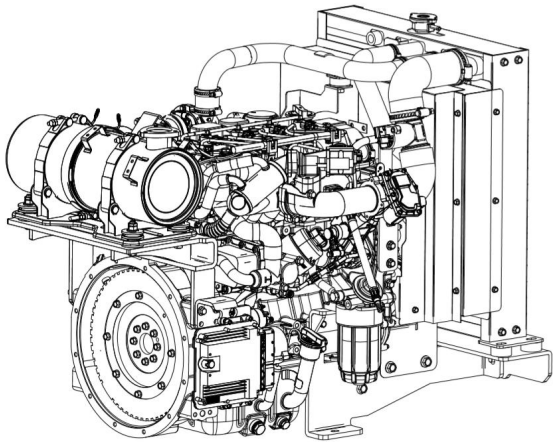
RAYWIN



4D20/5/4D30 Series Diesel Engine(EU Stage V)

Operation & Maintenance Manual

Please read this manual carefully before using the engine.

Raywin Powertrain Technology Co., Ltd.

Introduction to 4D20/5, 4D30 series non-road diesel engines

The “RAYWIN” 4D20/5, 4D30 series non-road diesel engines are upgraded on the basis of our company’s original products to meet the Europe Stage V requirements for the emission standard of diesel engines on non-road machinery. This series of diesel engines boasts excellent power performance, economy, reliability and durability and is mainly used for engineering machinery, agricultural machinery, marine main engines, marine auxiliary engines and generator sets, etc. Moreover, according to users’ requirements, some parts (such as oil supply system, combustion system, valve distribution mechanism and replacement of clutch housing, flywheel housing, flywheel, exhaust pipe, air inlet pipe, electrical system, external hydraulic pump interface) can be changed to fit the performance and installation requirements of different supporting machines.

In order to ensure the normal use of diesel engines, this manual mainly introduces the technical parameters, structure, performance and other knowledge of diesel engines for non-road machinery, and provides technical data on use, maintenance and failures analysis.

The data and instructions provided in this manual are subject to the current product. Since the product is being constantly improved and strengthened to meet the supporting needs of different users, if any discrepancy occurs between the product and the manual contents, the actual product sample shall prevail. Attention, please!

Before use, please read this manual carefully and use, maintain and serve the diesel engine in strict accordance with this manual.

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Introduction

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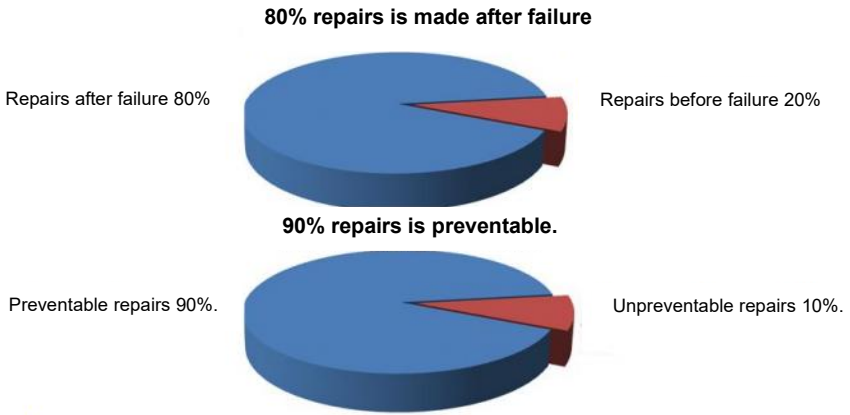

Preventive maintenance is simple and lower cost, please make the maintenance according to the maintenance instructions in this manual, and make regular preventative maintenance records.

Please utilize the fuel, oil and coolant correctly as per the instructions in this manual, and do not mix the fuel and oil together for the engines with after-treatment equipment.

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Warning

Before maintenance and service, carefully read through and understand all safety precautions and warnings. The following contents contain general safety precautions that must be followed to ensure personal safety.

1. When the diesel engine is working, do not touch its fan, pulley, belt and other rotating parts exposed lest injuries occur;

2. The operator shall not open the radiator filler cap when the diesel engine is hot to avoid being scalded by high-temperature steam;

3. When the diesel engine is hot, do not touch the exhaust pipe and other high-temperature parts to avoid scalding while checking or adjusting the diesel engine;

4. Never fill the diesel engine with cold water when it is too hot and short of coolant;

5. The diesel engine will emit CO and other harmful gases and soot during operation, so effective ventilation must be ensured during use;

6. The diesel engine will emit noise during operation, so the influence of exhaust gas, smoke exhaust and noise on the surrounding environment, personnel and objects must be considered.

Precautions

1. In order to ensure your personal and property safety, carefully read through the instructions before use, and use and maintain the diesel engine in strict accordance with the provisions described in the instructions;
2. Correctly follow the requirements in this manual for diesel engine start, running-in, operation and shutdown;
3. The operator shall pay attention to the safety precautions and shall not approach the area with safety warning during the operation of diesel engine;
4. Before plugging any harness connector, remember to turn off the ignition switch and disconnect the main switch of the battery 30 seconds later;
5. When welding on the vehicle or equipment, remember to turn off the main power supply, disconnect the positive and negative electrodes of the battery and unplug all connectors on the ECU and sensor to prevent ECU damages during welding;
6. ECU permits no hot plugging. Never weld on the engine or engine components; otherwise, the engine or components may be damaged.
7. In order to prolong the service life of the starter and battery, never start the engine continuously more than 15 seconds at a time. If necessary, try again 1-2 minutes later.

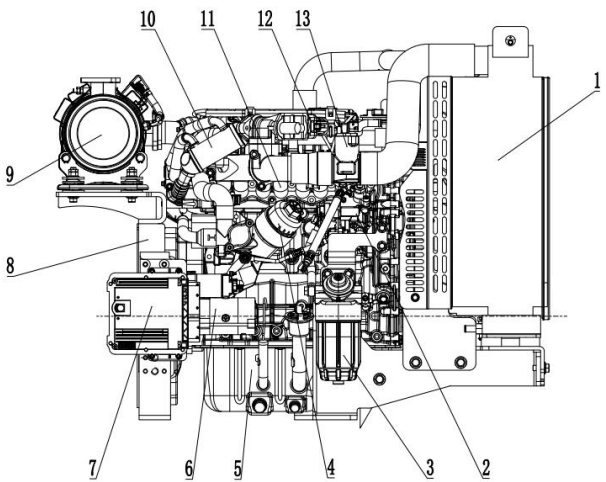
8. The air filter shall be cleaned as required, but never removed during service. During reassembly, the upper and lower sealing gaskets of the filter element shall be installed reliably to ensure good sealing. When a hose is used to connect the air filter, fix the hose firmly with a clamp lest it gets loose due to the vibration of the diesel engine. It is strictly prohibited that unfiltered air with dust enters the cylinder.

9. The oil supply system is an important system of the diesel engine, and its related parts shall not be disassembled or adjusted at will.

10. After the running-in period expires, please maintain the engine according to the manual instructions.

Chapter I Main Performance Parameters of Non-road D-Series Diesel Engines

1.1 4D20/5 outline drawing (it may be different in different states and the supporting technical agreement shall prevail)



1.Intercooling radiator

2.Fuel injection pump

3.Fuel filter

4.Oil filter

5.Oil sump

6.Starter

7.ECU

8.Flywheel housing

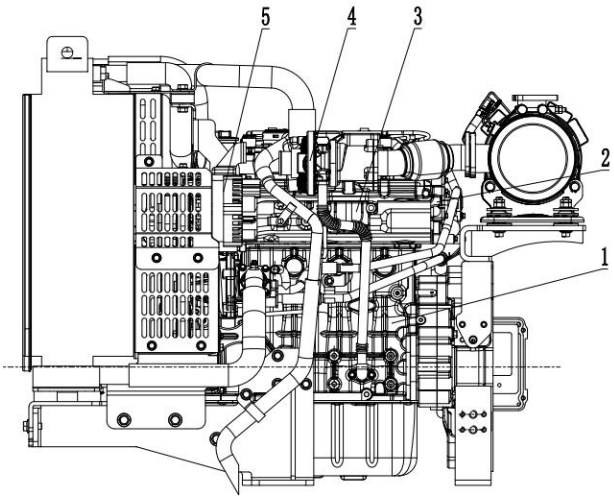
9.Aftertreatment(DOC+DPF)

10.EGR cooler

11.Airi ntake manifold

12.EGR valve

13.PFM sensor



1.Cylinder block

2.Cylinder head

3.Exhuast manifold

4.Turbocharger

5.Alternator

Main performance parameters of 4D20/5 series (G-Drive)

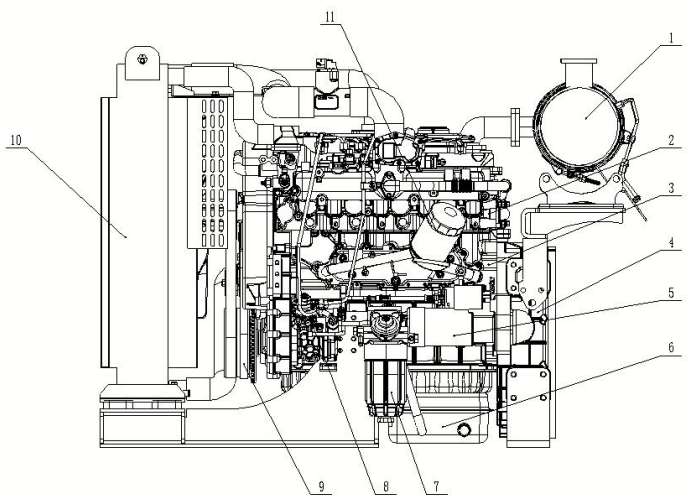
S/N	Name	Unit	Technical Parameters
1	Engine model		4D20/5 series
2	Maximum net power	kw	18.5/1800（4D20G00/5）
			18.8/1500（4D20G01/5）
			36.8/1800（4D20TIG0/5）
			36.8/1500（4D20TIG1/5）
			31/1800（4D20TIG2/5）
			26/1800（4D20TIG3/5）
			31/1500（4D20TIG4/5）
			26/1500（4D20TIG5/5）
3	Cylinder number x cylinder diameter x stroke	mm	4-81×97
4	Engine displacement	L	1.99
5	Compression ratio		17.5.1±0.5：1
6	Minimum specific fuel consumption	g/kw*h	≤215
7	Crankshaft rotation direction		Counterclockwise (from power output to fan)
8	Optimum operating water temperature of engine	℃	80-95
9	Oil pan volume	L	5-6.5
10	Net mass	kg	260±10
11	Applicable altitude	m	≤2000
12	Operating temperature of diesel engine	℃	- 30 to 55

Main performance parameters of 4D20/5 series (Industrial)

S/N	Name	Unit	Technical Parameters
1	Engine model		4D20/5 series
2	Maximum net power	kw	18.8/2400（4D2000/5）（Naturally aspirated）
			18.8/2200（4D2001/5）（Naturally aspirated）
			18.8/2000（4D2002/5）（Naturally aspirated）
			55/2500（4D20TI40/5）
			55/2400（4D20TI41/5）
			55/2300（4D20TI42/5）
			55/2200（4D20TI43/5）
			51.5/2400（4D20TI50/5）
			51.5/2300（4D20TI51/5）
			50/2400（4D20TI60/5）
			50/2200（4D20TI61/5）
			50/2200（4D20TI70/5）
			48/2400（4D20TI71/5）
			45/2400（4D20TI80/5）
			45/2200（4D20TI81/5）
3	Maximum net torque	N.m	288/1800
4	Cylinder number x cylinder diameter x stroke	mm	4-81×97
5	Engine displacement	L	1.99
6	Compression ratio		16.5:1
7	Minimum specific fuel consumption	g/kw*h	≤215
8	Crankshaft rotation direction		Counterclockwise (from power output to fan)
9	Optimum operating water temperature of	℃	80-95

	engine		
10	Oil pan volume	L	5.5
11	Net mass	kg	260±10
12	Applicable altitude	m	≤2000
13	Operating temperature of diesel engine	℃	- 30 to 55

1.2 4D30 outline drawing (it may be different in different states and the supporting technical agreement shall prevail)



1.Aftertreatment（DOC+DPF）2. Cylinderhead

3.Cylinderblock

4.Flywheelhousing

5.Starter

6.Oilsump

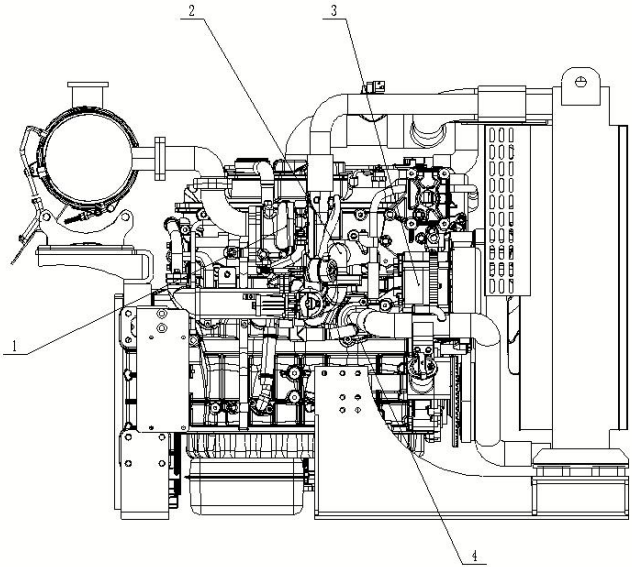
7.Fuelfilter

8.High pressure fuel pump

9.Crank shaft belt pulley

10.Fan

11.Oil filter



1.Turbocharger

2.Exhuast manifold

3.Alternator

4.Water pump

Main performance parameters of 4D30 series (G-Drive)

S/N	Name	Unit	Technical Parameters
1	Engine model		4D30
2	Maximum net power	kw	55/1800（4D30TIG00/5）
			55/1500（4D30TIG01/5）
			48/1800（4D30TIG10/5）
			48/1500（4D30TIG11/5）
			42/1800（4D30TIG20/5）
			42/1500（4D30TIG21/5）
3	Cylinder number x cylinder diameter x stroke	mm	4-95×105
4	Engine displacement	L	2.97
5	Compression ratio		16.6±1：1
6	Minimum specific fuel consumption	g/kw*h	≤215
7	Crankshaft rotation direction		Counterclockwise (from power output to fan)
8	Optimum operating water temperature of engine	℃	80-95
9	Oil pan volume	L	6.5L
10	Net mass	kg	380±10
11	Applicable altitude	m	≤2000
12	Operating temperature of diesel engine	℃	- 30 to 55

Chapter II Instructions for Diesel Fuel, Engine Oil, Coolant, etc

2.1 Fuel

In order to ensure the reliability of the oil supply system, clean diesel oil produced by national regular oil companies must be used. For areas with environmental requirements, diesel oil corresponding to environmental protection regulations must be used. When refueling on your own, keep the oil container clean and dedicated; the diesel oil fed into the oil container must be precipitated for more than 48 hours and the clean diesel oil on the upper part of the container only can be taken for use.

The brand of diesel selected is related to the ambient temperature. When the ambient temperature is low, the paraffin in the diesel will be separated out and the viscosity of the diesel will become larger, which will block the fuel pipeline, causing startup difficulty and black exhaust if the diesel for summer is used in winter. On the contrary, if the diesel for winter is used in summer, the high temperature will reduce the viscosity of the diesel, resulting in poor lubrication of the fuel supply system, the possibility of burning the fuel injection pump and injector, and the delayed ignition resulting in insufficient power and white smoke. Therefore, different brands of diesel should be selected in different seasons and regions.

Please select diesel as required in the table below according to the climatic conditions of the local region; the sulfur content in diesel shall be less than 50PPM.

Ambient temperature (T)	T≥5℃	-10℃≤T < 5℃	-20℃≤T < -10℃	T < -20℃
Fuel brand applicable	0 #	- 10 # light fuel	- 20 # light fuel	- 35 # light fuel

- **Cautions:**

Never drive until the fuel tank is completely empty. Otherwise, there will be air in the fuel pipe, which will cause abnormal fuel supply of the fuel system and engine stalling.

Please fill diesel at your local regular gas station. If the diesel engine fails due to the use of low-quality diesel, you will not enjoy the warranty rights.

2.2 Lubricating oil

CJ-4 and above diesel engine oil shall be used for diesel engines.

The viscosity grade of the selected lubricating oil is related to the ambient temperature. When the ambient temperature is high or low, the diesel engine is not easy to reach the starting speed or good lubrication due to the change of oil viscosity, which makes starting difficult or damages the engine. Therefore, in different seasons and different regions, appropriate brands of lubricating oil should be used according to different ambient temperatures.

Ambient temperature	Lubricating oil brand
- 10℃ and above	Grade 15W/40 CJ
-20℃ ~ -5℃	Grade 10W/30 CJ
- 20℃ and above	Grade 5W/30 CJ

a. Oils of different brands and manufacturers are not allowed to be mixed.

b. The added oil shall never contain impurities or water.

2.3 Coolant

Clean antifreeze coolant able to prevent freezing in winter or boiling in summer, and able to prevent corrosion, rust and scale must be used.We suggest to choose Bosch G11 and G12 model coolant.

The relationship is as follows between the freezing point and the proportion of ethylene glycol added in the coolant:

Ethylene glycol content/%	Freezing point/℃	Density/g.cm-3
28.4	-10	1.0340
32.8	-15	1.0426
38.5	-20	1.0506
45.3	-25	1.0586
47.8	-30	1.0627
50.9	-35	1.0671
54.7	-40	1.0731
57	-45	1.0746
59.9	-50	1.0780
68.1	-68	1.0866

The cooling system shall adopt a closed pressurized radiator system (the pressure of the pressure relief cap system shall be no lower than 1.1 bars). The maximum pressure of the system shall be controlled by the safety valve in the radiator filler cap. The higher the pressure in the system, the higher the boiling point of the coolant will become; for systems without a pressure relief cap, the boiling point of the coolant will decrease at higher altitudes.The principle of selection is that the free zing point of the coolant should be approximately 10°C lower than the lowest ambient temperature.

Regular replacement of coolant:

1. The light load coolant/inorganic salt coolant shall be replaced once every 3000 hours.
2. Heavy duty coolant/organic acid coolant shall be replaced once every 5000 hours.

The technical requirements for light load coolant/inorganic salt coolant and heavy load coolant/organic acid coolant must

meet the relevant standards of the petrochemical industry.

3. It is not recommended to use methanol based antifreeze because it will affect non-metallic materials in the cooling system and reduce the boiling point of the coolant.

4. It is not recommended to use antifreeze containing high silicate, which will cause serious precipitation.

5. Please use antifreeze correctly according to the mixing proportion recommended by antifreeze manufacturer.

- **Note:**

a. Clean the engine cooling system with clean water before filling antifreeze, and preferably with softened or deionized water if conditions permit;

b. Take care to check the level of antifreeze and the tightness of the cooling system. For vehicles or equipment without overflow tank, do not fill too much, but about 95% of the volume; for vehicles with overflow tank, firstly fill it with coolant up to the designated scale mark, and then continue to fill more antifreeze to the specified height after the engine has been idling for a few minutes;

c. The coolant with different freezing points shall be selected according to the temperature in the area where the vehicle is used. The freezing point of the coolant shall be at least 10℃ lower than the lowest temperature in the area to avoid losing the antifreeze effect;

d. Coolant of different brands shall not be mixed to avoid chemical reaction and damage to their comprehensive anti-corrosion capacity. The remaining coolant shall be marked on the container to avoid confusion;

e. After use, if the level of the radiator decreases due to the leakage of the cooling system, the same brand of coolant should be added in time. If the level decreases due to water evaporation, distilled water or deionized water should be added to the cooling system. Do not add hard water such as well water and tap water; if the coolant is found to be smelly or has suspended solids or sediment, it is proved that the coolant has started chemical reaction and lost its effectiveness due to deterioration. The cooling system should be cleaned in time and all coolant should be replaced;

g. Glycol coolant is toxic and harmful to human liver. Do not breathe it into your mouth. After skin contact, it should be cleaned immediately with water. In addition, the nitrite anti-corrosion additive in the coolant is carcinogenic, and the waste liquid should not be dumped randomly to avoid environmental pollution.

Chapter III Use of Diesel Engine

3.1 Running-in of diesel engine

The diesel engine must be run in before use, through which the surfaces of all moving parts of the diesel engine can be well matched to avoid abnormal wear and damage. The service life, working reliability and economy of a diesel engine largely depend on the running in at the initial stage of use.

The running in of the diesel engine can be carried out together with the supporting machinery, and the running in shall last 40-60 hours. During running in, the load shall be no greater than 70% of the specified load, and the speed shall be no greater than 80% of the rated speed. The engine shall not be allowed to idle for a long time. After running in, the user shall carry out running-in maintenance according to the requirements in Chapter IV.

a. Do not allow the diesel engine to work when the coolant is “boiling”, and do not let it work for a long time when the water temperature is too high or too low.

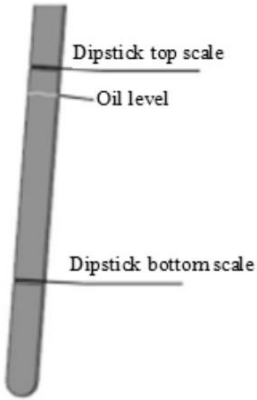
b. Do not allow the diesel engine to idle for more than 10 minutes.

3.2 Starting of diesel engine

Preparation and inspection before startup:

a. Check whether the amount of lubricating oil is sufficient, and supplement properly if insufficient;

Check the oil level 15~20 minutes after the machine is shut down. The oil pan shall be filled with oil until it is *near the scale line on the oil dipstick, as shown in the figure below*.



b. Check whether the coolant in the radiator is sufficient, and supplement properly if insufficient;

Add coolant to the water filler port of the radiator and let it stand for 3-5 minutes to remove the air from the engine and then cover the filler port.

c. Check whether the oil tank is short of oil, and supplement properly if insufficient;

Add clean diesel into the diesel tank, check whether the oil way is smooth, and exhaust the air in the fuel pipeline (refer to Inspection and Maintenance - Exhaust Operation of Fuel System).

d. Check whether the battery is correctly and firmly connected with the electrical system;

e. Check whether there is any sign of oil, water leakage or air leakage on any pipe or joint surface;

f. Check whether the fan belt tension is abnormal.

Startup steps:

a. If preheating is required during startup, turn the ignition switch to ON and wait for the preheating lamp to go out.

b. Turn on the power with the switch key after the preheating lamp is off, and observe whether all electrical instruments

indicate normally;

c. Turn the ignition key to the “Start” position;

d. Slowly release the accelerator pedal after the diesel engine is started;

e. Release the ignition key after the diesel engine is started.

- **Note: When a diesel engine has its oil or oil filter replaced, or when it is stopped for a long time (more than one week), remove the air in the fuel system before starting and check the pipeline sealing. After starting, never accelerate sharply, but let the engine idle for 3-5 minutes in advance.**

Inspection after preheating and starting:

During preheating, the following items shall be checked:

a. Oil pressure (the oil pressure alarm light goes out after preheating);

b. Generator charging state (the charging indicator is off during preheating);

c. Pay attention to the engine noise. If abnormal noise is heard, troubleshoot the engine immediately;

3.3 Precautions during diesel engine operation

During engine operation, there are some signs worth noting before abnormal phenomena will occur:

a. Oil pressure

Shut down the engine for immediate troubleshooting if the engine oil pressure alarm light flashes repeatedly or the engine oil pressure is relatively low when the diesel engine is working.

b. Coolant temperature

Let the engine cool down and stop for troubleshooting.

If the engine cannot reach normal water temperature, it means that the engine is too cold, which will lead to early wear. The radiator should be covered to solve this problem.

c. Engine noise

If the engine and related components make abnormal noises, it indicates that the engine is not working normally or some

moving parts rub each other, and the engine should be stopped for troubleshooting.

d. Exhaust color

If there is a large amount of white or black smoke from the engine exhaust, it indicates that the engine combustion is abnormal and the engine should be stopped for troubleshooting.

Color of engine exhaust

Exhaust color	Engine combustion state	Remarks
Colorless or slightly blue smoke	Normal	Ideal combustion state
Black smoke	Abnormal	The combustion state is not ideal
White smoke	Abnormal	The combustion state is not ideal

- **Note:**

a. Do not stop the overheated engine immediately.

b. The diesel engine is not allowed to work for a long time under overload.

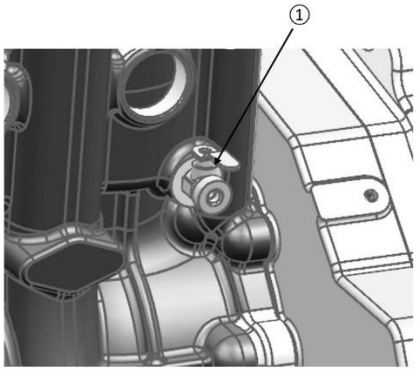
3.4 Shutdown and inspection of diesel engine

a. Before stopping the diesel engine, make sure that the vehicle gear is in neutral or the engine is in a no-load state.

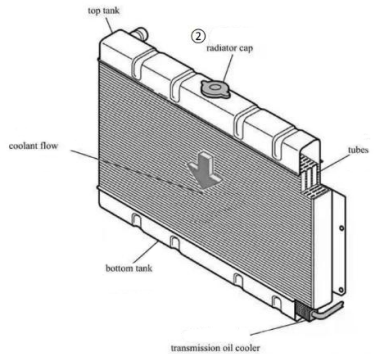
b. Before stopping the diesel engine, let it work at low speed for 3-5 minutes to cool down. During this period, check the engine noise, oil pressure, “water/oil/gas leakage”, etc.

c. Turn the key switch to the “OFF” position and disconnect the battery power.

3.5 Storage of diesel engine



Body drain valve position



Radiator cap position

a. Before long-term storage, maintain the diesel engine, repair damaged parts, clean it thoroughly and keep it in good condition.

b. The equipment must be parked in a dry room. If it has to be parked outdoors, it is recommended to remove the battery and store it indoors. The machine must be covered with a cover cloth.

c. When your machinery (or equipment) is stored in the ambient temperature of lower than 5℃ or more than 2 months, the coolant in the diesel engine shall be drained to avoid freezing the parts or causing corrosion inside the engine. Firstly, wait until the diesel engine and radiator are fully cooled (with the temperature dropping below 50℃), unscrew the pressure cap ② on the radiator, and then unscrew the drain valve ① on the oil cooler. After the coolant is drained, tighten the pressure cap and drain valve.

d. When the air temperature is lower than - 30℃, the battery should be removed and moved indoors to keep warm; otherwise, it is difficult to start the machine.

e. Replace the diesel engine oil. The new oil is usually neutral and will not corrode the metal parts of the diesel engine.

f. It is recommended to start the diesel engine once a month during the shutdown period to make the machine run for a short time, so as to establish a new oil film at the lubricating place of each part to prevent rust.

It should be noted that sufficient coolant should be filled before starting and completely drained at the end.

Chapter IV Regular Inspection and Technical Maintenance

The working environment of most non-road machinery is relatively harsh, so the degree of deterioration is determined by the service time and service state. If the deterioration and performance degradation are ignored, the mechanical structure and device performance will also be reduced, and the diesel engine will be irreparably worn. If you want to keep the diesel engine in good technical condition and work reliably for a long time, please carefully conduct regular inspection and technical maintenance according to the technical specifications in this chapter.

4.1 Inspection of fuel supply system

For high-pressure oil pump, injector, high-pressure fuel rail and other precision components, the water or impurities in the fuel will cause the pump plunger, fuel injection nozzle and various sensors to be strained or invalid, the filter element will become dirty and even blocked, and thus the engine output power will be reduced. Please check regularly according to the following conditions.

4.1.1 Fuel pre-filter

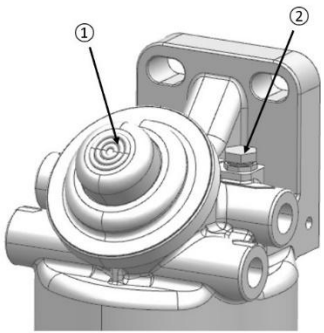
Drain water from the fuel pre-filter or fuel tank regularly (every time fuel is filled). If the fuel pre-filter has its indicator (if installed) light up during operation, stop the machine and drain the water.

4.1.2 Fuel system exhaust

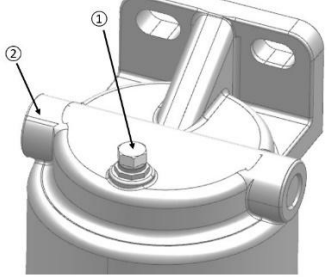
The air in the fuel system will cause difficulty in starting the engine and other engine failures. During use or

maintenance, if the fuel system is mixed with air, it is necessary to refill the fuel and exhaust the fuel system.

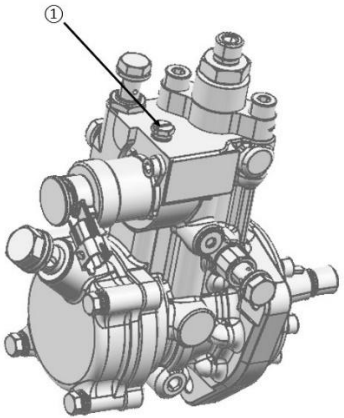
Steps for exhaust operation:



Pre-filter



Fuel-filter



Fuel pump

1) Loosen the air release screw ② on the prefilter, press the hand pump ① on the prefilter, and tighten the air release screw ② on the prefilter after the fuel without bubbles flows out from the air release screw ②.

Note: If the prefilter is completely empty, the emptying process will be relatively long.

2) Loosen the air release screw ① on the fuel filter (if there is no air release screw, loosen the fuel outlet connector ② of the fine filter), press the hand pump on the prefilter, and tighten the air release screw ① (or fuel outlet connector ②) on the fuel filter after the fuel with no bubbles continuously flows out from the air release screw (or fuel outlet port of the fin e filter).

Note: The oil outlet on the fine filter is generally indicated by an arrow and only the connector with the fuel pipe needs to be loosened.

3) Loosen the screw at the zero return hole ① on the fuel pump, press the hand pump on the prefilter continuously, and tighten the screw at the zero return hole ① after the fuel without bubbles flows out.

4) Press the hand pump ① on the prefilter continuously to let more fuel enter the fuel injection pump.

5) After the engine is started, it is recommended to let it idle for 2min-3min, and then let it run at 60% - 80% of the rated speed for 3min~5min, so that the air in the oil circuit can be fully drained.

4.2 Cooling system inspection

Check the drive belt.

a. Check whether there are cracks, cilia, wear or oil and water stains, and replace the belt if necessary. The belt must not touch the bottom of the belt chute.

b. Press the belt between the two pulleys to check the offset of the belt. When the offset of the fan belt exceeds the specified value or the fan belt is replaced, adjust the tension of the fan belt. See the table below for details.

Table 8 Belt offset: Unit: mm

Drive belt	Offset of old belt		Offset of new belt
	Limit	Offset after adjustment	
Fan belt	12-13	8-9	7-8
Applied pressure	98N		

4.3 Inspection and maintenance of catalytic postprocessor components

◎ Parking regeneration

(1) When the DPF regeneration warning lamp is always on, it prompts the driver to stop for parking regeneration; on the premise of ensuring driving safety, the driver shall park the vehicle in an open place without potential safety hazards as soon as possible and complete DPF regeneration as required.

a. If the regeneration status lamp is always on, press the parking regeneration switch and the engine will enter the parking regeneration mode.

b. If the regeneration warning lamp flashes, press the parking regeneration switch and the engine will enter the parking regeneration mode.

- **Note:**

All the following conditions shall be satisfied before regeneration: ① the vehicle speed is 0; ② the accelerator pedal is not

stepped down; ③ the brake pedal is not stepped down; ④ the clutch pedal is not stepped down; ⑤ the gear is in neutral; ⑥ the vehicle handbrake has been tightened; ⑦ start the engine and make it idle; ⑧ there is no DPF or engine-related failures; ⑨ the water temperature is higher than 50℃.

Warning 1: If the driver does not actively conduct parking regeneration operation within a limited time, the vehicle will trigger its speed limit function, and there is a risk of damage to the engine and postprocessor system during this process!

Warning 2: The regeneration temperature is high. It should be noted that there are no combustibles near the exhaust system or the vehicle. Do not trigger the parking regeneration in flammable and explosive areas such as gas stations and dusty places;

(2) Press and hold the regeneration switch button for more than 3s, and the engine will automatically enter the regeneration state. During this period, the engine speed will change periodically, which is a normal phenomenon. Regeneration lasts for about 20 to 40 minutes. Do not interfere with the regeneration process artificially to prevent adverse effects on the system;
After the regeneration process is completed, the engine will return to idle speed and the DPF light will go out automatically; after the regeneration is completed, the driver can operate the vehicle normally.

Warning: During regeneration, the driver shall monitor the vehicle nearby and place warning signs around the engine compartment to avoid scalding caused by touch.

(3) Unless there are special circumstances endangering the safety of vehicles or personnel, long press the DPF regeneration switch for more than 3 seconds to exit the parking regeneration;

◎ Service regeneration

Regeneration warning lamp

Regeneration status lamp

Regeneration cancel lamp

If the DPF regeneration warning light flashes quickly, the failures light is always on, and the machine has its torque and speed limited, you must go to the nearest service station to remove ash, get rid of smoke and ask for maintenance. Only after troubleshooting can the machine be used normally.

- **Note:**

Regeneration warning lamp:
a. If the regeneration warning lamp is always on, it indicates that regeneration is required;
b. If the regeneration warning lamp flashes, it indicates that the DPF is blocked and immediate parking regeneration is required. If it still flashes after the parking regeneration is completed, the postprocessor needs to be maintained.

Regeneration status lamp:
If the regeneration status lamp is on, it indicates that the engine is undergoing parking or driving regeneration.

Regeneration cancel lamp:
As it indicates, the regeneration cancel switch is pressed and the engine will not enter regeneration now.

◎ Postprocessor maintenance

During postprocessor service, routine maintenance shall also be carried out according to the following requirements by professional maintenance personnel;

DPF ash removal

Only good use and maintenance can ensure the continuous normal operation of catalytic postprocessor components:
(1) Check the integrity of the insulation material in the exhaust system. The passive regeneration capacity of DPF will be reduced if thermal insulation materials on the surface of exhaust manifold, turbocharger, exhaust pipe (between turbocharger and catalytic postprocessor components), catalytic filter components, etc. are missing during service or after maintenance. As a result, active regeneration and parking regeneration will be frequently triggered, resulting in higher fuel consumption.
(2) Check the sensor harness irregularly to avoid displacement of the harness and baking near the surface of the catalyst.
(3) Carry out DPF dust removal and maintenance.
DPF regeneration will leave incombustible ash, so the vehicle shall be cleaned regularly (2000h). If the DPF is completely blocked due to engine failures, for example, oil burning, troubleshooting is also needed at the service station. In both cases, take down the clamps at both ends of the DPF, remove the DPF, and then use special equipment to remove more than 90% of the ash or carbon deposits.

4.4 Inspection and maintenance of air filter

Air filter housing: clean the dust in the filter chamber, air guide cover and dust bag, and take care not to throw away the air guide cover as useless.

Main filter element: use a brush to remove the dust on the surface of the filter element, and then use compressed air (pressure 0.4MPa-0.6MPa) to blow out from the inside of the filter element.

Safety filter element: pat it with hands for cleaning but do not blow with air.

Installation: check whether the sealing ring is damaged or missing. When tightening, first rotate the filter element to make it set in place. Make sure that it must be firmly sealed to avoid air short circuit. Make sure that the dust bag must have its mouth kept downward.

Be sure to use the original matching air filter and its filter element.

Air prefilter:

① When the dust collector is full, shut down and remove the ash in it. It is recommended once every 10 hours (shorter if the environment is bad);

② When discharging the dust, be sure to turn off the engine, unscrew the dust discharge cover of the dust collector, and gently tap its outside to discharge the dust;

③ After ash discharge, check whether the rubber ring of the ash discharge cover is normal; then tighten the ash discharge cover.

4.5 Inspection and maintenance of storage battery

In order to ensure the reliability of cold starting at low temperature of diesel engine, when 24V electrical appliances are used, there are two batteries, each with a capacity greater than 110A. h, and the starting relay is 70-80A. The connecting wire between the battery and the starter should be as short as possible. When the total length of live wire and ground wire is less than 2m, the sectional area of conductor shall be no less than 40mm². When the total length of live wire and ground wire is longer than 2m, the sectional area of conductor shall be no less than 70mm².

The grounding wire between the engine and the vehicle beam must be installed.

- **Note:**

a. Keep the battery surface clean and dry. If there is corrosive liquid, wash it with alkaline water;

b. Keep the battery connector clean and firm;

c. If the vehicle is not used for 30 days or more, it is necessary to cut off the negative pole "-" of the battery (or turn off the starting power switch) to avoid leakage.

As temperature declines, the storage battery will have its capacity and discharge rate decrease sharply; therefore, it is recommended to check the battery before winter and replace it if necessary.

In cold seasons, make sure to fully charge the battery.

a. Cold starting consumes more current, so it takes longer to recharge the battery after starting compared to normal temperature.

b. The battery insufficiently charged is low in the specific gravity of electrolyte, which is easy to freeze and damage the battery.

c. In winter, the battery should be kept warm.

d. Distilled water should be supplemented to the battery shortly after the engine starts.

If distilled water is supplemented after the engine has stopped working, the distilled water added cannot be mixed with the original electrolyte, which may cause the unmixed distilled water to stay on the upper layer and cause icing.

Note: Do not put the battery near fireworks or electric sparks because the hydrogen released by the battery during reaction will explode. Please do not let the battery liquid contaminate your skin, eyes, fabric, or paint surface. Do not rub your eyes after touching the battery. Wash your hands thoroughly. Once the battery liquid comes into contact with eyes, skin or clothes, immediately rinse with water for at least 15 minutes and apply medicine.

4.6 Regular technical maintenance of engine

Regular maintenance is an important item for rational use of diesel engine. To keep the diesel engine in good technical condition and work for you reliably for a long time, careful technical maintenance must be carried out according to specifications.

During maintenance, pay special attention to the cleaning of parts. When reinstalling the removed parts, clean them thoroughly and ensure that they are installed correctly, and then turn on the machine to check whether the operation is normal.

Technical maintenance is classified as follows:

Daily maintenance (working for 8-10 hours):

a. Check whether the oil level of the oil pan is between the two scale marks on the oil dipstick, and add more oil if insufficient.

b. When the oil level rises or drops suddenly, troubleshoot it immediately.

c. Check the coolant level in the radiator, and add more if insufficient.

d. Check the fuel level in the fuel tank, and add more if insufficient.

e. Check whether all parts of the diesel engine are connected reliably, and tighten them if loose.

f. Troubleshoot such abnormalities as failures and “water/oil/gas leakage” found during the operation of the diesel engine.

g. Clean the sundries and dirt on the radiator surface.

h. Check whether the harness, rubber hose and other flammable objects are far away from the high-temperature heat source.

First mandatory running-in maintenance (1 month or accumulative 50 hours’ working (whichever comes first)):

a. Check the coolant level and leakage of the engine. There should be no leakage at the joints of the coolant water pipes.

b. Visually check the belt tension and abnormal wear.

c. Clean the air cleaner element with compressed air.

d. Clean the independent air filter element for the air compressor (air pump).

e. Drain the engine oil.

f. Replace the engine oil filter element.

g. Fill in engine oil and check whether the level of the engine oil is between the upper and lower scales of the dipstick and is closer to the upper limit.

h. Check whether there is water in the filter cup at the lower end of the diesel filter. If any, remove it.

i. Check the idle speed of the engine, slowly throttle up the engine and listen for abnormal noise from the engine.

g. Throttle up the engine slightly and listen whether the fan starts to work normally after the water temperature rises.

h. Check whether the harness, rubber hose and other flammable objects are far away from the high-temperature heat source.

Regular maintenance (every 3 months or 200 hours' working after the first maintenance (whichever comes first)):

a. Check the coolant level and leakage of the engine. There should be no leakage at the joints of the coolant water pipes.

b. Check whether all parts of the diesel engine are connected reliably, and tighten them if loose.

c. Clean the sundries and dirt on the radiator surface.

d. Visually check the belt tension and abnormal wear.

e. Replace the air cleaner element.

f. Drain the engine oil.

g. Replace the engine oil filter element.

h. Replace the engine diesel filter element.

i. Fill in engine oil and check whether the level of the engine oil is between the upper and lower scales of the dipstick and is closer to the upper limit.

j. Check the idle speed of the engine, slowly throttle up the engine and listen for abnormal noise from the engine.

k. Throttle up the engine slightly and listen whether the fan starts to work normally after the water temperature rises.

m. Check whether the harness, rubber hose and other flammable objects are far away from the high-temperature heat source.

n. Check the postprocessor parts for air leakage; when DPF regeneration failures affects normal use, please go to our service station for DPF ash removal and maintenance.

Chapter V Sealing and Storage of Diesel Engine

For diesel engines or diesel vehicles that have never been used and need to be stored for a long time, please handle them according to the following requirements in advance:

a. Drain the engine oil;

b. Open the drain valve to drain the coolant from the diesel engine;

c. Drain the diesel oil in the fuel tank and pipelines;

d. Clean the oil, water and dust on the surface of the diesel engine, and coat the unpainted parts with anti-rust oil (with dehydrated engine oil and butter mixed evenly after melted). Never apply oil to rubber products and plastic parts;

f. Pack and seal the air filter (or air inlet) and air vent nozzle with oiled paper to prevent dust and dirt contamination;

g. The diesel engine or vehicle shall be placed in a well-ventilated, dry and clean room without strong magnetic field (temperature: - 30~60℃, humidity: 0~80%). Never stack it where corrosive chemicals occur; protect the machine reliably against moisture (especially the electrical system);

For used diesel engines or diesel vehicles that need to be stored for a long time, please handle them according to the following requirements in advance:

a. Drain the engine oil while it is hot after parking; dismantle the oil pan and clean the oil pan and oil filter;

b. Open the drain valve to drain the coolant from the diesel engine;

c. Drain the diesel oil in the fuel tank and fuel pipelines;

d. Remove the dust on the air filter element (paper air filter); use diesel oil or kerosene to clean the filter element of oil bath air filter;

e. Remove the intake pipe, fill each cylinder with 300g of filtered HC-8 dehydrated engine oil from the air passage (that is, heat the engine oil to 110~120℃ until the foam completely disappears), and turn the crankshaft so that the engine oil could evenly adhere to the surfaces of valves, cylinder liners, pistons and other parts. Then install the intake pipe in place.

Chapter VI Handling, Installation and Unsealing of Diesel Engine

When transporting the diesel engine with a packing case, use steel wire rope to entangle the four lower corners of the case. For unpacked diesel engine, there are lifting lugs provided on both sides of the cylinder head for lifting.

When the diesel engine is used for fixed operation, the installation foundation must be well laid. The diesel engine must be installed in a well-ventilated spacious workshop that can prevent rain, moisture and dust.

For diesel engines that are sealed according to the sealing method described in Chapter V, the antirust oil must be removed before use. Pour hot water continuously into the diesel engine cooling system to preheat the diesel engine. Open the drain plug of the diesel engine to drain the lubricating oil sealed inside. Turn the crankshaft, or use the starter motor to drive the crankshaft to rotate (once no more than 15 seconds), and repeat it several times intermittently. Finally, start the diesel engine according to the starting procedure.

Appendix I List of Wearing Parts

S/N	Name	**Note:** 1. This list is for reference only, and the specific list of wearing parts shall be subject to what is provided by the
1	Main bearing bush	

2	Crankshaft thrust plate	customer service company; 2. The user is requested to check when unpacking. In case of any discrepancy, the relevant supporting status in the supply contract signed with the manufacturer shall prevail.
3	Cylinder head gasket	
4	Water seal ring	
5	Piston	
6	Piston ring	
7	Piston pin	
8	Connecting rod assembly	
9	Connecting rod bearing bush	
11	Front oil seal	
12	Rear oil seal	
13	Glow plug	
14	Intake and exhaust valves	
15	Intake and exhaust valve seat rings	
16	Speed sensor	
17	Camshaft signal sensor	
18	Fuel injector	
19	Fuel injection pump	
20	Turbocharge	

Appendix II Packing List

Category	S/N	Name	Quantity	Unit	Remarks
In packing case	1	Diesel engine	1	Set	
	2	Certificate	1	Piece	
	Attached documents				
	3	Operation manual	1	Copy	
	5	Packing list	1	Copy	

Note:

1. This list is only applicable to common models. Spare parts or attached accessories for models with special requirements of customers shall be added in the packing case according to the contract.

2. The user is requested to check when unpacking. In case of any discrepancy, the relevant supporting status in the supply contract signed with the manufacturer shall prevail.

Chapter VII Common Failures Analysis and Troubleshooting of Diesel Engine

7.1 Difficulty in diesel engine startup

Failures symptoms and reasons	Troubleshooting
1. Fuel system a. The ambient temperature is too low and the fuel grade is improper; b. There is no fuel in the fuel tank or the fuel tank switch is not turned on; c. The fuel pipeline and diesel filter are blocked or there is air; d. The fuel is mixed with water; e. The poor quality of diesel fuel leads to no fuel injection, little fuel injection, low injection pressure and poor atomization;	a. Use clean fuel suitable for the current ambient temperature; b. Fill the fuel tank with fuel and turn on the fuel tank switch; c. Replace the diesel filter and remove the air from the fuel system, and tighten the fuel pipe connectors; d. Remove the fuel pipe and filter for cleaning or replace the filter element; e. Check or replace the fuel injection pump, fuel injector and fuel rail; f. Clean the fuel metering unit and overflow valve of the fuel injection pump; g. Heat the coolant, clean the blockage in the fuel pipeline, and use

f. The fuel metering unit and overflow valve of the fuel injection pump are stuck, and the plunger coupling is damaged; g. The temperature is too low, the diesel oil is not easy to atomize due to high viscosity, and even the fuel pipeline is blocked.	the clean fuel suitable for the current ambient temperature;
2. Insufficient cylinder pressure a. The valve leaks; b. Air leaks at the joint of cylinder head and cylinder gasket; c. The piston ring is worn and cemented, or the opening position is overlapped; d. The cylinder and piston wear beyond the specified limit; e. The electronic throttle is stuck.	a. If the valve spring decreases in elasticity, replace the valve spring; if the valve cone is not tightly sealed, grind the valve; b. Replace the cylinder gasket; c. Remove the cement, replace the piston ring, and adjust the opening position of the piston ring; d. Replace the cylinder liner and piston; (Note: 4D204\D30 has no cylinder liner e. Replace the electronic throttle.
3. Electrical system a. The battery power is insufficient or the battery capacity is too small;	a. Charge the battery or configure a qualified one;

b. Poor contact of electrical appliances and circuit systems (such as harness, relay, fuse, ECU and key switch); c. The electromagnetic switch of the starter is failures, and the starter brush has poor contact with the commutator; d. The failures lamp lights up; e. Failures of preheating device or short preheating time; f. Crankshaft speed signal and camshaft signal are too weak, and synchronous judgment takes a long time.	b. Check whether the harness, ECU, key switch, relay, fuse and other electronic control systems are connected normally; c. Repair the electromagnetic switch of the starter or replace the starter; d. Read the failures code and complete troubleshooting according to the failures code; e. Replace the preheating device (in-cylinder glow plug or air preheater); f. Check or replace the crankshaft/camshaft sensor.

7.2 Insufficient engine power, limited speed and torque

Failures symptoms and reasons	**Troubleshooting**
a. Some fuel injectors do not work or the fuel injectors are poor in atomization; b. The engine water temperature is too high with the failures lamp on;	a. Check or replace the fuel injector assembly; b. Check whether the antifreeze in the radiator is sufficient, whether the thermostat is stuck, whether the water inlet and outlet hoses get flat, whether the fan and water pump are normal, and check

c. Sensor failures; d. The signal panel is damaged or falls off; e. The air filter element is blocked; f. The postprocessor is blocked or the front pipe leaks; g. The turbocharger shaft is loose, the turbine is damaged or stuck, and the vent valve is damaged; h. The air intake system is blocked or leaking, and the exhaust is blocked; i. The EGR valve fails; j. The postprocessor DOC and DPF are blocked or have too much carbon deposit.	or replace the water temperature sensor; c. Read the failures code, complete troubleshooting according to the failures code or replace the sensor; d. Check whether the camshaft signal panel falls off and whether the camshaft sensor is damaged; e. Clean or replace the air filter; f.Locate where air leaks at the front and rear ends of the postprocessor , and clean up the carbon deposits in the postprocessor; g Check whether the turbocharger shaft has large clearance or gets stuck after wear.Focu on the pipe line from turbocharger to intercoole r; h. Check whether the air filter is too dirty, the air inlet pipe is not tightly clamped, the air inlet pipe falls off or the rubber pipe breaks, the intercooler leaks, and the exhaust is not smooth; i. Replace the EGR valve; j. Disconnect the DOC and DPF from the exhaust pipe, start the engine to check whether the smoke exhaust is normal, and remove the carbon deposits on DOC and DPF (first tap the housing with a

	small hammer and then clean it with compressed air).

7.3 Abnormal smoke exhaust

Failures symptoms and reasons	Troubleshooting
1. White smoke a. Water enters the cylinder; b. There is water in the fuel; c. The EGR cooler has a water leak.	a. Check and eliminate failures; b. Replace the fuel; c. Replace the EGR cooler.
2. Blue smoke a. Oil leaks or the piston ring gets reversed, stuck or excessively worn; b. The fuel injector is poor in atomization; c. The valve stem oil seal is damaged; d. Wear in the cylinder; e. The turbocharger shaft shakes to pump oil.	a. Adjust or replace the piston ring; b. Replace the fuel injector; c. Replace the valve oil seal; d. Replace the piston, piston ring, cylinder liner or engine block. Note: 4D20\4D30 has no cylinder liner. e. Replace the turbocharger.
3. Black smoke a. The diesel engine is overloaded;	a. Reduce the load;

b. The air filter is blocked; c. The postprocessor is blocked or pipelines leak; d. The valve cone is not tightly sealed; e. The EGR valve gets stuck; f. The electronic throttle gets stuck.	b. Clean or replace the air filter; c. Locate postprocessor air leakage and clean its carbon deposits; d. Grind or replace the valve; e. Clean the carbon deposit in the EGR valve or replace the ECR valve; f. Replace the electronic throttle.

7.4 Abnormal noise during diesel engine operation

Failures symptoms and reasons	**Troubleshooting**
1. Abnormal noise outside the engine a. Friction between engine fan and radiator wind scooper;b. The engine belt is loose or worn; c. The engine air intake and exhaust pipes leak.	a. Adjust the position of the radiator; b. Fasten or replace the engine belt; c. Locate the engine air intake and exhaust pipe leakage and complete troubleshooting.
2. Abnormal noise inside the engine a. The clearance between piston and cylinder is too large, the cylinder makes a crash sound after the diesel engine is started, and the sound will become weaker as the diesel engine heats up; b. The clearance between piston pin and pin hole is too large, and the	a. Replace the piston, piston ring, cylinder liner or engine body; (Note: 4D20\4D30 has no cylinder liner.

sound is light and sharp, especially at idle speed; c. The clearance between the main bearing and the connecting rod bearing is too large. When the speed of the diesel engine suddenly decreases, the crash sound of the parts can be heard. At low speed, the sound is heavy and powerful; d. The axial clearance of the crankshaft is too large, and the impact sound of the crankshaft moving forward and backward can be heard when idling; e. The valve spring is broken, the push rod is bent, the valve clearance is too large, and the noise or light rhythmic knocking sound is heard at the cylinder head cover; f. The piston crown touches the cylinder head or valve, and the metal impact sound can be heard near the cylinder head at low speed; g. Due to the excessive wear clearance of the gear, the impact sound can be heard at the gear chamber when the speed is suddenly reduced.	b. Replace the relevant parts to ensure the specified clearance; c. Replace the relevant parts to ensure the specified clearance; d. Replace the crankshaft thrust plate to ensure the specified clearance; e. Replace the relevant parts and adjust the valve clearance; f. Adjust the valve clearance, match the phase or replace the cylinder gasket; g. Replace the gear as appropriate.

7.5 Excessive oil consumption

Failures symptoms and reasons	**Troubleshooting**

a. Too much lubricating oil and too much oil splash; b. Oil leaks from drain bolts, oil filters, cylinder heads, oil pan gaskets, cylinder head cover gaskets, front and rear oil seals, oil filter gaskets, plugs and end caps; c. The piston ring has the oil return hole of its oil ring blocked by carbon deposit; d. Poor oil quality; e. The piston ring is worn and stuck; f. The clearance is too large between cylinder liner and piston; g. The valve stem has its oil seal worn.	a. Drain some oil; b. Tighten bolts and replace gaskets, plugs and end caps; c. Remove the carbon deposit in the oil return hole; d. Change the engine oil; e. Replace the piston ring; f. Replace the cylinder liner or piston; (Note: 4D20\4D30 has no cylinder liner.) g. Replace the valve stem oil seal.

7.6 Excessive fuel consumption

Failures symptoms and reasons	Troubleshooting
a. The air filter is blocked; b. The fuel pipeline leaks; c. The exhaust pipe is blocked. d. The minimum no-load stable speed is too high; e. Poor fuel quality; f. The fuel injector is poor in atomization; g. The fuel injection pump works abnormally; h. The cylinder compression pressure is insufficient.	a. Clean the air filter element or replace it; b. Tighten the fuel pipe connector and replace the fuel pipe; c. Remove the dirt from the exhaust pipe; d. Adjust the minimum no-load stable speed to the specified value; e. Select the specified fuel; f. Replace the fuel injector; g. Replace the fuel injection pump; h. See Item 2 of “Difficulty in Diesel Engine Startup”.

7.7 Lubrication system failures

Failures symptoms and reasons	Troubleshooting
1. Too low oil pressure a. Insufficient oil in the oil pan; b. The oil passage is blocked; c. The oil filter is blocked;	a. Fill oil to the dipstick mark; b. Clean the oil way and blow it out with compressed air; c. Clean or replace the filter element;

d. The diesel engine is overheated, the engine oil temperature is too high, and the engine oil becomes thin.	d. Reduce the load, change the engine oil and reduce the engine oil temperature.
2. Others a. Poor oil quality; b. The oil return valve on the oil filter is stuck and there is too much oil return; c. The oil pump has its filter screen blocked; d. The oil pump gear is worn or the end clearance is too large; e. The oil pipe is cracked or the connector gets loose; f. The oil pump fails; g. The connecting rod bearing and main bearing are worn; h. The oil pressure gauge is damaged; i. The oil pressure sensor has failed.	a. Use qualified oil instead; b. Repair or replace the oil filter; c. Clean the filter screen of the oil pump; d. Adjust or replace the oil pump gear; e. Tighten the connector; f. Repair or replace the oil pump; g. Replace the connecting rod bearing and main bearing; h. Replace the oil pressure gauge; i. Replace the oil pressure sensor and check whether the harness of the oil pressure sensor is connected normally.

7.8 Cooling system failures

Failures symptoms and reasons	**Troubleshooting**

1. Excessively high water temperature a. The cooling water in the radiator is insufficient or polluted; b. The surface of the radiator is blocked by sundries or the temperature of the engine room is too high; c. The cooling system is blocked or there is air; d. The water pump belt gets loose; e. The water pump assembly fails; f. Thermostat failures; g. The lubricating oil is poor in quality; h. The water temperature gauge fails; i. The diesel engine is overloaded; j. Check whether the intake and outlet hoses are flat; k. The fan is damaged or the fan size and wind direction do not match; l. The water temperature sensor fails; m. Virtual connection between water temperature sensor and harness;	a. Fill or replace the cooling water in the radiator; b. Clean the sundries on the radiator surface and reduce the temperature in the engine room; c. Remove scale and dirt, make the pipeline smooth and remove the internal air; d. Adjust the water pump belt tension; e. Repair or replace the water pump; f. Repair or replace the thermostat; g. Replace the lubricating oil; h. Replace the water temperature gauge; i. Reduce the load; j. Use the intake and outlet rubber hoses with keels instead; k. Replace the fan that meets the service environment; l. Replace the water temperature sensor; m. Check whether the water temperature sensor and harness are connected normally; n. Use a new radiator with a large heat radiating area;

n. The radiator is too small; o. The radiator has no wind scooper or the fan is too far away from the wind scooper.	o. Add a wind scooper and reasonably install the scooper and fan in place.
2. Excessively low water temperature a. Thermostat failures; b. An improper thermostat is selected; c. The ambient temperature is too low.	a. Replace the thermostat; b. Select according to regulations; c. Set up a wind shelter.

7.9 Starter failures

Failures symptoms and reasons	**Troubleshooting**
1. The starter does not rotate a. The starting key switch is damaged or has poor contact; b. Poor contact of connecting wire; c. The starting relay and fuse are burnt out; d. The battery is under charged; e. Poor contact of electric brush; f. Starter failures.	a. Repair or replace the starting key switch; b. Clean and tighten the contacts; c. Replace the starting relay and fuse; d. Fully charge the storage battery; e. Clean the commutator surface; f. Repair or replace the starter.

2. The starter is idling and unable to start a. Poor contact of electric brush; b. The commutator is dirty or singed; c. Wire terminal desoldering; d. Poor contact; e. The battery is under charged or the capacity is too small.	 a. Clean the commutator surface; b. Clean the oil stain and polish it with fine emery cloth; c. Firmly weld the desoldering wire terminals; d. Clean and tighten the contact points; e. Fully charge the battery or replace it with a larger one.

7.10 Charging generator failures

Failures symptoms and reasons	Troubleshooting
1. No charging, insufficient charging, unstable charging current a. Virtual connection between generator harness and terminal; b. The engine harness fuse is burnt out; c. Open the rear cover of the generator and measure the diodes or integrated circuit regulators one by one with a multimeter; d. Check the vacuum pump body and pump seat for cracks,	 a. Check whether the generator harness and terminal are normal; b. Replace the fuse; c. Replace the damaged parts in time; d. Replace the damaged parts in time; e. Replace the damaged parts in time.

check the pump core fits the generator main shaft spline, and check whether the internal working surface is seriously worn and scratched; e. The blade of the vacuum pump is seriously worn in width.	

7.11 Engine postprocessor failures

Failures symptoms and reasons	Troubleshooting
1. The postprocessor is seriously blocked a. The differential pressure sensor hose is blocked or the hose leaks; b. Poor contact between differential pressure sensor and harness; c. Inferior fuel is used; d. The turbocharger shaft shakes and pumps oil; e. Poor atomization of fuel injector; f. The cylinder and piston are seriously worn; g. The air filter is blocked or too dirty;	a. Clean the sundries in the differential pressure sensor hose or replace the hose; b. Check whether the differential pressure sensor and harness are connected normally; c. Use clean fuel suitable for the current ambient temperature; d. Replace the turbocharger; e. Replace the fuel injector; f. Replace the piston, piston ring, cylinder liner or engine

h. The postprocessor is blocked or the front pipe leaks; i. The postprocessor has its front and rear exhaust temperature sensors invalid; J. The postprocessor is installed too far from the engine exhaust manifold.	body (note: 4D20\4D30 has no cylinder liner.) g. Clean or replace the air filter; h. Locate the air leakage at the front and rear ends of the postprocessor, and clean up the carbon deposits in the postprocessor; i. Replace the front and rear exhaust temperature sensors of the postprocessor; j. Install the postprocessor as close to the engine exhaust manifold as possible.

7.12 Engine Maintenance Cycle

PERIODIC MAINTENANCE	
Check fuel tube and clip	50 h
※ Change oil	250 h
Clean core of air filter	100 h
Check position of battery electrolyte	100 h
Check fan belt tension and damage	100 h
Check radiator hose and hose clamp	100 h
※ Change oil filter	250 h
Check the intake	250 h
Change fuel filter	250 h
Clean inner of fuel tank	400 h
Clean inside the water jacket and the radiator	500 h
Replace fan belt	1500 h
Recharge battery	1 or 2 months

EXTRAORDINARY MAINTENANCE	
Action	**Frequency**
Change core of air filter	1 year
Inspect post-processing before re-production	200 h
Maintenance aftertreatment	2000h
Clean injector	1500 h
Check injector	3000 h
Replace intake tube system	2 years
Replace the battery	2 years
Replace radiator hose and hose clamp	2 years
Replace fuel hose and clamp	2 years
Replace radiator coolant	2 years

Risk of damage

The procedures and methods for carrying out these operations are described in the FPT Technical and Repair Manual.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.