50 Disassembly and assembly

**Engine and cooling system**

[*5]
- Installed dimension (k) of clamp: 8 mm
- Installed dimension (l) of clamp: 28 mm

![Diagram](CPW22178)

[*6]

Mounting joint bolt of tubes (19a) and (19b):
24.5 to 34.3 Nm {2.5 to 3.5 kgm}

(Hose between radiator and tube) (HA)
- Installed dimensions of clamp (20f)
  (h): 12 mm
  (i): 26 mm
  (j): 65 mm
- Installed dimensions of clamp (20g)
  (k): 5 mm
  (l): 26 mm
  (m): 55 mm

Clamp mounting bolt:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

(Hose between aftercooler and EGR cooler)

(*Hose between aftercooler and EGR cooler)*

[*7]

- Installed dimensions of clamp (20f)
  (h): 10 mm
  (i): 28 mm
  (j): 68 mm
- Installed dimensions of clamp (20g)
  (k): 10 mm
  (l): 28 mm
  (m): 65 mm

Clamp mounting bolt:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

(Hose between tube and water pump) (20e)

- Install upper clamp (20h) and lower clamp (20i) of hose (20e), so that position (α) of these bolts installed are different 30 degrees each other.
- Installed dimensions of clamp (20h)
  (h): 10 mm
  (i): 28 mm
  (j): 68 mm
- Installed dimensions of clamp (20i)
  (k): 10 mm
  (l): 28 mm
  (m): 65 mm

Clamp mounting bolt:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

- When hose (20c) between tubes (20b) and (20d) is removed, install it according to the following procedure.
- Installed dimensions of clamp (20i)
  (h): 10 mm
  (i): 28 mm
  (j): 65 mm

[*8] [*9]
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2. Tube mounting bolt (22b):
   44.1 to 53.9 Nm {4.5 to 5.5 kgm}

2. U-clamp mounting nut (23b) (mounting nut for bracket (23a)):
   10.8 to 26.5 Nm {1.1 to 2.7 kgm}

[*10]

2. Mounting bolt (26a):
   Seizure prevention compound (LC-G)

[*11]

2. Clamp (29a) mounting bolt:
   8 ± 0.5 Nm {0.9 ± 0.05 kgm}

[*12]

2. Fuel tube (31) mounting nut:
   43 to 47 Nm {4.4 to 4.8 kgm}

[*13]

2. Joint of fuel tube (35):
   7.8 to 9.8 Nm {0.8 to 1.0 kgm}

[*14] [*15]

2. Joint of fuel tubes (37) and (38) (fuel filter side):
   24.5 to 34.3 Nm {2.5 to 3.5 kgm}

[*16]

★ Install oil tubes (40a) and (40b) according to the following procedure.
1. Install tubes (40a) and (40b) to flange (40c).
2. Install the oil filter side of oil tubes (40a) and (40b) to the oil filter head.
   ★ Check that O-rings (41a) and (41b) are fitted.
3. Lightly install flange (40c) to the cylinder block.
4. Tighten the mounting bolts of the oil filter head to the specified torque.
5. Tighten the mounting bolts of flange (40c) to the specified torque.
6. Install clip (41a) to bracket (41).
   ★ Install the clip of tube (40a) and the stay (41d) to the bracket as a unit.

[*17]

2. Joint of KCCV water tubes (42b) and (42c) (KCCV side):
   19.6 to 29.4 Nm {2.0 to 3.0 kgm}

2. Joint of KCCV water tubes (42b) and (42c) (cylinder block side):
   24.5 to 34.3 Nm {2.5 to 3.5 kgm}

★ When the intermediate hose of KCCV water tube (42b) is disconnected, tighten the hose clamp to the following torque.

2. Hose clamp mounting bolt:
   3.3 ± 0.49 Nm {0.34 ± 0.05 kgm}

2. Joint of fuel tubes (38) and (39) (fuel filter side):
   24.5 to 34.3 Nm {2.5 to 3.5 kgm}

[*18]

2. Clamp mounting bolt of drain hose (42f) (KCCV side):
   3.3 ± 0.49 Nm {0.34 ± 0.05 kgm}

★ When drain hose (42f) is disconnected from the oil filler pipe, tighten the joint to the following torque.

2. Hose mounting joint (oil filler pipe side):
   24.5 to 34.3 Nm {2.5 to 3.5 kgm}

★ When check valve (42p) at the bottom of drain hose (42f) is removed, install check valve (42p) with its black side (b) facing down.
   - (k): KCCV ventilator side (gray)
   - (b): Cylinder block side (black)
When KCCV filter assembly (42h) is removed from bracket (42i), install it according to the following procedure.

1. Finger-tighten KCCV filter assembly (42h) to the bracket.
   - Tighten it until you cannot finger-tighten any more.
2. Using tool A1, retighten by 1/15 to 2/15 turns. (Torque for reference)
   - 36.6 to 44.7 Nm {3.7 to 4.6 kgm}

Joint of fuel tube (36a) (dosing fuel solenoid valve side):
- 24.5 to 34.3 Nm {2.5 to 3.5 kgm}
Joint of fuel tube (36b) (dosing fuel solenoid valve side):
- 9.8 to 12.7 Nm {1.0 to 1.3 kgm}
Joint of fuel tubes (32a) and (32b) (fuel feed pump block side):
- 19.6 to 29.4 Nm {2.0 to 3.0 kgm}

Sleeve nuts of KVGT oil tubes (56) and (57):
- 24 to 27 Nm {2.4 to 2.7 kgm}

Joint of KVGT lubrication oil tube (63) (cooling plate bracket side):
- 24.5 to 34.3 Nm {2.5 to 3.5 kgm}

Joint of fuel return tube (64):
- 9.8 to 12.7 Nm {1.0 to 1.3 kgm}

Insert alternator upper mounting bolt (69b) from the rear side of the engine.

Install fuel high-pressure tube and clamp according to the following procedure.

Bent fuel high-pressure pipes must not be repaired for reuse.

Before installing the fuel high-pressure pipe, check it for the following. If the fuel high-pressure pipe has any defect, replace it with a new one since fuel may leak.

- Make sure with visual check that the taper seal part of the connection ((a) part: 2 mm area from the tip-end) is free from longitudinal slits (b) or pits (c).
- Make sure that part (d) (end of taper seal: 2 mm from the tip-end) is free from steps you can feel by your fingernail. (Namely, this portion must be free from fatigue.)

Install fuel high-pressure tube before installing the cylinder head cover, and tighten the sleeve nuts on the injector side and common rail side to the specified torque.

Install the fuel high-pressure tube of the No. 1 cylinder before installing the rocker arm.

1. Tighten the sleeve nuts of fuel high-pressure pipes (a) to (f) to the specified torque.

   - Sleeve nut on fuel injector side:
     - 39.2 to 44.1 Nm {4 to 4.5 kgm}
   - Sleeve nut on common rail side:
     - 39.2 to 44.1 Nm {4 to 4.5 kgm}

2. Perform the installation procedure up to the EGR connector assembly, intake hold connector assembly, and intake manifold connector assembly.
3. Install high pressure fuel pipe clamps (g) to (l) and the stay by hands.
4. Fasten fuel high-pressure pipe clamps (g) to (l) to the specified torque.
50 Disassembly and assembly

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5. Fasten the stay for fuel high-pressure pipe clamps (g) to (l) to the specified torque.
6. Install fuel high-pressure pipe clamps (m) to (u) and the stay by hands.
7. Install high pressure fuel pipe clamp (v) and gate-type frame (39).
8. Fasten fuel high-pressure pipe clamp (v) bolts (7 pieces) to the specified torque.

Fuel high-pressure pipe clamp bolt:
9.8 ± 1 Nm {1.0 ± 0.1 kgm}

9. Fasten gate-type frame (39) to the specified torque.
10. Fasten the stay for fuel high-pressure pipe clamps (m) to (u) to the specified torque.

[*26] [*27]
★ Replace the gasket on the flange surface of intake manifold (74) with a new one. Sling intake manifold (74), and install it.
★ Be careful not to damage each high-pressure fuel pipe when slinging intake manifold (74) for installation.

Intake manifold (74):
45 kg
★ Tighten the intake manifold mounting bolts in the order of (1) to (20).

Intake manifold mounting bolts (1) to (20):
58.8 to 73.5 Nm {6 to 7.5 kgm}

[*28]
Joints (KVGT side) of KVGT cooling tube, (78a), (78c), (78d), and (78e):
24.5 to 34.3 Nm {2.5 to 3.5 kgm}
★ When the nipples of the above joints are removed, install them to the following torque.

Nipples of above joints:
35 to 63 Nm {3.5 to 6.5 kgm}

[*29]
★ Check that the gaskets are fitted to the flanges on the KVGT side and cylinder block side of KVGT lubricating oil return tube (81) before installation.

[*30]
★ Install the mounting nut of air connector hose clamp (82) facing outward.

Clamp (82) mounting bolt:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

[*31]
KVGT mounting bolt (84a):
44.1 to 53.9 Nm {4.5 to 5.5 kgm}

[*32]
★ When KVGT assembly (84) and connector assembly (85) are disconnected, be sure to connect them according to "Removal and installation of KVGT assembly". (If they are connected without using the special tools, the KVGT may be broken.)
★ If wire (82b) is removed, be sure to fix cover (82c) by using wire (82b) according to the following figure when installing the KVGT.
Replace the gasket on the flange surface of exhaust manifold (88) with a new one. Sling exhaust manifold (88) and install it.

**Exhaust manifold (88):**

25 kg

Tighten exhaust manifold mounting bolts (1) to (24) according to the following procedure.
1. Tighten lightly mounting bolts (3 pieces) in the order of (1) to (3).
2. Tighten lightly the remaining mounting bolts (21 pieces) in the order of (4) to (24).
3. Tighten all mounting bolts to the specified torque in the order of (1) to (24).

**Exhaust manifold mounting bolts (1) to (24):**

Seizure prevention compound (LC-G)

**Exhaust manifold mounting bolts (1) to (24):**

58.8 to 73.5 Nm {6 to 7.5 kgm}

Fit the gasket and install cylinder head cover (91). Lightly tighten the mounting bolt on the front side of the intake manifold side since it is to be tightened together with the wiring bracket.

Apply engine oil to portion (e) of crosshead and socket part (f) of push rod (103).

Portion (e) of crosshead and socket part (f) of push rod (103):

Engine oil (For details, see "Table of fuel, coolant and lubricants").

When installing rocker arm and rocker shaft assembly (95), check that the ball part of adjustment screw (98) is fitted securely in the socket part of push rod (103), and then tighten mounting bolts (94a), (94b), and (94c).

Be careful that stem lengths of mounting bolts (94a), (94b), and (94c) are all different.
- Mounting bolt (94a): Stem length is 120 mm
- Mounting bolt (94b): Stem length is 90 mm
- Mounting bolt (94c): Stem length is 75 mm

**Mounting bolts (94a), (94b), and (94c):**

93 to 103 Nm {9.5 to 10.5 kgm}

Adjust the valve clearance. For details, see Testing and adjusting, "Testing and adjusting valve clearance".
Install the fuel injector wiring harness to the fuel injector assembly according to the following procedure.

1. Eliminate the sag of the fuel injector wiring harness, and press it against the fuel injector assembly so that it will not interfere with the rocker arm.
2. Install spring clamp (100).
3. Tighten capture nuts (101) (2 pieces).
   - Tighten capture nuts (101) alternately.
   - Capture nut (101):
     \[ 2 \pm 0.2 \text{ Nm} \ (0.2 \pm 0.02 \text{ kgm}) \]

- Wash off and remove dirt and dust attached on the parts around the harness connectors to prevent them from entering connectors.
- Use clean engine oil when applying engine oil to O-rings and lubricated portions.
- When replacing the fuel injector assembly with a new one, note the number of cylinder to which the new injector is installed and character string (M) indicated on QR code tab (Q) at the top of the injector as a set.
- Check that character string (M) is noted down correctly.

When fuel injector assemblies or the engine controller assembly have been replaced, write character strings (M) of the fuel injector assemblies to the engine controller. For details, see Testing and adjusting, "Writing offset value when replacing injector and engine controller".

Be sure to write the noted character string (M) into the cylinder number column of the cylinder to which the injector is installed.

If the character string (M) is not written correctly, the engine may not operate normally.

(Reference: The QR code and character string indicate the compensation value for fuel injection of the injector, which is specific to each injector.)

(Reading order of character string (M))

1. Install fuel injector assembly (102) according to the following procedure.
   - Check that the inside of the injector sleeve at the cylinder head side is free from dust.
   1) Install O-rings (2), (3) and gasket (4) to fuel injector (1).
      - Be careful not to fit O-ring (2) to groove (d).
   - O-rings (2) and (3):
     - Engine oil (For details, see "Table of fuel, coolant and lubricants").
2) Install holder (5) to fuel injector (1), and insert the fuel injector assembly to the injector sleeve at the cylinder head side.

★ When reusing fuel injector assemblies and engine controller, check the cylinder numbers and character strings (M) noted when the fuel injector assembly have been removed, and install the fuel injector assemblies to the corresponding cylinders.

★ When fuel injector assemblies or the engine controller have been replaced with new ones, check the cylinder numbers and character strings (M) written in the engine controller assembly, and install the fuel injector assemblies to the corresponding cylinders.

★ Check that the injector assembly is fitted to the bottom securely.

3) Install spherical washer (7) to holder mounting bolt (6) and fasten holder (5) lightly.

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Spherical washer (7):

Engine oil (For details, see "Table of fuel, coolant and lubricants").

★ Tighten lightly the fuel high-pressure pipe sleeve nut before tightening holder mounting bolt (6) to the specified torque.

---

Holder mounting bolt (6):

59 to 74 Nm {6 to 7.5 kgm}

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[41]

★ Adjust crosshead (104) according to the following procedure.

1. Loosen the lock nut and adjustment screw.
2. While pressing the top of crosshead (104) lightly, tighten the adjustment screw.
3. After the adjustment screw touches the valve stem, tighten it further by 20 degrees.
4. Tighten the lock nut to the specified torque.

---

Lock nut:

58.7 ± 5.9 Nm {6 ± 0.6 kgm}

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[42]

★ Install cylinder head assembly (108) according to the following procedure.

1. Check that there is no dirt and foreign matter on the cylinder head mounting surface and in the cylinders, and then set cylinder head gasket (109).

★ Check that cylinder head gasket (109) grommets are not fall off or lost.

---

2. If cylinder head mounting bolts (105) or (106) exceeds any of the limits as follows, do not reuse the bolt but replace it.

- The number of tightening times becomes six times (five punch marks) or more.
- Bolt stem length (a) exceeds the allowable limit.
  - Long bolt (105): Min. 205.8 mm
  - Short bolt (106): Min. 170.8 mm
3. By using eyebolts [1], sling cylinder head assembly (108) and install it, and tighten mounting bolts (105) (3 pieces), mounting bolts (106) (3 pieces), and auxiliary bolt (107) (1 piece).

Mounting bolts (105), (106), and auxiliary bolt (107):
Molybdenum disulfide lubricant (LM-P) or engine oil (For details, see "Table of fuel, coolant and lubricants")

Cylinder head assembly (108):
25 kg

★ Tighten mounting bolts (105) and (106) according to the following procedure.

Mounting bolts (105) and (106):
1st time: 137 to 157 Nm {14 to 16 kgm}
2nd time: 284 to 294 Nm {29.0 to 30.0 kgm}
3rd time:
1) When using tool A1, retighten bolt 90(+30/0)° in order of (1) to (6) shown in the following figure.
2) When not using tool A1, put (f) marks on bolt and flywheel, and retighten bolt 90(+30/0)° in order of (1) to (6) shown in the following figure.

★ After tightening the bolts, put a punch mark (g) on each bolt head to indicate the number of tightening.

★ When a new bolt is used, do not put a punch mark on its head.

1. Check for fuel leakage

★ When performing removal and installation of high-pressure fuel pipes, check if there is no fuel leaks according to the following method after assembling the engine.

★ Clean and degrease the engine and the parts around it in advance so that you can check it easily for fuel leakage.

1) Spray color checker (developer) over the fuel supply pump, common rail, fuel injector, and joints of the high-pressure piping.
2) Start the engine, keep its speed at 1,000 rpm or below, and stop it when its speed is stabilized.

3) Check the fuel piping and devices for fuel leakage.
   - Check the high-pressure circuit for fuel leakage focusing on the area where the color checker is sprayed.
   - If any fuel leakage is detected, repair it and perform testing again from Step 1).

4) Start the engine and keep it running at low idle.

5) Check the fuel piping and devices for fuel leakage.
   - Check the high-pressure circuit for fuel leakage focusing on the area where the color checker is sprayed.
   - If any fuel leakage is detected, repair it and perform testing again from Step 1).

6) Start the engine and keep it running at high idle.

7) Check the fuel piping and devices for fuel leakage.
   - Check the high-pressure circuit for fuel leakage focusing on the area where the color checker is sprayed.
   - If any fuel leakage is detected, repair it and perform testing again from Step 1).

8) Start the engine and keep it running at high idle, then apply a load to the engine.
   - When checking the engine for leakage as it is installed on the machine, stall the torque converter or relieve the hydraulic pump circuit.

9) Check the fuel piping and devices for fuel leakage.
   - Check the high-pressure circuit for fuel leakage focusing on the area where the color checker is sprayed.
   - If any fuel leakage is detected, repair it and perform testing again from Step 1).
   - If no fuel leakage is detected, check is completed.

- Refilling of oil
  Refill with the coolant to the specified level through the coolant filler port. Run the engine to circulate the coolant through system. Then check the coolant level again.

Radiator:
132.5 ℓ
Removal and installation of engine hood assembly

Place the machine on a level ground and set the parking brake to the LOCK position.

Set the lock bar to the front and rear frames to lock them and chock the wheels.

Lower the work equipment to the ground and set the work equipment lock lever to the LOCK position.

Turn the starting switch to the OFF position and stop the engine.

Turn the battery disconnect switch to the OFF position and remove the key.

When turning off the battery disconnect switch, be sure to perform the following procedure.
1. Turn the starting switch key to the OFF position.
2. Check that system operation lamp (SL) is turned off, and then turn battery disconnect switch (DS) to the OFF position.

For details, see Testing and adjusting, "Handling of battery disconnect switch".

Removal

1. Remove the top plate according to the following procedure.
   1) Remove top plate mounting bolts (left side) (1a) (5 pieces).
   2) Remove side cover mounting bolts (2a) (2 pieces), and open side cover (2).
      * Be sure to set lock (R) securely.
   3) Disconnect coolant sub-tank (3) from top plate (1).
   4) Remove covers (4a) and (4b), and install eyebolts (two places each on right and left) to the mounting bolt holes.
   5) Sling top plate (1), and remove top plate mounting bolts (1b).
      (Right side) 5 pieces
      (Rear) 3 pieces
      (Front) 3 pieces
   6) Sling top plate (1), pre-cleaner (5), and exhaust pipe (6) as a unit, and remove them.

Top plate (1), pre-cleaner (5), and exhaust pipe (6) assembly: 70 kg