Document Title: **Engine, description**	Function Group: **200**	Information Type: **Service Information**	Date: **2014/4/14**
Profile: **CEX, ECR28 [GB]**			

Engine, description

Model code (3TNV76)

Model code

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

- The engine is a 3–cylinder, indirect injected, water cooled diesel engine.

Engine, front view

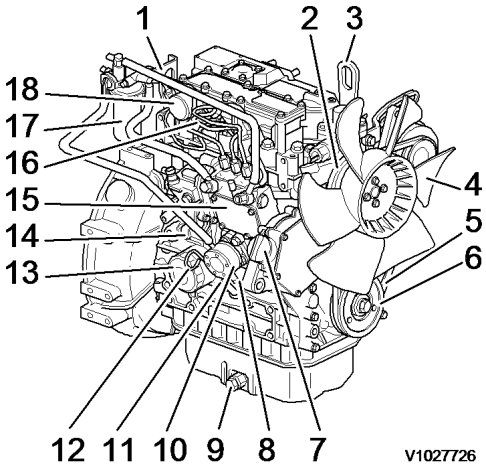

Figure 1
Engine, front view

1. Lifting eye
2. Cooling water pump
3. Lifting eye
4. Fan
5. V-belt
6. V-pulley
7. Filler port (lube oil)
8. Fuel oil inlet
9. Drain plug (lube oil)
10. Mechanical fuel feeding pump
11. Fuel priming lever
12. Dipstick
13. Oil filter
14. Governor lever
15. Fuel injection pump
16. Intake manifold
17. Fuel filter
18. Air intake port

Engine, rear view

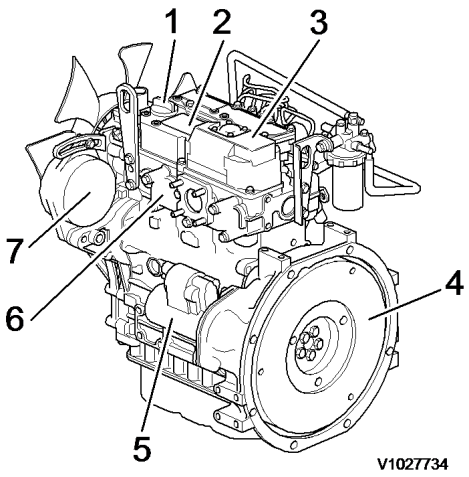

Figure 2
Engine, rear view

1. Filler port (lube oil)
2. Bonnet (rocker arm cover)
3. Engine name plate
4. Flywheel
5. Starter motor
6. Exhaust manifold
7. Alternator

Document Title:	Function Group:	Information Type:	Date:
Precautions	**200**	**Service Information**	**2014/4/14**
Profile: **CEX, ECR28 [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.

VOLVO

Construction Equipment

Service Information

Document Title:	Function Group:	Information Type:	Date:
Periodic inspection and maintenance procedure	**200**	**Service Information**	**2014/4/14**
Profile: **CEX, ECR28 [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.

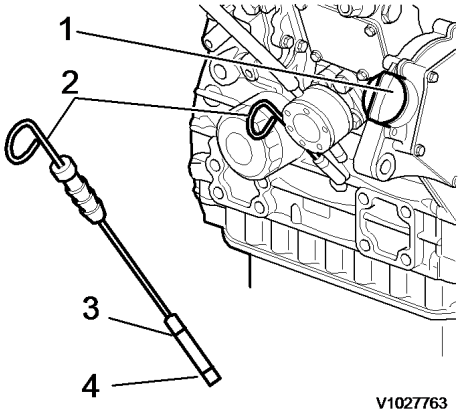

Figure 1
Checking oil level and replenishing with engine oil

1. Filler port (lube oil)
2. Dipstick
3. Upper limit
4. Lower limit

Engine oil capacity, unit: liter (gal.)

Total volume	Effective volume

3.5 (0.92)	1.6 (0.42)

- 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.

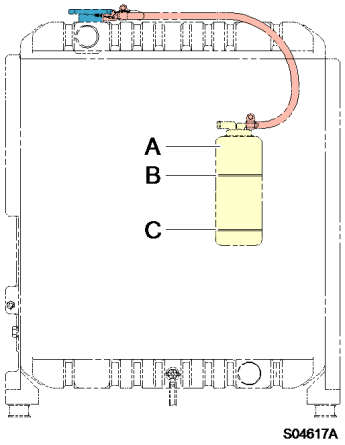

Figure 2
Checking, coolant level in the sub-tank

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.

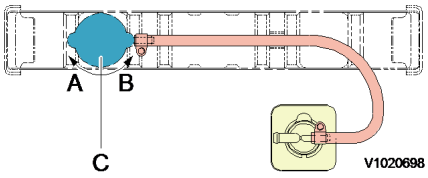

Figure 3
Replenishment, coolant

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
0.9 (0.23)

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

WARNING

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.

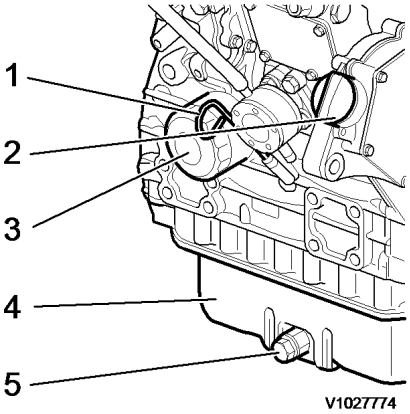

Figure 4
Dipstick gauge, oil pan and drain plug

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

- 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: 119305-35150.

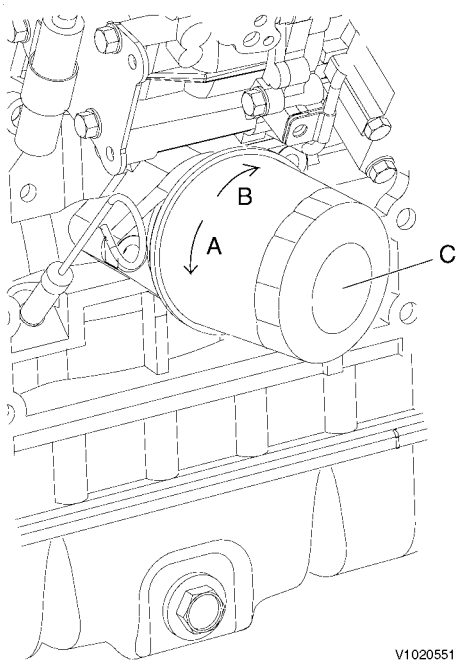

Figure 5
Replacement, engine oil filter

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.

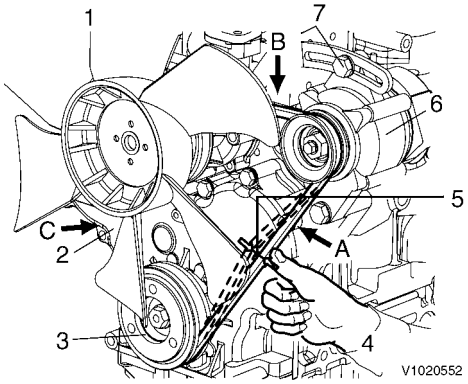

Figure 6
Checking and adjustment, radiator fan V-belt

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.

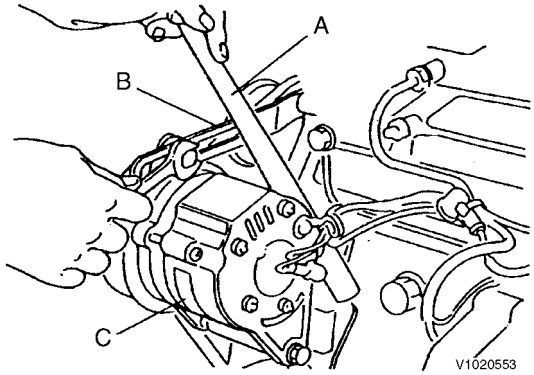

Figure 7
Adjustment, V-belt tension

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

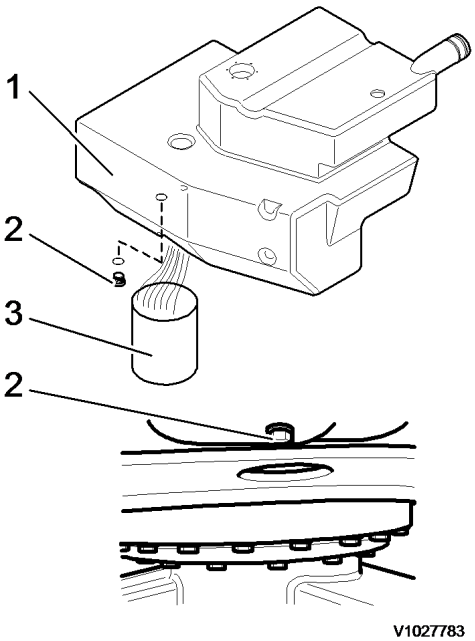

Figure 8
Draining, fuel tank

1. Fuel tank
2. Drain plug
3. Oil container

- 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.

Draining of the oil/water separator

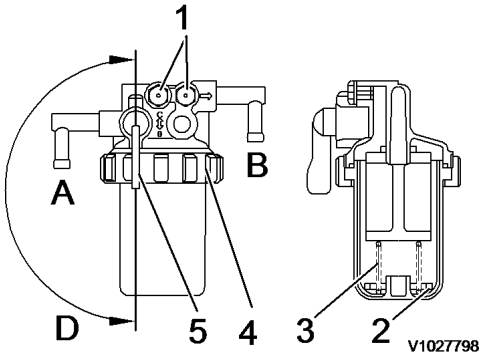

Figure 9
Draining, oil/water separator

1. Air bleeding screw
2. Float ring
3. Retaining spring
4. Retaining ring
5. Fuel cock

A. Inlet
B. Outlet
C. Close
D. Open

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.

- Close the fuel cock.
- Loosen the retainer ring, and remove the cup, then throw collected water and trash away.
- Put a float ring and a spring in the cup and tighten the retainer ring.
  Tightening torque: 13 ~ 16 Nm (1.3 ~ 1.6 Kgf.m).
- Be sure to bleed off any air in the fuel system.

Bleeding the fuel system

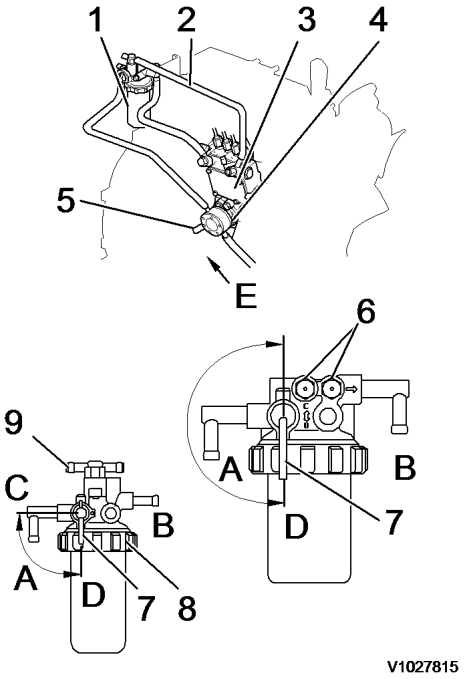

Figure 10
Bleeding, fuel system

1. Fuel filter
2. Fuel return hose
3. Fuel injection pump
4. Mechanical fuel feed pump
5. Priming lever
6. Air bleeding screw
7. Fuel cock
8. Retaining ring
9. Joint for fuel return

A. Inlet
B. Outlet
C. Close
D. Open
E. From oil/water separator

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.
    - Move the priming lever by hand up and down, and feed fuel until the fuel surface inside the fuel filter cup goes up and the air disappears inside. (Move the lever until feeling your hand slightly heavy).
      Don't do air bleeding by a starting motor.

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

- Keep the area around the battery well ventilated, paying attention to keep away any fire source. During operation or charging, hydrogen gas is generated from the battery and can be easily ignited.

NOTE!
Do not come in contact with battery electrolyte

- Pay sufficient attention to protect your eyes or skin from being in contact with the fluid. The battery electrolyte is diluted sulfuric acid and causes burns. Wash it off immediately with a large amount of fresh water if you get any on you.

Battery structure

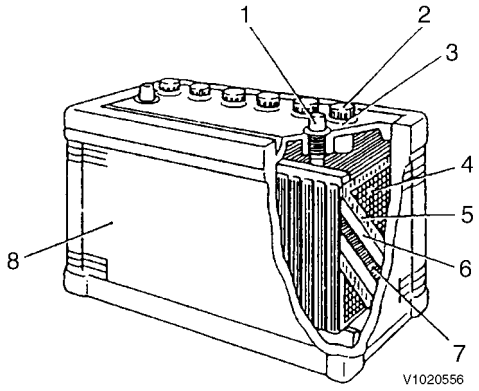

Figure 11
Structure, battery

1. Terminal
2. Cap
3. Cover
4. Cathode plate
5. Separator
6. Glass mat
7. Anode plate
8. Battery case

Electrolyte level

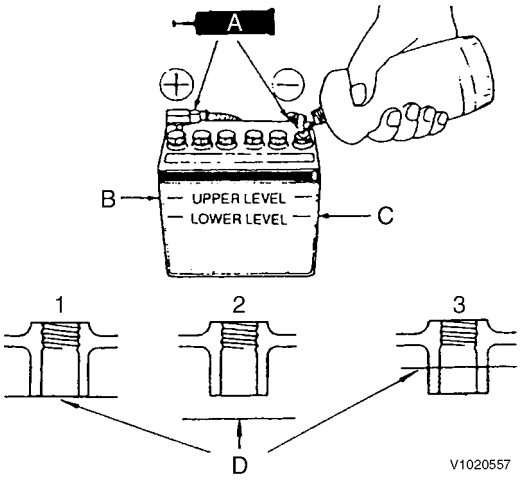

Figure 12
Checking, electrolyte level

1	OK
2	Too low
3	Excessive
A	Grease
B	Upper limit
C	Lower limit
D	Electrolyte level

- Check the level of fluid in the battery.
  When the amount of fluid nears the lower limit, fill with battery fluid (available in the market) to the upper limit. If operation continues with insufficient battery fluid, the battery life is shortened, and the battery may overheat and explode.
- Battery fluid tends to evaporate more quickly in the summer, and the fluid level should be checked earlier than the specified times.
- If the engine cranking speed is so slow that the engine does not start up, recharge the battery.
- If the engine still will not start after charging, replace the battery.
- Remove the battery from the battery mounting of the machine after daily use if leaving the machine in a place that the ambient temperature could drop at -15 °C (5 °F)or less. And store the battery in a warm place until the next use, to start the engine easily at low ambient temperature.

Battery charge

Use a battery tester or hydrometer and check the battery condition. If the battery is discharged, recharge it.

Measurement with a battery tester

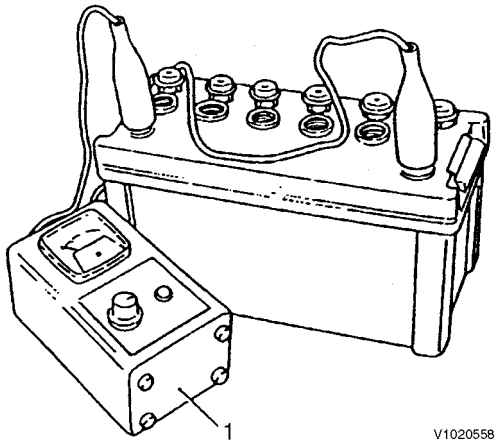

Figure 13
Measurement, battery charge

1. Tester

When checking the battery with the batter tester, connect the red clip of the tester to the battery positive (+) terminal and black clip to the battery negative (–) terminal by pinching them securely, and judge the battery charge level from the indicator position.
Green zone: Normal
Yellow zone: Slightly discharged
Red zone: Defective or excessively discharged

Measurement with hydrometer

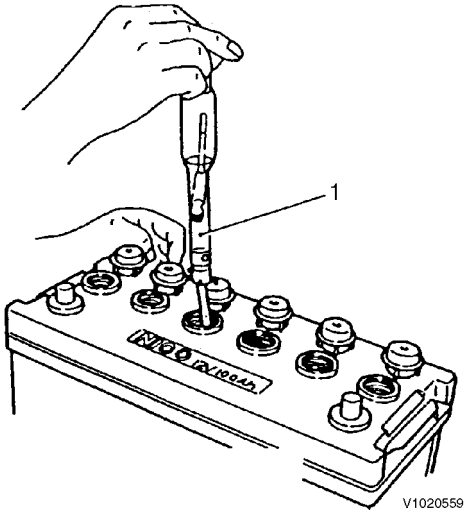

Figure 14
Measurement, battery charge

1. Float

When using a hydrometer, the measured specific gravity must be corrected according to the temperature at the time of measurement. The specific gravity of battery electrolyte is defined with 20 C (68 °F) as the standard. Since the specific gravity increases or decreases by 0.0007 when the temperature varies by 1 C (33.8 °F), correct the value according to the equation below.
S20 = St + 0.007 (t-20)
where to,
S20 = Converted specific gravity at 20 C (68 °F)
St = Specific gravity at measurement
t = Electrolyte temperature at measurement

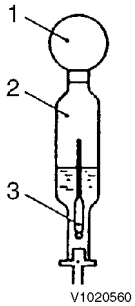

Figure 15
Hydrometer structure

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