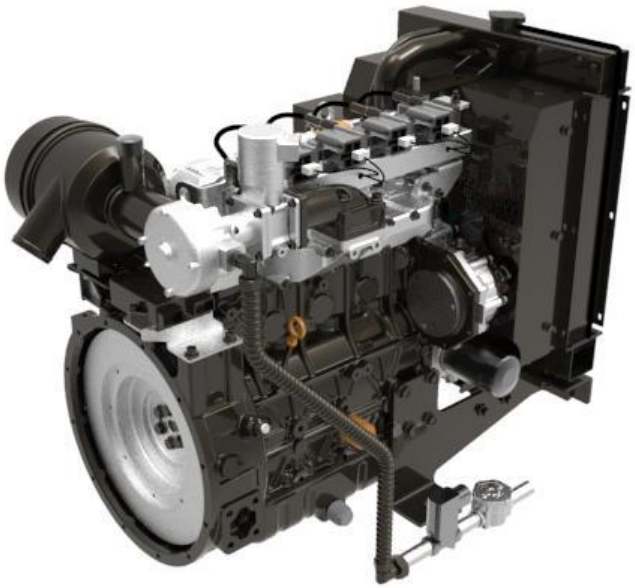
RAYWIN

R7100B-4003108SF1

4D24NG,4D24NTG Series gas Engine

Operation & Maintenance Manual

Please read this manual carefully before using the engine.



Raywin Powertrain Technology Co., Ltd.

March 2024

Preface

4D24NG & 4D24NTG series off-highway gas engines are developed by RAYWIN POWERTRAIN TECHNOLOGY CO., LTD. with international engine R&D institutions together. Adopted tunnel block, turbocharged/naturally aspirated and 2-valve technologies, 4D24NG & 4D24NTG series engines are with reliable, gas-efficient and strong power characters. It could be applied for agriculture & garden fields, construction equipment, power generation, marine and industrial equipment.

This manual contains some operation and maintenance instructions for 4D24NG & 4D24NTG series gas engines, and some usual failure removal methods as well. Please know well about the structure, operation and maintenance instruction of this engine. It helps prolong the engine lifetime if the users could make well maintenance.

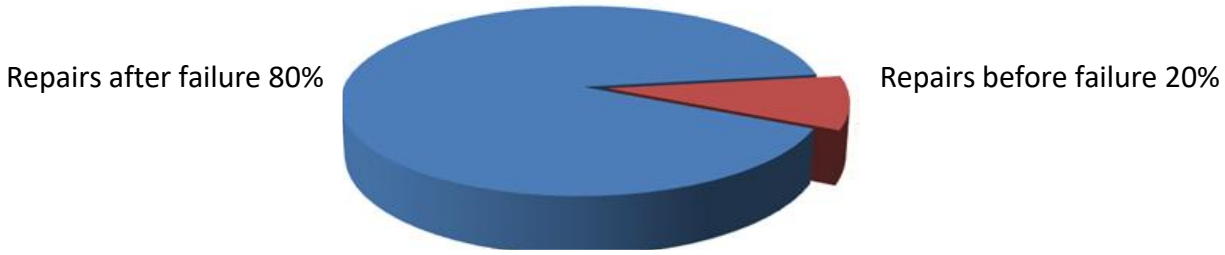
Further improvement and advancement of product design may causes changes which are not included in this manual.

CONTENT

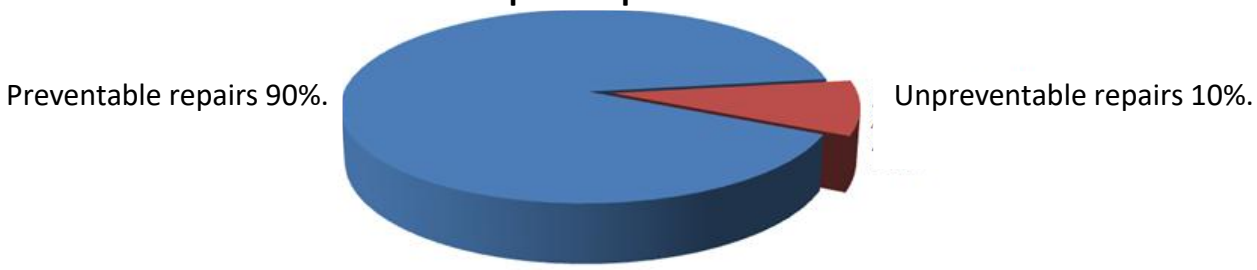
1. Foreword

The relating statistic data shows:

80% repairs is made after failure



90% repairs is preventable.



Preventive maintenance is simple and lower cost, please make the maintenance according to the maintenance instructions in this manual, and make regular preventative maintenance records.

Please utilize the gas, oil and coolant correctly as per the instructions in this manual, and do not mix the gas and oil together for the engines with after-treatment equipment.

Attention

When welding on the machinery, please remove the battery positive and negative pole cables from the battery, and dismantle all plugs on the ECU as per the procedure to prevent from ECU damage, do not connect or dismantle ECU plugs with electrification, also do not perform welding operations on the engine or on the engine mounting parts, otherwise the engine or components may be damaged.

The meaning of the safety alert symbols is listed as follows:

Warning

If do not follow this instruction, it will cause serious personal injury or substantial property damage

Attention

If do not follow this instruction, it will cause personal injury or parts, assembly, engine damages.

Illustration description: Some illustrations in this manual are schematic, it may be different from the engines or parts that you use actually.

1.1 General Safety Rules

Warning

Incorrect procedures, carelessness or neglect of warning instructions may cause burns, cuts, body mutilation, asphyxiation or other injury or even death.

Before maintenance, please read and understand all the security measures instructions and warnings carefully. The following pages contain a general security measures to ensure personal safety that you should follow.

◆ Maintenance area should be dry, bright and well ventilation, no sundries, scattered tools, parts, fire and other dangerous items. To pay attention to a dangerous situation may exist.

◆ Do not touch rotating parts, because the rotating parts may cause lacerations, physical disability, even death.

◆ Do not rotate the crankshaft by leveraging the fan. This approach may cause serious personal injury, property damage, or damage the fan blades, causing premature failure of the fan.

◆ If the engine has been running for a while, and the coolant is hot, the engine should be gradually cooled firstly, then loosen the filling port cap slowly to release pressure in the cooling system, or else it could cause scald and other personal injury.

◆ Corrosion inhibitor (coolant additives and ingredients in oil) contains alkali. Do not make these substances into the eyes. Avoid skin touch with it time and again. Do not swallow it. In case of contact, please wash the skin with soap immediately. If it enters eyes, please rinse with plenty of water for fifteen minutes at least, and go to hospital at once. Put it where children can not touch.

◆ In order to reduce the possibility of burns, do not touch the hot parts, exhaust pipeline, hot liquid and engine cabin while the engine is stopped.

◆ When replace the fasteners, please use the fasteners with the same part number (or equivalent). Do not use the poor quality fasteners.

◆ Avoid inhalation oil vapors, do not swallow, or contact used oil for a long time.

◆ Do not connect starting cable or battery charging cable with any ignition or speed control cable, or else it may cause ignition and governor damage.

◆ Please tighten fasteners and gas connectors according to the technical specifications. It may cause leakage if the fastener or connector is too tight or loose.

◆ The coolant is toxic, please make treatment in accordance with relating environmental regulations if you do not continue to use it.

2. Overview

2.1 Genset engine

4D24NG and 4D24NTG series gas engines are applied for power generation, covering multiple speed options:1500rpm

2.1.1 Model characters explanation

Product model is represented by Arabic numerals and capital letters, its composition is as follows：

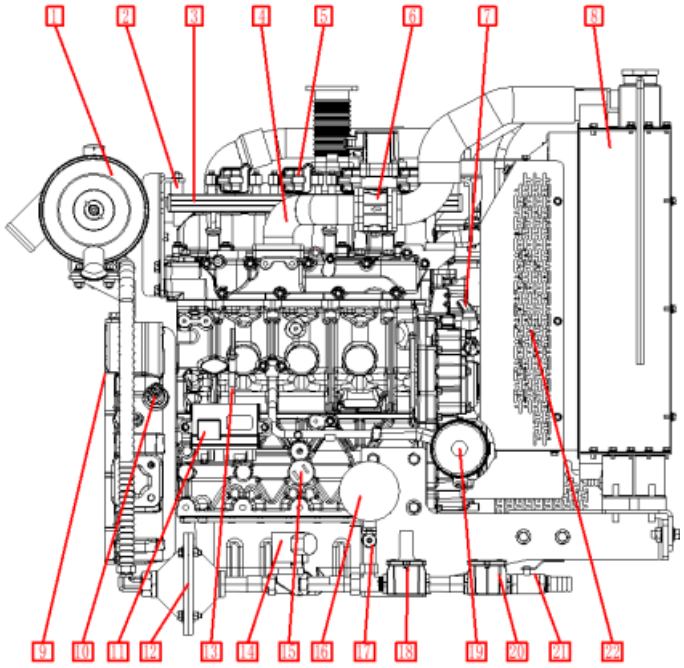
4D24NTG

4-----4 cylinders　　D----series code

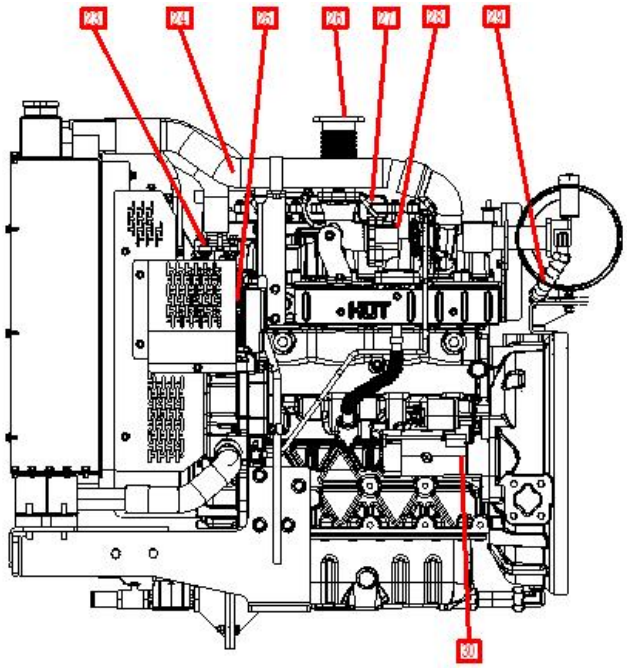
24—2.4 liters displacement　　T----- turbocharged

G----- Genset application　　N------ Gas appliances

2.1.2 Layout



1.Air Filter　2. Vibration Damp　3.Ignition Coil Bracket Assembly　4.　Intake Manifold Pipe
5.Ignition Coil　6.Electronic Governor　7. Camshaft Position Sensor　8.Intercooling
9.Flywheel Housing　10.Speed Sensor　11.ECU　12.Flame arrester　13.Dipstick Assembly
14.Solenoid valve 15.Oil Pressure Sensor　16.Pressure Gauge 17.Valve
18.Pressure regulating valve 19.Oil Filter　20.Gas Filter　21.Gas pipeline valve 22.Fan



23.Thermostat 24.Intercooling 25.Alternator 26.Turbocharger Rear Flexible Connection
27.Ignition High-Tension Lead 28.Turbocharging 29. Exhaust Flex Pipe 30.Starter

2.1.3 Engine Data & Specifications

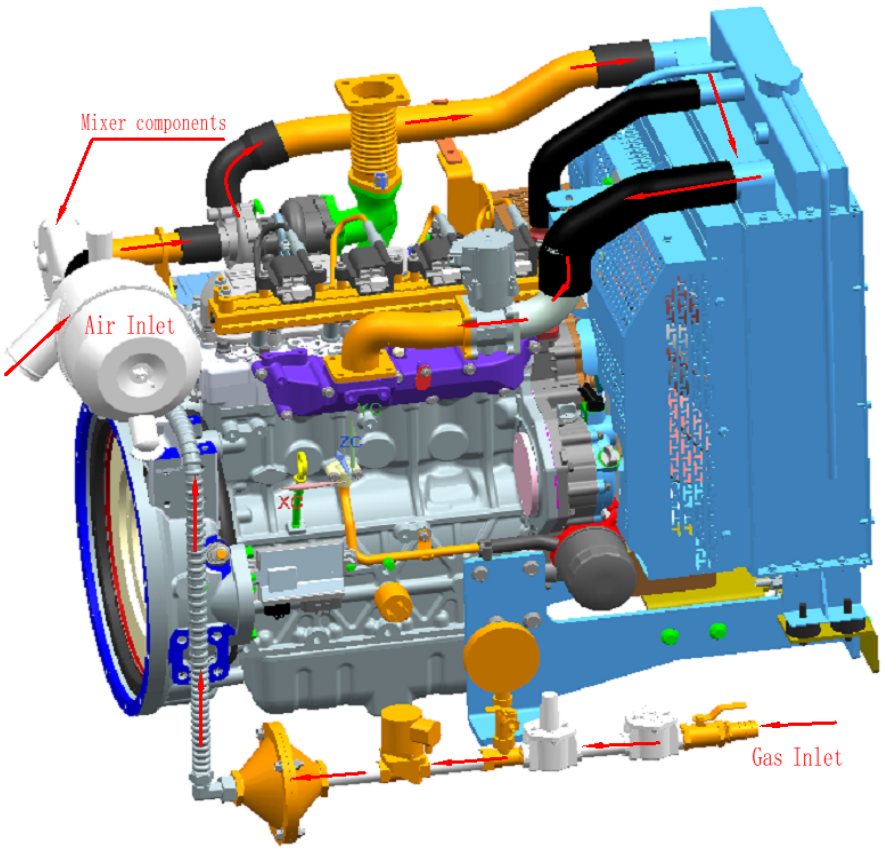
Sheet 2－2 4D24NG series (Naturally aspirated) gas engine Main Parameter

Model	4D24NG0	4D24NG1	4D24NG2	4D24NG3	4D24NG4
Type	Vertical, In-line, Water Cooled, Four Stroke				
Induction System	Naturally Aspirated				
Combustion Chamber	Direct injection				
Cylinder NO.	4				
Bore (mm)	87				
Stroke (mm)	103				
Displacement (L)	2.45				
Prime Power (kW) / Speed (rpm)	27 / 1500	23 / 1500	22 / 1500	21 / 1500	18.5 / 1500
Standby Power (kW) / Speed (rpm)	30 / 1500	25.3 / 1500	24.2/ 1500	23 / 1500	20.3 / 1500
Gas Consumption (m^3/kW·h)	≤0.34				
Gas system	Diaphragm mixer+electronic control unit + electronic governor				
Firing order	1—3—4—2				
Direction of rotation	Anticlockwise(view from flywheel)				
Oil capacity(L)	7L				
Start method	Electric start				
Net weight (with radiator) (kg)	275				

Sheet 2－3　4D24NTG（Turbocharged intercooling）series gas Engine Main Parameter

Model	4D24NTG0	4D24NTG1	4D24NTG2	4D24NTG3	4D24NTG4	4D24NTG6
Type	Vertical, In-line, Water Cooled, Four Stroke					
Induction System	Turbocharged+Intercooling					
Combustion Chamber	Direct injection					
Cylinder NO.	4					
Bore (mm)	87					
Stroke (mm)	103					
Displacement（L)	2.45					
Prime Power (kW)/ Speed (rpm)	36/1500	32/1500	28/1500	36/1800	25/1500	30/1500
Standby Power (kW)/Speed (rpm)	39.6/1500	35.2/1500	30.8/1500	39.66/1500	27.5/1500	33/1500
Gas Consumption (m^3/kW·h)	≤0.34					
Gas system	Diaphragm mixer+electronic control unit + electronic governor					
Firing order	1—3—4—2					
Direction of rotation	Anticlockwise(view from flywheel)					
Oil capacity(L)	9.5L					
Start method	Electric start					
Net weight (with radiator) (kg)	275(with radiator)					
Dimension（L×W×H） mm	1002*576*813(with radiator)					

2.2 Gas circuit flow Diagram



3. Installation

3.1 gas engine installation

3.1.1 Installation of front-end output terminal

1. The front additional pulley does not allow users to modify it themselves system
2. The belt should be arranged symmetrically
3. The groove of the pulley should be ensured to be in the same plane
4. The maximum allowable radial power of the front-end output pulley and the total power of the front-end power output equipment (including radial output and axial output) must comply with relevant technical regulations.

3.1.2 Check gas lines

1. Check the pressure of the gas and filter;

Attention:

When the gas pressure is insufficient, check whether there is a gas leak in the gas circuit and verify if the gas supply pressure is adequate.

3.1.3 Check the intake pipeline

1. Check if the air filter is clean
2. When the cabin temperature cannot be maintained at 25 degrees Celsius, it is recommended that the air intake be extended outside the cabin
3. It is not allowed to use air filters without installation

3.1.4 Check exhaust

1. The entire exhaust should be smooth
2. To check the diameter of the exhaust pipeline

3.1.5 Check electrical instruments

1. Check if the wiring and coil whether is connected correct.
2. Check if the connectors of each sensor are loose
3. Is there any metal contact at each joint

3.1.6 Others

The onshore power generation gas engine is only suitable for supporting onshore generator sets.

3.2 Gas engine test

3.2.1 Check the condition of internal and external circulating cooling water, engine oil, and gas

1. Is there enough oil pan.
2. Is there enough gas.

3.2.2 Check electrical instruments

1. Check whether the oil pressure, oil temperature, water temperature and Tachometer display are normal
2. Whether the pipeline connection is correct and whether the joints are loose

3.2.3 Check the intake and exhaust pipelines on the ship

1. Check for air leakage in the pipeline

3.2.4 Check the maximum idle speed

Auxiliary equipment (with unit): set and check according to the rated speed at full load, and it is not allowed to be lower than the rated speed;

Main engine: Check the idle speed, which should be between 1.0and 1.03 times the rated power speed.

4. Gas, oil, antifreeze and auxiliary battery

4.1 Gas

Gas quality and composition is very important. Poor quality gas reduces engine performance and durability

In order to make the gas engine has higher reliability and lower gas consumption, we recommend using the gas complied with relating national standard or international standard.

For more details of the gas standards, please refer to the technical specifications of the respective country.

Users must select suitable gas at different ambient temperature as follows:

Table 3- 1

Gas Type	Gas calorific value(MJ)	Pressure	Methane %
NG	31	3~5kPA	≥85%
CNG	38		

Warning

Because the gas system is extremely precise, it's very important to keep the gas clean and no dirt or water. If there is water or dirt in the gas system, it may severely damage the gas system.

RAYWIN requires the user to use recommended gas.

4.2 Oil

The precision of 4D24NG series engine parts is very high, hence the oil selection requirements is strict. need to choose gas specific oil
The oil with suitable grade should be selected according to the local season and temperature, and must pay attention to two indicators, namely the oil quality level (Performance Level) and viscosity grade as below,RAYWIN recommended oil for 4D24NG & 4D24NTG is listed below:

Name	Grade
Oil	Total MH40

Other rule:

●When the total alkalinity (TBN) of the engine oil drops to 1.0, it must be replaced. TBN（mg KOH/g）tested standard: as per JIS K-2501-5.2-2（HCl），or ASTMD4739(HCl)

●Standard engine oil replacement interval is 250 hours or 12 months.

●Do not add any additives in the engine oil.

●Do not blend different types, and/or brands oil.

4.3 Antifreeze

△Attention

When the engine stops working and no insulation measures is took below 0 ℃, the water in the cooling system will freeze, and the volume expands which causes block, radiator, cylinder head, water pump and other cooling system components cracked, therefore, antifreeze must be filled into the cooling system.

For a longer lifetime, we suggest to use RAYWIN recommended antifreeze.

△Attention

Fresh water is not suitable for the engine coolant, because the thermal conductivity of fresh water is very poor, which can lead to inadequate cooling and make engine internal component damaged.

Water preparation required for engine coolant

When available, please buy the antifreeze specified by RAYWIN POWERTRAIN TECHNOLOGY CO., LTD. If the appropriate antifreeze can not be got, ethylene glycol and soft water are allowed to be blended, and the relationship of the boiling point and pour point of this antifreeze is listed below:

Boiling point and pour point		
Glycol and soft water volume ratio	Boiling point	Pour point
	℃	℃
40	-24	106
50	-35	108
60	-52	111

Pressurized cooling system can increase its boiling point, radiator pressure cap can help keep the system pressure, in order to ensure good water quality, we recommend using our specified or international famous brands and grades of antifreeze

4.3.1 RAYWIN antifreeze brand and model information

Model	Spec.	Freezing Point	Available min. ambient temperature (℃)
YCF4—8	4kg	-8℃	2
YCF4—25		-25℃	-15

Usually, choose the freezing point as 10℃ lower than the lowest temperature of the equipment running area. For example: Suppose the minimum temperature in some area is -15 ℃, then select antifreeze with type of -25.

4.3.2 Note for using antifreeze

a) Please clean the engine cooling system with water before antifreeze is filled, it's better to clean it with demineralized or deionized water.

b) Pay attention to checking the antifreeze level and the tightness of cooling system. Do not fill up antifreeze fully if the machinery has no overflow tank, but 95% volume or so; If there is an overflow tank on the machinery, fill antifreeze to the specified scale firstly, then run the engine for a few minutes, and continue to fill antifreeze to the required scale;

c) The antifreeze from different manufacturers or with different types cannot be mixed, or else the antifreeze performance would be reduced, even it causes engine damage.

d) If the level is below required scale, please fill to a required scale. The filled antifreeze must be same type from same manufacturers as the existing antifreeze in the engine.

e) The glycol is toxic, please clean it with water immediately if the glycol is contacted with skin; Glycol will burn in case of fire, so do not weld or make fire near the engine with antifreeze leakage; The boiling point of glycol is 197.4 ℃, so it's easy to evaporate for the water in antifreeze, please make up water after the antifreeze works for some time.

4.3.3 Replace antifreeze regularly.

a) Light duty antifreeze/inorganic antifreeze replacement cycle is 24 months.

b) Heavy duty antifreeze/organic antifreeze, replacement cycle is 36 months.

c) The technical requirements of light duty antifreeze/inorganic antifreeze or heavy duty antifreeze/organic antifreeze should meet the petrochemical industry standards or RAYWIN Q /YC 908 "engine coolant technical conditions" requirement.

4.4 Battery selection

With the machinery electricity consumption is increasing in plateau or alpine regions in the winter (-15 ℃ or less), to ensure and improve engine cold starting performance, the machinery should be equipped with same capacity low temperature batteries.

Table 3-6 Battery Selection Table

Common region		**Plateau or alpine region**	
Battery capacity(Ah)	Cold starting current (A)	Battery capacity(Ah)	Cold starting current (A)
≥120（165）	570	≥180（195）	622
Note	It's better to select the battery type in the brackets for the engine that runs in plateau region.		

5. Engine Operation & Maintenance

5.1 Engine Operation

5.1.1 Before starting

a) Check the oil level in the oil sump. The level should be within the upper and lower scale limits of the oil dipstick. If the oil volume is not enough, fill some oil as required after checking the accordance of oil grade with temperature.

b) Check the coolant level, add some coolant if necessary, and the accordance of coolant type with temperature should be checked before filling.

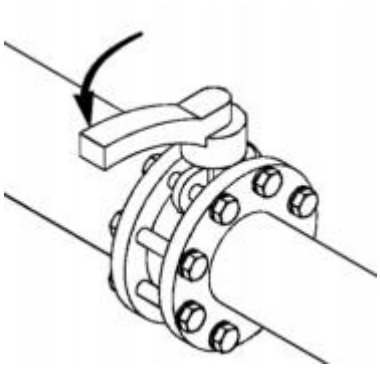
c) Inspect and rectify the sealing integrity of the gas piping system

d) Check the electrical system (including connecting wires, switches, electrolyte, fill enough electrolyte if it's insufficient.)

e) Check the tension of the driving belt，the tension should be moderate as required.

Inspect gas line seals

Starting Steps



⚠ CAUTION

1. Natural gas is explosive and flammable. Keep all cigarettes, flames, lighted lamps, arc-producing equipment, and switches away from the work area and shared ventilation spaces to reduce the risk of severe personal injury or death when working on natural gas systems

2. Natural gas is lighter than air. Check the ceiling of the work area for any potential ignition sources.

3. Maintain proper ventilation when working on natural gas systems

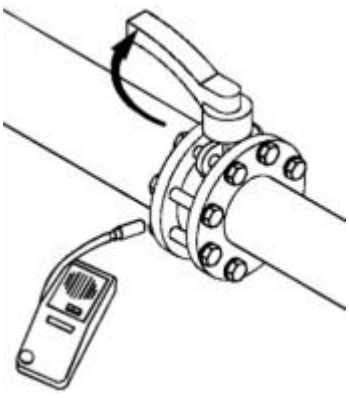
4. To minimize the risk of shock loading to downstream components, gas supply valves must be opened and closed slowly.

During the scheduled 10,000-hour overhaul, replace the gas line seals.

When the gas piping is supplied by the end user, maintenance and replacement shall be performed in accordance with the supplier's requirements.

Only trained and qualified personnel are permitted to perform this maintenance

Final Steps



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2. Natural gas is lighter than air. Check the ceiling of the work area for any potential ignition sources.

3. Maintain proper ventilation when working on natural gas systems.

4. To minimize the risk of shock loading to downstream components, gas supply valves must be opened and closed slowly.

Note:

During the scheduled maintenance at the 5,000-hour service interval, inspect the gas line seals.

Only trained and qualified personnel are permitted to perform this maintenance.

Check the turbocharger axial clearance and radial bearing clearance.

5.1.2 Start

Warning

Do not start the engine in the environment where may be flammable gases, that could be drawn into the engine through the intake system, resulting in engine acceleration and over-speed, which could cause fire, explosion and property damage. Engine manufacturer can't know how the user operates the engine. Engine user and operator are fully responsible for operating the engine safely under harsh environments.

△Attention

The engine cannot be started unless the preparations have been completed and confirmed to comply with requirements. (The engine could be started after warmed in cold winter). The continuous starting time can't be over 10 seconds, the next starting time interval is should not be less than 1 minute, if it can't be started after three times trial in succession, user should check the reasons and restart it after the malfunction is removed.

△ Attention

Check the oil pressure: it should not be lower than 0.1MPa at idle speed. If the low oil pressure indicator still flash within 15 seconds or the oil gauge displays no oil pressure, please shut down the engine immediately to prevent engine from damage.

Check whether the water pump operates properly and whether the coolant runs into water jacket of the gas engine. Check the leakage of oil, gas and water, and shoot the trouble if there is leakage. Check if there is abnormal noise. Check and confirm all meters work well. Please stop the engine immediately and check the reason if there is abnormal status, and send the engine to service center if necessary.

Cold start: Under the cold environment, it's the same as conventional starting operations. If there is preheating during start, please start the engine after the preheating indicator is turned off or flashing.

Starting steps after long time no running or oil replacement

To start the engine as per the normal steps stated in this chapter. The engine could not be started if the ECU detects that the oil pressure does not meet the minimum pressure of motor starting value. It will take a longer time to start the engine if it is no running for a long time or with replacement of oil.

5.1.3 Running

When the gas engine is started, it should keep running at low and medium revolution speed in sequence with no load, the engine could not run at high speed with full load unless the coolant temperature is higher than 60℃ and oil temperature higher than 45℃. Pay attention to the following instructions:

△ Attention

Do not idle for long time, or else it may reduce engine performance. The oil pressure should be not less than 0.1MPa

Observe the meters reading frequently during engine operation, ensure the oil

pressure, oil temperature and water temperature to be in normal range.

If there is alarm from meter, or engine abnormal sound or abnormal vibration, please stop the engine and check it as soon as possible.

Pay attention to the sealing of every water passage and the gas pipe. If there is leakage, remedy it immediately.

△ Attention

The new engine or overhauled engine is not allowed running at high-speed or with heavy load. In order to ensure a good break-in, the load should not exceed 65% within the first 40 hours.

5.1.4 Stopping the gas engine

Do not stop the engine sharply unless there is an emergency. Keeps the engine running at low revolution speed for 3 to 5 minutes before stopping it in order to make the engine cool down, and keep idling for 2 to 3 minutes in order that the oil could be carried to each part of the engine, then stop the gas engine.

When the ambient temperature is below 5℃ and the coolant is not sure to be anti-freezing, discharge all of the coolant liquid after stopping the engine to avoid engine damage by frost crack.

When the temperature is below -30 ℃, the battery should be disassembled and moved to warm space, otherwise it would be hard to start the engine.

5.1.5 Routine Operating Notes:

Comparing to the traditional mechanic gas system, electric control gas system requires higher gas cleanliness.

Please using gas with regular stations.

When the gas pipeline needs to be removed, the tools and hands must be cleaning to avoid the pipeline to be contaminated.

The malfunction indicator is on the control panel, if there is no malfunction, the indicator shall flash once then be turned off while the engine is electrified. If there is malfunction, the indicator will be turned on automatically and the malfunction reminder will be displayed, please turn off the ignition switch, and check the engine gas pipeline, air system and electric circuit carefully to find whether there is obvious gas leakage, air leakage or connectors fallen off.

In principle, when the malfunction indicator is turned on, the user check and find there is obvious gas pipeline, air system or electric circuit malfunction, the user may solve it by himself.

5.2 Maintenance of gas engine

- The initial maintenance should be made and recorded according to the warranty manual.
- During the use of gas engines, the following requirements should also be carried out for routine maintenance, daily maintenance by the user own, other levels of

maintenance by professional maintenance person；

- Air filter is a key component to ensure the gas engine clean air inhaled, to always check the air intake system and maintenance, to replace the air filter, ensure that the gas engine does not appear early wear.

5.2.1 gas engine breaking-in

The new gas engine need to have breaking-in period (starting 50h), in order to make the match performance of each moving parts to further improve, ensure the working reliability and service life of the gas engine：

1)After starting the gas engine in low speed to warm up for at least 5 minutes;

2)After starting, the load cannot be increased sharply, it needs to slowly increase;

3)gas engine idle speed or full load running not more than 5 minutes;

4)Often observe the oil, water temperature meter, to ensure the normal working status of the gas engine;

The overhauled gas engine, also need to have breaking-in period (refer to new machine breaking-in), to ensure of the friction pairs matching effect. After the end of the breaking-in period oil should be replaced, and replace the oil filter element. No idle running, which resulting in early wear and tear.

5.2.2 Maintenance of gas engine

Correct, timely and careful maintenance can guarantee gas engine working smoothly for a long time, to prevent the occurrence of fault, reduce wear, prolong the service life. The user should according to the content listed in gas engine maintenance, specific classification as follows:

5.2.5.1 Maintenance cycle of the table below**:**

Note: the use of harsh conditions (minimum temperatures below - 20℃, or the highest temperatures higher than 35℃, or environmental dust content in the high desert, mine site, construction sites, coal yards, etc.), it is necessary to shorten the replacement cycle of engine oil.

To ensure the long-term and safe operation of the engine, it is essential to conduct regular inspections in accordance with the table below.

Item	Before each run	Every 50h	Every 100h	Every 250h	Every 500h	Every 1 or 2 month	Every 1 year	Every 800h	Every 1500h	Every 2000h	Every 2 years
* Check gas piping and connections for leaks.	☆										
Replace Oil		★first		★							
Replace Gas Filter				☆							
* Clean air filter element（Replace the filter after 5 cleanings）			☆								
Check the electrolyte level of the battery.			☆								
Check the V-belt tension and inspect the fan belt for damage and wear.			☆								
Replace oil filter		★first		★							
Check the radiator hoses and clamps.				☆							
* Check the intake piping				☆							
Clean the water hose casing and radiator interior.				☆							
Replace fan belt					★						
Recharge the battery.			☆			☆					
* Replace air filter element							★				
Check valve clearance								☆			
Replace the mixer diaphragm valve								★			
Check spark plug								☆			
Check E-governor (throttle)									☆		
Flame arrester					☆				★		
Clean the pressure regulator filter screen and inspect the seals.									☆		
Alternator										☆	
Starter										☆	
* Check the turbocharger (if equipped).											☆
* Replace the air filter connection hose.											★
Replace Battery											★
Replace the radiator hose and clamp											★
Replace the radiator coolant (long-life coolant)											★
★Replace the relevant parts at the designated inspection points.											
☆Inspect the relevant parts at the designated inspection points.											
The items marked with * in the above table are identified by Raywin as emission-related critical components. As the engine owner, you are responsible for performing the necessary maintenance as instructed above or by consulting an authorized service station.											

△Attention

When replacing or inspecting, please make sure to level it out and stop the engine.

6. Gas engine daily maintenance instructions

Good maintenance from day to day of gas engine and its system are beginning to understand, starting gas engine before check the oil level and coolant level, check whether there is：

- leakage
- The loose and damaged parts
- The belt is worn or damaged
- Any change in the appearance of the gas engine
- No gas smell

At the same time need to see if there is no fault lights on, if there is a fault then need to identify, if it is historical failure, can be cleared 。

This section describes the daily maintenance instructions of some of gas engine system and parts.

6.1 Coolant level check of cooling system

Coolant level check

Warning

Do not open the radiator pressure cap from the hot gas engine, should wait for coolant temperature below 50℃ to open the pressure cap, otherwise high temperature coolant or steam spray may cause personal injury。

Warning

Coolant is poisonous to avoid contact with kids or pets. If it is not be used anymore, it should be treated according to the local environmental regulations。

Warning

Do not use corrosive cleaning agents in the cooling system, otherwise it will damage the aluminum parts**.**

Attention

Do not use the seal additive to solve the cooling system leakage problem. This will cause the cooling system block and the coolant flow is not smooth, thus causes the engine overheat.

The coolant level must be checked every day.

Attention

Do not add a cold coolant to the hot gas engine, otherwise it will damage the gas Engine Castings, wait until the gas engine temperature below 50 ℃, then add coolant**.**

Adding coolant to the gas engine must be mixed with the correct proportion of antifreeze, auxiliary coolant additives and water to prevent damage to the gas engine。

Fill the coolant to the bottom of filler, of the radiator or expansion tank。

6.2 cooling fan

The user every day should visually inspect cooling fan. Check for cracks, loose rivets, curved blade or loose. Check the fan and ensure it is installed firmly. If necessary, tighten the bolt

Warning

DO not rotate the gas engine by pulling or prying fan. Otherwise it will damage the fan blade, resulting in fan fault and caused personal injury or property loss, should use accessory drive shaft and the crankshaft turning tool to rotate the crankshaft.

Warning

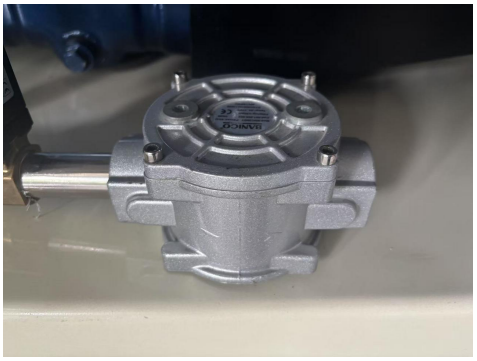
Do not attempt to bend the blades of the fan or continue to use the damaged fan, bending or damaged fan blades cannot work properly, and will result in personal injury or property damage.。

6.3 Gas filter

Warning

It is recommended to replace the gas filter regularly to extend engine service life and improve gas economy.

Attention



Close the discharge valve, the valve will not be overdone, excessive tightening will

damage the thread**.**

6.4 Check oil level

User should check the oil level before each starting.

Attention

It is strictly prohibited to running the engine in oil level below or above the oil limit marks, which can lead to gas engine performance degradation and damage of gas engine**.**

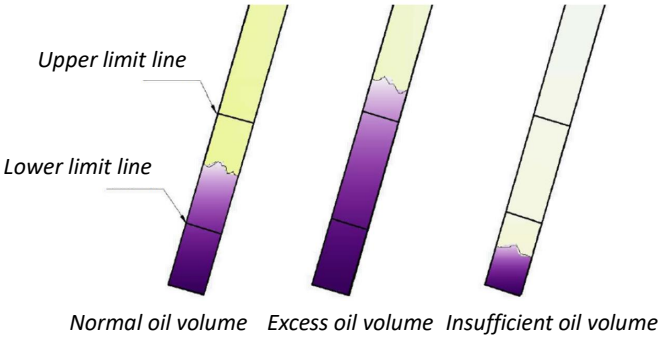


Fig. 5-1 Schematic diagram of oil dipstick

The precise reading can be measured after gas engine shutdown. At least until gas engine downtime longer than 15 minutes, then began to check the oil level. This period of time can let the oil back to the bottom of oil pan。

Warning

Used oil has a carcinogenic effect, and may produce reproductive disease, should avoid the inhalation of oil vapor, do not swallow and prolonged contact with the used oil, if no longer use should be handled in accordance with local environmental regulations

Warning

In order to reduce the possibility of personal injury, should avoid the skin direct contact with hot oil.

6.5 Drive belt check

Tightness of the belt cannot be too loose or too tight, too loose will reduce the transmission efficiency of the water pump, the rotation speed of the fan and the charger is not enough, influence the cooling effect. At the same time too-loose belt produces vibration will cause belt and pulley unnecessary wear, too tight, it will influence the belt and bearing parts service life。

6.6 Air filter

Users can observe the air resistance indicator to judge the air cleaner clogging which installed on the intake pipe of the air filter, when air resistance indicator changed from normal green to red, it indicates that the air intake filter resistance exceeds the limit value, and air filter need to be cleaned or replaced.

Fig.5-2 Air Filter

Attention

The engine is absolutely forbidden to work in case of air filter failure or without air filter. The intake air must be pre-filtered to prevent dust and impurities, otherwise caused engine early damage.

6.7 Valve

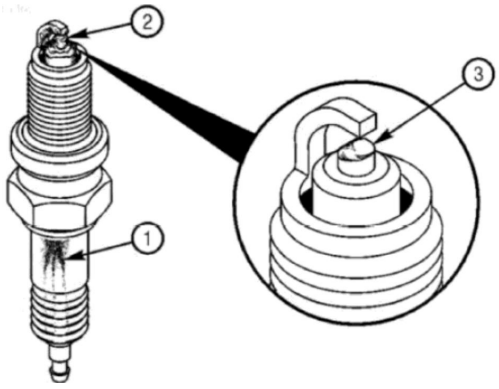
In order to ensure the normal working status of gas engine, the user should regularly check and adjust the valve clearance. In the cold status, the clearance of the intake valve is 0.2±0.05mm, the clearance of the exhaust valve is 0.2± 0.05mm

Valve clearance checking and adjustment method is：

The crankshaft turns to the first cylinder compression top dead point position, then you can check and adjust the 1,2,3,6 valve, after then the crankshaft rotates 360 degrees, then you can check and adjust the 4,5,7,8 valve. Valve clearance adjustment can be carried out by adjusting valve and adjusting screw. First loose lock nut, screw in or out with screwdriver, then check the rocker arm and the valve clearance with feeler, and tighten the lock nut after meeting the requirements.

6.8 Spark plug

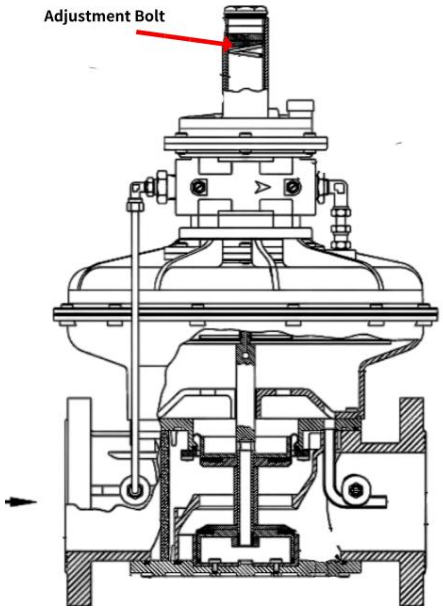
Inspect the spark plugs for the following issues:



1. Insulator flashover
2. Electrode deposits or fouling
3. Worn or missing electrode.
4. Need clean the carbon on the terminal pole

If a spark plug exhibits any of these conditions, the spark plug must be replaced.

Note: Ignition gap--0.3~0.4mm



6.9 Regulator

Regulation methods for gas pressure regulators:

1. Performance of the regulator:

   1)The built-in spring in the regulator can balance the fluctuations in the inlet pressure and maintain the stability of the outlet pressure;

   2.)There are pressure measurement interface ports on both the inlet and outlet sides of the regulator;

   3.)Set point accuracy: The error is ±5% of the outlet pressure set point.

2.Regulation of the regulator:

   1)Remove the sealing screws of the pressure measurement interface on the outlet side of the regulator;

   2)Connect the pressure measurement equipment to the pressure measurement interface;

   3)Rotate the top cover of the regulator counterclockwise;

   4)The outlet pressure is achieved by adjusting the setting screw. Clockwise rotation of the setting screw will increase the outlet pressure; conversely, it will decrease; the pressure measurement equipment can display the outlet pressure;

   5)When regulating the regulator, always adjust the outlet pressure from small to large, slowly, and do not exert excessive force;

   6)Record the outlet pressure set point of the regulator (suggest 0.3~0.6kpa);

   7)Reinstall the top cover of the regulator;

3. Replacement of the regulating spring:

   1)Remove the top cover of the regulator;

   2)Fully unscrew the setting screws counterclockwise;

   3)Remove the old spring or an unsuitable spring, and replace it with a new or suitable spring;

   4)Reinstall the setting screws and set the outlet pressure according to the regulation method of the regulator.

Raywin Powertrain Technology Co., Ltd

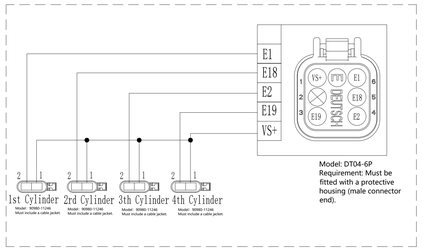
Add:NO.99jiujiang Rd,Shuangfu District,Jiangjin District,Chongqing,China

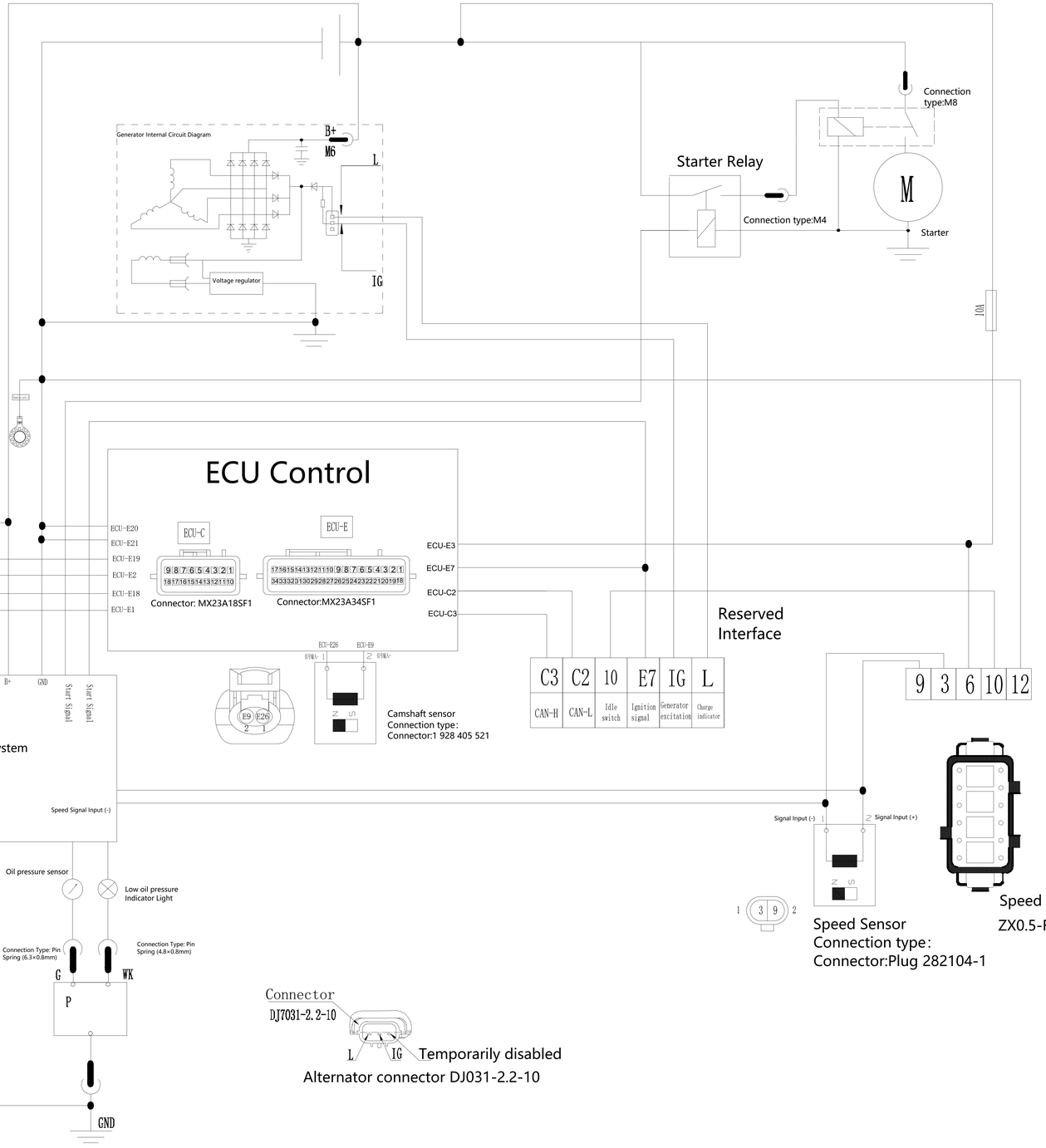
Tel：+86-23-85553153

Email: info@raywin.cc

Website:http://www.raywinpower.com

4D24NTG/4D24NG Series Electrical Diagram





Technical Requirements

1.System Power Supply Voltage: DC 12V.
2.Coolant Temperature Sensor: NTC type.
3.Oil Pressure Sensor:
  Terminal G= Pressure signal
  Terminal WK = Low oil pressure switch
4.Flywheel: 98 or 109 teeth (depending on variant).
5.Starter Power: 2.8 kW / 12V DC.
6.Alternator Power: 70A / 14V DC.
7.NTC Thermistor:
  Resistance at +25°C: 560Ω ±5%
  Error rate: 3930 Ω ±1.5% (Note: Likely a typo in original, assuming resistance value)
  Resistance vs. Temperature Reference Table (VDO, up to 120°C)

Temperature ℃	40	50
Resistance Ω	276-325	189-220
Temperature ℃	60	70
Resistance Ω	132-151	94-107
Temperature ℃	80	90
Resistance Ω	68-76	50-56
Temperature ℃	100	110
Resistance Ω	37-41	28-31
Temperature ℃	120	
Resistance Ω	21-24	

8.Oil Pressure Sensor Resistance vs. Pressure Reference Table (VDO, 10Bar max)

Mpa	0	0.2	0.4	0.6	0.8	1
Resistance Ω	10^{+2}_{-4}	58±3	88±3	124±4	155±4	184^{+20}_{-10}

Important Notes:

1.Engine Battery Requirements:
  For low-temperature operation, increase battery capacity as needed.
  12V System: 65Ah / 500 CCA (Cold Cranking Amps)
2.Controller Sensor Grounding Requirements:
  The common ground pin for all sensors must be securely grounded.
  If necessary, implement multiple grounding points to minimize signal interference.
  The wiring harness connecting the speed sensor to the controller must use:
    Twisted-pair cables (to reduce electromagnetic interference)
    Single-ended shielding (for additional noise protection)