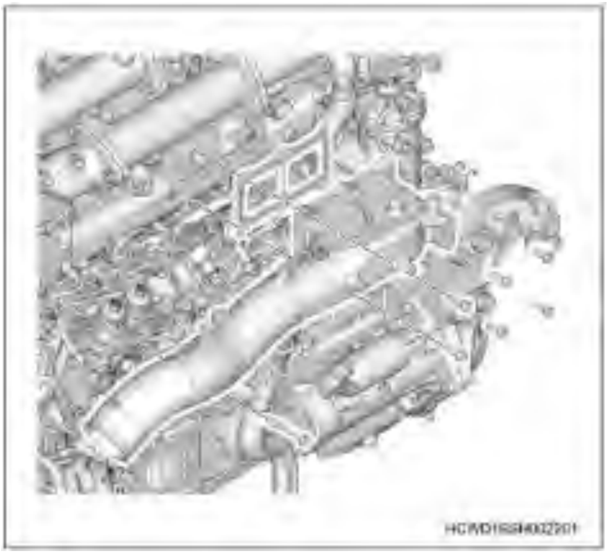


1. Exhaust pipe

10. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



11. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

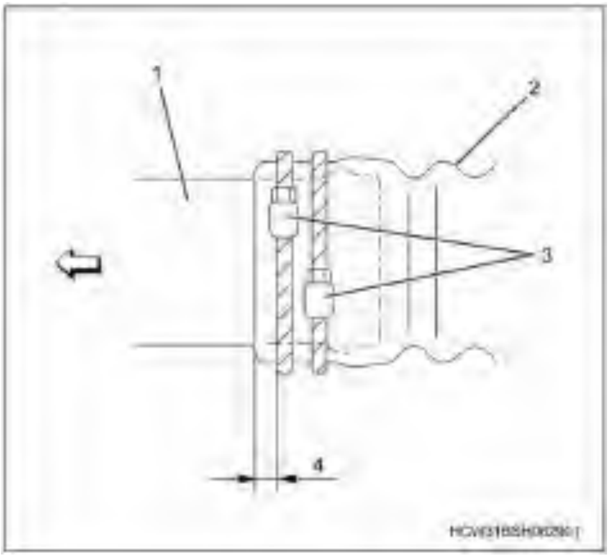
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been fixed installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30 °o r more.

Tightening torque: 6.4 N • m {0.7 kgf • m / 57 lb • in}



POWERSTAR

1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

12. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

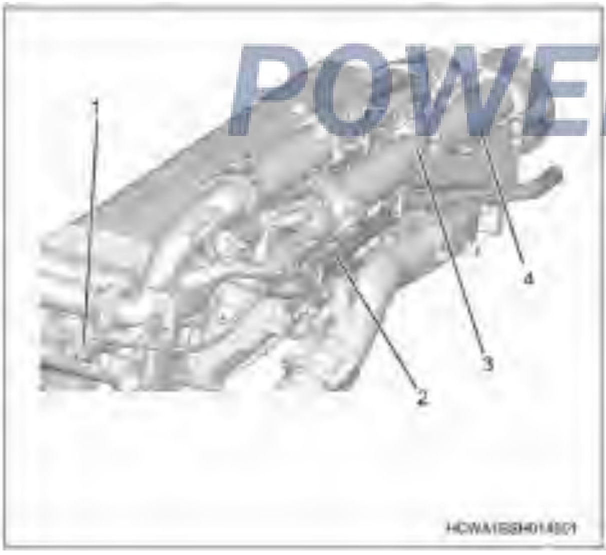
13. Air leakage pipe installation

1) Install the rear blow-by tube to the exhaust gas recirculation cooler and drain line and install 2 clips.

2) Install the blowholes to the exhaust gas recirculation cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Eyebolt



1. Outlet pipe

2. Water charge pipe

3. Back-end leakage pipe

4. Front leakage pipe

14. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.

1. Ventilation hose

2. Ventilation hose clip

15. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

POWERSTAR

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

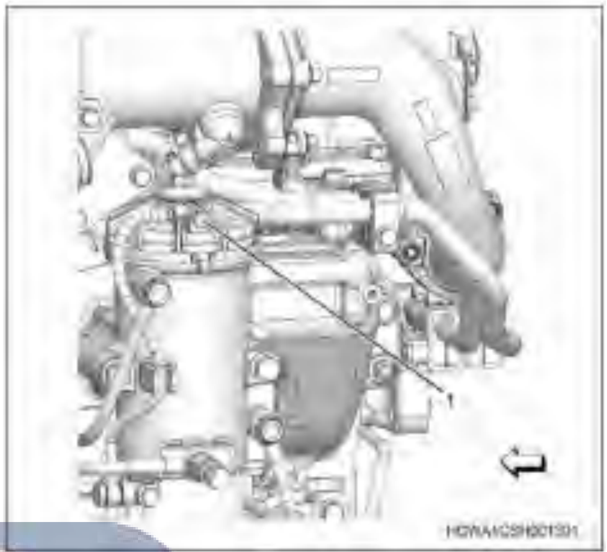
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

16. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

6) Operate the priming pump until large bubbles are no longer formed.

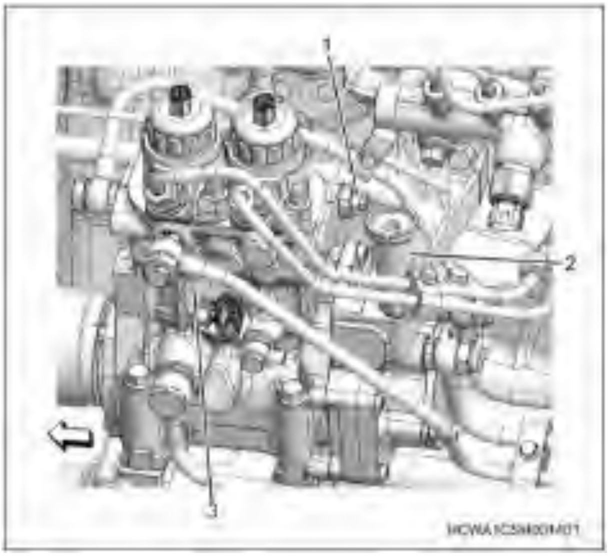
7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.

POWERSTAR



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

17. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

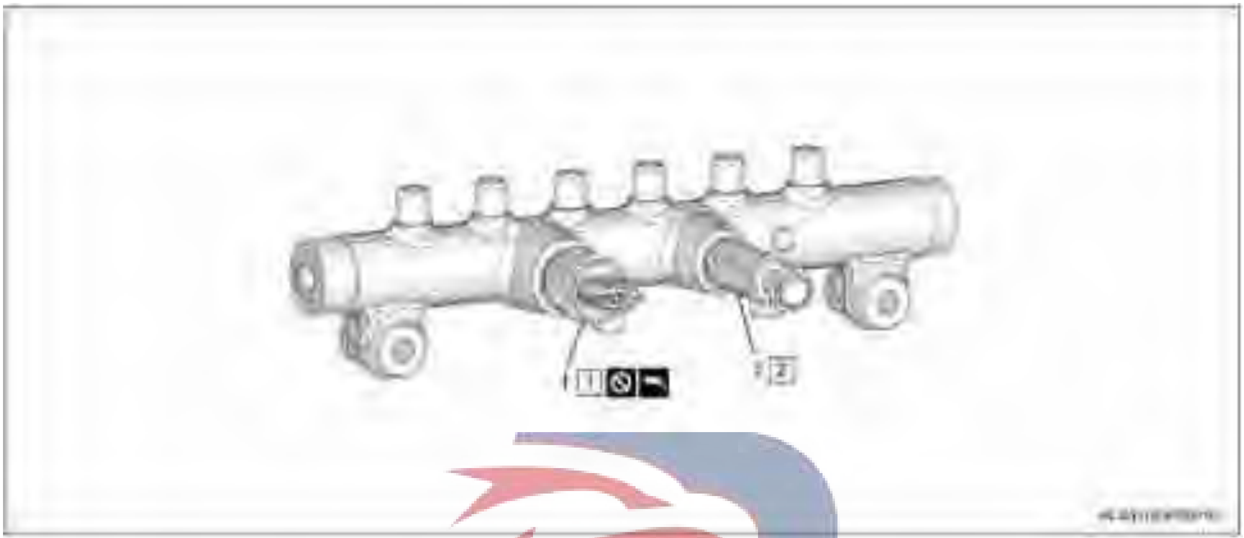
POWERSTAR

Pressure limiter

Removal

1. Component Views

Pressure limiter



Part name

1. FRP sensor

2. Pressure limiter

Tightening torque

1: 98 N• m {10.0 kgf • m / 72 lb • ft}

2: 172 N • m {17.5 kgf • m / 127 lb • ft}

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. The fuel drain is disconnected

1) Disconnect the fuel drain pipe on the common rail (fuel rail).

4. Pressure limiter removed

1) Using a socket wrench with a 19 mm (0.75 in) open width, remove the pressure limiter from the common rail (fuel rail).

Caution:

● Do not repeat the removed washer.

2) Do not damage the seat when removing the gasket.

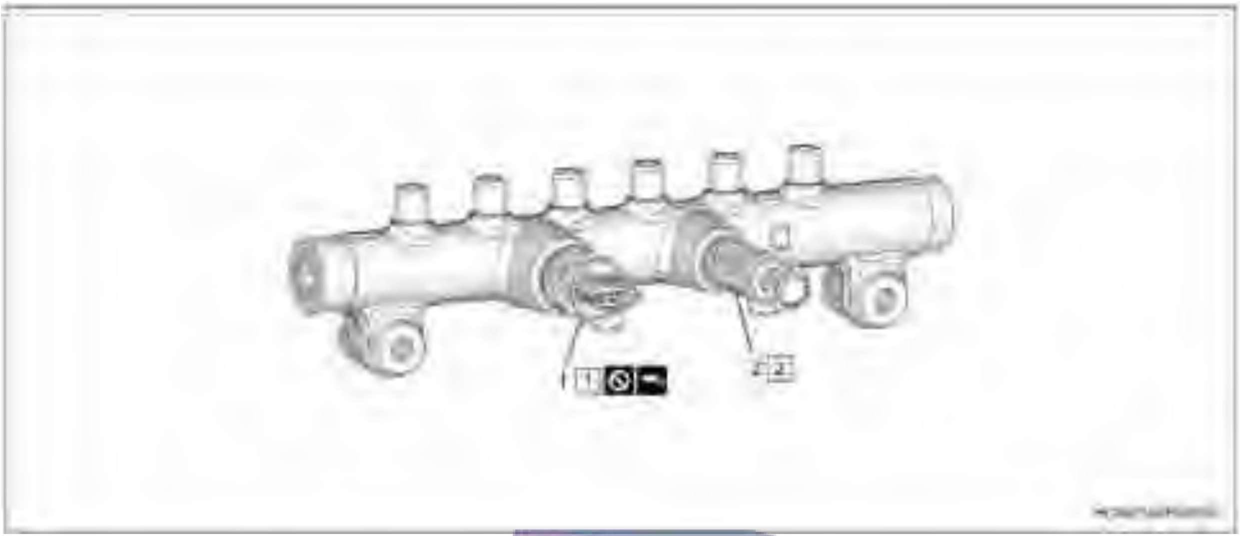
1. Pressure limiter

POWERSTAR

Installation

1. Component Views

Pressure limiter



Part name

1. FRP sensor

2. Pressure limiter

Tightening torque

1: 98 N • m {10.0 kgf • m / 72 lb • ft}

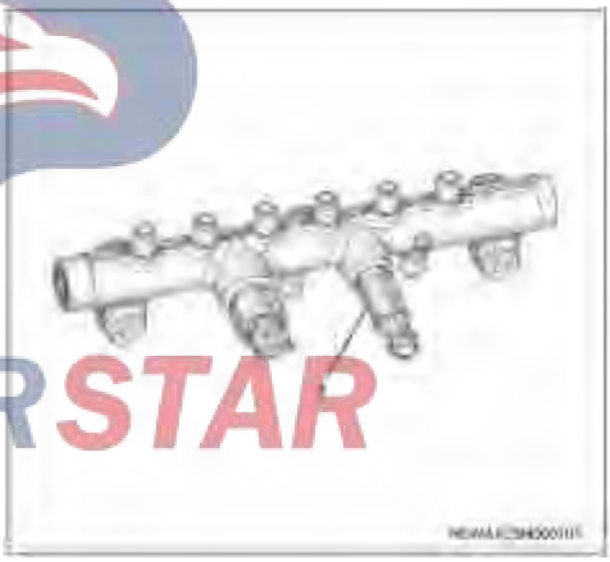
2: 172 N • m {17.5 kgf • m / 127 lb • ft}

2. Pressure limiter installation

1) Mount the pressure limiters and copper gaskets on the common rail (fuel rail) using a socket wrench with a 19 mm (0.75 in) open width.

2) Install after completely confirming that there is no foreign material in the installation location.

Tightening torque: 172 N • m {17.5 kgf • m / 127 lb • ft}



1. Pressure limiter

3. Fuel drain connection

1) Temporarily fasten the fuel drain to the common rail (fuel rail).

2) Fasten the oil drain pipe to the common rail (fuel rail).

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

4. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

POWERSTAR

Fuel pump

Removal

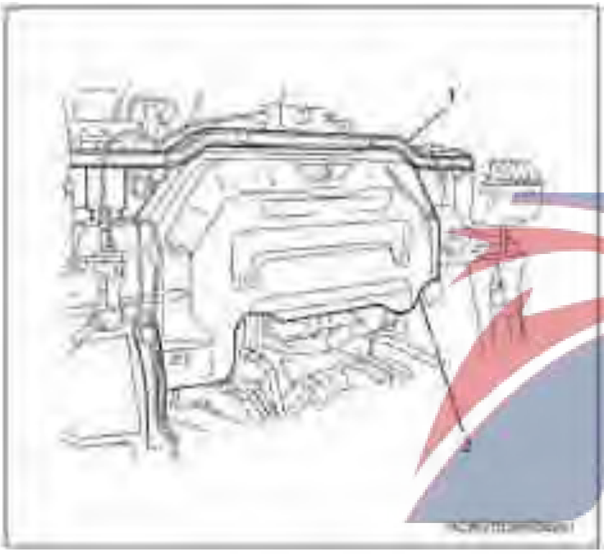
1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Cab back member noise cover removal

1) Remove the cab back member noise cover from the cab mounting rear member.



1. Cab mounting rear member

2. Cab back member noise cover

3. Fuel suction pipe disconnected

1) Disconnect the fuel supply pump's suction manifold.

2) Remove the suction pipe from the bracket.

4. Fuel drain pipe removed

1) Disconnect the fuel drain on the fuel supply pump.

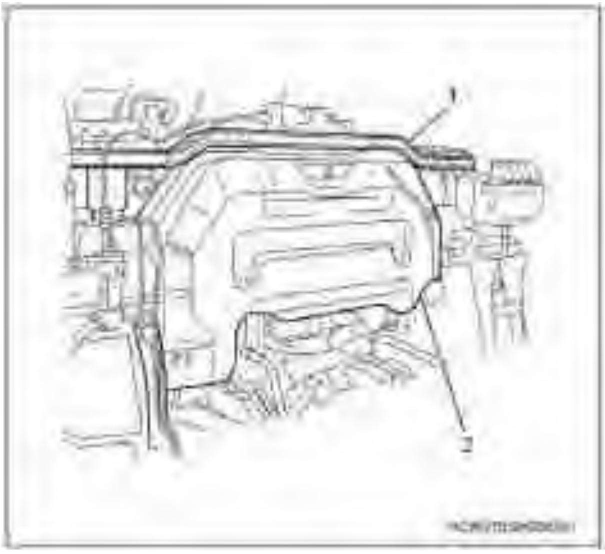
2) Disconnect the fuel drain hose from the fuel filter.

5. Oil feed pipe removal

1) Remove the clip on the fuel supply line.

2) Disconnect the fuel filter fuel supply line.

3) Remove the fuel supply line from the fuel supply pump.



1. Fuel suction pipe

2. Clip

3. Oil feed pipe

6. Fuel pipe removal

1) Disconnect the harness connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.

3) Remove the fuel pipe from the fuel supply pump.

7. Fuel pump removed

1) Disconnect the harness connector connected to the camshaft position sensor.

2) Disconnect PCV harness connector.

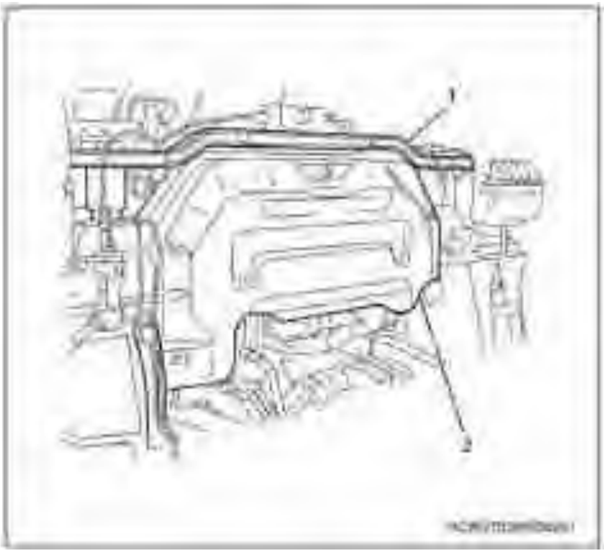
3) Disconnect the fuel supply pipe to the fuel supply pipe.

4) Remove the oil supply pipe from the cylinder block.

5) Disconnect the oil return pipe from the fuel supply pump.

6) Remove the oil return pipe from the cylinder block.

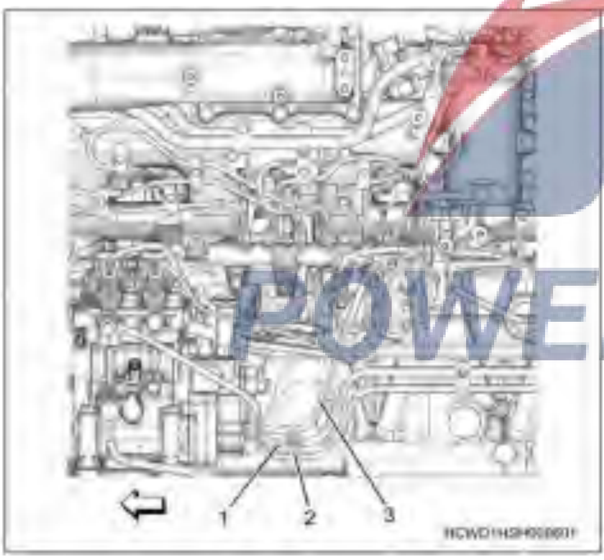
POWERSTAR



1. Oil return pipe

2. Oil feed pipe

7) Remove the pin bolts and coupling bolts on the coupling.



1. Cotter bolt

2. Coupling tightening bolt

8) Remove fuel supply pump from supply pump bracket.

9) Remove the supply pump bracket from the cylinder block.

POWERSTAR

Inspection

1. Check the fuel pump

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the PCV installation status and whether it is damaged.

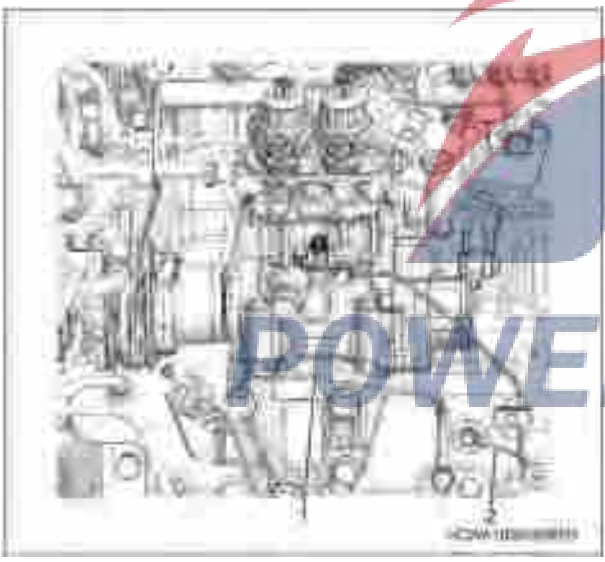
2) Check PCV terminals and harness connectors for looseness and damage.

3) Use a digital multimeter to measure the resistance of the PCV.

Standard: 3.2 Ω at room temperature

4) Check the camshaft position sensor installation status and whether damaged.

5) Check camshaft position sensor terminals and harness connectors for looseness and damage.



1. PCV1
2. PCV2
3. CMP sensor

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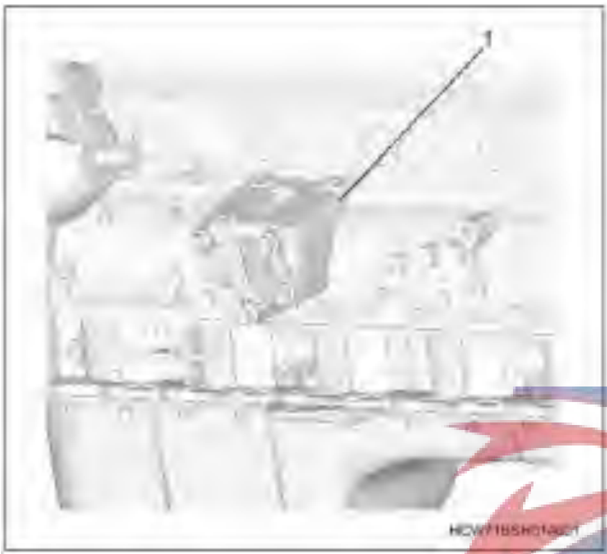
Installation

1. Fuel pump installed

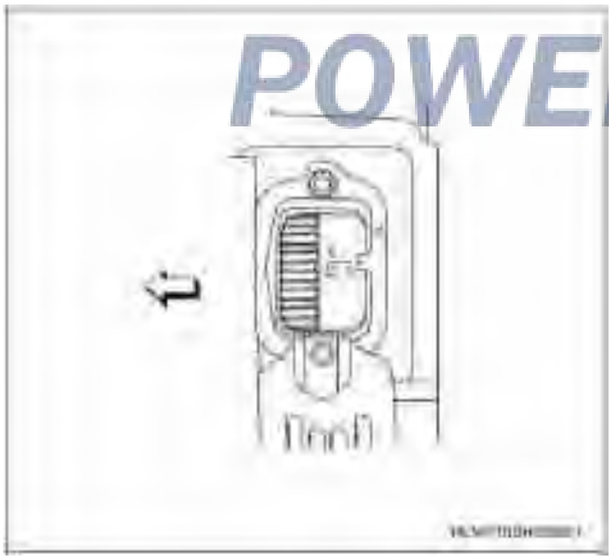
1) Attach the feed pump bracket to the cylinder block.

Tightening torque: 108 N • m {11.0 kgf • m / 80 lb • ft}



1. Fuel pump bracket

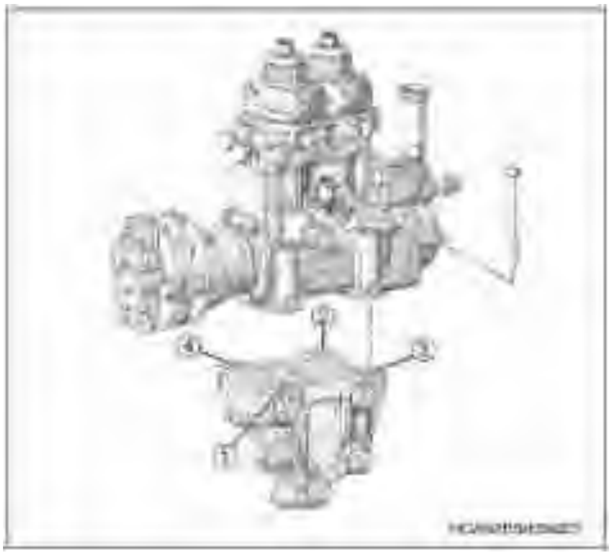
2) Align the No.1 cylinder to compression top dead center.



3) Align the pipe marked on the pipe with the marked pipe on the pump.

4) Install the fuel delivery pump in the order of numbers on the supply pump bracket.

Tightening torque: 57 N • m {5.8 kgf • m / 42 lb • ft}

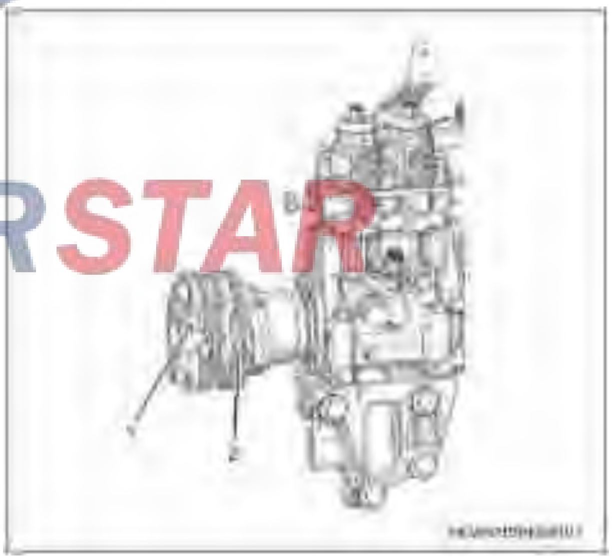


5) Slide the coupling to confirm firm contact with the feed pump and tighten the coupling bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}

6) After checking and making sure that the coupling laminate is not bent, tighten the pin bolt.

Tightening torque: 91 N • m {9.3 kgf • m / 67 lb • ft}



1. Cotter bolt

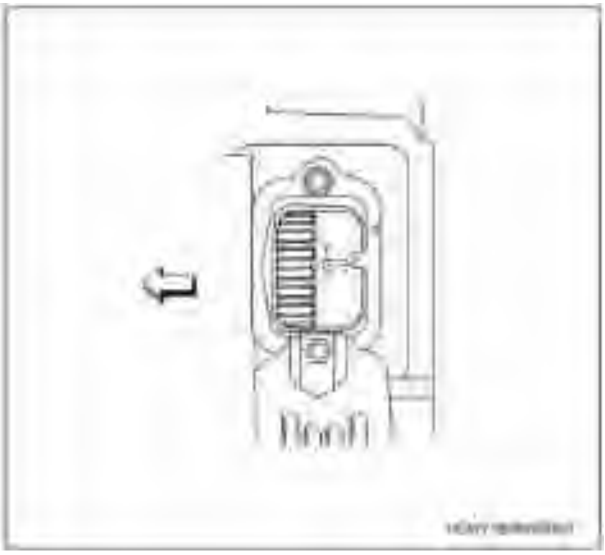
2. Coupling tightening bolt

7) Rotate the crankshaft forward to align cylinder # 1 to the top dead center of compression.

Note:

● Align with the center of the compression stop in a toothless state.

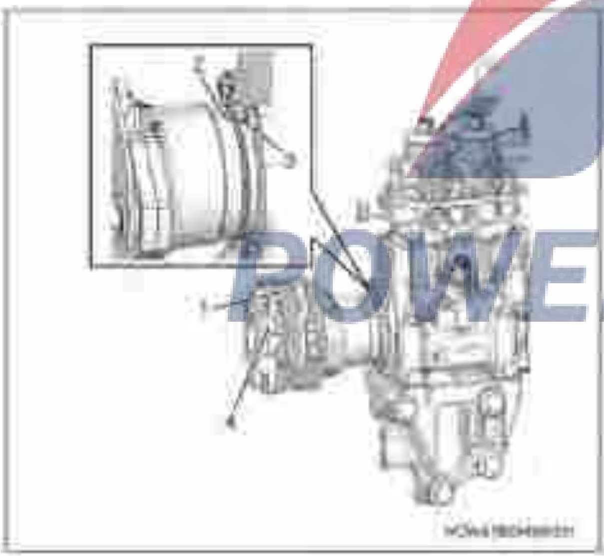
POWERSTAR



8) Verify that the marked pipe on the pipe fitting matches the marked pipe on the pump.

Caution:

● If the marking line is out of service, use the 2 oval bolts on the coupling to readjust.



1. Coupling bolts
2. Coupling end marking line
3. Pump end marking line
4. Cotter bolt

9) Install the return line to the cylinder block.

10) Install the oil return pipe to the fuel supply pump.

11) Install the tubing to the cylinder block.

12) Install the oil feed pipe to the fuel supply pump.

Tightening torque: 28 N • m {2.9 kgf • m / 21 lb • ft}

M10

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

M14

1. Oil return pipe
2. Oil feed pipe

13) Connect the harness connector to the PCV.

14) Connect the harness connector to the camshaft position sensor.

2. Fuel pipe installation

1) Temporarily tighten the fuel pipe of the fuel temperature sensor and fuel filter.

2) Tighten the fuel pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

3) Final tighten the fuel temperature sensor and the fuel filter fuel pipe.

Tightening torque: 22 N • m {2.24 kgf • m / 16 lb • ft}

4) Install the clip to the oil feed pipe.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

3.Oil feed pipe installation

1) Temporarily fasten the fuel drain to the cylinder head.

2) Tighten the fuel drain to the cylinder head.

Eyebolt Tightening torque list

Dimensions	Tightening torque
M8	: 15 N • m { 1.5 kgf • m / 11 lb • ft }
M10	: 27 N • m { 2.8 kgf • m / 20 lb • ft }
M12	: 34 N • m { 3.5 kgf • m / 25 lb • ft }
M14	: 41 N • m { 4.2 kgf • m / 30 lb • ft }

3) Temporarily fasten the fuel supply pipe to the fuel filter.

4) Tighten the fuel supply pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

4. Fuel leak-off pipe installation

1) Temporarily tighten the fuel leak-off pipe to the fuel filter.

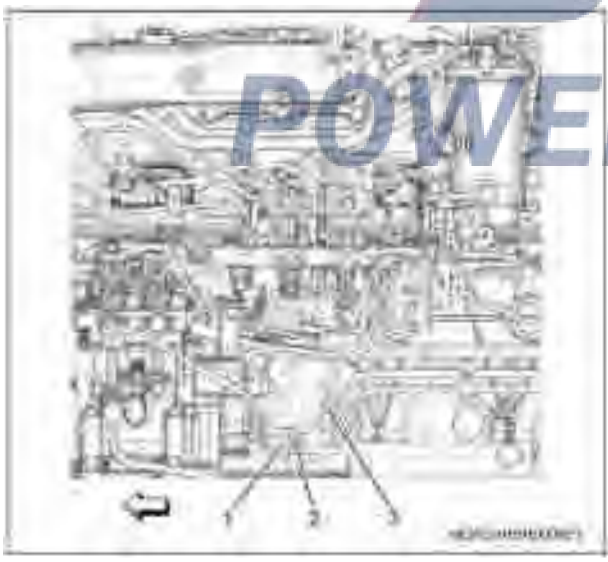
2) Tighten the fuel leak-off pipe to the fuel filter.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

5. Fuel suction pipe connection

1) Install the fuel suction pipe to the fuel supply pump.

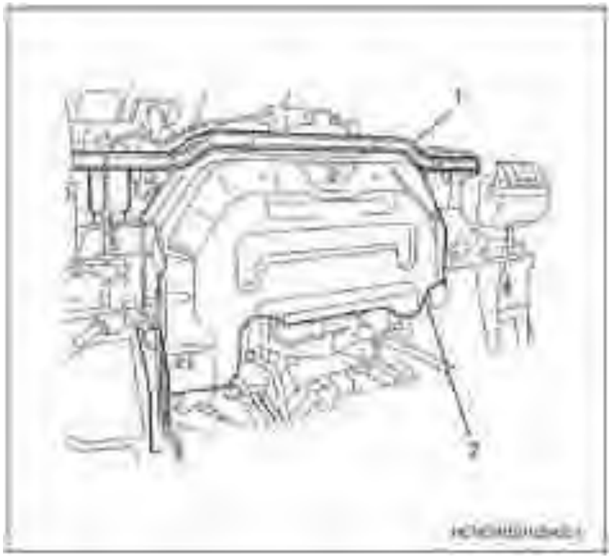
2) Connect the fuel suction line to the fuel filter.



1. Fuel suction pipe
2. Clip
3. Oil feed pipe

6. Cab back member noise cover installation

1) Install the cab back panel enclosure on the cab mounting rear element.

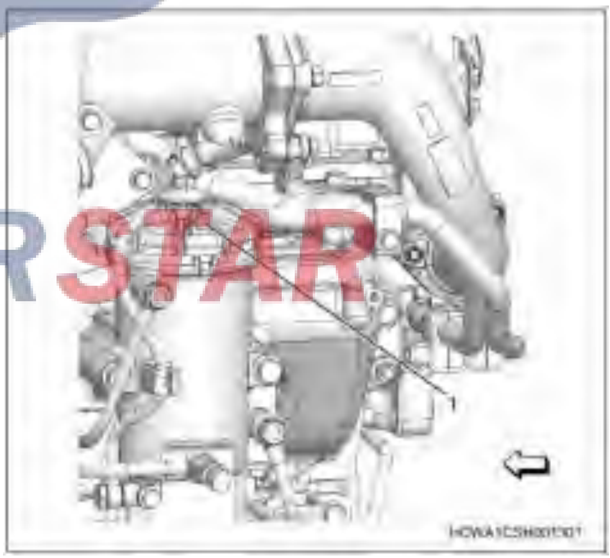


1. Cab rear mounting member
2. Cab back member noise cover

7. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

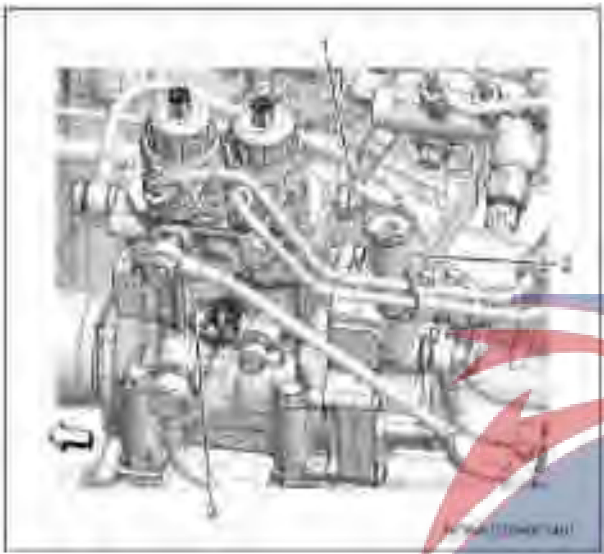
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

8. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

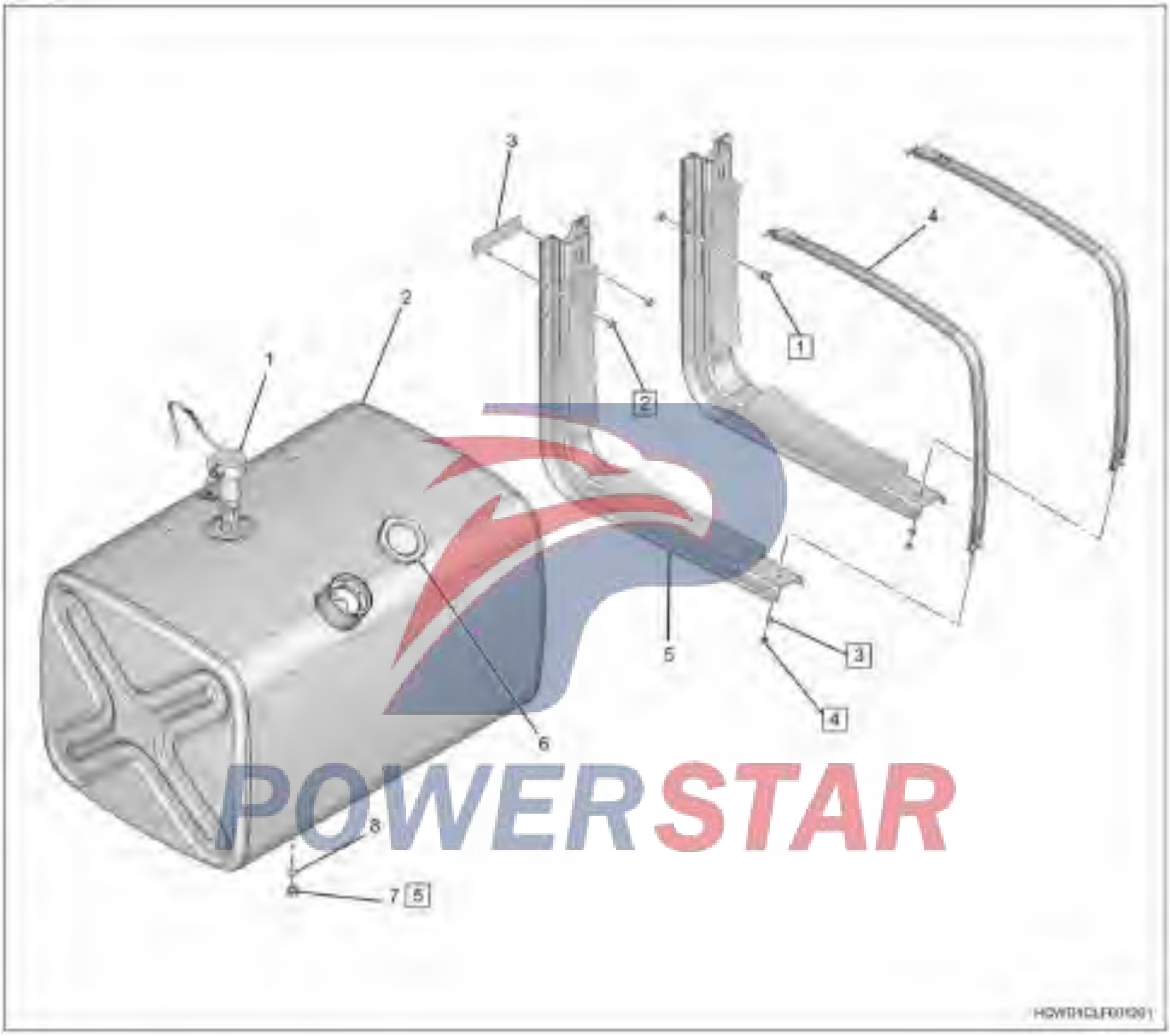
POWERSTAR

Fuel tank

Removal

1. Component Views

Fuel tank



Part name

1. Fuel tank device
2. Fuel tank
3. Bracket
4. Fuel tank fastening tape
5. Tank bracket
6. Oil filler cap
7. Drain plug
8. Discharge plug

Tightening torque

1: 97 N • m {9.9 kgf • m / 72 lb • ft}

2: 97 N • m {9.9 kgf • m / 72 lb • ft}

3: 18 N • m {1.8 kgf • m / 13 lb • ft}

4: 21 N • m {2.1 kgf • m / 15 lb • ft}

5: 29 N • m {3.0 kgf • m / 2 lb • ft}

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Fuel emissions

1) Remove the tank filler cap from the fuel tank.

2) Pull out the oil drain plug to allow the fuel to drain out of the fuel tank.

3) Install the drain plug on the fuel tank.

Tightening torque: 29 N • m {3.0 kgf • m / 21 lb • ft}

4. Fuel tank removed

1) Disconnect the harness connector from the fuel tank unit.

2) Disconnect the fuel tank hose from the fuel tank.

3) Disconnect the fuel tank return hose.

Caution:

● Insert a plug to prevent fuel leakage, then place the hose up and attach it to one end of the frame.

4) Remove the outer nut from the fuel tank harness.

5) Remove the inner nut from the fuel tank harness.

6) Remove the fuel tank cuff from the bracket.

7) Remove the fuel tank from the bracket.

Note:

● If the tank can not be pulled out, remove the bracket and pull the tank toward the bottom.

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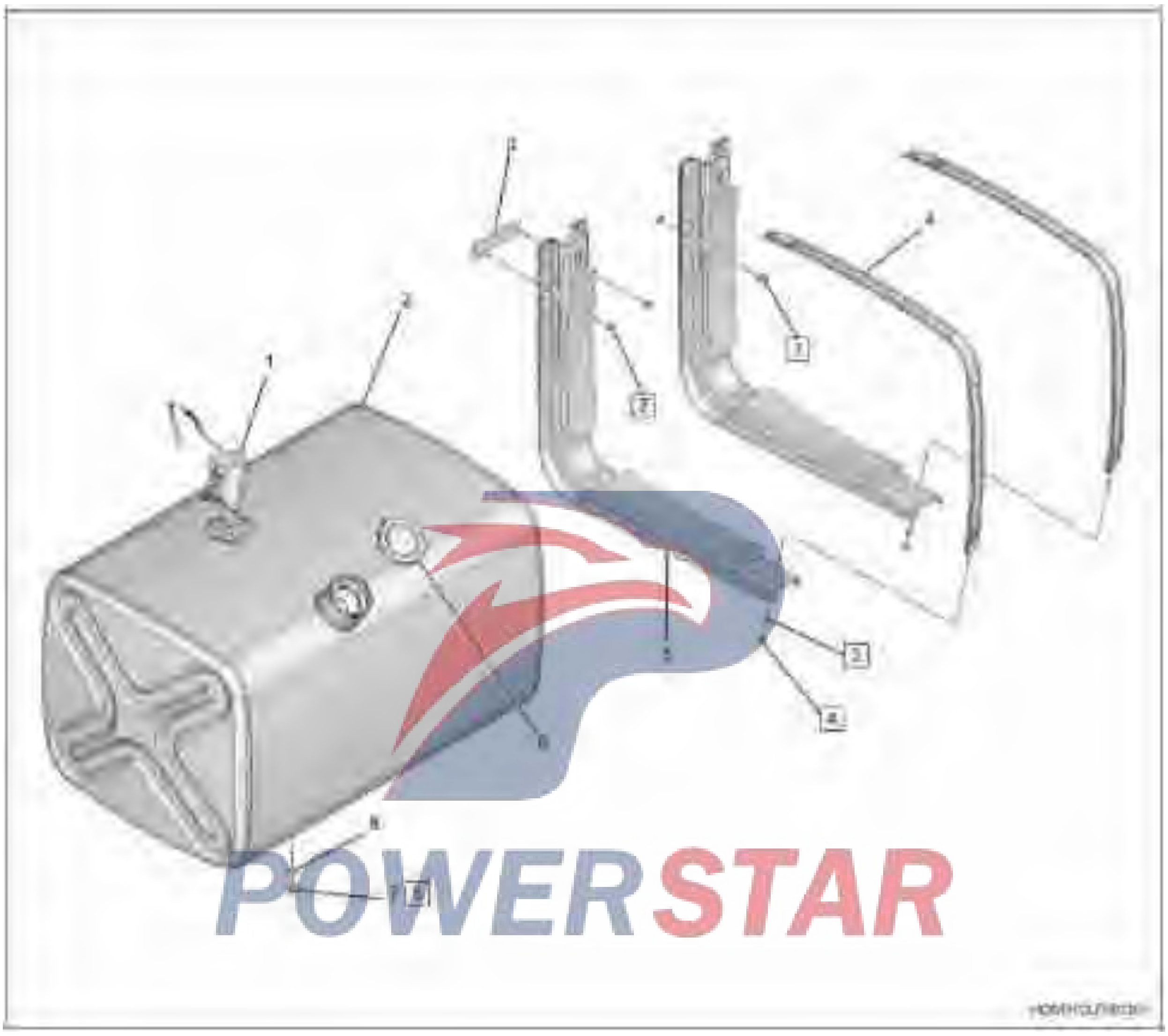
Installation

1. Component Views

Fuel tank



Part name

1. Fuel tank device
2. Fuel tank
3. Bracket
4. Fuel tank fastening tape
5. Tank bracket
6. Oil filler cap
7. Drain plug
8. Discharge plug

Tightening torque

1: 97 N • m {9.9 kgf • m / 72 lb • ft}

2: 97 N • m {9.9 kgf • m / 72 lb • ft}

3: 18 N • m {1.8 kgf • m / 13 lb • ft}

4: 21 N • m {2.1 kgf • m / 15 lb • ft}

5: 29 N • m {3.0 kgf • m / 21 lb • ft}

2. Fuel tank installation

1) After removing the bracket, attach the bracket to the frame.

Tightening torque: 97 N • m {9.9 kgf • m / 72 lb • ft}

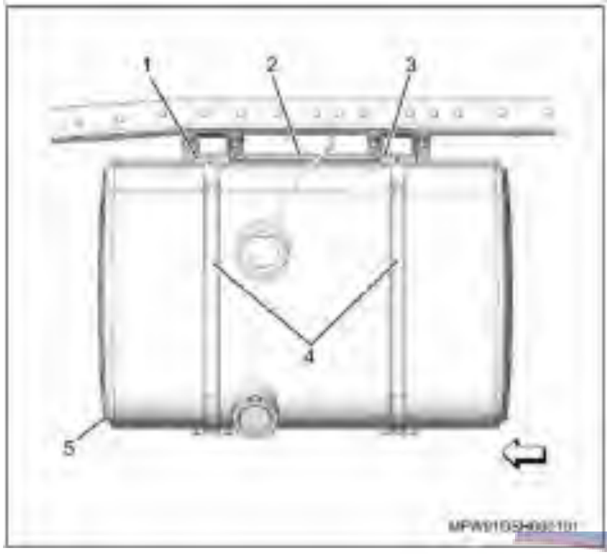
2) Install the fuel tank to the bracket.

3) Install the fuel tank fastening tape to the bracket.

Caution:

● Align the center of the fuel tank with the center of the two brackets and install them.

● During assembly, ensure that the raised area on the rear of the fuel tank for positioning rests between the cradle rubber.



1. Rubber

2. The positioning of the prominent part

3. Bracket

4. Fuel tank fastening tape

5. Fuel tank

4) Install the internal nuts on the fuel tank fastening tape.

Caution:

● When the fuel tank is empty, tighten the front and rear fuel tank fastening straps evenly with a torque wrench.

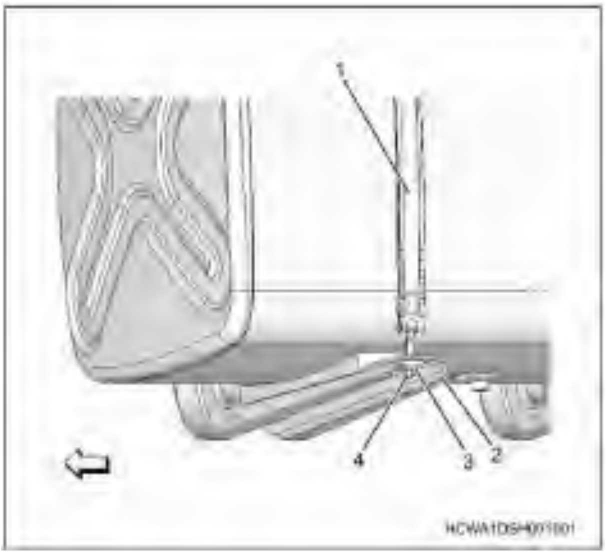
Tightening torque: 18 N • m {1.8 kgf • m / 13 lb• ft}

5) Tighten the inner nut and install the outer nut on the fuel tank band.

Caution:

● When the fuel tank is empty, tighten the front and rear fuel tank fastening straps evenly with a torque wrench.

Tightening torque: 21 N • m {2.1 kgf • m / 15 lb • ft}



1. Fuel tank fastening tape

2. Tank bracket

3. Nut

4. External nut

6) Connect the fuel supply hose to the fuel tank.

Caution:

● Insert the fueling hose into the pipe 25 mm {0.984 in} or deeper.

7) Connect the fuel return hose to the fuel tank.

Caution:

● Insert the return hose into the pipe 25 mm {0.984 in} or deeper.

8) Connect the harness connector to the fuel tank unit.

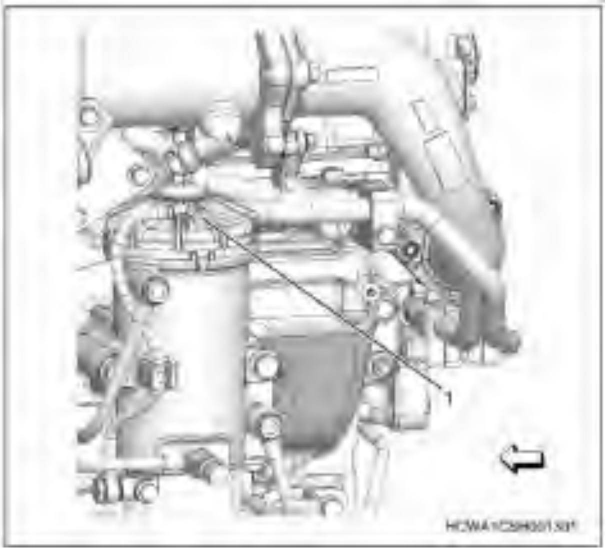
9) Refill the fuel tank with fuel.

10) Install the fuel filler cap onto the fuel tank.

3. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

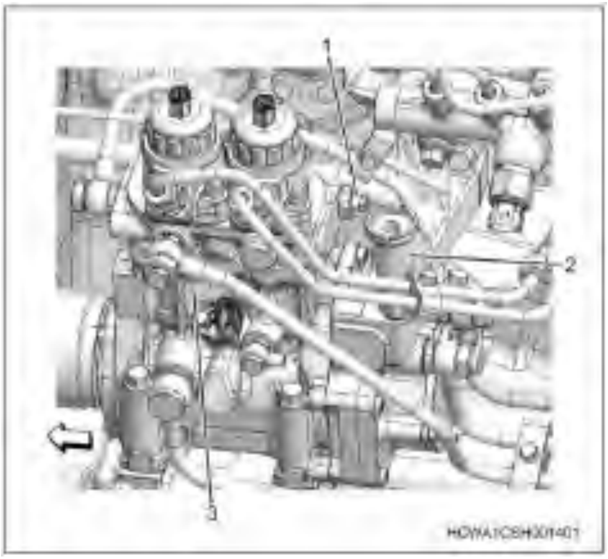
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw

2. Priming pump

3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

4. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

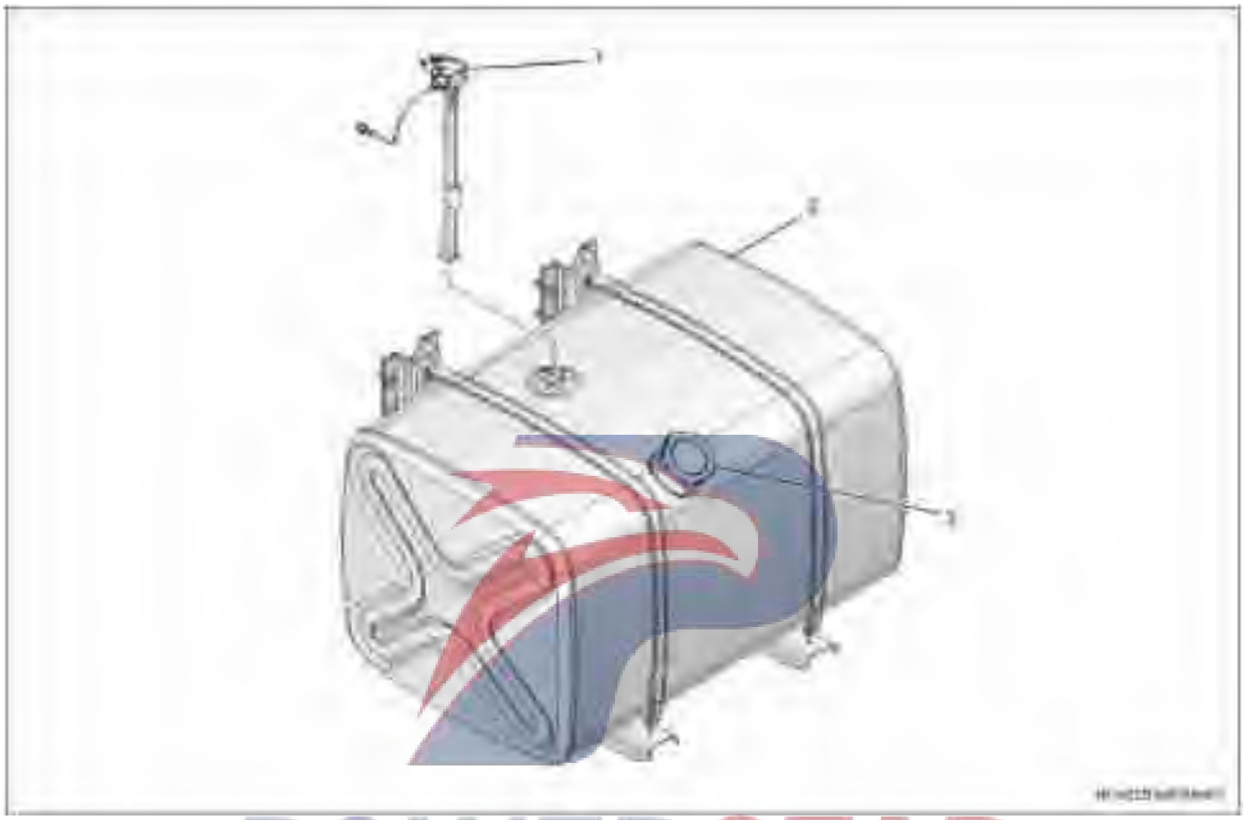
2) Lower the cab, and close the front lid.

Fuel tank device

Removal

1. Component Views

Fuel tank unit 400 L {88 Imp. Gal}



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Part name

1. Fuel tank device
2. Fuel tank
3. Filling port cover

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Fuel tank device removed

1) Disconnect the harness connector from the fuel tank unit.

2) Remove the screw and remove the fuel tank unit from the tank.

Caution:

● When removing the fuel tank unit, be careful not to disturb its periphery.

● After removing the fuel tank unit, the fuel tank unit should be properly covered to prevent foreign particles from entering.

Inspection

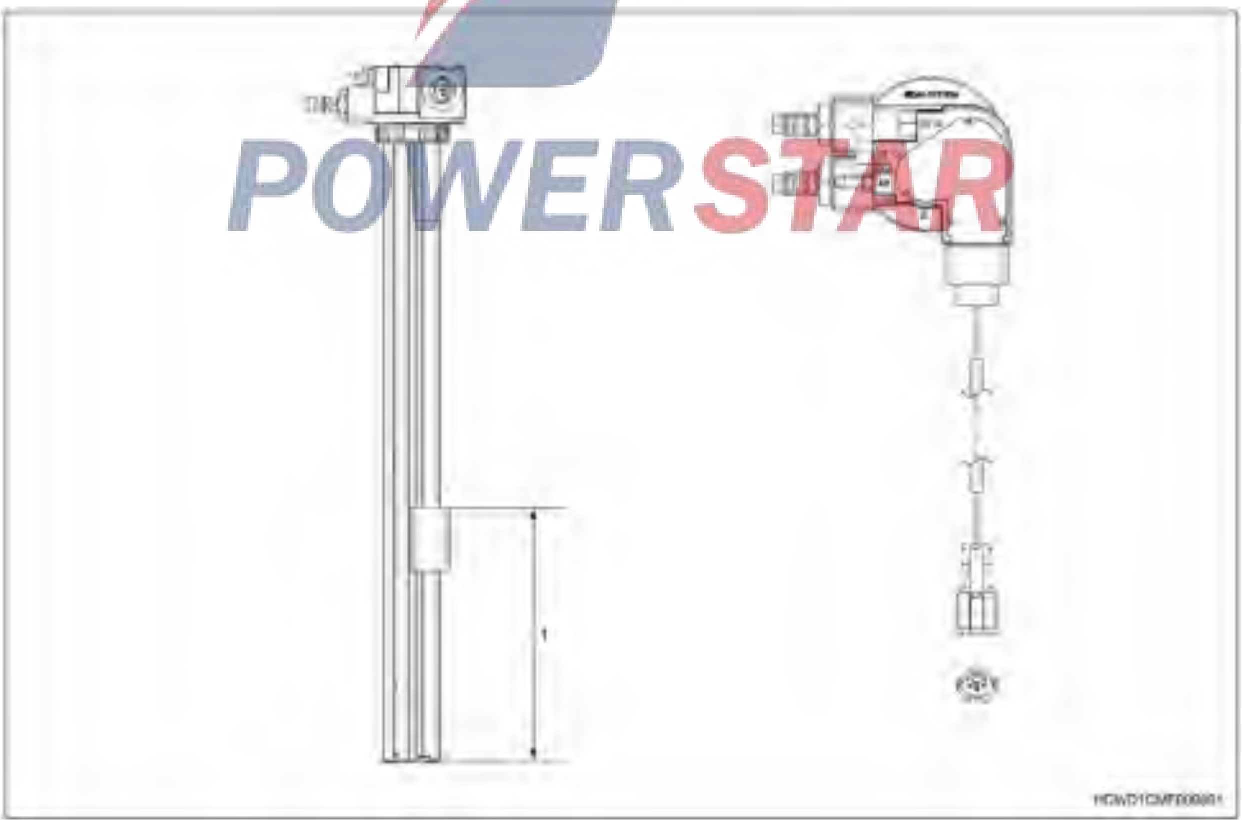
1. Fuel tank device inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Move the float up and down and use a digital multimeter to measure the resistance between the connector terminals.

Size (h)	Electric resistance: 0 Ω	Size (h)	Electric resistance: 0 Ω
: greater than 19.98 in }	: 0.0 Ω	: 276.6 mm { 10.89 in }	: 50.2 Ω
: 507.5 mm { 19.98 in }	: 3.5 Ω	: 255.5 mm { 10.06 in }	: 57.4 Ω
: 486.5 mm {19.15 in }	: 7.2 Ω	: 234.5 mm { 9.23 in }	: 64.9 Ω
: 465.6 mm { 18.83 in }	: 11.1 Ω	: 213.5 mm { 8.41 in }	: 72.4 Ω
: 444.5 mm { 17.50 in }	: 15.0 Ω	: 192.5 mm { 7.58 in }	: 79.9 Ω
: 423.6 mm { 16.68 in }	: 18.9 Ω	: 171.5 mm { 6.75 in }	: 87.4 Ω
: 402.6 mm { 15.85 in }	: 22.5 Ω	: 150.6 mm { 5.93 in }	: 95.6 Ω
: 381.6 mm { 15.02 in }	: 27.1 Ω	: 128.6 mm { 5.06 in }	: 105.6 Ω
: 360.6 mm { 14.20 in }	: 31.4 Ω	: 105.6 mm { 4.16 in }	: 116.5 Ω
: 339.6 mm { 13.37 in }	: 36.1 Ω	: 87.6 mm { 3.45 in }	: 128.6 Ω
: 315.5 mm {12.42 in }	: 40.5 Ω	: 56.6 mm { 2.23 in }	: 139.5 Ω
: 297.5 mm { 11.71 in }	: 45.5 Ω	: 53.0 mm { 2.09 in }	: 150.6 Ω



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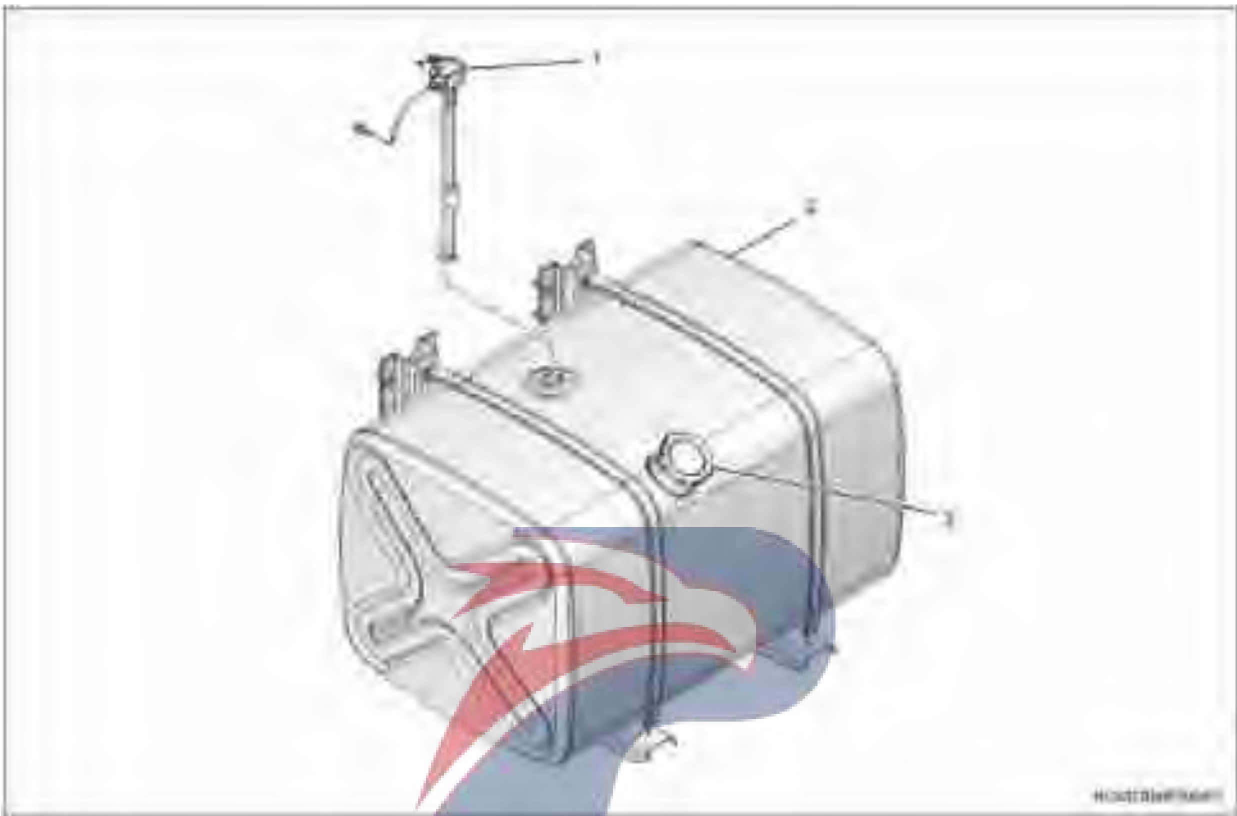
1. Size (h)

Installation

1. Component Views

Fuel tank unit 400 L {88 Imp. Gal}



Part name

1. Fuel tank device
2. Fuel tank
3. Filling port cover

2. Fuel tank installation

1) Install the fuel tank unit on the fuel tank.

2) Connect the harness connector to the fuel tank unit.

Caution:

● When installing the fuel tank unit, do not obstruct its surroundings.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

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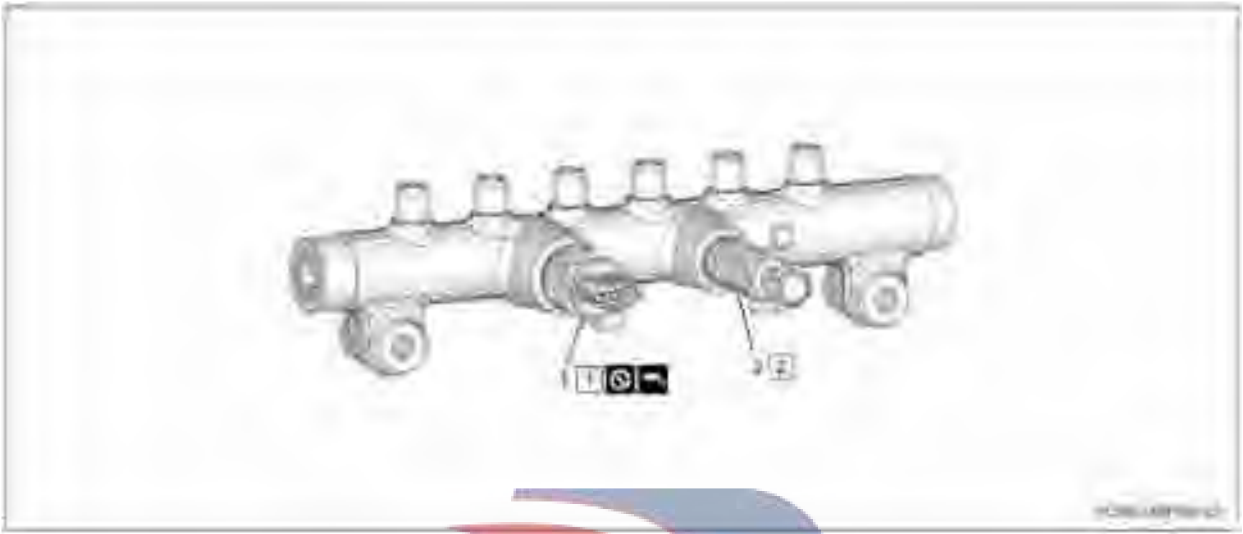
Supplementary information

1. Component Views

Pressure limiter



Part name	Tightening torque
1. FRP sensor	1: 98 N • m { 10.0 kgf • m / 72 lb • ft }
2. Pressure limiter	2: 172 N • m { 17.5 kgf • m / 127 lb • ft }

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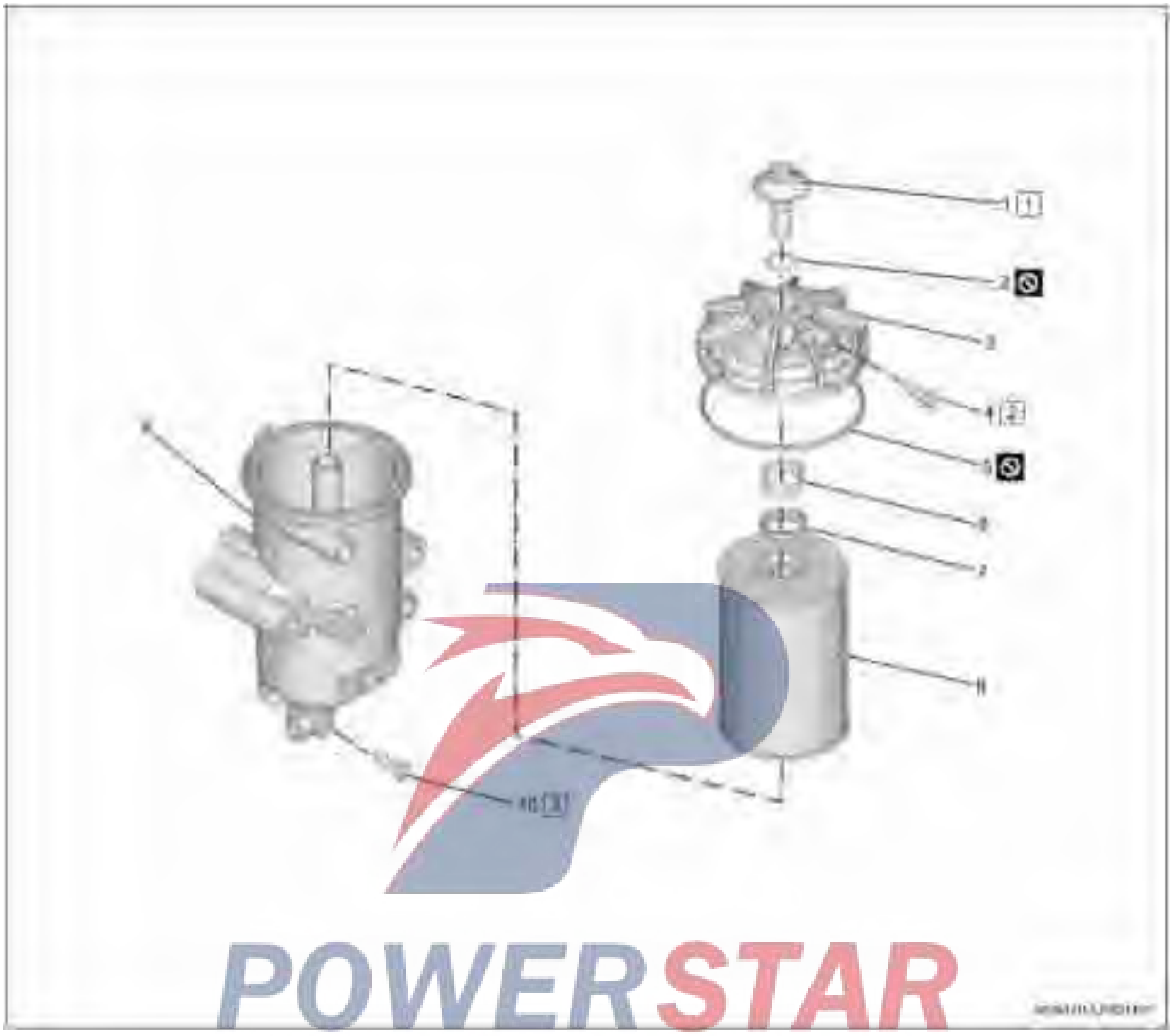
Fuel filter element



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Part name

1. Center bolt
2. O-ring
3. Cover
4. Deflate valve plug
5. O-ring
6. Spring
7. Bracket
8. Fuel filter cartridge
9. Fuel filter body
10. Drain plug

Tightening torque

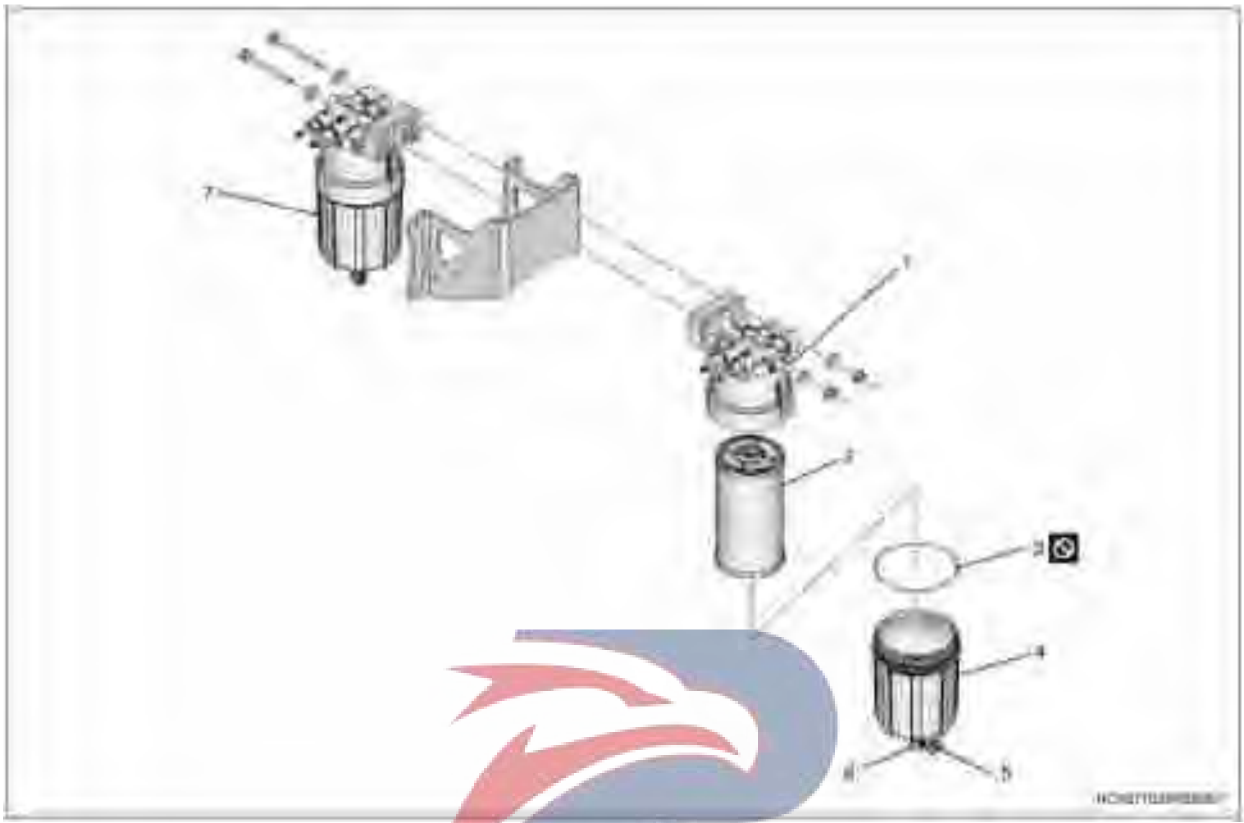
1: 29.4 N • m { 3.0 kgf • m / 22 lb • ft }

2: 7 N • m { 0.7 kgf • m / 62 lb • in }

3: 7 N • m { 0.7 kgf • m / 62 lb • in }

4: 2.5 N • m { 0.3 kgf • m / 22 lb • in }

Fuel pre-filter element



Part name	4. Component housing
1. Fuel filter body	5. Drain plug
2. Fuel pre-filter element	6. Precipitator switch connector
3. O-ring	7. Fuel pre-filter

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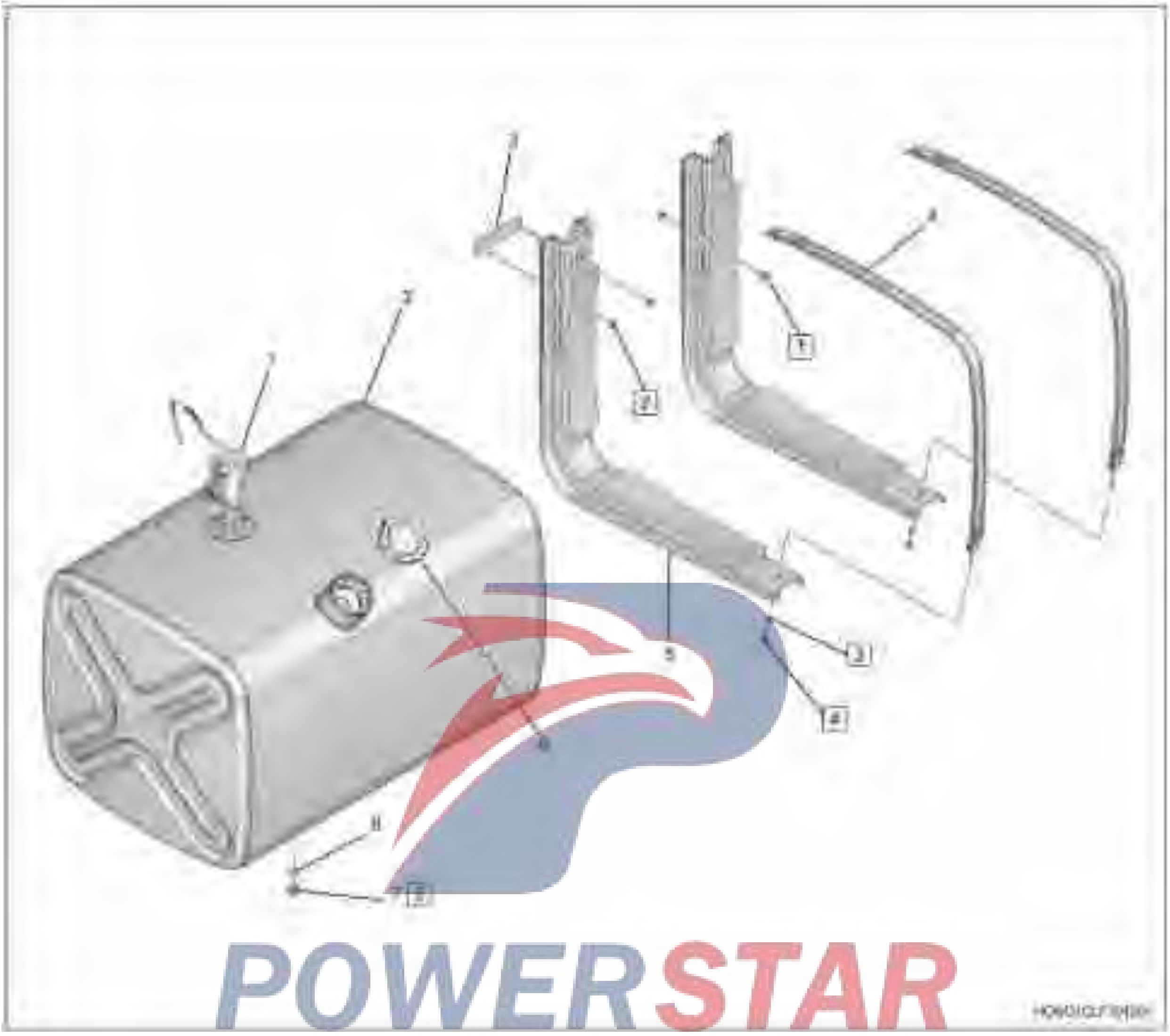
Fuel tank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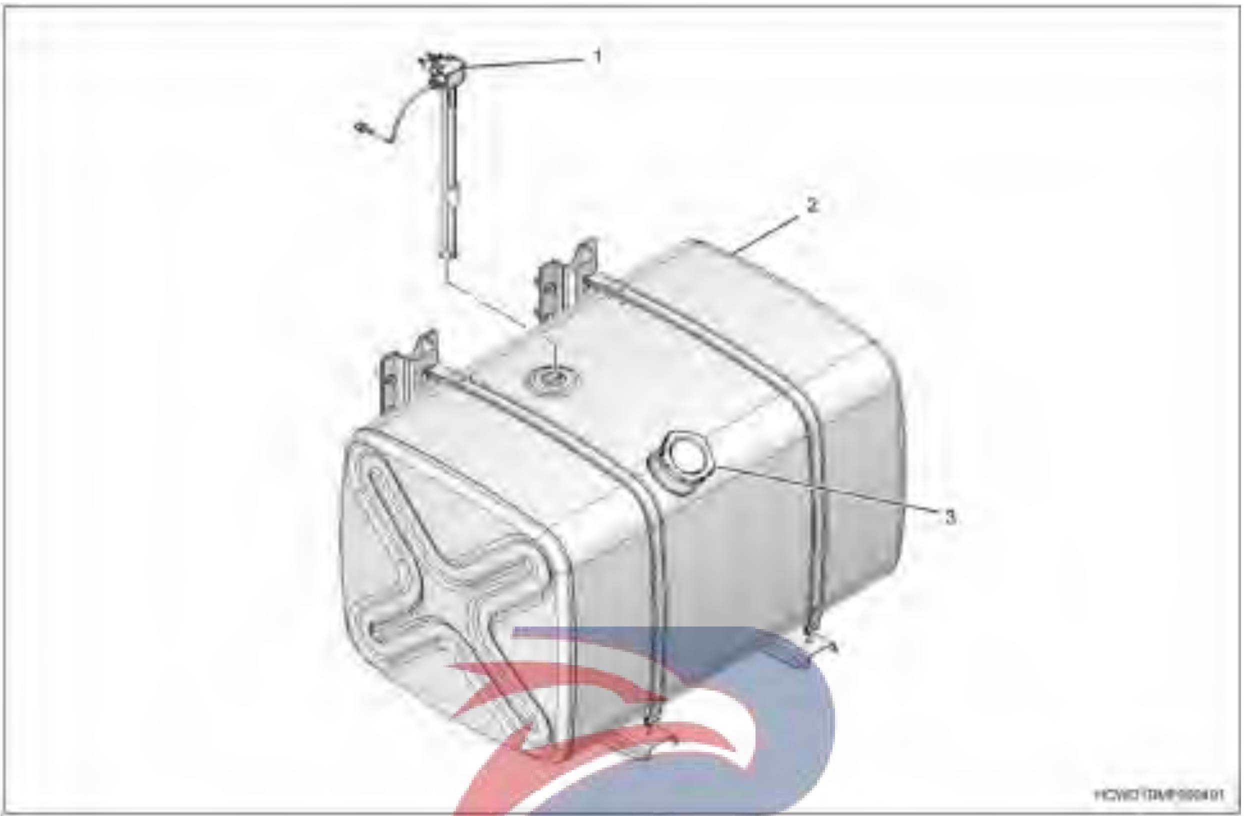
Part name	Tightening torque
1. Fuel tank device	1: 97 N • m { 9.9 kgf • m / 72 lb • ft }
2. Fuel tank	2: 97 N • m { 9.9 kgf • m / 72 lb • ft }
3. Bracket	3: 18 N • m { 1.8 kgf • m / 13 lb • ft }
4. Fuel tank fastening tape	4: 21 N • m { 2.1 kgf • m / 15 lb • ft }
5. Tank bracket	5: 29 N • m { 3.0 kgf • m / 21 lb • ft }
6. Oil filler cap	
7. Drain plug	
8. Discharge plug	

Fuel tank unit 400 L {88 Imp. Gal}



Part name

1. Fuel tank device
2. Fuel tank
3. Filling port cover

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MEMO

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