225-500KW

FDKGEN DIESEL GENSET

FE Series Diesel Engine

User Manual

Guangdong Fudiankang Diesel Gensets Co., LTD

Preface

This series of diesel engines is FE series diesel engines independently developed and manufactured by Guangdong Fudikang Diesel Generator Co., LTD.

This series of diesel engines have the characteristics of compact structure, reliable use, with excellent power, fuel economy and emission performance indicators, quick start, simple operation and convenient maintenance, especially the advanced emission indicators can reach the international advanced emission standards, which is the ideal power for industrial power.

This manual provides essential guidelines for diesel engine operation, maintenance, and user service. To ensure optimal performance and maximize the engine's efficiency, we recommend thoroughly understanding its structure and mastering proper maintenance and usage techniques. By diligently following the specified maintenance procedures, you can significantly extend the engine's service life.

With the continuous increase of diesel engine variants in this series, we hope you can pay attention to the various technical information released by our company.

Notes

Dear users:

Welcome to the Fudiankang FE Series! We sincerely appreciate your trust in our products.

To ensure optimal performance and longevity of your diesel engine, please carefully read and strictly adhere to the Operation & Maintenance Manual provided.

(1) This diesel engine has undergone strict factory testing according to test specifications. The throttle is sealed with a lead limit - do not remove the seal or increase fuel injection arbitrarily. The main bearing bolts, connecting rod bolts and cylinder head bolts have strict torque and angle requirements. Users must not loosen or disassemble them without authorization. Any resulting engine damage will not be covered under warranty.

(2) The turbocharger rotor shaft is a precision high-speed rotating component. Disassembly or impact is strictly prohibited. The exhaust pipe must be properly supported during installation - its weight must not be imposed on the turbocharger.

(3) Never operate the diesel engine without an air filter to prevent unfiltered air from entering the cylinders and causing abnormal wear.

(4) Operators must carefully read this operation and maintenance manual, familiarize themselves with the engine structure, and strictly follow the specified technical operations and maintenance procedures.

(5) For new engines, a 50-hour break-in operation is required. The maximum load should not exceed 80%, and the average load should not exceed 60%.

(6) Before each startup, always check that the coolant is full and engine oil is sufficient.

(7) Before each startup, manually operate the oil pump to pre-lubricate the oil passages and lubrication points. This operation extends engine life and ensures smoother startup.

(8) For cold starts, warm up the engine by idling for 5-10 minutes before accelerating and loading. Never operate at high speed with heavy load when coolant temperature is below 60°C. Before shutdown, cool down the engine by idling without load for 5-10 minutes - do not stop suddenly.

(9) Avoid prolonged idling operation - generally do not exceed 10 minutes of idling.

(10) Maintenance of electrical system components must be performed by personnel with electrical expertise.

(11) The engine's preservation period is one year. For engines exceeding one year, inspection and necessary supplementary preservation measures should be taken.

Diesel Engine Run-in Specifications

The run-in period for the diesel engine shall be no less than 50 hours, following the load and duration specifications below:

Diesel genset load idling	Running time	
25%	10 minutes	Check the oil pressure, diesel engine if abnormal sound, etc
50%	2 hours	
75%	30 hours	
100%	15 hours	

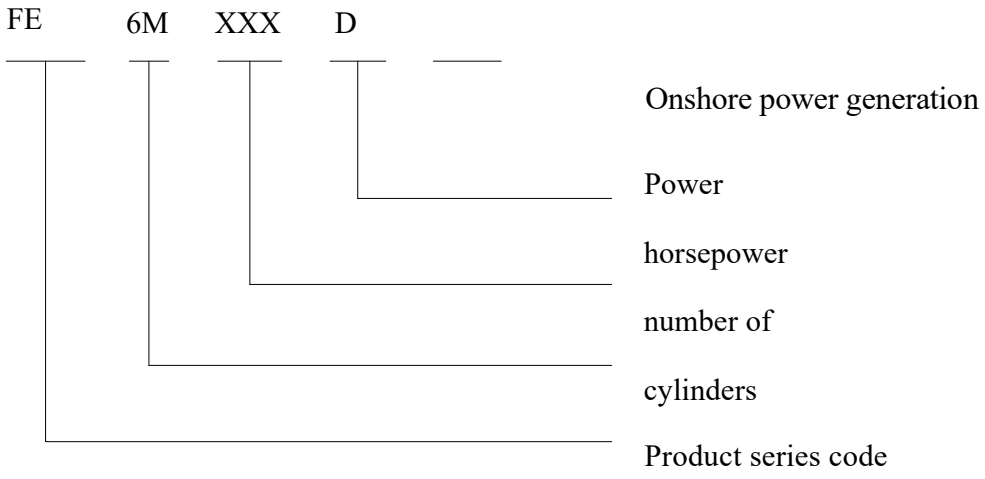
During the diesel engine's running-in period, the throttle should be kept fully open. The load value can be estimated based on the load it is equipped with, but it is necessary to follow the principle of gradually increasing the load from a low level.

Due to the different supporting machinery of the diesel genset, such as tractors, automobiles, construction machinery, generator sets, harvesting machinery, etc., the running-in process should be carried out according to the requirements of the supporting machinery; for diesel engines used with agricultural and sideline machinery, such as new diesel engines equipped with power output devices like water pumps, threshers, and crushers, which have undergone preliminary running-in before leaving the factory, users can appropriately shorten the running-in time of the diesel engine.

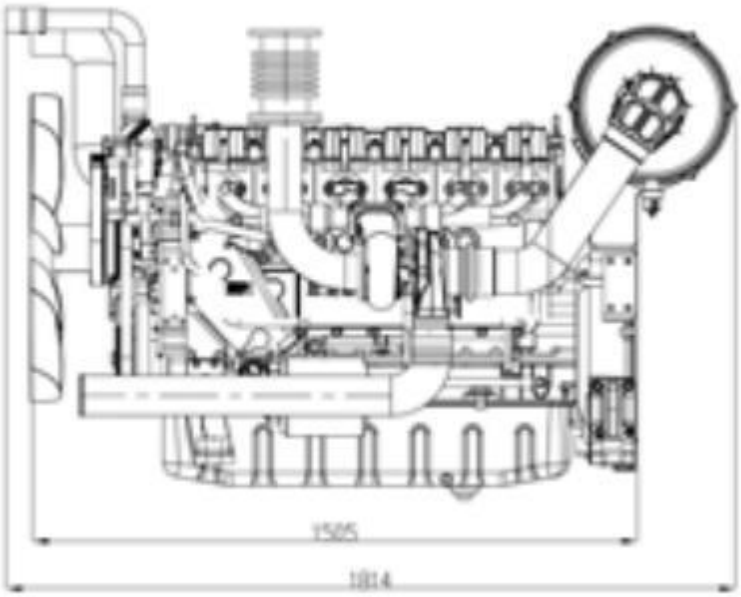
Catalogue

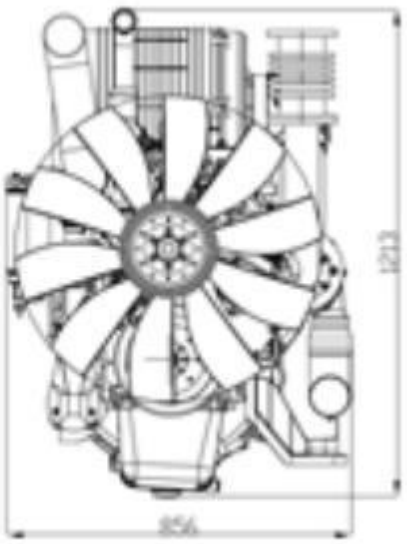
1. Structure and performance parameters of diesel engine

1.1 FE series diesel engine model meaning



1.2 F E series diesel engine shape diagram





1.3 Main uses of FE series diesel engines

Widely used in land power generation, high pressure water pump, low pressure water pump, fire pump and other industries.

1.4 Main technical parameters and performance parameters

Table 1-1 Main technical parameters table

order number	project		technical parameter
1	type		Water cooling, 4 stroke, direct injection, supercharged intercooling
2	Air intake mode		pressurize
3	Cylinder diameter/stroke (mm)		126×130 126×135 126×155 127×165
4	number of cylinders		6
5	displacement (L)		9.73 10.09 11.7
6	reduction ratio		17:1
7	Order of ignition		1-5-3-6-2-4
8	fuel system		mechanical pump
9	Starting mode		Electric start
10	lubricating system		forced lubricgtion
11	cooling-down method		Water cooling forced circulation
12	Oil pressure (kPa)	rated point	350 ~ 580
		Idle speed	130 ~ 280

2. Installation and use of diesel engines

2.1 Unsealing of diesel engine

After opening the diesel engine packing case, the user first counts the diesel engine and its accessories according to the factory packing list, checks whether there is any damage to the surface of the diesel engine, whether the connecting parts are loose, and then carries out the following work:

◆ Remove the rust-proof layer and anticorrosive agent of exposed parts;

◆ Drain the oil seal oil from the fuel filter and fuel system components (the oil seal oil in the fuel system may be drained before starting the engine, but this is only permitted after the fuel system's oil seal oil has been completely depleted and normal diesel fuel supply is restored, allowing the engine to operate under load). However, users should note that the oil seal service interval for diesel engines is one year. Any seals exceeding this period require inspection and necessary replenishment measures.

◆ Turn the flywheel and spray the solvent into the intake pipe until all the oil seal oil in the cylinder is exhausted.

◆ Spray solvent into the intake and exhaust holes of the turbocharger until the oil seal oil is exhausted.

◆ According to the agreement between the manufacturer and the user, the oil in the bottom of the tank should be lubricated according to the regulations if no oil is added.

Note: Do not start the diesel engine until it has been properly installed and connected to the final position. When the diesel engine is running in a closed environment, keep ventilation to ensure that exhaust fumes are discharged into the atmosphere.

2.2 Lifting of diesel engines

During lifting, the centerline of the engine's crankshaft should be kept horizontal. It is strictly prohibited to tilt or lift on one side (see Figure 2-1). Lifting and landing should be slow.

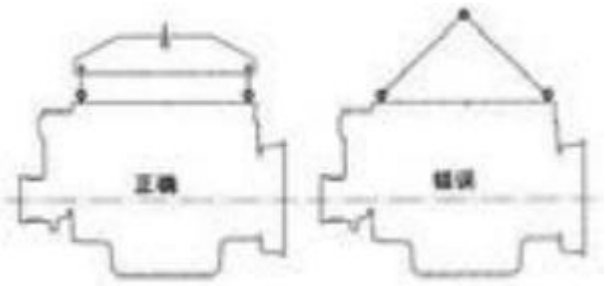


Figure 2-1 Diesel engine lifting diagram

2.3 Preparations before starting the diesel engine

◆ Check the coolant level

a) Close the pressure cover.

b) Run the engine for about 15 minutes at rated speed.

c) Check the coolant level gauge. If you need to add coolant, turn off the engine and carefully turn the pressure cap with the safety valve to the first dead center to release the pressure. Let the engine cool down, then fill up the coolant.

d) Check the coolant before the next debugging (under the condition of engine cooling), and add coolant if necessary.

e) Repeat this process until the coolant does not need to be added.

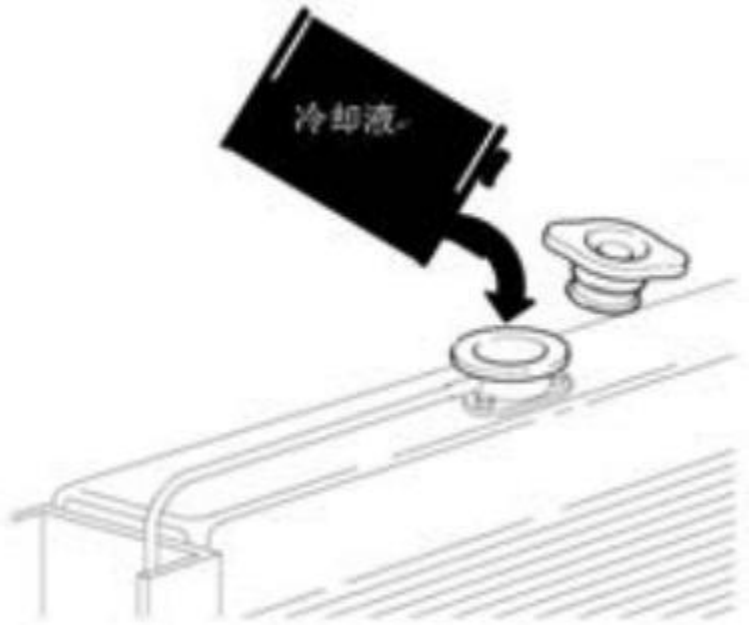


Figure 2-2 Refilling coolant

◆ Check the fuel level

If the engine is already installed on the machine, turn on the power switch and check the fuel level or check the fuel tank from the fuel gauge.

◆ Check the engine oil level

The oil level should be between the upper and lower scale lines of the oil gauge. Add oil from the oil filling port in time if necessary.

◆ Check whether the connection of various accessories of the diesel engine is reliable and eliminate abnormal phenomena.

◆ Check whether the starting system circuit wiring is normal and whether the battery is fully charged. Then open the fuel tank valve, loosen the air release screw on the fuel coarse filter, and use the hand press oil pump on the fuel coarse filter to drain all the air in the fuel system.

2.4 Starting of diesel engine

◆ Start the diesel engine when the whole machine has the starting conditions.

◆ When the diesel engine fails to start within 5-10 seconds after meeting startup conditions, wait 30 seconds before repeating the process. If three consecutive attempts fail, stop the operation and troubleshoot until resolved. After starting the diesel or oil engine, monitor all instrument readings closely. The oil pressure gauge should immediately display the pressure reading. For cold engines, avoid high-speed operation initially. Instead, run the engine at idle for a short period, but ensure the idle duration is not excessive.

◆ To start the diesel engine under low temperature, the auxiliary starting device should be used to make the electronic heating flange work through the relay, so as to realize the smooth start in-30℃ environment.

2.5 Operation of diesel engine

◆ After starting the diesel engine, run idle for 3min first, then add partial load. Only when the outlet water temperature is higher than 60℃, the machine will start

When the oil temperature is higher than 50℃ and the oil pressure is higher than 120kPa, it is allowed to enter full load operation. The increase of load and speed should be gradual, and sudden loading and unloading should be avoided as far as possible.

◆ Diesel engines should only work under medium load within 50h running-in period.

◆ The machine should not run for a long time under the condition of low speed and low load, otherwise it is easy to occur oil leakage and other phenomena.

◆ The diesel engine is allowed to run continuously at the rated power and speed during normal use. After unloading, the diesel engine should run idle (1-2) minutes before stopping.

◆ Parameters and inspection areas that should be paid attention to at any time during use:

Lubricating oil main oil passage pressure 380 kPa ~580 kPa.

The oil temperature of the main oil passage is 85℃~105℃.

The outlet temperature of the cooling liquid shall not exceed 98 C.

Turbo exhaust temperature ≤550℃

The temperature of the intake air after medium cooling is 50℃~55℃.

Check the exhaust color to identify the working quality and load of the injector. If there is heavy black or white smoke, stop the engine for inspection.

Pay attention to check whether there is leakage of water, air or oil in the diesel engine. If found, stop the engine to eliminate it.

◆ Precautions for operation in cold environment;

① Fuel oil: select different grades of diesel oil according to the outdoor temperature in winter.

② Lubricating oil: choose lubricating oil with different viscosity according to season.

③ Coolant: Add antifreeze additives to the cooling system. Select different grades and quantities according to outdoor temperature.

④ Start: When necessary in winter, auxiliary starter can be used. After the diesel engine starts, oil pressure and water temperature should be normal before adding

The load is running at high speed.

⑤ Before the beginning of the cold season, check the electrolyte level, viscosity and unit voltage. If the diesel engine is not used for a long time and at a very low temperature, remove the battery and store it in a warmer room.

⑥ Parking: When parking in cold weather, first unload the load and let the engine idle for 1 to 2 minutes until both water and oil temperatures drop. Never drain the coolant containing antifreeze additives after parking. If the coolant lacks antifreeze, open the drain valves on the engine block, oil cooler cap, radiator, and water inlet pipe to completely drain the coolant and prevent engine freezing.

2.6 Definition and operating conditions of power of F E series diesel engines

2.6.1 Power definition

Continuous power COP: The maximum power of a diesel engine running continuously at constant load for unlimited annual operating time. ISO standard power.

Common Power PRP: The maximum power of a diesel engine that can be continuously operated under variable loads without limiting the annual running time. It can exceed the standard ISO power by 10%.

Backup power ESP: The maximum power in a variable power series that a diesel engine can run for up to 200 hours per year. ISO standard power with oil quantity limit.

2.6.2 Operating conditions and uses of power

The operating conditions and uses of different power of diesel engines are shown in Table 2-1.

Power classification	operation requirement	use
continuous power COP	1. No limit on annual operation time; 2. Run under constant 100% load; 3. No overload capacity.	It can operate under high temperature and high original conditions.
Common power PRP	1. No limit on annual operation time; 2. The average load rate shall not exceed 70% in each 250h continuous period; 3. Run at 100% load for no more than 500h per year; 4. Within every 12h, it can run for 1 hour with 10% overload, and the cumulative overload operation per year does not exceed 25h.	Used for power output A relationship that has been agreed upon In this case, public use is allowed The reduction of electricity.

		Generator sets can be combined The Internet is connected to the utility grid.
non-firm power ESP	1. The annual operating time shall not exceed 200h, including the annual operation under 100% load shall not exceed 25h; 2. The average load rate should not exceed 80% in each 24-hour operation cycle; 3. No overload capacity. 4. Diesel engines lack a warm-up process during startup, requiring acceleration to the rated speed within 10 seconds. For naturally aspirated diesel engines: When ambient temperature is below 5°C°C, preheating facilities must be added to ensure outlet water temperature exceeds 30°C°C; no preheating facilities are required when ambient temperature is above 5°C°C. For turbocharged diesel engines: When ambient temperature is below 10°C°C, additional preheating facilities are necessary to maintain outlet water temperature above 30°C°C; no preheating facilities are required when ambient temperature exceeds 10°C°C.	During power outage Provide emergency power supply.

3. Maintenance of diesel engine

3.1 Fuel oil, lubricating oil, coolant and auxiliary materials used in the diesel engine

3.1.1 Fuel oil

At atmospheric temperatures above 5℃, No.0 diesel (GB252) is used; at-5℃ and above, No.10 light diesel (GB252) is generally used. When atmospheric temperature is below-15℃, No.20 diesel should be selected; when outdoor temperature is below-30℃, No.35 diesel should be selected.

Note: The fuel used must comply with the requirements of Appendix D, Table D.1 in Appendix D of GB 20891-2014.

3.1.2 Lubricating oil

FE series diesel engines use CF-4 grade oil, the specific standards are shown in Table 3-1.

Table 3-1 Specifications for selection of special oil

breed	type of production		packing specifications	Main models applicable
crude oil engine oil	CF-4	10W/30 15W-40 20W-50	4L，18L，170kg	FE series

The viscosity reference table 3-2 is selected according to the temperature of the special oil.

Table 3-2 Correspondence between viscosity and ambient temperature

SAE viscosity class	Applicable ambient temperature (℃)
10W-30	-25-30
15W-40	-20-40
20W-50	-15-45

pay attention to：

1) Before starting the diesel engine, it is necessary to check the height of the oil level in the oil pan first.

2) Do not check the oil level when the diesel engine is running.

3) Special engine oil is not allowed to be mixed with other manufacturers' oil.

Table 3-3 Oil filling amount and filter element quantity

type	Oil filling quantity	Number of filters		
	(L)	crude oil engine		
		Sneak shots	Chai Fu	
			colating	refined filtration
FE series	22~26	2	1	2

remarks：

1) The oil filling amount data is for reference only, and the actual filling amount shall be based on the oil gauge.

2) If the water cold treasure or water removal filter is configured on the vehicle, the water cold treasure or water removal filter element should be replaced together with the diesel filter.

3) The number of filters is for reference and subject to the actual model

3.1.3 Coolant

The diesel engine cooling system must be filled with all pure coolant, which has the properties of anti-freezing and anti-boiling to avoid coolant

Freezing in cold weather or "boiling" in high temperatures applies to vehicles operating at a variety of temperatures and coolant containing anti

Rust and corrosion additives have a special protective effect on the water tank and engine cooling chamber to prevent cylinder liner cavitation and cooling system

rustiness。

The freezing point of the special coolant is-25℃, -35℃, -40℃ and other specifications. Please choose different freezing points according to the local ambient temperature

The selection principle of special coolant is that the freezing point is about 10 degrees lower than the local temperature.

Table 3-4 Special heavy duty engine coolant

breed	type of production	packing specifications
Coolant for heavy duty engines	HEC-II-25 HEC-II-35 HEC-II-40	4kg， 10kg

pay attention to：

1) The coolant must be checked regularly. In order to prevent corrosion damage, it should be replaced in time according to the situation.

2) Do not use water and inferior coolant as engine coolant.

3.1.4 Auxiliary materials

Table 3-5 Auxiliary materials and uses

order number	name	pigment	Usage and application
1	MolykottePulver (fine molybdenum powder)	black	Apply to a smooth metal surface to prevent biting. For example, apply to the outer surface of a cylinder liner
2	MolykotteG.u.plus (Molybdenum disulfide oil)	dark grey	Provide lubrication before the lubricating oil pressure is established, for example: applied to the intake valve stem, etc

Table 3-6 Reference table of diesel engine glue application

the name of a shop	main application	List of application sites	supplementary specification
Special 242	Apply to the surface of the thread to hold it and prevent loosening. Medium force	Flywheel shell bolts 凸轮shaft thrust washer bolt 凸轮shaft timing gear bolt Intermediate idler bolt front end cover bolt Oil filter housing bolts, oil cooler bolts The plug of the oil cooler control valve, Bolts of the oil pump return pipe fixing device, and threads at the end of the air compressor shaft Filter bolts Sensors and wiring harness bolts	As an option Yes, it can put to use DriLoc20 4 Thread pre Coating proceeded precoat。
Special 262	Applied to the outer surface of the thread for locking, sealing and preventing loosening	Cylinder head auxiliary bolt	
Special 271	Do not loosen fasteners	A bowl-shaped plug that blocks the oil hole	
Special 277	Used for sealing between core and hole	The remaining bowl-shaped plugs	
Special 270	Used on the top surface of a sealing cylinder head	Piston tube-cylinder head	

special use	Seal the coating on a bright metal surface	Combination surface between cylinder body and crankcase The front of the body is connected to the front cover, and the rear end face is connected to the flywheel shell connection plate Oil filter housing and crankcase joint surface. Pump rear cover-front face of the engine block Flywheel shell connection plate-flywheel shell The cylinder body is combined with the oil cooler cover The cylinder body is combined with the oil filler cap	

3.2 Daily maintenance and maintenance

Check the coolant level, oil level and fuel level; whether the grease is sufficient in the place where the grease needs to be added;

Check whether there is leakage of oil, water and gas;

Whether the connection and fastening of external parts and accessories are good;

Whether the belt is too tight or too loose;

Diesel engine oil pressure;

Check the line connection and whether the connector is damaged;

Water temperature of diesel engine;

Whether the exhaust temperature, color, sound and vibration of the diesel engine are normal, and whether the speed is stable;

Check the coolant level and water temperature.

Observing the coolant level through the glass viewing hole, if the coolant is insufficient, open the filler port cover to add coolant. As shown in Figure 3-1.

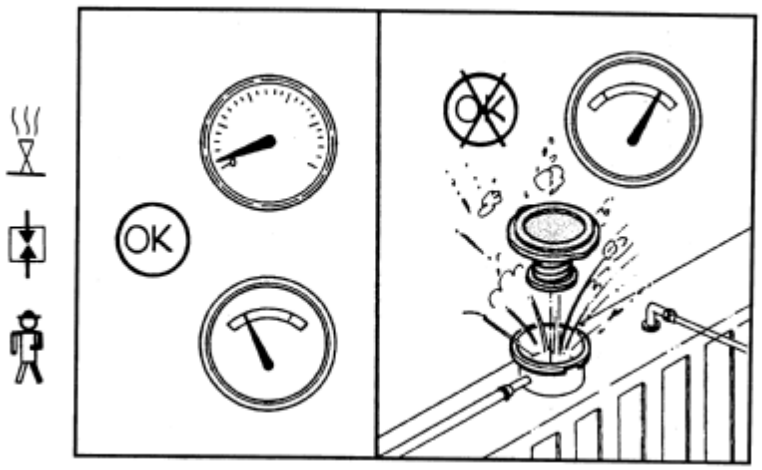


Figure 3-1 Exhaust button

Note: When opening the filler cap, you must press the exhaust button first to avoid injury from hot coolant in hot engine condition.

Check the oil level.

The diesel engine shall not be started when the oil level is below the lower mark or above the upper mark of the oil gauge.

Check the oil level after the diesel engine is stopped. Wait at least 5min to allow sufficient time for the oil to flow back to the oil pan.

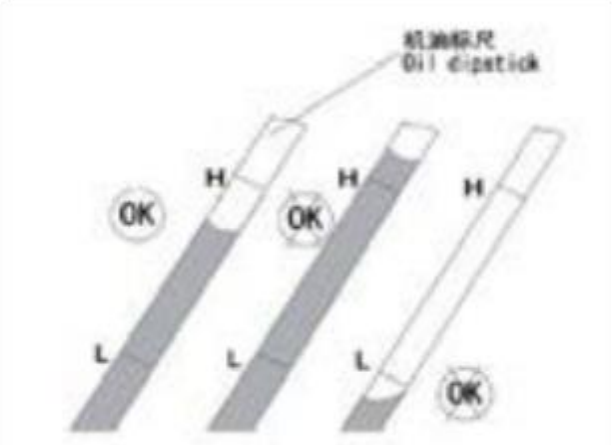


Figure 3-2 Check the oil level

Check the fuel level.

Check the fuel level indicator on the dashboard and add fuel in time.

Check three leaks.

The whole machine should have no leakage of water, air or oil.

Check the fan

Visual inspection of fan blades for damage and whether the connecting bolts are tightened. As shown in Figure 3-3.

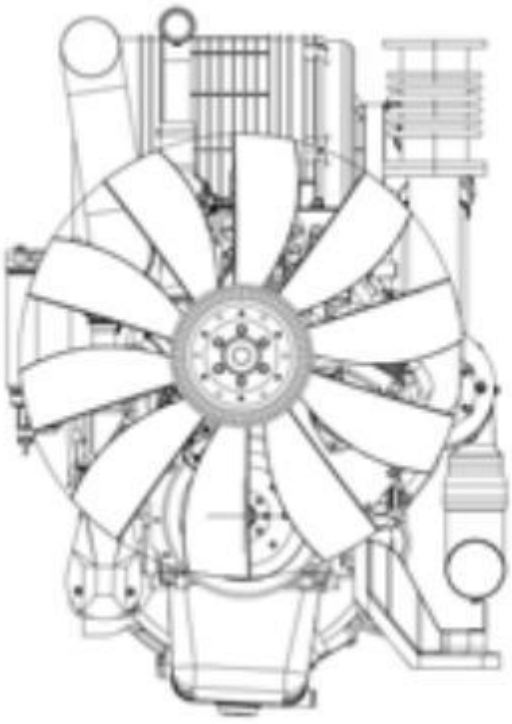


Figure 3-3 Schematic diagram of fan

Check the belt

The belt is tightened by the belt tension wheel, and the user checks the tightness of the belt by hand pressure. As shown in Figure 3-4.

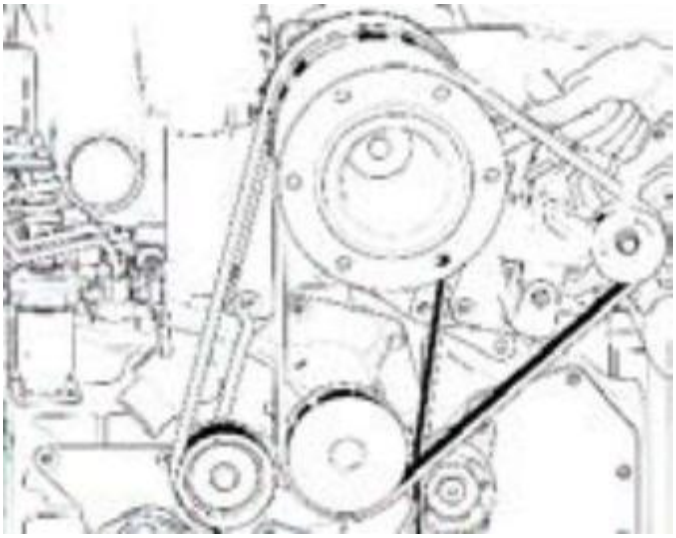


Figure 3-4 Check the belt

Check whether the exhaust color is normal. See Figure 3-5

Figure 3-5 Exhaust color

The normal exhaust color is light gray. If the color changes, check the cause and eliminate it.

Check whether the sound is normal.

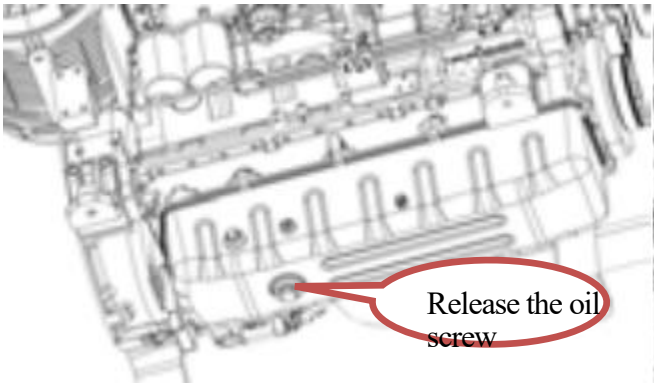
Check whether the speed and vibration are normal.

3.3 Regular maintenance of diesel engine

Change the diesel oil.

Turn off the drain plug at the bottom of the oil pan, drain the oil completely, and then screw on the drain plug;

Open the fuel filler cap, add oil from the oil filling port, observe the scale of the oil gauge until it reaches the required value, and then install the fuel filler cap. As shown in Figure 3-6 and 3-7.



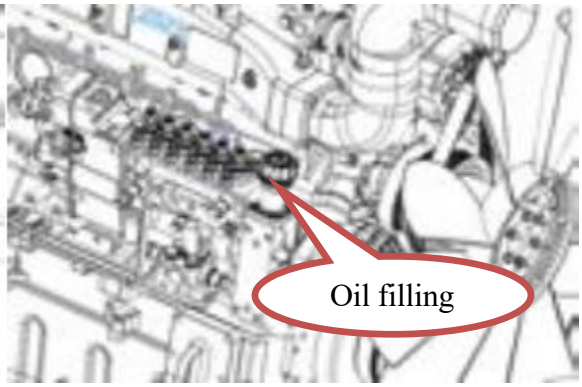


Figure 3-6 Oil drain plug figure Figure 3-7 Oil filling port Figure 3-6 Oil drain plug Figure 3-7 Oil filling port

Note: Waste oil should be placed in the designated place and container for recycling.

Change the oil filter or filter element. See Figure 3-8

Follow these steps when changing the oil filter:

① Remove the old oil filter;

② Fill the new filter with clean oil;

③ Apply oil on the rubber pad before installing the new oil filter;

④ After the rubber pad is in contact with the base, tighten 3/4 ~ 1 turn to make it sealed;

⑤ Start the diesel engine and check for oil leakage.

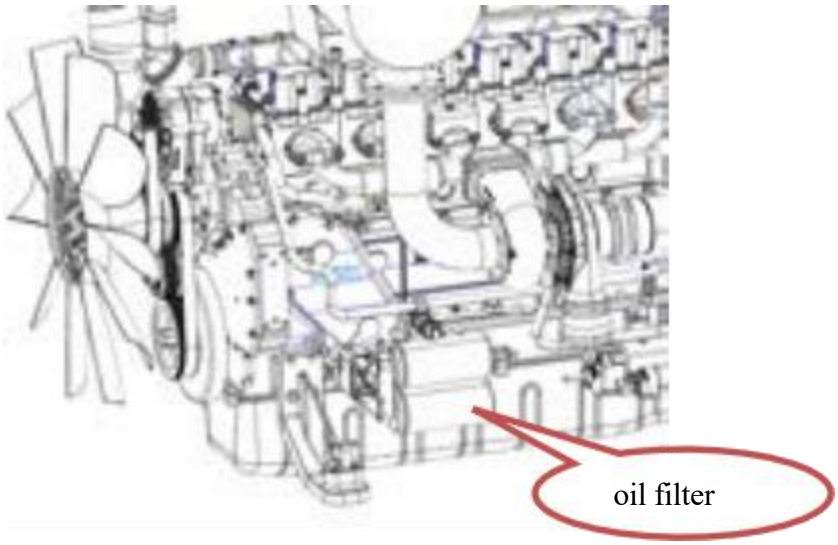


Figure 3-8 Oil filter

When changing the fuel filter element, follow the following steps:

① Remove the old fuel filter element; if the water collection vessel is installed on the coarse filter, it can be used again. Remove the water collection vessel.

② Lubricated sealing.

③ Turn on the filter by hand until the closure is combined with the interface.

④ Continue to turn the filter by hand until the filter is firmly installed (about 3/4 turns).

⑤ Drain until no bubbles appear.

⑥ Conduct leakage test.

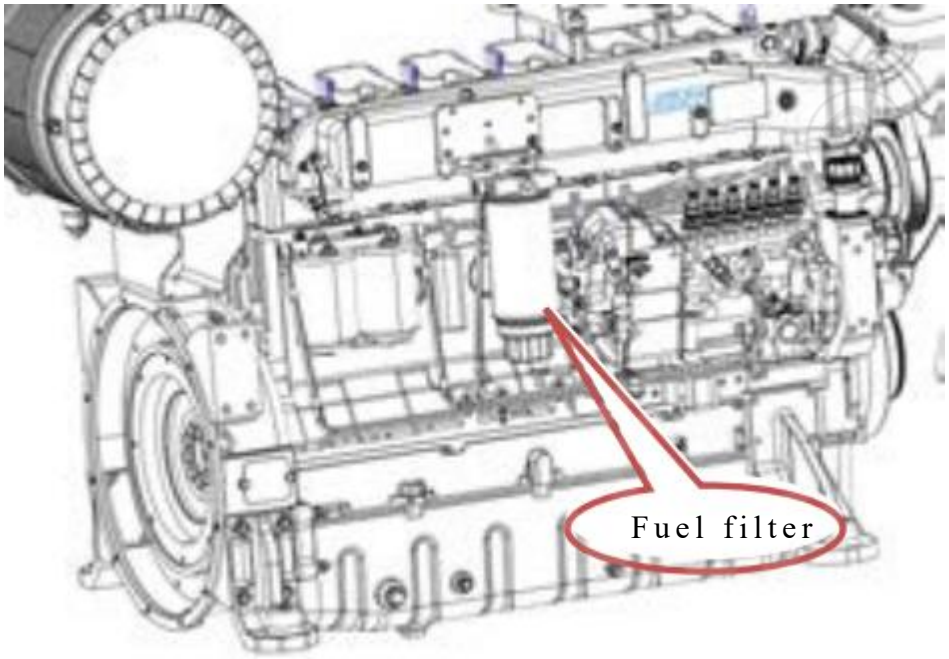


Figure 3-9 Fuel filter

pay attention to：

When the spinning coarse filter is replaced or the oil pipe is reinstalled, the coarse filter needs to be vented. Step

① Stop the engine.

② Remove the vent screw.

③ Use a hand pump to inflate until only oil is coming out of the vent screw.

④ Re-tighten the venting screw.

Note: When the collector is full or the rotary filter has been replaced, the collected water needs to be released in time.

Steps (as shown in Figure 3-10):

① Open the drain plug at the bottom of the collector 12 Drain the water.

② Tighten the drain plug again.

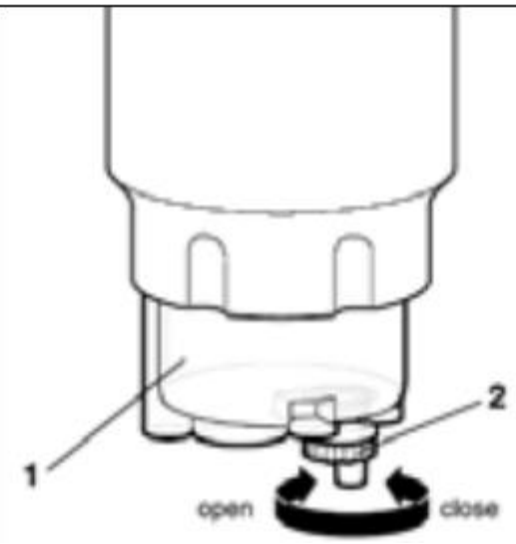


Figure 3-10 Drainage of the collector

Replacement of the collector (as shown in Figure 3-11):

① Turn off the engine.

② Drain water from the collector.

③ If possible, remove the screw 1 of the collector by hand. If it is too tight, use the installation tool in the new collector.

④ Use a few drops of oil to lubricate the seal of the new collector 2.

⑤ Mount the screw by hand and tighten it with a tool.

⑥ If the collection vessel is used on a new rotary filter, check for damage.

⑦ Use torque wrench to install, torque 20N·m.

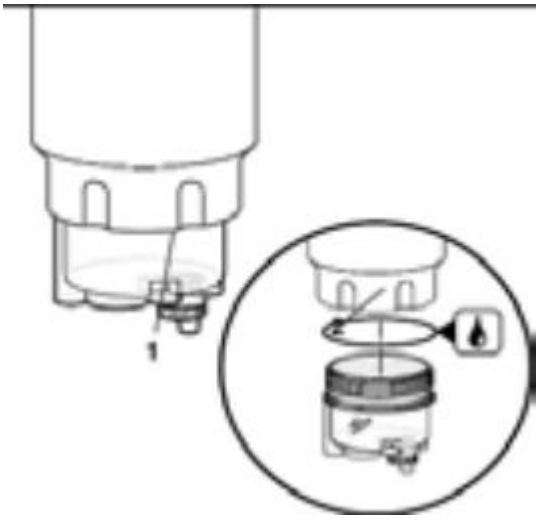


Figure 3-11 Replace the collector

Check the intake system, Figure 3-12

Check whether the intake hose is aging and cracked, and whether the ring clamp is loose. Tighten or replace parts if necessary to ensure the sealing of the intake system.

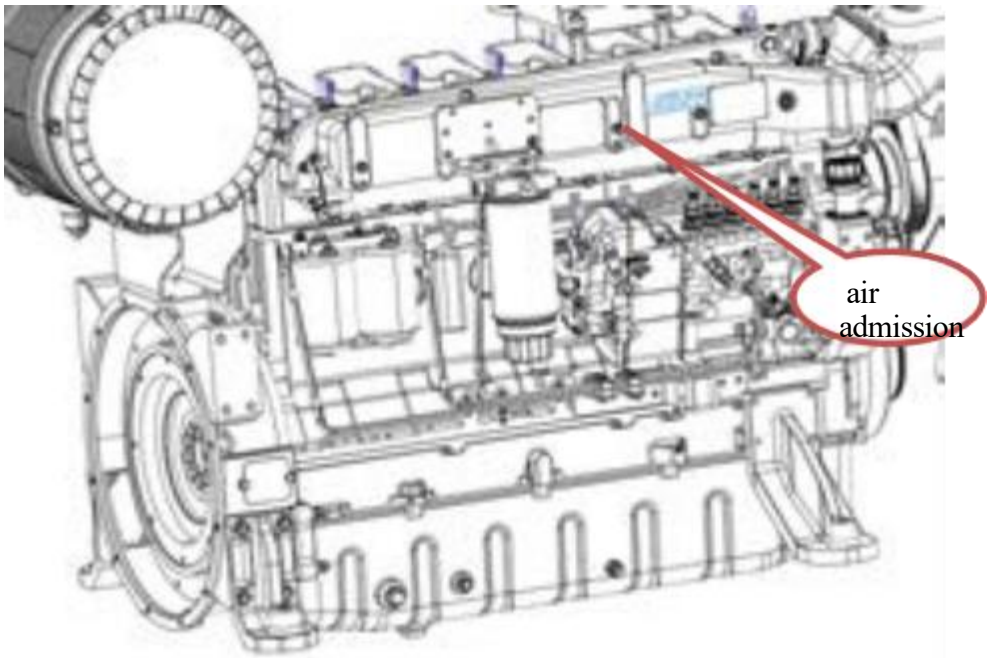


Figure 3-12, intake system

Check the air filter element

Type I radial sealed air filter

When the intake resistance indicator alarms (red), stop the engine and maintain the outer filter element of the air filter (note: the safety filter element is prohibited from being disassembled and cleaned). Pay attention to the maintenance:

1) Check whether there is dust on the inner surface of the outer filter element and the outer surface of the safety filter element. If there is dust, it indicates that the outer filter element is damaged or not installed properly, which should be paid great attention;

2) Blow clean air less than 0.5MPa from inside to outside the outer filter element to blow away the dust, and do not use oil or water to clean the filter element.

pay attention to：

Safety filter is not allowed to be disassembled and cleaned

It is forbidden to blow the outer filter element from outside to inside. If there is a lot of dust on the outer surface of the filter element, it can be knocked off by hand; the inner filter element (safety filter element) should not be disassembled or cleaned, and it should be replaced together with the outer filter element;

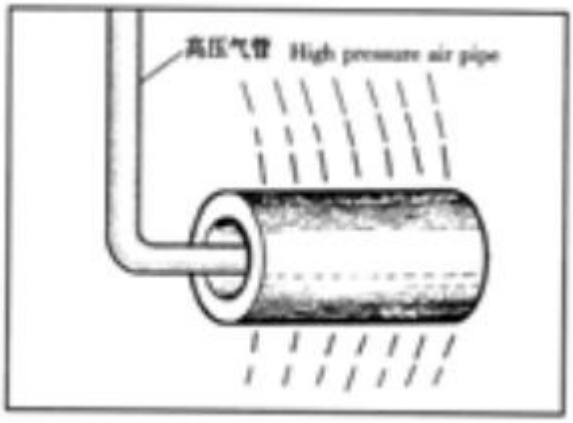


Figure 3-13, cleaning the filter element

Type 293 Dust filter

1) All the buckles connecting the rear cover and the housing are loosened, then take off the rear cover, and clean all the dust off the rear cover.

Note: When parking for inspection, the dust can be discharged in time through the dust discharge valve. The dust discharge valve should be replaced in time if it is damaged or lost.

2) Rotate the yellow sealing cover counterclockwise and remove it. At this time, the outer filter element can be seen.

3) Grab the rear cover of the outer filter element by hand and hang it on the nose, and pull out the outer filter element from the cavity of the air filter housing.

4) Maintain the outer filter element according to the air filter maintenance instructions.

5) Before installing the outer filter element, the dust accumulated in the inner cavity and inner thread of the filter should be cleaned, and the dust should be cleaned with a brush or cloth to ensure smooth threads and prevent dust from entering the inner part of the outer filter element.

6) Restore all parts in reverse order. Attention should be paid to correct installation to ensure sealing and no parts should be omitted.

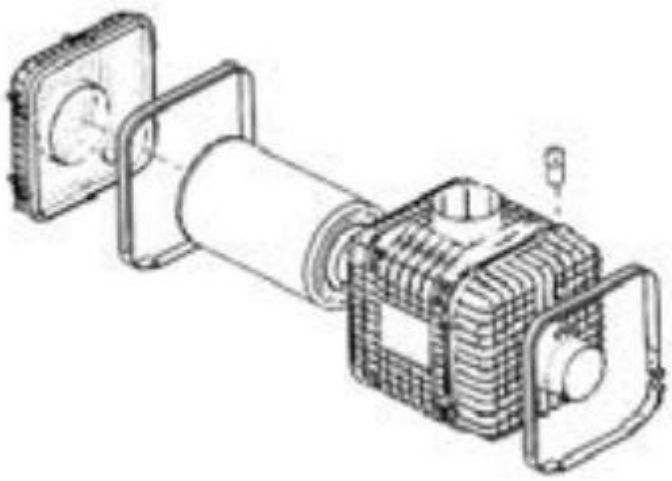


Figure 3-14 93 Dust filter

Note: Do not use the diesel engine without an air filter, otherwise dust and impurities entering the diesel engine will cause early wear of the diesel engine.

Regular maintenance rules

Table 3-7 Periods of first inspection, routine inspection and maintenance

First inspection	Diesel engine operation (30~50) hours
routine inspection (P)	The diesel engine is operated every 250 hours
Level 1 maintenance	The diesel engine runs every 250 hours
Level 2 maintenance	The diesel engine is operated every 500 hours
Level 3 maintenance	The diesel engine is operated every 1000 hours
Level 4 maintenance	The diesel engine is operated every 3000 hours
Note: The above maintenance cycle is calculated based on 1500 hours of diesel engine operation per year. If the annual working time of diesel engine is less than 500 hours, the maintenance cycle is 0.5 times of the above cycle.	

Table 3-8 Diesel engine maintenance specifications

working item	First insurance	Routine inspections check	Level 1	Level 2	Level 3	Level 4
Change the engine oil and oil filter element	●		●	●	●	●
Change the fuel filter			●	●	●	●
Check and adjust valve clearance	●		●	●	●	●
Check the coolant capacity and fill it up	●	●	●	●	●	●
Check for leakage of water pump	●		●	●	●	●
Clean the fuel pump coarse filter			●	●	●	●
Tighten the intake line and hose	●		●	●	●	●

Clean the oil cooler and core					●	●
Clean the intercooler core					●	●
Clean the fan water tank					●	●
Clean or replace the air filter element				●	●	●
Check the belt for tightness	●	●	●	●	●	●
Go to the maintenance station to check the fuel pump						●

Replace the zinc block of the heat exchanger	●		●	●	●	●

3.4 Maintenance of diesel engine during long-term storage

Clean diesel engines;

Protective work:

① After heating, release the oil, clean the oil filter and add anti-rust oil;

② Drain the oil and refill it with anti-rust mixture;

③ Drain water and add coolant with rust inhibitor;

④ Start up and idle for 15 ~ 25min;

⑤ Drain the oil, fuel oil and coolant;

⑥ Protection for other parts;

Protection during storage:

Use a lid or plastic sheet to seal the inlet and outlet of oil, gas and water; use weatherproof rust-proof film to seal the whole diesel engine.

If transportation is required, additional packaging should be added.

3.5 Maintenance specifications for main accessories of diesel engines

3.5.1 Use and maintenance of oil pump

◆ Preparation before use

(1) Before the oil pump is installed, check whether the model is correct. If the model is not correct, do not install it.

(2) Clean the surface rust preventive oil.

(3) Remove the anti-rust oil in the inner cavity of the governor and the inner cavity of the injection pump, and add the lubricating oil of the specified grade.

(4) The anti-rust oil in the fuel pipeline should also be removed before use. Connect the fuel to the injection pump pipeline and turn the injection pump camshaft continuously until the outlet valve seat spouts clean fuel oil.

◆ fuel oil

Using inferior fuel oil will not only reduce the performance of the engine, but also significantly shorten the life of the fuel pump and engine.

(1) High quality and qualified fuel oil must be used. Generally, No.0 light diesel oil is used in summer, and No.10 or higher grade light diesel oil is used in winter.

(2) The fuel used must be clean and free of any impurities and moisture. For this reason, the fuel must be settled for 72 hours before use. The filter element and oil pump screen should be cleaned regularly, and if damaged, they should be replaced in time.

(3) Air mixed in fuel can also impair the normal operation of the fuel injection pump. Therefore, before restarting after prolonged inactivity or hose replacement, it is essential to purge air from both the fuel pump and low-pressure oil circuits. During the venting process, continuously operate the fuel pump while loosening the relief valve connector to expel air. After completing this, promptly retighten the relief valve connector.

◆ lube

The fuel injection pump operates through forced lubrication, integrated into the engine's lubrication system with engine-supplied oil. For first-time users, it's essential to pre-fill the fuel injection pump with an appropriate amount of lubricant before initial operation to prevent damage caused by insufficient lubrication during engine startup. Additionally, periodically (aligned with engine maintenance schedules), the bolts securing the rear housing components must be loosened to drain contaminants. After re-tightening the rear housing components, the fuel injection pump should be refilled with lubricant.

◆ Adjustment of fuel supply advance angle

After installing the fuel injection pump on the engine, adjust the fuel injection timing according to engine specifications. This refers to the optimal injection timing when the first cylinder's piston is positioned before the top dead center of compression. To perform this adjustment, loosen the high-pressure fuel line for the first cylinder, release the flange bolts or coupling adjustment bolts of the fuel injection pump. Rotate the fuel injection pump or its camshaft while observing the first cylinder's piston rod extending oil, and simultaneously check the engine's flywheel markings. Adjust the fuel injection timing according to the engine's specified requirements, then securely reassemble all loosened bolts and connectors.

◆ seal up for safekeeping

When the oil pump is not used for a long time, it should be treated for rust prevention. The fuel and lubricating oil in the oil chamber should be emptied, and anti-rust oil should be replaced. Dust covers should be placed on the inlet and return oil hole joints, and the sealing should be repeated every year.

◆ matters need attention

(1) Users do not have certain experience and test conditions, and it is absolutely not allowed to disassemble the fuel pump assembly at will, especially the lead sealing part, and do not open the seal for adjustment.

(2) The oil pump assembly should be stored in a ventilated and dry warehouse, and should not be stored or transported together with batteries, acids and other chemical substances that can cause corrosion.

3.5.2 Use and maintenance of turbocharger

The oil from the supercharger is drawn from the main oil channel of the engine, lubricates and cools the supercharger, and returns to the lower part of the crankcase.

(1) Ensure good lubrication is very important for the operation of the turbocharger, so it is necessary to clean or replace the oil filter element regularly.

(2) The turbocharger operates at extremely high speeds (approximately 70,000r/min to 100,000r/min). Therefore, after starting the diesel engine, it should idle appropriately (about 5 minutes; short shutdowns may be appropriately shortened) before loading. When operating at high speed and heavy load, the diesel engine must not stop immediately. Instead, gradually reduce the load and speed, followed by 3-5 minutes of idle operation. Otherwise, this could cause damage and failure of the turbocharger bearings.

(3) Regular inspection Remove the compressor housing and turbine housing, and clean the impeller and internal flow channel of the housing. After the turbocharger is removed, clean oil should be added to the inlet during assembly.

(4) Precautions: The turbocharger rotor shaft is a precision high-speed rotating part, disassembly and collision are strictly prohibited, otherwise the factory guarantee will fail.

3.5.3 Use and maintenance of air compressor

The air compressor used in FE series diesel engine is single cylinder reciprocating crank connecting rod mechanism, and the transmission mode is gear transmission.

(1) The lubricating oil of the air compressor enters the lubricated bearing of the air compressor through the main oil channel and the lubricating oil pipe, and then returns to the oil bottom shell from the timing gear chamber.

(2) The air inlet of the air compressor is filtered by the air filter. After the air passes through the air filter, there is a branch pipe leading to the air compressor before entering the booster.

3.5.4 Pump use and maintenance

The water pump for the FE series diesel engines is installed at the front of the engine. The pump's volute is cast as a single unit above the timing gear chamber, with its outlet water directly entering the

right-side water chamber of the engine block. The cooling water flows across the oil cooler and enters the cylinder liner jacket through a channel hole in the lower right side of the engine block. After cooling the cylinder liner, it passes through an upper water inlet into the cylinder head water chamber. Following cooling of the cylinder head, the water exits through the cylinder head outlet pipe, which terminates at a thermostat. The thermostat has two outlets: one connects to the radiator, and the other leads to the pump inlet (forming a small circulation loop). When the coolant temperature reaches 71℃℃, the thermostat activates and fully opens at 82℃℃. At this point, all coolant passes through the radiator before being pumped into the engine block. However, when the coolant temperature drops below 71℃℃, the thermostat cuts off this circulation path, allowing direct coolant flow into the pump inlet. This rapid heating process ensures the diesel engine reaches the required operating temperature, preventing low-temperature wear and extending service life. If leakage is detected in the pump, the water seal should be replaced. Upon factory delivery, the pump's oil chamber is pre-filled with approximately 120cm³ of automotive-grade lithium-based grease, which requires periodic replenishment by users.

3.5.5 Starter usage and maintenance

(1) The starter is a short-time working device, and the starting time of each start should not exceed 15s. The interval between adjacent secondary starts should be greater than 30s.

(2) When the temperature is lower than-5℃ in winter, the engine should be preheated before starting.

(3) Once the engine is started, the starting switch should be loosened immediately to disengage the starter drive gear from the flywheel ring.

(4) Do not power the starter before the engine stops turning. To prevent damage caused by collision between the flywheel and the starter gear.

(5) When installing the starter, the wiring must be connected according to the starter wiring diagram. Before disassembling the starter, ensure that the battery is disconnected from the main starter circuit.

(6) The fasteners and insulation of the starter wires must be checked frequently to see if there is any damage, whether the contact of the wires is good or not, and the dirt should be removed.

3.5.6 Use and maintenance of generators

(1) Proper configuration: When the generator is idling, it should meet the power requirements of the main electrical equipment. Improper configuration between the generator and its connected devices may cause battery undercharging, leading to overheating that damages the regulator and burns out the stator. The generator's minimum operating speed must be maintained. Similarly, setting the engine idle too low will result in insufficient generator speed, which can also trigger these malfunctions.

(2) Secure Installation: The generator must be correctly, securely, and reliably mounted on the engine. Installation bolts must properly mate with and tighten into the generator's mounting holes, while pulley grooves and drive pulley slots should remain in the same plane. The generator mounting

bracket must meet required strength and rigidity specifications; otherwise, improper installation may cause damage to the generator.

(3) The belt tension should neither be too loose nor too tight. Generally, apply 150N (15 kg) of force by hand at half the distance between the two pulleys to press the belt down 10-20mm (or ensure no noticeable vibration during load operation). Check the belt tension every two months of use. Loose belts may cause the generator to "lose rotation", resulting in insufficient power generation, battery depletion, stator burnout, and bearing damage.

(4) Avoid heat sources and splashing soil to prevent external debris from entering the motor and causing damage. Ensure the generator operates in a suitable environment. The working temperature range for generators is typically-40°°C to 93°°C. Install the generator at locations approved by the engine manufacturer or supplier, away from heat sources (at least 400mm distance or with effective thermal insulation panels).

(5) The selection of conductors is reasonable, the wiring is correct and firm. Do not connect the terminals of the generator incorrectly to avoid burning the wire bundle and causing damage to the motor electrical components. The selection of reasonable conductor diameter is the premise of ensuring the complete output of the generator's power generation and the basis of the safety of the entire machine's electricity consumption.

(6) When performing generator disassembly, assembly, or welding operations on the entire unit, disconnect all battery connections to the generator. Generator maintenance must be conducted by certified professionals. During installation, inspect all insulation pads and sleeves for integrity. Replace any damaged components immediately. Ensure there is no short circuit between the generator's positive terminal and housing to prevent severe equipment failure.

(7) After the engine starts, from low speed to high speed, pay attention to whether the charging indicator light is on or off, otherwise please immediately find out the reason;

(8) Pay attention to whether the polarity of the battery is negative and grounded, otherwise it will burn out the generator and regulator;

(9) When the generator is running, the test lamp or diode can not be used to check whether the generator is generating electricity, otherwise it will burn out the test lamp or diode;

(10) When connecting the rectifier to the stator winding, it is forbidden to use megohmmeter or 220V AC power supply to check the insulation of the generator;

(11) The connection between the generator and the battery should be reliable, sudden disconnection will produce excessive voltage and damage the generator or voltage regulator;

(12) When a regulator is used for an AC generator, the voltage level of the AC generator must be the same as that of the regulator, the grounding type of the AC generator must be the same as that of the regulator, and the power of the regulator must not be less than that of the generator;

(13) The circuit connection must be correct.

3.5.7 Use and maintenance of oil pump

The FE series diesel engine oil pump is an external meshing gear pump. This mechanism utilizes two identically toothed gears that mesh with each other. By rotating in opposite directions and utilizing the clearance between the gears, it delivers oil from the low-pressure chamber to the outlet. As the gears continuously rotate, the oil pressure in the pressurization chamber gradually increases, ensuring stable oil supply to all lubrication systems in the diesel engine.

(1) The oil pump is equipped with a pressure relief valve. This device prevents excessive pressure buildup in the oil pump and lubrication system, ensuring safe and reliable operation of all components. Functioning as a bypass valve, it releases excess oil pressure to the oil pan when supply pressure exceeds preset limits. The pressure relief valve's spring mechanism automatically regulates oil pressure, with the factory-set preload requiring no adjustment by users.

(2) The performance of the oil pump mainly depends on the clearance between the oil pump gear and the housing (end face clearance and radial clearance). When the clearance is too large, the oil leakage is serious, the oil pressure is reduced, and the oil quantity is reduced. When the clearance is too small, the wear is serious.

(3) When the fuel supply pressure decreases and other diesel engine faults are ruled out, the oil pump should be inspected. During maintenance, first check for oil leakage or burn marks on the pump components. If no abnormalities are found, inspect the pressure limiter valve and disassemble the oil pump. Determine whether the issue stems from a softened pressure limiter spring or severe wear on gears, pump body, or end cover. Replace the oil pump if necessary.

(4) If the oil pressure is too high, the pressure limiting valve should be disassembled and checked. Focus on checking whether the pressure limiting valve can be opened.

(5) When disassembling the oil pump, special attention should be paid to avoid damage to the joint surface of the end cover and pump body and all positioning pins.

3.5.8 Use and maintenance of air filter

Warning! Incorrect maintenance methods can greatly shorten the service life of your engine.

(1) The selection of air filter should be matched strictly according to the performance indicators of diesel engine. Otherwise, it will affect the power and economy of diesel engine.

(2) The air filter with an alarm device should first observe the alarm when the diesel engine is working. When the intake resistance indicator alarms (turn red), the air filter element should be maintained.

(3) A coarse filter must be installed for a multi-stage filtration filter.

(4) The installation of dust discharge pipe must avoid sharp bend and leakage.

(5) Water should be avoided from entering the air filter.

(6) The air filter with the safety filter element is not allowed to be disassembled during maintenance.

(7) Under normal operating conditions, the paper main filter element of a diesel engine should be maintained every 100-200 hours of operation. Remove the main filter element and gently tap it to shake off dust. Inspect the seals of all filter elements; replace any damaged ones. Use clean, dry compressed air at no more than 500 kPa to blow air through the filter element from inside out. Place a light bulb inside the filter element and observe from the outside for any light transmission issues, cracks, perforations, or other damages. Never clean the main filter element with oil or water.

(8) Replace the main filter element and replace the safety filter element every 1000-2000 hours of work.

(9) The filter element assembly should be
replaced when the following conditions
occur: The filter element is damaged.

After installing the cleaned filter element, the alarm still alarms.

Clean the filter 3-6 times after

When replacing the filter element, it is necessary to choose reliable products to ensure the reliability of the diesel engine. It is recommended to buy original factory parts.

3.5.9 Use and maintenance of diesel filter

A diesel fuel filter consists of a coarse filter and a fine filter. Over time, contaminants accumulate on the filter element surface and at the housing base during prolonged use. If not promptly removed, these deposits can clog the filter core, leading to insufficient fuel supply and reduced engine power. Therefore, regular maintenance and cleaning of diesel filters are essential to prevent such issues.

(1) Open the oil drain screw plug at the bottom of the shell regularly to discharge the dirty oil and water.

(2) Under normal circumstances, the filter element should be maintained every 200-300 hours. If the fuel quality is poor, the maintenance time should be shortened appropriately. If any damage is found in the filter element during maintenance, it should be replaced in time.

(3) When maintaining, block the two holes of the filter element to prevent dirt from entering the inner cavity. Clean the filter element with a soft-bristled brush in clean kerosene or diesel. After cleaning with the brush, rinse the filter element again in clean kerosene or diesel. If conditions permit, use clean compressed air to blow out the filter element from the inside to the outside.

(4) Clean the inner surface of the shell and holes in the end cover with clean kerosene or diesel oil.

(5) Check whether the seals are damaged, and replace them in time if they are damaged.

(6) Check whether the sealing parts of the assembly leak oil after maintenance and before use.

3.5.10 Use and maintenance of freshwater cooler

The freshwater cooler used in FE series diesel engine is a shell and tube heat exchanger. Its working principle is that the seawater flowing in the cooling tube is cooled by heat exchange to the

fresh water flowing in the winding flow on the shell side. Its application improves the cooling condition of diesel engine and improves

The service life of the diesel engine is increased.

(1) When the diesel engine is out of service, the water in the fresh water cooler must be drained, otherwise it will be dangerous to the parts of the fresh water cooler

Harmful, especially in winter.

(2) Check the pipeline once every quarter, clear the dirt and replace the zinc block.

(3) After the freshwater cooler is disassembled, cleaned and reinstalled, a hydrostatic test must be carried out with a pressure of 0.4MPa. The pressure shall be maintained for 30 minutes without leakage before installation.

3.5.11 Use and maintenance of air cooler

The air cooler used in FE series diesel engine is a tube sheet heat exchanger. Its working principle is that cooling water flows in the heat exchange tube and takes away the heat of pressurized air through the tube wall, so as to reduce the intake temperature of diesel engine, increase the intake density and improve the power of diesel engine.

(1) When the diesel engine is out of service, the water in the air cooler must be drained, otherwise it will be harmful to the parts of the air cooler, especially in winter.

(2) Check the pipeline once every quarter, clear the dirt and replace the zinc block.

(3) After disassembly, cleaning and reinstallation of air cooler, hydraulic test must be carried out. The pressure is 0.4MPa, and the pressure should be maintained for 30 minutes without leakage before installation.

3.5.12 Use and maintenance of electronic speed regulator

The electronic governor for the FE series diesel engines consists of a speed controller, electromagnetic actuator, speed sensor, idle rate switch, fine-tuning potentiometer, control power supply, and power switch. The working principle is as follows: The engine's ideal speed is set by the speed setting potentiometer and fine-tuning potentiometer, while the actual speed is detected by the speed sensor installed at the flywheel root. The sensor outputs an AC voltage signal proportional to the rotational speed. This signal is converted into DC voltage through an F/V circuit, which is then compared with the speed setting value to obtain the speed deviation. After processing by the PID I regulator, this deviation is amplified to determine the fuel supply position command for the actuator. This position command is then compared with the actual position value of the electromagnetic actuator to obtain the actual position deviation. Finally, this deviation is processed by the PID II regulator into an electric current control signal, which drives the electromagnetic actuator to adjust its displacement.

(1) The rotational speed sensor should be installed on the engine's gear ring. The clearance between the sensor and the tooth tip should be maintained within 0.4mm~0.8mm. During installation, rotate the sensor to the tooth tip position first, then retract it by approximately 1/3 turn (for a 1.5mm pitch) or 1/2 turn (for a 1mm pitch), followed by securing the nut. If a flywheel gear ring is unavailable, alternative sensing gears made of magnetic materials can be used, provided they operate within the engine's operating speed range and ensure the sensor outputs a frequency of at least 1000Hz.

(2) The electromagnetic actuator is installed on the engine. Its installation position and installation mode are recommended to adopt the integrated installation mode with the oil pump, but in special cases or specific requirements, the external installation mode can also be adopted.(3) The speed controller should be installed in a protective enclosure free from severe shock vibrations and electromagnetic interference, with sufficient space reserved for installation maintenance and heat dissipation. Its casing must be properly grounded. The wiring between the speed sensor, speed adjustment potentiometer, and controller shall use shielded cables, with the shielding layer grounded at only one point on the controller.

(4) The speed regulator operates at a DC voltage of 24V (12V for special orders). It can be powered by the engine's control battery, starting battery, or other regulated/non-regulated power sources, provided that the system's peak power consumption and voltage fluctuation range requirements are met. When using the starting battery, a charging device must be installed to ensure sufficient battery capacity. During engine startup, brief voltage drops in the battery will not affect the normal operation of the speed regulator.

(5) Precautions for speed regulator power wiring:

The positive power terminal (2 legs) of the speed controller of the electronic speed regulator is directly connected to the positive pole of the 24V battery through the power switch (or stop switch), and a fuse can be added in series when necessary, that is, the power is directly taken from the positive pole of the battery.

The negative power terminal (pin 1) of the speed controller must be directly led from the negative terminal of the battery. If the negative power terminal needs to be grounded, the negative power terminal should be connected to the ground at the negative terminal of the battery, not from the negative terminal (pin 1) of the controller.

If the power cord is less than 10 meters long, the power cord should be greater than or equal to 0.75 square millimeters; if the power cord is more than 10 meters long, the power cord should also be thicker.

(6) Daily maintenance of electronic speed regulator

Check whether the cable is damaged and deal with it in time. The cable should be tightly bound along the layout route to avoid cable shaking and wear on the body. When arranging the cable, avoid the cable close to high temperature parts (such as supercharger, exhaust pipe, etc.

Check whether the actuator installation is loose, and deal with any loosening in time.

Check whether the oil is stained or loose on the actuator connector, sensor connector and cable fastening screw, and make corresponding treatment. Check whether the battery power is sufficient and whether the charging device is normal.

For non-mandatory lubricating oil pumps, the oil level of high and low oil pumps should be checked and the oil in the oil pumps should be replaced regularly.

To start the engine in a low temperature environment, push the actuator by hand several times to feel smooth operation.

After 2000 hours of operation and maintenance, dirt may form on the probe part of the speed sensor, which should be removed and cleaned. Open the cover plate of the observation hole on the intermediate body, check whether the connecting fasteners and pins between the actuator connector and the oil pump rack are loose or detached, and deal with any loosening in time.

After 6000 hours of operation and maintenance, remove the actuator from the high pressure oil pump and check whether the rack of the oil pump is flexible.

(7) Usage notes

The matching speed sensor is only for the electronic speed regulator and cannot be shared with other speed measuring devices.

In order to ensure the safety of the engine system, the speed control function of the electronic governor cannot replace the overspeed protection function, and an independent overspeed protection device must be installed.

The emergency shutdown actuator of the overspeed protection device must be independent and cannot be replaced by an electromagnetic actuator.

Before starting the engine each time, make sure that the "idle/rated" speed switch is in the "idle" position.

The adjustment potentiometers of the controller have been set at the factory, and non-professionals are not allowed to adjust them arbitrarily.

Do not adjust (especially increase) the rated speed setting potentiometer and speed fine-tuning potentiometer of the speed controller in the engine shutdown state to avoid overspeed caused by excessive speed setting at startup.

When the engine is reactivated after a long period of storage, or when starting the engine in a low temperature environment, push the actuator by hand several times first to feel smooth operation without sticking phenomenon. If there is sticking phenomenon, the engine cannot be started.

After the engine is sealed for a long time and restarted, short circuit the "test" contact of the controller before starting the engine, and set the output of the actuator to the maximum oil quantity. Disconnect the

"test" contact and the output of the actuator should return to zero as soon as possible. If there is any abnormality, it should be handled in time instead of starting the engine rashly.

4 Analysis and troubleshooting of common faults

4.1 Hazards and warning signs

This symbol is a world recognized warning symbol. In this manual, the symbol is used to emphasize the importance of the following information. Determine that you understand the consequences of dangerous situations and how to avoid them. Violation of warning information may result in property damage, personal injury, or even death.

The common hazard signs we use are usually used for general warnings. In this manual, warning information is divided into different types (minor injury, serious injury and death) according to the level of potential hazard consequences.

This warning sign indicates a potential dangerous situation, if not avoided, may lead to serious injury or even death or significant property damage.

This warning sign indicates a potential dangerous situation which, if not avoided, may cause minor injury or property damage.

This warning sign is also used for dangerous operations.

This information is provided to explain how to operate the engine correctly. However, simply reading this document does not eliminate various dangerous situations. Only by correctly understanding the information contained in this notice can you use it correctly.

The warnings in this guide do not cover all possible uses! If you decide to use the program, method, or recommended scope, make sure that the operation does not pose any danger to you, others, or your equipment.

Diesel engines should pay attention to the following two signs:

- ◆ Anti-wrapping safety mark
- ◆ Anti-scald safety mark

4.2 Safety signs

During the use of diesel engines, many potential hazards may occur without warning. Therefore, this manual cannot warn against every potential hazard. If the procedure you are using is not in the particularly recommended category, ensure that the procedure runs safely and does not cause any material loss.

Table 4-1 Safety signs

图片	意义
	戴上手部护具
	戴上耳部护具
	戴上眼部护具
	戴上头部护具
	穿上脚部护具
	戴上防护面罩
	穿防护服
	严禁明火
	禁止吸烟
	禁止使用手机
	危险，电瓶酸液
	危险，带电电缆，触电危险
	易燃物品
	远离悬重物体
	附近有灭火器

4.3 Health protection precautions

The following "Health Protection Precautions" are designed to reduce the risk of contamination.

◆ Avoid repeated exposure to used oil for a long time.

◆ If possible, wear protective clothing and waterproof gloves.

◆ Do not put oil soaked cloth in your pocket.

◆ Avoid oil getting on clothes, especially underwear.

◆ Wash work clothes frequently. Discard clothes and shoes that are soaked with oil and cannot be cleaned.

◆ If cut and injured, take first aid immediately.

◆ Always apply protective ointment before work; skin contamination with mineral oil will make it easier to remove the oil.

◆ Wash your hands with soap and hot water, or use hand sanitizer and a nail brush to remove all the oil. If you wash your hands and wash away the natural oils of the skin, wool fat products can replace the natural oils of the skin and help moisturize the skin.

◆ Do not use gasoline, kerosene, fuel oil, water or solvent to clean the skin.

◆ If you feel skin discomfort, seek medical attention immediately.

◆ If possible, remove oil from the parts before moving them.

◆ Use goggles or face masks if both eyes are at risk. Eye rinse must be available within easy access.

◆ When repairing a diesel engine, do not allow oil or other liquids to spill onto the ground. If hydrocarbons or other liquids are accidentally leaked, take all necessary measures to isolate the area in order to keep the environment clean and protect personnel from injury.

◆ The transportation, storage and recovery of hydrocarbons, ethylene, ethylene glycol or petroleum must comply with the safety and environmental standards implemented in the country where the operation is carried out.

4.4 Diagnostic methods

Common diagnostic methods for diesel engine faults are as follows:

◆ Observation method: judge the fault by observing the exhaust smoke and other fault characteristics of the diesel engine.

◆ Auscultation: according to the abnormal sound of diesel engine, judge the nature and degree of fault location by hearing.

◆ Cylinder break method: Stop the work of a certain cylinder to determine whether the fault occurs in that cylinder. The cylinder break method is generally to stop the oil supply to the cylinder suspected of failure, compare the state change of the engine before and after the cylinder break, so as to further find the fault location or narrow the scope of the cause.

◆ Comparison method: for some assemblies or parts, the replacement method is used to determine whether there is a fault.

pay attention to：

① Judging the cause of diesel engine failure is a very careful work, before the cause is clear, the diesel engine should not be disassembled and removed randomly, otherwise it will not eliminate the fault, but cause more serious faults due to improper assembly after disassembly.

② For key parts such as high pressure oil pump, ECU, common rail pipe and turbocharger, please go to the designated maintenance station for maintenance and inspection.

4.5 Common faults and troubleshooting

4.5.1 The diesel engine cannot start or has difficulty starting

order number	failure cause	Method of exclusion
1	A fault in the fuel system	
1-1	The fuel tank switch is not open or empty	Turn on the switch or fill up the fuel
1-2	There is air in the fuel system	Check whether the pipe joint is loose and remove air from the oil circuit
1-3	The oil pump is not supplying oil	Check the oil pump and replace those that are not qualified
1-4	The injector atomizes poorly	Adjust or repair the injector
1-5	The advance oiling angle is wrong	Check and adjust the fuel supply advance angle
1-6	Fuel line or fuel filter is blocked	Check and clean
2	The cylinder compression pressure is insufficient	
2-1	The piston ring and cylinder liner are too worn	Check the valve clearance and valve sealing, and grind the valve
2-2	valve blow-by	Check the valve clearance and valve sealing, and grind the valve
2-3	The cylinder head gasket is leaking	Check whether the cylinder head gasket leaks and remove it
3	Fault of the starting system	
3-1	The battery is undercharged	Battery charging and maintenance
3-2	The contact of each junction of the electrical circuit is poor	Check the wiring
3-3	The starter motor does not turn or is weak	Overhaul the starting motor

3-4	The starter gear does not mesh properly with the flywheel ring	Turn the flywheel gear ring to an Angle. If it still cannot start, check

		Check the starter motor

4.5.2 Unstable operation of diesel engine

order number	failure cause	Method of exclusion
1	There is air in the fuel system	Check whether the pipe joint is loose and remove air from the oil circuit
2	Fuel system blockage	Clean or replace the diesel filter
3	The fuel injection pump does not supply fuel evenly to each cylinder	The injection pump was repaired and adjusted on the oil pump test bench to make the fuel supply of each cylinder consistent
4	Some injectors do not work well	Check and determine the condition of the bad injector, clean or replace it
5	The governor is not working steadily	Check the speed regulator to eliminate the fault
6	The fuel quality is poor, or there is water in the oil	Check the fuel and replace it if necessary

4.5.3 Diesel engine power is insufficient

order number	failure cause	Method of exclusion
1	Fuel system failure	
1-1	Fuel system is blocked or air enters	Clean or replace the diesel filter and drain air
1-2	The injector atomization is not good and the injection pressure is insufficient	Check and verify the injector, replace it if necessary
1-3	The injection pump is faulty, and the oil supply is insufficient or uneven	Check or replace
1-4	The advance oil supply Angle is not up to the requirements	Check and adjust the fuel supply advance angle
1-5	The fuel is of poor quality, or there is water in the oil	Check the fuel and replace it if necessary
2	The cylinder compression pressure is insufficient	
2-1	The piston ring and cylinder liner are too worn	Check and replace piston rings, and replace cylinder liner and piston if necessary
2-2	valve blow-by	Check the valve clearance and valve sealing, and grind the valve
2-3	The cylinder head gasket is leaking	Check whether the cylinder head gasket leaks and remove it
3	Air filter is clogged	Clean or replace the filter element

4	Exhaust passage or muffler is blocked	Check and clean the exhaust channel and muffler
5	The exhaust pipe is not unobstructed	Find out the cause and eliminate it

4.5.4 The oil pressure of the diesel engine is abnormal

order number	probable cause	Method of exclusion
1	The oil level in the oil pan is too low	Refill the oil to the specified oil level
2	The oil pressure gauge is out of order	Overhaul or replacement
3	The oil coarse filter is blocked	Clean and replace the filter element
4	The crankshaft main bearing and connecting rod bearing are excessively worn	Overhaul or replacement
5	The oil grade is wrong and there is water in the oil	Check the oil grade, find out the cause, and replace the oil
6	Oil pump main and driven gears wear	Replace the oil pump
7	The pressure relief valve is out of service	Check and replace
8	Oil pipe blockage or oil leakage	Check and do corresponding treatment

4.5.5, diesel engine overheating

order number	probable cause	Method of exclusion
1	The diesel engine is overloaded for a long time	reduction in load
2	Combustion hazards	Check the injection and fuel advance angle
3	The oil temperature is too high	
3-1	Oil is insufficient or excessive	Check the oil gauge and add or subtract oil as required
3-2	The oil cooler is blocked inside	Clean or replace the oil cooler
4	Cooling water temperature is too high	
4-1	Cooling water is insufficient	Replace the oil pump
4-2	The pump displacement is insufficient	Check the water pump impeller clearance and replace it if necessary
4-3	Fan speed is insufficient	Adjust the tension of the fan belt
4-4	There is too much scale in the cooling system	Remove scale
4-5	The heat sink has poor heat dissipation effect	Remove the dirt on the radiator and improve the ventilation condition of the water tank
4-6	The thermostat fails to open	Identify and replace after investigation

4.5.6 The smoke color of the diesel engine is abnormal

order number	probable cause	Method of exclusion
1	Exhaust emits white smoke	
1-1	The physical and chemical quality of the injector is not good	Check the injection pressure and spray condition
1-2	There's water in the diesel	Clean the diesel tank and filter, and replace the diesel
1-3	The cylinder compression pressure is insufficient	Check the causes of leakage in valves, cylinder head gaskets and piston rings and eliminate them
2	Blue smoke is coming from the exhaust	
2-1	The oil level in the oil pan is too high	Release excess oil
2-2	The piston ring is worn or the spring force is insufficient, and oil is injected	Check and replace piston rings
2-3	The gas seal is not working	Check the valve seal and replace the valve stem seal
3	Exhaust fumes blackened	
3-1	Diesel engine overload	Adjust to the specified load
3-2	Poor injection oil, poor atomization	Overhaul or replace the oil outlet valve of the injection pump and the injector
3-3	The oil supply time is too late and the afterburn is serious	Adjust the fuel injection advance angle
3-4	Valve clearance is not right or valve seal is not good	Check valve clearance and valve seal
3-5	Air filter is clogged	Clean the air filter element
3-6	Poor fuel quality	Change to high quality fuel oil

4.5.7 Diesel engine automatic stop

order number	probable cause	Method of exclusion
1	The crankshaft won't turn after parking	
1-1	The crankshaft and bearing are locked	Overhaul, replace parts
1-2	The piston and cylinder liner are locked	Overhaul, replace piston, piston ring and cylinder liner
2	The crankshaft can be easily turned after parking	
2-1	Air enters the fuel system	Exhaust air and check the sealing of the pipeline
2-2	Fuel system blockage	Clean and replace the fuel filter element
2-3	The injection pump rack or plunger is stuck	Overhaul the fuel injection pump
2-4	The air intake pipe or air filter is blocked	Check and clean the air filter
2-5	Diesel is finished	Add diesel

4.5.8 There is abnormal noise when the diesel engine is running

order number	probable cause	Method of exclusion
1	The injection time is too early, and the cylinder produces a rhythmic crisp sound	Check and adjust the injection time
2	After the oil supply time is over, a low and unclear knocking sound is heard in the cylinder	Check and adjust the injection time
3	The clearance between the valve and rocker arm is too large, and there is a metal knocking sound in the valve mechanism	Check and adjust valve clearance
4	The piston and cylinder clearance is too large	Check cylinder clearance and replace piston or cylinder liner
5	The piston pin and the small end bearing of the connecting rod have too much clearance, and there is a loud metallic knocking sound, especially at low speed and high speed	Change the connecting rod bushing to ensure the specified clearance
6	The bearing clearance of the connecting rod is large, and there is a dull impact sound	Change the bearing
7	The clearance of the main bearing is too large, which is similar to the knocking sound of the connecting rod bearing	Replace the main bearing
8	The piston hits the valve, and a metallic clanging sound can be heard near the cylinder at low speeds	Check the timing of the valve train
9	When the gear clearance is too large, a crash sound can be heard at the gear chamber when the speed is suddenly reduced	Check and adjust the gear clearance, replace the gear if necessary

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