

Document Title: Engine, description	Function Group: 200	Information Type: Service Information	Date: 2014/4/10
Profile: CEX, EC20C [GB]			

Engine, description

The engine is a vertical, water-cooled, in-line, three-cylinder, four-stroke diesel with eddy chamber injection. It is a low emission engine to American EPA Guideline Tier IV.

The engine serial number is stamped on the name plate, on the top of the valve cover. The engine model designation and serial number must be indicated when ordering spare parts.

The direction of rotation viewed from the flywheel is anticlockwise. Ignition sequence: 1-3-2 (cylinder no. 1 on flywheel side).

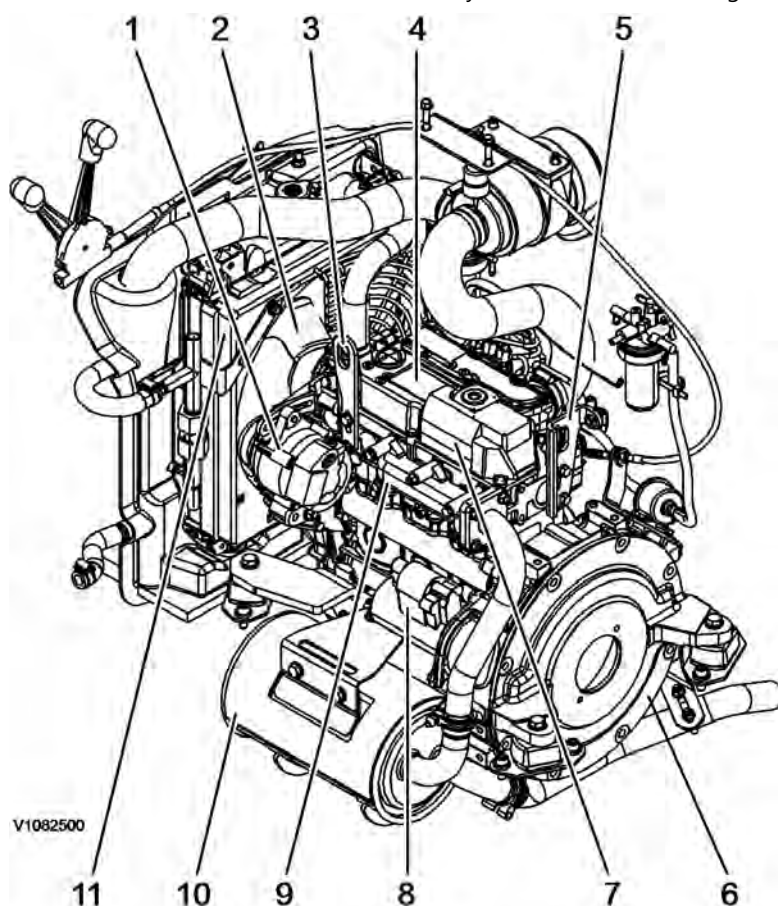


Figure 1
Engine and Components

- | | | | |
|---|-----------------------------|----|-----------------------------------|
| 1 | Alternator | 7 | Valve cover / cylinder head cover |
| 2 | Fan rotor | 8 | Starter motor |
| 3 | Lifting eye | 9 | Exhaust manifold |
| 4 | Engine identification plate | 10 | Muffler |
| 5 | Lifting eye | 11 | Radiator |
| 6 | Flywheel | | |

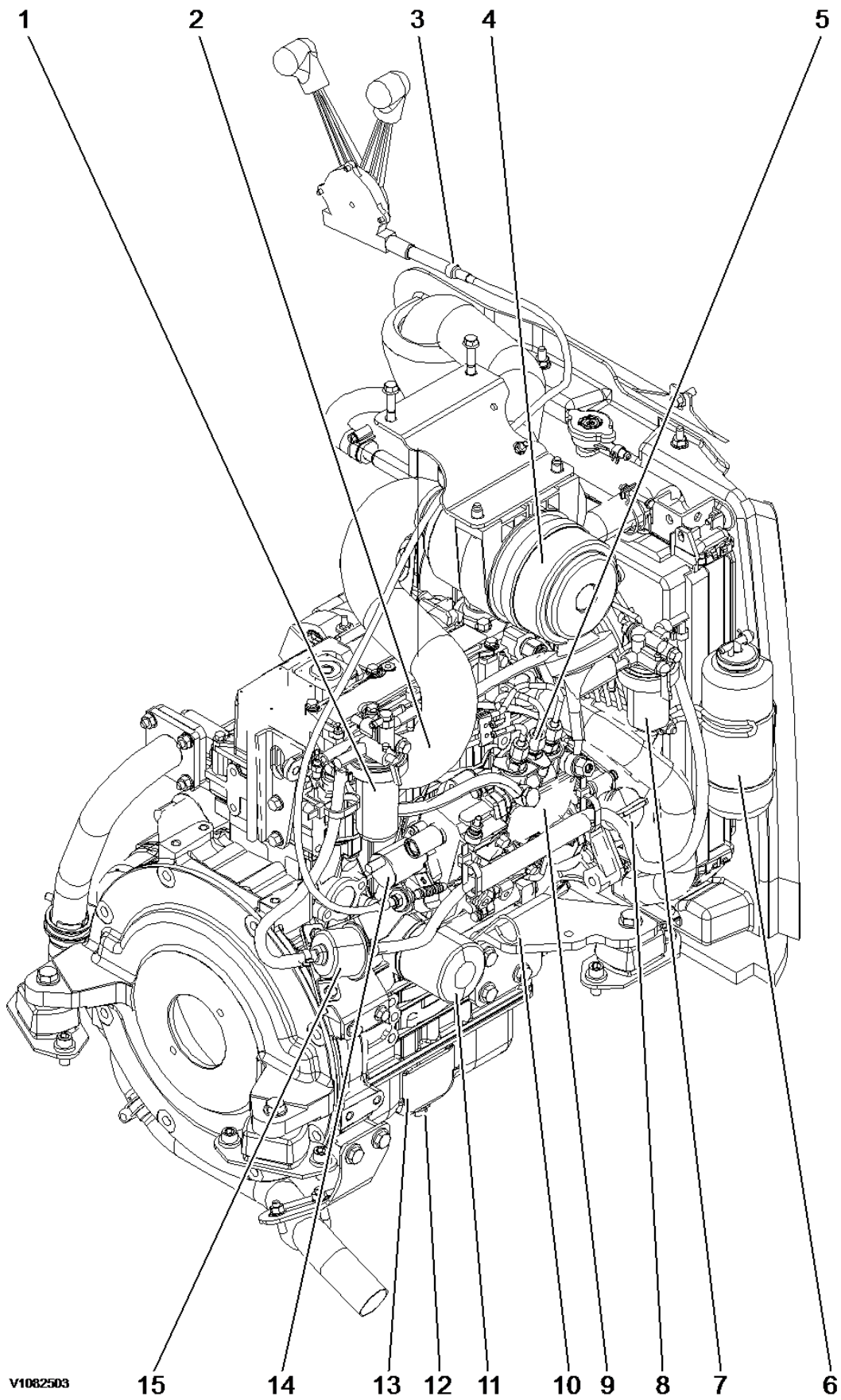


Figure 2
Engine and Components

1 Main fuel filter

9 Injection pump

- | | | | |
|---|------------------------|----|----------------------------------|
| 2 | Air intake hose | 10 | Dipstick gauge |
| 3 | Throttle cable | 11 | Engine oil filter |
| 4 | Air cleaner assembly | 12 | Gear oil outlet |
| 5 | Fuel delivery valves | 13 | Oil pan |
| 6 | Coolant expansion tank | 14 | Injection pump shutdown solenoid |
| 7 | Fuel water separator | 15 | Electric fuel feed pump |
| 8 | Oil filler pipe | | |

Document Title: Troubleshooting chart	Function Group: 200	Information Type: Service Information	Date: 2014/4/10
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Troubleshooting chart

The following table summarizes the general trouble symptoms and their causes. If any trouble symptom occurs, take corrective action before it develops into a serious problem so as not to shorten the engine service life.

Engine troubleshooting chart

Trouble symptoms	Causes	Corrective actions
Engine does not start	Improper clearance of inlet/exhaust valve	Adjust the valve clearance
	Seizure of inlet/exhaust valve	Correct or replace
	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
	Seized crankpin metal or bearing	Repair or replace
	Foreign matter trapped in combustion chamber	Disassemble and repair
	Improper open/close timing of intake/exhaust valves	Adjust the valve clearance
	Improper properties of lubricating oil	Use proper lubricating oil
	Water entrance in fuel system	Perform draining from the fuel filter
	Clogged fuel filter	Clean or replace
	Air entrance in fuel system	Perform air bleeding
	Clogged or cracked fuel pipe	Clean or replace
	Insufficient fuel supply to fuel injection pump	Check the fuel tank cock, fuel tank, fuel pipe and fuel feed pump
	Priming failure (foreign matter trapped in the valve inside the priming pump)	Disassemble and clean
	Starting motor defect	Repair or replace
	Alternator defect	Repair or replace
	Open circuit in wiring harness	Repair
	Battery voltage drop	Inspect and charge the battery
Engine starts, but stops soon. Exhaust smoke none.	Improper clearance of inlet/exhaust valve	Adjust the valve clearance
	Seized crankpin metal or bearing	Repair or replace
	Improper arrangement of piston rings joint	Correct the ring joint positions
	Defective governor	Make adjustment
	Improper properties of lubricating oil	Use proper lubricating oil
	Insufficient lubricating oil level	Add proper lubricating oil
	Clogged fuel filter	Clean or replace
	Air entrance in fuel system	Perform air bleeding
	Clogged or cracked fuel pipe	Clean or replace
	Insufficient fuel supply to fuel injection pump	Check the fuel tank cock, fuel tank, fuel pipe and fuel feed pump
Engine starts, but stops soon. Exhaust smoke excessive.	Seizure of inlet/exhaust valve	Correct or replace
	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
	Water entrance in fuel system	Perform draining from the fuel filter

Insufficient engine output. Exhaust color : ordinary	Clogged air filter	Clean
	Improper clearance of inlet/exhaust valve	Adjust the valve clearance
	Compression leakage from valve seat	Lap the valve seat
	Seizure of inlet/exhaust valve	Correct or replace
	Blowout from cylinder head gasket	Replace the gasket
	Worn crankpin and journal bearing	Measure and replace
	Improper properties of lubricating oil	Use proper lubricating oil
	Improper properties of fuel oil	Use proper fuel oil
	Clogged fuel filter	Clean or replace
	Air entrance in fuel system	Perform air bleeding
	Clogged or cracked fuel pipe	Clean or replace
	Insufficient fuel supply to fuel injection pump	Check the fuel tank cock, fuel tank, fuel pipe and fuel feed pump
	Clogged strainer at fuel feed pump inlet	Clean the strainer
Insufficient engine output. (Exhaust color : white)	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
	Improper arrangement of piston rings joint	Correct the ring joint positions
	Reverse assembly of piston ring	Reassemble correctly
	Worn inlet/exhaust valve guide	Measure and replace
	Improper open/close timing of intake/exhaust valves	Adjust the valve clearance
	Timing of fuel injection pump too late	Check and adjust
	Improper properties of fuel oil	Use proper fuel oil
	Water entrance in fuel system	Perform draining from the fuel filter
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
Insufficient engine output. (Exhaust color : black)	Compression leakage from valve seat	Lap the valve seat
	Seizure of inlet/exhaust valve	Correct or replace
	Improper open/close timing of intake/exhaust valves	Adjust the valve clearance
	Insufficient cooling effect of radiator, Defective thermostat (kept opened) or slipping fan belt	Repair or replace thermostat and fan belt
	Insufficient coolant level	Check leakage from cooling system
	Slackened fan belt	Adjust the belt tension
	Defective thermostat	Check or replace
	Timing of fuel injection pump too late	Check and adjust
	Improper properties of fuel oil	Use proper fuel oil
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
	Clogged air filter	Clean
	Engine used at high temperature or at high altitude	Study output drop and load matching
	Clogged exhaust pipe	Clean
Poor exhaust color : white (During work)	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
	Reverse assembly of piston ring	Reassemble correctly
	Improper open/close timing of intake/exhaust valves	Adjust the valve clearance
	Excessive cooling effect of radiator,	Repair or replace

Poor exhaust color : black (During work)	Defective thermostat (kept closed)	
	Defective thermostat	Check or replace
	Timing of fuel injection pump too early	Check and adjust
	Timing of fuel injection pump too late	Check and adjust
	Improper properties of fuel oil	Use proper fuel oil
	Water entrance in fuel system	Perform draining from the fuel filter
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
	Compression leakage from valve seat	Lap the valve seat
	Seizure of inlet/exhaust valve	Correct or replace
	Improper open/close timing of intake/exhaust valves	Adjust the valve clearance
	Timing of fuel injection pump too early	Check and adjust
	Timing of fuel injection pump too late	Check and adjust
	Improper properties of fuel oil	Use proper fuel oil
	Uneven injection volume of fuel injection pump	Check and adjust
	Excessive fuel injection volume	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
	Clogged air filter	Clean
	Engine used at high temperature or at high altitude	Study output drop and load matching
	Clogged exhaust pipe	Clean
High knocking sound during compression	Timing of fuel injection pump too early	Check and adjust
Abnormal engine sound	Improper clearance of inlet/exhaust valve	Adjust the valve clearance
	Compression leakage from valve seat	Lap the valve seat
	Seizure of inlet/exhaust valve	Correct or replace
	Seized or broken piston ring	Replace the piston ring
	Seized crankpin metal or bearing	Repair or replace
	Worn crankpin and journal bearing	Measure and replace
	Loosened connecting rod screw	Tighten to specified torque
	Foreign matter trapped in combustion chamber	Disassemble and repair
	Excessive gear backlash	Adjust gear and repair
	Improper open/close timing of intake/exhaust valves	Adjust the valve clearance
Uneven combustion sound	Improper properties of fuel oil	Use proper fuel oil
	Water entrance in fuel system	Perform draining from the fuel filter
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
	Clogged air filter	Clean
	Clogged exhaust pipe	Clean
Hunting during idling	Seized or broken piston ring	Replace the piston ring
	Seized crankpin metal or bearing	Repair or replace
	Worn crankpin and journal bearing	Measure and replace
	Defective governor	Make adjustment
	Water entrance in fuel system	Perform draining from the fuel filter
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
Hunting during work	Seizure of inlet/exhaust valve	Correct or replace

Large engine vibration	Seized crankpin metal or bearing	Repair or replace
	Worn crankpin and journal bearing	Measure and replace
	Defective governor	Make adjustment
	Water entrance in fuel system	Perform draining from the fuel filter
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
	Seizure of inlet/exhaust valve	Correct or replace
	Seized or broken piston ring	Replace the piston ring
	Seized crankpin metal or bearing	Repair or replace
	Worn crankpin and journal bearing	Measure and replace
	Loosened connecting rod screw	Tighten to specified torque
	Defective governor	Make adjustment
	Timing of fuel injection pump too early	Check and adjust
	Uneven injection volume of fuel injection pump	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
Difficulty in returning to low speed	Defective governor	Make adjustment
Excessive fuel consumption	Compression leakage from valve seat	Lap the valve seat
	Excessive cooling effect of radiator, Defective thermostat (kept closed)	Repair or replace
	Timing of fuel injection pump too late	Check and adjust
	Excessive fuel injection volume	Check and adjust
	Poor spray pattern from fuel injection nozzle	Check and adjust
	Engine used at high temperature or at high altitude	Study output drop and load matching
Excessive lubricating oil consumption	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
	Improper arrangement of piston rings joint	Correct the ring joint positions
	Reverse assembly of piston ring	Reassemble correctly
	Foreign matter trapped in combustion chamber	Disassemble and repair
	Worn inlet/exhaust valve guide	Measure and replace
	Improper properties of lubricating oil	Use proper lubricating oil
	Leakage from lubricating oil piping system	Repair
	Excessive fuel injection volume	Check and adjust
Lubricating oil diluted by fuel	Seizure of inlet/exhaust valve	Correct or replace
	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
Lubricating oil mixed with water	Blowout from cylinder head gasket	Replace the gasket
	Cracked water jacket	Repair or replace
Low lubricating oil pressure	Worn crankpin and journal bearing	Measure and replace
	Loosened connecting rod screw	Tighten to specified torque
	Cracked water jacket	Repair or replace
	Improper properties of lubricating oil	Use proper lubricating oil
	Leakage from lubricating oil piping system	Repair
	Insufficient delivery capacity of trochoid pump	Check and repair
	Clogged lubricating oil filter	Clean or replace
	Defective pressure regulating valve	Check, adjust or replace
	Insufficient lubricating oil level	Add proper lubricating oil
Excessive blow-by gas	Compression leakage from valve seat	Lap the valve seat

Overheating of coolant	Seizure of inlet/exhaust valve	Correct or replace
	Seized or broken piston ring	Replace the piston ring
	Worn piston ring, piston or cylinder	Perform honing and use oversize parts
	Seized crankpin metal or bearing	Repair or replace
	Improper arrangement of piston rings joint	Correct the ring joint positions
	Reverse assembly of piston ring	Reassemble correctly
	Foreign matter trapped in combustion chamber	Disassemble and repair
	Worn inlet/exhaust valve guide	Measure and replace
	Improper properties of lubricating oil	Use proper lubricating oil
	Clogged lubricating oil filter	Clean or replace
	Excessive fuel injection volume	Check and adjust
	Blowout from cylinder head gasket	Replace the gasket
	Seized or broken piston ring	Replace the piston ring
	Insufficient cooling effect of radiator, Defective thermostat (kept opened) or slipping fan belt	Repair or replace thermostat and fan belt
	Insufficient coolant level	Check leakage from cooling system
	Cracked water jacket	Repair or replace
	Slackened fan belt	Adjust the belt tension
	Defective thermostat	Check or replace
	Excessive fuel injection volume	Check and adjust
	Engine used at high temperature or at high altitude	Study output drop and load matching
Low coolant temperature	Excessive cooling effect of radiator, Defective thermostat (kept closed)	Repair or replace
	Defective thermostat	Check or replace
Air inlet pressure drop	Improper clearance of inlet/exhaust valve	Adjust the valve clearance
	Compression leakage from valve seat	Lap the valve seat
	Seizure of inlet/exhaust valve	Correct or replace
	Clogged air filter	Clean
	Engine used at high temperature or at high altitude	Study output drop and load matching
Air inlet pressure rise	Excessive fuel injection volume	Check and adjust
Exhaust temperature rise	Improper clearance of inlet/exhaust valve	Adjust the valve clearance
	Compression leakage from valve seat	Lap the valve seat
	Seized or broken piston ring	Replace the piston ring
	Insufficient cooling effect of radiator, Defective thermostat (kept opened) or slipping fan belt	Repair or replace thermostat and fan belt
	Insufficient coolant level	Check leakage from cooling system
	Slackened fan belt	Adjust the belt tension
	Timing of fuel injection pump too late	Check and adjust
	Uneven injection volume of fuel injection pump	Check and adjust
	Excessive fuel injection volume	Check and adjust
	Clogged exhaust pipe	Clean

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Engine, removing

Op nbr 210-070

Lifting device

Seat belt, 2m

Seat belt, 0.5m

2 Shackle



WARNING

The work involves handling heavy components - failure to stay alert may result in severe crushing injuries.

1. Place the machine in the service position 1, see [191 Service position 1](#)
2. Set the battery disconnect switch to the Off position.

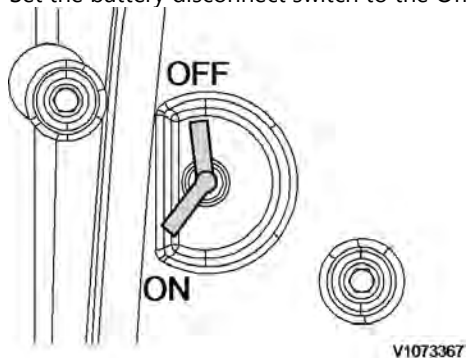


Figure 1
Battery disconnection switch

3. Turn fuel cock to position C.

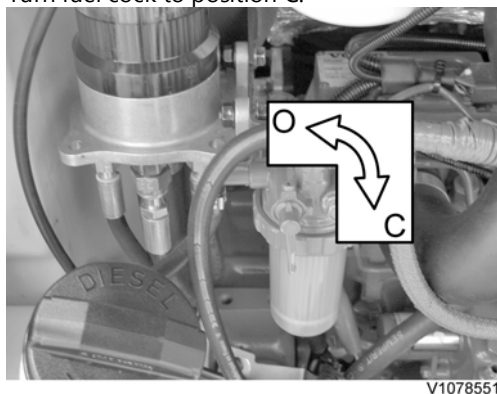


Figure 2
Main fuel filter

4. Turn fuel cock to position C.

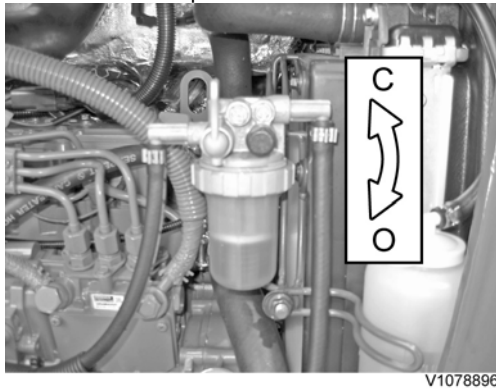


Figure 3
Water separator

5. Remove upper left-hand side panel.

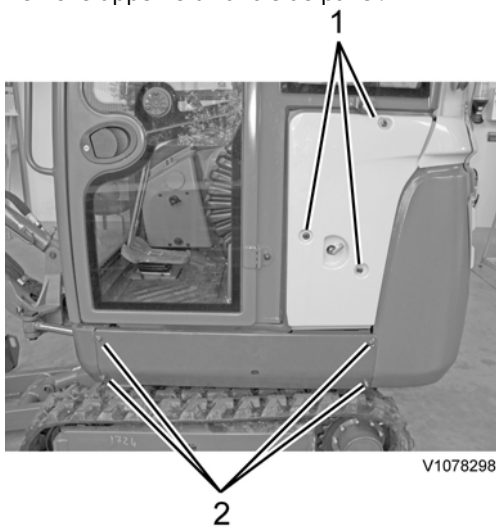


Figure 4
Left-hand side panels, remove

1. Attaching screws
2. Attaching screws

6. Remove lower left-hand side panel.



If the battery's plus terminal is short-circuited to the minus terminal or to the chassis, there is a risk of explosion or fire. Therefore, always protect the battery terminals.

7. Disconnect ground terminal (1) at battery.

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