Document Title: **Engine, description**	Function Group: **200**	Information Type: **Service Information**	Date: **2014/4/6 0**
Profile: **CEX, ECR58 [GB]**			

Engine, description

Model code

Model code

Symbol	Description	Remarks
D	Diesel Engine	
3.1,3.4	Displacement	
C	is the letter for Compact Equipment Blank	
A	is describing the performance version, A is the first version and the letter B will then be the second version if the performance is upgraded	
E	is the emission letter	
2	a number from 0 to 4 describing the emission level (Tier), E0 is then nonregulated	
E	Excavator	
C,W	Crawler Type, Wheel Type	
1,2,3,4	Order of Project in Korea	
U,K	Desiganation USA/Europe, Korea/International	

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

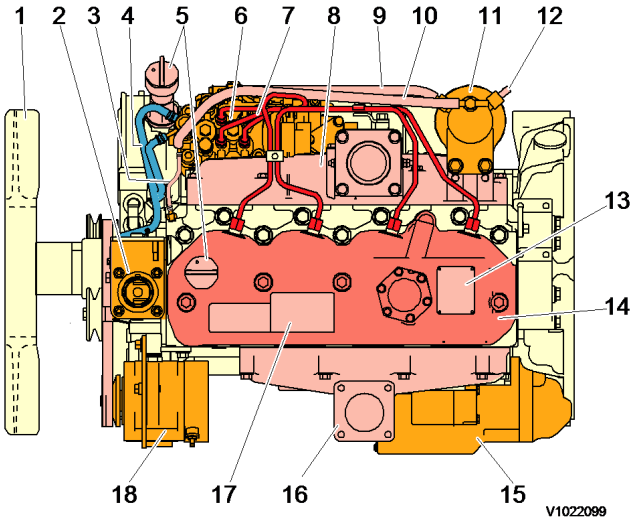

Figure 1
Engine, top side view

1	Cooling fan	7	Fuel pipe	13	Engine data plate
2	Thermostat housing	8	Intake manifold	14	Rocker arm cover
3	Fuel return line Flywheel	9	Fuel supply line to fuel injection pump	15	Start motor

4	Hose for thermostat element	10	Fuel return line	16	Exhaust manifold
5	Oil filler port	11	Fuel filter	17	Engine data plate
6	Fuel injection pump	12	Fuel supply line to fuel filter	18	Alternator

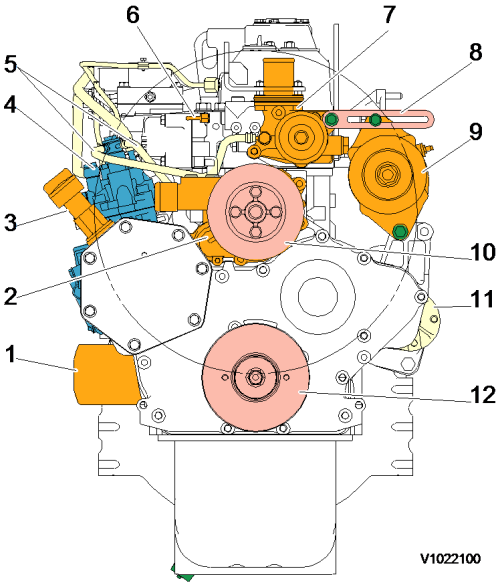

Figure 2
Engine, front side view

1	Engine oil filter	5	Hose for thermostat element	9	Alternator
2	Cooling water pump	6	Fuel return line	10	Fan pulley
3	Engine oil filler port	7	Thermostat housing	11	Starter motor
4	Fuel injection pump	8	Adjuster	12	Crankshaft V-pulley

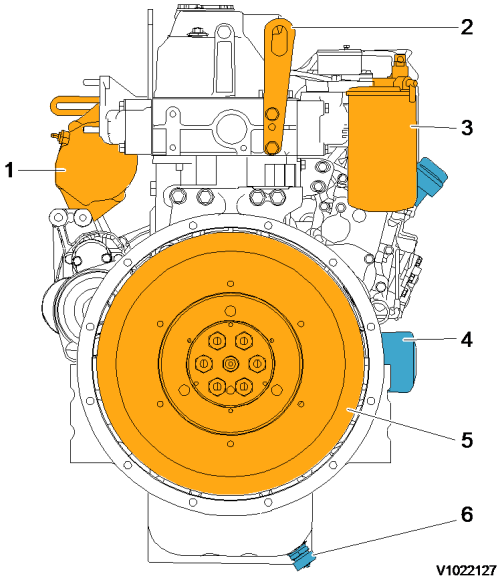

Figure 3
Engine, rear side view

1. Alternator
2. Lifting bracket
3. Fuel filler

4. Engine oil filter
5. Flywheel
6. Oil drain valve (M22 x 1.5P)

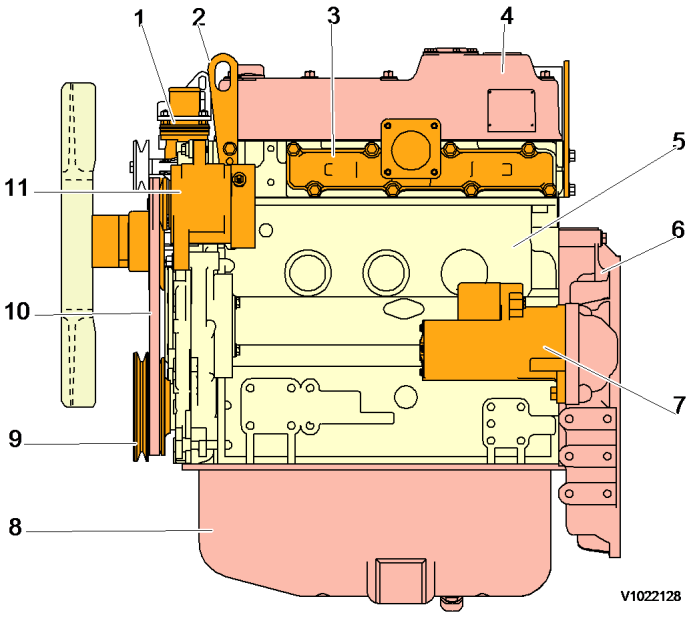

Figure 4
Engine, starter motor side view

1	Thermostat housing	7	Starter motor
2	Lifting eye	8	Engine oil pan
3	Exhaust manifold	9	Crankshaft V-pully
4	Rocker arm cover	10	V-belt
5	Cylinder block	11	Alternator
6	Flywheel housing		

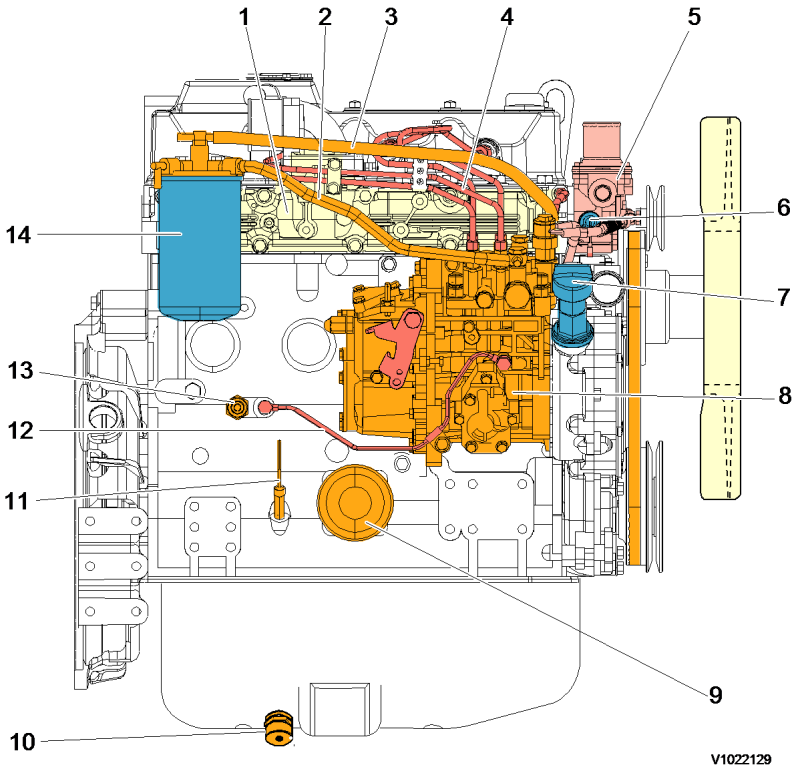

Figure 5
Engine, fuel filter side view

1	Intake manifold	6	C. W. switch	11	Engine oil dipstick
2	Fuel supply line	7	Oil filler port	12	Injection pump lubricant pipe
3	Fuel return line	8	Fuel injection pump	13	Oil pressure switch
4	Fuel injection pipe	9	Engine oil filter	14	Fuel filter
5	Thermostat housing	10	Engine oil drain valve		

Engine performance curve

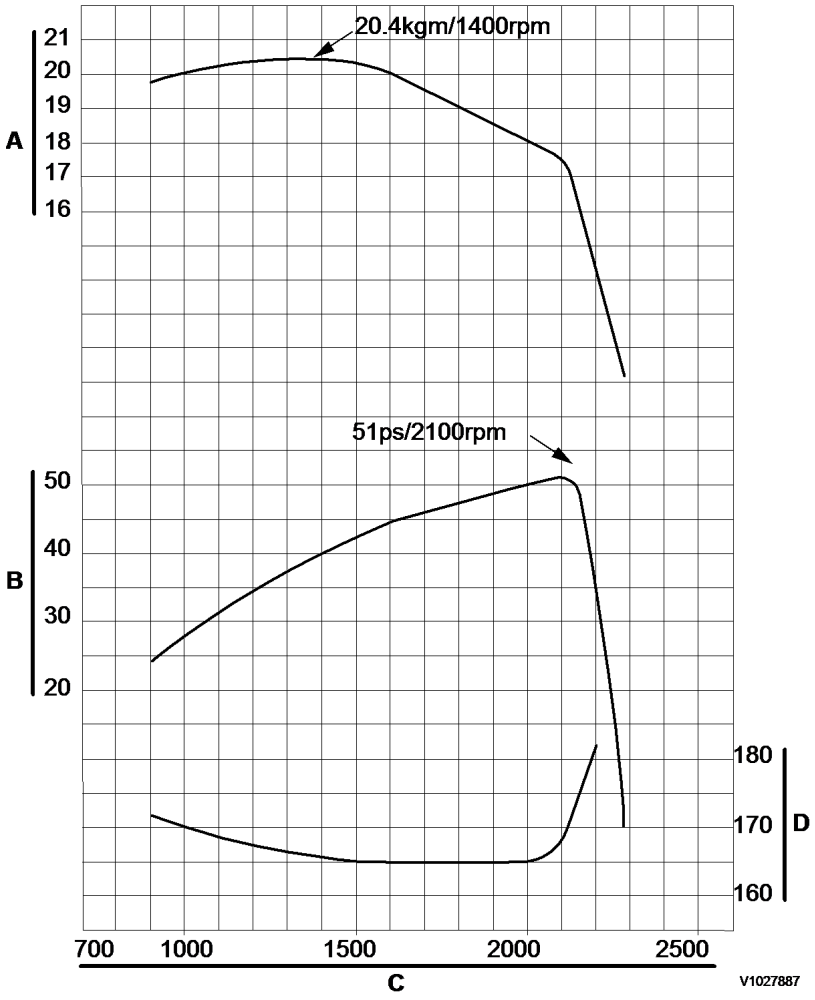

Figure 6
Engine performance curve

A. Torque (kg·m)
B. Power (PS)
C. Speed (rpm)
D. Fuel consumption (g/ps·hr)

Document Title: **Engine, tightening torque**	Function Group: **200**	Information Type: **Service Information**	Date: **2014/4/6 0**
Profile: **CEX, ECR58 [GB]**			

Engine, tightening torque

Tightening torque, unit: Nm (lbf ft)

Item	Nominal size	Tighten torque	Lubricating oil application (thread portion, and seat surface)
Cylinder head screw	M 11 × 1.25	103.1 ~ 112.9 (76 ~ 83)	Applied
Connecting rod screw	M10 × 1.0	53.9 ~ 58.8 (40 ~ 43)	Applied
Flywheel set screw	M14 × 1.5	186.2 ~ 205.8 (137 ~ 152)	Applied
Bearing cap set screw	M 11 × 1.25	108.1 ~ 117.9 (80 ~ 87)	Applied
Crankshaft pulley set screw	M14 × 1.5	107.9 ~ 127.5 (80 ~ 94)	Applied
Fuel injection nozzle set screw	M 8 × 1.25	22.6 ~ 28.4 (17 ~ 21)	Not applied
Fuel feed pump drive gear set nut	M 18 × 1.5	113 ~ 123 (83 ~ 90)	Not applied
High-pressure fuel lines screw	M 12 × 1.5	19.6 ~ 24.5 (174 ~ 217)	Not applied
Fuel return pipe joint screw	M 6 × 1.0	7.8 ~ 9.8 (70 ~ 86)	Not applied

Tightening torque for standard screws and nuts, unit: Nm (lbf ft)

Item	Nominal size	Tighten torque	Lubricating oil application (thread portion, and seat surface)
Screw (7T) and nut	M 6 × 1.0	9.8 ~ 11.8 (7 ~ 9)	• Use 80% of the value at left when the tightening part is aluminium. • Use 60% of the value at left for 4T screws and lock nuts.
	M 8 × 1.25	22.6 ~ 28.4 (17 ~ 21)	
	M 10 × 1.5	44.1 ~ 53.9 (33 ~ 40)	
	M 12 × 1.75	78.4 ~ 98 (58 ~ 72)	
	M 14 × 1.5	127.5 ~ 147.1 (94 ~ 108)	
	M 16 × 1.5	215.7 ~ 235.4 (157 ~ 174)	
PT plug	1/8	9.8 (7)	
	1/4	19.6 (14)	
	3/8	29.4 (22)	
	1/2	58.5 (43)	
Pipe joint screw	M 8	12.7 ~ 16.7 (9 ~ 12)	
	M 10	19.6 ~ 25.5 (14 ~ 19)	
	M 12	24.5 ~ 34.3 (18 ~ 25)	
	M 14	39.2 ~ 49 (29 ~ 36)	
	M 16	49 ~ 58.8 (36 ~ 43)	

NOTE!
Lubricating oil is not applied to threaded portion and seat surface.

VOLVO

Construction Equipment

Service Information

Document Title: **Periodic inspection and maintenance procedure**	Function Group: **200**	Information Type: **Service Information**	Date: **2014/4/6 0**
Profile: **CEX, ECR58 [GB]**			

Periodic inspection and maintenance procedure

Check before daily operation

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

If any problem is found, do not use the machine before the engine repairs have been completed.

- Oil leak from the lubrication system
- Fuel leak from the fuel system
- Coolant leak from the cooling system
- Damaged parts
- Loosened or lost screws
- Fuel, radiator rubber hoses cracked, loosened clamp

Thermostat and Thermal Switch Inspection

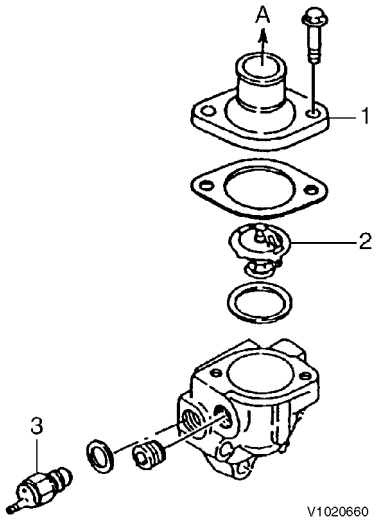

Figure 1
Thermostat

1. Cover
2. Thermostat
3. Thermostat switch

A. To radiator

1. Thermostat
   Place the thermostat in a container filled with water.
   Heat it while measuring the water temperature, and see that the thermostat is actuated at the temperature of following table.

Valve opening temperature, °C (°F)	Full open lift, mm (°C, °F)
69.5 ~ 72.5 (157.1 ~ 162.5)	8 mm or more (85 °C, 185 °F)

NOTE!
Valve opening temperature is scribed on the flange.

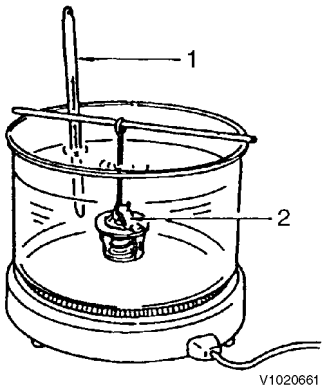

Figure 2
Thermostat inspection

1. Thermometer
2. Thermostat

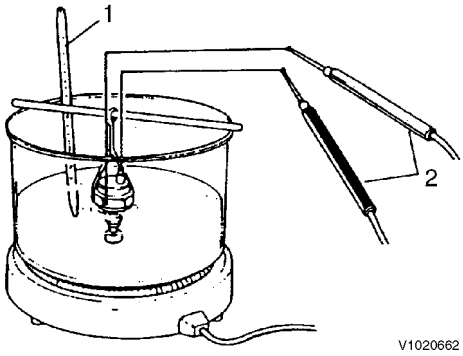

Figure 3
Thermostat switch inspection

1. Thermometer
2. Tester probes

2. Thermostat switch
   Place the thermostat switch in a container filled with antifreeze or oil. Heat it while measuring the fluid temperature. The switch is normal if the multi-meter shows continuity when the fluid temperature is 107 ~ 113 °C (225 ~ 235 °F).

- Inspection and replacement of fuel pipe and cooling pipes/hoses.
  - Regularly check the rubber hoses of the fuel system and cooling system. If cracked or degraded, replace them with new ones. Replace the rubber hoses at least every 2 years.
- Lapping the intake and exhaust valves
  - The adjustment is necessary to maintain proper contact of the valves and seats.
- Fuel injection timing inspection and adjustment

Sensor inspection

- Oil pressure switch
  Disconnect the connector from the oil pressure switch. Keep the multi-meter probes in contact with the switch terminal and cylinder block while operating the engine. If is abnormal if circuit is closed.
- Thermostat switch

Coolant leak check in cooling system

- Check coolant leakage from the cooling system visually. If any problem is found, Inspect as follows :

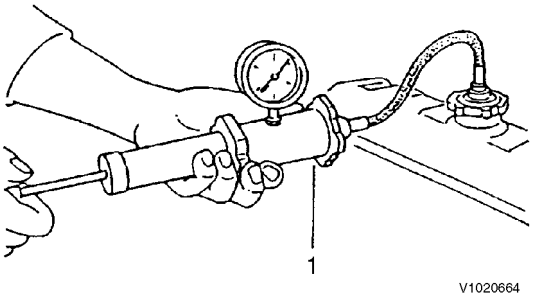

Figure 5
Water leak check in coolant system

1. Cap tester

- Fill coolant to the normal level in the radiator, and install the cap tester on the radiator.
- Operate the manual pump to set the pressure to 0.9 ± 0.15 kgf/cm2(12.8 ± 2.1 psi). If the cap tester pressure gage reading drops then, coolant is leaking from the cooling system. Check and repair the coolant leaking point.

Radiator cap inspection

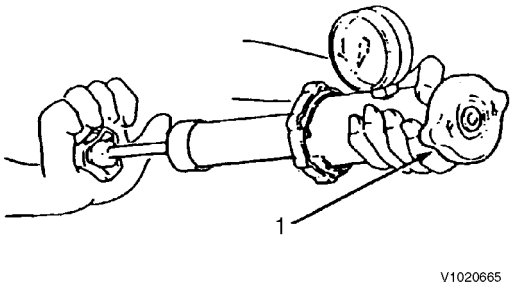

Figure 6
Radiator cap inspection

1. Radiator cap

- Install the radiator cap on the cap tester. Set the tester pressure to 0.9 ± 0.15 kgf/cm2(12.8 ± 2.1 psi) and check that the cap relief valve is opened. If the relief valve does not open, replace the cap since it is abnormal.

Document Title: **Compression pressure inspection**	Function Group: **210**	Information Type: **Service Information**	Date: **2014/4/6 0**
Profile: **CEX, ECR58 [GB]**			

Compression pressure inspection

Compression pressure drop is one of major causes of increasing blow-by gas (lubricating oil contamination or increased lubricating oil consumption as a resultant phenomenon) or starting failure. The compression pressure is affected by the following factors:

1. Degree of clearance between piston and cylinder
2. Degree of clearance at intake/exhaust valve seat
3. Gas leak from nozzle gasket or cylinder head gasket

In other words, the pressure drops due to increased parts wear and reduced durability resulting from long use of the engine. A pressure drop may also be caused by scratched cylinder or piston by dust entrance from the dirty air cleaner element or worn or broken piston ring. Measure the compression pressure to diagnose presence of any abnormality in the engine.

Compression pressure measurement method

1. After warming up the engine, remove the fuel injection nozzle from the cylinder to be measured.

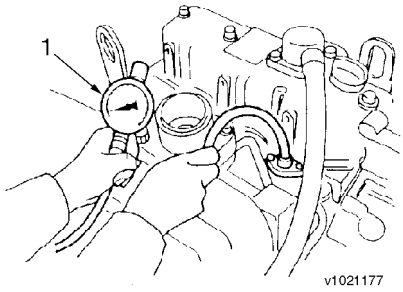

Figure 1
Measuring the compression pressure

1. Compression gauge

2. Crank the engine before installing the compression gauge adapter.
   - Perform cranking with the stop handle at the stop position (no injection state).
3. Install the compression gauge and compression gauge adapter at the cylinder to be measured.
   NOTE!
   Do not forget to install a gasket at the tip end of the adapter.
4. Crank the engine by the starting motor until the compression gage reading is stabilized.

Standard compression pressure

- Standard: 3.43 ±0.098 MPa (35 ±1 kgf/cm2) (498 ±14 psi) (34.32 ±0.98 bar)
- Limit: 2.74 MPa (28 kgf/cm2) (398 psi) (27.4 bar)
- Dispersion among cylinders: 0.19 ~ 0.29 MPa (2 ~ 3 kgf/cm2) (28 ~ 43 psi) (1.96 ~ 2.94 bar)

Engine speed and compression pressure

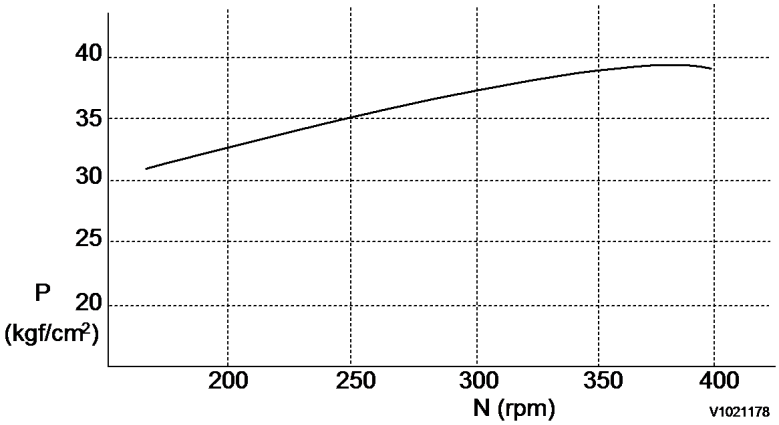

Figure 2
Engine speed and compression pressure

- P: Compression pressure
- N: Engine speed

Check items

When the measured compression pressure is below the limit value, inspect each part by referring to the table below.

Compression pressure check items

Item	Cause	Corrective action
Air cleaner element	• Clogged element • Broken element • Defect at element seal portion	• Clean the element. • Replace the element.
Valve clearance	• Excessive or no clearance	• Adjust the valve clearance.
Valve timing	• Incorrect valve clearance	• Adjust the valve clearance.
Cylinder head gasket	• Gas leak from gasket	• Replace the gasket. • Retighten the cylinder head screws to the specified torque.
Inlet/exhaust valve Valve seat	• Gas leak due to worn valve seat or foreign matter • Sticking valve	• Lap the valve seat. • Replace the inlet/exhaust valve.
Piston Piston ring Cylinder	• Gas leak due to scoring or wear	• Perform honing or boring/honing and use an oversized part.

Document Title:	Function Group:	Information Type:	Date:
Adjusting operation	**210**	**Service Information**	**2014/4/6 0**
Profile: **CEX, ECR58 [GB]**			

Adjusting operation

Perform adjusting operation as follows after the maintenance job:

- Supply the fuel oil, lubricating oil and coolant.

NOTE!
Check the levels of the lubricating oil and coolant again after test running (for about 5 minutes) and add as required.

- Start the engine, and carry out idling at a low revolution (700 ~ 900 rpm) for a few minutes.
- Run in the engine for about five minutes at the rated revolution (no–load). Check for coolant, fuel or oil leaks and existence of abnormal vibration or noise. Also check the oil pressure, coolant temperature and exhaust gas color.
- Adjust the no–load minimum and maximum revolutions according to the specifications.
- Perform loaded operation as required.

Long storage
Observe the following instructions when the engine is to be stored for a long period without operation:

- Always drain coolant in a cold season or before extended storage. (This is unnecessary when antifreeze is used.)

NOTE!
Negligence of water draining will cause the water remaining inside the engine to freeze and expanded, damaging the engine cooling system components.

- Coolant draining procedure

    1. Remove the radiator cap.
    2. Loosen the draining cock under the radiator to drain coolant.
    3. Loosen the drain cock on the side of the engine block to drain coolant.
    4. After draining coolant, tighten the radiator cap and drain plug and cocks.

- Remove all mud, dust, oil deposits and thoroughly clean the engine and attached components.
- Perform the nearest periodic inspection before the storage.
- Drain or fill the fuel oil fully to prevent condensation in the fuel tank.
- Disconnect the battery cable from the battery negative terminal.
- Cover the silencer, air cleaner and electric parts with PVC cover to prevent water and dust from depositing or entrance.
- Select a well–ventilated location without moisture and dust for storage.
- Perform battery recharging once a month during storage to compensate for self–discharge.

Checking and adjusting radiator fan V-belt

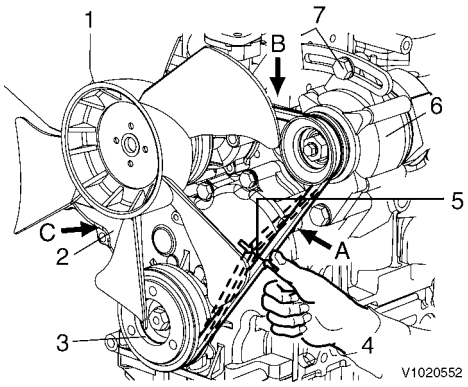

Figure 1
Checking and adjustment, radiator fan V-belt

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

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 [approximately 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.

    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)

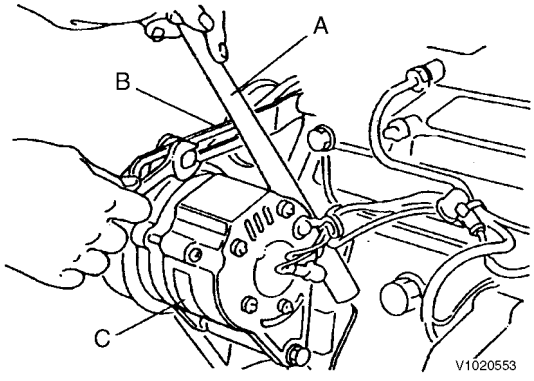

Figure 2
Adjustment, V-belt tension

A. Bar
B. Adjuster
C. Alternator

- 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.

- Inspection and adjustment: Injection pressure and spray pattern of fuel injection valve

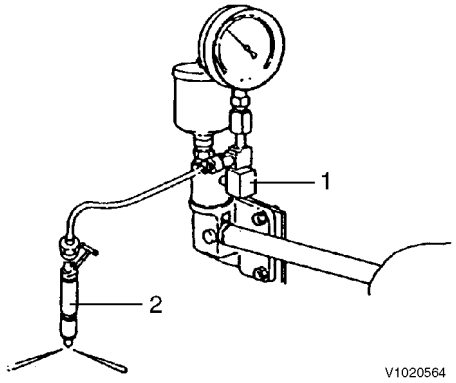

Figure 3
Injection pressure measurement

1. Nozzle tester
2. Injection nozzle

- Injection pressure measurement
  : 225 ± 5 kgf/cm2 (3200 ± 71 psi)
  Remove carbon deposit at the nozzle hole thoroughly before measurement.

  - Connect the fuel injection valve to the high pressure pipe of the nozzle tester.
  - Operate the nozzle tester lever slowly and read the pressure at the moment when the fuel injection from the nozzle starts.
  - If the measured injection pressure is lower than the standard level, replace the pressure adjusting shim with a thicker one.

    Injection pressure adjustment

Type of pressure adjusting shim thickness, mm (in)	**Injection pressure adjustment**
0.13(0.0051), 0.15(0.0059), 0.18(0.0071), 0.4(0.0157), 0.5(0.0197), 0.8(0.0315)	The injection pressure is increased by approximately 19 kgf/cm2 (270 psi) when the adjusting shim thickness is increased by 0.1 mm (0.004).

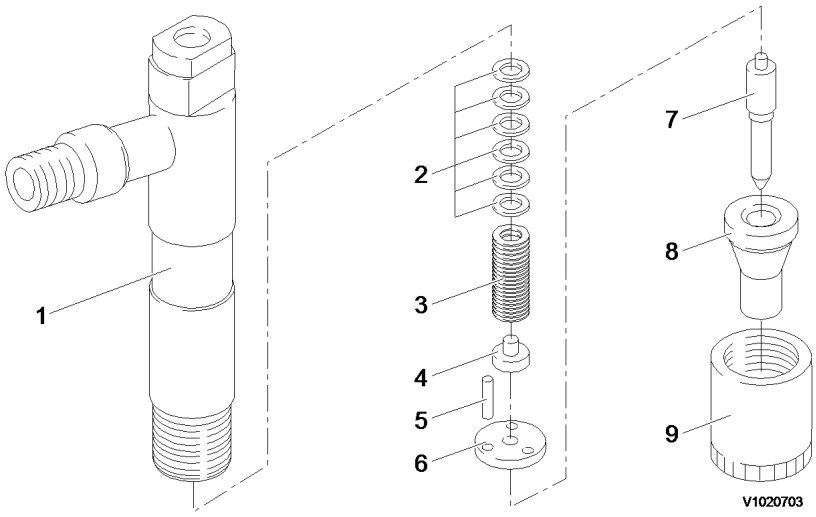

Figure 4
Exploded view, fuel injection valve

1	Nozzle holder
2	Pressure adjusting shim
3	Nozzle spring
4	Nozzle spring seat
5	Dowel pin
6	Valve stop spacer
7	Nozzle valve
8	Nozzle body
9	Nozzle case nut (tightening torque : 4.25 ± 0.25 kgf·m (30.7 ± 1.8 lbf·ft)

- Spray pattern inspection
  After adjustment to the specified valve opening pressure, use a nozzle tester and check the spray pattern and seat oil-tightness.

1. Seat oil tightness check

   - After injecting a few times, increase the pressure gradually.
   - Hold the pressure for about 5 seconds at a little before the valve opening pressure of 20 kgf/cm2 (285 psi), and check to see that oil does not drip from the tip end of the nozzle.
   - If extreme oil leak from the overflow joint exists during injection by the nozzle tester, check after retightening. If excessive oil is leaking, replace the nozzle assembly.

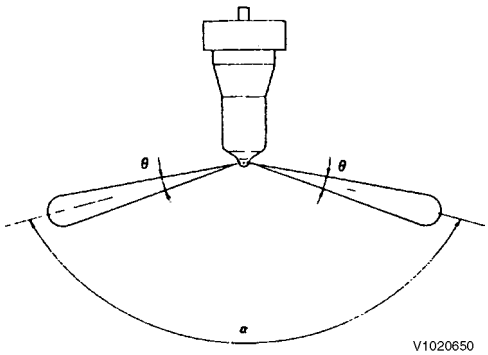

Figure 5
Uniform spray pattern from each nozzle (normal)

2. Spray and injection states

- Operate the nozzle tester lever at a rate of once or twice a second and check for abnormal injection.
- If normal injection as shown below cannot be obtained, replace the fuel injection valve.
  - No extreme difference in angle (θ)
  - No extreme injection angle difference (α)
  - Finely atomized spray
  - Excellent spray departure

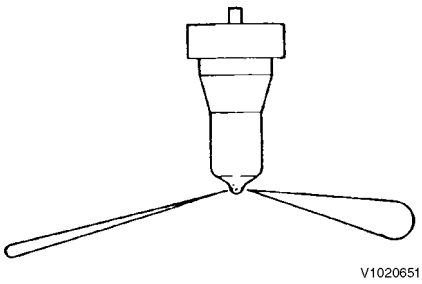

Figure 6
Non-uniform spray pattern from each nozzle (abnormal)

- Nozzle valve sliding test
  Wash the nozzle valve in clean fuel oil.
  Place the nozzle body vertically and insert the nozzle into the body to about 1/3 of its length.
  The valve is normal if it smoothly falls by its own weight into the body.
  In case of a new nozzle, remove the seal peel, and immerse it in clean diesel oil or the like to clean the inner and outer surfaces and to thoroughly remove rust-preventive oil before using the nozzle.
  NOTE!
  New nozzle is coated with rust-preventive oil and is pasted with the seal peel to shut off outer air.

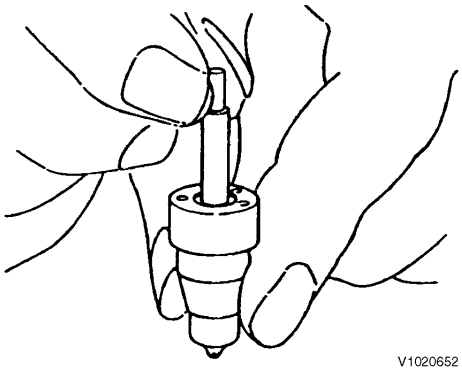

Figure 7
Nozzle valve sliding check by gravity

- The type of nozzle can be determined from the number inscribed on the outside of the nozzle body.

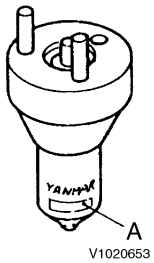

Figure 8
Nozzle body identification number

A. Identification number

- **Nozzle body identification number**

Symbol	Description	Remarks
Y	YANMAR	
DLL	Type (DLL : semi-long type)	
A	Nozzle insertion angle Code A : angled No code : no angle	
150	Injection angle	
P	Nozzle size : size P, size S	
244JO	Design code	

- Measuring and adjusting valve clearance
  Make measurement and adjustment while the engine is cold.

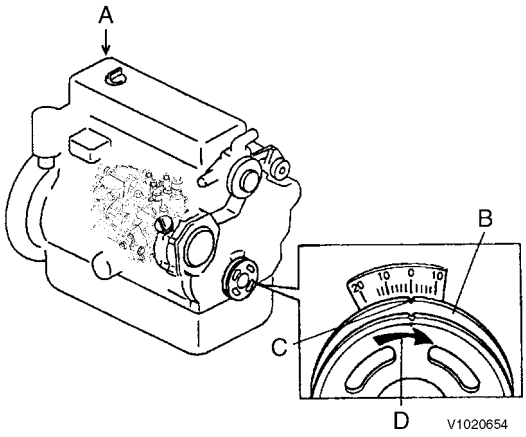

Figure 9
Valve clearance measurement

A. No.1 cylinder
B. Crankshaft pulley
C. Top mark
D. Rotational direction

1. Valve clearance measurement

   - Remove the rocker cover on cylinder head.
   - Turn the crankshaft to bring the piston of the No.1 cylinder to its compression top dead center while watching the rocker arm motion, timing scale and the top mark position of the crankshaft pulley.
     (Position where both the intake and exhaust valves are closed.)
     NOTE!
     The crankshaft shall be turned clockwise as viewed from the pulley side.

     NOTE!
     The No.1 cylinder position is on the flywheel side and the ignition order shall be 1-3-4-2-1 at 180° intervals.

     NOTE!
     Since the intake and exhaust valve rocker arms are operated the same and there is a clearance between the arm and valve generally at the top dead center, the position can be checked by means of the play when the arm head is held with a hand. Also see that the crankshaft pulley top mark is positioned at zero on the timing scale. If there is no valve clearance, inspection in the disassembled state is necessary since the valve seat may be worn abnormally.

   - Insert a thickness gage between the rocker arm and valve cap in case of 2-valve cylinder head, or insert between the rocker arm and the valve bridge in case of 4-valve head, and record the measured valve clearance. (Use it as the data for estimating the wear state.)

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