DIESEL ENGINE
6HK1
MODEL

Interim Tier 4 Compatible

WORKSHOP MANUAL

ISUZU MOTORS LIMITED

Recommended liquid gasket

1. Using the thread liquid gasket

Type	Product name	Manufacturer name	Area used (reference)
Silicon type (room temperature vulcanization process)	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215 ThreeBond 1216	ThreeBond ThreeBond ThreeBond ThreeBond	Engine oil seal retainer engine oil pan timing gear case cylinder head cover fuel pump water pump etc.
Water–soluble	ThreeBond 1141	ThreeBond	
Solvent type	ThreeBond 1104 ThreeBond 1194	ThreeBond ThreeBond	
Anaerobic	Loctite 515 Loctite 518 FMD127 (Loctite 5127) Loctite 271	Loctite Loctite Loctite Loctite Loctite	Engine oil seal retainer water pump plug etc.

Caution :

- Make sure to use a liquid gasket with the above product name or equivalent.
- Use an appropriate amount of liquid gasket.
- Follow the handling precautions for the product.
- Do not use Loctite 515/518 or FMD 127 (Loctite 5127), as they are anaerobic, and do not provide sufficient effect when there is a gap larger than 0.25 mm {0.0098 in} between the contact surfaces of metals.

Whenever disassembling, completely remove old liquid gasket using a scraper, and clean by removing any oil, moisture, filth, etc. from the locations of parts and the mating parts where liquid gasket was used by using a rag, etc. After cleaning, apply the specified liquid gasket to each location and assemble them.

Note :

- It is better to start the removal operation approximately 10 minutes after applying when using gasket remover to make the operation easier while cleaning.

Caution :

- Do not apply gasket remover to plastic parts and painted parts.

Apply liquid gasket of the specified bead width to one side of the contact surface thoroughly.

Caution :

- Be careful to apply a proper amount of the liquid gasket to avoid an excess or lack in application.
- Be sure to overlap the beginning and ending of the liquid gasket application.
- Be careful not to misalign the applied part with the mating part when assembling.

Note :

- When there is a misalignment, apply again.
- Use the same size studs as a guide when using with a section which has no positioning such as a knock pin.

Caution :

- After applying the liquid gasket, assemble within 15 minutes.

Note :

- When more than 15 minutes have passed after applying liquid gasket, remove the liquid gasket and apply it again.

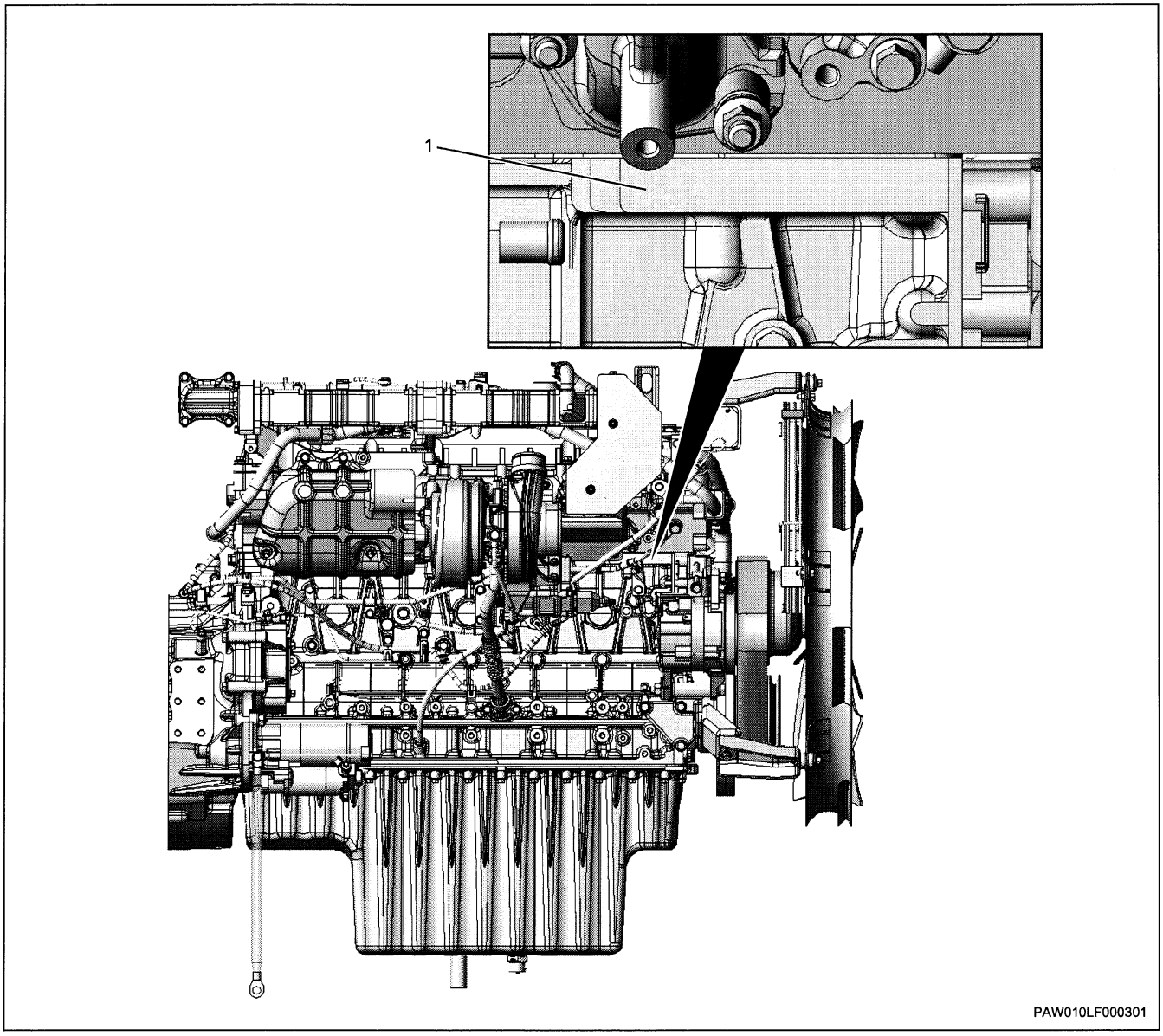
Caution :

- Wait at least 30 minutes before starting the engine after assembling each part.

M24 x 2	: 358.9 to 539.4 N・m { 36.6 to 55.0 kgf・m / 265 to 398 lb・ft }	-	: 430.5 to 711.0 N・m { 43.9 to 72.5 kgf・m / 318 to 524 lb・ft }	-
*M24 x 3	: 338.3 to 507.0 N・m { 34.5 to 51.7 kgf・m / 250 to 374 lb・ft }	-	: 406.0 to 608.0 N・m { 41.4 to 62.0 kgf・m / 299 to 448 lb・ft }	-

Function, Structure, Operation

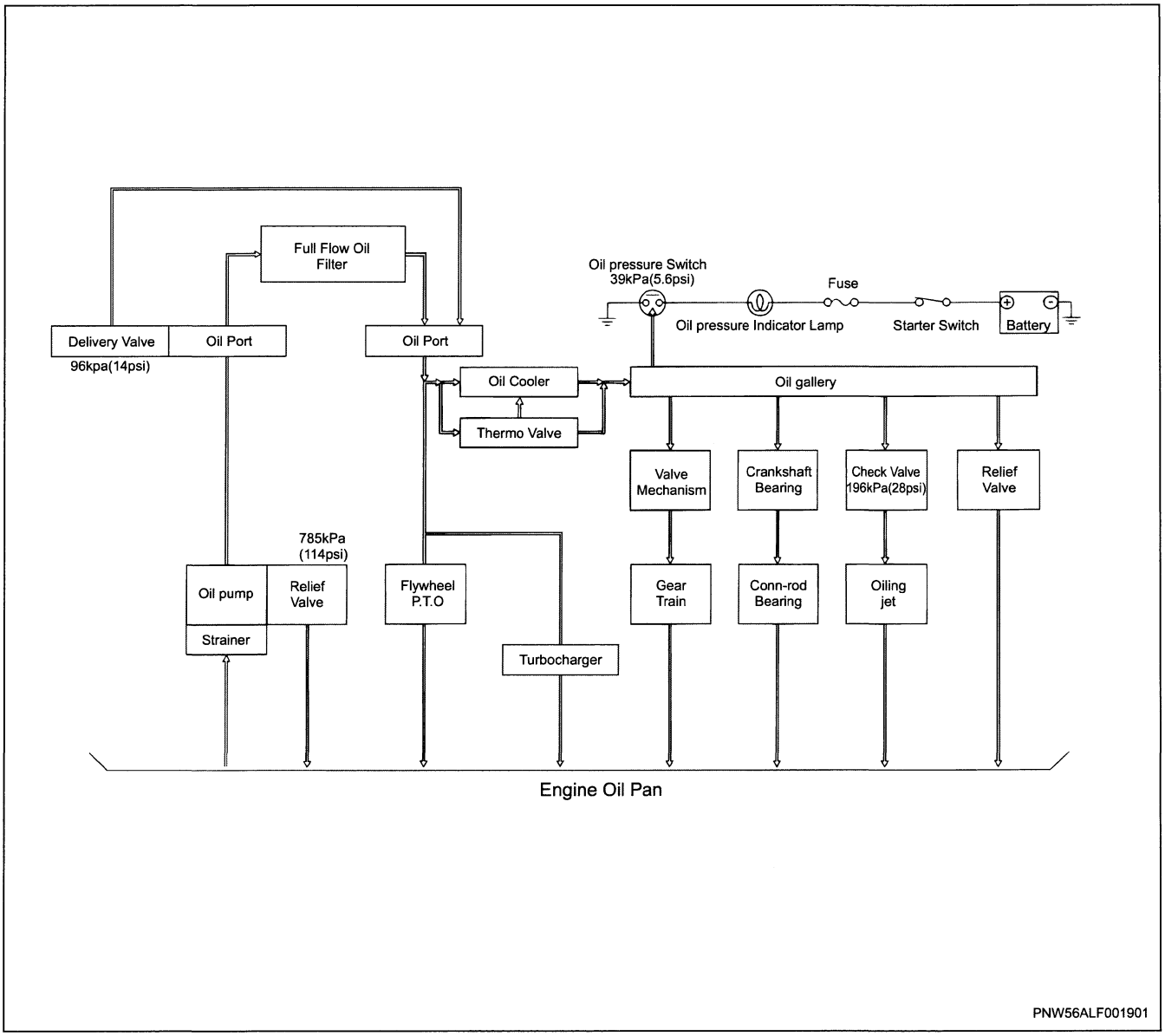
1. Engine number



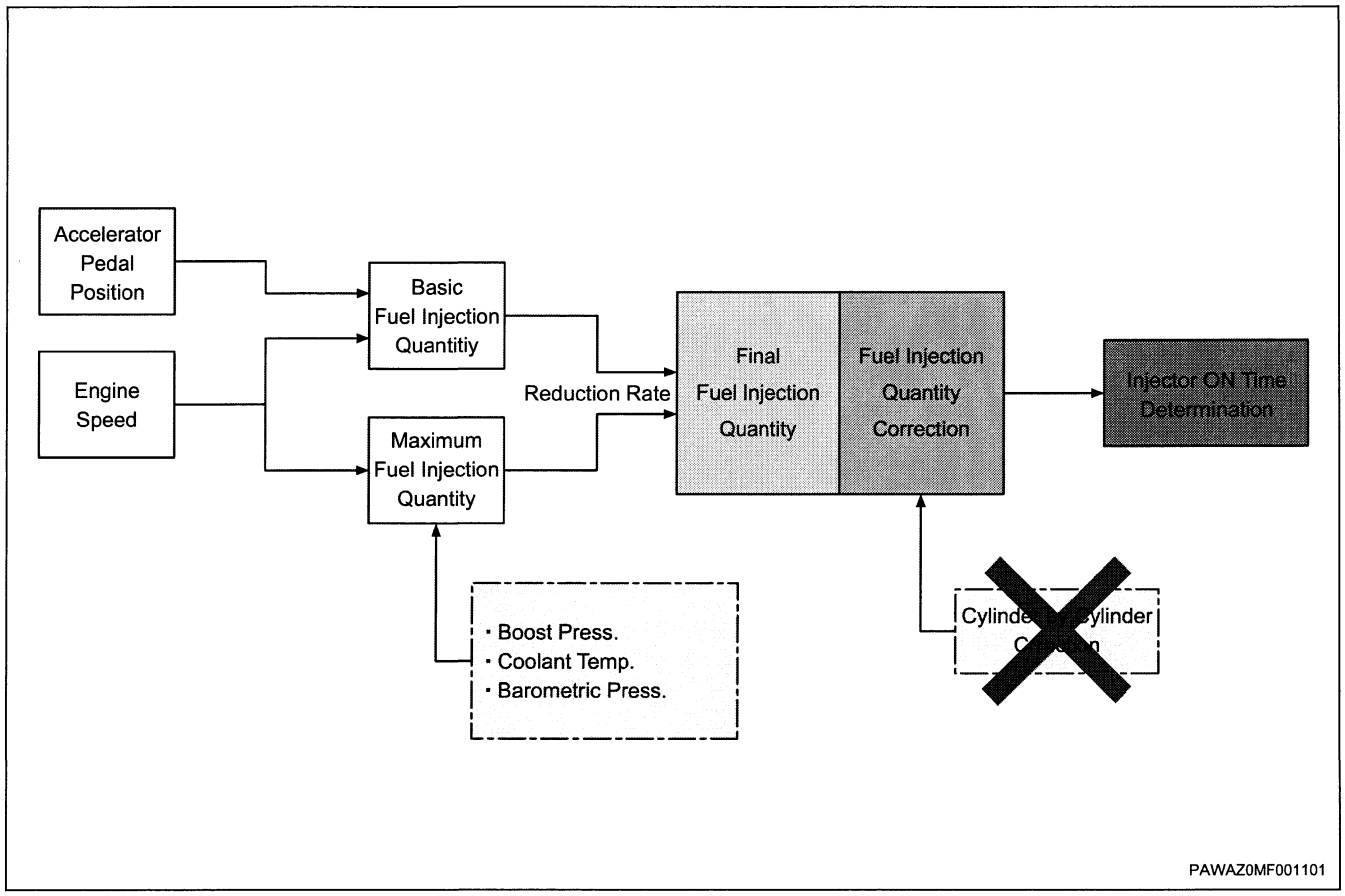
1. Engine number stamping

2. Function, Structure, Operation

1. Engine structural diagram



Oil pump structural diagram



Injection pressure control
The injection pressure is controlled by regulating the fuel pressure inside the common rail. The proper pressure inside the common rail is controlled by calculating from the engine RPM, fuel injection amount, etc., and the appropriate amount of the fuel is discharged by regulating the supply pump to be force-fed to the common rail.

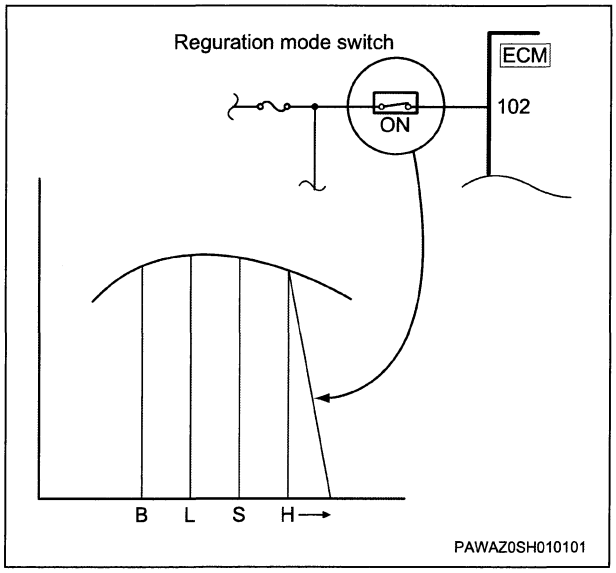
Injection timing control
This control is performed by calculating the proper fuel injection timing mainly from the engine RPM or injection amount in substitution for the timer function to regulate the injector.

Injection rate control
To improve combustion inside the cylinder, only a small amount of the fuel is injected first to be ignited, and then the second injection is performed when ignition is made. This control for injection timing and injection amount is performed through regulating the injector.

Maximum fuel injection amount
The maximum fuel injection amount is the amount of fuel injection calculated by adjustment of initial injection amount under certain water temperature, limitation of maximum injection amount for the boost pressure, and control of injection amount for the high altitude due to the atmospheric pressure.

Inter-cylinder correction
It is not used for this engine.

System schematic



Idling control
By operating the idling control change switch during the warm-up operation, the minimum idling RPM can be adjusted. In addition, by operating the idling control change switch, the minimum idling RPM can be automatically set to the optimum value in accordance with the engine coolant temperature.

Note :

- The specifications vary depending on the actual unit, so availability of functions also differ.

Idling control change switch
By operating the idling control change switch, the idling control functions can be switched.

The idling control switch
By operating idling control switch, the idling RPM can be adjusted.

Note :

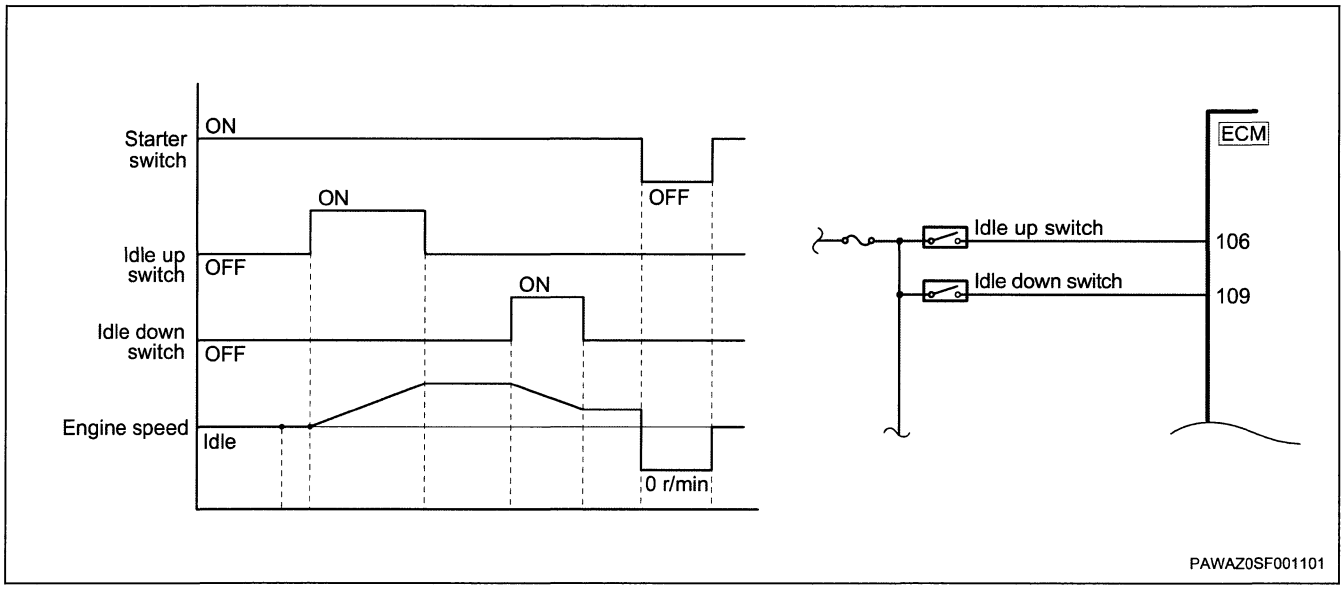
- As for the installation positions of the idling control change switch and idling control switch, refer to the manual of the actual unit.
  The engine RPM upper limit varies depending on the engine model, actual unit specifications and engine warming-up condition.

Up
While the Up side of the switch is pressed, the engine RPM is increased and the idling RPM can be raised.

Down
While the Down side of the switches is pressed, the engine RPM is decreased and the idling RPM can be lowered. However, the engine RPM cannot be decreased below the minimum idling RPM.

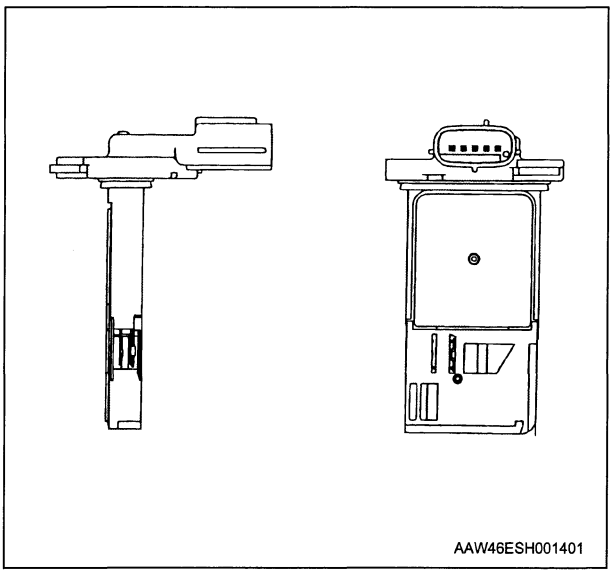
Control during starter switch OFF state
There are 2 types of controls provided when the starter switch is turned OFF after the idling control switch is operated, and either one of them is performed depending on the specification.
The engine RPM adjusted by the idling control switch is recorded in the ECM, and the next operation is performed with the engine RPM at the time when the starter switch is turned OFF.
The engine RPM adjusted by the idling control switch is not recorded in the ECM, and the next operation is performed with the default engine RPM.
As for confirmation and questions regarding the specifications, contact an Isuzu service related person.

Idle manual control

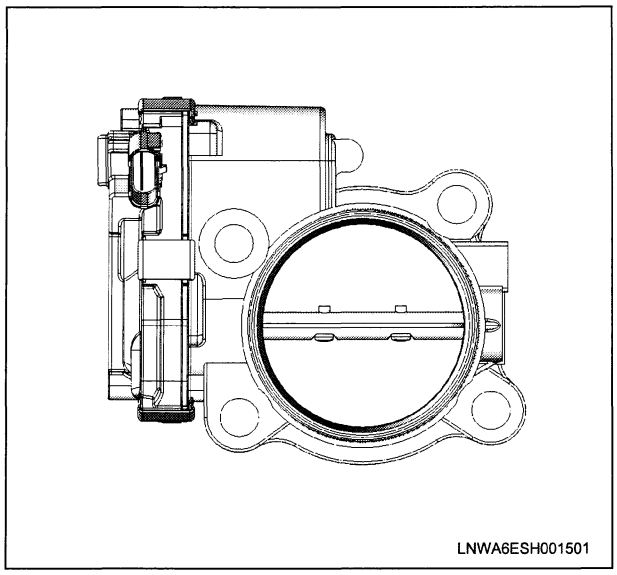


Engine RPM output to tachometer
The ECM outputs the engine rpm pulse to the tachometer as a tachometer output. The tachometer displays the engine RPM based on the engine RPM pulse sent from the ECM.

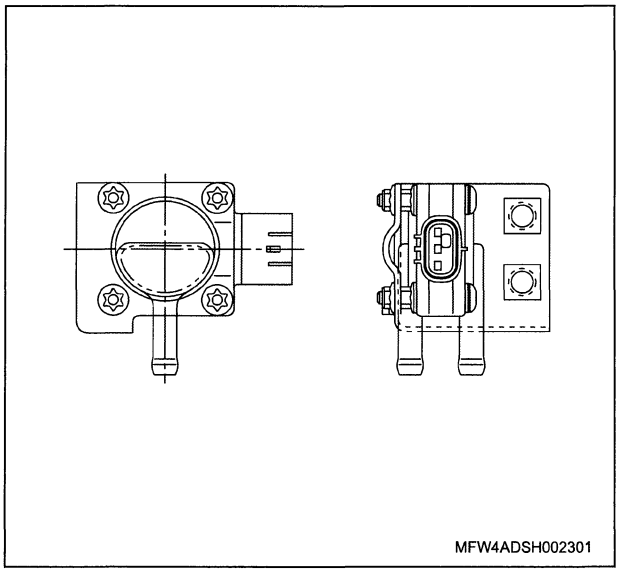
The mass air flow sensor measures the amount of air taken into the engine, and it is installed on the duct between the air cleaner and turbocharger. The mass air flow sensor consists of the mass air flow sensor and intake air temperature sensor to measure some of air flowing in the duct. A small amount of air taken into the engine indicates deceleration or idle RPM. A large amount of air indicates acceleration or high load.



Intake throttle valve
The intake throttle valve is installed on the inlet of the inlet manifold. The ECM controls the opening angle of the intake throttle valve according to the condition of engine operation. The motor inside the intake throttle valve is controlled based on the duty ratio signals sent from the ECM. The opening angle of the intake throttle valve is adjusted when the duty ratio is changing from 0 % to the appropriate ratio. The valve closes when the duty signal increases, and the valve opens when the duty signal decreases. The opening angle of the intake throttle valve is detected by the position sensor. The position sensor outputs the signal representing the intake throttle valve opening angle.
The ECM detects a low signal voltage when the opening angle is small or the valve is at the closed position. Also, the ECM detects a high signal voltage when the opening angle is large.



DPD differential pressure sensor
The DPD differential pressure sensor is installed near DPD. DPD differential pressure sensor varies the signal voltage according to changes of the exhaust gas differential pressure between in front and rear of DPD filter. The ECM detects a lower signal voltage when the differential pressure is small due to a small amount of accumulated PM. The ECM detects a higher signal voltage when the differential pressure is large due to a large amount of accumulated PM.
The ECM uses this voltage signal for controlling DPD regeneration and determining purification after regeneration.
It also uses the signal voltage to detect filter failures such as a too low differential pressure.



Exhaust gas temperature sensor
The exhaust gas temperature sensors are the variable resistors that are installed at 2 locations on the DPD housing, and one is installed in front of the DPD oxidation catalyst, and the other is installed in front of the

150	OS-HOUR	Hour meter relay
151	-	-
152	OS-STARTR	Starter cut relay
153	OS-GLOWR	glow relay
154	CC-CAN-H	CAN-High

Item	Item	Objective	Method
1	DTC check	Confirm the DTC display after the repair	Clear the previous DTCs. Keep the engine idling to warm up, then perform a racing run to increase the engine rpm to No Load Max to secure the test conditions.
2	Idling speed check after warming up the engine	To check whether the idling control is operating normally	Check whether the idling rotation speed is constant under the no load condition after engine is warmed up. If a problem is detected, refer to Idling Unstable in Diagnosis by Symptom.
3	Confirm the scan tool data list	Check the engine control, communication status error and abnormality under the standard condition.	Monitor the scan tool data list, and check the values using a typical value sheet. Confirm the typical values of the scan tool data list.
4	Re-startability check	To check whether the starting control is normal.	After warming up the engine, confirm that the cranking time is 5 seconds or less when restarting the vehicle, and that the engine revolution is stable after starting.
5	Check powerful electromagnetic transmitters	When electromagnetic transmitters such as a transceiver have been added to the vehicle, confirm that no interfering waves are being emitted.	Check whether turning the electromagnetic transmitter such as a transceiver ON and OFF causes the idling engine rpm to change. If a problem is found, let the customer know that the installation position and output of the electromagnetic transmitter need to be changed.

Supplementary information regarding the check for powerful electromagnetic transmitters
If you discover a problem in this item, convey it to the customer as necessary.
・Install the antenna to the a place distant from the electronic control system of the actual unit such as the control units and sensors.
・Install the antenna cord at least 20 cm away from the electronic systems of the actual unit, such as the control units and sensors.
・Do not wire other cables together with antenna.
Also, locate the antenna cord as far away from other wiring as possible.
・Make sure to attach retrofitted equipment in accordance with their respective installation manuals.
・Do not install high-output mobile communication devices.

Caution :

- Follow the steps when performing the OBD system checks to confirm the repair. Failure to follow these steps may result in performing unnecessary repair works.
- Review the scan tool data relating to the DTC that was diagnosed and make a record.
- Clear the DTC.
- Operate the actual unit while checking the related scan tool data.

9. DTC clearing method

Clearing DTC
If an error occurs in the system and the DTC is recorded in the ECU, that DTC is not deleted from the memory even when the malfunctioning part is repaired, so use the following measures to execute a forced deletion.

Using the scan tool to delete the DTC
If the trouble diagnosis scan tool is connected, you can delete codes by performing turning off of the trouble diagnosis scan tool.

Clearing method with use of harness for memory clear
HITACHI Construction Machinery Company
1, Connect the harness for memory clear to the data link connector.

Air intake system check

1. Air intake system check Description of Function

Caution :

- If the air intake system part is installed by the actual unit manufacturer, refer to the manual of the actual unit.

The air intake system is comprised of the air cleaner, air intake piping, turbocharger, etc. The intake air is supplied to the engine through the air cleaner and intake manifold.

2. Air intake system check Inspection

Inspection when there is a possibility that there is an abnormality in the air intake system

1. Inspect the air cleaner.

· No excessive contamination or clogging should be found.

2. Clean or replace if a problem is discovered.

3. Inspect the air intake piping.

· No collapsing, damage, or air leakage should be found.
· There are no distorted or improper piping arrangements which may lead to an increase in the air intake resistance.
· The lead valve should have no damage.

4. Repair or replace if a problem is discovered.

5. Inspect the turbocharger.

· The turbine axis should have no abnormal looseness.
· There are no oil leaks.

6. Repair or replace if a problem is discovered.

Inspection of the starter circuit system

1. Inspection of the starter circuit system Description of Function

The starter relay on the ECM is turned to ON when the starter switch moves to the START position. When the starter relay is turned to ON, the starter operates to start the engine.

2. Inspection of the starter circuit system Inspection

Inspection when the starter does not operate

1. Turn the emergency stop switch to OFF.

Note :

- If the actual unit does not have an emergency stop switch setting, do not perform this operation.

2. Check the DTC.

Note :

- If the DTC P0117, P0340, P0341, P0615, P0651, or P1625 is detected, inspect the corresponding DTC.

3. Turn OFF the starter switch.
4. Remove the starter cut relay.
5. Inspect the starter cut relay.

· Check the continuity between the switch side terminals.
Standard value: 100Ω or less

6. Replace the relay if a problem is discovered.
7. Remove the starter relay.
8. Inspect the starter relay.

· Connect the battery between the coil side terminals and check the continuity between the switch side terminals.
Standard value: 100Ω or less

9. Replace the relay if a problem is discovered.
10. Inspect the starter switch start signal circuit.

· No open circuits or high resistance should be found between the starter switch and ECM. Standard value: 100Ω or less
· No short circuits with the GND should be found between the starter switch and ECM. Standard value: 10MΩ or more

11. Repair the circuit if a problem is discovered.
12. Inspect the starter circuit.

· No open circuit should be found between the starter switch and starter cut relay.
· No open circuit should be found between the starter cut relay and starter relay.
· No open circuit should be found between the starter relay and GND.
· No open circuit should be found between the starter relay and starter.

13. Repair the circuit if a problem is discovered.
14. Inspect the starter.

Inspection of the starter

15. Replace the starter if a problem is discovered.
16. Replace the ECM.

Removal of ECM

Installation of ECM

17. After replacing the ECM, perform EGR learning.

Engine stalling

1. Engine stalling Description of Symptom

   Engine cranks but takes a long time to start. The engine ultimately operates, or starts but stops soon.

2. Engine stalling Diagnostics

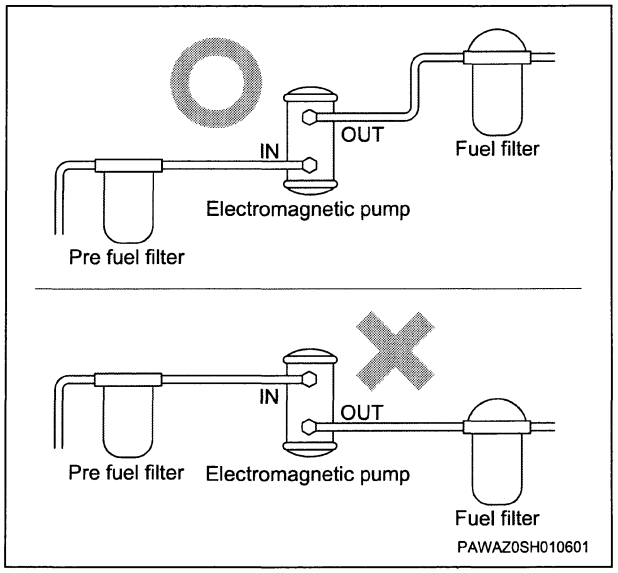
   · Preliminary inspection

   Before using this section, perform the functional inspection and OBD system check to check all of the following. Check whether the actual unit has a significant load. The ECM and diagnostic light are operating correctly. Since the crankshaft position sensor abnormalities will not be diagnosed with cranking less than 14 revolutions, crank for more than 14 seconds at 60 r/min or more. DTC check. For crankshaft position sensor errors at low engine revolution speed, the crankshaft position sensor DTC may not be detected. For intermittent failure, increase the engine revolution speed to No Load Max and check if the crankshaft position sensor related DTC is detected. The scan tool data is within the normal operating range. Check the condition of the actual unit, and locate the appropriate symptom. Check with the customers whether they are using the specified engine oil and fuel. Check whether fuel is contained.

   · Visual inspection

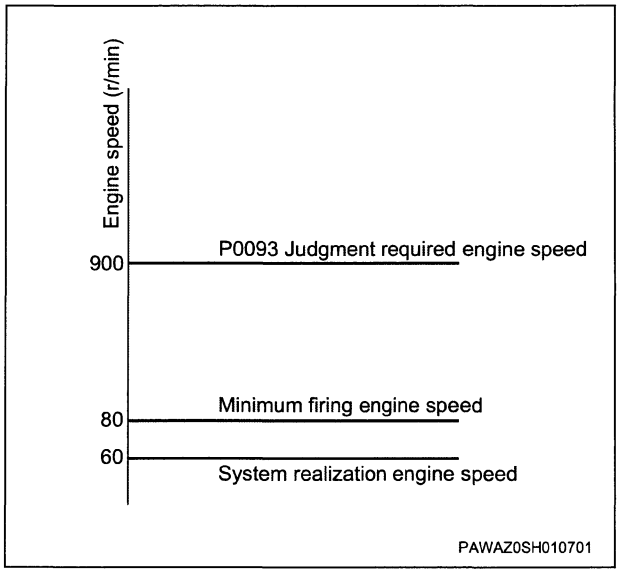
   Careful visual inspection is required for several symptom procedures. This can lead to fixing a problem without further inspections, and can save valuable time. The inspection includes the following. Whether there is an improper connection of connectors. Particularly for the crankshaft position sensor and camshaft position sensor. Proper wiring connections, tightening, and disconnection Whether the power of any commercial accessories is being taken divergingly from the ECM power. Whether the ECM ground is free of dirt, etc. and securely installed in the correct location. Proper connections, cracks, and twists in the pipes and hoses related to fuel, air, and oil. Extensively check for any leaks or blockage. Whether there are any fuel leaks, pipe damage, or dents in the fuel system. Whether the layout of the fuel filter, pre-filter, and electromagnetic pump has a structure in which air accumulates easily.

   Check whether they are arranged to prevent air accumulation as Isuzu genuine pre-filters do not have any plugs for air removal. Also check whether the inlet and outlet of the electromagnetic pump have an appropriate layout. Fix layouts which have the electromagnetic pump inlet on the upper side or have an outlet toward the motion direction of the actual unit. Abnormalities of the air intake system parts
   Abnormalities of the exhaust system parts

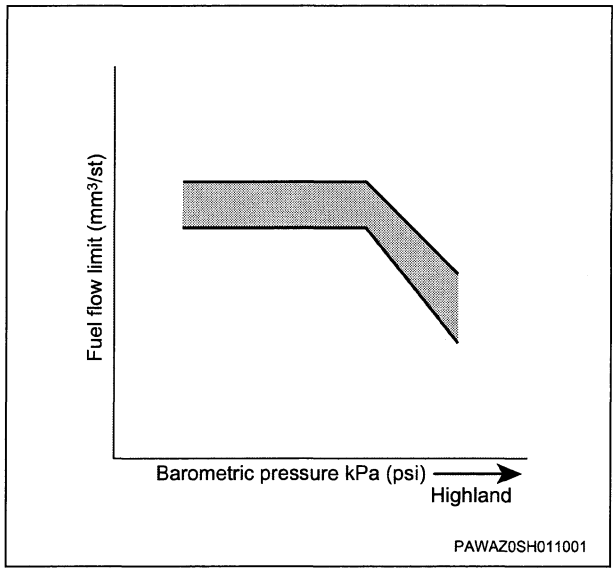


· Diagnostic aids

Fuel system abnormalities such as fuel running out, fuel freezing, mixture of air into the fuel piping, filter abnormalities, piping abnormalities, fuel quality, fuel tank, etc.
Air intake system abnormalities such as filter clogging and air intake piping abnormalities, etc.
Abnormalities of the supply pump, non-pressure fuel supply
The ECM determination of the supply pump non-pressure fuel supply DTC will not be detected unless a condition continues for 3 seconds or more in which the engine revolution speed is 900 r/min and the absolute pressure is below 15 MPa {153 kgf/cm2 / 2175 psi}. Therefore, the DTC will not be detected when the engine does not start with non-pressure fuel supply due to supply pump abnormalities.



The ECM calculates the current altitude in accordance with the signal from the atmospheric pressure sensor. Depending on the conditions of altitude, etc. at this time, the SCV opening and closing timing and injector energizing time are controlled and the fuel flow is corrected to be optimum.



DTC P0093 (Flash Code 227)
Fuel System Leak Detected

1. DTC P0093 Description of DTC

The general common rail system is comprised of the following two fuel pressure sections. The suction side between the fuel tank and the supply pump and the high-pressure side between the supply pump and injectors. The fuel is drawn from the fuel tank and supplied to the common rail by the three plungers located inside the supply pump. The common rail pressure is adjusted by the ECM through controlling the suction control valve based on the signal from the common rail pressure sensor. The DTC is set when the ECM detects that the common rail pressure is low compared to the engine RPM.

2. DTC P0093 Condition for setting the DTC

DTC P0087, P0091, P0092, P0192, P0193, P0201, P0202, P0203, P0204, P0205, P0206, P060B, P0651, P1261, P1262, P2146, and P2149 have not been detected
The battery voltage has been between 18 and 32 V
Starter switch the ignition switch has been ON
The engine RPM has been 900 r/min or more
When the ECM has detected that the actual common rail pressure has been 15 MPa {153 kgf/cm2 / 2175 psi} or lower for 3 seconds or longer (this may not be a prerequisite depending on the device manufacturer)

3. DTC P0093 Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note :

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

Restrict the fuel injection amount.
Restrict the fuel flow.
Stop the EGR control.
Stop the DPD regeneration.

DTC P0183 (Flash Code 211)
Fuel Temperature Sensor Circuit High

1. DTC P0183 Description of DTC

The fuel temperature sensor is installed on the supply pump. The fuel temperature sensor is a variable resistor, and measures the temperature of the fuel entering the supply pump. This sensor has a signal circuit and GND circuit. The ECM supplies 5 V to the signal circuit, and the GND circuit connects to GND. When the fuel temperature sensor is cold, the resistance of the sensor is high. When the fuel temperature rises, the resistance of the sensor 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. The DTC is set when the ECM detects an abnormally high signal voltage.

2. DTC P0183 Condition for setting the DTC

DTC P060B is not set
The battery voltage is between 18 and 32 V
The starter switch is ON
The engine is running for 3 minutes or longer
When the ECM has detected that the signal voltage of the fuel temperature sensor has been 4.85 V or higher for 4 seconds

3. DTC P0183 Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note :

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

Substitute the default value of fuel temperature sensor.

DTC P0219 (Flash Code 543)
Engine Overspeed Condition

1. DTC P0219 Description of DTC

   The crankshaft position sensor is installed on the upper position of the flywheel housing. The ECM calculates the engine RPM and the correct position of the crankshaft using the signal pulses from the crankshaft position sensor. When the ECM has detected that the engine has overrun, it sets DTC.

2. DTC P0219 Condition for setting the DTC

   When the ECM detects that the engine RPM is 2500 r/min or above for longer than 3 seconds

3. DTC P0219 Action taken when the DTC sets

   When it has been detected for 2 consecutive times, the failure is displayed on the monitor of the main device or the Diagnostic light illuminates.

   Note :

   - Depending on the manufacturer of the actual unit, the failure indication may not be shown.

DTC P041D (Flash Code 27)
Intake Manifold Temperature Sensor Circuit Low

1. DTC P041D Description of DTC

The IMT sensor is installed on the intake manifold. The IMT sensor is a thermistor type sensor to measure the temperature of intake air mixed with EGR gas. This sensor has a signal circuit and GND circuit. The ECM supplies 5 V to the signal circuit, and the GND circuit connects to GND. When the IMT sensor is cold, the resistance of the sensor is high. When the EGR gas amount increases, the intake air temperature rises and the sensor resistance decreases. The ECM detects the high voltage when the sensor resistance is high. The ECM detects the low voltage when the sensor resistance is low. When the ECM has detected that the DPD differential pressure is abnormally low, it sets DTC.

2. DTC P041D Condition for setting the DTC

DTC P060B has not been detected
When the ECM has detected that the signal voltage of the IMT sensor has been 0.1 V or lower for 4 seconds or longer

3. DTC P041D Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note :

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

Substitute the default value for the IMT sensor.

DTC P0563 (Flash Code 35)
System Voltage High

1. DTC P0563 Description of DTC

   The ECM monitors ignition voltage of the ignition feed terminal and makes sure that the voltage stays within the appropriate range.
   When the ECM has detected that the ignition power voltage is abnormally high, it sets DTC.

2. DTC P0563 Condition for setting the DTC

   DTC P060B is not set
   When the ECM has detected that ignition power supply circuit voltage has been 32 V or higher for 5 seconds

3. DTC P0563 Action taken when the DTC sets

   Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

   Note :

   - Depending on the manufacturer of the actual unit, the failure indication may not be shown.

DTC P0685 (Flash Code 416)
ECM/PCM Power Relay Control Circuit/Open

1. DTC P0685 Description of DTC

When the ECM has received the starter switch ON signal, power is applied to the ECM main relay and the battery power is supplied to the ECM via the relay switch side. When the starter switch was turned to OFF, power applied to the ECM main relay is discontinued after a certain period of time.
If the ECM has detected a low voltage with the relay voltage supply circuit when the ON command has been executed for the ECM main relay, it sets DTC.

2. DTC P0685 Condition for setting the DTC

The battery voltage is between 18 and 32 V
The starter switch is ON
When the ECM has detected the v oltage condition in the ECM main relay voltage supply circuit has been 1V or lower for 3 seconds while the ON command has been executed to the relay

3. DTC P0685 Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note :

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

DTC P1404 (Flash Code 45)
Exhaust Gas Recirculation (EGR) Closed Position Performance

1. DTC P1404 Description of DTC

The ECM controls the EGR valve opening and closing based on the engine running condition and by controlling the EGR solenoid. The EGR opening angle is detected by the position sensor and transmitted to the ECM. For the closed position error DTC, when the ECM has detected that the actual EGR valve opening angle is greater than a certain value, it sets this DTC.
For the learned position error DTC, when the ECM has detected a difference between the learned closed position and the actual closed position, it sets DTC.

2. DTC P1404 Condition for setting the DTC

When the ECM has detected that the EGR-learned closed position is not within the specific range when the starter switch was turned to OFF

3. DTC P1404 Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note :

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

Restrict the fuel injection amount.
Stop the EGR control.
Stop the DPD regeneration.

DTC P2138 (Flash Code 124)
Pedal Position Sensor 1 - 2 Voltage Correlation

1. DTC P2138 Description of DTC

The accelerator position sensor consists of 2 sensors installed within a single housing. The accelerator position sensor 1 and accelerator position sensor 2 are hall IC type sensors and each has the following circuits.
5 V power supply circuit
GND circuit
Signal circuit
The ECM supplies 5 V to the accelerator position sensor via the 5 V power supply circuit and the GND circuit connects to the GND. The accelerator position sensor transmits the signal related to changes of the accelerator pedal angle position to the ECM via the signal circuit. The signal voltage of the accelerator position sensor 1 is kept low first, and then increases as the pedal is depressed. The signal voltage of the accelerator position sensor 2 is kept high first, and then decreases as the pedal is depressed. When the ECM has detected that the accelerator position sensor 1 signal and accelerator position sensor 2 signal voltages are not related to each other, it sets DTC.

2. DTC P2138 Condition for setting the DTC

DTC P060B, P2122, P2123, P2127, and P2128 are not set
The battery voltage is between 18 and 32 V
The starter switch is ON
When the ECM has detected that both the accelerator pedal position sensors 1 and 2 have been outside the specified range for 45 % or more for longer than 2.6 seconds

3. DTC P2138 Action taken when the DTC sets

When the accelerator position sensors 1 and 2 are faulty, the accelerator opening angle is limited to 0 %.

DTC P2456 (Flash Code 47)
DPD Differential Pressure Sensor Learned Position

1. DTC P2456 Description of DTC

The DPD differential pressure sensor is installed near DPD itself. DPD differential pressure sensor varies the signal voltage according to changes of the exhaust gas differential pressure between in front and rear of DPD filter.
The ECM learns a variance of the exhaust differential pressure sensor signal at every ignition cycle after the starter switch has been ON with the engine OFF for 30 seconds.
If the ECM detects that learned exhaust differential pressure is not within a predetermined range, it sets DTC.

2. DTC P2456 Condition for setting the DTC

The battery voltage is between 18 and 32 V
The starter switch is ON
The engine is stopped
When the ECM detects that the learned absolute value of differential pressure is 4.5 kPa {0.05 kgf/cm2 / 0.7 psi} or higher

3. DTC P2456 Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note :

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

Limit the fuel injection amount.
Stop the EGR control.
Stop the DPD regeneration.
Substitute the default value of DPD differential pressure sensor.

Note :

- The fuel pipe can be disconnected and clogged with a plug.

46. Start the engine and use the idling control switch to increase the RPM to the highest level.
47. Check the pressure gauge.

specified value : 27.0 kPa { 203 mmHg / 8 inHg }

Note :

- When the pressure gauge is likely to indicate a value exceeding the standard value during inspection, release the fuel being blocked.
- Air mixture is checked with the negative pressure amount while the fuel flow is being blocked.

48. If the standard negative pressure cannot be generated, inspect to see if there is a cut or crack with the fuel hose.
49. If a problem is discovered, replace the fuel hose.
50. Inspect to see if appropriate clamp is used.
51. If a problem is discovered, replace the clamp with an appropriate one.
52. Turn OFF the starter switch.
53. Inspect the suction control valve harness connector for a contact failure.
54. If a problem is discovered, repair the harness connector.
55. Inspect the ECM harness connector for a contact failure.
56. If a problem is discovered, repair the harness connector.
57. Inspect each circuit for high resistance.
58. Repair the circuit if a problem is discovered.
59. If the suction control valve harness connector and the ECM harness connector are normal and there is no high resistance in each circuit, replace the fuel supply pump and the fuel filter element.

Refer to "*1.Engine 1C.Fuel System(6HK1) Fuel supply pump Removal*".

Refer to "*1.Engine 1C.Fuel System(6HK1) Fuel supply pump Installation*".

Refer to "*1.Engine 1C.Fuel System(6HK1) Fuel filter element Removal*".

Refer to "*1.Engine 1C.Fuel System(6HK1) Fuel filter element Installation*".

Note :

- When replacing the fuel supply pump, it is required to also replace the fuel filter element at the same time.

60. Perform the unit difference learning of the fuel supply pump to the ECM.

3. DTC P0088 Confirm Resolution

1. Clear the DTC using the trouble diagnosis scan tool.
2. Turn the starter switch OFF for 30 seconds or longer.
3. Start the engine.
4. Perform a test-run.
5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P0112 (Flash Code 22)
Intake Air Temperature Sensor Circuit Low

1. DTC P0112 Priority DTC

   DTC P0641

2. DTC P0112 Diagnostics
   1. Turn OFF the starter switch.
   2. Disconnect the harness connector from the intake air temperature sensor.
   3. Check the intake air temperature sensor display with the trouble diagnosis scan tool.

      voltage : 4.5 V
   4. If it is at or above the standard value, replace the intake air temperature sensor.
   5. Inspect to see if there is a short circuit to the GND with the signal circuit between the ECM and the intake air temperature sensor.
   6. If a problem is discovered, repair the signal circuit.
   7. Turn OFF the starter switch.
   8. Disconnect the harness connector from the ECM.
   9. Inspect the ECM harness connector for a contact failure.
   10. If a problem is discovered, repair the harness connector.
   11. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

       Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".
   12. Set the injector ID code on the ECM.
   13. Perform the unit difference learning of the fuel supply pump to the ECM.
3. DTC P0112 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P0201 (Flash Code 271)
Injector Circuit - Cylinder 1

1. DTC P0201 Diagnostics
   1. Turn OFF the starter switch.
   2. Disconnect the injector harness intermediate connector from the cylinder head cover case.
   3. Measure the resistance between the first cylinder injector power supply terminal and the first cylinder injector drive signal terminal of the injector harness intermediate connector.

   resistance : 2.0 Ω

   4. If it is at or below the standard value, inspect to see if there is an open circuit or high resistance with the circuit between the ECM and injector harness intermediate connector.
   5. Repair the circuit if a problem is discovered.
   6. Remove the cylinder head cover.
   7. Inspect to see if the first cylinder injector harness tightening nut is loose.
   8. If the first cylinder injector harness tightening nut is loose, tighten it.
   9. Inspect to see if a foreign matter is attached to the first cylinder injector terminal.
   10. If a foreign matter is attached to the first cylinder injector terminal, remove it.
   11. Inspect the injector harness intermediate connector for a contact failure.
   12. If a problem is discovered, repair the connector.
   13. Inspect the circuit between the first cylinder injector and intermediate connector.

   • There should be no open circuit or high resistance.
   • There should be no short between the injector circuits.

   14. Repair the circuit if a problem is discovered.
   15. If the circuit is normal, replace the first cylinder injector.

   Refer to "*1.Engine 1C.Fuel System(6HK1) Injector Removal*".

   Refer to "*1.Engine 1C.Fuel System(6HK1) Injector Installation*".

   16. When the injector has been replaced, set the injector ID code on the ECM.
   17. Inspect the ECM harness connector for a contact failure.
   18. If a problem is discovered, repair the harness connector.
   19. If the harness connector is normal, replace the ECM.

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   20. Set the injector ID code on the ECM.
   21. Perform the unit difference learning of the fuel supply pump to the ECM.
2. DTC P0201 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P0238 (Flash Code 32)
Turbo Charger Boost Sensor Circuit High

1. DTC P0238 Priority DTC

   DTC P1655

2. DTC P0238 Diagnostics
   1. Turn OFF the starter switch.
   2. Disconnect the harness connector from the boost sensor.
   3. Check the boost pressure sensor display with the trouble diagnosis scan tool.

      voltage : 0.1 V

   4. If it is at or above the standard value, inspect the signal circuit between the ECM and the boost sensor.

      • There should be no short to the battery or ignition power supply.
      • There should be no short to the 5 V power supply.

   5. If a problem is discovered, repair the signal circuit.
   6. Inspect to see if there is an open circuit or high resistance in the GND circuit between the ECM and the boost sensor.

      Note :
      - The boost sensor shares the GND circuit with other sensors.
      - The DTC set on a sensor which shares this circuit may be detected.

   7. If a problem is discovered, repair the GND circuit.
   8. Inspect the boost sensor harness connector for a contact failure.
   9. If a problem is discovered, repair the harness connector.
   10. If the harness connector is normal, replace the boost sensor.

       Refer to "*1.Engine 1F.Induction(6HK1) Boost sensor Removal*".

       Refer to "*1.Engine 1F.Induction(6HK1) Boost sensor Installation*".

   11. Inspect the ECM harness connector for a contact failure.
   12. If a problem is discovered, repair the harness connector.
   13. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

       Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   14. Set the injector ID code on the ECM.
   15. Perform the unit difference learning of the fuel supply pump to the ECM.

3. DTC P0238 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P041D (Flash Code 27)
Intake Manifold Temperature Sensor Circuit Low

1. DTC P041D Priority DTC

   DTC P1655

2. DTC P041D Diagnostics
   1. Turn OFF the starter switch.
   2. Disconnect the harness connector from the IMT sensor.
   3. Check the intake manifold temperature sensor display with the trouble diagnosis scan tool.

      voltage : 4.5 V

   4. If it is at or above the standard value, replace the IMT sensor.

      Refer to "*1.Engine 1F.Induction(6HK1) IMT sensor Removal*".

      Refer to "*1.Engine 1F.Induction(6HK1) IMT sensor Installation*".

   5. Inspect to see if there is a short circuit to the GND with the signal circuit between the ECM and the IMT sensor.
   6. If a problem is discovered, repair the signal circuit.
   7. Inspect the ECM harness connector for a contact failure.
   8. If a problem is discovered, repair the harness connector.
   9. If the harness connector is normal, replace the ECM.

      Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

      Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   10. Set the injector ID code on the ECM.
   11. Perform the unit difference learning of the fuel supply pump to the ECM.

3. DTC P041D Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P0560 (Flash Code 155)
System Voltage

1. DTC P0560 Diagnostics
   1. Turn OFF the starter switch.
   2. Disconnect the harness connector from the mass air flow sensor.
   3. Use the trouble diagnosis scan tool to check if a DTC is detected.
   4. If a DTC has not been detected, inspect the mass air flow sensor harness connector for a contact failure.
   5. If a problem is discovered, repair the harness connector.
   6. If the harness connector is normal, replace the mass air flow sensor.
   7. Turn OFF the starter switch.
   8. Leave the mass air flow sensor harness connector disconnected.
   9. Disconnect the harness connector from the dropping register.
   10. Use the trouble diagnosis scan tool to check if a DTC is detected.
   11. If a DTC has been detected, inspect the voltage supply circuit between the ECM and dropping register.

   • There should be no short to GND.
   • There should be no short to the battery or ignition power supply.

   12. If a problem is discovered, repair the voltage supply circuit.
   13. If the voltage supply circuit is normal, inspect the 12 V power supply circuit between the ECM and the mass air flow sensor.

   • There should be no short to GND.
   • There should be no short to the battery or ignition power supply.

   14. If a problem is discovered, repair the 12 V power supply circuit.
   15. Check the resistance value of the dropping register.

   resistance : 45.0 to 55.0 Ω

   16. If the resistance value is outside the standard range, replace the dropping register.
   17. Turn ON the starter switch.
   18. Measure the voltage between the ignition power supply circuit of the dropping register and a normal GND.

   voltage : 18.0 V

   19. If it is at or below the standard value, inspect the fuse.
   20. If the fuse is faulty, replace the fuse.
   21. If it is at or below the standard value, repair an open circuit or high resistance in the ignition power supply circuit between the fuse and dropping register.
   22. Measure the voltage between the voltage supply circuit of the dropping register and a normal GND.

   voltage : 13.0 V

   23. If it is at or above the standard value, inspect to see if there is a contact failure with the dropping register harness connector.
   24. If a problem is discovered, repair the harness connector.
   25. Inspect to see if there is an open circuit or high resistance in the voltage supply circuit between the ECM and the dropping register.
   26. If a problem is discovered, repair the voltage supply circuit.
   27. Inspect the ECM harness connector for a contact failure.
   28. If a problem is discovered, repair the harness connector.
   29. If the harness connector is normal, replace the ECM.

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   30. Set the injector ID code on the ECM.
   31. Perform the unit difference learning of the fuel supply pump to the ECM.
2. DTC P0560 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

28. If a problem is discovered, repair the fuel pressure sensor 5 V power supply circuit.
29. Replace the ECM.

    Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

    Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".
30. Set the injector ID code on the ECM.
31. Perform the unit difference learning of the fuel supply pump to the ECM.

2. DTC P0641 Confirm Resolution

1. Clear the DTC using the trouble diagnosis scan tool.
2. Turn the starter switch OFF for 30 seconds or longer.
3. Start the engine.
4. Perform a test-run.
5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P1112 (Flash Code 295)
Boost Temperature Sensor Circuit Low

1. DTC P1112 Priority DTC

   DTC P0651

2. DTC P1112 Diagnostics
   1. Turn OFF the starter switch.
   2. Remove the harness connector from the boost temperature sensor.
   3. Check the boost temperature sensor display with the trouble diagnosis scan tool.

      voltage : 4.5 V

   4. If it is at or above the standard value, replace the boost temperature sensor.

      Refer to "*1.Engine 1F.Induction(6HK1) Boost temperature sensor Removal*".

      Refer to "*1.Engine 1F.Induction(6HK1) Boost temperature sensor Installation*".

   5. Inspect to see if there is a short circuit to the GND with the signal circuit between the ECM and boost temperature sensor.
   6. If a problem is discovered, repair the signal circuit.
   7. Inspect the ECM harness connector for a contact failure.
   8. If a problem is discovered, repair the harness connector.
   9. If the harness connector is normal, replace the ECM.

      Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

      Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   10. Set the injector ID code on the ECM.
   11. Perform the unit difference learning of the fuel supply pump to the ECM.

3. DTC P1112 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

Note :

- When a DTC has been detected, clear it using the trouble diagnosis scan tool.
- After the DPD forced slow regeneration is completed, replace the engine oil.

21. Check the exhaust temperature (before the filter) display with the trouble diagnosis scan tool.
22. Confirm that the exhaust temperature is at or below the standard value.

Specified value : 130 ℃ { 266 °F }

23. If it is at or above the standard value, idle the engine until it falls to or below the standard value.
24. Check the exhaust differential pressure display when the exhaust temperature (in front of the filter) display has reached the standard value with the engine revolution increased to the maximum revolution speed without load.

Specified value : 150 ℃ { 302 °F }

25. Use the trouble diagnosis scan tool to check if the exhaust differential pressure display is at or below the standard value.

specified value : 1.8 kPa { 0.02 kgf/cm2 / 0.3 psi }

26. If it is at or above the standard value, perform ash removal.

Refer to "*1.Engine 1G.Exhaust(6HK1) DPD assembly Inspection*".

2. DTC P1471 Confirm Resolution

1. Turn ON the starter switch.
2. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P2146 (Flash Code 158)
Fuel Injector Group 1 Supply Voltage Circuit

1. DTC P2146 Diagnostics
   1. Turn the starter switch OFF.
   2. Disconnect the harness connector from the cylinder head injector harness intermediate connector.
   3. Turn the starter switch ON.
   4. Measure the resistance between the solenoid control circuit and a normal GND.

   Note :
   - Solenoid control circuit - normal GND of the first cylinder injector
   - Solenoid control circuit - normal GND of the second cylinder injector
   - Solenoid control circuit - normal GND of the third cylinder injector

   resistance : 10.0 MΩ

   5. If it is at or below the standard value, inspect to see if there is a short circuit to the GND with the control circuit between the ECM and injector harness intermediate connector.
   6. If a problem is discovered, repair the control circuit.
   7. Inspect the charge voltage circuit between the ECM and the injector harness intermediate connector.

   • There should be no short to the battery or ignition power supply.
   • There should be no short to GND.

   8. If a problem is discovered, repair the charge voltage circuit.
   9. If the charge voltage circuit is normal, replace the ECM.

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   10. Set the injector ID code on the ECM.
   11. Perform the unit difference learning of the fuel supply pump to the ECM.
   12. Inspect the injector harness intermediate connector for a contact failure.
   13. If a problem is discovered, repair the injector harness intermediate connector.
   14. Disconnect the ECM harness connector.
   15. Inspect the ECM harness connector for a contact failure.
   16. If a problem is discovered, repair the harness connector.
   17. ECM and components The ECM is designed to maintain regulation levels of exhaust gases while obtaining excellent fuel efficiency. The ECM monitors various engine functions via the sensors such as the crankshaft position sensor.
   18. If a problem is discovered, repair the charge voltage circuit.
   19. Remove the cylinder head cover.

   Refer to "*1.Engine 1B.Mechanical(6HK1) Cylinder head cover Removal*".

   20. Inspect the injector harness tightening nut for looseness.
   21. If the injector harness tightening nut is loose, tighten it.
   22. Inspect to see if any foreign matter is attached to the injector terminal.
   23. If any foreign matter is attached to the injector terminal, remove it.
   24. Inspect the injector harness intermediate harness connector for a contact failure.
   25. If a problem is discovered, repair the injector harness intermediate connector.
   26. Check if insulation resistance of the first cylinder, second cylinder, and third cylinder injector is at or above the standard value.

   resistance : 1.0 MΩ

   27. If any injector is at or below the standard value, replace the relevant injector.

   Refer to "*1.Engine 1C.Fuel System(6HK1) Injector Removal*".

   Refer to "*1.Engine 1C.Fuel System(6HK1) Injector Installation*".

   28. When the injector has been replaced, set the injector ID code on the ECM.
   29. If all the resistance values are at or above the standard value, repair or replace the injector harness.

2. DTC P2146 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.

DTC P2453 (Flash Code 141)
DPD Differential Pressure Sensor Circuit Range/Performance

1. DTC P2453 Priority DTC

   DTC P2456

2. DTC P2453 Diagnostics

   1. Inspect the DPD differential pressure sensor hose.

   • There should be no incorrect piping or disconnection.

   2. If a problem is discovered, repair the hose.

   3. Inspect the DPD differential pressure sensor.

   • DPD differential pressure sensor unit should not be damaged.
   • There should be no dirt or foreign matter blocking the DPD differential pressure sensor entrance.
   • There should be no detection error or slow response from the DPD differential pressure sensor.

   4. If a problem is discovered, replace the DPD differential pressure sensor.

   Refer to "*1.Engine 1G.Exhaust(6HK1) Exhaust differential pressure sensor Removal*".

   Refer to "*1.Engine 1G.Exhaust(6HK1) Exhaust differential pressure sensor Installation*".

   5. When the DPD differential pressure sensor has been replaced, perform the 0-point correction.

   Refer to "*1.Engine 1G.Exhaust(6HK1) Exhaust differential pressure sensor Inspection*".

   6. Inspect the exhaust system.

   • There should be no missing or damage with the gasket of the exhaust pipe.
   • There should be no exhaust gas leak from the exhaust system.
   • The exhaust system should not be modified.
   • There should be no flow limitation or crush of the exhaust system.

   7. If a problem is discovered, repair or replace the exhaust system.

   8. Turn OFF the starter switch.

   9. Disconnect the harness connector from the DPD differential pressure sensor.

   10. Inspect the DPD differential pressure sensor harness connector for a contact failure.

   11. If a problem is discovered, repair the harness connector.

   12. Disconnect the harness connector from the ECM.

   13. Inspect the ECM harness connector for a contact failure.

   14. If a problem is discovered, repair the harness connector.

   15. Inspect the signal circuit between the ECM and the DPD differential pressure sensor for a high resistance.

   16. If a problem is discovered, repair the signal circuit.

   17. If the harness connector and signal circuit are normal, replace the DPD assembly.

   18. If the DPD assembly has been replaced, use the trouble diagnosis scan tool to perform DPD regeneration data reset.

   19. Restore the actual unit.

   20. Turn the starter switch ON for 30 seconds.

   Note :
   - Do not start the engine.
   - This is for the DPD differential pressure sensor to relearn.

   21. Clear the DTC using the trouble diagnosis scan tool.

   22. Perform the DPD regeneration data reset with the trouble diagnosis scan tool.

   23. Turn the starter switch OFF for 30 seconds or longer.

   24. Perform the DPD forced regeneration with the trouble diagnosis scan tool.

   25. Use the trouble diagnosis scan tool to confirm that the exhaust temperature (before the filter) display is at or below the standard value.

   Specified value : 130 ℃ { 266 °F }

   26. If it is at or above the standard value, idle the engine until it falls to or below the standard value.

   27. Check the exhaust differential pressure display when the exhaust temperature (in front of the filter) display has reached the standard value with the engine revolution increased to the maximum revolution speed without load.

   Specified value : 150 ℃ { 302 °F }

   28. Use the trouble diagnosis scan tool to check if the exhaust differential pressure display is at or below the standard value.

   specified value : 1.8 kPa { 0.02 kgf/cm2 / 0.3 psi }

   29. If it is at or above the standard value, perform ash removal.

   Refer to "*1.Engine 1G.Exhaust(6HK1) Exhaust differential pressure sensor Inspection*".

DTC U0101 (Flash Code 85)
Lost Communication with TCM

1. DTC U0101 Diagnostics
   1. Inspect the CAN-Low circuit and CAN-High circuit between the ECM and the control unit of the actual unit.

   • There should be no short to the battery or ignition power supply.
   • There should be no open circuit or high resistance.
   • There should be no short to GND.

   2. If a problem is discovered, repair the CAN circuit.
   3. If the CAN circuit is normal, connect all harnesses.
   4. Clear the DTC using the trouble diagnosis scan tool.
   5. Turn the starter switch OFF for 30 seconds or longer.
   6. Perform a test-run.
   7. Check the DTC.
   8. If a DTC has been detected, replace the control unit of the actual unit.
   9. Connect all harnesses.
   10. Clear the DTC using the trouble diagnosis scan tool.
   11. Turn the starter switch OFF for 30 seconds or longer.
   12. Perform a test-run.
   13. Check the DTC.
   14. If a DTC has been detected, replace the ECM.

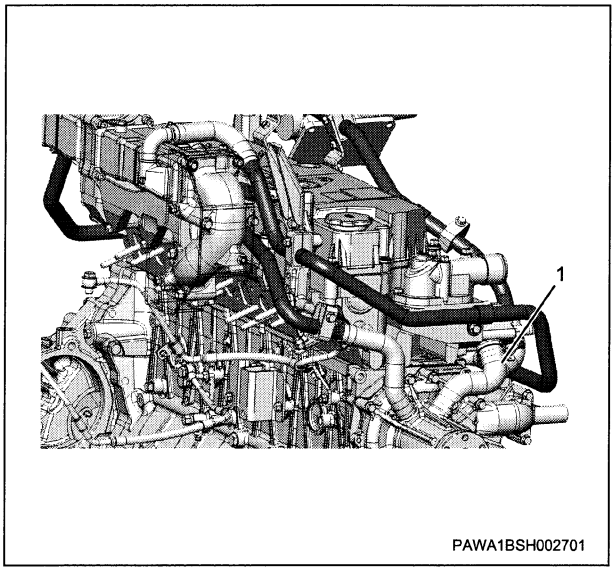
   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Removal*".

   Refer to "*1.Engine 1J.Electrical(6HK1) ECM Installation*".

   15. Set the injector ID code on the ECM.
   16. Perform the unit difference learning of the fuel supply pump to the ECM.
2. DTC U0101 Confirm Resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

2. Fan guide stay
3. Fan guide bracket

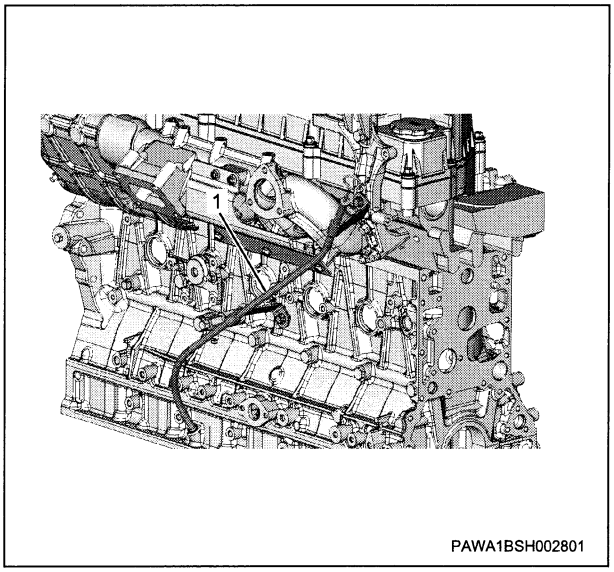
2. Disengage the radiator upper hose from the water outlet pipe.
3. Remove the EGR cooler water pipe from the engine assembly.
4. Remove the water bypass hose from the water pump assembly and the water duct.



1. Water bypass hose

9. Oil level gauge guide tube Removal

1. Remove the oil level gauge from the oil level gauge guide tube.
2. Disengage the oil level gauge guide tube from the front engine hanger bracket.
3. Remove the oil level gauge guide tube from the cylinder block.



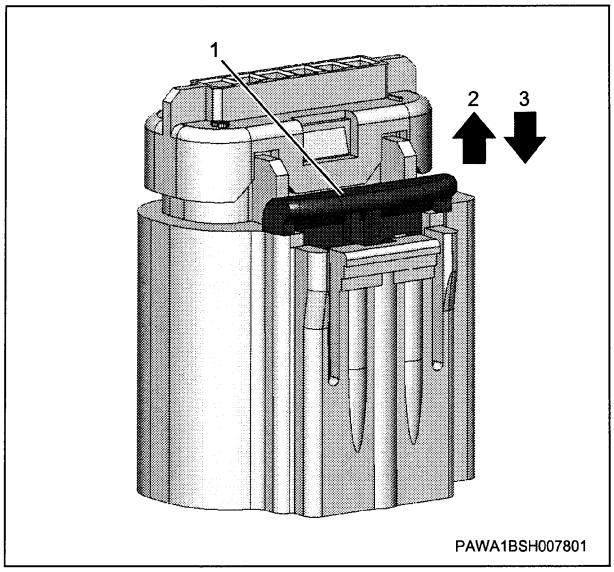
1. Oil level gauge guide tube

10. Intake throttle valve Removal

1. Remove the air duct from the intake throttle valve.
2. Disengage the harness connector from the intake throttle valve.

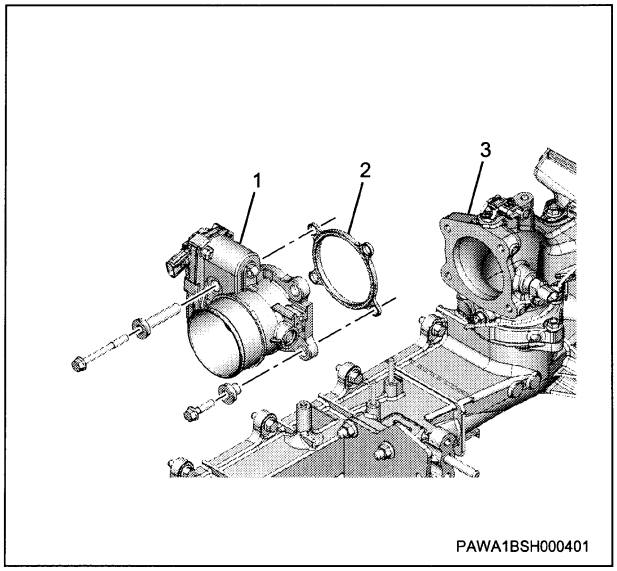
Note :

- Pull the lock operation portion to release the lock.



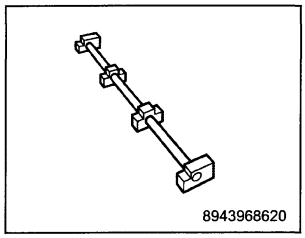
1. Lock operation section
2. Lock release
3. Lock

3. Remove the intake throttle valve from the inlet pipe.

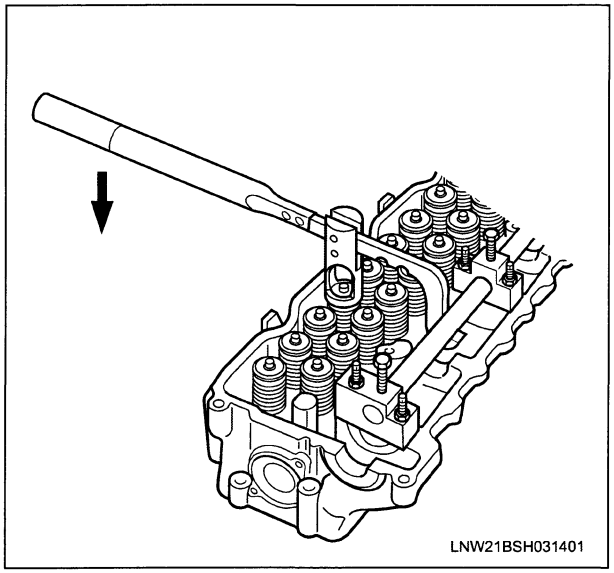


1. Intake throttle valve
2. Gasket
3. Inlet pipe

11. Inlet pipe Removal



SST: 8-9439-6862-0 - pivot ASM



2. Remove the split collar from the spring seat.
3. Remove the special tool from the cylinder head assembly.
4. Remove the valve spring seat from the valve spring.
5. Remove the valve spring from the cylinder head assembly.

Note :

- Store the removed valve springs according to the cylinders.

11. Inlet valve Removal
    1. Remove the inlet valve from the cylinder head assembly.

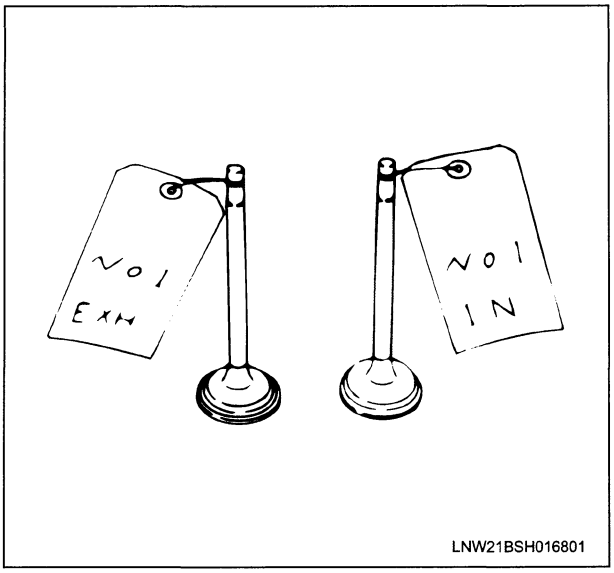
Note :

- Organize the removed valve according to the cylinders.

12. Exhaust valve Removal
    1. Remove the exhaust valve from the cylinder head assembly.

Note :

- Organize the removed valve according to the cylinders.



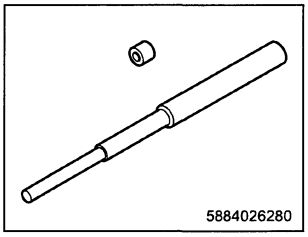
13. Valve stem oil seal Removal
    1. Remove the valve stem oil seal from the valve guide using the pliers.

Caution :

- Do not reuse the valve stem oil seal.

2. Remove the valve spring seat from the cylinder head assembly.

14. Valve guide Removal
    1. Remove the valve guide from the cylinder head assembly using the special tool.



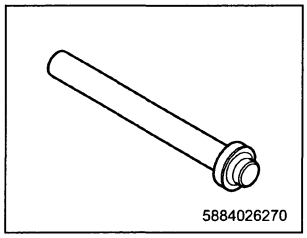
SST: 5-8840-2628-0 - valve guide replacer

Note :

- Tap the valve guides out from the bottom surface of the cylinder head.

Reassembly

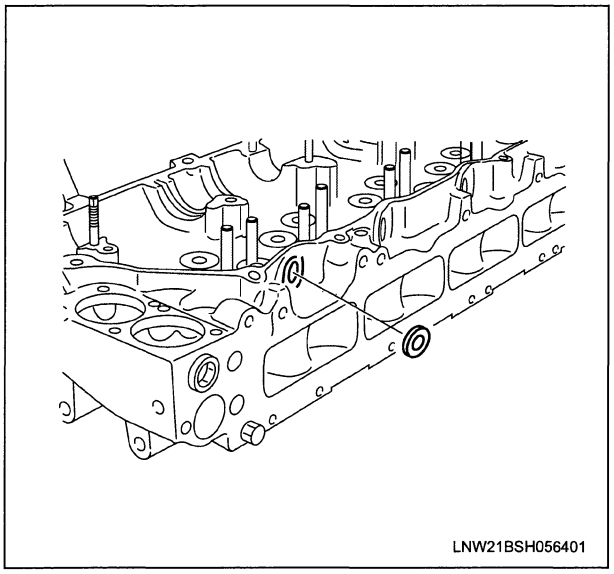
1. Oil seal Installation
   1. Install the oil seal to the cylinder head assembly.

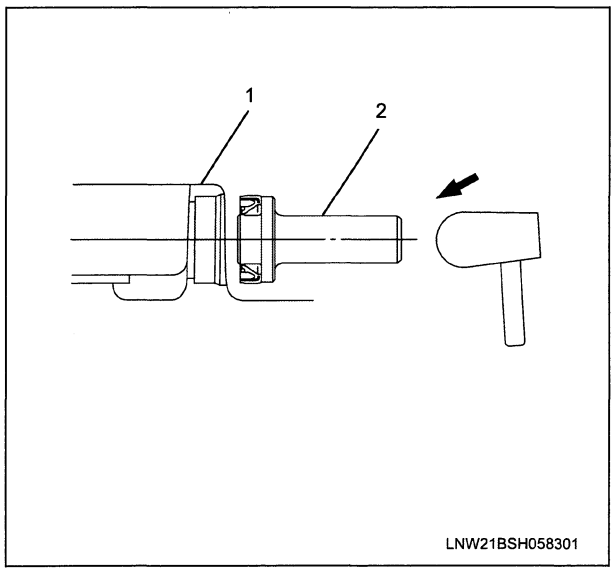


SST: 5-8840-2627-0 - oil seal installer

Caution :

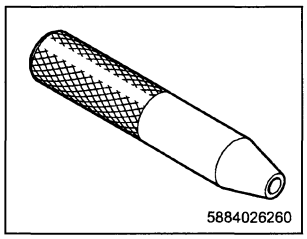
- Be careful not to damage the lip section of the oil seal.



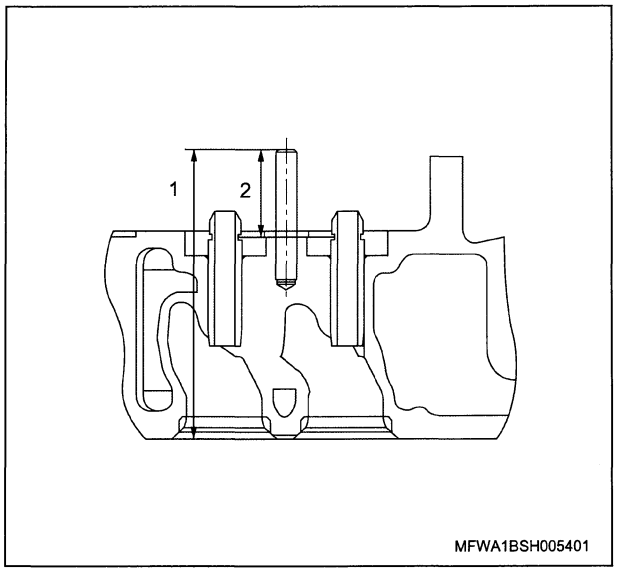


1. Cylinder head
2. Oil seal installer

2. Bridge guide Installation
   1. Apply the engine oil to the bridge guide.
   2. Install the bridge guide to the cylinder head assembly using the special tool.



SST: 5-8840-2626-0 - bridge guide setting tool



specified length : 122.0 to 123.0 mm { 4.8031 to 4.8425 in } 1 in the diagram

specified length : 37.5 mm { 1.4764 in } 2 in the diagram

3. Injector sleeve Installation
   1. Install the O-ring to the injector sleeve.
   2. Apply the engine oil to the O-ring.
   3. Apply the cement to the injector sleeve.

Note :

- Apply Loctite 620 to the tapered section of the injector sleeve.

   4. Apply the engine oil to the cylinder head assembly.

Note :

- Apply engine oil to the injector sleeve contact surface.

Installation

1. Cylinder head assembly Installation

Caution :

- Clean the aligning surface of the cylinder head and cylinder block before installing the cylinder head assembly.
- Be careful not to damage the cylinder head and cylinder block while cleaning.

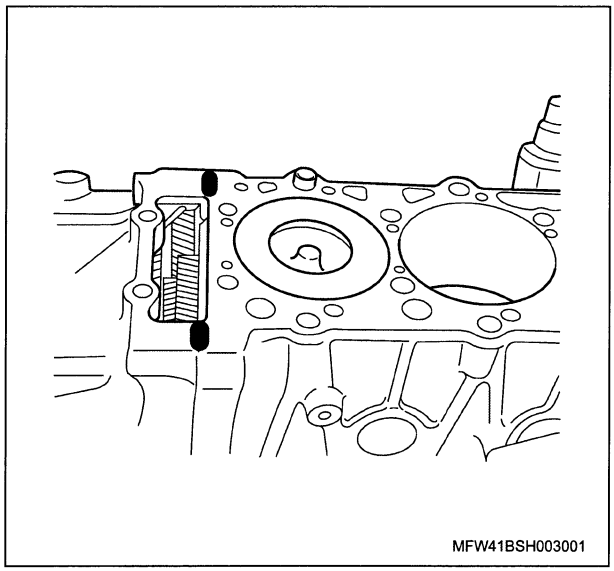
1. Apply the liquid gasket to the cylinder block.

Note :

- Use ThreeBond 1207B.

bead width : 3.0 mm { 0.1181 in }

bead height : 2.0 mm { 0.0787 in }



Caution :

- After applying liquid gasket, install the cylinder head within 5 minutes.

2. Install the cylinder head gasket to the cylinder block.

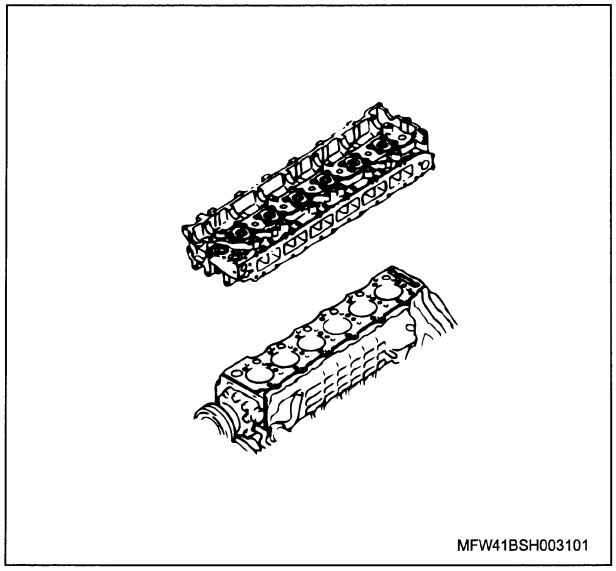
Caution :

- Use a new cylinder head gasket.

3. Install the cylinder head assembly to the cylinder block.

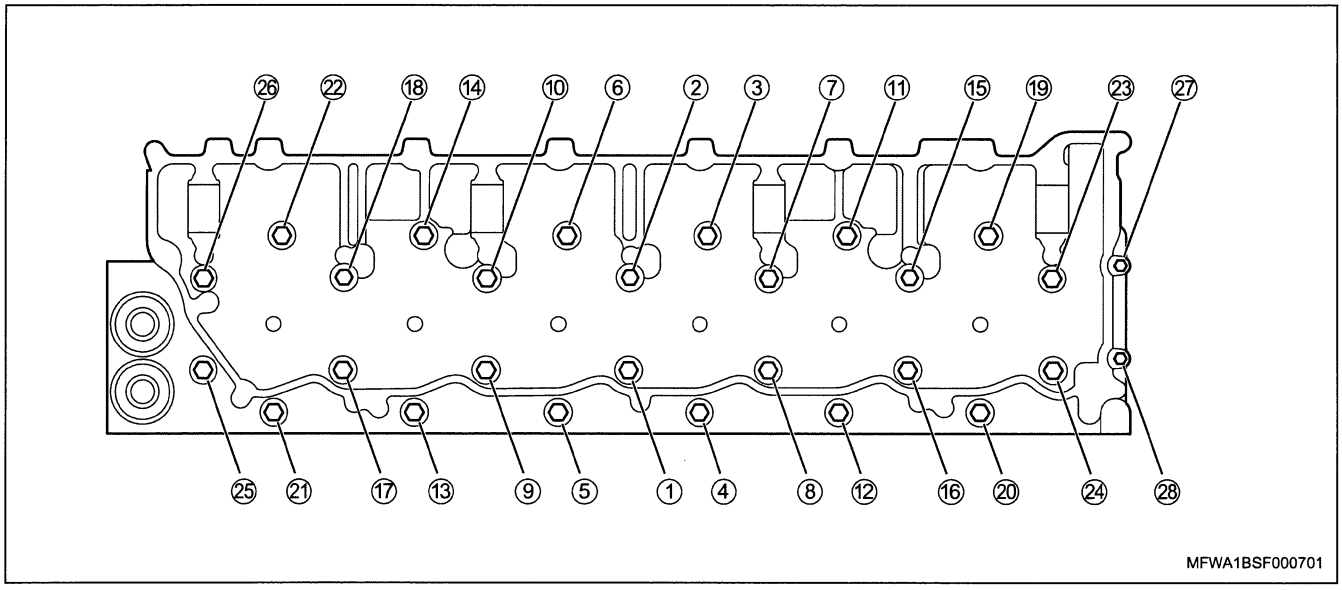
Caution :

- Be careful not to damage the cylinder head gasket.



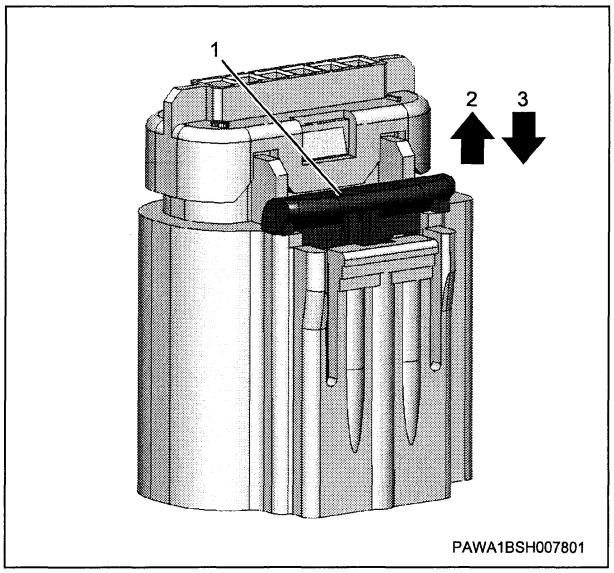
Note :

- Tightening order of the head bolts



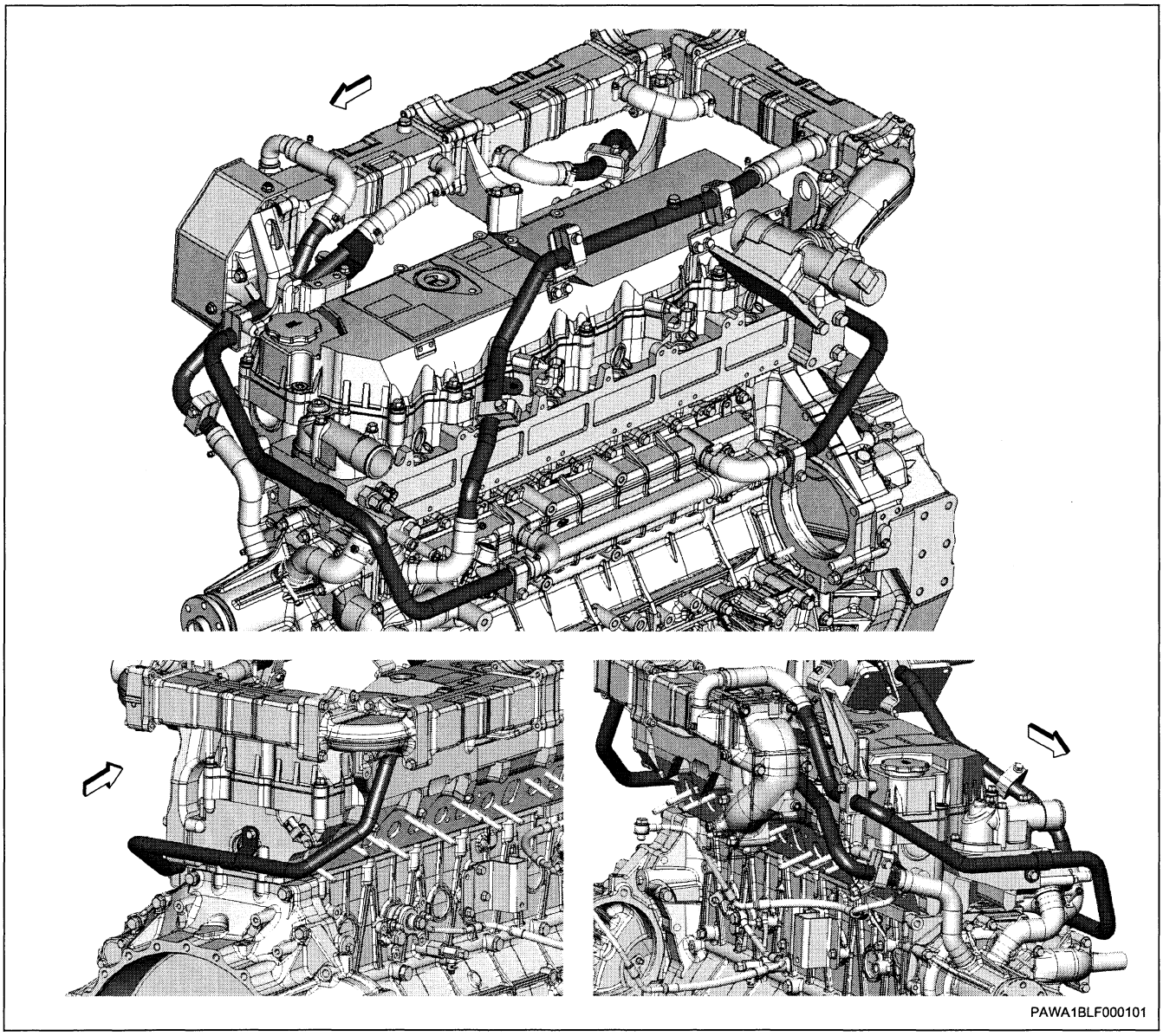
Note :

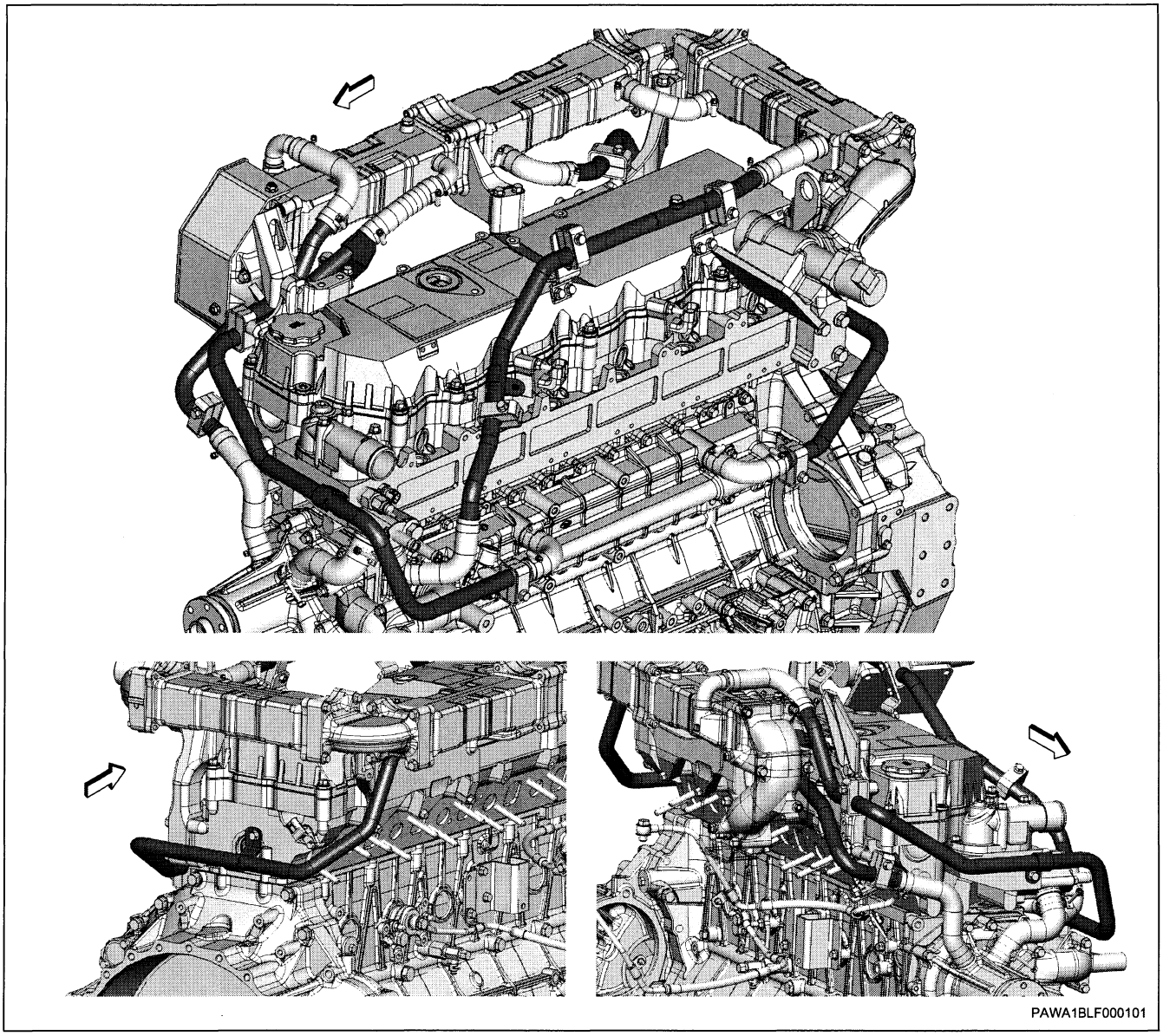
- 1 to 26 in the diagram indicate the M14 bolts.
- 27 and 28 in the diagram indicate the M10 bolts.



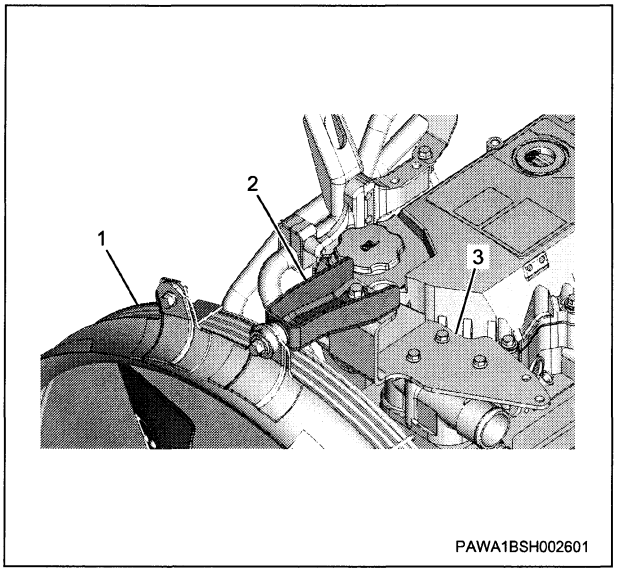
1. Lock operation section
2. Lock release
3. Lock

17. EGR cooler water pipe Installation





1. Remove the fan guide stay from the fan guide and the fan guide bracket.



1. Fan guide

Note :

- Attach the dial gauge to the idle gear tooth to be measured.

2. Inspect the backlash.

Note :

- Gently move the gear right and left to read the inconsistency on the dial gauge.

Caution :

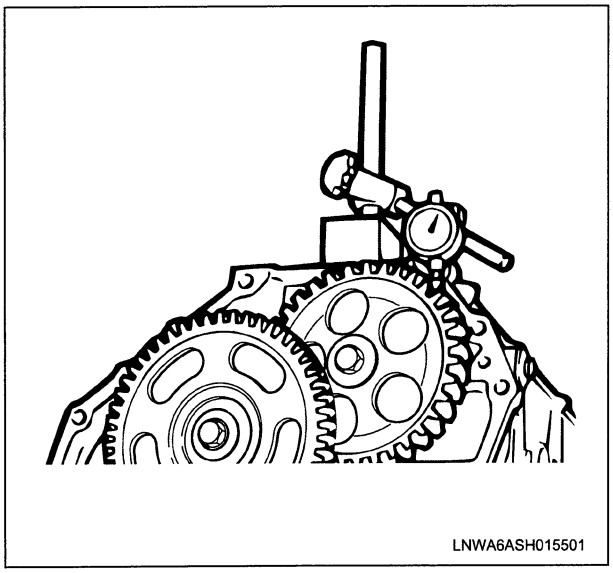
- Measure the idle gear backlash before removing the idle gear A.

Specified value : 0.10 to 0.17 mm { 0.0039 to 0.0067 in }

limit : 0.30 mm { 0.0118 in }

Caution :

- Replace the idle gear if the measured value exceeds the limit value.



3. Measure the clearance using the feeler gauge.

Note :

- Measure the clearance between the idle gear and the thrust collar.

Caution :

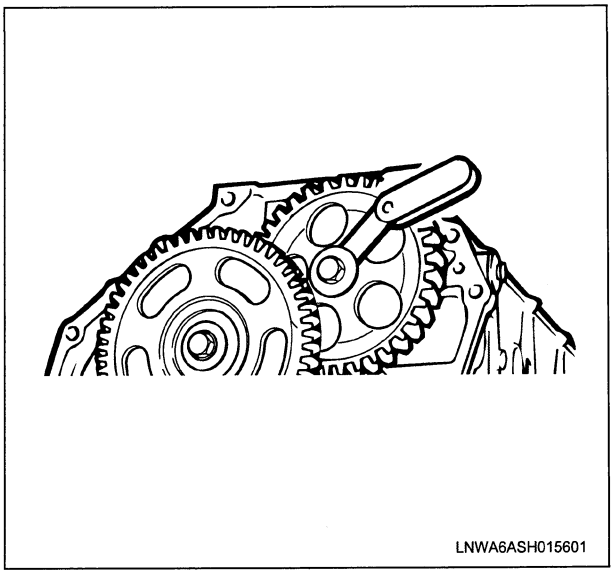
- Measure the play of the idle gear in the axis direction before removing the idle gear B.

Specified value : 0.080 to 0.155 mm { 0.0031 to 0.0061 in }

limit : 0.20 mm { 0.0079 in }

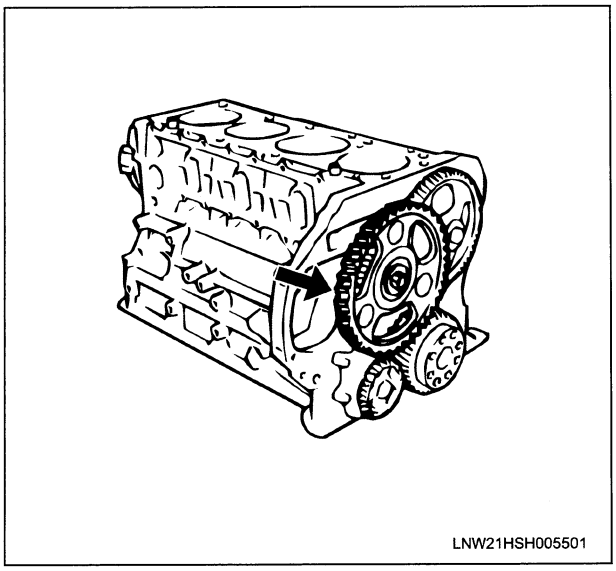
Caution :

- Replace the idle gear if the measured value exceeds the limit value.



34. Idle gear A Removal

1. Remove the idle gear A from the idle gear A shaft.
2. Remove the idle gear A shaft from the cylinder block.



35. Oil pump assembly Removal

1. Remove the oil pump assembly from the cylinder block.

10. Nut

5. Connect the harness connector to the fuel supply pump.

11. Cylinder head assembly Installation

Caution :

- Clean the aligning surface of the cylinder head and cylinder block before installing the cylinder head assembly.
- Be careful not to damage the cylinder head and cylinder block while cleaning.

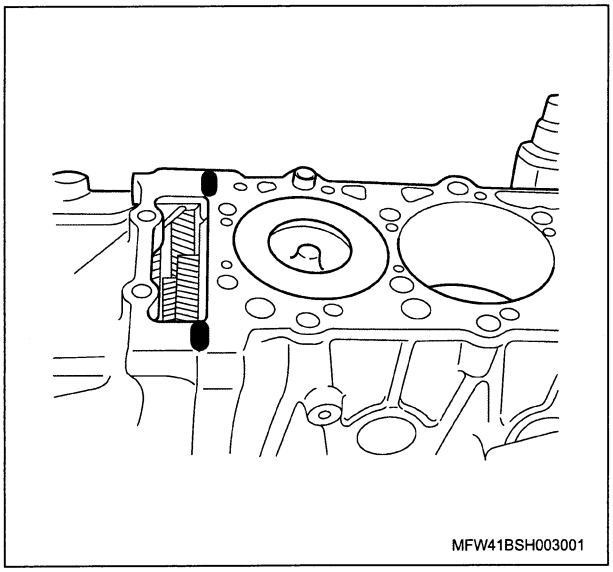
1. Apply the liquid gasket to the cylinder block.

Note :

- Use ThreeBond 1207B.

bead width : 3.0 mm { 0.1181 in }

bead height : 2.0 mm { 0.0787 in }



MFW41BSH003001

Caution :

- After applying liquid gasket, install the cylinder head within 5 minutes.

2. Install the cylinder head gasket to the cylinder block.

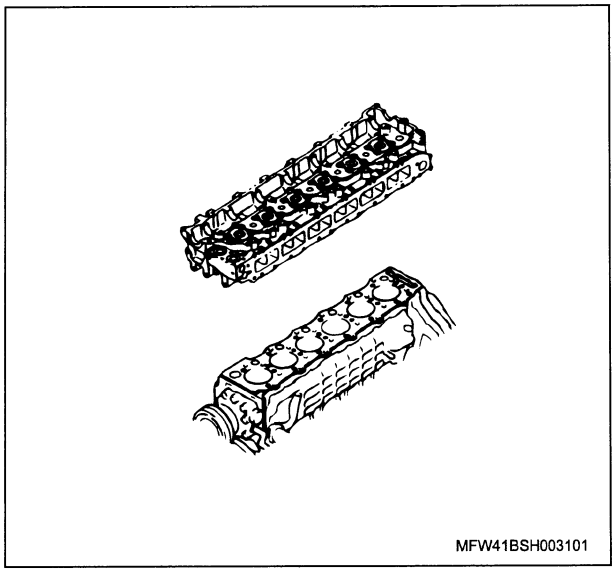
Caution :

- Use a new cylinder head gasket.

3. Install the cylinder head assembly to the cylinder block.

Caution :

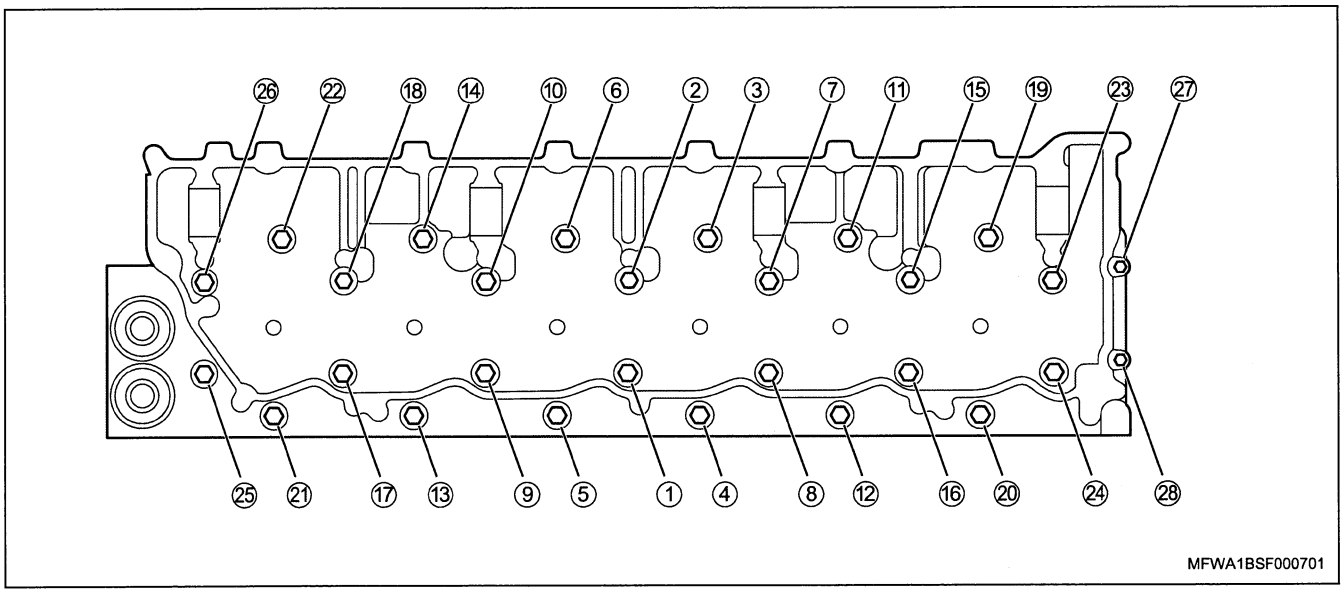
- Be careful not to damage the cylinder head gasket.



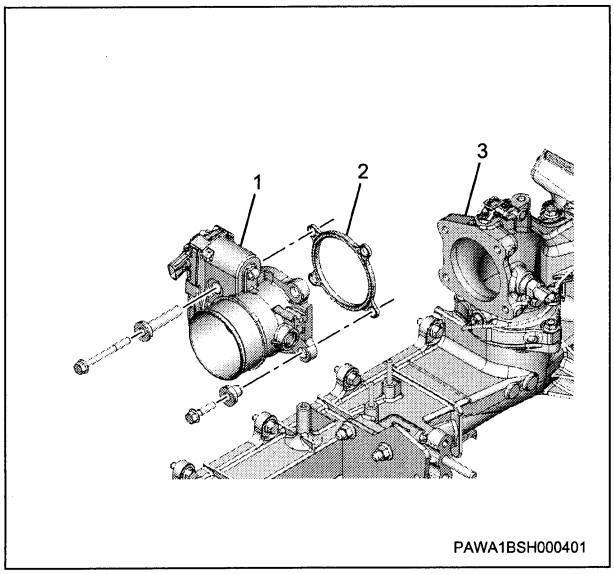
MFW41BSH003101

Note :

- Tightening order of the head bolts



MFWA1BSF000701

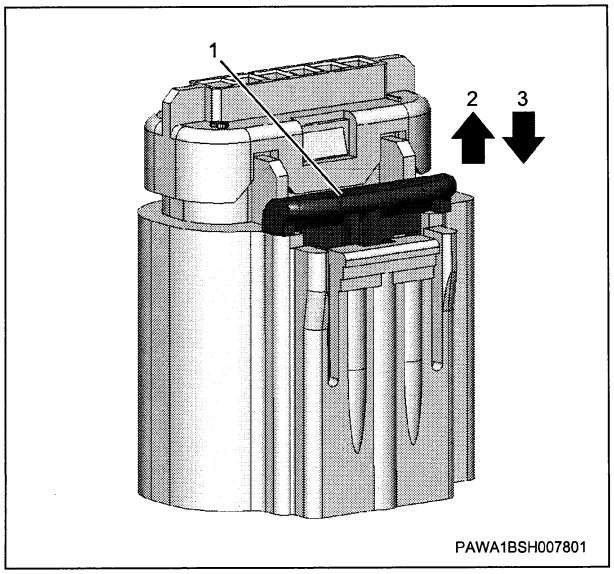


1. Intake throttle valve
2. Gasket
3. Inlet pipe

2. Install the air duct to the intake throttle valve.
3. Connect the harness connector to the intake throttle valve.

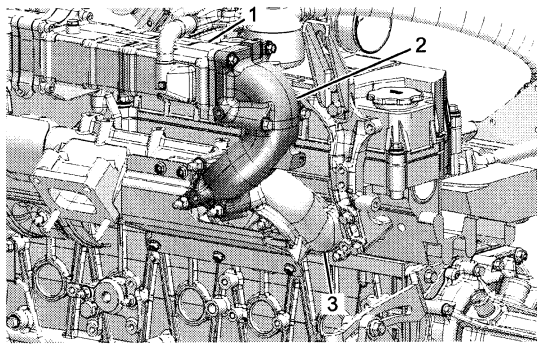
Note :

- After connecting the harness connector, press in the lock operation portion to lock.



1. Lock operation section
2. Lock release
3. Lock

27. EGR cooler water pipe Installation

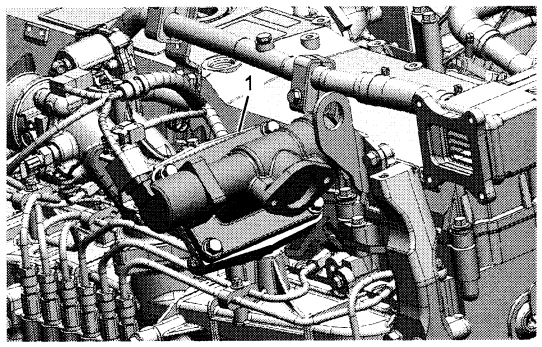


PAWA1BSH001301

1. EGR cooler A
2. EGR pipe A
3. Exhaust manifold

6. EGR valve Removal

1. Disengage the harness connector from the EGR valve.
2. Remove the EGR valve from the inlet pipe.

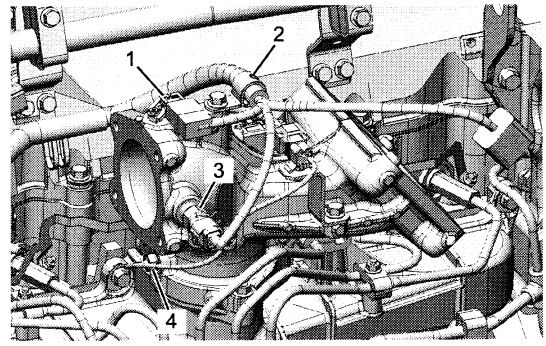


PAWA1BSH000701

1. EGR valve

7. Inlet pipe Removal

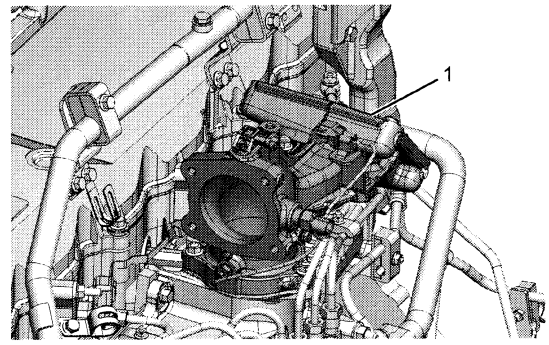
1. Disengage the harness connector from the boost sensor.
2. Disconnect the harness connector from the boost temperature sensor.
3. Disconnect the harness connector from the IMT sensor.
4. Remove the harness clip from the inlet pipe.



PAWA1BSH000801

1. Boost sensor
2. Harness clip
3. Boost temperature sensor
4. IMT sensor

5. Remove the inlet pipe from the inlet cover.



PAWA1BSH000901

1. Inlet pipe

8. Injection pipe Removal

1. Remove the clip from the inlet pipe.
2. Remove the injection pipe from the injector and the common rail assembly.

Caution :

- Do not reuse the removed injection pipe.
- Seal the common rail and injector to prevent foreign material from entering.

Cylinder block

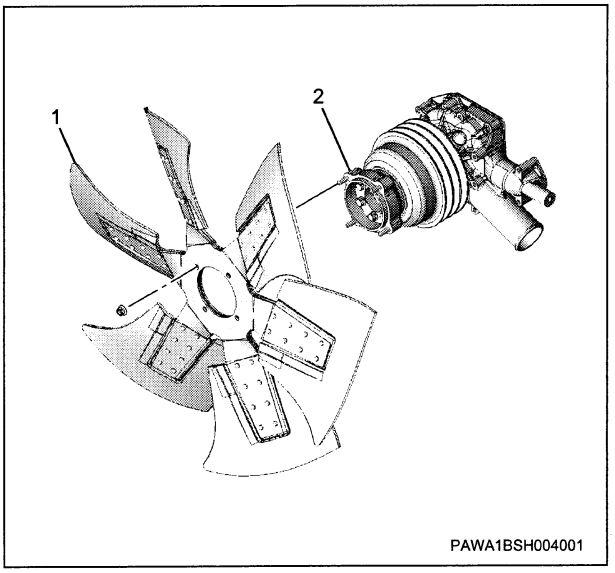
Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Coolant Drain
   1. Drain the coolant from the radiator.

   Caution :
   - After the coolant is discharged, make sure to tighten the drain plug.
3. Engine oil Drain
   1. Remove the drain plug from the oil pan.
   2. Drain the engine oil from the oil pan.
   3. Install the drain plug to the oil pan.

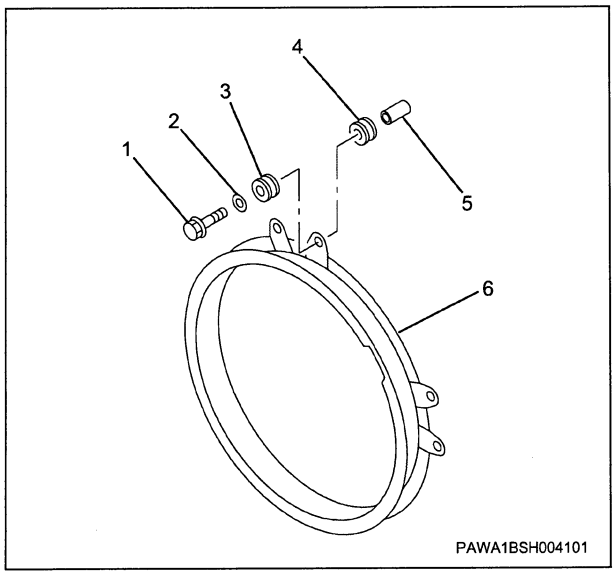
   tightening torque : 70 N・m { 7.1 kgf・m / 52 lb・ft }
4. Engine harness Disconnect
   1. Disengage the engine harness from the engine assembly.

   Note :
   - Disconnect each connector.
5. Cooling fan Removal
   1. Remove the cooling fan from the adapter.



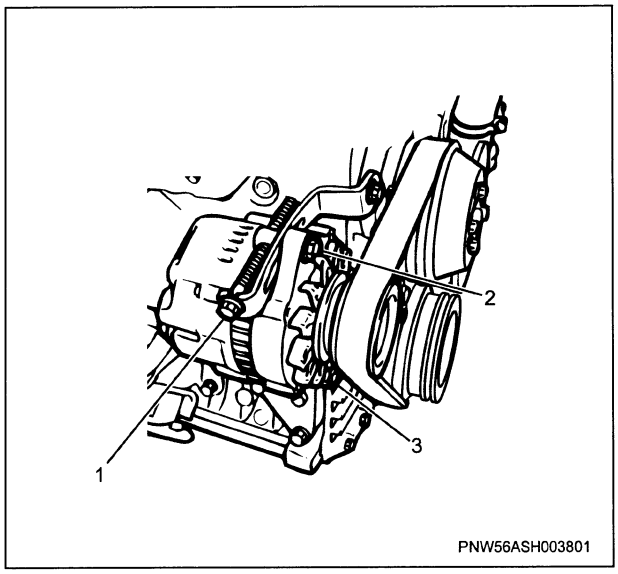
1. Cooling fan
2. Adapter

6. Fan guide Removal
   1. Remove the fan guide from the fan guide bracket.



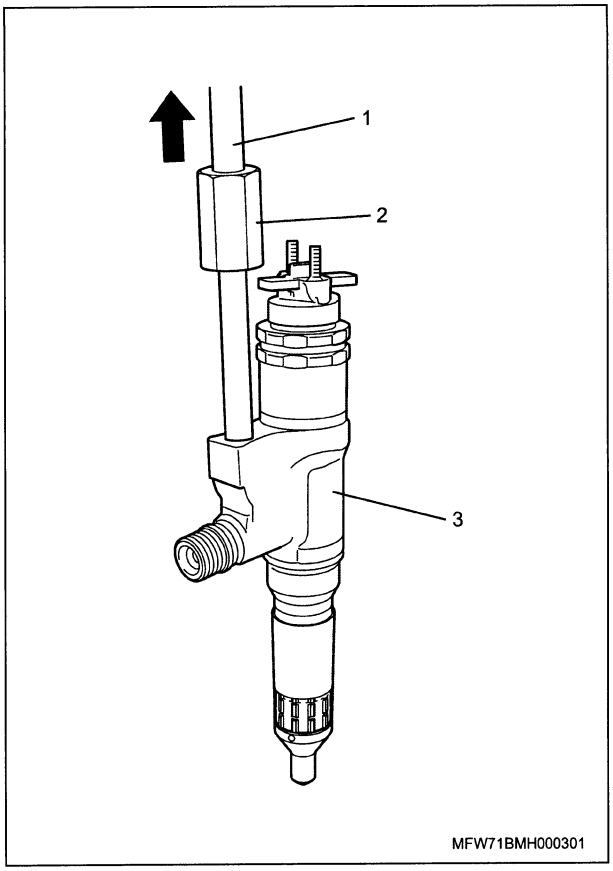
1. Bolt
2. Washer
3. Rubber mount
4. Rubber mount
5. Guide tube
6. Fan guide

   2. Remove the fan guide bracket from the engine assembly.
7. Drive belt Removal
   1. Remove the drive belt from the engine assembly.



1. Adjust bolt
2. Fixing bolt
3. Fixing bolt

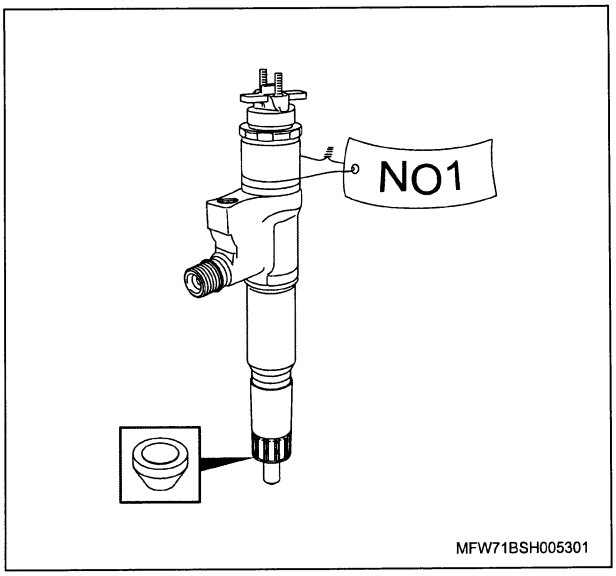
8. Crankshaft pulley Removal
   1. Remove the crankshaft pulley from the crankshaft.



1. Sliding hammer
2. Fuel injector remover
3. Injector

Caution :

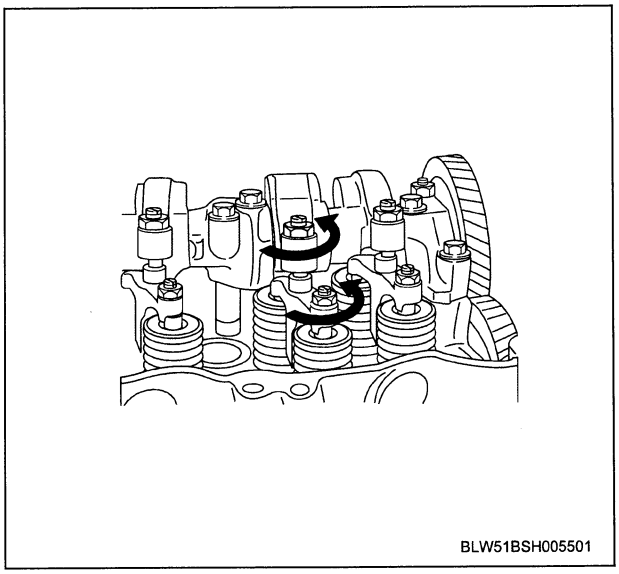
- Confirm that the sleeve is not pulled out together when pulling out the injector using a special tool.
- Store each ID code plate on the injector head with the cylinder number tag attached to avoid a mix-up.
- Be extremely careful not to damage the injector nozzle.



28. Lower cover Removal
    1. Remove the lower cover from the cylinder head assembly.
    2. Remove the rubber plug from the cylinder head assembly.
29. Rocker arm shaft Removal
    1. Loosen the adjust screw using the wrench.

Note :

- Loosen all valve clearance adjustment screws.



2. Remove the rocker arm shaft from the cylinder head assembly.

Note :

- Evenly loosen the rocker arm shaft bracket and the rocker arm assembly bracket tightening bolts from both ends and remove them.

Inspection

1. Cylinder block Inspection

Caution :

- Clean the each part of the cylinder block before inspecting.
- Be careful not to damage the cylinder block while cleaning.

1. Inspect the cylinder block.

Caution :

- Replace the cylinder block if damage such as a crack has been found in the inspection.

2. Perform dye penetrant check.

Note :

- Check if there is a problem which cannot be detected by visual inspection.

Caution :

- Replace the cylinder block if damage such as a crack has been found in the inspection.

3. Inspect the water leak using the water pressure tester.

Note :

- Check if there is a problem which cannot be detected by visual inspection.

specified pressure : 490 kPa { 5 kgf/cm2 / 71 psi }

specified time : 3 min

Caution :

- Replace the cylinder block if damage such as a crack has been found in the inspection.

4. Measure the cylinder liner using the cylinder gauge.

measurement position : 15.0 to 20.0 mm { 0.5906 to 0.7874 in } From the cylinder block top surface

Specified value : 115.021 to 115.050 mm { 4.5284 to 4.5295 in } Diameter

limit : 115.20 mm { 4.5354 in } Diameter

Caution :

- Replace the cylinder block if the measured value exceeds the limit value.

5. Remove the cylinder liner from the cylinder block.

6. Align the simple straight ruler to the cylinder block.

7. Measure the clearance using the feeler gauge.

Note :

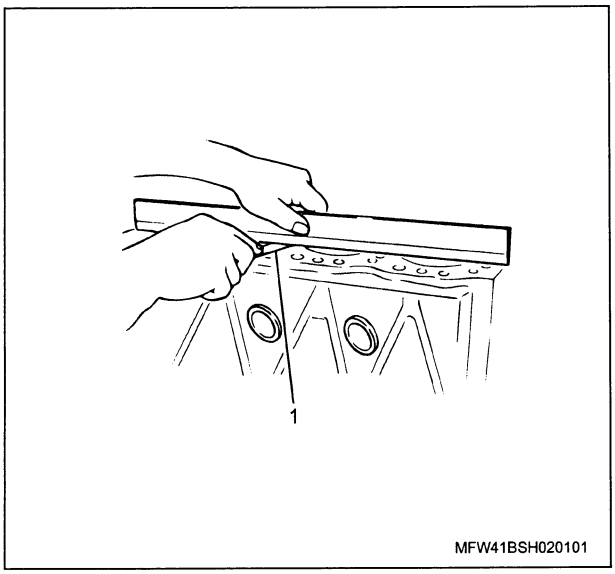
- Flatness of the cylinder block top surface

measurement part : 6 section(s)

limit : 0.2 mm { 0.0079 in }

Caution :

- Replace the cylinder block if the measured value exceeds the limit value.



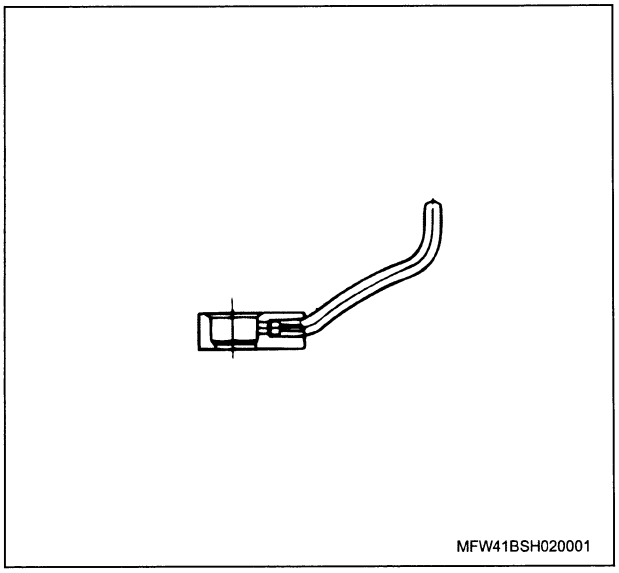
1. Thickness gauge

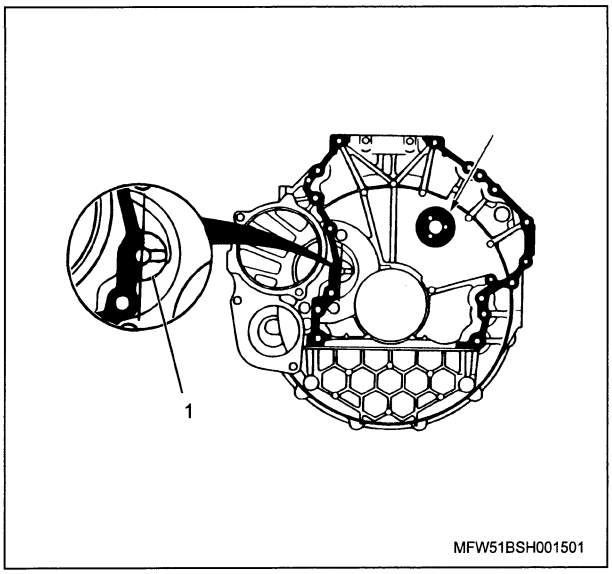
8. Inspect the oil jet.

Note :

- Oil hole clogging
- The fuel pipe deformation
- Check valve operation

: 160.0 kPa { 2 kgf/cm2 / 23 psi } Open valve pressure of check valve





1. Liquid gasket application prohibited area

Caution :

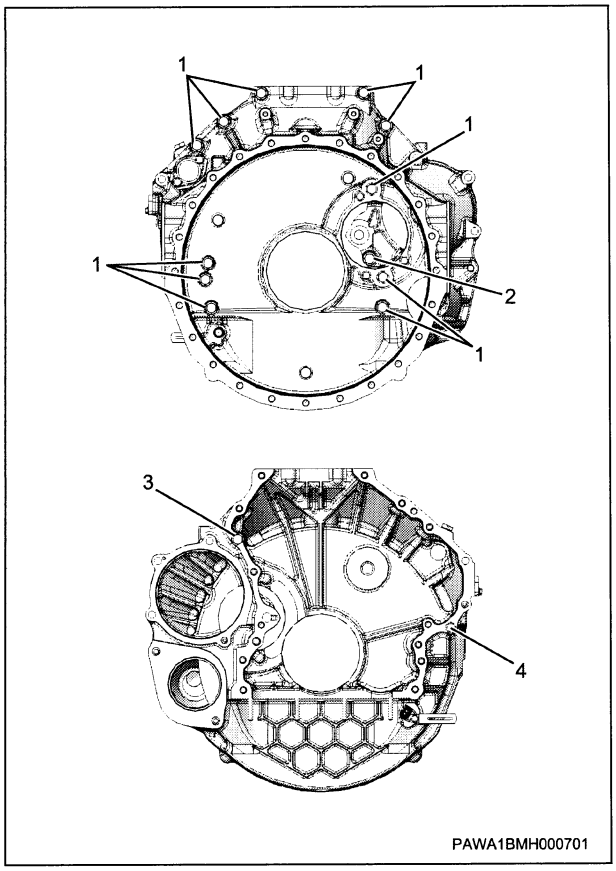
- Do not apply liquid gasket to the location indicated in 1 in the diagram.
- After applying the liquid gasket, install the flywheel housing within 5 minutes.

3. Install the flywheel housing to the cylinder block.

Note :

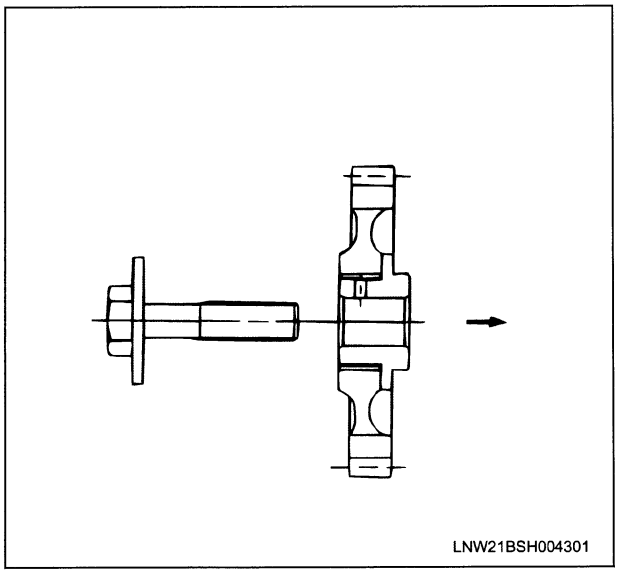
- Install the flywheel housing after aligning with the knock pin position of the cylinder block.

Tightening torque	
No.1 bolt	: 96 N・m { 9.8 kgf・m / 71 lb・ft }
No.2 bolt	: 119 N・m { 12.1 kgf・m / 88 lb・ft }
No.3 bolt	: 86 N・m { 8.8 kgf・m / 64 lb・ft }
No.4 bolt	: 53 N・m { 5.4 kgf・m / 39 lb・ft }



4. Apply engine oil to the PTO gear shaft.
5. Install the PTO idle gear shaft to the PTO idle gear.
6. Install the PTO idle gear to the cylinder block.

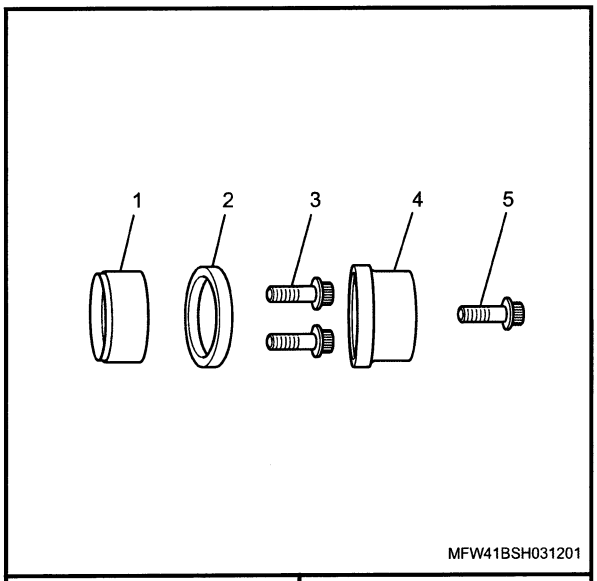
tightening torque : 119 N・m { 12.1 kgf・m / 88 lb・ft }



7. Install the O-ring to the cover.
8. Install the cover to the flywheel housing.

Note :

- In order to install the crankshaft front oil seal, use the one(s) in the following table from among the parts included in the kit.



Legend	Parts number
1: Adapter	8–9439–6857–0
2: Oil seal	-
3: Adapter tightening bolt	8–9702–0656–0
4: Sleeve	8-9702-0625-1
5: Center bolt	8–9702–0655–0

9. Apply the engine oil to the crankshaft front oil seal.

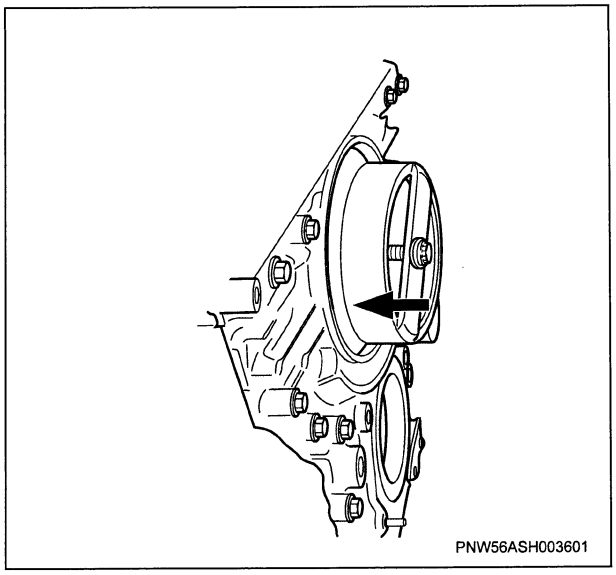
Caution :

- Apply only to the lip section of the oil seal.

10. Install the crankshaft front oil seal to the adapter.
11. Install the sleeve to the adapter.
12. Install the center bolt to the sleeve.
13. Tighten the center bolt using the wrench.

Note :

- Tighten the center bolt until the sleeve touches the adapter.

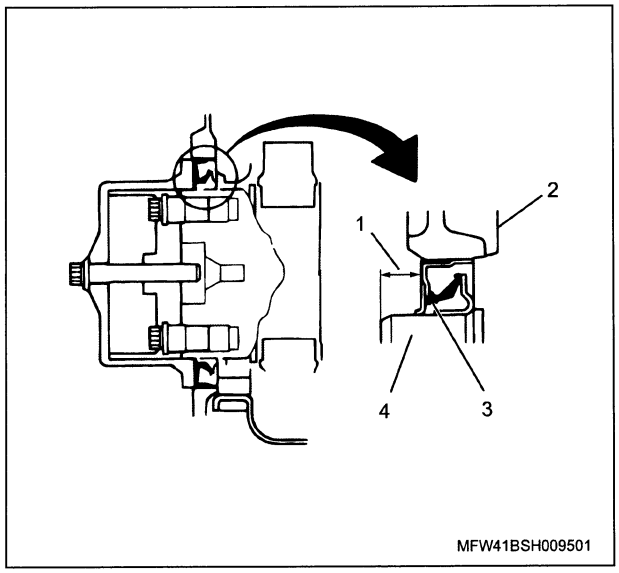


14. Inspect the crankshaft front oil seal.

Note :

- Measure the distance between the crankshaft head and the crankshaft front oil seal.

Specified value : 8.35 to 8.65 mm { 0.3287 to 0.3406 in }



1. Oil seal press-fitting measurement
2. Timing gear case
3. Crankshaft front oil seal
4. Crankshaft

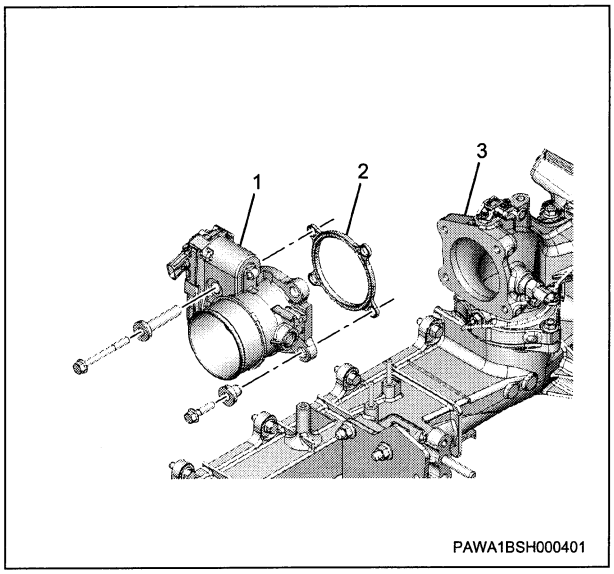
22. Crankshaft pulley Installation

1. Install the crankshaft damper to the crankshaft pulley.

tightening torque : 48 N · m { 4.9 kgf · m / 35 lb · ft }

Note :

- Tighten the bolts in a diagonal line order.

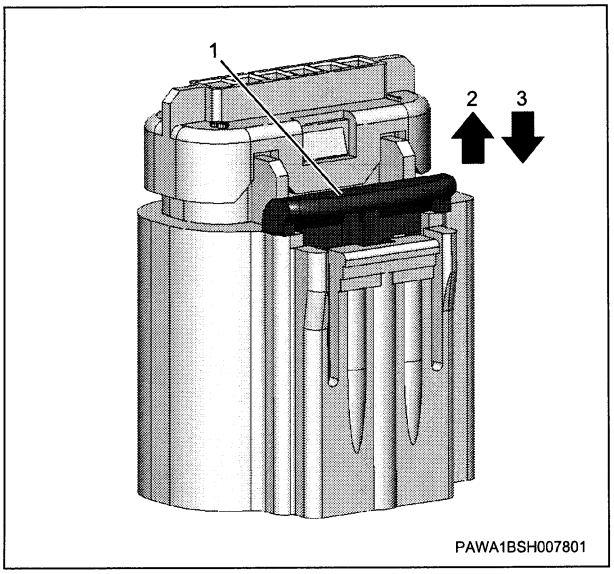


1. Intake throttle valve
2. Gasket
3. Inlet pipe

2. Install the air duct to the intake throttle valve.
3. Connect the harness connector to the intake throttle valve.

Note :

- After connecting the harness connector, press in the lock operation portion to lock.



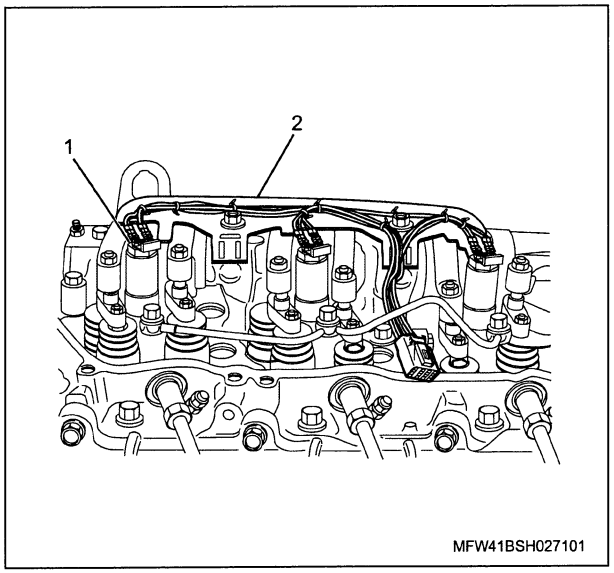
1. Lock operation section
2. Lock release
3. Lock

38. EGR cooler water pipe Installation

3. Remove the injector harness from the cylinder head assembly.

Note :

- Remove the bracket tightening bolts and then remove the injector harness together with the bracket.



1. Injector harness terminal
2. Injector harness bracket

4. Lower cover Removal

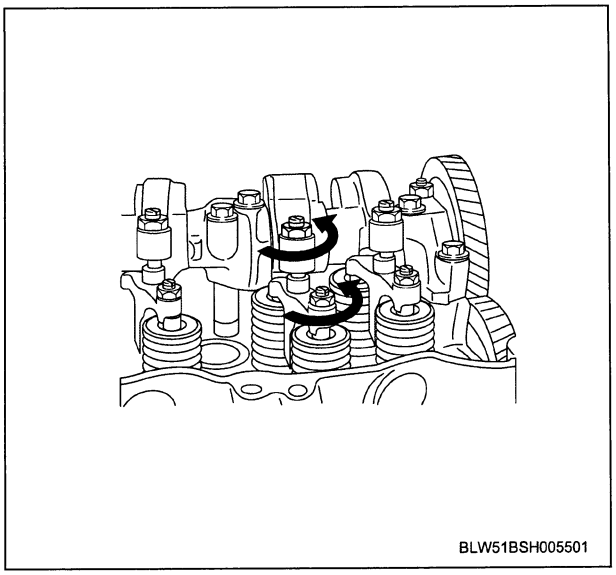
1. Remove the lower cover from the cylinder head assembly.
2. Remove the rubber plug from the cylinder head assembly.

5. Rocker arm shaft Removal

1. Loosen the adjust screw using the wrench.

Note :

- Loosen all valve clearance adjustment screws.



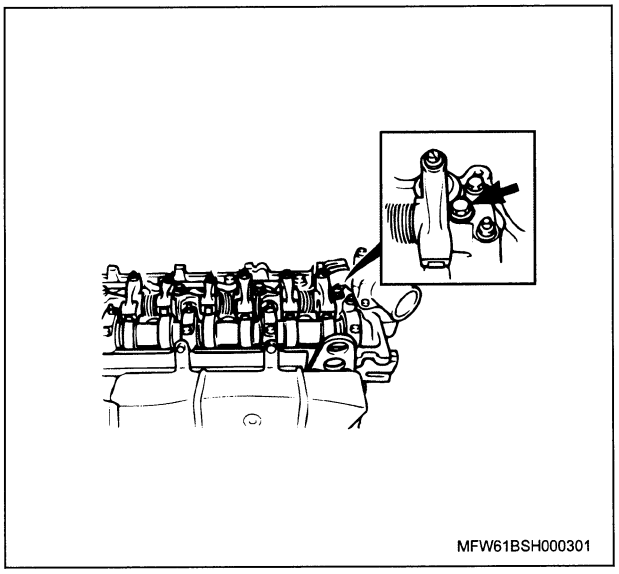
2. Remove the rocker arm shaft from the cylinder head assembly.

Note :

- Evenly loosen the rocker arm shaft bracket and the rocker arm assembly bracket tightening bolts from both ends and remove them.

Caution :

- Be careful not to remove the bolt shown in the diagram.



6. Camshaft Removal

1. Remove the camshaft bearing cap from the cylinder head assembly.
2. Remove the camshaft bearing from the camshaft bearing cap.
3. Remove the camshaft from the cylinder head.

Caution :

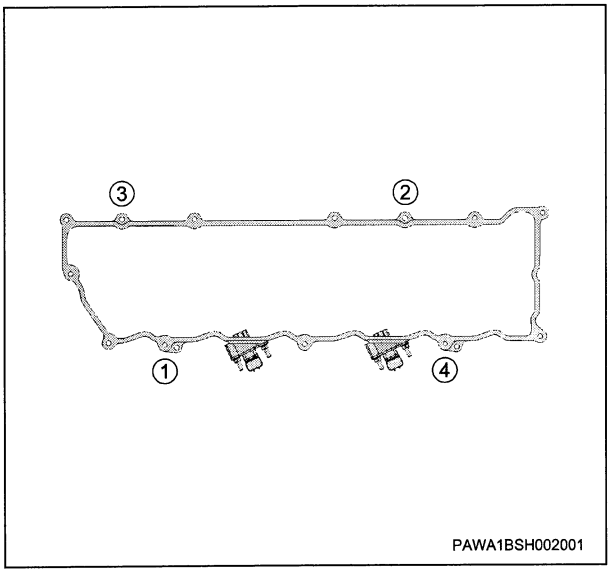
- After applying the liquid gasket, install the lower cover within 5 minutes.

2. Install the rubber plug to the cylinder head assembly.
3. Install the gasket to the lower cover.
4. Install the lower cover to the cylinder head assembly.

tightening torque : 13 N・m { 1.3 kgf・m / 112 lb・in }

Note :

- Tightening order



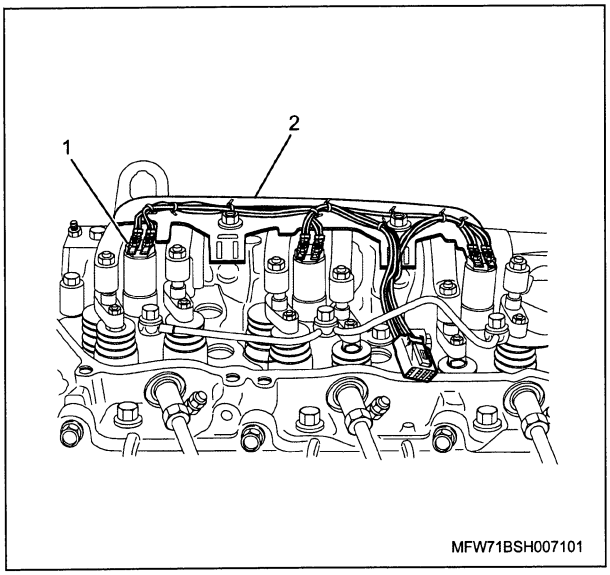
5. Injector harness Installation

1. Install the injector harness to the cylinder head assembly.

Note :

- Tighten the bolts on the bracket and install the injector harness together with the bracket.

tightening torque : 22 N・m { 2.2 kgf・m / 16 lb・ft }

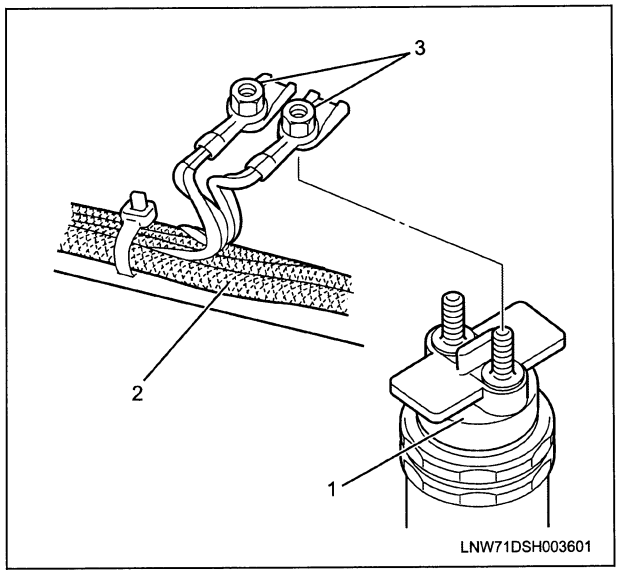


1. Injector harness terminal
2. Injector harness bracket

2. Connect the injector harness to the injector.

Caution :

- Be careful not to damage the injector side stud bolts.



1. Injector
2. Injector harness
3. Terminal nut

3. Install the connector to the lower cover.

tightening torque : 2 N・m { 0.2 kgf・m / 18 lb・in }

6. Cylinder head cover Installation

1. Align the head cover gasket to the cylinder head cover.
2. Install the cylinder head cover to the lower cover.

tightening torque : 13 N・m { 1.3 kgf・m / 115 lb・in }

Note :

- Referring to the tightening order in the diagram, temporarily tighten all bolts and then completely tighten them.

	Cylinder No.	1		2		3		4		5		6	
Condition	Arrangement of valves	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH
Valve to be adjusted	When the #1 cylinder is set at the compression top dead center	○	○	○			○	○			○		
	When the #6 cylinder is set at the compression top dead center				○	○			○	○		○	○

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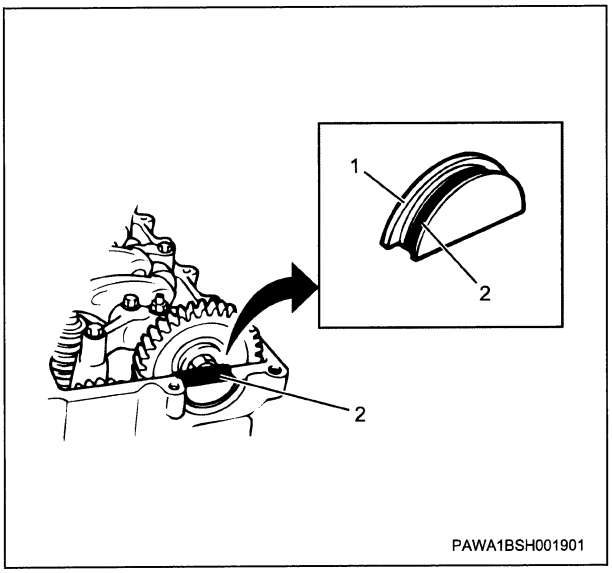
3. Lower cover Installation

1. Apply the liquid gasket to the rubber plug.

Note :

- Apply ThreeBond 1207B.



PAWA1BSH001901

1. Rubber plug
2. Liquid gasket

Caution :

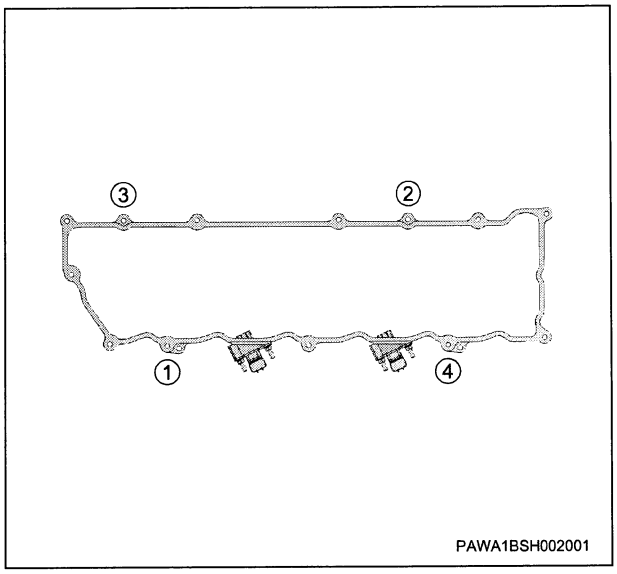
- After applying the liquid gasket, install the lower cover within 5 minutes.

2. Install the rubber plug to the cylinder head assembly.
3. Install the gasket to the lower cover.
4. Install the lower cover to the cylinder head assembly.

tightening torque : 13 N・m { 1.3 kgf・m / 112 lb・in }

Note :

- Tightening order



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4. Injector harness Installation

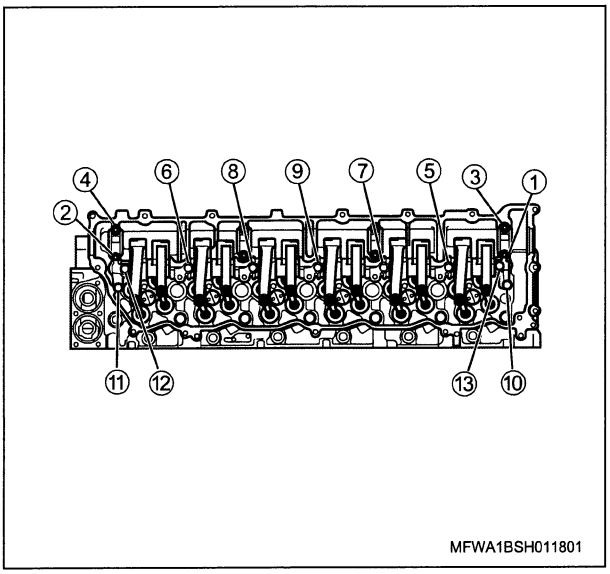
1. Install the injector harness to the cylinder head assembly.

Note :

- Tighten the bolts on the bracket and install the injector harness together with the bracket.

tightening torque : 22 N・m { 2.2 kgf・m / 16 lb・ft }

- Tightening order



Rocker arm shaft tightening torque	
Parts	Tightening torque
Front side camshaft bearing cap	: 28 N・m { 2.8 kgf・m / 20 lb・ft }
Rear side camshaft bearing cap	
Rocker arm bracket	: 56 N・m { 5.7 kgf・m / 41 lb・ft }

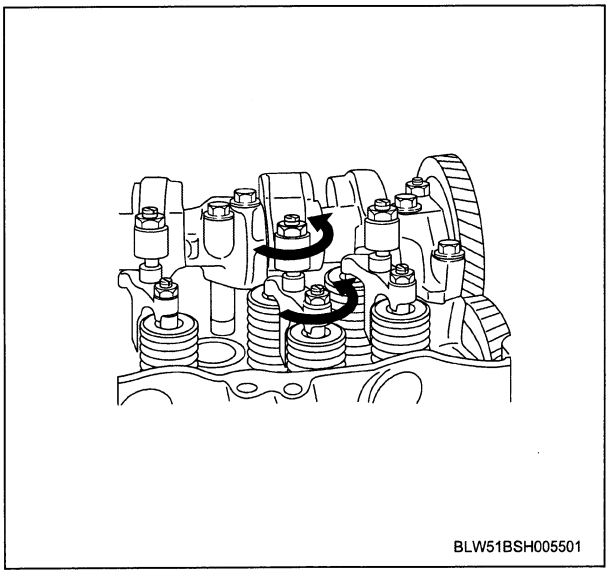
5. Rocker arm shaft Adjustment

Note :

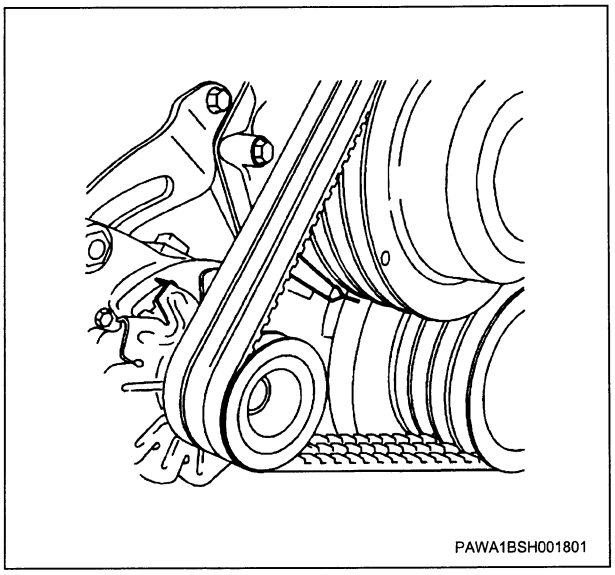
- Valve clearance adjustment

Caution :

- Adjust the valve clearance while cool.
- Loosen all adjust screws before adjustment.



1. Align 1st cylinder to the compression top dead center.



2. Prepare the feeler gauge.

thickness : 0.4 mm { 0.0157 in } 2 pieces

Note :

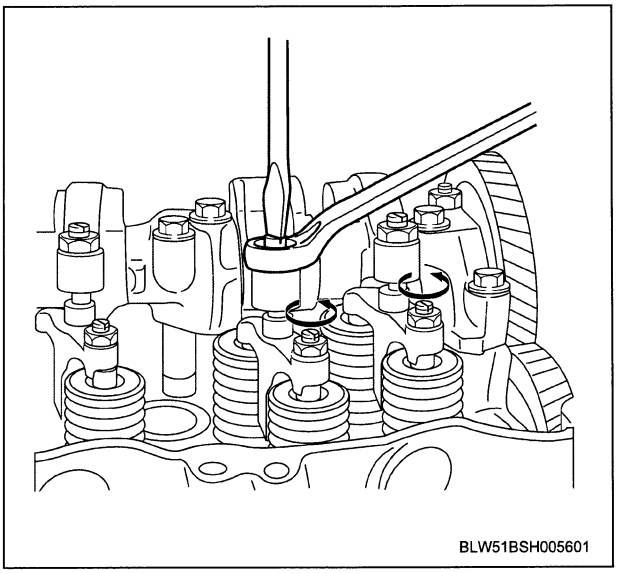
- Insert the thickness gauge between the rocker arm and bridge cap.
- Insert the thickness gauge between the bridge and valve.

3. Turn the adjust screw.

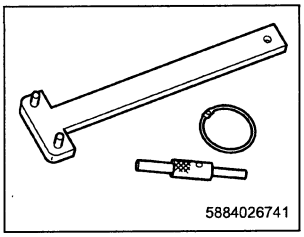
Note :

- When the movement of the thickness gauge becomes stiff, secure the adjust screw nut of the rocker arm.

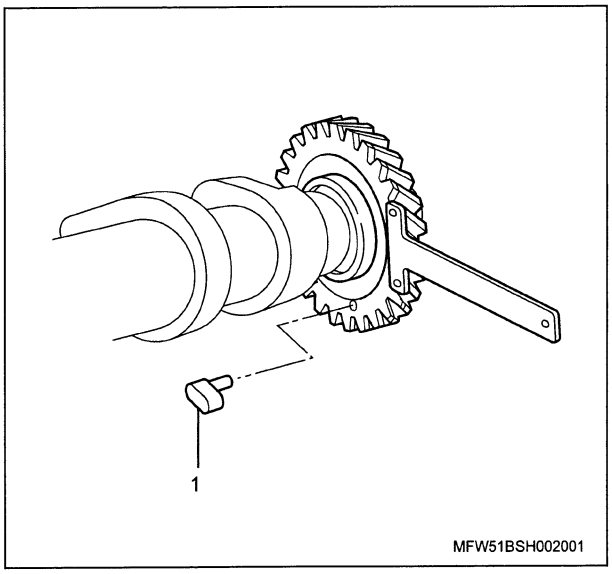
tightening torque : 22 N・m { 2.2 kgf・m / 16 lb・ft }



4. Turn the adjust screw.



SST: 5-8840-2674-1 - scissors gear spring wrench



1. Alignment pin

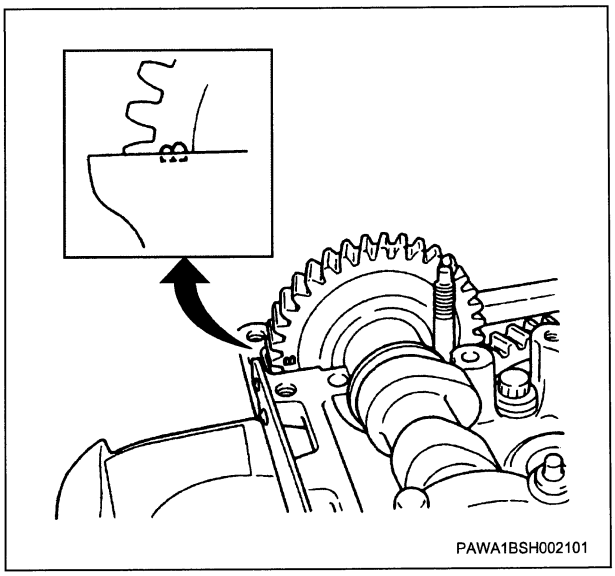
5. Install the camshaft to the cylinder head assembly.

Note :

- Mesh together the idle gear C and the camshaft gear so that the alignment mark on the camshaft gear matches the top surface of the cylinder head, and gently install the camshaft.

Caution :

- Align the alignment marks of the sub gear side.



6. Check alignment mark of the camshaft gear.

Caution :

- Confirm that the alignment mark is not misaligned before installing the camshaft bearing cap.
- If the alignment mark is not at the correct position, reinstall the camshaft.

7. Apply the engine oil to the camshaft bearing.

Note :

- Apply engine oil to the sliding surface of the bearing.

Caution :

- Apply engine oil after cleaning the bearing installation sections of the camshaft bearing and camshaft bearing cap.

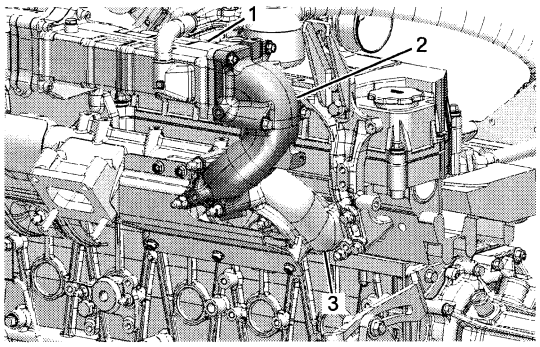
8. Install the camshaft bearing to the camshaft bearing cap.

9. Install the camshaft bearing cap to the cylinder head assembly.

Note :

- Turn the camshaft bearing cap so that the arrow mark on the top surface faces the engine front side, and assemble in numerical order.

tightening torque : 28 N・m { 2.8 kgf・m / 20 lb・ft }
Engine oil application

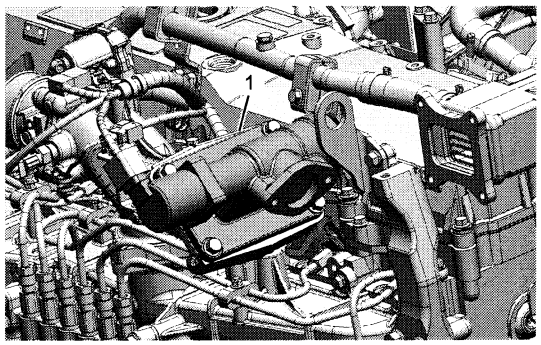


PAWA1BSH001301

1. EGR cooler A
2. EGR pipe A
3. Exhaust manifold

14. EGR valve Removal

1. Disengage the harness connector from the EGR valve.
2. Remove the EGR valve from the inlet pipe.

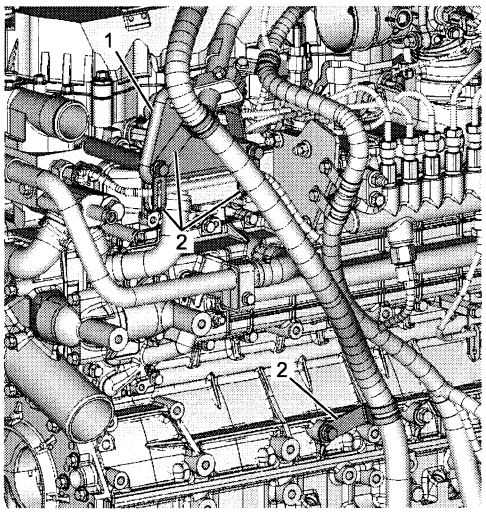


PAWA1BSH000701

1. EGR valve

15. Oil separator bracket Removal

1. Remove the clip from the cylinder block.
2. Remove the ventilation hose from the air breather.
3. Remove the oil separator bracket from the cylinder head assembly.



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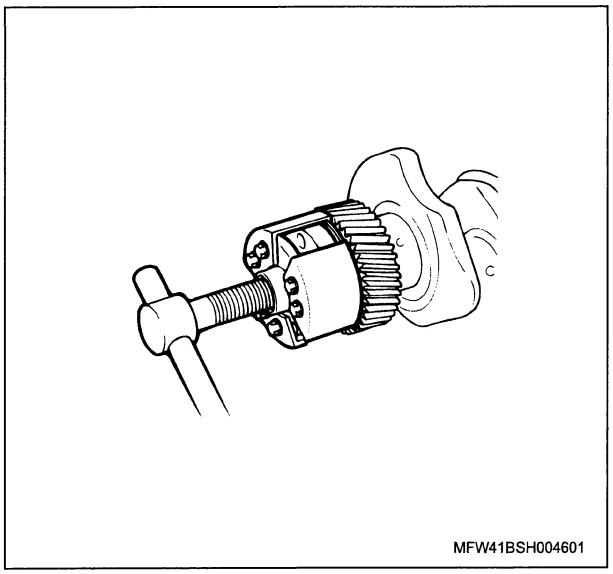
1. Oil separator bracket
2. Clip

16. EGR cooler water pipe Removal



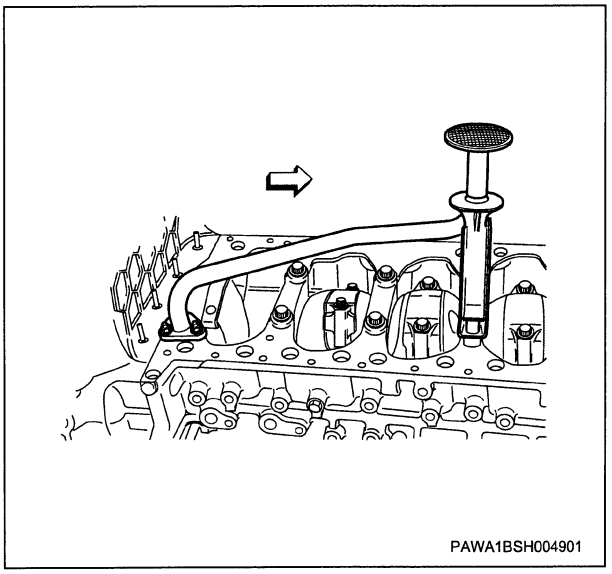
Caution :

- Be careful not to damage the oil seal press-fitting surface.

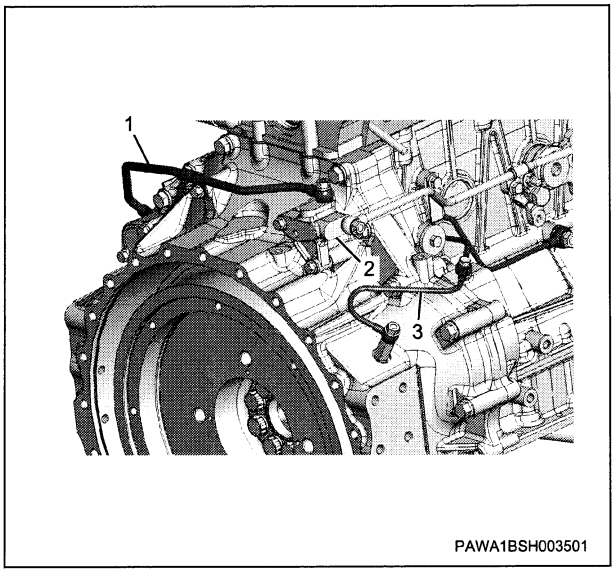
Note :

- Remove the slinger and oil seal together.

38. Oil pan Removal
    1. Disengage the harness connector from the oil level switch.
    2. Remove the oil pan from the crankcase.
    3. Remove the gasket from the oil pan.
39. Oil strainer Removal
    1. Remove the oil strainer from the crankcase.
    2. Remove the O-ring from the oil strainer.

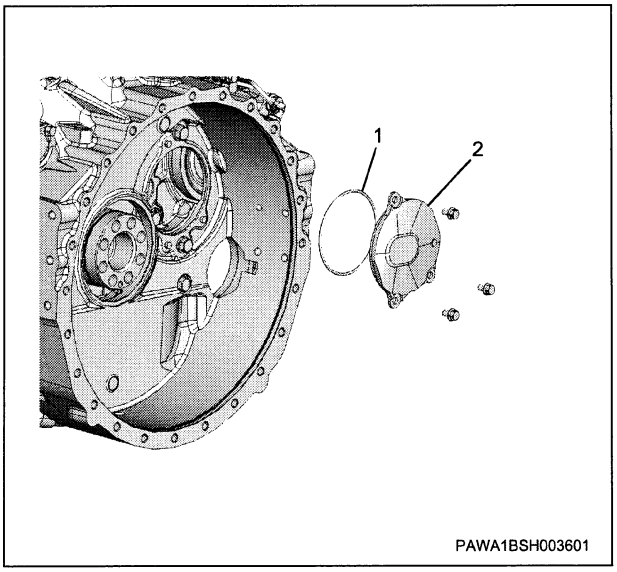


40. Flywheel housing Removal
    1. Remove the PTO oil pipe from the flywheel housing and the cylinder block.
    2. Remove the oil pipe from the pipe bracket and the oil port cover.



1. Oil pipe
2. Pipe bracket
3. PTO oil pipe

    3. Remove the cover from the flywheel housing.



1. O-ring
2. Cover

    4. Remove the PTO idle gear from the cylinder block.
    5. Remove the flywheel housing from the cylinder block and the crankcase.

Caution :

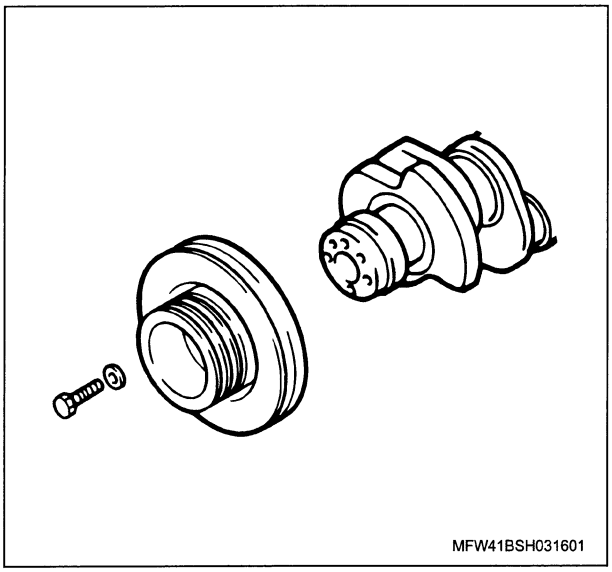
- Do not forget to remove the bolt shown in the diagram.

Note :

- Inspect the crankshaft damper for cracks and peeling.

Caution :

- Make sure to replace the crankshaft damper if any abnormality has been found otherwise cracking may occur.
- Inspect the bolts for the crankshaft and flywheel if any abnormality has been found in the crankshaft damper.



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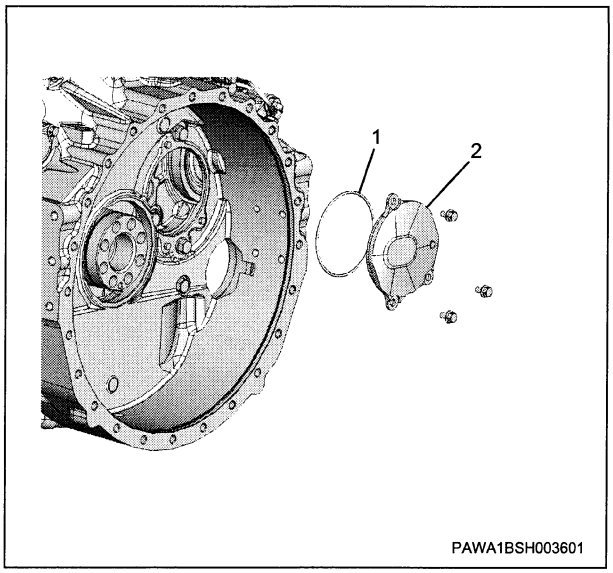


1. O-ring
2. Cover

9. Install the oil pipe to the pipe bracket and the oil port cover.

tightening torque : 34 N・m { 3.5 kgf・m / 25 lb・ft } Pipe bracket side

tightening torque : 28 N・m { 2.8 kgf・m / 20 lb・ft } Oil port cover side

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft } Clip

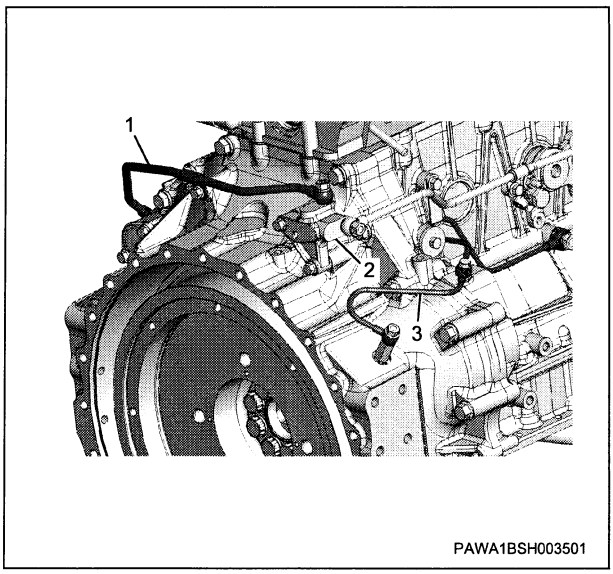
10. Install the PTO oil pipe to the flywheel housing and the cylinder block.

tightening torque : 34 N・m { 3.5 kgf・m / 25 lb・ft } Flywheel housing side

tightening torque : 15 N・m { 1.5 kgf・m / 11 lb・ft } PTO side

tightening torque : 41 N・m { 4.2 kgf・m / 30 lb・ft } Cylinder block side

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft } Clip



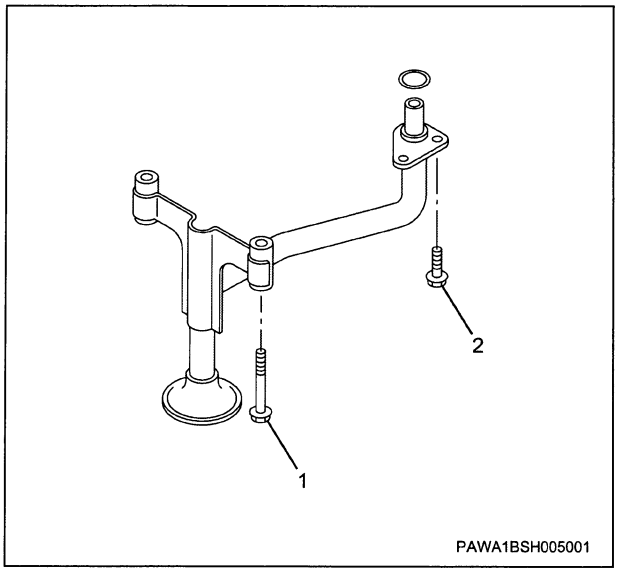
1. Oil pipe
2. Pipe bracket
3. PTO oil pipe

8. Oil strainer Installation

1. Install the O-ring to the oil strainer.
2. Install the oil strainer to the crankcase.

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft } M8 bolt

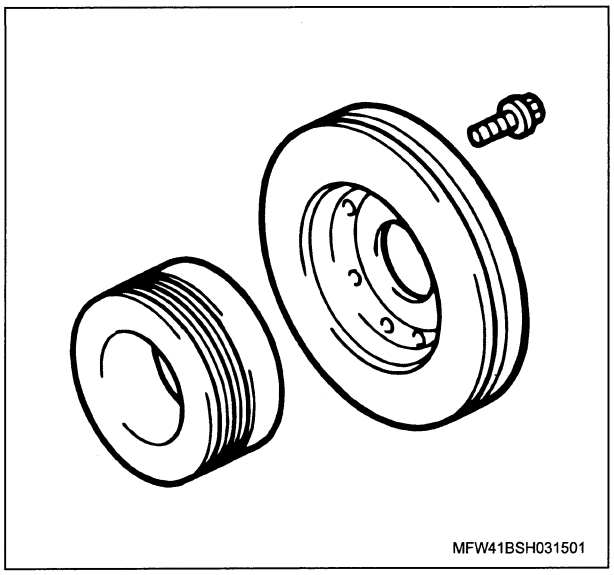
tightening torque : 48 N・m { 4.9 kgf・m / 35 lb・ft } M10 bolt



1. M10 bolt
2. M8 bolt

9. Oil pan Installation

1. Apply the liquid gasket to the crankcase.


MFW41BSH031501

2. Install the crankshaft pulley to the crankshaft.

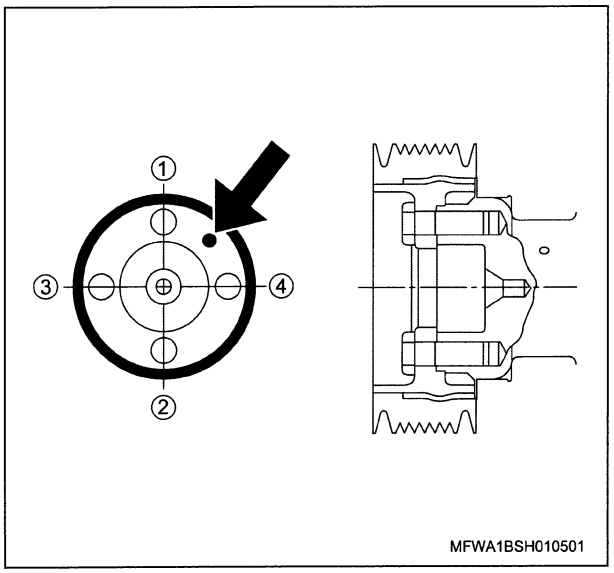
Caution :

- Pay attention to the knock pin position of the crankshaft.

tightening torque : 200 N・m { 20.4 kgf・m / 148 lb・ft } Apply engine oil on the threaded area of bolt

Note :

- Tightening order



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20. Bridge Installation

1. Apply the engine oil to the bridge.
2. Install the bridge to the bridge guide.

Caution :

- Confirm that the bridge moves smoothly.

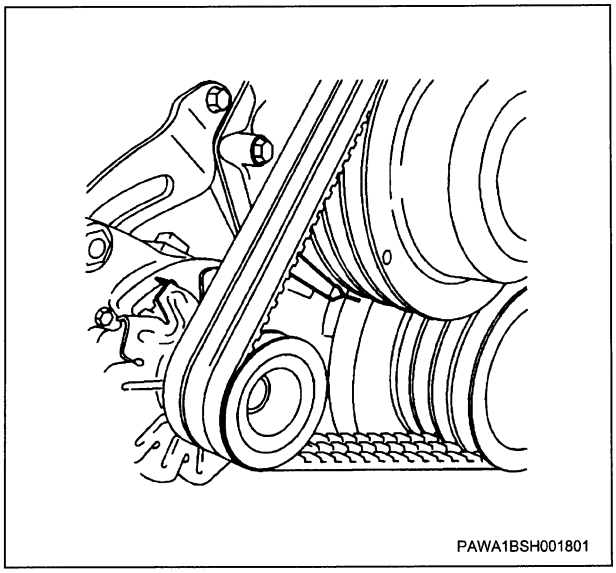
3. Apply the engine oil to the bridge cap.
4. Install the bridge cap to the bridge.

Caution :

- Be careful not to drop the bridge cap into the engine.

21. Camshaft Installation

1. Align 1st cylinder to the compression top dead center.


PAWA1BSH001801

2. Apply the engine oil to the camshaft bearing.

Note :

- Apply engine oil to the sliding surface of the bearing.

Caution :

- Apply engine oil after cleaning the bearing installation sections of the camshaft bearing and cylinder head.

3. Install the camshaft bearing to the cylinder head assembly.

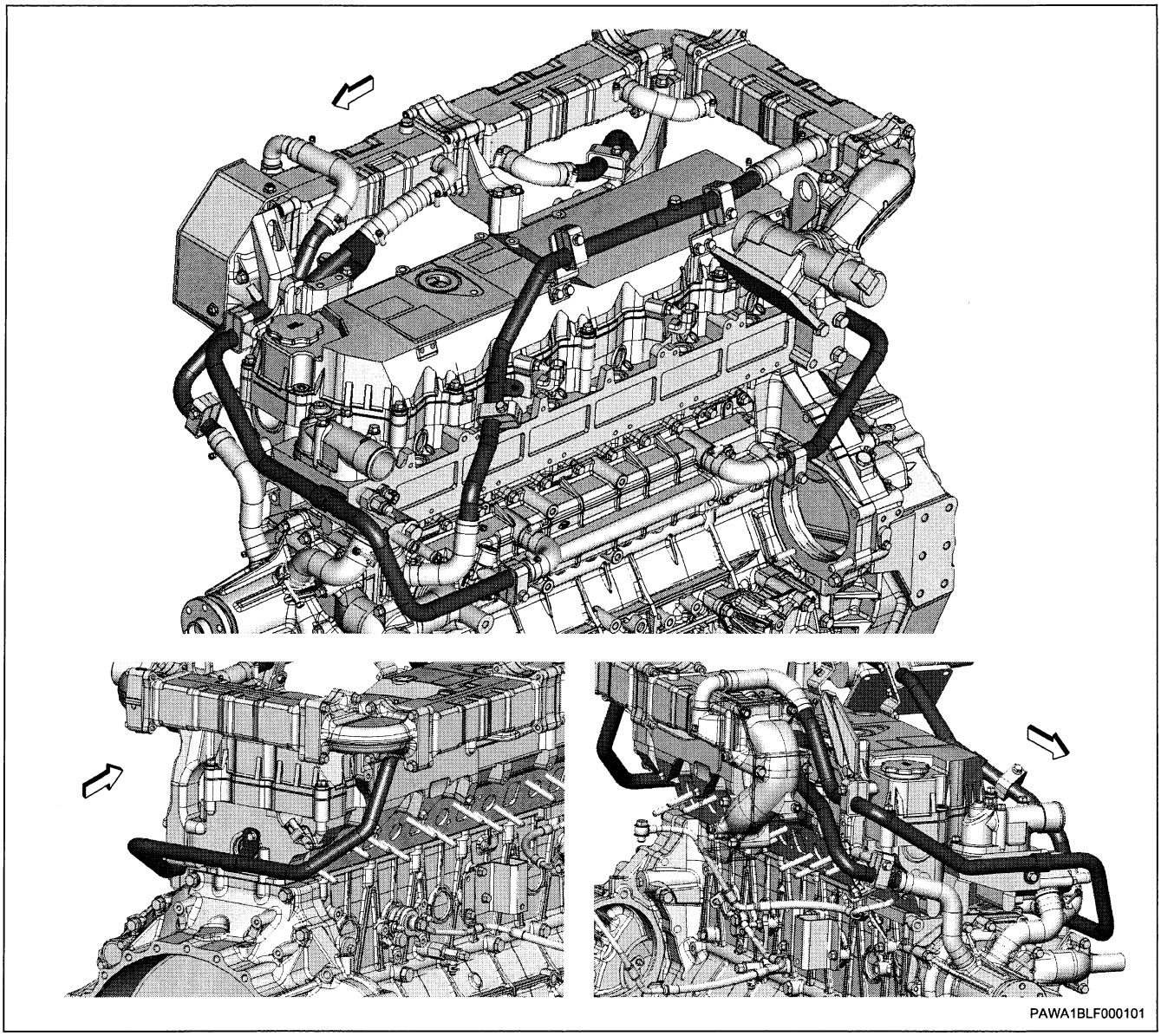
Note :

- To prevent the effect of spring force on the sub gear, use a scissors gear spring wrench to rotate the sub gear before installing the camshaft on the cylinder head.

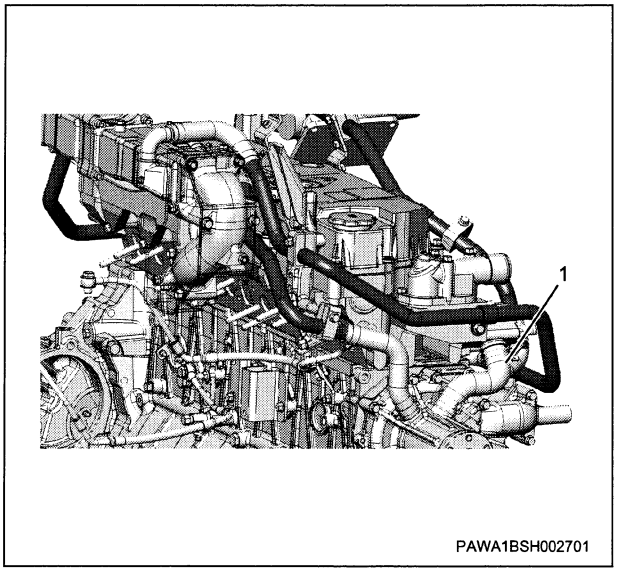
4. Align the sub gear to the camshaft gear using the special tool.

Note :

- Install the alignment pin from the sub gear side if the holes of the sub gear and the camshaft main gear are aligned.


PAWA1BLF000101

1. Install the water bypass hose to the water pump assembly and the water duct.



PAWA1BSH002701

1. Water bypass hose

Inspection

1. Flywheel Inspection
   1. Inspect the flywheel.

      Note :

      - Inspect the flywheel friction surface for damage such as cracks.

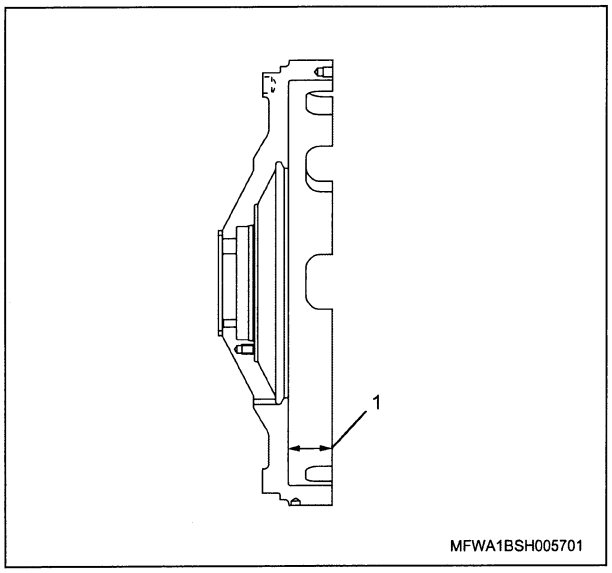
   2. Measure the flywheel using the vernier caliper.

      Note :

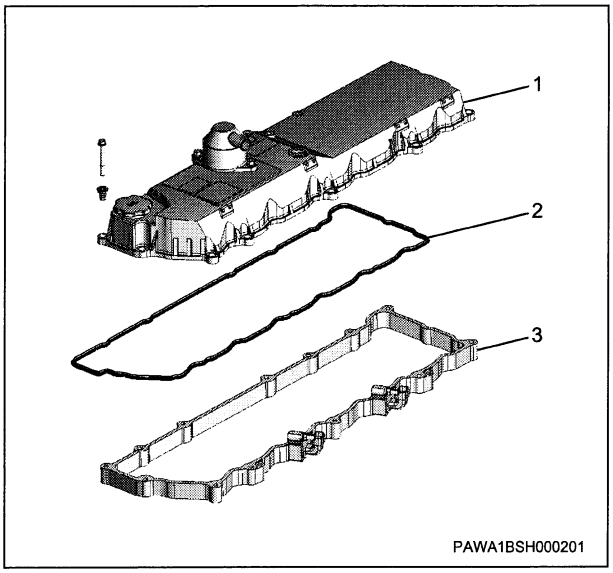
      - Measure the distance between the installation surface of the clutch cover and the contact surface of the clutch disc.

      Specified value : 48.0 mm { 1.8898 in } Wear of flywheel

      Specified value : 49.0 mm { 1.9291 in }



1. Distance between the installation surface of the clutch cover and the contact surface of the clutch disc.



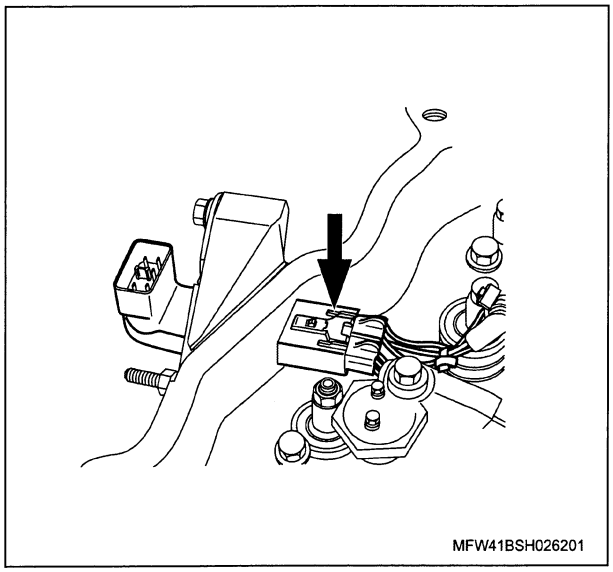
1. Cylinder head cover
2. Head cover gasket
3. Lower cover

21. Injector harness Removal

1. Remove the connector from the lower cover.

Caution :

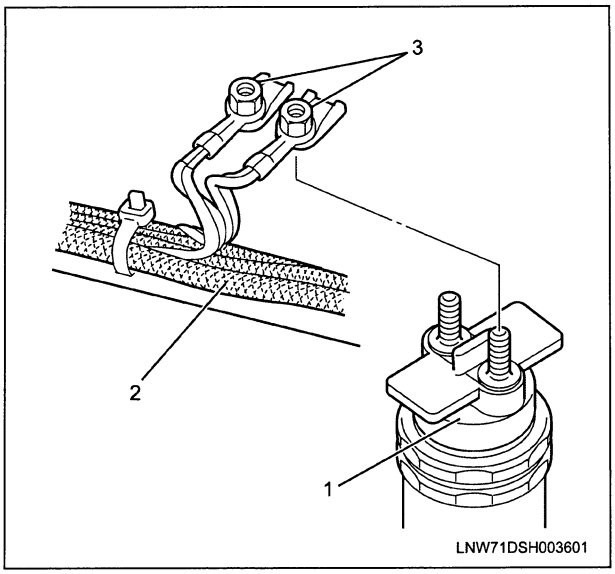
- Do not pull the wire, or pry the connector with a screwdriver.



2. Disengage the injector harness from the injector.

Caution :

- Be careful not to damage the injector side stud bolts.

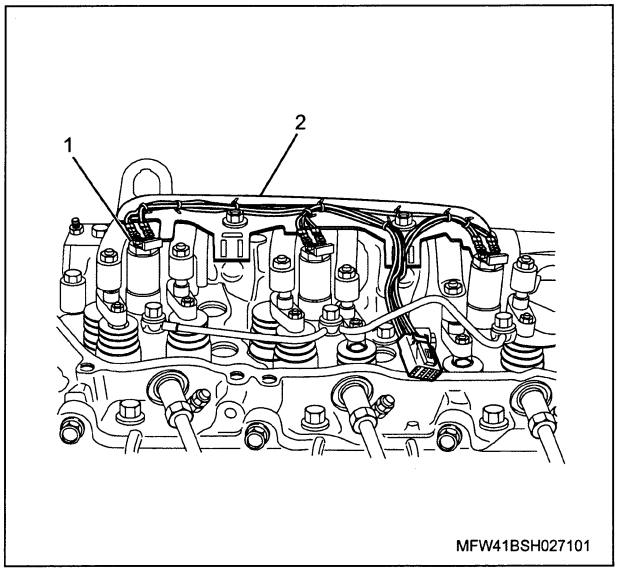


1. Injector
2. Injector harness
3. Terminal nut

3. Remove the injector harness from the cylinder head assembly.

Note :

- Remove the bracket tightening bolts and then remove the injector harness together with the bracket.



1. Injector harness terminal
2. Injector harness bracket

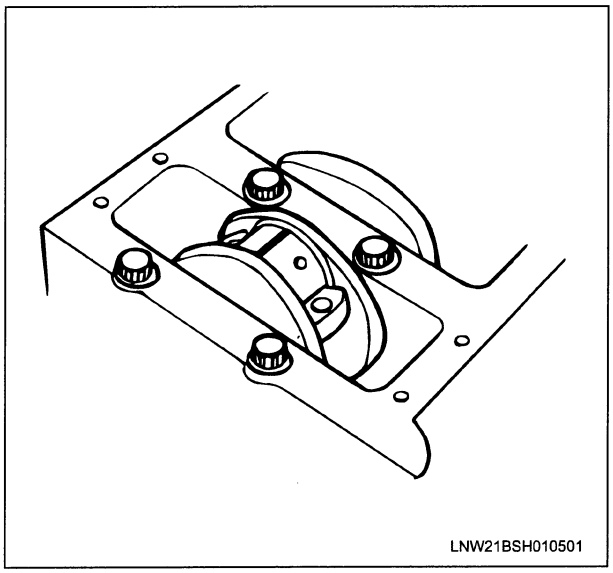
22. Injector Removal

1. Remove the injector leak-off pipe from the injector.
2. Remove the injector from the cylinder head assembly.

Note :

- The following is the measurement method for the connecting rod bearing clearance using a plastic gauge.

9. Put the plastigage on the crankshaft.



Caution :

- Do not rotate the crankshaft.

10. Install the connecting rod bearing cap to the connecting rod.
11. Apply the disulfide molybdenum grease to the bolt.

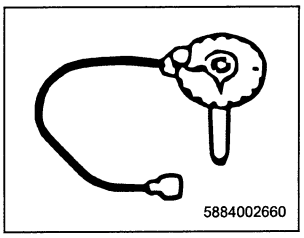
Note :

- Apply to the threaded portion and seat surface of the bolts for the connecting rod installation.

12. Tighten the bolt using the torque wrench.

tightening torque : 39 N・m { 4.0 kgf・m / 29 lb・ft }

13. Tighten the bolt using the special tool.

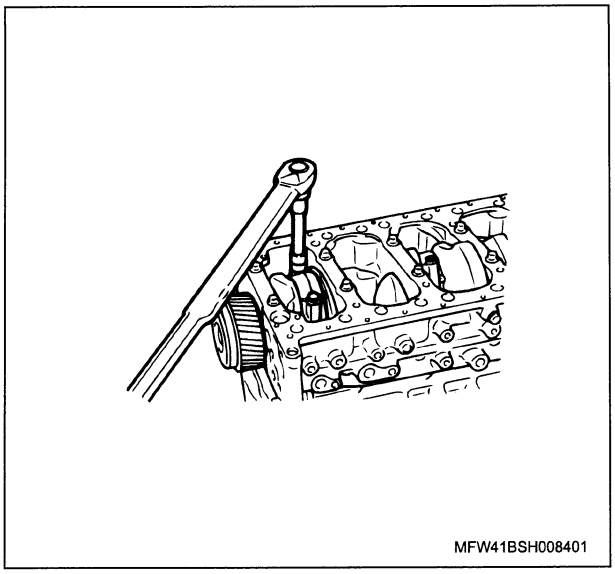


SST: 5-8840-0266-0 - angle gauge

tightening angle : 60 °

14. Tighten the bolt using the special tool.

tightening angle : 60 °



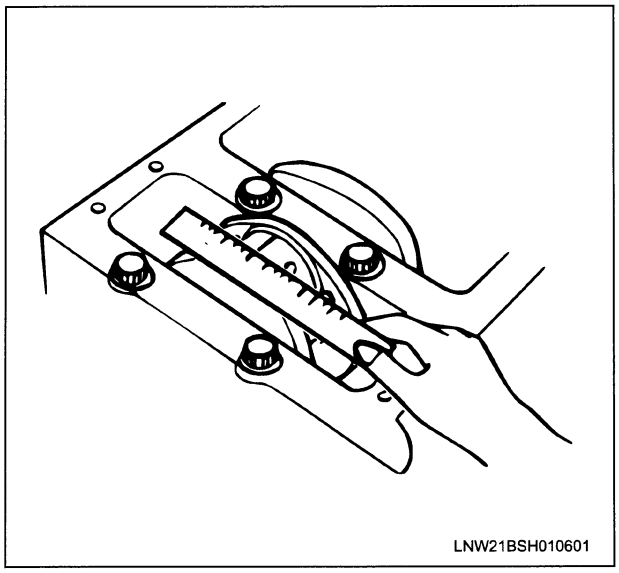
15. Remove the connecting rod bearing cap from the connecting rod.
16. Measure the plastigage using the gauge.

Note :

- Measure the maximum width of the plastic gauge.

Specified value : 0.041 to 0.077 mm { 0.0016 to 0.0030 in }

limit : 0.1 mm { 0.0039 in }

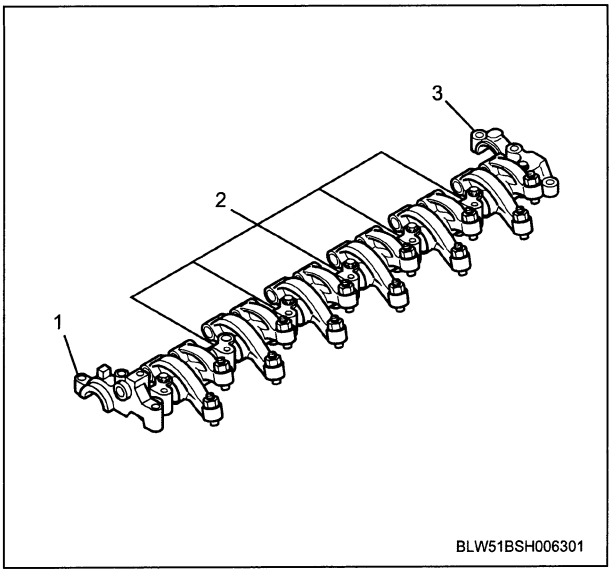


Caution :

- Replace the connecting rod bearing if the measured value exceeds the limit value.

Note :

- The following is the measurement method for the connecting rod bearing oil clearance using the measured difference between the outer

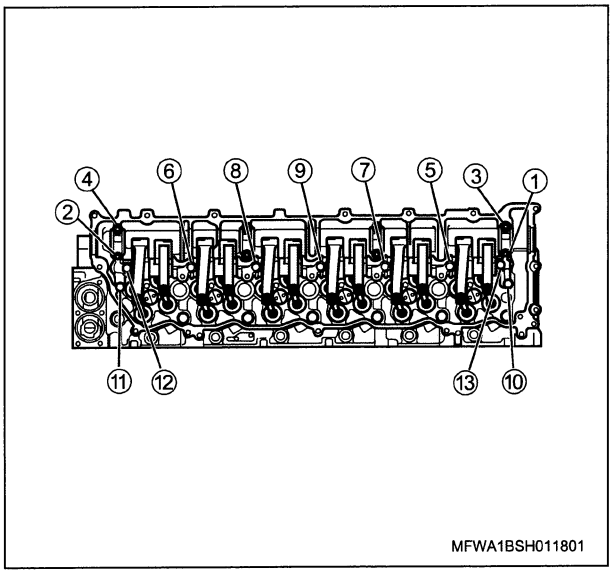


1. Front side camshaft bracket
2. Rocker arm
3. Rear side camshaft bracket

3. Install the rocker arm shaft to the cylinder head assembly.

Note :

- On the camshaft bearing assembly section only, apply oil to the threaded portion of the stud bolts and the seat surface/threaded portion of the nuts, then tighten them.
- Tightening order



Rocker arm shaft tightening torque	
Parts	Tightening torque
Front side camshaft bearing cap	: 28 N・m { 2.8 kgf・m / 20 lb・ft }
Rear side camshaft bearing cap	
Rocker arm bracket	: 56 N・m { 5.7 kgf・m / 41 lb・ft }

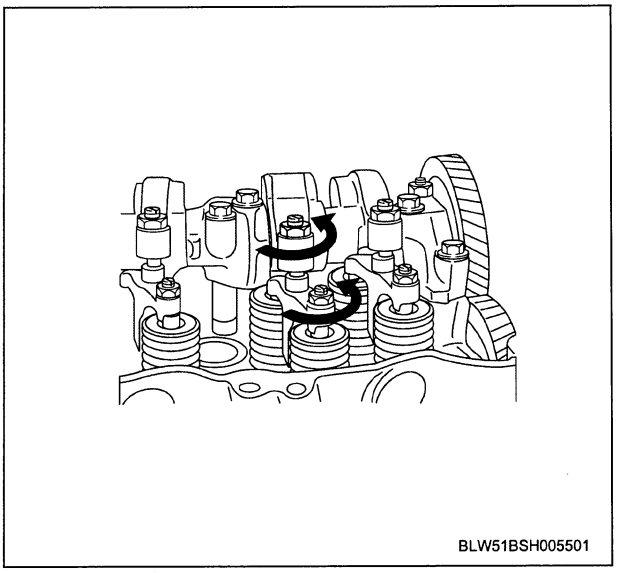
6. Rocker arm shaft Adjustment

Note :

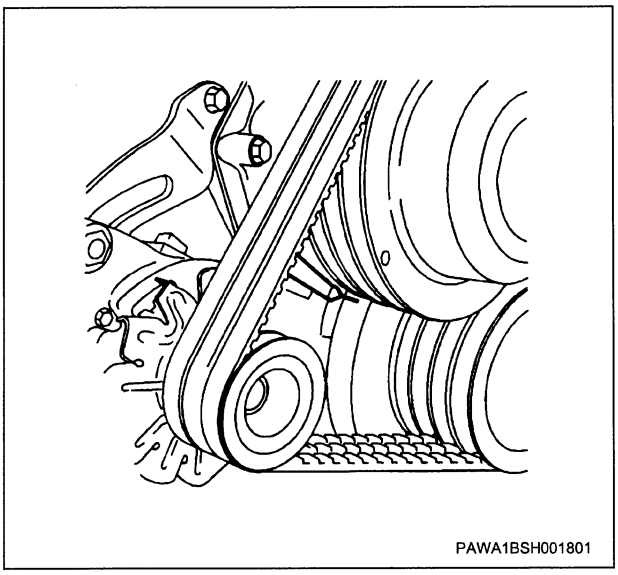
- Valve clearance adjustment

Caution :

- Adjust the valve clearance while cool.
- Loosen all adjust screws before adjustment.



1. Align 1st cylinder to the compression top dead center.



10. Securely tighten the EGR cooler B to the EGR cooler A.

tightening torque : 25 N・m { 2.5 kgf・m / 18 lb・ft }

11. Securely tighten the EGR cooler bracket C to the EGR cooler B.

tightening torque : 25 N・m { 2.5 kgf・m / 18 lb・ft }

12. Securely tighten the EGR cooler C to the EGR cooler bracket C.

tightening torque : 25 N・m { 2.5 kgf・m / 18 lb・ft }

13. Securely tighten the EGR pipe B to the EGR cooler C.

tightening torque : 25 N・m { 2.5 kgf・m / 18 lb・ft }

14. Securely tighten the EGR pipe B to the EGR valve.

tightening torque : 46 N・m { 4.7 kgf・m / 34 lb・ft }

15. Securely tighten the EGR cooler bracket A to the EGR cooler bracket C.

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft }

16. Securely tighten the EGR cooler bracket C to the EGR cooler bracket B.

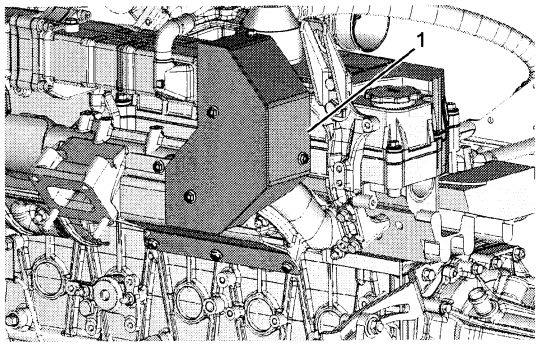
tightening torque : 46 N・m { 4.7 kgf・m / 34 lb・ft }

17. Securely tighten the EGR pipe B to the rear engine hanger bracket.

tightening torque : 46 N・m { 4.7 kgf・m / 34 lb・ft }

18. Install the EGR heat protector to the EGR pipe.

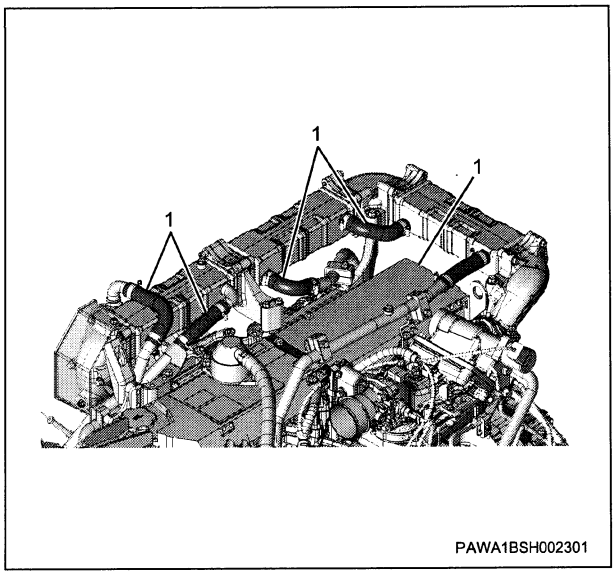
tightening torque : 31 N・m { 3.2 kgf・m / 23 lb・ft }



PAWA1BSH001201

1. EGR heat protector

19. Connect the water rubber hose to the EGR cooler.



PAWA1BSH002301

1. Water rubber hose

22. Oil level gauge guide tube Installation

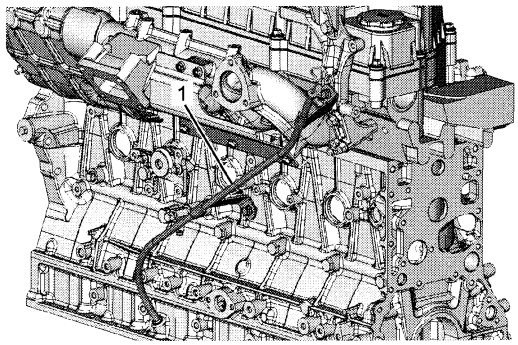
1. Install the oil level gauge guide tube to the cylinder block.

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft }

2. Connect the oil level gauge guide tube to the cylinder head assembly.

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft }

3. Install the oil level gauge to the oil level gauge guide tube.



PAWA1BSH002801

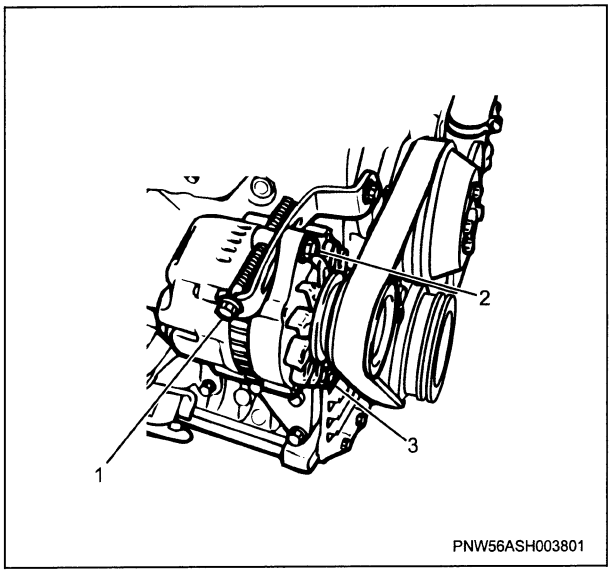
1. Oil level gauge guide tube

23. Turbocharger assembly Installation

1. Replenish the engine oil with the turbocharger assembly.
2. Align the gasket to the turbocharger assembly.

tightening torque : 75 N • m { 7.6 kgf • m / 55.3 lb • ft }
Nut of the adjust plate

tightening torque : 126 N • m { 12.8 kgf • m / 92.9 lb • ft } Bolt of the bracket side



1. Adjust bolt
2. Adjust plate side nut
3. Bracket side bolt

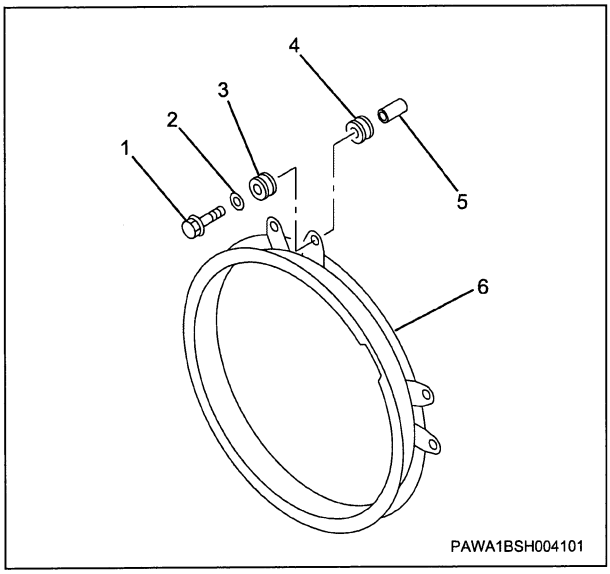
5. Fan guide Installation

1. Install the fan guide bracket to the engine assembly.

tightening torque : 40 N • m { 4.1 kgf • m / 29.5 lb • ft }

2. Install the fan guide to the fan guide bracket.

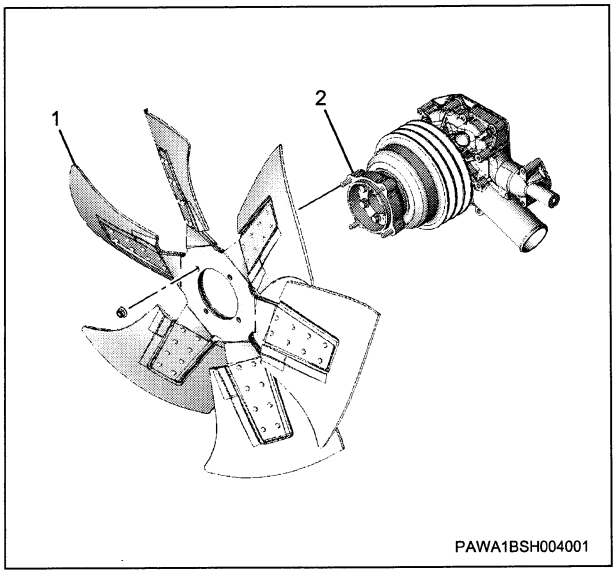
tightening torque : 30 N • m { 3.1 kgf • m / 22.1 lb • ft }



1. Bolt
2. Washer
3. Rubber mount
4. Rubber mount
5. Guide tube
6. Fan guide

6. Cooling fan Installation

1. Install the cooling fan to the adapter.



1. Cooling fan
2. Adapter

tightening torque : 52 N • m { 5.3 kgf • m / 38.4 lb • ft }

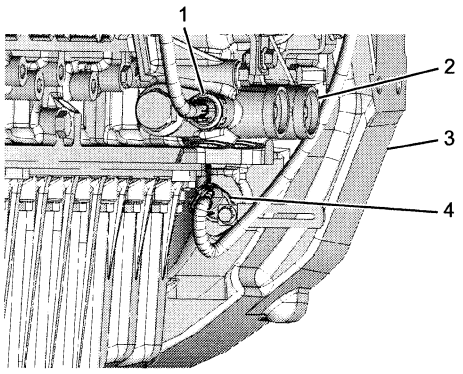
CKP sensor

Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. CKP sensor Removal
   1. Disengage the harness connector from the CKP sensor.
   2. Remove the CKP sensor from the flywheel housing.

Caution :

- Be careful not to subject the sensor to shock.



PAWA1BSH003401

1. Oil pressure switch
2. Oil port cover
3. Flywheel housing
4. CKP sensor

Exhaust manifold

Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Turbocharger assembly Removal
   1. Remove the air cleaner duct from the air cleaner assembly and the turbocharger assembly.
   2. Remove the air intake hose from the turbocharger assembly and the intercooler.
   3. Remove the exhaust pipe from the turbocharger.
   4. Disengage the oil feed pipe from the turbocharger assembly.

   Note :
   - Remove the clip.

   5. Remove the oil feed pipe from the pipe bracket.

   Note :
   - Remove the clip.

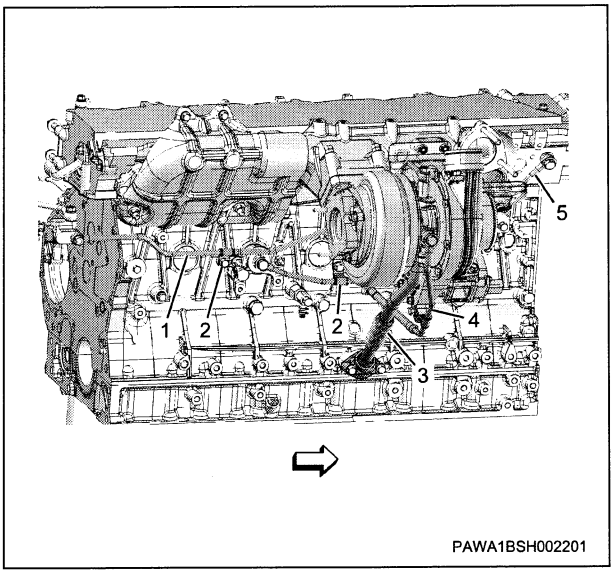
   6. Disengage the oil return pipe from the turbocharger assembly.
   7. Remove the oil return pipe from the cylinder block.
   8. Disengage the water return pipe from the turbocharger assembly.
   9. Remove the water return pipe from the cylinder head assembly.
   10. Disengage the water feed pipe from the turbocharger assembly.

   Note :
   - Remove the clip.

   11. Remove the water feed pipe from the cylinder block.

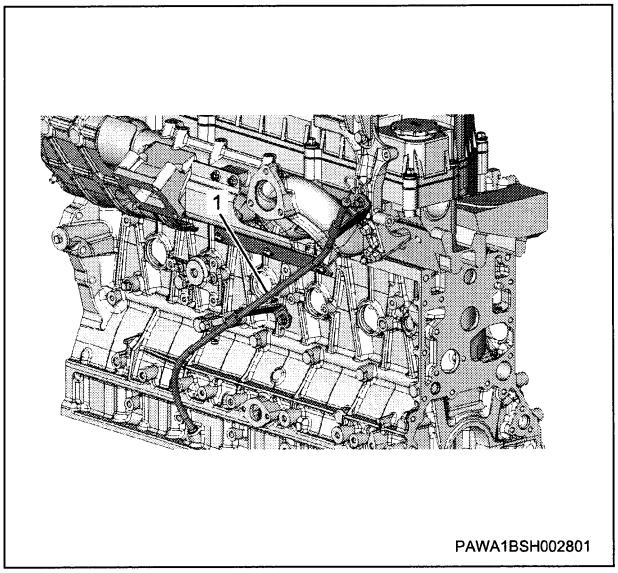
   Note :
   - Remove the clip.

   12. Disengage the harness connector from the turbocharger assembly.
   13. Remove the turbocharger assembly from the exhaust manifold.



1. Oil feed pipe
2. Clip
3. Oil return pipe
4. Water feed pipe
5. Water return pipe

3. Oil level gauge guide tube Removal
   1. Remove the oil level gauge from the oil level gauge guide tube.
   2. Disengage the oil level gauge guide tube from the front engine hanger bracket.
   3. Remove the oil level gauge guide tube from the cylinder block.



1. Oil level gauge guide tube

4. Exhaust manifold Removal

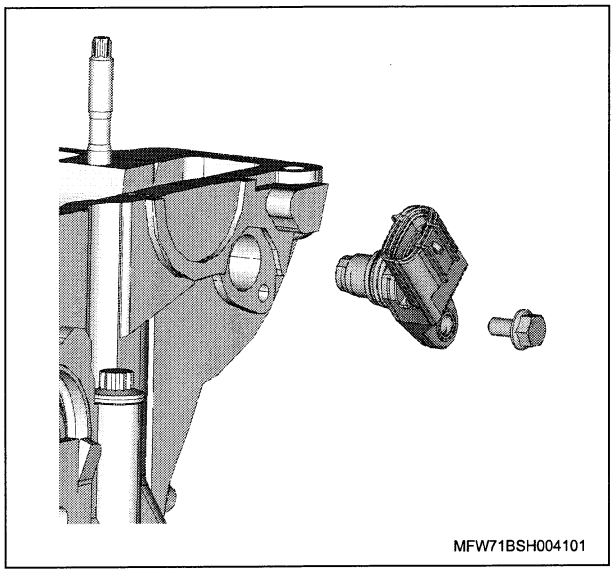
Installation

1. CMP sensor Installation
   1. Apply the engine oil to the O-ring.
   2. Install the CMP sensor to the cylinder head assembly.

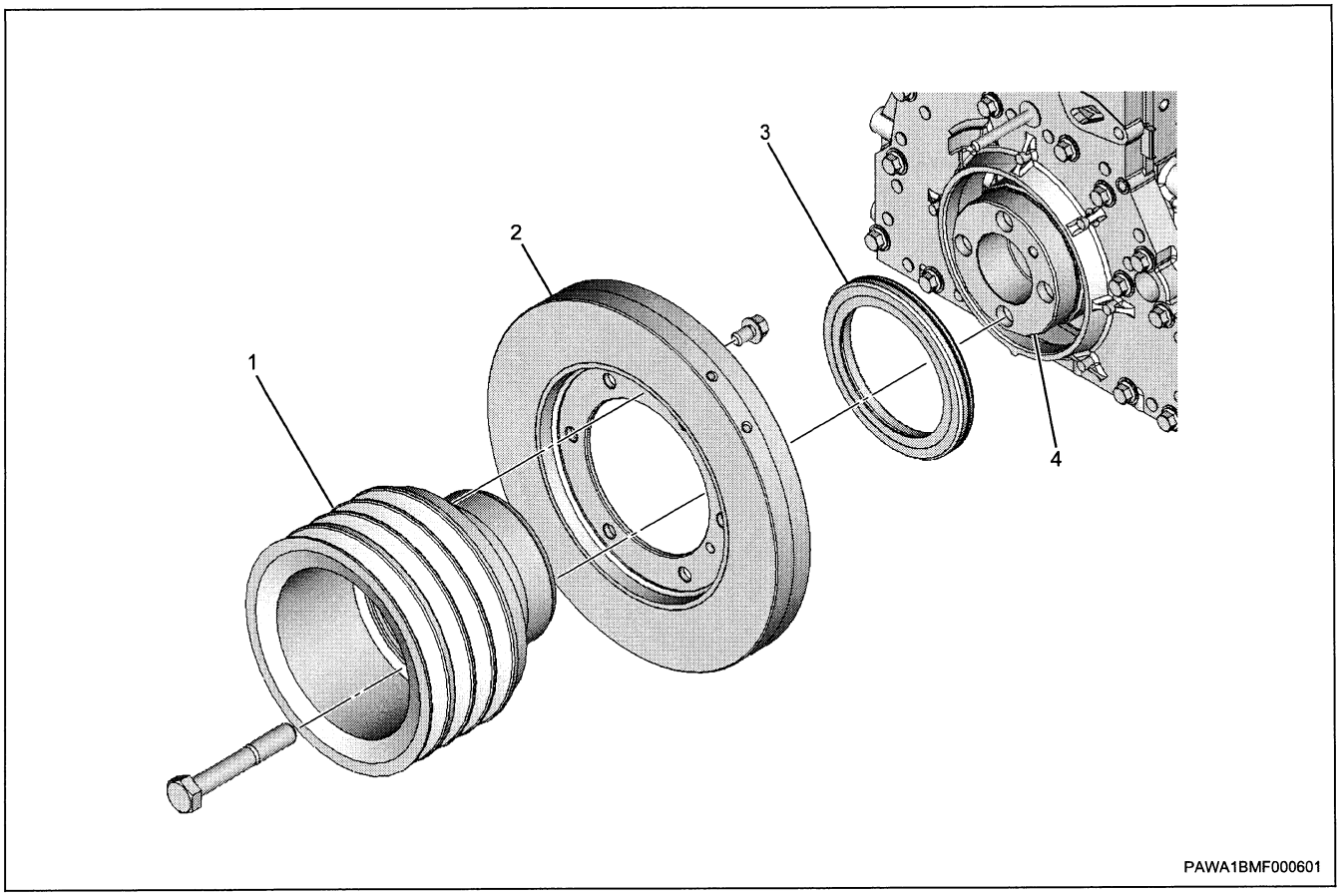
   Caution :
   - Be careful not to subject the sensor to shock.

   Note :
   - Tighten together with the clip.

   tightening torque : 8 N・m { 0.8 kgf・m / 69 lb・in }
   3. Connect the harness connector to the CMP sensor.



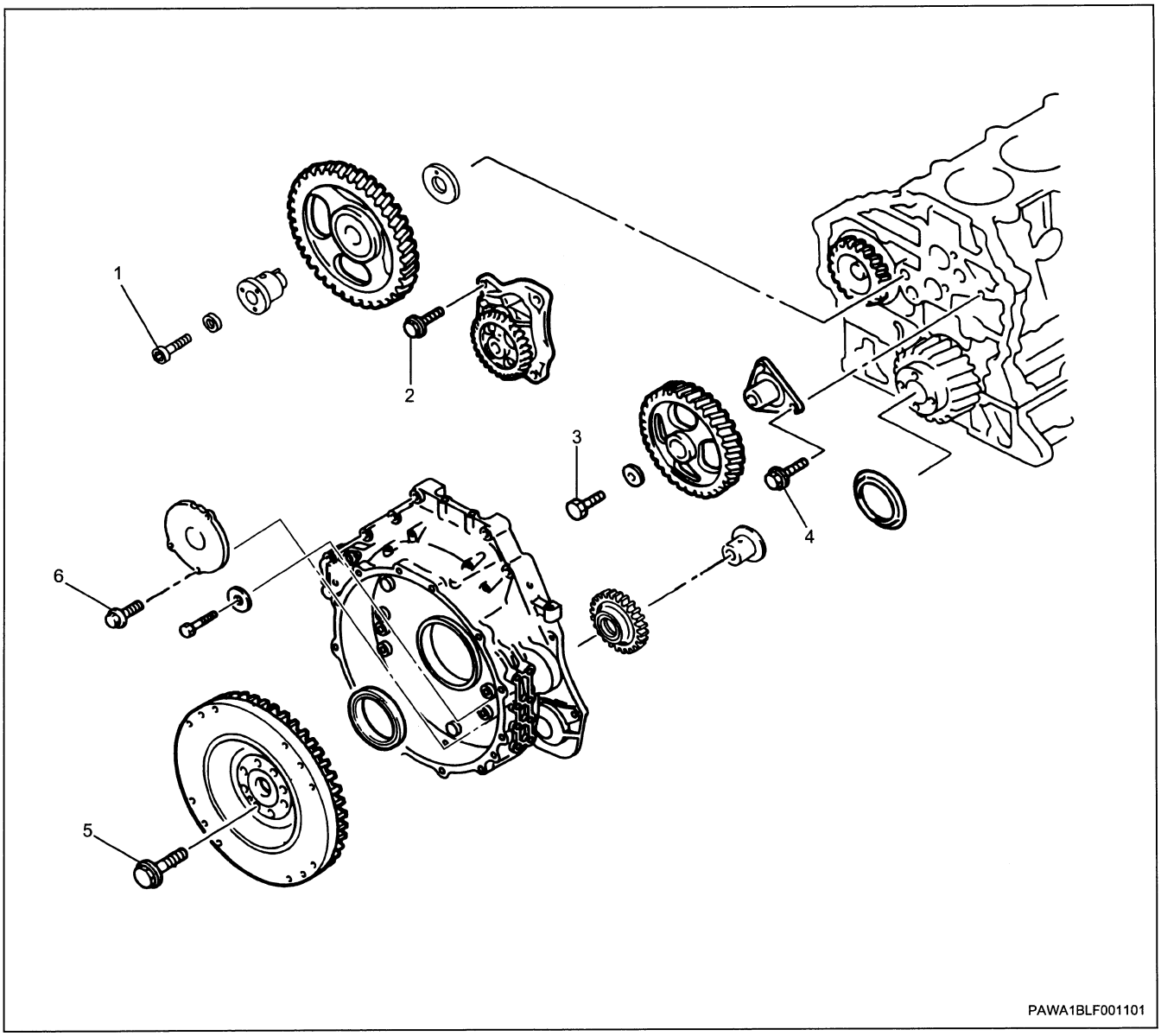
2. Battery ground cable Connect
   1. Connect the battery ground cable to the battery.



1. Crankshaft pulley
2. Crankshaft pulley damper
3. Crankshaft front oil seal
4. Crankshaft

Note :

- Gear case cover cover



1 : 133 N・m { 13.6 kgf・m / 98 lb・ft }

2 : 24 N・m { 2.4 kgf・m / 18 lb・ft }

3 : 95 N・m { 9.7 kgf・m / 70 lb・ft }

4 : 31 N・m { 3.2 kgf・m / 23 lb・ft }

5 : 78 N・m { 8.0 kgf・m / 58 lb・ft }

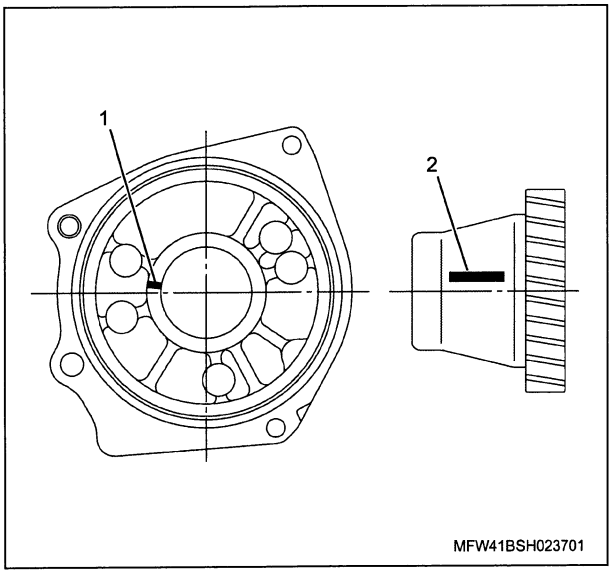
6 : 18 N・m { 1.8 kgf・m / 13 lb・ft }

Note :

- Crankshaft

Installation

1. Fuel supply pump Installation
   1. Align 1st cylinder to the compression top dead center.
   2. Align alignment mark to the bracket.

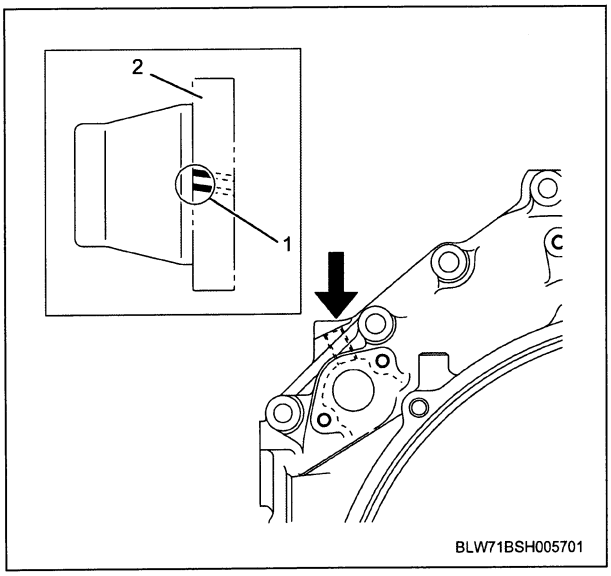


1. Supply pump bracket side slit
2. Supply pump gear side alignment mark

   3. Align the fuel supply pump to the cylinder block.

Note :

- Confirm that the white paint can be seen through the timing confirmation hole on the top surface of the flywheel housing.



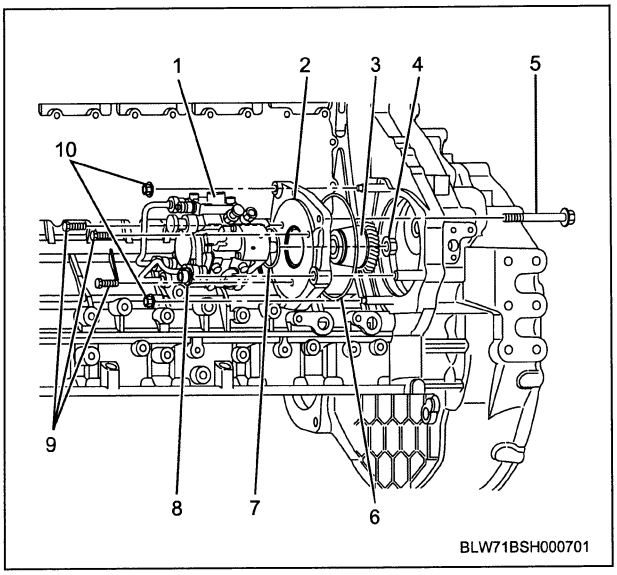
1. Confirmation hole
2. Supply pump gear

   4. Install the fuel supply pump to the cylinder block.

tightening torque : 75 N・m { 7.6 kgf・m / 55 lb・ft }
No.5 in the diagram

tightening torque : 75 N・m { 7.6 kgf・m / 55 lb・ft }
No.8 in the diagram

tightening torque : 51 N・m { 5.2 kgf・m / 38 lb・ft }
No.10 in the diagram



1. Fuel supply pump
2. Bracket
3. Gear
4. Nut
5. Bolt
6. O-ring
7. O-ring
8. Nut
9. Bolt
10. Nut

   5. Connect the harness connector to the fuel supply pump.

2. Fuel leak off pipe assembly Installation
   1. Temporarily tighten the fuel leak-off pipe to the cylinder head assembly.

Caution :

- Use new gaskets.

   2. Temporarily tighten the fuel leak-off pipe to the common rail assembly.

Caution :

- Use new gaskets.

   3. Temporarily tighten the fuel leak-off pipe to the fuel supply pump.

Note :

- Tighten the fuel feed pipe together.

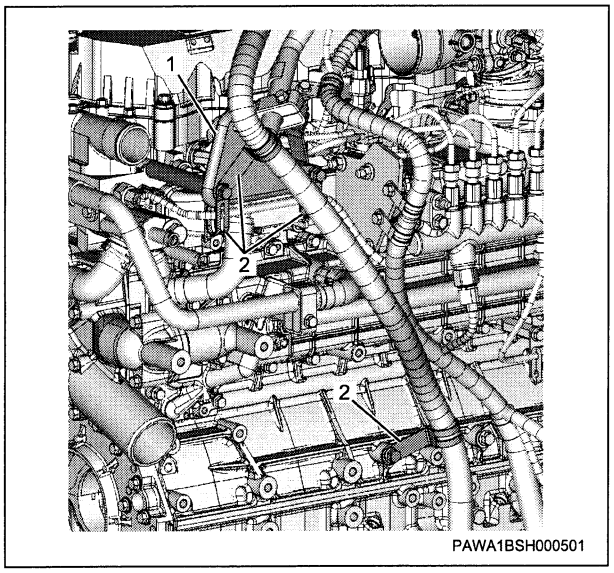
Common rail assembly

Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Coolant Drain
   1. Drain the coolant from the radiator.

   Caution :
   - After the coolant is discharged, make sure to tighten the drain plug.
3. Engine harness Disconnect
   1. Disengage the engine harness from the engine assembly.

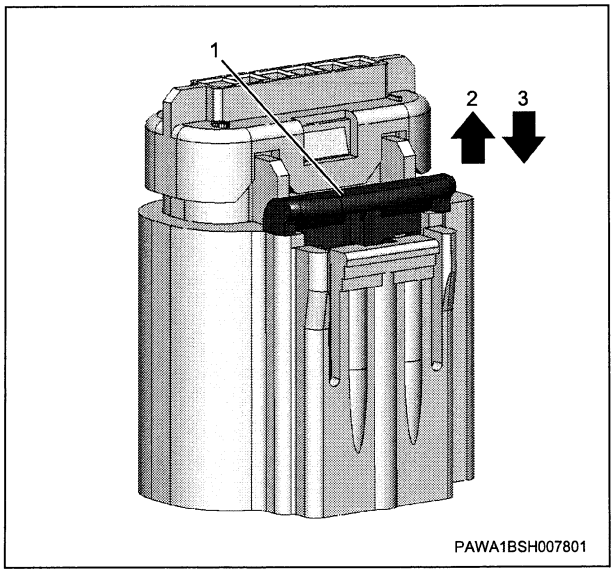
   Note :
   - Disconnect each connector.
4. Oil separator bracket Removal
   1. Remove the clip from the cylinder block.
   2. Remove the ventilation hose from the air breather.
   3. Remove the oil separator bracket from the cylinder head assembly.



1. Oil separator bracket
2. Clip

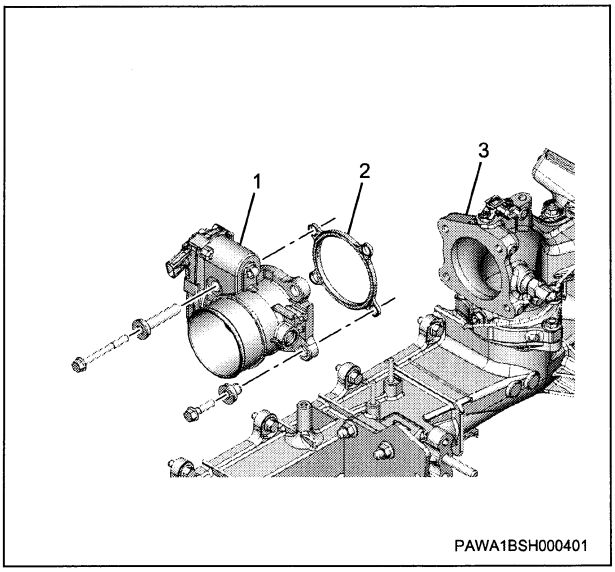
5. Intake throttle valve Removal
   1. Remove the air duct from the intake throttle valve.
   2. Disengage the harness connector from the intake throttle valve.

   Note :
   - Pull the lock operation portion to release the lock.



1. Lock operation section
2. Lock release
3. Lock

3. Remove the intake throttle valve from the inlet pipe.



1. Intake throttle valve
2. Gasket
3. Inlet pipe

6. EGR cooler Removal
   1. Disengage the water rubber hose from the EGR cooler.

Caution :

- Remove the fuel around the plug thoroughly after tightening.

15. Operate the priming pump.

Number of times : 10 count(s)

16. Start the engine.

Note :

- Do not accelerate the engine revolution right after staring.

specified time : 5 s

Note :

- Accelerate the engine revolution gradually.

specified time : 3 min

Note :

- Accelerate the engine revolution to maximum.
- Lower the rotation.

Fuel filter element

Removal

1. Fuel filter element Removal

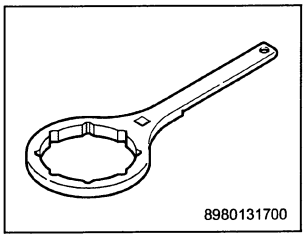
Caution :

- Be careful not to allow foreign matter to get inside the filter during work.

1. Loosen the plug using the wrench.
2. Prepare the pan.
3. Loosen the drain plug using the wrench.
4. Drain the fuel from the case.
5. Tighten the drain plug using the wrench.

tightening torque : 3 N・m { 0.3 kgf・m / 26.6 lb・in }

6. Remove the case from the fuel filter body using the special tool.

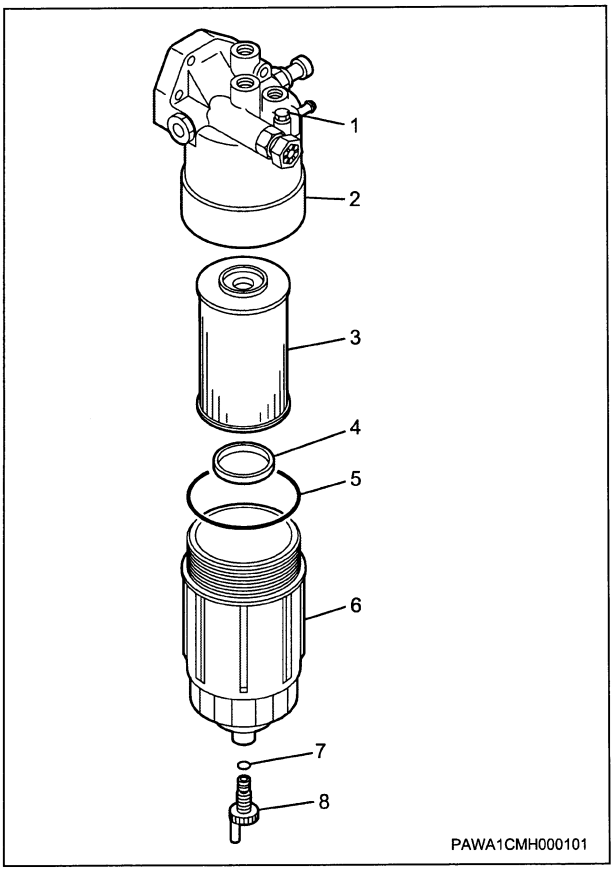


SST: 8-9801-3170-0 - filter wrench

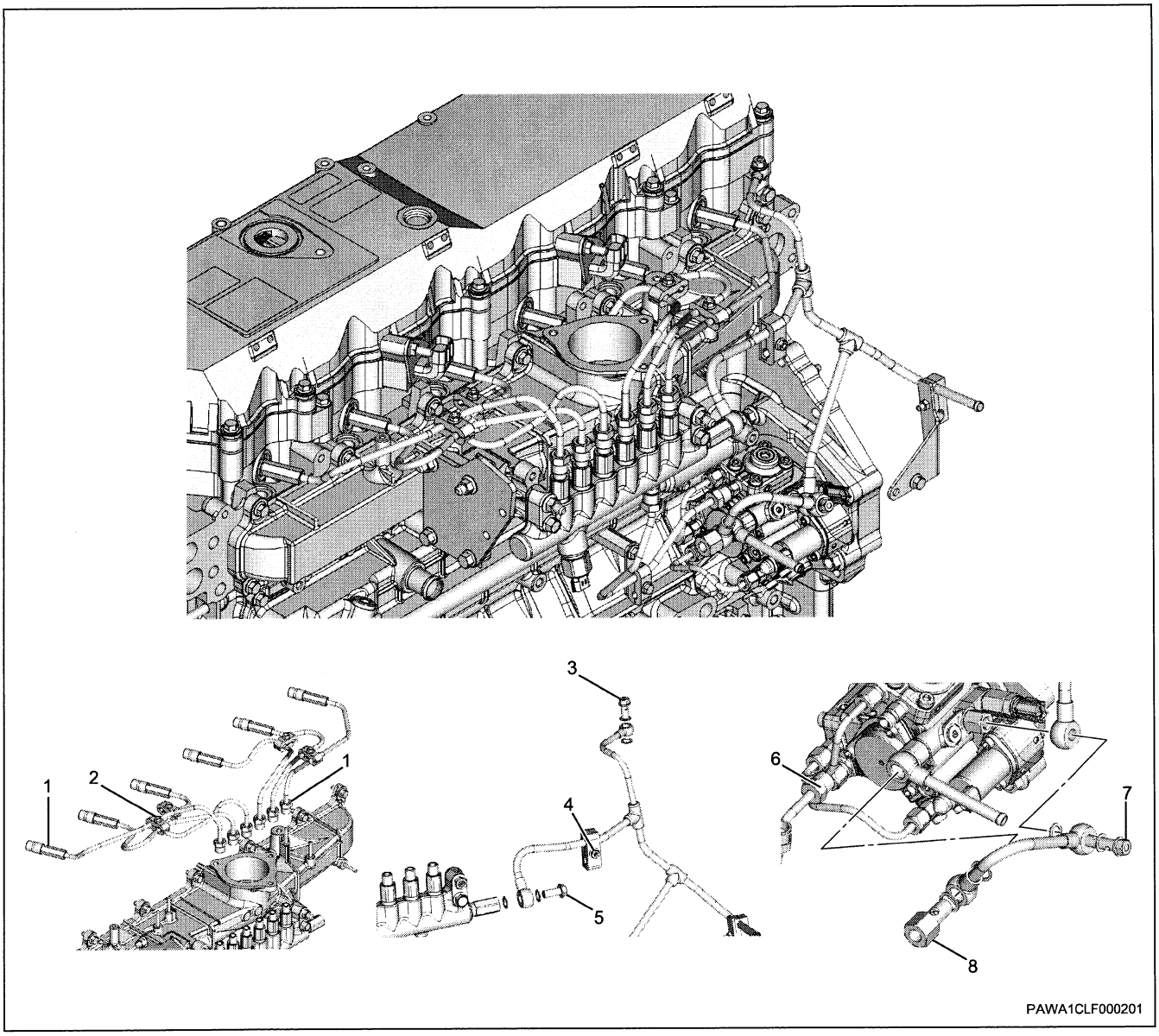
7. Remove the fuel filter element from the fuel filter body.
8. Remove the O-ring from the case.
9. Inspect the case.

Note :

- Clean if the inside of the case is dirty.



1. Plug
2. Fuel filter body
3. Fuel filter element
4. Float
5. O-ring
6. Case
7. Gasket
8. Drain plug



1 : 44 N・m { 4.5 kgf・m / 33 lb・ft }

2 : 6 N・m { 0.6 kgf・m / 52 lb・in }

3 : 14 N・m { 1.4 kgf・m / 10 lb・ft }

4 : 9 N・m { 0.9 kgf・m / 78 lb・in }

5 : 20 N・m { 2.1 kgf・m / 15 lb・ft }

6 : 44 N・m { 4.5 kgf・m / 33 lb・ft }

7 : 10 N・m { 1.1 kgf・m / 91 lb・in }

8 : 20 N・m { 2.0 kgf・m / 14 lb・ft }

Note :

- Suction control valve

Drive belt

Inspection

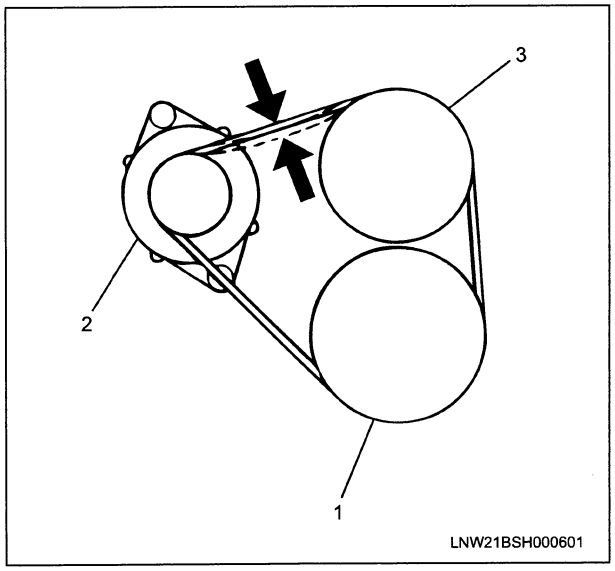
1. Drive belt Inspection
   1. Inspect the drive belt.

      Note :
      - Inspect for wear or damage.
2. Drive belt Adjustment
   1. Press the drive belt.

      Note :
      - Measure the amount of drive belt flex by pressing on the point indicated by the arrow in the diagram with the specified pressure.

      standard : 98.0 N { 10.0 kg / 22 lb }

      Specified value : 5.5 to 7.5 mm { 0.2165 to 0.2953 in } Amount of flex

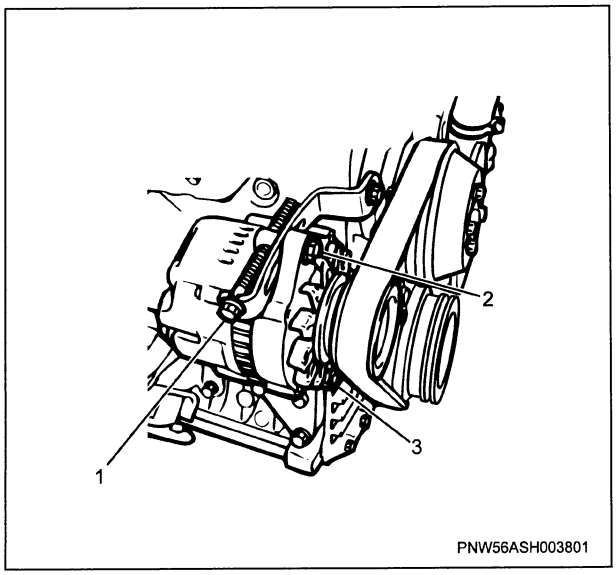


1. Crankshaft pulley
2. Generator
3. Fan pulley

   2. Adjust the drive belt to standard value using the adjust bolt.

      tightening torque : 75 N • m { 7.6 kgf • m / 55.3 lb • ft } Nut of the adjust plate

      tightening torque : 126 N • m { 12.8 kgf • m / 92.9 lb • ft } Bolt of the bracket side



1. Adjust bolt
2. Adjust plate side nut
3. Bracket side bolt

Coolant

Inspection

1. Coolant Inspection

Warning :

- If the coolant temperature is high, do not perform the inspection.
- When removing the cap, be careful as the coolant will burst out if the coolant temperature is high.

Caution :

- Be sure to use long life coolant which is specified or recommended by Isuzu.
- Using at an unspecified concentration may result in freezing due to decreased anti-freezing performance.
- Use a coolant concentration appropriate for the usage environment.

Note :

- Before using, dilute the specified long life coolant to the specified concentration with soft tap water.

Area where the equipment is used	LLC concentration
General area; Area where the lowest temperature is higher than (-12) degrees.	: 30 %
Cold area; Area where the lowest temperature is (-30) degrees.	: 50 %
Area where temperature drop to (-30) degrees.	: 55 %

1. Inspect the radiator reverse tank.

Note :

- If coolant level is MIN or less, add it until it reaches MAX.

Caution :

- When adding coolant, use coolant appropriate for the usage environment.

volume of coolant : 16.0 L { 4.2 US gal }

2. Inspect the water leak using the radiator cap tester.

inspection pressure : 200.0 kPa { 2.04 kgf/cm2 / 29 psi }

Note :

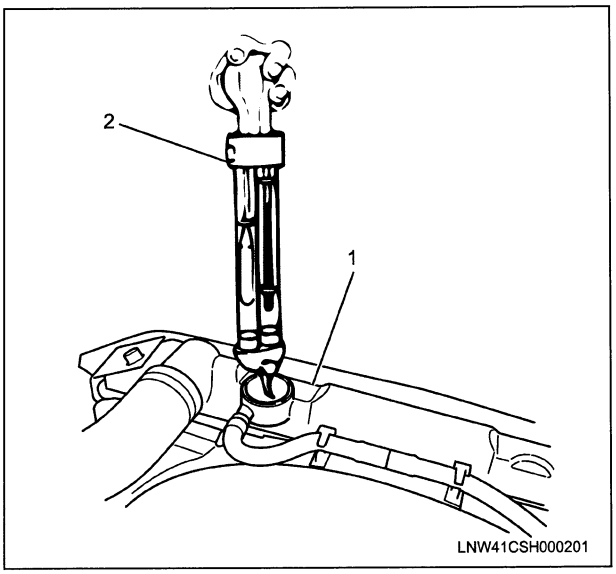
- Inspection locations
- Radiator assembly
- Water pump assembly
- Radiator hose
- Heater hose

3. Measure the specific gravity using the hydrometer.

engine coolant temperature : 0 to 50 ℃ { 32 to 122 °F } For inspection

Note :

- Use a container that is deeper than the length of the hydrometer.



1. Radiator
2. Hydrometer

4. Measure the temperature using the thermometer.

engine coolant temperature : 0 to 50 ℃ { 32 to 122 °F } For inspection

5. Calculate the concentration from the measured value.

Oil pan

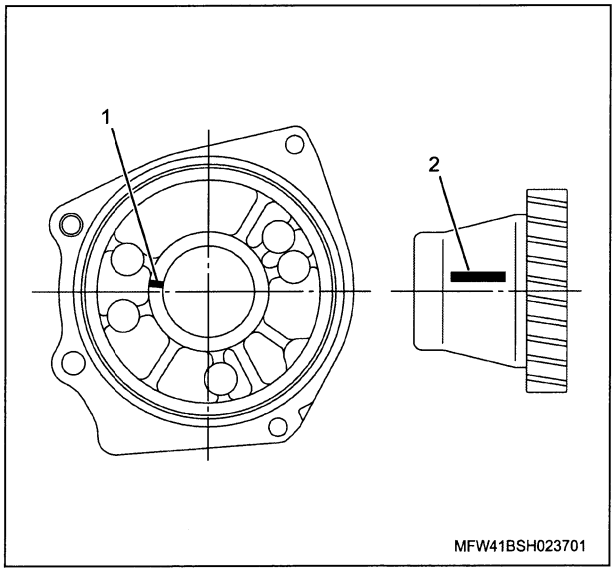
Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Engine oil Drain
   1. Remove the drain plug from the oil pan.
   2. Drain the engine oil from the oil pan.
   3. Install the drain plug to the oil pan.

   tightening torque : 70 N・m { 7.1 kgf・m / 52 lb・ft }
3. Oil pan Removal
   1. Disengage the harness connector from the oil level switch.
   2. Remove the oil pan from the crankcase.
   3. Remove the gasket from the oil pan.

3. Fuel supply pump Installation

1. Align 1st cylinder to the compression top dead center.
2. Align alignment mark to the bracket.

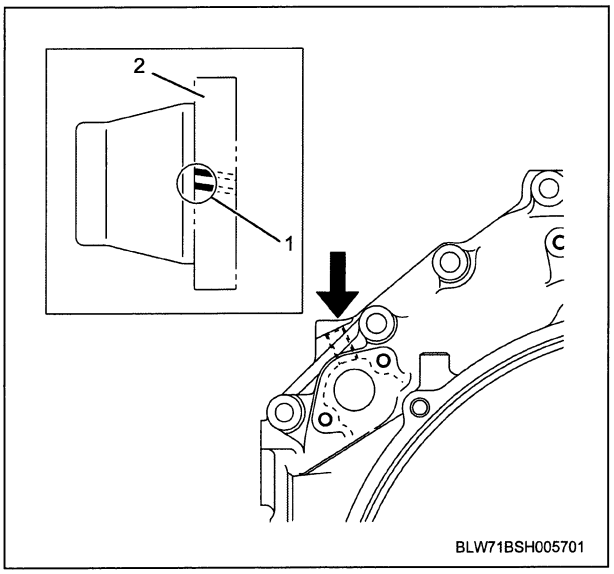


1. Supply pump bracket side slit
2. Supply pump gear side alignment mark

3. Align the fuel supply pump to the cylinder block.

Note :

- Confirm that the white paint can be seen through the timing confirmation hole on the top surface of the flywheel housing.



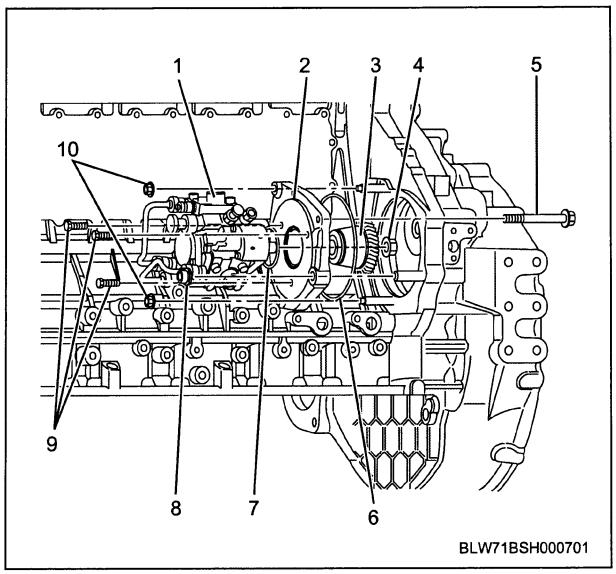
1. Confirmation hole
2. Supply pump gear

4. Install the fuel supply pump to the cylinder block.

tightening torque : 75 N・m { 7.6 kgf・m / 55 lb・ft }
No.5 in the diagram

tightening torque : 75 N・m { 7.6 kgf・m / 55 lb・ft }
No.8 in the diagram

tightening torque : 51 N・m { 5.2 kgf・m / 38 lb・ft }
No.10 in the diagram



1. Fuel supply pump
2. Bracket
3. Gear
4. Nut
5. Bolt
6. O-ring
7. O-ring
8. Nut
9. Bolt
10. Nut

5. Connect the harness connector to the fuel supply pump.

4. Common rail assembly Installation

1. Align the common rail assembly to the inlet cover.
2. Temporarily tighten the bolt to the common rail assembly.
3. Temporarily tighten the nut to the common rail assembly.
4. Securely tighten the bolt to the common rail assembly.

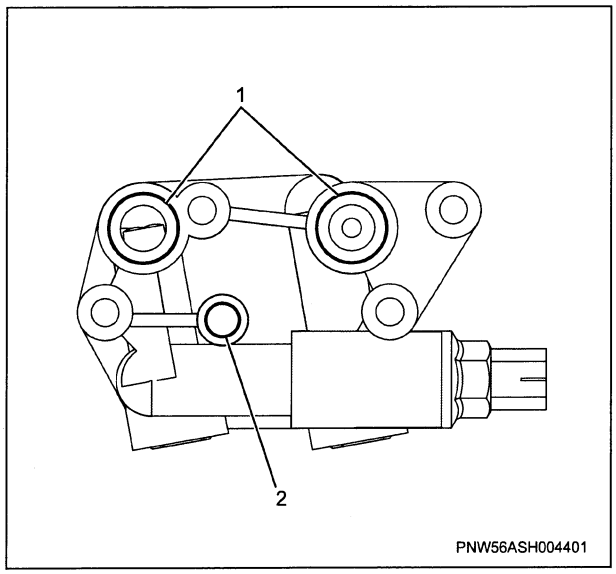
tightening torque : 25 N・m { 2.5 kgf・m / 18.4 lb・ft }

5. Securely tighten the nut to the common rail assembly.

tightening torque : 25 N・m { 2.5 kgf・m / 18.4 lb・ft }

Installation

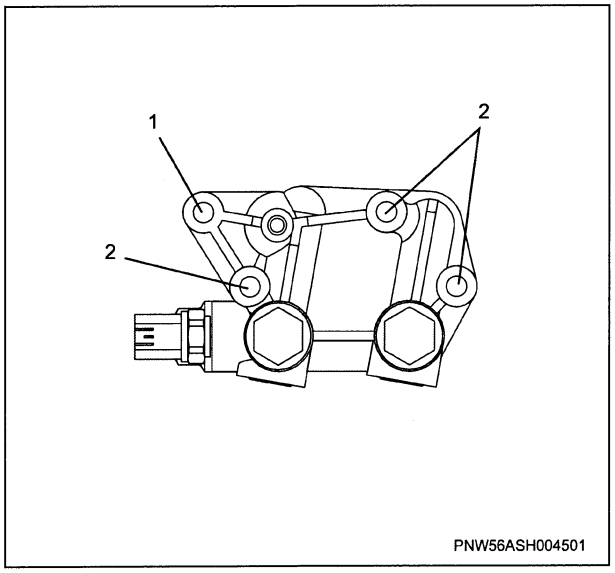
1. Oil port cover Installation
   1. Install the O-ring to the oil port cover.



1. O-ring
2. O-ring

   2. Install the oil port cover to the cylinder block.

tightening torque : 39 N・m { 4.0 kgf・m / 29 lb・ft }



1. Bolt - short
2. Bolt - long

   3. Connect the oil feed pipe to the oil port cover.

tightening torque : 28 N・m { 2.8 kgf・m / 20 lb・ft } eyebolt

Caution :

- Use new gaskets.

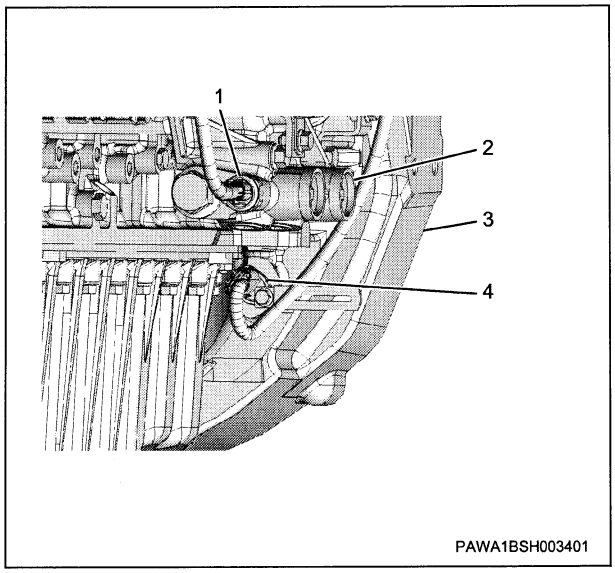
2. Oil pressure sensor Installation
   1. Install the oil pressure sensor to the oil port cover.

tightening torque : 41 N・m { 4.2 kgf・m / 30 lb・ft }

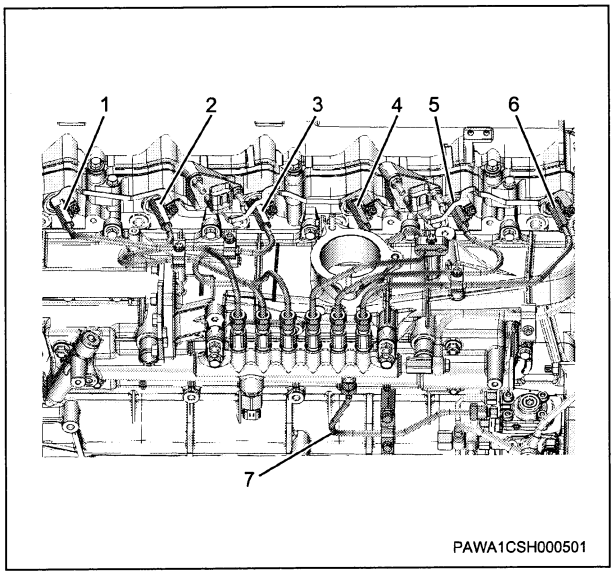
Caution :

- Use new gaskets.

   2. Connect the harness connector to the oil pressure sensor.



1. Oil pressure sensor
2. Oil port cover
3. Flywheel housing
4. CKP sensor



1. No.1 injection pipe
2. No.2 injection pipe
3. No.3 injection pipe
4. No.4 injection pipe
5. No.5 injection pipe
6. No.6 injection pipe
7. Fuel pipe

15. Fuel pipe Removal

1. Remove the fuel pipe from the fuel supply pump and the common rail assembly.

Note :

- Remove the clip.

Caution :

- Do not reuse the removed fuel pipe.

16. Fuel leak off pipe assembly Removal

1. Disengage the fuel leak-off pipe from the cylinder head.
2. Remove the fuel leak-off pipe from the fuel supply pump.

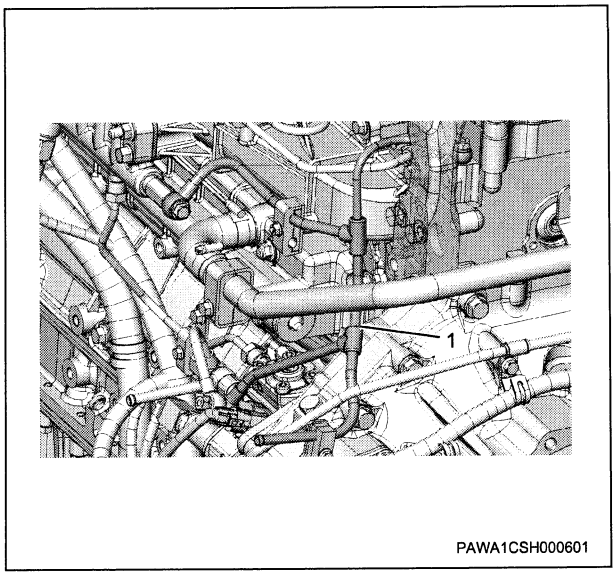
Note :

- Remove the eyebolt tightened together with the fuel feed pipe.

3. Disengage the fuel leak-off pipe from the common rail assembly.
4. Remove the fuel leak-off pipe from the inlet pipe.

Note :

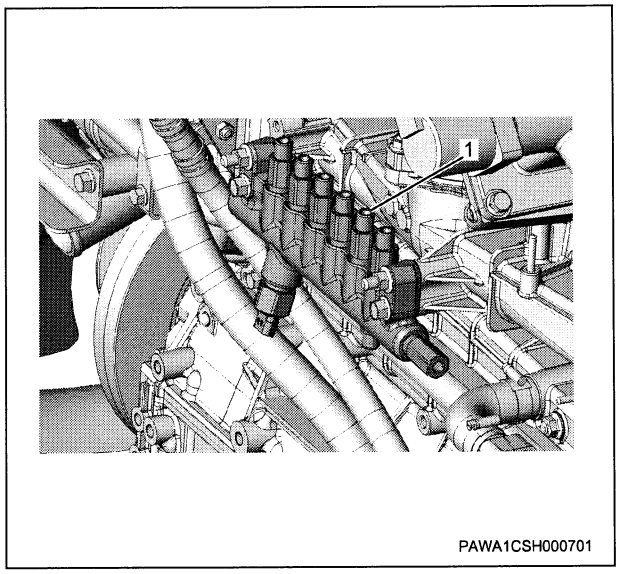
- Remove the clip.



1. Fuel leak-off pipe

17. Common rail assembly Removal

1. Disengage the harness connector from the fuel pressure sensor.
2. Remove the common rail assembly from the inlet cover.



1. Common rail assembly

18. Cylinder head cover Removal

1. Disengage the ventilation hose from the air breather.
2. Remove the cylinder head cover from the lower cover.
3. Remove the head cover gasket from the cylinder head cover.

Inspection

1. Oil pump assembly Inspection

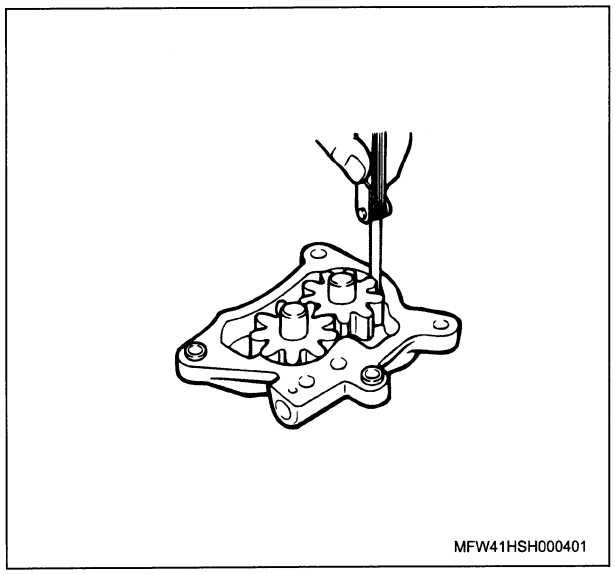
1. Measure the clearance using the feeler gauge.

Note :

- The clearance between the inner wall of the body and each gear tooth tip.

Specified value : 0.125 to 0.220 mm { 0.0049 to 0.0087 in }

limit : 0.30 mm { 0.0118 in }



Caution :

- Replace the gear if the measured value exceeds the limit value.

2. Measure the shaft using the micrometer.

Note :

- Driven gear shaft outer diameter

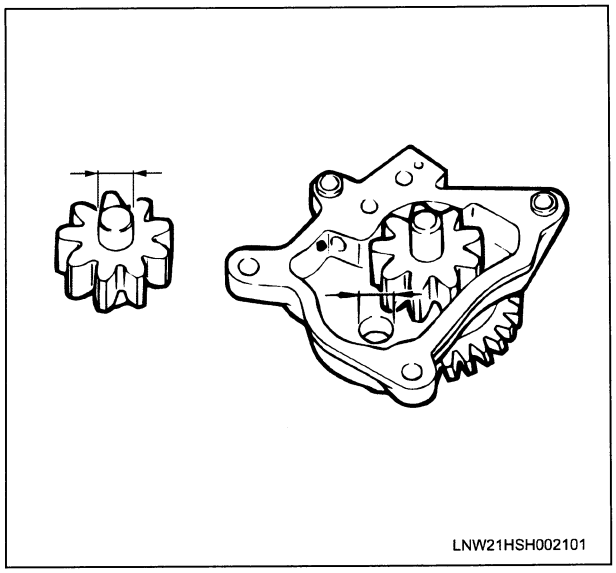
Specified value : 15.989 to 16.000 mm { 0.6295 to 0.6299 in }

limit : 15.900 mm { 0.6260 in }

3. Measure the body using the gauge.

Note :

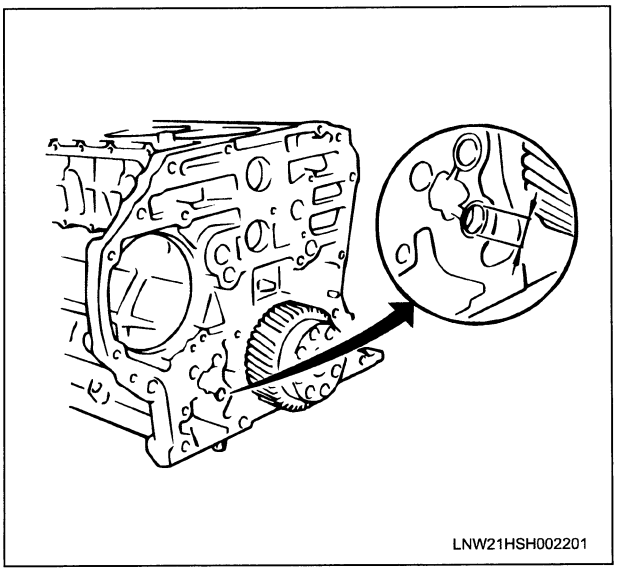
- Measure the bush inner diameter of the body.



4. Measure the cylinder block using the gauge.

Note :

- Measure the bush inner diameter of the cylinder block.



5. Calculate the clearance from the measured value.

Note :

- The difference between the shaft outer diameter and the bush inner diameter is the clearance.

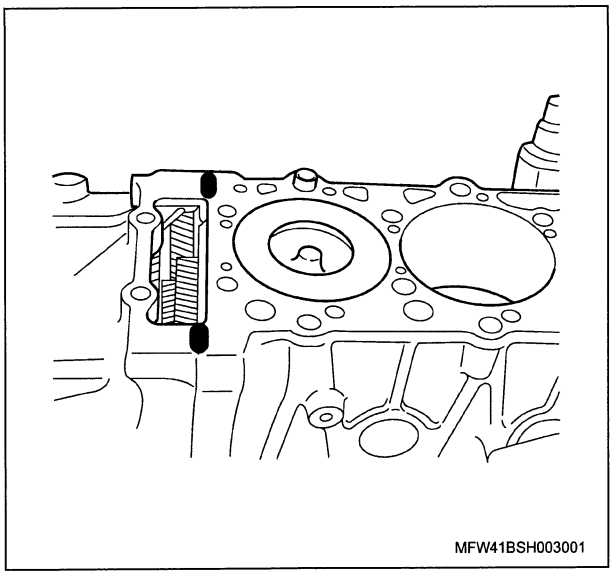
Specified value : 0.04 to 0.07 mm { 0.0016 to 0.0028 in }

Specified value : 0.20 mm { 0.0079 in }

Caution :

- Replace the gear if the clearance exceeds the limit value.

6. Inspect the ball.



Caution :

- After applying liquid gasket, install the cylinder head within 5 minutes.

2. Install the cylinder head gasket to the cylinder block.

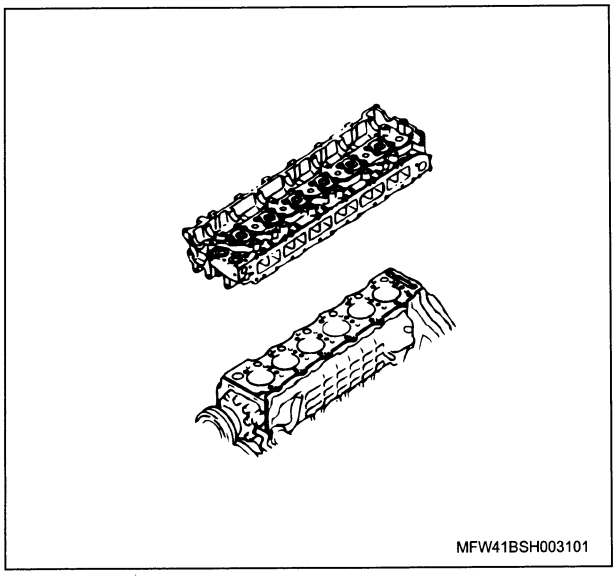
Caution :

- Use a new cylinder head gasket.

3. Install the cylinder head assembly to the cylinder block.

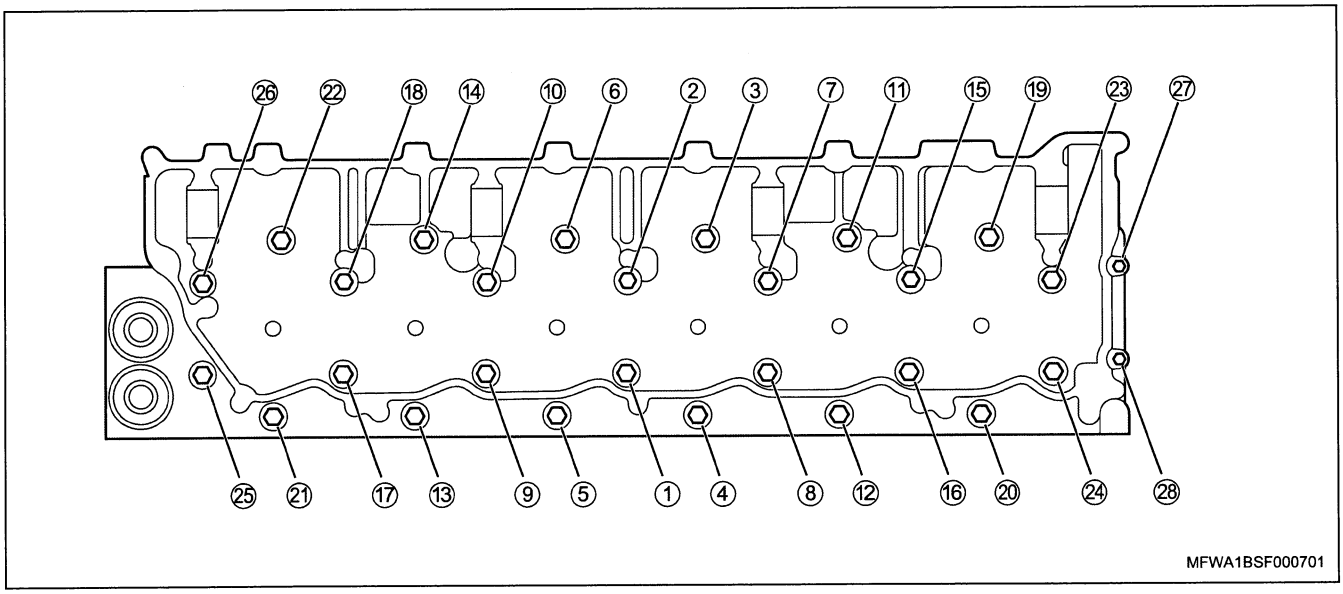
Caution :

- Be careful not to damage the cylinder head gasket.



Note :

- Tightening order of the head bolts



Note :

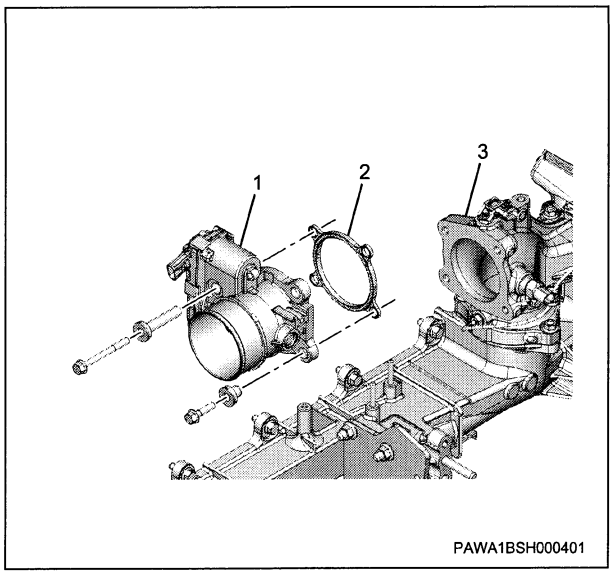
- 1 to 26 in the diagram indicate the M14 bolts.
- 27 and 28 in the diagram indicate the M10 bolts.

4. Prepare the head bolt.

Note :

- Apply molybdenum disulfide grease to the seat surface and threaded portion of the M14 head bolts.
- Apply engine oil to the seat surface and threaded portion of the M10 head bolts.

5. Tighten the head bolt using the torque wrench.

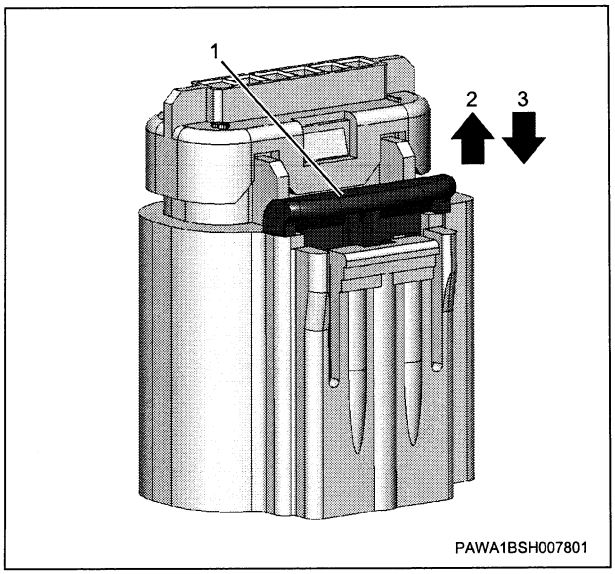


1. Intake throttle valve
2. Gasket
3. Inlet pipe

2. Install the air duct to the intake throttle valve.
3. Connect the harness connector to the intake throttle valve.

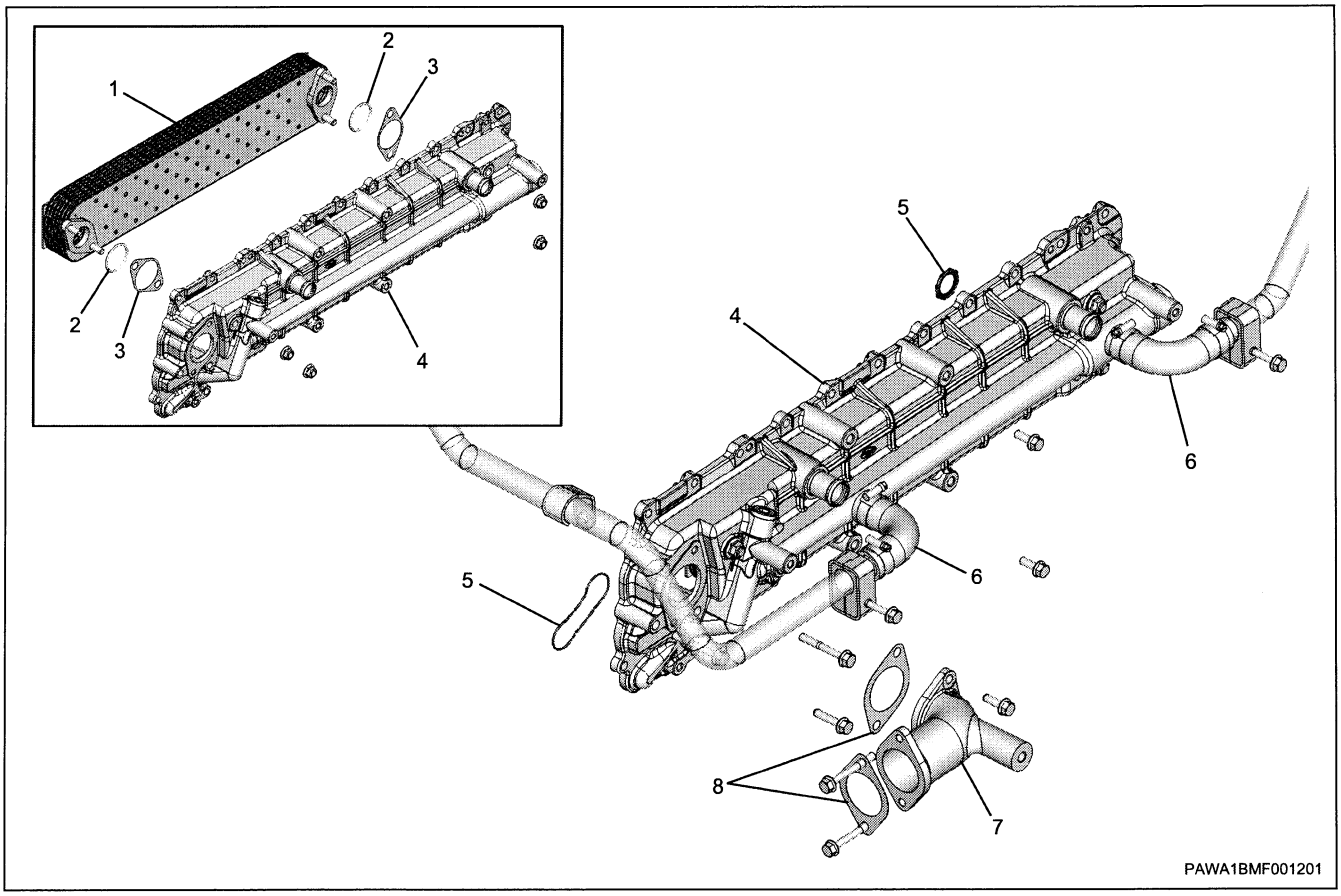
Note :

- After connecting the harness connector, press in the lock operation portion to lock.



1. Lock operation section
2. Lock release
3. Lock

26. EGR cooler water pipe Installation



1. Oil cooler element
2. O-ring
3. Gasket
4. Case
5. O-ring
6. EGR cooler water pipe
7. Water duct
8. Gasket

Note :

- Oil port cover

Turbocharger assembly

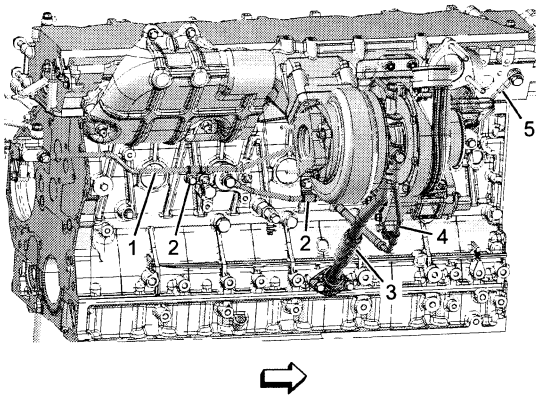
Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Coolant Drain
   1. Drain the coolant from the radiator.

   Caution :
   - After the coolant is discharged, make sure to tighten the drain plug.
3. Turbocharger assembly Removal
   1. Remove the air cleaner duct from the air cleaner assembly and the turbocharger assembly.
   2. Remove the air intake hose from the turbocharger assembly and the intercooler.
   3. Remove the exhaust pipe from the turbocharger.
   4. Disengage the oil feed pipe from the turbocharger assembly.

   Note :
   - Remove the clip.
   5. Disengage the oil return pipe from the turbocharger assembly.
   6. Disengage the water return pipe from the turbocharger assembly.
   7. Disengage the water feed pipe from the turbocharger assembly.

   Note :
   - Remove the clip.
   8. Disengage the harness connector from the turbocharger assembly.
   9. Remove the turbocharger assembly from the exhaust manifold.



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1. Oil feed pipe
2. Clip
3. Oil return pipe
4. Water feed pipe
5. Water return pipe

Air cleaner element

Inspection

1. Air cleaner element Inspection

   1. Inspect the air cleaner element.

   Note :

   - Inspect the air cleaner element for a damage and thinned portion.

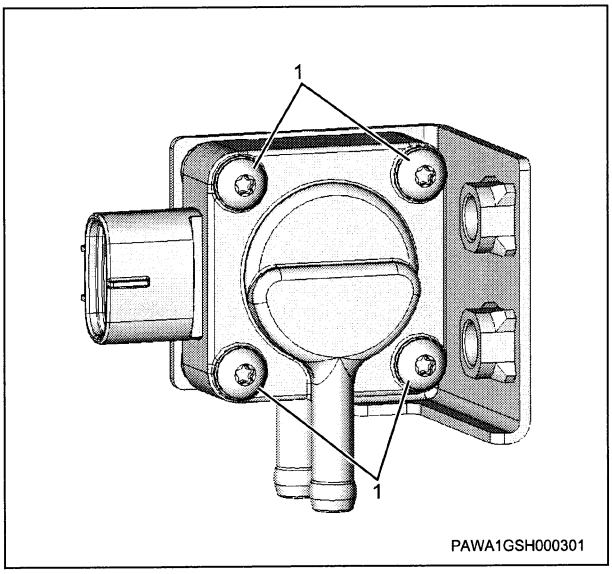
Exhaust differential pressure sensor

Removal

1. Exhaust differential pressure sensor Safety Information

Caution :

- Do not use a tool which causes vibrations such as an impact wrench when installing and removing the DPD differential pressure sensor.
- Do not reuse a DPD differential pressure sensor which has been subjected to shock such as being dropped.
- Install or remove the DPD differential pressure sensor together with the bracket.
- Be sure not to loosen the 4 screws installed on the DPD differential pressure sensor.
- Replace the DPD differential pressure sensor if the 4 screws installed on the DPD differential pressure sensor have been loosened.



1. Screw

2. Exhaust differential pressure sensor Removal

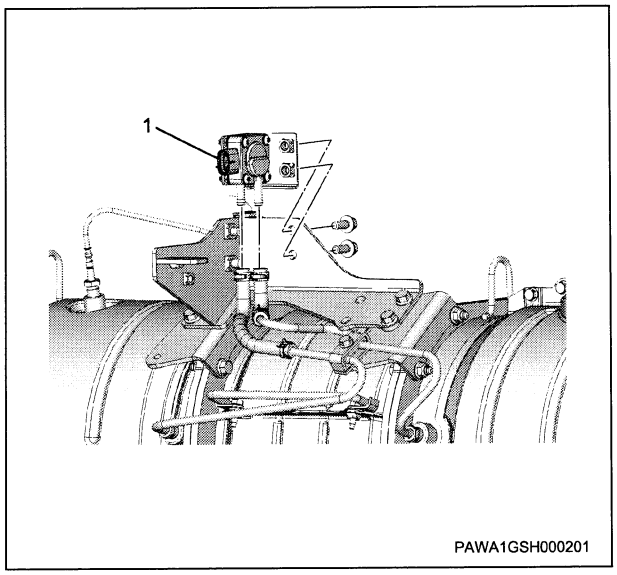
Caution :

- Before performing work, be sure to check the DPD differential pressure sensor precautions.

1. Disengage the differential pressure hose from the exhaust differential pressure sensor.
2. Disengage the harness connector from the exhaust differential pressure sensor.
3. Remove the exhaust differential pressure sensor from the DPD assembly.

Caution :

- Remove the DPD differential pressure sensor with the attached bracket.



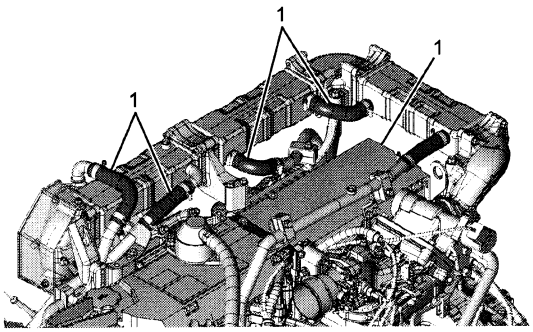
1. DPD differential pressure sensor

EGR valve

Removal

1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Coolant Drain
   1. Drain the coolant from the radiator.

   Caution :
   - After the coolant is discharged, make sure to tighten the drain plug.
3. EGR cooler Removal
   1. Disengage the water rubber hose from the EGR cooler.



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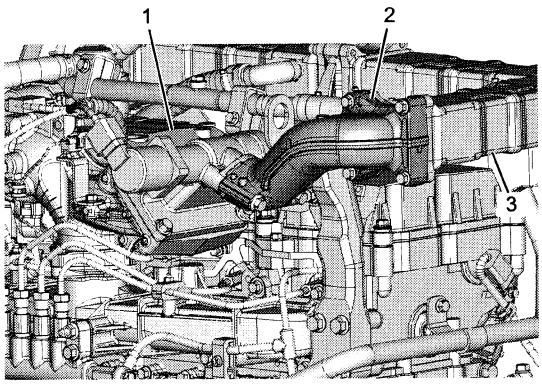
1. Water rubber hose

2. Remove the EGR pipe B from the EGR valve and the EGR cooler C.



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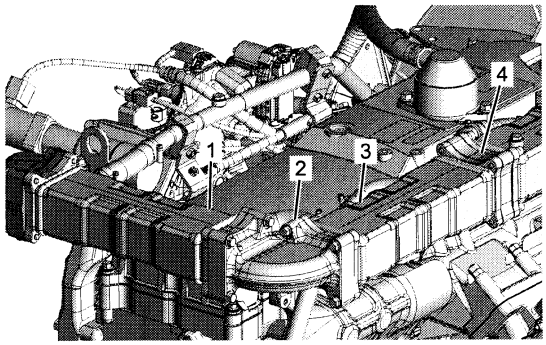
1. EGR valve
2. EGR pipe B
3. EGR cooler C

3. Remove the EGR cooler C from the EGR bracket C.
4. Remove the EGR bracket C from the EGR cooler B.
5. Remove the EGR cooler B from the EGR cooler bracket A.
6. Remove the EGR cooler bracket A from the EGR cooler A.



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1. EGR cooler C
2. EGR bracket C
3. EGR cooler B
4. EGR cooler bracket A

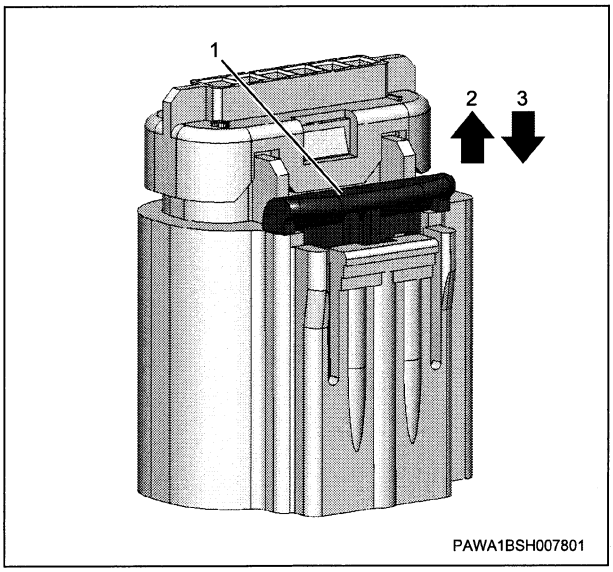
7. Remove the EGR heat protector from the EGR pipe A.

Glow plug

Removal

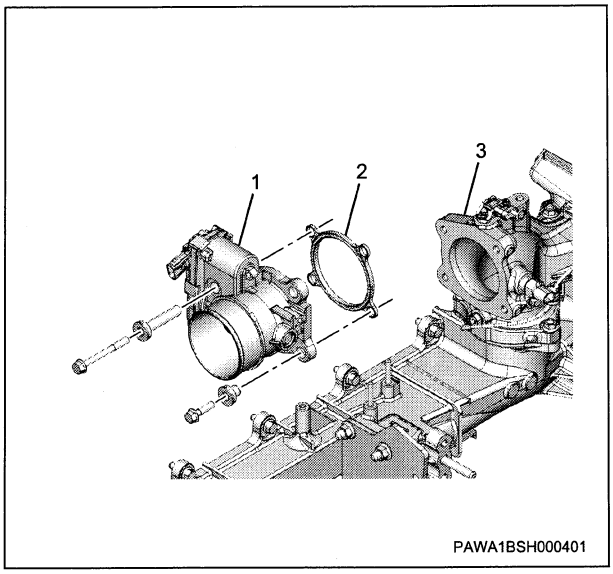
1. Battery ground cable Disconnect
   1. Disengage the battery ground cable from the battery.
2. Intake throttle valve Removal
   1. Remove the air duct from the intake throttle valve.
   2. Disengage the harness connector from the intake throttle valve.

   Note :
   - Pull the lock operation portion to release the lock.



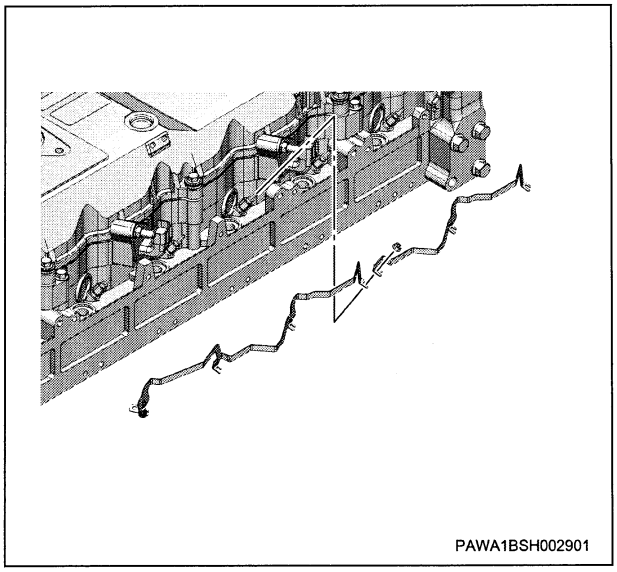
1. Lock operation section
2. Lock release
3. Lock

3. Remove the intake throttle valve from the inlet pipe.



1. Intake throttle valve
2. Gasket
3. Inlet pipe

3. Glow plug Removal
   1. Remove the glow plug connector from the glow plug.



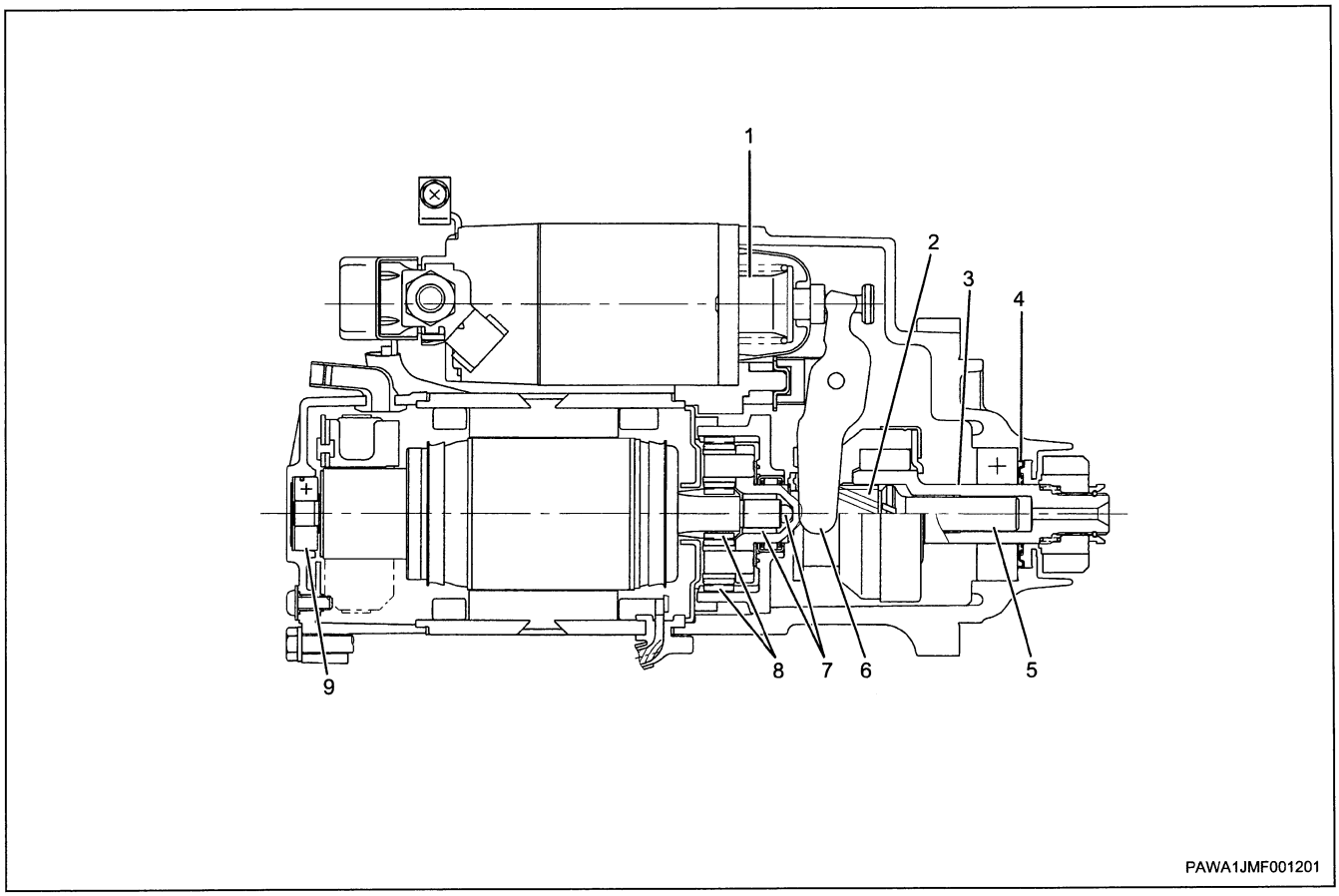
   2. Remove the glow plug from the cylinder head assembly.

Reassembly

1. Starter assembly Reassembly

Note :

- Grease application area when assembling the starter assembly



1. Plunger surface - small amount applied
2. Gear shaft spline section
3. Clutch shaft sliding section
4. Oil seal
5. Gear shaft sliding section
6. Lever and overrunning clutch sliding sections
7. Sleeve bearing and ball
8. Armature shaft gear, planetary gear, internal gear
9. Surface of the armature bearing outer circumference - small amount applied

Application area	List of recommended grease brands
No.1	Kyodo Yushi MULTEMP 6129
No.3	
No.4	
No.5	
No.6	
No.9	
No.2	Kyodo Yushi MULTEMP OA-171
No.7	Dow Corning MOLYKOTE AG650
No.8	

1. Install the washer to the gear shaft.
2. Install the internal gear to the gear shaft.
3. Install the overrunning clutch to the gear shaft.

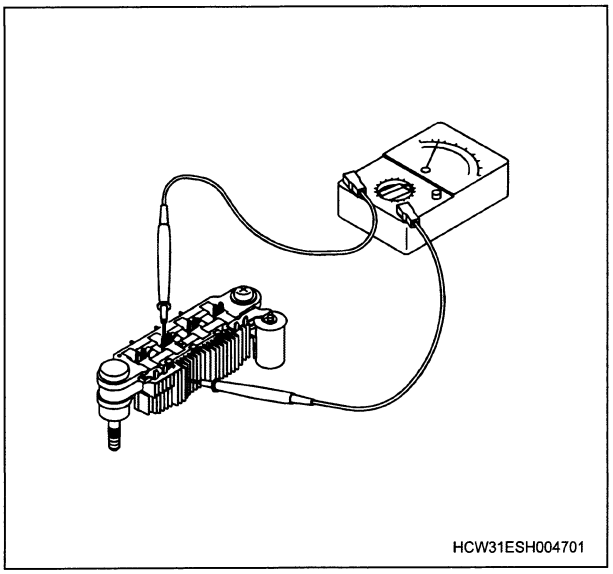
Note :

- Install the overrunning clutch on the gear shaft by rotating it by 1 spline tooth.
- Confirm that it does not come off the gear shaft when pulling the overrunning clutch.

4. Install the E-ring to the gear shaft.

Caution :

- Use new E-rings.



6. Bearing Inspection

1. Inspect the bearing.

Note :

- Inspect the grease leakage.
- Rotate the bearings with your hands, and inspect for abnormalities such as noise or looseness.

7. Regulator assembly Inspection

1. Measure the voltage using the tester.

Note :

- If the current is 5A or less when the generator revolution speed is approximately 5,000 rpm, measure the regulator adjustment voltage.

Regulator threshold voltage adjustment : 28.00 to 29.00 V

Caution :

- Replace the regulator assembly if the measured value is not within the range of the standard value.