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## Chapter I Maintenance for WD615/WD10/WD618/WD12 Diesel Engines

- Operators of diesel engines must carefully read Operation and Maintenance Manual, and well understand the structure of diesel engines, strictly comply with the operation and maintenance stipulated in the Operation and Maintenance manual.

- Based on the maintenance requirements stipulated in the manual, please periodically inspect diesel engines and replace oil in accordance with work condition.

Proper maintenance can effectively prolong service life of diesel engines, decrease trouble rate and reduce cost.

- Maintenance contents :

Replace fuel filter element and oil filter element;

Clean and check air filter element. Replace it every 5 times of cleaning.

- Maintenance interval:

Maintenance should be done in time at service stations authorized by Weichai Power according to the following requirements:



Recommend CF-4 oil to be used in Weichai Power diesel engine series. High quality oil is allowed to replace low quality oil. The specification of common oil is as follows:

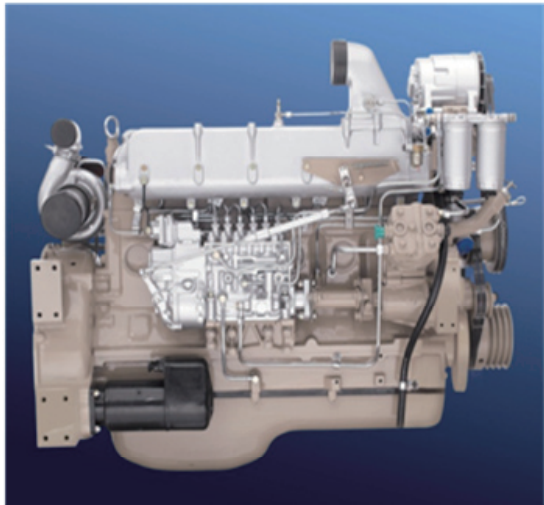
Viscosity grade	0W-30	5W-30	10W-30	15W-40	20W-50
Applied temperature	-40~30℃	-30~35℃	-25~35℃	-20~40℃	-15~50℃

Please use right oil according to ambient temperature, otherwise, engine trouble can occur.



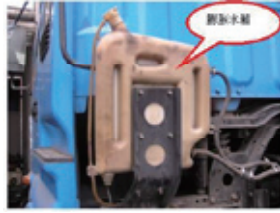
## 1.1 Daily Maintenance

- Inspection:
- Check the oil level;
- Check the coolant level;
- Check the fuel level;
- Check whether the fan is damaged;
- Check whether the V-belt is cracked or scratched;
- Check whether the accessories are fixed well;
- Check whether the water or oil is leaking;
- Check whether the charging indicator light is in order;
- Inspect sufficient grease;
- Inspect whether oil pressure and water temperature are in normal condition;
  - Inspect that exhaust temperature, sound and vibration are normal condition;
  - Inspect rotary speed is stable.



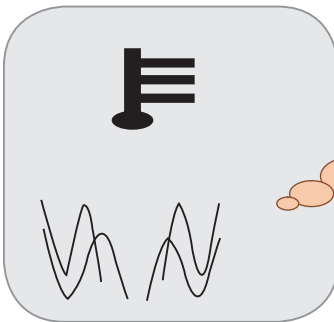
Before starting the engine one should check coolant level, and check whether the cooling system is leaking.

Check whether water temperature is at the required range or not when the engine is running.



When water temperature is too high, please check:

- ① the tension of water pump belt
- ② the tension of fan belt
- ③ thermosta

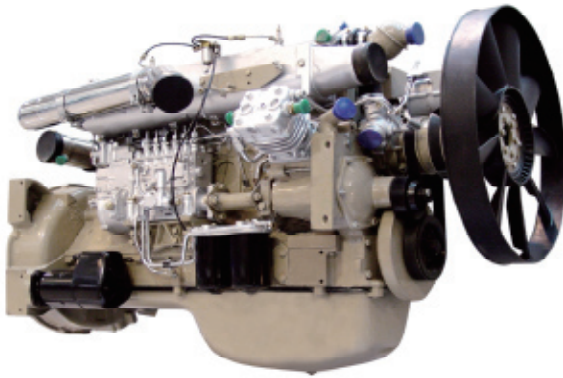


The normal water temperature is 80~95°C above sea-level to 3000 altitude.

Diagram of water temperature in cab

## 1.2 Periodic Maintenance

Regular maintenance should be done as per the following table. If the operating condition is heavy dust content or the engine running on starting- stopping frequently, the regular maintenance period should be shortened accordingly.



**Learning and thinking:**

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### 1.3 Maintenance Interval

(WG I )	(WG II )	(WG III )
Under tough operating condition (e.g. cold or hot weather, high dust content, short-distance transportation, service in construction site and bus, municipal engineering vehicle, snow sweeper, fire bridge vehicle), annual running mileage of the vehicle less than 20,000 km or annual operated time less than 600 h.	Annual running mileage of the vehicle less than 60,000 km, for short- or medium-distance transportation (for goods).	Annual running mileage of the vehicle more than 60,000 km for long distance transportation.

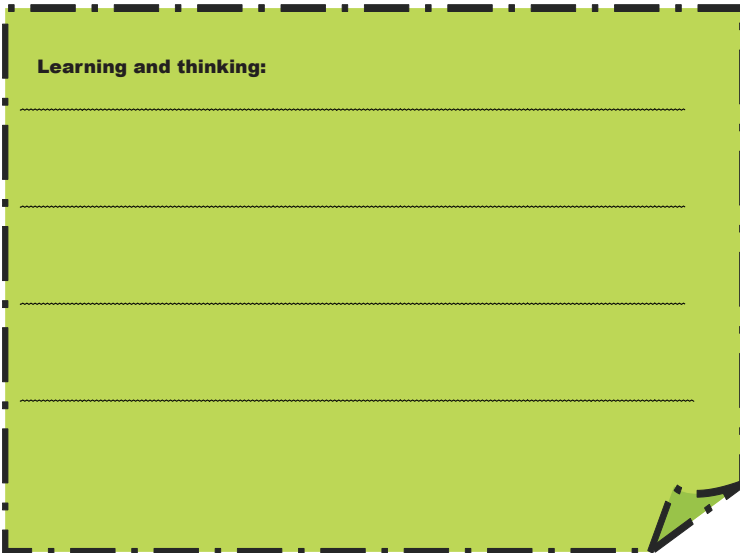
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- The first inspection, routine inspection and maintenance interval

Operating Condition Item	WG1	WG II	WGIII
		2x104 km Annual running mileage <20,000 km	6x104 km Annual running mileage <60,000 km
The first inspection	Running 1,000~1,500 km or 30~50 h	Running 1,500~2,000 km	Running 1,500~2,000 km
Periodical inspection	Every 5,000 km or 150 h	Every 10,000 km	Every 15,000 km
Level 1 maintenance	Every 10,000 km or 300 h	Every 20,000 km	Every 30,000 km
Level 2 maintenance	Every 20,000 km or 600 h	Every 40,000 km	Every 60,000 km
Level 3 maintenance	Every 40,000 km or 1200 h	Every 80,000 km	Every 120,000 km
Level 4 maintenance	Every 80,000 km or 2400 h	Every 160,000 km	Every 240,000 km

**Learning and thinking:**

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- Oil replacement period in vehicle maintenance system

Operating Condition Item	WG1	WG II	WGIII
	Annual running mileage<2×10 <sup>4</sup> km	Annual running mileage< 6×10 <sup>4</sup> km	Annual running mileage> 6×10 <sup>4</sup> km
The first inspection	Running 1000~1500 km	Running 1,500~2,000 km	Running 1,500~2,000 km
Periodical inspection	Every 500 km	Every 1×10 <sup>4</sup> km	Every 1.5×10 <sup>4</sup> km
Level 1 maintenance	Every 1×10 <sup>4</sup> km or 300 h	Every 2×10 <sup>4</sup> km	Every 3×10 <sup>4</sup> km
Level 2 maintenance	Every 2×10 <sup>4</sup> km or 600 h	Every 4×10 <sup>4</sup> km	Every 6×10 <sup>4</sup> km
Level 3 maintenance	Every 4×10 <sup>4</sup> km or 1,200 h	Every 8×10 <sup>4</sup> km	Every 12×10 <sup>4</sup> km
Level 4 maintenance	Every 8×10 <sup>4</sup> km or 2,400 h	Every 16×10 <sup>4</sup> km	Every 24×10 <sup>4</sup> km

- Maintenance items

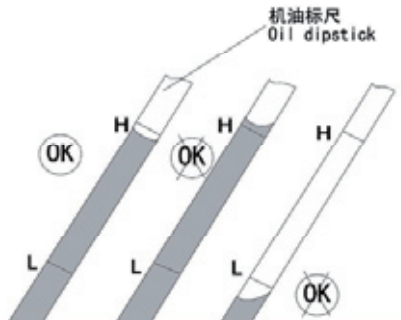
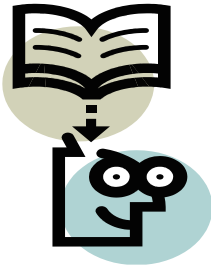
Items	Replacement	Adjustment	Inspection
●WD 3	<ul style="list-style-type: none"> <li>●Oil</li> <li>●Oil filter</li> <li>●Fuel filter</li> <li>●Coolant</li> <li>●Air filter</li> </ul>	<ul style="list-style-type: none"> <li>●Valve clearance</li> </ul>	<ul style="list-style-type: none"> <li>●Air filter</li> <li>●Air intake system</li> <li>●Tighten pipe clamps</li> <li>●Tighten V-belts</li> <li>●Inspect and adjust the injection fuel pump on test bench</li> </ul>
Items	Replacement	Adjustment	Inspection
●WD 4	<ul style="list-style-type: none"> <li>●Oil</li> <li>●Oil filter</li> <li>●Fuel filter</li> <li>●Coolant</li> <li>●Air filter</li> </ul>	<ul style="list-style-type: none"> <li>●Valve clearance</li> </ul>	<ul style="list-style-type: none"> <li>●Air filter</li> <li>●Air intake system</li> <li>●Tighten pipe clamps</li> <li>●Tighten V-belt</li> <li>●Check the bearing clearance of turbocharger</li> <li>●Inspect and adjust the injection fuel pump on test bench</li> </ul>

**Learning and thinking:**

## 1.4 Maintenance Contents

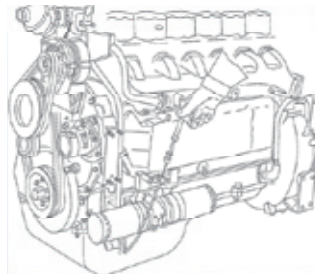
### Daily maintenance

- Preventive maintenance should be done every day in order to understand the engine's condition.
- Before starting the engine one should check the oil level, coolant level and the fuel level.
- Inspect the oil level height
- When the oil level is lower than the lower limit or higher than the upper limit, it is not allowed to start the engine



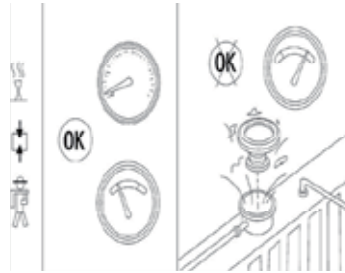
- After the engine stopped, inspect the oil level at least 5 minutes later in order to ensure the oil can flow back to the oil sump.

※ The oil volume tolerance between the lower limit and the upper limit is 3 liters.

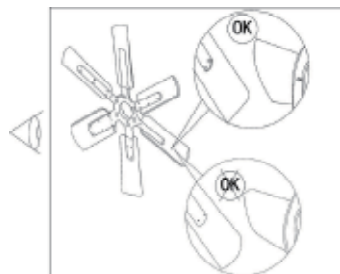


- Inspect the coolant level
- Inspect the coolant level through the vitreous view hole, if the coolant is not sufficient, open the inlet cover and fill into the coolant.

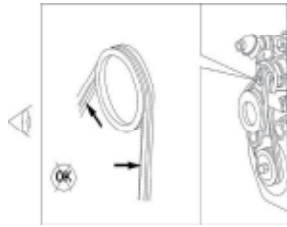
※ Note: When opening the inlet cover, one must press down the exhaust button firstly to prevent hot coolant from injuring people



- Inspect the fuel level
- Inspect the fan
- Check whether the plastic fan is distorted. For steel fan, check whether the rivet loosened and the vane is curved to ensure reliable running

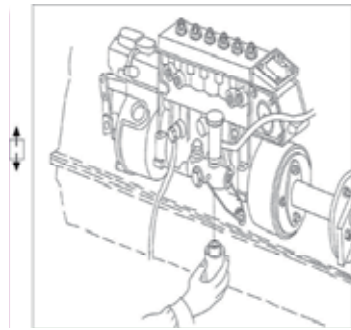
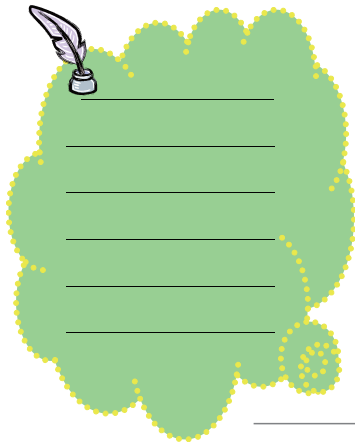


- Inspect the V-belts
- Inspect the V-belts with your eyes to find if there is any crack or scratch on the V-belts. Replace them if necessary.



- Drain off the water and deposit from the small filter cup fitted on the fuel delivery pump.

- Unscrew the bottom bolt of the small filter cup, dismount it and drain off the water and deposit, then re-install the cup again



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## 1.5 Replacement of Oil and Oil Filter.

### Maintenance items of various maintenances

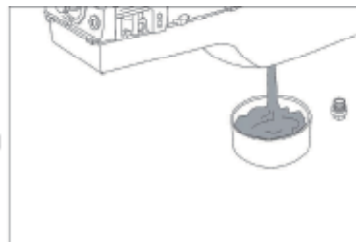
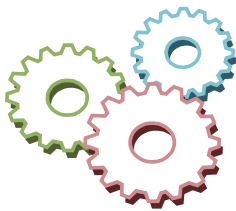
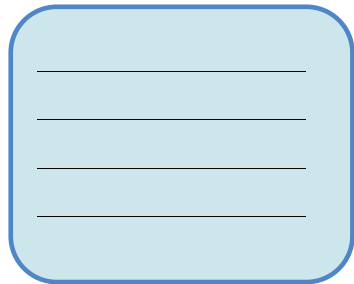
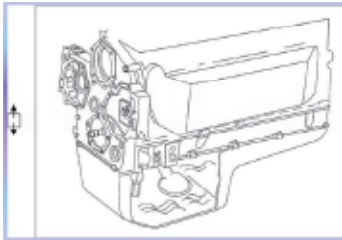
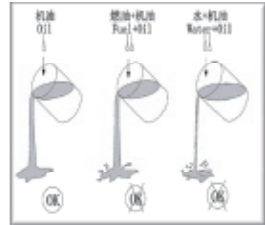
- Replacement of the oil and oil filter

※ Note: The replacement interval of oil under proper using condition cannot beyond 250 h(10,000 Kilometers)

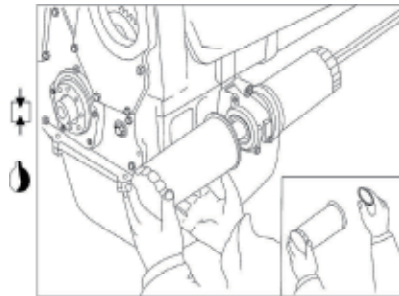
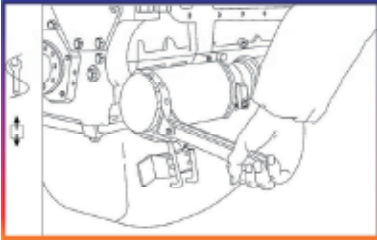
- Tool: 32 mm open-ended wrench

● Remove the whorl plug, prepare a container to collect 20 L of oil.

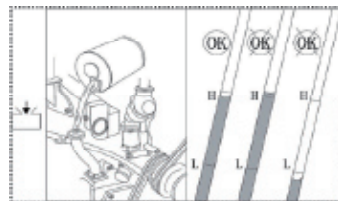
※ Note: The oil should be drained off when it is hot. Hot oil can injure people.



- Tool: The special wrench for filter
- Clean the end surrounding of the filter, and remove it
- Install the new oil filter
- Note: Adjust the seal ring and smear some lubricating oil on it while fitting the oil filter.

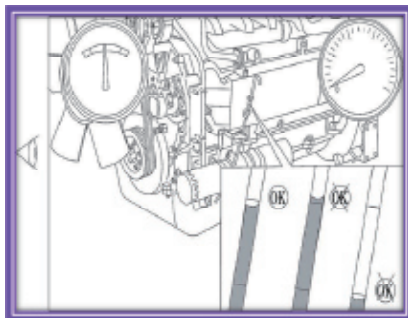
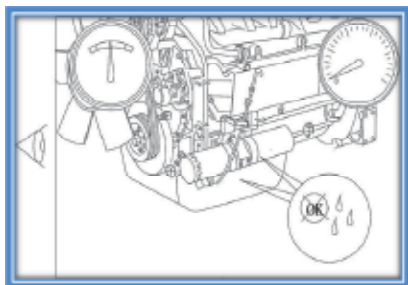


- Tool: 32 mm open-ended wrench
- Check and clean the screw thread and seal ring, and then install the whorl plug.
- Fill the clean oil up to the upper limit the capacity of the oil sump is 20 L.



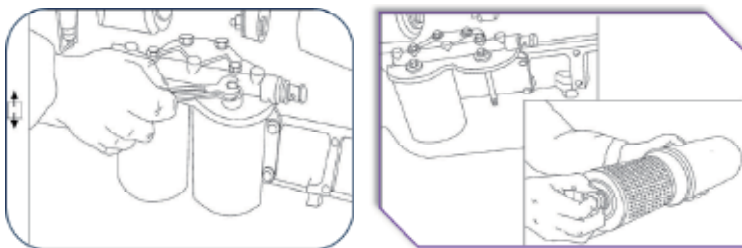


- Run the engine at idling speed and check the filter to find whether it leaks or not
- Stop the engine and make the oil run into the sump from the upper parts 5 minutes later, then check the oil level, fill oil up to the upper limit if necessary.

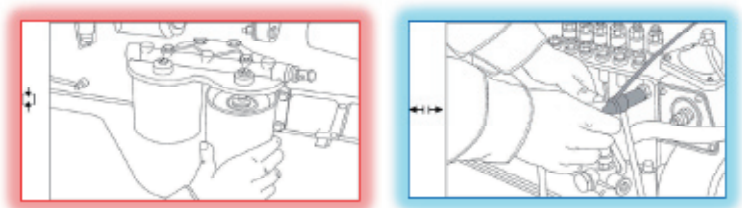


## 1.6 Replace Fuel Filter

- Tool: 13 mm open-ended wrench
- Clean the end surrounding of the fuel filter, unloosen the upper bolt and disassemble the fuel filter.
- Install the new fuel pre-filter element and filter element



- Install the replaced fuel filter on the bracket and tighten the bolt.
- Drain off the air from the fuel delivery pipe and fuel filter.
- Open the fuel draining bolt of the inlet of injection pump.



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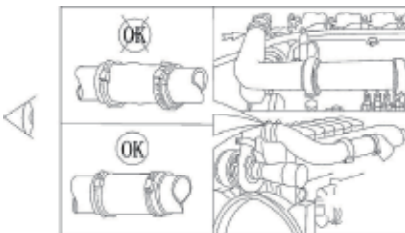
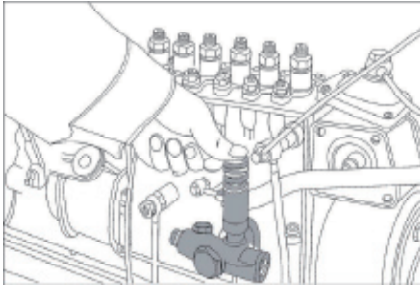
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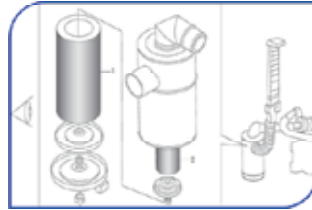
Press the fuel delivery pump plug till the fuel drained off from the draining bolt outlet does not contain air, then tighten the bolt.

- Check the air intake system.
- Check whether the air intake rubber pipes are aging or cracked, the steel wire hoop is loosening. If it is necessary, tighten or replace the parts to ensure good sealing performance.

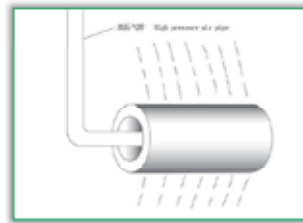
### 1.7 Check Air Filter Element

A large, vertical, trapezoidal area for taking notes. It features a blue header bar at the top. Below the header, there is a small icon of a quill pen in a holder. The main body of the area contains seven horizontal lines for writing.

- The max air intake resistance of the engine is 7 kpa. Air intake resistance must be checked when diesel engines run at rated speed and in full load. When the resistance reaches the max. limit permitted, one should clean or replace air filter element as per relevant requirements from suppliers.



Note: It is not allowed to use the engine without air filter, otherwise the dust and impurity will cause early wearing of the engine.



- Remove the filter core from the air filter element and beat the side of the element lightly to make dust fall down, or blow the element backward (blow back from inside to outside) by compressed air.

**Note:**

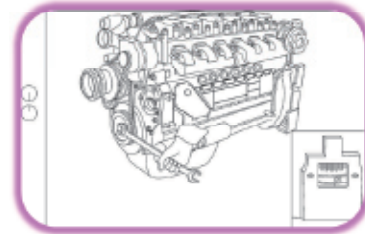
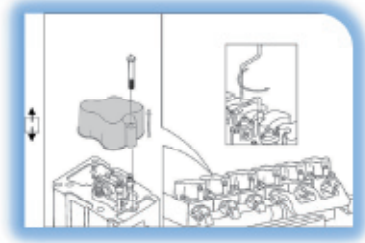
- Don't blow off the air filtering paper.
- Don't clean the air filtering paper by water and oil.
- Don't beat the core forcibly.

## 1.8 Check and Adjust Valve Clearance

- 1 3 mm sleeve wrench
- Disassemble 6 cylinder head covers

- Tool: 32 mm wrench for turning the crankshaft

- Turn the flywheel until its OT scale and the mark on its housing are aligned, push the piston to the position of TDC of compression stroke of 1st cylinder (the intake and exhaust valve of 1st cylinder are closed).



- Tool: Clearance gauge
- The clearance of intake valve is 0.30 mm
- The clearance of exhaust valve is 0.40 mm

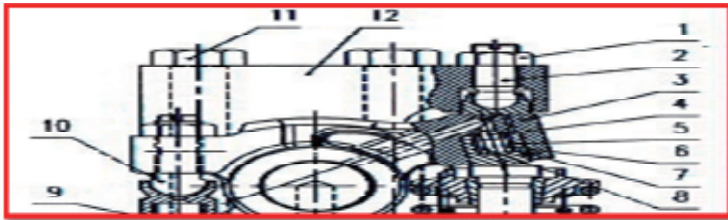
- The Clearance of WEVB system is 0.25 mm

- Note: When check the clearance of valve, the engine should be at the cool condition—its temperature is

less than 60°C. When the clearance gauge glides between the top of valve rod and rocker arm and can be felt retarded and sticky, the measuring result is proper.



- After WEVB system is used, the adjustment method of exhaust valve clearance is as follows (see Fig. 2 for part serial numbers)



1. Valve clearance adjusting nut
2. Regulating bolt assembly
3. Exhaust valve rocker arm assembly
4. Steel ball
5. Valve rocker arm piston
6. Rocker arm piston spring
7. Needle
8. Ball valve spring
9. Valve rocker arm seat assembly
10. Valve clearance adjusting screw
11. Hexagonal bolt
12. Support arm

- The cylinder piston to be adjusted is located on the top dead center of the compression travel.
- As shown in Fig. 2, loosen No. 2 adjusting bolt assembly. In case that the oil seal plane of exhaust valve rocker arm is not pressed, first by using No. 10 valve clearance adjusting.

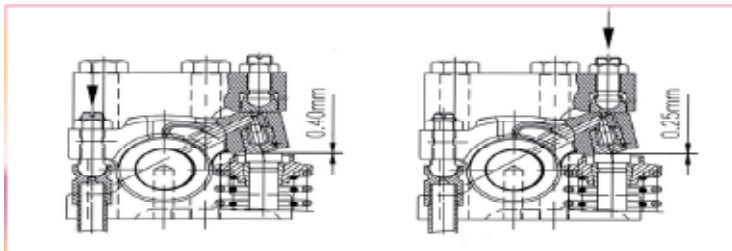


Fig. 2 Total Valve Clearance of Cold-State Exhaust Valve 0.4 mm

Fig. 3 End Valve Clearance of Cold-State Exhaust Valve 0.25 mm

- Then as shown in Fig. 3, insert the clearance gauge between No. 5 valve rocker arm piston and the exhaust valve rod end or valve rod cap. By turning No. 2 regulating bolt, adjust the valve clearance to 0.25 mm. Tighten check nut.



※ Caution: During adjustment, turn No. 2 regulating bolt until clearance gauge is clamped so that No. 5 valve rocker arm piston is pressed to its bottom. There is not clearance between No. 5 valve rocker

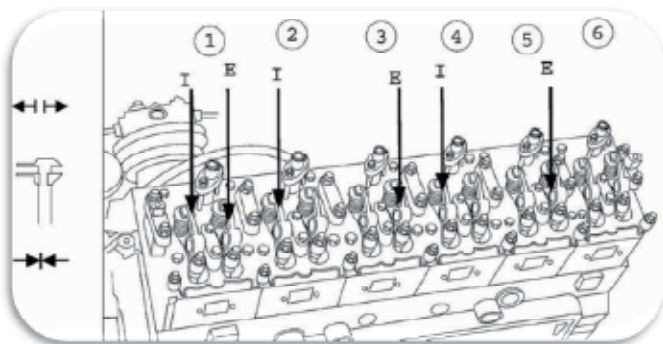


arm piston and the piston installation hole bottom plane in exhaust valve rocker arm.

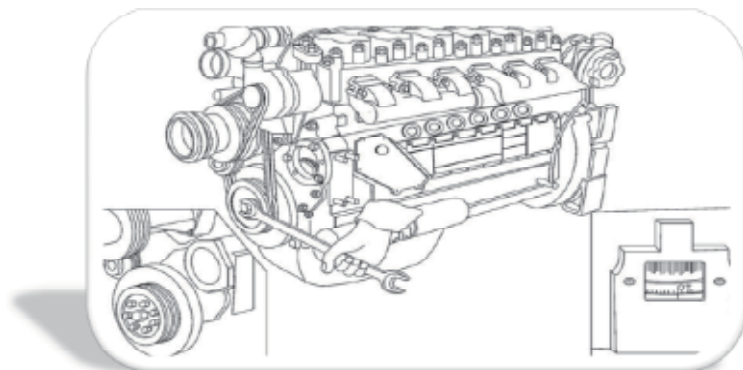
※ Tools: 6# screwdriver and 14 mm double offset ring wrench

- ※ The piston of 1 cylinder is at TDC of the compression stroke .
- ※ Check and adjust the valve clearance as step A (I-air intake Valve  
E-air Exhaust valve).
- ※ Adjust the clearance by gauge and tighten the fixing nut of rocker arm, re-check the clearance till it meets the requirement.

Step A



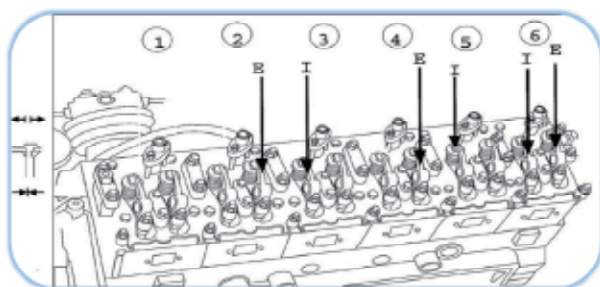
- ※ Turn the crankshaft 360° by the spanner ; it can also be turned 360° after marking on the vibration damper.



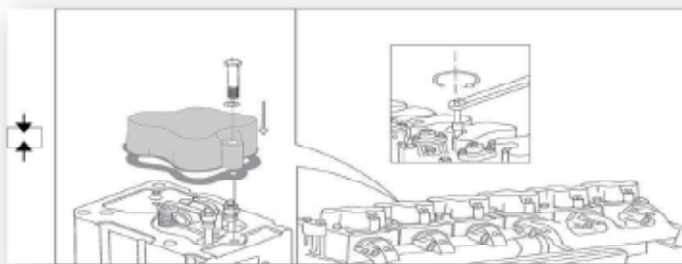


- ※ Adjust the valve clearance as step B
- ※ Loosen the fixing nut of rocker arm, adjust the clearance by gauge then tighten the nut again.

Step B



- ※ Tool: 13 mm sleeve wrench
- ※ Install the gasket and cylinder head cover
- ※ The tightening torque of bolt is 23 N•m (recommended)




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## 1.9 Adjustment of Fuel Supply Advance Angle

Torque wrench, 18# open-ended wrench, auxiliary material: 242 thread sealant

### Operation as follows :

- Turn the flywheel until the pistons of 1st and 6th cylinders reach the top dead center.
- Counterclockwise turn the flywheel to the scale required before pistons reach the top dead center.
- Loosen 12 MM hexagon bolts of the coupling.
- Rotate camshaft of fuel pump (rotate more rounds) to deflate air from fuel pump.
- Observe fuel level of fuel outlet valve seat of 1st cylinder: once the fuel level raises, stop rotating the camshaft. Here is the position of the camshaft when the fuel pump supplying fuel for 1st cylinder.
- Lock angle adjustment plate to meet the torque requirement.



### Operating requirements:

- ※ Turning direction of the flywheel should be same as that of crankshaft of engine.
- ※ Accurately judge the moving position of the piston of 1st cylinder.

※ Turn the flywheel to the accurate scale required.

※ Tighten bolts with the torque of 120-150 Nm and smear 242 sealant on the thread

● Check the fuel supply advance angle.

※ Turn the engine until fuel pump supplying fuel for 1st cylinder, and then check whether the scale is right or not.

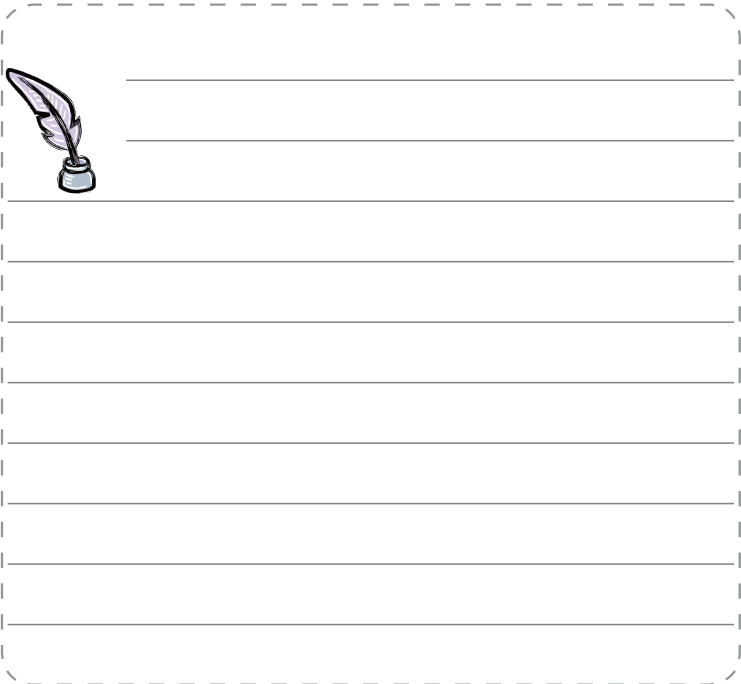
※ Check again, and the method is as the above.

※ Tighten the high pressure pipe of 1st cylinder

Note:

※ Turning direction of the flywheel should be same as that of crankshaft of engine.

※ Make sure the accurate scale required.



A dashed rectangular box containing a quill pen icon on the left and several horizontal lines for writing.

## **Chapter II Key Points about Assembling or Disassembling WD615 Diesel Engines**

### **2.1 Assemble Injection Nozzle, Camshaft and Cylinder Liner**

#### **2.1.1 Assemble Injection Nozzle**

- Burnish the bottom plane of the cylinder body, clear tilting oil passage and main & slave oil passage with compressed air, then rub the bottom plane.
- Use hollow bolt with sealing gasket to put the injection nozzles into the engine body and tighten them.



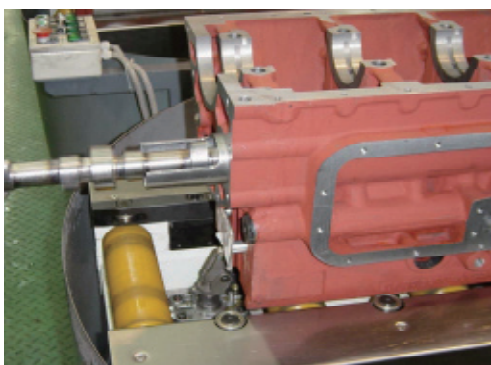
Note :

- ※ Check whether the injection nozzle is through or not
- ※ Pay attention to the position of injection nozzle when screw the hollow bolt. Make the cylindrical pin align with the pin bore in the engine body, and use copper stick to hit it when necessary.
- ※ Check injection nozzles whether there's scratching or burr.

#### **2.1.2 Assemble Camshaft**

- Rub the camshaft bore and smear lubricating oil.

- Rub camshaft, check and make sure no scratching, then put the camshaft in its bore.
- Assemble the thrust flake of camshaft, and loosen hexagon bolt, then tighten it.
- Smear the thrust flake with lubricating oil, then rotate camshaft to check the axial clearance, and make sure it's rotating freely with no retarding.



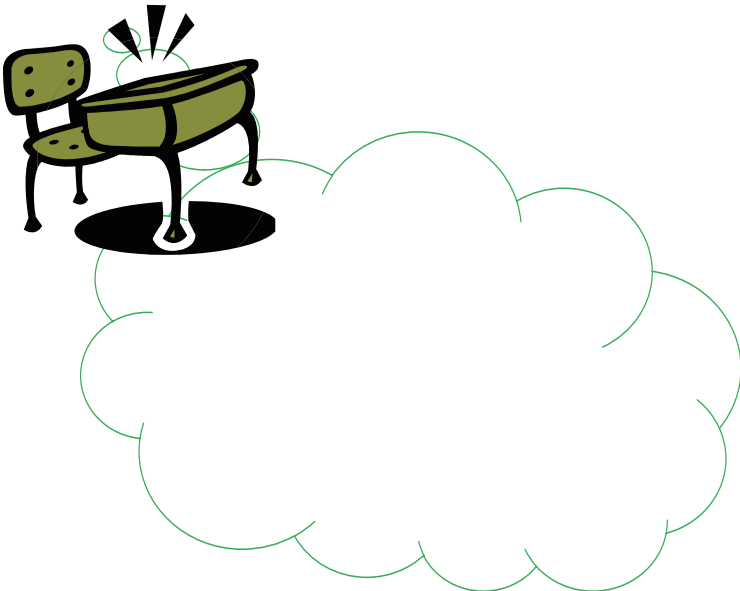
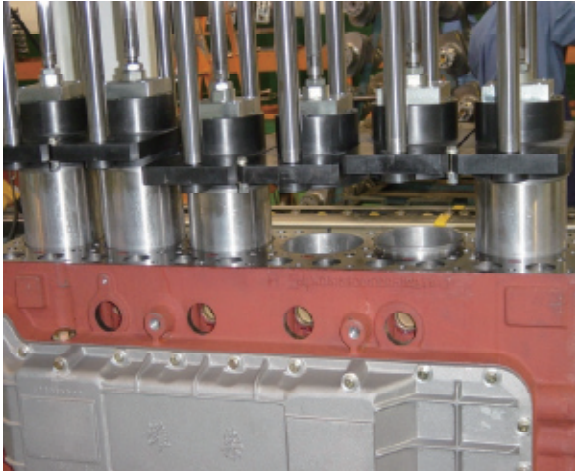
Note :

- ※ Check camshaft bush and make sure there's no scratching. Not allowed to use it after repair.
- ※ Before putting camshaft in, the guide tool must be lubricated with clean oil.
- ※ When putting camshaft in, pay attention in case of scratching camshaft bush.
- ※ Smear thread of bolts with 242 sealant

### **2.1.3 Assemble Cylinder Liner**

- Rub cylinder bore and inner and external walls of cylinder liner.
- Smear outer wall of cylinder liner with 0#, and then put the cylinder liner in its bore.

- Press the cylinder liner into the bore with presser machine.
- Cylinder liner is above the top plane of cylinder body of 0.05~0.10 mm.
- Check cylindricity and ellipticity inside the bore.



## 2.2 Pre-assemble & Assemble Crankshaft

### 2.2.1 Assembling Steps (1)

- Heat flange to 290°C , and its color becomes yellow. Heat crankshaft gear to 180°C (the heating temperatures are recommending results, they should be due to assembling condition)

Note:

Not allowed to assemble when the color of the gear and flange is purple.

- Remove the burr of flat key and key groove, and then mount the flat key, crankshaft gear and flange. Hit the cylindrical pin into the end of crankshaft.

- Drive rivet in the tilting bore of crankshaft, then punching pin used to punch two dots to fix rivet.



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**2.2.2 Assembling Steps (2)**

- Clean the bottom plane of cylinder body with 755 abluent or industrial alcohol.
- Mount main bearing shell, top thrust flake, and coat oil.
- Sling/Hang up crankshaft, blow oil passage bore with compressed air and rub main journal and connecting stick journal with towel, then gently put it in the engine body. Then mount the bottom thrust flake.

Note:

- ※ Carefully check whether there's scratching before hang up, and remove it if necessary.
- ※ The oil groove of thrust flake should face outside.
- Coat the plane of engine body (connecting face of crankcase) with 510 sealant, and sealant coated should be continuous line.



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### 2.3 Assemble Cylinder Body

- Insert guiding stick into the bolt bore of main bearing as Figure, then hang up then crankshaft and turn 180°, then gently put it into the engine body along the guiding stick.

Note:

- ※ Matching number of crankcase and that of cylinder body should be same.

- ※ Locating pin bore should be aligned

- ※ Avoid bush tube and seal ring dropping out in the process of hanging up.

- Lightly knock the bottom of crankcase to connect crankcase with cylinder body, then cylindrical pin used to lock them.



Note :

- ※ “Middle firstly, two sides lately” should be cared when hammer in the cylindrical pin.



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- Coat rear oil seal of crankshaft with sealant, then mount it on the crankshaft.

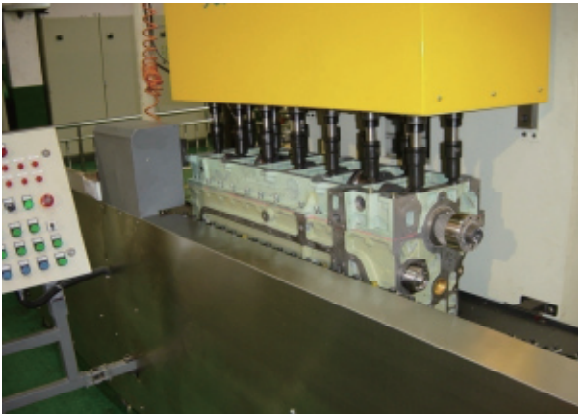
Note : Coat rear oil seal with sealant, and sealant should be continuous.

- Press the oil seal into cylinder body assembly with proper tool.

Note:

- ※ Must coat the tool with lubricating oil.

- Take out of the guiding stick, tighten main and slave bolts of engine body.



## **2.4 Pre-assemble & Assemble Connecting Stick and Piston**

- Put 6 pistons with similar weight in the same group on assembly table. Pistons with different weight are divided into 5 groups: G1, G2, G3, G4 and G5. The pistons in the same group are assembled in the same engine.

- Heat piston to 60-80 degree.

- Pre-assemble piston-connecting rod: Insert small end of connecting rod into the inner cavity of piston, and make sure the small end bore is aligned with piston pin bore, and then put in piston pin and snap ring of piston.



- The weight difference between each connecting rod assembly is 29 g. There are C, D, E, F, G, H, J, K and L groups. The connecting rods assembled on the same engine should be in the same weight group. And the connecting rod body and its corresponding connecting rod cap should have the matching numbers.

- Dismantle connecting rod bolts, then check whether they are damaging or not. Replace them when necessary. Check and make sure the matching number is right.

- Check whether the shell damaged or not before assemble connecting rod shells. Replace them when necessary. Not allowed to repair them.

- Clean inner wall of cylinder liner, crankshaft arm and piston-connecting rod, then coat moving parts with clean lubricating oil.

- Turn the engine to make crankshaft arm at a proper position.

A decorative scroll-shaped writing area. On the left side, there is a quill pen icon. The scroll contains five horizontal lines for writing. The scroll is open at the top and bottom, and has a vertical strip on the right side.

Note:

※ Check whether piston rings in ring groove moves freely or not, make sure no blocking.

※ The angle between the open end of the first ring and piston pin axial line should be  $30^{\circ} \pm 5^{\circ}$ , and make sure there is a degree of  $120^{\circ}$  between each open end of piston pins.

※ Piston-connecting rod parts assembled in the same engine must be in the same weight group.

※ Check connecting rod shells and see whether there's scratching or not. Not allowed to use them if there's scratching.

● Put in piston-connecting rod in sequence and gently screw connecting rod bolts.

Note:

※ The separate side of connecting rod shell should face oil cooler.

※ The piston should be put in its corresponding cylinder.

※ Connecting rod cap and connecting rod body should be matched, which cannot be interchanged.

※ Avoid connecting rod scratching crankshaft arm when assembly.

※ Coat supporting face and thread with clean lubricating oil before tighten connecting rod bolts.

※ The inner and outer walls of piston sliding bush must be lubricated.



- Tighten connecting rod bolts in accordance with process requirement. Tighten connecting rod bolts of the 1st and 6th cylinders first, turn engine 120°, then tighten connecting rod bolts of the 2nd and 5th, and turn engine 120°, then tighten connecting rod bolts of the 3rd and 4th cylinders.

Note:

- ※ Alternately tighten the two bolts of each cylinder by hand, 120 Nm for the first time, then turn 90°±5°, and the torque should be 170~250 Nm. Otherwise, replace them.

- ※ Turn the engine to feel freely and no retarding.



## **2.5 The Assembly of the Timing Gear Housing**

- Check whether every combining surface of timing gear housing is hurt and remove grease after polishing and cleaning.

- Drive springy cylindrical pin into side, coat thread locking agents on thread parts of the double-headed thud, tighten it and clean excessive sealant.

- Tighten hexagonal bolts with seal gaskets Install refueling tube gasket and then refueling tube. Insert hexagonal bolts with springy gaskets and then tighten them.

- Polish, clean, remove grease and coat sealing glue on the combining surface of cylinder block and timing gear housing.

- Install middle gear shaft into middle gear, and then put them into timing gear housing.

- Install timing gear housing parts. Drive intermediate gear shaft into

gear housing, insert hexagonal bolts with gaskets and tighten them.  
The level of the cover to the left groove.

- a. Smear general lithium grease on the shaft.
- b. Tightening torque:  $60 \pm 5$  Nm.
- c. Turn bolts  $90^\circ$ , and the torque range is 100~125 Nm. Replace those bolts that not reach required torque range.



- Install intermediate gear parts of oil pump, and then drive into intermediate gear shaft of oil pump.

Notice:

- ※ The convexity of intermediate gear parts of oil pump should be towards inside.

- ※ Check whether the intermediate gear shaft of oil pump can be turned flexibly after installing.

- Install hexagonal bolts in the intermediate gear shaft of oil pump and tighten them. Tightening torque:  $59 \pm 5$  Nm (smear glue). Tighten all the M10 bolts.

- Check the clearance of gear.



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**Appendix: fitting of gears in gear case**



**A**



**B**



**C**



**D**



**E**



**F**



## 2.6 The Assembly of Flywheel Housing and Flywheel

### 2.6.1 The Assembly of Flywheel Housing:

- Polish, clean, remove grease and coat sealing glue on the surface of cylinder block and fly wheel housing.

- Lift fly wheel housing and pre-assemble fly wheel housing bolts.

Notice:

- ※ Cylindrical pin of end back of cylinder block must match with orientational hole which is below fly wheel housing.

- ※ Coat clean lubricant on thread of bolts and supporting block.

- ※ Tighten bolts in twice by hand, the 1st time: 40+20 N•m, and make a mark between bolts and flywheel housing;

the 2nd time: 110~140 Nm. Replace those bolts that can not reach required torque range.

- ※ Tightening sequence as the sequence in above figure.

- ※ Special notice: The flywheel bolts of 4, 5, 6, 7, 8 and 9 are M12X60, the bolts of 1, 2, 3, 10, 11, 12 and 13 are M12X70.



### 2.6.2 The Assembly of Flywheel

- Fix tooth ring of fly wheel in the flywheel by accessory bolts.
- Drive centripetal ball bearing into flywheel axle hole and then install springy ring.

Notice:

- ※ Clean outer round before drive into bearing, and coat Automobile Lithium Grease on the inner hole of flywheel.

- Install flywheel and tooth ring of fly wheel in the crankshaft.

Notice:

- ※ Coat antirust oil on the inner surface of the flywheel.

- Insert flywheel bolts and tighten them.

Notice:

- ※ Coat lubricant on thread of bolts and supporting block before inserting bolts.

- ※ Tighten bolts by hand.



Firstly pre-tighten these bolts

symmetrically with a torque of 60~80 Nm, and then turn them  $90^{\circ} \pm 5^{\circ}$  symmetrically in twice. The torque range is 230~280 Nm. Replace those bolts that can not reach required torque range.

## **2.7 The Assembly of Front Oil Seal and Camshaft Timing Gear**

- Install front oil seal parts.
- Turn the engine block to the top dead center of cylinder 1 and 6.
- Turn engine block as rotary direction of crankshaft. The rotary direction is contra-rotation when you stand towards the side of timing gear housing.

- Install the camshaft timing gear. The scale and mark of camshaft timing gear and OT scale and the mark on timing gear housing should be aligned.

- Tighten hexagonal bolts, and then make a mark between any bolt and gear housing.

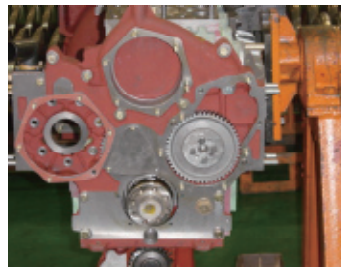
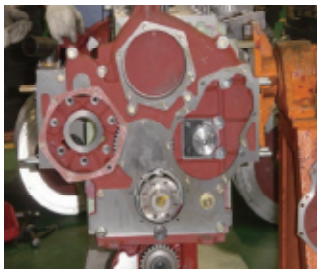
Notice:

- ※ Tighten symmetrically with a torque of 35 Nm and then coat thread with thread sealant.

- ※ Use hands to inspect the clearance of gears. (The control range of

clearance of gears is 0.034~0.265 mm, and recommended inner control range is 0.10~0.25 mm.

- Hit a pin into the front of the timing gear house.
- Install camshaft gear cover gasket and camshaft gear cover.
- Tighten inner hexagonal cylindrical head screws and matching saddle-shaped spring gaskets. Tighten (1) hexagonal nuts and matching spring gaskets.




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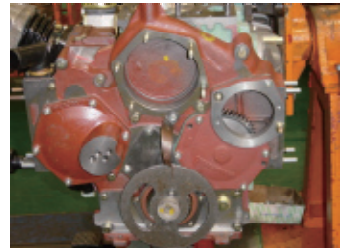
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## 2.8 Tightening Torque and Tightening Method of Main Bolts of Diesel Engine

Name	Tightening Torque(Nm)+Turning Angle	Time of reuse
Main bearing bolts M18	250+30 0	
Connecting rod bolts M14*1.5	120+(90 ° +/-5 °) at the same time reach 170-250 N.m	0
Cylinder head		
Main bolt for cylinder head M16	200+10+2*(90°+/-5°)at the same time reach 260-380 N.m 0	3
Auxiliary nuts of cylinder head M12	90+10+2*(90°+/-5°)at the same time reach 120-160 N.m 0	2
Bolt for flywheel M14*1.5	60+20+2*(90°+/-5°) at the same time reach 230-280 N.m 0	2
Bolt for flywheel housing M12	40+20+(120°+/-5°)at the same time reach 110-140 N.m 0	2
Bolt for oil pump idler gear shaft M10	60+5 0	
Bolt for camshaft gear M8	32-36	
Bolt for timing idling gear M10	60+5 N.m (at the same time reach 100-125 N.m)	
Bolt for pressing crankshaft belt pully M10	60+10	
Bolt for injector press plate M8	25	
Pressing bolt for press plate of iron plate injector M8	15	

Bolt for air exhaust pipe M10	50-70	2
Bolt for rocker-arm seat M12	100+10	
Press nut for air compressor gear M18*1.5	200+20 0	
Press nut for fuel pump gear M24*1.5	450-500	
Fixing bolt for tension pulley M16	195	
Fixing bolt for fuel pump coupling bearing cover M8	25	
Tension bolt for angel adjusting plate M12 / M14*1.5	130+20 / 150+15 0 0	
Connecting bolt for coupling springy connecting piece M10 /M12	74 / 110	

**Torque requirement: tightening bolts as techniques requirement.**

- 8.8 level:

M6, M8, M10, M12, M14, M16, M18

Nm: 9~12; 22~30; 45~59; 78~104; 124~165; 195~257; 264~354;

- 10.9 level:

M6, M8, M10, M12, M14, M16, M18

Nm: 13~16; 30~36; 65~78; 110~130; 180~210; 280~330; 380~450;

## Chapter III Introduction of Fault Case for WD615/618 Diesel Engine

### Failure diagnosis and remedy principle

- When a diesel engine has faults, we apply a method that the easier part first and remove faults one by one.
- Do not replace any part haphazard until find root of the fault.

### 3.1 Diesel Engine Starts Hard

- Inspect whether gear shift is at neutral position and neutral position switch is normal; inspect whether shut-down switch under vehicle is normal and flameout electromagnetism valve is damaged. Come into next step if it still can't be started.

- Inspect whether vehicle starting line and battery are normal. Come into next step if it still can't be started.

- Judge whether engine works normally. Inspect whether the rotation of engine is flexible and initial angles of valve gear are correct if the fault still does not be solved. Come into next step if it still can't be started.

- Inspect whether there is air in low pressure fuel passage. Come into next step if it still can't be started.

- Inspect whether the fault is caused by plateau and low

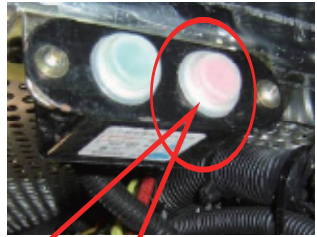
temperature

- Contact professional maintenance personnel from professional maintenance station to check for you.





Neutral position switch



Shut-down switch under vehicle



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### 3.1.1 Case Description about Diesel Engine Cannot Be Started (1)

1. Starting line, starter and battery are normal, but Diesel Engine cannot be started by starter for several times, so eliminate starting system failure.

2. Check low and high pressure fuel passage and exhaust air and engine can start; But 5 minutes of flameout later, engine starts hard again, if there is still air in fuel passage, it may be judged that there is air in low pressure fuel passage.

3. After checking low pressure fuel passage carefully, find that thread of fuel inlet of coarse filter is damaged and air enters into Fuel passage, which causes Diesel Engine cannot start normally.



#### Case analysis

Improper assembly of frequent dismantlement and assembly causes that sealing of low pressure fuel passage is not good.



#### Remedy

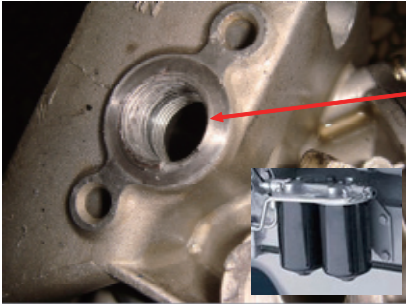
Replace coarse fuel filter or parts of low pressure fuel passage till sealing is good



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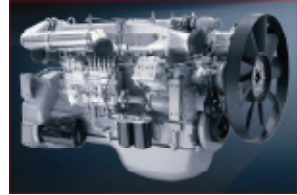
Thread of fuel inlet of coarse filter is damaged and its fuel inlet is cracked



Water filter

**Learning and thinking:**

A large, empty, rounded rectangular box with a blue border, intended for notes or a learning exercise.



### 3.1.2 Case Description about Diesel Engine Cannot Be Started (2)

- Starter operates normally, but engine can not be started.
- We find there is wax in low pressure fuel passage after checking, which causes fuel loses fluidity and blocks fuel passage and filter element.
- After inquiring customer we know that he (she) filled up -10 #fuel when he (she) bought a car, and the 2nd day it could not be started after he (she) got to Liaoning and parked the car. That is because the temperature in Liaoning is lower than Beijing, and the vehicle of Liaoning area need to fill up -35#fuel.



#### Case analysis

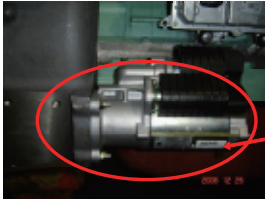
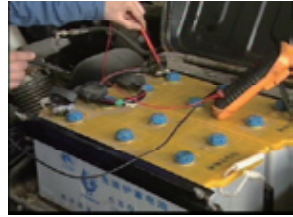
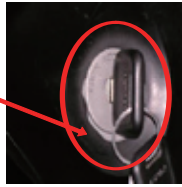
Select diesel fuel of different grade in accordance with different temperature, but customer didn't do so, which causes fuel curdle and block intake fuel pipe. When a vehicle is operating in several different temperature areas, replace fuel in time which can reach temperature requirement in accordance with actual temperature condition in local area.



#### Remedy

dredge fuel passage , replace -35#fuel

Ignition key switch



Starter

**Attached table: fault cause and remedy.**

cause	remedy
1. Fuel intake filter screen of supply pump or hose clogged	Clear away the dirt and check if the fuel is clean
2. Air entered into the fuel system	Drain off the air, check the sealing of the connector and repair it
3. Injection pump damaged	Check plunger, fuel outlet valve and repair or replace the broken parts
4. Injector damaged	Check the atomization of injector, and repair it
5. Initial angles of valve gear or fuel delivery is wrong	Check and adjust it
6. High pressure line damaged or leaked	Repair or replace
7. Insufficient pressure in cylinder	Check the sealing of the valve and cylinder gasket and the wear of the piston ring. Repair or replace
8. The temperature is too low	With the addition of start-assist device




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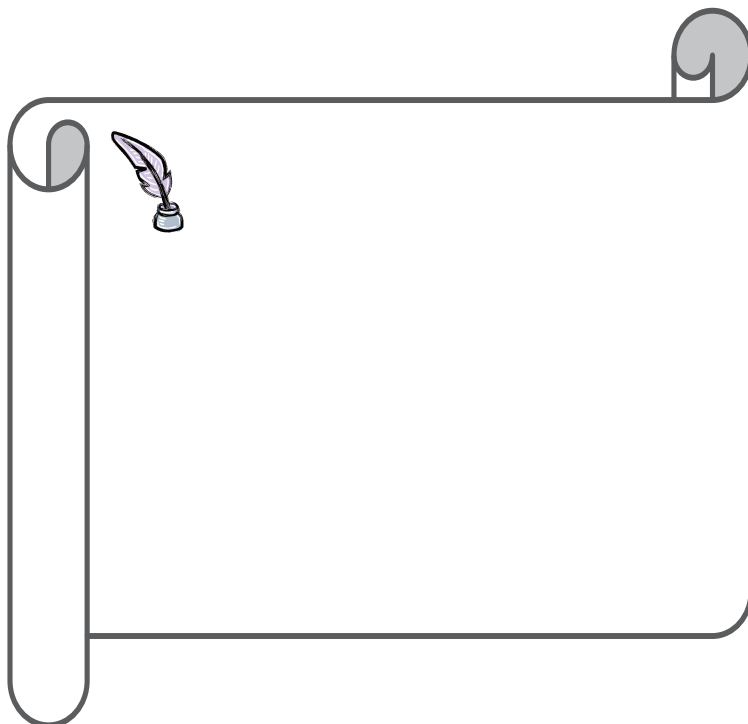
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### 3.2 Stop Soon after Starting

- Check whether air entered or leaked or choked in low press fuel passage. Come into next step if it still can not be started.
- Check whether gear pump is working. Come into next step if it still can not be started.
- Check whether idling speed and adjusting speed are too low. Come into next step if it still can not be started.
- Contact professional maintenance personnel from professional maintenance station to check for you.



### Case description about stop soon after starting

- Diesel engine can be started, but after starting it exhausted black smoke. Inspect air filter element and air passage are circulated and turbocharger is normal.
- Find fuel is mixed in water after inspecting low pressure fuel passage and fuel. Dismantle and inspect injector, and then find head of injector has water rust. We can judge that fuel is mixed in fuel, which causes 6 needle valves of injector are rusted and seized.



#### Case analysis

Fuel is disqualification, there is water in fuel and water filter is not installed, which causes needle valve of injector rust and atomization of fuel is not good.



#### Remedy

Replace quality fuel and injector, add water filter.



Injectors have rusted

Water filter



Left side represents fuel used in the car Right side is normal fuel



**Attached table: the inspection and removal of fault when engine starts soon stops**

Cause	Remedy
Fuel filter clogged	Dismantle and clean away dirt and water replace the filter element if necessary
Air entered into the fuel system	Check fuel pipe and sealing of the connector tighten air venting bolt, and drain off the air
Supply pump doesn't work	Check piston and valve of supply pump clean and repair
Poor quality of fuel	Clean fuel filter and renew fuel
Idling speed is too low	Readjust it




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**3.3 Insufficient Output**

- Check whether low pressure fuel passage and quality of fuel are normal. Come into next step if normal.
- Check whether air filter element, air inlet pipe and turbocharger are normal. Come into next step if normal.
- Check whether valve clearance is normal. Come into next step if normal.
- Check whether air exhaust pressure is too high. Come into next step if normal.
- Contact professional maintenance personnel from professional maintenance station to check for you.

### 3.3.1 Case Description about Insufficient Output (1)

- Insufficient output.
- Inspect fuel passage and whether fuel is normal.
- Inspect air filter element and air inlet pipe, and then find there is an opening of 15cm under intercooler.



**Case analysis**

Air inlet pipe leaks air



**Remedy**

Replace intercooler



Intercooler is cracked

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### 3.3.2 Case Description about Insufficient Output (2)

- There is insufficient output when engine is in large load, but there is no big smoke.
- Inspect air filter, turbocharger and initial angle of fuel supply are normal.
- Inspect whether low pressure fuel passage and every pipe are leaked. When check fuel filter, we find that fuel filter and fuel-passed screw filter net of fuel pump are dirty and blocked and that fuel passage isn't circulated, which causes high pressure fuel pump can't supply fuel and output is insufficient.



Block filter element



**Case analysis**



Block filter element

Block fuel filter element and fuel-passed screw filter net of fuel pump



**Remedy**

Add water filter, replace fuel filter element and fuel-passed screw filter net of fuel pump





### 3.3.3 Case Description about Insufficient Output (3)

- Output of the engine is insufficient, but engine doesn't exhaust black smoke clearly.
- Check fuel passage, fuel and initial angle of fuel supply are normal.
- Customers work in desert area, they find air filter elements are blocked and air inlet pipes are very dirty after checking.



**Case analysis**

Block air inlet pipe



**Remedy**

Add compound air filter to clean air inlet pipe



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**Attached table: fault cause and remedy**

Air intake clogged (air cleaner logged)	Check air cleaner and air intake pipe, clean or replace filter element
Exhaust back pressure is too high	Check the valve-timing and exhaust pipe adjust and repair
Insufficient pressure in supercharging system	Check and block up the leakage of pipeline
Faults in turbocharger	Replace the turbocharger assembly
Intercooler damaged	Replace or repair
Leakage or choke of fuel line	Check the sealing of fuel pipe and connector fuel filter and fuel line repair clean or replace the filter element
Excessive wear for injection pump or governor	Repair or replace
Smoke-limiter diaphragm of injection pump damaged	Repair or replace
Poor atomizing	Check the injecting pressure clean away the carbon deposit in nozzle adjust and repair injector
Incorrect timing of valve gear or fuel delivery	Check and adjust it
Oil level in the oil sump is too high	Check the oil-dipstick and drain off unnecessary oil
Leakage in cylinder gaskets	Check the compressed pressure at hot state, replace cylinder gaskets
Piston ring broken the clearance of main bearing is too large	Replace worn parts or overhaul the engine
Cylinder liner or piston worn or piston scuffing	Check the injecting pressure, clean away the carbon deposit in nozzle, adjust and repair injector

### 3.4 Fuel Consumption Is Too High

- Check whether low pressure fuel passage and quality of fuel are normal. Come into next step if normal.
  - Check whether air filter element, air inlet pipe and turbocharger are normal. Come into next step if normal.
  - Check whether valve clearance is normal. Come into next step if normal.
  - Check whether air exhaust pressure is too high. Come into next step if normal.

#### Case description about fuel consumption is too high

- When diesel engine is operating, there is a lot of smoke and fuel consumption is too high.
  - Inspect air filter, turbocharger and initial angle of fuel supply are normal.
  - There is no fuel leakage in low pressure fuel passage and high pressure fuel pipe.
  - High pressure fuel pump is normal, but atomization of 2 injectors is not good, so we judge there is fault in injector.



#### Case analysis

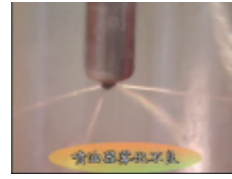
Needle vale of injector is worn heavily, and fuel atomization is bad



#### Remedy

Add water filter and replace fuel head of injector.





Checkout process of the injector



**Attached table: fault cause and remedy**

Air intake clogged(air cleaner choked)	Check air cleaner and air intake pipe, then clean them
Exhaust back pressure is too high	Check exhaust pipe and brake valve, then clean them
Poor quality of fuel	Renew the fuel according to requirements
Fuel line choked	Check and repair
Fuel line leaked	Check and repair
Poor atomizing	Check, adjust and repair
Incorrect timing of valve gear or fuel delivery	Adjust valve clearance and injection advance angle according to requirements
Leakage in cylinder gasket	Check compressed pressure
The clearance of main bearing shell is too large Engine need to overhaul	Check and overhaul
Piston scuffing	Replace cylinder liner, piston and piston ring
Insufficient pressure in supercharging system	Check and block up the leakage of pipeline
Faults in turbocharger	Check and replace
Intercooler damaged or leaked	Replace or repair

### 3.5 Black Smoke Exhaust

● Smoke emission is a very important target representing the fuel condition. The abnormal smoke emission indicates that there is problem with the combustion. The colors of the abnormal smoke are usually black, blue and white. Emitting black smoke indicates that the diesel fuel does not burn very well. Try to locate the reason on air and fuel. Emitting blue smoke suggests oil burning. Look for the reason on the oil. Emitting white smoke can be divided into two categories: continuous gray smoke indicates there is water in the fuel. The white smoke during startup is generally consisted of the tiny diesel fuel particles. The abnormal smoke emission is the incidental phenomenon of other failures. The diagnosis and the removal of relevant failure run through this material.



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## Case description about black smoke exhaust

- When diesel engine is operating, there is a lot of smoke and fuel consumption is too high.
- Inspect air filter, turbocharger, valve clearance and initial angle of fuel supply are normal.
- There is no fuel leakage in low pressure fuel passage and high pressure fuel pipe.
- Injector is normal, but high pressure fuel pump cannot supply average fuel in every cylinder, so we judge that there is fault in high pressure fuel pump



### Case analysis

Fuel pump pole plug is worn heavily, which causes fuel pump cannot supply average fuel in every cylinder.



### Remedy

Add water filter and replace fuel pump pole plug

Water filter



Check fuel pump



Fuel pump

**Attached table: fault cause and remedy**

Air intake is not free or exhaust back pressure is too high	Clean
Poor quality of fuel	Clean and renew
Incorrect timing of valve gear or fuel supply	Adjust according to requirements
Poor atomizing	Check, repair or replace injector
Excessive injection quantity	Check and adjust (by manufacturer)
Insufficient pressure in supercharging system	Check and block up the leakage of pipeline and connector
Faults in turbocharger	Check and replace
Intercooler damaged or leaked	Replace or repair
Incorrect working point of smoke-limiter	Readjust (by manufacturer)



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**3.6 Oil Is Gathered in Inlet and Exhaust Vents of Turbocharger and Inlet and Exhaust Pipe.**



- Check oil dipstick. Come into next step if oil level of oil pan is not high.
- Check whether turbocharger is good. Come into next step if yes.
- Contact professional aintenance personnel from professional maintenance station to check for you.



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## Case description

- Oil is gathered in inlet and exhaust vents of turbocharger and inlet and exhaust pipe and there is a lot of smoke when a new engine is operating without load.
- Check oil dipstick and then find oil level of oil pan is not high.
- Check whether turbocharger is good.
- Oil-returned pipe of turbocharger and oil-separator are folded.



## Case analysis

Oil return pipe of turbocharger is folded, which causes oil flows un-circulately. Air exhaust pipe of oil separator is folded, which causes failure of oil separator

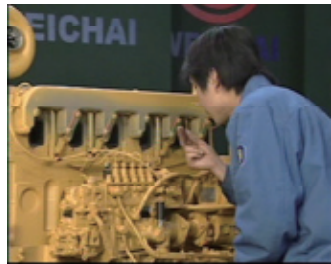


## Remedy

Re-install oil return pipe and air exhaust pipe of oil separator



Air exhaust pipe is folded





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**Fault inspection and removal of gathered oil in inlet and exhaust vents of turbocharger, inlet and exhaust pipe.**

The sealing of turbocharger cease to be in effect	Repair or replace turbocharger
The gas-oil separator cease to be in effect	Replace
Lub-oil level in oil sump is too high	Drain off unnecessary oil according to requirements

### 3.7 Lubricant-oil Pressure Is Too Low.

- Check whether oil level of oil pan is too low or insufficient.  
Come into next step if not.

- Check whether oil brand is satisfied to relevant rules. Come into next step if not.

- Check whether the resistance of oil filter is too large. Come into next step if not.

- Check whether the resistance of oil cooler is too large. Come into next step if not.

- Check whether water temperature in cooling system and oil temperature is too high. Come into next step if not.

- Contact professional maintenance personnel from professional maintenance station to check for you



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**3.7.1 Case Description about Lub-oil Pressure Is Too Low (1)**

- Lub-oil pressure is low. Oil level of oil pan is normal, but oil brand is not satisfied to requirement.
- Fault is not removed after replacing oil and oil filter and cleaning oil cooler.
- Inspect turbocharger, strainer, oil pipe and connecting washer are not blocked or broken
- Inspect limiter valve of main oil passage and then find that limiter valve dirty.



**Case analysis**

Users didn't replace oil, which causes limiter valve of main oil passage dirty



**Remedy**

Replace limiter valve of main oil passag



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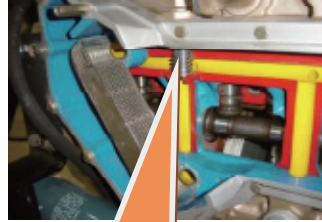
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**Limiter valve of main oil passage**



**Limiter valve of main oil passage**

- Lub-oil pressure is low. Oil level of oil pan is normal, but oil brand is not satisfied to requirement.
- Fault is not removed after replacing oil and oil filter and cleaning oil cooler.
  - Turbocharger and limiter valve of main oil passage are good.
  - Inspect strainer, oil pipe and connecting washer, and then find



**Case analysis**

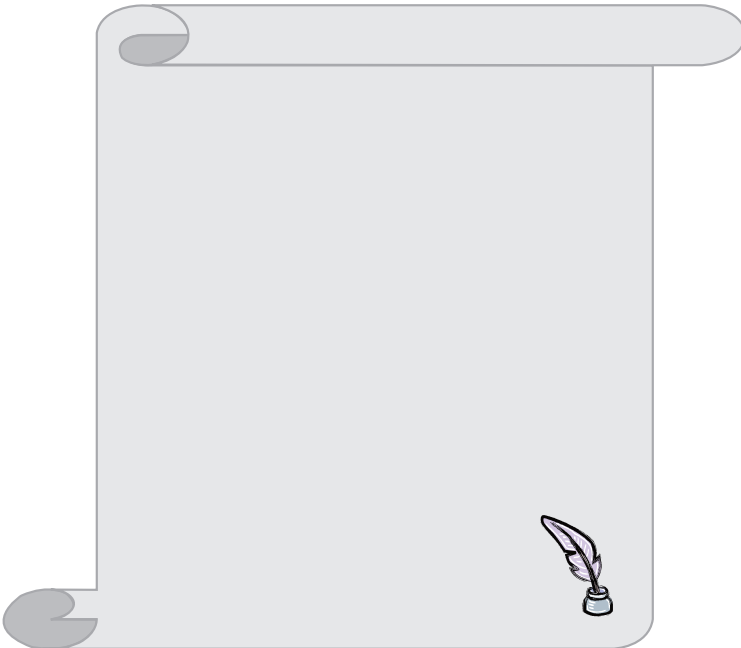
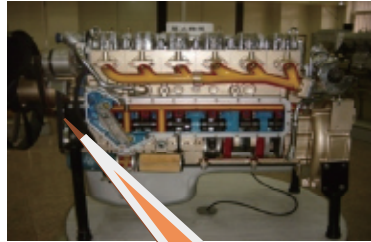
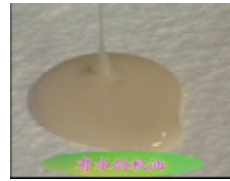
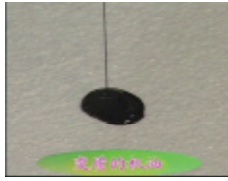
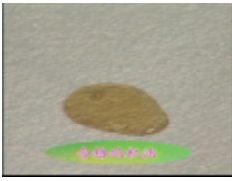
Customers didn't replace strainer in accordance with operation manual, which causes strainer was blocked.



**Remedy**

Clean strainer





**Attached table: fault cause and remedy**

1. Oil level in oil sump is too low	Check oil leakage, add oil
2. Faults in pressure regulating valve of main oil passage	Check valve clean and repair
3. Strainer, oil pipes, connector gasket choked or broken	Check strainer and connector check if there is any sponge in oil passage repair
4. Lub-oil doesn't conform to specifications	Renew the lub-oil according to requirements
5. Intake pipe of oil pump leaked	Check the oil pipe and connector repair or replace
6. Water temperature in cooling system and oil temperature is too high	Check cooling system and correct it
7. Excessive resistance of oil filter	Renew the filter element
8. Oil cooler choked	Check and clean
9. Main oil passage choked	Check and clean
10. The clearance of bearing is too large or bearing damaged	Check and replace
11. Excessive wear of parts need to overhaul	Check the working time of the engine, overhaul



### 3.8 Cooling Water Temperature Is Too High.

- Check whether water level of water tank, water belt and oil level of oil pan are normal. Come into next step if normal.
- Check thermostat. Come into next step if normal.
- Check whether connecting water pipe and water pump are normal. Come into next step if normal.
- Check whether water temperature meter and water sensor are normal. Come into next step if normal.
- Contact professional maintenance, and personnel from professional maintenance station will check for you.

#### Case of cooling water temperature is too high.

- Cooling water temperature is high when diesel engine is operating with high load. Check oil level of oil pan, water level of water tank and water pump belt are normal.
- Check thermostat, joint pipe and initial angle of fuel supply are normal.
- Check water temperature meter and water temperature sensor work normally.



#### Case analysis

There is no intake vent on engine cover, which causes fan blows dirt from ground to water tank so that heat-sinking of water tank is





**Remedy**

Add air intake on engine shell and  
clean water tank



Because fan sucks  
air from ground, water  
tank is too dirty and  
radiator vent of water  
tank is choked, which  
cause engine too hot

Add air vents on both  
sides of shell (left side)



Add air vent in the  
middle of shell



Vehicle has no air  
vent, so it only



Check thermostat



Check water  
temperature sensor



Check belt pulley with 4-5 kg force and press down 15-20 mm

1. Water level in water tank is too low	Check water leakage, add water
2. Water tank clogged	Check or repair
3. The belt of water pump loosened	Adjust tension according to requirements
4. Water pump gasket damaged, water pump impeller worn	Check and repair, or replace
5. Faults in thermostat	Replace it
6. Surge in turbocharger	Check wash compressor streets clean away the carbon deposit from exhaust passage
7. The oil level in oil sump is too low	Check oil leakage, repair, and add oil

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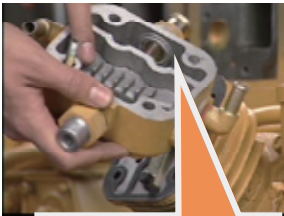


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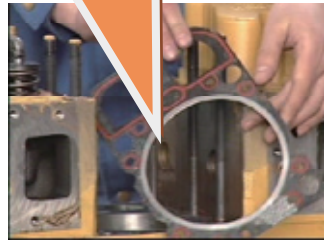
### 3.9 The Oil Mixed with the Water

- There is water in the oil. First check the cylinder head and the air compressor. Change the relevant components if there is any crack. Check whether the cylinder gasket is washed off or damaged letting cooling water mix with the oil. Change the gasket.
- There is oil in the cooling water. If it is indeed the oil, follow these steps: first, check whether the oil cooler is damaged. Drain off the water in the diesel engine, dismantle the cooler lid and let the engine run idly for 10-20 seconds. If there is leakage or damage on the cooler element, change it.



Check whether air compressor cover and washer are broken.

Check whether cylinder head washer is broken.



Drain water from engine, and remove oil cooler cover. Conduct 10-20s run-in with idling speed.

