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# SAFETY FIRST

The following signal words with the safety-alert symbol are used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read the safety instructions carefully. It is essential that you read the safety instructions and safety regulations before you try to repair or use this unit.

**DANGER**
- **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

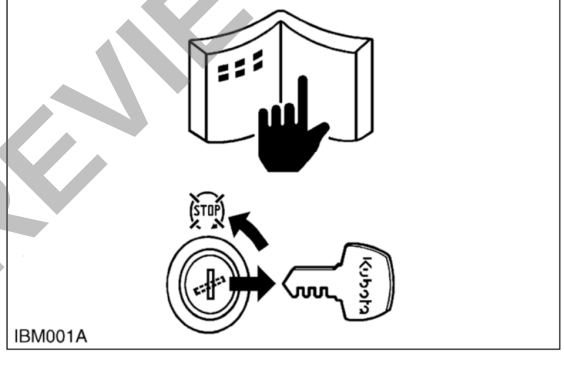
**WARNING**
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

**CAUTION**
- **Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.**

**IMPORTANT**
- **Indicates that equipment or property damage could result if instructions are not followed.**

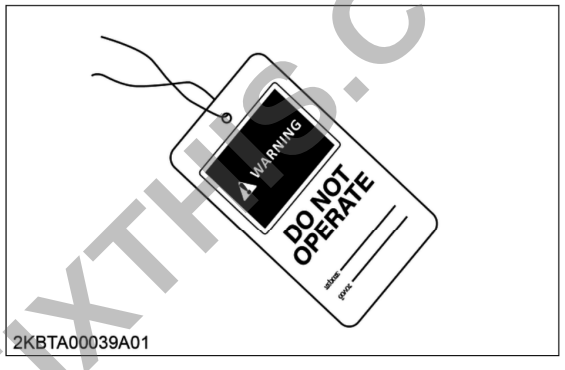
**NOTE**
- **Gives helpful information.**

## 1. Working precautions



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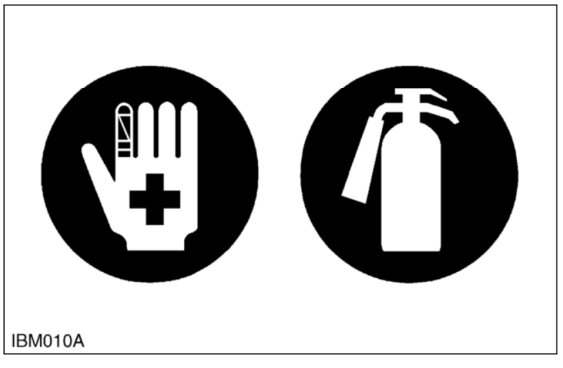
- Understand all safety instructions and safety labels in this manual.
- Park the machine on a stable and level ground then lower the attachment to check the machine safely.
- Stop the engine and remove the key when leaving the operator's seat for cleaning, maintenance, and servicing.



2KBTA00039A01

- Hang a DO NOT OPERATE tag near the operator's seat.
- Do not use worn or cracked tools. Use tools in a proper way with enough strength.
- In regards to the facility which is used in the workshop, follow each safety instruction.

## 2. Preparing for emergencies


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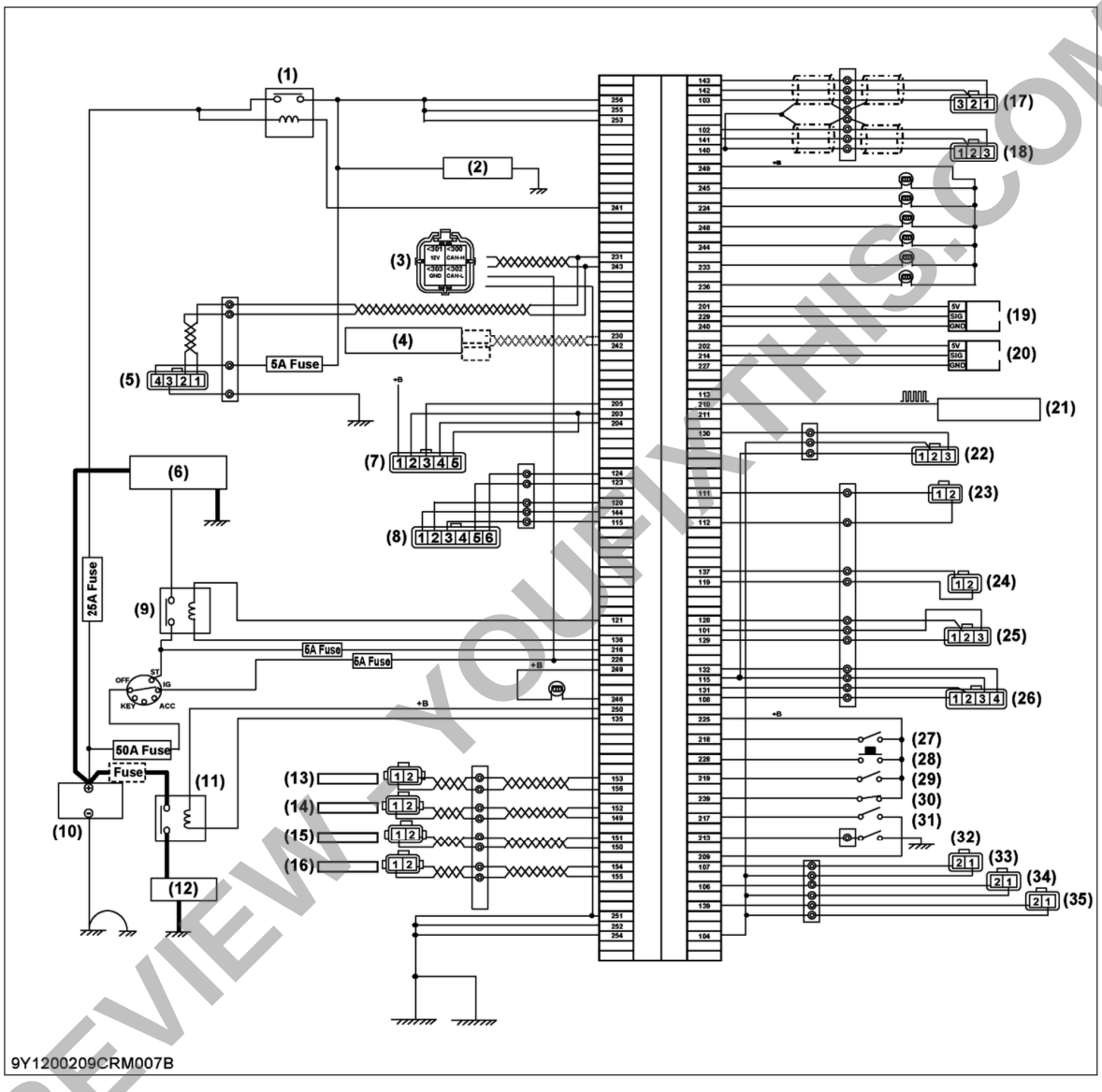
- Keep a first aid kit and fire extinguisher ready at all times.
- Keep emergency numbers near your telephone at all times.



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# 6.4 System wiring diagram for D1803-CR-E4, D1803-CR-TE4, V2403-CR-E4, V2403-CR-TE4, V2403-CR-TE4BG

**D1803-CR-E4, D1803-CR-TE4, V2403-CR-E4, V2403-CR-TE4, V2403-CR-TE4BG**




| | | | | | |
|---|---|---|---|---|---|
| (1) | Main relay | (13) | Injector 1 | (25) | Rail pressure sensor |
| (2) | Fuel feed pump | (14) | Injector 2 | (26) | Boost pressure sensor |
| (3) | CAN1 connector (for service) | (15) | Injector 3 | (27) | Stop switch |
| (4) | CAN2 connector (for vehicle) | (16) | Injector 4* | (28) | Parked regeneration switch |
| (5) | EGR valve | (17) | Crankshaft position sensor | (29) | Parking switch |
| (6) | Starter | (18) | Camshaft position sensor | (30) | Regeneration inhibit switch |

(Continued)



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| | Inspection item | Service interval | | | | | | | | | | | Reference page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Daily | Initial 50 hrs | Every 50 hrs | Every 250 hrs | Every 400 hrs | Every 500 hrs | Every 1000 hrs | Every 1500 hrs | Every 3000 hrs | Every 1 year | Every 2 years | |
| | Checking exhaust manifold (crack, gas, leakage and mounting screw) | | | | | | | | | | ○ | | 3-27 |
| | Replacing oil separator rubber hose | | | | | | | | | | | ○ | 3-27 |
| *2 | Replacing rubber hose of differential pressure sensor | | | | | | | | | | | ○ | 3-28 |
| | Replacing intake hose (after air flow sensor) and intercooler hose | | | | | | | | | | | ○ | 3-28 |
| | Replacing EGR cooler hose | | | | | | | | | | | ○ | 3-28 |
| | Replacing water hose | | | | | | | | | | | ○ | 3-28 |
| | Replacing lubricant hose | | | | | | | | | | | ○ | 3-28 |
| | Changing radiator coolant (L.L.C.) | | | | | | | | | | | ○ | 3-28 |
| | Replacing radiator hose and clamp bands | | | | | | | | | | | ○ | 3-30 |
| | Replacing fuel hose and clamps | | | | | | | | | | | ○ | 3-31 |
| | Replacing intake air line | | | | | | | | | | | ○ | 3-31 |

**■ NOTE**

- **When the battery is used for less than 100 hours in a year, check its electrolyte yearly (for refillable battery's only).**
- **The items above (*1 marked) are registered as emission related critical parts by KUBOTA in the U.S. EPA nonroad emission regulation.**
  **As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction.**
  **Please see the warranty statement in detail.**
- **The items listed above other than *1 marked are not necessary to keep the emission-related warranty valid.**
- ***2: Only for D1803-E4, -TE4, V2403-E4, -TE4**
- **Failure to perform the maintenance will cause problems that will significantly degrade the engine performance.**

**⚠ CAUTION**

- **When changing or inspecting, be sure to level and stop the engine.**

**■ NOTE**

- **Changing interval of engine oil.**

| Models | Interval |
|---|---|
| D1803-CR-E4<br>D1803-CR-TE4<br>D1803-CR-TIE4<br>D1803-CR-TIE4BG<br>V2403-CR-E4<br>V2403-CR-TE4<br>V2403-CR-TIE4<br>V2403-CR-TE4BG<br>V2403-CR-TIE4BG | Every 400 Hrs or 1 year whichever comes first<br>Initial 50 Hrs |
| API service classification: CJ-4 or CK-4 grade<br>Ambient temperature: below 35 ℃ (95 ℉) | |

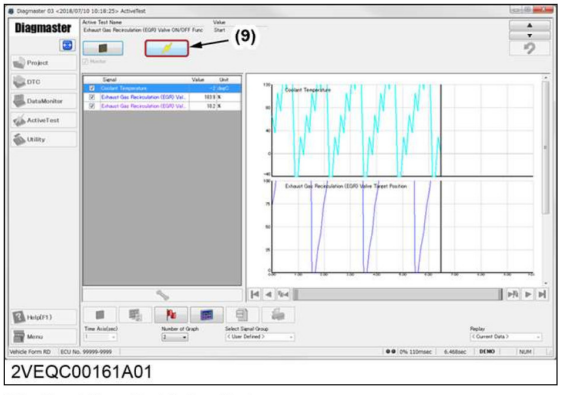


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7. Click the **[Send Specified Active Test Value]** button (9).

**■ NOTE**
- **If the actual position is traced target position, the EGR valve is normal.**
- **If the actual position is not traced target position, the EGR valve is abnormal so that check it.**

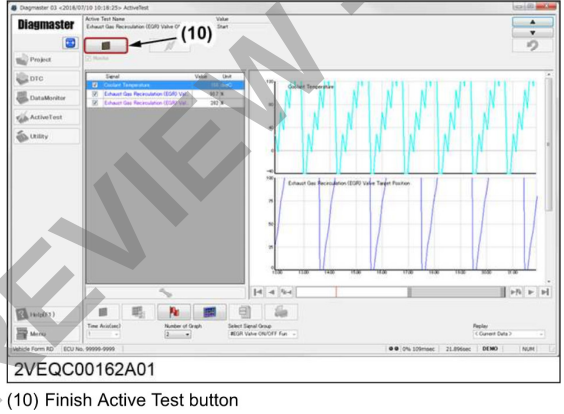


2VEQC00161A01

(9) Send Specified Active Test Value button

8. Click the **[Finish Active Test]** button (10).

**■ NOTE**
- **If it is determined that there is a failure, check that the EGR valve gas passage and coolant passage are not clogged.**
- **If it is determined that there is a failure, clean any soot from the gas passage so that it does not damage the EGR valve.**



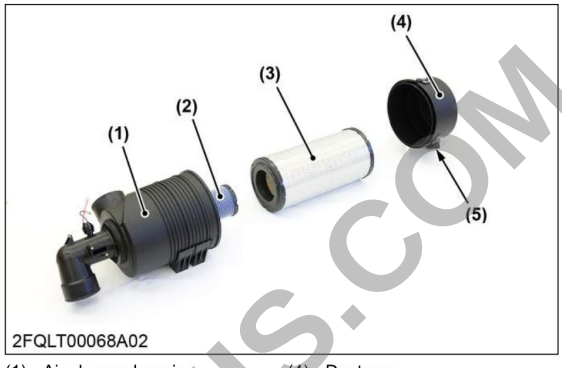
2VEQC00162A01

(10) Finish Active Test button

# 10. Check points of every 1 year

## 10.1 Replacing air cleaner element

1. Remove the dust cup (4).
2. Remove used air cleaner primary element (3) and secondary element (2).



2FQLT00068A02

(1) Air cleaner housing
(2) Secondary element
(3) Primary element
(4) Dust cup
(5) Evacuator valve

3. Replace new air cleaner primary element (3) and secondary element (2).

**■ NOTE**
- **The air cleaner uses a dry element. Never apply oil to it.**
- **Do not operate the engine with filter element removed.**

4. Install the removed parts.

## 10.2 Checking DPF differential pressure pipes and hoses

**■ IMPORTANT**
- **Be sure to loosen the differential pressure pipe tightening nut with crowfoot wrench to prevent the damage of the sensor or pipe. If it is still hard to loosen, apply the lubricant spray to threaded portion and soak it with lubricant.**
- **Tighten bolts and nuts to their specified torque. Also tighten the differential pressure pipe tightening nut to the specified torque with crowfoot wrench.**

**Tools required**
- Crowfoot wrench

1. Check the DPF differential pressure pipe (2), (3) for crack, gas leakage and loose mounting nut.

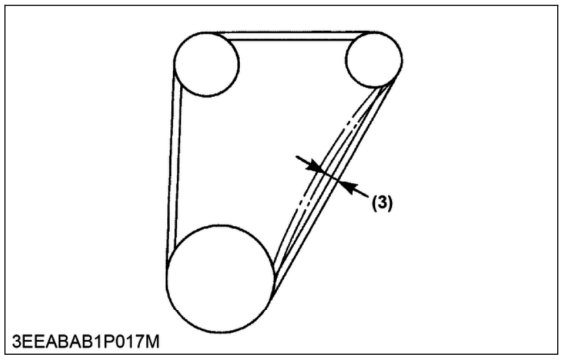
**■ NOTE**
- **If you find a crack, change the DPF differential pressure pipe.**
- **If you find a gas leakage, remove the DPF differential pressure pipe and wipe off the anti-seize & lubricating compound.**



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5. Adjust the tension of belt halfway between the fan drive pulley and alternator pulley at a specified force to measure the deflection (3).

| | | |
|---|---|---|
| Deflection (3) | Service specification | 10.0 to 12.0 mm<br>0.394 to 0.472 in.<br>(Under load of 98 N<br>(10 kgf, 22 lbf)) |




(3) Deflection

**■ NOTE**
- **If the measurement is out of the service specifications, loosen the alternator mounting screws and adjust its position.**

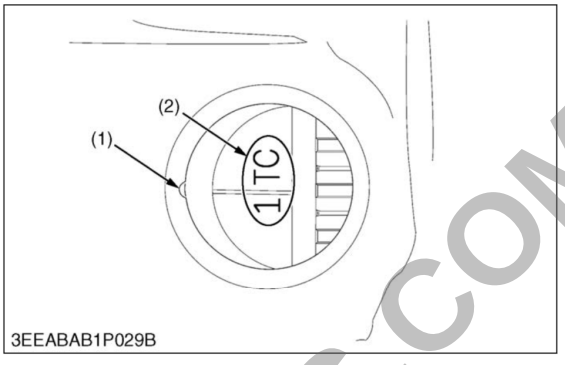
# 7. Check point of every 1000 hours

## 7.1 Checking valve clearance

**■ IMPORTANT**
- **You must check and adjust the valve clearance when the engine is cold.**

**Tools required**
- Feeler gauge

1. Remove the air cleaner and muffler.
2. Remove the cylinder head cover.
3. Align the **[1TC]** mark (2) line on the flywheel and projection (1) on the housing.




4. Make sure that the No.1 piston comes to the compression or overlap top dead center.

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# 3. Specifications

## 3.1 Specification for D1803-CR-E4, TE4

| Model | D1803-CR-E4 | D1803-CR-TE4 |
|---|---|---|
| Number of cylinder | 3 | |
| Engine type | Vertical, water-cooled, 4-cycle diesel | |
| Bore × Stroke | 87 × 102.4 mm (3.43 × 4.031 in.) | |
| Total displacement | 1826 $cm^3$ (111.4 cu.in.) | |
| SAE gross continuous | 24.3 kW / 2700 $min^{-1}$ (rpm)<br>(32.6 HP / 2700 $min^{-1}$ (rpm)) | 32.1 kW / 2700 $min^{-1}$ (rpm)<br>(43.0 HP / 2700 $min^{-1}$ (rpm)) |
| SAE gross intermittent | 28.0 kW / 2700 $min^{-1}$ (rpm)<br>(37.5 HP / 2700 $min^{-1}$ (rpm)) | 37.0 kW / 2700 $min^{-1}$ (rpm)<br>(49.6 HP / 2700 $min^{-1}$ (rpm)) |
| Maximum bare speed | 2900 $min^{-1}$ (rpm) | |
| Minimum bare idling speed | 800 $min^{-1}$ (rpm) | |
| Combustion chamber | Reentrant type (Direct injection) | |
| Fuel supply pump | BOSCH common rail system | |
| Governor system | | |
| Injector | | |
| Fuel supply timing | | |
| Fuel injection pressure | | |
| Direction of rotation | Counter-clockwise (Viewed from flywheel side) | |
| Firing order | 1-2-3 | |
| Compression ratio | 18.1 | |
| Lubricating system | Forced lubrication by trochoid pump | |
| Oil pressure indicating | Electrical type switch | |
| Lubricating filter | Full flow paper filter (Cartridge type) | |
| Cooling system | Pressurized radiator, forced circulation with water pump | |
| Starting system | Electric starting with starter | |
| Starter motor | 12 V, 1.4 kW | |
| Starting support device | By glow plug in combustion chamber | |
| EGR | External EGR (EGR cooler + Electric EGR valve + Reed valve) | |
| Battery | 12 V, 88 AH (105E41R) equivalent | |
| Charging alternator | 12 V, 480 W | |
| Fuel | Diesel fuel No. 2-D S15, see page 3-1. | |
| Lubricating oil (API classification) | Class CJ-4 or CK-4 lubricating oil as per API classification is recommended.<br>For details on recommended lubricating oils, see page 3-1. | |
| Lubricating oil capacity | 7.0 L (1.8 U.S.gals, 1.5 Imp.gals) | |
| Weight (Dry) | 185 kg (408 lbs) | 196 kg (432 lbs) |

■ **NOTE**

- **The specification described above is of the standard engine of each model.**
- **Conversion formula: HP = 0.746 kW, PS = 0.7355 kW.**



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# MAINTENANCE CHECK LIST

To make sure that the engine operates safely for a long time, refer to the table below to do regular inspections.

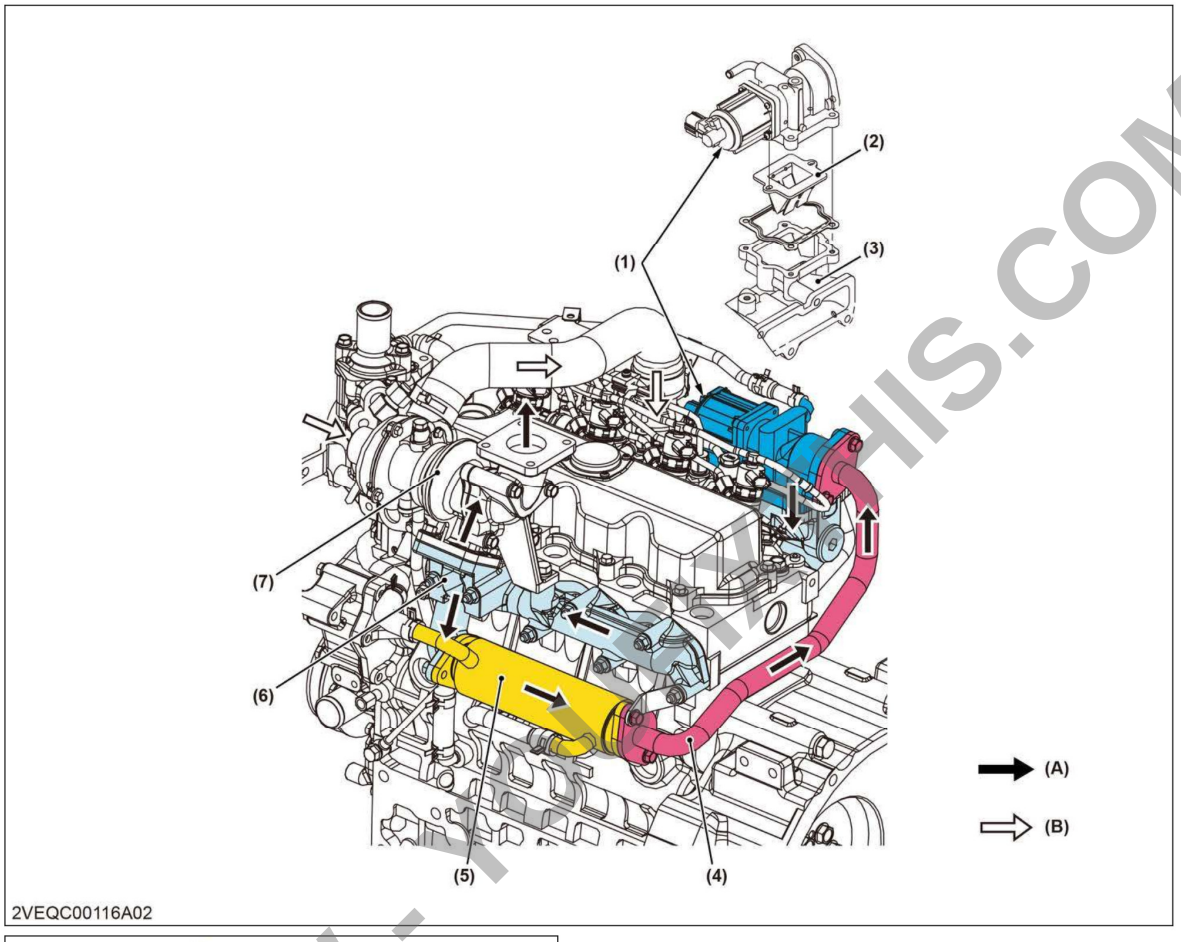
| Inspection item | | Service interval | | | | | | | | | | | Reference page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Daily | Initial 50 hrs | Every 50 hrs | Every 250 hrs | Every 400 hrs | Every 500 hrs | Every 1000 hrs | Every 1500 hrs | Every 3000 hrs | Every 1 year | Every 2 years | |
| | Checking engine oil level | ○ | | | | | | | | | | | 3-5 |
| | Checking fuel level | ○ | | | | | | | | | | | 3-6 |
| | Checking coolant level | ○ | | | | | | | | | | | 3-6 |
| | Checking fan belt | ○ | | | | | | | | | | | 3-7 |
| | Changing engine oil | | ○ | | | ○ | | | | | | | 3-7 |
| | Replacing oil filter cartridge | | ○ | | | ○ | | | | | | | 3-8 |
| | Checking fuel hoses and clamp bands | | | ○ | | | | | | | | | 3-8 |
| | Checking and draining water separator (Type 1) | | | ○ | | | | | | | | | 3-9 |
| | Cleaning of air cleaner element (replace the element after 6-times cleaning) | | | | ○ | | | | | | | | 3-9 |
| | Adjusting fan belt tension | | | | ○ | | | | | | | | 3-10 |
| | Checking radiator hose and clamp bands | | | | ○ | | | | | | | | 3-10 |
| | Checking intake air line | | | | ○ | | | | | | ○ | | 3-11 |
| | Replacing fuel filter cartridge | | | | | | ○ | | | | | | 3-12 |
| | Cleaning water separator (Type 1) | | | | | | ○ | | | | | | 3-13 |
| | Cleaning fuel tank interior | | | | | | ○ | | | | | | — |
| | Cleaning water jacket and radiator interior | | | | | | ○ | | | | | | 3-13 |
| | Replacing fan belt | | | | | | ○ | | | | | ○ | 3-15 |
| | Replacing water separator filter (Type2) | | | | | | ○ | | | | ○ | | 3-13 |
| | Checking valve clearance | | | | | | | ○ | | | | | 3-16 |
| *1 | Checking injector (with Diagmaster) | | | | | | | | ○ | | | | 3-17 |
| *1 | Checking EGR cooler | | | | | | | | ○ | | | | 3-18 |
| *1 | Replacing oil separator element | | | | | | | | ○ | | | | 3-19 |
| *1 | Checking positive crankcase ventilation (PCV) valve | | | | | | | | ○ | | | | 3-19 |
| *1 | Checking turbocharger | | | | | | | | | ○ | | | 3-19 |
| *1 *2 | Cleaning DPF | | | | | | | | | ○ | | | 3-20 |
| *2 | Checking EGR system (with Diagmaster) | | | | | | | | | ○ | | | 3-24 |
| | Replacing air cleaner element | | | | | | | | | | ○ | | 3-25 |
| *1 | Checking DPF differential pressure pipes and hoses | | | | | | | | | | ○ | | 3-25 |
| | Checking EGR piping | | | | | | | | | | ○ | | 3-26 |

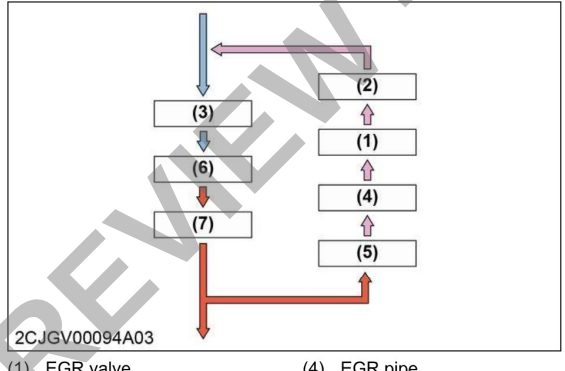
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## 5.3 Flow of EGR system




(1) EGR valve
(2) Reed valve
(3) Intake manifold
(4) EGR pipe
(5) EGR cooler
(6) Exhaust manifold
(7) Turbocharger
(A) Exhaust gas flow
(B) Intake air flow

1. A part of the exhaust gases that pass through the turbocharger (7) are cooled in the EGR cooler (5).
2. Thereafter the gases pass through the EGR pipe (4), EGR valve (1), reed valve (2), and are returned to the intake manifold (3).
3. Intake air and exhaust gases are mixed in the intake manifold (3) and are fed to the combustion chamber.



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## 3.3 Specification for D1803-CR-TIE4, V2403-CR-TIE4

| Model | D1803-CR-TIE4 (DOC only) | V2403-CR-TIE4 (DOC only) |
|---|---|---|
| Number of cylinder | 3 | 4 |
| Engine type | Vertical, water-cooled, 4-cycle diesel | |
| Bore × Stroke | 87 × 102.4 mm (3.43 × 4.031 in.) | |
| Total displacement | 1826 $cm^3$ (111.4 cu.in.) | 2434 $cm^3$ (148.5 cu.in.) |
| SAE gross continuous | 32.1 kW / 2700 $min^{-1}$ (rpm)<br>(43.0 HP / 2700 $min^{-1}$ (rpm)) | 42.1 kW / 2700 $min^{-1}$ (rpm)<br>(56.5 HP / 2700 $min^{-1}$ (rpm)) |
| SAE gross intermittent | 37.0 kW / 2700 $min^{-1}$ (rpm)<br>(49.6 HP / 2700 $min^{-1}$ (rpm)) | 48.6 kW / 2700 $min^{-1}$ (rpm)<br>(65.2 HP / 2700 $min^{-1}$ (rpm)) |
| Maximum bare speed | 2900 $min^{-1}$ (rpm) | |
| Minimum bare idling speed | 800 $min^{-1}$ (rpm) | |
| Combustion chamber | Reentrant type (Direct injection) | |
| Fuel supply pump | BOSCH common rail system | |
| Governor system | | |
| Injector | | |
| Fuel supply timing | | |
| Fuel injection pressure | | |
| Direction of rotation | Counter-clockwise (Viewed from flywheel side) | |
| Firing order | 1-2-3 | 1-3-4-2 |
| Compression ratio | 16.0 | |
| Lubricating system | Forced lubrication by trochoid pump | |
| Oil pressure indicating | Electrical type switch | |
| Lubricating filter | Full flow paper filter (Cartridge type) | |
| Cooling system | Pressurized radiator, forced circulation with water pump | |
| Starting system | Electric starting with starter | |
| Starter motor | 12 V, 1.4 kW | 12 V, 2.0 kW |
| Starting support device | By glow plug in combustion chamber | |
| EGR | External EGR (EGR cooler + Electric EGR valve + Reed valve) | |
| Battery | 12 V, 88 AH (105E41R) equivalent | 12 V, 92 AH (130E41R) equivalent |
| Charging alternator | 12 V, 480 W | |
| Fuel | Diesel fuel No. 2-D S15, see page 3-1. | |
| Lubricating oil (API classification) | Class CJ-4 or CK-4 lubricating oil as per API classification is recommended.<br>For details on recommended lubricating oils, see page 3-1. | |
| Lubricating oil capacity | 7.0 L (1.8 U.S.gals, 1.5 Imp.gals) | 9.5 L (2.5 U.S.gals, 2.1 Imp.gals) |
| Weight (Dry) | 195 kg (430 lbs) | 232 kg (511 lbs) |

**■ NOTE**

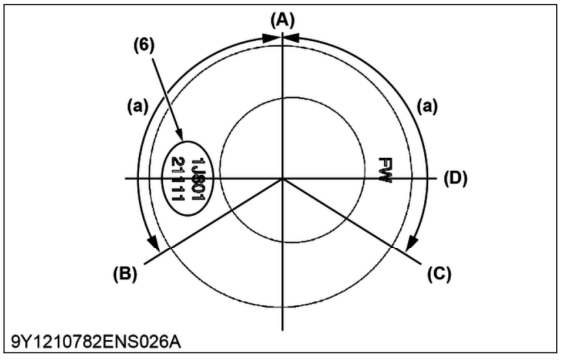
- **The specification described above is of the standard engine of each model.**
- **Conversion formula: HP = 0.746 kW, PS = 0.7355 kW.**

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3. Place the gap of each piston ring like the figure.



9Y1210782ENS026A

(A) Top ring gap
(B) Second ring gap
(C) Oil ring gap
(D) Piston pin hole
(a) 2.09 rad (120°)

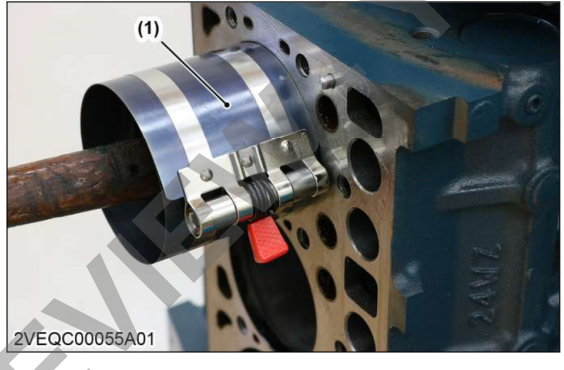
4. Set the piston ring compressor (1) to the piston.
5. Install the piston to cylinder.

**■ IMPORTANT**

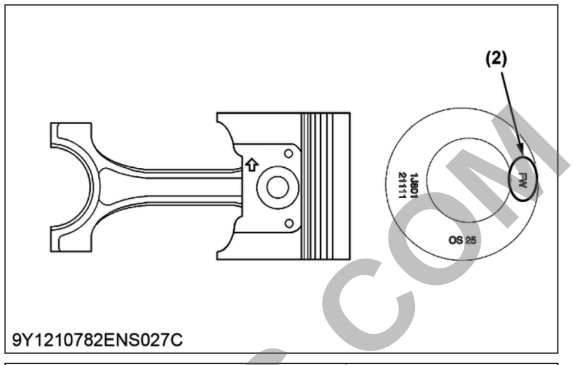
- **Be carefully to set the piston ring compressor. Otherwise, their chrome-plated section of piston rings may be scratched, causing trouble inside the liner.**

**■ NOTE**

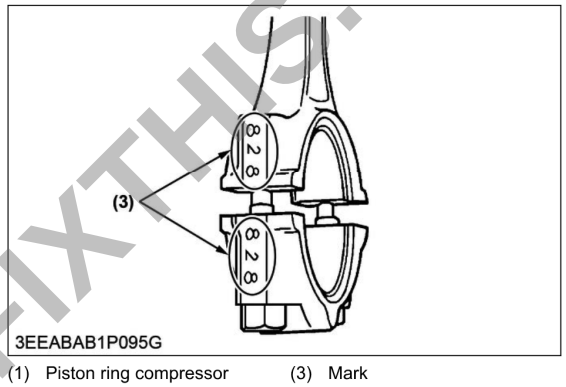
- **Apply sufficient engine oil to the piston.**
- **Align the mark [FW] (2) on the piston face to flywheel side.**
- **Align the marks (3) with each other.**



2VEQC00055A01



9Y1210782ENS027C



3EEABAB1P095G

(1) Piston ring compressor
(2) Mark **[FW]**
(3) Mark

6. Turn the flywheel and move the piston to bottom dead center.

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| Last digit of the Code No. | Month of Revision | Part name | Main revised point and corrective measure | Reference page |
|---|---|---|---|---|
| 7 | 2018.12 | Mechanism<br>Servicing | Added the information about all mechanism section.<br>Added the follow information about checking and adjusting.<br>• Checking injector<br>• Checking suction control valve (SCV)<br>• Checking sensors<br>• Adjusting air gap between crank/camshaft position sensor and flywheel/pulsar gear<br>Separate disassembling and assembling<br>Added follow servicing information.<br>• Replacing injector<br>• Replacing engine ECU<br>• Replacing DPF<br>Change notification about fan drive pulley mounting nut tightening torque | 4-96<br>4-107<br>4-107<br>4-114<br>4-115<br>4-192<br>4-194<br>4-197 |
| 8 | 2019.08 | Injector<br>Oil switch<br>Exhaust gas temperature sensor | Correction point<br>• System wiring diagram for D1803-CR-E4, D1803-CR-TE4, V2403-CR-E4, V2403-CR-TE4 V2403-CR-TE4BG<br>• System wiring diagram for D1803-CR-TIE4, V2403-CR-TIE4 | 2-30<br>2-32 |
| 9 | 2020.04 | SCV<br>Mechanism | Correction the value of SCV resistance<br>Correction errors | 4-107 |
| 9Y311-00670 | 2020.07 | General<br>Mechanism | The code number of this WSM has been changed from 9Y111-07829 to 9Y311-00670 | — |
| | | | Added the following information about D1803-CR-TIE4BG and V2403-CR-TIE4BG.<br>• Specification of D1803-CR-TIE4BG and V2403-CR-TIE4BG<br>• Specification of supply pump | 2-14<br>4-23 |
| 1 | 2021.02 | General | Correction the dimension of special tool | 2-36 |

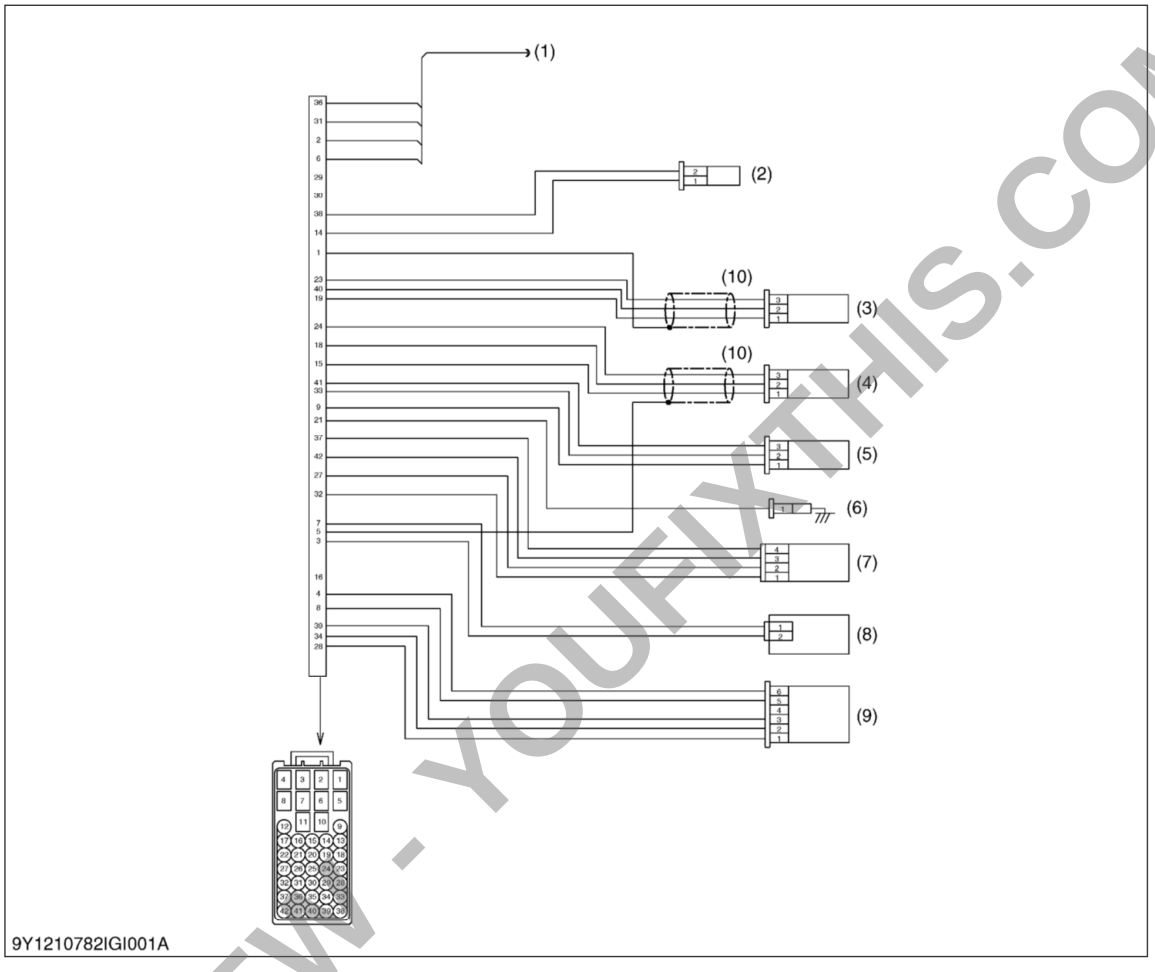
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# 6. Wiring diagram

## 6.1 Engine intermediate harness (Engine side harness)




| | | |
|---|---|---|
| (1) | – | CAN and EGR |
| (2) | CN202 | Coolant temperature sensor |
| (3) | CN204 | Crankshaft position sensor |
| (4) | CN205 | Camshaft position sensor |
| (5) | CN206 | Rail pressure sensor |
| (6) | CN207 | Oil pressure switch |
| (7) | CN208 | Boost pressure sensor |
| (8) | CN209 | Suction control valve (SCV) |
| (9) | CN210 | Intake throttle valve |
| (10) | – | Shield cable |

**■ NOTE**

- **The figure shows the pin arrangement of the connector housing viewed from wire side, not mating side.**



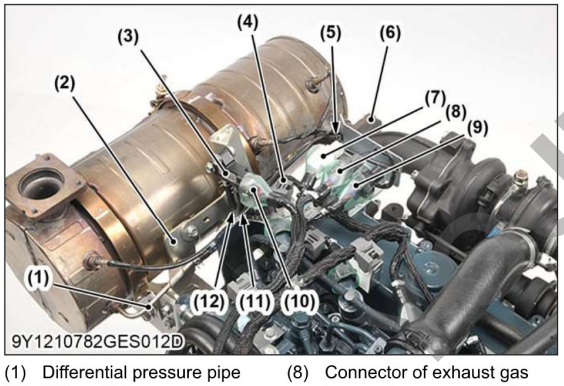
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- **When installing and removing the muffler full assembly (DPF), make sure that the temperature sensor, differential pressure sensor, and differential pressure pipe do not make contact with surrounding parts.**

**Tools required**

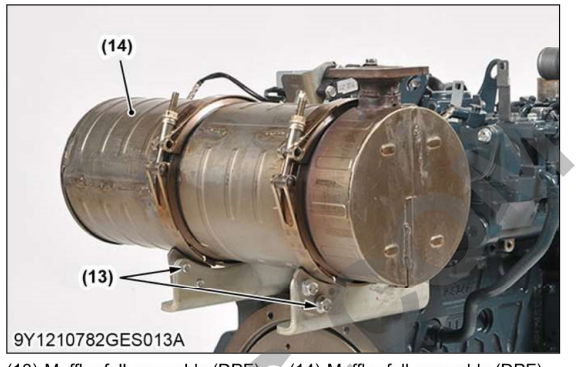
- Crowfoot wrench

1. Disconnect the harness of exhaust gas temperature sensor from the connector (7), (8), (9) and the harness of differential pressure sensor (10).
2. Remove the connector of exhaust gas temperature sensor (7), (8), (9) from the bracket.
3. Remove the clamp (5).
4. Remove the tube (11), (12) from the differential pressure pipe (1), (4).
5. Remove the differential sensor (3).
6. Remove the differential sensor bracket (2).
7. Remove the 4 screws of muffler flange (6).



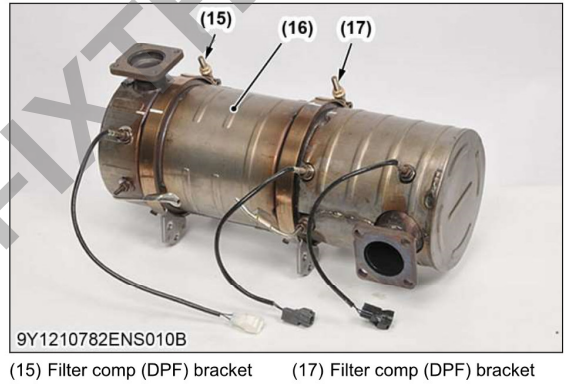

(1) Differential pressure pipe
(2) Differential pressure sensor bracket
(3) Differential pressure sensor
(4) Differential pressure pipe
(5) Clamp
(6) Muffler flange
(7) Connector of exhaust gas temperature sensor ($T_2$)
(8) Connector of exhaust gas temperature sensor ($T_1$)
(9) Connector of exhaust gas temperature sensor ($T_0$)
(10) Differential pressure sensor connector
(11) Tube
(12) Tube

8. Remove the muffler full assembly (DPF) mounting screws (13).
9. Remove the muffler full assembly (DPF) (14).




(13) Muffler full assembly (DPF) mounting screw
(14) Muffler full assembly (DPF)

10. Loosen the Filter comp (DPF) bracket (15), (17) and remove the Filter comp (DPF) (16).




(15) Filter comp (DPF) bracket
(16) Filter comp (DPF)
(17) Filter comp (DPF) bracket

11. Pack the filter comp (DPF) (16) and send it to a cleaning contractor.

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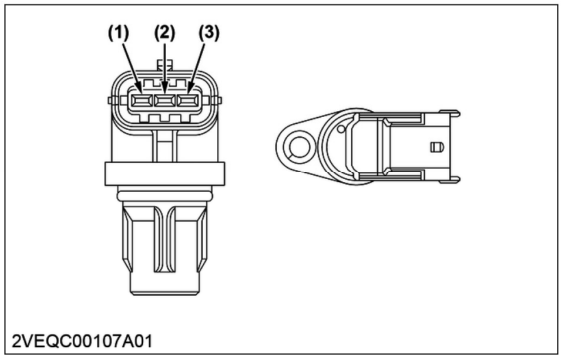
# 3.19 Camshaft position sensor

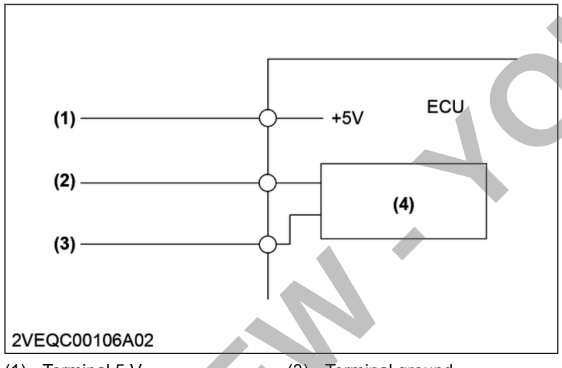
## 3.19.1 Outline of camshaft position sensor

The camshaft position sensor senses the teeth on a pulsar gear and detects the angular position of the camshaft.

## 3.19.2 Structure of camshaft position sensor

The camshaft position sensor is made up of a magnet and connector and the like.

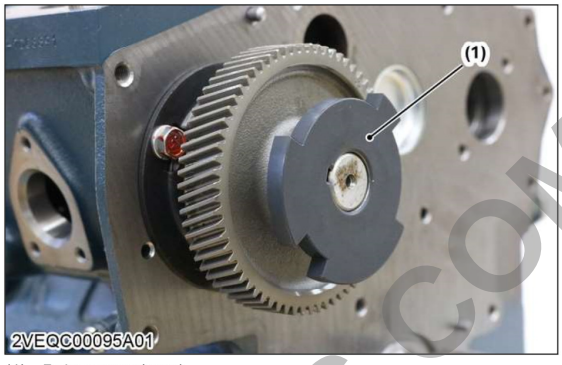



(1) Terminal 5 V
(2) Terminal signal
(3) Terminal ground
(4) G sensor input circuit

## 3.19.3 Function of camshaft position sensor

The camshaft position sensor senses the teeth on a pulsar gear and detects the angular position of the camshaft.
The pulsar gear has teeth at non-equal intervals.
The engine ECU calculates the piston position based on the signal detected.
The camshaft position sensor is a magnetic resistance element type sensor.
When the pulsar gear passes by the sensor part, the internal magnetic field changes.
AC voltage is generated by the change in magnetic field and this is rectified and output to the engine ECU.

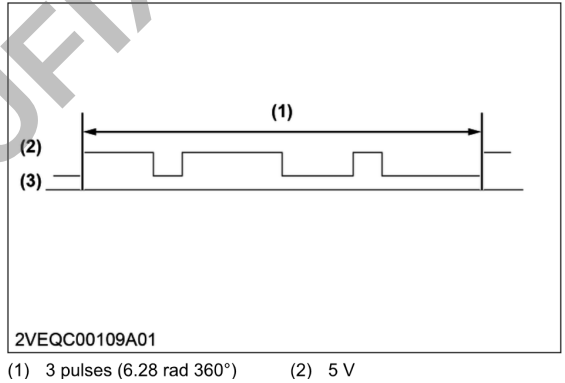



(1) Pulsar gear (cam)

## 3.19.4 Specification of camshaft position sensor

| | |
|---|---|
| Operating voltage | 5 V |
| Pulsar gear number of teeth | 3 |

**Output waveform**




(1) 3 pulses (6.28 rad 360°) crank angle
(2) 5 V
(3) 0 V

**NOTE**

- **Noted as G sensor on Diagmaster**

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## 9.4 Control of diesel particulate filter (DPF) system

The engine ECU determines the PM accumulation status from information from each sensor and sets regeneration or cleaning level and timing.

1. Automatic active regeneration
   When the PM level reaches 1, the engine ECU performs regeneration control to burn the PM that has been accumulated.
   If the DOC temperature (value of exhaust gas temperature sensor T0) is 250 °C (482 °F) or higher, the engine ECU gives instruction to the injector to perform post injection.
   Unburned fuel is combusted in the DOC raising the exhaust gas temperature to 550 °C (1022 °F) or higher and combusting the PM in the DPF.
   If the DOC temperature is less than 250 °C (482 °F), the fuel will not burn even if a post injection is performed so post injection is not performed.
   Therefore, regeneration is also not performed.
   If the DOC temperature is 550 °C (1022 °F) or higher, the PM combusts on its own so post injection is not performed (Passive regeneration state).
   In addition, if auto regeneration is not completed within specified time while in PM level 2 state, the engine ECU requests parked regeneration.
2. Parked active regeneration
   When the PM level reaches 3, the engine ECU sends a warning to the machine on which it is equipped to perform parked regeneration and commands output restriction.
   During parked regeneration, pre-programmed operation processes are performed automatically.
   As a preparation step for regeneration, first the intake throttle valve is operated reducing the amount of intake air raising the exhaust gas temperature.
   Further, engine speed is raised and adjusted so that the DOC temperature rises to 250 °C (482 °F) or higher.
   After the DOC reaches 250 °C (482 °F) or higher, control is performed the same as for auto regeneration.
   When regeneration is finished, the operation state is returned what it was prior to auto regeneration (idle speed).
3. Forced regeneration
   When the PM level reaches 4, forced regeneration has to be performed using a failure diagnostics tool (Diagmaster).
   Regeneration control itself is the same as that for parked regeneration.

| PM warning level | | Regeneration method | | | Regeneration status | Control |
|---|---|---|---|---|---|---|
| | | Automatic active regeneration | Parked active regeneration | Regeneration with service tools | | |
| 0 | Not necessary | × | × | ○ | Not necessary regeneration. | — |
| 1 | Automatic active regeneration | ○ | × | ○ | When the warning level reaches 1, regeneration is started automatically. | 1. If the DOC temperature (value of exhaust gas temperature sensor T0) is 250 °C (482 °F) or higher, the engine ECU gives instruction to the injector to perform post injection.<br>2. Unburned fuel is combusted in the DOC raising the exhaust gas temperature to 550 °C (1022 °F) or higher and combusting the PM in the DPF.<br>3. If the DOC temperature is less than 250 °C (482 °F), the fuel will not burn even if a post injection is performed so post injection is not performed. Therefore, regeneration is also not performed. |

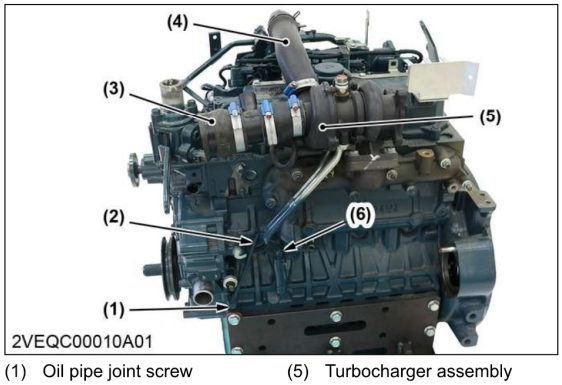
(Continued)



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5. Remove the turbocharger assembly (5).

■ NOTE
- **Put tape or cover on all openings to prevent damage in the oil holes in the turbocharger by unwanted materials.**

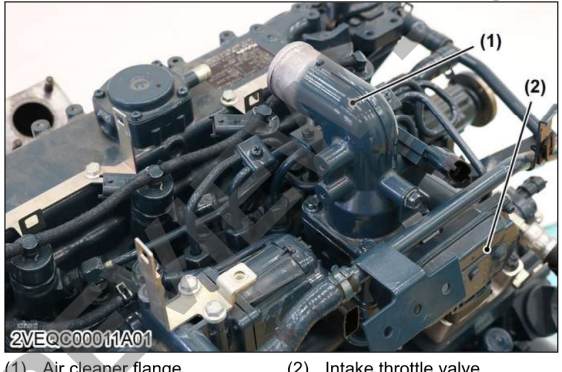



(1) Oil pipe joint screw
(2) Oil pipe
(3) Inlet hose
(4) Inlet hose
(5) Turbocharger assembly
(6) Return pipe

## 5.9 Removing intake throttle valve

1. Remove the air cleaner flange (1).
2. Remove the intake throttle valve (2).

■ NOTE
- **Do not disassemble the intake throttle valve (2).**

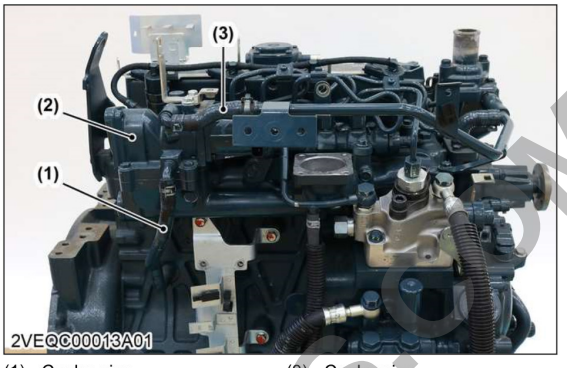



(1) Air cleaner flange
(2) Intake throttle valve

## 5.10 Removing EGR valve

1. Disconnect the cooler pipe (1), (3) of EGR valve (2).
2. Remove the EGR valve (2).

■ NOTE
- **Do not disassemble the EGR valve assembly.**




(1) Cooler pipe
(2) EGR valve
(3) Cooler pipe

## 5.11 Removing common rail

⚠ CAUTION
- **Do not loosen the injection pipe (1) when the fuel is under high pressure (within five minutes of stopping the engine).**

■ NOTE
- **Replace the rail assembly if the exchange of the pressure limiter (3) or the rail pressure sensor (5) is necessary.**
- **Do not remove the pressure limiter (3) and rail pressure sensor (5) from the common rail (4).**
- **When removing the common rail (4), do not hold it by the pressure limiter (3) and rail pressure sensor (5).**

1. Remove the injection pipe (1).

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3. Take the piston to an intermediate position, install the cylinder head and tighten the cylinder head mounting screw to the specified torque.

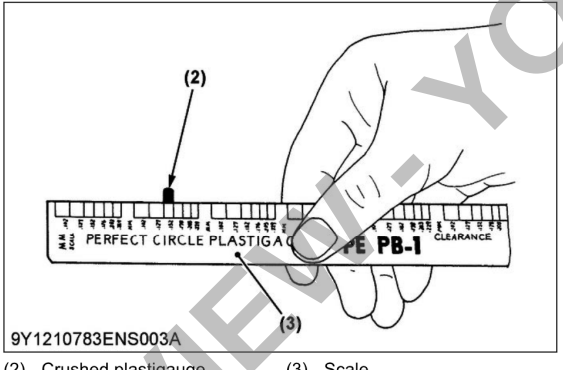
**■ NOTE**
- **The polished cylinder head mounting screw with no marking on the screw head has possibly used.**
- **In this case, tighten this screw to the same torque as normal one.**

| | | |
|---|---|---|
| Tightening torque | Cylinder head mounting screw | 93.2 to 98.1 N·m<br>9.51 to 10.0 kgf·m<br>68.8 to 72.3 lbf·ft |

4. Turn the crankshaft so the piston goes through T.D.C.
5. Remove the cylinder head and compare the width of the crushed plastigauges (2) with the scale (3).

**■ NOTE**
- **Top clearance = Width of the crushed plastigauge (2)**
- **If they are out of service specification, check the oil clearance of the crankpin, journal and piston pins.**

| | | |
|---|---|---|
| Top clearance | Service specification | 0.60 to 0.70 mm<br>0.024 to 0.027 in. |

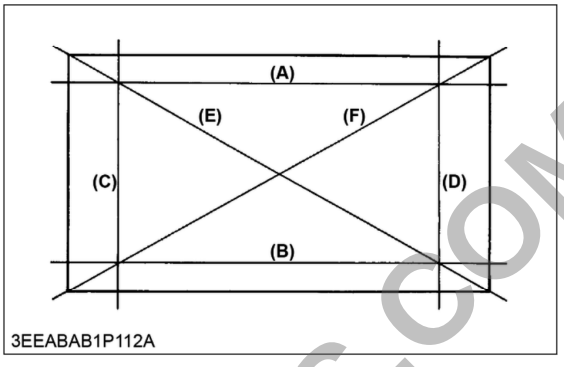



(2) Crushed plastigauge (3) Scale

## 7.2 Checking cylinder head surface flatness

**Tools required**
- Straightedge
- Feeler gauge

1. Clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides (A), (B), (C) and (D) and two diagonal (E) and (F) as shown in the figure.

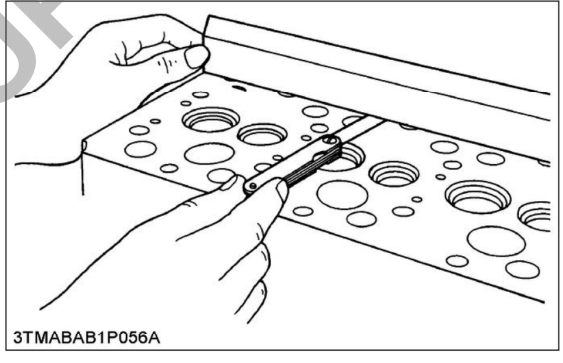



3. Measure the clearance with a feeler gauge.

**■ NOTE**
- **If the measurement is more than the service limit, make it straight with a surface grinder.**

**■ IMPORTANT**
- **Check the valve recessing after you correct.**

| | | |
|---|---|---|
| Cylinder head surface flatness | Service limit | 0.05 mm<br>0.002 in. |




## 7.3 Checking cylinder head flaw

**Tools required**
- Red permeative liquid
- Detergent
- White developer

1. Clean the surface of the cylinder head with detergent (2).
2. Apply some red permeative liquid (1) on the cylinder head surface.
3. After you apply, do not touch it for 5 to 10 minutes.
4. Clean away the red permeative liquid on the cylinder head surface with detergent (2).

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