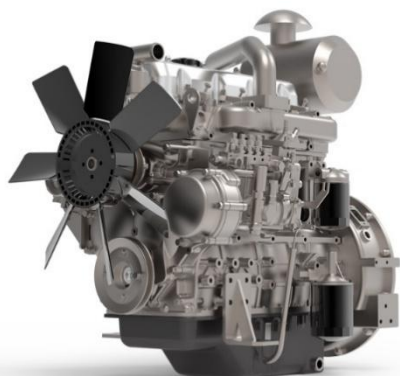




SDEC POWER

Z
SERIES

POWER
GENERATION ENGINES



G-DRIVE POWERPACK

Power Generation Specification

OPERATION & MAINTENANCE MANUAL

Power Output Range

16kW – 88kW

STAGE II EMISSION COMPLIANT

FOR USE IN THE FOLLOWING TERRITORIES ASIA MIDDLE EAST AND AFRICA

Z SERIES DIESEL ENGINE

MODELS	MAX ENGINE OUTPUT		RATED GENERATOR OUTPUT	
	Prime kW	Standby kW	Prime kVA	Standby kVA
4Z2.3-G21 (1500 rpm)	16	18	15	17
4Z2.3-G21 (1800 rpm)	21	23	20	21
4Z2.7-G21 (1500 rpm)	22	24	20	23
4Z2.7-G21 (1800 rpm)	26	29	25	28
4Z3.0-G21 (1500 rpm)	27	30	25	28
4Z3.0-G21 (1800 rpm)	30	33	30	33
4Z3.2-G21 (1500 rpm)	32	35	31	35
4Z3.2-G21 (1800 rpm)	38	42	40	44
4ZT3.2-G21 (1500 rpm)	39	44	40	44
4ZT3.2-G21 (1800 rpm)	42	46	44	48
4ZT3.5-G21 (1500 rpm)	49	54	50	55
4ZT3.5-G21 (1800 rpm)	60	66	63	69
4ZTAA4.1-G21 (1500 rpm)	64	70	72	75
4ZTAA4.1-G21 (1800 rpm)	76	83	80	88
4ZTAA4.1-G22 (1500 rpm)	74	81	80	83
4ZTAA4.1-G22 (1800 rpm)	80	88	81	89

Generator outputs calculated using nett engine power at 0.8 power factor, at an altitude below 1000 m.a.s.l, and 40 degree Celsius ambient temperature.
Refer to outputs and ratings table for exact site conditions.

TABLE OF CONTENTS

1	Introduction	3
1.1	To User and Operator.....	3
1.2	Scope of use	3
1.3	Notice to users about product quality	3
1.4	Notice to users about product quality	3
1.5	Notice to users about product quality	3
1.6	Precautions for the use of diesel engines	5
1.7	Warning marks on the diesel engine	7
2	Diesel Engine Overview	8
2.1	Outline drawing of diesel engine	8
2.2	Model identification of diesel engine	16
2.3	Diesel engine nameplate	16
2.4	Diesel engine technical specifications	17
3	Diesel engine installation and connection	19
3.1	Diesel engine installation	19
3.2	Diesel engine connection	19
4	Diesel engine use	20
4.1	Diesel fuel	20
4.2	Engine oil	21
4.3	Coolant	21
4.4	Diesel engine and work machinery power matching	21
4.5	Diesel engine starting	22
4.6	Diesel engine running	23
4.7	Diesel engine parking	24
4.8	Break-in of new diesel engine or diesel engine after overhaul	24
5	Diesel engine maintenance	25
5.1	Diesel engine maintenance plan	25
5.2	Diesel engine maintenance records	26
5.3	Diesel engine maintenance content and methods	27
6	Diesel Engine Troubleshooting Guide	33
6.1	Overview	33
6.2	Diesel Engine Troubleshooting	33
7	Preservation after oil engine shutdown	47
7.1	Short-term shutdown preservation	47
7.2	Long-term outage preservation	47

1. INTRODUCTION

1.1 To Users and Operators

Thank you for purchasing a product of Shanghai Diesel Engine Co.,Ltd!

This manual provides detailed information on the technical specifications, operation, and maintenance guidelines for this series of diesel engines. It is intended to help users understand the product and ensure proper use and maintenance. Users are advised to read this manual carefully before operating the diesel engine. Due to the continuous improvement of the product performance and structure, the technical specifications and illustrations listed in this manual may be slightly different from the actual product in use, which will be supplemented and improved by our company in future editions. In case of any questions during your engine operation and maintenance, please never hesitate to contact SDEC's after-sales service center spare@sdecie.com for technical advice or guidance.

The authorized service stations are located all over China, providing repair services and spare parts supply, and the maintenance personnel are professionally trained.

If the diesel engine is transferred or sold, this manual should be transferred to the new user with the diesel engine.

1.2 Scope of use

This manual is suitable for supporting power station series diesel engines.

1.3 Users to reflect the quality of the product information

In order to facilitate our company to understand and analyse the quality of the product and its causes of failure, improve the quality of the product in a timely manner, and better serve the users, we would like to ask the users to explain the following matters when reflecting the quality of the product.

1. The time and place of failure.
2. The diesel engine factory number (engine number), model, order number, delivery date, the exact address of the recipient.
3. The conditions of use of the diesel engine, the cumulative time of work (hours), the state of work (power, speed), the fuel used and the grade of oil.
4. The characteristics of the driven equipment (model, power consumption, structural characteristics, etc.)
5. Description of the failure phenomenon.
6. The parts or components to be compensated or overhauled should be sent or brought to our company for analysis, together with a record or description of the damage process. If the user finds more problems or the problem is particularly serious, the site should be maintained and informed in time, and our company will send staff to analyse it together.

The treatment of diesel engine quality problems is in accordance with the relevant provisions of the quality warranty manual.

1.4 Product after-sales service commitment

To do a good job of after-sales service and reduce the loss caused to users due to the quality problems of the products, Shanghai Diesel Engine Co.,Ltd has established a 24-hour repair processing system. Users can get timely and professional consultation and after-sale service from Shanghai Diesel Engine Co.,Ltd.

1.5 Important safety precautions

All safety precautions and warnings should be carefully read and understood before using and regularly maintaining the engine. The following safety precautions and warnings must be observed or personal injury may result.

- Always be alert when operating the engine and stop working if you feel unwell or mentally ill.
- No smoking when operating the engine.
- Do not smoke when refilling fuel, as fuel vapor burns easily.
- Do not smoke when checking the battery electrolyte level, as the electrolyte can release flammable gases.
- Do not wear bulky clothing and remove all accessories when working around the engine or its drive unit. If necessary, wear protective eyewear, work clothes, helmets or other protective gear.
- To prevent fires during operation, the generator set must be kept at a distance of more than 1 meter from buildings and other equipment when in use.
- The exhaust gas of the engine contains carbon monoxide and other components harmful to the human body, and there is a risk of exhaust gas poisoning when operating in poorly ventilated places. If the engine is operated indoors, the exhaust gas must be discharged to the outside, and make sure that there is no exhaust gas leakage from the connection of the exhaust pipe, etc.
- If the exhaust system parts are equipped with protective devices or heat shields, they must not be removed; if the exposed rotating parts are equipped with protective shields, they must not be removed either, otherwise they may cause injuries to people. In order to prevent personal accidents, the marine equipment manufacturer must install protective devices for exhaust tail pipe and exhaust muffler and it is recommended to install protective devices for exposed rotating parts such as drive belt pulley and screen winder.
- No combustible materials such as fuel, lubricating oil, coolant, gunpowder and other dangerous items should be placed around the engine. There is a risk of fire or explosion.
- Fuel, oil or coolant that spills outside should be wiped away. Fuel, lubricant or coolant can cause a fire hazard if it catches fire. Store rags with oil or coolant in fireproof containers and do not place them on the engine.
- To remove dirt, mud, foreign objects, etc. on or around the engine. This can be the cause of fire or engine overheating. - Before starting the engine, make sure there are no people around the engine and no tools or other objects on the engine. Never start the engine when there is a "No Start" warning sign on the starter switch, etc.
- If you find fuel, oil or exhaust leaks, take immediate measures to stop the leak. If fuel or lubricating oil splashes on the hot parts of the engine, or if exhaust gas comes in contact with combustible materials, it may cause a fire, a personal accident or a risk of damage to the engine.
- Do not check for engine leaks by hand, as high-temperature, high-pressure fuel, lubricant and coolant can harm humans. Be especially careful when checking for leaks in high-pressure fuel lines, as fuel under high pressure can be injected into the skin and cause personal injury or death. A thick plate should be used to check for fuel leaks and avoid direct contact with the fuel emitted when a fuel leak is found.
- When testing fuel, lubricating oil, cooling water or battery electrolyte, use explosion-proof lighting if lights are required to avoid the risk of ignition and explosion.
- Do not smoke or use open flames when handling or working near any fuel system related components. Fuel vapours can ignite and cause damage to parts or risk of personal injury.
- Do not service any parts of the fuel system while the engine is running.
- Diesel fuel flows from the injection pump to the injectors through the high-pressure fuel line at ultra-high pressure.
- Do not loosen any high-pressure fuel lines while the engine is running, failure to observe this warning
- Failure to follow this warning can result in serious burns.
- When the engine is out of service for a long period of time or needs to be serviced, remove the engine and battery connection wires, and in the case of air start motors, remove the air connection lines to prevent the engine from starting accidentally. At the same time must be hung in the operating room or control parts of the "no running" sign. When removing the battery terminals, always start with the (-) terminal side. When installing, always start from the (+) terminal side first.
- The two terminals of the battery should not be contacted by tools and other metal objects, and the positive and negative terminals of the battery should not be short-circuited, which may cause the risk of combustion and explosion.
- The battery terminals should be firmly connected. If the terminals are loose, there is a risk of explosion if the contact is poor and fire is generated. Damaged cables and wires can cause a fire. Check and replace before reconnecting.
- Do not use open flame or welding work near the battery. Flammable hydrogen and oxygen are generated in the battery, and there is a risk of fire if an open flame is used in the vicinity of the battery. Stop using the battery when the electrolyte is below the lowest level. Improper use of electrolyte can cause blindness or scalding accidents.
- If you run the engine indoors, always have a fire extinguisher and keep it in working condition. Be familiar

with the use of fire extinguishers. The first aid kit should be kept in a specified place and be immediately available in case of need. Measures to deal with fires and accidents should be specified, as well as the place and method of contact in case of first aid. Do not use carbon tetrachloride fire extinguishers, which not only emit toxic gases, but also damage the insulation of electrical wires with their liquid.

- When adding or replacing coolant or adding special battery fluid, avoid contact of cooling water or electrolyte with skin and eyes. If it comes into contact with the skin, rinse the skin with soap and water as soon as possible, and if it gets into the eyes, rinse the eyes with plenty of water for 15 minutes and go to the hospital immediately.
- When refilling coolant, be careful to prevent vapor injury. Only when the coolant temperature is below 50° C, slowly loosen the pressure cap on the radiator to depressurize the cooling system, and then refill. If the end cap is opened, steam or hot water may be emitted and there is a risk of scalding if the cooling water is hot when the engine had just stopped. After checking the coolant level, adding coolant or replacing coolant, make sure to tighten the filler cap.
- When the engine is running, the temperature of the intake and exhaust system is high, so do not touch the exhaust pipe, exhaust tail pipe, supercharger, medium cooler intake pipe, expansion tank and other high temperature parts with your hands. Do not open the radiator fluid filler cap when the engine is running as the cooling water temperature is very high. If you open the radiator filler cap, there is a risk of scalding from steam or hot water.
- If the fan belt breaks, stop the engine immediately, otherwise the engine will overheat and the coolant in the expansion tank will form a steam jet, which may cause a risk of scalding.
- When draining the lubricating oil or replacing the oil filter, do not use your hands directly. High temperature oil or parts can burn the skin on your hands.
- Before removing or loosening any lines, fittings, connections, or related parts, relieve pressure in the system to which they belong, such as the air system, cooling system, lubrication system, or fuel system. Otherwise, high-pressure fuel, oil and coolant can be harmful to humans.
- Do not approach rotating parts while the engine is running. Do not place objects around rotating parts that can easily be caught. Serious personal accidents can occur if your body or tools are caught in the rotating parts.
- Always stop the engine before adjusting the engine and its drive unit. Caught in a rotating part can cause a major accident.
- Do not use the fan part of the engine crankshaft as this could cause serious personal injury or damage to the fan blades.
- When working on parts of the engine that cannot be reached by hand, do not stand on the engine or use your feet to prop up the parts on the side of the engine, but stand on a stable and reliable workbench and be careful not to slip and fall; do not use a parts box or tool box as a substitute for a workbench. Careless work methods will not only damage engine parts but also cause personal accidents.
- Used lubricants may contain carcinogenic ingredients and can cause regenerative toxicity. Avoid breathing or prolonged contact with lubricant vapors. Dispose of used oil in an appropriate and safe manner.
- To prevent asphyxiation or frostbite, always wear protective clothing when removing air conditioning refrigerant (Freon) lines and always do so in a well-ventilated environment. To protect the environment, refrigeration systems must be emptied or filled with special equipment to prevent the spread of Freon to the atmosphere. The refrigerant should be recovered and recycled.
- In order to protect the environment, when replacing lubricating oil, lubricating oil filter, fuel filter or coolant, the discharged lubricating oil or coolant, replaced lubricating oil filter or fuel filter should not be disposed of casually, but should be disposed of according to the relevant environmental protection regulations. The disused battery should also be disposed of according to the relevant environmental protection regulations.

1.6 Precaution for Diesel Engine use

Before using and regularly maintaining the engine, you should read and understand all the precautions and warnings for engine use and maintenance.

The following precautions must be observed, otherwise engine failure or damage may result.

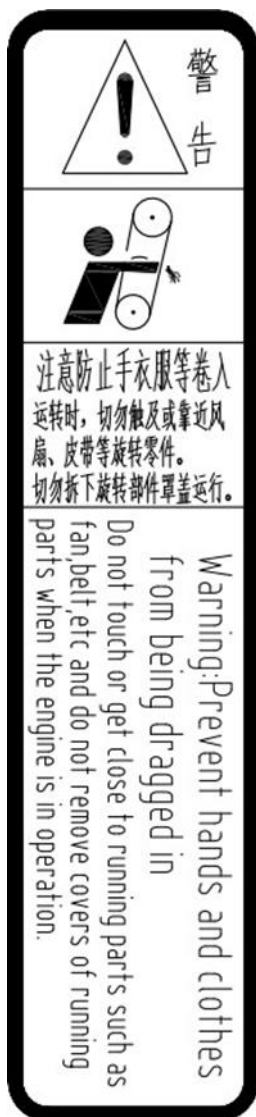
- Read this manual carefully and strictly follow the operating procedures and maintenance procedures specified in this manual.

- Should strictly comply with the provisions of this manual, carry out routine maintenance and four levels of maintenance, and make regular maintenance records.
- The proper fuel, lubricant and coolant should be used as specified in this manual.
- The cooling system of the engine should use the coolant specified in this manual in all climates.
- When refilling the lubricant, lubricants of different specifications should not be mixed.
- Before starting the engine, check that the coolant, lubricating oil and fuel are sufficient.
- Remember that the engine must be started at no load.
- For new or overhauled engines, 60 hours of break-in operation is required before use.
- Do not allow the engine to run without air filter (except for marine use) to avoid early engine wear. If the engine is running indoors, the engine room should always be well ventilated. Insufficient air intake by the engine will cause the engine temperature to rise, the output power to be insufficient and the performance to be reduced; if necessary, the engine room ventilation equipment must be provided.
- When the engine is running, it should always observe its running status and the display values of all the instruments. If abnormal conditions are found or in case of emergency, take emergency stopping measures and troubleshoot to prevent the engine moving parts from galling due to lack of water and overheating or low lubricating oil pressure.
- When the coolant temperature is lower than 60°C, it is strictly forbidden to run the engine at high speed and high load.
- Forbid the engine to run overload.
- When the engine overheats and must stop, do not inject cooling water immediately after stopping, otherwise it will damage the cylinder head and other parts.
- After the engine stops abnormally, do not start it again immediately. If the engine stops while an abnormal alarm is issued, the cause of the problem must be identified and removed before starting again. If the engine continues to run without troubleshooting, a more serious accident may occur.
- When the engine lubricating oil pressure drops abnormally for any reason, stop the engine immediately, check all parts of the lubricating oil system, and confirm the cause of the problem. Continued operation at low oil pressure may cause engine bearing burnout and other accidents.
- When starting a newly restored engine, be prepared to cut off the air supply. If the engine starts and then flies, stop the engine immediately by cutting off the air supply.
- Avoid welding on engines or equipment with electronic equipment. If necessary, disconnect the equipment and disconnect the electronic equipment from the wiring harness before welding. Do not plug and unplug harnesses with electricity. Do not plug or unplug the harness; if plugging or unplugging is necessary, do so after power is removed to avoid failure.
- The engine should be at a stop when checking the belt tension and other drive devices.
- The drive belt should not be removed from the pulley or installed on the pulley with a pry bar as this may damage the reinforcing fibers inside the belt. It should be removed and installed manually.
- If the drive belt is contaminated with lubricant, fuel or other harmful fluids, it must be replaced and the source of contamination removed. Do not use solvents to clean the belt.
- When storing or handling drive belt, ensure that they are not bent less than 25mm in diameter and are not hung on hooks.
- All surfaces of the drive belt pulleys must be smooth in order to prolong the life of the belt. Therefore, before installing the belt, make sure that the pulley surface is free of rough surfaces or burrs and that it rotates freely.
- The battery has a certain life span and must be replaced at a certain time.
- If the thermostat fails to work, it should be replaced in time and should not be removed at will.
- In order to maintain the normal performance of the engine, the fuel control linkage is sealed with fuel injection and speed control seal. If the engine is used after these seals are cut, there is no warranty in case of failure. When the seals are cut, the following failures may occur: increased wear of the sliding and parts of the injection pump, melt and damage, sharp increase in fuel consumption and lubricating oil consumption, loss of balance between fuel injection and governor, performance degradation, and major accidents such as over speeding.
- Do not use seawater to cool the engine directly.

- The injection pump with electronic governor should not be cleaned by direct spraying with water.
- Be careful not to let rainwater enter through the exhaust or air intake. Do not clean the engine while it is running. The detergent (water) may be drawn into the engine. If water enters the combustion chamber of the engine, the engine may be damaged internally by water pressure when the engine is started, causing a major accident.
- Do not change the use of the engine or the scope of use at will, as this may cause damage to the engine or/and equipment, and may result in a personal accident. No warranty will be given for unauthorized engine modification, even during the warranty period.
- The engine will be disposed of according to national and local regulations after it is scrapped.

1.7 Warning Marks on the Diesel Engine

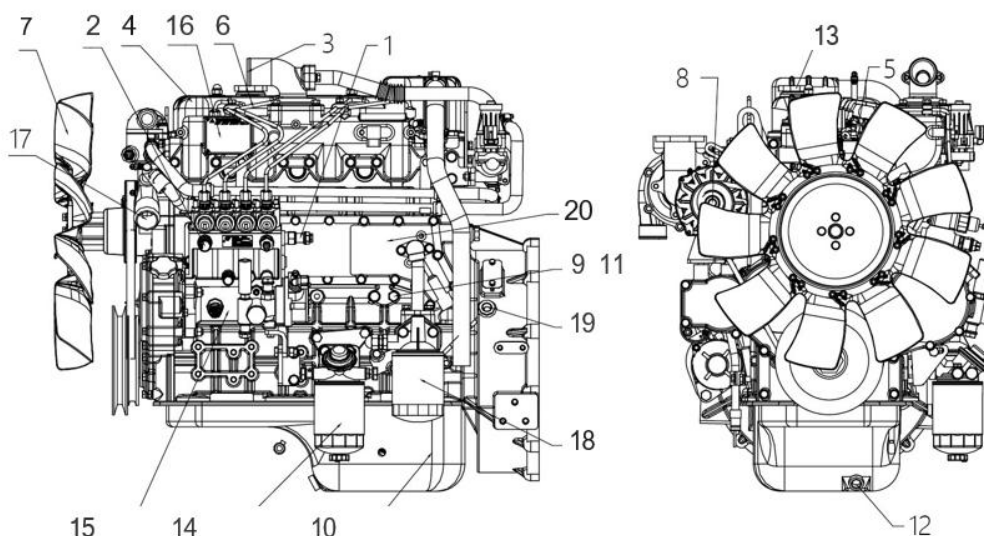
There are the following warning marks on the diesel engine, which must be strictly observed, otherwise it will cause personal injury and engine damage.



2. DIESEL ENGINE OVERVIEW

2.1 Outline Diagram of Diesel Engine

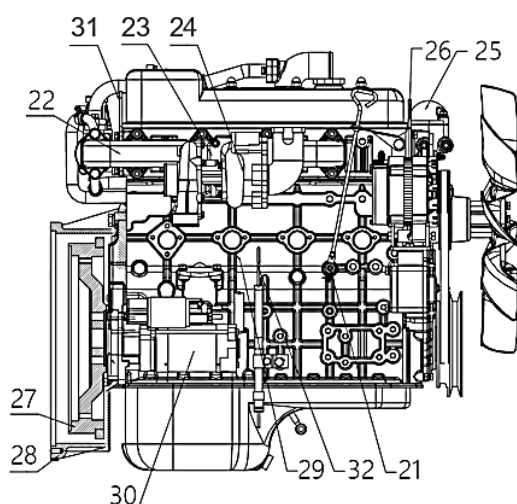
2.1.1 Outline Diagram of Diesel Engine for Power Station



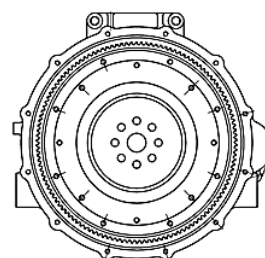
Diesel Engine Intake Side

Front End of Diesel

1	Fuel Return Fitting
2	Fuel Inlet Fitting
3	Air Inlet Pipe Connection
4	Cylinder Head Cover Housing
5	Fuel Injector
6	High Pressure Oil Hose
7	Fans
8	Alternator
9	Oil Pressure Gauge Connector
10	Oil Sump
11	Oil Temperature Gauge Connector
12	Oil Drain Screw Plug
13	Oil Filler
14	Fuel Filter
15	High Pressure Oil Pump
16	Nameplate
17	Water Pump Inlet
18	Oil Filter
19	Speed Sensor
20	Oil Cooler



Diesel Engine Exhaust Side

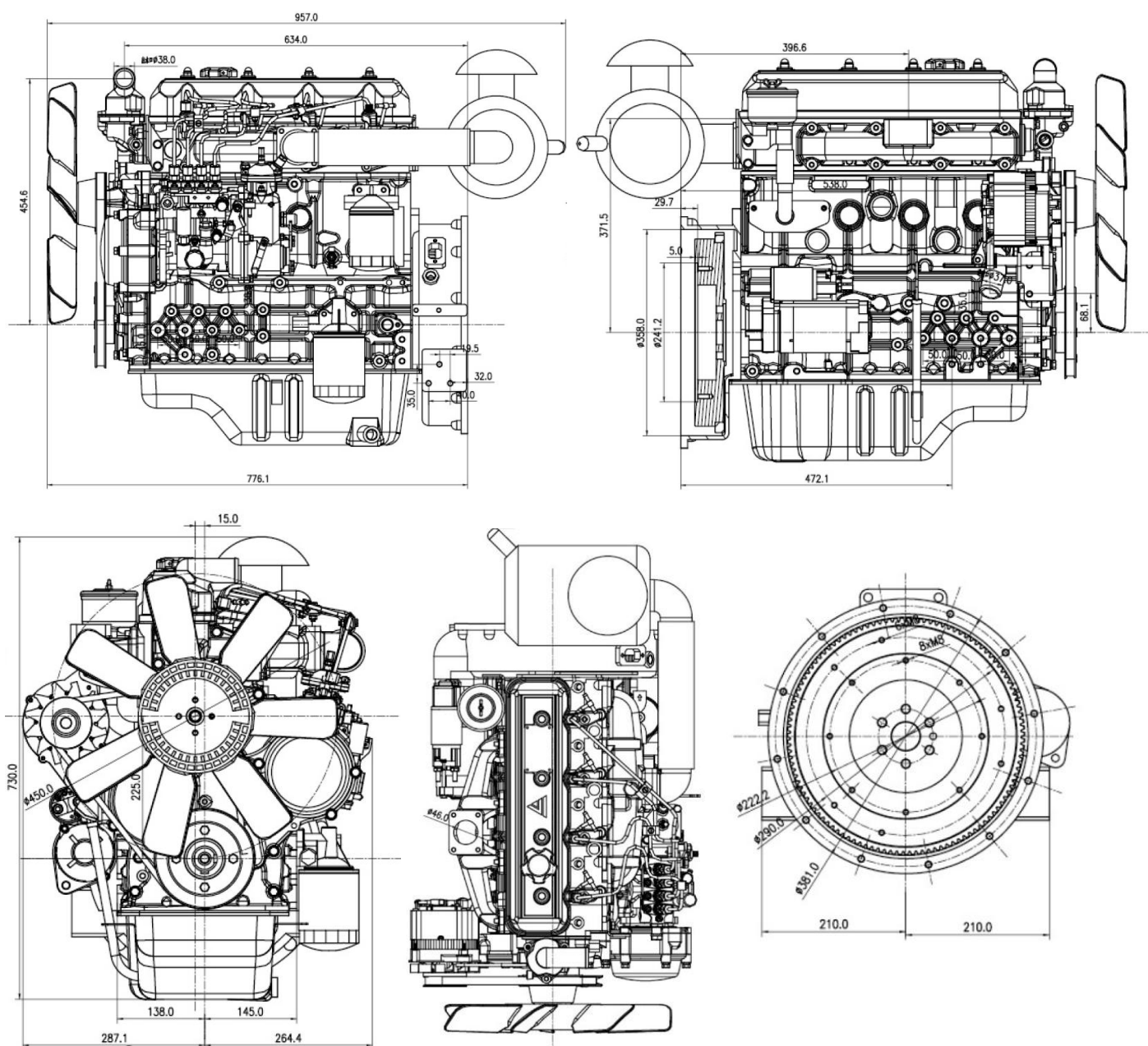


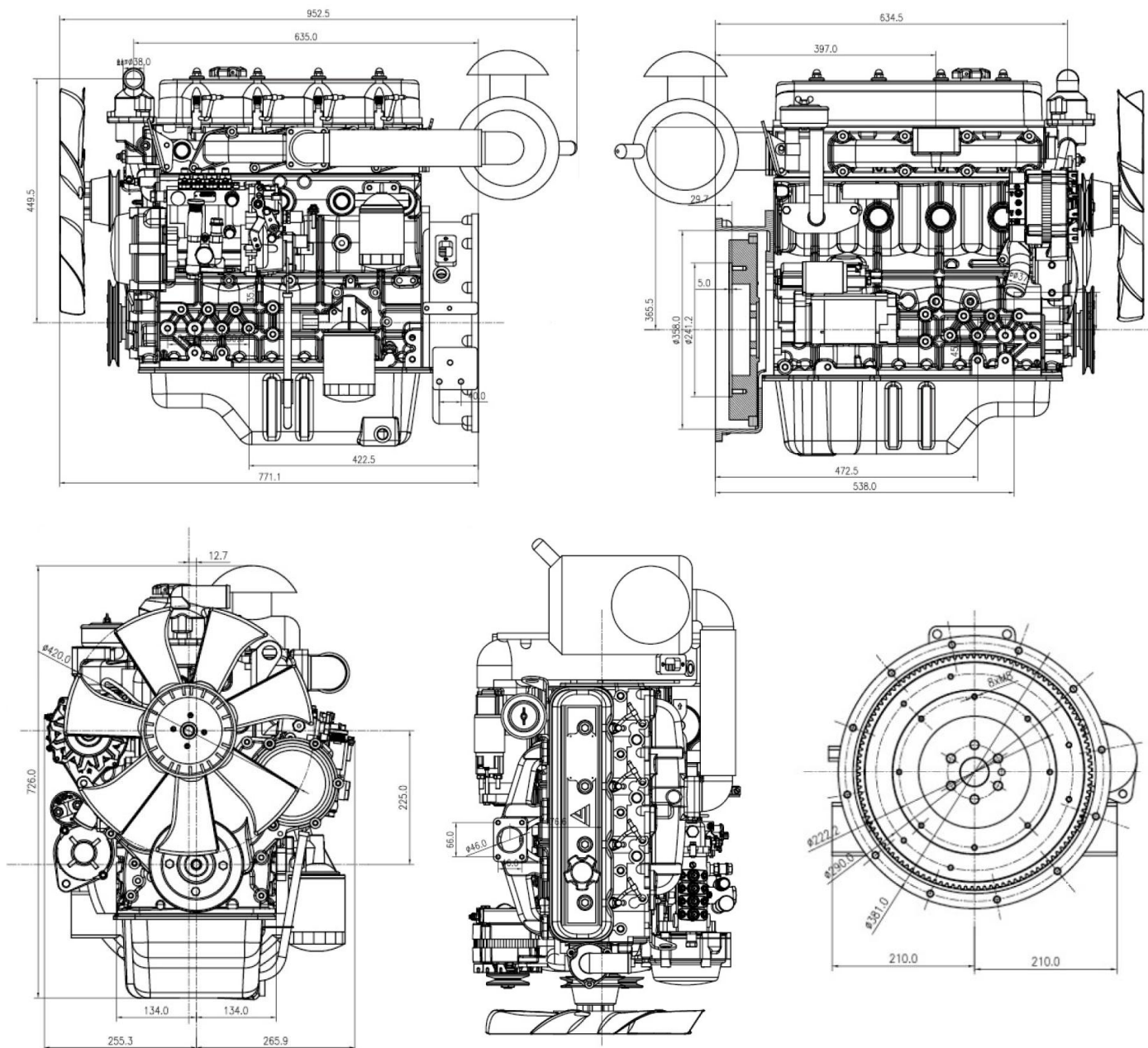
Diesel Engine Rear End

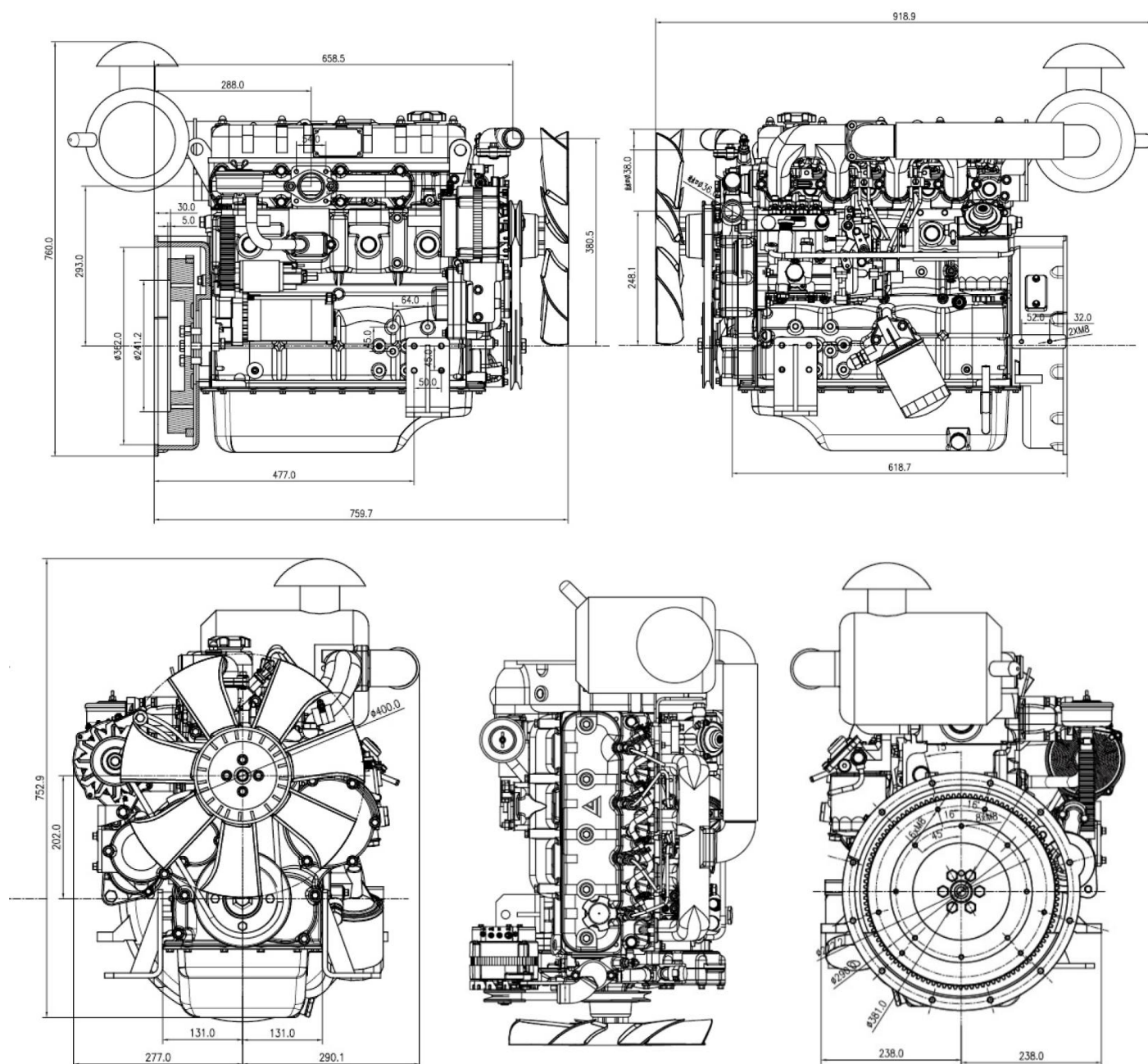
21	Drain Screw Plug
22	Exhaust Pipe
23	Booster Oil Inlet Pipe
24	Booster
25	Thermostat Outlet
26	Front Lifting Ring
27	Flywheel
28	Flywheel Shell
29	Turbocharger Return Line
30	Starter Motor
31	Rear Lifting Ring
32	Dipstick

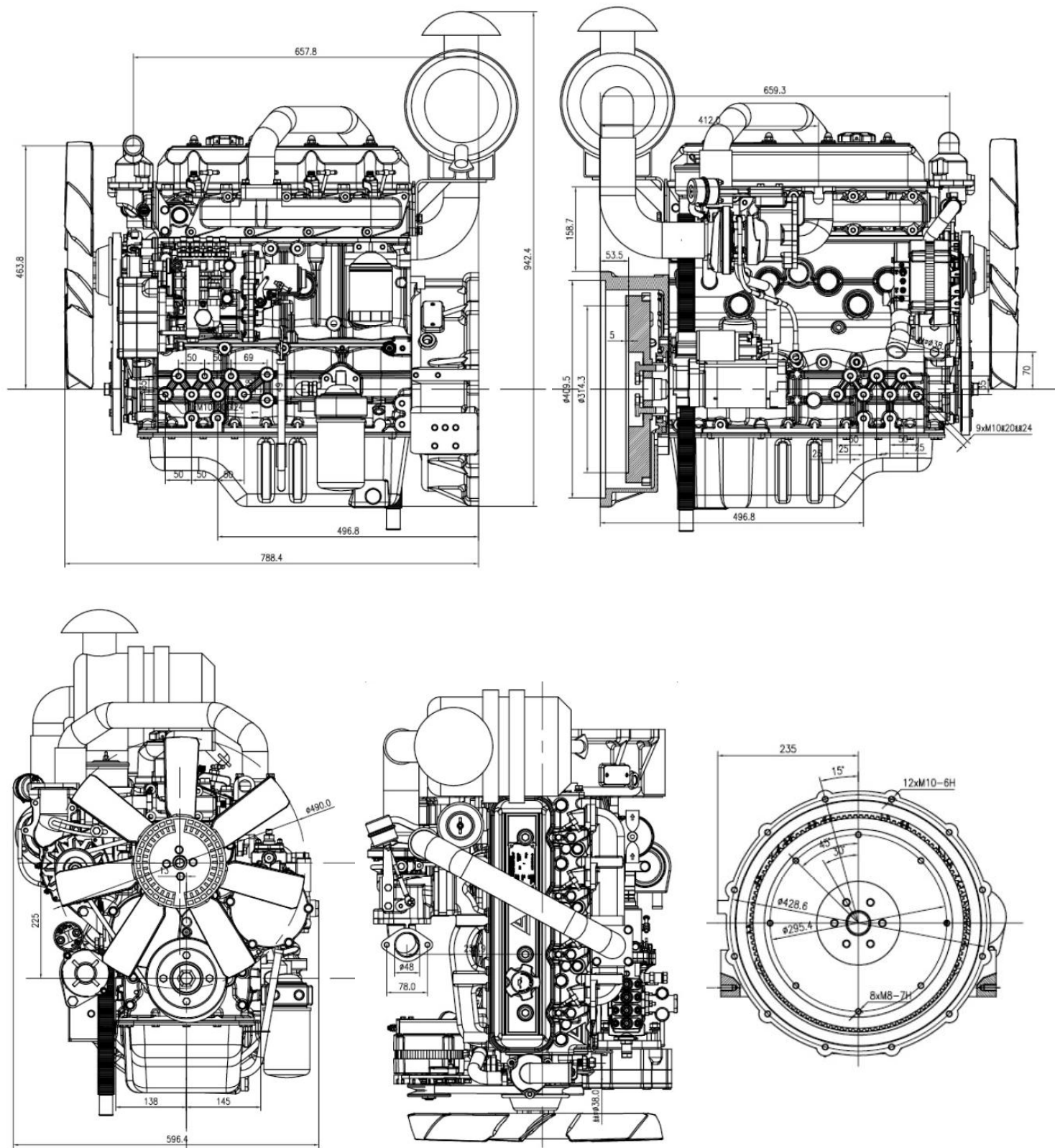
2.1.3 Diesel Engine External Installation Drawing

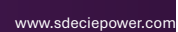
4Z3.2

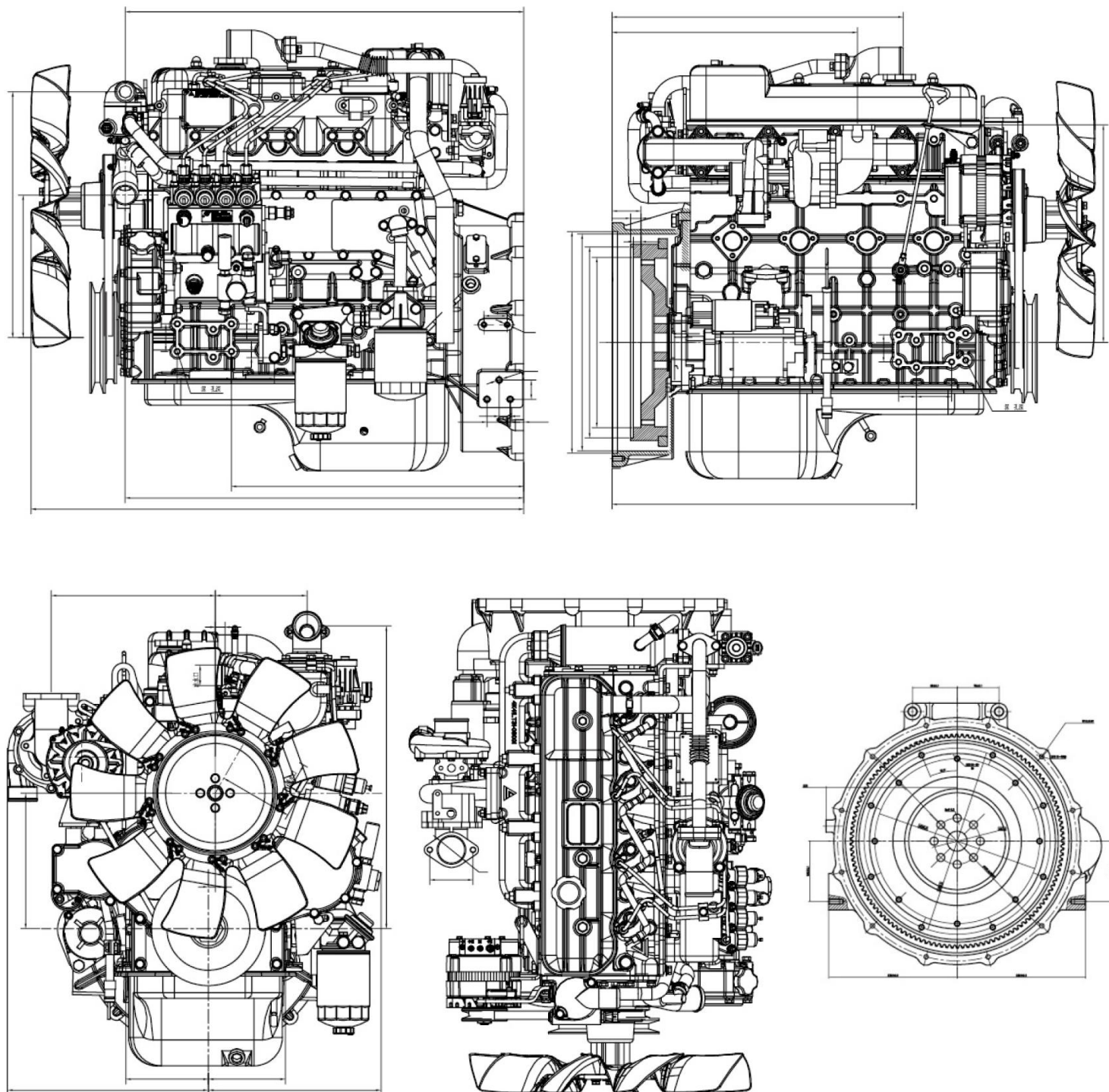








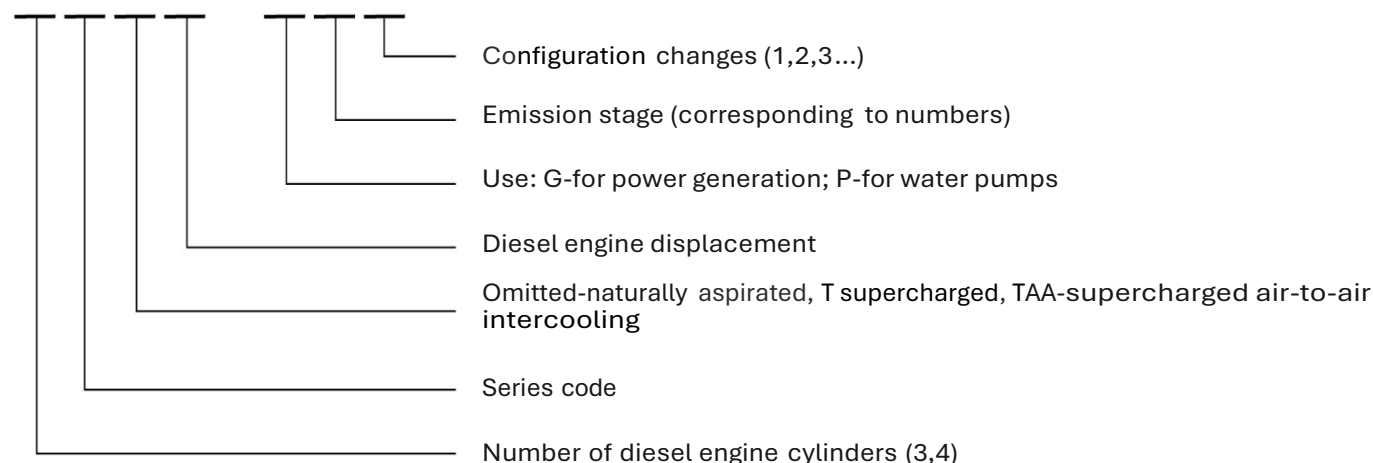




2.2 Model Identification of Diesel Engine

2.2.1 Model Representation Method 1 of Z Series Diesel Engine:

□Z□□-□□□



e.g.

4Z2.7-G21 stands for Z series 4-cylinder total displacement 2.7L naturally aspirated Stage II (non-road) emission standard 1st configuration diesel engine for power station.

4ZT3.2-G21 represents Z series 4-cylinder total displacement 3.2L supercharged Stage II (non-road) emission standards, the first configuration of power station diesel engines.

4ZTAA4.L-G21 represents Z series 4-cylinder total displacement 4.1L supercharged air-to-air intercooled Stage II (non-road) emission standards, the first configuration of power station diesel engines.

2.3 Diesel Engine Nameplate

The diesel engine nameplate indicates the main technical data and information of the diesel engine you purchased: model number, order number, engine number, date of shipment, power, and rated speed, which is the main basis for the user to purchase maintenance parts and our company to provide after-sale technical service. We hope that you will record this information and data in the logbook of your diesel engine or the equipment you are equipped with. When you contact us for maintenance or quality problems in the future, it will be helpful to provide this information in time to solve your problems correctly. Please protect the nameplate from damage.

 上柴动力 SDEC POWER		型号 MODEL	订货号 ORD.NO.		
		机号 SER.NO.	功率段 POWER BAND		
		额定功率/转速 NET POWER/SPEED	kW/r/min	净质量 NET WT.	kg
		最大功率/转速 MAX. POWER/SPEED	kW/r/min	后处理装置类型 AFTER TREATMENT TYPE	
执行标准 EXECUTED STANDARD		信息公开编号 INFO. PUBLIC NO.			
物料号 MATERIAL NO.	系族名称 FAMILY ENGINE		排放阶段 EMISSION LM.		
柴油机 DIESEL ENGINE	适配机组功率(常备备用) GENSET POWER(PRIME/STANDBY)	kW		生产日期 DATE	
上海新动力汽车科技股份有限公司 Shanghai New Power Automotive Technology Company Limited (原上海柴油机股份有限公司) (SHANGHAI DIESEL ENGINE CO., LTD.)			中国上海市军工路2636号 2636 JUNGONG ROAD, SHANGHAI, CHINA		

Note: Without our permission, users are not allowed to change the diesel engine nameplate at will!

2.4 Technical Specifications of Diesel Engine

2.4.1 Main Technical Specifications and Performance Parameters

Engine model	4Z2.3	4Z2.7	4Z3.0	4Z3.2	4ZT3.2	4ZT3.5	4ZT4.1	4ZTAA4.1	4ZTAA4.1
Type	Inline, four-stroke, water-cooled, direct injection								
Air inlet mode	Natural aspirated				Supercharged intake		Supercharged intercooler		
Number of cylinders	4								
Cylinder diameter x stroke (mm)	85x100	90x105	95x105	98x105		98x115	105x118		
Exhaust volume (L)	2.3	2.7	3.0	3.2		3.5	4.1		
Compression ratio	18	18.5					18		
Speed regulation mode	Mechanical / electrical regulation		Mechanical / electrical regulation						Electric control
Steady state speed regulation rate	5%/3%								
Ignition sequence	1-3-4-2								
Fuel consumption rate (g / kW. H)	235	225	228	224	220	212	223	210	
Oil consumption rate (g / kW. H)	0.2	1.2					0.5		
Lubricating oil capacity (L)	10	8							
Cooling system capacity (L)	2.3	2.7	3.0	3.2		3.5	4.1		
Maximum intake resistance (Kpa)	4								
Maximum exhaust resistance (Kpa)	10								
Startup mode:	Motor start-up								
Crankshaft rotation direction	Counterclockwise								

Note:

- 1) The performance parameters in the table are the performance parameters when the diesel engine is running under the standard environmental condition, which means ambient temperature 25°C, relative humidity 30%, atmospheric pressure 100kPa.
- 2) The engine should be used in accordance with the altitude specified in the technical conditions.
- 3) The power of the engine will be reduced when it is used in the highland environment. When the altitude exceeds 2000m, please contact our sales department or agent for help.

Model		422.3	4Z2.7-4ZT3.5	4ZT4.1	4ZTAA4.1
Exhaust temperature (before turbo) /°C		≤550	≤550	≤550	≤550
Oil pan oil temperature/°C	Maximum Allowed	115	115	115	115
	Suitable range	90 ~ 110	90 ~ 110	90 ~ 110	90~110
Main oil passage oil pressure/ MPa	Rated speed	0.2~0.45	0.2~0.45	0.2~0.45	0.2~0.45
	Idle speed (When oil temperature is ≥75°C)	≥0.05	≥0.05	≥0.05	≥0.05
Oil pan oil capacity (high - low oil level)/ L		8-10	8-10	8-10	8-10
Total capacity of lubrication system/ L		8	8	8	10
Minimum inlet water temperature/ °C		60	60	60	60
Maximum outlet water temperature/ °C		100	100	100	100
Suitable working water temperature/ °C		85 ~ 95	85 ~95	85 ~95	85 ~95
Speed regulation performance of governor	Minimum no-load stable speed/ (r/ min)	1500			
	Speed fluctuation at the lowest no-load stable speed/ (r/ min)	±30			
	Maximum no-load stable speed/ (r/ min)	1620			
	Instantaneous speed regulation rate/%	≤10			
	Stable speed regulation rate/%	≤8			
Battery	Minimum recommended battery capacity/ Ah*	60	80	100	100
	Voltage/ V	12	12	12	12
Motor start-up	Voltage/ V	12	12	12	12
	Power/ kw	3.0	3.8	3.8	3.8
Alternator	Voltage/ V	14	14	14	14
	Rated power / kw	750	750	750	750

For applications with high starting requirements, the capacity of the battery should be appropriately increased.

2.4.3 Supporting Technical Requirements

Since the environmental conditions have a great impact on the operation of the air-to-air cooled supercharged diesel engine, the maximum total power and operating parameters of the diesel engine are specified in the table below according to the ambient temperature. Users should match appropriate air-to-air coolers, radiators, silencers and their connecting pipes according to the requirements of this table, maintain the air filter in time, and control the load of the diesel engine according to the requirements of this table, so as to prevent the diesel engine from running over-load and causing diesel engine failure.

Environmental temperature °C	Speed r/min	Allowable maximum total power ratio	Intercooler outlet temperature °C	Intercooler pressure drop kPa	Outlet water temperature of diesel engine °C	Oil pan oil temperature °C	Air inlet resistance kPa	Exhaust back pressure kPa
≤30	1500	100%	≤50	≤6	< 100	≤115	≤3	≤6
40	1500	96%	≤60	≤6	< 100	≤115	≤3	≤6
50	1500	88%	≤70	≤6	< 100	≤115	≤3	≤6

3. DIESEL ENGINE INSTALLATION AND CONNECTION

3.1. Diesel Engine Installation

There are 2 mounting brackets on both sides of the diesel engine body. There are lifting rings and lifting plates on each diesel engine, which can bear the full weight of the diesel engine. When lifting, use the chain carriage or other lifting tools, but must pay attention to: do not make the stressed chain pressed to the thin-walled parts or instrument parts (and try not to make the lifting ring bear the bending moment); lifting to be smooth, so that the diesel engine is basically kept in a horizontal position; handling lifting, the diesel engine should be placed on a special base or a stable cushion to prevent the oil sump from directly bearing the weight of the diesel engine.

3.2. Diesel Engine Connection

3.2.1. Connecting The Air Intake Pipe

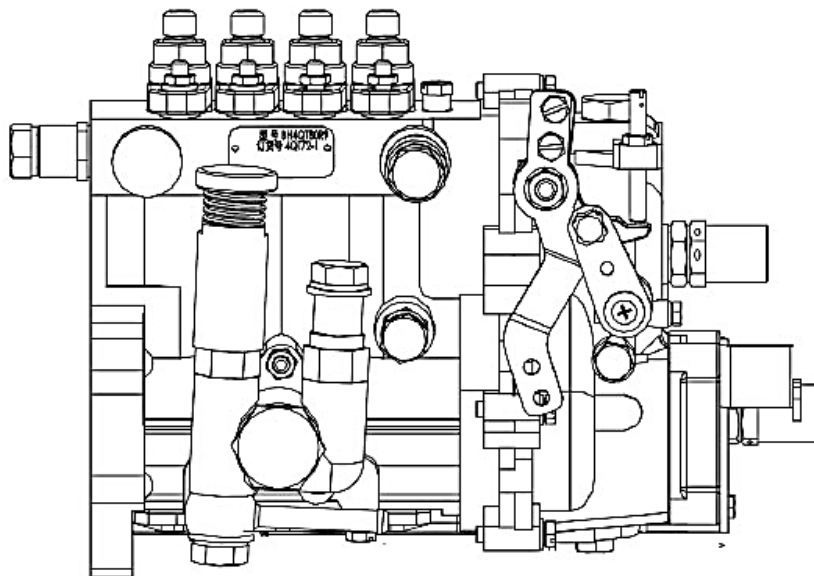
Note: When using an extended air intake line, it is necessary to have a sufficient air intake section. It is recommended that the inner diameter of the pipe before and after the intercooler is 40mm, and it should not be too long or turn sharply, otherwise it will increase the air inlet resistance and affect the performance of the diesel engine. In addition, we must pay attention to the sealing of the intake pipe, otherwise it will lead to early wear of the diesel engine.

3.2.2. External Connection of Water Pipeline

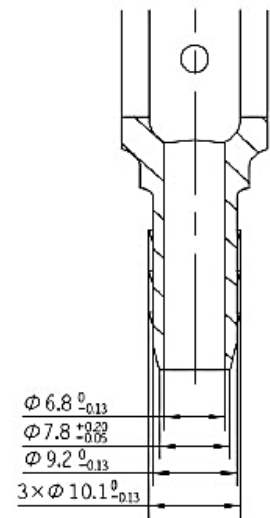
Z series improved diesel engine cooling system is closed cycle, the user does not need to set up another pool or cooling water tower and other devices. The inner diameter of water pump inlet pipe is recommended 38-50 mm, and the inner diameter of thermostat outlet pipe is recommended 38 mm.

3.2.3. External Fuel Piping

Diesel fuel tank inlet and fuel back to the fuel tank connector location as shown in the figure. The fuel inlet connector dumpling screw is M14X1.5 mm, the inner diameter of fuel inlet pipe is recommended to be 9 mm, the inner diameter of fuel return pipe is recommended to be 8 mm, and the size of fuel return connector is shown in the figure.



Fuel Return Joint



The fuel tank capacity should be able to store the fuel for more than 8 hours of diesel engine operation. The fuel tank should ensure that the minimum oil level of the fuel supply is not lower than the center blood of the fuel pump, and the suction port of the fuel inlet pipe must be higher than the bottom of the fuel tank by more than 50mm; it is recommended to connect a coarse filter at the suction port to prevent the sediment from being sucked in and blocking the oil circuit. In order to facilitate cleaning, it is recommended to have a drain valve at the bottom of the fuel tank. The fuel tank should not be near the heat source (such as exhaust pipe) and electrical equipment.

3.2.4. Power Output of Diesel Engine

The diesel engine outputs power from the flywheel end to drive the equipment. When coupling is used to connect the driven equipment, the centerline of the equipment and the centerline of the crankshaft should be in the same line. If a flexible coupling is used, the coaxiality should be no more than $\phi 0.30\text{mm}$; if a rigid coupling is used, the coaxiality should be no more than $\phi 0.10\text{mm}$.

Note: Diesel engines are not allowed to start with a load, so there should be a clutch device between the diesel engine and the load device which cannot run without a load itself.

It is forbidden to install the belt disc directly on the flywheel to drive the driven equipment laterally, which will easily damage the crankshaft and main bearings. If you need to use it for lateral dragging, you should choose a variant of diesel engine suitable for lateral dragging or another power transmission transition device adapted to lateral dragging, do not make the diesel engine crankshaft and main bearings directly subjected to lateral force.

4. DIESEL ENGINE USE

The correct use of the diesel engine will not only keep the engine working properly and performing well, but will also extend the life of the engine and reduce the cost of use. Use the correct fuel, oil, and coolant as required by this section and follow the correct operating procedures.

4.1. Diesel Fuel

The specifications of diesel fuel used in this series of diesel engines should be in accordance with the national standard GB252-2015 for general diesel fuel. Choose the grade of fuel according to the ambient temperature. In winter, when the temperature is low, diesel fuel with low freezing point should be used, while in summer, the opposite is true. The choice of fuel grade can be recommended according to GB252-2015 standard, and users can also choose according to the recommendations in the table below: for example, when the ambient temperature is -27°C , -35 diesel fuel should be selected.

The relationship between the diesel grade and the applicable minimum temperature

Diesel fuel grade	NO.0	NO.-10	NO.-20	NO.-35
Cetane number	≥45	≥45	≥45	≥45
Freezing point	≤0	≤-10	-20	-35
Applicable minimum air temperature (diesel engine working environment temperature / °C)	Above 4°C	Above -5°C	Above -14°C	Above -29°C

Note: Diesel oil must be kept highly clean and free from dust, impurities or water pollution.

4.2. Engine Oil

In order to ensure the normal operation and long service life of the diesel engine and improve the emission of the diesel engine, please use CF-4 grade lubricating oil or above. CF-4 15W-40 engine oil shall be selected under general ambient temperature. When the ambient temperature is kept below - 5°C, lighter CF-4 5W-30 engine oil shall be selected to facilitate starting, but continuous use of low viscosity engine oil will increase diesel engine wear. The specifications of the engine oil used in this diesel engine shall comply with the provisions of the national standard GB11122-2006.

Engine oil specification (GB11122-2006)

Specification viscosity grade	Kinematic viscosity (100/°C)mm ² /s	Flash point (opening)°C not less than	Pour point °C not higher than	Mechanical impurities (mass fraction)/% no more than	Moisture (%) not more than
5W-30	9.3~ <12.5	200	-35	0.01	mark
15W-40	12.5~ <16.3	215	-25	0.01	mark

Note: The oil must be kept clean and not contaminated by dust impurities or water. Different brands of engine oil should not be mixed.

4.3. Coolant

In order to ensure the normal operation and long life of diesel engine, please use the special organic type (anti-freeze) coolant of New Power Technology Company under all weather conditions. The coolant has the characteristics of anti-freeze, anti-corrosion, good thermal conductivity, good stability and environmental protection.

Title	Part No	Freezing point/ °C	Boiling point/ °C
New power technology (antifreeze) coolant	F/LQY-45	-45	108

Note: When the diesel engine is used as the main and auxiliary power of the ship, it is absolutely not allowed to use seawater as the coolant to directly cool the diesel engine.

4.4. Matching of Power Between Diesel Engine and Working Machinery

When the user selects a diesel engine, he should not only consider the power required by the matching working machinery but also consider the load rate of the working machinery, such as whether it is used intermittently or continuously. At the same time, the operating economy of the working machinery should be considered, that is, the working characteristics of the load and the characteristics of the diesel engine must be reasonably matched. Therefore, the correct calibration of the diesel engine power and the reasonable matching of the diesel engine and the working mechanical characteristics are the preconditions to ensure the reliable, economical and long service life of the diesel engine. Otherwise, the diesel engine may be overloaded and cause unnecessary faults, or the load power is too small, and the diesel engine power can not be fully used, which is neither economical nor easy to cause oil channeling and other drawbacks.

4.5. Diesel Engine Starting

Before using the diesel engine, select engine oil, fuel oil and coolant of appropriate specifications according to the specific operating environment and conditions. The following work shall be done before starting:

- (1) Conduct a look around inspection on the diesel engine and the starting system, and solve the problems found in time.
 - (2) Check whether the oil pressure gauge, oil temperature gauge, coolant temperature gauge, warning lamp and other instruments are in normal conditions.
 - (3) Check whether the air filter maintenance indicator has a red plunger.
- Note:** It is not allowed to start the diesel engine without air filter to prevent early wear of the diesel engine.
- (4) Check whether the oil level is within the specified range.
 - (5) Check whether the coolant level is within the specified range.
 - (6) Check whether the liquid level of electrolyte is within the specified range.
 - (7) When the diesel engine is just put into use, or stopped working for many days, or the fuel filter is just replaced, there will be air in the fuel system, so it is necessary to bleed the fuel system. See Chapter 5.3 for specific operations.
 - (8) Check whether the electric starting circuit is in normal state.
 - (9) Check whether the circuit wiring of the electric starting system is correct.
 - (10) All safety protection devices must be installed in place.
 - (11) Check whether the accelerator operating lever is flexible.
 - (12) For new engines or diesel engines that have not been used for more than 5 days, turn the crankshaft for 3-5 revolutions with turning tools before starting.

4.5.1. Routine Starting Steps

The Z series diesel engine can be started smoothly when the ambient temperature is not lower than -10°C.

The method is as follows:

- Disconnect the diesel engine from the transmission.
- The mechanical control device is in the running position.
- Push the fuel injection pump governor control handle to no-load position.
- Insert the electric key and turn the switch from off to start to start the diesel engine. If it fails to start within 10 seconds, turn the switch from the start position to the off position immediately.
- After 2 minutes, start for the second time. If it cannot be started for 3 consecutive times, stop the start. Refer to Chapter 6 troubleshooting guide to find out the cause and eliminate the fault before starting. Each start-up time is generally 2 to 3 seconds.

Note: The diesel engine must be started without load.

- After the start is successful, the switch will automatically return from the start position to the On position. The engine oil pressure gauge of the diesel engine must display a reading within 15 seconds after starting, and the reading should be greater than 0.15Mpa » if the engine oil pressure is not indicated within 15 seconds, stop the engine immediately to prevent damage to the diesel engine. Find out the cause and remove the fault according to the troubleshooting guide in Chapter 6.
- After the hot diesel engine is started, it should run at idle speed for 1-3 minutes, and then gradually accelerate the loading operation.
- After the cold diesel engine is started, it should first run at idle speed for 3-5 minutes, then gradually increase the speed to 1000-1200 rpm, and enter partial load operation. Only when the outlet water temperature of the diesel engine is higher than 75°C, the engine oil temperature is higher than 50°C, and the engine oil pressure is higher than 0.40MPa can it enter full load operation.

Note: Especially after low-temperature starting, the increase of speed should be as slow as possible to ensure sufficient lubrication of all bearings and stable oil pressure.

- When The diesel engine is running at idle speed, check whether all instruments work normally.

Note: It is forbidden to accelerate the loading operation immediately after the diesel engine is started.

Note: The idle running time of the diesel engine shall not be too long, otherwise the diesel engine will be damaged. Because of the low temperature of the combustion chamber during idle operation, the fuel can not be completely combusted, causing carbon deposition in the cylinder, causing blockage of the injector injection hole, stagnation of the piston ring and valve, resulting in the degradation of the performance of the diesel engine.

Note: When a jumper cable is used to start the diesel engine, the cable must be connected in parallel: the positive pole is connected to the positive pole, and the negative pole is connected to the negative pole. When starting the diesel engine with an external power source, turn the disconnect switch to the "off" position. Before connecting the jumper cable, in order to prevent accidental starting, pull out the key.

4.5.2. Low Temperature Starting

Low-temperature starting refers to starting at ambient temperature below -10°C. When starting, the user should use the corresponding low temperature starting aid according to the actual ambient temperature. The diesel engine should then be started according to the usual starting procedure. The following low temperature starting aids are generally used:

- Preheat the diesel engine oil and coolant to 40-50°C.
- Place a preheating device in the intake pipe or use a simple ignition method to heat the intake air at the intake port (be careful with this method).
- Increase the ambient temperature of the engine room.
- Use diesel fuel, oil and coolant that are suitable for low temperatures.
- Use heat preservation measures for the battery or use a battery with increased capacity or high discharge rate (special low temperature battery).

4.5.3. Starting After a Long Stop or Oil Change

Whenever you start the diesel engine after changing the oil or after being parked for more than 30 days, you must first fill the lubrication system with oil. Use the pan method to make the oil enter the frictional subsets and start the diesel engine only after it feels smooth and easy to pan. Make the following starting preparations and then start the diesel engine according to the regular starting procedure or low temperature starting procedure.

- (1) Check the engine oil level.
- (2) Check if the battery voltage is normal.
- (3) Pump and vent the fuel system, see section 5.3 for details.

For diesel engines that are normally parked for emergency use, in order to be able to start and run quickly in case of emergency, they should be started and run once every 3 to 5 days during the parking period until the coolant temperature and oil temperature reach above 60°C.

4.6. Diesel Engine Operation

Precautions when running the diesel engine.

- Frequently pay attention to the oil pressure and coolant temperature is normal, if see abnormal should stop and check.
- Oil pressure: 150kPa at idle speed (the lowest allowed); 400kPa at nominal speed (the lowest allowed); 600kPa at nominal speed (the highest allowed)
- Coolant temperature: 75-95°C when the diesel engine is working normally.
- If the diesel engine temperature is overheated (water temperature alarm), reduce the speed or load or both until the diesel engine coolant temperature returns to the normal operating range; otherwise, refer to Chapter 6 "Troubleshooting Guide" for maintenance.
- In the process of operation, especially the sudden load reduction should pay attention to prevent the injection pump governor failure to make the diesel engine speed suddenly rise above the specified value (commonly known as runaway) If such a situation occurs, emergency shutdown measures should be taken immediately before investigating the cause.

Note: Over-speeding of the diesel engine can lead to serious damage.

- Most of the diesel engine failures have obvious signs before appearing. By listening to the diesel engine sound changes, see the diesel engine performance changes and appearance changes can know in advance that the diesel engine needs maintenance or repair, should be timely maintenance or repair, otherwise it will lead to serious failure. If necessary, you should contact Shanghai Diesel Engine call center in time to get technical guidance or professional repair service.
- Typical signs before diesel engine failure:

Diesel engine stalled, diesel engine abnormal vibration, diesel engine abnormal sound, diesel engine coolant temperature, oil pressure suddenly changed, diesel engine black smoke, power shortage, oil consumption increased, fuel consumption increased, three leaks (oil, fuel, coolant leakage)

4.7. Diesel Engine Stopping

4.7.1. Normal Stopping

After a long period of high speed and high load operation, the diesel engine should be stopped before gradually removing the load, reducing the speed, and running at idle speed for 5 minutes, so that the engine cools evenly, so that the speed of the supercharger drops significantly, and then stop to protect the diesel engine and supercharger. After stopping, close the fuel tank, marine diesel engine also needs to close the seawater intake valve.

If the diesel engine needs to be stopped for a period of time, it needs to be preserved properly, see Chapter 7, Preservation after diesel engine stoppage.

4.7.2. Emergency Stop

In case of emergency or special circumstances, emergency stop can be used to avoid serious failure of the diesel engine. In this case, the emergency stop handle can be toggled by hand to achieve the purpose.

4.8. Break-in of a New or Overhauled Diesel Engine

The new or overhauled diesel engine should be broken in by 60h before official use and oil replacement before putting into full load use, in order to improve the working condition of the moving parts of the diesel engine and improve the operational reliability and service life of the diesel engine. The break-in should be considered depending on the use of the diesel engine and towing mode, the specific break-in program. In principle, as the break-in time increases, the speed and load of the diesel engine should be gradually increased in stages. In the whole break-in period, the load should be 50% to 80% of the nominal power, and the rotational speed should be no more than 80% of the nominal speed. The constant speed diesel engine of the power station is allowed to break in at the nominal speed, but the no-load running time at the beginning of the break-in period or the running time under too small a load should not be too long.

Diesel engines should not run at idle speed or low load for a long time during the break-in period and the normal working period after break-in. Diesel engine idling time should not exceed 10 minutes continuously to avoid early wear or affect the performance of diesel engine due to carbon accumulation.

Whenever the cylinder liner, piston, piston ring, connecting rod shaft tile, main shaft tile or crankshaft is replaced, it should also be properly run for a short time according to the above break-in conditions.

5. DIESEL ENGINE MAINTENANCE

5.1. Diesel Engine Maintenance Plan

The following table gives the maintenance cycle and maintenance content of this series diesel engine. Users should carry out regular maintenance according to the provisions of this table. If the diesel engine is often operated under the ambient temperature below -18°C or above 38°C, or in dusty environment, the maintenance cycle must be shortened appropriately.

Maintenance contents	First maintenance: 60 hours	Daily maintenance	Every 250 hours or every 3 months	Every 500 hours or every 6 months	1000-1500 hours or every 12 months	Every 2000 days or every 2 years
Check the periphery of the oil engine	•	•	•	•	•	•
Check the fuel tank	•	•	•	•	•	•
Check the air filter maintenance indicator	•	•	•	•	•	•
Check the oil level	•	•	•	•	•	•
Check the coolant level	•	•	•	•	•	•
Check electrolyte level	•	•	•	•	•	•
Check the drive belt*	•	•	•	•	•	•
Check cooling fan	•	•	•	•	•	•
Check the air intake system			•	•	•	•
Add lubricating grease			•	•	•	•
Check the tension of the drive belt	•		•	•	•	•
Change engine oil and filter	•		•	•	•	•
Check the intercooler, heat exchanger and its piping			•	•	•	•
Clean intercooler and water heat exchanger			•	•	•	•
Fuel filter replacement				•	•	•
Fuel system pump oil exhaust				•	•	•
Check and adjust valve clearance	•			•	•	•
Check fan bearings						•
Check the supercharger						•
Check the shock absorber						•
Coolant replacement, cooling system cleaning						•

* When the belt surface cracks or other defects affecting the use, it must be replaced.

Note: Some marine diesel engine air filter without maintenance indicator, whenever the oil and oil filter, clean the air filter element as specified in 5.3.23.

Note: This table specifies the maintenance interval in hours or years and months, whichever comes first.

5.3. Diesel Engine Maintenance Contents and Methods

5.3.1. Checking The Periphery of Diesel Engine

Check the periphery of the diesel engine every day before starting the diesel engine. Inspection content is as follows:

- 1) Check the diesel engine and radiator for any accumulated debris such as cloth, waste wires, pipe clamps, screws and other debris to keep the diesel engine clean and tidy.
- 2) Check the fuel system, cooling system, lubrication system joints and joints for leakage.
- 3) Check whether the fan connection and safety shield are safe and reliable.
- 4) Check the fastening of accessories.
- 5) Check whether the joints of electrical circuit are loose and whether the wires are intact.
- 6) Check whether the transmission belt is intact.

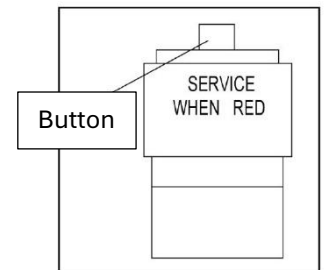
5.3.2. Check The Fuel Tank

Check the fuel level in the fuel tank daily.

5.3.3. Check The Air Filter Maintenance Indicator

Check the maintenance indicator on the air filter every day. If the inspection window shows red, the air intake resistance of the air filter exceeds the specified value and the filter element needs to be replaced. After changing the filter insert, the button on the top of the maintenance indicator must be pressed to reset it.

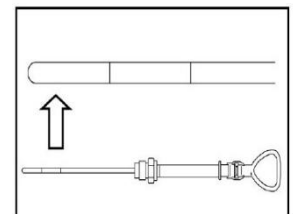
Note: Never run the diesel engine (except for marine diesel engines) without the air filter. Otherwise, it is easy to cause early wear of diesel engine.



5.3.4. Check The Oil Level of Engine Oil

Check the oil level every day before starting or when stopping (at least 10 minutes after stopping, so that the oil has enough time to flow back to the oil pan). The oil level should be between the high oil level mark (upper mark) and low oil level mark (lower mark) on the dipstick. If the amount of oil is not enough, add oil to the high oil level line.

Note: Never run the diesel engine with the oil level below the low oil level. Otherwise, it will lead to the poor performance of diesel engine and even damage the diesel engine. But the oil level should not exceed the high oil level line.



5.3.5. Check Coolant Level

Warning: When the diesel engine is working, its coolant temperature is high and there is pressure, which can easily cause burns. The coolant level should not be checked or added until the diesel engine is stopped and the coolant temperature has dropped below 50°C.

Warning: The rust inhibitor in coolant contains alkali, avoid skin and eye contact with it to prevent injury.

Check the coolant level of the diesel engine before starting or when it is parked every day:

- 1) After the coolant temperature drops below 50°C before starting or after stopping the diesel engine, slowly unscrew the pressure cap (filler cap) on the radiator or expansion tank to release the cooling system pressure.
- 2) Remove the pressure cap and check the coolant level through the fill port or level check port to be within the upper and lower scales or as specified by the equipment manufacturer.
- 3) Add as necessary. Add until it is close to the upper line or meets the equipment manufacturer's specifications.

Note: The coolant should be added slowly to prevent air resistance.

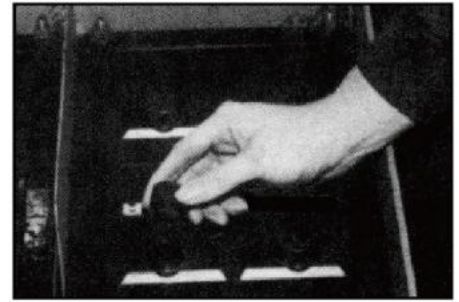
5.3.6. Check The Electrolyte Level

Some batteries are non-maintenance type and need to pay attention to the life of the battery, see the instructions on the battery. When the life of the battery expires, it must be replaced in time.

Some batteries need to be replenished with special rechargeable liquid or steaming water, so it is necessary to check the electrolyte level.

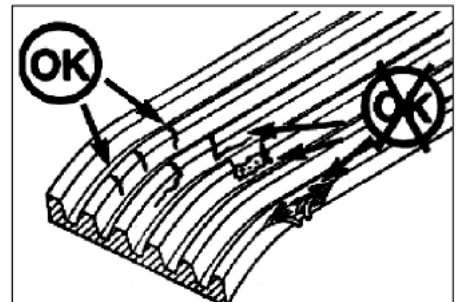
- 1) Remove the filler cap and check the electrolyte level every day. The electrolyte level should be at the bottom of the filler. If the level is insufficient, replenish it as required.
- 2) Put on the filler cap.

Note: Do not use pure water instead of drinking water. Because pure water contains many kinds of trace elements, which will have bad influence on the battery.



5.3.7. Check The Transmission Tape

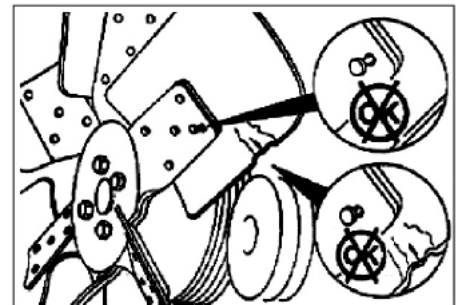
Visually inspect the drive belt every day. Check the belt for crosswise and longitudinal cracks. Transverse cracks along the width of the belt are allowed, but longitudinal (along the length of the belt) and transverse crossover cracks are not allowed. The belt should be replaced if it is worn or if the material is peeling.



5.3.8. Inspection of The Cooling Fan

Visually inspect the fan daily for cracks, loose nails, loose blades, bent blades, etc. Make sure the fan is installed reliably. If necessary, tighten the fan fastening bolts or replace the damaged fan.

A Warning: Damage to the fan blades can cause serious injury. Never drag or pry the fan and never use the fan to turn the diesel engine crankshaft.

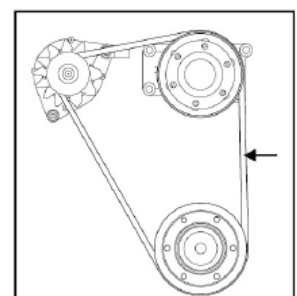


5.3.9. Check The Air Inlet System

Check whether there are cracks or perforations in the air intake hose and whether the clamp is loose. If the air intake hose fails, replace it. If the clamp is loose, tighten the clamp screw to ensure that the air intake system does not leak.

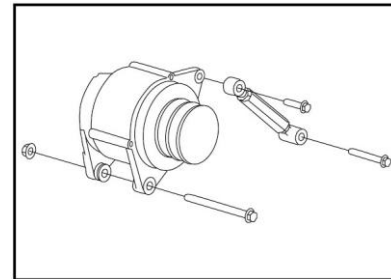
5.3.10. Check The Tension of The Transmission Belt

Check In the central position of the two pulleys of the belt, press down or pull up with your fingers (apply a force of about 98N) and observe the distance of pressing down or pulling up. The distance that meets the required belt tension should be 8 to 12 mm, and if it exceeds this range, adjustment is required.



Adjustment

- 1) Loosen all the bolts and nuts on the alternator and alternator spacer 1, change the position of the alternator and spacer, and adjust the belt tension force.
- 2) Tighten the bolts and nuts to the specified torque.

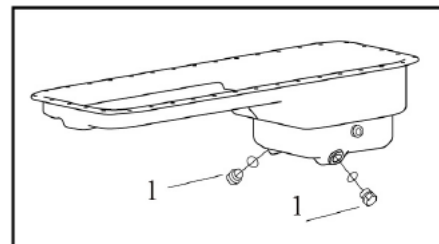


5.3.11. Changing Oil and Oil Filter

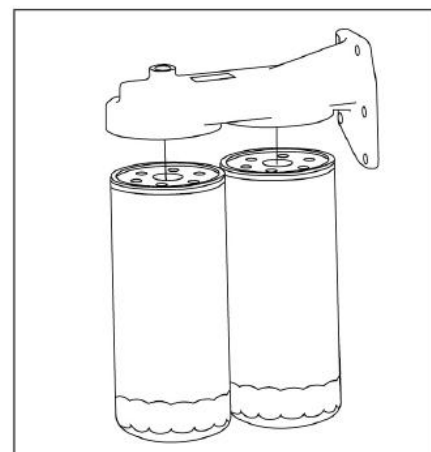
A Warning: Pay attention to safety when changing oil and oil filter, contact with hot oil and diesel engine surface may cause skin burns.

- 1) Stop the diesel engine when the coolant temperature reaches 60°C, remove the oil screw plug, scrap the gasket and drain the oil.

Note: Do not drain the oil when the diesel engine is cold. Because when it is cold, the impurity particles suspended in the engine oil have been deposited to the bottom of the oil pan and they cannot be discharged together with the oil. When the oil is warm, the impurity particles are suspended in the oil, and when the oil is released at this time, the impurity particles can be easily discharged.

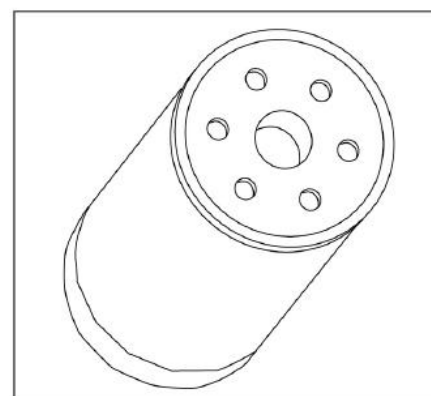


- 2) Clean the mounting surface of the oil drain plug, use a new gasket, and then install the oil drain plug, tighten the torque to 60-70Nm.
- 3) Clean the outer surface of the oil filter, remove the oil filter with a tool and scrap it.
- 4) Clean the seal surface of the filter seat, no old seal should be left.
- 5) Before installing the new oil filter, inject clean oil from the 8 small holes around the filter, fill the inner cavity of the filter, the oil surface is 3-15 mm from the lower end of the threaded hole, and apply a thin layer of petroleum jelly or clean oil on the sealing surface of the O-ring to form a lubricating film.



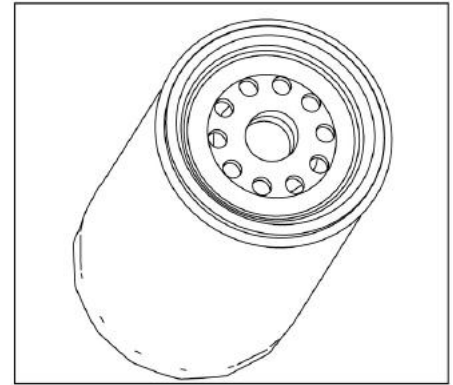
Note: Do not inject oil from the center hole of the filter.

- 6) Rotate the filter by hand until the seal contacts the mounting surface of the filter seat, and then tighten it by 50(+ 10, -5)Nm or 3/4 turn to 1 turn with a tool.
- 7) Open the oil filler cap and fill the diesel engine with clean oil until it is close to the high oil level mark on the dipstick. Diesel engine lubrication system oil capacity is 8-10L
- 8) Start the diesel engine and idle, check the oil filter and oil drain screw for oil leakage.
- 9) Stop the engine, wait about 10 minutes to let the oil have sufficient time to flow. Then check the oil level. If necessary, add oil until it is close to the high oil level mark on the dipstick.
- 10) Install the oil filler cap and tighten it by hand.



5.3.12. Replace The Fuel Filter

- 1) Clean the outer surface of the fuel filter, remove the fuel filter with a tool and scrap it.
 - 2) Clean around the fuel filter seat and the sealing surface of the filter seat. There should not be any old O-ring left.
 - 3) Before installing the new fuel filter, inject clean fuel from 10 small holes around the filter and fill the filter cavity with oil 3-15 mm from the lower end of the threaded hole and apply a thin layer of petroleum jelly or clean engine oil on the sealing surface of the O-ring to form a lubricating film.
- Note:** Do not inject fuel through the center hole of the filter.
- 4) Hand spin the filter until the seal touches the filter mounting surface and then tighten $45 \pm 5\text{Nm}$ with a tool or 3/4 turn to 1 turn.

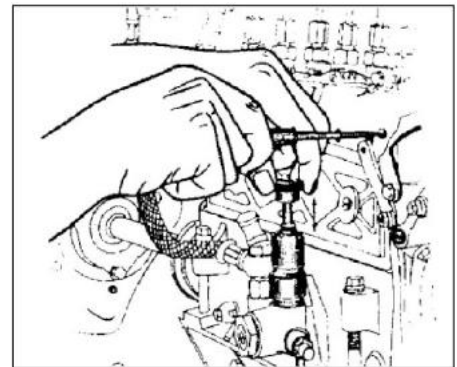


5.3.13. Fuel System Pumping Exhaust

After the diesel engine has stopped working for many days or after replacing the fuel filter, the following steps are required to pump the fuel to bleed the system:

- 1) Loosen the bleed screw on the fuel injection pump.
- 2) Press the hand pump for manual pumping and venting until there are no air bubbles in the fuel overflowing at the bleeder screw.
- 3) Tighten the bleeder screw.

Note: If air enters the fuel system due to not adding fuel in time, or if other factors cause air in the fuel system, it is necessary to remove the air.



5.3.14. Checking and Adjusting Valve Clearance

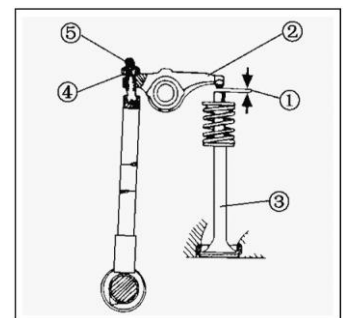
The valve clearance of the diesel engine must be checked and adjusted after maintenance or technical maintenance. The adjustment methods of valve clearance and valve train are as follows:

- 1) Remove the cylinder head cover, check and tighten the nuts that compress the valve rocker shaft support.
- 2) Rotate the crankshaft until the piston of the first cylinder is at the top deadcenter. At this time the mark on the observation window on the flywheel housing is aligned with the "0" mark on 1 the flywheel, or the "0" mark on the crankshaft V pulley is aligned with the pointer on the timing gear housing cover.

Insert a thickness gauge between the intake and exhaust valves of the first cylinder and the valve rocker arm, check and adjust the clearances of the intake and exhaust valves, and keep the clearances of 0.35mm and 0.45mm respectively in cold state. After that, turn the crankshaft by corresponding angles (180° for four cylinder engine, 240° for three cylinder engine and 360° for two cylinder engine) according to the working sequence of the cylinders to adjust the valve clearance of each cylinder.

Taking the four cylinder machine as an example, the adjustment method is as follows:

- Remove the cylinder head cover
- Before adjusting the valve clearance, stop the engine for 30 minutes and the oil temperature should be lower than 80°C
- Use a feeler gauge to check the gap 1 between 2 and 3. After the feeler gauge is inserted, it should be slightly rubbed. See the below table for the correct valve clearance.



Adjust the valve clearance as follows:

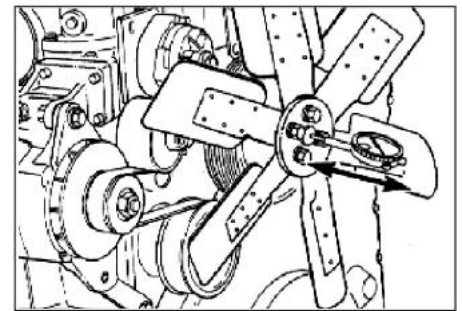
- 1) Loosen the nut
- 2) Tighten the bolts and nuts with a screwdriver to obtain the correct valve clearance
- 3) Check and adjust the valve clearance of other cylinders
- 4) Install cylinder head cover

Adjust the valves marked with Y in the following table as shown in the figure

Cylinder serial number	1		2		3		4	
Cylinder part	out	in	out	in	out	in	out	in
Rocker arm serial number	1	2	3	4	5	6	7	8
Compression top dead center of the fourth cylinder			y			y	y	y

5.3.15. Check The Fan Bearing

Remove the drive belt and rotate the fan belt wheel by hand to check if there is any abnormality in the rotating shaft bearing. There should be no vibration and excessive axial play when turning the fan. If necessary, replace the fan bearing housing.



5.3.16. Check The Turbocharger

Visually check whether the turbocharger turbine blade and compressor blade are damaged or cracked. Gently press the blade with your fingers, check whether the blade is in contact with the turbine casing or compressor casing and check whether the rotating shaft of the turbocharger is stuck. If the above problems are found, the turbocharger needs to be replaced.

5.3.17. Inspect The Vibration Dampers

Check the damper for damping fluid (silicone oil) leakage and for collapse of the damper surface. Check the damper thickness to determine if the damper is deformed. If any of these problems occur, the damper needs to be replaced.

5.3.18. Replace The Coolant and Clean The Cooling System

To ensure the cooling and anti-corrosion effect of the diesel engine coolant, the coolant must be replaced and the cooling system cleaned every 2000 hours or 2 years (whichever comes first).

A Warning: At operating temperature, the diesel engine coolant is hot and under pressure, and steam can cause personal injury. Only after the diesel engine stops working, wait for the coolant temperature to drop below 50°C, then slowly unscrew the pressure cap (filler cap) on the radiator to release the pressure of the cooling system.

A Warning: The rust inhibitor in the coolant contains alkali, so avoid skin and eye contact with it to prevent personal injury.

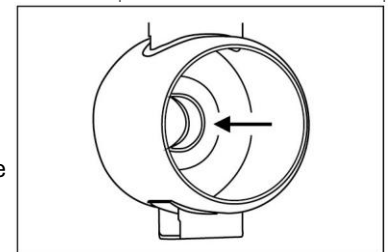
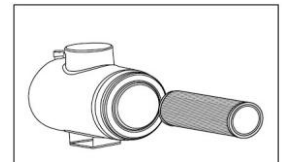
- 1) After the diesel engine has stopped and the coolant temperature has dropped to 50°C, slowly loosen the upper radiator pressure cap to relieve the cooling system pressure, then remove the cap. Unscrew the radiator drain valve and drain the coolant from the radiator.
- 2) Loosen the drain valve on the water pump and drain the coolant from the diesel engine cooling system.

- 3) Clean the cooling system according to the following steps.
 - a. Install and tighten all drain valves and drain plugs and add sodium carbonate solution (or a commercially available mixture of sodium carbonate and water) to the cooling system through the radiator fill port.
Note: Use 0.5 kg of sodium carbonate mixture for every 23 L of water. Do not use cleaning agent containing corrosive agent, otherwise it will damage the aluminium parts.
Note: In the process of filling the cleaning fluid, the air must be discharged from the cooling water chamber and injected slowly to prevent air resistance. Cleaning fluid needs to be added to the bottom of the radiator filler, wait 3 - 5 minutes, so that the air is fully exhausted.
 - b. Start the diesel engine, wait for the cleaning fluid temperature to rise above 50°C and then run for 5 minutes, and then stop to release the cleaning fluid in the cooling system.
Note: The whole cooling system cleaning process, not to install the pressure cover, and run the diesel engine without cover.
 - c. Fill the cooling system with fresh water.
Note: When filling water, inject slowly to prevent air resistance. Water should be added to the bottom of the radiator filler, wait for 3 to 5 minutes, so that the air is fully discharged.
 - d. Start the diesel engine, wait for the water temperature to rise above 80°C and then run for 5 minutes, then stop the engine and drain the water from the cooling system.
Note: If the water is still dirty, you must clean the cooling system again according to the above steps until the water is clean.
- 4) After cleaning, tighten the water release valve on radiator and diesel engine.
Note: The total amount of coolant above refers to the total amount of diesel engine cooling system. The amount to be added to the whole cooling system should be based on the data of the equipment manufacturer.
Note: When filling coolant, inject it slowly to prevent air resistance. The coolant should be filled to the bottom of the radiator filler or in accordance with the equipment manufacturer's requirements and wait for 3 to 5 minutes to allow the air to be fully discharged.
- 5) Install the pressure cap, start the diesel engine until the coolant temperature reaches 80°C, then stop the engine to check the cooling system for leaks.
- 6) Wait until the coolant temperature drops below 50°C, open the pressure cap and review the coolant level, if necessary, refill the appropriate amount of coolant.

5.3.19. Replace The Air Filter Element (Paper Filter Element)

- 1) Blow off the dust attached to the housing with compressed air.
- 2) Remove the air filter cover and filter element and discard the filter element.
- 3) Cover the air filter housing with a clean covering to prevent dust from entering the air intake system.
- 4) Blow the inside of the air filter housing with compressed air.
- 5) Check whether the new filter element is intact and remove the cover at the compressor inlet.
- 6) Install a new filter element and ensure that both ends of the air filter are sealed reliably. Install the air filter cover.

Note: After replacing the air filter element, ensure that the two ends of the air filter are reliably sealed without air leakage.



6. DIESEL ENGINE TROUBLESHOOTING GUIDE

6.1. Overview

If the diesel engine fails, the operator should be calm and careful, analyse the characteristics of the failure in time and determine the cause of it. Generally proceed according to the following principles:

- 1) When the diesel engine is operating abnormally, you can use "see, hear, feel, smell" to determine which part or which system is malfunctioning.

"Look": observe the readings of each instrument, the colour of exhaust smoke and the changes of coolant temperature and oil pressure.

"Listen": use a thin metal rod or wooden handle as a "stethoscope" to touch the corresponding part of the diesel engine exterior, "auscultation" of the sound and its changes.

"Touch": to examine the working condition of the parts such as the gas distribution mechanism and the vibration of the diesel engine by the feeling of the fingers.

"Smell": by the sense of smell, sniff out whether the diesel engine has an abnormal smell.

- 2) When the diesel engine suddenly fails or the cause of the failure has been determined and the failure will affect the normal operation of the diesel engine, it should be stopped in time for inspection. For the fault that can not immediately identify the cause, you can first run the diesel engine at low speed without load, and then observe and analyse the cause in order to avoid a bigger accident.
- 3) When judged to be a large fault or diesel engine suddenly stop on its own, that should be timely disassembly and repair.
- 4) Every malfunction, especially major ones should be recorded along with the troubleshooting methods for reference during the next maintenance.

The common faults and troubleshooting methods of diesel engines listed in this chapter are for the reference of operators only. In practice, according to the specific local conditions and practical experience should be flexible, to find out the internal and external causes of the failure, "the right medicine", timely elimination.

6.2. Diesel Engine Troubleshooting

The following table lists some typical failure modes in the use of diesel engines, followed by a fault table listing the fault characteristics, possible causes and troubleshooting methods. Users can troubleshoot simple faults on their own, and complex faults, if needed, can contact the SDEC's after-sales service center spare@sdecie.com for help with technical guidance or professional maintenance services.

NO.	Diesel engine failure mode	NO.	Diesel engine failure mode
1	The diesel engine cannot start	6	Engine oil temperature is too high and engine oil consumption is too high
2	Insufficient power of diesel engine	7	Coolant in engine oil
3	Abnormal noise and excessive vibration of diesel engine during operation	8	Outlet water temperature of diesel engine is too high
4	Abnormal exhaust smoke color	9	Outlet water temperature of diesel engine is too low
5	Abnormal oil pressure	10	Oil in coolant

NO.	Common faults of system and parts	NO.	Common faults of system and parts
11	Common faults with electrical system	14	Common faults with oil transfer pump
12	Common faults with fuel injection pump	15	Common faults with fuel injector
13	Common faults with governor	16	Common faults with exhaust gas turbocharger

1) The diesel engine cannot start

Fault characteristics	Probable cause	Exclusion method
The diesel engine does not start after being driven by the starter motor, and there is no oil return in the oil return pipe	Fuel system failure: (1) there is air in the fuel system (2) The "cloud point" of fuel is higher than the ambient temperature, which affects the normal fluidity (the so-called cloud point is the temperature at which fuel begins to decompose) (3) Fuel line blocked (4) Fuel filter is blocked (5) The oil transfer pump does not supply oil or intermittently supplies oil (6) The fuel injection pump governor control level is not in the correct position (7) Incorrect static fuel supply timing of fuel injection pump (8) Little or no oil injection or atomization	To purge air from the fuel system, see Section 5.3. Drain all fuel from the fuel tank and fuel filter. Select the correct fuel quality and grade as required in 4.1, and then refill the fuel tank. Use your hand to lift the pump and bleed screw to purge air from the fuel system. Check whether the pipeline is smooth Clean the filter screen and replace the fuel filter. Check for leaks in the oil inlet pipe and for blockages in the filter screen at the oil inlet pipe joint. If the oil supply is still not working after these checks, you should... Check the oil inlet pipe and oil pump. When starting, the handle should be pushed to the no-load position. Check or adjust the static injection advance angle of the fuel injection pump. Remove the injector, inspect it, and adjust the injection pressure to the specified range on an injector test bench. Replace the injector assembly if necessary.
When the start switch is turned on, the diesel engine does not turn.	(1) Circuit wiring error or poor contact (2) Insufficient battery power (3) The starter motor brushes and commutator are not making contact or are making poor contact. (4) Internal mechanical failure of the diesel engine hinders crankshaft rotation	Check that the wiring is correct and secure. Charge the battery or use a fully charged battery or Add parallel use of storage batteries Repair or replace the carbon brushes, clean the commutator surface with sandpaper and blow it clean, or adjust the pressure of the brush springs. If the crankshaft still cannot turn after disconnecting the driven equipment, the crankshaft should be manually rotated to check whether the problem is caused by a seized crankshaft or connecting rod bearing, a stuck piston, or an incorrect installation of the camshaft timing gear.
Fuel injection is normal but the engine is not firing; there is fuel in the exhaust pipe.	Insufficient compression pressure in the cylinder: (1) Excessive wear of piston rings or cylinder liners (2) Valve leakage	Replace piston rings; replace cylinder liners depending on wear; check valve clearance, valve springs, valve guides, and valve seat sealing; repair and resurfacing are necessary if sealing is poor.
Long start-up time and no spark	Ambient temperature is too low	Based on the actual ambient temperature, appropriate low-temperature start-up auxiliary measures shall be taken.

2) Insufficient power of diesel engine

Fault characteristics	Probable cause	Exclusion method
Power or RPM does not increase even after increasing throttle.	Fuel system failure: (1) Fuel line rupture, pipe joint leak, fuel filter blockage, air in the fuel system (2) Insufficient fuel in the fuel tank or water and impurities in the fuel tank. (3) Incorrect static fuel injection timing of the fuel injection pump (4) Insufficient fuel supply from the fuel injection pump (5) Poor fuel injector atomization or low fuel injection pressure	Replace the ruptured fuel line, tighten the pipe fittings, clean the filter screen, replace the fuel filter, and purge the fuel system. Ensure the fuel tank contains sufficient clean fuel and drain water and sediment from the tank through the drain valve. If originally... Some fuels are not clean and should be replaced with clean fuel. Check and adjust the static injection advance angle of the fuel injection pump. Inspect and repair and replace the fuel injection pump if necessary. Check the spray pattern or adjust the injection pressure and inspect the injector assembly; replace if necessary.
Under normal circumstances, the exhaust temperature is high and the smoke color is poor.	Intake and exhaust system malfunctions: (1) Air filter blockage (2) Air leakage in the intake system (3) The exhaust pipe is blocked or the pipe is too long, the turning radius is too small, or there are too many bends. (4) Incorrect valve clearance (5) Incorrect static fuel injection timing of the fuel injection pump	Clean the dust off the paper filter element; replace the filter element if necessary. Check for air leaks between the turbocharger compressor outlet and the cylinder head intake; eliminate the source of the leak if necessary. Clean carbon deposits from the exhaust pipe, reinstall the exhaust manifold, ensuring there are no more than three bends and a sufficiently large exhaust cross-section. Check and adjust the valve clearance. Check and adjust the static injection advance angle of the fuel injection pump.
Performance deteriorates at different speeds	Fuel injection pump injection advance angle or intake/exhaust phase change	Check and adjust the static injection advance angle of the fuel injection pump; if necessary, check the camshaft gear timing.
Diesel engine overheating	(1) The ambient temperature is too high (2) The engine oil and coolant temperatures are very high, and the exhaust temperature is also greatly increased.	However, if the ambient temperature is too high, ventilation should be improved and cooling temporarily increased. Inspect the oil cooler and radiator, removing scale; check if the relevant pipe diameters are too small.
The diesel engine has insufficient power, degraded performance, and exhibits symptoms such as air leakage, black smoke from the intake manifold, and abnormal knocking sounds.	Cylinder head assembly failure: (1) Air leakage at the mating surface between the cylinder head and the engine block; during gear shifting, a stream of air rushes out from the cylinder head gasket, causing the cylinder head nut to loosen or the gasket to be damaged. (2) Air leakage from intake and exhaust valves (3) Damaged valve spring (4) Incorrect valve clearance (5) Air leakage from the injector nozzle or damage to its copper gasket. (6) Piston ring jamming or valve stem seizing causes insufficient cylinder compression pressure.	Tighten the cylinder head nuts to the specified torque or replace the cylinder head gasket; if necessary, scrape the mating surfaces. Disassemble and inspect the intake and exhaust valves, and grind the valve and valve seat sealing surfaces. Replace the damaged valve spring. Check and adjust valve clearance to the specified value. Disassemble, inspect, and replace any damaged parts. Inspect piston rings, piston, cylinder liners, and valves; replace these parts if necessary.

The diesel engine is making abnormal noises and exhibiting symptoms such as decreased oil pressure.	The connecting rod bearing bush engages with the surface of the connecting shaft journal of the crankshaft	Check the lateral clearance of the connecting rod big end and see if it can move back and forth. If it cannot move, it indicates seizing, and the journal should be ground and the connecting rod bearing replaced.
Decreased engine speed, reduced intake pressure, air leakage, or abnormal noises, etc.	Turbocharger failure: (1) The turbocharger bearing is worn, and the rotor is rubbing. (2) The compressor intake duct is contaminated, blocked, or leaking.	Have a professional technician inspect it; replace the turbocharger if necessary. Please have a professional turbocharger maintenance technician inspect and clean the compressor housing and impeller. Clean the intake pipe; tighten the nuts and clamps at the mating surfaces, etc.

3) Abnormal noise and excessive vibration of diesel engine during operation

Fault characteristics	Probable cause	Exclusion method
The cylinder emits a rhythmic and crisp metal knocking sound	Static fuel supply timing of fuel injection pump is too early	Adjust the static fuel supply advance angle of the fuel injection pump
The cylinder emits a low and unclear knocking sound	Static fuel supply timing of fuel injection pump is too late	Adjust the static fuel supply advance angle of the fuel injection pump
There is a slight and sharp noise during operation, especially when idling	Excessive fit between piston pin and connecting pin small end bushing hole	Check whether the inner hole of the connecting Bush is worn. If so, replace the connecting rod
The cylinder emits a low and unclear knocking sound when the propeller oil engine suddenly reduces the speed, a heavy and powerful impact sound is heard	The connecting rod bearing bush is worn, making the fitting clearance too large	Check the axial clearance and the wear degree of the thrust bearing, and replace the thrust bearing if necessary
When the diesel engine idles, the collision sound of crankshaft moving back and forth can be heard	The crankshaft thrust bearing is worn and the axial clearance is too large, resulting in the crankshaft moving back and forth	Check the axial clearance and the wear degree of the thrust bearing, replace the thrust bearing if necessary, replace the damaged parts, and adjust the valve clearance
The cylinder head emits a rhythmic slight knocking sound	The valve spring is broken, or the lifter is bent, or the push sleeve is worn or the valve is damaged	Replace damaged parts and adjust valve clearance
During the operation of the diesel engine, the cylinder head emits a heavy, even and rhythmic knocking sound. Gently pinch the nut of the cylinder head cover with your fingers, and you will feel a collision	Valve against piston	Remove the cylinder head cover, check the cause of collision and adjust the valve clearance. If necessary, check whether the piston model is correct
An abnormal sound is made at the front cover plate, and an impact sound can be heard when the speed drops suddenly	The transmission gear is worn and the backlash is too large	Check the backlash and replace the gear according to the wear
Hear the squeaking sound of dry friction at the cylinder head	There is no oil between the rocker arm adjusting screw and the spherical seat of the pusher	Remove the cylinder head cover and check the cause of oil failure
A loud rhythmic sound is heard at the cylinder head	Excessive clearance between intake and exhaust valves	Check and adjust the valve clearance

There is abnormal rubbing sound when the turbo is running	The oil passage is blocked and the bearing is worn due to poor lubrication, which leads to the bending of the impeller blade	Ask professional maintenance personnel to check the wear of bearings and the bending of impeller blades and replace the turbo if necessary. Clean the oil inlet and outlet pipes of the booster to ensure smooth lubrication oil passage
Combustion noise is too loud	(1) Poor fuel quality (2) Fuel injection pump failure	Drain the fuel in the fuel tank and replace the fuel filter. Inject clean fuel with good quality into the fuel tank to make the diesel engine run under the condition of maximum combustion noise and then unscrew the oil pipe nuts of each cylinder on the injection pump one by one (one at a time). If the combustion noise disappears after the oil pipe nut is loosened, check the plunger pair of the cylinder injection pump and replace it with new parts if necessary

4) Abnormal exhaust smoke colour

Fault characteristics	Probable cause	Exclusion method
Black smoke from exhaust	(1) The load of diesel engine exceeds the regulation (2) Uneven oil supply of each cylinder (3) Incorrect valve clearance and poor valve sealing lead to air leakage and combustion deterioration (4) The static fuel supply timing of the fuel injection pump is too late, causing some fuel to burn in the exhaust pipe (5) Poor atomization of fuel injector (6) The air filter or intake pipe is blocked, and the turbocharger casing is too dirty, resulting in insufficient intake air (7) The O-ring of the turbocharger is burnt or worn, and air leaks from each turbine joint surface (8) The piston ring is severely worn	Reduce the load to within the specified range Adjusting the fuel injection pump Adjust the valve clearance, check the sealing cone and eliminate the defects Check and adjust the static fuel supply advance angle of the fuel injection pump Check atomization of fuel injector Clean and remove dust and dirt, and replace the air filter element if necessary Let professional maintenance personnel check the elastic gas seal ring and replace it if necessary. Screw in the closing face screw and replace with a new ring
White smoke from exhaust	(1) Poor atomization of fuel injector, oil dripping and low injection pressure (2) When the diesel engine is just started, some cylinders do not burn, especially in winter (3) There is too much water in the oil (4) Cracks in the cylinder head cause coolant to enter the cylinder	Check the fuel injection nozzle coupling and repair or replace it. Adjust the injection pressure to the specified range Properly increase the speed and load, and run for more time to remove the moisture in the fuel pipeline Check whether there is moisture condensation in the exhaust, and replace the cylinder head if necessary

Blue smoke from exhaust	(1) The air filter is blocked and the air intake is not smooth (2) Piston ring is stuck or worn too much, with insufficient elasticity; During installation, the chamfer direction of the piston ring is reversed to allow oil to enter the combustion chamber (3) During long-term low load operation (less than 40% of the rated power), the clearance between the piston and cylinder liner is large, which makes the oil easy to blow into the combustion chamber (4) Too much oil is added into the oil pan (5) The turbocharger oil seal is damaged, and the oil enters the intake pipe, thus entering the cylinder	Disassemble, inspect and clean the air filter element Disassemble and inspect the piston ring, and replace the piston ring if necessary Appropriately increase the load; Appropriate power shall be selected when matching Fill engine oil according to the oil dipstick marking and do not exceed the high oil level marking Check whether there is oil in the intake pipe and check or replace the turbocharger if necessary
-------------------------	--	---

5) Abnormal oil pressure

Fault characteristics	Probable cause	Exclusion method
The oil pressure dropped, and the pressure regulating valve remained malfunctioning even after adjustment. Simultaneously, the pressure gauge reading fluctuated.	(1) Oil leak in the engine oil line (2) Air enters the oil pump, resulting in insufficient oil in the oil pan. (3) The oil cooler or oil filter is blocked, or the cooler core is broken. (4) Severe oil leakage at the crankshaft bearing, crankshaft front and rear oil seals, camshaft bearing, connecting rod bearing, and/or rocker arm shaft and rocker arm. (5) Diesel fuel is present in the engine oil. (6) Piston cooling nozzles are missing from the machine body (7) Oil dilution	Inspect and tighten nuts Add engine oil to the specified level. Clean the oil cooler and replace the oil filter and oil cooler element if necessary. Inspect the wear of each bearing; replace the corresponding parts if the wear value exceeds the specified range. Locate where diesel fuel entered the engine oil and repair as needed. Change the engine oil and oil filter. Install piston cooling nozzle Check the cause and change the engine oil.
There is no oil pressure, and the pointer of the pressure gauge does not move	(1) Damaged oil pressure gauge (2) The oil passage is blocked (3) The oil pump is severely damaged (4) The oil pressure regulating valve	Replace Purge after maintenance and cleaning Reinstall the oil pump as required and replace it if or improperly assembled and stuck necessary Replace the pressure regulating valve fails and its spring is damaged

6) Engine oil temperature is too high and engine oil consumption is too high

Fault characteristics	Probable cause	Exclusion method
The reading of the oil thermometer exceeds the specified value, which is still high after enhanced cooling, and the exhaust emits black smoke	(1) Excessive load of diesel engine (2) Incorrect indication of thermometer (3) The oil level of engine oil is too low or too high (4) Insufficient coolant capacity or fan air volume (5) Oil cooler blocked	Reduce load Check the thermometer and replace it if necessary Adjust the engine oil to the specified requirements Pay attention to keep the coolant unblocked, adjust the tension of the belt, and make the water pump and fan meet the requirements
The oil level in the oil pan drops rapidly, and the oil color is black. The vent pipe and fuel filler emit white smoke, and the exhaust pipe emits blue smoke	(1) Long term low load operation (2) Improper brand of engine oil used (3) Turbocharger O-ring fails (4) The oil return hole of the oil ring on the piston is blocked by carbon deposits (5) The piston ring is stuck or worn too much and the cylinder liner is worn too much, causing the engine oil to blow into the combustion chamber and the gas to enter the crankcase (6) Worn valve guide	Appropriately increase the load Select the brand of engine oil specified in this manual Ask professional maintenance personnel to remove and check whether the O-ring is burnt out and elastic failure. If necessary, replace the O-ring to clean up carbon deposits. If necessary, replace the oil ring Replace piston rings and if necessary, cylinder liners Replace cylinder head and replace guide pipe

7) Cooling water in engine oil

Fault characteristics	Probable cause	Exclusion method
Yellow foam floats in the engine oil, and water vapor condenses on the filter element surface of vent pipe	Coolant leakage caused by damaged water seal ring of cylinder liner	Replace the sealing ring
	Coolant leakage from the joint surface of cylinder liner and engine block	Check whether the joint surface between the shoulder blade of the cylinder liner and the engine body is flat and whether the adjusting gasket of the cylinder liner is damaged. Replace relevant parts if necessary
	Coolant leakage of cylinder liner due to pitting and perforation	Replace cylinder liner
	Coolant leakage due to damaged cylinder head gasket	Replace the cylinder head gasket
	The core of the oil cooler is damaged, so that the coolant and oil are mixed	Disassemble and inspect the oil cooler core, and replace the cooler core if necessary
	Coolant in the water pump leaks into the oil pan: (1) Coolant leakage at the water pump shaft and O-ring (2) O-ring of water pump is damaged	Check and replace the O-ring and replace the water pump if necessary
	Coolant leakage caused by cavitation corrosion of the water chamber wall of the engine block (especially the cylinder wall near the push rod side)	Replace the engine body

8) Coolant temperature is too high

Fault characteristics	Probable cause	Exclusion method
After the diesel engine is started, the water outlet pipe does not discharge coolant or the amount of coolant is small, and the coolant temperature keeps rising	There is air in the cooling system	Loosen the air outlet pipe on the water outlet pipe, drain the air until the coolant flows out smoothly, and tighten all joints in the water pipeline
Under high load, the coolant temperature is too high and the oil temperature is also increased	(1) The speed of water pump or fan fails to meet the requirements (2) Insufficient coolant in the cooling system (3) Radiator pressure cap failure (4) Blocked water pipe (5) There is too much dirt on the surface of the radiator, resulting in blockage of the cooling water pipe (6) Incorrect water temperature gauge (7) Thermostat failure (8) The clearance between the water pump impeller and the housing is too large (9) Damaged water pump impeller	Adjust the tension of the drive belt to the specified requirements Supplement coolant to specified requirements Check the operation of the pressure cap and replace it if necessary Clean the pipeline and remove the scale in the water channel Clean the radiator, check the water temperature gauge and replace it if necessary Check whether the opening and closing temperature and opening lift of the thermostat meet the requirements, and replace the thermostat if necessary Replace the water pump
The coolant in the radiator is bubbling	Cracks on shoulder blade of cylinder liner	Replace cylinder liner

9) Outlet water temperature of diesel engine is too low

Fault characteristics	Probable cause	Exclusion method
	Low ambient temperature and low service load	Appropriately increase the load
	Incorrect indication of water temperature gauge	Check the water temperature gauge and replace it if necessary
	The thermostat is not flexible or damaged	Replace the thermostat

10) Oil in cooling water

Fault characteristics	Probable cause	Exclusion method
	Damaged oil cooler core	Replace the oil cooler core
	Cylinder head gasket failure	Replace the cylinder head gasket

11) Common faults of electrical system

Fault characteristics	Probable cause	Exclusion method
Starter motor does not rotate	(1) Poor contact of connecting wire (2) Poor contact of electromagnetic switch contact (3) Poor contact of brush (4) Short circuit of starter motor itself (5) The battery is under charged or its capacity is too small	Cleaning and unscrewing the splice Check the switch contacts and polish them with sand Clean the commutator surface or replace the brush
The starting motor idles without starting power	(1) Poor contact or desoldering of brush and terminal (2) Wear of bearing sleeve (3) Local short circuit of field winding or armature winding (4) Contact of electromagnetic switch is singed and poor (5) The battery is under charged or the capacity is too small, and the voltage drop of the starting motor is too large	Clean the surface, re-weld or replace Replace with new ones Find the short circuit and repair it Inspect the switch contacts and polish them with sandpaper. Charge the battery and replace it if necessary.
Starting motor gear and top gear of flywheel gear ring or starting motor gear cannot be retracted	(1) The center of starter and flywheel gear ring is not parallel (2) The contacts of the electromagnetic switch burn together	Reinstall the starter, eliminate the non-parallelism, check the switch contact, file it flat and sand the burnt unevenness
The start button is disengaged, and the starting motor continues to run	(1) Starting electric key or button does not reset (2) The electromagnetic switch contact and connecting screw are burnt (3) The starting relay is burnt	Readjust Overhaul Readjust
Alternator won't charge	(1) The drive belt of the alternator is loose. (2) Poor contact in the charging circuit, grounding circuit, or battery terminals. (3) Rotor (magnetic field coil) malfunction	Adjust the drive belt to the appropriate tension. Inspect all wires and connectors, clean all connectors and tighten them. Replace wires and connectors or the rotor if necessary.

Charging alternator voltage is too low or charging is abnormal	(1) Loose transmission belt (2) Poor contact of charging circuit, grounding circuit or battery connector (3) The alternator voltage regulator is damaged (4) Rotor (field coil) failure	Adjust the drive belt to the proper tension Check all wires and connectors, wipe all connectors clean and tighten them. Replace the wires and connectors as necessary Replace the voltage regulator Replace the rotor Replace rectifier diode
Charging alternator voltage is too high	(1) Poor contact at the connector on the alternator or the generator voltage regulator (2) The alternator voltage regulator has failed	Tighten all connectors on the alternator or voltage regulator Replace the voltage regulator
Abnormal sound of alternator	(1) The drive belt is worn or damaged (2) Loose transmission belt (3) The drive belt and the pulley belt are not aligned with each other (4) Wear of alternator bearing (5) Armature or rotor shaft bending (6) Short circuit of rectifier element of alternator	Replace the drive belt Adjust the drive belt to the proper tension Adjust to align the center of the drive belt with the center of the belt wheel Replace the alternator

12) Common faults of fuel injection pump

Fault characteristics	Probable cause	Exclusion method
Fuel injection pump does not supply oil	(1) There is no diesel in the fuel tank (2) Air enters the fuel system (3) Fuel filter or oil pipe is blocked (4) Fuel pump failure, no fuel supply (5) Plunger coupling is blocked (6) Poor sealing of the joint surface between the oil outlet valve seat and the plunger sleeve	Add diesel in time Use the fuel pump to purge air. Clean the filter screen, replace the fuel filter, and blow the pipeline clean after cleaning. Repair according to the troubleshooting methods for oil pump malfunctions. Have a professional repair technician disassemble the plunger assembly for grinding; replace it if necessary. Have a professional technician disassemble and repair it; replace it if necessary.
Uneven oil supply	(1) There is air in the fuel line, causing intermittent fuel supply. (2) Oil outlet valve spring broken (3) Wear of the oil outlet valve seat surface (4) Impurities cause the plunger to be blocked. (5) Insufficient oil inlet pressure	Use the fuel pump to purge air. Replace fuel injection pump Have a professional repairman replace the oil delivery valve assembly. Have a professional mechanic clean and check the fuel pump inlet filter and fuel filter for blockages, and replace them if necessary. Perform regular cleaning and maintenance. Inspect the fuel delivery valve assembly; replace or clean the filter screen if necessary; replace the fuel filter. Replace plunger couple
Insufficient oil output	(1) Oil leakage from the oil outlet valve assembly (2) Fuel pump inlet filter or fuel Filter clogged (3) Wear of plunger assembly	Inspect the fuel delivery valve assembly; replace or clean the filter screen if necessary; replace the fuel filter. Replace plunger couple

13) Common faults of governor

Fault characteristics	Probable cause	Exclusion method
Unstable rotation speed (motor)	(1) Uneven fuel supply to each cylinder (2) Carbon buildup or dripping from fuel injector nozzle holes (3) Loose gear connecting pin (4) Excessive axial clearance of the fuel injection pump camshaft (5) The fly iron pin hole is worn and loose. (6) Adjusting the meshing between the rack and the gear, the gaps are too large or there are burrs between them. (7) The adjusting rack or throttle lever moves flexibly. (8) There is air in the fuel system (9) The flying iron or the flying iron base is not opening properly. (10) Improper low-speed adjustment	Readjust the fuel supply to each cylinder Have a professional mechanic clean, repair, or replace the fuel injectors. Have a professional mechanic repair or replace the fuel injection pump. Use the fuel pump to purge air. Have a professional mechanic repair or replace the fuel injection pump. Have a professional repairman readjust it.
The rated speed cannot be reached	(1) Permanent deformation of speed regulating spring (2) Insufficient fuel supply of fuel injection pump (3) The joystick is not in the maximum speed position	Ask professional maintenance personnel to repair or replace the fuel injection pump Handle according to the troubleshooting method of fuel injection pump Check and adjust the joystick mechanism
The minimum idle speed is not reached	(1) The joystick is not fully lowered (2) The adjusting gear rod and the adjusting gear ring are slightly stuck (3) Improper adjustment of low speed stabilizer	Ask professional maintenance personnel to adjust or replace the fuel injection pump Ask professional maintenance personnel to repair or replace the fuel injection pump Let professional maintenance personnel adjust
The governor suddenly fails, causing the speed to exceed the rated speed by more than 110% (commonly known as runaway)	(1) The speed is too high (2) The adjusting gear lever or accelerator lever is stuck (3) The connecting pin between the adjusting gear rod and the accelerator pull rod falls off (4) Accelerator pull screw falls off (5) The speed regulating spring breaks or the spring hanger falls off	Emergency shutdown shall be carried out immediately, and the diesel engine shall be stopped by cutting off the fuel supply or air intake, and the professional maintenance personnel shall inspect and repair or replace the fuel injection pump Ask professional maintenance personnel to repair or replace the fuel injection pump Ask professional maintenance personnel to repair or replace the fuel injection pump Ask professional maintenance personnel to repair or replace the fuel injection pump Ask professional maintenance personnel to repair or replace the fuel injection pump Ask professional maintenance personnel to repair or replace the fuel injection pump

14) Common faults of oil transfer pump

Fault characteristics	Probable cause	Exclusion method
Insufficient oil delivery	(1) Worn or broken check valve (2) Piston wear (3) Leakage of oil inlet tight cap (4) The filter screen at the inlet of the oil transfer pump is blocked (5) The piston is stuck and the oil is cut off (6) Oil leakage of oil transfer pump	Repair or replace the oil transfer pump Replace the fuel transfer pump Retighten or repair Clean the filter screen Replace the fuel transfer pump Check the fuel transfer pump and replace it if necessary

15) Common faults of fuel injector

Fault characteristics	Probable cause	Exclusion method
Very little or no oil is sprayed	(1) There is air in the fuel system. (2) Fuel injector assembly seized (3) Abnormal fuel supply from the fuel injection pump (4) Severe fuel system leaks (5) Wear of fuel injector assembly	Remove air from low-pressure or high-pressure oil lines Have a professional mechanic inspect or replace the fuel injectors. Find and resolve the cause using the fuel injection pump troubleshooting methods. Inspect, repair or replace the relevant parts. Have a professional repair technician inspect and replace the nozzle assembly.
Low injection pressure	(1) The fuel injector pressure regulating screw is loose (2) The fuel injector pressure regulating spring is deformed and broken (3) The nozzle needle valve is sticky	Let professional maintenance personnel readjust to the specified pressure and tighten the lock nut Ask professional maintenance personnel to replace the injector spring Ask professional maintenance personnel to replace the fuel injection nozzle couple
Injection pressure is too high	(1) The spring force of fuel injector pressure regulating spring is too high (2) Sticking needle valve of fuel injection nozzle (3) Carbon deposit or blockage of spray hole	Let professional maintenance personnel readjust to the specified pressure Ask professional maintenance personnel to replace the fuel injection nozzle couple Ask professional maintenance personnel to clean the spray hole or replace the fuel injector
Fuel injector leakage	(1) Fuel injector pressure regulating spring is broken (2) The grinding surface of injector needle valve body is damaged (3) The needle valve of the fuel injection nozzle is stuck (4) The tight cap of fuel injector is deformed (5) Poor contact between the fuel injection nozzle and the sealing plane of the fuel injector body leads to leakage	Ask professional maintenance personnel to replace the injector spring Ask professional maintenance personnel to replace the fuel injection nozzle couple Let professional maintenance personnel replace the nozzle couple Ask professional maintenance personnel to replace the tight cap. Ask professional maintenance personnel to repair or replace the fuel injector coupling. If necessary, replace the fuel injector

Poor spray atomization	(1) The elastic force of the pressure regulating spring is attenuated or the spring is broken (2) The seat surface of the fuel injection nozzle is worn (3) There is garbage on the mating surface of fuel injection nozzle couple (4) Deformation or wear of fuel injection nozzle couple (5) The needle valve of the fuel injection nozzle is stuck	Ask professional maintenance personnel to replace the injector spring Let professional maintenance personnel repair or replace the fuel injection nozzle couple Let professional maintenance personnel replace the nozzle couple
Injection line or oil drop	(1) Carbon deposition and blockage of spray hole (2) Excessively worn seat surface of injector needle valve body (3) The needle valve of the fuel injection nozzle is stuck	Let professional maintenance personnel clean the spray hole and replace the fuel injector if necessary Ask professional maintenance personnel to replace the fuel injection nozzle couple
The surface of needle valve is burnt or blue black	Diesel engine overheating	Check the cooling system. Do not overload the diesel engine for a long time. Ask professional maintenance personnel to check the fuel injection nozzle couple and replace it if necessary

16) Common faults of exhaust gas turbocharger

Fault characteristics	Probable cause	Exclusion method
The diesel engine fails to reach the specified power	(1) Bearing wear (2) Contamination of compressor impeller and its volute channel (3) Excessive carbon deposits on the back of turbine and compressor impeller and O-ring	Ask professional maintenance personnel to replace the bearing Let professional maintenance personnel clean
The exhaust smoke color of the diesel engine is abnormal, and the exhaust pipe emits black smoke (insufficient air intake)	(1) Contamination of part of flow passage of compressor (2) Air leakage of compressor	Clean and check the sealing condition, Eliminate air leakage
Blue smoke from exhaust	(1) O-ring loses elasticity or is excessively worn (2) The oil return passage of intermediate casing is blocked or the pipeline is deformed	Ask professional maintenance personnel to replace the O-ring, Clean and repair the deformed part
Abnormal sound and vibration	(1) Compressor surge, the turbocharger vibrates with a large amplitude (severe contamination of the compressor passage, intake pipe and turbine outlet passage is one of the causes of surge). (2) Improper assembly (turbine or compressor rotor loses dynamic balance or rotating parts rub against stationary parts)	Let professional maintenance personnel clean Let professional maintenance personnel dismantle, inspect and repair

	(3) The blades of the turbine impeller or compressor impeller are damaged by foreign objects. (4) Turbine housing deformation causes friction (5) If there are foreign objects in the bladeless volute passage, an abnormal sound can be heard when the diesel engine is idling.	Let professional maintenance personnel inspect and repair, and replace the supercharger if necessary Have a professional repairman determine the cause of the deformation and resolve the issue; replace the turbocharger if necessary. Have a professional mechanic disassemble and inspect the cross-section of the access panel, and simultaneously check the diesel engine's intake and exhaust systems.
The turbine compressor rotor cannot rotate or is inflexible	Serious carbon deposition at the back of turbine and compressor and the seat of elastic seal ring	Let professional maintenance personnel clean the diesel engine and check the poor combustion and oil leakage
Bearing burning and rotor rubbing	(1) The lubricating oil is too dirty, the oil pressure is too low or the oil passage is blocked (2) Oil inlet temperature is too high (3) The dynamic balance of turbine and compressor rotor is damaged or improperly assembled (4) Exhaust temperature is too high and turbocharger speed is too high (5) Turbine casing deformation	Check the lubrication system and clean the filter Find out the cause and reduce the oil temperature Let professional maintenance personnel disassemble check and recalibrate the balance and replace the turbocharger if necessary Check the diesel engine and exhaust pipe for serious air leakage, deformation and blockage, repair and clean Find out the cause of deformation and eliminate it. If necessary, replace the turbocharger
Speed drop, intake pressure drop, air leakage or abnormal sound, etc	(1) The turbocharger bearing is worn, and the rotor is collided (2) Contamination, blockage or air leakage of compressor inlet pipeline	Let professional maintenance personnel repair and replace the turbocharger if necessary Clean the compressor casing, wipe the impeller and clean the air inlet pipeline; Tighten the joint nut, clamp, etc

7. OIL ENGINE PRESEVATION AFTER SHUTDOWN

7.1. Short-Term Out-of-Service Preservation

Short-term out-of-service preservation of diesel engines need to be out of service for a period of time (1 to 3 months), the need to do a good job of cleaning and the necessary oil sealing measures to prevent rusting

7.1.1. Before Sealing

- 1) Clean the surface of the diesel engine, check that there is no visible dirt, oil, rust, water stains, etc., and then blow dry with pressurized air; use a brush to apply anti-rust oil evenly on the machined surface (i.e. unpainted surface) of all diesel engine metal surfaces; note that rubber parts, plastic parts and fiber fabric parts are not allowed to apply anti-rust oil or contact with anti-rust oil on the surface.

Note: The surface of the drive pulley of the attachment needs to take certain anti-rust measures.

It is recommended to use FD615 dehydrated antirust oil or antirust oil that meets the following performance requirements for external sealing of the engine.

Item	Quality index	Item		Quality index
Appearance	Uniform brown	Salt	Cast iron sheet	≥ 7
Water content	Nil	Damp heat test	Steel sheet	≥ 30
Drip	≥ 55		Cast iron sheet	≥ 14
Cold resistance	Up to standard	Laminate	Steel sheet	Up to standard
Oil based stability (ml)	≤ 2	Corrosion	Steel sheet	Up to standard
Salt spray test I Steel sheet	≥ 14		Cast iron sheet	Up to standard

- 2) Disconnect the battery connecting wire, clean the terminal, apply a thin layer of grease and charge the battery.
- 3) Loosen the drive belt.
- 4) All exposed air pipes, water pipes or oil pipe orifices shall be sealed or bound with moisture proof paper or vapor phase rust proof paper or polyethylene plastic film tape. The entire air filter shall also be sealed or bound with moisture-proof paper.
- 5) Cover the diesel engine with a plastic cover or similar covering and place the diesel engine in a well-ventilated dry room.

7.1.2. Preservation Period

Charge the battery every month. Check the liquid level of the battery, add when needed, and then charge it. Rotate the crankshaft 3-4 times a month with a disk tool.

7.1.3. After Unpacking

Remove the fuel injection pump and send it to the service station designated by Shanghai Diesel Engine for adjustment; remove the coverings and wrappings and connect the piping; install the fuel injection pump and pump oil and exhaust into the fuel system; connect the battery connection and tension the drive belt; check the level of lubricating oil and coolant and add the appropriate amount of clean oil to the oil inlet of the turbocharger; turn the crankshaft 3-5 revolutions with the disk tool first. Turn the crankshaft for 3-5 revolutions. Refer to section 4.5 Diesel engine starting, use the correct method to start the diesel engine.

7.2. Long-Term Out-of-Service Preservation

Long-term out-of-service preservation of diesel engines out of service for more than 3 months, the need for storage treatment

7.2.1. Before Storage

- 1) After the last diesel engine use, put out the diesel engine lubricating oil, including the oil in the oil filter, in the hot state. Because the coolant has the function of rust prevention, it does not need to be discharged. Add qualified sealed oil of specified capacity to the crankcase, start the diesel engine to idle speed, run it for 1-1.5min and stop it, then drain the sealed oil from the oil sump. The internal storage oil of the engine is CF15W-40 lubricant by dehydration.
- 2) The external surface of the diesel engine should be cleaned to prevent rust and other requirements of storage, see section 7.1.1, Article 1, 2, 3, 4, 5, and hang a label on the diesel engine, and the label should state that the diesel engine has no oil and should not be used.

7.2.2. Storage Period

Refer to 7.1.2

7.2.3. Use After Unpacking

When starting, remove the fuel injection pump and send it to the service station designated by New Power Technology Company for adjustment; remove the diesel engine coverings and wrappings and connect the pipeline; install the fuel injection pump and pump oil and exhaust into the fuel system; connect the battery connection and tension the drive belt; add clean oil and add an appropriate amount of clean oil to the oil inlet of the booster; check the oil level and coolant level; turn the crankshaft for 3-5 revolutions with the pan tool first. Turn the crankshaft for 3-5 revolutions. Refer to section 4.5 Diesel engine starting and use the correct method to start the diesel engine. If the storage period exceeds 2 years, the coolant must be replaced and the cooling system must be cleaned.

NOTES

NOTES

MANUFACTURER DETAILS

HEADQUARTERS & FACTORY



SDEC POWER

Shanghai New Power Automotive Technology Company Limited.

No.2636 Jungong Road, Yangpu District, Shanghai, China 200438

Engine	Spare parts	Service
+86-21-60652308	+86-21-60652314	+86-21-60652369
motor@sdecie.com	spare@sdecie.com	sc_fw@sdec.com.cn
www.sdecie.com		

DEALER INFORMATION

CONTACT DETAILS



Vert Energy Africa (Pty) Ltd

28A Cnr. Avalon & Private Roads, Westlake View Ext 12, Modderfontein, Johannesburg, Gauteng, South Africa

General Enquiries

+27 (0)11 453 9669

info@vertgroup.co.za

www.vertgroup.co.za

O&OE

All information in the document is substantially correct at the time of printing but may be subsequently altered by the company.