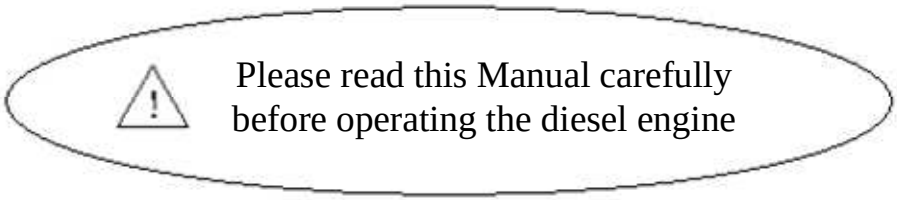
Operation and Maintenance Manual for WP13 Series Diesel Engines

Weichai Power Co., Ltd.

Special Notes

- The fuel injection pump and injectors are precision components, so no adjustment or disassembly shall be available for any user. Otherwise, our company's warranty will become invalid.
- The supercharger rotor shaft is a precision high-speed rotating part, so no dismantling or collision is permitted. Otherwise, our company's warranty will become invalid.
- The diesel engine main bearing bolts and connecting rod bolts have their torques and rotation angles subject to strict requirements, so any user shall not be permitted to unscrew or remove any bolt. Otherwise, our company's warranty will become invalid.
- Every time the diesel engine is started, you must check whether it has been filled with enough coolant and engine oil.
- The connecting rod bolts shall never be used for a second time.



Precautions

1. This diesel engine has been strictly tested in accordance with the test specifications before delivery, so never adjust the ECU data or increase the power of the diesel engine arbitrarily. Otherwise, our company will not implement the three guarantees. Please take care!
2. The diesel engine operators must read this Operating and Maintenance Manual carefully, familiarize them with the engine structure and strictly follow the technical operation and maintenance procedures as provided in the Manual.
3. Any new engine should have a running-in period of 50 hours.
4. The diesel engine can only be accelerated slowly after cold start, but never be forced to work at its high speed in a sudden or idle for long. After heavy load operation, never stop it immediately but let it idling for 5-10 minutes in advance.
5. After shutdown, if the ambient temperature may be lower than 0℃ but no antifreeze additive is used, the water in the water tank and the diesel engine should be drained.
6. Never have the diesel engine working if there is no air filter to prevent air into the cylinder before filtered.
7. When refueling or oiling the diesel engine, you must use the grades as provided in this Manual by means of dedicated clean container with the fuel or oil filtered in advance. The fuel shall be precipitated for more than 72 hours.
8. The electrical system shall have its parts overhauled by anyone familiar with electrical knowledge.
9. In order to prevent rust, our company’s diesel engine have been oil sealed before delivery and sealing effective period should generally be one year, once longer than one year, any engine should be checked, and additional measures should be taken when necessary.
10. The diesel engine should not be kept idling for long (generally no more than 10 minutes).
11. Please use the oil filters, diesel filters and air filters produced by the manufacturers as provided by our company. Otherwise, our company will not implement the three guarantees.

Introduction

The WP13 series diesel engines are of high-speed diesel engines developed on the basis of WP12 Landking diesel engines in accordance with National III / IV / V emission requirements and designed according to the relevant national standards. The engines feature reliable operation, excellent economic and technical indicators, low emission, fast start-up, simple operation and convenient repair, being the ideal power of heavy-duty vehicles.

This Manual has detailed the structure, performance, operation, inspection, maintenance and relevant contents of WP13 series diesel engines. With the continuous development of production and technology, the structure of the engine will be improved, so this Manual may have its contents different from later improvement. Hope you can pay attention to it.

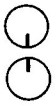
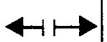
We sincerely hope that the repairmen and relevant personnel should read this Manual carefully before operation and maintenance of this diesel engine, and strictly implement various provisions in the Manual to ensure correct and reasonable use and prolong the engine service life.

If any problem is found during operation, please contact the after-sales service department of our company as soon as possible to get timely and thoughtful services.

October, 2012

Contents

图 示 标 记 说 明
Description of the illustration marks

	拆卸(组合件) Dismounting (assembly parts)		涂润滑油 Oil coating
	装配(组合件) Fitting (assembly parts)		专用工具,如 S K……, KUKKO,……,TS……W Special tools, such as K------, KUKKO, ------, TS------ W
	打记号 (分解前打上,重新装配时注意对正) Marking (do before disassemble, adjust when assemble)		注意装配方向 Pay attention to assembly direction
	注入—充满(如润滑油、冷却水等) Filling- full charge (such as lubricating oil, cooling water etc.)		放气 Deflating
	排出(例如润滑油、冷却水等) Draining off (lubricating oil or cooling water)		松开(例如:夹紧装置的松开) Unloosing (such as: unloose clamping equipment)
	(防松—粘固)涂液态密封剂 (loose-proof -fixed) Coat fluid sealant		夹紧(例如:夹紧装置的夹固) Clamping (such as: reinforcing clamp equipment)
	防止人身事故(危险场合标记) Accident preventing (marks for dangerous occasion)		检测—调整 (例如:拧紧力矩,尺寸,压力,间隙等) Inspecting -adjusting (such as: tightening torque, dimension pressure and clearance)
	每次装配都要更换 Replacement when re-assembly		检查 Inspecting

Product implementation standards:

Q/WCG134 WD10 Series Diesel Engines (for filing)

Q/WCG131 WP10 Series Diesel Engines (for filing)

GJBZ768A-1998 Guide for Fault Tree Analysis

GJB/Z3-1988 After-sales Technical Services for Military Products

GJB1443-1992 Quality Management Requirements for Product Packaging, Loading and Unloading, Transport and Storage A.1

GJB/Z1391-2006 Guide for Analysis of Fault Mode Effects and Danger

GJB1107-1991 Maintainability Specifications for Military Vehicles

Chapter I Product Technical Survey

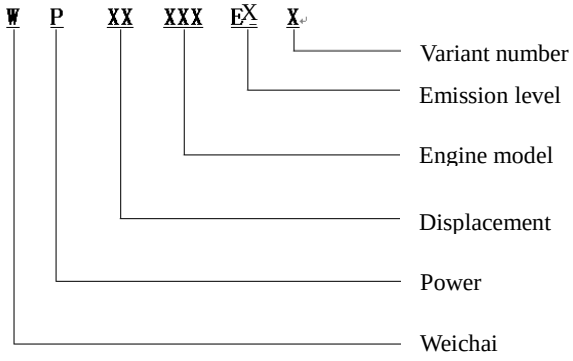
1.1 Diesel Engine Power and Speed

The WP13 engine has its power range and rated speed of 353 - 405 kW and 2100r/min respectively (therein, WP13.480 has its rated speed of 1900r/min).

1.2 Main Structural Characteristics of the Diesel Engine

- One cylinder one head, reliable work and convenient disassembly
- Right-mounted common rail system (seen from the free end), convenient for arrangement of the complete vehicle
- Frame main bearing structure, high overall rigidity, conducive to the reliability and service life of the complete engine
- Mid-set supercharger, fewer dimensional changes of all types of the engine series
- Rear-set gear transmission, featuring a compact structure and low noise
- Inline six cylinders of the whole series, featuring a high degree of universality and convenient for complete vehicle matching

1.3 Meanings of WP13 Series Diesel Engine Models



Chapter II Technical and Performance Parameters of Diesel Engines

2.1 Main Technical Parameters of WP13 Series Diesel Engines

Table 2-1 Main Technical Parameters of WP13 Series Diesel Engines

Model		WP13.480	WP13.500	WP13.530	WP13.550
Type		Inline, water-cooling, four-stroke, direct-injection, turbocharged and intercooled			
Fuel system		High-pressure common rail			
Number of cylinders × bore × stroke mm×mm		6×127×165			
Direction of rotation		Clockwise (towards the free end)			
Firing order		1-5-3-6-2-4			
Rated power – speed kW-r/min		353-1900	368-2100	390-2100	405-2100
Maximum torque Nm		2110	2100	2220	2300
Speed at the maximum torque r/min		1100-1400	1200-1500		
Piston total displacement L		12.54			
Cold valve clearance mm		Intake valve 0.4 Exhaust valve 0.6			
Valve timing (Valve clearance: intake 0.4 mm, exhaust 0.6 mm)		Intake valve opening 20° before the TDC (Top Dead Center) Intake valve closing 34° after the BDC (Bottom Dead Center) Exhaust valve opening 49° before the BDC (Bottom Dead Center) Exhaust valve closing 21° after the TDC (Top Dead Center)			
Lubrication mode		Pressure lubrication			
Startup mode		Electric starting			
Engine oil capacity L		28 (trucks) /25 (buses)			
Cooling mode		Water-cooling forced circulation			
Overall dimensions mm		1556×817×1094			
Complete engine mass kg		1000			
Cold start - without an auxiliary starting device ℃		-10			
Cold start - with an auxiliary starting device ℃		-30			
Emission level		National III / IV / V			
Allowable longitudinal inclination (°)	Front / rear	Long term 10/10		Short term 30/30	
Allowable transverse inclination (°)	Exhaust manifold side / fuel injection pump side	Long term 45/15		Short term 45/30	

Chapter III Fuel, Lubricating Oil, Coolant and Auxiliary Materials for Diesel Engine

3.1 Fuel

Summer: 0# diesel fuel (GB252)

Winter: -10# light diesel fuel for general use (GB252), but when the air temperature is below -20°C, -20# diesel fuel should be used; when the outdoor temperature is below -30°C, -35# diesel fuel should be used.

3.2 Engine Lubricating Oil

Lubricating oil capacity of diesel engine: 28L for trucks (reference value), 25L for buses (reference value), subject to the oil dipstick mark (with the oil capacity slightly different for different models).

Selection of lubricating oil: in order to achieve safe and reliable operation of your diesel engine, please use such grades of lubricating oils 15W/40CF-4 or 20W/40CF-4. Therein, 15W/40CF-4 and 20W/40CF-4 can be applicable within the range of -15°C to +30°C and -10°C to +30°C respectively (Weichai special oil is recommended), but 5W/20CF-4 lubricating oil should be used when lower than -15℃.

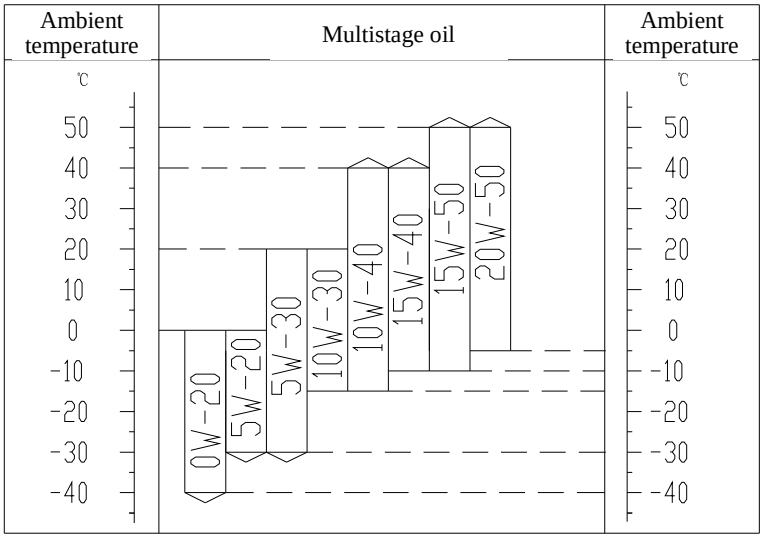


Figure 3-1 Table for Grade Options of Lubricating Oil

Attention: The WP13 series diesel engines shall never use any lubricating oil below level CF, and once the engine oil is replaced, you should replace the oil filter element at the same time!

3.3 Lubrication of Tension Gear

For the lubrication of tension gear , lithium base grease common for automobiles should be used (see the GB5671 standard).

3.4 Antifreeze additive of the Engine Cooling System

It adopts the antifreeze additive of ethylene glycol, with domestic long-acting antifreeze additive permitted for alternative, but the quality must be reliable, referring to the relevant instructions for its specific use. Currently, the two long-acting antifreeze additives domestically available are recommended as follows:

Type JFL-336 long-acting antifreeze additive

FD-30# long-acting antifreeze additive

It should be noted that the long-acting additives should be regularly replaced in accordance with the relevant requirements.

Calculation of antifreeze additive (only for reference)

Total coolant: 40L (when the mounted engine is equipped with a radiator)

Antifreezing check temperature at present: - 20°C

Minimum antifreezing temperature as required: - 30°C

Calculation method: Find out the point of the total coolant of “40L” on the abscissa, draw a line through the point, and find out its intersections 1 and 2 with the above oblique lines of - 20°C and - 30°C (as shown in Figure 3-2).

Result: in time of - 20°C, 13.5L antifreeze additive should be added.

The antifreeze additive quantity in time of -30°C has a difference of 4L from that in time of - 20°C.

According to the above difference of 4L, then calculate the additive amount by 50% more, which is necessary. Before filling the antifreeze additive, a portion of the coolant must be drained, so that the antifreeze additive in the drained coolant will be drained at the same time.

Therefore, the amount of antifreeze additive should be 4L+50%×4L=6L.

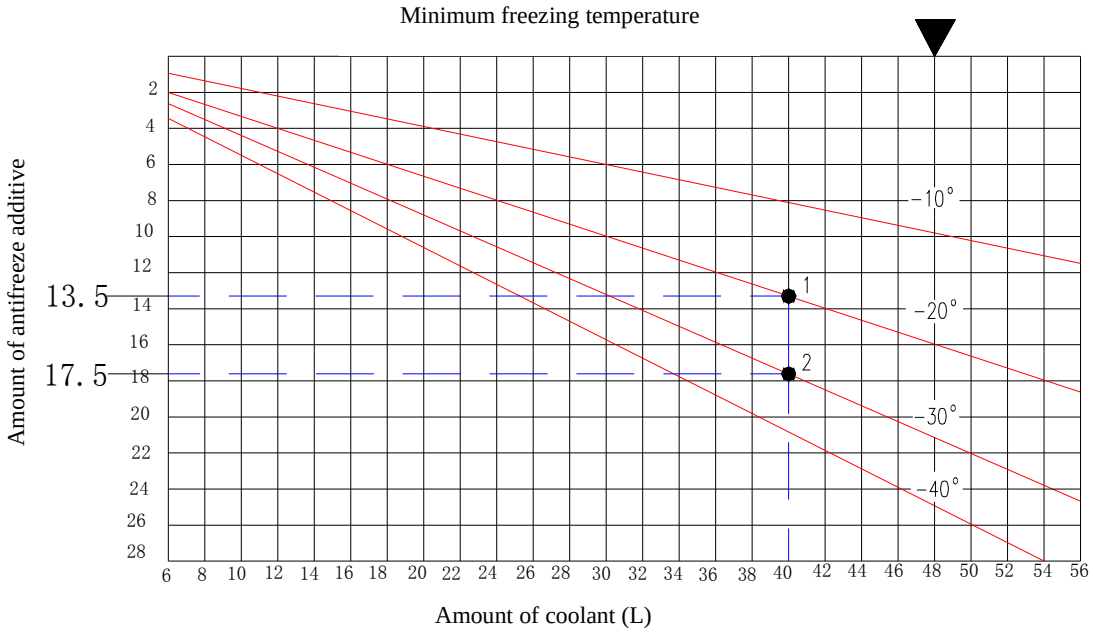


Figure 3-2 Calculation of Antifreeze Additive

3.5 Auxiliary Materials

Table 3-2

Ser. No.	Name	Color	Use and application
1	Molykotte Pulver (fine molybdenum powder)	Black	Coated on smooth metal surfaces to prevent occlusion For example: coated on the cylinder liner surface, etc.
2	Molykotte G.u.plus Molybdenum disulfide (MoS2 oiling agent)	Dark grey	For lubrication before the lubricating oil has its pressure built up For example: coated on the intake valve rod, etc.

Table 3-3 References for Diesel Engine Sizing

Brand	Main uses	List for sizing parts	Additional remarks
Loctite 242	Coated on the thread surface for fixing to prevent looseness due to shaking, medium strength	Bolts of the oil filter base Bolts of the oil cooler Plug screws of the oil cooler regulating valve Bolts of the fixing device for the oil pump return pipe Compressor shaft end thread Oil strainer bolts Bolts of the fixing device for the sensor and its wire harness	As an option, DriLoc204 thread pre-coating glue can be used for precoating.
Loctite 518 (updated product of 510)	Coated on polished metal surface for sealing	Joint surface between the oil filter base and the crankcase Joint surface between the cylinder body and the engine oil cooler cover Joint surface between the cylinder body and the oil filler cover plate	

Chapter IV Use and Operation of Diesel Engine

4.1 Unsealing of the Diesel Engine

After the packing box of diesel engine is opened, the user should first make an inventory of the diesel engine and its accessories according to the delivery packing list, and check whether the engine has any visual damage, check whether there is any connector loose, and then complete the following work:

- Wipe off the antirust coat of the exposed parts, as well as corrosion inhibitor, etc.;
- Drain the sealing oil in the fuel filter and the fuel system components (possibly, the engine can be started before the sealing oil is drained, but only when the sealing oil in the fuel system has been used up with normal fuel already available can you have the engine loaded for working).

Note: The diesel engine has its sealing effective period of one year, once longer than one year, any engine should be checked, and additional measures should be taken when necessary.

- Rotate the flywheel and spray solvent into the intake manifold until the sealing oil in cylinder is exhausted.
- Spray solvent into the turbocharger inlet and exhaust vent until the sealing oil is exhausted.
- According to the agreement between the manufacturer and the user, the oil sump shall be filled with engine oil as required if there is no oil in it; if the oil sump has been filled with engine oil containing running-in accelerant before delivery, it is recommended that the old oil should be replaced after 2000 kilometers' or 50 hours' running.

- According to the agreement between the manufacturer and the user, if the engine has been filled with coolant as the user requires, the coolant performance should be checked in time of unsealing; if the coolant antifreezing ability can satisfy the needs for -30℃ or -35℃, with its PH value and total hardness value of 7-8 (neutral) and 5-15°d [9-15°f (hardness)], then such coolant can be further used; if the requirements are not satisfied, such coolant should be replaced by new coolant containing antifreeze additive.

4.2 Lifting of the Diesel Engine

In time of lifting, the engine should have its crankshaft centerline kept level, with tilting or unilateral lifting strictly prohibited. Lifting and seating should be kept slow enough (see Figure 4-1).

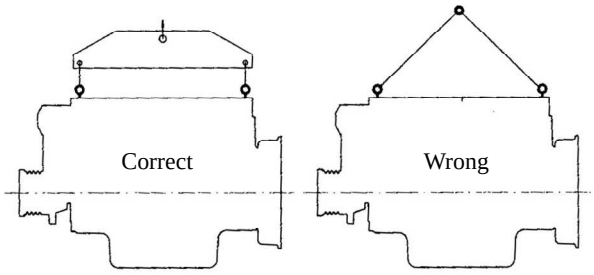


Figure 4-1 Lifting of Diesel Engine

4.3 Installation of the Diesel Engine

In time of installation, it should be guaranteed that the diesel engine has its crankshaft centerline coaxial to the input shaft axis of the driving devices (gearbox, transmission or generator, etc.), and it should be ensured that the crankshaft is subject to any additional axial force caused by installation.

4.4 Preparation before Starting

- Check the coolant level

If the engine has been installed on a vehicle or a bench, the coolant level can be seen through the glass window on the expansion tank at any time, and if there is insufficient coolant, you can open the coolant filler cover to add more. When opening any coolant filler cover provided with a pressure relief valve and an exhaust button, you must first press the exhaust button if you want to open the cover when the engine is still in hot state. Never fill with a large amount of coolant if the engine is still in hot state. Otherwise, its parts will be damaged due to sharp changes of the temperature. If there is no coolant in unusual circumstances, you can add cool water slowly from the coolant filler until there is coolant flowing out. Start the engine, let it idling (1000 r/min), continue to add coolant until the coolant level is kept steady, and finally cover the coolant filler.

- Check the fuel level.

If the engine has already been installed on a vehicle, open the power switch and check the fuel level from the fuel gauge or check the fuel tank.

- Check the engine oil level

The oil level should be kept between the top and bottom scale lines on the oil dipstick, and more engine oil should be added from the oil filler when necessary.

- Check the diesel engine accessories

Check whether the engine accessories are reliably connected and eliminate any abnormality. Check

whether the starting system circuits are normally connected and whether the battery is sufficiently charged. Then open the fuel tank valve, loosen the vent screw on the fuel strainer, use the hand pump on the fuel strainer to exclude the air in the fuel system.

4.5 Starting of the Diesel Engine

- Turn the power switch and its power key of the vehicle to the starting positions, and place the gear shift lever at its neutral position, and then set down to start the engine.
- Step down the clutch and accelerator pedals, rotate the power key to start the diesel engine, and if the engine cannot be started in 5-10 seconds, you should wait for 1 minute and then repeat the above-mentioned starting process. But if the engine cannot be started for 3 consecutive times, you should stop starting it and never start it again before troubleshooting. After the engine is started, you should pay attention to the meter readings and the oil pressure gauge should show the pressure immediately. Take care not to let the cold engine running at its high speed, and you should let it idling first for some time (but not for long).
- If the diesel engine is to be started under the condition of low temperature, auxiliary starting devices should be used so that the relay could have the electronic heating flange working to realize smooth starting in the environment temperature of -30℃.

4.6 Operation of the Diesel Engine

- After the diesel engine is started, first let it idling for a few minutes, then increase its speed up to 1000-1200 r/min, and then have it partially loaded. Only when the water and engine oil temperature is higher than 60℃ and 50℃ respectively can you have it working at its full load. You should increase its load and speed gradually, and try to avoid sudden increase or decrease of its load.
- During the running-in period of 60h (first 3000 kilometers' running), the diesel engine should be working at a medium load, and the vehicle should not be equipped with a trailer.
- Slow down in time when driving along any slope and never have it working for long at a large torque. Moreover, do not have its load too small or have its speed too low. Otherwise, it may easily suffer from engine oil channeling and other faults.
- Under normal use, the diesel engine can work continuously at its rated power and rated speed, but if it is working at 105% of its rated speed and 110% of its rated power, a maximum of 20 minutes' running can be permitted. The diesel engine should be kept idling for 1-2 minutes before shutdown after unloading.
- Attention should always be paid to the parameter values and checking points as follows:

① Pressure of the lubricating oil in the main oil passage is 350-550 kPa

② Temperature of the oil in the oil sump ＜110℃.

③ Coolant outlet temperature (80+5) ℃, never beyond 95℃.

④ Exhaust temperature after turbine ＜600℃

⑤ Inlet temperature after intercooler (50-55) ℃.

⑥ Check the exhaust color in order to identify the working quality and load conditions of the fuel injector, and if the smoke color is seriously bad, stop immediately for troubleshooting.

⑦ Particularly, check whether the diesel engine has water, gas or oil leakage, and if found, stop immediately for troubleshooting.

◆ The operating personnel should understand the following characteristics of the diesel engine:

① In time of the maximum torque, there will be lower fuel consumption; when the speed increases, the fuel consumption will rise.

② The torque will achieve its best value when the engine is working at its medium speed range (1200-1600 r/min).

③ The engine power will increase as the speed increases and reach its rated power at the rated speed.

◆ Considerations for operation in a cold environment:

① Fuel: the diesel fuel of different grades should be selected in accordance with the difference of outdoor temperature.

② Lubricating oil: the lubricating oil of different viscosity should be selected according to the season changes.

③ Coolant: add antifreeze additive in the cooling system and select the coolant different in grade and quantity in accordance with changes of the outdoor temperature.

④ Starting: an auxiliary starter can be used in winter when necessary. After started, the engine shall never be made to work at its high speed before the oil pressure and water temperature has become normal.

⑤ Before starting in cold season, you should check the electrolyte level, viscosity and unit voltage of the battery, and if the engine is kept idle for long at a very low temperature, the battery should be removed and stored in a warm room.

⑥ Parking: when parking in a cold climate, you should first remove its load, then let it idling for 1-2 minutes, and then stop it until the water temperature and oil temperature have dropped, but after stopping, the engine shall never have its coolant with antifreeze additive drained. You must open the discharge valves or water plugs on the body, engine oil cooler cover, radiator and water inlet pipe to drain the coolant with no antifreeze additive contained to prevent the engine cracking due to frost.

Chapter V Regular Inspection and Maintenance of the Diesel Engine

5.1 Daily Maintenance and Services

Check its coolant, oil and fuel levels; grease any part if needed; check whether there is oil, gas or water leakage; check whether the external parts and accessories are connected and fastened reliably; check whether the fan and belt are rather tensioned or loose; check the oil pressure and water temperature of the diesel engine; check whether the diesel engine has its exhaust normal in temperature, color, sound and vibration, and whether its speed is stable.

- Check the coolant level and water temperature

Observe the coolant level through the glass eye hole, and if there is insufficient coolant, open the water filler cover to add more coolant.

Note: To open the water filler cover, you must first press the exhaust button so as to prevent personal injuries due to hot coolant when the engine is still hot enough.

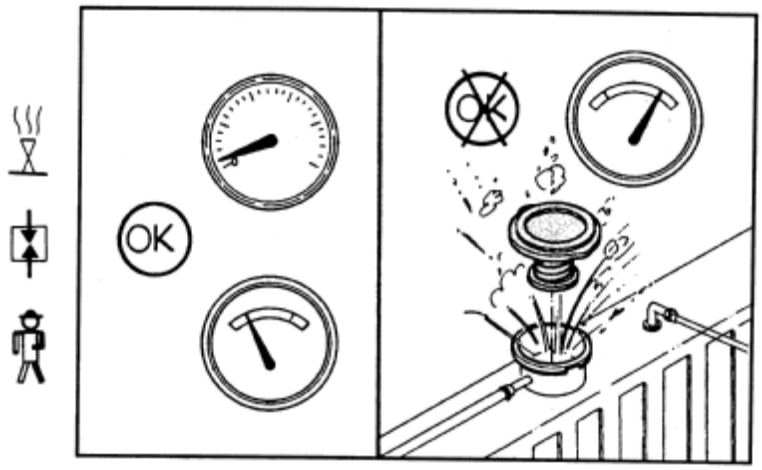


Figure 5-1

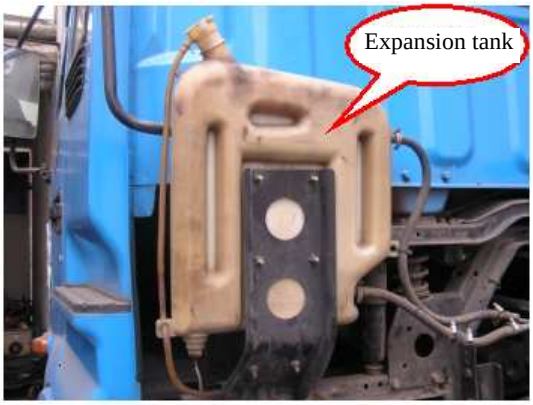


Figure 5-2

- Check the engine oil level

When the oil level is lower than the bottom scale line or higher than the top scale line of the oil dipstick, absolutely never start the diesel engine.

Check the oil level after the diesel engine has been stopped for at least 5 minutes, so that the oil has sufficient time to flow back into the oil sump.

The oil quantity difference is 3L from the bottom scale line to the top scale line of the oil dipstick.

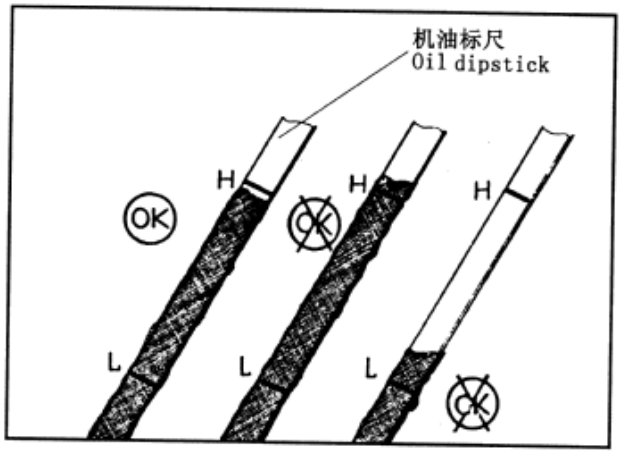


Figure 5-3

- Check the fuel level
- Check the water, gas and oil leakage

Check whether the complete engine has water, gas or oil leakage

Figure 5-4

- Check the level of the urea solution.

The level should be maintained at 30%-80% of the urea tank total volume.

- Check the fan.

Visual check whether the fan has any blade damaged and whether the connecting bolts are tightened.

Figure 5-5

- Check the belt.

The belt can be tensioned automatically through the belt tensioner, and users can check the belt tension by pressing the belt as shown in Figure 5-6.

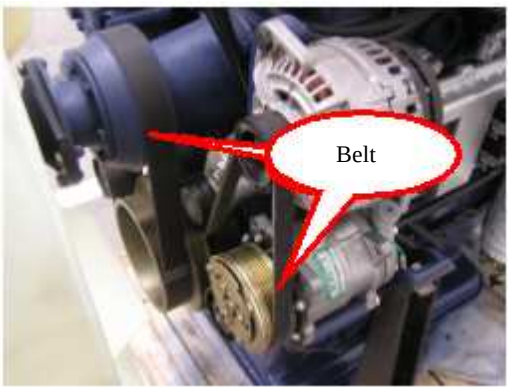


Figure 5-6

Figure 5-7

- Check whether the exhaust color is normal.

The normal color is light grey. If the color changes, you should check and troubleshoot it. As shown in Figure 5-7.

- Check whether the sound is normal.
- Check whether the speed and vibration is normal.

5.2 Maintenance Contents for Different Levels of Maintenance

In addition to completion of the daily maintenance, the following contents should also be added:

- Replace the diesel engine oil.
- Unscrew the oil drain plug at the bottom of the oil sump, drain the oil and then screw the drain plug as shown in Figure 5-9.
- Open the oil filler cap, (see Figure 5-8) add more oil from the oil filler, observe the oil dipstick scale, and then mount the oil filler cap until the requirement has been satisfied.

Figure 5-8

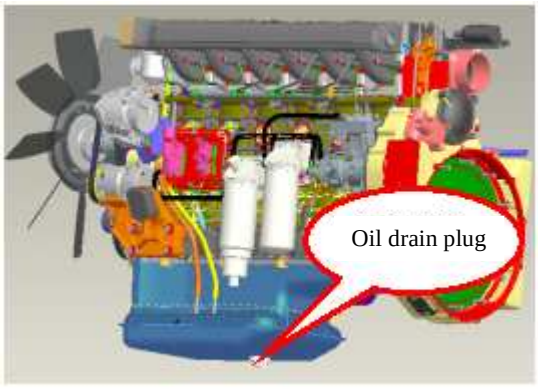


Figure 5-9

- Replace the oil filter or filter element, as shown in Figure 5-10:

To replace the oil filter, you should follow the steps below:

A. Remove the old oil filter;
B. Fill the new filter with clean oil;
C. Coat the rubber pad with engine oil before installing the new oil filter;
D. When the rubber pad contacts the base, then tighten at 3/4 to 1 circle to have it firmly sealed;
E. Start the diesel engine to check whether there is oil leakage.

Figure 5-10

- Check and adjust the valve clearance.

Check and adjust the clearances of intake valve and exhaust valve according to the following steps:

A. When the diesel engine is in its cold state, turn the crankshaft forward (in the direction of the diesel engine running) to TDC of Cylinder 1 and Cylinder 6. At this moment, the groove on the flywheel is aligned to the pointer on the observation hole cover plate, as shown in Figure 5-11;

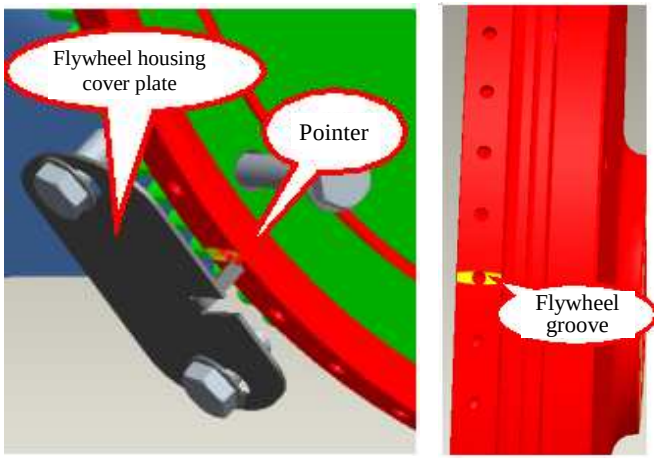


Figure 5-11

B. Remove the valve rocker cover on the cylinder head to judge whether Cylinder 1 or Cylinder 6 is at its compression stroke (the cylinder in its compression stroke has clearances between its intake and exhaust valves and the rocker arm), as shown in Figure 5-12;

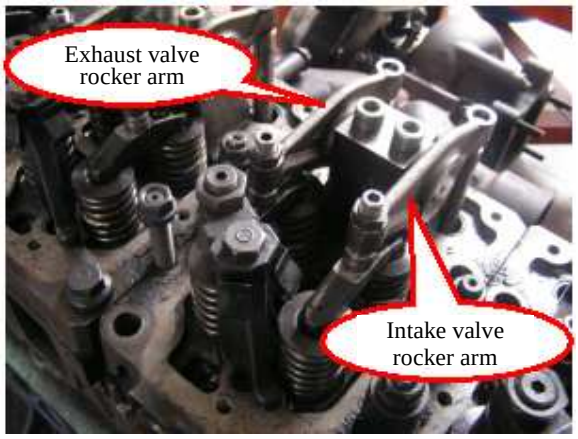
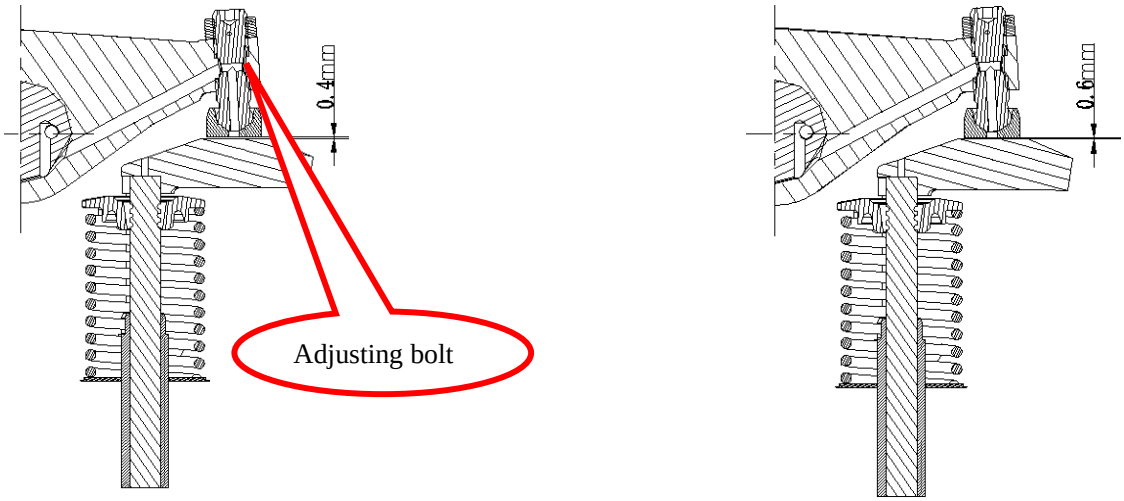


Figure 5-12

C. As shown in Table 3-1, use a feeler to check the clearance between the upper surface of the valve axle and the valve rocker arm. The WP13 diesel engine should have its intake and exhaust valve clearance of 0.4mm and 0.6mm respectively as required. If a too large or too small clearance exists, you can adjust the adjusting bolt on the rocker arm to meet the above-mentioned clearance requirements, as shown in Figure 5-13;



Intake valve clearance in the cold state 0.4mm Exhaust valve clearance in the cold state 0.6mm

Figure 5-13

D. After Cylinder 1 or Cylinder 6 has been checked, turn the crankshaft forward 360° to have Cylinder 6 or Cylinder 1 at its working stroke, then check and adjust the remaining valves.

Table 5-1

	Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4	Cylinder 5	Cylinder 6
Cylinder 1 compression stroke	Intake and exhaust valves	Intake valve	Exhaust valve	Intake valve	Exhaust valve	Unable to be adjusted
Cylinder 6 compression stroke	Unable to be adjusted	Exhaust valve	Intake valve	Exhaust valve	Intake valve	Intake and exhaust valves

For such exhaust valve with an EVB auxiliary braking device, its clearance can be adjusted as follows:

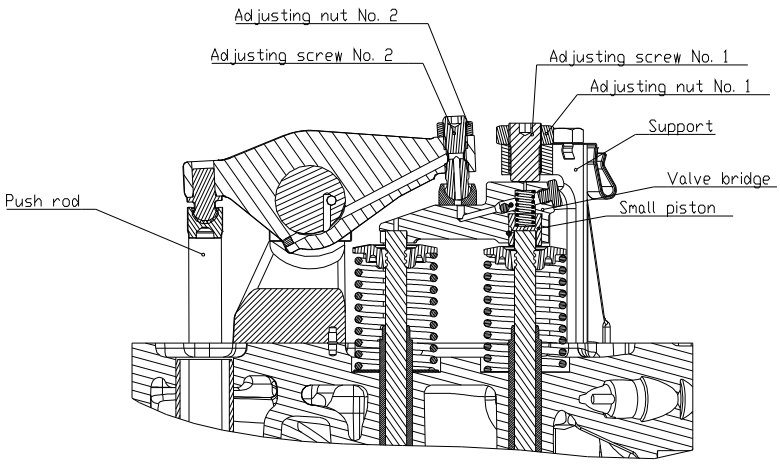


Figure 5-14 Exhaust Valve and EVB Clearance Adjustment

A. The piston is at the compression TDC;

B. Loosen nut 1;

C. Adjust the adjusting bolt 1 until the contact clearance is 0 to the valve bridge;

D. Loosen nut 2;

E. Adjust the adjusting bolt 2 and insert a feeler gauge (0.6mm) between the adjusting bolt 2 and the valve bridge;

F. Adjust the adjusting bolt 2 until the small piston goes down to its limit to clamp the feeler gauge;

G. Adjust the valve clearance (0.6mm), rotate the adjusting bolt until the feeler gauge has no clearance, keep it and lock the nut;

H. Adjust the adjusting bolt 1 and insert a 0.4mm feeler between the valve axle and the adjusting bolt;

I. Adjust the adjusting bolt 1 until the small piston goes to its limit to clamp the feeler, keep it and lock the nut;

J. Check the valve clearance again, and if necessary, adjust it again.

- Replace the fuel filter element as shown in Figure 5-15.

Follow the steps below to replace the fuel filter element:

A. Remove the old fuel filter element; if the water collecting vessel installed on the strainer can also be used, please remove it;

B. Lubricate the seal port;

C. Screw the filter by hand until the seal port contacts the interface;

D. Screw the filter again by hand (at about a 3/4 circle) until the filter is firmly installed;

E. Exhaust the air until there is no bubble appearing;

F. Conduct leakage test.

Figure 5-15

Attention!

When replacing the spinning strainer or reinstalling the oil delivery pipe, you need to exhaust the air in the strainer.

Steps (as shown in Figure 5-16)

A. Stop the engine;

B. Remove the vent screw;

C. Use a hand pump to inflate until there is oil coming out from the vent screw;

D. Retighten the vent screw;

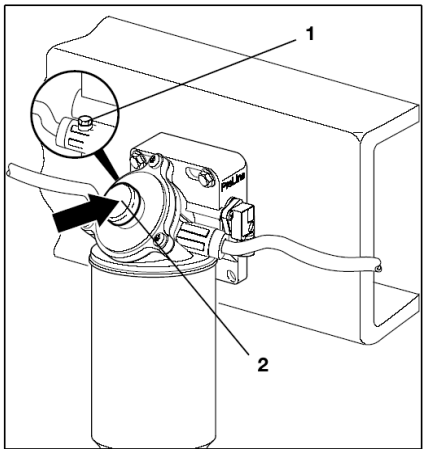


Figure 5-16 Exhaust the Air in the Strainer

Drain the water in the water collector

Attention!

When the water collector is full or the spinning filter has been replaced, it is necessary to drain the water collected.

Steps (as shown in Figure 5-17)

A. Open the oil drain plug (2) at the bottom of the water collector (1) to drain the water;
B. Retighten the oil drain plug.

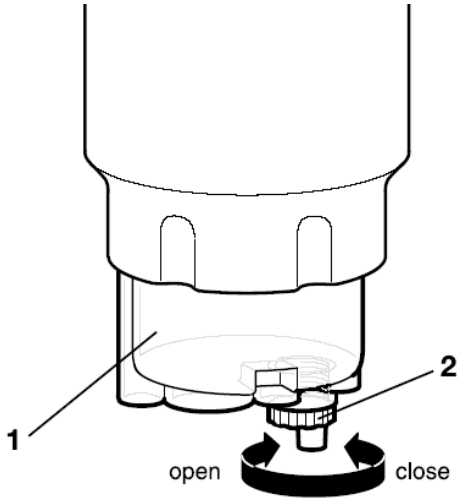


Figure 5-17 Drain the Water in the Water Collector

Replace the water collector.

Steps (as shown in figure 5-18)

A. Turn off the engine;
B. Drain the water in the water collector;
C. If possible, remove the collector screw (1) by hand. If it is too tight, use the handling tool in the new water collector;
D. Use a few drops of oil to lubricate the sealing ring of the new collector (2);
E. Mount the screw by hand and use a tool to tighten it;
F. If the water collector is to be used again on a new spinning filter, check for any damage;
G. Use a torque wrench to install it at the torque of 20N.m.

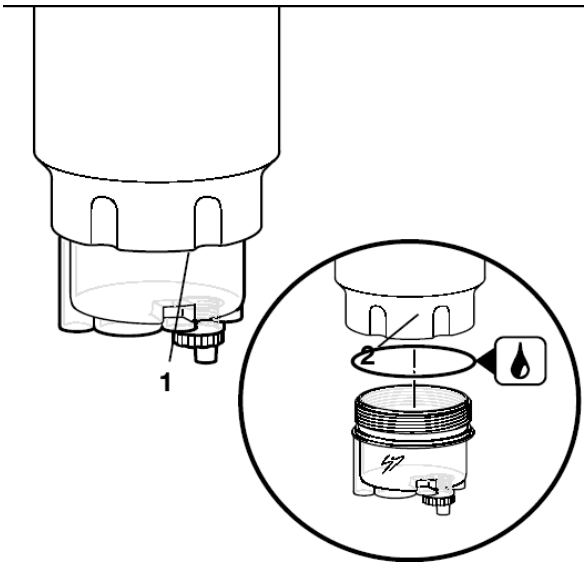


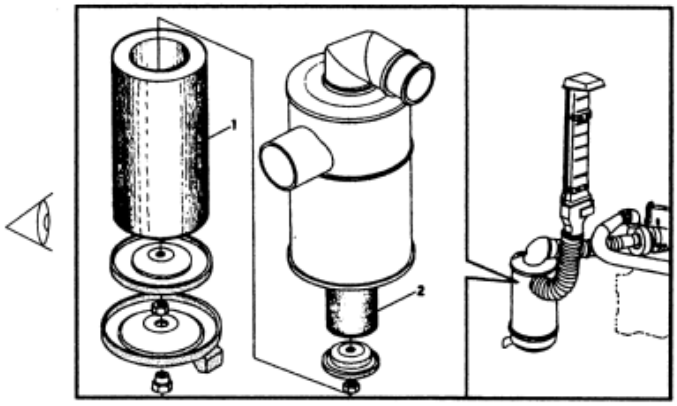
Figure 5-18 Replace the Water Collector.

- Check the intake system, as shown in Figure 5-19.

Check whether the air intake hose is aging or cracked and whether the hoop becomes loose. When necessary, tighten or replace relevant parts to ensure sealing performance of the intake system.

Figure 5-19

- Check the air filter element.



1.纸质主滤芯 Paper filtering element
2.毛毡安全滤芯 Blanketry safety filtering element

Figure 5-20

The diesel engine allows the maximum intake resistance of 7kPa, which shall be checked when the diesel engine is working at the rated speed and full load, and when the intake resistance reaches the maximum allowable limit, the filter element should be cleaned or replaced according to the provisions of the manufacturer.

Note: never use the engine in the absence of air filter. Otherwise, dirt and impurities will enter the diesel engine to result in premature wear.

Remove the air filter element from the air filter and pat the end face to remove the dust, or you can use compressed air to purge it (from the inside outward).

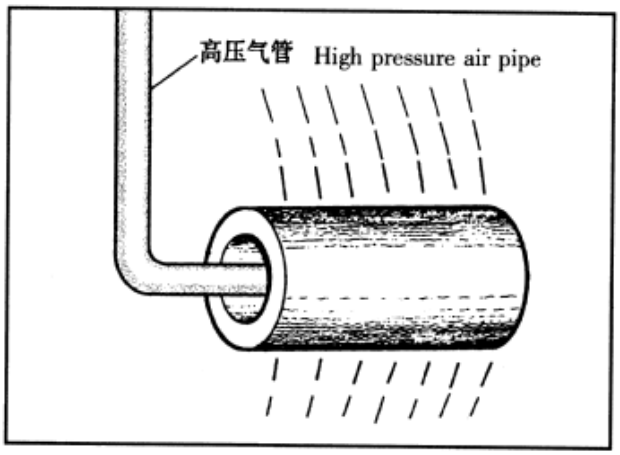


Figure 5-21

Note: Never blow the filter paper broken, never use water or oil to clean the filter paper, and never beat or tap the filter element by force.

5.3 Maintenance of the Diesel Engine Kept in Storage for Long

- Clean the diesel engine;
- Protective work:
  - ✧ After warming-up, drain the oil, clean the oil filter and apply antirust oil;
  - ✧ Drain the fuel and add anti-rust oil mixture again;
  - ✧ Drain the water and add coolant with anti-rust agent;
  - ✧ Start the engine and keep it idling for 15 - 25 minutes;
  - ✧ Drain the engine oil, fuel and coolant;
  - ✧ Take protective measures for other parts;
- Protection during the storage period:
  - ✧ Use lids or plastic cloth to strap and seal all oil, air and water inlets and outlets;
  - ✧ Use VCI antirust film to seal the whole diesel engine.
- If transportation is needed, additional packaging should be applied.

5.4 Complete Regular Maintenance and Keep Detailed Records

Table 5-2 Class-II Use Conditions for Vehicle matching

(WG Class Ⅰ)	**(WG Class Ⅱ)**
Harsh use conditions (extremely hot or cold climate, high dust contents, short-distance transport, worksite use, or use on buses, municipal engineering vehicles, snow removal trucks and fire fighting trucks) or the vehicle annual mileage is less than 2×10^4km or its yearly working time is less than 600h	Multi-function commercial vehicles of with its annual mileage more than 2×10^4km

Table 5-3 Maintenance Period

Service conditions / Item	Mileage (time)	WG Ⅰ	WG Ⅱ
First mandatory maintenance	3000km(50h)	A	A
Routine maintenance	10000km(200h)	B	C
	30000km(400h)		B
	Therein, for WG Class-II, contact Weichai Power Maintenance Service Center for National-III Landking Engines once every 10000 kilometers' (200 hours') working.		

A- First mandatory maintenance: replace the engine oil and oil filter, but do not replace the fuel strainer and fine filter elements.

B- Routine maintenance: Replace the engine oil, oil filter element, fuel strainer element and fuel fine filter element.

C- Only replace the oil filter element.

Table 5-4 Specifications for Diesel Engine Maintenance

Diesel engine maintenance contents	First mandatory maintenance	Routine maintenance
Replace the oil filter or filter element	●	When replacing the engine oil every time
Check and adjust the valve clearance	●	●
Check the coolant level and fill with enough coolant	●	●
Fasten the cooling pipe and pipe clamps	●	
Fasten the intake manifold, hose and flange connectors	●	●
Check the air filter maintenance indicator lamp or indicator		●
Clean the dust collector of the air filter (not including the types of automatic dust removal)		●
Clean the main filter element of the air filter	When the indicator lights up	
Replace the main filter element of the air filter	Refer to the relevant Manual provisions.	

Replace the safety filter element of the air filter	After the main filter element has been cleaned for 5 times	
Check and fasten the belt	●	●
Check the supercharger bearing clearance		Once every 160,000km
Check and adjust the clutch stroke	●	●
Note: ●marker for maintenance needed		

Chapter VI Analysis and Troubleshooting of the Common Troubles

The WP13 series diesel engines are designed and manufactured in a strict quality assurance system, and each diesel engine has been tested as specified. At the same time, the diesel engine is a kind of precision machinery, with its long-term effect closely related to normal maintenance and services. Generally speaking, the earlier failure of a diesel engine may have the following several reasons:

- Illegal operation, improper management and use;
- No maintenance or services are made as required and even the repair is used to replace maintenance.
- The accessories ill manufactured and especially fake and shoddy products bought for sake of the lower price will greatly shorten the service life of the diesel engine;
- The fuel or lubricating oil is unqualified or has the grade inappropriately selected.

6.1 Diagnostic Methods

The methods generally used for diagnosis of diesel engine faults are as follows:

- Observation method: observe the diesel engine smoke and other fault characteristics to judge the fault conditions;
- Listening: listen and judge the nature and degree of the fault location according to the abnormal sound of the diesel engine;

- Cylinder-off method: stop a cylinder to judge whether this cylinder has something wrong. In general, stop feeding the cylinder in doubt of fault and compare the state changes of the engine before and after the faulty cylinder has been cut off, in order to narrow the scope to find out the fault position or reasons;
- Comparison method: replace some assemblies or parts to determine whether there is something wrong.

Note:

1. It is a very careful task to judge the causes for faults of diesel engines, and before the

basic reasons are found out, never dismantle the diesel engine arbitrary. Otherwise, not only the fault cannot be eliminated, but more serious problems may happen due to improper assembly after dismantled.

2. **The high-pressure fuel pump, ECU, common rail pipe, supercharger and other key parts should not only need dedicated instrument and equipment, but also need some experienced repairmen, so inexperienced users shall never disassemble or adjust such key parts at will if conditions are not satisfied.**

6.2 Common Faults and Troubleshooting

6.2.1 The Diesel Engine Can Not Be Started

(1) The starter does not work

The WP13 series diesel engines have their starters controlled by ECU, in time of normal work, the ECU will output a current to drive the starting relay, and after the relay is connected, the battery will drive the starter to start the engine. When any fault occurs, the inspection should mainly focus on the neutral gear.

Several elements necessary for inspections: neutral switch, starting relay, and relevance between the battery and the parking switch

◆ Check whether the neutral position is engaged

Before starting, first check whether the gear shift lever is engaged in the neutral position

◆ Check the position of the parking switch (which should be in its “OFF” state)

The parking switch is designed as an inching type, able to reset automatically. Check whether this switch is normal.

If this switch cannot reset automatically as designed, you should check whether this switch is in its “ON” state.

◆ Check whether the neutral switch and wiring is intact, and try to use the emergency start (with the ignition switch pressed continuously for more than 5 seconds)

For engine with its starter controlled by ECU, in time of starting, the ECU will first determine whether the neutral position is engaged according to the signal from the neutral switch; when the neutral switch is damaged or bad connected, the ECU cannot receive the neutral signal and the starter will not work.

◆ Check whether the battery cannot drive the starter due to excessively low voltage

General speaking, the battery voltage is 24V and it cannot drive the starter if the voltage is too low. You can use the voltage tester of a multimeter to check the voltage or use a fault diagnosis instrument to read the actual value of the “battery voltage”.

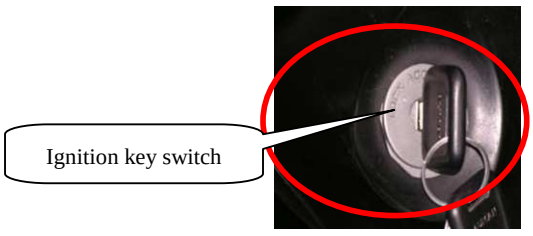
◆ Check whether the starter relay and its wiring is intact

Check whether the wiring terminal surface is contaminated with too much oxide and whether the wiring terminal surface bolts are loose or fractured.

◆ Check whether the starter has been burnt out

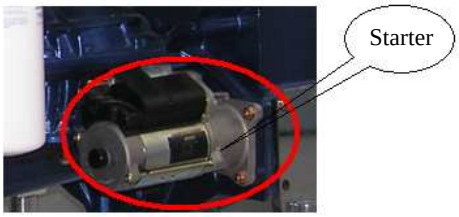
Use a multimeter to check whether the starter relay is normal

◆ Check whether the ignition and starting switches have gone bad

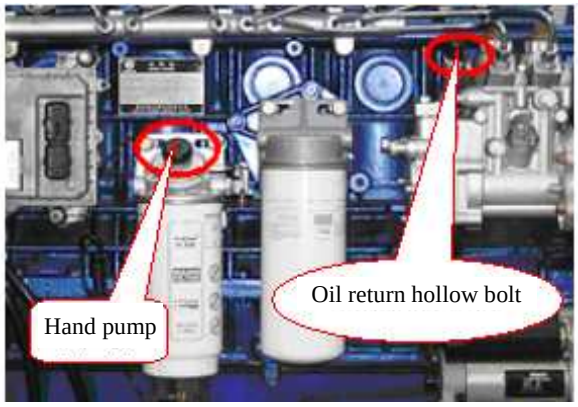


Turn the ignition key to the “ON” position and see whether the instrument panel indicators light up.

Turn the ignition key to the “Start” position and check whether the starter acts (if other reasons have been eliminated).



(2) The rail pressure cannot be established (The starter can work normally, but it cannot start the engine)



◆ Check whether the fuel tank has its level excessively low.

This reason may be ignored more easily, so take great care.

◆ Check whether the hand pump is working normally

Press the hand pump by hand to see whether it is normal.

◆ Check whether there is air in the low-pressure fuel way and if any, eliminate it (sometimes, the low-pressure fuel way leakage is not obvious, so you need to check it carefully).

Exhaust method: mainly exhaust the air in the strainer. Loosen the vent bolt on the strainer and press the hand pump on the strainer by hand until there is fuel flowing out continuously from the vent bolt.

If the diesel engine still cannot be started after the low-pressure fuel way has its air completely exhausted, then it can be judged that the high-pressure fuel way suffers from air invasion and you should also exhaust the air in the high-pressure fuel way.

Exhaust method: loosen the high-pressure fuel pipe of a cylinder, and use the starter to drive the diesel engine to run until there is fuel flowing out continuously from the high-pressure fuel pipe! (It is not recommended that you often remove the joints of the high-pressure fuel pipe!)

◆ Check whether the high-pressure fuel way has any leakage

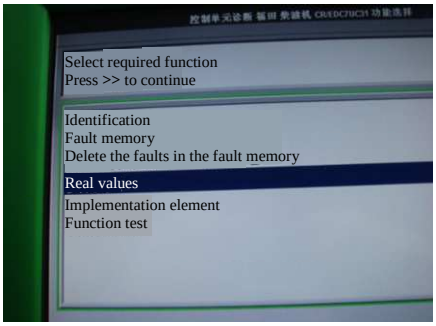
This usually can be seen obviously. Check whether the high-pressure fuel pipe has its joint nuts loose, and if so, tighten the nuts.

◆ Check whether the fuel way is smooth, check whether the diesel fuel filter is blocked, and replace the diesel filter element in time as suggested.

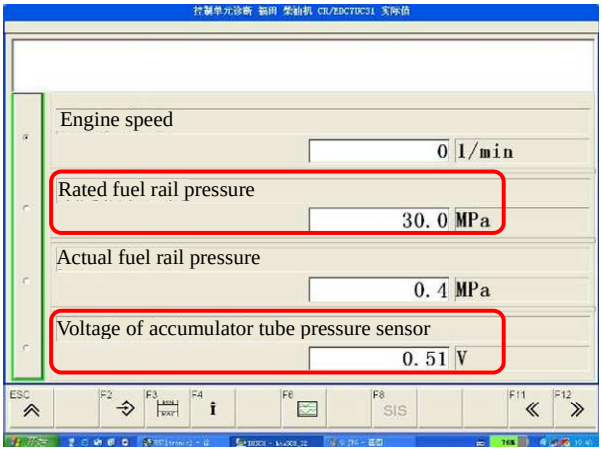
Inspection method: loosen the filter outlet bolts, use the starter to drive the diesel engine to run, see whether there is diesel fuel spraying or flowing out, if only a small amount of diesel fuel flows out, it can be determined that the filter element is blocked, and at this time, you need to replace the filter element.

◆ Check whether the rail pressure sensor has its initial voltage of about 500mV, or check whether the set rail pressure is 30-50 MPa. It can be measured as follows:

Enter the operation interface of the fault diagnosis instrument, select the “real values” and click “Next”.



At this time, all “real values” will appear. Select “Voltage of accumulator tube pressure sensor” and “rated fuel rail pressure”.



If not normal, first check whether the connectors are fastened reliably, and if there is no problem, the rail pressure sensor may be damaged.

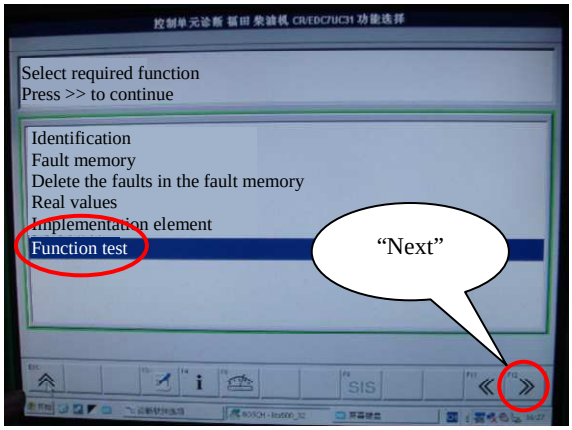
If no inspection equipment is available, unplug the rail pressure sensor connector and try restarting it (after started, let it enter the “limp home mode”).

◆ Check whether the flow measurement unit is intact, unplug the flow measurement unit connectors and try starting it again.

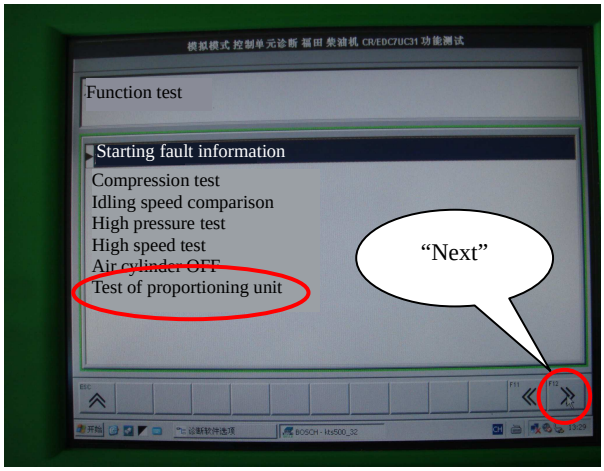
① Firstly, observe whether there is any hardware damage and whether the connectors are firmly connected.

② Connect the fault diagnosis instrument to complete the Meter-unit test.

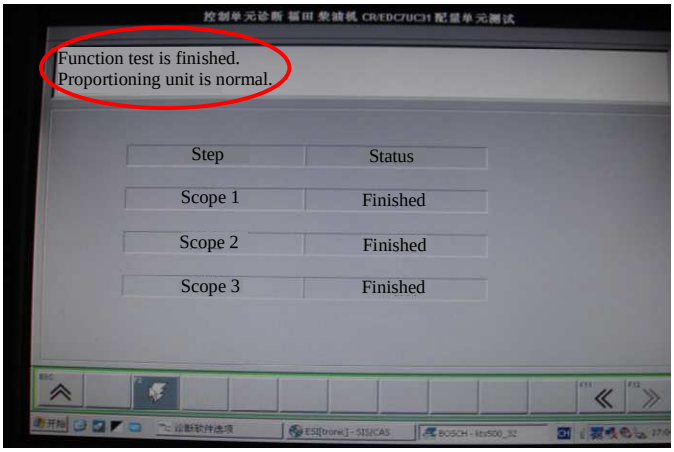
Enter the operation interface of the fault diagnosis instrument, select the “function test” and click “Next”.



Enter the sub-interface for function test, select "Test of proportioning unit", and click "Next";



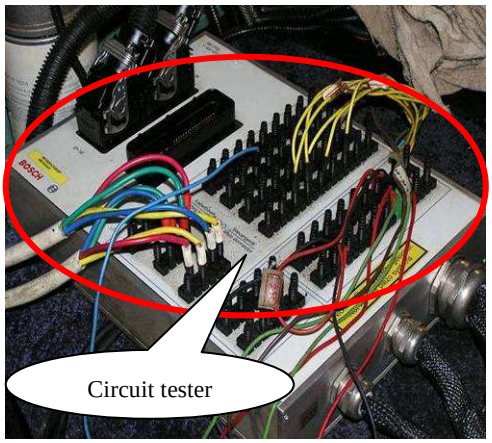
At this time, the interface for test conditions will appear. After the operator has confirmed that the conditions are satisfied, click "Next" to start the test;

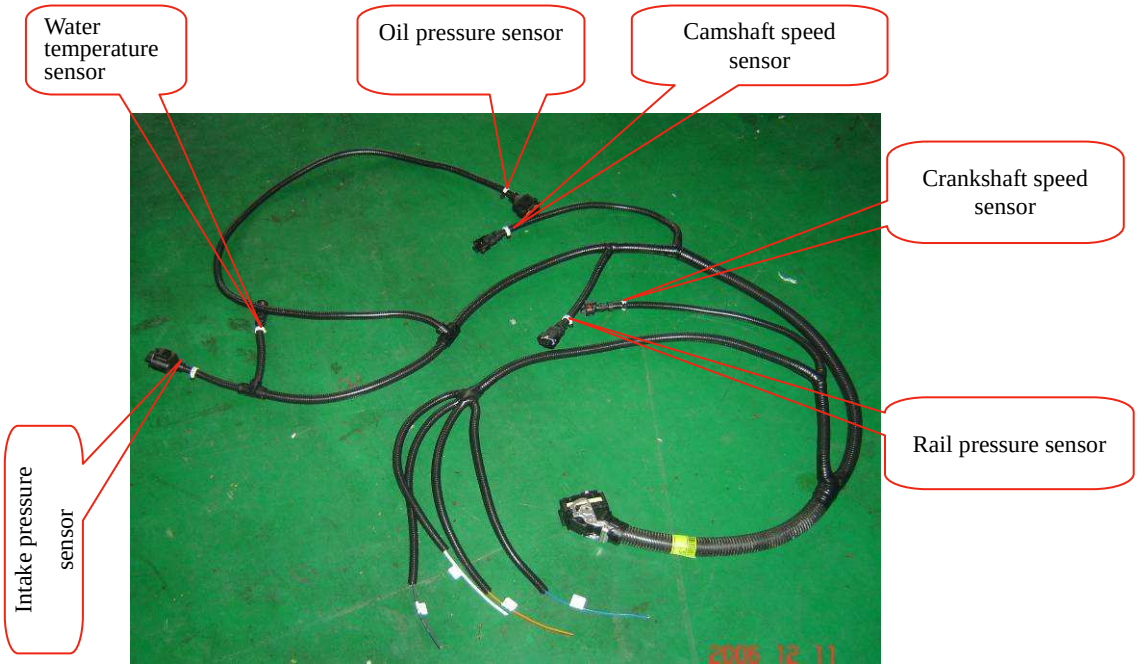


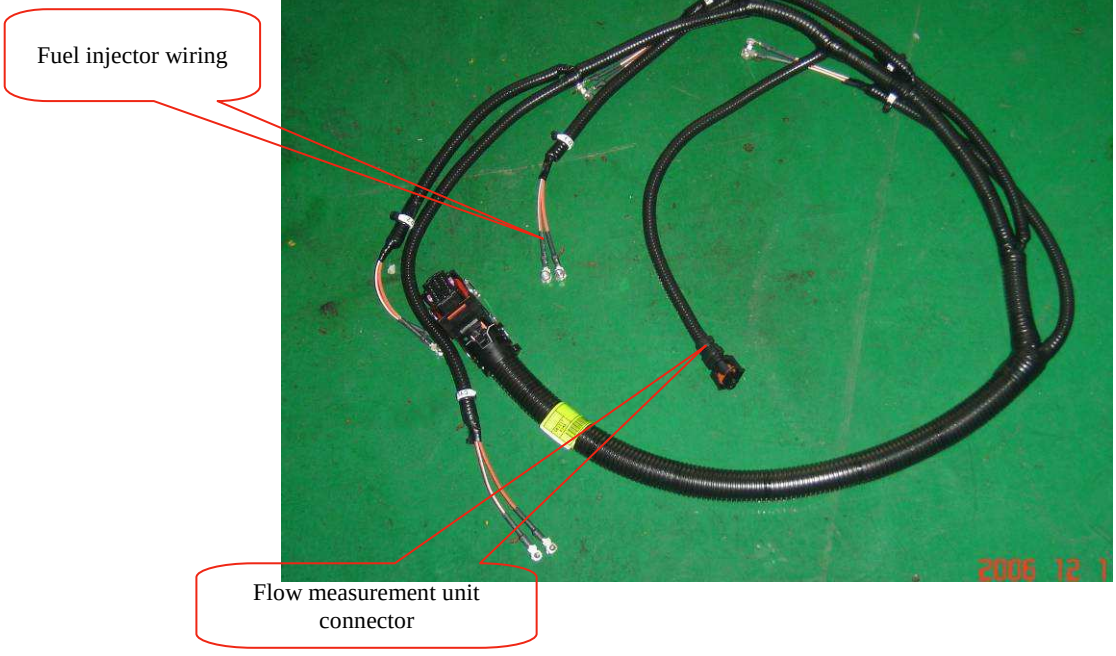
After the test, it will show whether the fuel metering unit is normal.

(3) The fuel injector, sensor and complete machine have their wire harness connectors improperly fixed, or the wiring harnesses are open or short.

◆ Check the connector installation and use a multimeter (preferably a "line tester") to check the line ON-OFF status in accordance with the pointer definitions of the wiring diagram.


Circuit tester


Water temperature sensor
Oil pressure sensor
Camshaft speed sensor
Crankshaft speed sensor
Rail pressure sensor
Intake pressure sensor


Fuel injector wiring
Flow measurement unit connector

(4) The crankshaft and camshaft signals are missing

On the diesel engine, there are two speed sensors mounted respectively outside the flywheel housing and the high-pressure fuel pump. The functions are respectively shown as follows: the crankshaft position sensor and cylinder identification sensor will decide the fuel injection timing of electronic control engine, and if a diesel engine cannot be started, such two signals have been missing.

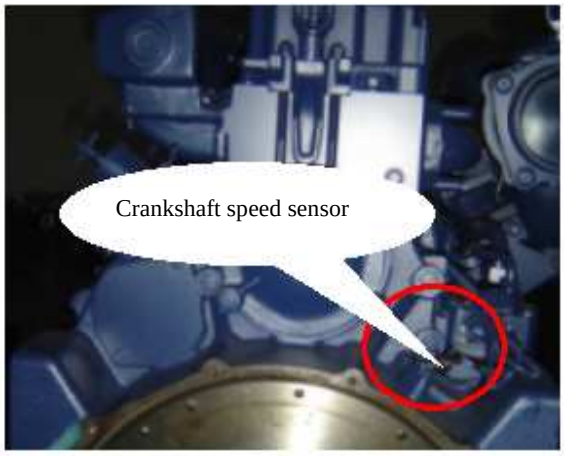
- Possible causes for missing of the two signals

(1) The sensors are damaged and their harnesses are open or short circuit

(2) Excessively larger or smaller clearance (usually 1mm ± 0.5mm) appears between the sensors and the induction gears due to poor connection of the sensors.

Troubleshooting: check whether the sensors are damaged, whether the wire harness is well connected, and whether the sensors are loose.

- After disassembly, the high-pressure fuel pump and the flywheel should be installed in strict accordance with the relevant technical documents to ensure synchronization of the signals.



6.2.2 Difficult to Start

Reason and Troubleshooting of the difficulty in engine starting:

- The diesel engine hasn't been working for a long time: Stretch the fuel return pipe under the diesel fuel surface.
- The low-pressure pipeline has a small amount of air: Exhaust the air.
- The crankshaft and camshaft have too weak speed signals, resulting in longer time for synchronous judgment: Find out the specific reasons and make readjustment.
- The ambient temperature is too low, resulting in failure of the preheating device: check whether the heating flange wiring is normal or replace the preheating device.
- The diesel fuel and engine oil is too poor in quality and not up to the standard: Use standard fuel and oil instead.
- The starter or flywheel has ring gears hitting: replace the starter and the flywheel ring gears.
- The piston rings and cylinder liners are worn or the valves are not sealed tightly: replace the piston rings, cylinder liners or valve seats and valves.
- The exhaust brake butterfly valve is stuck at its "Off" state, resulting in poor exhaust: replace the butterfly valve.

6.2.3 Insufficient Engine Power

Limp home: a mode of the engine operating with faults. The ECU detects the engine fault, but the engine will not stop immediately, but the engine power will be limited and the engine speed can only be increased to 1500 rpm for the driver to drive to the nearest repair station for troubleshooting.

(1) The fuel injector has fault

The fuel injector has fault, generally including mechanical and wiring faults.

The mechanical faults are as follows: the needle valve is stuck in the fuel injector with no action due to more filth in the diesel fuel or water corrosion. (Note: The ECU may not report any error!)

The wiring faults are as follows: due to vibration, abrasion and other relevant reasons, if the wire harness is disconnected or directly lowered on the cylinder head to short to the ground, the ECU will report an error.

(2) Water, oil or intake temperature is excessively high

When the water, oil or intake temperature is excessively high, the ECU overheating protection function will act to limit the engine power.

Before troubleshooting, first eliminate the response distortion of sensors and instrumentation.

◆ Reason and troubleshooting of the high water temperature

① The water level is too low in the water tank: check whether there is any water leakage, and if any, add more water.

② The fan is running too slowly or does not work: check the fan driving components.

③ The water tank is blocked: check the water tank and clean or repair it.

④ The water pump belt is loose: adjust the tension as provided

⑤ The water pump has its gaskets and impellers damaged or worn: check and repair or replace the faulty parts.

⑥ Thermostat fault: replace it.

⑦ The water pipe has its sealing elements damaged with air invasion: check the water pipe, joints and gaskets, and replace the damaged parts.

◆ Reason and troubleshooting of excessively high oil temperature

① The oil sump has insufficient oil or a low oil level: check the oil level and leakage. Repair it and add more oil.

② High water temperature: troubleshoot it immediately.

③ The oil cooler cannot work smoothly: check and clean it.

◆ Reason and troubleshooting of excessively high intake temperature

Check the cooling capacity of the intercooler

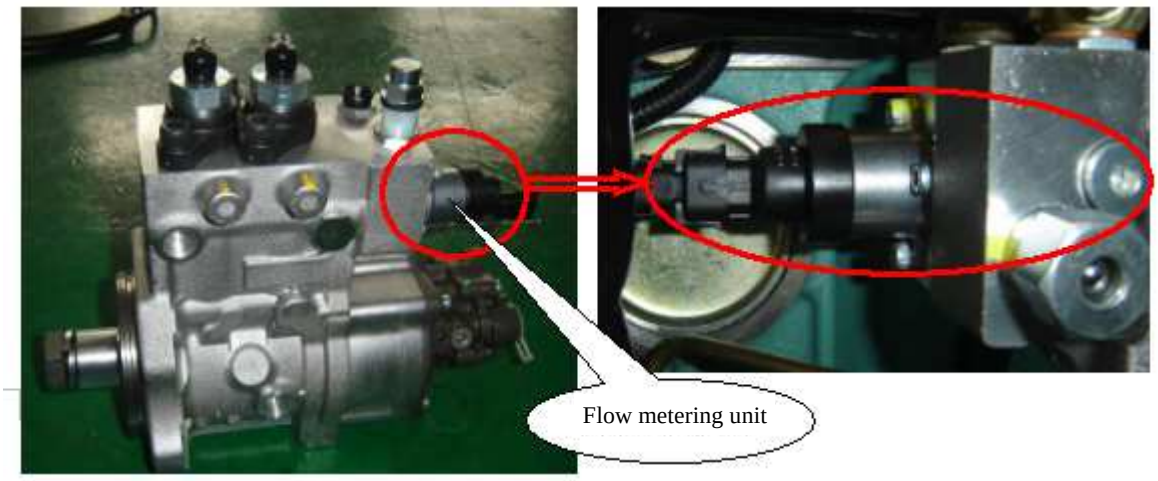
(3) Synchronization signal error

If this error appears, one sensor generally has its signal invalid.

Read out the flash code by means of the flash code indicator and refer to the table for flash codes to find out the specific reasons, with the troubleshooting measures identical to 9.2.1-4.

(4) Flow measurement unit fault

The flow measurement unit installed on the high-pressure fuel pump is an actuator to control the rail pressure, and after it goes wrong, the high-pressure fuel pump will feed the common rail pipe at its greatest capacity. At this moment, the relief valve on the common rail pipe will generally be open and the engine will be “clicking”. Similar phenomenon will also appear when the rail pressure sensor has fault.



◆ Troubleshooting: overhaul the circuits to confirm that the flow measurement unit or the rail pressure sensor has failed, and notify the Office for further treatment.

(5) The rail pressure fluctuates abnormally due to leakage of the fuel pipeline

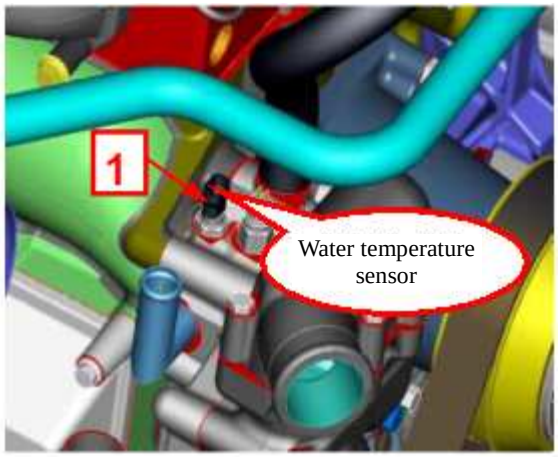
During running, the vehicle speed may become instable and the vehicle may be stampeding forward occasionally.

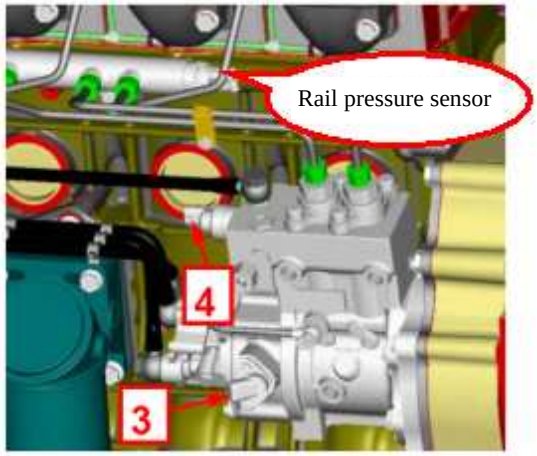
◆ Troubleshooting

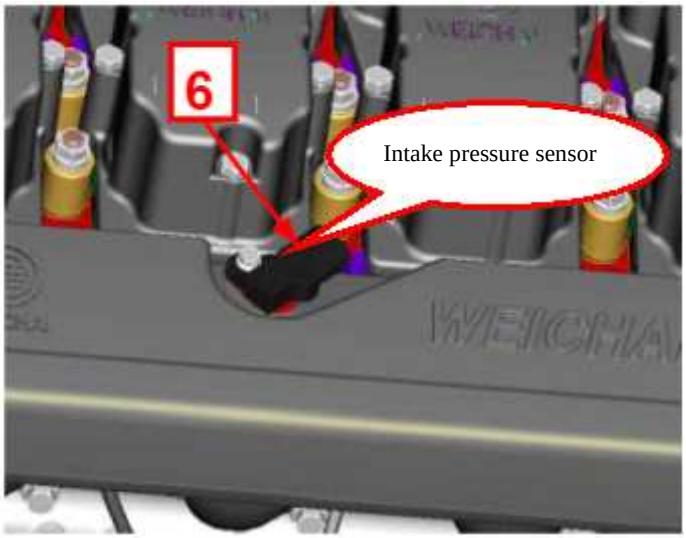
First cut off the power supply and start the engine again in a minute. If the problem is still kept as usual, check the fuel pipeline air tightness and troubleshoot it.

(6) Sensor fault

The intake pressure sensor (installed on the intake manifold) is used by the ECU to estimate the air intake, the water temperature sensor (installed on the water pump) is used to judge the thermal load of the engine, and the rail pressure sensor (installed on the common rail pipe) is used to detect the fuel pressure of the common rail pipe.







◆ Troubleshooting

Check the intake temperature and pressure, water temperature and rail pressure sensors to see whether the connectors are installed firmly.

Note: When the fault (1, 3, 4, 5 or 6) appears, the diesel engine will enter its "limp home mode".

6.2.4 The engine is always running at 1000rpm

At this moment, the accelerator has become invalid: the ECU will judge the load by means of the signal given by the pedal potentiometer, and when the pedal is faulty, for sake of security, the ECU will control the diesel engine to automatically return to idling at 1000rpm.

◆ The electronic accelerator pedal line is loose or wrongly connected

Plug it again or check whether the accelerator wiring is correct and connect the line again.

◆ The electronic accelerator has its connectors flooded by water

Use a tool to dry the connectors and then start again.

Note: an accelerator of the same type should be needed in time of replacement.

6.2.5 Engine hunting during Idling

◆ Reason and troubleshooting of engine hunting:

① The fuel injector is not working normally: check the fuel injector and wiring harness of each cylinder

② The complete vehicle equipped with speed sensor will have input of speed signals in time of parking: check the speedometer and speed sensor signals and wiring.

③ The fuel is poor in quality with water or wax: clean the fuel system and replace the fuel filter.

④ The low-pressure fuel way suffers from air invasion: check the fuel pipe and joint tightness, and exclude the air;

⑤ The fuel injector atomization is instable: check and repair

Note: the idle speed rise due to the low water temperature is the normal function of the ECU.

When any other load (for example, the air-conditioner is started) is applied, the idle speed will naturally increase by 100 rpm.

Appendix: Table for Power Correction Coefficients

Air pressure kPa \ Temperature ℃	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
110	0.97322	0.97487	0.97650	0.97813	0.97975	0.98136	0.98297	0.98456	0.98615	0.98773	0.98930	0.99086	0.99242	0.99397	0.99551	0.99704
108	0.97572	0.97737	0.97902	0.98065	0.98227	0.98389	0.98550	0.98710	0.98869	0.99027	0.99185	0.99341	0.99497	0.99652	0.99807	0.99960
106	0.97828	0.97993	0.98158	0.98322	0.98485	0.98647	0.98808	0.98968	0.98128	0.99286	0.99444	0.99602	0.99758	0.99914	1.00068	1.00222
104	0.98089	0.98255	0.98420	0.98584	0.98748	0.98910	0.99072	0.99232	0.99392	0.99552	0.99710	0.99868	1.00024	1.00180	1.00336	1.00490
102	0.98356	0.98523	0.98688	0.98853	0.99016	0.99197	0.99341	0.99503	0.99663	0.99823	0.99981	1.00139	1.00297	1.00453	1.00609	1.00764
100	0.98629	0.98796	0.98962	0.99127	0.99291	0.99455	0.99617	0.99779	0.99940	1.00100	1.00259	1.00417	1.00575	1.00732	1.00888	1.01043
98	0.98909	0.99076	0.99242	0.99408	0.99573	0.99736	0.99899	1.00061	1.00223	1.00383	1.00543	1.00702	1.00860	1.01017	1.01174	1.01330
96	0.99195	0.99362	0.99529	0.99695	0.99860	1.00025	1.00188	1.00351	1.00513	1.00673	1.00834	1.00993	1.01151	1.01309	1.01466	1.01622
94	0.99487	0.99656	0.99823	0.99990	1.00155	1.00320	1.00484	1.00647	1.00809	1.00971	1.01131	1.01291	1.01450	1.01608	1.01766	1.01922
92	0.99787	0.99956	1.00124	1.00291	1.00457	1.00622	1.00787	1.00950	1.01113	1.01275	1.01436	1.01596	1.01756	1.01915	1.02073	1.02230
90	1.00095	1.00264	1.00433	1.00600	1.00767	1.00933	1.01097	1.01262	1.01425	1.01587	1.01749	1.01910	1.02070	1.02229	1.02387	1.02545
88	1.00410	1.00580	1.00749	1.00917	1.01084	1.01251	1.01416	1.01581	1.01744	1.01907	1.02069	1.02231	1.02391	1.02551	1.02710	1.02868
86	1.00734	1.00904	1.01074	1.01242	1.01410	1.01577	1.01743	1.01908	1.02072	1.02236	1.02398	1.02560	1.02721	1.02881	1.03041	1.03200
84	1.01066	1.01237	1.01407	1.01577	1.01745	1.01912	1.02079	1.02244	1.02409	1.02573	1.02736	1.02899	1.03060	1.03221	1.03381	1.03540
82	1.01408	1.01579	1.01750	1.01920	1.02089	1.02257	1.02424	1.02590	1.02755	1.02920	1.03084	1.03246	1.03409	1.03570	1.03730	1.03890
80	1.01759	1.01931	1.02102	1.02273	1.02442	1.02611	1.02778	1.02945	1.03111	1.03276	1.03441	1.03604	1.03767	1.03928	1.04089	1.04250

Note: the temperature and air pressure indicated in this correction table refers to the intake temperature and the pressure of the dry intake air (not equal to the atmospheric pressure) respectively; this correction table is only applicable to the temperature of 10-40℃ and the pressure of 80-110 Pa. The experiment should need relevant measures or an appropriate time, so that the engine could have its actual intake status within the range above.

Corrected power $P_{a0}=a_d \cdot P_a$ (P_{a0} —— Corrected power, P_a —— Measured power, a_d —— Correction coefficient)