SERVICING

CONTENTS

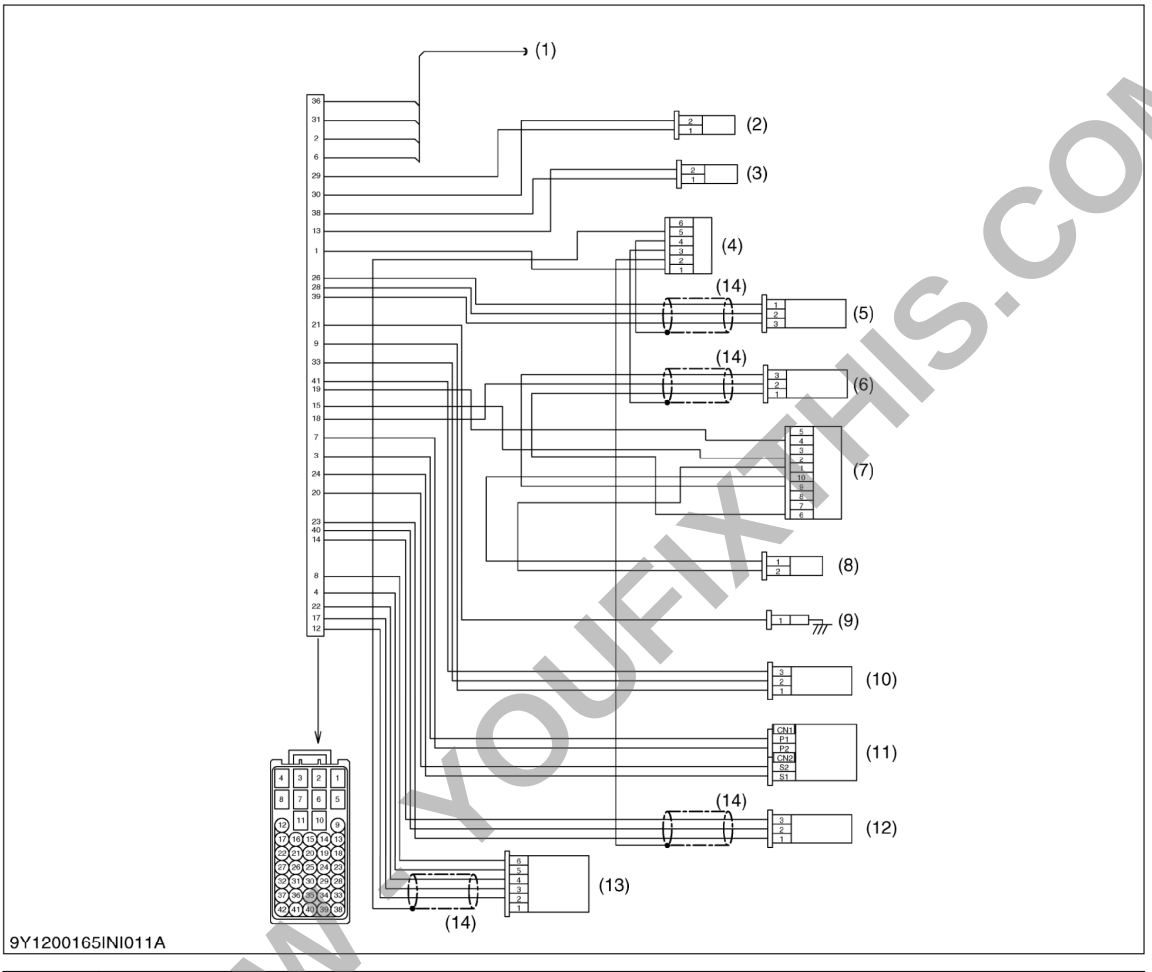
1. TROUBLESHOOTING 1-S1
2. SERVICING SPECIFICATIONS 1-S5
3. TIGHTENING TORQUES 1-S12
   [1] TIGHTENING TORQUES OF SCREWS, BOLTS AND NUTS FOR GENERAL USE 1-S12
   [2] TIGHTENING TORQUES OF SCREWS, BOLTS AND NUTS FOR SPECIAL USE 1-S13
4. CHECKING, DISASSEMBLING AND SERVICING 1-S15
   [1] CHECKING AND ADJUSTING 1-S15
      (1) Engine Body 1-S15
      (2) Lubricating System 1-S17
      (3) Cooling System 1-S17
      (4) Electrical System 1-S19
      (5) Turbocharger 1-S22
   [2] DISASSEMBLING AND ASSEMBLING 1-S23
      (1) Draining Engine Oil and Coolant 1-S23
      (2) External Components 1-S24
      (3) Turbocharger and EGR 1-S32
      (4) Common Rail 1-S33
      (5) Cylinder Head and Valves 1-S38
      (6) Thermostat 1-S44
      (7) SCV 1-S45
      (8) Fuel Temperature Sensor 1-S47
      (9) Supply Pump 1-S48
      (10) Water Pump and Oil Cooler 1-S54
      (11) Gear Case and Timing Gear 1-S55
      (12) Piston and Connecting Rod 1-S60
      (13) Flywheel and Crankshaft 1-S63
      (14) Intake Air Heater 1-S69
      (15) Starter 1-S69
      (16) Alternator 1-S70
   [3] ENGINE BODY AND SERVICING 1-S72
      (1) Cylinder Head 1-S72
      (2) Timing Gears 1-S78
      (3) Piston and Connecting Rod 1-S82
      (4) Crankshaft 1-S85
      (5) Cylinder 1-S88
      (6) Oil Pump 1-S88
      (7) Starter 1-S89
      (8) Alternator 1-S91

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5. WIRING DIAGRAM

[1] ENGINE INTERMEDIATE HARNESS (ENGINE SIDE HARNESS)



(1)	–	CAN and EGR
(2)	CN202	Intake Air Temperature Sensor
(3)	CN203	Coolant Temperature Sensor
(4)	CN215	Engine Joint Connector 1
(5)	CN204	Rail Pressure Sensor
(6)	CN205	Crankshaft Position Sensor
(7)	CN216	Engine Joint Connector 2
(8)	CN206	Resistance Connector (1.1 kΩ)
(9)	CN207	Oil Pressure Switch
(10)	CN208	Boost Pressure Sensor
(11)	CN209 / 210	Supply Pump
(12)	CN211	Camshaft Position Sensor
(13)	CN212	Intake Throttle Valve
(14)	–	Shield Cable

■ **NOTE**

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

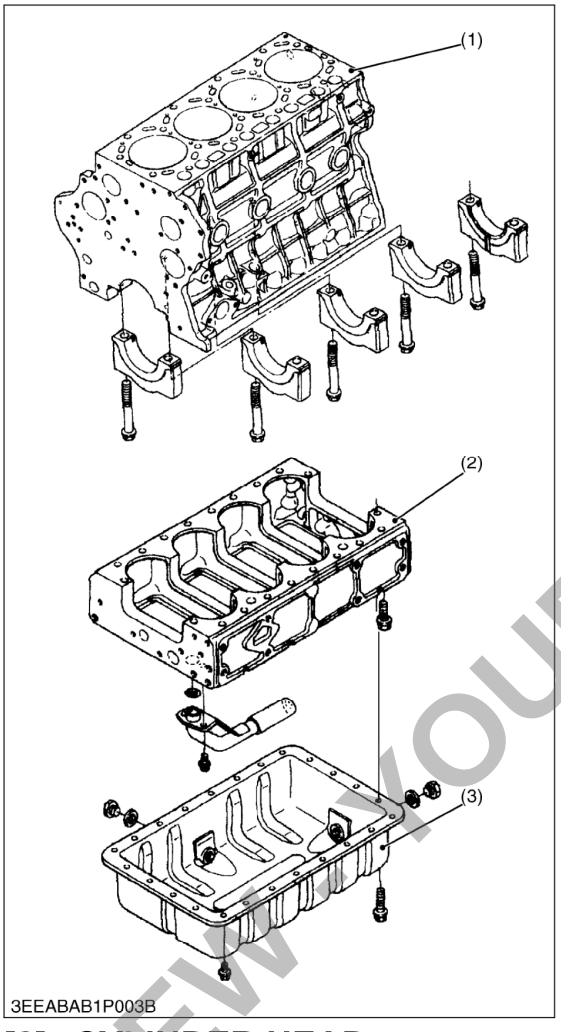
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1. ENGINE

[1] CYLINDER BLOCK



3EEABAB1P003B

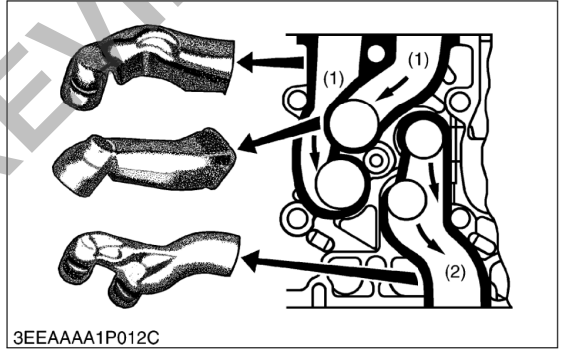
The engine utilizes a split crankcase to produce greater durability and operate more quietly; the crankcase is split into two parts, crankcase 1 (1), which houses the parts for combustion and crankcase 2 (2), which completes crankcase 1 and produces low-noise.

It uses a hanger type of crankshaft support which allows for easy dis/assembly and the lining of the cylinder is a linerless type, which offers good cooling performance and excellent resistance to wear as it is little affected by distortion.

(1) Crankcase 1
(2) Crankcase 2
(3) Oil Pan

9Y1210651ENM0001US0

[2] CYLINDER HEAD



3EEAAAA1P012C

We have improved the helical shaped 2-valve, 2-stage ports in order to generate an ideal swirl and intake air inertia at the intake port and to gain a greater amount of air for the air/fuel mixture.

(1) Intake Port
(2) Exhaust Port

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[2] TIGHTENING TORQUES OF SCREWS, BOLTS AND NUTS FOR SPECIAL USE

■ **NOTE**

- **For the screws, bolts and nuts with the mark "*", apply engine oil to their threads and seats before you tighten.**
- **The alphabet "M" in Dimension × Pitch shows that the screw, bolt or nut dimensions are in the metric system. The dimension is the nominal external diameter in mm of the threads. The pitch is the nominal distance in mm between 2 threads.**

Item	Dimension × Pitch	N·m	kgf·m	lbf·ft
Injector clamp nut	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Overflow pipe joint screw	M6 × 1.0	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
Cylinder head cover 1 screw	M6 × 1.0	6.87 to 11.2	0.700 to 1.15	5.07 to 8.31
Cylinder head cover 2 screw	M6 × 1.0	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
Injection pipe retaining nut	M12 × 1.5	23 to 36	2.3 to 3.7	17 to 26
Oil pressure switch taper screw	R 1/8	15 to 19	1.5 to 2.0	11 to 14
Supply pump mounting nut	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Supply pump gear mounting nut (M14)	M14 × 1.5	59 to 68	6.0 to 7.0	44 to 50
Supply pump gear mounting nut (M18)	M18 × 1.5	128 to 147	13.0 to 15.0	94.1 to 108
Overflow pipe joint screw (M8)	M8 × 1.25	16 to 19	1.6 to 2.0	12 to 14
Overflow pipe joint screw (M10)	M10 × 1.0	7.9 to 12	0.80 to 1.3	5.8 to 9.4
Supply pump gear cover mounting screw	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Common rail mounting screw	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Coolant temperature sensor	–	16 to 23	1.6 to 2.4	12 to 17
Camshaft position sensor mounting screw	–	4 to 5	0.4 to 0.6	3 to 4
Crankshaft position sensor mounting screw	–	4 to 5	0.4 to 0.6	3 to 4
Intake air temperature sensor	–	30 to 39	3.0 to 4.0	22 to 28
Injector terminal nut	–	1.6 to 2.2	0.16 to 0.23	1.2 to 1.6
Rocker arm bracket nut	M10 × 1.25	49 to 55	5.0 to 5.7	37 to 41
*Cylinder head mounting screw	M12 × 1.25	98.1 to 107	10.0 to 11.0	72.4 to 79.5
Oil cooler joint screw	M20 × 1.5	40 to 44	4.0 to 4.5	29 to 32
*Crankshaft screw	M16 × 1.5	255 to 274	26.0 to 28.0	188 to 202
Gear case cover mounting screw (7T)	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Gear case cover mounting screw (10T)	M8 × 1.25	33 to 36	3.3 to 3.7	24 to 26
Relief valve retaining screw	M22 × 1.5	69 to 78	7.0 to 8.0	51 to 57
Idle gear mounting screw	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Camshaft set screw	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
Mounting screw of camshaft position pulsar gear	M5	4.7 to 5.6	0.48 to 0.58	3.5 to 4.1
Plate mounting screw	M8 × 1.25	24 to 27	2.4 to 2.8	18 to 20
*Connecting rod screw	M10 × 1.25	79 to 83	8.0 to 8.5	58 to 61
*Flywheel screw	M12 × 1.25	98.1 to 107	10.0 to 11.0	72.4 to 79.5
Flywheel housing mounting screw (7T)	M12 × 1.25	78 to 90	7.9 to 9.2	58 to 66

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1. TROUBLESHOOTING

This "TROUBLESHOOTING" shows only mechanical failures. The failures related to the common rail system (CRS), refer to the diagnosis manual (DM) for common rail system engine (9Y120-01740).

Symptom	Probable Cause	Solution	Reference Page
The engine does not start	No fuel	Fill up the fuel	–
	Air in the fuel system	Bleed the air	–
	Water in the fuel system	Change the fuel and repair or replace the fuel system	G-14
	The fuel pump is defective	Replace	–
	The fuel hose is clogged	Clean or replace	G-14
	The fuel filter is clogged	Replace	G-16
	The viscosity of fuel at low temperature is too high	Replace the specified fuel	I-5, G-8
	The cetane number of fuel is low	Replace the specified fuel	I-5, G-8
	Fuel leakage because of loose injection pipe retaining nut	Tighten the retaining nut	1-S33
	The injector is clogged	Replace	1-S39
	The supply pump is defective	Replace	1-S48
	Seizure of the crankshaft, camshaft, piston or bearing	Repair or replace	–
	Compression leakage from the cylinder	Replace the head gasket Tighten the cylinder head screw	1-S42, 1-S43
	Incorrect valve timing	Check the timing gear	1-S58
	Piston ring and cylinder are worn out	Replace	1-S84, 1-S88
	Incorrect valve clearance	Adjust valve clearance	1-S16
The starter does not operate	Discharged battery	Charge or replace	–
	Starter is defective	Repair or replace	1-S21
	The key switch is defective	Replace	–
	The connection of the wires is incorrect	Check or correct	–

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2. SERVICING SPECIFICATIONS

ENGINE BODY

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	–	0.05 mm 0.002 in.
Top Clearance		0.70 to 0.90 mm 0.028 to 0.035 in.	–
Compression Pressure	V3800-CR-TE4 V3800-CR-TE4C V3800-CR-TIE4 V3800-CR-TIE4C	3.09 to 3.28 MPa / 200 min^{-1} (rpm) 31.5 to 33.5 kgf/cm^2 / 200 min^{-1} (rpm) 448 to 476 psi / 200 min^{-1} (rpm)	2.41 MPa / 200 min^{-1} (rpm) 24.6 kgf/cm^2 / 200 min^{-1} (rpm) 350 psi / 200 min^{-1} (rpm)
	V3800-TIE4 V3800-TIE4C	2.95 to 3.13 MPa / 200 min^{-1} (rpm) 30.0 to 32.0 kgf/cm^2 / 200 min^{-1} (rpm) 427 to 455 psi / 200 min^{-1} (rpm)	2.30 MPa / 200 min^{-1} (rpm) 23.5 kgf/cm^2 / 200 min^{-1} (rpm) 334 psi / 200 min^{-1} (rpm)
Variance Among Cylinders		–	10 % or less
Valve Seat	Angle (Intake)	1.0 rad 60 °	–
	Angle (Exhaust)	0.79 rad 45 °	–
	Width (Intake)	1.5 to 1.9 mm 0.059 to 0.074 in.	–
	Width (Exhaust)	2.0 to 2.3 mm 0.079 to 0.091 in.	–
Valve Face	Angle (Intake)	1.0 rad 60 °	–
	Angle (Exhaust)	0.79 rad 45 °	–
Valve Recessing	Intake	0.60 to 0.80 mm 0.024 to 0.031 in.	1.2 mm 0.047 in.
	Exhaust	0.850 to 1.05 mm 0.0335 to 0.0413 in.	1.2 mm 0.047 in.
Valve Stem to Valve Guide	Clearance (Intake)	0.035 to 0.065 mm 0.0014 to 0.0025 in.	0.1 mm 0.004 in.
• Valve Stem	O.D. (Intake)	6.960 to 6.975 mm 0.2741 to 0.2746 in.	–
• Valve Guide	I.D. (Intake)	7.010 to 7.025 mm 0.2760 to 0.2765 in.	–

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4. MAINTENANCE CHECK LIST

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

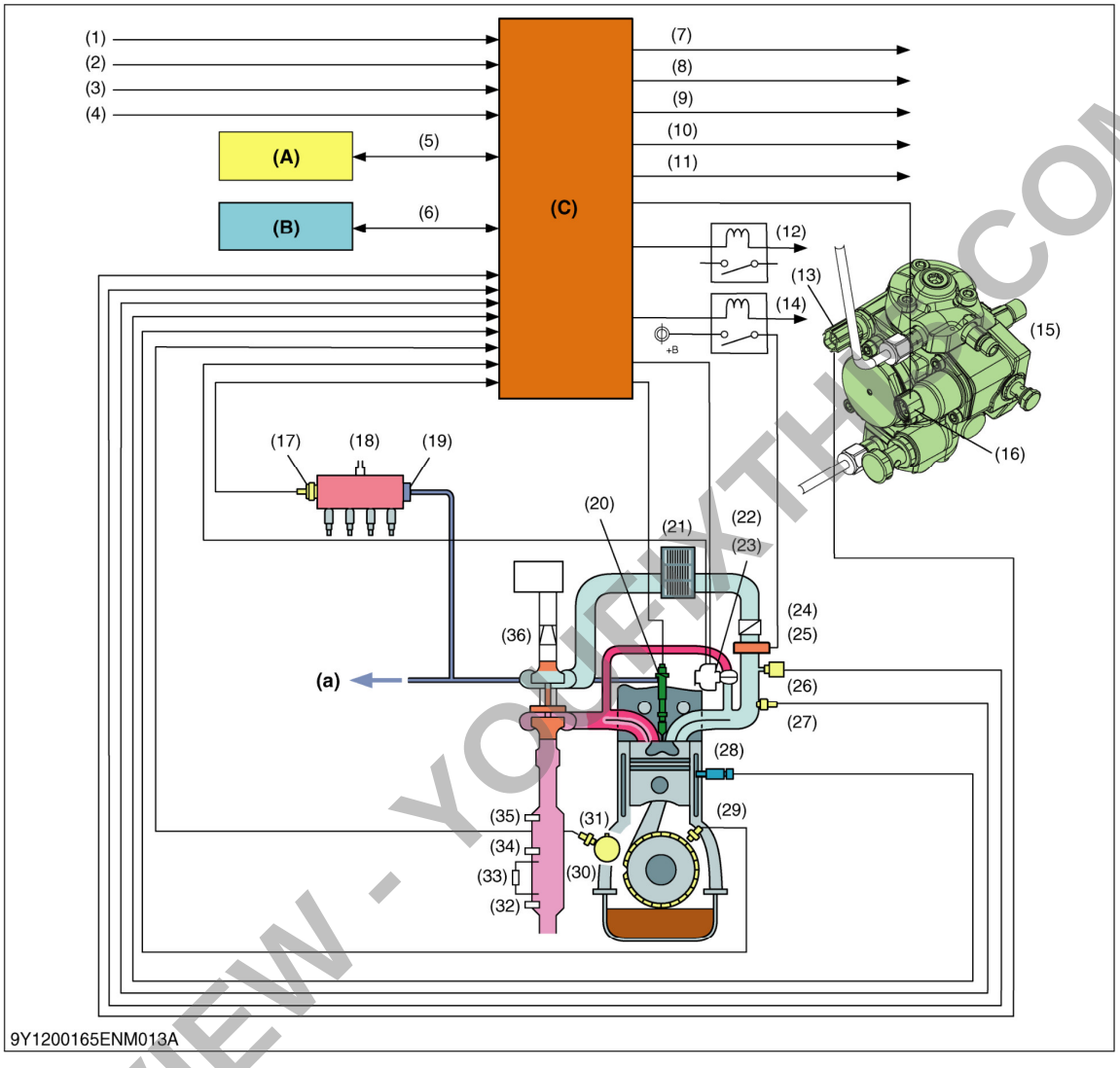
Inspection Item		Service Interval									
		Daily	Initial 50 hrs	Every 50 hrs	Every 250 hrs	Every 500 hrs	Every 1000 hrs	Every 1500 hrs	Every 3000 hrs	Every 1 year	Every 2 years
	Check of engine oil level	❍									
	Check of fuel level	❍									
	Check of coolant level	❍									
	Check of fan belt	❍									
	Check of fuel hoses and clamp bands			❍							
	Check of draining of water separator			❍							
	Check of radiator hoses and clamp bands				❍						
	Cleaning of air cleaner element (Replace the element after 6-times cleaning)				❍						
	Adjustment of fan belt tension				❍						
	Check of intake air line				❍						
	Change of engine oil		❍			❍					
	Replacement of oil filter cartridge		❍			❍					
	Replacement of fuel filter cartridge					❍					
	Cleaning of water separator					❍					
★1	Cleaning of fuel tank interior					❍					
★1	Cleaning of water jacket and radiator interior					❍					
★1	Replacement of fan belt					❍					❍
★1	Check of valve clearance						❍				
★1,★2	Check of injector							❍			
★1,★2	Check of EGR cooler							❍			
★2	Replacement of oil separator element							❍			
★1	Check of PCV (Positive Crankcase Ventilation) valve							❍			
★1,★2	Check of turbocharger								❍		
★1,★2	Cleaning of DPF								❍		
★1,★2	Check of EGR system								❍		
★1	Replacement of air cleaner element									❍	
★1	Check of DPF differential pressure pipes and hoses									❍	
★1	Check of EGR piping									❍	
	Check of intake air line									❍	
	Check of exhaust manifold (Crack, gas leakage and mounting screw)									❍	
★1	Replacement of oil separator rubber hose										❍
★1	Replacement of rubber hose of DPF differential pressure sensor										❍
★1	Replacement of intake hose (After air flow sensor) and inter cooler hose										❍
★1	Replacement of pressure detection hose of boost sensor										❍
★1	Replacement of EGR cooler hose										❍
★1	Replacement of water hose										❍
★1	Replacement of lubricant hose										❍
	Change of radiator coolant (L.L.C.)										❍
★1	Replacement of radiator hoses and clamp bands										❍

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[5] ENGINE CONTROL SYSTEM

V3800-CR-TE4, V3800-CR-TIE4, V3800-CR-TE4C, V3800-CR-TIE4C



(1) Key Switch ON Signal
(2) Starter Switch Signal
(3) Emergency Stop Switch
(4) Oil Pressure Switch
(5) CAN Communication for OEM Machine (*Accelerator Position Signal, *Neutral Switch, *Machine Travel Speed Signal)
(6) CAN Communication for Service
(7) Engine Warning Light Signal
(8) Stop Lamp Signal
(9) Oil Pressure Warning Lamp Signal
(10) Overheat Lamp Signal
(11) Glow (Air Heater) Lamp Signal
(12) Starter Relay
(13) Fuel Temperature Sensor
(14) Glow (Air Heater) Relay
(15) Supply Pump
(16) SCV (Suction Control Valve)
(17) Rail Pressure Sensor
(18) Rail
(19) Pressure Limiter
(20) Injector
(21) Inter cooler
(22) EGR DC Motor
(23) EGR Lift Sensor
(24) Intake Throttle Valve
(25) Intake Air Heater
(26) Intake Air Pressure Sensor
(27) Intake Air Temperature Sensor
(28) Coolant Temperature Sensor
(29) Crankshaft Position Sensor
(30) Diesel Particulate Filter (Hereinafter Referred To As The "DPF") Muffler
(31) Camshaft Position Sensor
(32) Temperature Sensor (DPF Outlet Exhaust Temperature) (T_2)
(33) Differential Pressure Sensor (DPF Differential Pressure) (ΔP)
(34) Temperature Sensor (DPF Inlet Exhaust Temperature) (T_1)
(35) Temperature Sensor (DOC Inlet Exhaust Temperature) (T_0)
(36) Air Flow Sensor

(A) CAN2 Connector (For OEM Machine)
(B) CAN1 Connector (For Service)
(C) Engine ECU
(a) To Fuel Tank

(To be continued)

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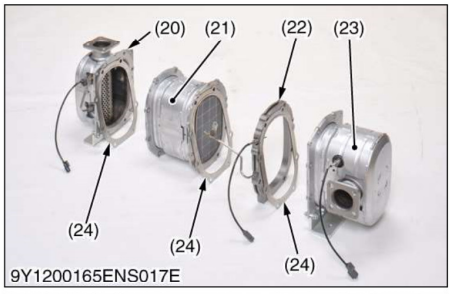
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(Continued)



9Y1200165ENS017E



9Y1200165GES011C

(When reassembling)

- Replace the gaskets (24) with new ones.
- If the differential pressure tube is damaged or cracked, replace it.
- When the differential pressure pipe (11), (14) and temperature sensor (10), (12), (13) is removed, wipe off the anti-seize & lubricating compound, apply a anti-seize & lubricating compound (Bostik, NEVER SEEZ, Pure Nickel Special Grade), and then attach them to their correct position.
- When replacing the differential pressure pipe (11), (14), apply a anti-seize & lubricating compound (Bostik, NEVER SEEZ, Pure Nickel Special Grade), and then attach it to its correct position.
- When replacing the temperature sensor, check that it is coated with anti-seize & lubricating compound, and then attach it to its correct position.
- Tighten bolts and nuts to their specified torque. Also tighten the temperature sensor tightening nut or the differential pressure pipe tightening nut to the specified torque with crowfoot wrench.
- After attaching the assembly, start the engine and make sure that there are no gas leaks.
- Reassemble the filter comp (DPF) (21) in the correct direction by referring the mark "GAS FLOW→" (25) (Catalyst (DOC) to Body (DPF Outlet)) on the side showing the flow of exhaust gas.

Tightening torque	DPF Stay 1	M8	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft
		M10	49 to 55 N·m 5.0 to 5.7 kgf·m 37 to 41 lbf·ft
	DPF Stay 2		49 to 55 N·m 5.0 to 5.7 kgf·m 37 to 41 lbf·ft
	Screw of muffler flange		49 to 55 N·m 5.0 to 5.7 kgf·m 37 to 41 lbf·ft
	Muffler full assembly (DPF) mounting screw		49 to 55 N·m 5.0 to 5.7 kgf·m 37 to 41 lbf·ft
	Filter comp (DPF) mounting screw		49 to 55 N·m 5.0 to 5.7 kgf·m 37 to 41 lbf·ft
	Temperature sensor		25 to 34 N·m 2.5 to 3.5 kgf·m 18 to 25 lbf·ft
	Differential pressure pipe		16 to 22 N·m 1.6 to 2.3 kgf·m 12 to 16 lbf·ft

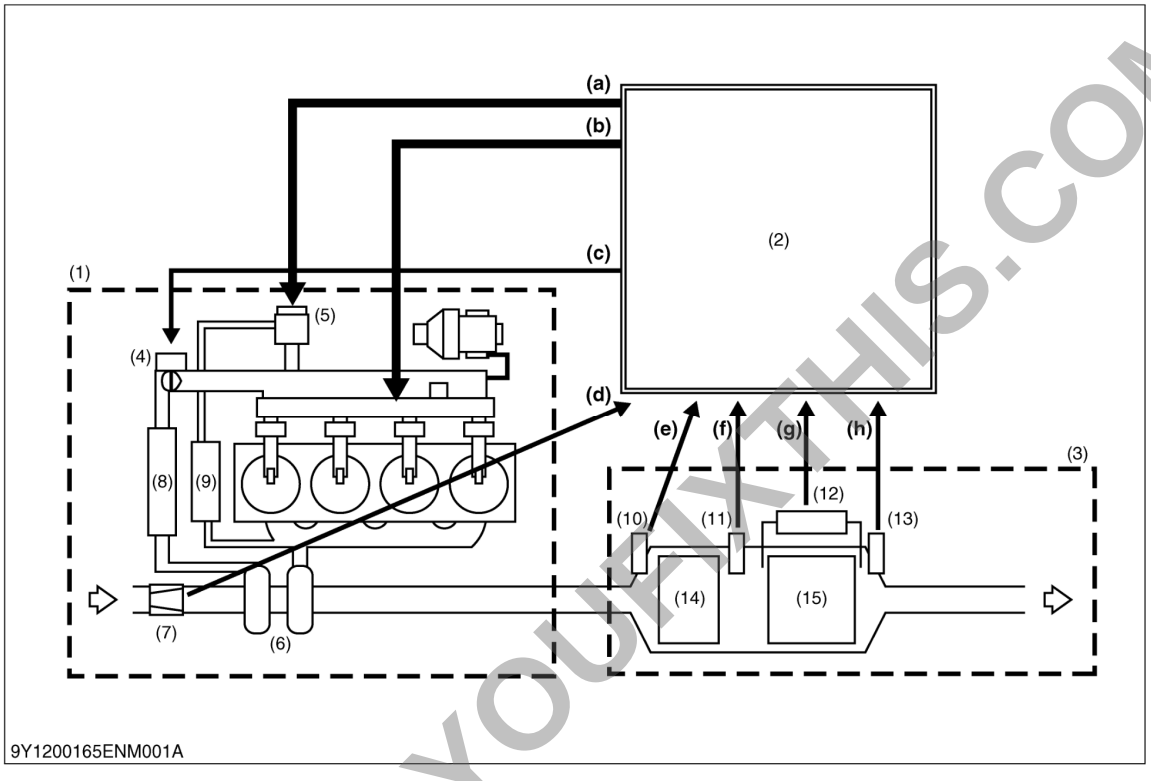
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6. AFTER TREATMENT SYSTEM

[1] AFTER TREATMENT DEVICES [V3800-CR-TE4, V3800-CR-TIE4, V3800-CR-TE4C, V3800-CR-TIE4C]



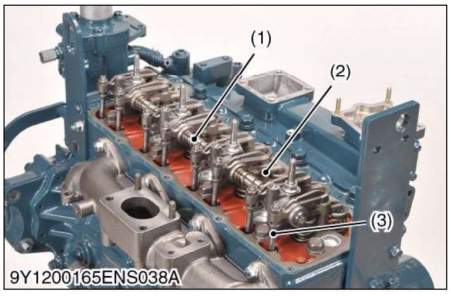
(1) Common Rail System
(2) ECU
(3) After Treatment Devices
(4) Intake Throttle Valve
(5) EGR Valve
(6) Turbo Charger
(7) Air Flow Sensor
(8) Inter Cooler
(9) EGR Cooler
(10) Temperature Sensor (DOC Inlet Exhaust Temperature) (T0)
(11) Temperature Sensor (DPF Inlet Exhaust Temperature) (T1)
(12) Differential Pressure Sensor (DPF Differential Pressure) (ΔP)
(13) Temperature Sensor (DPF Outlet Exhaust Temperature) (T2)
(14) Diesel Oxidation Catalyst (DOC)
(15) Diesel Particulate Filter (DPF)

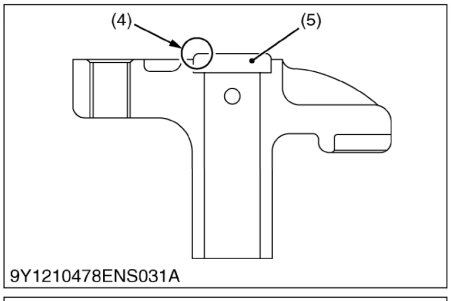
(a) EGR Valve Opening
(b) Injection Pattern
(c) Inlet Throttle Valve Angle
(d) Air Flow Sensor
(e) T_0 (DOC Inlet Exhaust Temperature)
(f) T_1 (DPF Inlet Exhaust Temperature)
(g) ΔP (DPF Differential Pressure)
(h) T_2 (DPF Outlet Exhaust Temperature)

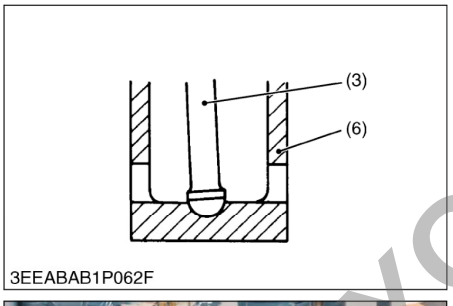
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Rocker Arms and Push Rods

1. Remove the rocker arm (1).
2. Remove the push rod (3).
3. Remove the valve bridge arm (2).

(When reassembling)

- Face the pad (5) R face (4) up and install it on the bridge arm.
- When installing the push rod (3), mount it securely in the groove of the tappet (6).

■ **IMPORTANT**

- **After installing the rocker arm, adjust the valve clearance.**

Tightening torque	Rocker arm bracket nut	49 to 55 N·m 5.0 to 5.7 kgf·m 37 to 41 lbf·ft

(1) Rocker Arm
(2) Valve Bridge Arm
(3) Push Rod
(4) R Face
(5) Pad
(6) Tappet

9Y1210651ENS0046US0

Injector Oil Seal (If necessary)

1. Remove the injector oil seal (2) from cylinder head cover1 (1).

(When reassembling)

- When install the injector oil seal (2), use the new one.

(1) Cylinder Head Cover 1
(2) Injector Oil Seal

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