

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

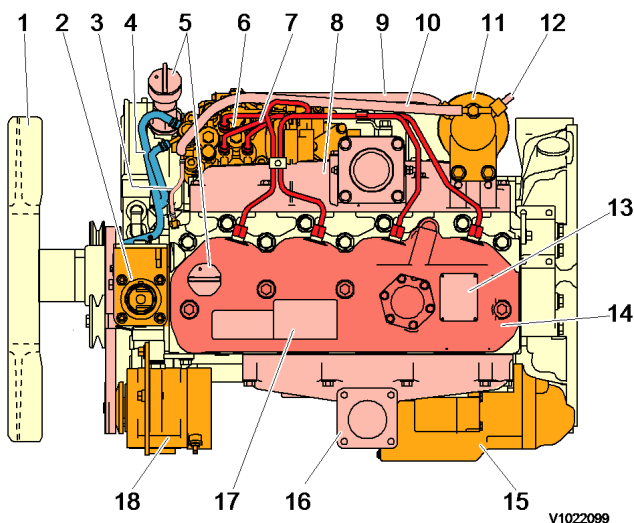
## Engine, description

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	Designation USA/Europe, Korea/International	

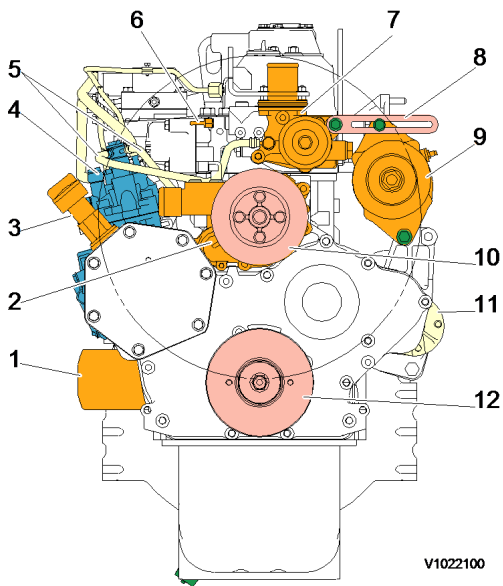
- The engine is a 4-cycle, 4-cylinder, direct injected, water cooled diesel engine.
- The engine produces powerful performance using direct injection type combustion chamber.



**Figure 1**  
**Engine, top side view**

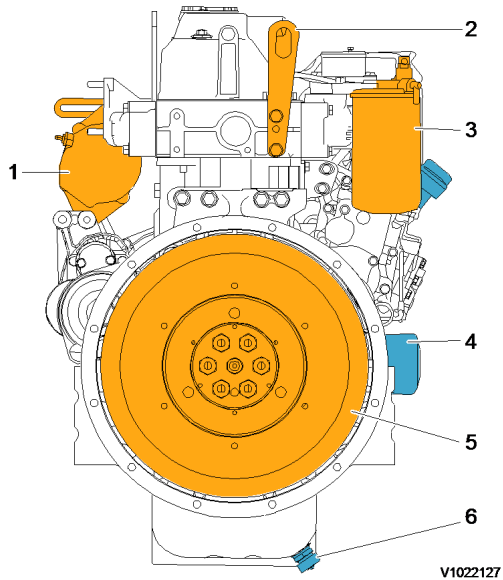
1	Cooling fan	7	Fuel pipe	13	Engine data plate
2	Thermostat housing	8	Intake manifold	14	Rocker arm cover
3	Fuel return line	9	Fuel supply line to fuel injection pump	15	Start motor
	Flywheel				

- |   |                             |    |                                 |    |                   |
|---|-----------------------------|----|---------------------------------|----|-------------------|
| 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 |



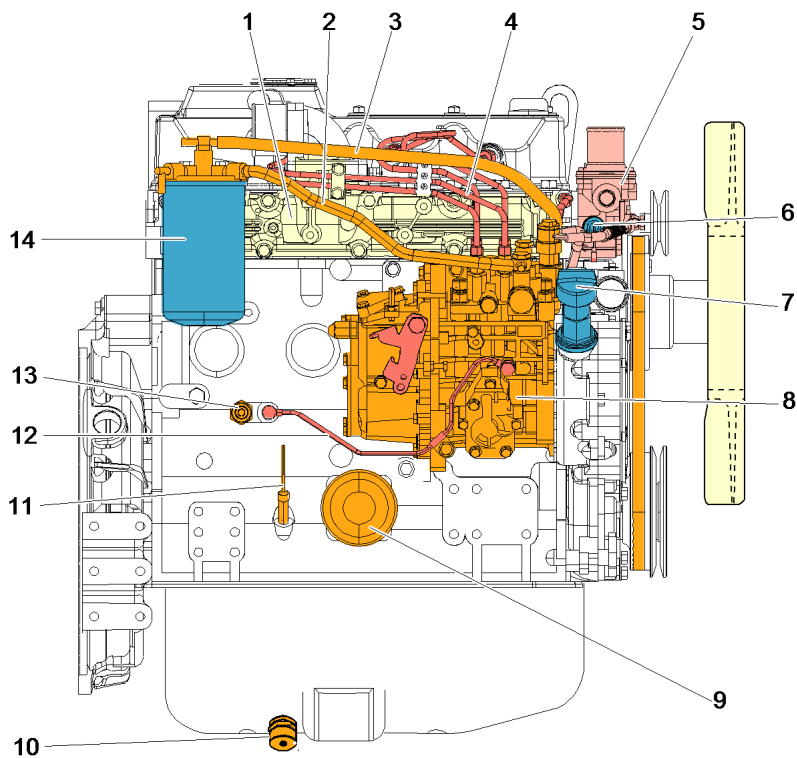
**Figure 3**  
**Engine, rear side view**

1. Alternator
2. Lifting bracket
3. Fuel filler

- 
- Technical drawing of a V1022128 engine assembly, showing various components labeled with numbers 1 through 11. The drawing is a side view of the engine, highlighting the cylinder block, crankshaft, and various accessories. The components are color-coded: red for the main engine block, yellow for the cylinder block, and orange for the crankshaft and various accessories. The labels point to the following parts:
- 1: Accessory drive bracket
  - 2: Accessory drive pulley
  - 3: Water pump
  - 4: Timing cover
  - 5: Timing belt
  - 6: Timing belt tensioner
  - 7: Crankshaft
  - 8: Oil pan
  - 9: Oil pump
  - 10: Oil pump drive
  - 11: Oil pump drive pulley

**Figure 4**  
**Engine, starter motor side view**

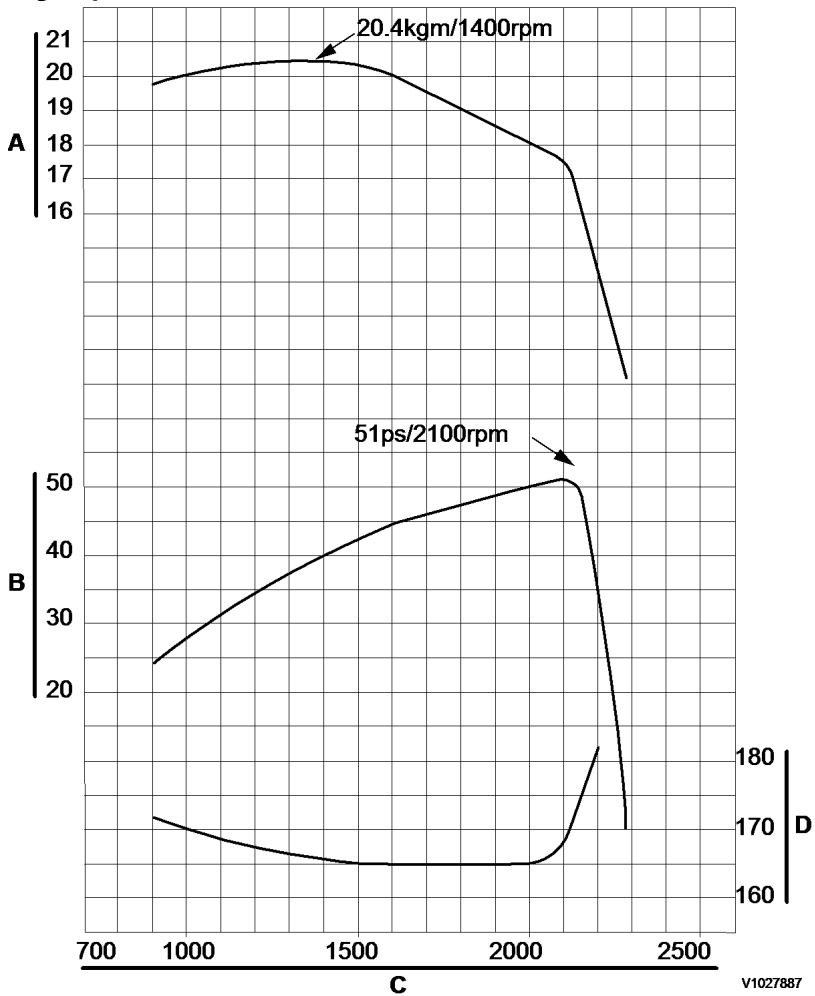
- |   |                    |    |                    |
|---|--------------------|----|--------------------|
| 1 | Thermostat housing | 7  | Starter motor      |
| 2 | Lifting eye        | 8  | Engine oil pan     |
| 3 | Exhaust manifold   | 9  | Crankshaft V-pully |
| 4 | Rocker arm cover   | 10 | V-belt             |
| 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: <b>Engine, tightening torque</b>	Function Group: <b>200</b>	Information Type: <b>Service Information</b>	Date: <b>2014/4/6 0</b>
Profile: <b>CEX, ECR58 [GB]</b>			

## 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)	<ul style="list-style-type: none"> <li>Use 80% of the value at left when the tightening part is aluminium.</li> <li>Use 60% of the value at left for 4T screws and lock nuts.</li> </ul>
	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.

Document Title: <b>Precautions</b>	Function Group: <b>200</b>	Information Type: <b>Service Information</b>	Date: <b>2014/4/6 0</b>
Profile: <b>CEX, ECR58 [GB]</b>			

## Precautions

Make preparation as follows before starting engine inspection and service.



**Risk of personal injury. Very heavy object.**

**Be sure to fix the engine securely to prevent injury or damage due to parts falling during the work.**



**Risk of personal injury! Wear safety glasses and use protective gloves.**

**Always wear glasses or a protective face shield when using compressed air or steam to prevent any foreign matter from getting into the eyes.**

- 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: <b>Periodic inspection and maintenance procedure</b>	Function Group: <b>200</b>	Information Type: <b>Service Information</b>	Date: <b>2014/4/6 0</b>
Profile: <b>CEX, ECR58 [GB]</b>			

## Periodic inspection and maintenance procedure

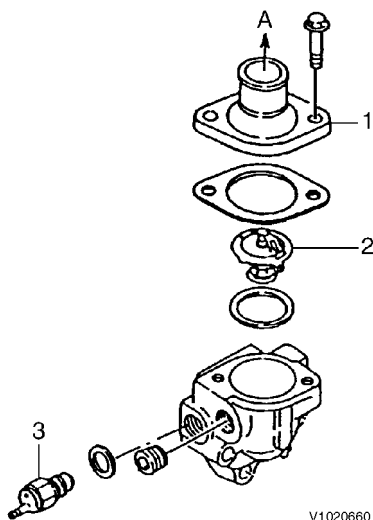
### Check before daily operation

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

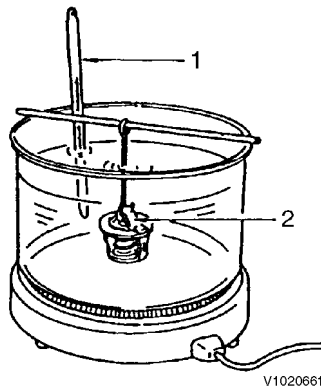
A. To radiator

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)

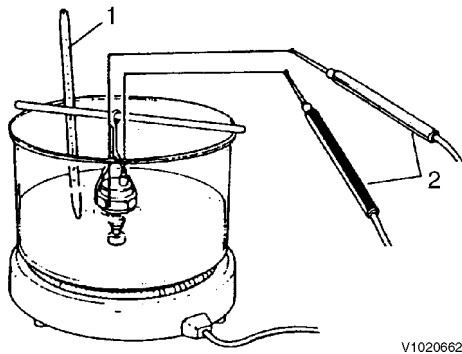
**NOTE!**

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

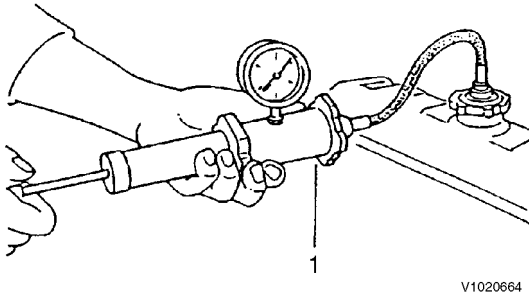
2. Thermostat switch  
Place the thermostat switch in a container filled with antifreeze or oil. Heat it while measuring the fluid temperature. The switch is normal if the multi-meter shows continuity when the fluid temperature is 107 ~ 113 °C (225 ~ 235 °F).
- Inspection and replacement of fuel pipe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

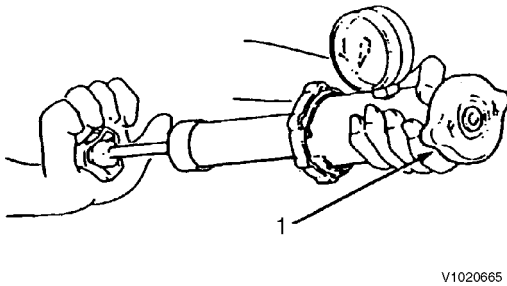
- Check coolant leakage from the cooling system visually. If any problem is found, Inspect as follows :



**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  $0.9 \pm 0.15 \text{ kgf/cm}^2$  ( $12.8 \pm 2.1 \text{ psi}$ ). 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  $0.9 \pm 0.15 \text{ kgf/cm}^2$  ( $12.8 \pm 2.1 \text{ psi}$ ) 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: <b>Compression pressure inspection</b>	Function Group: <b>210</b>	Information Type: <b>Service Information</b>	Date: <b>2014/4/6 0</b>
Profile: <b>CEX, ECR58 [GB]</b>			

## Compression pressure inspection

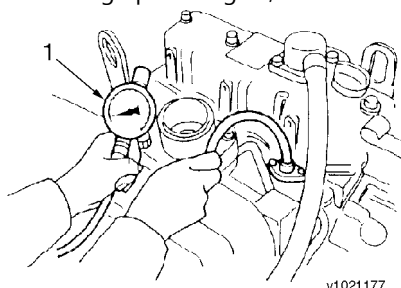
Compression pressure drop is one of major causes of increasing blow-by gas (lubricating oil contamination or increased lubricating oil consumption as a resultant phenomenon) or starting failure. The compression pressure is affected by the following factors:

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.



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**Figure 1**  
**Measuring the compression pressure**

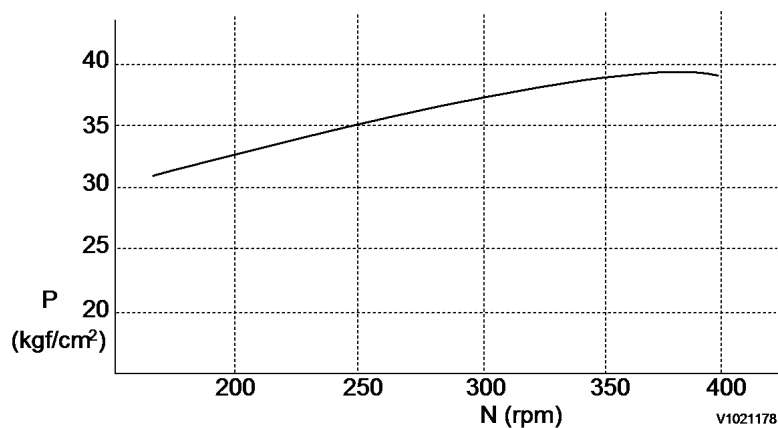
1. Compression gauge
2. Crank the engine before installing the compression gauge adapter.
  - Perform cranking with the stop handle at the stop position (no injection state).
3. Install the compression gauge and compression gauge adapter at the cylinder to be measured.

**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/cm<sup>2</sup>) (498 ±14 psi) (34.32 ±0.98 bar)
- Limit: 2.74 MPa (28 kgf/cm<sup>2</sup>) (398 psi) (27.4 bar)
- Dispersion among cylinders: 0.19 ~ 0.29 MPa (2 ~ 3 kgf/cm<sup>2</sup>) (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	<ul style="list-style-type: none"> <li>• Clogged element</li> <li>• Broken element</li> <li>• Defect at element seal portion</li> </ul>	<ul style="list-style-type: none"> <li>• Clean the element.</li> <li>• Replace the element.</li> </ul>
Valve clearance	<ul style="list-style-type: none"> <li>• Excessive or no clearance</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust the valve clearance.</li> </ul>
Valve timing	<ul style="list-style-type: none"> <li>• Incorrect valve clearance</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust the valve clearance.</li> </ul>
Cylinder head gasket	<ul style="list-style-type: none"> <li>• Gas leak from gasket</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the gasket.</li> <li>• Retighten the cylinder head screws to the specified torque.</li> </ul>
Inlet/exhaust valve Valve seat	<ul style="list-style-type: none"> <li>• Gas leak due to worn valve seat or foreign matter</li> <li>• Sticking valve</li> </ul>	<ul style="list-style-type: none"> <li>• Lap the valve seat.</li> <li>• Replace the inlet/exhaust valve.</li> </ul>
Piston Piston ring Cylinder	<ul style="list-style-type: none"> <li>• Gas leak due to scoring or wear</li> </ul>	<ul style="list-style-type: none"> <li>• Perform honing or boring/honing and use an oversized part.</li> </ul>

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

## 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:

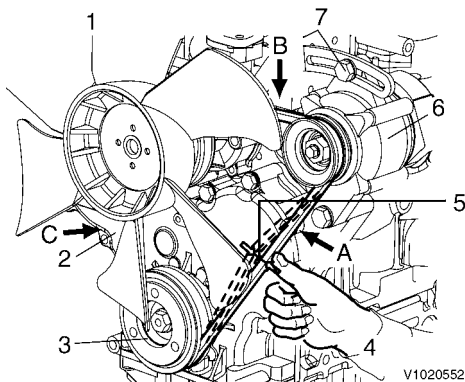
- Always drain coolant in a cold season or before extended storage. (This is unnecessary when antifreeze is used.)

### 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).

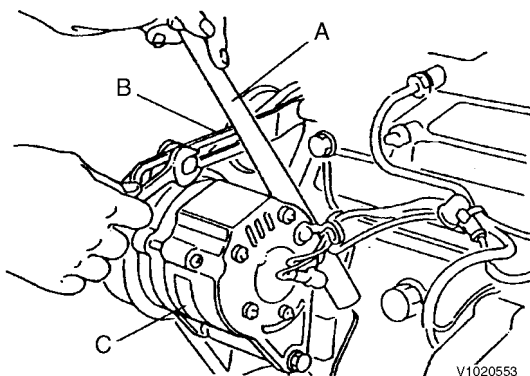
Available positions to check and adjust the V-belt tension (deflection) are at the A, B or C direction as shown in the illustration right.

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)**

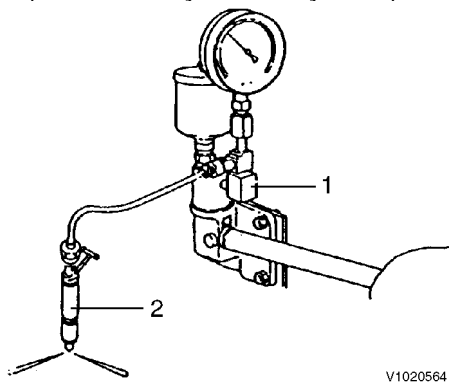
Direction	A	B	C
For used V-belt	10 ~ 14 (0.39 ~ 0.55)	7 ~ 10 (0.28 ~ 0.39)	9 ~ 13 (0.35 ~ 0.51)
For new V-belt	8 ~ 12 (0.31 ~ 0.47)	5 ~ 8 (0.20 ~ 0.31)	7 ~ 11 (0.28 ~ 0.43)



**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  
:  $225 \pm 5 \text{ kgf/cm}^2$  ( $3200 \pm 71 \text{ psi}$ )  
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 $19 \text{ kgf/cm}^2$ (270 psi) when the adjusting shim thickness is increased by 0.1 mm (0.004).



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