

501-1210KW

FDKGEN DIESEL GENSET

FE Series Diesel Engine

User Manual

Guangdong Fudiankang Diesel Gensets Co., LTD.

Preface

This series of diesel engines is independently developed and manufactured by Guangdong Fudiankang Diesel Generator Co., Ltd.

The FE Series Diesel Engine features a compact structure, reliable performance, excellent power output, fuel efficiency, and emission standards, along with quick startup, user-friendly operation, and easy maintenance. Notably, its advanced emission technology meets international emission standards, making it an ideal power source for industrial applications.

This manual primarily covers the operating instructions, maintenance guidelines, and customer service information for the diesel engine. To ensure optimal performance and longevity, we strongly recommend thoroughly familiarizing yourself with the engine's structure, maintenance procedures, and proper usage. Adhering to the prescribed maintenance schedule will significantly extend the engine's service life.

As our FE Series continues to expand with new variants and upgrades, we encourage you to stay updated with the latest technical bulletins and announcements from 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.

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ChapterI Overview

I. Introduction to diesel engines

Our diesel engines are four-stroke, direct-injection, water-cooled high-speed models. Classified by cylinder arrangement: 6-cylinder inline and 12-cylinder V-type; by intake method: naturally aspirated and turbocharged; by piston stroke: 150mm and 168mm; and by application: marine, power generation, automotive, construction machinery, agricultural irrigation, and industrial support systems. Designed with series standardization and universalization principles, our products feature interchangeable key components to ensure maximum compatibility.

Diesel engines are primarily categorized into two configurations: inline and V-type. The layout of a six-cylinder inline diesel engine is fundamentally similar. Figure 1-1 shows the structural anatomy of a standard six-cylinder inline diesel engine. The tunnel-type engine block features 14 large bolts securing the top surface, with cylinder heads shared by every two cylinders. A cast iron or stamped steel oil pan is installed on the bottom surface. Inside the cylinders are piston-connecting rods with W-shaped combustion chambers. The main bearing holes accommodate a disc-type composite crankshaft with rolling bearings. On the right side (facing the flywheel end), camshafts and valve trains are positioned. The front end houses transmission mechanisms, while the left side contains the fuel injection pump and governor assembly, intake manifold, and instrument panel. The right side features exhaust pipes, oil filters, cooling systems, starter motor, and generator. A freshwater pump is installed at the front, and an oil pump is housed within the engine block's front oil pan. For turbocharged diesel engines, exhaust turbochargers are arranged in two configurations depending on the specific model.

One is placed at the rear end of the dedicated exhaust pipe (above the flywheel housing), and the other is placed above the middle outlet of the exhaust pipe.

Only the 12-cylinder V-type Marine diesel engine is added to meet the requirements of the double paddle arrangement. The right turning machine is added, which is opposite to the basic steering, and the layout of its main accessories is symmetrical with that of the left turning machine.

II. Description of characteristic curve and power of diesel engine

According to the different uses of diesel engines, the requirements for the characteristics of diesel engines are also different. For the convenience of users, the speed characteristic curve and load characteristic curve of diesel engines are also given in the specification for users to check the relevant technical parameters in practical use.

1) The speed characteristics of the diesel engine refer to the relationship between the measured effective power, fuel consumption rate, torque and exhaust temperature that change with the speed when the oil regulating rack and the speed regulator handle are kept at a certain position and the load is gradually reduced.

The speed characteristic curve obtained by fixing the oil regulating rack and the speed regulator handle at the 12h power position is called the 12h power speed characteristic curve.

2) The load characteristics of a diesel engine refer to the relationship between fuel consumption rate and exhaust temperature and other factors with the load when the diesel engine is kept at a constant speed.

Here is the load characteristic curve at the rated speed.

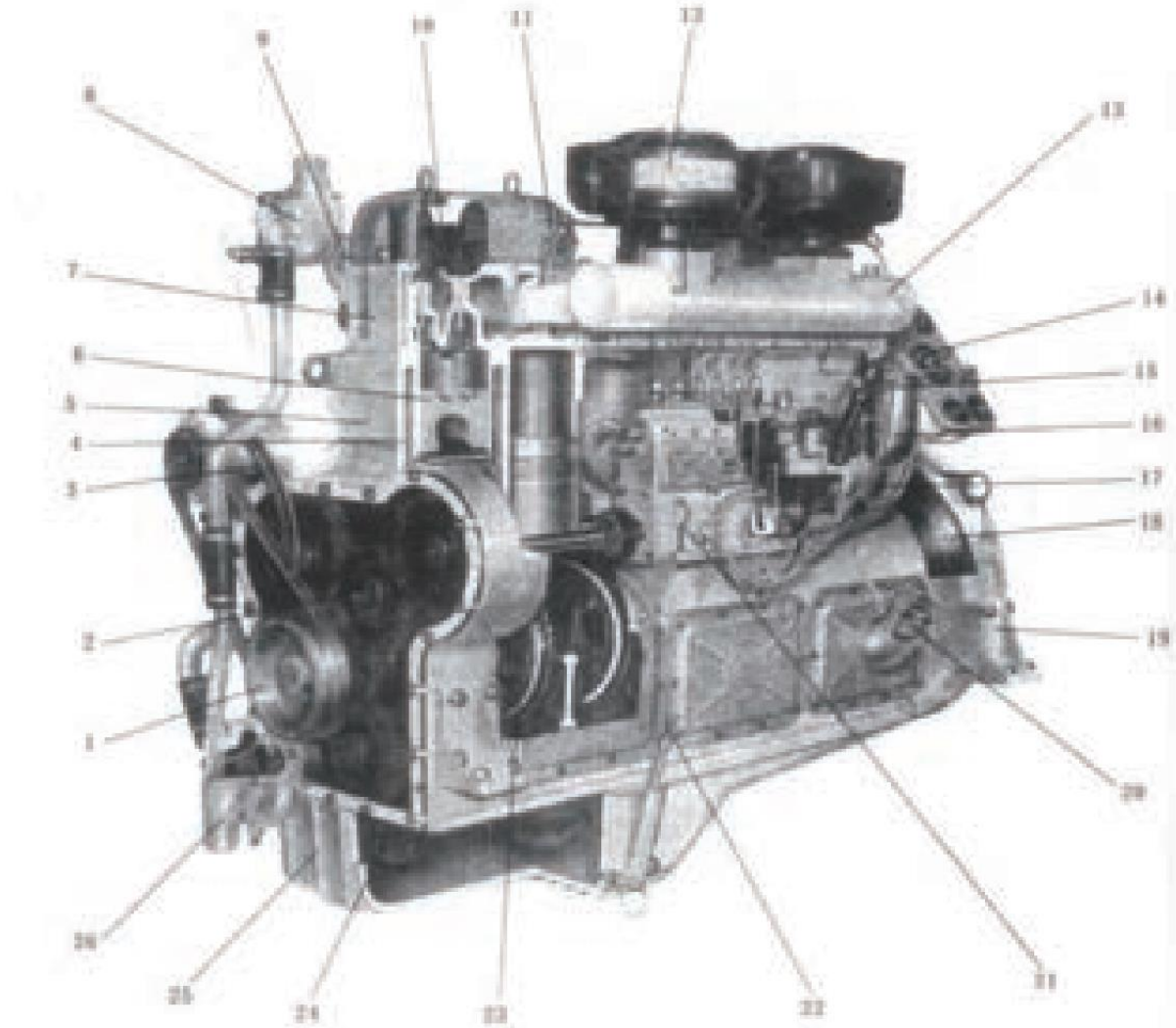
3) According to the above set of curves, users can find the power and economic indicators of diesel engines at different speeds under full load or partial load at rated speed according to different usage conditions.

4) When the company's diesel engine leaves the factory, the maximum fuel supply is limited to the position of 1h power (that is, 110% of the overload power of 12h power).

5) The rated power of the company's diesel engine refers to the effective power that allows continuous operation for 12 hours under atmospheric pressure of 100kPa (750 mmHg), ambient temperature of 25°C, and relative humidity of 30%, when equipped with an air filter but without accessories such as a fan, muffler, seawater pump, or gearbox. During this 12-hour continuous operation, short-term overload operation at 110% of the 12-hour power is permitted, with the duration not exceeding 1 hour. If continuous operation exceeds 12 hours is required, it should be operated at 90% of the 12-hour power (continuous power).

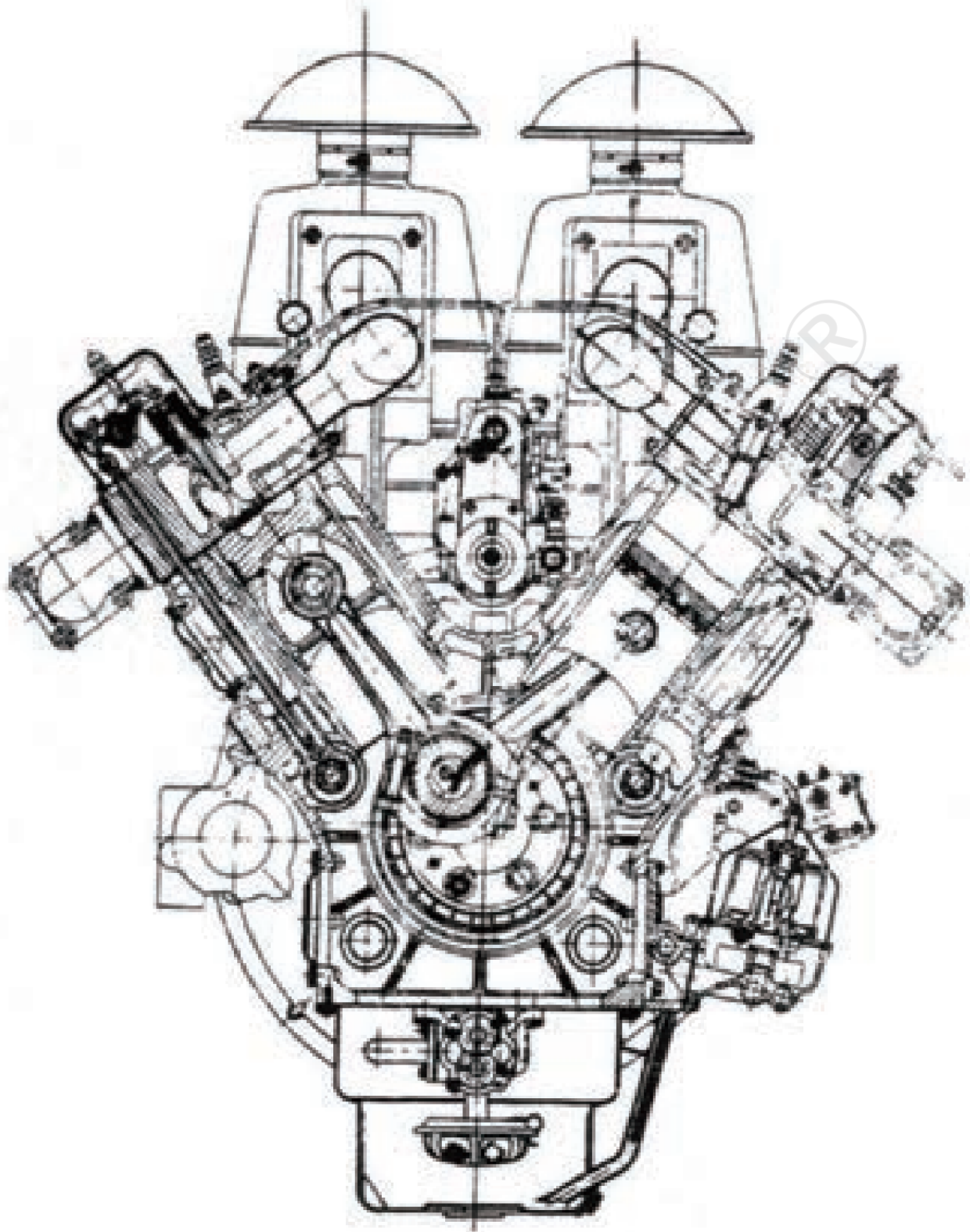
When atmospheric pressure, ambient temperature and relative humidity are not in accordance with the above standard conditions, the available power can be converted according to the instructions in Chapter 12.

In the 12h power speed characteristic curve of the general model represented by the basic type, the maximum torque is allowed to occur at the rated speed.

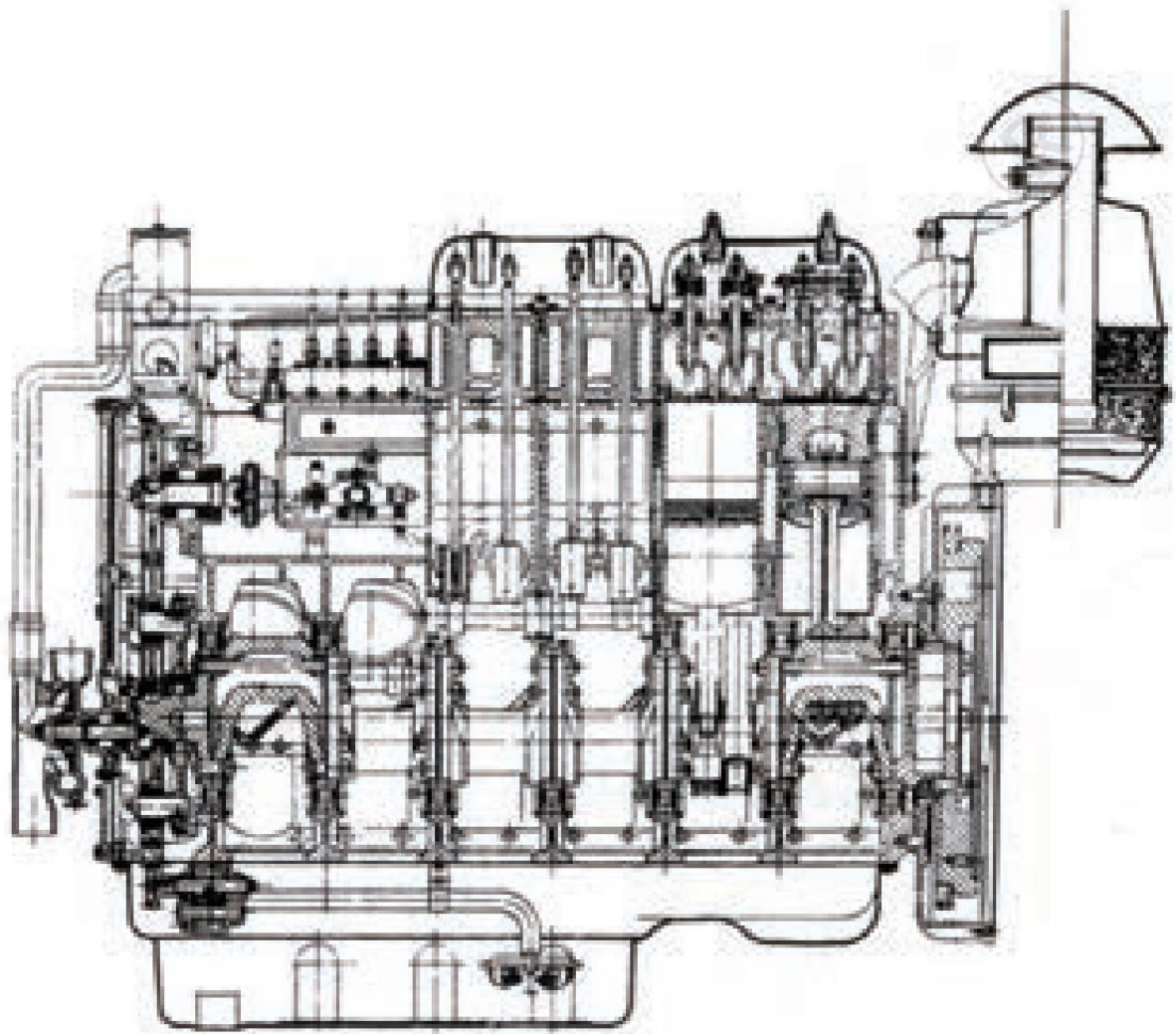


Schematic diagram of 6 cylinder inline basic diesel engine

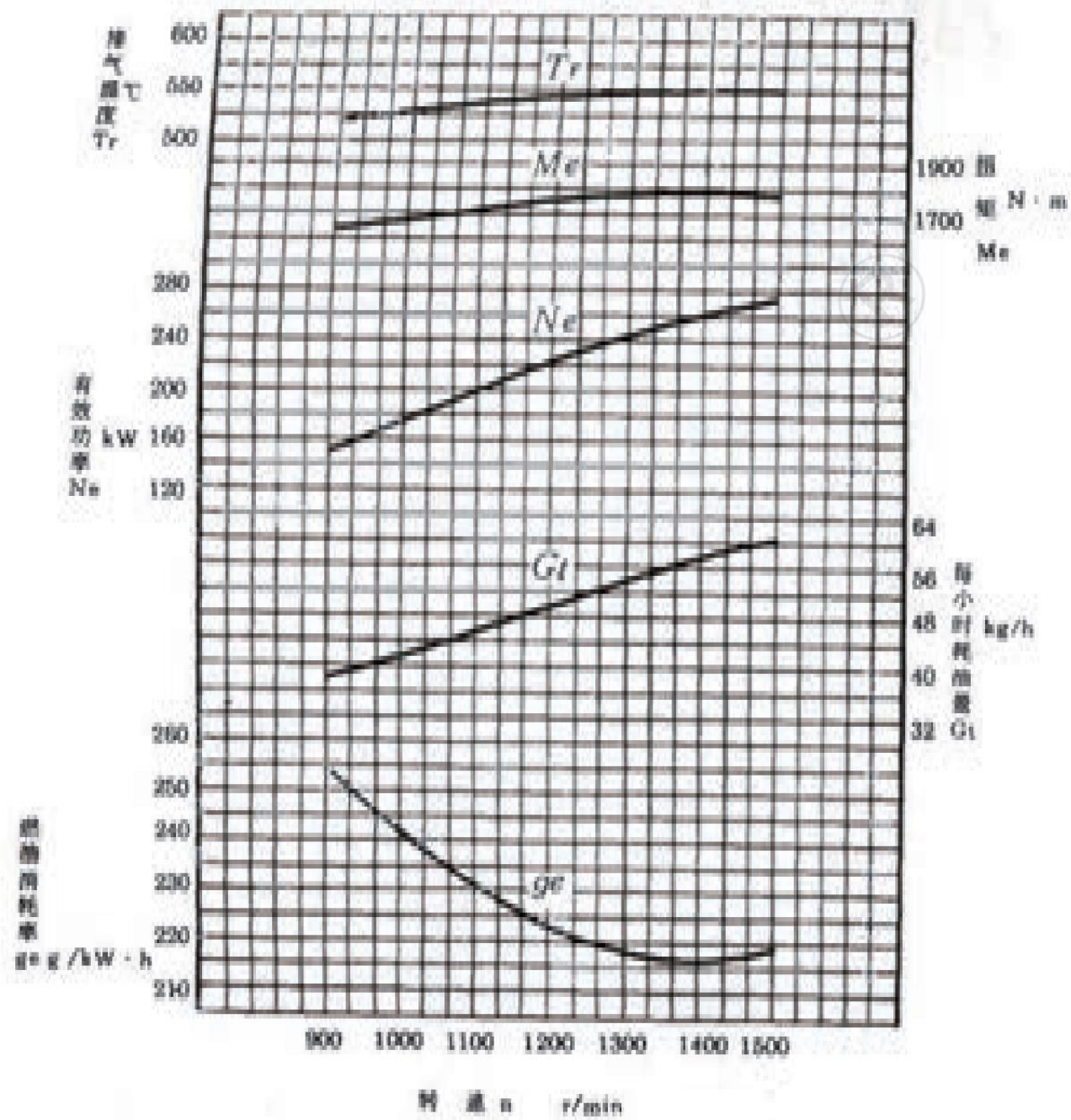
1-belt drive; 2-transmission mechanism; 3-silicon rectifier charging generator; 4-cylinder liner; 5-body; 6-piston connecting rod; 7-cylinder head; 8-thermostat body; 9-cylinder head outlet pipe; 10-Valve train; 11-Fuel injector; 12-Air filter; 13-Intake pipe; 14-Dashboard; 15-Speed control lever; 16-Fuel filter; 17-Flywheel; 18-Mounting bracket; 19-Fuel and ventilation cover; 20-RPM indicator flexible shaft; 21-Fuel injection pump governor assembly; 22-Oil gauge; 23-Disk combination crankshaft; 24-Oil pump; 25-Oil pan; 26-Freshwater pump;



Diesel engine cross section



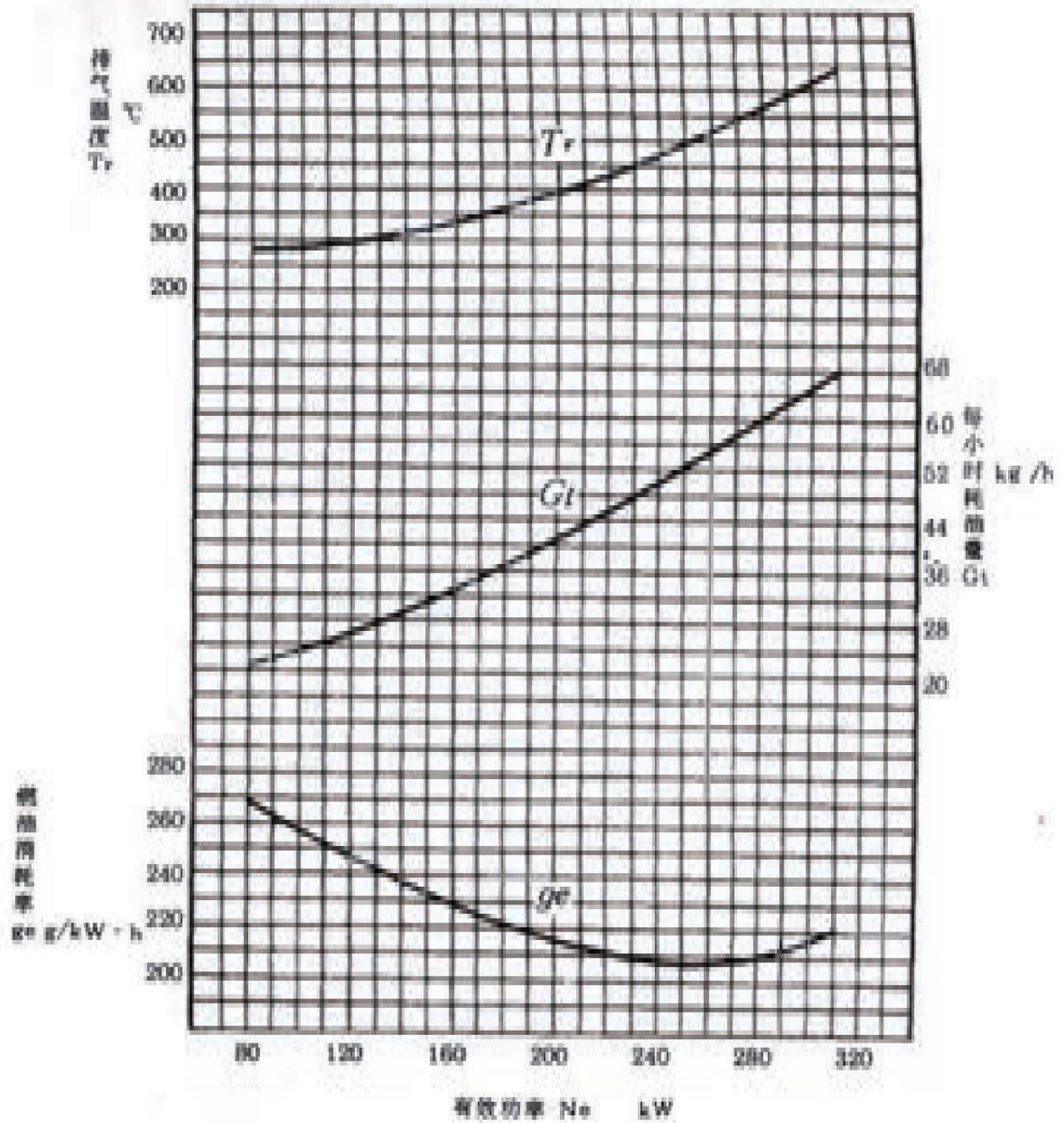
Diesel engine cross section



a) 12h power speed characteristics

FE16G, FE25G, FE27G, FE28G, FE30G diesel engine characteristics curve

Diesel engine curve



b) Calibration of speed load characteristics

FE16G, FE25G, FE27G, FE28G, FE30G diesel engine characteristics curve

Diesel engine curve

III. Specifications and main technical parameters of diesel engines

1. Specifications of basic diesel engine

engine type	FE16G700D	FE25G700D	FE25G748D
Engine type	Straight line, water cooling, four stroke, direct injection, two valves		
Air intake mode	Boost/intercooler		
power	510kW		550kW
Cylinder diameter * stroke	127*165mm	135*155mm	
number of cylinders	6	12	
Type of cylinder	Replaceable wet cylinder liner		
total displacement	12.5L	26.6L	
Calibrate fuel consumption rate under working conditions	≤205(g/kW·h	≤205(g/kW·h)	
Determine the oil consumption rate under working conditions	≤0.4(g/kW·h)	≤0.6(g/kW·h)	
mode of speed regulation	Electronic speed control		
idling speed	750(rpm)		
rated engine speed	1500(rpm)		
starting mode	Electric start		
Axis rotation direction	Counterclockwise/face the flywheel end		
noise	≤115(db)		
bell housing	SAE NO.1#		
Free wheel	INO.14 INO.18	INO.18	INO.14
Fuel grade (according to GB 252)	Generally ambient 0 or-10 light diesel		
South China	No.10 light diesel oil		
Northern cold regions	No.135 or light diesel with a lower freezing point		
The oil shall be in accordance with GB 11122	CF15W/40 (at ambient temperature-5℃)		

Supplementary table

engine type	FE27G830D	FE27G900D	FE27G990D	FE27G1060D	FE28G1120D	FE30G1210D	FE30G1310D	FE30G1500D	FE30G1600D	FE30G1650D
Engine type	V type, water cooled, four stroke, direct injection, two valves								V type, water cooled, four stroke	
Air intake mode	Boost/intercooled direct injection, four valves injection, four valves								Boost/intercooled direct	
power	610kW	660kW	728kW	780kW	820kW	920kW	960kW	1090kW	1180kW	1210kW
Cylinder diameter * stroke	135*155mm					138*160mm	138*165mm		138*168mm	
number of cylinders	12									
Type of cylinder	Replaceable wet cylinder liner									
total displacement	26.6L					28.7L	29.6L		31.04L	31.15L
Determine the fuel consumption rate under working conditions	≤205(g/kW·h)									
Determine the oil consumption rate under working conditions	≤0.6(g/kW·h)									
mode of speed regulation	Electronic speed control									
idling speed	750(rpm)									
rated engine speed	1500(rpm)									
starting mode	Electric start									
Axis rotation direction	Counterclockwise/face the flywheel end									
noise	≤115(db)									
bell housing	SAE NO.0#									
Freewheel	INO.18									
Fuel grade (according to GB 252)	Generally ambient 0 or-10 light diesel									
South China	No.10 light diesel									
Northern cold regions	No.135 or light diesel with a lower freezing point									
Oil shall be in accordance with GB 11122	CF15W/40 (at ambient temperature-5°C)									

2. Main technical data of basic diesel engine

Diesel engine type	FE16G	FE25G、M27G	FE28G	FE30G
At 12h power and calibration speed:				
delivery temperature °C	≤500	≤500	≤550	≤580
Maximum oil temperature of the oil bottom shell °C	95	95	95	95
circulating cooling water temperature °C				
Minimum inlet temperature °C	60	60	60	60
Maximum outlet water temperature C	95	95	95	95
Oil pressure gauge reading (camshaft end)				
Pressure MPa (kgf/cm ²) at rated speed	0.25~0.35 (2.5~3.5)	0.25~0.35 (2.5~3.5)	0.25~0.35 (2.5~3.5)	0.30 ~ 0.35 2.5~3.5
"Pressure MPa (kgf/cm ²) at 500~600r/min"	≥0.05(0.5)	≥0.05(0.5)	≥0.05(0.5)	≥0.05(0.5)
Piping phase (measured by crankshaft rotation)				
intake valve				
Start point (before top dead center)	20±6.	20±6.	20±6.	20±6.
Close the end point (after the lower stop)	48±6	48±6.	48±6.	48±6.
Maximum valve lift mm	14.5	14.5	16	16
Cold workshop clearance of valve and rocker arm mm	0.30~0.35	0.25~0.30	0.25~0.30	0.30~0.35
exhaust valve				
Start point (before bottom dead center)	48±6.	48±6	48±6.	48±6.
Close the end (after the upper stop)	20±6.	20±6.	20±6.	20±6.
Maximum valve lift mm	14.5	14.5	16	16
Cold workshop clearance between valve and rocker arm mm	0.35~0.40	0.30~0.35	0.30~0.35	0.35~0.40
injection advance angle (Before the upper stop point, measured by crankshaft rotation Angle)	16~18.	26~29.	26~29.	20~22.
The injector extends above the bottom plane of the cylinder head (The distance from the center of the nozzle to the bottom plane of the cylinder head) mm	15~19	16~2	15~19	15~19
Distance between top surface of piston and bottom plane of cylinder head (gas storage gap) mm	1~19	0.85~1.7	1~19	0.85~1.7

Mechanical centrifugal full-process speed regulator speed regulation performance:	≤ 500
Speed fluctuation at minimum no-load stable speed r/min	± 25
speed fluctuation at rated speed r/min	± 5
During 12h power condition, sudden load is unloading	≤ 10
instantaneous speed change rate %	≤ 5
steady state speed governing rate %	≤ 10
Speed re-stabilization time s	

3. Summary of tightening torque of bolts and nuts in basic diesel engines

order number	name	Thread specifications	"Tightening torque N·m (kgf·m)	Tighten the method
1	The cylinder head bolts rotate into the body	Special GM16 Middle diameter 14.701+-..8	39~49(4~5)	Tighten by the threaded end. See Chapter 5
2	cylinder head nut	M16X1.5	245~265(25~27)	Tighten in 2-3 times according to the sequence. See Chapter 5
3	Connect the curved screw	M18X1.5	226~255(23~26)	Tighten in two stages in accordance with the sequence. See Chapter 5
4	Linked screws	M18X1.5	255~274(26~28)	Tighten alternately 2-3 times. See Chapter 5
5	Flywheel bolts	M18X1.5	235~255(24~26)	Tighten alternately 2 to 3 times. See Chapter 5
6	Transmission gear locking bolt	M27X1.5	255~274(26~28)	See chap. V
7	Oil pump outlet valve seat	M22X1.5	39~68(4~7)	See chap. VI
8	Tighten the injector cap	M20X1.5	59~78(6~8)	See chap. VI
		GM10	20~25	
9	Dual-head bolts for injection pumps	The median diameter is 9.0260+0.06	(2~2.5)	See chap. V
10	Intensifier self-locking nut	M12X1.25	39~44(4~4.5)	See chap. XI
11	Generally bolt and nut	M6	10~15(1~1.5)	
12	Generally bolt and nut	M8	15~25(1.5~2.5)	
13	Generally bolt and nut	M10	39~49(4~5)	
14	Generally bolt and nut	M12	59~78(6~8)	
15	Generally bolt and nut	M14	78~137(8~14)	
16	Generally bolt and nut	M16	146~195(15~20)	

IV. Installation and connection of diesel engines

1. Support and foundation

The diesel engine's gear chamber and flywheel housing are equipped with four mounting brackets on both sides. Each bracket features two 16mm through-holes (for 12-cylinder V-type diesel engines, two M16 threaded holes), which can be securely fastened to the foundation using corresponding bolts (see the diesel engine exterior installation dimensions diagram). For land-based fixed diesel engines, foundations are typically constructed with reinforced concrete based on user requirements and application scenarios. The foundation base must be solid and reliable, with a level supporting surface. Adjustable shims can be placed between the diesel engine bracket and foundation to ensure stability, as shown in Figure 1-6a. Where feasible, flat guide rails may be installed on the foundation, requiring additional base plates or shims between the diesel engine bracket and foundation, as illustrated in Figure 1-6b. When the diesel engine is mounted on steel public chassis (e.g., agricultural drainage systems and power station units), 5-10mm thick rubber pads can be used between the chassis and foundation to reduce vibrations. In such cases, bolt tightening forces between the chassis and foundation should not be excessive to prevent chassis movement.

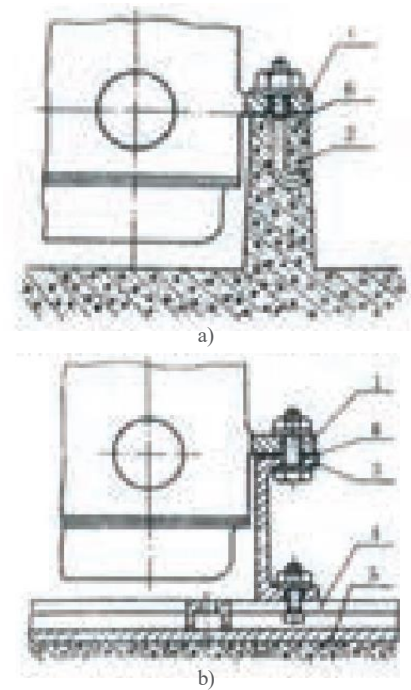


Figure 1-6 Installation foundation of land fixed diesel engine
1-diesel engine bracket; 2-cement base; 3-gauge steel base; 4-rail;
5-cement base; 6-adjust the washer

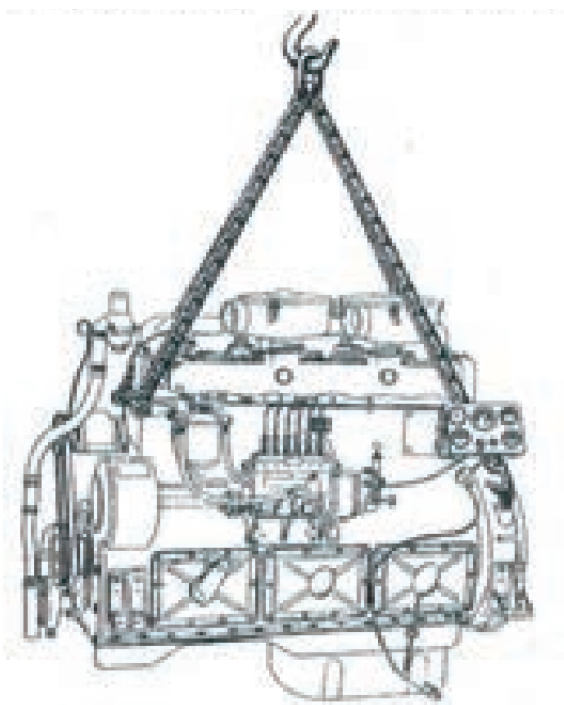


Figure 1-7 Lifting of diesel engine

2. Lifting

Each diesel engine is equipped with 4 or 3 lifting rings designed to support its full weight. During installation, use chain hoists or similar tools. Key safety guidelines: Avoid pressing the load-bearing chains against thin-walled components like casings and instruments (and minimize bending moments on lifting rings); perform lifting operations gently to maintain the engine's horizontal alignment (as shown in Figure 1-7); when transporting or installing, securely place the engine on a dedicated base or stable cushion blocks to prevent the stamped steel oil pan from directly bearing the engine's weight.

3. External connection of air inlet and exhaust pipe

In addition to diesel engines operating in clean environments, air filters are typically installed on intake manifolds. When using extended intake pipes, sufficient cross-sectional area must be ensured, and the pipes should neither be excessively long nor have sharp bends. Otherwise, increased intake resistance may impair engine performance. Additionally, strict attention must be paid to the sealing integrity of the intake manifold, as inadequate sealing can lead to rapid engine wear.

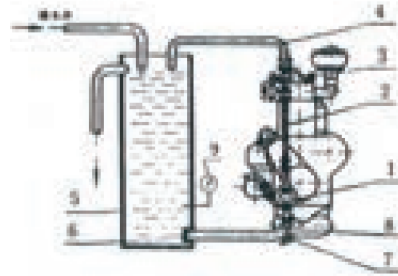
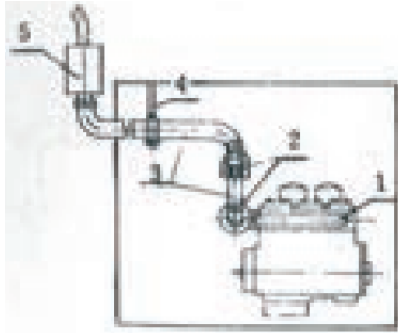
The flange dimensions for the exhaust pipe or turbocharger outlet face of diesel engines are specified in Table 1-1. For land-based fixed diesel engines, refer to Figure 6 for exhaust system installation. External exhaust pipes should generally be routed to outdoor or underground pipelines, avoiding excessive length or sharp bends. The number of bends should not exceed three. The inner diameter of pipes must be no less than $\varnothing 75\text{mm}$ for non-turbocharged engines and no less than $\varnothing 95\text{mm}$ for turbocharged engines to prevent increased exhaust backpressure that could reduce output power. Typically, exhaust backpressure should not exceed 3kPa (6kPa for turbochargers). A thermal expansion joint or bellows expansion joint should be installed between external pipelines and the diesel engine's exhaust outlet. Exhaust pipe support devices (as shown in Figure 1-8) are essential; otherwise, vibrations may cause pipe fractures or turbocharger damage. Outdoor exhaust pipe outlets must incorporate fireproofing, thermal insulation, and waterproofing measures.

△ Note: Do not put the weight of the external exhaust pipe on the turbocharger or diesel engine exhaust pipe.

Installation dimensions of exhaust pipe flanges Table 1-1
Installation dimensions of exhaust pipe flanges Table 1-1

Diesel engine type	FE27G	FE28G	FE30G
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Connection flange dimensions mm	
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Installation of exhaust pipe for land-based fixed diesel engine

1-diesel engine exhaust pipe; 2-temperature difference expansion joint;

3-exhaust pipe; 4-support; 5-muffler

External connection of open circulating cooling water piping

1-fresh water pump; 2-return pipe; 3-thermostat;

4-outlet pipe; 5-mixing tank; 6-filter screen;

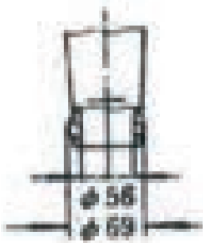
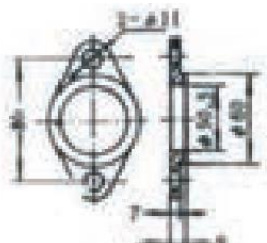
7-water drain valve; 8-water inlet pipe; 9-water temperature gauge

4. External connection of cooling water pipeline

To accommodate different application scenarios, our company's diesel engine cooling systems are available in two configurations: closed-loop and open-loop systems. The closed-loop system is pre-engineered at the manufacturing facility, eliminating the need for users to install additional components like water tanks or cooling towers. Figure 1-9 illustrates the piping configuration of a standard diesel engine open-loop cooling system. A mixing tank is installed between the cooling water source and the diesel engine's freshwater pump to regulate the inlet water temperature. During operation, maintaining an average water temperature of 60-70°C in the mixing tank is recommended, achieved by adjusting the cold water flow rate. The cooling system must ensure sufficient water supply (preferably connected to a municipal water supply system; otherwise, a dedicated cooling water tank or tower should be installed). The water level or pressure in the cooling source must guarantee adequate water supply to the mixing tank. The water level in the mixing tank should remain higher than the diesel engine's outlet. The freshwater pump's inlet pipe should be equipped with a filter screen of sufficient flow area to prevent debris ingress, and a drain valve should be installed at the lowest point. The outlet pipe should be directly connected to the highest point of the diesel engine to allow air release from the cooling system and piping. Specifications for standard diesel engine outlet pipe fittings are detailed in Table 1-2.

Dimension of inlet and outlet pipe joint of basic diesel engine Table 1-2

Dimension of inlet and outlet pipe joint of basic diesel engine Table 1-2

Diesel engine type	FE25G、FE27G、FE28G、FE30G	
Joint position	Freshwater pump inlet	Thermostat outlet
joint dimension mm		

5. External connection of fuel line

The external connection of fuel lines refers to the connection between the fuel pump inlet pipe, the return pipe of the fuel filter, and the fuel tank as shown in Figure 1-10. All models use $\varnothing 10 \times 1$ pipes for inlet and return connections, with external pipes made of corresponding-sized copper or plastic tubing. The fuel tank must have sufficient capacity to store fuel for over 8 hours of diesel engine operation, maintaining a minimum oil level no lower than 1/2 inch above the fuel pump center. The tank should not be placed near heat sources (e.g., exhaust pipes) or electrical equipment. The suction port of the inlet pipe must be at least 50mm above the tank bottom, and it's advisable to install a coarse filter screen at this point to prevent sediment from entering and clogging the fuel line. For easy cleaning, a drain valve should ideally be installed at the tank's bottom.

6. Power output of diesel engine

The diesel engine of this company generates power through the flywheel end to drive working machinery. During operation, it is strictly prohibited to directly install belt pulleys or lateral drag mechanisms on the flywheel, as such installations may damage the crankshaft and main shaft, causing them to bear lateral forces directly. When using coupling connectors, the centerlines of the equipment must align in a straight line. If elastic couplings are employed, their coaxiality deviation should not exceed $\varphi 0.10\text{mm}$.

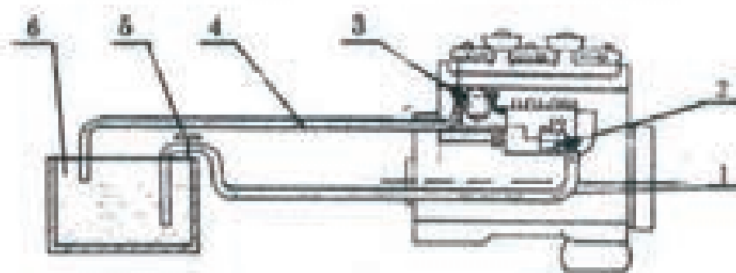


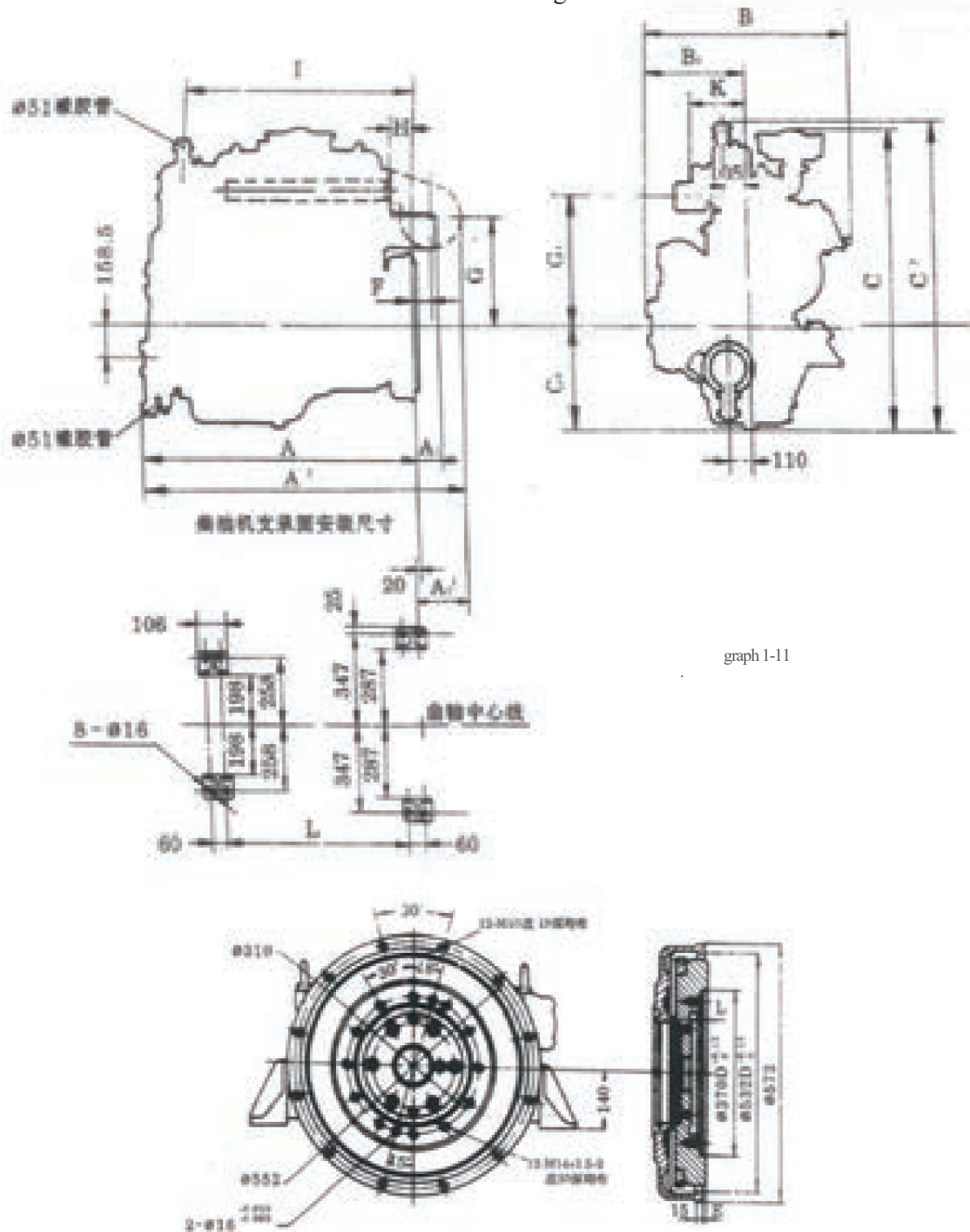
Figure 1-10 External connection of fuel line
1-oil inlet pipe; 2-oil pump; 3-fuel filter;
4-return oil pipe; 5-valve; 6-fuel tank

△ Note: The diesel engine is not allowed to start with load, so there should be a clutch device between the diesel engine and the load device which cannot run without load

The front end of the crankshaft of a diesel engine can output part of the power, and its maximum output power is not greater than 35kW (for a 12-cylinder V-type diesel engine, it is not greater than 50kW), but the output power directly using the front axle belt disk for lateral drag should not be greater than 11kW.

7. Main dimensions of diesel engine shape and installation

The shape and main installation dimensions of the basic 6-cylinder inline diesel engine are shown in Figure 1-11; the shape and installation of the 12-cylinder V-type diesel engine is shown. The main dimensions of the installation are shown in Figure 1-12.



Note: The dimension from the flange end face of the turbocharger exhaust outlet to the transverse centerline of the cylinder is 288mm.

Chapter II Use and adjustment of diesel engines

I. Selection of diesel oil, oil and coolant

Before the use of diesel engine, appropriate specifications of oil, diesel and coolant should be selected according to the specific environment and conditions. The quality and physical and chemical indicators of oil, water or other coolant selected have a great impact on the performance and service life of diesel engine.

1. Diesel oil

As for the selection of diesel oil, first of all, it should be based on the ambient temperature of the diesel engine. In hot southern regions, light diesel oil with high freezing point can be selected; in cold northern regions, light diesel oil with low freezing point should be selected.

The less water and mechanical impurities in diesel oil, the better, otherwise it is easy to cause early filter blockage and parts corrosion.

The freezing point of diesel oil should be at least 16-10. C lower than the minimum ambient temperature at which the diesel engine is used to ensure its necessary fluidity.

In general ambient temperature, the company's diesel engine can choose 0 or-10 light diesel oil. If used in southern regions, 10 light diesel oil can be selected, while in cold northern regions, -35 or lower freezing point light diesel oil can be selected. The specifications of domestic light diesel oil are shown in Table 2-1.

Light diesel specification (GB252-81) Table 2-1

Light diesel specification (GB252-81) Table 2-1

name	sixteen Alkanes Not less	recovered temperature °C			move ment dynam ic visco sity	car bo n residu e % ≤	sul fur co nte nt % ≤	ash co nte nt % ≤	flash point (shut up) ≥	con den sati on poi nt °C ≤	cold filter pluggin g point °C Not high	Shuif en % Not much more than that	mach inery im pur ity % not hav e	Shuif en % Not much more than that
		50% Not higher than	50% Not higher than	50% Not higher than										
firsts	No.1	45	300	355	365	0.3	0.5	0.01	60	10	12	12	not hav e	mark
	0								60	0	4	4		
	No.0								60	-10	-5	-5		
	-10								60	-20	-14	-14		
	-20								45	-35	-29	-29		
	-25								45	-50	-44	-44		
	-50													

Diesel oil must be clean and should be settled for a long time (preferably seven days) or filtered with silk cloth to remove mechanical impurities from the diesel oil before use.

2. Oil

Motor oil serves to lubricate moving parts in diesel engines while providing cooling, heat dissipation, impurity removal, and rust prevention. The grade and quality of the oil not only affect the diesel engine but also influence its service life. Therefore, users should select appropriate oil grades based on different engine models and operating temperatures. Generally, turbocharged engines with rated speeds exceeding 2000 r/min should use CC-grade oil, whereas naturally aspirated engines with rated speeds below 2000 r/min may use CA-grade oil. Oil must maintain good fluidity at minimum ambient temperatures and appropriate kinematic viscosity at maximum operating temperatures

If the diesel engine of our company is used in the cold region, we should choose the special thickening oil with lower freezing point. The specifications of domestic diesel engine lubricating oil are shown in Table 2-2.

Diesel engine lubricant specifications

Diesel engine lubricating oil specifications (CA diesel engine oil: GB5323-85 L-ECC diesel engine oil: GB11122-89) Table 2-2

name		kinematic viscosity (100°C) mm ² /s"	Viscosity index is not less than	Flash (open) °C Not less than that	condensation point °C Not higher than	Boundary pumping temperature °C Not much more than that	mechanical admixture % Not much more than that	Water content not greater than	Refer to the minimum ambient temperature °C
C A level	HCA-18	7~9.3		195	-20				-10
	HCA-11	10~12.5		205	-15				-5
	HCA-14	12.5~16.3		210	0		0.01	mark	5
L- EC level	30	9.3~12.5		210					0
	40	12.5~16.3		220					5
	5W/30	9.3~12.5		180					-20
	10W/30	9.3~12.5		205		-30			-15
	15W/40	12.5~16.3		210		-25		mark	-10
	20W/40	12.5~16.3		210		-20			-5

Note: Do not mix different grades of oil

3. Coolant

Coolant used for direct cooling of diesel engines in cooling systems should preferably be clean freshwater such as rainwater, tap water, or clarified river water. If well water or other groundwater (hard water) is directly used, the high mineral content may cause scale formation in the engine's water chamber, impairing cooling efficiency and potentially leading to malfunctions. When hard water is unavailable due to limitations, it must be softened before use. Softening methods include: ① Boiling method: Boil water until sediment forms; ② Add 0.67g of caustic soda (sodium hydroxide) per liter of water, stir until sediment settles, then discard the upper layer and use fresh water.

△ Note: It is absolutely not allowed to use seawater to directly cool the diesel engine.

When operating diesel engines in sub-zero temperatures, strict precautions must be taken to prevent coolant freezing and subsequent cracking of critical components. Therefore, after each diesel engine operation, all coolant should be completely drained from all systems. For models equipped with closed-loop cooling systems, appropriate antifreeze coolant with matching freezing point specifications should be selected based on local minimum ambient temperatures. The recommended formulations for common antifreeze coolants are listed in Table 2-3 (for reference).

Anti-freezing coolant formula Table 2-3

Anti-freezing coolant formula Table 2-3

name	ingredient %					condensation point °C ≤
	glycol	ethyl alcohol	glycerol	water	A unit of composition ratio	
Ethylene glycol antifreeze	60			-40	Volume ratio	-55
	55			45		-40
	50			50		-32
	40			60		-22

Alcohol glycerin antifreeze		30 40 42	10 15 15	60 45 43	The ratio of weight	-18 -26 -32
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When using flammable antifreeze coolant, precautions must be taken for fire safety as ethylene glycol and alcohol are highly flammable. Before applying antifreeze coolant to diesel engines, ensure the cooling system is thoroughly cleaned to prevent new chemical deposits that could compromise cooling efficiency. Engines using antifreeze coolant do not require coolant drain after each shutdown, but regular replenishment and component inspections are essential.

△ Note: Never use 100% antifreeze as coolant

When excessive scale or contaminants accumulate in a diesel engine's cooling system, cleaning solution can be used for maintenance. The solution is prepared by mixing water, sodium bicarbonate (Na_2CO_3), and sodium silicate (Na_2SiO_3) at a ratio of 40g sodium bicarbonate to 10g sodium silicate per liter of water. During cleaning, pour the solution into the engine's cooling water chamber. Run the engine until the outlet temperature exceeds 60°C , then continue running it for approximately two hours before stopping. Drain the cleaning solution, wait for the engine to cool completely, rinse twice with clean freshwater, drain thoroughly, refill the system with fresh coolant, and run the engine again until the outlet temperature reaches above 75°C . Finally, stop the engine, drain the contaminated water, and refill with new coolant.

II. Diesel engine opening and inspection

The storage period of the diesel engine manufactured by our company is one year. Especially if the purchased diesel engine exceeds the above storage period from the date of factory delivery, special attention should be paid to the opening inspection before the first use.

- 1) Wipe clean the rust-proof oil applied to the exposed surface of some parts of the installed diesel engine.
- 2) First, fill the machine with about 80°C hot water and let it flow slowly for 5-10min.
- 3) Open the door cover on the engine body and fuel pump, and check whether there is any corrosion or other abnormal phenomenon inside.
- 4) Turn the crankshaft manually slowly, and observe the movement of the connecting rod, fuel pump camshaft and plunger. There should be no sticking or inflexibility.
- 5) Move the speed control handle from low speed to high speed several times, and observe that there is no sticking phenomenon in the movement of the rack and the core sleeve. If the above opening inspection is confirmed to be good, the start can be carried out. Otherwise, it should be used after necessary maintenance.

III. Starting and preheating of diesel engines

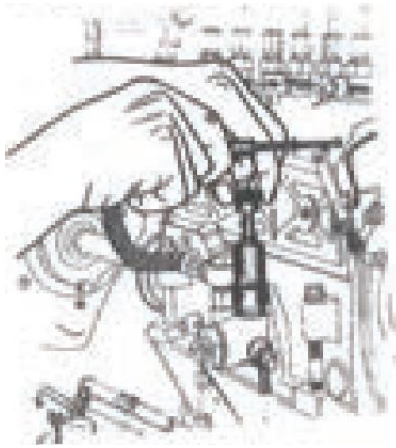
1. Preparations before startup

- 1) Check whether all parts of the diesel engine are normal, whether the connection of accessories is reliable, and eliminate abnormal phenomena.
- 2) Check whether the circuit wiring of the electric starting system is correct and whether the battery is sufficient.
- 3) Add oil to the oil pan to the specified oil level.
- 4) Add coolant to the cooling system. For open circulation cooling system, water source should be connected.
- 5) Add oil to the injection pump and governor to the specified oil level.
- 6) The specified grease should be injected into the place where the butter nozzle is installed.
- 7) Use the hand pump on the fuel pump to pressurize the fuel system with fuel. Then loosen the vent screw on the fuel pump (as shown in Figure 2-1), or loosen the vent plug on the fuel filter to purge air from the system until no bubbles remain in the discharged fuel. Tighten the vent screw or plug afterward. Continue pumping fuel until the return line shows fuel flow, then securely tighten the hand pump.

8) Loosen the nuts on the high-pressure oil pipe joints of each cylinder injector in turn, adjust the speed control, and rotate the diesel engine at the running position to discharge the air in the high-pressure oil pipes

9) For diesel engines equipped with pre-supplied oil pumps, the pre-supplied oil pump should be started first, each time

The operation time should not exceed 30S. If the operation time does not meet the requirements, stop for 30S and repeat it



Next, until the oil pressure gauge reaches 196.6~294.3kPa (2~3kgf/cm²). Figure 2-1 Loosen the screw to remove air from the fuel system

Next, until the oil pressure gauge reaches

10) For new machines or diesel engines that have been parked for more than 5 days, turn the crankshaft 3~5 times before starting.

11) For the diesel engine parked as emergency use, in order to facilitate the rapid start-up and operation in case of emergency, it should be started and tested every 3-5 days during the parking period until the water and oil temperature reaches above 60°C.

△ Note: The diesel engine must be started under no load.

2. Starting the diesel engine

The starting performance of a diesel engine is related to the number of cylinders, compression ratio, ambient temperature at startup, oil specification selected and whether preheating measures are taken. Generally, it can be divided into two types: conventional starting without auxiliary measures and low-temperature starting with auxiliary measures. The following is a description of them.

1) Normal start: The basic type diesel engine can be started smoothly at an ambient temperature not lower than that specified in Table 2-4.

Minimum ambient temperature for normal start-up
Table 2-4
Minimum ambient
temperature for normal start-up Table 2-4

name	FE16G、FE25G、FE27G、FE28G、FE30G
ambient temperature °C	5

① Disconnect the diesel engine from the load linkage device.

② Push the injection pump speed regulator control handle to the no-load position with a speed of about 700r/min.

③ Turn the key to the "Right" position (for 12-cylinder V-type diesel engines), then press the start button to activate the engine. If it fails to start within 12 seconds, immediately release the button and attempt a second start after 2 minutes. Should three consecutive attempts fail, stop the process, identify the cause, resolve the issue, and restart the engine.

④ After successfully starting the diesel engine, immediately release the button and rotate the key to the center position (for 12-cylinder V-type engines, turn it to the "left" position to activate the charging circuit). Monitor the oil pressure gauge to ensure it reads above 0.05kPa (0.5kgf/cm²) within 15 seconds after startup (when engine speed reaches 500r/min). Then let the engine idle at approximately 750r/min for 3-5 minutes to check all components. You may inspect the valve train's moving parts by touching them with your fingers (as shown in Figure 2-2), or open the cylinder head cover to observe the rocker arms' lubrication status. Only after confirming these checks can you proceed with acceleration or load operation.

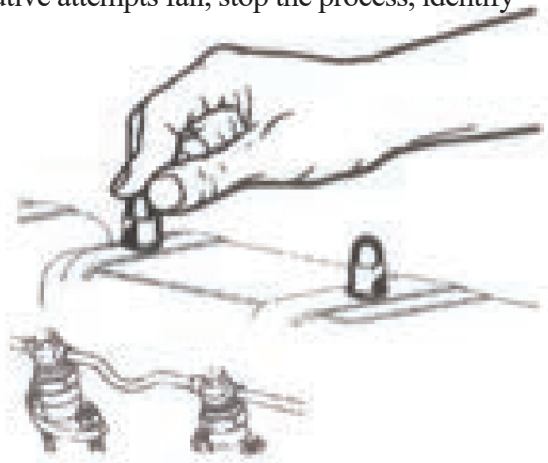


Figure 2-2 Check the working condition of the valve train

2) Low temperature start:

Low temperature start refers to the start-up at a temperature lower than the minimum ambient temperature specified in Table 2-4. At the start-up, users should adopt corresponding low temperature start-up auxiliary measures according to the actual ambient temperature. Then proceed with the conventional start-up steps. The following measures are generally adopted.

① Preheat the oil and coolant of the diesel engine to 60. -80. C.

② Install a device to preheat the intake air in the intake pipe or use a simple ignition method to heat the intake air at the inlet of the intake pipe

- (Be sure to pay attention to safety when using this method).
- ③ Improve the ambient temperature of the computer room.
 - ④ Choose diesel oil, oil and coolant suitable for low temperature.
 - ⑤ Take thermal insulation measures for the battery or use a larger capacity or special low temperature battery.

3. Preheating of diesel engine

After the diesel engine starts, the no-load operation time should not exceed 5min', and then gradually increase the speed to 1000~1200r/min' and enter partial load operation. Full load operation is allowed only when the outlet water temperature of the diesel engine is higher than 75°C, the oil temperature is higher than 50K, and the oil pressure is higher than 0.25MPa(2.5kgf/cm²).

△ Note: Especially after low temperature start, the increase of speed should be as slow as possible to ensure that the bearing is sufficiently lubricated and the oil pressure is stable.

IV. Friction and use of diesel engines

1. Diesel engine running-in

New or overhauled diesel engines must undergo 60 hours of break-in operation before full-load use to optimize component performance, enhance operational reliability, and extend service life. The break-in schedule should be tailored to specific engine models, operational requirements, and towing configurations. Generally, gradually increase engine speed and load in phases as the break-in progresses. During this period, maintain loads at 50-80% of rated power (12-horsepower) while keeping engine speed below 80% of rated speed. However, avoid prolonged idle operation or excessive light-load running during initial break-in stages.

After replacing the cylinder liner, piston, piston ring, connecting rod bearing and crankshaft, short-term running should be carried out appropriately according to the above running conditions.

2. Normal use of diesel engine

After the diesel engine is put into normal use, we should always pay attention to the indicator values of all instruments and observe the dynamic operation of the whole machine; we should often check the cooling system and the liquid level of lubricating oil in each part. If there is any non-conforming requirements or leakage, we should immediately replenish or check the cause to eliminate it.

During operation, especially when the load is suddenly reduced, attention should be paid to prevent the sudden increase of diesel engine speed (commonly known as runaway) due to the failure of the governor beyond the specified value. Once such a situation occurs, emergency stop measures should be taken first, and then the cause should be ascertained.

3. Matching of power between diesel engine and working machinery

When selecting a diesel engine, users must consider not only the power requirements of the associated machinery but also its load characteristics—whether intermittent or continuous operation. Equally important is ensuring operational efficiency through proper coordination between the load's working parameters and the engine's performance. Accurate power calibration and optimal engine-machinery compatibility are fundamental to maintaining reliable, long-lasting, and cost-effective diesel engines. Failure to meet these requirements may lead to overloading, causing unnecessary malfunctions, or insufficient power output due to underutilized capacity. Such inefficiencies are not only uneconomical but can also result in issues like oil leakage.

4. Use of diesel engines in plateau areas

The use of diesel engines in plateau areas is different from that in plain areas, which brings some changes to the performance and use of diesel engines. The following points are for the reference of users who use diesel engines in plateau areas.

1) Due to the low atmospheric pressure and thin air composition in high-altitude regions with reduced oxygen content, naturally aspirated diesel engines face challenges. Insufficient air intake leads to suboptimal combustion conditions, preventing them from delivering their rated power specifications. Although diesel engines share similar basic structures, their rated power varies across different models, resulting in differing operational capabilities at high altitudes. Considering the tendency for delayed ignition under high-altitude conditions, it is generally recommended to advance the fuel injection timing of naturally aspirated diesel engines to enhance operational efficiency.

Due to the increase of altitude, the power decreases and the exhaust temperature rises. Therefore, users should also consider the highland working capacity of diesel engines when selecting diesel engines and strictly avoid overload operation.

According to the test results in recent years, exhaust turbocharging can be used as a high method for diesel engines used in plateau areas. The original power compensation. The exhaust turbocharging can not only make up for the lack of power at high altitude, but also improve the smoke color and restore the power

Can and reduce fuel consumption rate.

2) As altitude increases, the ambient temperature becomes lower than in lowland areas. Generally, for every 1,000 meters elevation gain, the temperature drops by approximately 0.6°C. Additionally, due to the thinning air at high altitudes, diesel engines exhibit poorer starting performance compared to lowland regions. Users should implement auxiliary starting measures specifically designed for low-temperature conditions when operating these engines.

3) As altitude increases, water boils at lower temperatures. Combined with reduced cooling air pressure, decreased air mass for cooling, and increased heat dissipation per kilowatt-hour, the thermal efficiency of cooling systems becomes inferior compared to lowland conditions. In high-altitude regions, open cooling cycles are generally unsuitable. Instead, pressurized closed-loop cooling systems (see Chapter 8) should be employed to elevate the boiling point of coolant fluids during plateau operations.

V. Characteristics of the use of supercharged diesel engines

1. In order to improve the starting performance, the turbocharged diesel engine designed by our company has taken measures to increase the compression ratio.

In some supercharged models, in order to further improve their low temperature starting performance, the intake pipe of the diesel engine is also equipped with an intake preheating device, as shown in Figure 9-13. The use method of preheating at start-up can be seen in Chapter 9.

2. After starting a diesel engine, accelerate only after the oil pressure has risen to prevent damage to the turbocharger bearings. This is especially critical when: 1) the engine has undergone lubricant changes, turbocharger cleaning, filter replacement, or components overhaul; 2) the engine has been idle for over a week. During engine startup, first loosen the turbocharger's fuel inlet connection slightly. Tighten it after lubricant starts flowing freely, then idle for a few minutes before applying full load.

3. The diesel engine should avoid long idling, otherwise it is easy to cause the oil of the turbocharger to leak into the compressor and cause oil spraying in the exhaust pipe.

4. After a new diesel engine or after replacing the turbocharger, it is necessary to remove the fuel pipe joint on the turbocharger and add 50-60mL of machine oil to prevent the turbocharger bearing from being burned out due to lack of oil during starting.

5. Before stopping the diesel engine, it is necessary to run at idle for 2-3min. Under non-special circumstances, sudden stopping is not allowed to prevent the turbocharger bearing from being locked due to overheating of the turbocharger.

6. It is necessary to frequently listen for the sound of collision between the impeller and the housing of the turbocharger when the diesel engine stops. If there is a sound of collision, the turbocharger should be disassembled immediately to check whether the bearing clearance is normal.

7. The sealing of the inlet and exhaust pipes of the turbocharged diesel engine must be maintained, otherwise the performance of the diesel engine will be affected. The loosening of nuts or bolts should be checked regularly, and the clamps of rubber tubes should be tightened. The sealing gasket should be replaced if necessary.

VI. Diesel engine shutdown

1. Normal parking

1) Before stopping, unload the load first, then adjust the speed regulator handle, gradually reduce the speed to about 750r/min, run for 3-5min before turning the stop handle to stop; try not to stop the diesel engine quickly under full load, in order to avoid accidents such as overheating.

2) For 12-cylinder V-type diesel engines, after stopping the engine, rotate the electrical key from "left" to "center" position to prevent reverse current flow in the battery. When stopping for extended periods in cold regions, immediately open the drain valves on the engine block side, freshwater pump, oil cooler (or cooling water pipes), and radiator to drain all coolant and prevent freezing cracks. If using antifreeze coolant, there is no need to open the drain valves.

3) For the diesel engine that needs to be stored for a long time, at the last stop, the original oil should be drained and replaced with sealed oil, and then run for about 2min for sealing. If antifreeze coolant is used, it should also be drained.

2. Emergency stop

In case of emergency or special circumstances, emergency stop can be adopted to avoid serious accidents of diesel engine. At this time, the emergency stop handle should be turned in the direction shown in Figure 2-3 to achieve the purpose.

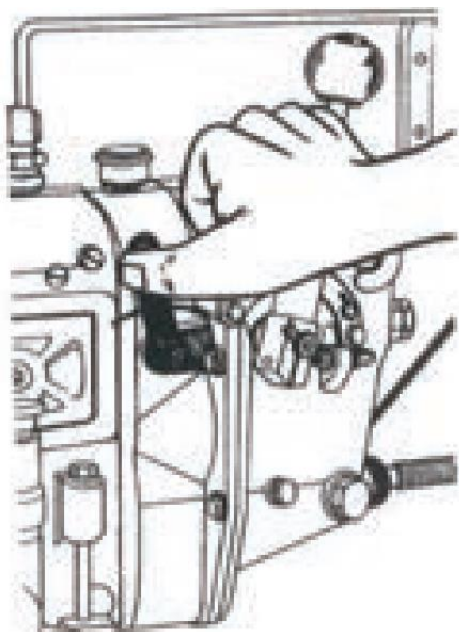


Figure 2-3 Emergency shutdown of type B oil pump

VII. Adjustment and inspection of valve timing

The valve timing refers to the precise control of intake and exhaust valve operation in diesel engines. Accurate adjustment is essential, as improper timing can significantly impact engine performance and may lead to critical failures such as valve-piston collisions, rocker arm fractures, or connecting rod bending. Therefore, valve clearance must be recalibrated after cylinder head reinstallation or tightening of cylinder head nuts. For diesel engines undergoing major overhauls or disassembly and reassembly, the valve timing should also be verified through professional inspection.

1. Adjustment of valve clearance

1) Valve clearance of the company's diesel engine when cold:

name	Intake valve clearance mm	Exhaust gate clearance mm
Non-boosted diesel engines	0.25 ~ 0.30	0.30 ~ 0.35
supercharged diesel engine	0.30 ~ 0.35	0.35 ~ 0.40

2) The cylinder sequence of the inline diesel engine is calculated from the front end (free end) of the diesel engine. The cylinder sequence of the 12-cylinder V-type diesel engine is shown in Figure 2-4. The ignition sequence of the diesel engine is as follows:

name	firing order
Six cylinder inline diesel engine	1-5-3-6-2-4
12 cylinder V left turn diesel engine	1-12-5-8-3-10-6-7-2-11-4-9
12 cylinder V right turn diesel engine	1-8-5-10-3-7-6-11-2-9-4-12

Note: Except for the 12-cylinder V-type right-turn diesel engine used as the main engine of the ship, all the diesel engines are left-turn engines, and their steering is shown in Figure 2-4, that is, the reverse direction is considered from the flywheel end, and the steering of the right-turn engine is opposite to it, and the ignition sequence is also different.

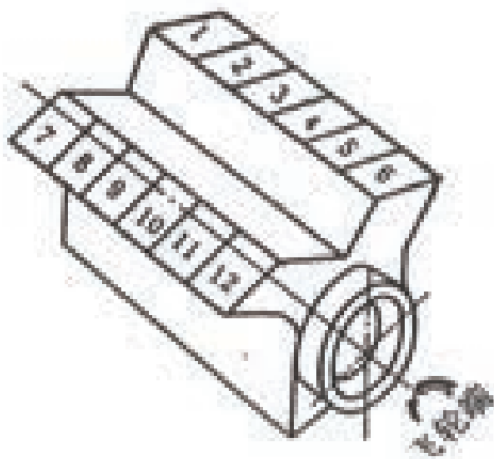


Figure 2-4 Cylinder sequence number of

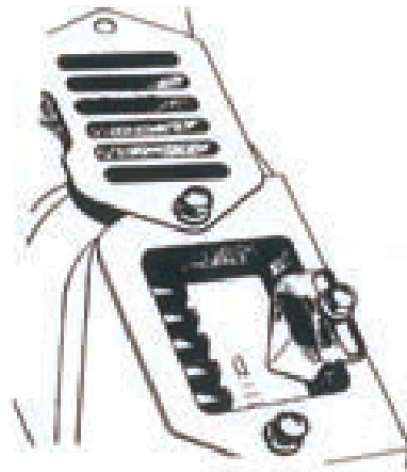


Figure 2-5 Scale lines and pointers on the flywheel

3) Before adjusting the valve clearance, first remove the cylinder head cover. Rotate the crankshaft to align the pointer on the flywheel housing inspection window with the timing "0" mark on the flywheel (as shown in Figure 2-5). During operation, ensure the pointer remains undistorted and stays between the two limit lines on the flywheel housing. At this stage, both cylinders 1 and 6 in V-type diesel engines with 6-cylinder and 12-cylinder configurations will be at top dead center.

To determine which cylinder at the top dead center is at the beginning of the expansion stroke, first remove the fuel pump's side cover plate. Check if the fuel pump plunger spring remains compressed (when properly installed) or gently rotate the crankshaft to observe whether both intake and exhaust valves are stationary. The cylinder where both valves remain stationary when the fuel pump plunger spring is compressed and the crankshaft rotates is identified as the starting position of the expansion stroke.

4) For the company's diesel engine, after determining the starting point of the expansion stroke, the valve clearance can be adjusted according to Table 2-5.

Interrature clearance adjustment table Table 2-5
Interrature clearance adjustment table Table 2-5

name		The cylinder number of the adjustable valve can be adjusted at the beginning of the expansion stroke of the first cylinder piston	The sixth cylinder piston of the 6-cylinder and 12-cylinder engine can adjust the cylinder sequence of the valve at the beginning of the expansion stroke
Six cylinder machine	intake valve	1-2-4	3-5-6
	blast gate	1-3-5	2-4-6
12 cylinder left turn machine	intake valve	1-2-4-9-11-12	3-5-6-7-8-10
	blast gate	1-3-5-8-9-12	2-4-6-7-10-11
12 cylinder right turn machine	intake valve	1-2-4-8-9-12	3-5-6-7-10-11
	blast gate	1-3-5-8-10-12	2-4-6-7-9-11

5) When adjusting valve clearance, first use a wrench and screwdriver to loosen the locking nut and adjustment screw on the rocker arm. Insert a feeler gauge (also known as a micrometer) between the rocker arm and valve according to the specified clearance value. Then adjust the adjustment screw (as shown in Figure 2-6). Stop when the rocker arm and valve contact the feeler gauge but it can still move, then tighten the nut. Finally, repeat the process of moving the feeler gauge once more for inspection.

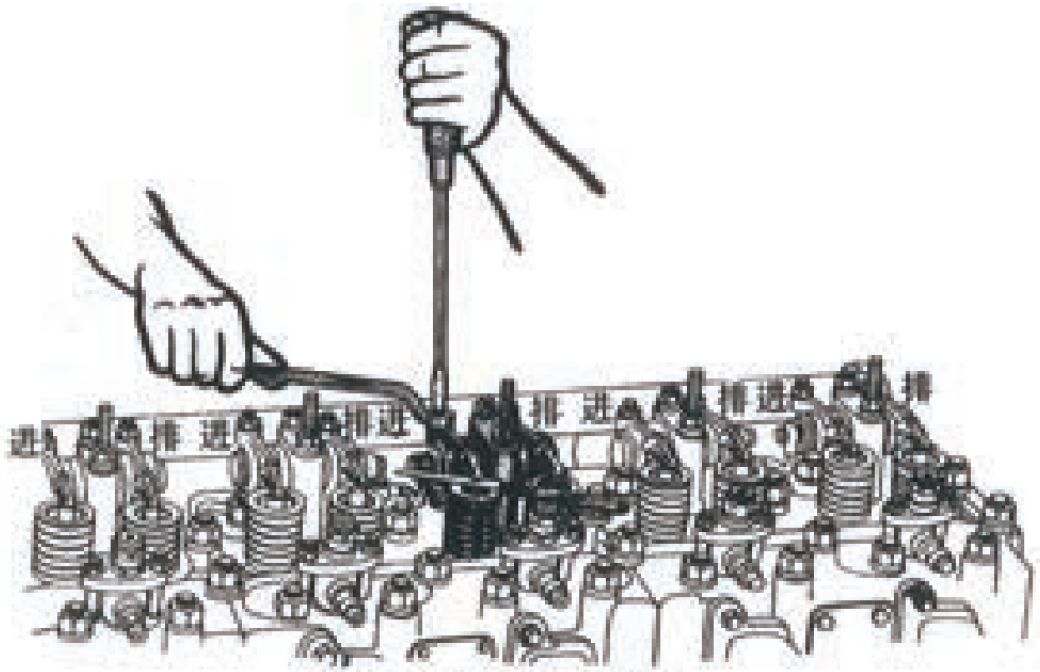


Figure 2-6 Adjustment of valve clearance

2. Check the valve timing

Although the cam structures of our diesel engines share identical dimensions, they employ two distinct valve timing configurations. As illustrated in Figure 2-7, Figure a) is designed for the

1500r/min naturally aspirated and improved turbocharged diesel engines, while Figure b) is specifically engineered for the 1800r/min model. Notably, these two camshaft configurations are not interchangeable. All engine valve timing has undergone pre-assembly verification and remains within specified tolerance limits, eliminating the need for additional checks. However, when timing gears require replacement due to severe tooth surface wear or after reinstallation for other reasons, a re-inspection must be performed.

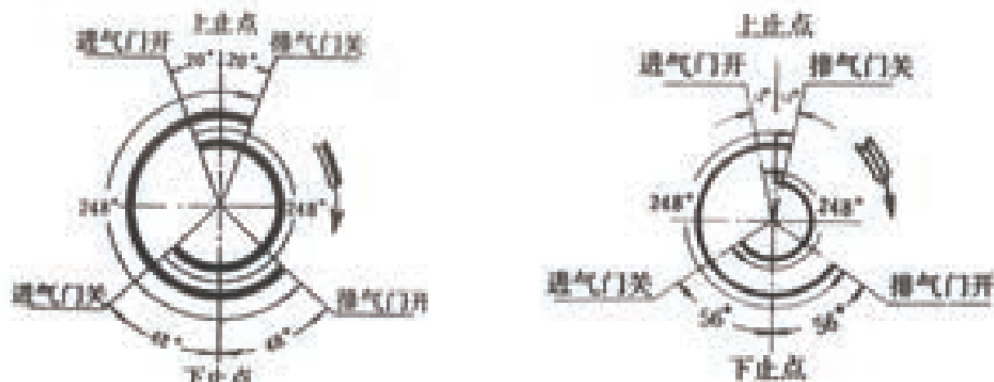


Figure 2-7 Valve timing diagram

1) The inspection of valve timing should be carried out after the adjustment of valve clearance. During the inspection, first install a 360-degree engraved dial at the front end of the crankshaft, and install an adjustable pointer on the front cover plate, then turn the crankshaft,

Align the pointer on the flywheel housing inspection window with the "0" degree line on the flywheel. Adjust the pointer on the front cover plate to align with the "0" degree line on the tachometer dial and secure it. Place a micrometer gauge on the cylinder head cover, positioning its sensing tip against the spring seat of the intake or exhaust valve to be inspected. Rotate the crankshaft according to the tachometer dial's steering arrow and ignition sequence to check each cylinder sequentially (as shown in Figure 2-8). The tachometer dial in the diagram is specifically designed for 6-cylinder and 12-cylinder V-type left-turn diesel engines, where numbers 1', 6', 5', 2', 3', 4' indicate the starting positions of the expansion stroke for each cylinder. For 12-cylinder V-type right-turn engines, the same method should be adapted based on their steering configuration, ignition sequence, and firing interval angle.

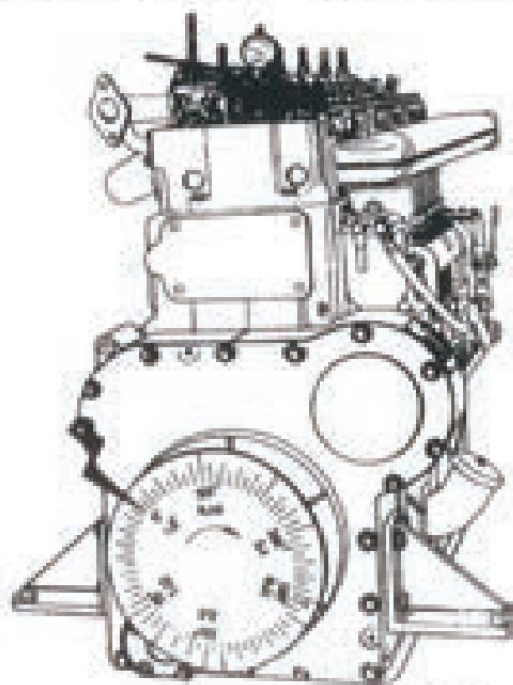


Figure 2-8 Valve timing check

2) For inline diesel engines, inspection is typically required only for the first cylinder. In 12-cylinder V-type diesel engines, both the first and seventh cylinders require examination. The remaining cylinders are controlled by camshafts. During inspection, when the micrometer needle begins to swing (the instant when manual rotation of the push rod ceases), it indicates the valve's initial opening. The angle marked on the tachometer dial at this moment represents the valve lift angle. Subsequently, as the crankshaft continues to rotate, the micrometer needle moves from zero to a maximum value (indicating valve lift) before returning. The instant the needle returns to zero (when manual rotation resumes) marks valve closure, with the angle indicated on the tachometer dial representing the valve closing angle. The angular displacement of the crankshaft from the start of valve opening to its final closure is termed the valve lift duration.

The results of the gas distribution phase inspection shall conform to the values specified in Figure 2-7.

The tolerance is ± 6 .

3) When detecting misalignment in valve timing, first verify the correct installation position of the timing gear, as its positioning between the camshaft and crankshaft is critical. Next, inspect the meshing clearance on the tooth surfaces to ensure compliance with specifications, while checking for severe wear on both the tooth surfaces and the camshaft's surface. If any non-compliance is detected, recalibrate the timing or replace the component before rechecking the valve timing.

VIII. Adjustment of injection advance Angle

In order to achieve good combustion and normal operation of the diesel engine, and to obtain the most economical fuel consumption rate, it is necessary to check and adjust the injection timing every 500h or after each disassembly of the diesel engine. The injection timing of the diesel engine is specified as follows:

name	FE16G	FE25G	FE27G	FE28G	FE30G
Oil injection advance angle (top dead center forward in crankshaft rotation angle)	16~18°	26~28°	26~28°	26~29°	20~22°

1) Method 1: Remove the high-pressure oil line from the first cylinder. Rotate the crankshaft to position the piston at the start of the expansion stroke. Align the pointer on the flywheel housing with the "0" mark on the flywheel. Reverse the diesel engine crankshaft until the indicator window aligns with the angle corresponding to the front injection timing on the flywheel. Loosen the two locking bolts on the fuel injector drive shaft coupling plate. Rotate the fuel injector camshaft in the correct direction until the fuel surface at the first cylinder outlet begins to ripple (as shown in Figure 2-9), then tighten the two bolts on the coupling plate.

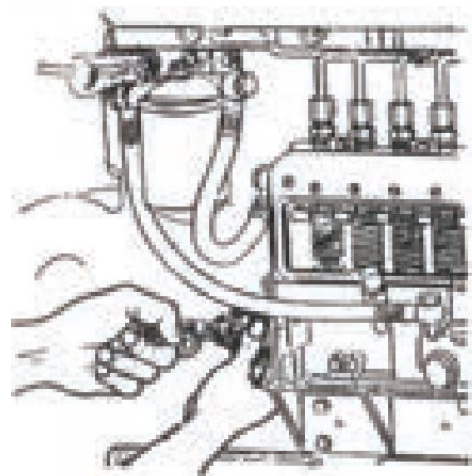


Figure 2-9 Adjustment of injection advance Angle

2) The second method: Remove the high pressure oil pipe of cylinder 1, turn the crankshaft, and make the piston of cylinder 1 at the end of compression 40.

Rotate the crankshaft slowly and evenly in the diesel engine's rotation direction while closely monitoring the oil level at the No.1 cylinder outlet of the fuel injection pump. The moment when the oil surface begins to ripple indicates the start of fuel injection for the first cylinder. At this point, the advance angle value corresponds to the scale reading on the flywheel indicated by the pointer on the inspection window. If the angle deviates from the specified range, loosen the two bolts on the coupling plate and adjust the fuel injection pump camshaft by the required angle (the scale on the drive shaft coupling plate shows 3 degrees per grid). A smaller advance angle causes the camshaft to rotate in the direction of operation, while a larger angle causes it to rotate in the opposite direction. Tighten the bolts on the coupling plate and repeat the verification process until the angle meets the specified range.

Sometimes, the injection timing is very close to the specified value, so there is no need to loosen the joint plate and turn the injection pump camshaft. Instead, just loosen the four installation screws of the injection pump slightly, so that the injection pump body can rotate slightly to adjust. The rotation direction should be opposite to the second type. After adjustment, tighten the screws.

Generally, after the injection advance angle of cylinder 1 is adjusted correctly, the injection advance angle of other cylinders depends on the phase Angle of each camshaft of the oil pump and does not need to be checked separately.

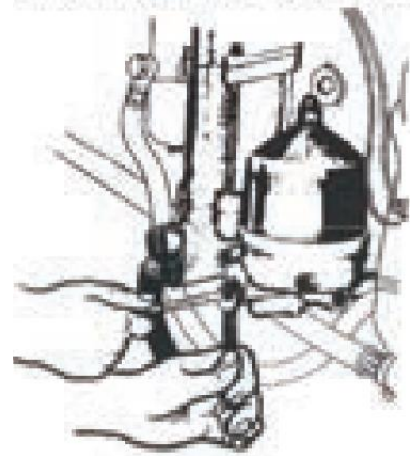


Figure 2-10 Adjustment of oil pressure

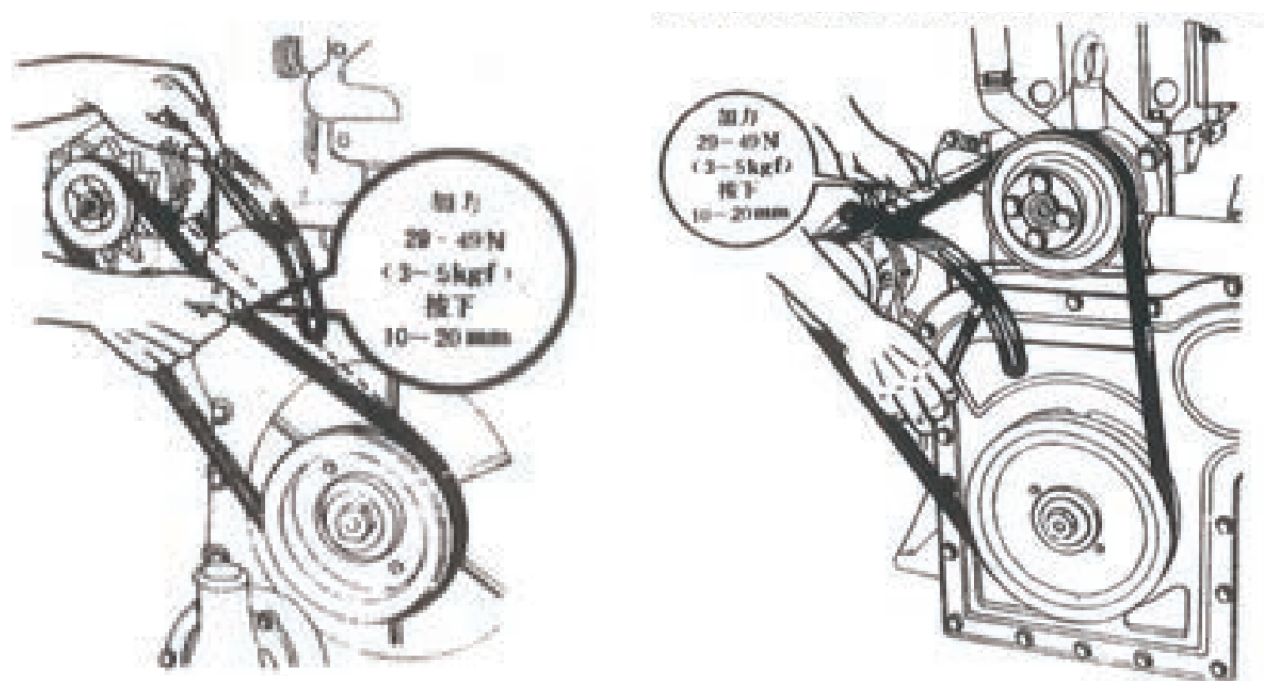
IX. Adjustment of oil pressure

For diesel engines in our company, the oil pressure at rated speed should be 0.25~0.35MPa(2.5~3.5kgf/cm²) where 0.30~0.40MPa (3~4kgf/cm²). The oil pressure at 500~600 °r/min must not be less than 0.05MPa(0.5kg-f/cm²). If the operating pressure deviates from these specified ranges, adjustments should be made promptly. To adjust: First, loosen the sealing nut on the pressure regulator valve and remove the locking nut. Then use a screwdriver to turn the adjustment bolt (as shown in Figure 2-10). Turning the bolt inward increases oil pressure; turning it outward decreases pressure until reaching the specified range. After adjustment, retighten the locking nut and reapply the sealing nut.

X. Adjustment of triangle rubber belt tension

During diesel engine operation, the V-belt should maintain proper tension. Under normal conditions, applying 29-49N (3-5 kgf) pressure to the middle section of the V-belt should allow it to press down 10-20 mm. Over-tightening will accelerate bearing wear in the generator, fan, and water pump systems. Conversely, excessive looseness may prevent driven components from reaching required rotational speeds, leading to reduced generator voltage, decreased airflow from fans, and diminished water pump flow—factors that compromise diesel engine performance. Therefore, regular inspection and adjustment of V-belt tension are essential to ensure optimal operation.

The tension of the triangle rubber belt in a 6-cylinder inline basic diesel engine can be adjusted by changing the position of the charging generator bracket (as shown in Figure 2-11). After the triangle rubber belt is properly tightened, the support bar is fixed.



A) Adjustment of tension of the triangle rubber belt in open cycle cooling B) Adjustment diagram of tension of the triangle rubber belt in closed cycle cooling
A) Adjustment of tension of the triangle rubber belt in open cycle cooling B) Adjustment diagram of tension of the triangle rubber belt in closed cycle cooling

Figure 2-11 Adjustment of triangular rubber belt tension in inline diesel engine

The tension of the rubber belt in the 12-cylinder V-type diesel engine is adjusted by changing the position of the fan shaft on the seat frame using the adjustment screw on the fan frame, as shown in Figure 2-12.

The correct use and tension of the V-belt is beneficial to prolong the service life of the V-belt, which is generally not less than 3500h. When the V-belt is separated and layered and cannot reach the specified tension due to excessive elongation, it should be replaced immediately.

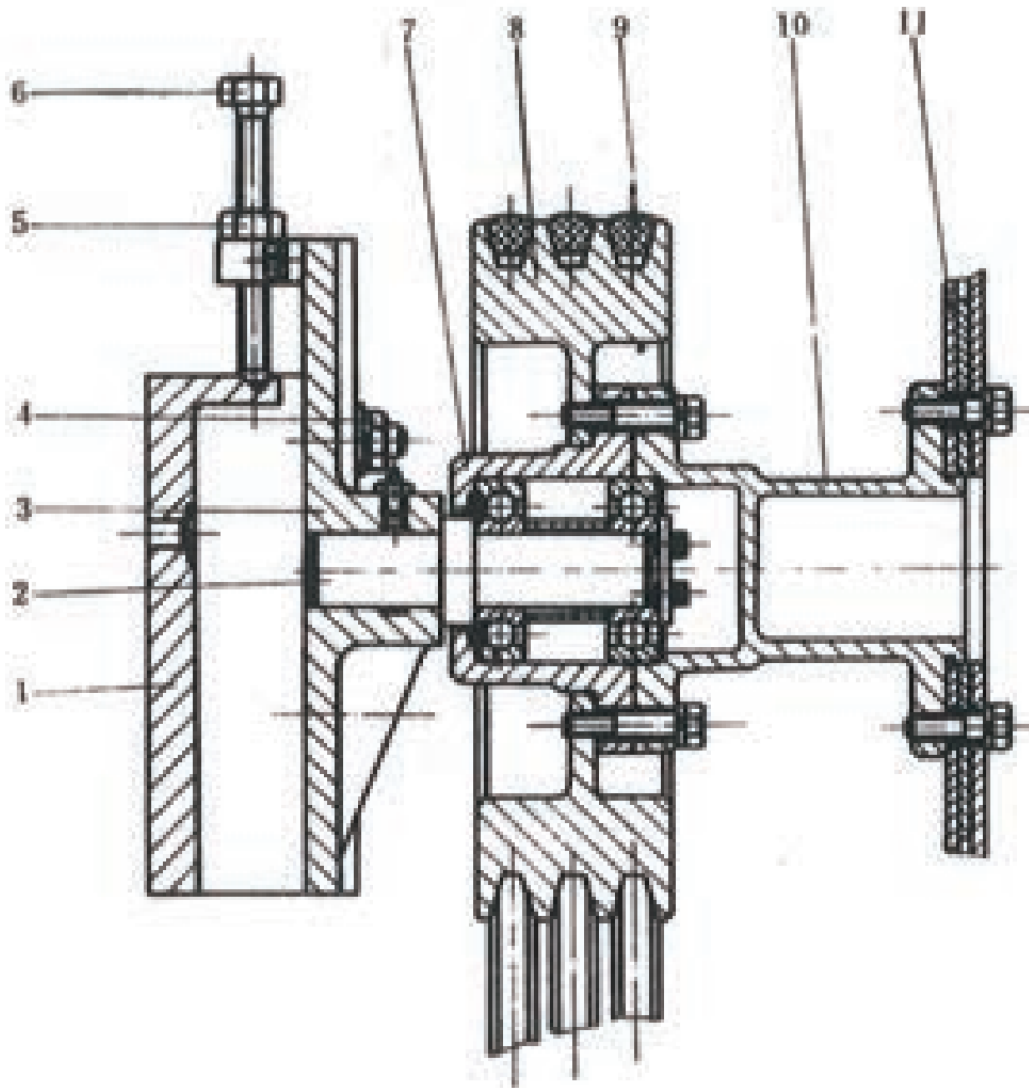


Figure 2-12 Triangular rubber belt tension adjustment device for closed cycle cooling of 12 cylinder V type diesel engine

1-seat frame; 2-fan shaft; 3-adjustment bracket; 4-adjustment bracket locking nut; 5-tension nut; 6-adjustment screw; 7-front bushing; 8-belt pulley; 9-triangle rubber band; 10-rear bushing; 11-fan

When purchasing and replacing V-belts, attention should be paid to the model and length of the new belt being the same as the original V-belt. If a set of more than two identical V-belts is used, they should also be selected with approximately the same actual length. Otherwise, uneven tension in each V-belt may cause damage.

Chapter III Maintenance of diesel engines

Proper maintenance of diesel engines, particularly preventive care, represents the most cost-effective approach to extending service life and reducing operational expenses. The primary step involves maintaining daily operational logs during engine use, enabling timely adjustments and repairs based on detected issues. By integrating this practice with the technical guidelines outlined in this chapter, customized maintenance schedules can be developed according to specific operational requirements and user experience across different applications.

The contents of the daily report generally include the following aspects:

The date and start and end time of each shift; the routine recording of all instrument readings; the use of power; whether there is leakage or excessive consumption of fuel oil, oil and coolant; the color of exhaust smoke and abnormal sound; the situation before and after the occurrence of failure and the handling opinion.

Main contents of maintenance

Users should carry out regular maintenance according to the technical maintenance items listed in this section. The maintenance classification is as follows:

Daily maintenance (per shift);

Level 1 technical maintenance (cumulative work 100h or every month);

Secondary technical maintenance (cumulative work 500h or every six months);

Level 3 technical maintenance (accumulated working 1000~1500h or every year).

Regardless of the maintenance method used, disassembly and reassembly should be conducted systematically with planned procedures. Tools should be used appropriately with controlled force. After disassembly, all components must be thoroughly cleaned and coated with rust preventive oil or grease to prevent corrosion. Special attention should be given to the relative positioning of detachable parts, structural characteristics of non-detachable components, assembly clearances, and adjustment methods. Additionally, the diesel engine and its accessories must be kept clean and intact throughout the process.

1. Daily maintenance

Daily maintenance items and maintenance procedures can be shown in Table 3-1
Daily maintenance items and maintenance procedures can be shown in Table 3-1

order number	Maintenance items	order of procedure
1	Check the fuel tank fuel level	Observe the fuel tank oil level and replenish it as needed
2	Check the oil level in the oil pan	The oil surface should reach the scale mark on the oil gauge. If it is insufficient, add the specified amount
3	Check the oil level of the injection pump governor	The oil surface should reach the mark on the oil gauge, and if not enough, it should be added
4	Check the leakage of water, oil and gas	Eliminate oil leakage and water leakage on sealing surfaces such as oil pipe joints; eliminate air intake and exhaust pipes, cylinder head gasket and turbocharger leakage
5	Check the installation of all accessories of the diesel engine	Including the degree of stability of installation of all accessories, the reliability of the anchor pins and the connection with the working machinery
6	Check all gauges	Check whether the reading is normal, otherwise it should be repaired or replaced in time
7	Check the fuel pump drive disc	Check whether the connecting screw is loose, otherwise, recalibrate the injection advance angle and tighten the connecting screw
8	Clean the exterior of the diesel engine and accessories	Use a dry cloth or a cloth soaked in diesel oil to wipe off the oil, water and dust on the surface of the fuselage, turbocharger, cylinder head cover, air filter, etc.; wipe clean or blow clean the dust on the surface of the charging generator, radiator, fan, etc

2. Level 1 technical maintenance

In addition to the routine maintenance items, additional work is required as shown in Table 3-2

order number	Maintenance items	order of procedure
1	Check battery voltage and electrolyte specific gravity	The specific gravity of the electrolyte should be measured with a hydrometer. As shown in Figure 9-8, the value should be 1.28~1.30 (when the ambient temperature is 20°C), and generally should not be lower than 1.27. At the same time, the liquid surface should be 10~15mm higher than the plate. If not enough, distilled water should be added
2	Check the triangular rubber band The tension of the zhang	Check and adjust the tension of the belt according to the belt tension adjustment method introduced in Chapter 2, as shown in Figure 2-11.2-12
3	Clean the coarse filter screen of the oil pump suction	Remove the large window cover plate of the body, turn off the spring lock of the coarse filter screen, remove the filter screen and put it in the diesel for cleaning, then blow it clean
4	Clean air filter	For inertial oil bath air filter, the steel wool filter element should be cleaned and the oil should be replaced; for basin (cyclone) air filter, the dust on the dust collecting plate should be removed and the paper filter element should be maintained according to the method described in Chapter 10
5	Clean the filter element in the ventilation pipe	Take out the filter element from the fuel pipe on the top cover of the body, clean it in diesel or gasoline, and then install it after soaking in oil
6	Clean the fuel filter	Every 200h, as shown in Figure 6-41 and Figure 6-42, remove the filter element and housing, clean or replace the filter element in diesel or coal oil, and at the same time, remove water and sediment
7	Clean the oil filter	Generally every 200h or so: ① Clean the winding coarse filter element, as shown in Figure 7-6 ② For the scraper filter, turn the handle to remove oil dirt on the surface of the filter element, or put it in diesel for scrubbing, as shown in Figure 7-8 ③ The centrifugal filter rotor is cleaned in diesel oil or kerosene, as shown in Figure 7-10
8	Clean the turbocharger oil filter and inlet pipe	Clean the filter element and pipe in diesel or kerosene, then blow dry to prevent dust and debris from being contaminated
9	Change the oil in the oil pan	According to the use condition of oil (oil dirt and viscosity reduction degree), replace it every 200~300h
10	Add lubricating oil or grease	Apply grease or oil in accordance with the regulations to all oiling nozzles and mechanical tachometer joints
11	Clean the cooling water radiator	Clean water is introduced into the radiator to remove the sediment until it is clean

3. Level 2 technical maintenance

In addition to the first-level technical maintenance items, additional work items are required as shown in Table 3-3

In addition to the first-level technical maintenance items, additional work items are required as shown in Table 3-3

order number	Maintenance items	order of procedure
1	Check the injector	Check the injection pressure, observe the spray situation, and carry out necessary cleaning and adjustment, as shown in Figure 6-45
2	Check the fuel pump	Readjust as necessary, see chapter VI
3	Check valve clearance and injection timing	Adjustments will be made when necessary, as shown in Chapter II
4	Check the sealing of intake and exhaust doors	Remove the cylinder head and observe the sealing and wear of the mating conical surface. If necessary, grind and repair it. See Chapter 5
5	Check for water leakage in the pump	If the water drips into a stream at the overflow port, replace the sealing ring
6	Check the sealing of the cylinder liner seal	Remove the large window cover plate of the body and check whether there is leakage at the lower end of the cylinder liner. If not, remove the cylinder liner and replace the new rubber sealing ring
7	Check the fuel injection plugs on the transmission cover	Remove the front cover plate and check whether the injection port of the injection plug is unblocked. If blocked, clean it up
8	Check the cooling radiator and oil radiator Oil cooler	If there is leakage of water or oil, necessary repairs shall be made, see Chapter VII or Chapter VIII
9	Check the fastening of major components	Check the connecting rod screw, crankshaft nut, cylinder head bolt, etc. Remove them if necessary and retighten them to the specified torque
10	Check electrical equipment	Whether all wire joints are firmly connected, and replace those with burn damage
11	Clean oil and fuel system pipes	This includes cleaning the oil bottom shell, oil pipes, oil cooler, fuel tank and its pipelines, removing dirt and blowing it clean
12	Clean the water pipes of the cooling system	In addition to the cleaning solution introduced in Chapter 2, a solution of 150g of caustic sodium (NaOH) per liter of water can also be filled into the diesel engine cooling system and left for 8-12 hours before starting the diesel engine. The outlet water temperature should be above 75°C, and the cleaning solution should be drained and dry
13	Clean the air and oil passages of the turbocharger	Including cleaning the oil and carbon deposits on the guide wheel, compressor impeller, compressor shell inner surface, turbine and turbine shell

4. Level 3 technical maintenance

In addition to the secondary technical maintenance items, additional work items are required as shown in Table 3-4

order number	Maintenance items	order of procedure
1	Check the cylinder head assembly	Check the valve, valve seat, valve guide, valve spring and push rod If necessary, grind or replace the wear of the mating surface with the rocker arm
2	Check the piston connecting rod assembly	Check the wear of piston rings, cylinder liner, connecting rod end bushing and connecting rod bearing. Replace them if necessary
3	Check the crankshaft assembly	Check the thrust bearing, the wear of the thrust plate, whether there is circumferential movement phenomenon in the inner and outer rings of the rolling main bearing, and replace it if necessary
4	Check the transmission mechanism and valve timing	Check the valve timing (see chapter 2) and observe the meshing surface of the transmission gear Check for wear and measure the meshing clearance. Repair or replace if necessary
5	Check the injector	Check the spray of the injector. If necessary, grind or replace the nozzle pair
6	Check the fuel pump	Check the sealing of the plunger pair and the wear of the fly iron pin, and replace them if necessary
7	Check the turbocharger	Check the clearance between impeller and housing, floating bearings, turbine rotor shaft, gas seal, oil seal and other parts of the wear condition, repair or replace when necessary
8	Check the oil pump and fresh water pump	Remove and inspect vulnerable parts, measure them and adjust them
9	Check the cylinder head and intake/exhaust pipe gasket	If it is damaged or loses its sealing function, it should be replaced
10	Check the charger generator and starter motor	Clean all parts and bearings, blow dry and add new grease, check the wear of starting motor gears and whether the transmission device is flexible

The fitting tolerance and wear limit of the main parts of the diesel engine

Unit: mm Table 3-5m

Unit: mm Table 3-5m

order number	name	regular size	Nature of cooperation	fit tolerance	Hardness limit
1	Crankshaft journal and crankshaft bearing hole	$\Phi 95_{-0.06}^{+0.071}$ $\Phi 95_{-0.020}^{+0.071}$	interval	0.080 ~ 0.151	0.25
2	The front end face of the connecting rod is open at the neck of the crankshaft connecting rod 6 cylinder inline type diesel engine 12 cylinder V type diesel engine	$65_{-0.095}^{+0.196}$ $65_{-0.300}^{+0.100}$ $2 \times 45_{-0.075}^{+0.160}$ $90_{-0.350}^{+0.120}$	end play end play	0.195 ~ 0.495 0.270 ~ 0.670	0.70 0.90
3	Crankpin bushing and crankpin hole Crankpin bushing and crankpin hole	$\Phi 55_{-0.000}^{+0.000}$ $\Phi 58_{-0.080}^{+0.100}$ $\Phi 58_{-0.080}^{+0.100}$	interference interference	0.050 ~ 0.100 0.050 ~ 0.100	
4	Live piston pin and connecting rod small end bushing hole Live piston pin and connecting rod small end bushing hole	$\Phi 48_{-0.010}^{+0.010}$ $\Phi 48_{-0.015}^{+0.050}$ $\Phi 52_{-0.012}^{+0.012}$ $\Phi 52_{-0.035}^{+0.050}$	interval interval	0.035 ~ 0.060 0.035 ~ 0.062	0.15 0.15
5	Rolling bearing outer ring and main shaft bore of the body	$\Phi 280_{-0.035}^{+0.035}$ $\Phi 280_{-0.06}^{+0.02}$	transition fit	Gap 0.015~ Overfill 0.060	
6	Shaft journal and roller bearing inner hole		interference	0.060 ~ 0.105	
7	4G7002136L main bearing roller clearance	$\Phi 180_{-0.060}^{+0.080}$ $\Phi 180_{-0.025}^{+0.025}$	clearance diametral Radial clearance after assembly	0.145 ~ 0.195 0.05-0.12	
8	Crankshaft thrust surface and thrust bearing surface		end play	0.130 ~ 0.370	0.70
9	Crankshaft thrust surface and thrust bearing surface	$\Phi 72_{-0.060}^{+0.030}$ $\Phi 72_{-0.220}^{+0.260}$	interval	0.250 ~ 0.320	0.45
10	Oil outlet is provided in the flange and flywheel housing	$\Phi 225_{-0.030}^{+0.030}$ $\Phi 225_{-0.430}^{+0.550}$	interval	0.450 ~ 0.580	

Supplementary table

order number	name	regular size	Nature of cooperation	fit tolerance	Hardness limit
11	Cylinder bearing and body bearing hole	$\Phi 66^{+0.125}_{-0.030} \begin{smallmatrix} +0.045 \\ 0 \end{smallmatrix}$	interference	0.015 ~ 0.125	
12	Camshaft journal and cam bearing hole 6 cylinder inline type diesel engine 12 cylinder V-type diesel engine	$\Phi 60^{+0.030}_{-0.030}$ $\Phi 60^{+0.030}_{-0.030}$	interval interval	0.050 ~ 0.110 0.070 ~ 0.130	0.25 0.25
13	The first gear journal of the camshaft and the thrust bearing hole	$\Phi 42^{+0.030}_{-0.030}$ $\Phi 42^{+0.030}_{-0.030}$	interval	0.060 ~ 0.110	0.25
14	Camshaft thrust surface and thrust bearing surface 6 cylinder inline type diesel engine 12 cylinder V type diesel engine		end play	0.195 ~ 0.645 0.195 ~ 0.545	1.00 0.80
15	Piston pin and piston pin hole, piston pin and piston pin hole	$\Phi 48 \Phi 48^{+0.012}_{-0.010}$ $\Phi 52 \Phi 52^{+0.012}_{-0.010}$	transition fit transition fit	Gap 0.008~ Overfill 0.014 Gap 0.010~ Overfill 0.017"	
16	Upper piston skirt to cylinder liner, upper piston skirt to cylinder liner	$\Phi 134.64 \Phi 135.040$ $\Phi 134.73 \Phi 135.040$	interval interval	0.360 ~ 0.427 0.270 ~ 0.337	0.75 0.75
17	Piston skirt lower part and cylinder liner, piston skirt lower part and cylinder liner	$\Phi 134.76 \Phi 135.040$ $\Phi 134.82 \Phi 135.040$	interval interval	0.240 ~ 0.307 0.180 ~ 0.247	0.75 0.60
18	The first air ring and the groove	$\Phi 3^{+0.0015}_{-0.0010}$	end play	0.100 ~ 0.135	0.25

19	The second air ring and the groove	$3_{+0.000}^{+0.0015}$	end play	0.080 ~ 0.115	0.22
20	The third gas ring and groove	$3_{+0.000}^{+0.0015}$	end play	0.070 ~ 0.105	0.20

Supplementary table

order number	name	regular size	Nature of cooperation	fit tolerance	Hardness limit
21	Oil ring and groove	$6^{+0.0180}_{-0.0000}$	end play	0.060 ~ 0.098	0.18
22	First air ring (chromed ring)		A gap in the opening	0.600 ~ 0.800	2.00
23	The second and third gas rings		A gap in the opening	0.500 ~ 0.700	2.00
24	oilring		A gap in the opening	0.400 ~ 0.600	2.00
25	The upper positioning shoulder of the cylinder liner is positioned with the upper positioning hole of the engine block	$\Phi 155^{+0.034}_{-0.0000}$ $\Phi 155 \ 0$	interval	0.043 ~ 0.146	
26	The lower locating shoulder of the cylinder liner is positioned with the lower locating hole of the engine block	$\Phi 154^{+0.083}_{-0.0000}$ $\Phi 154^{+0.0630}_{-0.0000}$	interval	0.043 ~ 0.146	
27	Pusher sleeve and body 4. 6 cylinder inline diesel engine	$\Phi 40^{+0.039}_{-0.0000}$ $\Phi 38^{+0.039}_{-0.0000}$	interval	0.050 ~ 0.124	0.25
	12 cylinder V type diesel engine	$\Phi 38^{+0.039}_{-0.0000}$	interval	0.050 ~ 0.124	0.25
28	Exhaust valve seat and cylinder head	$\Phi 54^{+0.030}_{-0.0000}$ $\Phi 55^{+0.030}_{-0.0000}$	interference	0.045 ~ 0.105	
29	Intake valve seat and cylinder head	$\Phi 62^{+0.030}_{-0.0000}$ $\Phi 65^{+0.030}_{-0.0000}$	interference	0.045 ~ 0.105	
30	Valve duct and cylinder head	$\Phi 19^{+0.023}_{-0.0000}$ $\Phi 20^{+0.023}_{-0.0000}$	interference	0.007 ~ 0.060	
31	Valve stem and valve guide	$\Phi 12^{+0.040}_{-0.0000}$ $\Phi 12^{+0.040}_{-0.0000}$	interval	0.057 ~ 0.101	0.20
32	Exhaust gate rod and valve guide	$\Phi 12^{+0.040}_{-0.0000}$ $\Phi 12^{+0.040}_{-0.0000}$	interval	0.065 ~ 0.109	0.20
33	Shaft and rocker arm	$\Phi 26.8^{+0.007}_{-0.0000}$ $\Phi 26.8^{+0.007}_{-0.0000}$	interval	0.030 ~ 0.087	0.20
34	Gear oil pump drive shaft and bushing	$\Phi 18^{+0.060}_{-0.0000}$ $\Phi 18^{+0.060}_{-0.0000}$	interval	0.036 ~ 0.078	0.15
35	Oil pump driven shaft and driven gear hole	$\Phi 18^{+0.027}_{-0.0000}$ $\Phi 18^{+0.027}_{-0.0000}$	interval	0.030 ~ 0.082	0.15

36	Oil pump gear end face and cover plate		end play	0.050 ~ 0.115	adjustable
37	Oil pump body and gear	$\Phi 48^{+0.09}_{-0.075}$ $\Phi 48^{+0.09}_{-0.075}$	interval	0.150 ~ 0.275	0.40

Supplementary table

order number	name	regular size	Nature of cooperation	fit tolerance	Hardness limit
38	Oil pump gear and oil pump drive gear		backlash	0.12 ~ 0.35	adjustable
39	Fresh water pump impeller and pump body		end play	0.330 ~ 1.770	
40	Fresh water pump impeller and pump hom Direct-type diesel engine pump with triangular rubber belt drive. Direct-type diesel engine pump with gear drive V type diesel engine pump		end play end play end play	0.060 ~ 0.800 0.200 ~ 1.000 0.200 ~ 0.800	adjustable adjustable adjustable
41	Quadrature gear and timing idler gear		backlash	0.08 ~ 0.350	0.50
42	Timing idler gear and fuel pump transmission gear		backlash	0.08 ~ 0.350	0.50
43	凸轮shaft gear and timing idler gear		backlash	0.08 ~ 0.350	0.50
44	Bearings on the oil filter rotor and shaft	$\Phi 12^{+0.018}_{-0.012}$	interval	0.045 ~ 0.094	0.20
45	Oil filter rotor lower bearing and shaft turbocharger section:	$\Phi 15^{+0.018}_{-0.015}$	interval	0.045 ~ 0.094	0.20
46	Compressor impeller (import) and housing		clearance diametral	0.40 ~ 0.61	
47	Axial movement of turbine compressor rotor			0.15 ~ 0.20	
48	At the turbine end, there is an axial clearance between the compressor end elastic sealing ring and the annular groove			0.10 ~ 0.22	
49	The elastic seal ring closes the gap in the seat hole			0.15 ~ 0.25	
50	Intermediate shell bore diameter (turbine end)	$\Phi 26^{+0.013}_{-0.008}$			26.025
51	Intermediate shell bore diameter (compressor end)	$\Phi 26^{+0.013}_{-0.008}$			26.025
52	Floating bearing inner diameter	$\Phi 18^{+0.008}_{-0.004}$			18.08
53	Floating bearing outer diameter	$\Phi 26^{-0.013}_{-0.008}$			25.85
54	Floating bearing length	$12^{-0.05}_{-0.008}$			11.92
55	Thrust plate thickness	$2.5^{-0.02}_{-0.008}$			2.47
56	Thrust bearing thickness	$5.5^{-0.03}_{-0.008}$			5.43
57	Turbo rotor shaft neck (bearing section)	$\Phi 18^{-0.08}_{-0.008}$			17.985
58	Turbine and compressor end shaft seal groove width	$4.1^{+0.08}_{-0.008}$			4.25
59	Spring force seal ring thickness	$2^{-0.02}_{-0.008}$			1.95

60	The diameter of the seat hole of the gas seal plate at the compressor end	$\Phi 26^{+0.033}_0$			26.06
61	Orifice of sealing ring seat in middle shell of turbine end	$\Phi 26^{+0.013}_0$			26.05

Chapter IV Common faults and troubleshooting methods of diesel engines

If the diesel engine is faulty, the operator should be calm and careful, analyze the characteristics of the fault in time, and judge the cause of the fault. Generally, the following principles should be followed:

- 1) When there is an abnormal phenomenon in the operation of the diesel engine, you can use "look, listen, touch, smell" and other comprehensive judgment which part or which system has a fault.
 - "Look" --observe the readings of various instruments, exhaust smoke color and water and oil changes;
 - "Listen" --use a long metal rod or wooden handle as a "stethoscope" to touch the corresponding parts of the diesel engine's outer surface and "listen" to the sounds and changes of moving parts;
 - "Feeling" --check the working condition of parts such as the air distribution mechanism and the vibration of the diesel engine by finger feeling;
 - "Smell" --by the sense of smell, to smell out any abnormal odor in the diesel engine.
- 2) When the diesel engine suddenly fails or the cause of the fault has been determined, and the fault will affect the normal operation of the diesel engine, it should be stopped in time for inspection. For the fault that cannot be immediately found out, the diesel engine can be run at low speed and empty first, and then observe and analyze to find out the cause, so as to avoid greater accidents.
- 3) When it is judged to be a large fault or the diesel engine suddenly stops by itself, it should be disassembled and maintained in time.
- 4) The causes and troubleshooting methods of each failure, especially the big failure, should be recorded in the diesel engine's operation book for reference during the next maintenance.

The common faults and troubleshooting methods of diesel engines listed in this chapter are only for the reference of operators. In actual work, we should flexibly grasp the internal and external causes of the faults according to the specific conditions and practical experience at that time and place, "treat the symptoms" and eliminate them in time.

I. Common faults in the process of diesel engine use

1. The diesel engine cannot start

order number	Fault characteristics and causes	Method of exclusion
1	Fuel system failure: The diesel engine is driven by the starting motor and there is no return oil in the return oil pipe. (1) There is air in the fuel system (2) Fuel line blockage (3) Fuel filter blockage (4) The oil pump does not supply oil or supplies oil intermittently (5) The oil is rarely sprayed, or the oil cannot be sprayed or the oil is not atomized (6) The position of the injection pump speed regulator handle is wrong	Check if the fuel line connections are loose and purge air from the fuel system. First, loosen the drain bolts on both the fuel pump and filter. Use a hand pump to deliver fuel until no bubbles appear in the overflow, then tighten the drain bolts. Repeat this process until fuel returns through the return line, at which point secure the hand pump. Loosen the nut on the high pressure oil pipe at one end of the injector, pry up the plunger spring seat of the injection pump. After the fuel oil flowing out of the pipe has no bubbles, tighten the nut and pry up several times again. In this way, each cylinder is filled with fuel oil Check whether the pipeline is unblocked Clean the filter or replace the filter element Check whether the oil inlet pipe is leaking and whether the filter screen on the oil inlet pipe joint is blocked. If no oil is supplied after elimination, check the oil inlet pipe and oil pump Remove the injector and connect it to the high pressure oil pump. Pliers the plunger spring of the injector and observe the spray condition. If necessary, remove and check the injector and adjust the injection pressure to the specified range on the injector test bench or replace the injector couple When starting, push the handle position to the empty load, and the speed is about 700~900r/min

Supplementary table

order number	Fault characteristics and causes	Method of exclusion
2	Power start system failure: (1) Circuit wiring error or poor contact (2) Battery power is insufficient (3) The starting motor brush does not contact or has poor contact with the commutator	Check whether the wiring is correct and secure Use a battery with sufficient power or add batteries in parallel Refurbish or replace the carbon brush, clean and blow off the surface of the commutator with wood sandpaper, or adjust the pressure of the brush spring
3	Insufficient compression pressure in the cylinder: normal fuel injection but no spark, fuel in the exhaust pipe (1) Excessive wear of piston rings or cylinder liners (2) Valve leakage (3) The gas storage gap or combustion chamber volume is too large	Replace the piston ring and replace the cylinder liner according to the wear condition Check the valve clearance, valve spring, valve guide and valve seat for sealing. If the sealing is not good, repair and grind it Check whether the piston belongs to the model. If necessary, measure the air storage gap or combustion chamber volume
4	The injection timing is too early or too late, even 180 degrees apart. The diesel engine does not ignite or stops after ignition	Check whether the scale on the coupling disc of the fuel pump drive shaft is correct or loose, and readjust if it does not meet the requirements
5	The gas distribution phase is not correct	Check the valve timing according to the method in Chapter 2
6	The ambient temperature is too low: the ignition does not occur for a long time after starting	According to the actual ambient temperature, take corresponding low temperature starting measures

2. The power of the diesel engine is insufficient

order number	Fault characteristics and causes	Method of exclusion
1	Fuel system failure: Power or speed cannot be increased after increasing the throttle (1) The fuel line and fuel filter are air or blocked (2) The fuel pump is not supplied enough (3) The atomization of the injector is poor or the injection pressure is low	Exhaust air or replace the fuel filter element in accordance with the above method Check, repair or replace the pair Make a spray observation or adjust the injection pressure, and check the nozzle pair or replace it
2	Fault of intake and exhaust system: the temperature is higher than normal and the smoke color is poor (1) Air filter blockage (2) The exhaust pipe is blocked or the pipe is too long, the turning radius is too small, and there are too many bends	Clean the air filter element or remove dust from the paper filter element, and replace it if necessary; and check whether the oil level is normal Remove the carbon deposits in the exhaust pipe; reinstall the exhaust pipe, and the elbow should not be more than three, and have a large enough exhaust section
3	Advance injection angle or intake and exhaust phase change: performance deteriorates at all speeds	Check whether the two screws at the transmission shaft of the fuel injection pump are loose, and tighten them after adjusting the fuel injection advance angle. Check the valve phase and valve clearance if necessary
4	Diesel engine overheating, ambient temperature is too high: oil and coolant water temperature is very high, exhaust temperature is also greatly increased	Overhaul the cooler and radiator, remove the scale; check whether the relevant pipeline is too small. If the ambient temperature is too high, improve the ventilation and temporarily strengthen the cooling measures
5	Cylinder head assembly failure: not only the power is insufficient, the performance is reduced, but also there are air leakage, black smoke from the intake pipe, abnormal knocking sound and other phenomena (1) Leakage at the joint surface between the cylinder head and the engine block occurs during shifting, and a stream of air is blown out from the gasket: the large stud nut of the cylinder head is loose or the gasket is damaged (2) Leakage of intake and exhaust doors (3) Valve spring damage (4) The valve clearance is incorrect (5) The injector hole leaks or its copper gasket is damaged; the piston ring is stuck and the valve stem is bitten, resulting in insufficient cylinder compression pressure	Tighten the large stud nut or replace the cylinder head gasket according to the torque specified. If necessary, scrape the joint surface Remove and inspect the intake and exhaust valves, and grind the mating surfaces of the valves and valve seats Replace the damaged spring Recheck the valve clearance to the specified value Remove, inspect, clean and replace damaged parts

Supplementary table

order number	Fault characteristics and causes	Method of exclusion
6	The connecting rod bearing and the connecting rod journal surface of the crankshaft have abnormal sound, and there are phenomena such as oil pressure drop	Remove the side cover of the diesel engine, check the lateral clearance of the big end of the connecting rod, and see whether the big end of the connecting rod can move forward and backward. If it cannot move, it indicates that the shaft is bitten, and the shaft neck should be ground and the connecting rod bearing should be replaced
7	Turbocharger failure: reduced speed; reduced intake pressure; air leakage or abnormal sound, etc (1) The turbocharger bearing is worn and the rotor has a collision phenomenon (2) The intake pipe of the compressor and turbine is contaminated, blocked or leaking	Overhaul and replace bearings Clean the air inlet, shell and clean the impeller; tighten the joint surface nuts, clamps, etc

3. There is abnormal noise when the diesel engine is running

order number	Fault characteristics and causes	Method of exclusion
1	Too early injection: a rhythmic, crisp metallic knock is heard in the cylinder	Adjust the injection advance angle. See Chapter 2 for the method
2	Too late injection: a low, unclear knock is heard in the cylinder	ditto
3	The piston pin is too loose in the bearing bushing hole of the connecting rod head: there is a slight and sharp noise when turning, which is especially clear at high speed	Replace the small end bushing of the connecting rod to make it within the specified clearance range
4	Excessive clearance between piston and cylinder liner: impact sound is heard on the outer wall of cylinder body during operation, and the impact sound intensifies when the speed increases	Replace the piston or replace the cylinder liner depending on wear
5	Wear of connecting rod bearing causes excessive clearance: During operation, the sound of impact can be heard in the crankcase. When the speed is suddenly reduced, a heavy and powerful impact can be heard	Remove and inspect the bearing bushing. Replace it if necessary
6	The radial clearance of the crankshaft rolling main bearing is too small: a particularly sharp and harsh sound is heard during operation, and the sound becomes clearer when the throttle is increased; the radial clearance of the crankshaft rolling main bearing is too large: a "hollow" sound is heard during operation	Check the rolling main bearing for noise and replace it if necessary
7	The front and rear thrust bearings of the crankshaft wear, and the axial clearance is too large, resulting in the front and rear movement of the crankshaft: when the diesel engine idles, the collision sound of the front and rear movement of the crankshaft can be heard	Check the axial clearance and thrust bearing wear, replace if necessary
8	The valve gate spring is broken, the push rod is bent, and the push rod sleeve is worn: a rhythmic and slight knocking sound is heard at the cylinder head	Replace the damaged parts and adjust the valve clearance according to the method described in Chapter 2
9	Piston with valve cover: During operation, a heavy, uniform and rhythmic knocking sound is heard at the cylinder head. When you gently pinch the nut of the cylinder head cover with your finger, you can feel the collision	Remove the cylinder head cover, check the cause of collision and adjust the valve clearance. If necessary, check whether the piston model is wrong. If there is a collision, you can dig the valve groove deeper or add a purple copper gasket with a thickness of 0.20mm or 0.40mm and the same shape as the bottom surface of the cylinder head
10	Transmission gear wear, excessive tooth clearance: abnormal sound at the front cover plate, impact sound can be heard when the speed is suddenly reduced	Adjust the tooth clearance and replace the gear according to the wear condition
11	No oil between the rocker adjustment screw and the ball seat of the push rod: A "squeak" of dry friction is heard at the air cover	Remove the cylinder head cover and fill with oil
12	Too much clearance: A loud rhythmic sound is heard at the cylinder head	To reset the valve clearance, see Chapter 2
13	There is an abnormal scraping sound when the turbocharger is running	Check whether the bearing is worn and whether the impeller blade is bent. At the same time, measure the main clearance and adjust and replace the damaged parts. Clean the oil filter of the turbocharger and the inlet and outlet oil pipeline to ensure the smooth flow of lubricating oil.

4. Abnormal exhaust smoke color

order number	Fault characteristics and causes	Method of exclusion
1	Black smoke from exhaust: (1) The load of the diesel engine exceeds the specified value (2) The oil supply of each cylinder is not uniform (3) The valve clearance is not correct and the valve sealing is poor, resulting in valve leakage and combustion deterioration (4) The injection advance angle is too small, and the injection is too late, so that part of the fuel oil burns in the exhaust pipe (5) Insufficient air intake: air filter or intake pipe blockage, turbocharger compressor housing is too dirty, etc (6) The spring seal ring of the turbocharger is burned or worn, and air leakage occurs at each joint surface of the turbocharger	Adjust the fuel pump to reduce the load within the specified range Adjust valve clearance, check sealing cone surface and eliminate defects Adjust the injection advance angle. See Chapter 2 for the method Clean and remove dust and dirt, replace the filter element if necessary, check or replace the air seal ring; tighten the joint surface screws
2	Exhaust with white smoke: (1) The atomization of the fuel injected by the injector is poor, there are oil dripping and the injection pressure is too low (2) When the diesel engine starts, some cylinders do not burn (especially in winter)	Check the nozzle pair and grind or replace it. Re-adjust the injection pressure to the specified range. Increase the speed and load appropriately and run for a longer time
3	"Blue smoke from the exhaust: (1) The air filter is blocked, the air intake is not smooth, or there is too much oil in the oil bath air filter (oil bath air filter) (2) The piston ring is stuck or worn too much, and the elasticity is insufficient. When installing, the chamfer direction of the piston ring is reversed, so that the oil enters the combustion chamber	Check and clean the air filter, reduce the oil to the specified plane. Check and remove the piston rings, replace them if necessary
	(3) Long-term low load (less than 40% of the rated power) operation, the gap between the piston and the cylinder liner is large, so that oil is easy to enter the combustion chamber (4) Too much oil is added to the oil bottom shell	Appropriate increase the load; when supporting, select the appropriate power and add oil according to the oil scale line
4	Condensation of water in the exhaust: cracks in the cylinder head allow coolant to enter the cylinder	Replace the cylinder head

5. The oil pressure is abnormal

order number	Fault characteristics and causes	Method of exclusion
1	The oil pressure is low, and the pressure regulating valve is not adjusted properly. At the same time, the pressure gauge reading fluctuates: (1) Oil pipe leakage (2) Air is injected into the oil pump and the oil in the oil pan is insufficient (3) The crankshaft thrust bearing, the oil seal at the output flange end of the crankshaft, and the camshaft bearing and connecting rod bearing are seriously leaking oil (4) The connecting oil pipe between the rocker shaft is broken, and the oil nozzle of the lubrication transmission gear is missing or fallen off (5) Oil cooler or oil filter blockage, coolant oil pipe rupture, etc.: oil leakage or blowing sheet at the oil seal pad	Check and tighten the nut Add oil to the specified level Check all parts, and replace them when the wear value exceeds the specified range Repair or replace after disassembly and inspection Clean, weld or replace the core in time. If aluminum chips are found in the centrifugal oil fine filter, it indicates that the alloy layer of the connecting rod bearing is peeling off, and the connecting rod bearing should be disassembled and inspected in time, and the damaged one should be replaced; check and replace the sealing gasket in time
2	No oil pressure, pressure gauge needle is stationary: (1) The oil pressure gauge is damaged (2) Oil passage blockage (3) The oil pump is seriously damaged or stuck due to improper assembly (4) The oil pressure regulating valve is faulty and its spring is damaged	renewal Clean after maintenance and cleaning After disassembly and inspection, adjust the clearance and make oil pump performance test. Replace the spring and grind the sealing surface of pressure regulating valve

6. The oil pressure is too high and the consumption is too large

order number	Fault characteristics and causes	Method of exclusion
1	The oil temperature gauge reading exceeds the specified value, and remains high after strengthening cooling, while black smoke is emitted from the exhaust (1) Diesel engine overload (2) Oil cooler or radiator blockage (3) The cooling water or fan air volume is insufficient (4) Insufficient oil capacity (5) The temperature indicator is not accurate	decrease of load Clean the oil circuit of the cooler or radiator Ensure that the cooling water is unimpeded and adjust the tension of the rubber belt to make the pump and fan reach the specified speed Add oil to the specified level Check or replace
2	The oil level in the oil bottom shell drops rapidly, the oil color is black, the air pipe and the filling port emit white smoke, and the exhaust pipe emits blue smoke: (1) The oil grade used is not appropriate (2) The piston rings are stuck or worn too much, and the cylinder liner is worn too much to let the oil into the combustion chamber and the gas into the crankcase (3) The oil return hole of the piston upper oil ring is blocked by carbon deposits (4) The elastic sealing device of the turbocharger of the supercharged diesel engine fails (5) Long-term low load operation	Select according to the grade specified in Chapter 2 Replace the piston ring and replace the cylinder liner if necessary Clean the carbon deposits or replace the oil ring Check whether the sealing ring is sintered and elastic failure, otherwise replace it and increase the load appropriately

7. The oil level plane of the oil bottom shell is raised

This is because the cooling water enters the oil, the oil floats yellow foam, and there is water vapor condensation on the surface of the air pipe filter element.

order number	Fault characteristics and causes	Method of exclusion
1	The cylinder liner seal ring is damaged and leaking	Replace the water seal
2	The cylinder liner is leaking at the joint with the engine block	Check whether the joint surface between the cylinder liner shoulder and the body is smooth, and replace the damaged purple copper washer
3	The cylinder liner leaks due to pitting and perforation	Replace the new cylinder liner
4	The cylinder head gasket is damaged and leaking	Replace the gasket
5	The water-cooled oil cooler core is damaged, causing the cooling water and oil to mix	Remove the oil cooler core or replace it
6	Cooling water from the freshwater pump leaks into the oil pan: (1) The shaft and seal of the fresh water pump leak (2) The rubber ring sealing the water of the fresh water pump is damaged	Overhaul or replace the water seal, grind the sealing surface and replace it
	The cavity wall of the body is eroded and leaks water (especially on the cylinder wall near the push rod)	The small holes of pitting corrosion can be carefully welded or sealed, but the mating surface should not be damaged and deformation should not occur. If the corrosion is serious, the body should be replaced

8. The outlet water temperature is too high

order number	Fault characteristics and causes	Method of exclusion
1	Air in the water pipe: after the diesel engine starts, the outlet water pipe does not produce water or very little water, and the water temperature keeps rising	Remove the temperature gauge joint on the water pipe, release all the air until the water outlet is smooth, and tighten all the joints in the water pipe
2	Insufficient circulating water: under high load, the outlet water temperature is too high, and the oil temperature also rises (1) The speed of the fresh water pump or fan cannot be reached (2) The impeller of the fresh water pump is damaged (3) The gap between the impeller and the housing of the fresh water pump is too large (4) In the open cycle, the water level of the water source is too low for the fresh water pump to suck up water (5) In the closed cycle, the radiator water is insufficient (6) Water pipe blockage	Adjust the tension of the triangular rubber band to the specified value and replace it Adjust the gap to the specified value Raise the water level of the source Add cooling water Clean the pipes and remove the scale in the cooling water channels
3	In closed circulation, too much scale on the radiator surface area affects heat dissipation	Remove dirt and clean the surface
4	One thermostat is out of order	renewal
5	The water temperature gauge is incorrect	Repair or replace
6	There is a crack at the shoulder of the cylinder liner: at this time, there is a bubble phenomenon in the coolant in the radiator	Replace the cylinder liner

9. The outlet water temperature is too low

order number	Fault characteristics and causes	Method of exclusion
1	In an open cycle, water is fed directly into the diesel engine	Add a mixing tank according to Figure 1-18
2	The thermostat is not flexible or damaged	renewal
3	Low ambient temperature and low service load	Appropriate load increase
4	The water temperature indicator is incorrect	Check or replace

10. Organic oil in cooling water

order number	Fault characteristics and causes	Method of exclusion
1	The water-cooled oil cooler core is damaged	Overhaul or replacement

11. Common faults of electric start system components

order number	Fault characteristics and causes	Method of exclusion
1	The starter motor does not turn: (1) Poor contact of the connecting wire (2) Brush contact is poor (3) The starting motor itself is short circuit (4) The battery is not fully charged or the capacity is too small (5) The contact of the electromagnetic switch is poor	Clean and tighten the connector Clean commutator surface or replace brushes Find out the short circuit and repair it Charge or add the battery well for use, otherwise replace the new battery Check the switch contact and polish it with sandpaper
2	Start the motor idling without starting power: (1) The brush and connector are in poor contact or the solder is off (2) Bearing sleeve wear (3) Local short circuit of magnetic field winding or armature winding (4) The contact of the electromagnetic switch is burned and the contact is poor (5) The battery is not fully charged or the capacity is too small, and the line voltage drop of the starting motor is too large	Clean the surface, weld or replace change for new Find out the short circuit and repair it Check the switch contacts and polish them with sandpaper Charge or update, increase the wire section or shorten the length
3	The starter motor gear and flywheel ring top teeth cannot be removed or the starter motor gear cannot be removed: (1) The starter is not parallel to the center of the flywheel gear ring (2) The contacts of the electromagnetic switch are burned together	Restart the starter to eliminate the misalignment Check the switch contacts and file down the rough areas
4	The start button is disengaged and the start motor continues to operate: (1) The moving contact of the electromagnetic switch is burned with the connecting screw (2) The adjustment screw of the ST614 starting motor is not adjusted properly	examine and repair readjust
5	The charger generator does not generate electricity or the current is very small: (1) Silicon diode, magnetic coil, rotor coil open circuit or short circuit (2) The regulator voltage is lower than the battery voltage (3) The excitation circuit is open or short circuit (4) The rubber belt is worn or the tension is insufficient (5) The charging ammeter is damaged (6) The line is connected incorrectly	Replacement and repair Adjust the voltage to the specified range shown in Table 9-3 and connect the disconnected wire Change or adjust the tension change for new Check and correct the wrong wiring
6	Unstable charging current: (1) The carbon brush is contaminated, worn or in poor contact, and the carbon brush spring pressure is insufficient (2) The silicon diode is loose at the press-fit position (3) The internal components of the regulator are welded off or the contact is poor (4) The rubber belt is loose (5) The wiring head is loose	Clean the surface, weld or replace it, replace it with the radiator assembly, re-solder or polish it with No.0 sandpaper and readjust the tension Check and tighten
7	The charging current is too large and the voltage is too high, and the generator is hot (1) Magnetic field wiring short circuit or magnetic field coil inter-turn short circuit (2) Short circuit of rotor coil and contact with stator (3) The voltage is too high (4) The emitter and collector of the power tube in the final stage of the transistor regulator are short circuit (5) The magnetizing coil in the vibration voltage regulator is broken or short circuit and the additional resistance is burned out	examine and repair Maintenance, use a lithium knife to touch the surface and adjust it to the specified value Replace the power tube Overhaul or replacement
8	Generator noise: (1) Bearing loosening or fragmentation (2) The rotor and stator collide	renewal File off the surfaces that touch each other
9	The battery cannot be charged, the output current is not large and the voltage drop is very large, and there are white crystals (lead sulfate) on the plate	Special treatment according to the method described in Chapter IX
10	The temperature is high, the voltage is low and the specific gravity is low when the battery is charged. If the bubble is small or the bubble is late in the end of charging, it indicates that the battery has an internal short circuit	If the battery is short circuit due to too much sediment at the bottom of the battery, the battery can be discharged, the electrolyte can be poured out, and then recharged after repeated cleaning with distilled water. If there are other reasons, the partition or plate should be removed and replaced, or sent to the relevant factory for repair

II. Common faults of fuel supply and speed control system

1. Common faults of oil pump

order number	Fault characteristics and causes	Method of exclusion
1	The injection pump does not spray oil: (1) There is no diesel oil in the fuel tank (2) Air enters the fuel system (3) Fuel filter or oil pipe blockage (4) The oil pump is out of service and no oil is supplied (5) The plunger pair is stuck (6) The sealing between the oil outlet valve seat and the plunger is not good	Add diesel in time Loosen the oil discharge screw such as the fuel pump, pump oil with a hand pump, remove air and clean, wash the paper filter element or replace it. After cleaning the pipeline, blow it clean and check the oil pump for troubleshooting. Remove the plunger pair for grinding or replacement Remove and polish, otherwise replace"
2	Uneven oil supply: (1) There is air in the fuel line and the oil supply is intermittent (2) The oil outlet valve spring breaks (3) The oil valve seat surface is worn (4) Plunger spring fracture (5) Impurities block the plunger (6) Too small oil pressure (7) Adjust the loosening of the gear ring	Use a hand pump to drain air renewal Grind repair or replacement renewal wash Check whether the oil inlet joint filter screen and fuel filter of the oil pump are blocked, and clean and maintain them regularly Tighten the screw against the factory mark
3	Insufficient oil output: (1) Oil leakage of oil valve pair (2) The oil inlet joint filter screen or fuel filter is blocked (3) Plunger pair wear (4) Oil pipe joint leakage	Grind repair or replacement Clean the filter screen or core Replace the new plunger coupleg and retighten or overhaul

2. Common faults of speed regulator

order number	Fault characteristics and causes	Method of exclusion
1	Unstable speed (trolley) (1) Uneven oil supply from each sub-pump (2) Carbon and oil dripping in the nozzle hole (3) The connecting pin of the rack rod is loose (4) The axial clearance of the camshaft is too large (5) The plunger spring or the oil valve spring is broken (6) The fly iron pin hole is worn and loose (7) Adjust the gear. The gap between the rod and the adjusting gear is too large or there are burrs between them (8) The adjustment of the rack or throttle pull rod is not flexible (9) Air in the fuel system (10) The fly iron is not flexible to open or the fly iron seat is not flexible to open (11) Improper adjustment of low speed	Re-adjust the oil supply of each cylinder. Clean, grind or replace it. Repair or replace it Adjust to the specified gap value and replace Replace bushings and fly iron pins and readjust the assembly Repair or reassemble, drain air by hand pump, check and correct Retune the low speed stabilizer or low speed limit screw
2	The specified speed cannot be reached: (1) Permanent deformation of speed regulating spring (2) The fuel supply of the injection pump is insufficient (3) The handle is not pulled to the end	Adjust or replace Handle the fault according to the oil pump troubleshooting method. Check and adjust the control lever mechanism
3	Minimum idle speed cannot be reached: (1) The handle is not fully depressed (2) The adjusting gear rod and the adjusting gear ring are slightly rolled (3) Too many low speed stabilizers or low speed limiting screws are screwed in	Check and adjust the control lever mechanism until it is flexible readjust
4	Flywheel: The governor suddenly fails, making the speed exceed the rated speed by more than 110% (1) Too high speed (2) The gear rod or throttle pull rod is stuck (3) The connecting pin between the gear rod and pull rod is loose (4) The pull rod screw falls off (5) Speed adjustment spring fracture	The diesel engine should be stopped immediately by stopping fuel supply or cutting off air intake. Check each part, remove the high speed limit screw and readjust the lead seal Reinstall or replace, reinstall or replace

3. Common faults of oil pump

order number	Fault characteristics and causes	Method of exclusion
1	Insufficient oil transmission: (1) Check valve wear or fracture (2) Piston wear (3) Oil pipe joint leakage (4) The filter screen at the oil inlet joint is blocked	Grind or replace renewal Retighten or repair Clean the filter screen
2	Oil leakage from the top rod	examine and repair
3	The piston is stuck and the oil is cut off	Remove and repair the mill
4	Hand pump oil and gas leakage	Disassemble and repair

4. Common faults of fuel injectors

order number	Fault characteristics and causes	Method of exclusion
1	Little or no oil is sprayed: (1) Air in the fuel system oil circuit (2) The nozzle pair is stuck (3) The oil supply of the injection pump is abnormal (4) Oil leakage in high pressure oil pipe (5) Wear of nozzle pair	Remove air from low or high pressure oil lines Grind or replace Find out the cause and deal with it according to the troubleshooting method of the oil pump. Tighten the nut, and replace the oil pipe if there is a crack renewal
2	Low injection pressure: (1) The voltage regulating screw is loose (2) Voltage regulating spring deformation (3) Needle valve sticking (4) Spring seat, push rod and other parts wear	Adjust to the specified pressure according to the provisions of Chapter VI, and tighten the locking nut for adjustment or replacement Clean or grind Repair or replace
3	Too high injection pressure: (1) The spring force of the voltage regulating spring is too high (2) Needle valve sticking (3) nozzle blockage	Re-adjust to the specified pressure in accordance with Chapter VI. Clean or grind Clean the nozzle or replace it
4	Oil leakage from the injector: (1) The voltage regulating spring breaks (2) The grinding surface of needle valve body is damaged (3) Needle valve bite (4) Tightening deformation of the cap (5) The plane of the injector body is worn	Replace with a new spring renewal Clean, sharpen or replace. Replace Grind or replace
5	Poor oil spray atomization: (1) Low oil pressure (2) The nozzle seat surface is worn or burned (3) There is garbage on the mating surface of the nozzle pair	Adjust to the specified pressure and grind or replace Clean in time
6	Oil injection line: (1) Nozzles are blocked (2) Excessive wear of needle valve seat surface (3) Needle valve bite	Use steel wire with diameter of 0.2- 0.3mm to unclog the nozzle and replace the new needle valve body Clean, grind or replace
7	The needle valve surface is burnt or blue-black (overheating of diesel engine)	Check the cooling system and replace the couplings. Do not overload the diesel engine for a long time

III. Common faults of exhaust turbocharger

order number	Fault characteristics and causes	Method of exclusion
1	The diesel engine cannot produce the specified power (1) Bearing wear (2) Contamination of compressor impeller and volute flow channel (3) Leakage of turbine intake shell (4) Too much carbon is accumulated on the back of the turbine and compressor impeller and the sealing ring	Change and clean Check the seal and remove any leakage Check the sealing condition, eliminate the leakage phenomenon, disassemble and clean
2	The exhaust color of the diesel engine is abnormal, and the exhaust is black smoke (inadequate air intake) (1) The compressor partial flow channel is contaminated (2) Compressor leakage	wash Check the seal and eliminate leakage
3	Blue smoke is coming from the exhaust (1) The spring sealing ring loses its elasticity or is excessively worn (2) The oil return channel of the intermediate shell is blocked or the pipeline is deformed	renewal Clean and repair the deformed parts
4	Abnormal sound and vibration (1) The compressor is out of balance and the turbocharger vibrates with a large amplitude (the compressor channel, intake pipe and turbine outlet channel are seriously contaminated, which is one of the causes of out of balance) (2) Improper assembly (loss of dynamic balance of turbine and compressor rotor or collision between rotating parts and fixed parts) (3) The blades of the turbine impeller or compressor impeller are damaged by foreign matter (4) The deformation of the turbine shell causes collision and friction (5) Foreign matter in the bladeless volute channel can be heard as abnormal sound when the diesel engine idles	wash disassembling inspection Replace and check the intake and exhaust system of the diesel engine. Find out the cause of deformation and eliminate it Remove the cross section of the inspection passage and check the intake and exhaust systems of the diesel engine
5	The turbine compressor rotor is not rotating or not flexible; severe carbon deposits are found in the turbine, compressor back and spring seal ring seat	Clean and check the diesel engine combustion failure and oil leakage
6	Bearing burn and rotor friction (1) The lubricating oil is too dirty, the oil pressure is too low or the oil circuit is blocked (2) The oil inlet temperature is too high (3) Dynamic balance failure or improper assembly of turbine and compressor rotor (4) Excessive exhaust temperature and supercharged turbocharger (5) Turbine shell deformation	Check the lubrication system and clean the filter Find out the reason to reduce the oil temperature Remove, disassemble, check and balance the rotor. Replace the rotor assembly if necessary Check whether the diesel engine and exhaust pipe have serious leakage, deformation, blockage and so on, repair and clean Find out the cause of deformation and eliminate it



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