



SDEC POWER

D
SERIES
POWER
GENERATION ENGINES



G-DRIVE POWERPACK

Power Generation Specification

OPERATION AND MAINTENANCE MANUAL

Power Output Range

230kW – 282W

STAGE II EMISSION COMPLIANT
FOR USE IN THE FOLLOWING TERRITORIES. ASIA, MIDDLE EAST AND AFRICA.

H SERIES DIESEL ENGINE

MODELS	MAX ENGINE OUTPUT		RATED GENERATOR OUTPUT	
	Prime kW	Standby kW	Prime kVA	Standby kVA
6DTAA8.9-G23 (1500 rpm)	230	253	250	275
6DTAA8.9-G23 (1800 rpm)	255	282	275	303

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 the outputs and ratings tables for exact site conditions.

ADMONITION

To reduce the possibility of personal injury and property damage, and to minimize the deterioration of diesel engine performance and the likelihood of premature wear or damage, please strictly adhere to the safety instructions and operating procedures given in this manual, especially the operating warnings and precautions.

The warnings in this manual must be strictly followed, otherwise it may result in burns, amputation, disability, suffocation, other personal injury or death. The precautions are to remind operators to operate the diesel engine correctly to avoid damage to diesel engine parts or deterioration of diesel engine performance. These "warnings" and "precautions" are not exhaustive, and Shanghai Diesel Engine Co., Ltd. cannot and should not provide for all potentially dangerous consequences of violating these safety instructions and operating procedures.

PRODUCT REPAIR, TECHNICAL CONSULTATION, COMPLAINTS AND SUGGESTIONS

Product repairs, technical consultations, complaints, and suggestions, please contact the Shanghai "Easy People" call center. We provide fast, professional, and sincere service 24/7, **365** days a year. National toll-free service hotline: **400-820-5656**.

For Product Repair Requests

Please be sure to provide the following information:

- Diesel engine model.
- Diesel engine order number
- Diesel engine number
- Equipment purchase date
- More detailed fault description
- Contact person's address and phone number

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1. INTRODUCTION

I. To User and Operator

Thank you for choosing Shanghai Diesel Engine Co., Ltd.'s diesel engine products!

6DTAA8.9 diesel engine is a four-valve, high-power diesel engine developed by Shanghai Diesel Engine Co., Ltd. based on its 9DF electronically controlled vehicle diesel engine for off-road applications. It meets relevant national emission regulations. The 6DTAA8.9 diesel engine is powerful, economical, reliable, and easy to operate and maintain, making it an ideal power source for various construction machinery and land-based power plants.

This manual primarily describes the technical specifications, usage, and maintenance precautions for the basic model of this diesel engine to help users familiarize themselves with the product and use and maintain it correctly. Users should carefully read the relevant content and requirements in this manual before using the diesel engine. Due to continuous improvements in product performance and structure, the technical specifications and illustrations listed in this manual may differ slightly from the actual product you are using. Our company will continuously supplement and improve this manual in future editions without further notification to users; please be aware of this. For any questions regarding the use and maintenance of this product, please contact the Shanghai Diesel Engine Co., Ltd. "Easy People" call center (400-820-5656) for technical consultation or guidance.

Shanghai Diesel Engine Co., Ltd. (Shanghai Diesel) products utilize the latest technology and high-quality components. For maintenance and repair, it is recommended to use Shanghai Diesel brand service parts. Shanghai Diesel's authorized service stations are located throughout China, providing repair services and spare parts supply; their service personnel are professionally trained.

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

II. Notice Regarding User Feedback on Product Quality

To facilitate our company's understanding and analysis of product quality issues and their causes, enabling timely product quality improvements and better service for our users, we kindly request users to specify the following when reporting product quality problems:

- The time and location of the malfunction.
- Diesel engine serial number (engine number), model, order number, shipping date, and exact address of the recipient.
- Diesel engine operating conditions, cumulative working time (hours or kilometers), operating status (power, speed), and fuel and oil grades used.
- Characteristics of the driven device (model, power consumption, structural features, etc.).
- Description of the fault phenomenon.
- For any parts or components requiring compensation or repair, please send or bring a record or description of the damage to our company for analysis. If the user finds numerous or particularly serious problems, please preserve the scene and inform us promptly so that our company can send personnel to jointly analyze the issue.

The handling of diesel engine quality problems shall be carried out in accordance with the relevant provisions of the quality warranty manual.

III. Product After-Sales Service Commitment

To improve after-sales service and minimize losses for users due to product quality issues, Shanghai Diesel Engine Co., Ltd. has established a 24-hour repair reporting and handling system.

Users nationwide can call 400-820-5656 to receive timely professional consultation and after-sales service from Shanghai Diesel Engine Co., Ltd.

IV. Safety Precautions

Before using or performing regular maintenance on the engine, carefully read and understand all safety precautions and warnings.

The appearance of this symbol in the maintenance section of this manual indicates a potential danger that could cause personal injury or death, or serious damage to the engine. However, this danger can be avoided by paying attention and taking necessary measures. We cannot anticipate all potential hazards that may occur; therefore, users are advised to always be mindful of safety.

The following safety precautions and warnings must be followed; otherwise, personal injury may result.

- Ensure safety for four weeks during operation and always be aware of potential dangers.
- Always remain vigilant when operating the engine. If you feel unwell or mentally unwell, stop working.
- Smoking is prohibited while operating the engine.
- Do not smoke while refueling, as fuel vapors are easily flammable.
- Do not smoke when checking the electrolyte level in a battery, as the electrolyte will release flammable gases.
- When working around the engine or its driving unit, do not wear loose clothing and remove all jewelry. Wear protective eyewear, work clothes, a safety helmet, or other protective equipment as necessary.
- To prevent fires during operation, generator sets must be kept at least 1 meter away from buildings and other equipment when in use.
- Engine exhaust contains harmful components such as carbon monoxide. Operating in poorly ventilated areas poses a risk of exhaust poisoning. If the engine is running indoors, exhaust gases must be vented outdoors, and it must be ensured that there are no leaks in exhaust pipe connections.
- Exhaust system components with protective devices or heat shields should not be removed; exposed rotating parts with protective covers should also not be removed, otherwise it may cause personal injury.
- Fuel, lubricating oil, coolant, or other flammable materials, as well as explosives or other dangerous goods, must not be placed around the engine. This poses a risk of fire or explosion.
- Wipe up any spilled fuel, lubricating oil, or coolant. Fuel, engine oil, or coolant can ignite and cause fire hazards. Store oily or coolant-soaked clothes in fireproof containers and never place them on the engine.
- Dust, dirt, and foreign objects should be removed from or around the engine. These can be causes of fires or engine overheating.
- Before starting the engine, ensure that there are no people around the engine and that there are no tools or other items on the engine. Never start the engine if the starter switch or other equipment displays a "Do Not Start" warning sign.
- If a fuel, lubricating oil, or exhaust leak is discovered, measures should be taken immediately to stop the leak. Fuel or lubricating oil splashing onto hot engine components, or exhaust encountering flammable materials, can cause a fire, posing a risk of personal injury or machine damage.
- Never use your hands to check for engine leaks, as the high temperature and pressure of fuel lubricating oil, and coolant can harm your body. Exercise extreme caution when checking for leaks in high-pressure fuel lines, as fuel under high pressure can penetrate the skin and cause injury or death. Use a thick plate to check for fuel leaks, and if a leak is found, avoid direct contact with the sprayed fuel.
- When testing fuel, lubricating oil, coolant, or battery electrolyte, if lighting is required, explosion-proof lighting equipment must be used to avoid the risk of ignition and explosion.
- Smoking and open flames are prohibited when handling any components related to the fuel system or working in its vicinity. Fuel vapors may ignite, posing a risk of damage to parts or personal injury.
- Do not perform any maintenance on any parts of the fuel system while the engine is running.
- Diesel fuel flows from the injection pump to the injectors under ultra-high pressure through high-pressure fuel lines. Therefore, never loosen any high-pressure fuel lines while the engine is running. Failure to comply with this warning may result in serious burns.
- When the engine is to be out of service for an extended period or requires maintenance, the connecting wires between the engine and the battery should be disconnected. If the engine is started by an air starter motor, the air connection line should be disconnected to prevent accidental engine starting. A "Do Not Operate" sign must be displayed in the control room or at the control area. When disconnecting the battery terminals, always start from the (-) terminal side. When installed, it always starts from the (+) terminal side.
- Tools or other metal objects must not be used to contact the two terminals of the battery. The positive and negative terminals of the battery must not be short-circuited, as this poses a risk of combustion and explosion.
- Battery terminal connections must be secure. Loose terminals can cause arcing due to poor contact, posing a risk of explosion. Damaged cables and wires can cause fires. Inspect and replace any faulty components before reconnecting.
- Do not use open flames or perform welding near the battery. The battery produces flammable hydrogen and

oxygen; using an open flame near it could cause a fire or explosion. The battery should not be used if the electrolyte level is below the minimum level line. Improper use of electrolyte can cause blindness or burns.

- If an engine is running indoors, fire extinguishers should be readily available and kept in a usable condition. Users should be familiar with how to use fire extinguishers. First-aid kits should be placed in designated locations and readily available for immediate use if needed. Fire and accident response procedures should be established, including contact information and locations for emergency response. Carbon tetrachloride fire extinguishers must not be used, as they not only release toxic gases, but their liquid can also damage the insulation of electrical wires.
- When adding or replacing coolant or battery fluid, avoid contact between the coolant or electrolyte and your skin and eyes. If contact occurs, wash the skin with soap and water as soon as possible. If the fluid gets into your eyes, flush it with plenty of water for 15 minutes and seek immediate medical attention.
- When adding coolant, take care to prevent steam burns. Cool the engine first. Only when the coolant temperature is below 50 °C should you slowly loosen the filler cap (pressure cap) on the radiator to depressurize the cooling system before adding coolant. The coolant temperature is very high immediately after shutdown; opening the cap may cause steam or hot water to spray out, posing a scalding risk. After checking the coolant level, adding coolant, or changing the coolant, ensure the filler cap is tightened securely.
- When the engine is running, the intake and exhaust systems are very hot. Do not touch hot components such as the exhaust pipe, exhaust tailpipe, turbocharger, intercooler intake pipe, and expansion tank. The coolant temperature is also very high when the engine is running; do not open the radiator filler cap. Opening the radiator filler cap may result in scalding from steam or hot water.
- If the fan belt breaks, the engine should be stopped immediately. Otherwise, the engine will overheat and the coolant in the expansion tank will steam out, posing a risk of burns.
- Do not operate directly with your hands when draining lubricating oil or changing the lubricating oil filter. Hot lubricating oil or parts can burn your skin.
- Before disassembling or loosening any pipes, fasteners, interfaces, or related components, the pressure in the systems to which these components belong, such as the air system, cooling system, lubrication system, or fuel system, should be released. Otherwise, high-pressure fuel, lubricating oil, and coolant can cause injury.
- Do not approach rotating parts while the engine is running. Do not place objects that could be caught in rotating parts around them. Serious personal injury can occur if a person or tool is caught in rotating parts.
- Always stop the engine before adjusting its drive mechanism. Getting caught in rotating parts can cause a serious accident.
- Use proper engine cranking techniques. Do not crank the engine crankshaft by rotating the fan section, as this may cause serious personal injury or damage to the fan blades.
- The turning tools used during maintenance must be removed after use. Leaving the turning tools plugged into the engine can not only damage the engine but also cause personal injury.
- Used lubricating oil may contain carcinogenic components and can cause regenerative toxicity. Avoid inhaling lubricating oil vapors or prolonged contact with them. Dispose of waste oil using appropriate, safe, and reliable methods.
- To prevent suffocation or frostbite, protective clothing must be worn, and the process must be carried out in a well-ventilated environment when disconnecting air conditioning refrigerant (Freon) piping. To protect the environment, the refrigeration system must be emptied or refilled using specialized equipment to prevent Freon from releasing into the atmosphere. Refrigerant should be recovered and recycled.
- To protect the environment, when replacing lubricating oil and oil filters, fuel filters, or coolant, the discharged lubricating oil or coolant, as well as the replaced oil or fuel filters, must not be discarded indiscriminately but should be disposed of in accordance with relevant environmental protection regulations. Discarded batteries should also be disposed of in accordance with relevant environmental protection regulations.

V. Usage and Maintenance Precautions

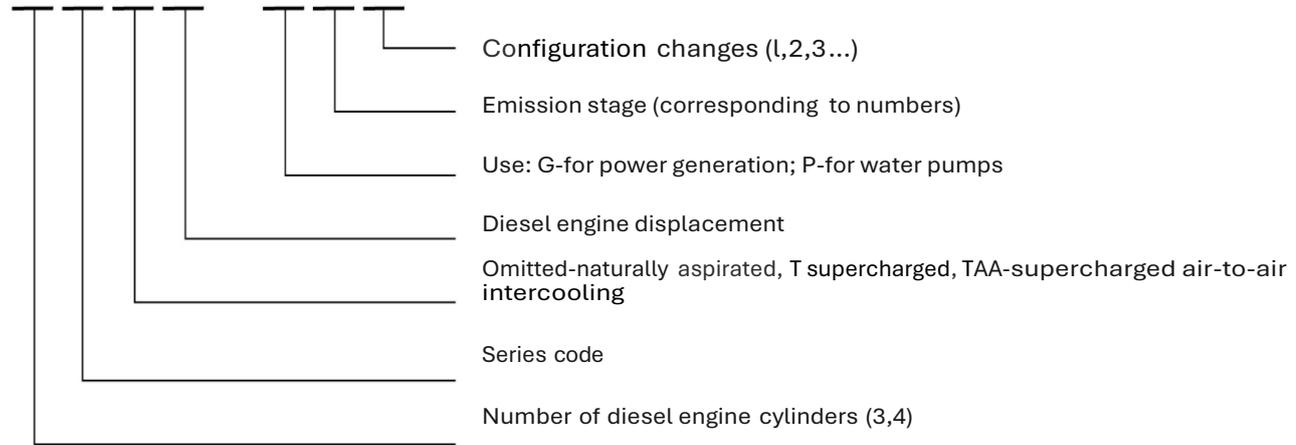
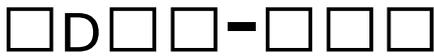
Before using or performing regular maintenance on the engine, carefully read and understand all engine usage and maintenance precautions and warnings. The following usage and maintenance precautions and warnings must be followed, otherwise engine malfunction or damage may occur.

- Read this manual carefully and strictly follow the operating procedures and maintenance regulations specified in this manual.
- The provisions of this manual should be strictly followed for daily maintenance and Level 4 maintenance, and regular maintenance records should be kept.
- Use appropriate fuel, lubricating oil and coolant as specified in this manual.
- The engine cooling system should use the coolant or antifreeze specified in this manual in any climate.
- When adding lubricating oil, different grades of lubricating oil must not be mixed.

- Before starting the engine, you must check whether the coolant, lubricating oil, and fuel are sufficient.
- Remember that the engine must be started under no-load conditions.
- For new engines or engines that have undergone major overhauls, a 60-day inspection is required before use. Hours of break-in operation.
- Do not operate the engine without an air filter (except for marine engines) to avoid premature engine wear.
- If the engine is running indoors, the engine room should always be well-ventilated. Insufficient air intake will cause the engine temperature to rise, output power to be insufficient, and performance to degrade; if necessary, engine room ventilation equipment must be provided.
- When the engine is running, its operating status and the readings of all instruments should be observed frequently. If any abnormality is found or an emergency occurs, emergency stop measures should be taken and the fault should be rectified to prevent the engine moving parts from seizing due to overheating caused by lack of water or low lubricating oil pressure.
- When the coolant temperature is below 60 °C, it is strictly forbidden to run the engine at high speed and high load.
- It is strictly forbidden to operate the engine under overload.
- If the engine overheats and must be shut down, do not immediately inject coolant after shutdown, otherwise it will damage parts such as the cylinder head.
- Do not restart the engine immediately after an abnormal shutdown. If the engine stops while issuing an abnormal alarm, the cause of the fault must be identified and rectified before restarting. Continuing to operate the engine without addressing the fault may lead to a more serious accident.
- If the engine's lubricating oil pressure drops abnormally for any reason, the engine should be stopped immediately, and all parts of the lubrication system should be inspected to identify the cause of the malfunction. Continuing to operate under low oil pressure can cause accidents such as engine bearing burnout.
- When starting a newly repaired engine, be prepared to cut off the air supply. If the engine runs away after starting, immediately stop the engine by cutting off the air supply.
- Avoid welding on engines or equipment containing electronic devices. If welding is necessary, disconnect the power supply to the equipment and disconnect the electronic devices from the wiring harness before welding. Never plug or unplug the wiring harness while it is powered on. Do not arbitrarily plug or unplug the wiring harness; if plugging or unplugging is necessary, the power must be turned off first to prevent malfunction.
- When checking the belt tension and other drive devices, the engine should be stopped.
- Do not use a pry bar to remove or install the drive belt from the pulley, as this may damage the reinforcing fibers inside the belt. It should be removed and installed manually.
- If the transmission belt becomes contaminated with lubricating oil, fuel, or other harmful liquids, it must be replaced and the source of contamination eliminated. Solvents must not be used to clean the belt.
- When storing or handling transmission belts, ensure that their bending diameter is not less than 25. mm, must not be hung on hooks.
- All surfaces of the pulleys on the transmission belt must be smooth to extend the belt's lifespan. Therefore, before installing the belt, ensure that the pulley surfaces are free of roughness or burrs and that they rotate freely.
- Batteries have a limited lifespan and must be replaced at a certain point in time.
- If the thermostat malfunctions, it should be replaced promptly and should not be removed or left unused.
- To maintain normal engine performance, the fuel injection quantity and speed control are sealed on the fuel control linkage. Using the engine after these seals have been broken will void the warranty if a malfunction occurs. Breaking these seals can cause the following malfunctions: increased slippage and wear in the fuel injection pump, leading to melting and damage; a sharp increase in fuel and lubricating oil consumption; imbalance between fuel injection quantity and the governor; performance degradation; and potentially serious accidents such as speeding.
- Seawater must not be used to directly cool the engine.
- Do not use water to directly spray and clean fuel injection pumps equipped with electronic speed controllers.
- Be careful not to allow rainwater or other substances to enter through the exhaust or intake manifold. Do not clean the engine while it is running. Cleaning agents (water) may be drawn into the engine. If water enters the engine's combustion chamber, the water pressure during engine start-up could cause internal damage and lead to a serious accident.
- The purpose and scope of use of the engine must not be altered arbitrarily, otherwise it may easily lead to damage to the engine and / or equipment and may also cause personal injury. Unauthorized modifications to the engine will not be covered by warranty, even within the warranty period.

1. Overview

1.1 Diesel Engine Model Identification



Example: 6DTAA8.9-G23 Representing Shanghai Diesel Engine Co. LTD. D series 6DTAA8.9-G23 with four valves horsepower meets national II (non-road) power plant diesel engine requirements.

1.2 Diesel Engine Nameplate

The diesel engine nameplate displays the main technical data and information of the diesel engine you purchased. It serves as the primary basis for users to purchase repair parts and for our company to provide after-sales technical services. We hope users will record this information and data in the working log of your diesel engine or the equipment it is paired with. Providing this information promptly when contacting repair services or reporting quality issues will help in correctly resolving the problems you report. Please protect the nameplate from damage. The nameplate is located on the top surface of the diesel engine cylinder head cover. Below are two examples of nameplate styles:

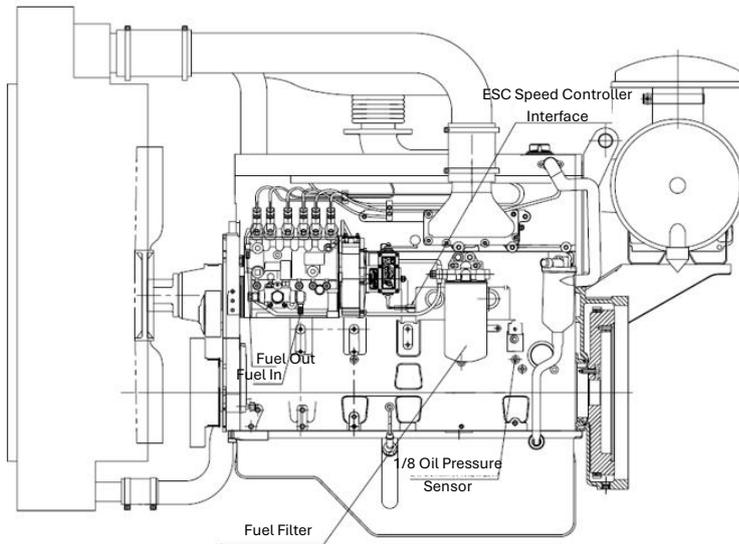
		型号 MODEL				
		机号 SER NO.				
产品名称 PRODUCT NAME		订货号 ORDER NO.	额定转速 RATED SPEED	r/min	额定功率 RATED POWER	kW
柴油机		出厂日期 DATE			净重 NET WT	kg
型式批准号 TYPE-APPROVAL NO.					海拔高度 SEA-LEVEL	m
执行标准 EXECUTED STANDARD					排放阶段 EMISSION LPM	
许可证号 LICENSE NO.						
中国·上海柴油机股份有限公司制造 MADE IN SHANGHAI DIESEL ENGINE CO., LTD. CHINA						

		型号 MODEL				
		机号 SER NO.				
产品名称 PRODUCT NAME		订货号 ORDER NO.	额定转速 RATED SPEED	r/min	最大净功率 MAXIMUM NET POWER	kW
柴油机		出厂日期 DATE			净重 NET WT	kg
型式批准号 TYPE-APPROVAL NO.					海拔高度 MAX ALT	m
执行标准 EXECUTED STANDARD					排放阶段 EMISSION LPM	
许可证号 LICENSE NO.						
中国·上海柴油机股份有限公司制造 MADE IN SHANGHAI DIESEL ENGINE CO., LTD. CHINA						

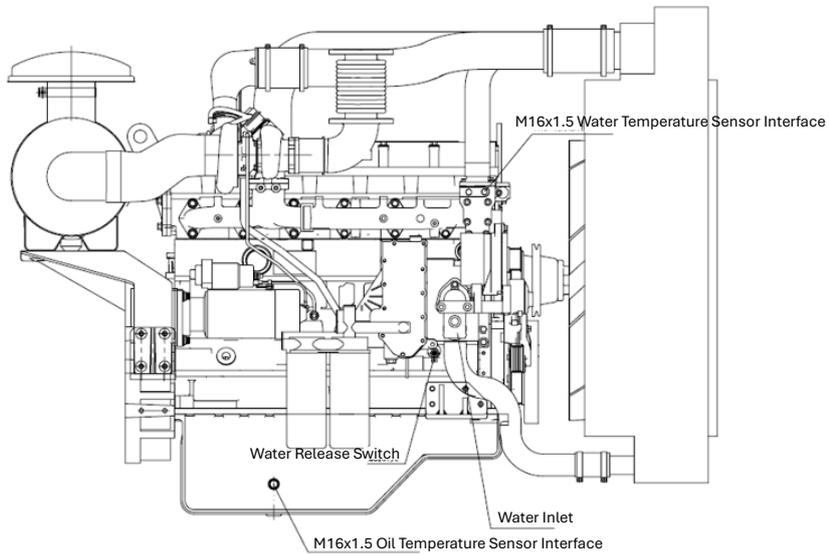
Note: Users are not allowed to replace the diesel engine nameplate without our company's permission!

1.3 Diesel Engine Outline Drawing

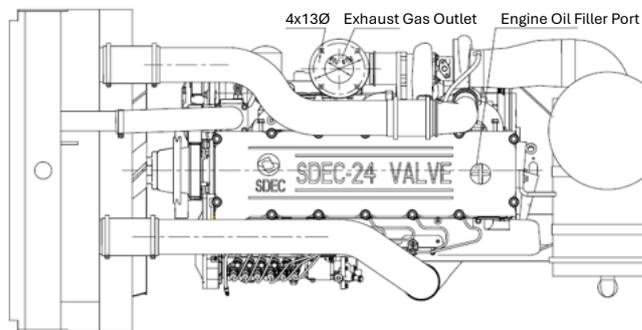
The exterior design is for illustrative purposes only. Different models have different diesel engine configuration requirements, which will result in differences in appearance.



Intake Side View



Exhaust Side View



Top View

2. Main Technical Specifications and Parameters of Diesel Engines

2.1 Main Technical Specifications

Model	6DTAA8.9-G23
Type	Four-stroke, water-cooled, in-line, turbocharged intercooled
Gas cylinder number	6
Cylinder diameter, mm	114
Piston stroke, mm	144
Total piston displacement: L	8.82
Pressure Shrink Compare	17.3
Power / Speed kW / rpm	221~236/2000~2200
Firing order (Counting from the free end)	1 - 5 - 3 - 6 - 2 - 4
Crankshaft rotation direction (Facing the flywheel end)	Counterclockwise
Start-up method	Electric start

2.2 Main Technical Parameters

Diesel engine model	6DTAA8.9-G23
Lubrication system	
Oil pressure, kPa At idle (minimum allowable speed) When calibrating the speed (minimum permissible speed)	≥ 100 ≥ 300
Maximum oil temperature in the oil pan, °C	122
Oil pan capacity, L (dip gauge "high" - "low")	26.5~ 22.5
Total system capacity, L	» 30
Cooling system	
Thermostat Turn-on temperature, °C. Full-on temperature, °C Lift, mm	82 93 ≥10
Pressure cap pressure (suitable for water tank upper chamber temperature 95 ° C), kPa	50

Coolant capacity (engine body), L	13	
Intake and exhaust systems		
Intake system resistance limits (clean air filter/dirty air filter) (Calibrated operating condition), kPa	4.5/5.5 (Level 2); 5.2/6.0 (Level 3)	
Maximum permissible exhaust temperature, °C	700 (Turbine import)	
Fuel system		
Maximum resistance of fuel delivery pump to oil suction, kPa	13.3	
Maximum outlet pressure of fuel delivery pump, kPa	low traffic	83
	High traffic	172
Maximum resistance to fuel return, kPa	70	
Fuel injection pump oil passage pressure, kPa	low traffic	48
	High traffic	140
Fuel inlet temperature, °C	≤ 60	
Speed regulation performance of mechanical centrifugal speed controller		
Minimum no-load stable speed, r/min	See the nameplate of each diesel engine model.	
Stable rate regulation	Full program	8~12 %
Fuel injection advance angle, °	16~18	
Cold start system		
Minimum starting temperature without auxiliary starting device, °C	- 15	
Minimum start-up temperature when adding preheating device, °C	- 25	
Electrical system		
Recommended minimum battery capacity		
24V system:		
-18 °C Cold starting current, A (Spare capacity current, A)	900 (320)	
0 °C Cold starting current, A (Spare capacity current, A)	640 (240)	
Starter motor		
Voltage, V	24	
Power, kW	7.5	
Dynamo		
Voltage, V	28	
Current, A	110 Or 140	

Composed of two 12V The batteries are connected in series; each battery is set at -18 °C. Calibrate the cold start current. Reserve capacity refers to the length of time that the generator can continuously supply power after a generator failure.

2.3 Other Technical Requirements

2.3.1 Fuel

Warning: Do not mix gasoline or alcohol with diesel fuel, as this mixture may cause detonation.

The diesel fuel used in this series of diesel engines should have a quality standard no lower than that specified in China's GB 19147 standard. The standard for automotive diesel fuel specifies the following key specifications: Main Specifications for Automotive Diesel Fuel (GB 19147).

Designation of fuel	0#	-10#	-20#	-35#
Cetane value	≥49	≥49	≥46	≥45
Solid point/°C	≤0	≤-10	-20	-35
Minimum applicable temperature (engine working temperature)/°C	Above 4°C	Above -5°C	Above -14°C	Above -29°C

The grade of diesel fuel should be determined based on the ambient temperature. In low-temperature winter environments, diesel fuel with a low pour point should be used, and vice versa in summer. For example, when the ambient temperature is -27°C, -35 diesel fuel should be selected. Diesel fuel must be kept highly clean and free from dust, impurities, or water contamination. Maintaining the cleanliness of diesel fuel and removing impurities and water is crucial, as the presence of water and impurities in the fuel system can cause serious damage to the fuel injection pump and nozzles. Therefore, diesel fuel must be allowed to settle for a sufficient period or filtered through a silk cloth before use.

Different types of diesel fuel have significantly different sulfur content requirements. To ensure normal engine operation and protect the atmospheric environment, diesel fuel of the same specification with the required sulfur content should be used according to the table below.

Diesel models	Ordinary diesel	National III diesel
Sulfur content (ppm)	≤2000	≤350
Applicable diesel engines	National II and below	National III and below

2.3.2 Lubricating Oil

To ensure the normal operation and long service life of diesel engines and to improve diesel engine emissions, 6DTAA The specified type of diesel engine is the Shanghai Diesel Engine Co., Ltd.'s D- type diesel engine. Series diesel engine special oil or CF If you cannot purchase Shanghai Diesel engine oil of grade 1 or higher, you can use CF-4 engine oil that meets the requirements of the American Petroleum Institute (API). Lubricating oil of grade, A or above.

The applicable ambient temperature ranges for diesel engine oils of different viscosity grades are shown in the figure below.

Engine oil viscosity grade	Ambient temperature	
	Lowest	Highest
0W-20	-40 °C	25 °C
0W-40	-40 °C	35 °C
5W-20	-35 °C	25 °C
5W-50	-35 °C	40 °C
10W- 30	-30 °C	30 °C
10W- 40	-30 °C	35 °C
15W- 40	-25 °C	35 °C
20W- 50	-20 °C	40 °C

Note: The engine oil must be kept clean and free from dust, impurities, or water contamination.

Note: The appropriate viscosity grade of diesel engine oil should be selected according to the local ambient temperature.

For most regions of China, we recommend using CF-4. 15W-40 For engine oil, if the ambient temperature is below -15 °C, CF-4 10W-40 engine oil can be used to facilitate starting and ensure that enough engine oil is pumped smoothly to the lubrication points.

In extremely cold regions, if the diesel engine is constantly running in ambient temperatures below -23 °C, and there are no warming measures after the diesel engine stops running, CF-4 5W-50 engine oil with superior low-temperature characteristics should be selected.

Note: While low-viscosity engine oil can help start diesel engines, continued use may shorten the engine's lifespan due to potential wear and other issues caused by its low viscosity.

Therefore, we should try our best to avoid or limit its use.

Note: Using inferior engine oil will cause excessive engine oil consumption, premature wear, and even serious malfunctions such as cylinder scoring.

Note: To ensure the performance characteristics of the engine oil, D The recommended series of diesel engines is the D series from Shanghai Diesel Engine Co., Ltd. A series of diesel engine oils specifically designed for diesel engines.

Shanghai Diesel Engine Co., Ltd. uses a dedicated CF-4 Lubricant Part Number:

Y/1511000001 (3.5kg)	Y/1511000002 (16 kg)	Y/AG0105 (3.5 kg)	Y/AG0106 (16 kg)
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Engine oil deterioration and oil change period:

After a period of use, engine oil deteriorates due to high-temperature oxidation and the entry of road dust, sand, worn metal particles, combustion byproducts, and unburned fuel, resulting in reduced lubrication and cooling performance. Therefore, it is essential to change the engine oil regularly and replace the oil and oil filter according to the maintenance schedule.

Note: Do not extend the oil change interval. Due to corrosion, carbon buildup, and wear, extending the oil change interval will shorten the life of the diesel engine!

2.3.3 Coolant

To ensure the normal operation and service life of the diesel engine, please use the Shanghai Diesel Engine Co., Ltd.'s special organic (antifreeze) coolant under all climatic conditions. This coolant features antifreeze, corrosion resistance, good thermal conductivity, good stability, and environmental friendliness.

Name	Part Number	Freezing point / ° C	Boiling point / ° C
Shanghai organic (antifreeze) coolant	F/LQY- 45	- 45	108

If other brands of antifreeze are selected, or a mixture of water and ethylene glycol is used as the diesel engine coolant, the content of silicate (anhydrous sodium silicate), oxides, and acetic acid in the coolant must not exceed 1000 pm, 5 ppm and 100 ppm, otherwise it may cause scale buildup on the surface of cooling system parts, block the radiator and cause water pump seal leakage.

By adjusting the mixing ratio of water and ethylene glycol, antifreeze with different freezing points (i.e., freezing points) can be obtained. Generally, the freezing point of the selected antifreeze should be about 10 ° C lower than the lowest temperature in the area where the diesel engine is used.

For most climates, the relationship between the volume ratio of ethylene glycol to water and the freezing point is as follows, with a recommended ratio of 50:50 for water and ethylene glycol.

Ethylene glycol: water	10:90	20:80	30:70	40:60	50:50	55:45	60:40	65:35
Freezing point, °C	- 3.8	- 7.5	- 14.1	- 22	- 32	- 42	- 55	- 64

The recommended ratio of water and ethylene glycol is 50:50.

Caution: Anti-freezing liquid is mandated for the engine as coolant for any climate.

Caution: It is required to replace engine coolant every 6,000 hours or 2 years (whichever comes first) to remove those harmful chemical sediments.

DCA4 chemical additive

As water and ordinary antifreeze liquid both have no protection for the cooling system, it is not allowed to use either water or ordinary antifreeze without anti-erosion and anti-corrosion function as an engine coolant.

It is recommended to use a multi-functional antifreeze liquid with anti-rust and anti-corrosion function or add DCA4 chemical additive with specified density in ordinary antifreeze liquid for the engine. DCA4 chemical additive can protect the cooling system from cavitation erosion, corrosion and scale depositing, and restrain and eliminate air bubbles, etc. DCA4 chemical additive and concentration checking kit are available from the after-service net of SDEC.

Caution: Do not touch the test paper with hand; keep the DCA4 chemical additive away from contact with eyes, skins or clothes; the test should be done at a bright place without contaminating the test paper and containers used.

The content of DCA4 additive in coolant is specified as follows: 0.264 units DCA4 per liter of coolant; no more than 0.528 units per liter and no less than 0.132 units per liter. One-unit DCA4 additive weights 22.68 g. For example, a coolant filter with 12 units of solid DCA4 additive is required for a cooling system of 30-liter coolant. Such cooling system has 0.4 units DCA4 additive per one liter coolant.

To maintain proper DCA4 additive concentration, a coolant filter with proper solid DCA4 additive is recommended.

Caution: When using coolant filter and powdered DCA4 additive, total amount of DCA4 additive in coolant should not exceed the specified value: 0.528 unit per liter.

Coolant filter

The correct content of DCA4 additive in coolant is important. Low concentration results in server erosion leading to parts and components damage, while high concentration results in engine overheating. A coolant filter with correct amount of DCA4 powder is recommended. The coolant filter can be helpful to keep correct content of DCA4 in coolant and can also remove impurity in coolant. So, it is required to change the filter periodically.

Caution: Replacement of coolant filter is required every 250 hours or 3 months, whichever comes first.

DCA4 Additive concentration check

Coolant filter should be replaced at specified time to ensure the proper concentration of DCA4 in coolant or check DCA4 additive content regularly.

Use DCA4 checking kit to check the DCA4 additive content of coolant. The method is as follows:

1. Take the plastic cup from the kit and fill it with the coolant from the engine and check it. It is more accurate to measure when the coolant is in little warm. Checking DCA4 additive content of new coolant should be done only after the coolant is used for more than two hours in engine operation.
2. Take a test paper from a sealed bag in the kit and dip the top of test into the coolant in the cup for 5 seconds, take and compare it with the standard color card, and determine the content of DCA4 additive in the measured coolant through comparison.
3. Clean up the cup and seal the test paper bag and put it in a dark dry place for future use. Usually, we have measurements every half month.

Standard color card for checking DCA4 additive content:

Correct content is 6 g of DCA4 per liter of coolant (6 g/L) and acceptable range is from 3 g/L to 12 g/L. Too much or too less content is very harmful to components.		
	Content of DCA4 per Coolant	Necessary measures
	< 3 g	Replacement of coolant filter
	3 g	Supplement of DCA4 by 3 g per liter of coolant
	6 g	
	6 g	Replacement of coolant filter
	12 g	No need for measures
		Drainage of 50% coolant into a plastic container for next coolant supplement.
	18 g	

2.4 Main-Bolt and Nut Tightening Torque and Methods

Table 1 Torque specification for main fastening bolts

No.	Name	Thread spec.	Final torque	Tightening method
1	Main bearing cap bolts	M16-4h6h	125±5 N·m Final angle 210°±5°	First: 50 N·m Second: 120-130 N·m Third: angle 210°±5°
2	Cylinder head bolts	M14-4h6h	115±5 N·m Final angle 240°±5°	First: 50N·m Second: 110 ~ 120 N·m Third: angle 240°±5°
3	Connecting rod bolts	M12×1.25-4g6g	60±5 N·m Final angle 150°±3°	First: 60±5 N·m Second: angle 150°±3°
4	Flywheel bolts	M14×1.5-5h6h	220±5 N·m Final angle 25°±3°	First: 70±5N·m Second: 100±5N·m Third: 220±5N·m
5	Vibration damper bolts	M14×1.5-5h6h	100±5 N·m Final angle 30°±3°	First: 50±5 N·m Second: 100±5 N·m Third: angle 30°±3°
6	Fuel pump gear nut	M18×1.5	180±8 N·m (Longke) 105±5 N·m (Yijie)	
7	Air compressor gear nut	M16	134±13 N·m	
8	Fuel pump flange nuts and bolts	M10	45±4 N·m	
9	Oil pump bolts	M8	30±3 N·m	
10	Injector bolts	M8	25±3 N·m	
11	Engine support bolts	M12	112±10 N·m	
12	Rocker arm shaft bolts	M10-6h	55±3 N·m	
13	Air compressor nuts	M12	77±7 N·m	
14	Flywheel bolts	M12	112±10 N·m	
15	Turbocharger bolts	M10	45±4 N·m	
16	Alternator pulley nut	M16	80±8 N·m	
17	Fuel filter	13/1"M16	Additional 3/4-1 turn after O-ring contacts the head sealing surface	
18	Inlet and outlet joint nuts of fuel filter	M14	24±3 N·m	

19	High pressure fuel pipe joint nuts	M12	45±3 N·m	
20	Fuel pump fuel return banjo bolts	M10	10±2 N·m	
21	Fuel pump fuel inlet banjo bolt	M14	18±2 N·m	
22	Fuel filter sensor	M11	20±3 N·m	
23	Lifting plate bolts	M12	77±6 N·m	
24	Oil filter		45-60 N·m or additional 3/4-1 turn after O-ring contacts the head sealing surface	
25	Oil drain plug	M18	80±4 N·m	
26	Heater plugs in oil sump	M22	80±4 N·m	
27	Oil pressure regulating valve	M34	80±4 N·m	
28	Oil suction pipe (flange)	M10	45±4 N·m	
29	Oil suction pipe (support)	M6	9±1 N·m	
30	Rocker arm adjusting screws and nuts	M10	45±4 N·m	
31	Turbocharger oil inlet pipe	M12	32±4 N·m	
32	Fuel pump idle gear clamp bolt	M8	32±3 N·m	
33	Mid cylinder head cover bolts	M8	24±3 N·m	
34	Cylinder head cover bolts	M8	24±3 N·m	
35	Exhaust manifold bolts	M10	50±4 N·m	

Caution: The connecting rod bolt can be used once only.

For bolts unlisted in Table 1, the torques in Table 2 can be applied to. Tapered screw plugs are tightened with the torques in table 3, and banjo bolts are tightened according to the torques in table 4.

Table 2 Approximate tightening torque for common screw plugs and standard bolts

Grade	8.8		10.9	
	Torque/ N·m		Torque/ N·m	
	Cast iron	Aluminum	Cast iron	Aluminum
Diameter of bolt/mm				
6	9	7	14	11
8	25	18	32	25
10	40	30	60	45
12	70	55	105	80
14	115	90	160	125
16	180	140	240	190
18	230	180	320	250

Note: The torque values given in the above table only applies to the threads of bolts and nuts that have been properly lubricated.

Table 3 Recommended tightening torque for tapered screw plugs

Specification of screw plug		Torque/ N·m	
Thread diameter	Effective thread (outer diameter)	Cast iron or steel	Aluminum
1/16	8.1	15	5
1/8	10.4	20	15
1/4	13.7	25	20
3/8	17.3	35	25
1/2	21.6	55	35
3/4	26.7	75	45
1	33.5	95	60
1 ¹ / ₄	42.2	115	75
1 ¹ / ₂	48.3	135	85

Table 4 Recommended tightening torque for banjo bolts

Specification	M8 ´1	M10 ´1	M12 ´1.25	M14 ´1.5	M16 ´1.5	M18 ´1.5	M20 ´1.5	M22 ´1.5
Torque/N·m	13	22	32	45	50	65	85	105

Note: The torque described above is applicable to bolts made of steel, cast iron or aluminum substrate.

3. Operation of Engine

Oil, fuel and coolant with suitable specifications shall be chosen according to specific application environment and conditions before running the diesel engine. The selected oil, fuel and coolant shall comply with technical specifications as given in Article 2.3.

Correct and reasonable application will enable the engine to have a longer service life, better work performance and high economic efficiency.

3.1 Starting

3.1.1 Normal Starting

Check the accelerator for operational flexibility.

Disconnect the engine from the drive system and move the transmission gear (if equipped) to the neutral position.

Wait until the preheating indicator lamp goes out.

Caution: To avoid damages of the starting motor, the starting time shall be less than -15 seconds when ambient temperature is -15°C and above, less than 30 seconds when ambient temperature is below -15°C. The interval of two starting shall be at least 2 minutes (for the starter motor only).

Each starting usually lasts 2-3 seconds.

Check preheating device if the engine is failed to start to run after three consecutive startups.

The diesel engine will run at idle speed after starting.

The oil pressure must be indicated on the pressure meter within 15 seconds after the engine has been started up, if not, immediately shut down the engine to avoid it being damaged. And then check the oil level.

When the engine starts from cold state, it increases the speed slowly to ensure full lubrication of all the bearings.

3.1.2 Low Temperature Starting

Some models of the engine are equipped with an auxiliary intake pre-heater, which is used for starting at a low temperature. It can heat up the air intake automatically when the temperature of the coolant in the engine is below -10°C .

- Insert the key and turn it from the OFF position to the ON position to electrify the pre-heater before starting, and then the indicator lamp lights up.
- Turn the electric key from the ON position to the START position to start the engine when the indicator lamp blinks and goes off.

Caution: The engine can usually be started quickly and run smoothly even in a very low temperature environment. When the engine is to be placed outdoors in such cold weather, cold protection and specific warm-up time shall be provided. The lube oil, fuel and coolant must be used properly according to different temperature ranges of local areas where the engine is operated.

3.1.2 Starting After Long Time Out of Operation

- When the engine has been out of use for more than 30 days, check the oil level and make supplements before starting.
- Close the accelerator to avoid the engine being started by ignition.
- Discharge the air in the fuel system according to descriptions in article 4.4.2.
- Rotate crankshaft by the starter motor until the oil pressure gauge reads the pressure.
- Open the accelerator.
- Start the engine as per the start procedures specified in 3.1.1 (Normal starting) or 3.1.2 (Low temperature starting).

3.2 Operation

3.2.1 New Diesel Engine Running-in

When the engine is new or has been overhauled, before running it in full load condition, run it for 60 hours in running-in condition and change its oil to improve its moving parts working condition and its reliability and service life.

The way of running-in varies from one engine application and loading manner to another. In principle, engine speed and load in running-in process will be increased gradually with the running-in going on. Load should be 50%-80% of its full load, and speed should not exceed 80% of its rated speed.

Do not run the engine at idle or with low load for a long-time either in running-in period or normal working period thereafter. Continuous running at idle should not exceed 10 minutes to avoid early engine wear due to carbon deposit or engine performance degeneration.

3.2.2 Normal Operation

Continuous full- accelerator running at a speed lower than maximum torque speed shall not longer than 1 min.

- Check oil pressure and coolant temperature frequently during engine operation and see Chapter II "Main Specifications and Parameters" for details. If the running-in conditions are not met, stop the engine for check, or repair it if necessary.

Caution: The engine will be damaged in case of continuous operation when the coolant temperature is lower than 60°C or higher than 100°C .

- In the case of too high temperature of coolant, decrease engine speed or reduce load or take both until the temperature recovers to the range of normal working conditions, otherwise, find the cause and trouble shoot the problems as specified in Chapter V "Troubleshooting Guidelines".
- Most failures will develop with symptoms. Observe the change of engine performance and sound of abnormality or check if one of following signs occurs. If so, it is necessary to repair it.
 1. Misfire
 2. Abnormal smoke
 3. Abnormal vibration
 4. Power loss
 5. Abnormal noise
 6. Increased oil consumption
 7. Sudden change of oil pressure or coolant temperature
 8. Increased fuel consumption

Warning: The engine will be damaged in case of running at overspeed (a speed exceeds the maximum value under empty load)

3.3 Stopping

3.3.1 Normal Shutdown

- After full-load operation and before shutdown, gradually reduce the engine speed and load, and run the engine for 3~5 minutes at the idle to let turbocharger speed fall considerably and let the engine cool down gradually and evenly to protect the turbocharger and engine.
- Turn the start key switch to the OFF position.
- Unless it is necessary, no emergency stop should be made while running under high loads, or serious failures will occur due to overheating.

3.3.2 Emergency Shutdown

Under an emergency or special condition, make an emergency stop to avoid serious engine failure. Manually pulling the emergency stop handle can achieve an emergency shutdown.

3.4 Engine Working Range

Caution: The engine can operate with full accelerator under the transitional working conditions at a speed above the maximum torque speed, which is in line with recommended strategy for economical running. If the engine is running with full accelerator at a speed below the maximum torque speed for a long time, this will shorten the engine service life, leading to overhauling or causing serious damage to the engine, which is treated as an abuse behavior.

Caution: The engine will operate at a speed below the maximum torque speed during shifting gears. This is due to different transmission ratios among transmission gears. However full- accelerator running at a speed below the maximum torque speed shall not be longer than 1 minute.

4. Maintenance of Engine

4.1 Maintenance Schedule

It is recommended to maintain the 6DTAA diesel engine implemented according to the "Repair and Maintenance Schedule". The maintenance interval shall be shortened appropriately when the engine is always operating in an area with ambient temperature lower than -18°C or higher than 38°C, or running in dust environment, or working in frequent stopping condition.

Maintenance Schedule for 6DTAA Diesel Engine

Maintenance tasks	First maintenance 80~100 hours	Daily	Every 250 hours or 3 months	Every 500 hours or 6 months	Every 1000 hours or 12 months	Every 2000 hours or 2 years
Check engine periphery	●	●	●	●	●	●
Check fuel tank	●	●	●	●	●	●
Check primary fuel filter service indicator	●	●	●	●	●	●
Check oil level	●	●	●	●	●	●
Check coolant level	●	●	●	●	●	●
Check electrolyte level	●	●	●	●	●	●
Check drive belt	●	●	●	●	●	●
Check fan belt	●	●	●	●	●	●
Check leakage	●	●	●	●	●	●
Check accessories fasteners	●	●	●	●	●	●
Check intake system			●	●	●	●

Check Intercooler			●	●	●	●
Check Air filter			●	●	●	●
Change lubricating oil, oil filter and oil centrifugal filtration	●		●	●	●	●
Change fuel filter including fuel-water separator			●	●	●	●
Change coolant filter (e.g. Used)			●	●	●	●
Check fuel-system bleed				●	●	●
Check oil separator				●	●	●
Check coolant density				●	●	●
Check/adjust valve clearance	●			●	●	●
Check belt tension					●	●
Check fan bearing					●	●
Check Belt tensioner					●	●
Check turbocharger						●
Check Belt tension						●
Check air compressor						●
Change coolant and clean cooling system						●
<p>The belt must be replaced when it has cracks or defects that affect its use. Check fuel filter replacement period and make replacement according to the requirement. When there are many impurities in fuel, the replacement period of the primary fuel filter must be shortened. The belt tensioner must be replaced when its pulley doesn't rotate freely.</p>						

Note: The user should carry out periodical maintenance and keep the maintenance record in the format specified in Annex. It's recommended that periodical maintenance be done at an authorized service station or provider.

Note: The maintenance interval in this table is in hour, or month, whichever comes first.

Note: First maintenance contents are subject to our product quality warranty manual.

4.2 Routine Inspection and Maintenance

Preventative maintenance work starts with understanding daily working conditions of the engine itself and its systems. Daily maintenance shall be done before starting the engine:

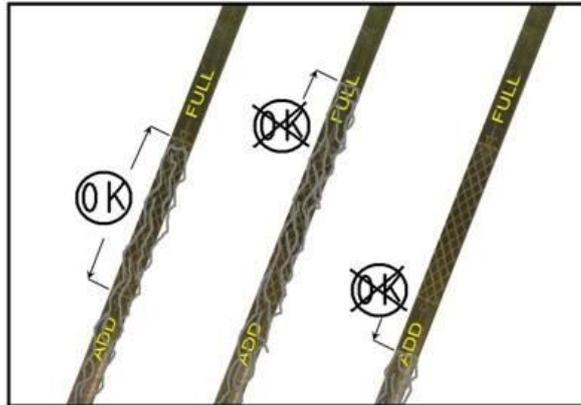
- Check oil level.
- Check coolant level.
- Check drive belt.
- Check cooling fan.
- Check primary fuel filter service indicator.
- Visually check leakage.
- Check smoke color.

Take care of any abnormal changes when starting and running the engine, such as oil pressure, power fluctuation, coolant, or fuel consumption, coolant or oil temperature, smoke and so on. If any abnormal condition is found, find out causes and remove problems.

4.2.1 Check Oil Level

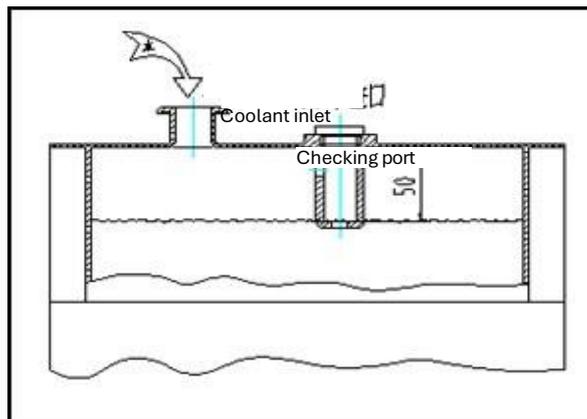
Check the oil level after the engine has been shut off (at least five minutes later, so that the oil can have enough time flow back to the oil sump). It's prohibited to start the engine when the oil level is lower than the ADD mark or higher than FULL mark in the oil dipstick.

The volume difference between higher and lower levels is about 4 L.

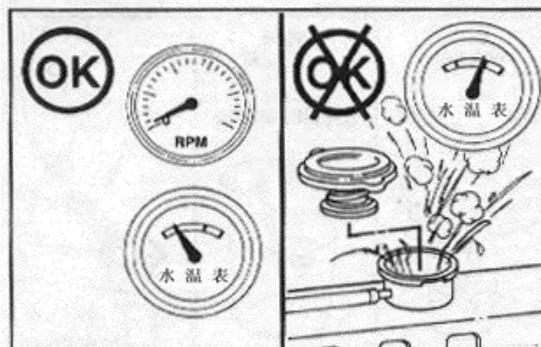


4.2.2 Check Coolant Level

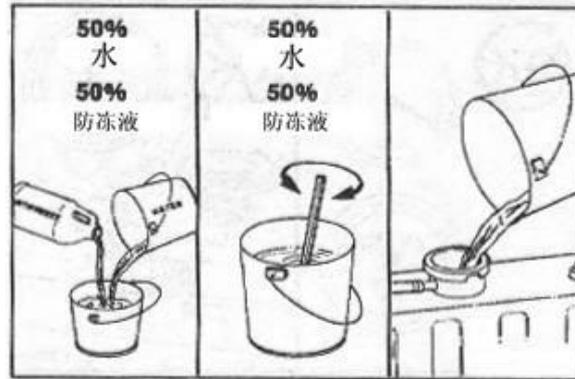
Open the coolant filler cap or remove the plug on the inspection port on the radiator or expansion tank to check the coolant level.



Warning: The coolant filler cap or inspection port plug of the cooler can be unscrewed only after the engine coolant temperature falls below 50°C. If unscrewed operation is done immediately after the engine has been stopped, this can cause injuries due to suddenly spraying out of high temperature water and steam! It is required to unscrew them slowly to reduce the pressure of the cooling system gradually.

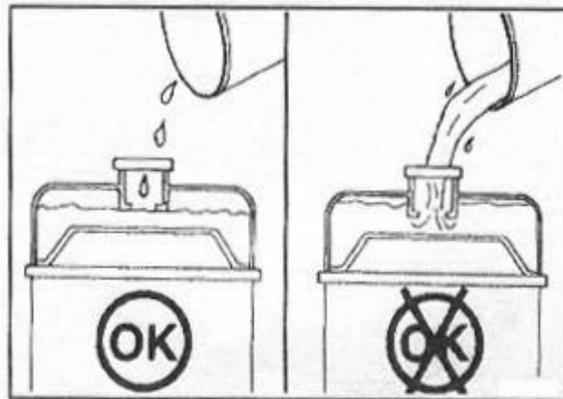


The concentration of coolant and its additives injected into the diesel engine must comply with the provisions of Chapter 2. If antifreeze needs to be added to the coolant, it must be mixed before being injected into the diesel engine, because antifreeze has a different heat transfer capacity than water. If it is injected directly into the diesel engine before the coolant is properly mixed, it will cause overheating.



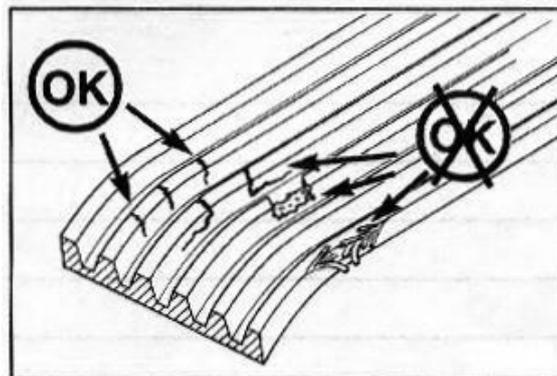
Warning: When using ordinary diesel engine antifreeze (without rust and corrosion prevention functions), if the antifreeze does not contain DCA4 additive, cavitation corrosion will occur in the cylinder liners, severely affecting their service life. If the diesel engine's exhaust port and drain hole are corroded and blocked, vapor lock will occur, causing the diesel engine to overheat. This can lead to serious accidents such as the engine block freezing and cracking due to the inability to drain water in winter.

The coolant fluid shall be added into the cooling system until the level reaches bottom surface of the coolant filler cap or inspection port of radiator or expansion tank. It shall be filled slowly to avoid air block and wait for 2-3 minutes to allow the air to be exhausted fully.



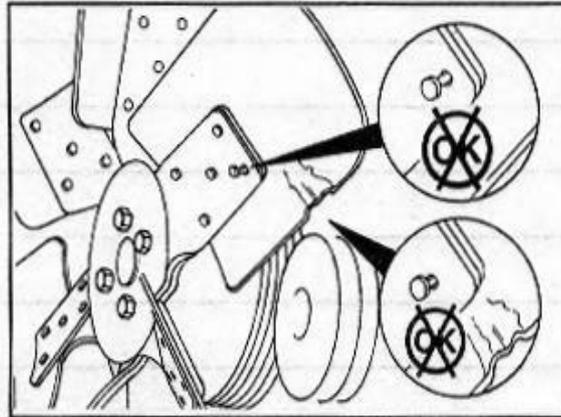
4.2.3 Check Drive Belt

Inspect the drive belt visually. Check for crisscrossing cracks. Transverse cracks along the width of the belt are permissible, but longitudinal (along the length of the belt) and transverse through cracks are not allowed. Replace the belt if it is worn or shows signs of material peeling.



4.2.4 Check Cooling Fan

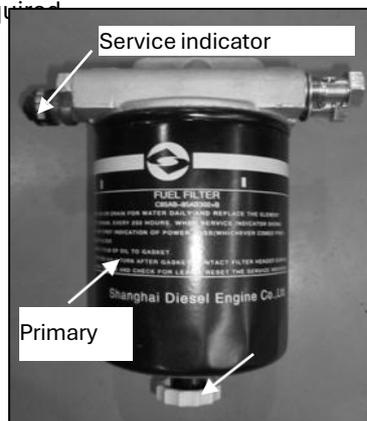
The fan must be visually inspected daily for cracks, loose rivets, loose blades, and bent parts. Ensure the fan is securely installed. Tighten bolts as needed and replace any damaged fans.



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

4.2.4 Check Primary Fuel Filter Service Indicator

The fuel pre-filter has a maintenance indicator. When impurities accumulate in the pre-filter to a certain level, causing difficulty in pumping fuel, the maintenance indicator on the filter will turn red, reminding the user that the fuel pre-filter needs to be replaced. Check the maintenance indicator daily. When the indicator turns red, the pre-filter needs to be replaced promptly. Even if the indicator does not turn red after 500 hours of use, it must still be replaced according to maintenance regulations. The fuel pre-filter is also a screw-in type; the replacement steps are the same as for the fuel fine filter, see Fuel Fine Filter Replacement. The pre-filter has an oil-water separation function. When the water level in the fuel pre-filter's water reservoir reaches a certain height, the water level sensor sends a signal to the water level indicator light, indicating that drainage is required.



4.3 Maintenance Every 250 Hours or 3 Months

In addition to routine maintenance, the following maintenance items should be added:

- Change oil and oil filter.
- Check air filter.
- Check air intake system.
- Check and maintain intercooler.
- Replace the fuel filter.

4.3.1 Change Oil and Oil Filter

After diesel engine use, the engine oil will become dirty, and the oil additives will decrease. Therefore, it is necessary to change the engine oil and oil filter regularly to remove contaminants suspended in the engine oil.

Oil change interval:

The oil change interval in the maintenance table is given for common diesel engines. Oil change interval differs from one application to other. See the table below for recommended intervals for some main applications. As for unlisted applications, refer to the recommended intervals in the maintenance schedule or those of similar applications.

Applications	Change intervals of oil and oil filter		
	Kilometer	Hour	Month
Crane truck, onsite goods transportation machinery	10000	250	3
Pavers, cranes, bulldoze, Backhoes, carry-scrappers	×	250	3

Note: The change interval in this table is in month, or hour, whichever comes first.

Caution: Even if the engine is under use, the replacement interval of lube oil should by no means be prolonged beyond the above recommended intervals.

Change oil filter:

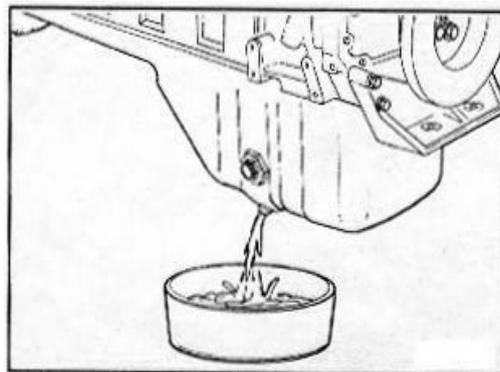
Stop the diesel engine when the coolant temperature reaches 60°C and clean the area around the oil filter. Use a suitable socket wrench to cover the top of the filter and remove the screw-on oil filter (using a regular wrench will damage the can, causing it to deform and making it difficult to unscrew). Replace the oil filter.

Oil filter tightening method: Hand-tighten the filter until the sealing ring contacts the filter housing mounting surface, then use a tool to tighten it to 45~60 N·m, or 3/4~1 turn.



Caution: Before installing the new filter, apply a layer of clean oil on the surface of the O-ring on the filter.

Remove the drain plug to drain the hot engine oil containing contaminants in a suspended state.



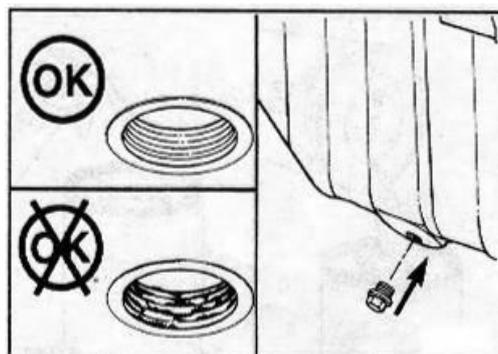
Inspect and clean the threads and sealing surface of the drain plug and replace the sealing gasket.

Install the drain plug.

Tightening torque:

80 N·m

56 N·m (aluminum oil sump)

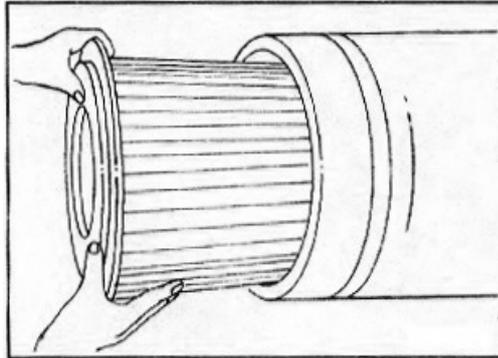


Fill the diesel engine with clean engine oil that meets the requirements specified in Chapter 2 to the appropriate oil level; the lubrication system capacity is approximately 30L. Start the diesel engine and let it idle, checking for leaks from the oil filter and drain plug. Stop the engine and wait at least 5 minutes to allow the oil to drain from the upper parts, then check the oil level again. If necessary, add engine oil to the specified range.

4.3.2 Check Air Filter

The air filter element shall be replaced if the resistance exceeds the following value:
6.2kPa (turbocharged model, turbocharged and intercooled model).

Note: Air filter resistance should be checked under diesel engine calibrated operating conditions.



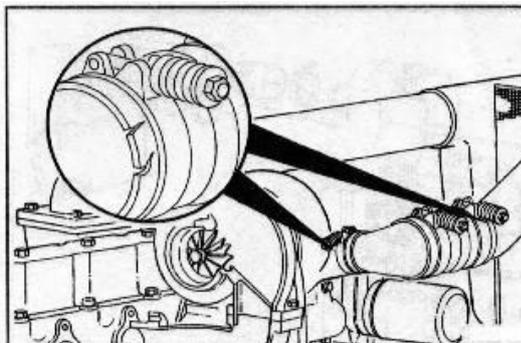
If the air filter has a maintenance indicator, it should be checked regularly. If the red indicator rises to the inspection port position, the air filter element should be replaced. After replacing the air filter element, the push-button switch on top of the maintenance indicator will reset.



Warning: It's prohibited to start the engine without an air filter. Intake air must be filtered to prevent dust and dirt from entering the diesel engine to avoid early wear.

4.3.3 Check Air Intake System

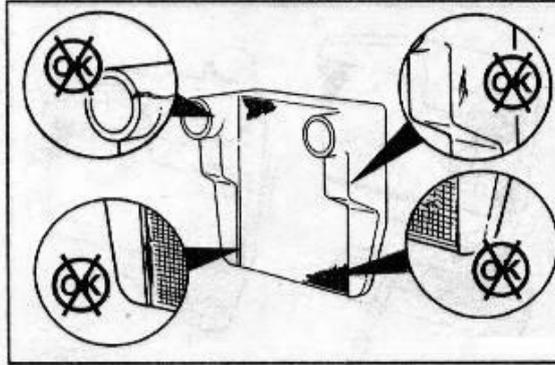
Check the intake hose for cracks or perforations, and check the clamps for looseness. If any are found, tighten them or replace the hose to ensure the intake system is leak-free, otherwise it may damage the diesel engine.



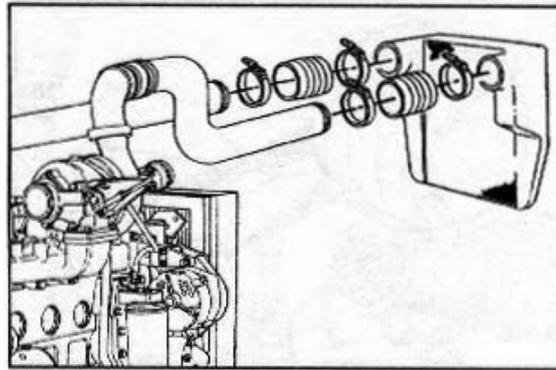
4.3.4 Check and Maintain Intercooler

Visually check the air inlet/outlet chamber of the intercooler to see whether there are cracks, perforation or other defects.

Check the intercooler pipes, cooling core and welding seams to see whether there are cracks, tip off or other defects.

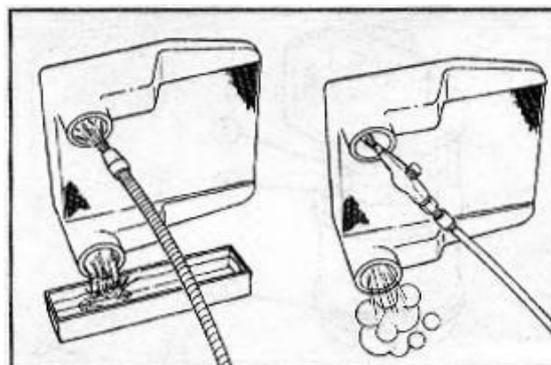


If inspection reveals that engine oil or debris has entered the intake intercooler due to turbocharger failure or other reasons, the intercooler must be removed from the equipment for cleaning.



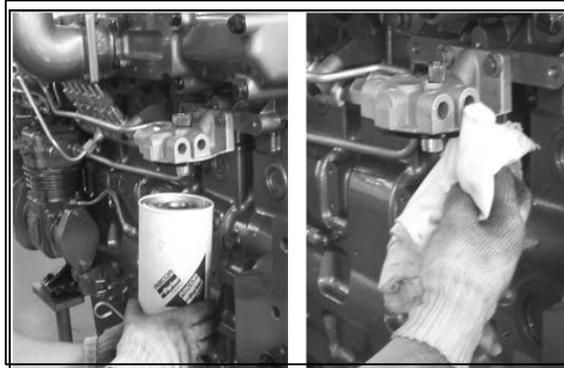
Note: Do not use corrosive cleaning agents to clean the intake intercooler, as this will severely damage it.

Use solvent to flush the intercooler interior along the airflow direction. During flushing, vibrate or gently tap the intercooler with a rubber mallet to flush out accumulated debris. After completely flushing the intercooler of oil and debris, rinse off any remaining solvent with hot soapy water, and finally rinse thoroughly with clean water. Dry the intercooler interior with compressed air along the air intake direction.

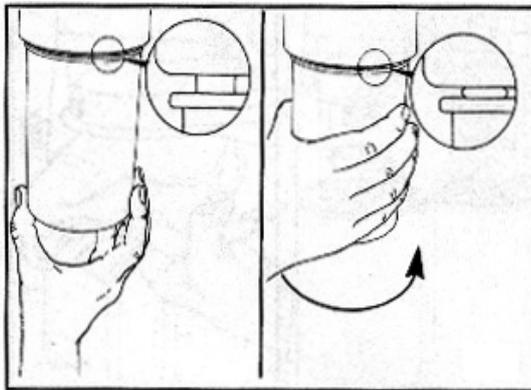


4.3.5 Replace Fuel Filter

Clean the area around the fuel filter housing. Remove the fuel filter and wipe the sealing surfaces of the filter housing clean.



Fill the new fuel filter with clean diesel and lubricate the rubber seal ring with clean oil. Install the fuel filter according to the instruction printed on the surface of the fuel filter.



Note: To prevent fuel leaks, the fuel filter must be tightened according to the instructions but not overtightened to avoid damaging the fuel filter.

4.4 Maintenance Every 500 Hours or 6 Months

In addition to completing routine maintenance and the previous periodic maintenance items, the following maintenance items will be added:

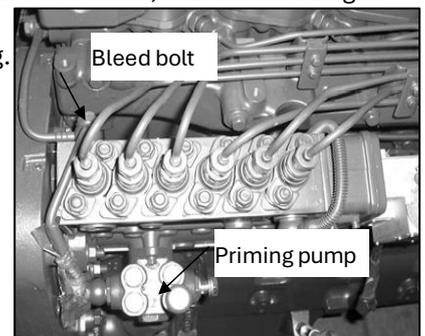
- Prime the fuel system.
- Check anti-freeze fluid and coolant additive concentration.
- Adjust valve clearance.

4.4.1 Prime Fuel System

An overflow valve is installed on the fuel injection pump inlet chamber. If the fuel filter is replaced as specified in this manual, the small amount of air entering the fuel system can be automatically expelled. However, manual bleeding of the fuel system is required in the following situations:

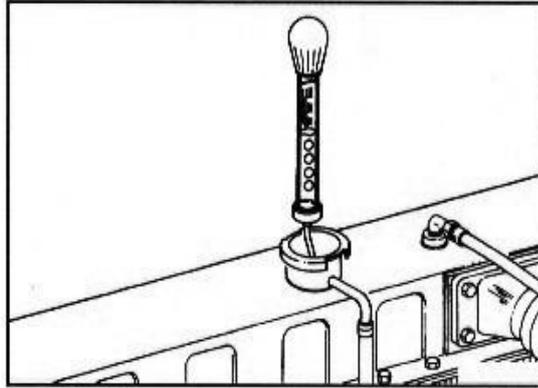
- The inner chamber of the fuel filter has not been filled with fuel before installing.
- Replace the fuel injection pump.
- Replace the fuel line or check for a loose high-pressure fuel line connection.
- The diesel engine fails to start initially or continue running after starting.
- Diesel fuel is sucked out of the fuel tank.

Loosen the bleed plug on the fuel injection pump, press the manual pump to deliver diesel fuel until no more air bubbles come out of the fuel through the plug, then tighten the plug.



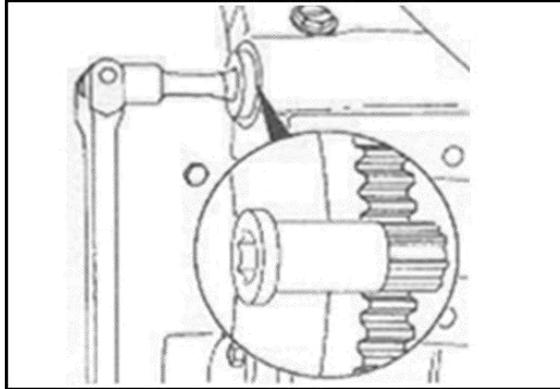
4.4.2 Check Concentrations of Anti-freeze Fluid and Coolant Additive

Use a freezing point meter to check the antifreeze concentration. Antifreeze must be used as the diesel engine coolant under all climatic conditions. Adding antifreeze raises the coolant's boiling point and lowers its freezing point, thus expanding the diesel engine's operating temperature range. The antifreeze concentration should be controlled so that the coolant's freezing point is approximately 10°C lower than the local lowest ambient temperature. The relationship between the antifreeze/water volume ratio and freezing point is explained in Section 2.3.3. If DCA4 additive is used, its concentration should be checked according to the specifications in Section 2.3.3.



4.4.3 Adjust Valve Clearance

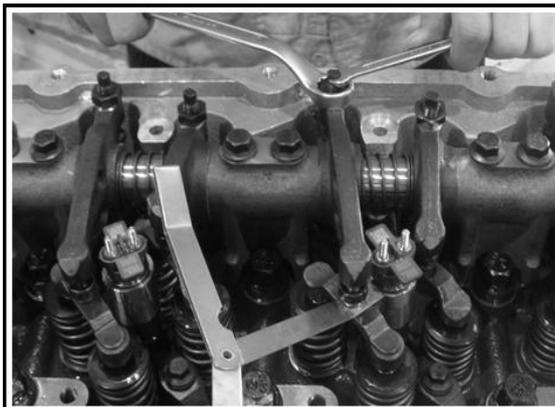
Before adjusting valve clearance, the cylinder head cover and related components must be removed. Remove the inspection window cover from the flywheel housing, insert a cranking tool into the cranking hole on the flywheel housing and engage it with the flywheel ring gear. Slowly rotate the crankshaft until the pointer on the flywheel housing aligns with the "0" mark on the flywheel. Then check if the intake and exhaust valves of cylinder 1 are closed, i.e., whether the valve pushrods can rotate freely. If they can rotate freely, the piston of cylinder 1 is at top dead center (TDC) of compression; otherwise, rotate the crankshaft 360° to bring the piston of cylinder 1 to TDC of compression.



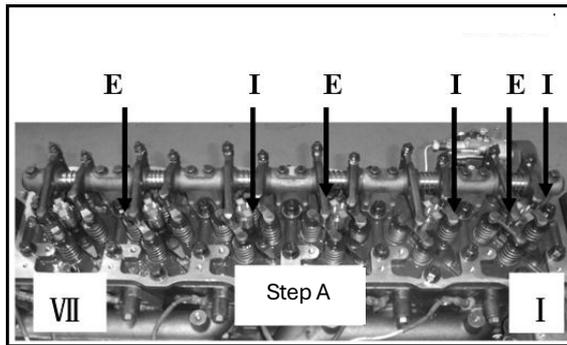
Check and adjust valve clearance with a feeler gauge. Intake valve clearance: 0.30 mm; Exhaust valve clearance: 0.50 mm.

Valve clearance check must be conducted after the engine has cooled down to below 60°C.

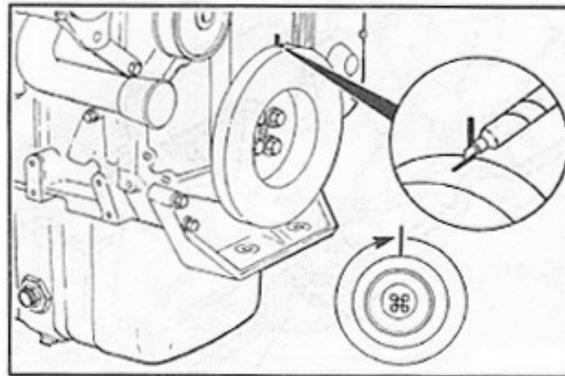
Caution: The clearance is correct when some resistance is felt when the feeler gauge is slipped between the rocker arm and the valve bridge.



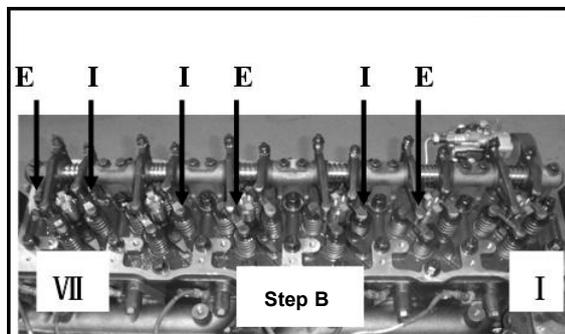
At the top dead center position of the piston in cylinder 1, check and adjust the clearances of each valve as shown in step A (I represent the intake valve; E represents the exhaust valve). After tightening the rocker arm lock nut, recheck the clearances of each valve; the clearance values should not have changed. Lock nut tightening torque: 45 N·m



Mark the shock absorber and rotate the crankshaft 360°CA.



Next, check and adjust the clearances of each valve as shown in step B. After tightening the rocker arm lock nut, recheck the valve clearances; the values should not have changed. Lock nut tightening torque: 45 N·m. Restore the cylinder head cover and other accessories.



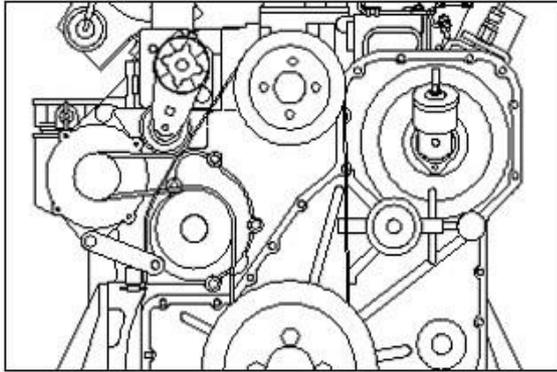
4.5 Maintenance Every 1000 Hours or 1 Year

The following maintenance items shall be completed in addition to daily maintenance and the previous periodical maintenance items:

- Check belt tension.
- Check tensioner bearing.
- Check fan bearing.

4.5.1 Check the Belt Tension

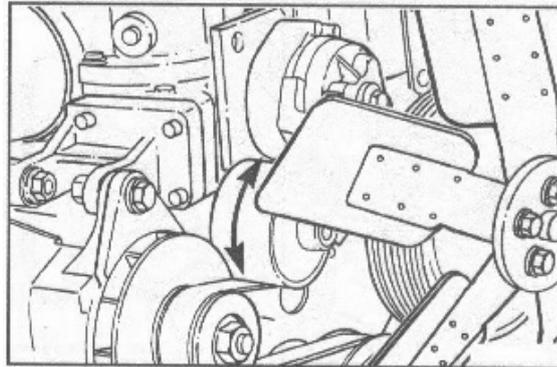
Measure the deflection of the belt at its maximum span. The maximum deflection shall not be more than 9. -12.7mm. It's also allowed to measure the tensile force at the maximum span of the belt if an instrument for measuring the belt tensile force can be available; the limit of the tensile force is 360-480N.



4.5.2 Check Tension Pulley Bearing

Check whether the drive belt has been damaged, rotate the tensioner pulley bearing to see whether there exists any abnormality, and check whether the tensioner pulley bolts are loose. Retighten them to 45 N·m when needed.

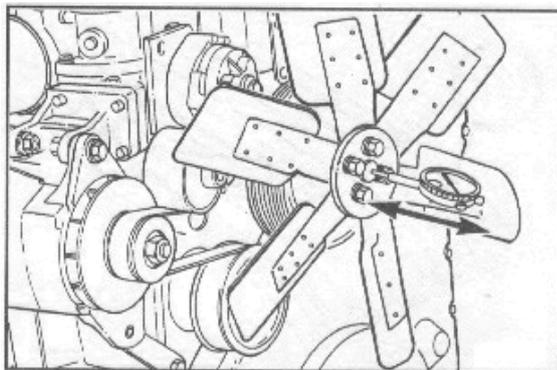
Caution: The tensioner pulley shall be rotated freely without any resistance or excessive radial/axial movement.



4.5.3 Check Fan Bearing

Rotate the fan to check whether the bearing works normally.

Caution: The fan shall be free of vibration and without excessive axle movement.



4.6 Maintenance Every 2000 Hours or 2 Years

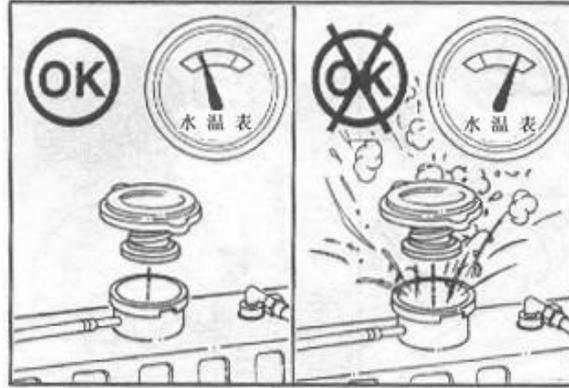
The following maintenance items shall be completed in addition to daily maintenance and the previous periodical maintenance items:

- Clean cooling system and replace coolant.
- Check vibration dampers.
- Check air compressor.

4.6.1 Clean Cooling System

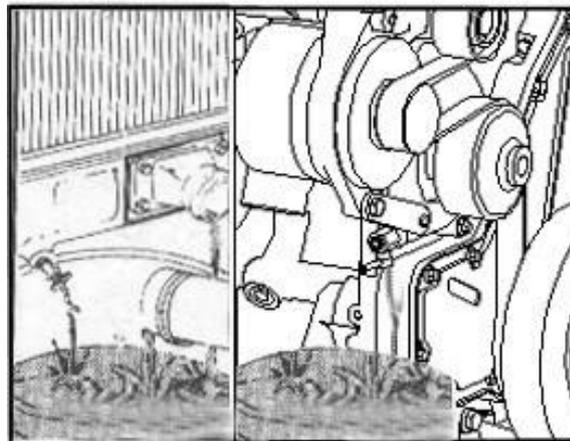
To ensure effective cooling and corrosion prevention in diesel engines, the cooling system must be cleaned regularly. Even with filtered and regularly maintained coolant, it must be changed and cleaned every two years; otherwise, the replacement and cleaning cycle should be shortened accordingly. Cooling system cleaning steps:

Drain the coolant.

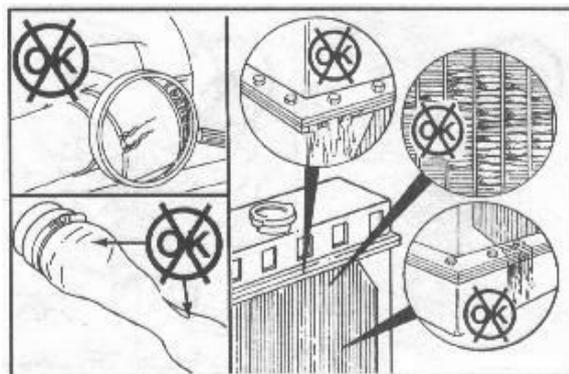


Warning: The coolant filler cap on the radiator must be removed only after the coolant temperature is lower than 50°C; otherwise, hot coolant spray will result in serious injury.

Open the drain valves on the radiator and diesel engine water pump to drain the coolant from the cooling system. For most applications, the coolant capacity of the system is approximately 25–30 L.



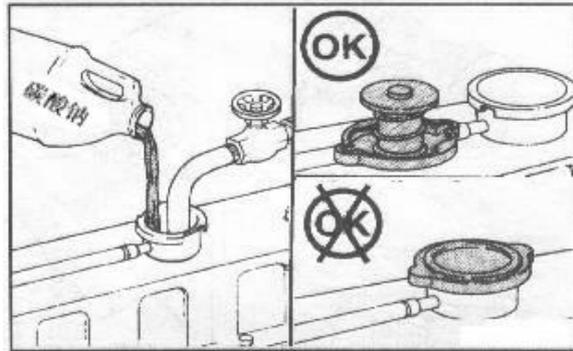
Inspect the hose for damage and check for loose or damaged clamps. Replace it if necessary. Check for leaks, damage, and dust accumulation. Clean and repair as needed.



Fill the engine cooling system with sodium carbonate detergent.

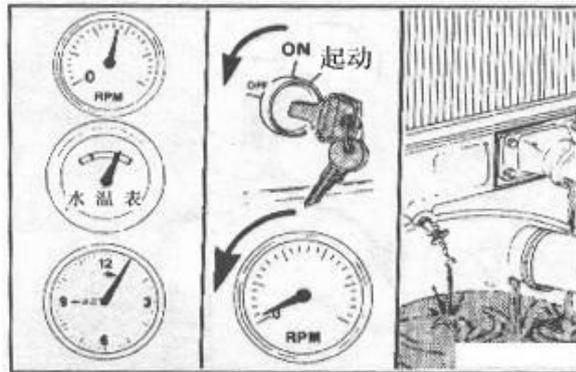
Note: Each 23 L of water should be mixed with 0.5 kg sodium carbonate.

Caution: Do not install the filler cap during cleaning the cooling system and run the diesel engine without the cap on the radiator.



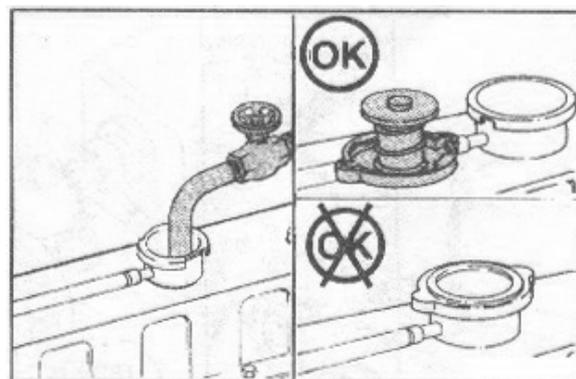
Note: Air must be purged from the cooling water chamber during the cleaning process. First, open the vent valve on the intake intercooler (if applicable), and slowly inject the cleaning agent to avoid air blockage. Wait 2 to 3 minutes to allow sufficient air to be expelled. The cleaning agent should be added to the bottom of the radiator filler neck or liquid level check port.

Start the diesel engine and run it for 5 minutes with the coolant temperature above 80°C. Then stop the engine and drain the cleaning agent.



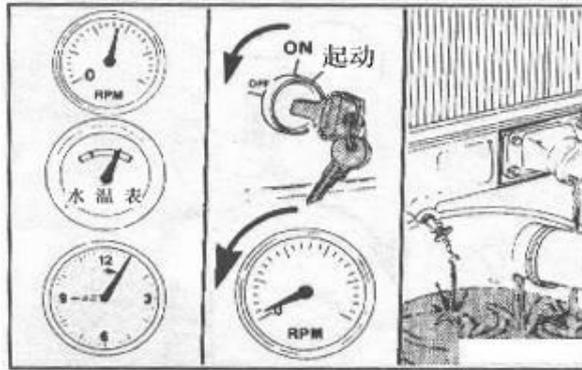
Fill the cooling system with clean water

Note: To ensure the engine is filled with clean water, the diesel engine and intake intercooler must be bled. Do not install the radiator filler cap, and do not install a new coolant filter currently.



Start the engine and run it for 5 minutes after the coolant temperature goes higher than 80°C. Stop the engine and drain all the clean water.

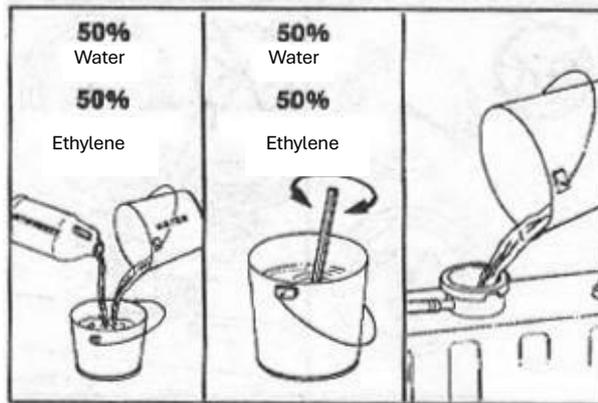
Caution: If the discharged water is very dirty, continue to fill clean water to water the system until discharged water becomes clean.



Refill the coolant into cooling system.

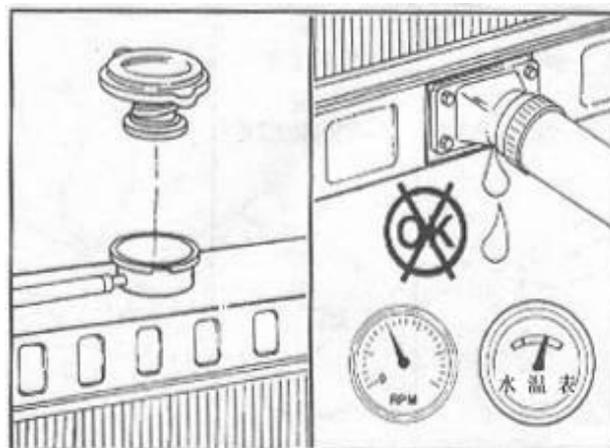
Note: It is absolutely forbidden to use only water as coolant without additives, as this will cause serious diesel engine accidents due to corrosion.

The preparation of antifreeze coolant should be carried out according to the instructions in Section 2.4. It is essential to pre-mix the coolant with water outside the machine before injection.



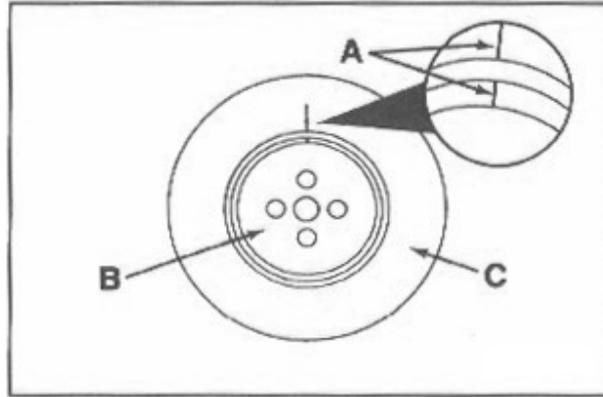
Note: During coolant filling, air must be purged from the coolant chamber. This requires opening the bleed valve (if applicable) on the intake intercooler. Coolant must be poured in slowly to prevent air lock; allow 2-3 minutes for the air to be fully expelled. Coolant should be filled to the bottom of the radiator's filler neck or level gauge.

After installing the radiator filler cap, start the diesel engine and run it until the coolant temperature reaches 80°C. Then, check the cooling system for leaks. After stopping the engine, wait until the coolant temperature drops below 50°C, then open the radiator filler cap and check the coolant level again. If necessary, add an appropriate amount of coolant.



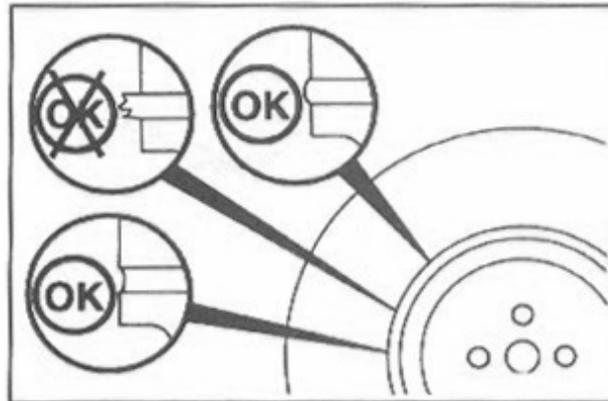
4.6.2 Check Vibration Damper

Check if the markings (A) on the inner ring (B) and outer ring (C) of the torsional vibration damper have shifted. If the misalignment between the two markings is greater than 1.6 mm, the damper should be replaced.



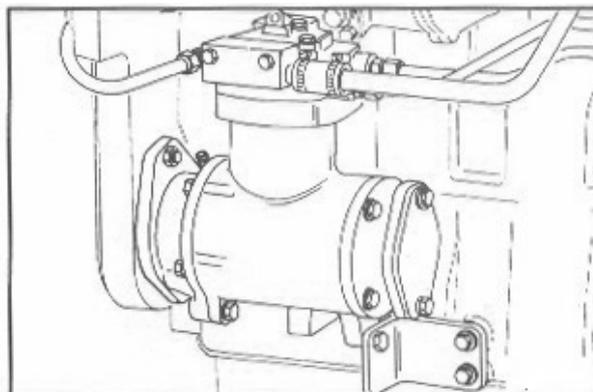
Check the rubber components of the shock absorber for aging. If you find any fragmented rubber falling off or a large gap between the rubber ring and the metal surface, check for signs of aging. If the deviation is 3.2 mm, the shock absorber should be replaced.

Check if the inner ring of the shock absorber has moved forward relative to the outer ring. If so, the shock absorber should be replaced.



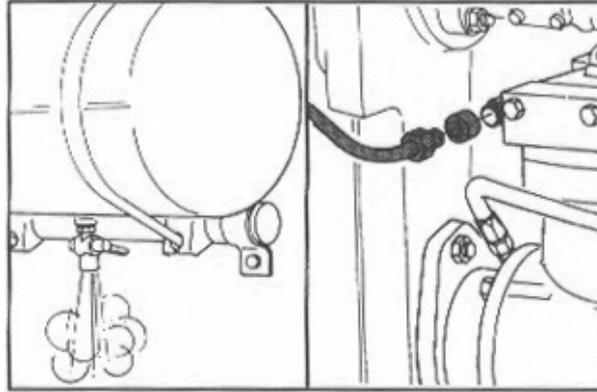
4.6.3 Check Air Compressor

All air compressors introduce a small amount of engine oil to lubricate the piston rings and moving parts. When this oil is used for an extended period at the air compressor's normal operating temperature, it can gum or deposit carbon. If the following checks are not performed, the air compressor's piston rings will be subjected to high operating temperatures and pressures, eventually leading to a loss of sealing.

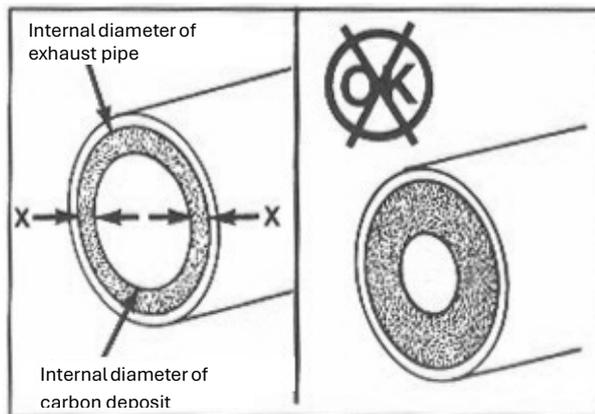


Check the air outlet pipe of the air compressor

Release the pressurized air from the brake air reservoir. Disconnect the air outlet hose from the air compressor.

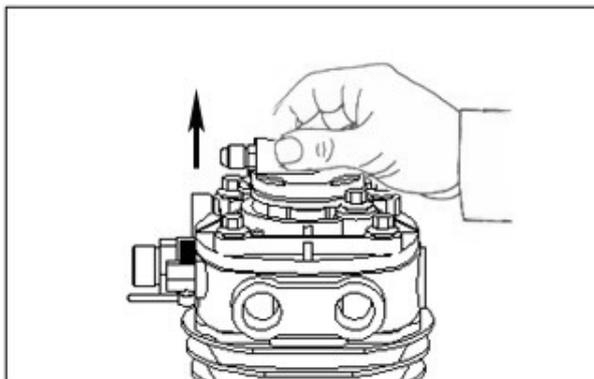


Measure the total thickness of the carbon deposit layer inside the air compressor's outlet pipe. If the total carbon deposit thickness ($x + x$) is greater than 2 mm, the air compressor cylinder head, valve assembly, and outlet pipe should be cleaned and inspected. Replace them if necessary. If the total carbon deposit thickness is greater than the specified value, continue inspecting the outlet pipe between the air compressor and the compressed air receiver until the carbon deposit thickness is less than the specified value. Clean or replace pipes or fittings with a carbon deposit thickness greater than the specified value.

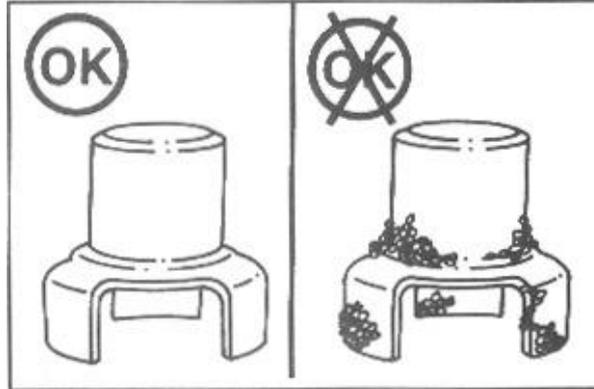


Check inlet valve of air compressor

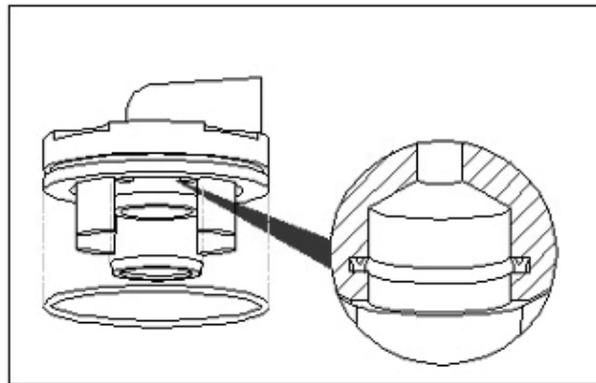
Warning: When removing the unloading valve body screws, press down on the unloading valve body; otherwise, the sudden release of the unloading valve spring may cause it to spring up and injure someone.



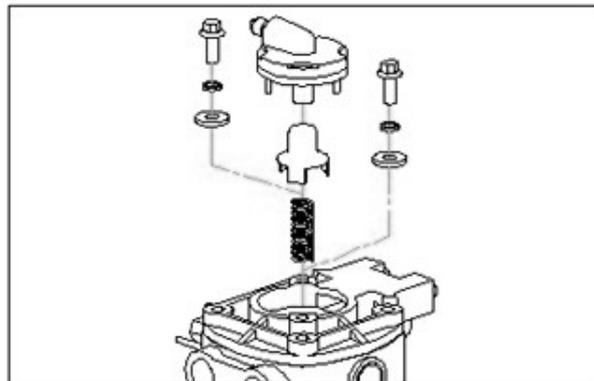
Carefully inspect the unloading valve for carbon buildup. If severe carbon buildup is found, remove and clean it thoroughly. Also inspect the air compressor cylinder head and inlet/outlet valve components, replacing any parts as necessary.



If the unloading valve is clean or has only slight carbon buildup, a new O-ring can be installed on the unloading valve body and a new Y-ring can be installed inside the bore of the unloading valve body.



Apply an anti-seize compound to the outer surface of the unloading valve cap. Apply clean 15W-40 machine oil to the outer surface of the O-ring of the unloading valve body. Install the unloading valve assembly into the air compressor cylinder head and tighten the clamping bolts of the unloading valve body.
Torque: 14 N·m.



5. Troubleshooting Guidelines

Correct operation and diligent adherence to regulations for daily and periodic inspections and maintenance are essential for effectively eliminating malfunctions. Any abnormalities encountered during diesel engine use should be taken seriously, and the relevant repair department should be notified and consulted promptly. This manual lists some typical diesel engine malfunctions, possible causes, and acceptable solutions. If the malfunction is unclear, cannot be repaired, or is not listed in this section, please contact the Shanghai Diesel Engine Co., Ltd. "Easy People" call center (national toll-free service hotline 400-820-5656) for diagnosis and repair.

- Engine is difficult to start or cannot start
- Sudden misfire
- Engine's power loss
- Fuel consumption is too high
- Oil consumption is too high
- Oil pressure is too high
- Oil pressure is too low
- Engine is overheating
- Black smoke
- Coolant temperature is too low
- Excessive noise
- Excessive Vibration
- Alternator cannot be charged or fully charged

5.1 Engine is Difficult to Start or cannot Start

Possible Causes		Correction
The starter motor is not running properly.	The starting line is loose or corroded	Clean and tighten the line connectors
	The battery is charged insufficiently	Charge or replace the battery
	Starter motor and electrical system failure	Consult the authorized service station or provider
Starter motor runs normally	The starting procedure is incorrect	See Section 3.1 Starting Procedure
	The preheating device is operated improperly (when required)	Follow proper procedure for preheating
	The intake system is blocked	Check whether the intake system pipeline is blocked
	There lacks fuel in the fuel tank	Refill appropriate fuel
	Air enters the fuel system	Discharge the air

5.2 Sudden Misfire

Possible Causes	Correction
The fuel is contaminated	Replace with clean and qualified fuel
Air enters the fuel system	Prime the fuel system
There is fuel leakage at high-pressure fuel line	Check the line for leakage, tighten and replace relevant parts if necessary
The low-pressure fuel pipe or fuel filter is blocked	Check the pipe and filter element, clean the primary fuel filter and strainer, and replace the fuel filter if necessary
The fuel injection timing or valve timing is incorrect	Please consult the authorized service station or provider
Fuel delivery pump failure	Repair or replace the fuel delivery pump

5.3 Engine Power Loss

Possible Causes	Correction
Fuel supply disruption	Check the fuel inlet resistance; if necessary, clean the coarse filter and filter screen, and replace the fuel filter
The fuel quality is poor	Perform verification using a temporary fuel tank containing approved diesel fuel
There is fuel leak at high-pressure fuel pipes or joints	Check the joints or high-pressure fuel pipes for leakage, tighten and replace them if necessary
Air enters the fuel system	Prime the fuel system and check fuel inlet pipe for leakage
The intake or exhaust system is blocked	Check the intake and exhaust system for resistance. Check the air filter and replace the air filter element if necessary
The fuel injection timing or valve timing is incorrect	Consult the authorized service station or provider
The turbocharger is damaged	Check the turbocharger for pressure, replace it if the pressure is too low
The injector orifice is blocked, resulting in poor atomization	Check and clean the injector or replace it
The ambient temperature is too high, or the engine operates in high-altitude area	In high-altitude areas or under excessively high ambient temperatures, diesel engine power will decrease; therefore, the load should be appropriately reduced during use.

5.4 Fuel Consumption is too High

Possible causes	Correction
The fuel leaks	Check the fuel system lines for leaks; tighten any loose connections
The fuel quality is poor	Use the qualified fuel as specified in the manual
Additional load caused by auxiliary device failure	Check auxiliary devices
Increased intake system resistance	Check the air filter element and replace it if necessary

5.5 Oil consumption is too High

Possible causes	Correction
Diesel engine exterior oil leak	Inspect the diesel engine's external piping, gaskets, oil seals, etc. for leaks, and replace any damaged parts.
Engine oil level too high	Check the engine oil level and adjust if necessary.
Using unsuitable engine oil	Change to the recommended engine oil
Oil cooler leak	Check if there is oil in the coolant
Turbocharger oil leaked and seeped into the intake and exhaust pipes	Check for oil leakage at the turbocharger inlet and outlet
Excessive wear and seal failure of internal parts in diesel engine	Please consult an authorized service center.

5.6 Oil Pressure is too High

Possible causes	Correction
Pressure gauge malfunction	Check the pressure gauge function
The operating temperature of the engine is too low	See if the coolant temperature is too low.
Incorrect engine oil specification, engine oil viscosity too high	Check and replace with qualified oil
The bypass is stuck in the closed position.	Check and replace the bypass valve

5.7 Oil Pressure is too Low

Possible causes	Correction
The oil level is too low	Adjust the oil level
Incorrect engine oil specification, engine oil viscosity too thin	Check and replace with qualified oil
Loose oil line connectors or detached oil passage plugs	Check the pipeline for oil leaks
Engine oil diluted with water	Find the cause of the dilution and change the engine oil
Oil pressure regulating valve malfunction	Check/replace the pressure control valve
Oil pressure gauge malfunction	Check the oil pressure gauge
The oil filter is clogged	Check/replace the oil filter
Wear of diesel engine shaft and bearings	Replace worn shaft or bearings

5.8 Engine is Overheating

Possible Causes	Correction
Coolant is Insufficient	Check the cooling system for leakage, add coolant and discharge air completely
Radiator pressure cap failure	Check the radiator cap
The engine is overloaded	Reduce load
The radiator is covered with excessive dust	Check the radiator and clean it if necessary
The cooling fan shroud is damaged or has detached from the fan.	Inspect the air deflector and repair or replace it if necessary
The fan drive belt is damaged or loose	Check the belt and tensioner
Water pump failure	Disassembly and inspection of the water pump
Air or gas enters the cooling system	Check the water system for leaks and loose parts
Damaged water temperature sensor or water temperature gauge	Check the sensors and water temperature gauge
Thermostat malfunction	Replace the thermostat

5.9 Black Smoke

Possible Causes	Correction
Engine overload	Reduce load
There is air in the fuel system	Purge air to check for leaks in the oil suction section.
Intake system obstructed	Check the air intake system for clogging
Turbocharger failure	Replace the turbocharger
Injector malfunction	Consult the authorized service station

5.10 Coolant Temperature is too Low

Possible causes	Correction
Too much cold air flowing through the radiator	Inspect the fan and fan clutch; refer to the manufacturer's instructions
Temperature sensor malfunction	Check and calibrate the sensor
Thermometer malfunction	Calibrate the thermometer and replace it if necessary
Thermostat damaged	Replace the thermostat
The radiator louvers are stuck at maximum opening	Inspect the blinds and replace them if necessary

5.11 Excessive Noise

Possible causes	Correction
Whistling sound of transmission belt	Inspect the belt drive system
Intake and exhaust leaks	Inspect/Repair Leaks
Excessive valve clearance	Check and adjust valve clearances
The turbocharger is noisy	Check whether the impeller touches the housing
Oil in the engine is insufficient	Check and refill oil
The drive gear is noisy	Consult the authorized service station or provider

5.12 Excessive Vibration

Possible causes	Correction
Diesel engine supports (including vibration damping pads) are loose or damaged.	Inspect/replace the diesel engine mounts (including vibration damping pads).
Fan damage or accessory malfunction	Check and replace the faulty parts
Crankshaft torsional vibration damper failure	Inspect/Replace faulty parts
Wear and imbalance of drive system components	Inspect/replace according to the manufacturer's specifications.
Loose or damaged moving parts	Consult the authorized service station or provider

5.13 Alternator cannot be Charged or Fully Charged

Possible cause	Correction
Loose or corroded battery terminals	Clean and tighten the battery connectors
The engine belt slips	Check the belt and tensioner, and replace them if needed
Instrument or indicator light failure	Check and replace the instrument and indicator lamp, and make replacement if necessary
Engine wiring loose or damaged	Repair the wire
The alternator had failed	Replace the alternator

6. Storage of Engine

6.1 Short Time Storage

If the engine is to be out of service for a period (1 to 3 months), measures of cleaning and necessary oil seal should be taken for rust protection.

6.1.1 Before Storage

- Clean the engine surface and check for any dirt or oil stain or water stain and rust. Dry the engine with compressed air. Apply anti-rust oil to the unpainted machining surfaces of the engine with a brush and keep the parts of rubber, plastic and fiber free from the anti-rust oil.

Caution: The surfaces of the front drive pulleys must be kept from rust.

The anti-rust oil requirement for outside engine is as follows

Item		Requirement
Appearance		Brown in even
Moisture		None
Drop point		≥55
Freezing resistance		Qualified
Oil stability (ml)		≤2
Salt test	Steel sheet	≥14
	Cast iron sheet	≥7
Humid heat test	Steel sheet	≥30
	Cast iron sheet	≥14
Lamination test (7 days)	Steel sheet	Qualified
Corrosion test (14 days)	Steel sheet	Qualified
	Cast iron sheet	Qualified

- Disconnect the battery, clean terminals and apply a light film of grease. Charge the battery.
- Let the drive belt loose.
- Seal all ports of air, fuel, oil and coolant, as well as the air filter with damp-proof material or plastic one.
- Cover the engine with a plastic cover or similar stuff and place the engine in a dry area with good ventilation.

6.1.2 During the Storage

Charge the battery every month. Check the battery electrolyte level before charging. Crank the crankshaft three to four turns every month with barring tool.

6.1.3 After Storage

When putting the engine into use, remove the fuel pump and send it to the authorized service provider for adjustment. Remove the engine cover and all port covers and connect necessary pipes. Install the fuel pump and prime the fuel system. Connect battery and install the belt. Check lubricating oil and coolant levels and add proper amount of clean lubricating oil into the turbocharger from its oil inlet. Crank the engine three to five circles with barring tool. Then follow the starting procedure in Section 3.1 to start the engine.

6.2 Long Term Storage

6.2.1 Before Storage

If the engine is to be out of service for a long time (more than 3 months), proper storage of the engine is required.

- On last engine operation, drain the lubricating oil in the engine and oil filter after the engine has stopped and cooled down to warm state. It is not necessary to drain coolant because it is anti-rust. Add qualified anti-rust oil (dewatered CF 15W-40 oil) into the engine, start the engine to idle for 1-1.5 minutes and stop it, then drain the anti-rust oil.
- Refer to Article 1, 2, 3, 4 and 5 in Section 6.1.1 Short Time Storage for cleaning, preventing rust and other requirements. And put a tag which reads "The engine does not contain oil and do not use it."

6.2.2 During Storage

Refer to 6.1.2 for storage.

