

Document Title: Engine, description	Function Group: 200	Information Type: Service Information	Date: 2014/4/7 0
Profile: CEX, ECR38 [GB]			

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Engine, description

Model code (3TNV88)

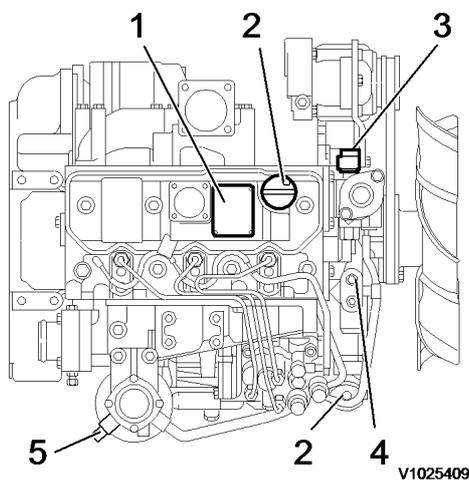
Model code

Symbol	Description	Remarks
3	Number of cylinders	
TNV	Model series	
88	Cylinder bore (mm)	

- The engine is a 4-cycle, 3-cylinder, direct injected, water cooled diesel engine.
- The engine produces powerful performance using direct injection type combustion chamber.

Engine external views

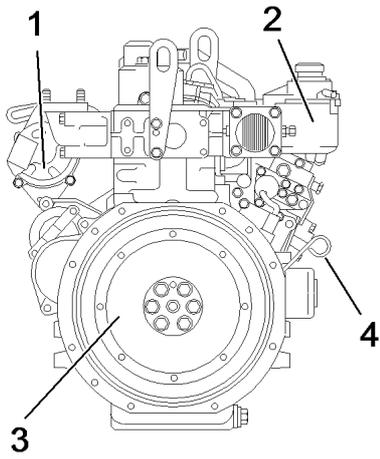
1. Engine data plate
2. Oil filler port
3. heated water out
4. Heated water return
5. Fuel oil inlet



V1025409

Figure 1
Engine, top side view

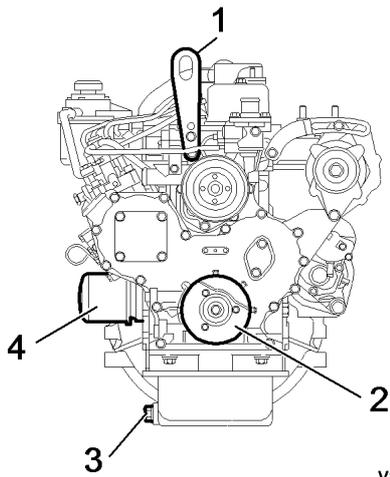
1. Alternator
2. Fuel filter
3. Engine oil dipstick
4. Flywheel



V1025410

Figure 2
Engine, rear side view

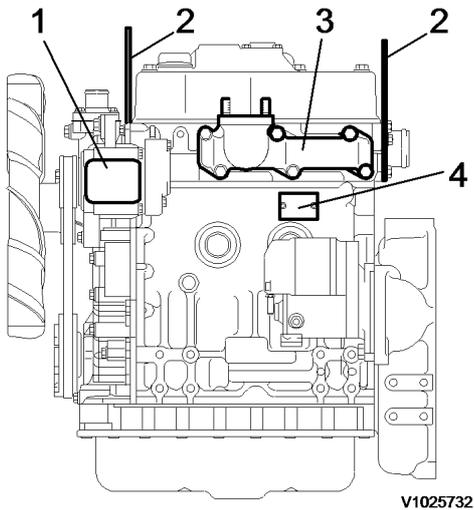
1. Lifting eye
2. Crankshaft V-pulley
3. Oil drain valve (M22X1,5)
4. Engine oil filter



V1025731

Figure 3
Engine, front side view

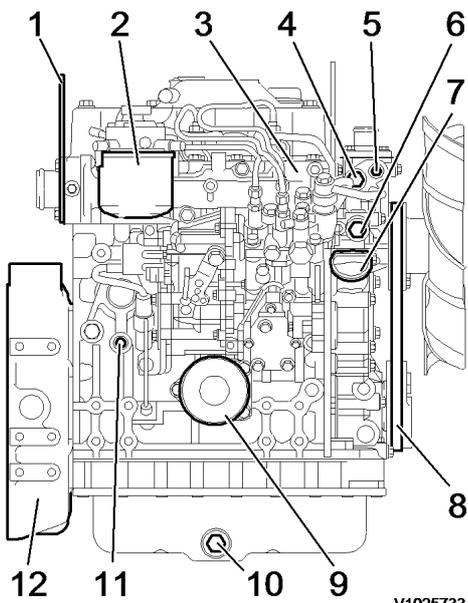
1. Alternator
2. Lifting eye
3. Exhaust manifold
4. Engine model marking



V1025732

Figure 4
Engine, starter motor view

1. Lifting eye
2. Fuel filter
3. Intake manifold
4. Water temperature switch
5. Heated water out
6. Water inlet
7. Oil filler port
8. V-belt
9. Engine oil filter
10. Oil drain plug
11. Oil pressure switch
12. Water drain



V1025733

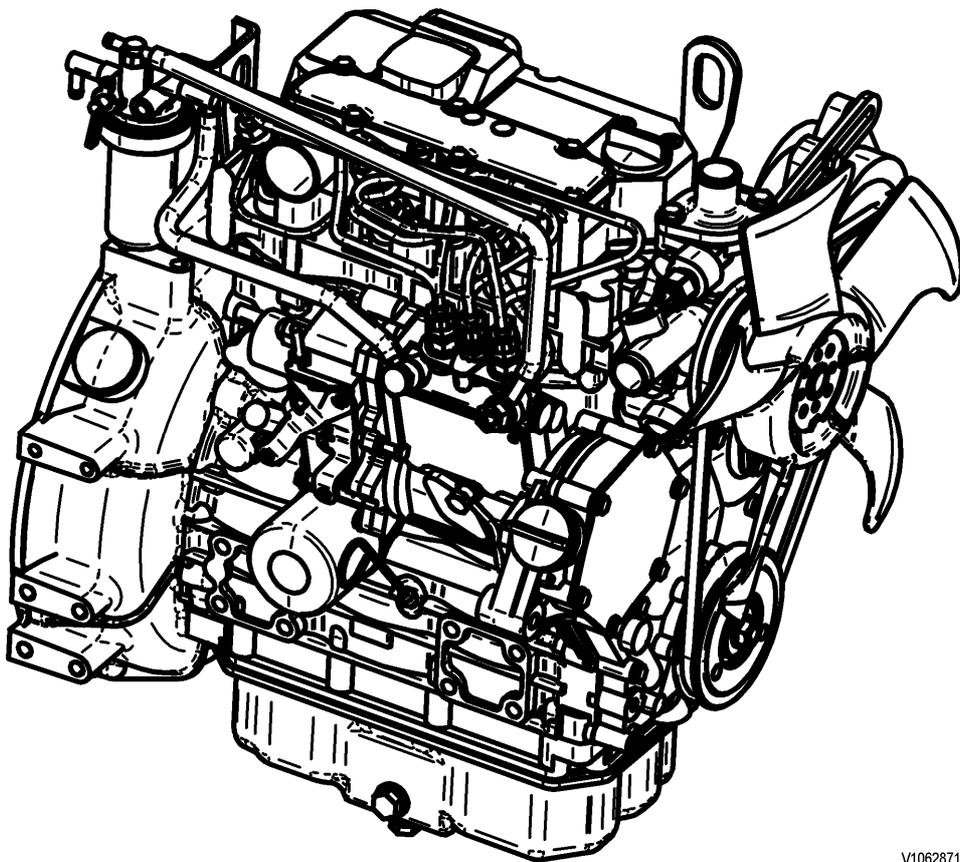
Figure 5
Engine, fuel filter side view

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Engine, description

The engine is a four cycle, three cylinder, direct injection, water cooled diesel engine. The engine produces powerful performance using an indirect injection type combustion chamber. The engine is equipped with a 12 V glow plug that has a four second timer built into it that acts as a preheating function.



V1062871

Figure 1
ECR38 engine

Document Title: Precautions	Function Group: 200	Information Type: Service Information	Date: 2014/4/7 0
Profile: CEX, ECR38 [GB]			

Precautions

Make preparation as follows before starting engine inspection and service.

- Fix the engine on a horizontal base.
- Remove the coolant hoses, fuel oil pipes, wire harness, control wires etc. connecting the driven machine and engine, and drain coolant, lubricating oil and fuel.
- Remove soil, oil, dust, etc. from the engine by washing with solvent, air, steam, etc. Carefully operate so as not to let any foreign matter enter the engine.
- Any part which is found defective as a result of inspection or any part whose measured value does not satisfy the standard or limit shall be replaced.
- Any part predicted to dissatisfy the standard or limit before the next service as estimated from the state of use should be replaced even when the measured value then satisfies the standard or limit.

Document Title: Periodic inspection and maintenance procedure	Function Group: 200	Information Type: Service Information	Date: 2014/4/7 0
Profile: CEX, ECR38 [GB]			

Periodic inspection and maintenance procedure

Check before daily operation

Be sure to check the following points before starting the engine every day.

Visual check around engine

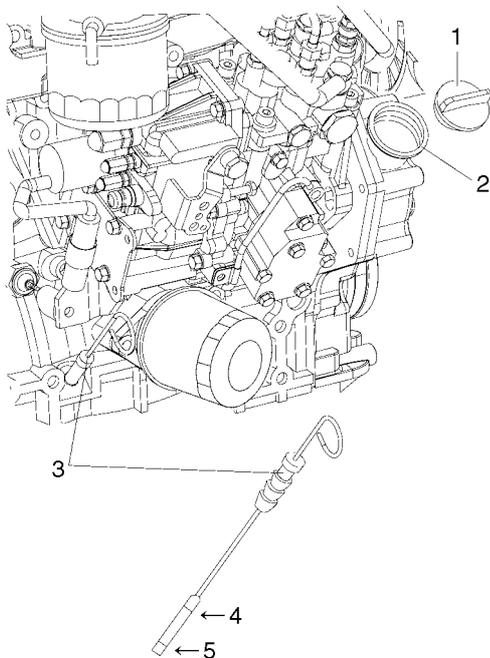
- Oil leak from the lubrication system
- Fuel leak from the fuel system
- Cooling water leak from the cooling water system
- Damaged parts
- Loosened or lost bolts
- Fuel, radiator rubber hoses, V belt cracked, loosened clamp

Fuel tank level check and fuel supply

Check the remaining fuel oil level in the fuel tank and refuel the recommended fuel if necessary.

Lube oil level check and replenishment

- Checking oil level.
Check the engine oil level with the dipstick, after adjusting the posture of the machine unit so that the engine is level. Insert the dipstick fully and check the oil level. The oil shall not be contaminated heavily and have appropriate viscosity. No coolant or diesel oil shall be mixed.
The level shall be between the upper and lower limit lines on the dipstick.



V1020549

Figure 1
Checking oil level and replenishing with engine oil

1. Filler cap

2. Filler port (engine oil)
3. Dipstick gauge
4. Upper limit
5. Lower limit

Engine oil capacity, unit: liter (gal.)

Total volume	Effective volume
6.7 (1.77)	2.8 (0.74)

- Replenishing oil pan with engine oil.
If the remaining engine oil level is low, fill the oil pan with the specified engine oil to the specified level through the filler port.

NOTE!

The oil should not be overfilled to exceed the upper limit line. Otherwise, oil may jet out from the breather or the engine may become faulty.

Coolant inspection

Daily inspection of the coolant should be done only by sub-tank.



WARNING

Risk of scalding and burns when the expansion tank cap (radiator cap) is opened due to high pressure in the cooling system.



WARNING

Risk of scalding and burns when the expansion tank cap (radiator cap) is opened due to high pressure in the cooling system.



WARNING

Before removing the radiator cap, stop the engine and let it cool down sufficiently. When removing it, turn it slowly to release the pressure.

NOTE!

Securely tighten the filler cap after checking the radiator. Steam can spurt out during operation, if the cap is not properly tightened.

- Checking coolant volume
Check the coolant level in the sub-tank. If the water level is close to the LOW mark, open the sub-tank cap and replenish the sub-tank with clean soft water or premix to the FULL mark.
The coolant level of the sub-tank shall be between the upper and lower limit lines.

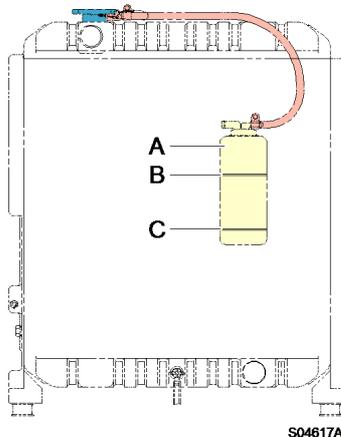


Figure 2
Checking, coolant level in the sub-tank

- A. Sub-tank

- B. Upper limit
- C. Lower limit

○ Replenishment engine with coolant

If the sub-tank coolant level is lower than the LOW mark, open the radiator cap and check the coolant level in the radiator. Replenish the radiator with coolant, if the level is low.

Check the coolant level while the engine is cool. Checking when the engine is hot is dangerous. And the coolant volume is expanded due to the heat.

Daily coolant level check and replenishing shall be done only at the sub-tank. Usually do not open the radiator cap to check or replenish.

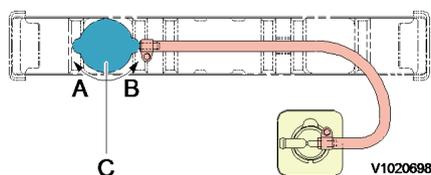


Figure 3
Replenishment, coolant

- A. Tighten
- B. Loosen
- C. Radiator cap

NOTE!

If the coolant runs short quickly or when the radiator runs short of coolant with the sub-tank level unchanged, coolant may be leaking or the air tightness may be lost. Increase in the sub-tank level during operation is not abnormal. The increased coolant in the sub-tank returns to the radiator when the engine is cooled down. If the level is normal in the sub-tank but low in the radiator, check for loosened clamping of the rubber hose between the radiator and sub-tank or a tear in the hose.

Engine: The radiator shall be filled up.

Coolant capacity, unit: liter (gal)

Coolant volume in the engine
2.0 (0.53)

Fuel pipe and cooling water pipe inspection and maintenance

Check the rubber hoses for fuel and cooling water pipes cracked. If the cracked hose is found, replace it with new one. Check the loosened clamp. If found, tighten it.

Warning lamp & instruments function check

Before and after starting the engine, check to see that the alarm function normally. Failure of alarm cannot warn the lack of the engine oil or the cooling water. Make it a rule to check the alarm operation before and after starting engine every day.

Checking accelerator operation

Make sure the accelerator of the machine unit can be operated smoothly before starting the engine. If it feels heavy to manipulate, lubricate the accelerator cable joints and pivots. Adjust the accelerator cable if there is a dislocation or excessive play between the accelerator and the governor lever.

Inspection after initial 50 hours operation



Hot oil and hot engine coolant can cause severe burns!

NOTE!

Replace engine oil after the engine oil becomes warm. It is most effective to drain the engine oil while the engine is still warm.

In early period of use, the engine oil gets dirty rapidly because of the initial wear of internal parts. Replace the engine oil earlier. Engine oil filter should also be replaced when the engine oil is replaced. Engine oil and engine oil filter replacing

procedures are as follows. Remove the oil filler cap to drain easily while draining the engine oil.

- Drain engine oil
 - Prepare a waste oil container collecting waste oil.
 - Remove the drain plug using a wrench to drain the engine oil.
 - Securely tighten the drain plug after draining the engine oil.

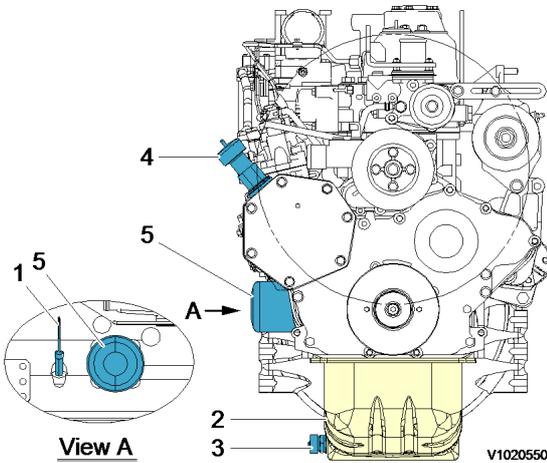
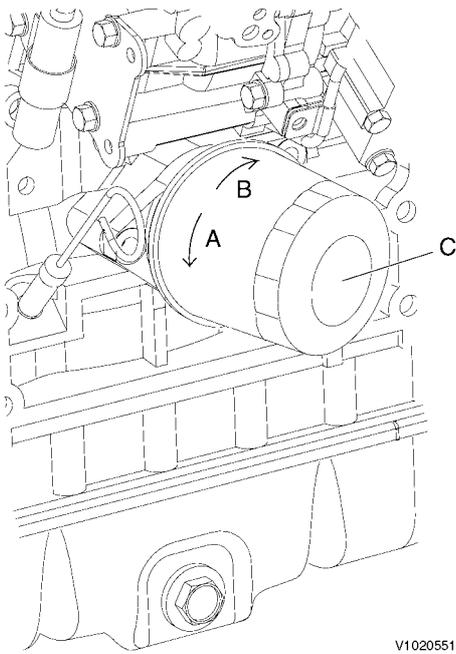


Figure 4
Dipstick gauge, oil pan and drain plug

1. Dipstick
2. Oil pan
3. Drain plug
4. Oil filler port
5. Oil filter

- Replacing oil filter
 - Turn the engine oil filter counterclockwise using a filter wrench to remove it.
 - Clean the mounting face of the oil filter.
 - Moisten the new oil filter gasket with the engine oil and install the new engine oil filter manually turning it clockwise until it comes into contact with the mounting surface, and tighten it further to 3/4 of a turn with the filter wrench.
 - Tightening torque: 2.0 ~ 2.4 kgf-m (14.4 ~ 17.3 lbf-ft).
 - Applicable oil filter part number: 129150-35151.



V1020551

Figure 5
Replacement, engine oil filter

- A. Loosen
- B. Tighten
- C. Engine oil filter

- Filling oil and inspection

- Filling oil and inspection

NOTE!

Do not overfill the oil pan with engine oil. Be sure to keep the specified level between upper and lower limit on the dipstick.

- Warm up the engine by running for 5 minutes while checking any oil leakage.
- Stop the engine after warming up and leave it stopped for about 10 minutes then recheck the engine oil level with dipstick and replenish the engine oil. If any oil is spilled, wipe it away with a clean cloth.

Checking and adjusting radiator fan V-belt

When there is not enough tension in the V-belt, the V-belt will slip making it impossible for the alternator to generate power and water pump and cooling fan will not work causing the engine to overheat. Check and adjust the V-belt tension (deflection) in the following manner.

- Press the V-belt with your thumb [approx. 98N (10kgf)] at the middle of the V-belt span to check the tension (deflection).

Available positions to check and adjust the V-belt tension (deflection) are at the A, B or C direction as shown in the illustration right.

You may choose a position whichever you can easily carry out the check and adjustment on the machine unit.

- "New V-belt" refers to a V-belt which has been used less than 5 minutes on a running engine.
- "Used V-belt" refers to a V-belt which has been used on a running engine for 5 minutes or more.
- The specified deflection to be measured at each position should be as follows.

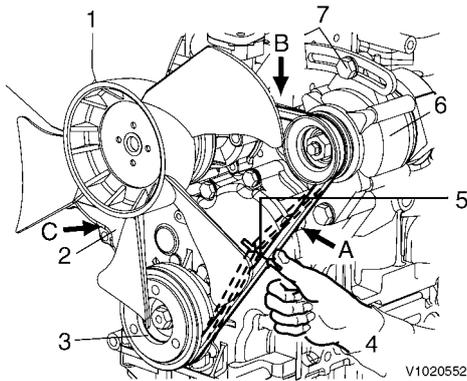


Figure 6
Checking and adjustment, radiator fan V-belt

1. Radiator fan
2. V-belt
3. Crankshaft V-pulley
4. Press with thumb
5. Deflection
6. Alternator
7. Set screw

V-belt deflection, unit: mm (in)

Direction	A	B	C
For used V-belt	10 ~ 14 (0.39 ~ 0.55)	7 ~ 10 (0.28 ~ 0.39)	9 ~ 13 (0.35 ~ 0.51)
For new V-belt	8 ~ 12 (0.31 ~ 0.47)	5 ~ 8 (0.20 ~ 0.31)	7 ~ 11 (0.28 ~ 0.43)

- If necessary, adjust the V-belt tension (deflection). To adjust the V-belt tension, loosen the set screw and move the alternator to tighten the V-belt. After replacing with a new V-belt and adjusting it, run the engine for 5 minutes and readjust the deflection to the value in the table above.
- Visually check the V-belt for cracks, oiliness or wear. If any, replace the V-belt with a new one.

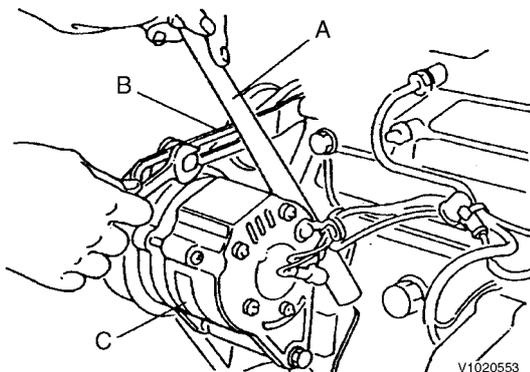


Figure 7
Adjustment, V-belt tension

- A. Bar
- B. Adjuster
- C. Alternator

Inspection 50 hours

Be sure to check the following points every 50 hours operation.

Draining of the fuel tank

- Prepare a waste oil container.
- Turn the drain cock valve of the fuel tank to drain (water, dirt, etc.) from the fuel tank bottom.
- Drain until fuel with no water and dirt flow out. Then tighten the drain cock valve firmly.

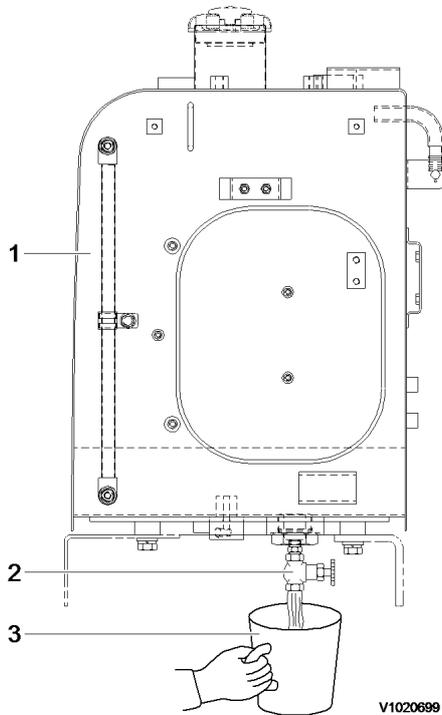


Figure 8
Draining, fuel

1. Fuel tank
2. Drain cock valve
3. Oil container

Draining of the oil/water separator

Drain off the oil/water separator whenever there is a lot of drain collected in the oil/water separator at the bottom of the cup even if not the time for periodic inspection hour. The cup of the oil/water separator is made from semi-transparency material and in the cup, the red colored float ring which rises on the surface of the drain is installed to visualize the amount of drain. Also, the oil/water separator with a sensor to detect the drain for warning device on the control panel is provided as an option.

Drain off the oil/water separator in the following manner.

- Prepare a waste oil container.
- Close the fuel cock.
- Loosen the drain cock at the bottom of the oil/water separator, and drain off any water collected inside.
- Tighten the drain cock by hand.
- Be sure to bleed off any air in the fuel system.

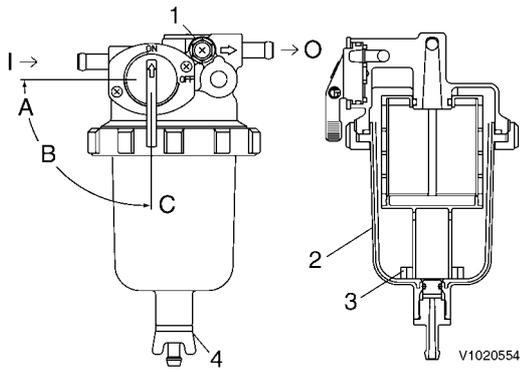


Figure 9
Draining, oil/water separator

1	Air bleeding screw
2	Cup
3	Float ring
4	Drain cock
A	Close
B	Fuel cock
C	Open
I	Inlet
O	Outlet

NOTE!

If no drain drips when the drain cock is opened, loosen the air bleeding screw on the top of the oil/water separator by turning counterclockwise 2 ~ 3 times using screwdriver. (This may occur in case of the oil/water separator position is higher than the fuel oil level in the fuel tank). After draining, be sure to tighten the air bleeding screw.

Bleeding the fuel system

Bleed the fuel system according to the following procedures. When there is air in the fuel system, the fuel injection pump will not be able to function.

- Check the fuel oil level in the fuel tank. Refuel if insufficient.
- Open the cock of the oil / water separator.
- Loosen the air bleeding screw on the oil /water separator by turning 2 ~ 3 times to the counterclockwise using a screw driver or spanner.
- When the fuel coming out is clear and not mixed with any air bubbles, tighten the air bleeding screw.
- Feed the fuel with the fuel priming pump or electro-magnetic fuel feed pump.
 - In case of the engine using the electro-magnetic fuel feed pump. Turn the starter switch to the ON position and hold it in the position for 10 ~ 15 seconds to operate the fuel feed pump.
 - In case of the engine installed the fuel filter mounting with the fuel priming pump. The priming pump is on the top of the fuel filter mounting. Move the priming pump up and down to feed fuel until you feel an increase in pressure.

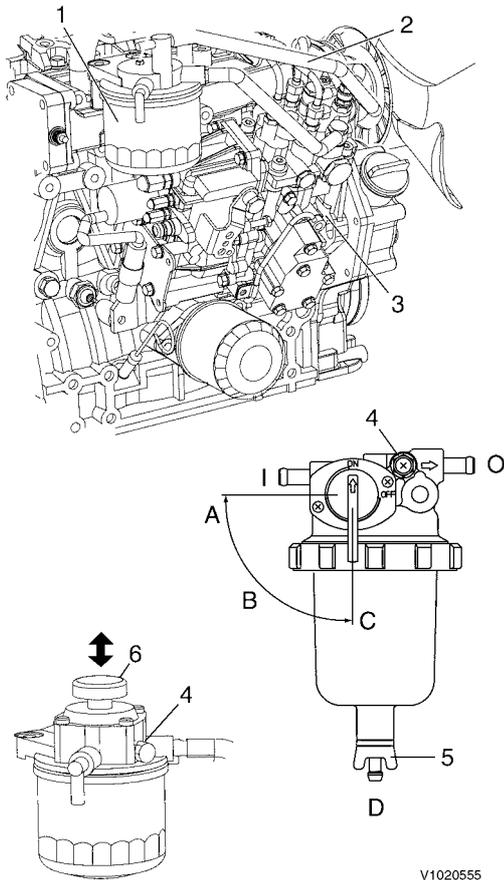


Figure 10
Bleeding, fuel system

1	Fuel filter
2	Fuel return hose
3	Fuel injection pump
4	Air bleeding screw
5	Drain cock
6	Fuel priming pump
A	Close
B	Fuel cock
C	Open
D	Oil/water separator
I	Inlet
O	Outlet

Battery inspection

NOTE!

Fire due to electric short-circuit

- Make sure to turn off the battery switch or disconnect the negative cable (-) before inspecting the electrical system. Failure to do so could cause short-circuits and fires.
- Always disconnect the (-) Negative battery cable first before disconnecting the battery cables from battery. An accidental "Short circuit" may cause damage, fire and or personnel injury. And remember to connect the (-) Negative battery cable (back onto the battery) LAST.

NOTE!

Proper ventilation of the battery area

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