2B06 Series Diesel Engine
Operation&Maintenance Manual

Please read the instruction manual carefully before use!

- 2B06G0/5
- 2B06G1/5
- 2B06G2/5
- 2B06G3/5
- 2B0600/5
- 2B0600/5
- 2B0601/5
- 2B0602/5
- 2B0603/5
- 2B0604/5
- 2B0605/5
- 2B0606/5

Raywin Powertrain Technology Co., Ltd.

2025/1/9

Introduction

The 2B06 series diesel engines, jointly developed by Raywin Powertrain Technology Co., Ltd. and internationally renowned engine research and development institutions as well as expert teams, adopt two-valve, naturally aspirated technology, along with an inline plunger fuel injection pump and an axial-pin fuel injector system. They offer excellent reliability, fuel economy, and power performance, meeting the diverse application needs of customers across various markets such as agriculture, forestry, construction, horticulture, electricity, industrial, and marine sectors.

This manual introduces the basic knowledge of operation and maintenance for the 2B06 series diesel engines, as well as common troubleshooting methods for your reference. To ensure that the 2B06 series diesel engines better serve you and fully exert their effectiveness, please thoroughly understand the engine's structure and master its maintenance and operation methods. If you diligently perform maintenance as required, you will significantly extend the diesel engine's service life.

As the 2B06 series diesel engines continue to increase in variety and undergo improvements, we may not be able to notify all users of every change. We kindly request users' attention and understanding in this regard.

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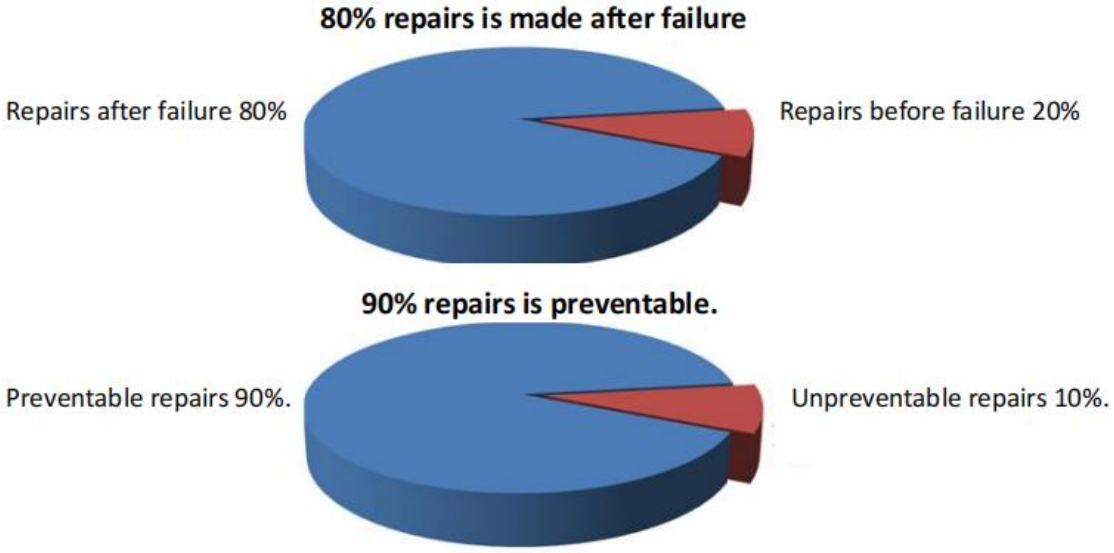
Catalogue

1.Introduction

To Users and Operators,

Relevant survey results indicate that:



Preventive maintenance is very simple and costs little. Please follow the maintenance specifications recommended in the maintenance section of this manual and keep records of regular preventive maintenance.

Use the correct fuels, oils, and coolants as specified in this manual.

Notice

When welding on the chassis or the generator set frame, please disconnect the positive and negative cables from the battery and remove all plugs on the electronic control system according to the power disconnection procedure to prevent damage to the electronic control system during welding. It is strictly prohibited to hot-swap components of the electronic control system. Welding operations should also not be performed on the diesel engine or components installed on the diesel engine, as this may damage the engine or components.

Symbol Explanation: The following symbols in this manual are used to aid in understanding the instructions. When a particular symbol appears, it conveys the following specific meaning:

Warning - Failure to follow these instructions can result in serious personal injury or significant property damage.

Attention - Failure to follow these instructions can result in general personal injury or damage to parts, assemblies, and the diesel engine.

Illustration Note: Some of the illustrations in this manual are schematic and may differ from the diesel engine or parts you are actually using.

General Safety Regulations

Warning!

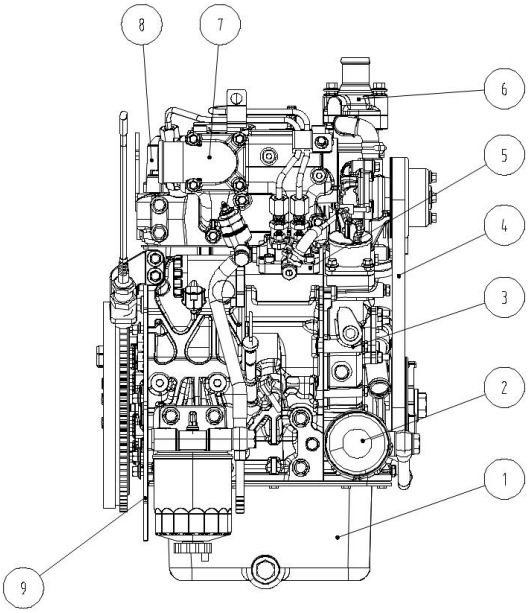
Improper procedures, carelessness, or ignoring warning instructions may cause burns, cuts, disfigurement, asphyxiation, or other personal injuries, and even death. Before performing maintenance, carefully read and understand all safety precautions and warnings. The following content contains general safety measures that must be followed to ensure personal safety. Specific safety measures will be included in the specific steps of implementation.

- The maintenance work area should be dry, well-lit, well-ventilated, and free of debris, scattered tools, parts, fire sources, and other hazardous materials. Be aware of potential dangerous situations
- Strictly prohibit contact with rotating parts as they may cause cuts, disabilities, or even loss of life.
- Never turn the crankshaft by pulling or prying on the fan. This practice may cause serious personal injury, property damage, or damage to fan blades, leading to premature fan failure.
- If the diesel engine has been running for some time and the coolant is hot, allow the engine to cool down gradually before slowly loosening the filler cap to release pressure from the cooling system. Otherwise, personal injuries such as burns may occur.
- Anti corrosives (coolant additives and components in engine oil) contain alkalis. Do not allow these substances to enter your eyes. Avoid prolonged and repeated skin contact. Do not ingest. If contact occurs, immediately wash the skin with soap and water. If it gets in your eyes, flush with plenty of water for at least 15 minutes and seek medical attention immediately. Keep it out of reach of children.
- To reduce the risk of burns, be cautious after shutting down the diesel engine and avoid contact with hot parts, exhaust pipes, hot liquids in pipes, and the engine compartment.
- When replacing fasteners, always use fasteners with the same part number (or equivalents). If replacement is necessary, do not use inferior fasteners.
- Avoid inhaling engine oil vapors, ingesting used oil, and prolonged skin contact with used oil.
- Do not connect jump-start cables or battery charging cables to any ignition or governor control wires. This may cause electrical damage to the ignition or governor.
- Always tighten fasteners and fuel connectors according to technical specifications, as over-tightening or under-tightening can lead to leaks.
- Since the smell of leaked fuel can gradually diminish, always test for fuel leaks according to the indicated method.
- Coolant is toxic. If it is no longer in use, dispose of it according to local environmental regulations.

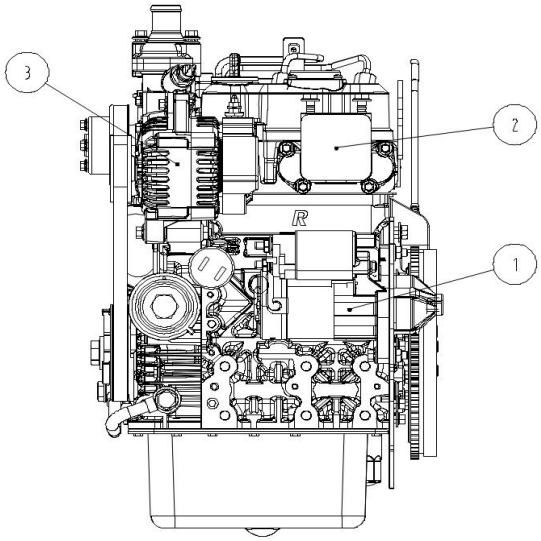
2.Overview

2.1 Variable Speed Model

2.1.1 Diagram of a Diesel Engine



1.Oil pan 2.Oil filter 3.Gear chamber 4.Belt 5.Fuel pump 6.Thermostat 7.Intake Pipe 8.Cylinder head cover 9. Flywheel plate



1. Starter 2.Exhaust pipe 3.Alternator

2.1.2 Composition and Representative Meaning of Model Numbers

The product model number is represented by Arabic numerals and uppercase English letters, and its composition structure is as follows:：

2B0600：

2-----2cylinders **B----platform number**

06—0.6 litter **00---TypeSpectrumCode**

2.1.3 Main Purpose and Application Scope

The 2B06 series diesel engines are widely used in agriculture, forestry, construction, horticulture, power generation, industry, and marine applications.

They are suitable for operation in ambient temperatures ranging from -25℃ to 45℃. Operation in water-logged or fire-hazard environments is prohibited. When the ambient temperature is below -25℃ or above 45℃, or at altitudes exceeding 1000 meters, users should consult the technical service department of Raywin Engine Co., Ltd. to take effective measures or use corresponding specialized diesel engines to ensure normal operation of the diesel engine.

2.1.4 Technical Characteristics

Table 2－1 2B06 Technical Data Sheet

NO.	ITEM	Technical parameters						
1	Engine model	2B0600/5	2B0601/5	2B0602/5	2B0603/5	2B0604/5	2B0605/5	2B0606/5
2	Engine type	In line 2 and 4 stroke,water cooled						
3	Intake air system	NA						
4	combustion type	IDI						
5	Bore×Stroke(mm)	72×74						
6	valve per cylinder	2						
7	Displacement (L)	0.603						
8	Compression ratio	24:1						
9	Dimension(L×W×H)mm	366×400×540（With Radiator and air filter）						
10	Dry Weight kg	60						
11	Lubricating system	pressure and splash lubrication						
12	Cooling system	Forced water cooling closed cycle						
13	Fan type	Φ260 Blowing type (installed coaxially with the water pump or crankshaft to reduce the height of the radiator)						
14	Start type	Starting motor 12V 1.0kw						
15	Alternator	14V 40A						
16	FIE system	Insertion type plunger fuel injection pump +pintle nozzle						
17	Electronic fuel lift pump	12V 1.2A、Flow rate: 75L/h、Pressure: 35 kPa,Suction lift: 0.5 m						

18	Speed regulation method	E-Governor						
19	Oil capacity L	2.7						
20	Coolant capacity L	3.7（With radiator）						
21	Fire order	1—2						
22	Crank Rotation	CCW (Facing flywheel)						
23	Rated power /speed kW/rpm(hp/rpm)	12/3600	10.4/3200	10.1/3000	9.3/2800	8.7/2600	8/2400	7.1/2200
24	Min specific fuel consumption(g/kW·h)	≤285						
25	Oil consumption rate (g/kW·h)	≤0.2						
26	speed drop %	≤2						
27	The related speed drop range %	≥5.5						
28	The related speed rise range %	≥2.5						
29	(Under the rated speed) Instantaneous speed variation %	5.5						
30	Smoke at calibrated working condition FSN	≤3.5						
31	Noise Limit No *Lp*dB(A) (1m)	≤92						
32	Fuel type	Summer: a product 0#,10# light diesel oil, Winter:a product 0#,-10# -20#,-35# light diesel oil.						
33	Oil type	Summer:15W/40CF Winter:0W/30CF						
34	Flywheel interface.	SAE5# flywheel housing + 6.5 inch flywheel.						
35	Fuel pipe interface	Outer diameter of fuel inlet pipe.mmΦ10						
		Outer diameter of return fuel pipe.mmΦ5						
36	Applicable altitude	Recommended for use at altitudes below 2000 meters.						
37	Applicable ambient temperature	Please use the glow plug when the temperature is lower than -5 degrees Celsius						
38	Glow plug type	In-cylinder glow plug(Dc 11V, 1.5Ω)						

2.2 G-Drive Model

The 2B06 series diesel engines are designed for use as power generators, covering a wide range of speeds including 1500rpm, 1800rpm, 3000rpm, and 3600rpm, as well as multiple power ratings.

2.2.1 Composition and Representative Meaning of Model Numbers

The product model number is represented by Arabic numerals and uppercase English letters, and its composition structure is as follows:
2B06G0/5

2-----2 cylinders

B----Platform number

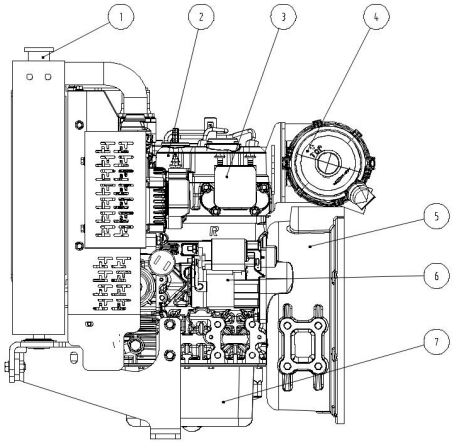
06—0.6 liter

G-----G-drive

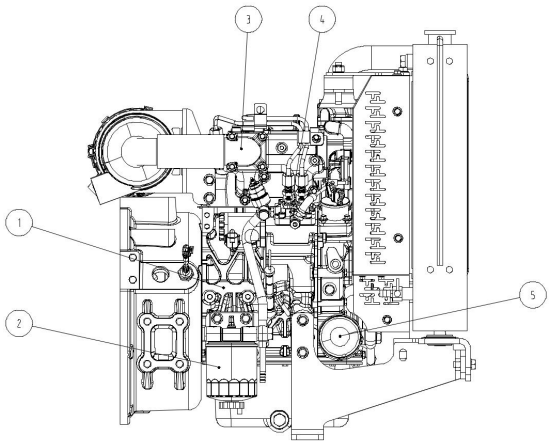
0----Type Spectrum Code

5-----Emission Level EU Stage V

2.2.2 Layout Method



1.Radiator 2.Cylinder head cover 3.Exhaust pipe 4.Air filter 5.Flywheel house 6.Starter 7.Oil pan



1.Cylinder 2.Fuel filter 3.Inlet pipe 4.Fuel pump 5.Oil filter

2.2.3 Technical features

Sheet 2－2 2B06 Technical Data Sheet

NO.	ITEM	Technical parameters			
1	Engine model	2B06G0/5	2B06G1/5	2B06G2/5	2B06G3/5
2	Engine type	In line 2 and 4 stroke,water cooled			
3	Intake air system	N A			
4	Combustion type	IDI			
5	Cylinder No. Bore×Stroke(mm)	2-72×74			
6	Valve per cylinder	2			
7	Displacement (L)	0.603			
8	Compression ratio	24:1			
9	Dimension(L×W×H) mm	610×440×640 (With Radiator and air filter)			
10	Dry Weight kg	100（With Radiator and air filter）			
		60(Bare engine without radiator and air filter.)			
11	Lubricating system	pressure and splash lubrication			
12	Cooling system	Forced water cooling closed cycle			
13	Fan type	Φ260 Blowing type (installation method with the water pump coaxial, or coaxial installation with the crankshaft to reduce radiator height)			
14	Start type	Starting motor 12V 1.0kw			
15	Alternator	14V 40A			
16	FIE system	Insertion type plunger fuel injection pump +pintle nozzle			
17	Electronic fuel lift pump	12V 1.2A、Flow rate: 75L/h、Pressure: 35 kPa、Suction lift: 0.5 m			
18	Speed regulation method	E-Governor			
19	Oil capacity L	2.7			
20	Coolant capacity L	3.7（With radiator）			
21	Fire order	1—2			
22	Crank Rotation	CCW (Facing flywheel)			
23	Rated Power/Speed kW/rpm(hp/rpm)	12/3600	10.1/3000	6/1800	5/1500
24	Min specific fuel consumption(g/kW·h)	≤285			
25	Oil consumption rate (g/kW·h)	≤0.2			
26	speed drop %	≤2			
27	The related speed drop range %	≥5.5			
28	The related speed rise range %	≥2.5			
29	(Under the rated speed) Instantaneous speed variation %	5.5			

30	Smoke at calibrated working condition FSN	≤3.5
31	Noise Limit No *Lp* dB(A)(1m)	≤92
32	Fuel type	Summer: a product 0#,10# light diesel fuel, Winter: a product 0#,-10#,-20#,-35# light diesel fuel..
33	Oil type	Summer:15W/40CF Winter:0W/30CF
34	Flywheel interface.	SAE5# flywheel housing + 6.5 inch flywheel.
35	Fuel interface.	Outer diameter of fuel inlet pipe.mmΦ10
		Outer diameter of return fuel pipe.mmΦ5
36	Applicable altitude	Recommended for use at altitudes below 2000 meters.
37	Applicable ambient temperature	Please use the glow plug when the temperature is lower than -5 degrees Celsius
38	Glow plug type	In-cylinder glow plug(Dc 11V, 1.5Ω)

2.3 Marine Model

The 2B06 series diesel engines are designed for power generation applications, featuring multiple speed configurations of 1500 rpm, 1800 rpm, 3000 rpm, and 3600 rpm, along with various power output ranges.

2.3.1 Composition and Representative Meaning of Model Numbers

The product model number is represented by Arabic numerals and uppercase English letters, and its composition structure is as follows:
2B06G0/5

2-----2 cylinders

B----Platform number

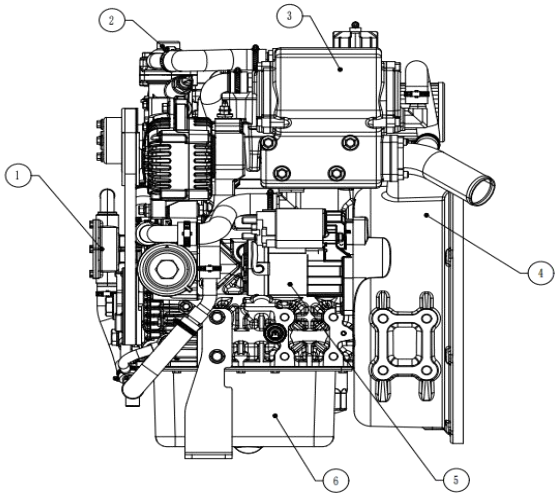
06—0.6 liter

G-----G-drive

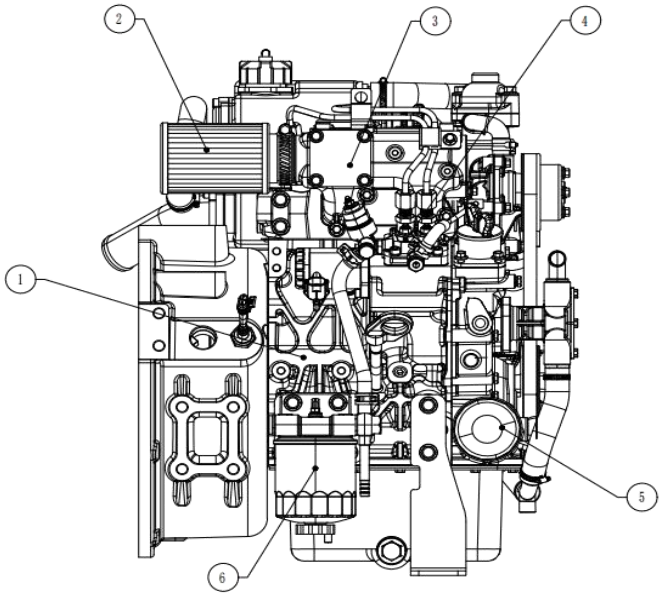
0----Type Spectrum Code

5-----Emission Level EU Stage V

2.3.2 Layout Method



1.Sea water pump 2.Thermostat assembly 3.Heat exchanger 4.Flywheel housing 5.Starter motor 6.Oil pan



1.Engine block 2.Air Filter 3.Intake manifold 4.Fuel Pump 5.Oil Filter 6.Fuel Filter

2.3.3 Technical features

Sheet 2－3 2B06 Marine Technical Parameters

NO.	ITEM	Technical parameters			
1	Engine model	2B06G0/5	2B06G1/5	2B06G2/5	2B06G3/5
2	Engine type	Vertical,In line ,4 stroke,water cooled			
3	Intake air system	Naturally Aspirated			
4	Combustion Chamber	IDI			
5	Cylinder No.-Bore×Stroke(mm)	2-72×74			
6	valve per cylinders	2			
7	Displacement	0.603			
8	Compression ratio	24:1			
9	Rate power@Speed kW/rpm(hp/rpm)	12/3600 (16.3/3600)	10.1/3000 (13.7/3000)	6/1800 (8.2/1800)	5/1500 (6.8/1500)
10	Cooling system	Forced water cooling + Seawater pump heat exchanger system			
11	Speed governor type	E-Governor			
12	FIE system	Insertion type plunger fuel injection pump + pintle nozzle			
13	Oil capacity （L）	2.5			
14	Fire order	1—2			
15	Standby Power(kw)/speed(r/min)	12/3600			
16	System voltage (v)	12V			
17	Emission Stage	EU Stage V			
18	Dry Weight（KG）	85(With Radiator,air filter)			
19	Dimensions(L×W×H)mm	465×412×572			

2.4 Range-Extended Model

The 2B06 series diesel engines are designed for power generation applications, covering multiple speed variants including 1500 rpm, 1800 rpm, 3000 rpm, and 3600 rpm, as well as various power output ranges.

2. 4. 1 Composition and Representative Meaning of Model Numbers

The product model number is represented by Arabic numerals and uppercase English letters, and its composition structure is as follows:
2B06G0/5

2-----2 cylinders

B----Platform number

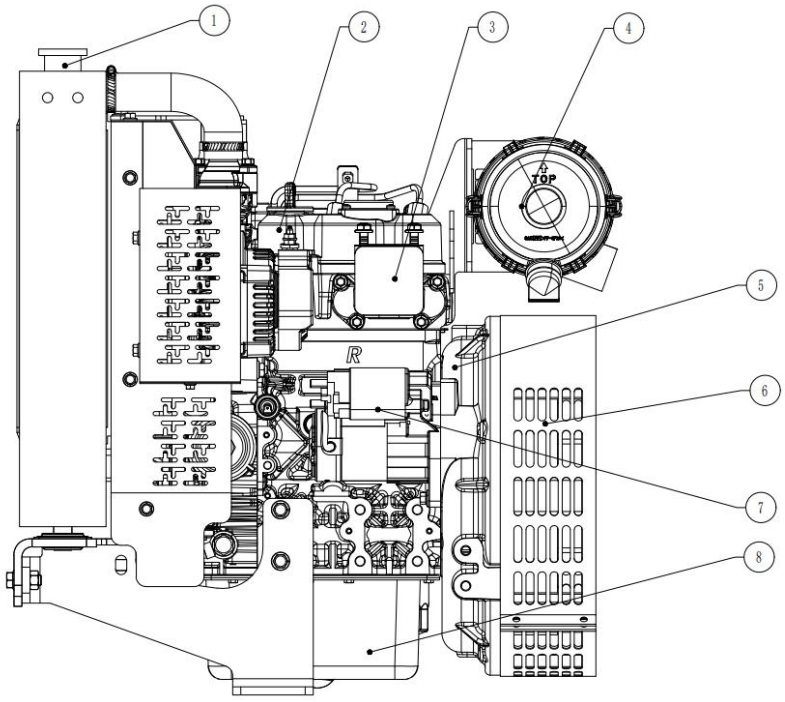
06—0.6 liter

G-----G-drive

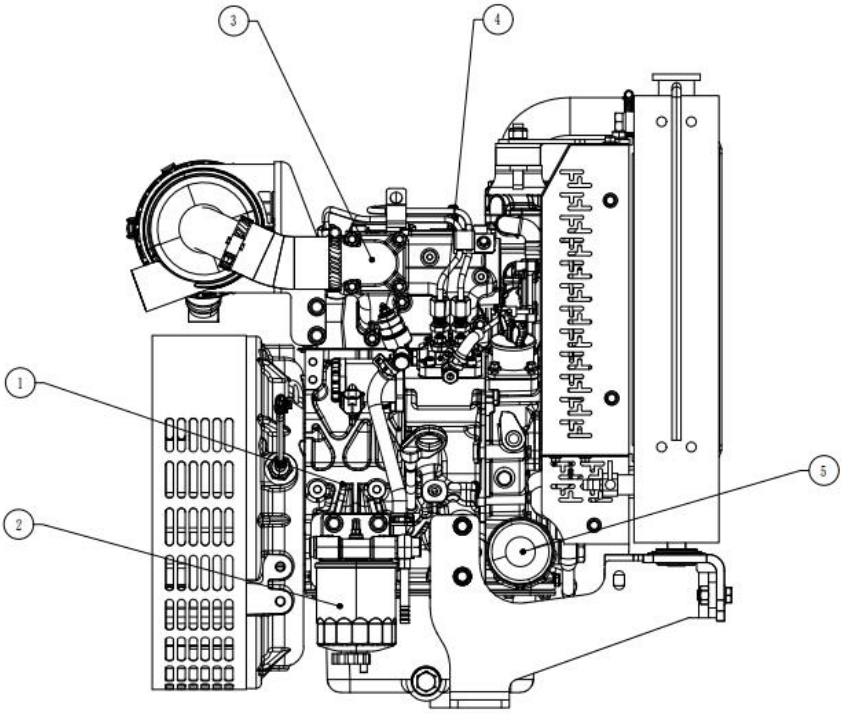
0----Type Spectrum Code

5-----Emission Level EU Stage V

2. 4. 2 Layout Method



1.Radiator 2.Cylinder head cover 3.Exhaust Pipe 4.Air filter 5.Flywheel house 6.Alternator 7.Starter 8.Oil pan



1.Engine Block 2.Fuel Filter 3.Intake Pipe 4.Fuel Injection Pump 5.Oil filter

2.4.3 Technical features

Sheet 2－4 2B06 Main Specification

NO.	ITEM	Technical parameters	
1	Engine type	Vertical,In line,4 stroke,water cooled	
2	Displacement	0.603L	
3	FIE system	Insertion type plunger fuel injection pump + pintle nozzle	
4	Alternator Type	Permanent Magnet Motor	
5	Communication protocol	485,CAN-J1939,Bluetooth (Application)	CAN-J1939,(Application)
6	Output	DC	AC
7	Transfer Type	Controller/Rectifier	Inverter
8	Rated Power (kw)	8kw	8kw
9	Rated Current (A)	≤134A/60V，100A/80V	≤38A/220V
10	Rated Voltage (V)	60	220
11	Fire order	1—2	
12	Emission Stage	EU Stage V	
13	Dry Weight(kg)	120	
14	Dimensions(L×W×H)(With radiator)mm	650×440×640	
15	BSFC(g/kWh)	≤285	
16	Operational Temperature(℃)	-25~50	

2.5 Agricultural & Engineering Machinery & Marine Engine Power Module

The 2B06 series diesel engines have a wide range of applications, suitable for agricultural machinery, engineering machinery, and marine engines. They provide high-quality and reliable power for agricultural equipment such as harvesters, tractors, and picking machines, as well as for engineering machinery like excavators, and vessels including fishing boats and yachts.

2.5.1 Application

Table 2－5　2B06 Technical Data Sheet

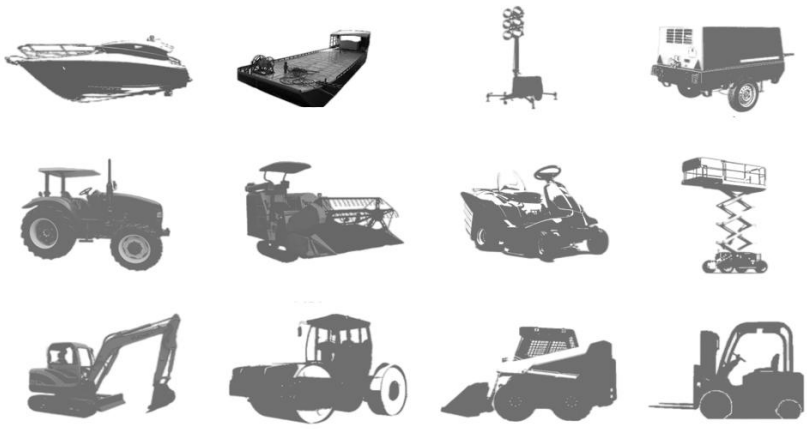
Application / Data	Genset	Marine	Agricultural
Rated Power(kW)	10.1	12	12
Rated Speed (r/min)	3000	3600	3600
Max torque (N.m)	/	/	32
Max torque speed (r/min)	/	/	2600
Torque reserve (%)	/	No Requirement	No Requirement
Emission	EU V		
Net weight (kg)	120	85	60
Dimension(L×W×H)(mm)	610×440×640	465×412×571	366×400×540

3.Fuel, oil, coolant, and auxiliary materials used in diesel engines

3.1 Fuel

The quality and composition of fuel are crucial. Inferior fuel can degrade engine performance and durability.

To achieve higher reliability and lower fuel consumption in diesel engines, it is



recommended to use diesel fuel that meets the following technical specifications:

Insert specific technical specifications for the diesel fuel here：

1. It should comply with the national or international standards of the region or country where it is used. For more details on fuel standards, please refer to the technical specifications of the corresponding country.
2. Users must select clean diesel of different grades according to the ambient temperature of the usage environment, as shown in the following table:

Table 3-1

Oil type	Ambient Temperature
0# diesel	4℃ above
-10# diesel	-5℃ above
-20# light diesel	-14℃ above
-35# light diesel	-29℃ above
-50# light diesel	-44℃ above

Warning

Do not mix gasoline, alcohol, or alcohol-gasoline blends into diesel fuel. Otherwise, it may cause explosions.

Notice

Due to the extremely precise tolerances in diesel injection systems, it is extremely important to keep the fuel clean and free of dirt or water. The presence of water or dirt in the fuel system can cause severe damage to the fuel pump and fuel injectors.

3.2 Oil

The components of the 2B06 series diesel engines are of high precision, thus there are also high requirements for the selection of engine oil. It is necessary to use diesel engine oil of CF-4 grade or higher. Specifically, CF4 15W-40 specialized engine oil with a quality grade of CF-4 and a viscosity grade of 15W-40 is recommended.

When selecting engine oil, it is important to choose the appropriate grade based on the local season and temperature. Special attention should be paid to two indicators: the oil quality grade (performance grade) and the viscosity grade. For selection reference, please see the table below.

Table 3-2

Common Quality Grades	CF-4	CH-4	CI-4	CI-4+	CJ
Applicable Emission Stages	EU Stage V	EU Stage V	EU Stage V		

Table 3-3

Type	Mineral Oil Type					Synthetic Oil Type	
Viscosity Grade	30	20W-50	15W-50	10W-40	5W-50	5W-50	10W-40
	40	20W-40	15W-40	10W-30	5W-30	5W-30	10W-30
Suitable Operating Temperature (℃)	10～50	-15～30	-20～50	-25～30	-30～30	-35～40	-30～40

The normal operating oil pressure requirement for this diesel engine is between

0.3 and 0.6 MPa, and should not fall below 0.1 MPa during idling.

Raywin recommends the use of multi-grade viscosity engine oil for its diesel engines. This is because multi-grade oil has a broader suitable temperature range, making it suitable for areas with large diurnal temperature variations, as well as situations where the diesel engine needs to operate across different temperature zones or within extended seasonal ranges. Additionally, the viscosity of multi-grade oil can meet the normal operating needs of the diesel engine. Another important factor is that the consumption rate of single-grade oil is approximately 30% higher than that of multi-grade oil.

The grade of engine oil represents the level of additives in it. For heavy-duty diesel engines, the additives in the oil play a major protective role. Since additives gradually deplete over time, it is necessary to choose an oil of sufficient grade to ensure reliable protection for the diesel engine throughout the oil change cycle.

After replacing parts in the 2B06 series diesel engine, add oil as appropriate. After filling the oil and running the engine for 2 minutes, let it stand for 15 minutes. Then check the oil level in the oil pan, which should be maintained between the 1/2 mark and the upper limit mark on the oil dipstick. (The maximum capacity of the oil pan is 2.7 liters.)

It is recommended to use the specified dedicated engine oil from Raywin or engine oil that meets the requirements for Stage V. For thismodel, the following Raywin dedicated engine oils are recommended:

Table 3-5

Product Name	Model	Package Specification	Scope of Application
Dedicated oil for EU Stage V(China IV) engines	CF-4/SL 10W-30 CF-4/SL 15W-40 CF-4/SL 20W-50	4L 16L 18L 170Kg	For use in diesel engines that meet Euro Stage V(or China I V) emission standards.

Note: Higher grade oil can be used to replace lower grade oil, provided that the oil-to-fuel ratio meets the corresponding national or international standards.

Other Guidelines:

- The engine oil must be replaced when the Total Base Number (TBN) drops to 1.0. The TBN (mgKOH/g) can be tested using JIS K-2501-5.2-2 (HCl) or ASTM D4739 (HCl) methods.
- The standard engine oil maintenance interval is 250 hours or 12 months.
- Do not add any additives to the engine oil；
- Do not mix different types (brands) of oil.

3.3 Coolant

△Notice

When the temperature drops below 0°C in winter and there are no insulation measures in place, and the diesel engine is not in operation, the water in the cooling system will freeze. As water expands when it freezes, it can cause cracking of cooling system components such as the engine block, radiator, cylinder head, and water pump. Therefore, it is necessary to fill the cooling system with antifreeze.

To enhance the lifespan of diesel engines, it is recommended to use the specialized antifreeze designated by Raywin.

Note: Fresh water is not suitable as engine coolant due to its poor thermal conductivity, which can lead to inadequate cooling and subsequent damage to internal engine components.

Water quality requirements for preparing engine coolant:

When conditions permit, please purchase the antifreeze specified by Raywin If the corresponding antifreeze is unavailable, it is permissible to mix ethylene glycol with softened water that meets the specifications outlined in the previous table. The relationship between the boiling point and freezing point of this type of antifreeze is as follows (refer to the table below)：

Boiling point and freezing point		
Volume ratio of ethylene glycol	freezing point	Boiling point
	℃	℃
40	-24	106
50	-35	108
60	-52	111

Note: Increasing the pressure in the cooling system can raise its boiling point. A radiator pressure cap helps maintain system pressure. To ensure good water quality, it is recommended to use the antifreeze brand and type specified by Raywin or internationally renowned brands.；

3.3.1 Coolant type

Tabel 3-6

Brand	Type	Package Specification	Freezing point	Minimum operating temperature
Hanhu	YCF4—8	4kg	-8℃	2
	YCF4—25		-25℃	-15

	YCF4—30		-30℃	-20
	YCF4—35		-35℃	-25
	YCF4—40		-40℃	-30
	YCF4—45		-45℃	-35
	YCF9—8	9kg	-8℃	2
	YCF9—25		-25℃	-15
	YCF9—30		-30℃	-20
	YCF9—35		-35℃	-25
	YCF9—40		-40℃	-30
	YCF9—45		-45℃	-35
	YCF10—8	10kg	-8℃	2
	YCF10—25		-25℃	-15
	YCF10—30		-30℃	-20
	YCF10—35		-35℃	-25
	YCF10—40		-40℃	-30
	YCF10—45		-45℃	-35
	YCF18—8	18kg	-8℃	2
	YCF18—25		-25℃	-15
	YCF18—30		-30℃	-20
	YCF18—35		-35℃	-25
	YCF18—40		-40℃	-30
	YCF18—45		-45℃	-35
	YCF200—8	200kg	-8℃	2
	YCF200—25		-25℃	-15
	YCF200—30		-30℃	-20
	YCF200—35		-35℃	-25
	YCF200—40		-40℃	-30
	YCF200—45		-45℃	-35

Generally, select a coolant with a freezing point about 10℃ lower than the lowest temperature in the area where the diesel engine operates. For example, if the lowest temperature in Beijing is assumed to be -15℃, then a coolant with a grade of -25℃ should be selected.

3.3.2 Precautions for the use of antifreeze

a.Before adding antifreeze, it is recommended to clean the diesel engine's cooling system with clean water. If conditions permit, it is best to use softened water or decolonized water for cleaning.；

b.Pay attention to checking the level of antifreeze and the tightness of the cooling system. For diesel engines without an overflow tank, do not fill it to the brim; instead, fill it to approximately 95% of its capacity. For diesel engines with an overflow tank, first fill it to the specified mark, start the diesel engine, and then continue to add

antifreeze to the prescribed level after a few minutes of operation.

c.Antifreeze for diesel engines from different manufacturers or of different types should not be mixed, as it may degrade the performance of the antifreeze and even cause damage to the diesel engine.；

d.If the fluid level falls below the specified mark, it needs to be topped up to the prescribed level. The antifreeze used for topping up must be of the same manufacturer and brand.

e.Ethylene glycol is toxic, and if it comes into contact with the skin, it should be washed off immediately with water. Ethylene glycol is flammable, so do not perform electric welding or use open flames near the engine body where antifreeze has leaked. The boiling point of ethylene glycol is 197.4°C, so the water in antifreeze is prone to evaporation. Therefore, water should be added after using the antifreeze for a certain period of time.

3.3.3 Regular replacement of antifreeze

a. The replacement cycle for light-duty antifreeze/inorganic salt-based antifreeze is 24 months.
b. The replacement cycle for heavy-duty antifreeze/organic acid-based antifreeze is 36 months.
c. The technical requirements for light-duty antifreeze/inorganic salt-based antifreeze and heavy-duty antifreeze/organic acid-based antifreeze must meet the relevant standards of the petrochemical industry or the requirements specified in "Q/YC 908 Diesel Engine Coolant Technical Specifications" by Raywin Engine Co., Ltd.

3.4 Selection of Batteries

In winter, especially in plateau, alpine, and cold regions (below -15°C), the discharge capacity of batteries decreases significantly. To ensure and improve the cold-starting performance of diesel engines, it is recommended to use or replace the batteries with low-temperature types of the same capacity. Examples of selection are provided in the table below.：

Table 3-7

For use in general areas		**For use in plateau and alpine regions**	
Battery capacity (Ah)	Cold-cranking current (A)	Battery capacity (Ah)	Cold-cranking current (A)
≥65(85)	140	≥85（120）	140

Note	In plateau regions (where frequent starting and high power consumption occur), it is advisable to choose batteries with the capacity specified in parentheses.

4.Use and Maintenance of Diesel Engines

4.1 Use of Diesel Engines

4.1.1 Before start

a. Check the oil level in the oil pan to ensure adequate lubrication. If insufficient, add oil to the level specified on the dipstick, ensuring the oil grade matches the ambient temperature.
b. Check the coolant in the radiator to ensure proper cooling. When adding coolant, ensure the coolant grade matches the ambient temperature.
c. Inspect and remove air from the fuel lines and water from the diesel filter.
d. Check the fuel tank and add fuel if necessary, ensuring the fuel grade matches the ambient temperature when refueling.
e. Inspect the electrical system, including the connections and switch wiring for firmness and reliability, and check the battery electrolyte level. If insufficient, top up the electrolyte.
f. Inspect the belts for proper tightness. Excessively loose belts can cause the water pump and fan to malfunction, leading to poor cooling and high diesel engine water temperature. Excessively tight belts can over stress the pulley shaft and shorten belt lifespan.

4.1.2 Start

Warning

Do not operate diesel engines in environments where flammable gases are present or may be present, as these gases may be drawn into the diesel engine through the intake system, causing the engine to accelerate and over speed, which can lead to fire, explosion, or property damage. Please remember that the diesel engine manufacturer cannot know how you operate the engine. Diesel engine users and operators bear full responsibility for safely operating the engine in adverse environments.

Notice

Only after completing the pre-startup preparations and confirming that they meet the requirements, should the diesel engine be started (in cold winter weather, the diesel engine needs to be preheated before starting). When starting the diesel engine, the continuous starting time should not exceed 10 seconds; the time interval between two starts should not be less than 1 minute; if the engine fails to start after three consecutive attempts, the cause should be checked, the

fault should be removed, and then the engine can be started again.。

△ Notice

After starting, check the oil pressure: it should not be lower than 0.1 MPa at idle speed. If the low oil pressure warning light does not go out within 15 seconds or the instrument indicates no oil pressure, shut down the engine immediately to prevent damage to the diesel engine.

Check the water pump to ensure it is working properly and confirm that the coolant has entered the diesel engine's water jacket for circulation. There should be no "three leaks" (oil, water, and gas leaks) or abnormal noises. Monitor the operation of all instruments. If any abnormalities are found, the engine must be stopped immediately for inspection and troubleshooting. If necessary, send it for repair.

Cold start： In colder environments, the starting procedure remains the same as usual. If there is a preheating process during startup, wait for the preheating indicator light to flash or go out before starting the engine.

Startup Procedure After Extended Shutdown or Oil Change:

Follow the normal startup steps outlined in this section. If the electronic control system detects that the oil pressure has not reached the minimum starting motor oil pressure, the diesel engine will not start. After an extended shutdown or oil change, it may take longer to start the diesel engine.

4.1.3 Start

After starting the diesel engine, warm it up at low and medium speeds with no load. Full-load and high-speed operation are only allowed when the coolant temperature of the diesel engine is above 60°C and the oil temperature is above 45°C. Pay attention to the following points：

△ Notice

Do not idle the diesel engine for too long as prolonged idling may degrade engine performance. The oil pressure should not fall below 0.1 MPa when idling.

Regularly observe the instrument readings during diesel engine operation to ensure that the oil pressure, oil temperature, and coolant outlet temperature are within the normal range.

If any instrument alarms, abnormal sounds, or vibrations are detected, the engine should be shut down for inspection as soon as possible, ensuring safety first.

Pay attention to the sealing of oil, gas, and water. If any leaks are found, they should be eliminated immediately.

△ Notice

New diesel engines or diesel engines that have undergone major repairs

should not be operated at high speeds or under heavy loads initially. Within the first 40 hours of operation, the power should be reduced and the load should not exceed 65% to ensure proper running-in.

4.1.4 Stop

Diesel engines should avoid abrupt shutdown. Before shutting down, let the engine run at low RPM for 3 to 5 minutes to cool down, then idle for 2 to 3 minutes to ensure all parts are well lubricated with oil before finally shutting it down.

Additionally, when the ambient temperature drops below 5°C, if the diesel engine's coolant cannot be guaranteed to remain unfrozen, the coolant should be drained promptly to prevent damage to engine components due to freezing.

When the temperature falls below -30°C, the battery should be removed and stored in a warm room for insulation, otherwise it may be difficult to start the engine.

4.1.5 Precautions for Daily Operation

Compared to traditional mechanical fuel systems, electronically controlled pump systems have more stringent requirements for fuel cleanliness.

It is essential to fill with properly refined and clean fuel.

Avoid contamination of the filled fuel.

When it is necessary to disconnect or connect fuel lines, ensure that your hands and tools are clean to prevent contamination of the fuel lines.

The diesel engine fault indicator light is located on the control panel. In the absence of any faults, the fault indicator light should flash once when the diesel engine is powered on and then remain off. When the diesel engine's electronic control system detects a fault, the fault indicator light will illuminate, accompanied by a corresponding fault prompt. First, turn off the ignition switch and carefully inspect the diesel engine's fuel, air, and electrical circuits for any obvious signs of fuel leaks, air leaks, or disconnected wiring harness connectors.

The general principle is that when the fault indicator light illuminates, if the user discovers obvious faults in the fuel, air, or electrical circuits upon inspecting the diesel engine, the user can address the issue themselves.

4.1.6 Refueling Method After Fuel Depletion

When air enters the fuel line due to fuel depletion in the fuel line, or when replacing fuel filters, pre-filters, or fuel lines, it is necessary to completely remove the air. The steps and precautions for bleeding are as follows:

Loosen the air bleed plug on top of the fuel filter and use a electrical lifting pump to bleed the airuntil the fuel filter is filled with fuel and no more bubbles emerge,

then tighten the air bleed plug.
Loosen the high-pressure fuel pump return line and use electrical lifting pump to blee d the air until the high-pressure fuel pump is filled with fuel and no more bubbles eme rge, then tighten the return line.

Loosen the connectors connecting the high-pressure fuel lines to the fuel injectors for each cylinder and use a hand pump to expel the air from the high-pressure fuel lines until fuel flows out, then tighten the connectors.

After bleeding is complete, wipe away any fuel that has spilled onto the diesel engine and frame before starting the engine.

During the bleeding process, avoid spilling fuel onto the exhaust pipe, starter, or wiring harness (especially connectors). If fuel is accidentally spilled, it must be wiped away cleanly.

During the bleeding operation, it is essential to ensure that the fuel remains clean and free from contamination.

4.2 Maintenance and Servicing of Diesel Engines

The diesel engine must undergo its first maintenance promptly as required by the user's warranty manual, and the maintenance situation should be recorded.

- During the use of the diesel engine, routine maintenance should also be carried out according to the following requirements. Daily maintenance can be performed by the user themselves, while other levels of maintenance should be conducted by professional maintenance personnel.
- The air filter is a critical component ensuring that the diesel engine inhales clean air. Regularly check the sealing of the intake system, maintain and replace the air filter to ensure that the diesel engine does not experience early wear and tear.

4.2.1 Running-in of Diesel Engines

A new diesel engine requires a running-in period (the first 50 hours) to further improve the fitting performance of its moving parts and ensure operational reliability and service life. During the running-in period, attention should be paid to the following matters:

1. After starting, the diesel engine should be warmed up at medium to low speeds for at least 5 minutes.
2. After starting, do not abruptly increase the load; it should be increased gradually.
3. Avoid operating the diesel engine at idle or full load for more than 5 minutes.
4. Frequently check the oil and water temperature gauges to ensure the diesel engine is operating normally.

For a diesel engine that has just undergone major repairs, it also requires a running-in period (similar to that of a new machine) to ensure the cooperation effect of various friction pairs. After the running-in period, the oil and oil filter element should be replaced. Running-in at idle speed should be avoided as it can cause early wear and tear.

4.2.2 Maintenance and servicing of diesel engine

Proper, timely, and meticulous maintenance can ensure the long-term and efficient operation of diesel engines, prevent breakdowns, reduce wear and tear, and extend their service life. Users should perform maintenance on diesel engines according to the contents listed in this section, with specific classifications as follows:

4.2.2.1 The maintenance schedule is specified in the table below：

Note: In harsh operating conditions (with minimum temperatures below -20°C, or maximum temperatures above 35°C, or in dusty environments such as deserts,

mining areas, construction sites, coal yards, etc.), the oil change interval needs to be shortened.

Engine Maintenance Schedule

Item	Maintenance Interval												
	50h	100h	200h	250h	400h	500h	1 or 2 months	1 year	800h	1500h	3000h	2 years
Inspect the fuel hose and hose clamps	☆											
※Replace Oil	★	☆										
Clean air filter element		☆										
Clean fuel filter		☆										
Check the battery electrolyte level		☆										
Check the fan belt tension and for any damage		☆										
Check the radiator hoses and clamps			☆									
※Replace oil filter	★	☆										
Check the air intake pipe			☆									
Replace fuel filter			☆									
Clean fuel tank						☆						
Clean the water jacket and radiator interior.						☆						
Replace fan belt						☆						
Recharge battery							☆					
Replace air filter					☆							
Inspect valve clearance									☆			
※Inspect fuel nozzle										☆		
Check Turbocharger (If have it)											☆	
Replace air intake pipe line												☆
Replace battery												☆
Replace the radiator hose(s) and clamp(s).												☆
Replace the fuel hose and clamp(s)												☆
Replace coolant (L.L.C.)												☆
Replace seawater pump sealing and impeller						☆						

Note:★ After the initial 50 hours of operation,replace the engine oil and oil filter.

※ In accordance with the U.S. Environmental Protection Agency (EPA) off-road emission standards,the items marked with ※ (above) are classified by our company as emission-related critical components.

5.Instructions for Daily Maintenance and Servicing of Diesel Engines

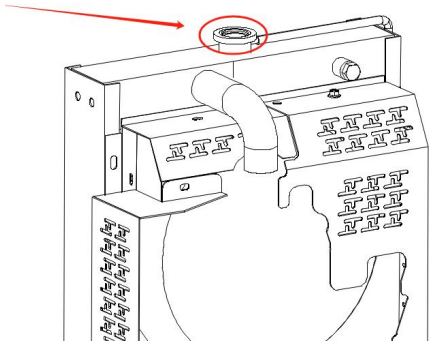
Good maintenance starts with understanding the condition of the diesel engine and its system every day. Before starting the diesel engine, check the oil level and coolant level, and look for any：

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any changes in the appearance of the diesel engine
- Presence of fuel odor

This section provides instructions for the daily maintenance and servicing of some systems and components of diesel engines.

5.1 Inspection of coolant level in the cooling system

Coolant level check



Warning

Do not open the radiator pressure cap on a hot diesel engine. Wait until the coolant temperature drops below 50°C before opening the pressure cap, as high-temperature coolant or steam may eject and cause personal injury

Warning

Coolant is toxic, so avoid children and pets coming into contact with it. If it is no longer in use, dispose of it in accordance with local environmental protection regulations.

Warning

Do not use corrosive cleaners in the cooling system, as it may damage aluminum components. (Note: The sentence was repeated in your request, so I provided the translation for one instance.)

Notice

Do not use seal additives to address leaks in the cooling system. This can cause

blockages in the cooling system and impede the flow of coolant, leading to overheating of the diesel engine.

It is imperative to check the coolant level on a daily basis.

△Notice

Do not add cold coolant to a hot diesel engine. This can damage the engine castings. Wait until the engine temperature drops below 50°C before adding coolant.

The supplementary coolant added to the diesel engine must be mixed with the correct proportions of antifreeze, auxiliary coolant additives, and water to avoid damaging the engine.

Fill the coolant to the bottom of the filler neck of the radiator or expansion tank.

5.2 Fan

Perform a visual inspection of the cooling fan daily. Check for cracks, loose rivets, bent or loose blades. Inspect the fan and ensure it is securely mounted. If necessary, tighten the bolts.

Warning

Do not turn the diesel engine by pulling or levering the fan. This can damage the fan blades, cause fan failure, and result in personal injury or property damage. Instead, use the accessory drive shaft or crankshaft turning tool to rotate the crankshaft.

Warning

Do not attempt to straighten bent fan blades or continue using a damaged fan. Bent or damaged fan blades cannot operate properly and can cause personal injury or property damage.

5.3 Fuel filter

Warning!

Drain the water from the fuel filter (pre-filter) into a container and dispose of it in accordance with local environmental protection regulations.

Raywin requires the installation of fuel filters (pre-filter and fine filter) or water separators in the fuel supply system, and daily drainage of water and sediments from the fuel filter (pre-filter) or water separator.

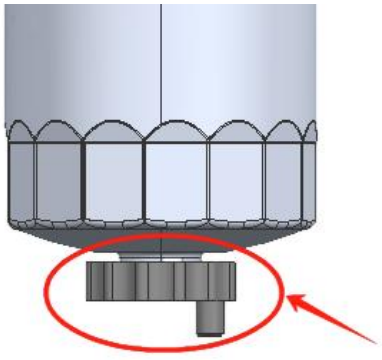


Figure 5-1 Diagram for Draining Water from Fuel Filter

Notice

When closing the drain valve, do not over tighten it as excessive tightening can damage the threads.

5.4 Oil level check

Check the oil level before each start-up.

Notice

It is strictly prohibited to operate the diesel engine when the oil level is below the lower limit mark or above the upper limit mark, as this can lead to decreased engine performance and damage to the diesel engine.

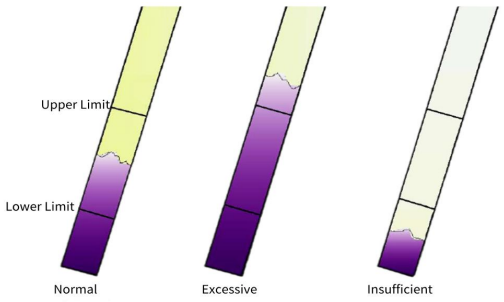


Figure 5-2 Illustration of Oil Level Indicator and Refueling Amount

An accurate reading can only be obtained when the diesel engine is stopped. Wait for at least 15 minutes after the diesel engine has been shut off before starting to check the oil level. This period allows the oil to drain back into the oil pan.

Warning!

Used oil is carcinogenic and may cause reproductive diseases. Inhalation of oil vapor, ingestion, and prolonged contact with used oil should be avoided. If it is no longer in use, it should be disposed of according to local environmental regulations.

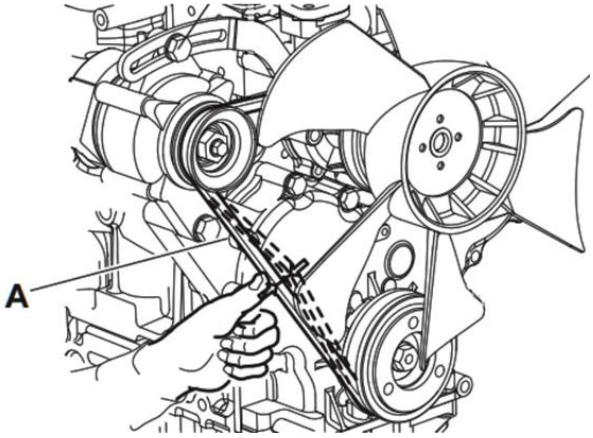
Warning!

To reduce the possibility of personal injury, avoid direct skin contact with hot oil.

5.5 Belt Check

The tightness of the belt should not be too loose or too tight. Being too loose can reduce transmission efficiency, resulting in insufficient rotational speed of the water

pump, fan, and charger, which can affect cooling performance. Additionally, the vibration caused by being too loose can lead to unnecessary wear on the belt and pulley. Being too tight, on the other hand, can affect the service life of the belt, bearings, and other components.



5.6 Air filter

Users can judge the clogging condition of the air filter by observing the air resistance indicator installed on the intake pipe behind the air filter. When the indicator window of the air resistance indicator changes from green (normal) to red, it indicates that the intake resistance of the filter exceeds the limit value, and it needs to be cleaned or replaced.

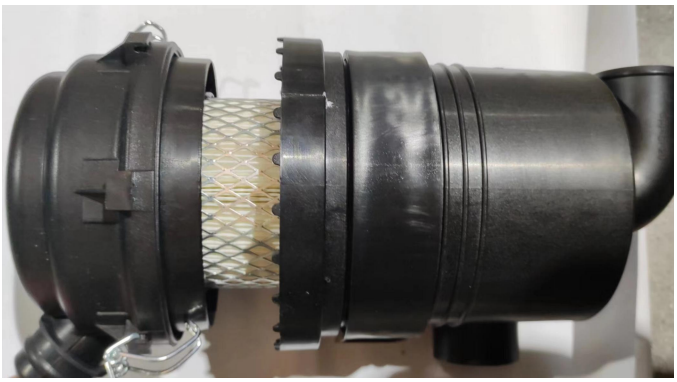
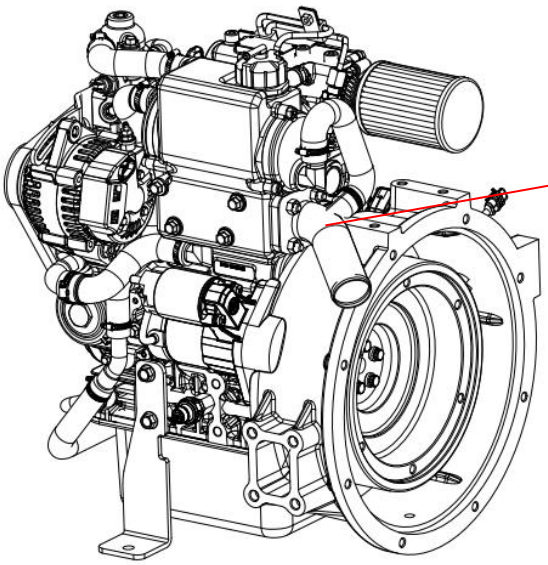


Figure 5-3 Air filter

Notice

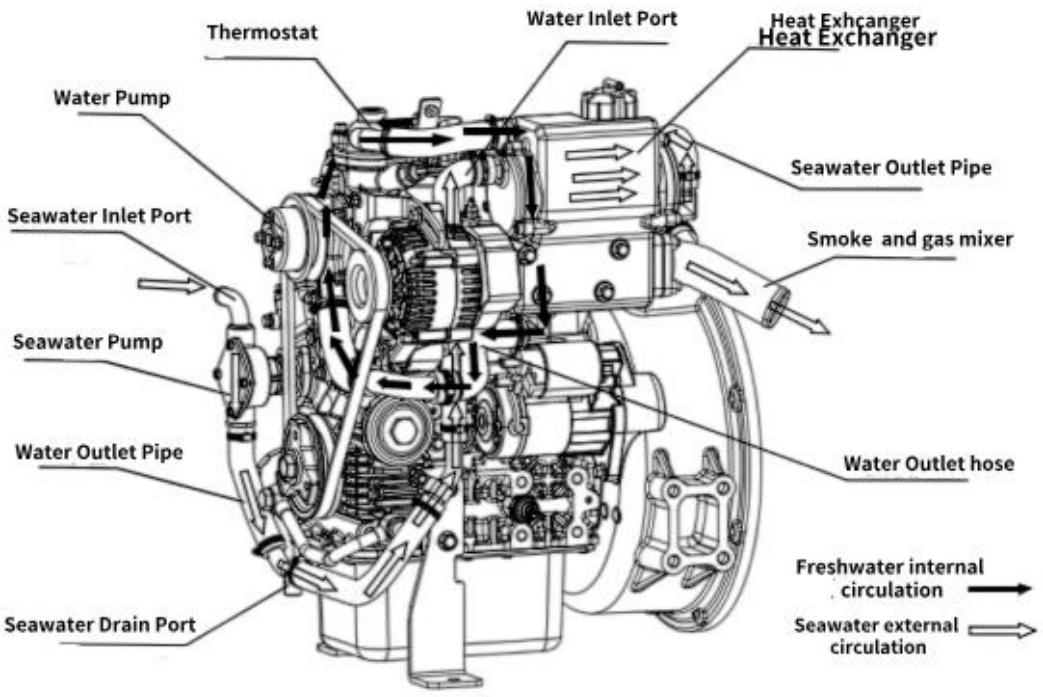
It is absolutely prohibited to operate the diesel engine without an air filter or with a malfunctioning air filter. The intake air must be pre-filtered to prevent dust and impurities from entering the diesel engine and causing premature wear.

5.7 Exhaust Pipe（Smoke-Water Mixing Device）

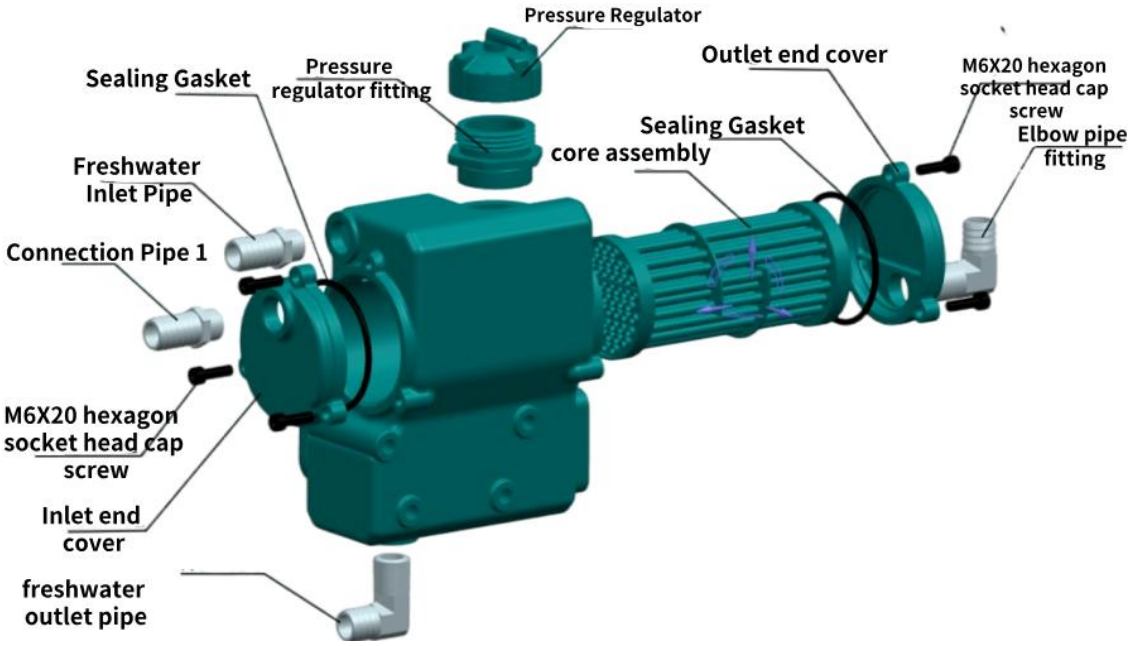


Flue Gas-Water Mixer (For interface outer diameter, refer to the dimensional drawing of the specified model)

5.8 Heat-Exchanger System



5.8.1 Heat-Exchanger



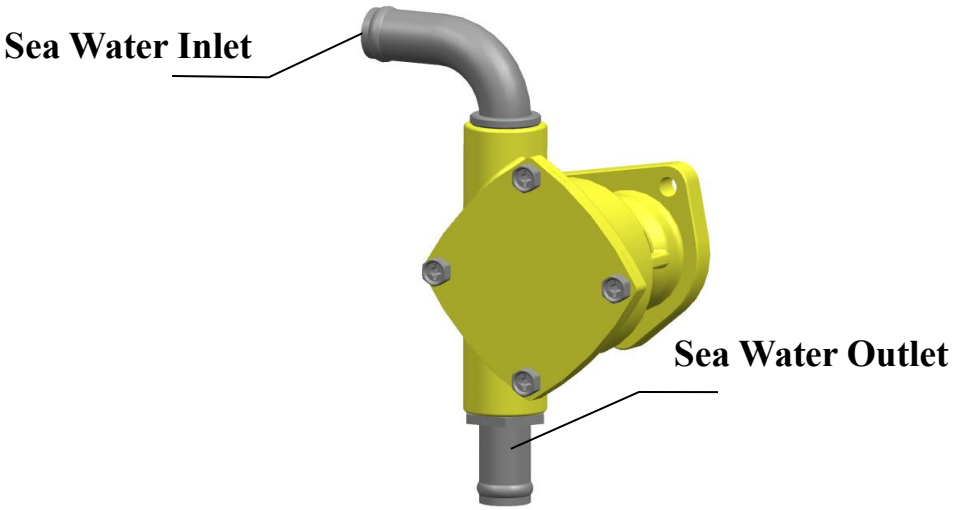
The core of the heat exchanger consists of a tubular structure. Seawater flows inside the tubes, while freshwater circulates outside the tubes through baffle plates, transferring heat via the cooling tubes to dissipate heat from the jacket water.

Due to the corrosive nature of seawater, it can degrade the protective surface layer, leading to pipe corrosion and fouling. This reduces the seawater flow area and decreases cooling efficiency, necessitating regular and frequent cleaning.

To clean the heat exchanger:

- Remove the inlet and outlet end covers.
- Extract the cooling core and immerse it in water mixed with a cleaning agent.
- Use a non-metallic brush to clean the inner diameter of the cooling tubes.
- After 15 minutes of descaling, remove the tube bundle and thoroughly rinse it with water.
- Replace all sealing rings/gaskets.

5.9 Seawater Pump

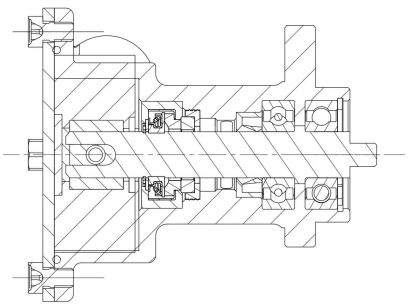


The seawater pump is equipped with a high-elasticity plastic impeller.

Proper use and maintenance are essential; otherwise, it may lead to reduced pumping performance or damage.

Maintenance Precautions:

1. Do not run the seawater pump dry, as this may cause severe wear or even complete failure of the impeller.
2. Install a seawater filtration device at the inlet of the pump to prevent debris from entering, which could damage the impeller and the water seal.
3. Regularly replace the impeller to maintain optimal pumping performance; failure to do so may result in inadequate engine cooling.
    - Replacement procedure:
        - Remove the end cover first.
        - Use a tool to take out the rubber impeller.
    - Replacement schedule:
        - Inspect every 500 hours, replace every 800 hours.
    - When the engine is idle for an extended period:
        - Drain all seawater from the pump and piping.
        - Use compressed air to blow out any remaining water inside.



6. Diesel Engines

Description: This manual describes some typical operational issues of diesel engines, their causes, and targeted solutions.

 **Warning**

Note: Performing fault diagnosis and troubleshooting steps outside of this chapter may result in equipment damage or personal injury or even death. Fault diagnosis and troubleshooting must be carried out by trained technicians. For diagnostic and troubleshooting steps and symptoms not listed in this chapter, please contact the authorized Raywin service station.

When conducting fault diagnosis, please follow these suggestions:

- Carefully analyze the problem before taking action.
- Start with the easiest and most obvious places first.
- Identify and eliminate the root cause of the problem.

6.1 The diesel engine fails to start.

Issue Reason		Solution
Fuel quality does not meet requirements: 1.Incorrect grade of fuel is used. 2.The impurities in the fuel exceed the standard. 3.The water content in the fuel exceeds the limit.	……	Replace the fuel with qualified quality and clean the fuel line.
If it is qualified, proceed to step one.		
The electronic control system fails to power up.	……	Check the wiring harness and fuse of the electronic control system, as well as the main power switch, especially the ignition switch. Practical and quick methods to diagnose this fault: 1.The fault indicator light does not illuminate during power-on self-test.

		2.The diagnostic tool cannot establish a connection.

If it is qualified, proceed to step two.

Battery is low power	……	Replace battery or charge the power to battery

If it is qualified, proceed to step three.

Starter does not work	……	1.Check if the switch and its wiring are intact. Try using the emergency start (keep the start request switch engaged for more than 5 seconds) and observe if the starter responds. 2.Check the start request switch, the start control relay, and their wiring. 3.Verify if the shutdown switch is in the off position. 4.Inspect the starter.

If it is qualified, proceed to step four.

Inability to establish operating timing: 1.During the starting process, the diagnostic tool cannot detect any change in RPM. 2.All crankshaft signals are lost. 3.The oscilloscope displays an installation phase error.	……	1.Check if the crankshaft position sensor is intact and undamaged. 2.Inspect the crankshaft connectors and wires to ensure they are intact and undamaged. 3.Examine the crankshaft signal plate for damage or dirt accumulation (through the sensor signal hole). 4.Check the installation gap between the crankshaft position sensor and the signal plate (typically ranging from 0.7-1.2mm). 5.If the signal plate or other components have been disassembled and reassembled during maintenance, verify that the timing phase assembly is correct.

If it is qualified, proceed to step five.

Fault in the low-pressure fuel line.	……	1.Ensure there is sufficient diesel fuel in the fuel tank. 2.Remove air from the low-pressure fuel line. 3.Check the tightness of the piping and connectors, as well as whether the hoses and connectors are compressed, damaged, or have incorrect diameters. 4.Inspect the fine filter and pre-filter for blockage or damage. 5.Check if the fuel tank ventilation device is clogged or contaminated (open the fuel tank cap to listen for fuel drawing sounds). 6.Verify if the fuel inlet and return lines of the fuel pump and filter are connected incorrectly.

If it is qualified, proceed to step six.

Injector malfunction	……	1.Check the atomization of the injector. 2.Verify the correct thickness of the injector gasket. 3.Inspect the correct protrusion height of the injector.

If it is qualified, proceed to step seven.

High-pressure fuel pump malfunctions: 1.Blockage in the internal oil passages of the high-pressure fuel pump. 2.Wear on the plunger of the high-pressure fuel pump. 3.Clogging, contamination, or sticking of the relief valve in the high-pressure fuel pump.	……	Clean or replace the high-pressure fuel pump, replace with clean fuel, and conduct a thorough road test.

If it is qualified, proceed to step eight.

Cylinder airtightness and compression performance faults:	……	1.Replace the piston rings and, depending on the situation, machine the cylinder bore. 2.Check the valve clearance, the sealing of

Insufficient compression pressure. Excessive wear on piston rings. Valve leakage.		the valve spring, valve guide, and valve seat. If the sealing is poor, grind the valve seat. 3.Tighten, clean, or replace (the affected components). 4.Remove carbon deposits from the combustion chamber. 5.Check for any bending of the crankshaft connecting rod, etc.

If it is qualified, proceed to step night.

Faults in other mechanical components	……	1.Check the fuel/oil lines; 2.Check the intake/exhaust passages; 3.Check if the filters are clogged, etc.

6.2 Engine difficultly start

Issue Reason		Solution
Inadequate Preheating: 1.Under extremely cold conditions, the engine is started without waiting for the cold start indicator light to flash or go out. 2.The multimeter or diagnostic tool indicates abnormal battery voltage fluctuations during the preheating process.	……	1.Check if the preheating circuit is properly wired; 2.Check if the battery has sufficient capacitance.

If it is qualified, proceed to step one.

Other reason	……	Refer to the troubleshooting process for diesel engine starting issues.

6.3 Low power

Issue Reason	Solution

Fuel Quality Does Not Meet Requirements: 1.Using fuel of an incorrect grade. 2.Exceeding the impurity limit in fuel. 3.Exceeding the water content limit in fuel.	……	Replace the fuel with qualified quality and clean the fuel lines.

If it is qualified, proceed to step one.

Water temperature sensor	……	1.Check the connectors and wiring of the water temperature sensor. 2.Inspect the water temperature sensor for dirt and damage.

If it is qualified, proceed to step two.

Fault in the low-pressure fuel system	……	1.Ensure there is sufficient diesel in the fuel tank. 2.Remove air from the low-pressure fuel system. 3.Check the tightness of pipes and connectors, and inspect hoses and connectors for crimping, damage, or incorrect diameter sizes. 4.Check if the fine filter and pre-filter are clogged or damaged. 5.Check if the fuel tank ventilation device is clogged or contaminated (open the fuel tank cap to check for suction noise). 6.Check if the fuel pump and filter inlet and return lines are connected in reverse. 7.Check if the fuel pump's oil delivery gear pump is malfunctioning.

If it is qualified, proceed to step three.

Blockage or leakage in the intake system	……	Inspect the air filter and intake manifold, and clean or replace the air filter element.

If it is qualified, proceed to step four.

Excessively high exhaust back pressure	……	Check the valve timing and adjust it if necessary; clean the exhaust pipe.

If it is qualified, proceed to step five.

Fuel leakage or blockage in the fuel lines	……	Check the sealing of the fuel lines and connectors, as well as the blockage of the fuel filter. Replace the spin-on filter element or fuel filter if necessary.

If it is qualified, proceed to step six.

Excessively high coolant temperature in the diesel engine	……	Inspect and repair the radiator and thermostat, and adjust the fan belt tension.

If it is qualified, proceed to step seven.

Injector defect	……	1.Check the atomization of the fuel injector. 2.Verify the correct thickness of the fuel injector gasket. 3.Inspect the correct protrusion height of the fuel injector.

If it is qualified, proceed to step eight.

High-pressure fuel pump malfunction: 1.Blockage in the internal oil passages of the high-pressure fuel pump. 2.Wear on the plunger of the high-pressure fuel pump. 3.Blockage, contamination, or sticking of the relief valve in the high-pressure fuel pump.	……	Clean or replace the high-pressure fuel pump, replace with clean fuel, and conduct a thorough road test.

If it is qualified, proceed to step night.

Cylinder airtightness and compression performance issues: 1.Insufficient compression pressure. 2.Excessive wear on piston rings. 3.Valve leakage.	……	1.Replace the piston rings and, depending on the condition, machine the cylinder liner. 2.Check the valve clearance, and the sealing of the valve spring, valve guide, and valve seat. If the sealing is poor, grind the valve seat. 3.Tighten, clean, or replace [the relevant components]. 4.Remove carbon deposits from the

		combustion chamber. 5.Check for bending of the crankshaft connecting rod, etc.

If it is qualified, proceed to step ten.

Excessive auxiliary power consumption	……	Check if the operating cycle time of the cooling fan and the transmission device of the diesel engine are functioning normally.

If it is qualified, proceed to step eleven

Internal damage to the diesel engine	……	Visit an authorized service station to inspect the engine and replace any damaged parts.

6.4 Abnormal noise during diesel engine operation

Based on the location of the abnormal noise, one can locate the fault, adjust the troubleshooting steps, and quickly resolve the issue. It is important to distinguish between the collision sounds of rotating parts, interference and collision sounds due to vibration, and resonant sounds. The sounds of rotating parts are generally regular. Meanwhile, resonant sounds may disappear or intensify as the rotational speed changes.

Step one

Fault in crankshaft sensor and its wiring	……	1.Check the connectors and wiring of the crankshaft sensor. 2.Verify the correct installation gap between the crankshaft sensor and the signal disc. 3.Inspect the crankshaft sensor for dirt and damage.

If it is qualified, proceed to step two.

Abnormal noise at idle speed	……	1.Check if there is air in the fuel line. 2.Verify the functionality of the fuel injector. 3.Check if there is water accumulation in the fuel filter causing poor fuel supply.

If it is qualified, proceed to step three.

There is a roaring sound when accelerating, and excessive exhaust noise.	……	1.Check if the air filter is clean; if it's clogged, replace it. 2.Inspect if the intake and exhaust pipes are securely connected and not leaking; if there is leakage, address the issue.

If it is qualified, proceed to step four.		
Mechanical noise / abnormal noise during acceleration under load	……	1.Verify if the timing marks on the diesel engine are correctly aligned. 2.Check if the valve timing and valve clearance are correct, and adjust if necessary. 3.Inspect the diesel engine valve springs for abnormalities, such as breaks, and arrange for replacement if found. 4.Check for wear on the camshaft and rocker arm shaft, which may be severe. 5.Confirm the cylinder head gasket's sealing performance for any leakage and replace it if necessary. 6.Confirm if the breather is emitting smoke to judge if the piston rings are faulty and need replacement. 6.The piston clearance is too large. 7.Wear on the timing mechanism.

6.5 Black smoke emission

It is a normal phenomenon for non-plateau-specific diesel engines used in plain vehicles to emit black smoke when they are taken to high altitudes and operated under overload conditions. This issue will disappear once the vehicle returns to the plain.

Issue Reason		**Solution**
Fuel quality does not meet requirements: 1.Using incorrect grade of fuel. 2.Excessive impurities in the fuel. 3.Excessive water content in the fuel.	……	Replace the fuel with one that meets quality standards and clean the fuel line.
If it is qualified, proceed to step one.		
Fault in the cooling water temperature sensor or its circuit	……	Check the cooling water temperature sensor and its wiring. You can monitor the water temperature signal value through a diagnostic tool to see if it is lower than the actual value. If necessary, disconnect the

		water temperature sensor connector and compare the readings after starting the engine.
If it is qualified, proceed to step two.		
The resistance in the intake system exceeds technical specifications.	……	Check if the intake system is clogged. If necessary, clean or replace the air filter and intake manifold.
If it is qualified, proceed to step three.		
Intake or exhaust leakage	……	Check the intake and exhaust systems for air leaks.
If it is qualified, proceed to step four.		
Radiator blockage or leakage	……	Check if the radiator is blocked or leaking.
If it is qualified, proceed to step five.		
The resistance in the exhaust system exceeds technical specifications.	……	Check if the exhaust system is clogged.
If it is qualified, proceed to step six.		
The muffler is squeezed, deformed, or clogged.	……	Replace muffler
If it is qualified, proceed to step seven.		
Injector defect	……	1.Check the atomization of the fuel injector. 2.Verify the correctness of the fuel injector gasket thickness. 3.Inspect the correctness of the fuel injector protrusion height.
If it is qualified, proceed to step eight.		
Valve leakage or abnormal valve clearance.	……	Check and adjust the valve sealing performance and valve clearance.
If it is qualified, proceed to step night.		
Insufficient pressure in the supercharging system.	……	Check and eliminate leaks in the piping and connections.
If it is qualified, proceed to step ten.		
Excessive power consumption	……	Check the operating cycle time of the cooling fan and ensure the transmission of the diesel engine is functioning normally.

If it is qualified, proceed to step eleven		
Internal damage to the diesel engine.	……	Go to an authorized service station to inspect the engine and replace any damaged parts.

6.6 Exhaust white smoke or blue smoke.

Sometimes, white smoke may appear when the engine is started cold, but this phenomenon will disappear as the engine runs longer and the water temperature rises. This is a normal condition and not a fault.

Issue		**Solution**
Fuel quality does not meet requirements: 1.Using incorrect grade of fuel; 2.Excessive impurities in the fuel; 3.Excessive water content in the fuel.	……	Replace the fuel with qualified quality and clean the fuel system.
If it is qualified, proceed to step one.		
The cooling water temperature sensor or its circuit is malfunctioning.	……	Check the cooling water temperature sensor and its wiring. You can monitor the water temperature signal value using a diagnostic tool to see if it is lower than the actual value. If necessary, disconnect the water temperature sensor connector and compare the readings after starting the engine.
If it is qualified, proceed to step two.		
The diesel engine is operating at a relatively low temperature.	……	Check the operating temperature of the thermostat and replace it if necessary.
If it is qualified, proceed to step three.		
The auxiliary preheating system needed for starting in extremely low temperatures has malfunctioned.	……	Check if the glow plug is functioning properly.
If it is qualified, proceed to step four.		

Malfunction of the low-pressure fuel line	……	1.Ensure there is sufficient diesel in the fuel tank. Remove any air from the low-pressure fuel line. Check the tightness of pipes and connectors, and inspect if the hoses and connectors are squeezed, damaged, or have incorrect diameters. Check if the fine filter and pre-filter are clogged or damaged. Check if the fuel tank ventilation device is blocked or contaminated (open the fuel tank cap to listen for any suction noise). Verify that the fuel pump and filter inlet and return lines are not connected incorrectly. Check if the fuel pump's oil delivery gear pump is malfunctioning.

If it is qualified, proceed to step five.

The blockage of the air filter leads to an increase in intake air resistance in the cylinder, resulting in poor air intake and the formation of a certain negative pressure, which draws lubricating oil into the combustion chamber.	……	Check if the air filter is clogged.

If it is qualified, proceed to step six.

The oil level in the oil pan is too high.	……	Check if the oil level in the oil pan exceeds the upper limit.

If it is qualified, proceed to step seven.

Injector defect	……	1.Check the atomization of the fuel injector. 2.Verify the thickness of the fuel injector gasket to ensure it is correct. 3.Check if the protrusion height of the fuel injector is correct.

If it is qualified, proceed to step eight.

Valve leakage or abnormal	……	Check and adjust the valve tightness and

valve clearance.		valve clearance.
If it is qualified, proceed to step night.		
Coolant leakage into the combustion chamber.		Check for coolant leakage.
If it is qualified, proceed to step ten.		
Severe wear on the cylinder wall, piston, and piston rings has led to excessive clearances, allowing oil to seep up into the combustion chamber and burn.	……	Check the condition of the cylinder wall, piston, and piston rings.
If it is qualified, proceed to step eleven.		
Excessive clearance between the valve and guide tube results in a large amount of oil being drawn into the combustion chamber and burned.	……	Replace the worn valves and valve guides.
If it is qualified, proceed to step twelve		
Low compression pressure and incomplete combustion.	……	Inspect the piston rings and cylinder head gasket, and replace them if necessary.
If it is qualified, proceed to step thirteen		
The piston rings are installed in the wrong direction, and their gaps are not staggered	……	Check and reassemble.
If it is qualified, proceed to step fourteen		
Long-term operation at low load	……	Pay attention to using appropriate operating speeds and loads.
If it is qualified, proceed to step ten fifteen		
Internal damage to the diesel engine	……	Go to an authorized service station to inspect the engine and replace any damaged parts.

6.7 Abnormal oil pressure

6.7.1 Excessively low oil pressure

Step one

The oil pressure gauge or oil pressure temperature sensor has malfunctioned or is installed in the wrong position.	……	Check if the oil pressure gauge, oil pressure temperature sensor, and their circuits are functioning properly, as well as if they are installed in the correct position.

If it is qualified, proceed to step two.

The lubricating oil has thinned or the wrong type of lubricating oil is being used.	……	Select and use appropriate lubricating oil as specified.

If it is qualified, proceed to step three.

The pressure regulating valve of the lubricating oil filter is malfunctioning or improperly adjusted.	……	Repair

If it is qualified, proceed to step four.

The oil filter is clogged.	……	Replace a new filter element

If it is qualified, proceed to step five.

There is a crack in the oil inlet pipe of the oil pump.	……	Inspect and repair or replace.

If it is qualified, proceed to step six.

The fixing bolt of the oil inlet pipe of the oil pump is loose.	……	Tighten to the specified torque.

If it is qualified, proceed to step seven.

Wear of lubricating oil pump rotor or oversized assembly gap	……	Replace a new oil pump.

If it is qualified, proceed to step eight.

excessive clearance between bearing shells	……	Inspect and replace

6.7.2 Excessively high oil pressure

Step one

The oil pressure gauge or oil pressure temperature sensor has malfunctioned or is installed in the wrong position.	……	Check whether the oil pressure gauge, oil pressure temperature sensor, and their circuits are functioning normally, as well as whether they are installed in the correct position.

If it is qualified, proceed to step two.

Excessively low temperature increases the viscosity of the oil.	……	Use the specified grade of lubricating oil, and after starting, operate at low speed first. Check the oil temperature once it has reached normal levels.

If it is qualified, proceed to step three.

The relief valve is clogged.	……	Inspect and clean.

6.8 High oil consumption, excessive oil consumption.

Issue Reason		Solution
There are leaks in the external lubricating oil lines.	……	Inspect and repair.

If it is qualified, proceed to step one.

The diesel engine is overloaded.	……	Reduce the load. Verify whether there are any abnormalities in the intake system, as obstructions can cause the diesel engine to be overloaded.

If it is qualified, proceed to step two.

Using an inappropriate grade of lubricating oil.	……	Select according to specifications.

If it is qualified, proceed to step three.

The oil dipstick calibration	……	Verify and adjust the oil dipstick or replace

is incorrect.		it.

If it is qualified, proceed to step four.

The breather is clogged.	……	Replace it

If it is qualified, proceed to step five.

The air filter is clogged, causing oil leakage in the turbocharger.	……	Check if the air filter is clogged, and confirm if the turbocharge shaft rotates normally without any sticking or obstruction.

If it is qualified, proceed to step six.

The piston rings are seized or excessively worn.	……	Inspect, repair, and replace if necessary.

If it is qualified, proceed to step seven.

The valve guide is excessively worn, causing failure of the valve stem seal.	……	Inspect and replace

6.9 The cooling water temperature is excessively high.

(The outlet temperature gauge is alarming.)

Issue		Solution
Insufficient cooling water volume, or excessively low water flow rate.	……	Check if the cooling water volume is sufficient. If not, add more water.

If it is qualified, proceed to step one.

Whether the belt is too loose.	……	Adjust

If it is qualified, proceed to step two.

The water temperature gauge is damaged, and the	……	Check if the actual temperature matches the temperature indicated on the gauge. If not,

water temperature sensor is malfunctioning.		replace the temperature sensor or the water temperature gauge.

If it is qualified, proceed to step three.

The expansion tank has poor sealing.	……	Repair in time.

If it is qualified, proceed to step four.

Water pump leakage water	……	Repair in time.

If it is qualified, proceed to step five.

The thermostat is malfunctioning or damaged.	……	Inspect and replace.

If it is qualified, proceed to step six.

Cylinder Head Gasket Failure	……	Inspect and replace.

If it is qualified, proceed to step seven.

Matching issues between the radiator and fan in modified situations.	……	Re-match according to the requirements.

6.10 The engine shuts down automatically.

Issue reason		**Solution**
Fuel quality does not meet requirements: 1.Using incorrect grade of fuel; 2.Excessive impurities in the fuel; 3.Excessive water content in the fuel.	……	Replace the fuel with qualified ones and clean the fuel system

If it is qualified, proceed to step one.

Fuel run out	……	Inspect and fill the fuel to fuel tank

If it is qualified, proceed to step two.		
The ignition switch circuit has malfunctioned.	……	Check the ignition switch circuit.
If it is qualified, proceed to step three.		
The battery voltage supplying the electronic control system is too low, interrupted, or open-circuit.	……	Check the battery terminals, fuses, and related circuits.
If it is qualified, proceed to step four.		
Fault in crankshaft sensor and its wiring.	……	1.Check the connectors and wiring of the crankshaft sensor; 2.Check if the installation gap between the crankshaft sensor and the signal plate is correct; 3.Inspect the crankshaft sensor for dirt and damage.
If it is qualified, proceed to step five.		
Low-pressure fuel line malfunction.	……	1.Ensure there is sufficient diesel in the fuel tank; 2.Remove air from the low-pressure fuel line; 3.Check the tightness of pipes and connectors, and inspect if the hoses and connectors are squeezed, damaged, or have incorrect diameters; 4.Check if the fine filter and pre-filter are clogged or damaged; 5.Check if the fuel tank ventilation device is clogged or contaminated (open the fuel tank cap to check for suction noise); 6.Check if the fuel pump and filter inlet and return lines are connected incorrectly; 7.Check if the fuel pump's delivery gear pump is malfunctioning.
If it is qualified, proceed to step six.		
Injector defect	……	1.Check the atomization of the fuel injector; 2.Check if the thickness of the fuel injector

		gasket is correct; 3.Check if the protrusion height of the fuel injector is correct.

If it is qualified, proceed to step seven.

Fuel injection pump malfunction: Blockage in the internal fuel passages of the fuel injection pump; Wear on the plunger of the fuel injection pump; Blockage, contamination, or sticking of the overflow valve in the fuel injection pump.	……	Clean or replace the high-pressure fuel pump, replace with clean fuel, and conduct a thorough road test.

If it is qualified, proceed to step eight.

The lubricating oil circuit of the diesel engine is obstructed, causing bearing burnout.	……	If the engine suddenly stalls with normal water temperature, it is mostly due to this situation. The oil pan should be disassembled for inspection and repair, and the corresponding damaged parts should be replaced.

If it is qualified, proceed to step night.

Cylinder scoring due to diesel engine overheating is generally caused by water shortage or excessively high water temperature.	……	First, allow the engine to cool down by itself (never add cold water or use cold water to flush it). Then, try to turn the crankshaft. If there is no seizing, you can add coolant and start the engine. If it cannot be turned, dismantle the engine for inspection, repair, and replace any damaged parts.

If it is qualified, proceed to step ten.

The electronic control system of the diesel engine has malfunctioned.	……	Replace the controller of the electronic control system.

If it is qualified, proceed to step eleven.

Internal damage to the diesel engine.	……	Go to the authorized maintenance service station to inspect the engine and replace the damaged parts.

6.11 Diesel engine vibration.

Step one

The ignition switch circuit has malfunctioned	……	Check the ignition switch circuit.

If it is qualified, proceed to step two.

The battery voltage supplying power to the electronic control system is abnormal or interrupted.	……	Check for poor contact at the battery terminals and related circuits.

If it is qualified, proceed to step three.

Malfunction of the crankshaft sensor and its wiring.	……	Check the connectors and wiring of the crankshaft sensor; Check if the installation gap between the crankshaft sensor and the signal plate is correct; Check if the crankshaft sensor is dirty or damaged.

If it is qualified, proceed to step four.

Low-pressure fuel line malfunction (or failure).	……	1.Ensure there is sufficient diesel in the fuel tank; 2.Remove air from the low-pressure fuel line; 3.Check the tightness of the pipes and connectors, and inspect if the hoses and connectors are squeezed, damaged, or have incorrect diameters; 4.Check if the fine filter and pre-filter are clogged or damaged; 5.Check if the fuel tank ventilation device is clogged or contaminated (open the fuel

		tank cap to check for suction noise); 6.Check if the fuel inlet and return lines of the fuel pump and filter are connected incorrectly; 7.Check if the fuel delivery gear pump of the fuel pump is malfunctioning.

If it is qualified, proceed to step five.

Injector defect	……	1.Check the atomization of the fuel injector; 2.Verify the correct thickness of the fuel injector gasket; 3.Confirm the correct protrusion height of the fuel injector.

If it is qualified, proceed to step six.

Malfunction of the cooling water temperature sensor or its circuit.	……	Inspect the cooling water temperature sensor and its wiring; you can monitor the water temperature signal value through a diagnostic scanner to see if it is lower than the actual value; if necessary, you can unplug the water temperature sensor connector and compare the readings after starting the engine.

If it is qualified, proceed to step seven.

The diesel engine installation bolts are loose, the damping pads are damaged, and it is not aligned with the power transmission system.	……	Tighten the bolts, replace the damping pads, and realign the components.

If it is qualified, proceed to step eight.

The intake system is clogged or leaky.	……	Check the air filter, intake manifold, and other components for any blockages or leaks.

If it is qualified, proceed to step night.

The driving accessory has malfunctioned.	……	Check the fan, generator, drive belt, and brackets for any interference, damage, etc.

If it is qualified, proceed to step ten.		
The electronic control system of the diesel engine has malfunctioned.	……	Replace the controller of the electronic control system.
If it is qualified, proceed to step eleven.		
Internal damage to the diesel engine.	……	Visit an authorized maintenance service station to inspect the engine and replace any damaged parts.

6.12 The diesel engine has unstable idling.

Step one		
The crankshaft sensor and its wiring are faulty.	……	1.Check the connector and wiring of the crankshaft sensor. 2.Verify if the installation clearance between the crankshaft sensor and the signal disk is correct. 3.Inspect if the crankshaft sensor is dirty or damaged.
If it is qualified, proceed to step two.		
Malfunction of the low-pressure fuel line.	……	1.Ensure that there is sufficient diesel in the fuel tank. 2.Bleed any air from the low-pressure fuel line. 3.Check the tightness of pipes and connectors, and inspect hoses and connectors for any crushing, damage, or incorrect diameter size. 4.Inspect the fine filter and pre-filter for any blockage or damage. 5.Check if the fuel tank ventilation device is blocked or contaminated (open the fuel tank cap to listen for any abnormal suction noise). 6.Verify if the fuel pump and filter inlet and return lines are connected in reverse. 7.Check if the fuel pump's fuel transfer gear

		pump is malfunctioning.

If it is qualified, proceed to step three.

Injector defect	……	1.Check the atomization of the fuel injector. 2.Verify if the thickness of the fuel injector gasket is correct. 3.Check if the protrusion height of the fuel injector is correct.

If it is qualified, proceed to step four.

The shock pad is damaged**.**	……	Check the Shock pad

If it is qualified, proceed to step five.

The speed sensor and its circuit are faulty.	……	Check the speed sensor and its circuit.

If it is qualified, proceed to step six.

The intake system is clogged or has leaks.	……	Check the air filter, intake piping, and other components for any blockages or leaks.

If it is qualified, proceed to step seven.

Valve leakage or abnormal valve clearance.	……	Check and adjust valve sealing performance and valve clearance.

If it is qualified, proceed to step eight.

The electronic control system of the diesel engine has malfunctioned.	……	Replace the controller of the electronic control system.

If it is qualified, proceed to step night.

The interior of the diesel engine is damaged.	……	Visit an authorized maintenance service station to inspect the engine and replace any damaged parts.

6.13 Oil dilution

Issue reason		**Solution**
Fuel injector sealing issue	……	1.The sealing sleeve of the fuel injector mounting hole is damaged, causing

		leakage; 2. the fuel injector leaks inside the cylinder head.

If it is qualified, proceed to step one.

There are cracks in the cylinder head.	……	Inspect and replace

If it is qualified, proceed to step two.

Poor sealing of the fuel pump.	……	Check the fuel seal of the fuel pump.

If it is qualified, proceed to step three.

The O-ring of the fuel injector is damaged.	……	Check the O-ring of the fuel injector.

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