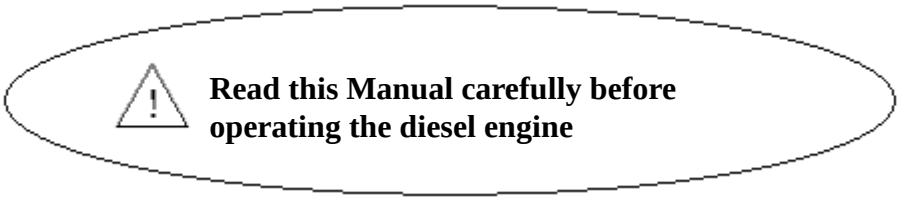
Operation and Maintenance Manual of WP13D Series Diesel Engines

Weichai Power Co., Ltd

Weichai Power Pursuit of Excellence

Special instruction

- In order to protect your legitimate rights, it is prohibited to unseal the lead seal of fuel pump by yourself.
- If you adjust the fuel injection pump or remove the lead seal, the warranty will be invalid.
- The fuel injection pump and the fuel injector are precise parts, and users shall not disassemble them. Otherwise, the warranty will be invalid.
- The supercharger rotor shaft is of precise and high speed rotating part, it is prohibited to disassemble or collide it. Otherwise, the warranty will be invalid.
- The main bearing bolts and connecting rod bolts of diesel engine have strict requirements on torque and rotation angle, users shall not loosen or remove them. Otherwise, the warranty will be invalid.
- Every time before operating the engine, check whether the coolant and the oil are sufficient.
- The connecting rod bolts are disposable bolts, do not reuse them.



Precautions

1. Please note that before delivery, the diesel engine is already tested strictly according to the test specification, and the accelerator is lead sealed for limit. Do not remove the lead seal, increase the throttle, otherwise, we will not provide the “three guarantees” services.
2. The diesel engine operating personnel must read this Operation and Maintenance Manual carefully to get familiar with the structure and strictly observe the technical operation and maintenance regulations specified in the manual.
3. When the user uses the new diesel engine, carry out the test run for 50h.
4. After cold starting, increase the speed of diesel engine slowly, do not run it at high speed sharply or idle it without load for a long time. After heavy load running, do not stop immediately, run it at low speed without load for (5~10) min and then stop.
5. After stopping, if the ambient temperature may be below 0℃ and there is no antifreeze additive, please drain the water in the water tank and the diesel engine.
6. Do not operate the diesel engine which is not equipped with an air filter, otherwise, the air may enter the cylinder without filtering
7. When adding oil or fuel added to the diesel engine, select the grade specified in the manual. Adopt a special cleaning container and filter the fuel or oil through the filter screen. Let the fuel precipitate for more than 72h.
8. Check and maintenance of all parts of the electrical system shall be carried out by personnel having good electrical knowledge.
9. Oil seal is carried out on the diesel engine before delivery in order to prevent rust. Generally speaking, the oil seal period of diesel engine is one year, carry out check and take necessary supplement measures when exceeding one year.
10. Do not run the diesel engine at idle speed for a long time, generally no more than 10min.
11. Please use the oil filter, diesel filter and air filter made by the manufacturers designated by our company. Otherwise, we will not provide the “three guarantees” service.

Foreword

The WP13D series diesel engines are variant products of WP13 Landking series diesel engines. The design meets requirements of national standards and ship regulations. It is featuring reliable use, good economic and technology index, low emission, fast starting, simple operation and convenient maintenance, and are the ideal power for industrial power stations.

This manual describes the WP13D series diesel engines in aspects of structure, performance, operation, test, operation and maintenance. With the continuous development of production and technology, the structure will be further improved, and users are reminded of the possible inconsistency between contents of this instruction and future improved contents.

We sincerely hope that personnel operating and maintaining this diesel engine and other related personnel read this manual in advance and strictly observe the regulations to ensure correct and reasonable operation of the diesel engine and prolong the service life.

During operation, if there is any problem, please do not hesitate to contact the after-sales service department of our company timely, and they will offer you prompt and considerate services.

september, 2013

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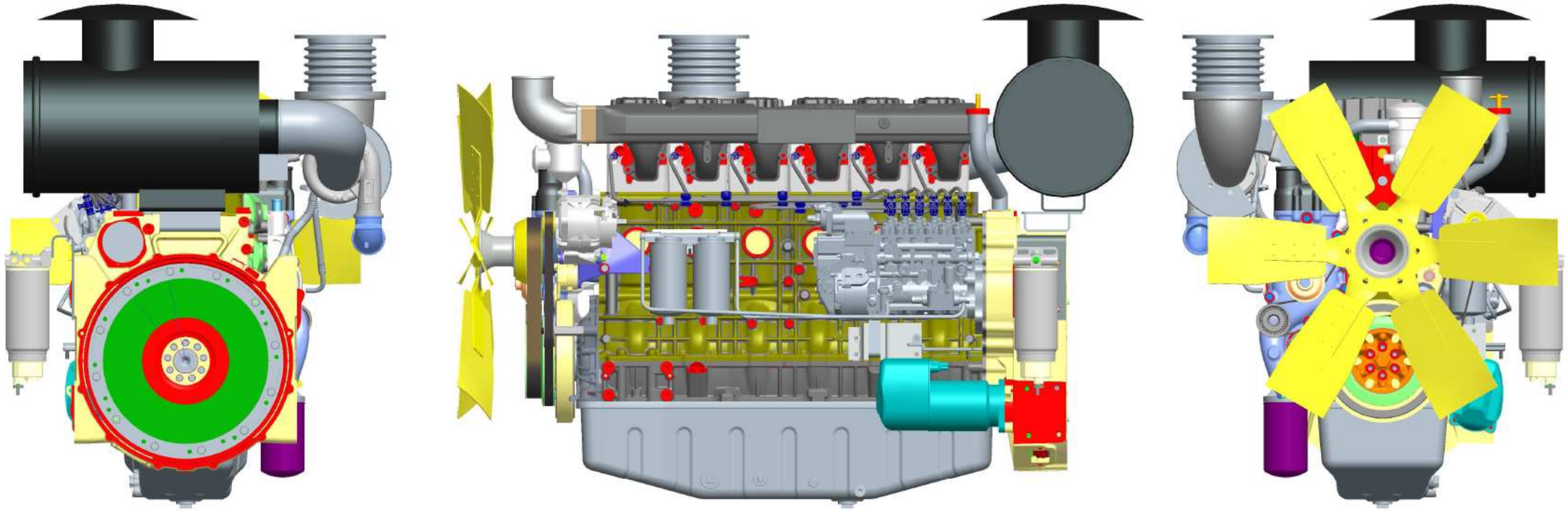
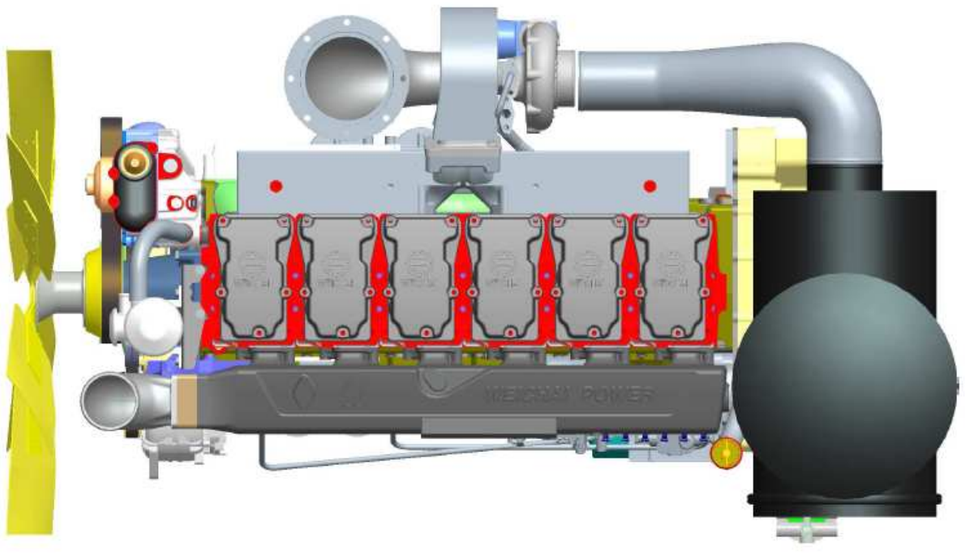




Chapter I Main technical parameters of WP13D series diesel engines

1. Technical parameters of WP13D385 diesel engine

Table 1 Main technical parameters of WP13D385 diesel engine

Model	WP13D385E200	WP13D385E201	WP13D442E201
Type	Inline, water-cooling, 4-stroke, direct injection, supercharged and inter-cooled		
Number of cylinders × bore × stroke	6×127×165		
Rotation direction	Clockwise (watch from the free end)		
Firing order	1-5-3-6-2-4		
Fuel supply advance angle ºCA	14	19	16.5
ICXN (rated power-speed)	350kW-1500r/min	350kW-1800r/min	402kW-1800r/min
ION (overload power-speed)	385kW-1500 r/min	385kW-1800 r/min	442kW-1800 r/min
Total displacement of piston L	12.54		
Idling speed r/min	600±50		
Cold state valve clearance (mm)	Intake valve 0.4; exhaust valve 0.6		
Valve timing (valve clearance: intake valve 0.4mm, exhaust valve: 0.6mm)	Intake valve open 20° before top dead center Intake valve closed 34° after bottom dead center Exhaust valve open 49° before bottom dead center Exhaust valve closed 21° after top dead center		
Starting manner	Electric start		
Oil capacity L	36		
Cooling manner	Turbocharged and intercooled		
Overall dimensions mm	1752×943×1188		
Total mass kg	1020 (without water tank)		

Chapter II Instruction on structure and systems of diesel engine

1. Gear train and valve mechanism

1.1 Gear train diagram

The WP13D series diesel engines adopt the rear-mounted gear train (figure2-1), in which the gear chamber and the flywheel housing are integrated in order to reduce the gear noise and improve the overall reliability.

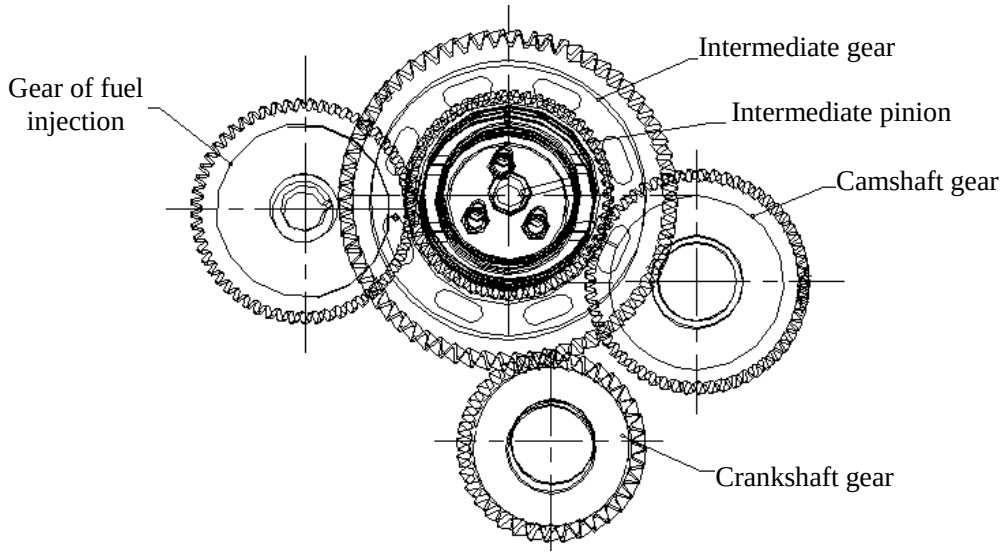


Figure 2-1 Gear train transmission diagram

1.2 Valve clearance adjustment

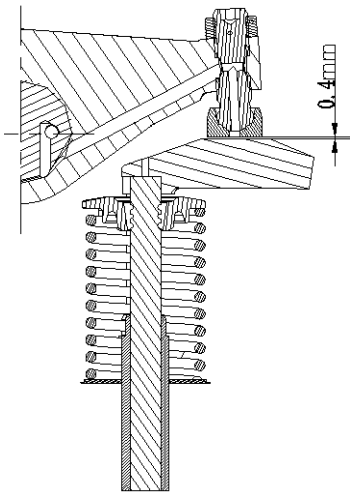


Fig.2-2 Cold state intake valve clearance 0.4mm

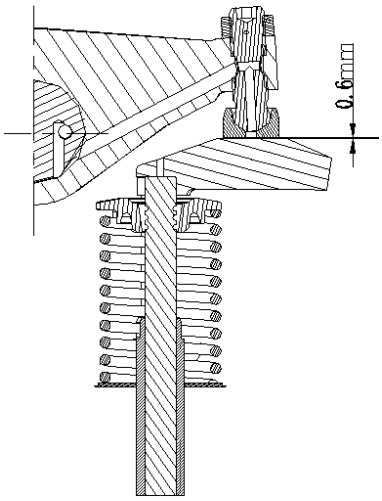


Fig.2-3 Cold state exhaust valve clearance 0.6mm

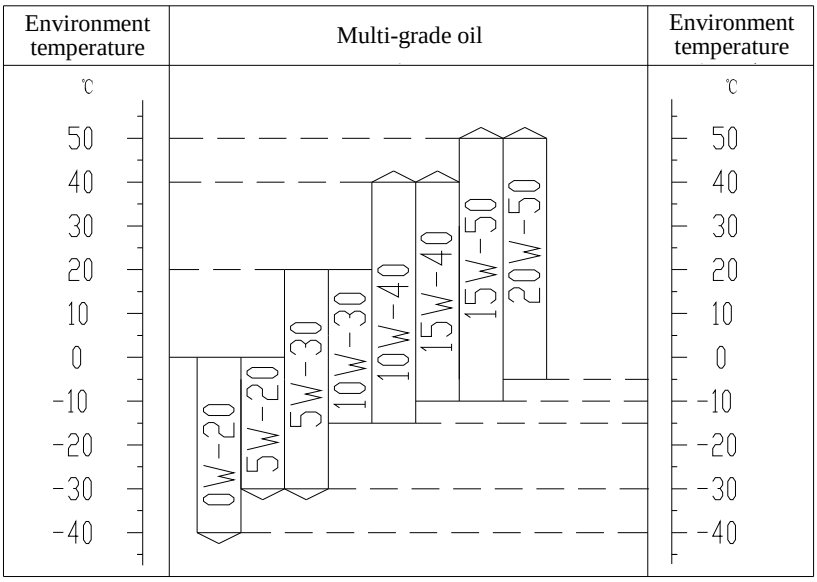
2. Lubricating system

The lubricating system is functioned for wear reducing, flushing, cooling and rust proofing. Please use the oil of CI or higher grade. Multi-grade oil shall be preferably selected for better cold starting performance. Full-season multi-grade oil (such as 15W40) can also be used within the specified temperature scope. During occasional low temperature period, oil preheating measures can be taken or change the oil which is suitable for the environment temperature.

The oil change intervals shall be determined according to maintenance requirements.

- Generally, the lubricating oil is not applied in delivery, so please apply it before starting the engine.
- Please select the viscosity grades (see table 2) of lubricating oil according to environment temperatures and only multi-grade lubricating oil is allowed.
- It is recommended that Weichai special lubricating oil be used.
- When the engine is stay still, the oil level shall be between the highest and lowest scale lines on the dipstick.
- Until now, there is no proof that the oil additives have any positive influence on running of WP13D mechanical pump series diesel engine, so it is prohibited to use any oil additives.

Table 2 Lubricating oil grade selection



Caution: For WP13D mechanical pump series diesel engine, it is not allowed to use grade CH and lower grade lubricating oil. Please replace the oil filter element every time when changing the oil!

Pressure lubrication

Through a strainer, the oil pump absorbs oil from the oil sump, press the oil to the oil filter and the oil cooler and then through the oil line system to the lubrication position. Most oil can reach the main bearing and through the oil hole on the crankshaft to the connecting rod bearing. The cylinder liner surface and the piston pin are lubricated by oil sprayed from nozzles. Lubrication of valve control system, supercharger, oil pump, air compressor and intermediate gear bearing is also realized by pressure lubrication through oil pipes and oil groove. The piston top is cooled by oil sprayed from nozzle to the internal cooled oil cavity; and oil is cooled by coolant through the oil cooler. The oil pressure of oil circulation system is adjusted by the pressure-limiting valve in the oil pump.

When starting the diesel engine, as the oil temperature is low and the viscosity is high, the oil pressure will be high in a short time. However, with water temperature rises, the oil temperature also rises, the oil pressure lowers gradually, and normal oil pressure shall be (350~550)kPa.

3. Fuel system

The fuel system mainly consists of the fuel delivery pump, fuel filter, high pressure fuel pump, fuel injector and high/low pressure oil pipes. When the diesel engine is working, the fuel delivery pump absorbs diesel fuel from the fuel tank, the fuel flows through the fuel filter, high pressure fuel pump, enters the fuel injector for being injected into the combustion chamber, and remaining diesel fuel flows back to the fuel tank through the fuel return pipe. (See figure 2-4).

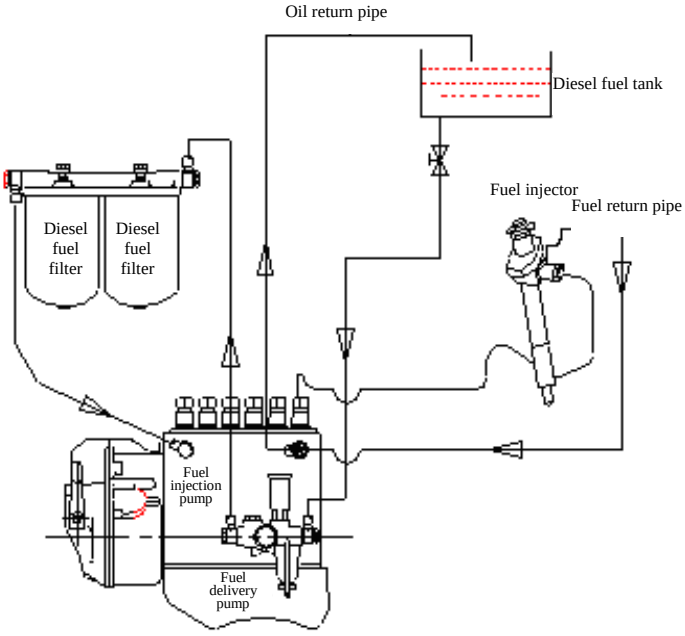


Fig.2-4 Circulation diagram of fuel system

The fuel system is a very critical component of diesel engine and is externally connected with the fuel tank and fuel pipes, and its manufacturing and mounting quality and the fuel quality used influence the performance and reliability of diesel engine. The user's fuel tank shall be clean, free of rust and corrosion, and there shall be no impurity generated by chemical reaction between materials and diesel fuel. The fuel tank shall be equipped with a fuel drainage device to drain water and impurities in the fuel, and it is preferable that the fuel outlet pipe of fuel tank be equipped with a valve to facilitate maintenance of pipeline.

3.1 Fuel return

When mounting the fuel return pipe, be careful to avoid contact with high temperature parts (exhaust pipe, turbocharger, exhaust return pipe, etc) of the diesel engine. No throttling area is allowed in the fuel return pipe. The fuel return pipe shall not contact with sharp edges, or be bent into sharp corner, or even twisted. Improper mounting of the fuel return pipe may cause fuel leakage to engine.

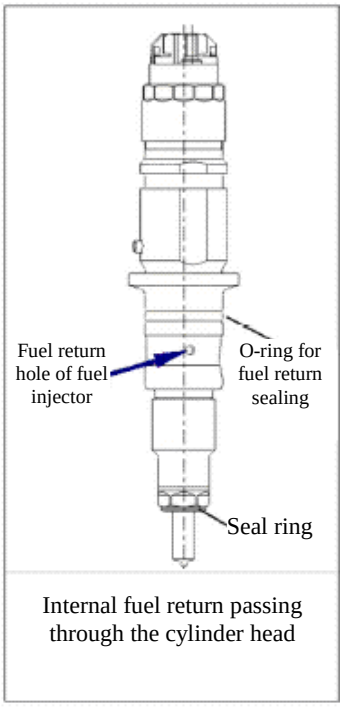


Fig.2-5 Fuel return manner

The fuel return of WP13D series diesel engines are the internal fuel return passing through the cylinder head (figure 2-5). In this manner that the mounting hole of fuel injector is in the cylinder head, complete sealing of fuel return must be ensured.

3.2 Internal high pressure connecting

The high pressure fuel reaches the fuel injector through the fuel inlet joint inside the cylinder head. When carrying out proper high pressure sealing of a standard fuel inlet joint, the required minimum pre-pressing force is 12kN and maximally 22kN is allowed. If the force is too high, it may lead to overload of fuel inlet joint and cause leakage.

When mounting the fuel inlet joint, please apply lubricating oil on the O-ring and thread pair. Apply recommended mineral oil on the threads and shaft shoulder. The oil used must be suitable for material of O-ring. If surface lubrication of O-ring and threads is already carried out, oiling is not required.

Due to lateral sealing force of fuel inlet joint, random mounting will cause improper stress (lateral force generated by fuel inlet joint will bend the fuel injector) on the fuel injector, and this is very dangerous. Learned from previous practices, tightening in 5 steps is most suitable to minimize the stress distortion of fuel injector.

The recommended 5 steps for tightening the fuel inlet joint are as follows:

(1) Insert the fuel injector into the cylinder head. Make sure that the fuel injector is properly positioned and contact with the seal rings correctly, tighten the clamping bolts of fuel injector by torque of 3Nm;

(2) Loosen the clamping bolts of fuel injector until the axial force of fuel injector is 0 and make sure that the fuel injector is correctly positioned in the cylinder head.

(3) Pre-tighten the high pressure fuel inlet joint (nut) by the torque of(15-20)Nm. This force is essential for aligning the fuel injector with the fuel hole;

(4) Tighten the clamping bolts of fuel injector by the torque of 8Nm+90°;

(5) Tighten the high pressure fuel inlet joint (nut) by the torque of (50-55) Nm.

Caution: O-ring and seal gasket of high pressure fuel inlet joint can be used only for one time.

4. Cooling system

The cooling system has the function of ensuring the continuous work of diesel engine at suitable temperature, and the forced circulation cooling provides the best guarantee for quickly reaching the operation temperature, see figure 2-6 for cooling system diagram. The cooling system mainly includes the following parts: water pump, water tank radiator (intercooler), diesel engine coolant cavity, oil cooler, thermostat and water pipes, etc. The cooling system is a closed circulation system, mainly used for cooling the oil and the diesel engine and ensuring continuous work at the suitable temperature. The cooling circulation is divided into long circulation and short circulation. When the diesel engine water temperature is low, the thermostat closes, and the coolant enters the diesel engine water pump through the thermostat to quickly increase the water temperature. When the diesel engine water temperature reaches 76℃, the thermostat opens, and the coolant enters the water tank radiator for cooling.

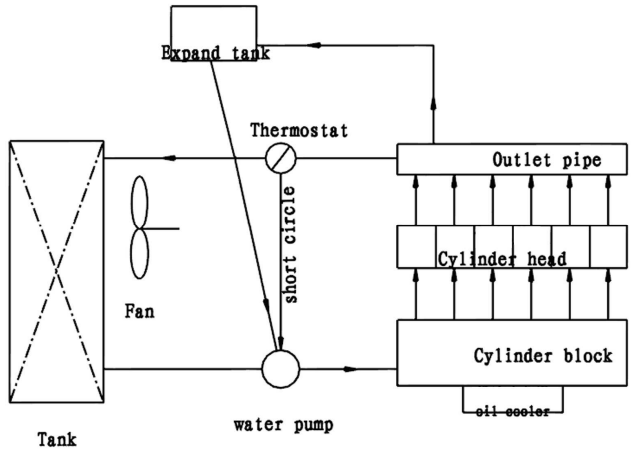


Fig.2-6 Cooling system circulation diagram

For the WP13D series diesel engines, there is a water drainage port on the engine body and the oil cooler cover respectively for draining the water (figures 2-7 and 2-8).

Caution: After stopped in winter or cold regions (environment temperature below 5℃), if there is no antifreeze in the coolant, open the plugs on the engine body and the oil cooler simultaneously to drain the coolant to prevent the engine body from frost cracking.

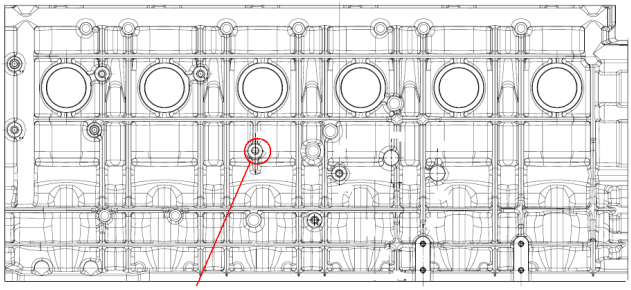


Fig.2-7 Water drain port on the engine body

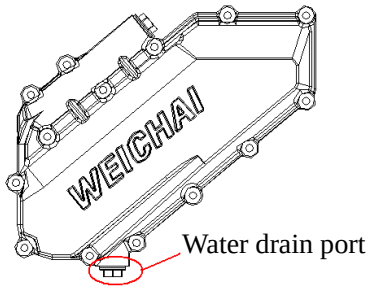


Fig.2-8 Water drain port on the oil cooler cover

5. Electrical equipment

The electrical equipment includes a generator, a starter and a diesel engine monitor, etc.

(1) Generator

The generator is of a three-phase alternator and changed to direct current after silicon rectifier. Rotation direction: clockwise from the drive end. See figure 2-9 for generator circuit diagram.

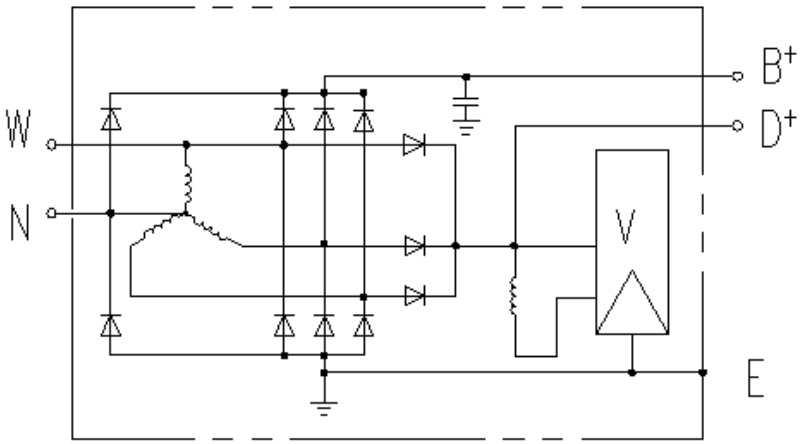


Fig.2-9 Generator circuit diagram

Pay attention to the following when installing and connecting the geneartor:

◇ Cool completely

◇ Prevent dust, splashing and oil

◇ Check the generator belt tension

◇ Can only be operated when connected with voltage regulator and battery.

(2) Starter

The voltage of DC starter is 24V and the power is 5.4kW, rotate rightward, and the number of teeth is 10. See figure 2-10 for starter circuit diagram. The internal circuit of starter is connected, the external terminals:

30: To battery positive terminal;

31: To ground;

50: To solenoid switch.

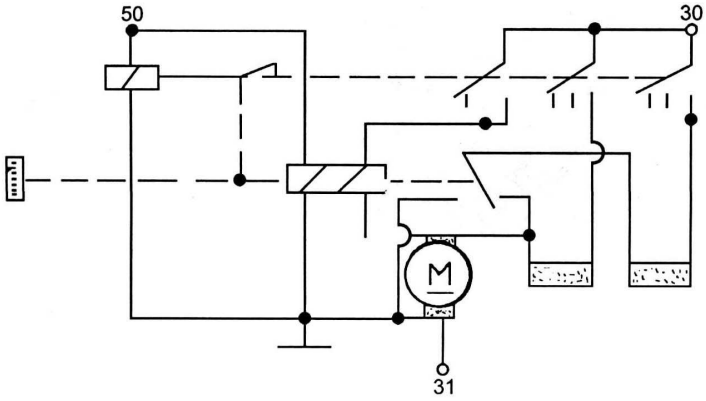


Fig.2-10 Starter circuit diagram

(3) Diesel engine monitoring instrument

The WP13D series diesel engines adopt the advanced microcomputer controlled full-automatic diesel engine electronic monitoring system for precise monitoring and digital display of engine speed, oil pressure, oil temperature and water temperature. When the parameters exceed the limit, it will give sound/lighting alarm signals and shutdown signals, and it also has the functions of starting and stopping the engine.

See table 3 for diesel engine instrument parameters.

Table 3 Diesel engine instrument parameters

S/N	Displayed parameter	Alarm value	Shutdown value (to oil cut-off electromagnet)
1	Speed	115% of rated speed	120% of rated speed
2	Oil pressure	0.08 MPa	0.045 MPa
3	Oil temperature	105℃	
4	Water temperature	97℃	

(4) Battery

2×12V 165Ah, or select 180Ah.

Chapter III Installation precautions for WP13D series diesel engines

1. Mounting of diesel engine

The WP13D series diesel engines can be matched with SAE I flywheel housing and gear case for generation. When mounting, the coaxiality of diesel engine crankshaft and gear case input shaft must be ensured. The diesel engine and the gear case are connected by elastic coupling. After butting of the couplings, no axial force is allowed on the diesel engine crankshaft, or else the thrust plate on the diesel engine will be damaged.

2. Mounting of intake system

The air inlet of diesel engine shall be arranged outside the engine set to ensure fresh air supply for the diesel engine. Use as few elbows for the air inlet pipes as possible and adopt big circular arc transition. Add a protective cover for the air filter at the air inlet to prevent water and dirt from entering the diesel engine

3. Mounting of exhaust system

The external exhaust pipes adopt steel pipes and avoid too many elbows. The external exhaust pipes shall be securely fixed on the engine set, no vibration is allowed, and the weight shall not be applied on the diesel engine expansion pipe. After mounting of the exhaust pipes, it is required that the exhaust back pressure of diesel engine shall not exceed 7.5kPa; otherwise, the engine performance will be affected. As the exhaust pipe surface temperature is very high during diesel engine working, avoid mounting the exhaust pipes near flammable materials so as to protect the working personnel against scald accidents. Please install heat insulation device on the surface of external exhaust pipe.

4. Mounting of cooling system

The coolant pipes in the diesel engine are connected before the diesel engine leaves the factory, so mounting is not required. Adopt anticorrosion materials for coolant pipes and reduce the pipe length and number of elbows. The inner diameter of coolant pipe shall not be smaller than that of joint connecting parts, so as to reduce the water resistance and improve the water pump efficiency.

5. Precautions for mounting of diesel engine front end output

The diesel engine front end output belt pulley can be used for driving small machines such as the water pump and the generator and be arranged at sides of diesel engine symmetrically to protect the diesel engine crankshaft against one-way pulling force. If large machines (such as net hauler) need to be driven, the elastic couplings must be used for connecting and mount the couplings according to alignment accuracy of different couplings. During operation, correct the coaxial accuracy regularly to ensure coaxiality of couplings. Otherwise, the diesel engine parts may be damaged.

6. Refer to the aforementioned chapters when mounting other parts of the diesel engine.

Chapter IV Maintenance of WP13D series diesel engines

Correct maintenance can ensure normal and reliable operation of diesel engine, and it is important for prolonging the service life of diesel engine. Users shall carry out diesel engine maintenance regularly according to the technical maintenance items in this chapter.

1. Maintenance interval of WP13D series diesel engines

Initial check (P)	Diesel engine running for 30~50h
Level 1 maintenance (WD1)	Diesel engine running for every 250h
Level 2 maintenance (WD2)	Diesel engine running for every 500h
Level 3 maintenance (WD3)	Diesel engine running for every 1000h
Level 4 maintenance (WD4)	Diesel engine running for every 4000h

Explanation: The above maintenance intervals are calculated assuming that the diesel engine runs for 1500h each year. If the running time of diesel engine each year does not exceed 500h, the maintenance intervals can be 0.5 times of the above intervals. If the running time of diesel engine each year exceeds 1500h, the maintenance intervals can be 1.5 times of the above intervals.

2. Major works during diesel engine check and maintenance

Table 4 Work during diesel engine maintenance

Work item	Initial check	Routine check	WD1	WD2	WD3	WD4
Change the diesel engine oil	▲	▲	▲	▲	▲	▲
Water pump leaking?	▲		▲	▲	▲	▲
Replace the oil filter	▲	Every time when change the oil				
Check and adjust the valve clearance	▲		▲	▲	▲	▲
Replace the fuel filter			▲	▲	▲	▲
Clean the coarse strainer of fuel pump filter			▲	▲	▲	▲
Check the coolant capacity and add if insufficient	▲	▲	▲	▲	▲	▲
Fasten the coolant pipe clamps	▲					
Fasten the air inlet pipes and hoses	▲		▲	▲	▲	▲
Clean the filter element of air filter				▲	▲	▲
Check and fasten the V-belt	▲	▲	▲	▲	▲	▲
Check the fuel injection pump in the special workshop						▲
Adjust the idle speed	▲					

Note: ▲ Mark for items requiring maintenance.

3. Daily maintenance of diesel engine

3.1 During diesel engine running, pay attention to the oil temperature, oil pressure and outlet water temperature, and check for leakages (oil, water, gas). In case of any abnormality, find out the causes immediately and troubleshoot timely.

3.2 After shutdown of diesel engine, check the capacity of fuel, coolant and oil, and add to the specified level if insufficient.

3.3 Drain the water in primary fuel filter.

3.4 Check the tension of drive belt and adjust as necessary.

3.5 If the environment temperature may be below 0℃ and no antifreeze is used, drain the coolant empty to protect the diesel engine parts against frost cracking.

4. Maintenance during long-term shutdown of diesel engine

4.1 Oil seal method

Add anticorrosive agent in the lubricating oil of lubricating system. Carry out preparations before starting for diesel engine normal running. Stop the engine after running for 5~10min, add oil seal oil for fuel system by using a clean container, remove the original fuel inlet pipe of diesel engine, insert it into the container, and eliminate the air in the fuel system. Start the diesel engine, run it for 15min at 2/3 of rated speed, and then stop it to let the starting motor drive the diesel engine for running. Use the high pressure spray gun filled with intake/exhaust pipe oil seal oil to spray the oil seal oil toward the inlet of supercharger until the exhaust pipe or supercharger exhaust port sprays oil mist for 15sec. Remove the pipe of oil seal oil, and

seal all exposed pipe ports of the diesel engine with plastic covers. Apply antirust oil on the unpainted surfaces (excluding diesel engine monitor, rubber pipe and diesel engine warning signs) of diesel engine. Wrap the diesel engine with a plastic bag, and place the diesel engine in a well ventilated dry storeroom.

4.2 Oil seal oil for diesel engine

Table 5 Oil seal oil of diesel engine

S/N	Name	Specification (code)
1	Oil seal oil for fuel system	Spindle oil
2	Oil seal oil for intake/exhaust pipe	Spindle oil

5. Tightening torque and tightening method for main bolts and nuts of diesel engine

Table 6 Tightening torque and tightening method for main bolts and nuts of diesel engine

Bolt name	Bolt specification	Technical requirement on tightening	Bolt length mm	Allowable use frequency
Main bearing bolt	M18-10.9	140Nm+210°	169	2
Auxiliary bolt of crankcase	M8-8.8	8Nm+30°	25; 110	2
Main bolt of cylinder head	M14-10.9	60Nm+2×120°	185	3
Auxiliary bolt of cylinder head	M12×1.5-8.8	20+10Nm, seal with Loctite 262	195, at least exceed the cylinder block by 175mm	3
Auxiliary nut of cylinder head		25Nm+2×120°		3
Crankshaft belt pulley bolt	M12×1.5-10.9	45Nm+135°	75	2
Torsional vibration damper bolt	M10-8.8	15Nm+30°	30	2
Flywheel bolt	M16×1.5-10.9	105Nm+270°	120	2
Connecting rod bolt	M14×1.5-10.9	Hand tightening: 115Nm+90° Automatic tightening: 80Nm+153°	67.5	
Bolt pin of idle gear	M12×1.5-10.9	105Nm	90	
Clamping bolt of fuel injector	M8-8.8	8Nm+90°	50	3
Camshaft gear bolt	M8-8.8	8Nm+120°	30	2

Bolt name	Bolt specification	Technical requirement on tightening	Bolt length mm	Allowable use frequency
Piston cooling nozzle bolt	M10	30Nm	25	
Exhaust manifold bolt	M10	15Nm+60°	65	2
Standard M6 bolt	8.8	8Nm	10.9	13Nm
Standard M8 bolt	8.8	22Nm	10.9	31Nm
Standard M10 bolt	8.8	39Nm	10.9	58Nm
Standard M12 bolt	8.8	70Nm	10.9	100Nm

Note: ① The angle value is the torsional angle after tightening to the specified torque;

② There are requirements on strength grades of bolts and nuts used at all parts of the diesel engine, bolts and nuts of same specification but different strength grades shall not be wrongly mounted or exchanged randomly. Do not exceed the reuse frequency, or else it may cause serious results.

6. Operation requirements of diesel engine

6.1 Unpacking of new diesel engine

After opening the diesel engine package, the user shall check the diesel engine and its accessories according to the packing list, check the diesel engine surface for damage, connecting parts for looseness, and then carry out the following:

a. Wipe the antirust layer of exposed parts and apply the anticorrosive agent;

b. Drain the oil seal oil in the fuel filter and fuel system parts (starting without draining the oil seal oil in the fuel system is also allowed, but only after the oil seal oil in the fuel system is used up and normal diesel oil supply is available, running the engine with increased load is allowed). **However, the user shall pay attention to that the oil seal period of diesel engine is 1 year, after this period, please check and take necessary supplement measures.**

c. Rotate the flywheel and spray solvent into the air inlet pipe until the oil seal oil in the cylinder is drained;

d. Spray solvent to the intake/exhaust holes of supercharger until the oil seal oil in the cylinder is drained;

e. Add oil to the oil sump according to the instruction;

f. Add coolant to the diesel engine cooling system. The coolant shall be fresh water after softening process or coolant containing antifreeze additives. It is forbidden to add seawater in the cooling system.

6.2 Check and preparation before starting

a. Check the coolant level

Observe the coolant level through the upper hole on the expansion water tank. If the coolant is insufficient, open the filling port cover and add the coolant. Never add a great quantity of coolant when the engine is hot, or else the parts may be damaged. If there is no coolant in emergency cases, cold water of which the temperature is not too low is allowed to be added slowly from the filling port until the coolant flows out from the filling port.

b. Check the fuel level

c. Check the oil level

The oil level shall be between upper and lower scale marks of dipstick, add oil from the filling port if necessary.

d. Check whether the accessories of diesel engine are reliably connected and eliminate the abnormality. Check whether the circuits of the starting system are normal and whether the battery charging is sufficient. Open the fuel tank valve, and drain the air in the fuel system by using the hand pump on the fuel delivery pump.

6.3 Starting of diesel engine

Turn on the instrument power switch, turn the accelerator handle to the full-open position, and press the starting button, if the engine cannot start within (5~10) sec, repeat the aforementioned procedures after 1min. If the engine still cannot be started after continuously 3 times, stop starting, find out the cause and eliminate and then restart. After starting, release the button immediately, and pay attention to the instrument readings, the oil pressure gauge shall display the pressure. Please pay attention not run the cold engine at high speed, run it for a period of time at idle speed but not too long.

6.4 Stopping of Diesel engine

Before stopping, unload first, slow down the engine speed to (600~1000) r/min, run several minutes and then turn the shutdown handle to stop. Turn off the instrument power. In case of emergency stopping, immediately turn the shutdown handle to the stop position, or disconnect the fuel delivery pipe of fuel injection pump or plug the inlet of air filter.

6.5 Operation precautions

a. After starting the diesel engine, idle running the engine for several minutes, then speed up to (1000-1200) r/min and increase some load. When the outlet water temperature is higher than 60℃ and oil temperature is higher than 50℃, run the engine at full load. Increase the load and the speed gradually to avoid sharp loading and sharp unloading

b. During the 60h running-in period of diesel engine, run it with medium load and below.

c. Do not run at idle speed for a long time, or it may cause faults such as oil leaking.

d. During normal operation of diesel engine, continuous running at rated power and rated speed is allowable. However when run at 103% of rated speed and 110% of rated power, it is allowed to run the engine for 1h every 12h. After unloading, idle running the engine for (1~2) min and then stop it.

e. Parameters to pay attention to and check positions during operation:

Pressure of main lubricating oil channel: (350~550) kPa.

Oil temperature in the oil sump: ≤110℃.

Coolant outlet temperature: (80+5) ℃, not to exceed 95℃.

Exhaust temperature after turbine: ≤580℃

Intake air temperature after intercooler: (55±5) ℃.

Check the exhaust color to identify the working quality of fuel injector and load conditions, if the smoke color is serious, please stop the engine to check.

Pay attention to check the diesel engine for leakages of water, gas or oil. In case of any, please stop and eliminate.

f. The operator shall understand the following features of diesel engine:

-- When the engine runs at the medium speed range of(60%~90%)of rated power and speed, the fuel economy is best;

-- The engine power will increase along with the speed, and the rated power is reached at the rated speed.

-- Check and maintain the diesel engine according to the regular check and technical maintenance intervals.

6.6 Diesel engine operations in winter

a. Fuel: select diesel fuels of different grades according to outdoor temperatures in winter;

b. Lubricating oil: select lubricating oil of different viscosity according to seasons;

c. Coolant: add antifreeze additives to the cooling system, select coolant of different grades and quantity according to outdoor temperatures;

d. Starting: the auxiliary starter can be used in winter if necessary. After starting of the diesel engine, load and run it at high speed after the oil pressure and the water temperature are normal;

e. Before cold seasons, check the battery electrolyte level, viscosity and unit voltage. If the diesel engine is not used for a long time and the temperature is very low, please take down the battery and store it in a warm room;

f. Shutdown: When stopping in cold weather, unload first and idle for (1~2) min, and shutdown after the temperature lowers. After stopping, do not drain the coolant containing antifreeze additives. If there is no antifreeze additives in the coolant, open the water drain valve or plugs on the engine body and the oil cooler cover, and drain the coolant empty to prevent the engine from frost cracking.

Chapter V Troubleshooting

1. The engine fails in start

	Reason	How to remove
1	Oil channels like inlet screen of delivery pump or hose blocked	Check and remove the blockage
2	Air comes into fuel system	Release air, inspect the joint sealing and repair
3	Injection pump error	Examine the plug, oil outlet valve, repair or replaced the damaged parts
4	Injector error	Examine the atomization and repair
5	Wrong initial angle of air distribution or fuel supply	Inspect and adjust
6	High pressure fuel pipe damaged or leaks	Repair and replace
7	Cylinder insufficient pressure	Inspect the valve sealing, gasket and the piston ring, repair or replace;
8	Low ambient temperature	Add low temperature start equipment

2. Stops soon after start

	Reason	How to remove
1	Fuel filter blocked	Disassemble the filter and clean filter, or replace the element if necessary
2	Air comes into the fuel system	Examine the joint and sealing of the fuel pipe, if the screw is tightened and release the air
3	Fuel pump does not work	Examine the piston and valve of feul delivery pump, clean

		or repair them
4	Poor quality fuel contains too much water	Clean the filter or change fuel
5	Low idle adjusting	Re-adjust

3. Insufficient power

	Reason	How to remove
1	Air intake blocked (air filter blocked)	Inspect the air filter, intake pipe; clean or change the filter
2	High exhaust back pressure	Inspect the valve timing, if the exhaust pipe is blocked; adjust and repair it
3	Insufficient pressure of supercharging system	Inspect and remove leakage with pipes and joints
4	Abnormal working of supercharger	Inspect or change the assembly
4.1	Compressor and turbine channel are blocked	Clean or replace
4.2	Floating bearing fails	Replace
4.3	Carbon, dust or oil are accumulated at the back of turbine and compressor	Wash
5	Intercooler damaged, blocked or leaks	Replace or repair
6	Fuel pipe leaks or blocked	Examine the pipe and joint sealing, filter, repair or remove the blockage, replace the element
7	Poor fuel quality	Wash the fuel tank, filter assembly and pipe, change the fuel
8	Injection pump or speed governor seriously worn	Repair or replace
9	The smoking limiter diaphragm of injector damaged	Replace or repair
10	The air pipe of smoking limiter damaged	Replace
11	Poor atomization of injector nozzle	Inspect the injection pressure, carbon deposits on the nozzle ; adjust and repair it;
12	Poor timing for air distribution and fuel supply	Inspect and adjust it
13	Insufficient high speed adjusted by the governor	Examine the speed adjuster and adjust it
14	High level of oil pan	Inspect the dipstick and release surplus oil
15	Cylinder gasket leaks; valve leaks	Examine the cylinder compression pressure when the engine is warm and replace the damaged parts
16	Piston ring broken or too large gap of bearing shell	Replace the damaged parts or overhaul the engine
17	Cylinder liner or piston ring are worn or scratch the cylinder	Repair the engine

4. Great fuel consumption

	Reason	How to remove
1	Air intake blocked (air filter blocked)	Inspect the air filter, intake pipe; clean or change the filter
2	High exhaust back pressure	Inspect the valve timing, if the exhaust pipe is blocked; adjust and repair it
3	Poor quality fuel	Clean the oil tank, filter parts and oil pipe; replace the fuel
4	Leakage with fuel pipe	Inspect and repair it
5	Poor atomization of injector nozzle	Inspect the injection pressure, carbon deposits on the nozzle ; adjust and repair it;
6	Poor timing for air distribution and fuel supply	Inspect and adjust it

7	Cylinder gasket leakage and poor sealing of valve	Inspect the compression pressure when the cylinder is warm; replace the damaged parts
8	Large gap of bearing shell	Inspect and repair
9	The piston is stuck in the cylinder	Change the liner, piston and piston rings
10	Insufficient pressure of supercharging system	Inspect and remove leakage with pipes and joints
11	Abnormal working of supercharger	Inspect or change the assembly
12	Intercooler damaged, blocked or leaks	Change or repair

5. Exhaust dark smoke

	Reason	How to remove
1	Air intake blocked or high exhaust back pressure	Cleaning
2	Poor quality fuel	Clean the fuel tank, filter parts and fuel pipes; replace the fuel;
3	Wrong timing for air distribution and fuel supply	Inspect and adjust it
4	Poor atomization of injector nozzle	Adjust and repair it
5	Too much fuel injected by the injector	Inspect and adjust (by special workshop)
6	Insufficient pressure of supercharging system	Inspect and remove leakage with pipes and joints
7	Abnormal working of supercharger	Inspect or change the assembly
8	Intercooler damaged, blocked or leaks	Change or repair

6. Exhaust gray or blue smoke

	Reason	How to remove
1	Poor quality fuel containing too much water	Change the oil
2	. Low cooling water temperature	Inspect the working temperature of thermostat and replace it in necessary
3	Wrong timing for air distribution and fuel supply	Inspect and adjust it
4	Poor atomization of injector nozzle	Adjust and repair it
5	Low compression pressure, incomplete burn and the piston is stuck in the cylinder liner	Inspect the piston ring, liner, gasket and repair
6	Poor running-in between piston ring and liner	Continue to running-in
7	Un-staggered piston ring openings	Adjust and re-assemble
8	Piston ring fails	Change
9	Large gap between piston and liner	Repair or replace
10	Supercharger sealing ring worn	Examine and replace
11	Supercharger thrust bearing worn	Examine and replace
12	Supercharger oil return pipe blocked	Wash or repair

7. Too much oil is collected in air intake port and pipe of supercharger

	Reason	How to remove
1	Supercharger sealing fails	Repair or replace
2	Oil-gas separator fails	Change
3	Oil pan high level or surplus oil	Inspect and drain a proper amount of oil

8. Unstable speed

	Reason	How to remove
1	Poor quality fuel containing water and wax	Washing fuel pipe and change the fuel
2	Air comes into fuel suction pipe	Inspect the sealing of pipe and joint and release the air
3	Uneven oil supply	Inspect and repair (by special workshop)
4	Uneven atomization of injector	Inspect and repair
5	Superchargersurge	Inspect, wash the channel to remove dirt; Remove carbon collected in the exhaust channel
6	Supercharger damaged	Change

9. Low oil pressure

	Reason	How to remove
1	Oil pan low level or insufficient oil	Inspect the oil level and if there is any leakage; if so, add oil
2	Pressure adjusting valve of the main oil channel error	Inspect the valve, wash and repair it
3	If the oil strainer, pipes, connector and gaskets are blocked or damaged	Inspect the oil strainer and joint; if there is any shrinkage porosity in the oil channel; if so, repair it
4	Unqualified oil brand or grade	Change the oil with specified brand and grade
5	Inlet pipe of oil pump leaks	Inspect the oil pipe and connector, repair or replace
6	High temperature of water in cooling system and inlet oil	Examine the cooling system and correct it
7	Oil inlet filter suffering great resistance	Change the element
8	Oil cooler blocked	Inspect and clean
9	Main oil passage blocked	Inspect and wash
10	Large gap between bushings or the bushing is damaged	Inspect and replace
11	Parts are greatly worn and require major repairing	Inspect the engine working hours, then repair it

10. High cooling water temperature

	Reason	How to remove
1	Low level of water tank	Inspect if there is any leakage; if so, add water
2	Water tank radiator (intercooler) blocked	Clean or repair
3	Loose water pump belt	Adjust the tension as specified
4	Pump washer damaged or the impeller is worn	Inspect and repair or replace
5	Thermostat error	Replace
6	Air comes into damaged pipe	Inspect the pipe, joint, gasket, and replace the damaged parts
7	Oil pan low level or insufficient oil	Inspect the oil level and leakage; repair and add oil

11. Fast wearing of parts

	Reason	How to remove
1	Air filter element damaged	Examine and replace the element
2	Air intake system shorted	Inspect the air intake pipe, gasket and repair or replace the

		damaged parts
3	Oil pan low level or insufficient oil	Inspect the oil level and if there is any leakage; if so, add oil
4	Oil brand and grade are unqualified	Replace by specified oil grade and brand
5	Oil channel blocked	Clean the channel
6	Piston ring broken or worn	Replace the damaged part
7	Element of oil filter is not changed in time	Replace the element as required
8	Cylinder liner or piston are worn or scratch the cylinder	Disassemble to check the piston and liner, repair or change it
9	Crankshaft and the driven part are not concentric	Inspect the mounting bracket and repair
10	Parts are greatly worn and require major repair	Inspect for engine working hours and repair

12. Too much noise

	Reason	How to remove
1	Poor fuel quality	Change the fuel
2	Low cooling water temperature	Inspect the thermostat and replace it in necessary
3	Wrong timing for air distribution and fuel supply	Inspect, repair, adjust
4	Poor atomization of injector	Inspect, repair and adjust
5	Large injecting amount by the injector	Inspect and adjust (by special workshop)
6	Shock absorber damaged	Inspect and repair
7	Valve leaks or improper adjustment	Inspect the valve and adjust
8	Too large gap between gears or the teeth are broken	Inspect and replace the damaged parts
9	The liner or piston are worn or scratch the cylinder	Inspect and repair or replace
10	Curved or broken push rod	Replace
11	Piston ring broken or worn	Inspect and replace the damaged parts
12	Bearing is greatly worn	Inspect and replace the bearing
13	Too large gap between crankshaft thrust bushings	Change the thrust shoes
14	Main bushings are not concentric	Inspect and repair
15	Main shafts of driven parts of crankshaft are not concentric	Inspect the bolts of mounting bracket , and repair
16	Parts are greatly worn and require overhaul	Inspect the parts and determine if repair or not
17	Supercharger surge	Remove blockage in the channel and repair
18	Supercharger sealing ring damaged	Replace the assembly
19	Supercharger bearing damaged or the rotating part contacts with fixing part	Replace the assembly
20	Foreign matter comes into the turbine of supercharger or impeller of compressor	Repair or replace

13. Starter motor fails.

	Reason	How to remove
1	Undercharged battery	Inspect, charge and replace the battery
2	Poor wire connection	Inspect and tighten the terminal
3	Fuse broken	Replace the fuse

4	Electric brush poor contact	Clean the brush o replace it with a new one
5	Starter short circuit	Contact to motor or replace the assembly

14. Powerless starter motor

	Reason	How to remove
1	Undercharged battery	Inspect, charge and replace the battery
2	Bearing bushing worn	Replace the assembly
3	Battery undercharged	Inspect, charge and replace the battery
4	Dirty or burnt commutator	Remove the oil and polish with sand paper, or replace the assembly
5	Wire end id out of welding	Re-weld
6	Poor contact of switch	Inspect and repair the switch

15. Generator does not work

	Reason	How to remove
1	Open or shorted circuit; joint loosed	Repair
2	Part shorted, open or ground circuit of rotor and coil	Repair or replace the assembly
3	Rectifier tube damaged	Replace the assembly
4	paper insulation is damaged and the wires are disconnected	Repair
5	Low voltage adjusted by the regulator	Repair
6	Contacts of regulator are burnt	Repair or replace the assembly

16. Undercharged generator

	Reason	How to remove
1	Open or shorted circuit; joint loosed	Repair
2	Part shorted or open circuit of rotor and coil	Repair or replace the assembly
3	Generator belt loosed	Repair and adjust the belt tension
4	Generator rectifier tube damaged or bad contact of brush	Repair
5	Low voltage adjusted by the regulator	Adjust
6	Disconnected coil or resistance of regulator	Repair or replace
7	Insufficient electrolyte or the battery is not fresh	Add electrolyte or replace the battery

Chapter VI List of Wearing Parts of WP13D series diesel engines

Part number	Name	Quantity per unit	Remarks
61270040018	Cylinder head gasket	6	
61560110210	Turbocharger gasket	1	
612630110710	Exhaust manifold gasket	6	
612630120005	Intake manifold gasket	6	
612630040007	Cylinder head cover gasket	6	
612630060212	V-Ribbed Belt (10PK)	1	
612630060057	V-Ribbed Belt (6PK)	1	
612600111068	Air circuit connection hose	1	
612700120029	Air circuit connection hose	1	
612630060844	Thermostat	2	
612630080442	Fuel pipe	1	
612630080323	Fuel pipe	1	
612700080007	Fuel pipe	1	
612630110684	Oil inlet pipe, turbocharger	1	
612630110580	Oil return pipe, turbocharger	1	
612600115353	Oil return pipe gasket, turbocharger	1	
612600080934	Fuel filter element	2	
612630010239	Oil filter element	2	