SDEC POWER

K SERIES POWER GENERATION ENGINES

G-DRIVE
POWERPACK
Power Generation Specification

OPERATION AND MAINTENANCE MANUAL

Power Output Range
520kW – 968W

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

K SERIES DIESEL ENGINE

MODELS	MAX ENGINE OUTPUT		RATED GENERATOR OUTPUT	
	Prime kW	Standby kW	Prime kVA	Standby kVA
6KTAA25-G310 (1500 rpm)	520	572	563	625
6KTAA25-G310 (1800 rpm)	572	629	625	688
6KTAA25-G39 (1500 rpm)	572	629	625	700
6KTAA25-G39 (1800 rpm)	622	684	700	750
6KTAA25-G38 (1500 rpm)	622	684	700	750
6KTAA25-G38 (1800 rpm)	622	684	700	750
6KTAA25-G32 (1500 rpm)	685	754	750	825
6KTAA25-G32 (1500 rpm)	685	754	750	825
6KTAA25-G31 (1500 rpm)	728	800	825	900
6KTAA25-G31 (1800 rpm)	-	-	-	-
6KTAA25-G320 (1500 rpm)	820	902	900	1000
6KTAA25-G320 (1800 rpm)	-	-	-	-
6KTAA25-G321 (1500 rpm)	880	968	1000	1100
6KTAA25-G321 (1800 rpm)	-	-	-	-

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.

CAUTION

Be sure to read this instruction manual carefully and strictly observe the safety and operation instructions herein, especially the warnings and cautions, to reduce the possibilities of personnel injury, property loss, engine performance deterioration, premature wear or damage.

Warnings in this manual must be observed strictly. Failure to do so can cause burns, amputation, mutilation, asphyxiation, other personal injury or death. Cautions are provided for the user to operate the engine in a proper way, to avoid damage to engine parts and engine performance deterioration. Warnings and cautions in this manual are not complete because Shanghai Diesel Engine Co., Ltd. (SDEC) has no possibility and is not able to foresee all potential risks resulted from the failures to follow the safety cautions and operation instructions.

REPAIR, TECHNICAL CONSULTATION, COMPLAINTS AND SUGGESTIONS

For engine repair, technical consultation, complaints or suggestions, please contact SDEC's after-sale service centre: spare@sdecie.com.

Please provide the following information for product repair:

- The model of the diesel engine
- The order number of the diesel engine
- The serial number of the diesel engine
- The date of the equipment procurement
- The detailed description of the fault
- The address and phone number of contact person

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1. INTRODUCTION

1.1 To User and Operator

Thank you for purchasing a product of Shanghai Diesel Engine Co., Ltd!
The K series electronic-controlled diesel engine is a large power diesel engine that is newly developed by SDEC to meet the market demand on large diesel engine for generator set application. Featuring strong power and low fuel consumption, and with high reliability, The K series diesel engine is a perfect power for land generator sets.
This manual mainly covers the technical specifications, operation and maintenance instruction, with an aim to familiarize you with the engine, as well as the proper operation and maintenance thereof. Before using the engine, read carefully the relevant contents and requirements in this manual. Due to the continuous improvement of performance and structure of the engine, the technical specifications and illustrations of the engine in this manual may be slightly different from those of the engine you have, please note that we will provide the supplement and perfection in the later editions without notice. In case of any question during your engine operation and maintenance, please never hesitate to contact SDEC's after-sale service center spare@sdecie.com for technical advice or guidance.
SDEC has adopted the latest technology and high-quality parts for the engine. The genuine SDEC service parts are recommended to be used for repair and maintenance. Please contact SDEC's after-sale service center spare@sdecie.com for service parts.
Since this manual ensures proper engine operation and maintenance, it should be given to the new owner when the engine is traded or sold.

1.2 Scope

This manual is for the operation and maintenance of K series electronic-controlled diesel engine for generating set.

1.3 Notice for Engine Quality Feedback

To better our service, please provide following information when you make feedback about quality issue(s), whereby, we can understand and analyze the quality issue(s) and the root cause(s) thereof, and make the improvement in time:

1. When and where fault occurred.
2. Engine serial number, model, order number, delivery date and the detailed address of consignee.
3. Service conditions, cumulative operation time (in hours), operating conditions (power, speed) and the grades of fuel and engine oil that were used.
4. The characteristics of the driven equipment (model, power consumption and structural feature, etc.).
5. The description of fault(s).
6. Part(s) or component(s) claimed for compensation or repair should be mailed or sent in person to SDEC headquarters with the damage process record or description for facilitating analysis. If there are several problems or very serious problems, please leave the site as it was and inform us promptly, and then SDEC will send staff for a joint analysis.

Quality issues should be settled based on the relevant provisions in the quality warranty manual.

1.4 Safety Notes

Read and understand all safety notes and warnings before use and maintenance of the engine. Following safety notes and warnings should be obeyed to avoid any personal injuries.

- Be sure to work in a safe place and be prepared for potential danger at any time.
- When working on the engine, always remain alert. Never work on the engine when physically or mentally fatigued.
- Do not smoke when working on the engine.
- Smoking is not allowed during fuel refilling, otherwise, fuel steam can cause fire easily.
- Smoking is not allowed when checking battery electrolyte level because electrolyte releases flammable gases.
- Do not wear a loose garment or any jewelry when working around the engine or its driven equipment. If necessary, wear safety goggles, work clothes, safety helmet or other protective items.
- Gen-sets must be kept 1 meter away from buildings or other equipment during operation to avoid fire.
- The engine exhaust fumes contain carbon monoxide and other harmful stuff which can be DEADLY. If the engine runs indoors, exhaust gas must be piped safely away from any building or enclosure that houses the engine.
- Do not remove guards and protective devices with which the engine is equipped for its exhaust system parts and exposed rotating parts when required, or personal injury can be likely triggered.
- Do not put flammable stuff like fuel, lubricating oil, coolant, or danger stuff like explosive around the engine. They may cause fire or explosion.
- Wipe up any fuel, oil or coolant spills. They may cause fire when light. Put rags with fuel, oil or coolant into a fire-protection container, and do not leave it on the engine.

- Remove dust, mud or other odds and ends on the engine. They can be a cause of fire or engine overheating.
- Before starting the engine, make sure there are no persons around, nor tools or other things on the engine. Do not start the engine when a tag of Do Not Start is on the starting switch.
- When fuel, oil, or exhaust gas leak is found, take measures to eliminate the leakage source immediately. Splashed fuel or oil on high temperature parts or exhaust gas contacting flammable stuff can cause fire, personal injury or engine damage.
- Do not check fuel, oil and coolant leaks with hand. High pressure and high temperature fuel, oil or coolant can cause personal injury. Be very careful when checking fuel leak, because high pressure fuel can inject into skin and cause personal injury or even death. Use a thick plate to check for fuel leak and avoid contacting injected fuel when finding fuel leak.
- Use an explosion-proof light to check fuel, oil, coolant or electrolyte if light is needed to prevent fire explosion.
- Do not smoke, and do not use fire when handling or working near fuel system components, for fuel steam may be lit and cause damage to components or personal injury.
- Do not make any maintenance of fuel system parts when the engine is in operation.
- Fuel flows from the injection pump to the injectors through the high-pressure fuel pipes under very high pressure. Do not loosen the high-pressure fuel pipes when the engine is in operation. This will result in serious scald.
- The electronic unit pump fuel system and the common rail fuel system generate high electric voltage during engine operation. Do not touch the fuel injection pump solenoid wires or solenoid parts. Do not touch the injector solenoid wires or solenoid parts. This will result in serious electric shock.
- If the engine is not used for a long time or for repair, always disconnect the battery cables to prevent accidental startup. Meanwhile, place a tag of Do Not Operate in the operation room or on the starting switch. Disconnect the cable from the post indicated by a NEGATIVE, NEG, or (–) first, then remove the POSITIVE, POS, or (+) cable. When reconnecting the cables, connect the POSITIVE cable first, the NEGATIVE cable last.
- Do not use a metal tool to contact the two battery posts, and do not make the two posts short circuit, or explosion may happen.
- The connection of the battery cable posts must be secured. Explosion may happen due to poor connection. Damaged wires or cables will cause fire. Check and replace them before reconnecting the wires and cables.
- Do not use fire, nor make welding near the battery(s) because battery can produce flammable hydrogen and oxygen. Do not use the battery(s) when its electrolyte is lower than the minimum level. Improper use of electrolyte can cause blind or scald.
- If the engine runs indoors, always keep a fire extinguisher near the engine. Keep the extinguisher properly charged and be familiar with its use. Keep an emergency medical box in a specified place where it is accessible. Make sure there are measures available for dealing with fire or accidents. Do not use any carbon fire extinguishers of tetrachloride type. These fire extinguishers emit toxic fumes, and the liquid can damage wiring insulation.
- Keep skin or eyes free from coolant or electrolyte when refilling and changing. In case of skin contact, please flush the contacted part with soap and clean water; in case of eye(s) contact, flush your eye(s) for 15 minutes with clean water and seek medical treatment immediately.
- Cool down the engine first when refilling coolant to avoid being hurt by coolant steam. Open the pressure cap or filler cap only when the coolant temperature is lower than 50℃, and then slowly loosen the cap to release the pressure of coolant. The coolant is very hot when the engine has just stopped, and coolant steam or hot coolant can inject and cause scalding if the cap is opened. The cap must be tightened after checking, refilling or changing coolant.
- Do not touch by hand the intake and exhaust system components like the exhaust manifold, exhaust tailpipe, turbocharger, intercooler air inlet pipe and expand tank when the engine is in operation because they are very hot. The coolant is very hot when the engine is in operation, and steam or hot coolant will inject and cause scald if the cap is opened.
- Stop the engine when the fan drive belt breaks, or the engine will overheat, and coolant steam in the expansion tank will inject and can cause scald.
- Do not handle discharged oil or replaced oil filter with bare hand, for high temperature oil or lubricating system part are very hot and can cause scald.
- Release the pressure in the air, lubricating, cooling or fuel system prior to dismantling or loosening any of its pipelines, permanent joints, connectors or relevant parts of the system. Otherwise, high pressure fuel, lubricating oil and coolant can cause personal injury.
- Do not get near to the exposed rotating parts when the engine is in operation and keep away things that may be easily caught by the rotating parts from around the engine, or serious personal injury can happen.
- Make sure to shut down the engine before any adjustment is performed to it and its driven equipment. Anything that is caught in rotating parts can cause a serious accident.
- Use a barring tool to rotate the engine. Do not rotate the engine with the fan, otherwise severe personal injury or damage to fan blades can be caused.

- Take away the barring tool after being used, or it can damage the engine and cause personal injury when the engine is in operation.
- Do not stand on the engine or on the side of the engine to work on parts high on the engine. Use a stable step and be careful when working on the step to avoid falling. Do not use a parts box or toolbox as a step. Careless operation can cause damage to the engine and personal injury.
- Used lubricating oil may contain carcinogenic substance which can result in reproductive toxicity, therefore, inhalation of or longtime exposure to oil steam should be avoided. Waste oil should be disposed of in proper, safe and reliable manner.
- To prevent choke or cold injury, removal of air-conditioning refrigerant (Freon) pipeline should be conducted in well-ventilated environment with protective clothing on. For environment protection, the refrigerating system should be emptied or filled using dedicated equipment to prevent diffusion of Freon into atmosphere. Refrigerant should be recovered and recycled.
- For environment protection, used oil, fuel, coolant, oil filter or fuel filter must be properly disposed of according to relevant environment protection regulations when changing oil, oil filter, fuel filter or coolant. And discarded battery(s) must be also properly disposed.

1.5 Operation and Maintenance Notes

- Read and understand all notes and warnings before operating or maintaining the engine. The following instructions must be observed to prevent engine faults or damage.
- Read this manual carefully and be in strict accordance with operation instructions and maintenance procedures specified in this manual.
- Carry out daily and level 4 maintenance as outlined in this manual and ensure all scheduled maintenance activities are properly recorded.
- Use the proper fuel, lubricating oil and coolant specified in this manual.
- The coolant specified in the manual should be adopted for the engine in any climate.
- When refilling lubricating oil, it is not allowed to use the mixture of oil of different specifications.
- Check if fuel, oil and coolant are enough before starting the engine.
- When an electronically controlled unit pump engine is first put into use or after being shut down for more than 7 days, air can enter the fuel system. Before starting the engine, after purging the air from the low-pressure fuel line, it is necessary to purge the air from the high-pressure fuel line of each cylinder.
- Be sure to remember that the engine must be started with no load.
- 60 hours' running-in must be conducted for a new or overhauled engine.
- Do not run the engine without an air filter, otherwise, early engine wear can happen.
- If the engine runs indoors, always keep the engine room in good ventilation. Insufficient air sucked by engine will cause high coolant temperature, low power output and poor performance. Ventilation equipment is provided for the engine room if necessary.
- Observe the engine operation and all the instrument readings. In case of abnormal condition or critical situation, an emergency stop should be performed, and faults must be removed to prevent the seizure of moving parts caused by low oil pressure or engine overheating due to lack of coolant.
- Do not run the engine at high load and high speed when the coolant temperature is blow 60℃.
- Do not run the engine in an overloaded condition.
- Stop the engine when it is overheating. Do not add coolant right after the engine has stopped, which leads to damage to cylinder head parts.
- If the engine stops abnormally, it must not be restarted immediately. If the engine stops while issuing an abnormal alarm, the cause of the fault must be identified and rectified before attempting to restart it. Continuing to operate the engine without addressing the fault could potentially lead to a more serious accident.
- Stop the engine when its oil pressure goes down abnormally due to some reason. Find and remove the root cause. Let the engine continue to run at low pressure oil will lead to engine bearings burning.
- After disassembling any bolts or plugs with washers, the washers must be replaced with new ones and must not be reused.
- Before starting the engine after being repaired, make sure to be ready to cut ECU power supply at any time. In case of any abnormal, switch off the power supply immediately.
- Electronic unit pump fuel systems and common rail fuel systems generate high voltage during engine operation. When the engine is running, do not touch the fuel injection pump solenoid valve wires or components, or the fuel injector solenoid valve wires or components, as this may damage the solenoid valve.
- The ECU, common rail, high-pressure fuel pump, electronic unit pump, and injectors are precision components. Users are strictly prohibited from attempting to repair them themselves; otherwise, our company will not provide any

related service guarantees. Repairs of any components of the electronic control system must be performed by professional personnel from our service stations.

- Welding on the engine or equipment is not recommended.
- When welding on the engine or equipment is necessary, cut equipment power supply before welding, disconnect electronic components from their harnesses. It is not allowed to connect and disconnect harnesses when power is on and use protective caps to cover their connectors to prevent particulates and spark from entering. Do not touch the pins of the connectors with hand.
- The ground of the welding device must be as close to the welded location as possible to avoid welding current going through ECU or electronic components and prevent ECU or electronic components from being damaged.
- Do not plug a harness in and out without necessity. If necessary, plug it in and out when power is off to avoid its malfunction.
- Do not connect the jumper starting cables or charging cables to the wiring of the electronic control system. This can cause electrical damage to the control system.
- Belt tension and other drive components should only be inspected when the engine is completely stopped.
- Do not pry the drive belt in the pulleys with a crowbar, or this can cause damage to the reinforced fibers inside the belts. Remove and install the belts only by hand.
- If the belt has been contaminated by oil, fuel, or other harmful liquid, make sure to replace it. Do not try to clean it. Find out and remove the source of pollution.
- When storing and carrying the drive belt, make sure its bent diameter is not less than 25 mm. Do not hang it on a hook.
- The surfaces of the drive belt pulleys must be smooth to prolong the belt service life. Therefore, before installing the belt, make sure the pulley surfaces are free from roughness or burr, and the pulleys can rotate smoothly.
- The battery(s) must be replaced when its lifetime is due.
- A faulty thermostat should be replaced promptly; however, the thermostat must never be omitted from use
- Do not clean the engine by watering it directly, prevent electronic components from being damaged.
- Do not let rain enter the engine from the exhaust and intake ports. Do not clean the engine when it is in operation. Detergent or water may be introduced into the inside of the engine. When the engine is started, detergent or water inside the engine combustion chamber can cause damage to the parts inside by its hydraulic pressure, which leads to a serious accident.
- Do not modify the engine's application or operating scope without authorization, as this may result in damage to the engine or equipment, and could cause personal injury. Any modified engine will not be covered under warranty, even if it is still within the warranty period.
- If the engine is scrapped, it should be disposed of according to the relevant national and local laws and regulations.

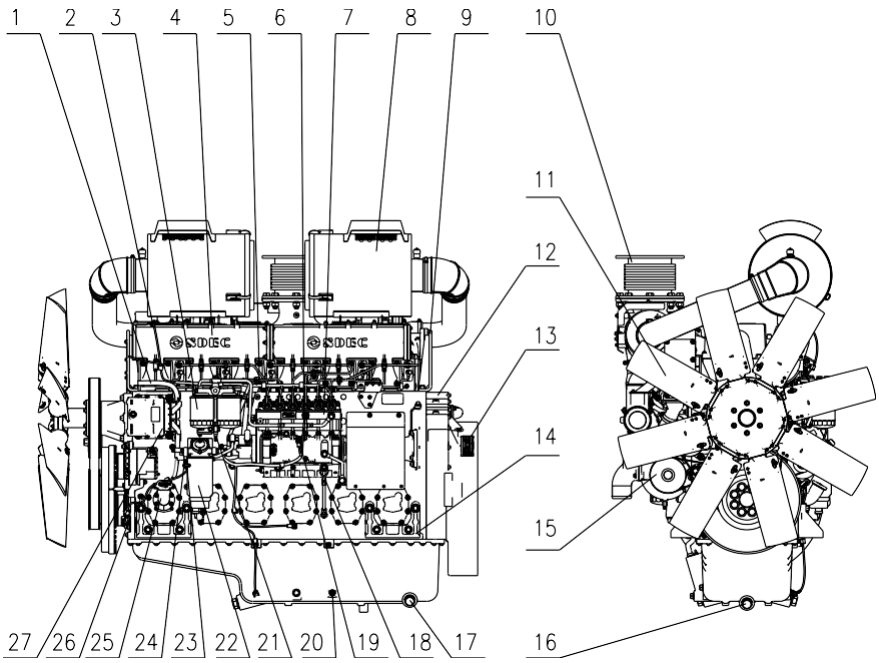
1.6 Warning Signs

Warning labels are affixed to the engine. These must be observed carefully, as ignoring them may result in personal injury or engine damage.

2. ABOUT THE ENGINE

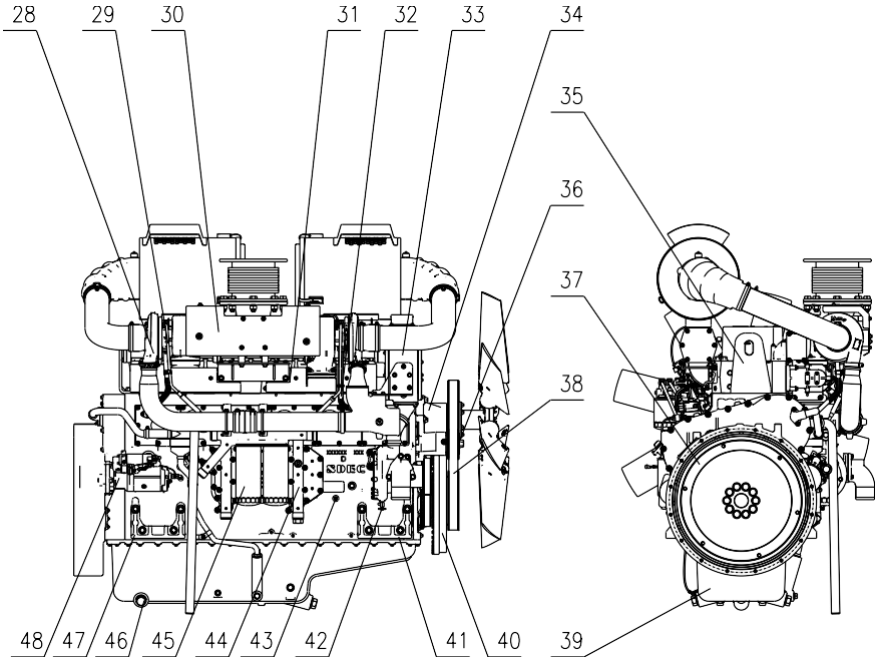
2.1 Engine Outline Diagrams

2.1.1 Outline Drawing of Electronically Controlled Unit Pump Diesel Engine



Intake Side View

Front End View

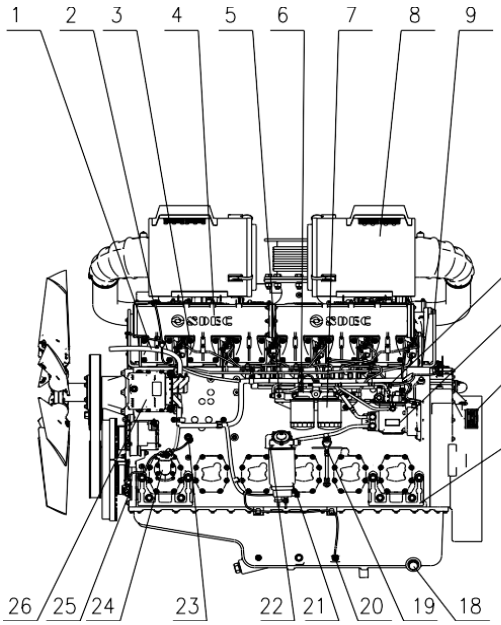


Exhaust Side View

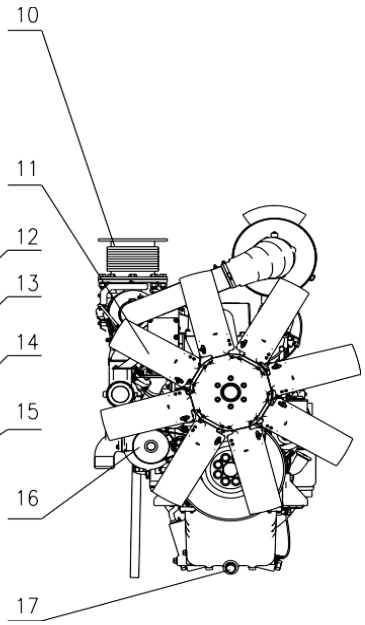
Rear End View

1	Engine harness
2	Air intake temperature and pressure sensor
3	Fine fuel filter
4	Intake manifold
5	High-pressure fuel pipeline
6	Fuel temperature sensor
7	Electrically controlled unit pump
8	Air filter
9	Engine lifting ring
10	Expansion joint
11	Fan
12	Flywheel housing
13	Engine nameplate
14	Rear engine support
15	Water pump
16	Oil drain plug
17	Oil drain plug
18	Oil dipstick
19	Camshaft sensor, EUP
20	Oil temperature sensor
21	Fuel return joint
22	First fuel filter
23	Oil pressure sensor
24	Fuel inlet joint
25	Oil filter
26	Crankshaft sensor
27	ECU
28	Turbocharger
29	Turbocharger oil inlet pipe
30	Heat shield
31	Exhaust manifold
32	Turbocharger oil return pipe
33	Thermostat
34	Fan bearing base
35	Engine lifting ring
36	Tensioner
37	Flywheel
38	Fan belt
39	Oil pan
40	Vibration damper
41	Front engine support
42	Water drain valve
43	Water drain screw plug
44	Oil cooler
45	Oil filter
46	Oil drain screw plug
47	Rear engine support
48	Starter

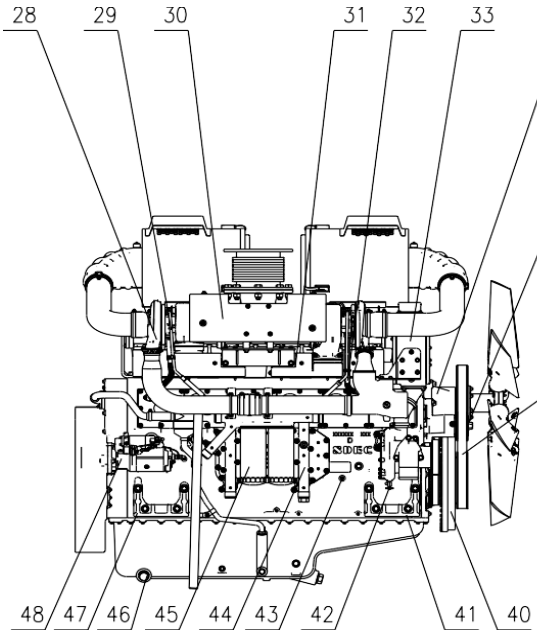
2.1.2 Outline Diagram of High-pressure Common-rail Diesel Engine



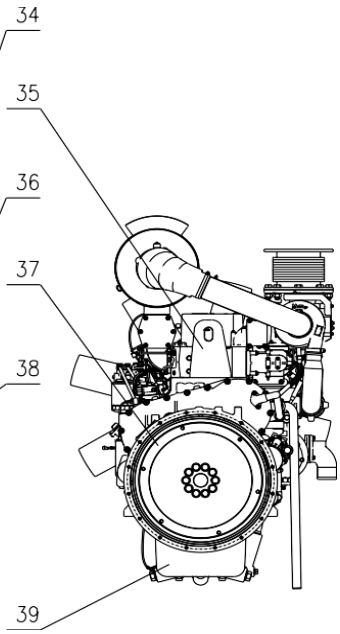
Intake Side View



Front End View



Exhaust Side View



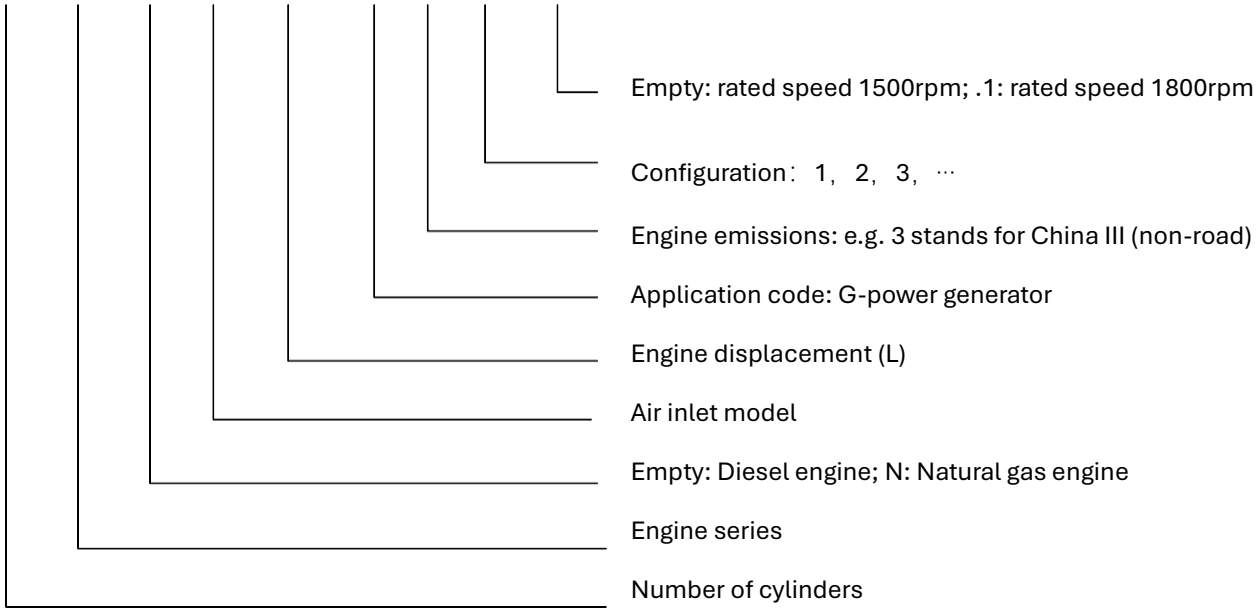
Rear End View

1	Engine harness
2	Air intake temperature and pressure sensor
3	High-pressure fuel pipeline
4	Intake manifold
5	Fuel return joint
6	Fuel temperature sensor
7	Fine fuel filter
8	Air filter
9	Engine lifting ring
10	Expansion joint
11	Fan
12	Rail pressure sensor
13	Fuel injection pump
14	Nameplate
15	Rear engine support
16	Water pump
17	Oil drain screw plug
18	Oil drain screw plug
19	Oil dipstick
20	Oil temperature sensor
21	First fuel filter
22	Fuel inlet joint
23	Oil pressure sensor
24	Oil filter
25	Crankshaft sensor
26	ECU
27	Turbocharger
28	Turbocharger oil inlet pipe
29	Heat shield
30	Exhaust manifold
31	Turbocharger oil return pipe
32	Thermostat
33	Fan bearing base
34	Engine lifting ring
35	Tensioner
36	Camshaft sensor
37	Flywheel
38	Fan belt
39	Oil pan
40	Vibration damper
41	Front engine support
42	Water drain valve
43	Water drain screw plug
44	Oil cooler
45	Oil filter
46	Oil drain screw plug
47	Rear engine support
48	Starter

2.2 Engine Model Identification

The engine model represents the meanings as follows:

□ □ □ □ □ - G □ □ .1

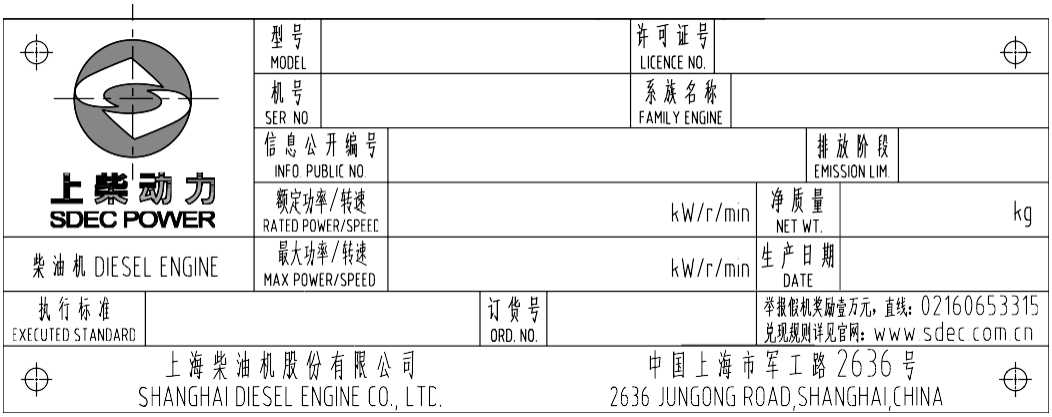


Note: Air inlet mode is divided into three types: T means Turbo, TA means Turbo with water-air intercooler and TAA means Turbo with air-air intercooler.
For example: 6KTAA25-G31 represents Shang Chai K series six-cylinder 25-liter air-air intercooler turbo NO.1 spec diesel engine for power station compliant with China III (rated speed: 1500rpm).
6KTAA25-G31.1 represents Shang Chai K series six-cylinder 25-liter air-air intercooler turbo NO.1 spec diesel engine for power station compliant with China III (rated speed: 1800rpm).

2.3 Diesel Engine Nameplate

The engine nameplate indicates the main technical data and information: engine model, order number, serial number, date of production, rated power and rated speed, which are the major basis for you to purchase service parts and for SDEC to conduct after-sale technical service. We hope you to put the information and data into the daily work record of your engine or equipment for later repair and reflection of quality problems. That is helpful to the correct settlement of your problems. The nameplate locates on the gear housing cover. Protect it from being damaged.

For generator sets application:



Caution: Do not change the nameplate without our permission!

2.4 Specifications and parameters

2.4.1 Specifications

Engine model		6KTAA25-G38	6KTAA25-G31
Type		In-line, six-cylinder, water-cooled, four-stroke, direct injection,	
Aspiration		Turbocharged and intercooled	
Bore (mm)		170	
Stroke (mm)		185	
Displacement (L)		25.18	
Compression ratio		16: 1	14.5: 1
Fuel system		Electronic unit pump fuel system	High-pressure common-rail fuel system
Starting temperature/℃		≥-10	
Starting time (s)		≤10	
Crankshaft rotation (facing flywheel)		Counterclockwise	
Firing order (Viewed from the free end)		1-5-3-6-2-4	
Min. fuel consumption (g/kWh)		195	192
Rated power	Power (kW)	622	728
	Speed (r/min)	1,500	1,500
Max. power	Power (kW)	684	800
	Speed (r/min)	1,500	1,500
Oil to fuel ratio (%)		≤0.2	
Starting mode		Electrical	
Net weight (kg)		2766(excluding accessories not on the engine)	2700(excluding accessories not on the engine)
Dimensions	Length (mm)	2,045	
	Width (mm)	1,252	
	Height (mm)	1,822	

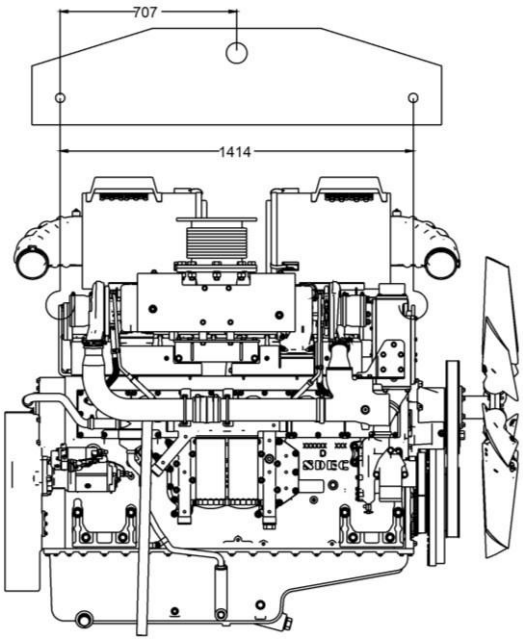
3. INSTALLATION AND CONNECTION OF DIESEL ENGINE

3.1 Installation Instructions

1. The installers must read carefully all the accompanying documents and information and become familiar with the engine structure and the installation requirements before installing the engine.
2. The installers must be qualified mechanic and electrical technicians with rich installation experience.
3. If the engine to be installed differs greatly from that described in the manufacturer's instructions, it must be installed under the guidance of the relevant professionals.

3.2 Unpacking and Lifting of Diesel Engine

Be sure to avoid damage to any engine part when unpacking. If unpacking finishes, check whether the seal of each exposed oil, water or gas pipe orifice is in good condition. No foreign object in each pipe is permitted. Check whether the documents and spare parts accompanying the engine are full and complete in accordance with the packing list. There are four engine installation supports on both sides of the cylinder block. There are lifting rings and plates on the engine, strong enough to bear the engine weight. Chain pulley or other facilities can be used when lifting the engine. However, attention should be paid to avoid thin parts or instrument parts of the engine being pressed by stressed chains, causing damage to them. Keep the lifting rings and plates from bearing bent moment and keep smooth handling when lifting to remain the engine in horizontal position. The engine should be placed on a special base or stable block to prevent the oil sump from directly bearing the engine weight. The recommended lifting sling structure is shown in the figure



3.3 Installation of Diesel Engine

3.3.1 Space Around Engine

When the engine is being installed, make sure the space around the engine is enough to operate and maintain the engine.

3.3.2 Avoid Stress

To avoid the stress due to deformation of the chassis affecting the engine and reduce the spread of vibration sources, vibration isolation pads should be installed between the engine and the chassis. Make sure the chassis is provided with sufficient rigidity and good flatness (≤0.2mm) and remove the clearance between the engine bracket and the chassis by grinding and other methods. Depending on type of the engine, the dimension from the engine mounting bracket to the engine crankshaft centerline changes.

3.3.3 Engine Power Output

Engine power output for driving the equipment is taken from flywheel. The engine shall be equipped with a single-bearing generator. The engine output power by connecting the flywheel with the generator steel disc, and the flywheel housing is connected with the generator end cover. After the generator is installed, the axial clearance of the crankshaft should be checked to ensure that there is no mechanical load on the crankshaft.

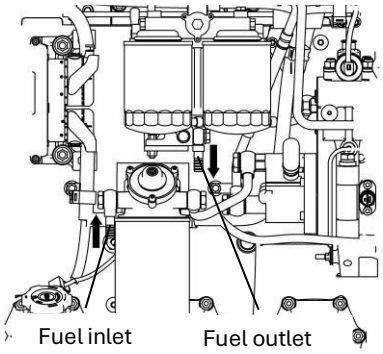
Caution: The engine should not be started with load. So, there should be a kind of clutch device between the engine and driven equipment.

It is forbidden to directly install a pulley on the flywheel to drive equipment transversely by belt because such operation can easily damage the crankshaft and main bearings. If it is required to have a transverse driving, use an engine or an additional device that is suitable for transverse driving. Do not let the crankshaft and main bearings sustain transverse forces directly.

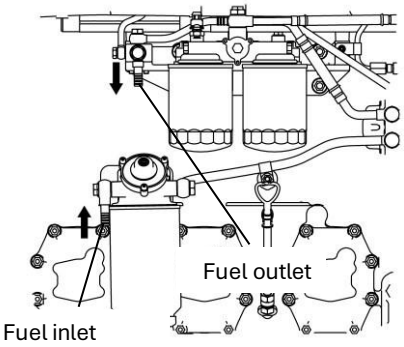
3.3.4 Fuel Line Extended

The fuel inlet from and the fuel return to the fuel tank are showed in the figure below. The fuel inlet banjo bolt is M18x1.5, the fuel outlet banjo bolt is M14x1.5. It is recommended to use fuel inlet pipe with an inner diameter of 14mm and fuel return pipe with an inner diameter of 14mm. The dimensions of the fuel inlet pipe joint and fuel return pipe joint is showed in the figure below.

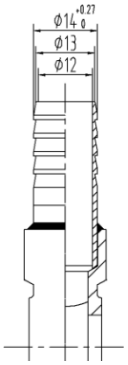
Electronic unit pump diesel engine



High-pressure common-rail diesel engine



Fuel inlet and fuel return pipe joint



The capacity of the fuel tank should be large enough to hold the fuel that can be used for more than 8 hours. The fuel tank should be such positioned that the lowest fuel level of fuel supply is 1 meter higher than the centre of the fuel transfer pump. The inlet port of the fuel suction pipe should be more than 50 mm above the bottom of fuel tank. It is better to add a strainer at the inlet port to avoid sucking in sediments that can block of the pipeline, and to have a drain valve at the bottom of the fuel tank for an easy cleaning. The fuel tank should be away from the heat source (such as exhaust manifold or exhaust pipes) and electrical equipment.

3.3.5 Installation of the Exhaust System

The external exhaust pipe should be made of steel pipe and connected with the engine turbocharger through flexible coupling, and its inner diameter should be greater than the expansion joint, and it should be equipped with a minimum number of bends. The external exhaust pipe should be fixed by bracket or hanging bracket without vibration, and its weight should not be imposed on the engine expansion joint. No expansion joint is permitted to be used to eliminate the inter-pipe misalignment.

Caution: After installation of the exhaust system finishes, the engine backpressure should be no more than 10kPa. Failure to do so can affect the engine performance!

The exhaust system must be able to prevent seawater, rainwater, and/or other objects from entering the engine. Since the exhaust pipe surface is hot when the engine running, the exhaust pipe should be installed to avoid approaching any combustible objects.

Caution: To prevent fire, staff burns and other accidents, take additional insulation measures on the surface of the external exhaust pipe!

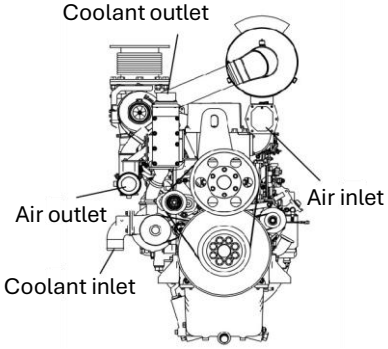
When several engines are fitted together, if they share one external exhaust pipe, this may cause the following problem: when several engines work non-simultaneously, the condensate water caused by the exhaust gas will enter into the inoperative engine(s), and this can easily do damage to the engine parts

Caution: Each diesel engine should be equipped with its own independent exhaust system!

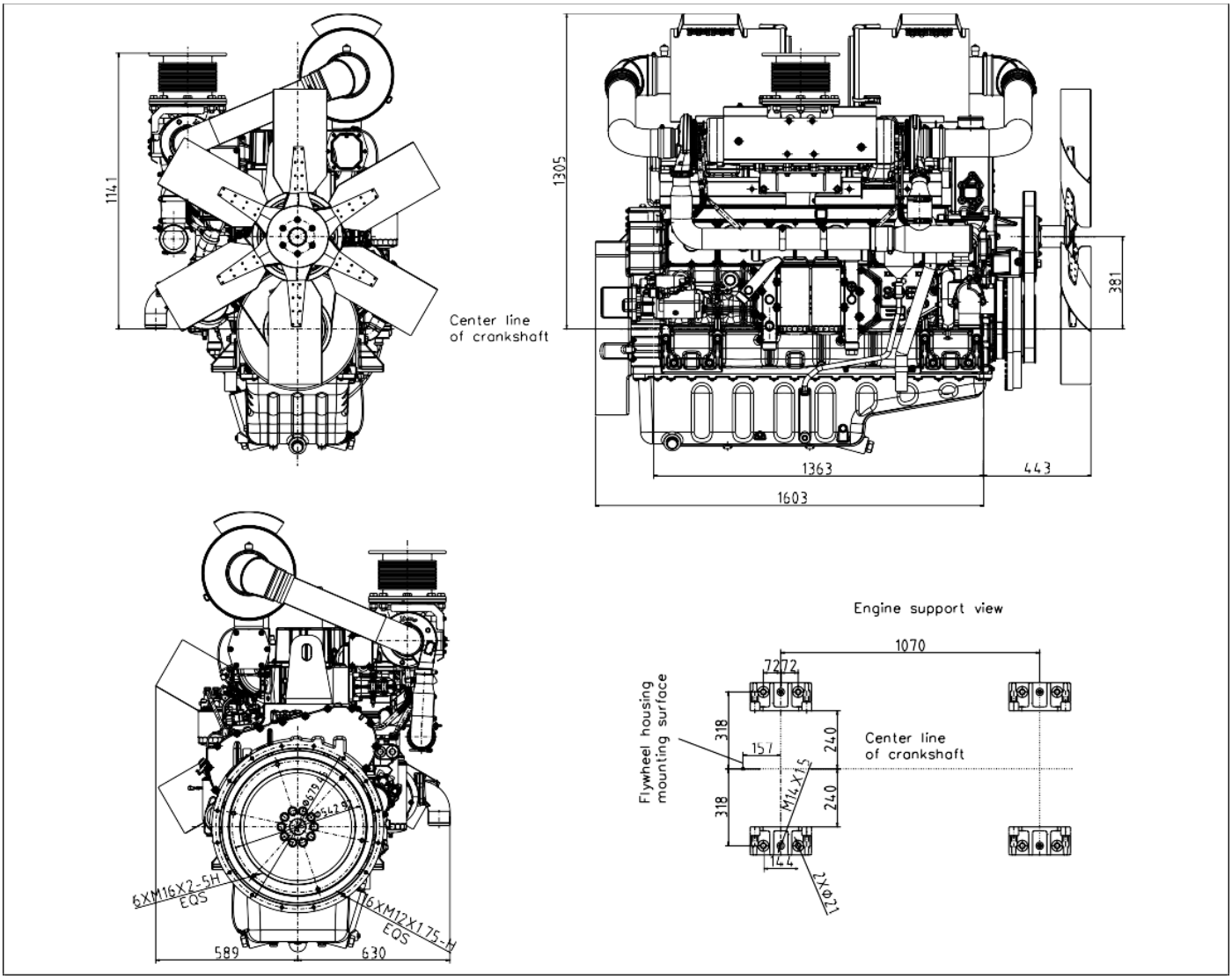
If the exhaust system needs to be equipped with an exhaust muffler additionally, the exhaust muffler should be selected and installed to minimize the increased backpressure of the exhaust system.

3.3.6 Cooling System and Air Intake System

For engines that are manufactured with radiator, the radiator's cooling area and protection shield have been reasonably designed, and users do not need to make other changes. If the engine is not manufactured with radiator, the radiator matching with the engine shall be selected carefully, otherwise the best working performance cannot be achieved. To avoid big air inlet resistance, a pipe with inner diameter of 110 mm and without sharp angles or over length is recommended for the pipes before and after the intercooler. Air intake pipes must be well sealed or else early engine wear will happen. The recommended inner diameter of water pump inlet is 98 mm and that of thermostat outlet pipe 85 mm.



3.4 Engine Installation Dimensions



4. Engine Operation Instructions

Proper use of your engine can not only keep it in normal working order and good performance, but also extent its service life and reduce its operational cost. Adopt proper fuel, oil and coolant, as well as the correct operation steps stipulated in this section.

4.1 Diesel Fuel

The specifications of the fuel used for the engine should be in accordance with the standards GB 19147.
Proper fuel designation should be chosen for the engine according to ambient temperature. In cold winter, fuel with low-freezing-point should be adopted, while in contrast in summer. You may choose the right fuel according to national standards GB 19147 or refer to the table below, e.g. fuel with the designation of -10# should be used for ambient temperature of -5℃.

Relationship between diesel fuel designations and applicable minimum temperatures：

Fuel designation	0#	-10#	-20#	-35#
Cetane value	≥49	≥49	≥46	≥45
Solid point/℃	≤0	≤-10	-20	-35
Minimum applicable temperature (engine working temperature)/℃	Above 4℃	Above -5℃	Above -14℃	Above -29℃

Caution: Fuel must be kept at the highest level of cleanness and not polluted by dust, impurities or water.

4.2 Engine Oil

To ensure normal operation and long service life of the engine as well as improve engine emissions, it is recommended to use SDEC's special lube oil of CF-4 15W-40, or the engine oil of equivalent viscosity grade which formal enterprises produce and are not lower than that of CF-level grade in the market.

Caution: Lubricating oil must be kept clean and free from dust, impurities or water.

Caution: Do not mix oils of different specifications.

4.3 Coolant

To ensure the normal operation and long service life of the engines, use SDEC- designated special organic coolant (anti-freezing type) under any kind of climate. The coolant proves antifreeze, anticorrosion, good thermal conductivity, performance stability, and environmental friendliness

Name	Part No.	Freezing point/℃	Boiling point/℃
SDEC-designated special organic coolant	F/LQY-45	-45	108

4.4 Power Matching

When choosing a diesel engine, users should not only consider the power required by equipment to be driven, but also engine operation type, such as intermittent use or continuous use. Meanwhile, operational economy is an important item to be considered, that is, the characteristics of equipment load and engine power output must be reasonably matched. Correct power rating and reasonable match between engine power output and equipment load are essential to guarantee a reliable, long-life and economic operation of an engine. Otherwise, it would lead to overloaded operation and unnecessary failure of an engine. Or load is too small, and the capacity of an engine cannot be fully used, which is not an economic way to use an engine and also easy to lead to oil carry-over.

4.5 Engine Start

Before using the engine, choose proper lubricating oil, fuel and coolant according to ambient conditions. Besides, the following work should be done before starting:

- Inspect the engine and its starting system thoroughly before operation, and promptly resolve any issues found.
- Check oil pressure and temperature gauges, coolant temperature gauge, warning lights and other instruments for normality.
- Check the service indicator of the air filter for appearance in red.

Caution: Do not start the engine without the air filter installed, as this can lead to premature engine wear.

- Check the oil level for being within the specified range.
- Check the coolant level for being within the specified range.
- Check the electrolyte level for being within the specified range.
- When the engine is first put into use or is out of service for some days, or its fuel filter has just been replaced, there can be air in the fuel system. Prime the fuel system with the priming pump. Refer to section 5.3 for specific priming operation.
- Check the electric starting wires for normality.
- Check that the starter motor wiring is correct and that the battery has sufficient charge
- All the safety devices must be installed in place.
- Before starting the diesel engine, drain the oil from the diesel engine.
- When the engine is new or is not in use for over 5 days, rotate the crankshaft 3 to 5 circles before starting.

4.5.1 Normal Starting Procedure

The K series electronic-controlled diesel engine for generating set can be started smoothly at temperature of -10℃ and above. Starting procedure is as follows:

- Disengage the diesel engine from the drive system.
- Put the mechanical operating devices into the "running" position.
- Start the electric oil pump to pre-supply oil and make the pressure of the oil in the main gallery reach 100 kPa.

Caution: Do not start the engine until the pressure of the oil in the main gallery reaches 100 kPa.

Caution: The electric oil pump should not work continuously over 20 seconds.

- Press the start button to start the diesel engine. Release the button immediately after you hear a continuous popping sound from the diesel engine.

Caution: The engine should be started without load.

Caution: Each starting should not last over 10 seconds and there should be a two- minute interval between each starting.

Caution: The oil pressure gauge should show reading within 15 seconds after the engine has started; otherwise, stop the engine immediately to prevent damage to the engine and find the causes and remove the fault according to Section 7 Troubleshooting Guidelines.

- Having started up from a hot state, the engine should run at idle for 3-5 minutes before being accelerated and loaded gradually.
- After starting a cold diesel engine, allow it to idle for 5-10 minutes to warm it up. During this time, check all instruments for proper functioning, inspect the seals of the diesel engine and external piping, listen to the engine and turbocharger, and observe the exhaust smoke color. If any abnormalities are found, stop the engine immediately and inspect it. Only after the warm-up is complete should you gradually increase the load.

Caution: Especially starting the engine from a cold stat, increasing the engine speed and load slowly as far as possible to have every bearing adequately lubricated and oil pressure stable.
Caution: Do not accelerate and load the engine immediately after it has started up.
Caution: Do not idle the engine for a long period of time or it can cause problems for the engine. When an engine idles, the temperature in combustion chamber is low and combustion is not complete. It can cause carbon deposit in cylinder, resulting in block of the orifices of fuel injector, as well as seizures of piston rings and valves, thus leading to engine performance deterioration.
Caution: If the engine is start with a jumper cable, parallel connection of the cable should be adopted by connecting the positive pole to the positive terminal and the negative pole to the negative terminal. If the engine is start by external power supply, the circuit breaker should be set to the position OFF. Take out the key to prevent accidental activation before the connection of a jumper cable.

4.5.2 Cold Start

Cold start refers to starting the engine at temperature below -10℃. Choose proper cold starting aid to warm the engine according to ambient temperature and then follow the normal starting procedures to start the engine. There are, in general, several ways to warm the engine:

- Warming the lubricating oil and coolant to 40-50℃.
- Installing a heating device in the air inlet pipe.
- Increasing the surrounding temperature of the engine room.
- Using diesel fuel, lubricating oil and coolant that are suitable for cold areas.
- Take heat preservation measures for the battery or use a battery with larger capacity or higher discharge rate (specially low temperature battery).

4.5.3 Starting After a Long-time Stop or Replacement of Lubricating Oil

Whenever you change the engine oil or start a diesel engine after it has been parked for more than 30 days, you must first fill the lubrication system with engine oil. Use the turning gear method to allow the engine oil to enter all friction pairs. Only start the diesel engine after you feel smooth and easy turning motion. Then, perform the following starting preparations, and then start the diesel engine according to the normal starting procedure or cold start procedure:

- Check the oil level for being within the dipstick marks range.
- Check the voltage of the battery for abnormality.
- Prime the fuel system. Refer to Section 5.3 for operation.

In order to have a quick starting of a standby engine for emergency need, start the engine every three to five days and operate it until its engine oil and coolant temperatures reach 60℃ and above.

4.6 Engine Operation

Cautions for operation of the engine:

- Pay frequent attention to oil pressure, coolant temperature and the fault indicator light. In case of any abnormality, stop the engine immediately for inspection.

Engine oil pressure:
200 kPa @ idle speed (minimum allowable)
400 kPa @ rated speed (minimum allowable)
600 kPa @ rated speed (maximum allowable)
Coolant temperature:
85 - 95℃ (normal working range)

- If the diesel engine temperature is too high (water temperature alarm sounds), reduce the engine speed or load, or both, until the engine temperature returns to the normal operating range; otherwise, refer to Chapter 7, "Troubleshooting Guide," for troubleshooting.

- During operation, especially during sudden load reduction, care should be taken to prevent the diesel engine speed from suddenly increasing beyond the specified value (commonly known as runaway). If this occurs, emergency shutdown measures should be taken immediately, and then the cause should be investigated.

Caution: Over-speed running will cause serious damage to the engine.

- Do not run the engine at the maximum power for over one hour. Run the engine at lower power for more than 30 minutes after running the engine at the maximum power for one hour. The sum of working time at the maximum power must not exceed 10% of overhaul period.
- It is recommended that idle speed be no higher than the stable idle speed and duration at idle speed no more than 1 hour.
- Continue running at load below 30% must not exceed 1 hour. Long time running at load below 30% will cause poor combustion. The engine must run at load higher than 30% for 5 minutes after running at low load for 1 hour to prevent carbon deposit.
- Unless emergency, it is not allowed to increase or reduce engine speed or load suddenly. A smooth increase in speed and load is required.

There are significant signs before most engine faults occur, such as changes in performance, sound, or engine appearance. Listening and observing will help detect in advance or predict some problems of the engine that will occur later, with which the proper measures can be taken in time to eliminate such problems as can lead to serious engine failure.

Typical engine fault signs:

Engine misfires
Engine vibrates abnormally
Engine sounds abnormal
Sudden changes in diesel engine coolant temperature and oil pressure
Engine produces black smoke
Engine power output is insufficient
Engine oil consumption is too much
Fuel consumption is too much
There is leakage of oil, fuel or/and coolant

4.7 Engine Shutdown

4.7.1 Normal Shutdown

After a diesel engine has been running at high speed and high load for an extended period, the load should be gradually reduced and the engine speed lowered before shutdown. The engine should then idle for 6 minutes to allow for even cooling and a significant drop in turbocharger speed before shutting down, thus protecting both the engine and the turbocharger. After shutdown, close the fuel tank.

If the diesel engine needs to be stored for a period of time, proper storage procedures must be followed. See Chapter 8, "Storage After Diesel Engine Shutdown," for details.

4.7.2 Emergency Shutdown

Under emergency or special condition, make an emergency stop to avoid serious engine failure.

4.8 Running-in of a New or Overhauled Engine

When the engine is new or has been overhauled, run the engine for 60 hours in running-in condition and change its oil thereafter before running it in full load so as 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 one, and speed should not exceed 80% of its rated speed. If the engine is for generator sets with constant speed, it is allowed to run-in at rated speed. However, long time running at idle or with too small load at the beginning of running in is not recommended.

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 be longer than 10 minutes to avoid early wear due to carbon deposit or engine performance being affected.

The above running-in process with less time should also be required every time the cylinder liner, piston, piston ring, connecting rod bearing, main bearings or/and crankshaft are replaced

5. Engine Maintenance

5.1 Maintenance plan

The following table gives maintenance period and tasks. Make regular maintenance based on this table. If the engine frequently operates at the ambient temperature below -18°C or above 38°C, or in dusty environment, the maintenance period should be shortened properly.

Maintenance tasks	Daily	Electronic unit pump diesel engine		High-pressure common-rail diesel engine	
		First maintenance 250 hours	Every 250 h or 3 months	First maintenance 250 hours	Every 250 h or 3 months
Checking engine periphery	●	●	●	●	●
Checking fuel tank	●	●	●	●	●
Checking air filter service indicator	●	●	●	●	●
Checking oil level in engine	●	●	●	●	●
Checking coolant level	●	●	●	●	●
Checking electrolyte level	●	●	●	●	●
Checking drive belt *	●	●	●	●	●
Checking liquid level of injection pump secondary fuel return reservoir	●	●	●	-	-
Checking cooling fan	●	●	●	●	●
Excluding water and sediment in first fuel filter	●	●	●	●	●
Checking engine wire harness			●		●
Checking fan belt tension			●		●
Checking intake system			●		●
Adding grease			●		●
Checking radiator fin			●		●
Checking and adjusting valve clearance		●	Every 500 h or 6 months	●	Every 500 h or 6 months
Changing engine oil and oil filter		Every 250 h or 3 months		Every 250 h or 3 months	
Changing fuel filter (first and second stages)		Every 500 h or 6 months		Every 500 h or 6 months	
Priming fuel system		Every 500 h or 6 months		Every 500 h or 6 months	
Checking fuel injection pump coupling		Every 500 h or 6 months		-	
Checking mechanical fuel injector		Every 500 h or 6 months		-	
Checking intercooler and its line		Every 500 h or 6 months		Every 500 h or 6 months	
Checking belt tensioner		Every 500 h or 6 months		Every 500 h or 6 months	
Checking fan bearing		Every 2,000 h or 2 years		Every 2,000 h or 2 years	
Checking turbocharger		Every 2,000 h or 2 years		Every 2,000 h or 2 years	
Checking vibration damper		Every 2,000 h or 2 years		Every 2,000 h or 2 years	
Changing coolant and cleaning cooling system		Every 2,000 h or 2 years		Every 2,000 h or 2 years	

- Replace the belt when cracks or other defects affecting its use appear on the belt surface.
- The initial valve clearance check and adjustment should be performed 250 hours after the first service; after the first service, check and adjust the valve clearance every 500 hours or every 6 months.
- When the fuel contains a lot of impurities, the replacement interval for the fuel filter (fine or coarse) should be appropriately shortened.
- During maintenance, after replacing the fuel filter (fine or coarse), bleed the fuel system by pumping oil; only the low-pressure fuel line needs to be bled.
- Replace the tensioner pulley when it becomes stuck or rotates slowly.
- When starting up for the first time or after a long period of inactivity, rotate the crankshaft several times.
- Maintenance intervals specified in this table are in hours or months, whichever comes first.

5.2 Maintenance Record

Make a regular maintenance record. You may make your own maintenance log by referring to the format of Maintenance Record below.

Maintenance Record

Engine serial number_____ Engine model & order No._____

User_____ Equipment description & serial No. _____

Date	Hour or Interval	Maintenance	Operator	Remark

5.3 Tasks and Methods of Engine Maintenance

5.3.1 Checking Engine Periphery

Check the periphery of the engine each time before starting:

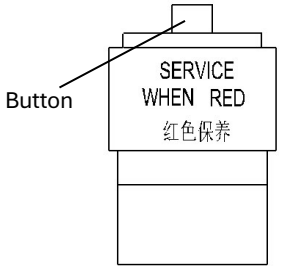
- Check if the engine is in a clean state and free from useless things on it.
- Check the joints and connections of the fuel system, cooling system and lubricating system for leakage.
- Check if the fan and its safety guard are fastened in place.
- Check the fastening condition of the accessories.
- Check whether the electrical wiring connections are loose and whether the wires are intact.
- Check if the transmission belt is intact.

5.3.2 Checking Fuel Tank

Check the fuel level in the fuel tank daily.

5.3.3 Checking Air Filter Service Indicator

Check the maintenance indicator on the air filter daily. If the inspection window displays red, it indicates that the air filter's intake resistance exceeds the specified value, and the filter element needs to be replaced. See 5.3.29 for filter element replacement requirements and procedures. After replacing the filter element, you must press the button on top of the maintenance indicator to reset it.

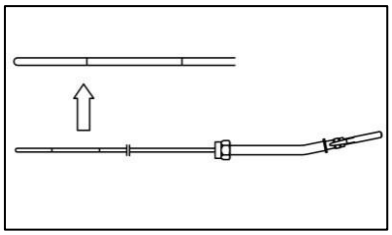


Caution: Be sure that both end faces of the air filter are reliably sealed without leakage after the air filter element has been changed.

Caution: Do not start the engine without an air filter, and failure to do so would easily cause early engine wear.

5.3.4 Check Oil Level

Check the engine oil level daily before starting the diesel engine or when it is stopped (at least 15 minutes after stopping to allow sufficient time for the oil to drain back into the oil pan). The oil level should be between the high mark (upper mark) and the low mark (lower mark) on the dipstick. If the oil level is low, add oil until it is close to the high mark.
Caution: Do not run the engine when the oil level is below the lower mark, otherwise it can result in poor engine performance, or even damage to the engine. But the oil level should not exceed the high-level mark



5.3.5 Checking Coolant Level

Check the coolant level daily before starting the engine or after the engine has been stopped.
Warning: At operating temperature, engine coolant is hot and under pressure, and the steam can cause personal injury. Do not remove the pressure cap on the radiator until the engine stops and the coolant temperature drops to below 50℃. Slowly loosen the cap to release the cooling system pressure before checking the coolant level or making supplement.
Warning: Avoid skin or eye contact with coolant to prevent personal injury because the coolant contains alkali.

- Slowly loosen the pressure cap on the radiator to release pressure before starting the engine or after the engine has stopped and the coolant temperature has gone below 50℃.
- Remove the pressure cap and check coolant level from the filler or inspection port. The coolant level should remain between the marks in the radiator or expansion tank or meet the requirement of the equipment manufacturer.
- Add if necessary. Coolant should be added near the upper mark or meet the requirement of the equipment manufacturer.

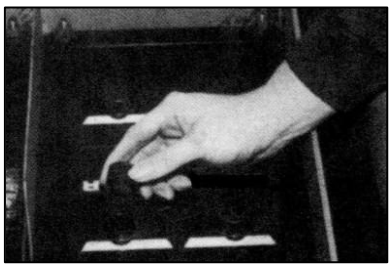
Caution: Coolant should be added slowly to avoid air block.

5.3.6 Checking Electrolyte Level

Some batteries are free from maintenance. Pay attention to its lifetime and change it when the lifetime is due. Refer to the instruction on the battery for the lifetime.
Some batteries need maintenance (adding special liquid or distilled water).

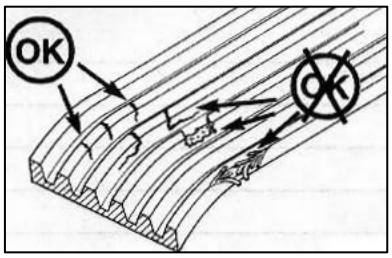
- Remove the electrolyte filler cap daily and check the electrolyte level. The electrolyte level should be at the bottom of the filler port. If the level is insufficient, add electrolyte as required.
- Install the cap.

Caution: Never use pure drinking water for the battery, as it contains various minerals and microelements that can damage the battery.



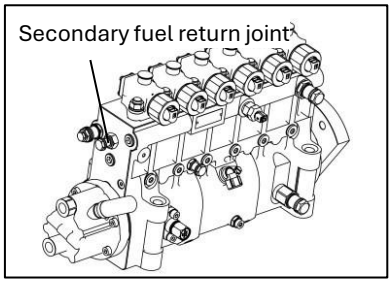
5.3.7 Checking Drive Belt

Perform visual check on the drive belt every day for any intersecting cracks. Transverse cracks along the width direction of the belt are acceptable, while longitudinal cracks (along the length direction) that intersect with transverse cracks are not allowed. If any wear or abrasion occurs, replace it.



5.3.8 Checking Liquid Level of Injection Pump Secondary Fuel Return Reservoir

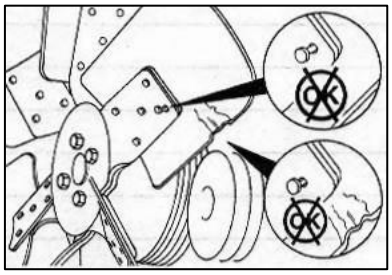
Check the liquid level inside the secondary fuel return reservoir of the injection pump every day. The secondary returned fuel of the injection pump needs to be treated on a regular basis, and the waste fuel inside the reservoir shall not exceed 2/3 of the total volume.



5.3.9 Check the cooling fan

Visually inspect the fan daily for cracks, loose rivets, loose blades, and bent blades. Ensure the fan is securely installed. Tighten bolts or replace any damaged fans if necessary.

Warning: Damaged fan blade can cause serious personal injury. Do not pull or pry the fan, and do not rotate the engine with the fan.



5.3.10 Excluding Water and Sediment in First Fuel Filter

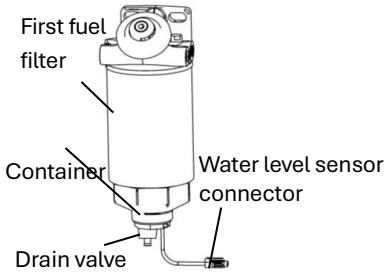
The coarse filter has an oil-water separation function. The pressure at the drain is high, so the machine must stop to drain the water. To drain, loosen the drain valve to expel water and sediment until clean fuel flows out, then close the valve tightly. Do not tighten it forcefully; it should feel tight to the touch.

- **First fuel filter with water level sensor**

When the water level in the fuel pre-filter water reservoir reaches a certain height, the water level sensor sends a signal to the water level indicator light installed in the cab, reminding the driver to drain the water in time.

- **First fuel filter without water level sensor**

You need to check the water cup below the fuel filter daily for water accumulation. If water is found, it needs to be drained.



5.3.11 Check Engine Wiring Harness

Inspect the condition of the electrical control system wiring, visually checking for any signs of breakage, looseness, wear, exposure, or burning in the wiring harnesses.

5.3.12 Checking Fan and Drive Belts Tension

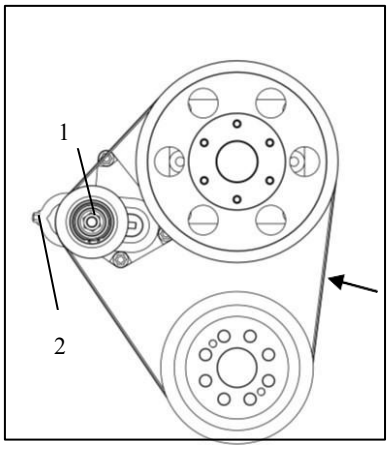
Check

Check the tension at the middle point (see the arrow) of the belt span between the two pulleys, if the tension is lower than 1500N, adjust it to the required tension level according to the adjustment method to meet the working requirements of the drive system.

Adjustment

Unscrew the tensioner nut 1 and turn the adjusting bolt 2 to adjust belt tension and ensure the tension at the arrow position is 2100N.

Tighten the tensioner nut 1 to 350±18 N·m.

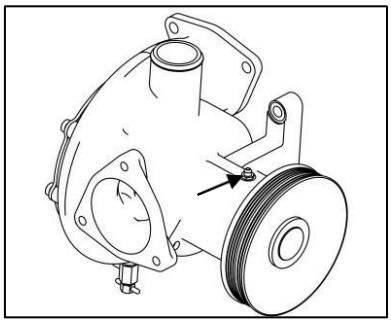


5.3.13 Checking Intake System

Check the intake hose for cracks or perforations, and ensure the clamps and bolts are secure. Replace the intake hose if it is malfunctioning. Tighten any loose clamps or bolts to ensure the intake system is leak-free.

5.3.14 Adding Grease

Add an appropriate amount of sodium-based lubricating grease using a grease gun through the straight-through grease cup at the bearing of the water pump. Do not add too much at once.

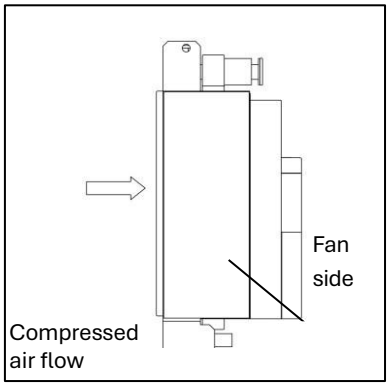


5.3.15 Checking Radiator Fin

- Inspect the radiator fin for dirt, grease, and other debris. Clean the exterior of the radiator, if necessary.

Warning: During the use of high-pressure air, wear a protective face shield and protective clothing. Maximum air pressure at the nozzle must be less than 205kPa for cleaning purpose.

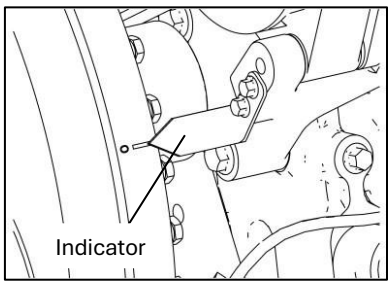
- If there are a few debris, use compressed air to blow directly onto the heat sink perpendicularly, so that the foreign matter is blown out of the core under high-speed air. When there is oil on the core, you can first spray a small amount of degreaser on the surface of the core. After the oil is fully decomposed, rinse with clean water. After rinsing, use compressed air to blow directly onto the heat sink perpendicularly for 1-2 minutes to dry the heat sink core.
- Inspect the fins for damage. Arrange for repairs or replacement as necessary.



5.3.16 Checking and Adjusting Valve Clearance

When doing the first maintenance for a new or overhauled engine, conduct valve-clearance checking to timely regulate and correct the initial changes of the valve clearances. Later valve clearance checking and regulating should be done based on the maintenance plan if the engine operates normally.
Valve clearance checking should be conducted after the engine has been stopped and the coolant temperature falls to below 60℃.

- Remove the nut on the valve cover.
- Rotate the engine anticlockwise (facing flywheel) with barring tool to make the piston of No. 1 or No. 6 cylinder position at the top dead center on compression stroke. When the indicator on the alternator bracket points at mark “0” in the vibration damper, the piston of No .1 or No. 6 cylinder is at the top dead center on compression stroke.



- Check if the rocker arms of No.1 cylinder are loose. If they are loose, the piston of No. 1 cylinder is at the top dead center on compression stroke; if not, the piston of No. 6 cylinder is at the top dead center on compression stroke.
- When the piston of No.1 cylinder is at the TDC on compression stroke, check with a feeler gauge the intake valve clearances of No. 1, 2 and 4 cylinders, as well as the exhaust valve clearances of No.1, 3 and 5 cylinders. When the piston of No.6 cylinder is at the TDC on compression stroke, check with a feeler gauge the intake valve clearances of No. 3, 5 and 6 cylinders as well as the exhaust valve clearances of No. 2, 4 and 6 cylinders.

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

- If a valve clearance fails to meet the requirement, loosen the adjusting screw locknut on the corresponding rocker arm, adjust the clearance to the specified value and tighten the locknut to 75 ± 5 N·m. Check the valve clearance again and it should not change.

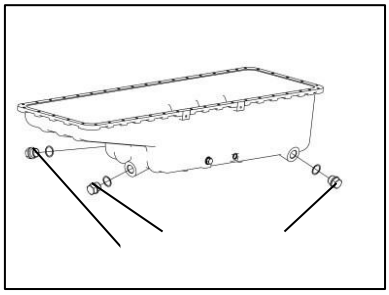
Valve clearance:
Intake-0.35±0.05 mm
Exhaust-0.60±0.05 mm

- Mark the shock absorber or crankshaft pulley, then rotate the crankshaft one full turn (360°) and adjust the remaining intake and exhaust valve clearances using the same steps.
- Install the valve cover. Check the valve cover seal and gasket and replace them if necessary. Tighten the cover bolts to 31 - 35 N·m.

5.3.17 Changing Lubricating Oil and Oil Filter

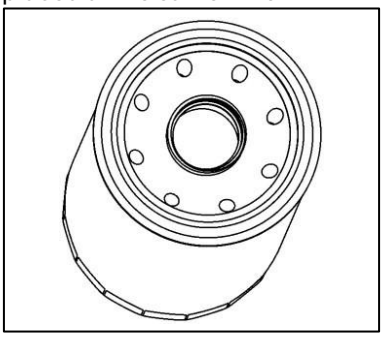
Warning: Be careful when changing lubricating oil and oil filter because skin contact with the hot oil or hot engine surface can cause scalding.

- Don't stop the engine until the temperature of the coolant reaches 60°C, then remove the oil drain plug, scrap the washer and drain the oil.



Caution: Do not drain lube oil when the engine is in cold state at which foreign particles has deposited and attached to the bottom of the oil pan and will not drain with the oil. When the lube oil is warm, foreign particles suspend in it and can easily drain with it.

- Clean the installation surface of the oil drain plug onto the oil pan. Install the oil drain plug with a new washer and tighten it to 200 ± 10 N·m.
- Clean the outside surface of the oil filter. Remove the oil filter with tool and scrap it. There are three oil filters on the engine, and all three filters should be replaced at the same time.



- Clean the filter head and its seal surface. There should be no old O-ring.
- Before installing a new oil filter, fill it with clean oil from the 8 peripheral holes. The oil level should be 3-15 mm below the threaded hole. Apply a light film of Vaseline or clean lubricating oil to the O-ring on the new filter to form a lubricating film.

Caution: Do not add oil from the central hole of the filter.

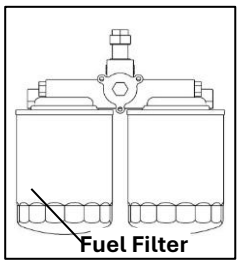
- Turn the filter by hand until the O-ring contacts the sealed surface of the filter head, and further tighten it to 50(+10，-5) N·m or 3/4 turn to one turn with tool.
- Open the filler cap and fill the diesel engine with clean engine oil until it is close to the mark on the dipstick (high oil level mark). The oil pan's capacity is 70 L.
- Start the engine and keep it running at idle and then check the oil filter and drain plug for oil leak.
- Shut off the engine, wait for about 15 minutes to provide enough time for the oil to flow back to the oil pan, and check the oil level. If required, add engine oil until it is near the upper mark in the oil dipstick.
- Install the filler cap and tighten it until you feel suitable.

5.3.18 Changing Fuel Filter (Second Stage)

- Be sure to shut the engine down.

Note: Do not replace the fuel filter cartridge when the diesel engine is running.

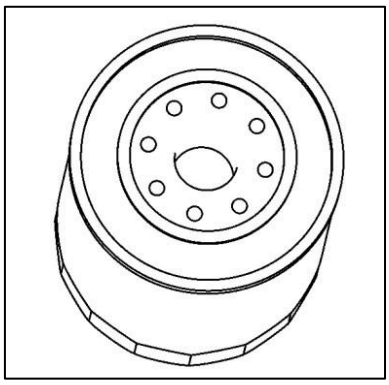
- Clean the outside surface of the oil filter on the left and remove the oil filter with tool and scrap it.
- Clean the filter head and its seal face off, and there should be no old O-ring left.



- Before installing a new fuel filter, fill it with clean fuel from the 8 peripheral holes. The fuel level should be 3-15 mm below the threaded hole. Apply a light film of Vaseline or clean engine oil to the O-ring on the new filter to form a lubricating film.

Caution: Do not add fuel from the central hole of the filter.

- Turn the filter with hand until the O-ring contacts the sealed surface of the filter head and further tighten it to 45 ± 5 N·m or 3/4 turn to one turn with tool.



5.3.19 Change Primary Fuel Filter

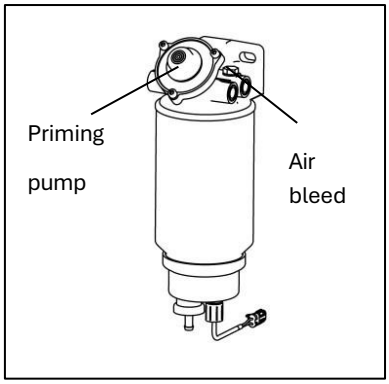
The first stage fuel filter is also spin-on type. Refer to “Changing fuel filter (second stage)” for replacement procedure. Remove the water container before replacing the filter.

5.3.20 Priming Fuel System

If the fuel filter (primary fuel flier and fine fuel filter) is changed, air will enter the fuel system. It is required to prime the low-pressure fuel pipeline as per following steps:

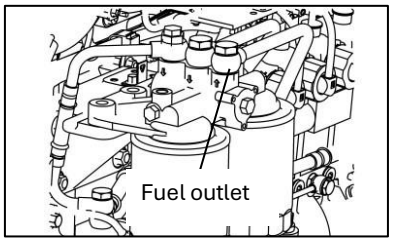
Prime the low-pressure fuel pipeline

- Loosen the air bleeding plug on the first stage fuel filter.
- Press the hand pump to pump fuel and vent the gas until there are no more air bubbles in the diesel fuel flowing out from the vent plug.
- Tighten the plug by 10 N·m.

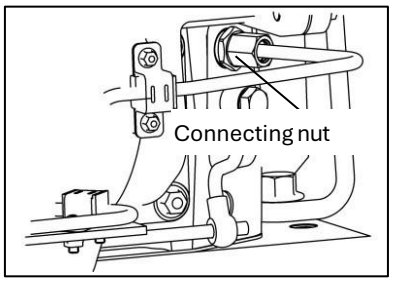


- Unscrew the fuel outlet banjo bolt on the base of the secondary fuel filter, scrap the washers.
- Prime the priming pump until there is no bubble visible in the fuel that outflows from the banjo bolt.
- Tighten the banjo bolt with new washers.

Note: If fuel is not added in time, causing air to enter the fuel system, or if air is present in the low-pressure fuel system due to other factors, the air must be purged.

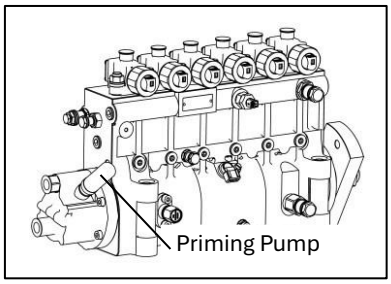


For electronically controlled unit pump diesel engines, air can enter the fuel system when the engine is first put into use or after it has been out of service for more than 7 days. Before starting the engine, after purging the air from the low-pressure fuel line, it is necessary to purge the air from the high-pressure fuel line of each cylinder.



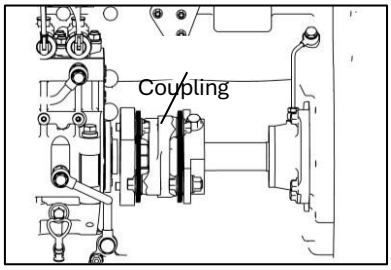
High-pressure oil circuit exhaust (electronically controlled unit pump diesel engine)

- Finish priming the low-pressure fuel pipeline.
- Unscrew the connecting nut that connects high pressure fuel pipe of the cylinder 6 (located at the flywheel end) and the oblique joint pipe of injector, prime the priming pump in fuel injection pump until there is no bubble visible in the fuel that outflows from the high-pressure fuel pipe.
- Tighten the connecting nut of high-pressure fuel pipe to 40 - 45 N·m.
- According to the step (2) and (3) above, prime the high-pressure fuel pipe of cylinder 5, 4, 3, 2 and 1 in turn.



5.3.21 Checking Fuel Injection Pump Coupling

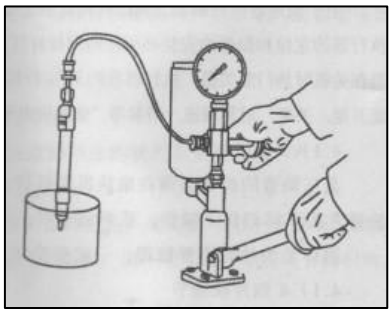
Check the coupling bolts for looseness and tighten them when required. Visually check the sheet steels of the coupling for cracks or other faults and replace the coupling if necessary.



5.3.22 Checking Mechanical Fuel Injector

Check the atomization of the mechanical fuel injector on the test bench. The correct spray pattern should be a thin, uniform cone. If any of the following conditions are found, it indicates a malfunction, requiring disassembly, inspection, troubleshooting, and replacement if necessary.

- The opening pressure of the mechanical fuel injector is designed to be 25 - 26MPa. When the opening pressure is significantly reduced, the atomization is deteriorated.
- The sprayed fuel mist is in a branched state.
- The fuel is not atomized, but sprayed out in a distinct, continuous coarse line.
- Fuel drips.

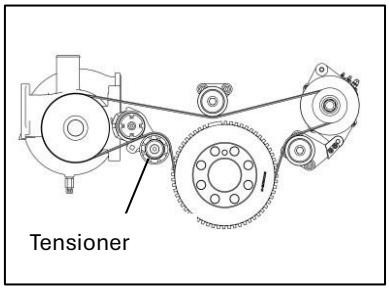


5.3.23 Checking Intercooler and its Lines

Visually inspect the intercooler's inlet and outlet chambers for cracks, perforations, or other damage. Inspect the inlet and outlet pipes for cracks, detached welds, or other damage. If any are found, replace them. Inspect the connecting hoses between the intercooler's inlet and outlet pipes and the inlet and outlet water pipes for breaks or perforations, and for loose clamps. If any are found, replace the hoses and tighten the clamps.

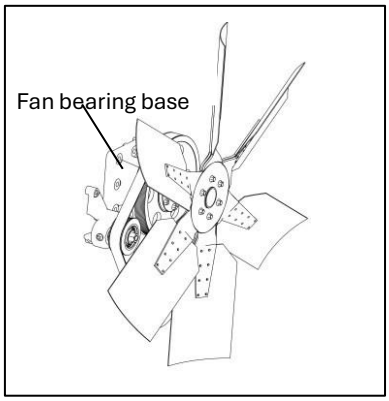
5.3.24 Check Belt Tensioner

- Rotate the belt tensioner clockwise and remove the drive belt. Turn the tensioner pulley to check it for seizure or radial/axial movement, by which to determine if there is scratch or wear on the bearing surface of the tensioner pulley. Swing the tensioner arm to check if the spring performs well.
- Install the drive belt and make a visual inspection after the installation to make sure that the belt centre line is in alignment with the centre lines of the pulleys



5.3.25 Checking Fan Bearing

Remove the drive belt. Turn the fan to check the fan bearing for normality. When rotating the fan, there should be no vibration or excessive axial movement. Replace the fan hub if necessary.



5.3.26 Checking Turbocharger

Perform visual check on the impeller blades of the turbine and compressor of the turbocharger for damage, crack, or contact with their housings when a light finger pressure applied on them. And check the turbocharger shaft for not being free spinning. In case any of the above problems occur, the turbocharger should be replaced.

5.3.27 Checking Vibration Damper

Check the shock absorbers for leaks of damping fluid (silicone oil) and for any surface sagging. Inspect the thickness of the shock absorbers to determine if they are deformed. If any of these problems occur, the shock absorbers need to be replaced.

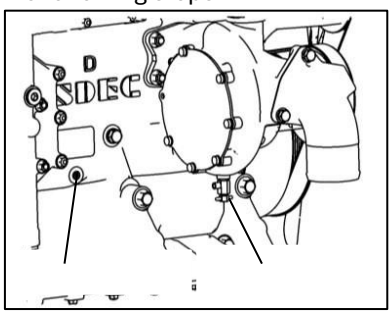
5.3.28 Changing Coolant and Cleaning Cooling System

To ensure the cooling and corrosion protection effects of the diesel engine coolant, the coolant must be changed, and the cooling system cleaned every 2000 hours or 2 years (whichever comes first).

Warning: At operating temperatures, the diesel engine coolant is hot and pressurized; the vapors can cause personal injury. Only after the diesel engine has stopped running and the coolant temperature has dropped below 50°C should the pressure cap on the radiator (filler cap) be slowly loosened to release the cooling system pressure.

Warning: The anti-rust additive in the coolant contains alkali. Avoid skin and eye contact with it to prevent personal injury.

- Stop the engine and wait until the temperature of the coolant falls to below 50℃. Slowly unscrew the pressure cap to release the cooling system pressure and remove it. Loosen the drain cock on the radiator to completely drain the coolant in the radiator.
- Loosen the water drain plug on the engine, as well as the water drain cock on the water pump, and completely drain the coolant in the cooling system.
- Clean the cooling system according to the following steps.



- Install and tighten all drain valves and drain plugs and add a sodium carbonate solution (or a commercially available mixture of sodium carbonate and water) to the cooling system through the radiator filler neck.

Caution: Each 23 L of water should be mixed with 0.5 kg sodium carbonate. Do not use caustic cleaner, or it will do harm to aluminum parts.

Caution: Purge the air in the coolant system while adding the cleaning fluid. Pour the cleaning fluid slowly to avoid air block. The cleaning fluid should be added up to the bottom of the filler in the radiator and wait for about 3-5 minutes for a full purge of air.

- Start the engine and keep it running for 5 minutes after the cleaning fluid temperature has gone up to above 80℃, then stop the engine and completely drain the cleaning fluid in the cooling system.

Caution: During the whole cleaning process the pressure cap should not be on and the engine runs without the cap on.

- Add clean water into the cooling system

Caution: Pour clean water slowly to avoid air block. Clean water should be added up to the bottom of the filler in the radiator and wait for about 3-5 minutes for a full purge of air.

- Start the engine and keep it running for 5 minutes after the water temperature has gone up to above 80℃, then stop the engine and completely drain the clean water in the cooling system.

Caution: If the discharged water is still dirty, clean the cooling system again according to the aforesaid steps until discharged water becomes clean.

- After the cleaning, tighten the water drain cocks on the radiator, and the drain cock on the water pump. Apply sealant Loctite 567 or Tonsan 1567 to the threads of the water drain plug onto the engine. Install the water drain plug on the engine and tighten it by 25 N·m.
- Add coolant. Fill the cooling system with proper coolant. The total engine coolant capacity is 50L.

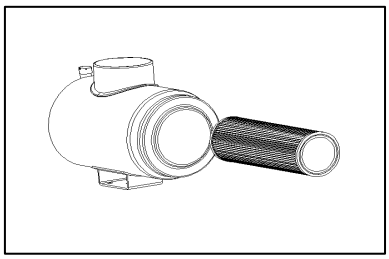
Caution: The actual amount of coolant should refer to the equipment data.

Caution: Add coolant slowly to avoid air block. Coolant should be added up to the bottom of the filler in the radiator or meet the requirement of the equipment manufacturer. Wait for about 2-3 minutes for a full purge of air.

- Install the pressure cap on the radiator, start and run the engine until coolant temperature reaches 80℃, then stop the engine and check the cooling system for leakage.
- Stop the engine and wait until the coolant temperature falls to below 50℃. Then open the pressure cap and recheck the coolant level. Supplement properly, if necessary.

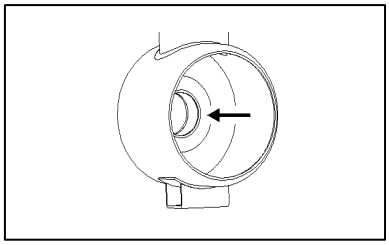
5.3.29 Replacing Air Filter Element

- Blow off dirt on the filter with compressed air.
- Remove the filter cover, remove and scrap the element.
- Cover the compressor inlet from inside the air filter body with clean stuff to prevent dirt from entering the intake system.
- Clean the inside of the filter body.



- Check the new filter element for any defects and remove the covering stuff from the compressor inlet. Install the new element and make sure a sound seal at both ends.
- Install the air filter cover and the service indicator.

Caution: Be sure that both end faces of the air filter are reliably sealed without leakage after the air filter element has been changed.



6. OPERATION ATTENTIONS FOR ELECTRICAL CONTROL SYSTEM

6.1 Notices of Operation of Electronic-Controlled Diesel Engine

- **Collision:** Collision to the engine sensors and harness connectors should be avoided during unpacking, transportation and installation of the engine, for those parts made of plastics or sealed with high pressure are vulnerable to damage.
- **Cleaning:** During diesel engine cleaning, users must not rinse the sensors and wiring harness connectors with water and absolutely must not spray them directly with a high-pressure water gun. Doing so can easily cause internal short circuits, burning out the sensors and ECU**.**
- **Bleeding of air in fuel lines:** Refer to 5.3.20.
- **Moisture-proof, waterproof, oil-proof, and heat-proof**: During the wiring harness installation process, users should place the connectors in a dry, waterproof, oil-proof, and heat-proof location. Prevent moisture and foreign objects from entering, which could create a source of ignition, leading to short circuits or burnout.
- **Welding operation:** When electric or gas welding on engine is required, disconnect the ECU from electric power or remove the ECU to prevent the ECU and sensors from being burned due to excessively high electric current.
- **Connection Check:** Users must check the connections of the ECU, sensors, and wiring harness terminals to prevent foreign objects from entering the terminals; prevent loose connections by checking that the terminals are securely connected; prevent short circuits by avoiding short circuits between wiring harness terminals and between wiring harness terminals and ground. Ensure equipment and personal safety.
- **Avoiding of faulty operation:** Never disconnect the battery during engine operation. Be sure to stop the engine and disconnect the battery before checking when the engine has problems.

6.2 ECU

- Before performing welding operations on the engine, the ECU connector harness must be disconnected.
- When connecting the ECU power cable and the battery, be sure to confirm the positive and negative terminals of the battery and make the correct connection to avoid burning out the electronic control unit.
- Always disconnect the ECU power supply before plugging or unplugging the ECU connector, otherwise the relevant components of the electronic control unit will be damaged.
- When performing ECU connector insertion and removal operations, ensure proper operation. Do not perform loose insertions, forced insertions or removals, or improper insertions or removals that could damage the ECU pins.

- The ECU requires a stable power supply. For the alternator in the engine, substandard products must not be used. A substandard alternator can generate abnormal voltage when the battery fails, which can cause fatal damage to the ECU.
- In process of assembling the engine, if it is required to carry out relevant energized tests for other electrical elements of the engine, the ECU connecting & plug-in components and wire harness must be pulled out. Otherwise, there will be risk of burning out the ECU.
- If the ECU is in a wet environment for a short period of time, ensure that the wiring harness connectors are securely connected to prevent water from flowing into the controller through the connector ends.

7. TROUBLESHOOTING GUIDELINES

7.1 General

When a diesel engine malfunctions, the operator should remain calm and careful, promptly analyze the characteristics of the malfunction, and determine its cause. Generally, the following principles should be followed:

- When there are abnormal phenomena in the operation of a diesel engine, you can use "seeing, listening, touching, and smelling" to comprehensively determine which part or system is malfunctioning.

"**See**" —to observe the readings of each instrument, and changes of the color of exhaust smoke, coolant temperature and oil pressure.

"**Listen**" — Use a thin metal rod or a wooden-handled screwdriver as a "stethoscope" to touch the corresponding parts of the diesel engine's exterior and listen to the sounds produced and their changes.

"**Touch**"— Check the working condition of parts such as the valve train and the vibration of the diesel engine by feeling with your fingers.

"**Smell**"— Using your sense of smell, detect any unusual odors emanating from the diesel engine.

- The engine should be stopped timely for inspection when the engine suddenly goes wrong, or the cause of a failure has been found, and the failure will affect the normal engine operation. If it is difficult to identify the cause of a failure, reduce engine speed and keep the engine running at low-speed without load for observation and inspection in order to avoid a serious failure.
- When a failure is judged as a serious one or the engine suddenly stops, it should be disassembled for inspection and repair.
- Failure causes, especially big ones as well as solutions to the failures, should be recorded in the log of the engine as a reference for next maintenance.

The common faults and correction methods listed in this chapter are only for reference. In practical work, it should be flexible to find out internal and external causes of malfunctions according to specific engine operation condition and practical experience, provide the right remedy to eliminate failures.

7.2 Troubleshooting Guidelines

Some typical and simple diesel engine fault modes, possible causes and troubleshooting steps are listed in the table below. If any one of these symptoms occurs in engine operation, it is required to eliminate it by taking appropriate measures. Otherwise, it can lead to severe engine failure. For simple engine faults, you can locate and eliminate them on your own. For complex faults, contact SDEC's after-sale service center (spare@sdecie.com) for technical guidance.

No.	Fault Mode	No.	Fault Mode
1	Engine will not start	8	Oil pressure too low
2	Engine power output low	9	Oil pressure too high
3	Abnormal noise and vibration	10	Oil consumption too much
4	Fuel consumption too much	11	Coolant temperature above normal
5	Black smoke	12	Coolant temperature below normal
6	White smoke	13	Unsteady idle speed
7	Blue smoke	14	Engine cannot reach rated speed with load

1) Engine will not Start

Step 1	.....	Insufficient fuel in the tank Fuel oil waxes in cold weather	.....	Add fuel Choose proper fuel specified in this manual based on the ambient condition
		OK Go to Step 2		
Step 2	.....	The ECU has no power supply	.....	Check the connection of wire harness and ECU
		OK Go to Step 3		
Step 3	.....	The starting speed is too low	.....	Check the battery voltage and inspect the starter motor and wiring connections for looseness or corrosion.
		OK Go to Step 4		
Step 4	.....	Error codes are displayed.	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go to Step 5		
Step 5	.....	Signal error occurs for camshaft sensor and crankshaft sensor	.....	Let a professional serviceman check camshaft sensor, crankshaft sensor, signal panel and wire harness, and replace if necessary
		OK Go to Step 6		
Step 6	.....	Air in the fuel system The connectors of low-pressure fuel pipeline are loose The fuel filter or fuel suction pipe is blocked	.....	Check for air in the system. Tighten or replace the fuel joints, fuel pipes and relevant parts if necessary and then prime the system Check the low-pressure fuel pipeline and tighten all the connectors Replace the fuel filter or fuel suction pipe
		OK Go to Step 7		
Step 7	.....	Signal error occurs with rail pressure sensor	.....	Let a professional serviceman check common rail and wire harness, and replace if necessary
		OK Go to Step 8		
Step 8	.....	Fuel injector fault: Very small or no injected fuel flow or no fuel atomization of mechanical fuel injector Seizure of needle valve The solenoid valve of electronic fuel injector has no power supply or is damaged	.....	Let a professional serviceman check the injector and wire harness, and replace if necessary
		OK, Go to Step 9		
Step 9	.....	Fuel injection pump fault: The solenoid valve of the injection pump is damaged Abnormal fuel supply from the fuel feed pump	.....	Let a professional serviceman check the fuel injection pump and wire harness, and replace if necessary
		OK Go To Step 10		
Step 10	.....	Insufficient cylinder compression pressure: Over wear of piston ring or cylinder liner Leakage at valves Gas leak from the joint plane of cylinder head and engine block	.....	Replace the piston ring and replace the cylinder liner according to the wear condition Check the valve clearance, valve spring, valve guide and the sealing condition of the valve seat. Make replacement, repair or grinding if necessary; Check the tappet guide bolt for looseness

				Tighten the cylinder head bolts to the defined torque. Replace the cylinder head gasket
		OK, Go to Step 11		
Step 11	.....	An internal mechanical fault in the diesel engine prevented the crankshaft from rotating.	.....	If the crankshaft still cannot turn after disconnecting the driven equipment, it should be manually rotated to check whether the crankshaft or connecting rod bearings are seized, the piston is stuck, or the camshaft timing gear is incorrectly installed.

2) Engine Power Output Low

		Cause		**Correction**
Step 1	.....	The engine load exceeds the defined value	.....	Reduce the load to the defined range
		OK Go to Step 2		
Step 2	.....	Fuel is not proper, or its quality is poor	.....	Use the fuel specified in this manual
		OK Go to Step 3		
Step 3	.....	Error codes are displayed.	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go to Step 4		
Step 4	.....	Signal error occurs for camshaft sensor or crankshaft sensor	.....	Let a professional serviceman check camshaft sensor, crankshaft sensor, signal panel and wire harness, and replace if necessary
		OK Go to Step 5		
Step 5	.....	Signal error occurs with rail pressure sensor	.....	Let a professional serviceman check common rail and wire harness, and replace if necessary
		OK Go to Step 6		
Step 6	.....	Signal error occurs with the coolant temperature sensor or the intake air pressure & temperature sensor	.....	Let a professional serviceman check the coolant temperature sensor, the intake air pressure & temperature sensor and wire harness, and replace if necessary
		OK Go to Step 7		
Step 7	.....	Air in the low-pressure fuel system The fuel filter or fuel suction pipe is blocked	.....	Check for air in the system. Tighten or replace the fuel joints, fuel pipes if necessary and then prime the low-pressure fuel system Replace the fuel filter or fuel suction pipe
		OK Go to Step 8		
Step 8	.....	Leakage in the intake system The resistance of intake system exceeds the specified value	.....	Check the connection of intake manifold, intake pipe, intercooler, its pipeline for looseness or leakage Check the intake system resistance and replace the air filter element if necessary
		OK, Go to Step 9		
Step 9	.....	Leakage of the exhaust manifold or turbocharger The resistance of exhaust system fails to meet the requirements	.....	Check the exhaust manifold and boost pressure to find and eliminate the source of leakage Check the exhaust system resistance
		OK, Go to Step 10		
Step 10	.....	Fault of the turbocharger	.....	Check the boost pressure

		OK, Go to Step 11		
Step 11	.....	Ambient temperature too high The temperatures of lube oil and cooling water are very high, and the exhaust temperature is also high	.....	Improve the ventilation condition and take a good temporary cooling measure if the ambient temperature is too high Check and repair the cooler and radiator and remove the scale. Inspect the diameter of relevant pipelines for too small across areas
		OK Go to Step 12		
Step 12	.....	Very small or no injected fuel flow or no fuel atomization of mechanical fuel injector Poor contract of the solenoid valve of electronic fuel injector Leakage at fuel injector hole of cylinder head or the damage of injector copper washer	.....	Let a professional serviceman inspect the mechanical fuel injector and adjust the injection pressure to the specified value on a test stand. Replace the injector if required Let a professional serviceman check the electronic fuel injector and wire harness, and replace if required Check and repair the damaged parts. Replace the relevant parts when required
		OK Go to Step 13		
Step 13	.....	Fuel injection pump fault: Abnormal fuel supply from the fuel feed pump Wear of plunger and barrel assembly	.....	Let a professional serviceman check the fuel injection pump and wire harness, and replace if necessary
		OK, Go to Step 14		
Step 14	.....	Insufficient cylinder compression pressure: Over wear of piston ring or cylinder liner Leakage at valves Gas leak from the joint plane of cylinder head and engine block	.....	Replace the piston ring and replace the cylinder liner according to the wear condition Check and adjust the valve clearance. Check valve spring, valve guide and the sealing condition of the valve seat, and make replacement, repair or grinding if necessary; Check the tappet guide bolt for looseness Tighten the cylinder head bolts to the defined torque. Replace the cylinder head gasket

3) Abnormal Noise and Vibration

		Cause		**Correction**
Step 1	.....	Pulley or vibrator bolts or nuts loose Fan or accessories are broken The vibration damper is broken	.....	Check and tighten loose bolts or nuts Check/replace the broken part Check/replace the damper
		OK Go to Step 2		
Step 2	.....	Noise from drive belt due to poor tension or heavy load	.....	Check the belt drive system and ensure all pulleys spinning free
		OK Go to Step 3		
Step 3	.....	Fuel is not proper, or its quality is poor	.....	Use the fuel specified in this manual
		OK Go to Step 4		

Step 4	.....	Air in the fuel system	.....	Check for air in the system. Tighten or replace the fuel joints, fuel pipes if necessary and then prime the system
		OK Go to Step 5		
Step 5	.....	Leakage of intake system and exhaust system	.....	Check the intake and exhaust systems for leakage. Tighten the loose components and replace the related parts if necessary
		OK Go to Step 6		
Step 6	.....	Noise from the turbocharger	.....	Check if the impeller and turbine are in contact with the casing.
		OK Go to Step 7		
Step 7	.....	Valve clearance too large Valve spring(s) damaged	.....	Check and adjust valve clearance Replace the valve spring(s)
		OK Go to Step 8		
Step 8	.....	Clearance between piston pin and small end bushing of connecting rod is too big	.....	Check the small end bushings of the connecting rods and replace the connecting rod(s) if necessary
		OK Go to Step 9		
Step 9	.....	Too big gear backlash due to tooth wear	.....	Adjust the tooth clearance, and replace the gear according to the wear condition

4) Fuel Consumption too Much

		Cause		**Correction**
Step 1	.....	Fuel is not correct, or its quality is poor	.....	Use the fuel specified in this manual
		OK Go to Step 2		
Step 2	.....	The fuel gauge is damaged	.....	Check the fuel gauge, and replace it if necessary
		OK Go to Step 3		
Step 3	.....	The resistance of intake or exhaust is too great	.....	Check the intake and exhaust systems, especially the air filter and exhaust muffler
		OK Go to Step 4		
Step 4	.....	Leakage of fuel	.....	Check the fuel system pipeline for leakage and tighten connectors if loosened
		OK Go to Step 5		
Step 5	.....	Poor sealing of intake or exhaust valves	.....	Check and adjust valve clearance
		OK Go to Step 6		
Step 6	.....	The drive system cannot match the engine	.....	Check the drive system and make sure that the components of the engine and drive system are correct

5) Black Smoke

		Cause		**Correction**
Step 1	.....	The engine load exceeds the defined value	.....	Reduce the load to the defined range
		OK Go to Step 2		
Step 2	.....	Fuel is not proper, or its quality is poor	.....	Use the fuel specified in this manual
		OK Go to Step 3		

Step 3	.....	Error codes are displayed.	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go to Step 4		
Step 4	.....	Signal error occurs for the intake air pressure & temperature sensor	.....	Let a professional serviceman check the intake air pressure & temperature sensor and wire harness, and replace if necessary
		OK Go to Step 5		
Step 5	.....	Signal error occurs with the coolant temperature sensor	.....	Let a professional serviceman check the coolant temperature sensor and wire harness, and replace if necessary
		OK Go to Step 6		
Step 6	.....	Intake system resistance exceeds the specified value	.....	Check the intake system for resistance and replace the air filter element if necessary
		OK Go to Step 7		
Step 7	.....	Poor fuel atomization of mechanical fuel injector Poor contract of the solenoid valve of electronic fuel injector.	.....	Let a professional serviceman check mechanical fuel injector for fuel atomization on a test stand. Replace the injector if necessary Let a professional serviceman check the electronic fuel injector and wire harness, and replace if required
		OK Go to Step 8		
Step 8	.....	Incorrect valve clearance or poor valve sealing can lead to valve leakage and deteriorated combustion.	.....	Adjust valve clearance, inspect sealing cone surface, and eliminate defects.

6) White Smoke

		Cause		**Correction**
Step 1	.....	The engine is in cold state	.....	Warm the diesel engine
		OK Go to Step 2		
Step 2	.....	Water in fuel	.....	Check the first stage fuel filter for fuel and water separate function. Replace it if required
		OK Go to Step 3		
Step 3	.....	Fuel is not correct, or its quality is poor	.....	Use the fuel specified in this manual
		OK Go to Step 4		
Step 4	.....	The fault is shown by the fault code	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go to Step 5		
Step 5	.....	Bad fuel atomization with fuel dripping and too low injection pressure of mechanical fuel injector Poor contract of the solenoid valve of electronic fuel injector	.....	(1) Let a professional serviceman inspect the mechanical fuel injector and adjust the injection pressure to the specified value on a test stand. Replace the injector if required 2) Let a professional serviceman check the electronic fuel injector and wire harness, and replace if required
		OK Go to Step 6		
Step 6	.....	Coolant entering cylinder due to crack of the cylinder head	.....	Check the exhaust pipe for water condensation and replace the cylinder head if necessary

7) Blue Smoke

		Cause		Correction
Step 1	.....	Poor air intake due to the block of the air filter	.....	Replace the air filter refer to Section 5.3
		OK Go to Step 2		
Step 2	.....	Too much lube oil in oil sump	.....	Adjust lube oil level near high level mark in the dipstick
		OK Go to Step 3		
Step 3	.....	Damage of the oil seal of the turbocharger leads to lube oil into the intake manifold	.....	Check the intake manifold for oil trace, check or replace the turbocharger when necessary
		OK Go to Step 4		
Step 4	.....	Damage of valve-seal(s) leads to lube oil leaks into the combustion chamber	.....	Replace valve-seal(s)
		OK Go to Step 5		
Step 5	.....	The clearance between the valve and valve-guide is too large, and the lube oil is sucked into the combustion chamber	.....	Repair cylinder head, replace guide pipes; replace valves
		OK Go to Step 6		
Step 6	.....	Piston rings may be stuck or excessively worn, resulting in insufficient elasticity; the piston rings may also be installed with the chamfered direction reversed, allowing engine oil to enter the combustion chamber.	.....	Remove and check the piston rings, make replacement if necessary
		OK Go to Step 7		
Step 7	.....	Large clearance between piston and cylinder liner due to long-term low load running (less than 40% of rated power) facilitates oil entering the combustion chambers	.....	Increase load to a proper degree, and choose a proper application power

8) Oil Pressure too Low

		Cause		Correction
Step 1	.....	Oil temperature is higher than the specified value	.....	Refer to the fault mode “Coolant temperature above normal”
		OK Go Step 2		
Step 2	.....	Error codes are displayed.	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go Step 3		
Step 3	.....	Oil level is too low	.....	Check oil level and adjust it to the specified range
		OK Go Step 4		
Step 4	.....	The oil pressure gauge is damaged The engine oil pressure sensor malfunctions	.....	Check the oil pressure gauge, and replace it if necessary Let a professional serviceman check oil pressure sensor and wire harness, and Replace it if necessary
		OK Go Step 5		
Step 5	.....	Oil is diluted The engine oil fails to meet the requirements, and the oil viscosity is too low	.....	Find the cause and change the oil and oil filter Check the oil specification and replace the oil and oil filter if necessary

		OK Go Step 6		
Step 6	.....	The oil pressure regulating valve on the Oil cooler does not work	.....	Check the oil cooler and replace it if necessary
		OK Go Step 7		
Step 7	.....	The oil filter is blocked	.....	Replace the oil and oil filter
		OK Go Step 8		
Step 8	.....	Leakage of the oil pipeline	.....	Check the oil pipeline and eliminate the leakage
		OK Go Step 9		
Step 9	.....	Damage or seizure of the oil pump due to incorrect assembly	.....	Reinstall the oil pump and replace it if required
		OK Go Step 10		
Step 10	.....	Severe oil leakage is observed at the crankshaft bearing, crankshaft front and rear oil seals, camshaft bearing, connecting rod bearing, and/or rocker arm shaft and rocker arm.	.....	Check each part, and replace those whose wear exceeds the defined value

9) Oil Pressure too High

		Cause		**Correction**
Step 1	.....	Error codes are displayed.	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go to Step 2		
Step 2	.....	The oil pressure gauge is damaged The engine oil pressure sensor malfunctions	.....	Check the oil pressure gauge, and replace it if necessary Let a professional serviceman check oil pressure sensor and wire harness, and Replace it if necessary
		OK Go to Step 3		
Step 3	.....	The operating temperature of the engine is too low, and the oil viscosity is high	.....	Warm the diesel engine
		OK Go to Step 4		
Step 4	.....	The lubricating oil fails to meet the requirements	.....	Use the lubricating oil specified in this manual and replace the oil filter

10) Oil Consumption too much

		Cause		**Correction**
Step 1	.....	External oil leakage of the engine	.....	Check the external pipeline, sealing gasket and crankshaft seals for leakage and replace the damaged components
		OK Go to Step 2		
Step 2	.....	The engine runs at idle speed for too long time	.....	Shorten the time of the engine running at idle
		OK Go to Step 3		
Step 3	.....	Oil is not correct	.....	Check the oil for its specification. Use correct oil and change the oil and oil filter
		OK Go to Step 4		
Step 4	.....	The crankcase pressure is too high, forcing engine oil out of the oil-gas separator.	.....	Check the crankcase ventilation device for oil trace on its periphery
		OK Go to Step 5		
Step 5	.....	The oil in the turbocharger leaks into the intake system or exhaust system	.....	Check for traces of oil around the oil-gas separator; if necessary, contact the Shanghai "Easy Human" call center.

		OK Go to Step 6		
Step 6	.....	The seizure or serious wear of the piston ring(s) or/and over wear of cylinder liner leads to oil into combustion chamber and the combustion gas into the crankshaft case	.....	Replace the piston rings, and replace the cylinder liner(s) if necessary
		OK Go to Step 7		
Step 6	.....	Damage of valve-seal(s) The clearance between the valve and valve-guide is too large	.....	Replace the damaged valve stem seals. Repair the cylinder head, replace the guide pipes; replace the valves.

11) Coolant Temperature Above Normal

		Cause		**Correction**
Step 1	.....	The engine load exceeds the defined value	.....	Reduce the load to the defined range
		OK Go to Step 2		
Step 2	.....	Coolant level is too low	.....	Check the coolant level and engine external for leakage, eliminating the leakage and adding the coolant to be within the specified range
		OK Go to Step 3		
Step 3	.....	The radiator core is broken or blocked	.....	Check the radiator core and repair or replace it if necessary
		OK Go to Step 4		
Step 4	.....	Coolant hose collapsed and leaked	.....	Check the pipe and replace it if necessary
		OK Go to Step 5		
Step 5	.....	The speed of the water pump or fan cannot reach the defined value	.....	Check the water pump belt and tensioner, and replace it if necessary; Adjust the fan belt tension to the define value, and replace it if necessary
		OK Go to Step 6		
Step 6	.....	Fault of the water pump	.....	Check the water pump and replace it if necessary
		OK Go to Step 7		
Step 7	.....	Fault of the thermostat	.....	Check the thermostat and replace it if necessary
		OK Go to Step 8		
Step 8	.....	Oil level is too high or too low	.....	Check oil level and adjust it to be within the specified range
		OK Go to Step 9		
Step 9	.....	Radiator pressure cap malfunction, low pressure calibration	.....	Check the function of the pressure cap
		OK Go to Step 10		
Step 10	.....	Fault of the thermometer The water temperature sensor malfunctions	.....	Check the thermometer and replace it if necessary Check the water temperature sensor and wire harness, and replace if necessary

12) Coolant Temperature Below Normal

		Cause		Correction
Step 1	.....	The radiator shutter is blocked at the maximum opening	.....	Check the radiator shutter and replace it if necessary
		OK Go to Step 2		
Step 2	.....	Too much cold air flows though the radiator	.....	Check the fan for operation
		OK Go to Step 3		
Step 3	.....	Low ambient temperature, low load	.....	Increasing load to a proper degree
		OK Go to Step 4		
Step 4	.....	Fault of the thermometer The water temperature sensor malfunctions	.....	Check the thermometer and replace it if necessary Check the water temperature sensor and wire harness, and replace if necessary
		OK Go to Step 5		
Step 5	.....	The thermostat didn't work well or was damaged	.....	Replace the thermostat

13) Unsteady Idle Speed

		Cause		Correction
Step 1	.....	Error codes are displayed.	.....	Refer to the fault code table in chapter 7.3 for the causes
		OK Go to Step 2		
Step 2	.....	Engine temperature is too low	.....	Warm up the engine
		OK Go to Step 3		
Step 3	.....	Signal error occurs for camshaft sensor or crankshaft sensor	.....	Let a professional serviceman check camshaft sensor, crankshaft sensor, signal penal and wire harness, and replace if necessary
		OK Go to Step 4		
Step 4	.....	Air in the low-pressure fuel pipeline The fuel filter or fuel suction pipe is blocked	.....	Check the low-pressure fuel pipes, eliminating the leakage. Tighten or replace the fuel joints, low-pressure fuel pipes if necessary and then prime the low-pressure fuel system Replace the fuel filter or fuel suction pipe
		OK Go to Step 5		
Step 5	.....	Poor atomization or low injection pressure of mechanical injectors. Poor contact of solenoid valve in electronic injectors. Air leakage in cylinder head injector holes or damage to copper gaskets.	.....	Let a professional serviceman inspect the mechanical fuel injector for injection spray and injection pressure and make adjustment on a test stand. Replace the injector if necessary Let a professional serviceman check the electronic fuel injector and wire harness, and replace if required Check and repair the damaged parts. Replace the relevant parts when required
		OK Go to Step 6		
Step 6	.....	The vibration damper is broken	.....	Check/replace the damper
		OK Go to Step 7		

Step 7	.....	Leakage in the intake system The resistance of intake system exceeds the specified value	.....	(Check the intake manifold, intercooler, and their piping connections for looseness or leaks. Check the intake system resistance; replace the air filter element if necessary.
		OK Go to Step 8		
Step 8	.....	Engine support problem	.....	Check the engine support and cushion
		OK Go to Step 9		
Step 9	.....	Wrong valve clearance or leakage at valves	.....	Check and adjust the valve clearance; Check valve spring, valve guide and the sealing condition of the valve seat, and make replacement, repair or grinding if necessary; Check the tappet guide bolt for looseness
		OK Go to Step 10		
Step 10	.....	The ECU is damaged	.....	Let a professional serviceman check the wire harness and ECU, and replace if necessary

14) Engine cannot Reach Rated Speed with Load

		Cause		**Correction**
Step 1	.....	The engine load exceeds the defined value	.....	Reduce the load to the defined range
		OK Go to Step 2		
Step 2	.....	The fault of tachometer	.....	Check the tachometer and wire harness, and replace it if necessary
		OK Go to Step 3		
Step 3	.....	The resistance of fuel inlet is great	.....	Check the fuel filter and fuel suction pipe and replace the fuel filter if necessary
		OK Go to Step 4		
Step 4	.....	Leakage in the intake system The resistance of intake system exceeds the specified value	.....	Check the connection of intake manifold, intake pipe, intercooler, its pipeline for looseness or leakage Check the intake system resistance and replace the air filter element if necessary
		OK Go to Step 5		
Step 5	.....	Fault of the turbocharger	.....	Let a professional serviceman check the turbocharger

7.3 Engine Fault Codes

7.3.1 Electronic Unit Pump Diesel Engine Fault Codes

No.	Fault Description	DTC	SPN	FMI
1	Crankshaft Sensor Signal Loss	0x000C00BE	190	
2	Crankshaft Sensor signal error	0x000B00BE	190	
3	Camshaft Sensor Signal Loss	0x000C027C	636	12
4	Camshaft Sensor signal error	0x000B027C	636	
5	Camshaft Cylinder Identification Sensor Signal Deviation Too High	0x000700BE	190	
6	Barometric Pressure Sensor Voltage Signal High	0x0003006C	108	3
7	Barometric Pressure Sensor Voltage Signal Low	0x0004006C	108	
8	Barometric Pressure Sensor Voltage Signal Error	0x000C006D	109	12
9	Ambient Pressure Sensor Temperature Over Maximum Limit	0x0003006D	109	3
10	Ambient Pressure Sensor Temperature Under Minimum Limit	0x0004006D	109	4
11	Boost Pressure Sensor Voltage Signal High	0x00030066	102	3

12	Boost Pressure Sensor Voltage Signal Low	0x00040066	102	4
13	Boost Pressure Sensor Voltage Signal Rationality Fault	0x00020066	102	2
14	Boost Pressure Sensor Physical Value High	0x000F0066	102	15
15	Boost Pressure Sensor Physical Value Low	0x00110066	102	17
16	Boost Pressure Deviation Too High	0x000F04A8	1192	15
17	Boost Pressure Deviation Too Low	0x001104A8	1192	17
18	Boost Temperature Sensor Voltage Signal High	0x00030069	105	
19	Boost Temperature Sensor Voltage Signal Low	0x00040069	105	
20	Intake Air Temperature Sensor Physical Value High	0x000F0069	105	
21	Intake Air Temperature Sensor Physical Value Low	0x00110069	105	
22	Intake Air Temperature Sensor Signal Static Value Rationality Fault	0x000C0069	105	
23	Water Coolant Temperature Sensor Voltage Signal High	0x0003006E	110	
24	Water Coolant Temperature Sensor Voltage Signal Low	0x0004006E	110	
25	Water Coolant Temperature Sensor Voltage Signal Rationality Fault	0x0002006E	110	
26	Water Coolant Temperature Sensor Physical Value High	0x000F006E	110	
27	Water Coolant Temperature Sensor Physical Value Low	0x0011006E	110	
28	Water Coolant Temperature Too High	0x000F006E	110	15
29	Water Coolant Temperature Sensor Dynamic Test	0x00E2F006	520198	
30	Water Coolant Temperature Sensor Absolute Value Test	0x00E2F006	520198	
31	Fuel Temperature Sensor Voltage Signal High	0x000300AE	174	3
32	Fuel Temperature Sensor Voltage Signal Low	0x000400AE	174	
33	Fuel Temperature Sensor Physical Value High	0x000F00AE	174	
34	Fuel Temperature Sensor Physical Value Low	0x001100AE	174	17
35	Accelerator 1 Signal Voltage Signal High	0x0003005B	91	
36	Accelerator 1 Signal Voltage Signal Low	0x0004005B	91	4
37	Accelerator 1 Signal Voltage Signal Rationality Fault	0x0002005B	91	2
38	Accelerator 2 Signal Voltage Signal High	0x0003001D	29	3
39	Accelerator 2 Signal Voltage Signal Low	0x0004001D	29	
40	Engine Overspeed	0x000F0215	533	
41	Engine Oil Pressure Sensor Voltage Signal High	0x00030064	100	
42	Engine Oil Pressure Sensor Voltage Signal Low	0x00040064	100	
43	Engine Oil Pressure Rationality Low	0x00110064	100	
44	Engine Oil Pressure Rationality High	0x00020064	100	
45	Engine Oil Temperature Sensor Voltage Signal High	0x000300AF	175	
46	Engine Oil Temperature Sensor Voltage Signal Low	0x000400AF	175	
47	Engine Oil Temperature Rationality Fault	0x000200AF	175	
48	Engine Oil Temperature Rationality Over Maximum Limit	0x000F00AF	175	
49	Cylinder 1 Injection Driver Short Circuit	0x0003028B	651	3
50	Cylinder 1 Injection Driver Open Circuit	0x0005028B	651	5
51	Cylinder 1 Injection Driver Rationality Fault	0x0002028B	651	2
52	Cylinder 2 Injection Driver Short Circuit	0x0003028C	652	3
53	Cylinder 2 Injection Driver Open Circuit	0x0005028C	652	5
54	Cylinder 2 Injection Driver Rationality Fault	0x0002028C	652	2
55	Cylinder 3 Injection Driver Short Circuit	0x0003028D	653	3
56	Cylinder 3 Injection Driver Open Circuit	0x0005028D	653	5
57	Cylinder 3 Injection Driver Rationality Fault	0x0002028D	653	2
58	Cylinder 4 Injection Driver Short Circuit	0x0003028E	654	3
59	Cylinder 4 Injection Driver Open Circuit	0x0005028E	654	
60	Cylinder 4 Injection Driver Rationality Fault	0x0002028E	654	2
61	Cylinder 5 Injection Driver Short Circuit	0x0003028F	655	
62	Cylinder 5 Injection Driver Open Circuit	0x0005028F	655	
63	Cylinder 5 Injection Driver Rationality Fault	0x0002028F	655	2
64	Cylinder 6 Injection Driver Short Circuit	0x00030290	656	
65	Cylinder 6 Injection Driver Open Circuit	0x00050290	656	
66	Cylinder 6 Injection Driver Rationality Fault	0x00020290	656	2
67	Cylinder 1 Starting Point Rationality Fault	0x000C028B	651	
68	Cylinder 2 Starting Point Rationality Fault	0x000C028C	652	

69	Cylinder 3 Starting Point Rationality Fault	0x000C028D	653	
70	Cylinder 4 Starting Point Rationality Fault	0x000C028E	654	
71	Cylinder 5 Starting Point Rationality Fault	0x000C028F	655	12
72	Cylinder 6 Starting Point Rationality Fault	0x000C0290	656	
73	Cylinder 1 Misfire	0x0003052B	1323	
74	Cylinder 2 Misfire	0x0003052C	1324	3
75	Cylinder 3 Misfire	0x0003052D	1325	
76	Cylinder 4 Misfire	0x0003052E	1326	
77	Cylinder 5 Misfire	0x0003052F	1327	
78	Cylinder 6 Misfire	0x00030530	1328	3
79	Fuel Injection Frequency Limited by Power System Capacity	0x00F0F021	520225	16
80	Fuel Injection Frequency Limited by High Pressure Pump Capacity	0x00EFF021	520225	
81	Fuel Injection Frequency Limited by System Capacity	0x00EBF021	520225	
82	Limit for Engine Fuel Level	0x00EEF022	520226	
83	OBD Fault Fuel Level Limit 1	0x00EEF023	520227	
84	OBD Fault Fuel Level Limit 2	0x00EEF024	520228	
85	OBD Fault Fuel Level Limit 3	0x00EEF025	520229	
86	OBD Fault Fuel Level Limit 4	0x00EEF026	520230	
87	Main Relay Open Circuit	0x00E5F01C	520220	
88	Main Relay Short to Power	0x00E3F01C	520220	
89	Main Relay Short to Ground	0x00E4F01C	520220	
90	OBD Trouble Lamp Short to Power	0x00E3F002	520194	3
91	OBD Trouble Lamp Short to Ground	0x00E4F002	520194	4
92	OBD Trouble Lamp Circuit Break	0x00E5F002	520194	5
93	SVS Lamp Short to Power	0x00030270	624	3
94	SVS Lamp Short to Ground	0x00040270	624	4
95	SVS Lamp Circuit Break	0x00050270	624	5
96	Engine Temperature Too High	0x00F0F008	520200	16
97	MCU Temperature Sensor Voltage Signal High	0x00E3F009	520201	3
98	MCU Temperature Sensor Voltage Signal Low	0x00E4F009	520201	4
99	MCU Temperature High	0x00EFF009	520201	15
100	MCU Temperature Low	0x00F1F009	520201	
101	Number of Unavailable EEPROM Sectors Over Limit	0x00020276	630	2
102	EEPROM Erase Error	0x000C0276	630	
103	EEPROM Programming Error	0x00040276	630	
104	AD Reference Voltage Too High	0x00E3F00A	520202	3
105	AD Reference Voltage Too Low	0x00E4F00A	520202	
106	CAN0_ERR	0x00E3F009	520203	
107	CAN0_ERR	0x00E4F009	520204	12
108	5VLDO#1 Power Module Fault	0x00ECF01D	520221	
109	5VLDO#2 Power Module Fault	0x00ECF01E	520222	
110	5VLDO#3 Power Module Fault	0x00ECF01F	520223	
111	Battery Voltage High	0x000300A8	168	
112	Battery Voltage Low	0x000400A8	168	4
113	Battery Voltage Over Maximum Limit	0x000100A8	168	
114	Battery Voltage Under Minimum Limit	0x000200A8	168	
115	DCDC Short Circuit	0x00E3F028	520232	3
116	DCDC Open Circuit	0x00E5F028	520232	
117	PIC Communication Fault	0x00ECF029	520233	

7.3.2 High-pressure Common-rail Diesel Engine Fault Codes

No.	Fault Description	DTC	SPN	FMI
1	Crankshaft Sensor Signal Loss	0x000C00BE	190	12
2	Crankshaft Sensor Signal Error	0x000B00BE	190	11
3	Camshaft Sensor Signal Loss	0x000C027C	636	12
4	Camshaft sensor Signal error	0x000B027C	636	11
5	Camshaft Cylinder Identification Sensor Signal Deviation Too High	0x000700BE	190	7

6	Barometric Pressure Sensor APS High	0x0003006C	108	3
7	Barometric Pressure Sensor APS Low	0x0004006C	108	4
8	Boost Pressure Sensor BPS High	0x00030066	102	3
9	Boost Pressure Sensor BPS Low	0x00040066	102	4
10	Boost Pressure Sensor BPS Rationality Fault	0x00020066	102	2
11	Boost Pressure Sensor Physical Value High	0x000F0066	102	15
12	Boost Pressure Sensor Physical Value Low	0x00110066	102	17
13	Boost Pressure Deviation Too High	0x000F04A8	1192	15
14	Boost Pressure Deviation Too Low	0x001104A8	1192	17
15	Boost Temperature Sensor IATS High	0x00030069	105	3
16	Boost Temperature Sensor IATS Low	0x00040069	105	4
17	Intake Air Temperature Sensor Physical Value High	0x000F0069	105	15
18	Intake Air Temperature Sensor Physical Value Low	0x00110069	105	17
19	Intake Air Temperature Sensor Signal Static Value Rationality Fault	0x000C0069	105	12
20	Water Coolant Temperature Sensor CTS High	0x0003006E	110	3
21	Water Coolant Temperature Sensor CTS Low	0x0004006E	110	4
22	Water Coolant Temperature Sensor CTS Rationality Fault	0x0002006E	110	2
23	Water Coolant Temperature Sensor Physical Value High	0x000F006E	110	15
24	Water Coolant Temperature Sensor Physical Value Low	0x0011006E	110	17
25	Water Coolant Temperature Too High	0x000F006E	110	15
26	Water Coolant Temperature Sensor Dynamic Test	0x00E2F006	520198	2
27	Water Coolant Temperature Sensor Absolute Value Test	0x00E2F006	520198	2
28	Fuel Temperature Sensor FTS High	0x000300AE	174	3
29	Fuel Temperature Sensor FTS Low	0x000400AE	174	4
30	Fuel Temperature Sensor Physical Value High	0x000F00AE	174	15
31	Fuel Temperature Sensor Physical Value Low	0x001100AE	174	17
32	Engine Overspeed	0x000F0215	533	15
33	Ambient Temperature Sensor ETS High	0x000300AB	171	3
34	Ambient Temperature Sensor ETS Low	0x000400AB	171	4
35	Engine Oil Pressure Sensor OPS High	0x00030064	100	3
36	Engine Oil Pressure Sensor OPS Low	0x00040064	100	4
37	Engine Oil Pressure Rationality Low	0x00110064	100	17
38	Engine Oil Pressure Rationality High	0x00020064	100	2
39	Engine Oil Temperature Sensor OTS High	0x000300AF	175	3
40	Engine Oil Temperature Sensor OTS Low	0x000400AF	175	4
41	Engine Oil Temperature Rationality Fault	0x000200AF	175	2
42	Engine Oil Temperature Rationality Over Maximum Limit	0x000F00AF	175	15
43	Rail Pressure Sensor SRC High	0x0003009D	157	3
44	Rail Pressure Sensor SRC Low	0x0004009D	157	4
45	Rail Pressure Sensor Rationality Fault	0x0002009D	157	2
46	Rail Pressure Sensor Deviation Test Too High	0x000F009D	157	15
47	Rail Pressure Sensor Deviation Test Too Low	0x0011009D	157	17
48	Starter Motor Driver Open Circuit	0x000502A5	677	5
49	Starter Motor Driver Short Circuit	0x000302A5	677	3
50	Water in Fuel Indicator Open Circuit	0x00E5F000	520192	5
51	Water in Fuel Indicator Short Circuit	0x00E3F000	520192	3
52	Remote Accelerator 1 Signal ACCPED High	0x00E3F033	520243	3
53	Remote Accelerator 1 Signal ACCPED Low	0x00E4F033	520243	4
54	Remote Accelerator Signal ACCPED Rationality Fault	0x00E2F033	520243	2
55	Remote Accelerator 2 Signal ACCPED High	0x00E3F034	520244	3
56	Remote Accelerator 2 Signal ACCPED Low	0x00E4F034	520244	4
57	Cylinder 1 Injection Driver Short Circuit	0x0003028B	651	3
58	Cylinder 1 Injection Driver Open Circuit	0x0005028B	651	5
59	Cylinder 1 Injection Driver Rationality Fault	0x0002028B	651	2
60	Cylinder 2 Injection Driver Short Circuit	0x0003028C	652	3
61	Cylinder 2 Injection Driver Open Circuit	0x0005028C	652	5
62	Cylinder 2 Injection Driver Rationality Fault	0x0002028C	652	2

63	Cylinder 3 Injection Driver Short Circuit	0x0003028D	653	3
64	Cylinder 3 Injection Driver Open Circuit	0x0005028D	653	5
65	Cylinder 3 Injection Driver Rationality Fault	0x0002028D	653	2
66	Cylinder 4 Injection Driver Short Circuit	0x0003028E	654	3
67	Cylinder 4 Injection Driver Open Circuit	0x0005028E	654	5
68	Cylinder 4 Injection Driver Rationality Fault	0x0002028E	654	2
69	Cylinder 5 Injection Driver Short Circuit	0x0003028F	655	3
70	Cylinder 5 Injection Driver Open Circuit	0x0005028F	655	5
71	Cylinder 5 Injection Driver Rationality Fault	0x0002028F	655	2
72	Cylinder 6 Injection Driver Short Circuit	0x00030290	656	3
73	Cylinder 6 Injection Driver Open Circuit	0x00050290	656	5
74	Cylinder 6 Injection Driver Rationality Fault	0x00020290	656	2
75	Cylinder 1 Starting Point Rationality Fault	0x000C028B	651	12
76	Cylinder 2 Starting Point Rationality Fault	0x000C028C	652	12
77	Cylinder 3 Starting Point Rationality Fault	0x000C028D	653	12
78	Cylinder 4 Starting Point Rationality Fault	0x000C028E	654	12
79	Cylinder 5 Starting Point Rationality Fault	0x000C028F	655	12
80	Cylinder 6 Starting Point Rationality Fault	0x000C0290	656	12
81	Cylinder 1 Misfire	0x0003052B	1323	3
82	Cylinder 2 Misfire	0x0003052C	1324	3
83	Cylinder 3 Misfire	0x0003052D	1325	3
84	Cylinder 4 Misfire	0x0003052E	1326	3
85	Cylinder 5 Misfire	0x0003052F	1327	3
86	Cylinder 6 Misfire	0x00030530	1328	3
87	Fuel Injection Frequency Limited by Power System Capacity	0x00F0F021	520225	16
88	Fuel Injection Frequency Limited by High Pressure Pump Capacity	0x00EFF021	520225	15
89	Fuel Injection Frequency Limited by System Capacity	0x00EBF021	520225	11
90	Limit for Engine Oil Level	0x00EEF022	520226	14
91	OBD Fault Oil Level Limit 1	0x00EEF023	520227	14
92	OBD Fault Oil Level Limit 2	0x00EEF024	520228	14
93	OBD Fault Oil Level Limit 3	0x00EEF025	520229	14
94	OBD Fault Oil Level Limit 4	0x00EEF026	520230	14
95	Main Relay Short Circuit	0x00030A4A	2634	3
96	Main Relay Open Circuit	0x00050A4A	2634	5
97	Main Relay Adhesion	0x000C0A4A	2634	12
98	Main relay Early open	0x000C0A4A	2634	12
99	OBD Trouble Lamp Short Circuit	0x00E3F002	520194	3
100	OBD Trouble Lamp Open Circuit	0x00E5F002	520194	5
101	SVS Lamp Short Circuit	0x00030270	624	3
102	SVS Lamp Open Circuit	0x00050270	624	5
103	Rail Pressure Control Positive Deviation Exceeds the Upper Limit	0x00F0FD5D	523613	16
104	Rail Pressure Control Negative Deviation Under Minimum Limit	0x00F1FD5D	523613	17
105	Oil Volume in High Pressure Oil Pump Too Low	0x00E7FD5D	523613	7
106	Rail Pressure Too Low	0x00E4FD5D	523613	4
107	Rail Pressure Too high	0x00E3FD5D	523613	3
108	Improper Opening of VCV Valve at Idle	0x00E2FD5D	523613	2
109	Overrun Pump Flow Fault	0x00ECFD5D	523613	12
110	Pump Flow Fault	0x00ECFD5D	523613	12
111	Fault in Monitoring of Rail Pressure Positive Deviation Based on Speed	0x00F4FD5D	523613	20
112	Fault of Excessive Pressure Drop Under Overrun State	0x00F4FD5D	523613	20
113	Rail Pressure Driver Open Circuit	0x00E5FD5F	523615	5
114	Rail Pressure Driver Short to Ground	0x00E4FD5F	523615	4
115	Rail Pressure Driver Overload	0x00E3FD5F	523615	3
116	Rail Pressure Driver Overheating	0x00ECFD5F	523615	12
117	VCV Valve Current Feedback Signal SRC High	0x00F0FD5F	523615	16
118	VCV Valve Current Feedback Signal SRC Low	0x00F2FD5F	523615	18
119	VCV Valve Virtual Connection	0x00E7FD5F	523615	7

120	PCV Driver Open Circuit	0x00E0FCCE	523470	5
121	PCV Driver Short to Ground	0x00E0FCCE	523470	4
122	PCV Driver Open Overload	0x00E7FCCE	523470	3
123	PCV Driver Overheating	0x00EAFCCE	523470	12
124	PCV Valve Current Feedback Signal SRC High	0x00EBFCCE	523470	16
125	PCV Valve Current Feedback Signal SRC Low	0x00ECFCCE	523470	18
126	Engine Temperature Too High	0x00F0F008	520200	16
127	Water in Fuel Sensor Failed to Pass Its Self-inspection	0x000C0061	97	12
128	Detected Water in Fuel	0x000B0061	97	11
129	MCU Temperature Sensor SRC High	0x00E3F009	520201	3
130	MCU Temperature Sensor SRC Low	0x00E4F009	520201	4
131	MCU Temperature High	0x00EFF009	520201	15
132	MCU Temperature Low	0x00F1F009	520201	17
133	Number of Unavailable EEPROM Sectors Over Limit	0x00020276	630	2
134	EEPROM Erase Error	0x000C0276	630	12
135	EEPROM Programming Error	0x00040276	630	4
136	AD Reference Voltage Too High	0x00E3F00A	520202	3
137	AD Reference Voltage Too Low	0x00E4F00A	520202	4
138	CAN0_BusOff	0x00E3F009	520203	12
139	CAN1_BusOff	0x00E4F009	520204	12
140	Receive Message 1 Timed Out	0x00EFF009	520205	12
141	Receive Message 2 Timed Out	0x00F1F009	520206	12
142	Receive Message 3 Timed Out	0x00020276	520207	12
143	Receive Message 4 Timed Out	0x000C0276	520208	12
144	Receive Message 5 Timed Out	0x00040276	520209	12
145	Receive Message 6 Timed Out	0x00E3F00A	520210	12
146	Receive Message 7 Timed Out	0x00E4F00A	520211	12
147	Receive Message 8 Timed Out	0x00E4F00A	520212	12
148	Receive Message 9 Timed Out	0x00ECF015	520213	12
149	Receive Message 10 Timed Out	0x00ECF016	520214	12
150	Receive Message 11 Timed Out	0x00ECF017	520215	12
151	5VLDO#1 Power Module Fault	0x00ECF01D	520221	12
152	5VLDO#2 Power Module Fault	0x00ECF01E	520222	12
153	5VLDO#3 Power Module Fault	0x00ECF01F	520223	12
154	Battery Voltage High	0x000300A8	168	3
155	Battery Voltage Low	0x000400A8	168	4
156	DCDC Short Circuit	0x00E3F028	520232	3
157	DCDC Open Circuit	0x00E5F028	520232	5
158	PIC Communication Fault	0x00ECF029	520233	12
159	Reset Caused by Clock Error	0x00ECF02A	520234	12
160	Reset Caused by Watchdog	0x00ECF02B	520235	12
161	Illegal Address Access	0x00ECF02C	520236	12

8. ENGINE STORAGE

8.1 Short Time Storage

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

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.

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.
- Cover the engine with a plastic cover or similar stuff and place the engine in a dry area with good ventilation.

8.1.2 During the Storage

Charge the battery every month. Check the electrolyte level of the battery that needs maintenance and add adding special liquid or distilled water, if necessary, before charging. Crank the crankshaft three to four circles every month with barring tool.

8.1.3 After Storage

When putting the engine into use, remove the engine cover and all port seals, and connect necessary lines. Prime the fuel system. Connect the battery and install the belt. Check lubricating oil and coolant levels and add proper amount of clean specified 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 4.5 to start the engine.

8.2 Long Time Storage

8.2.1 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 8.1.1 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.”

8.2.2 During the Storage

Refer to 8.1.2 for storage.

8.2.3 After Storage

When putting the engine into use, remove the engine cover and all port seals, and connect necessary lines. Connect the battery and install the belt. Prime the fuel system. Fill the engine and oil filter with clean specified lubricating oil and add proper amount of the oil to the turbocharger from its oil inlet. Check oil and coolant levels and crank the engine three to five circles with barring tool. Then follow the starting procedures in Section 4.5 to start the engine. If the engine is stored for over 2 years, its coolant should be changed, and its cooling system should be cleaned. If the engine has been out of use for a long time, the rubber hoses are aged. Check them for cracking, aging before putting the engine into use, and make replacement if necessary.

NOTES

NOTES

MANUFACTURER DETAILS

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