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The generating set technology of diesel oil operates and safeguards maintaining the manual

# DIESEL GENERATING SET



# OPERATION MANUAL

## **FOREWORD**

Thank you for purchasing our diesel generator set.

This manual contains information for the correct operation and maintenance of your generator set. It also contains important safety and installation information, troubleshooting guidelines. Please always keep this manual with the equipment.

Please operate this equipment after thoroughly reviewing and understanding the contents of this manual.

This manual does not cover diesel engine and alternator maintenance procedures. Please consult the engine and the alternator operation and maintenance manuals if necessary.

The information contained in this manual was based on the genset in production at the time of publication. We reserve the right to make changes at any time without notice and without incurring any obligation.

Without express written permission from us, any part of this manual can not be reproduced in any form or by any means.

## **SAFETY INFORMATION**

Failure to properly follow these precautions can result in property damage, serious injury or DEATH! Read these manual carefully. It is essential that you read the manual and safety regulations before you attempt to assemble or use this unit.

### **WARNING**

It indicates a strong possibility of severe personal injury or even death if instructions are not followed.

### **CAUTION**

It indicates a possibility of minor or moderate injury if instructions are not followed.



It indicates a possibility of potential hazards if instructions are not followed.

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# 1. Safety Information

Before operating the machine, read the safety regulations carefully and find out about the local requirements in safety. It can reduce the possibility of personal injury, damage to the equipment, or improper service.

The operation, maintenance and repairs must be carried out only by authorized and competent personnel.

The owner is responsible for maintaining the generator set in good safety conditions.

Read carefully the safety symbols attached on the generator set and obey all messages that follow the symbols to avoid possible injury or death.

## 1.1 Safety Precautions

- 1) Do not allow children or animals to access the operating area of the generator set.
- 2) The exhaust gas from the engine contains many harmful elements to human, and can be deadly. Always operate the generator set in well ventilated areas. Check the correct ventilation of the premises so that the exhaust gas can be released to the atmosphere, to the exterior of the premises, and verify that they are in a safe position away from doors, windows and air intakes.
- 3) All the loads connection and maintenance of the generator set must be carried out by specialized personnel.
- 4) Before starting the engine, check all electrical connections are correct, safety insulated.
- 5) Make sure that all the ground wires are suitably earthed for proper operating safety.
- 6) Before operating the generator set, check all the door are well locked and covers are fixed.
- 7) Make sure there are no losses or leaks in the oil, fuel and coolant pipes.
- 8) Check the level of the oil, fuel and coolant.
- 9) Installation and repair procedure require specialized skill with electrical generating equipment and small engine systems. Any person that installs or performs repairs must have these specialized skills to ensure that the generator set is safe to operate.
- 10) When performing check or maintenance, make sure that the poles has been disconnected from the battery.

### 1.1.1 Electric shock hazards

The generator set will produce enough electric current to cause a serious shock or electrocution if misused. Do not connect to the building's power system without installation of the transfer switch performed by a qualified electrician. Failure to properly ground generator can result in electrocution. Failure to isolate generator from power utility can result in death or injury to electric utility workers. **DO NOT** handle generator or electrical

cords while standing in water, while barefoot, or while hands or feet are wet. Before performing any maintenance on the generator, disconnect the battery cable first. When finished, reconnect that cable last.

#### 1.1.2 Carbon monoxide hazards

Exhaust gas contains poisonous carbon monoxide, a colorless and odorless poison gas. Inhaling exhaust can cause loss of consciousness and lead to death. If you run the generator set in unventilated or confined place, the air you breathe could contain a dangerous amount of exhaust gas. So be sure to keep the good ventilation to prevent the exhaust gas from building up. Breathing carbon monoxide can cause headache, fatigue, dizziness, vomiting, confusion, seizures, nausea, fainting or death.

#### 1.1.3 Safe running

DO NOT expose generator set to excessive moisture, dust, dirt, corrosive or explosive vapors.

Do not approach the generator set if you are wearing loose clothes or objects that may be attracted by the airflow or by the mobile parts of the engine. It is forbidden to lean on the generator set or to leave objects on it. Do not touch the engine and muffler during operation or just after the engine stops, because the temperature can reach extremely high.

#### 1.1.4 Fire and burn hazard

Keep the generator set clean and the generator set house tidy. The exhaust gets hot enough to ignite some materials. Keep flammable materials away from the generator set. The fuel is flammable and fuel vapor can explode. Safety dictated that fully charged BC and ABC fire extinguishers are kept on hand.

#### 1.1.5 Battery and charging

Battery electrolyte fluid contains acid and is extremely caustic. Contact with battery contents will cause severe chemical burns and blindness. If electrolyte contacts skin or eyes, immediately flush the area with water and seek medical attention quickly.

Storage batteries give off explosive hydrogen gas during recharging. Slightest spark will ignite hydrogen and cause explosion.

#### 1.1.6 Safety during using fuel and oil

If fuel or oil contacts skin, immediately flush the area with water. Wear protective gloves to avoid contacting fuel or oil. Do not add oil or fuel to a hot engine. Allow the engine to cool

down firstly.

### 1.1.7 Safety during using coolant

Always check the coolant level before operating the generator set. Do not open the radiator cap during operation or just after stopping the engine. The radiator fluid is hot and under pressure and may cause serious burns. Only when engine is cool, coolant level could be checked.

### 1.1.8 Grounding

The generator set has been equipped with grounding bolt on the base frame. Grounding should be made before running the generator set, and all the bonnets of the loads must be also grounded to the earth. Take extreme caution to avoid risk of fulguration, make sure the grounding has been fitted according to the regulations.

### 1.1.9 Safety during maintenance

When performing check or maintenance, make sure that the engine has been stopped. Disconnect all external loads and the poles from battery before maintenance.

## 2. Generator set introduction

The generator set is designed to be safe when used in correct manner. However responsibility for safety rests with the personnel who install, use and maintain the set. Before performing any procedure or operating technique, it is up to the user to ensure that it is safe. The generator set should be operated by personnel who are authorized and trained.

### 2.1 General description

Generator set is a power station which is driven by the diesel engine. General speaking, it contains the diesel engine, alternator and control system. The engine drives the alternator to produce output electrical power while the control system controls the operation and output of the generator set and protects the machine from possible malfunctions. Besides, the generator set also includes accessories such as the control system, radiator, fuel tank, battery, muffler and base frame.

#### 2.1.1 Diesel engine

The diesel engine powering the generator set has been chosen for its superior

performance and reliability and the fact that it has been specifically designed for powering the generator set.

### 2.1.2 Alternator

The alternator producing output electrical power has been chosen for its superior performance and reliability. All the standard alternators are the machines without slip rings and revolving field brushes with class H insulation.

### 2.1.3 Control system

The control system is equipped to control the operation and output, and protect the machine from possible malfunctions. The control module is being used to automatically start and stop the engine, indicating the operational status and fault conditions, automatically shutting down the engine and indicating the engine failure by alarm LEDs on the front panel. It can display presenting all output values and various alarms information.

### 2.1.4 Electrical system and cooling system

The engine electrical system is 12 (or 24) volt DC electricity, which consists of the start motor, battery and battery charger.

The engine cooling system is comprised of radiator, pusher fan and a thermostat. The alternator cooling system is air cooled which consists of a fan to pull cool air across alternator to cool it.

### 2.1.5 Vibration isolator

The engine and alternator are coupled together and mounted on the base frame. The generator set is fitted with vibration isolators which are designed to reduce engine vibration being transmitted to the foundation on which the generator set is mounted. These vibration isolators are fitted between the engine/alternator feet and the base frame.

## 2.2 Ambient condition

- 1) Temperature: -25°C to 45°C (use the water preheat unit below 5°C)
- 2) Humidity: Less than 80%
- 3) Altitude: Less than one thousand meters above sea level

## 2.3 Power derating

For environmental conditions of installation and operation different from those above



specified, it is necessary to foresee an eventual loss of power, or derating, not only in the engine but also in the generator that is fitted into it, and therefore, in the electrical power provided by the generator set.

The user/customer must clearly establish the effective environmental conditions in which the generator set will operate when placing the order, so that both the engine and the alternator are correctly sized.

## **3. Installation**

### **3.1 General**

When the generator set is delivered, it is advisable to check that the received matches the order, and to compare it to with the delivery note. Also, check that the machine is not damaged.

If any flaw is detected, you must contact the shipping company immediately in order to report the incident to the insurance company.

### **3.2 Base and foundation**

Special foundation is unnecessary. A level and sufficiently strong concrete floor is adequate.

- 1) Provides a rigid support to prevent deflection and vibration.
- 2) Support the total weight of the generator set.
- 3) Isolate generator set vibration from surrounding structure.
- 4) The width and depth of the foundation need to meet the requirement. Typically the foundation should be 150mm to 200mm (6 to 8 inches) deep and at least as wide and long as the generator set. The following formula may be used to calculate the minimum foundation depth:

$$T=K/(D \times W \times L)$$

T= thickness of foundation in m

K= net weight of generator set in Kg

D= density of concrete (take 2403 Kg/m<sup>2</sup>)

W= width of foundation in m

L= length of foundation in m

The foundation strength may still vary depending on the safe bearing capacity of supporting materials and the soil bearing load of the installation site, therefore reinforced gauge steel wire mesh or reinforcing bars or equivalent may be required to be used.

- 5) It essential that the foundation should be level, preferably within  $\pm 0.5^\circ$  of any horizontal plane.

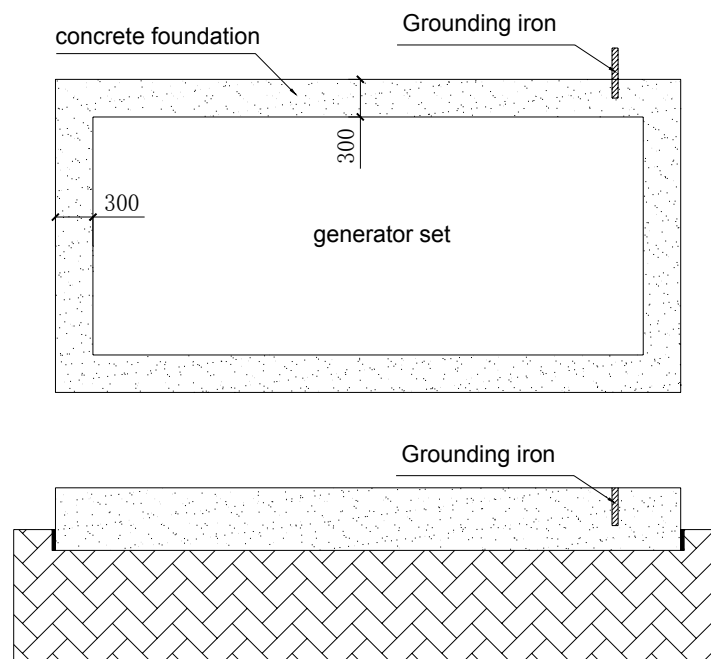
If the ground or floor may be wet from time to time such as in a boiler room, the foundation should be raised above the floor. This will provide a dry footing for generator set and for

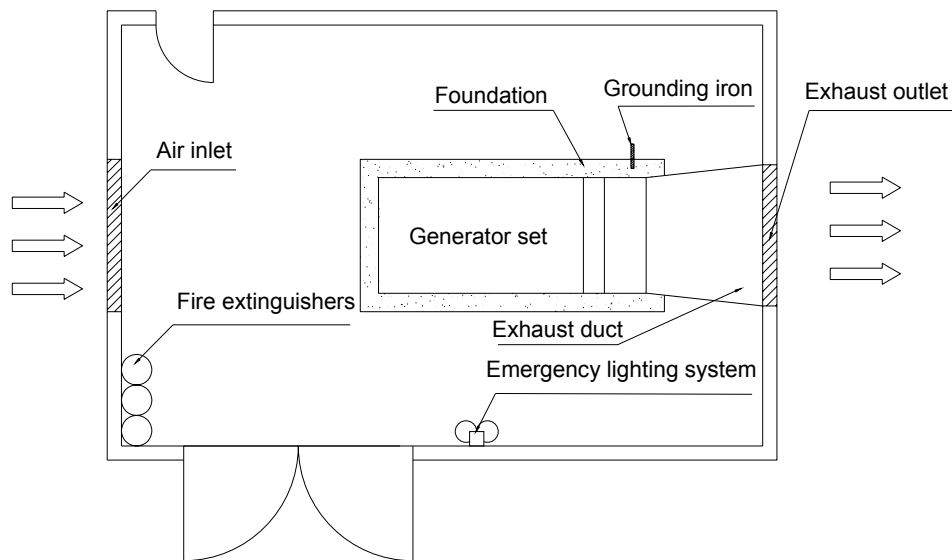
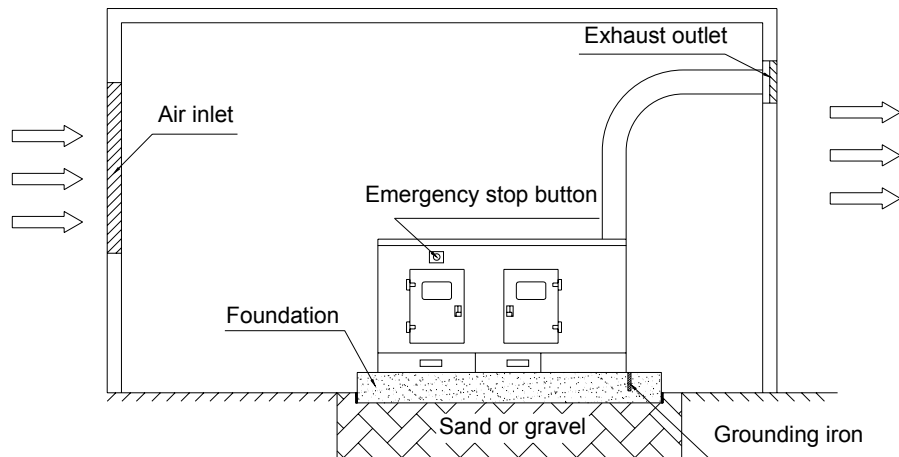
those who connect service or operate it. It will also minimize corrosive action on the base frame.

### 3.3 Room design

In order to start to consider the possible layouts for the room, the follow criteria must be determined:

- 1) Room should have one or two entrances. The one size should make allowance for the delivery and installation of the equipment, and afterwards for servicing and maintenance of the equipment.
- 2) Room should be well ventilated. The air inlet and outlet openings should be large enough to ensure free of air into and out of the room. As rough guide, the opening should be at least 1.5 times the area of the radiator core. It is important that adequate ventilation is provided to keep engine and alternator cool. Proper air flow requires that the air comes in at the alternator end of the set, pass over the engine, through the radiator and out the room via a flexible exhaust duct. Without the ducting of the hot air outside the room, the fan will tend to draw that hot air around and back through the radiator, reducing the cooling effective.
- 3) Room should keep the good ventilation to prevent the exhaust gas from building up. Do not install generator set where exhaust gas could accumulate and enter inside or be drawn into a potentially occupied building.
- 4) Room dimension should allow for good maintenance/escape access around the generator: at least 1 meter around the set and at least 2 meters headroom above the set.
- 5) Room must be equipped with fully charged BC and ABC fire extinguishers.
- 6) Protection from exposure to airborne contaminants such as abrasive or conductive dust, lint, smoke, oil vapors, engine exhaust fumes or other contaminants.



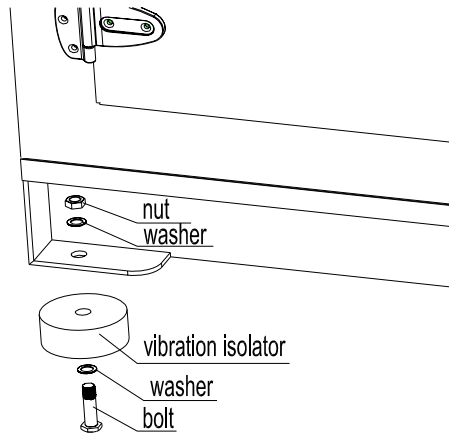


### 3.4 Installation

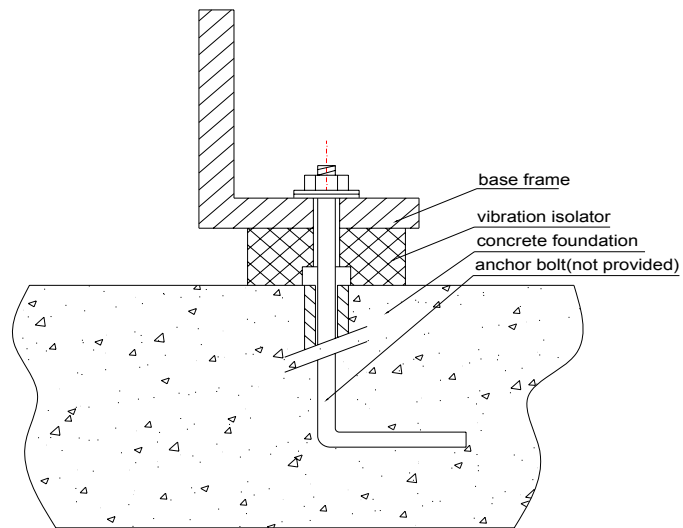
#### **⚠ WARNING**

***All piping and electrical connections should be flexible to prevent damage from the vibration of the generator set.***

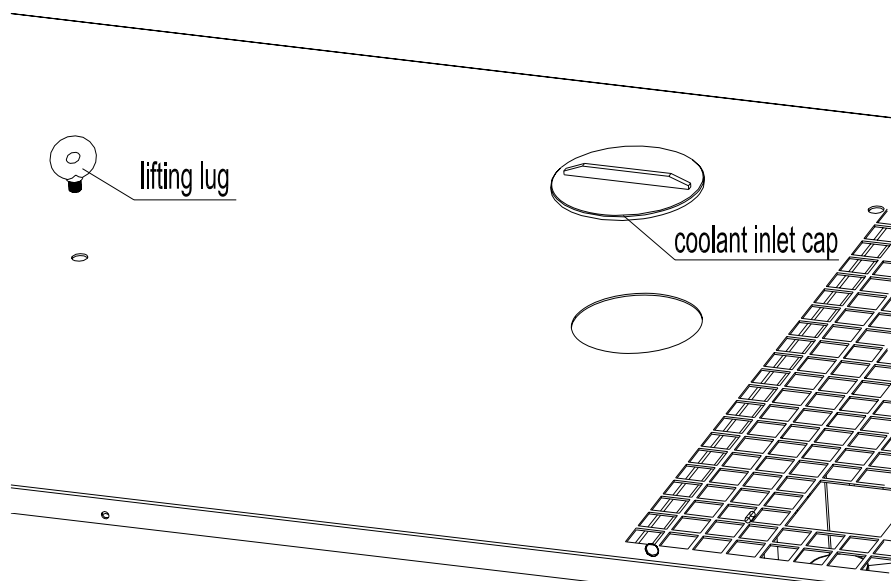
- 1) Fix the vibration isolators to the base frame with provided bolts as below. And place the generator set at a level and sufficiently strong foundation.



Use the anchor bolt to fix the generator to the foundation if necessary.



2) Tighten the lifting lug and the coolant inlet cap.



## 3.5 Utility power

Utility can provide power to critical components on the generator set, like battery charger, water heater, oil heater and other devices.

The battery naturally discharges while it is stored or not running. To maintain the generator set in a good capability of starting, recharge it once a month in summer, and every 2 months in winter. The user can charge the battery through ATS equipment, or by connecting utility wirings to terminals of the battery charger.

The engine will be hard to start in the cold environment. It is recommended to equip appropriate heater unit. Connect wirings of the heater to utility before starting the engine. Turn on the utility switch, the heater unit starts to work. When the temperature reaches the preset value or the engine has started, the heater unit will stop working automatically.

## 3.6 Load connections

### 3.6.1 Select load cable

Select the cable with proper diameter, based on its allowable amperage and the distance between the generator set and the load.

Recommend to select the proper diameter and length of cable. There is maximum 5% marginal drop only for the rated voltage between the terminals of loads generator set via the cable. It should be considered while selecting the cable.

#### WARNING

- 1) *If load exceeds allowable amperage, the cable may be damaged in overheating.*
- 2) *If the cable is either too long or too small, there will be greater voltage drop between cables which bring voltage drop to loads. It may result in reduced performance in the connected loads.*

### 3.6.2 Connecting load cable

The generator set is ready for user connections. The user load cable should be connected to the corresponding wire terminal which is located inside the control cabinet or switch cabinet, then use a wrench to tighten cable connections and fix them.

Power cables must be placed in suitable channel, tunnels or protective conduct-holder. Do not include AC and DC cables in the same channeling.

#### WARNING

*Connection must be carried out only by a licensed electrician.*

## 3.7 Ground connections

Metal parts of installation, which are exposed to human or have insulation flaw or other reasons, may get in contact with voltage. There must be connected to the ground.

The generator set and electric components have been equipped with their respective grounding terminals which are all connected to the ground terminal in the control cabinet. The terminal is connected to the ground bolt on the base frame. Connect the ground bolt to the land-dispersion.

The connection to the land-dispersion must be made with bare copper wires conductors with a minimum section of 16mm<sup>2</sup>, or if not available, galvanized iron with a 50mm<sup>2</sup> section.

### WARNING

- 1) *If the grounding terminal is unconnected by mistake or accident, it will be very dangerous for human because leaking current inevitably goes through the body.*
- 2) *All the bonnets of the loads must be grounded to the earth.*
- 3) *Grounding should be made before running the generator set.*

## 3.8 ATS connections

The generator set is equipped with an automatic transfer switch receptacle on the control cabinet. The customer can select an appropriate ATS(automatic transfer switch) and connect it to the generator set.

- 1) Connect the control terminal on the generator set and ATS cabinet.
- 2) Connect the output wiring terminals on the generator set to the ATS cabinet.
- 3) Connect the mains supply to the ATS cabinet.
- 4) Connect the load to the ATS cabinet.

### WARNING

- 1) *Stop the generator set before connecting the ATS.*
- 2) *Each phase line and the ground wire connect to the one correspondence.*

The ATS is controlled by the PLC module which can monitor the incoming AC mains supply. If the mains supply is normal, the module will give a signal to the ATS. Then ATS transfers to the mains supply and make it become power for loads, and the generator set does not run. On the contrary the generator set will run and supply power if the mains supply is abnormal.

The ATS location is important, and several key considerations are following:

- 1) The ATS should be located inside the building near the main breaker box or the disconnect box.
- 2) Locate the ATS in a clean, dry, well ventilated location, away from excessive heat. Allow adequate working space around the transfer switch.

- 3) If the ambient air is above 40°C, fuses and circuit breakers must be derated.
- 4) Never install control wires in the same conduit as power conductors.
- 5) Conduit, wire, circuit protective device sizes, insulation etc. must conform to applicable local and national codes and regulations.
- 6) The ATS must be kept away from any location that might allow water to get on it. Do not mount the ATS where flammable liquids or vapors are present.
- 7) If the ATS is mounted outside, it must be protected from the environment.
- 8) Do not mount the ATS on the generator set.

## 3.9 Battery connections

The battery cable should be disconnected to the posts when the generator set is required to transport or store for a long term. Before running the machine, connect the battery cables.

### WARNING

*Do not dispose of battery in a fire. The battery is capable of exploding. If it explodes, electrolyte solution will be released in all directions. Battery electrolyte solution is extremely caustic and can cause severe chemical burns and blindness. If electrolyte contacts skin or eyes, immediately flush the area with water and seek medical attention quickly.*

## 4. Pre-check before starting

### 4.1 General pre-check

Before starting the generator set, check each item below to make sure that the machine can be started up properly and reduce possible problems.

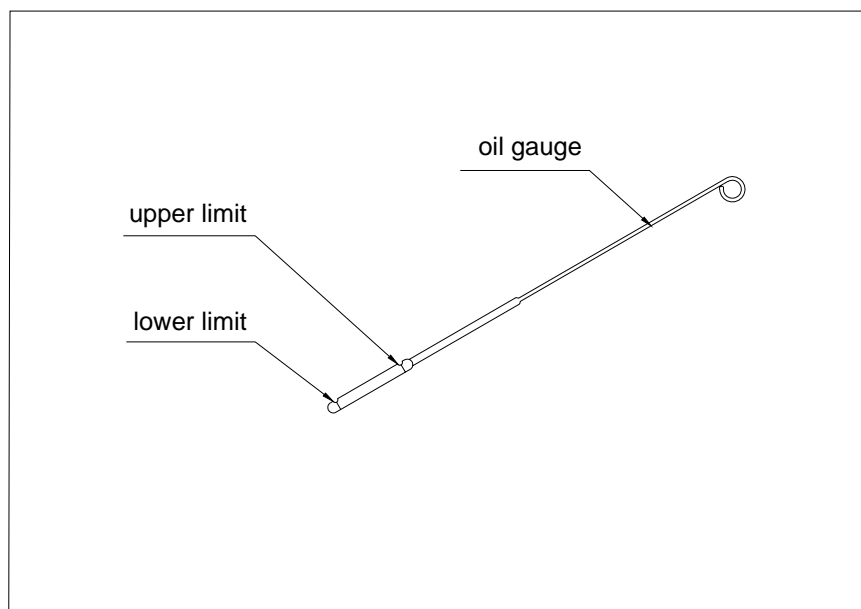
- 1) Check engine oil, fuel and coolant leakage at the hose connections.
- 2) Check to make sure no debris has lodged in vents, near radiator or around fan.
- 3) Check to make sure that nothing is touching the muffler or exhaust pipes.
- 4) Check the looseness of the parts and all the electrical connections.
- 5) Check to make sure that the battery cables are firmly secured to the post. Tighten the clamps more if necessary.
- 6) Check to make sure that fan belt and hoses on engine have no loose connections or fraying. Tighten or replace as required.
- 7) Check that all the loads connections were made in compliance with local regulations and NEC standards.
- 8) Check that generator set is grounded to a good earthen ground per local regulations.
- 9) Close and secure access doors, control cabinet and switch cabinet doors.
- 10) Review and follow safety instructions in the front of this manual.

## **⚠**WARNING

- 1) *Do not use the machine when any leak is found. Repair it first of all. Tighten or change the connection hose if necessary.*
- 2) *Failure to follow the procedures listed may cause injury to personnel or damage to the generator set. Be certain that all persons setting up the generator set are certified or fully trained on the installation of the generator set.*
- 3) *Always wear protective gloves and clothe during operation.*

## 4.2 Checking engine oil level

Keep the generator set level when checking engine oil, insert the oil gauge all the way in. The appropriate level should be between the lower limit and upper limit on the oil gauge.



Add the engine oil if the level is below the lower limit:

- 1) Select the proper engine oil.
- 2) Loosen the oil inlet cap and remove it.
- 3) Fill engine oil into the oil inlet through an oil filter until the level is slightly less than the upper limit by checking the oil gauge.
- 4) Tighten the oil inlet cap.

## **⚠**WARNING

- 1) *If the generator set is not level when checking the engine oil, you can not obtain accurate oil level.*
- 2) *Do not overfill the engine oil. The level can not exceed the upper limit because the excessive amount of engine oil may damage the engine.*
- 3) *Do not smoke or make light fires near the generator set when filling the engine oil.*



### 4.3 Checking coolant level

Remove the coolant inlet cap and radiators cap, check the radiator if full of the cooling water or not. Engine coolant must include antifreeze according to the coolest weather conditions in the area. A mixture of 50% antifreeze and 50% water is recommended.

Add coolant in case of shortage:

- 1) Select the proper coolant.
- 2) Remove the coolant inlet cap.
- 3) Remove the radiator cap.
- 4) Fill coolant up to the radiator inlet top.
- 5) Tighten the radiator cap and coolant inlet cap.

#### **⚠WARNING**

- 1) ***Make sure that the gas is fully drained out of the cooling system.***
- 2) ***Do not open the radiator cover when the engine is running or after the engine is stopped just for a while. Because the coolant temperature is very high in this time. The vapor and splashed coolant may scald you seriously.***

### 4.4 Checking fuel level

Check the fuel level in the tank.

Add fuel in case of shortage:

- 1) Select the proper fuel.
- 2) Loosen the fuel cap and remove it.
- 3) Fill the fuel through the inlet until the fuel is slightly less than the full tank level.
- 4) Tighten the fuel cap.

#### **⚠WARNING**

- 1) ***Do not smoke or make light fires near the generator set when filling the engine oil.***
- 2) ***Often open the drain plug in the fuel tank to drain the sediment and impurity.***

### 4.5 Checking the fan belt

Check the tension and the extend length of the belt. Check the belt if good or not. Replace it if necessary. Refer to its engine manual for the regulation or replacement of the belt.

## **4.6 Checking the battery**

Check if the battery is full charged. Check the battery connection cables. Take care to tighten the loosened battery terminal with spanner and keep clean in order to avoid oxidation.

## **4.7 Checking the grounding protection**

The generator set frame and load must be installed grounding protection, and make sure the grounding protection is ok.

## **4.8 Checking the coolant and oil leakage**

Inspect the wholly unit and open the door to check if there is coolant leakage and oil leakage. If there is, please contact with your dealer for service.

## **4.9 Check the looseness of the parts**

Check the nuts and screws if loosened. If loosened, tighten them. Specially inspect the air cleaner, muffler and charging alternator. Pay attention to the broken cables and loosened terminal.

## **4.10 Clean the dirty and dusty in the unit**

Check the unit inner for dusty and dirty and clean it. Check the muffler and the place near the engine for trash and flammable materials and clean them. Check the intake and exhaust port if clogged by the dirty. Clean it, if necessary.

## **4.11 Electrical connection with load**

Make sure that load does not exceed the power capacity of your unit. Connect electrical connections properly.

## **4.12 Checking the emergency stop button**

Make sure that the emergency stop button is not pressed.

## 5. Operation

### 5.1 Start-up

- 1) Turn off every circuit breaker and all switches of loads.
- 2) Turn off the generator set main circuit breaker and other circuit breakers.
- 3) Press the start button on the generator set panel and the engine begins to start. It will attempt to start about 10 seconds. If the engine fails to start, you need to wait at least 2 minutes before retry.
- 4) After the engine starts successfully, allow the engine to warm up no more than 10 minutes.
- 5) The control module will check the value of voltage and frequency. If the value is abnormal, the warning LED would flash.
- 6) Once the generator is running at the correct voltage and frequency, turn on the generator set main circuit breaker and the circuit breaker of loads, send power to the load side.

### **WARNING**

- 1) ***Before turning on the main circuit breaker, make sure any circuit breaker and switch of loads are positioned to OFF. Otherwise, it may cause electric shock to the operator.***
- 2) ***Do not touch wires and connections to the alternator when the generator set is running because they are live.***

### 5.2 Stop

- 1) Turn off every switch and circuit breaker of loads.
- 2) Keep the engine idle for about 3-5 minutes to allow cool down.

### 5.3 General precautions during operation

- 1) Check the value of voltage, current and frequency, which should be desired.
- 2) Check the value of engine oil pressure and the coolant temperature.
- 3) Check for any leakage of coolant, oil and fuel.
- 4) Check for any unusual vibration or noise.
- 5) Check for any unusual color from the exhaust. Under normal condition, the exhaust gas has no color or light bluish color.
- 6) If engine speed is not stable or engine can not run because of no fuel, extract the air in the fuel system.

## **⚠ WARNING**

- 1) Press the emergency stop button if an emergency occurs and the generator must be stopped immediately.**
- 2) Be sure to keep the tolerance among three phases less than 20%. The load for each phase must be below the rated load as well as the current must be less than rated current.**

## **6. Maintenance**

Before performing any check or maintenance, stop the engine.

For detailed maintenance procedures on the engine and alternator, refer to engine and alternator operator's manual.

In hot and dusty environments maintenance procedure of changing engine oil and oil filter should be performed more frequently.

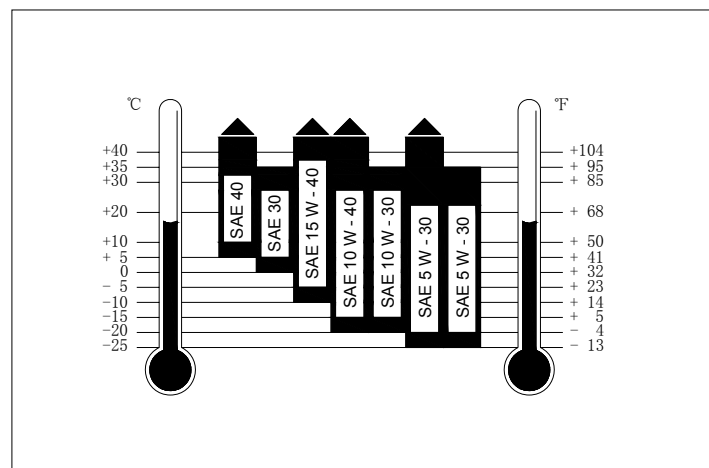
## **⚠ WARNING**

- 1) Accidental starting of the machine during maintenance can cause severe personal injury or death. Disconnect generator set starting battery cables before performing maintenance.**
- 2) Maintenance should be performed by a licensed engineer.**

### **6.1 Lubrication oil**

Oil system of diesel engine is one of the most important elements of the engine. Correctly made engine overhaul prolongs the life cost of the engine.

We recommend that high quality multi grade SAE 15W/40 high service engine oil in diesel engines is used. At ambient temperatures above -15°C is 15W/40. The minimum API oil quality levels recommended for use is CH/CI-4.



## 6.2 Engine coolant

Water for coolant should be clean and free from any corrosive chemicals such as chlorides, sulphates and acids. It should be kept slightly alkaline with a PH value in the range 8.5 to 10.5. Antifreeze must be added to the coolant where is any possibility of freezing to protect the engine form damage due to coolant freezing. A 50% antifreeze / 50% water mixture is recommended.

## 6.3 Fuel choice

It is very important that the fuel oil purchased for use in any engine be as clean and water-free as possible. Dirt in fuel, the fuel can clog injector outlets and ruin the finely machined precision parts in the fuel injection system. Water in the fuel will accelerate corrosion of these parts. The fuel temperature is a critical factor for appropriate working conditions of the engine.

|                        |     |      |      |        |         |         |
|------------------------|-----|------|------|--------|---------|---------|
| Ambient temperature °C | >12 | 4~12 | -5~4 | -14~-5 | -29~-14 | -44~-29 |
| Fuel                   | 10  | 0    | -10  | -20    | -35     | -50     |

## 6.4 Daily check

Inspect the generator set daily or after every 8 hours of operation. Check the mechanical, exhaust, fuel and DC electrical systems as described below.

### 6.4.1 New machine

- 1) Run the generator set at least 60-100% of continuous load for the first 100 hours.
- 2) Change engine oil and replace oil filter after the first 50 hours.

### 6.4.2 Mechanical system

Inspect any signs of mechanical damage. Start the generator set and listen for any unusual noises, which may indicate mechanical problems. Repair them immediately.

Inspect the mounting fasteners to make sure the generator set is secure in its compartment.

Check the generator set air inlet and outlet areas, make sure that they are not blocked with debris.

Clean the machine whenever dust and dirt begin to accumulate. Usually remove dust and dirt with a damp cloth.

## WARNING

- 1) *Do not clean the generator set when the engine is running.*
- 2) *Protect the alternator, air cleaner, control panel and electrical connections from cleaning solvents because cleaning solvents can damage electrical connections.*

### 6.4.3 Fuel system

Inspect the fuel supply lines, return lines, filters and fittings for leaks during the machine running. Replace worm fuel line components if necessary before leaks occur.

### 6.4.4 Exhaust system

Inspect the entire exhaust system including the exhaust manifold, exhaust elbow, muffler and exhaust pipe during the machine running.

Visually and audibly check for leaks at all connections, welds, gaskets and joints.

If any leaks are found out, shut down the machine and do not operate until corrected.

Replace corroded exhaust components if necessary before leaks occur.

### 6.4.5 DC electrical system

Inspect the battery terminals for clean and tight connections with the generator set off. Loose or corroded connections cause resistance which can impede starting. Clean and reconnect loose battery cables if necessary.

In order to reduce the possibility of arcing, always disconnect the negative battery cable first and connect it last.

## 6.5 Periodic maintenance schedule

Following the maintenance schedule and using the machine properly will result in longer generator set life, better performance and safe operation. Perform each maintenance procedure at the time period indicated or after the number of operating hours indicated, whichever comes first.

| Service items                                 | Daily or after 8h | Weekly or after 50h | Monthly or after 100h | 6 months or after 250h | 1 year or after 500h | 2 years or after 1000h |
|---|-------------------|---------------------|-----------------------|------------------------|----------------------|------------------------|
| Check engine oil, fuel and coolant level      | ●                 |                     |                       |                        |                      |                        |
| Check leakage(oil, fuel and coolant)          | ●                 |                     |                       |                        |                      |                        |
| Change engine oil(new machine)                |                   | ●                   |                       |                        |                      |                        |
| Check battery charging system                 |                   |                     | ●                     |                        |                      |                        |
| Drain water/sediment in oil-water separator   |                   |                     | ●                     |                        |                      |                        |
| Drain water/sediment in fuel filter           |                   |                     | ●                     |                        |                      |                        |
| Change engine oil                             |                   |                     |                       | ●                      |                      |                        |
| Drain water/sediment in fuel tank             |                   |                     |                       | ●                      |                      |                        |
| Change engine oil filter                      |                   |                     |                       | ●                      |                      |                        |
| Clean air filter if the clog indicator is on  |                   |                     |                       | ●                      |                      |                        |
| Change fuel filter                            |                   |                     |                       |                        | ●                    |                        |
| Clean gauze filter in oil-water separator     |                   |                     |                       |                        | ●                    |                        |
| Change air filter if the clog indicator is on |                   |                     |                       |                        | ●                    |                        |
| Check cooling system                          |                   |                     |                       |                        | ●                    |                        |
| Check drive belt tension                      |                   |                     |                       |                        | ●                    |                        |
| Change oil and fuel pipes                     |                   |                     |                       |                        |                      | ●                      |
| Change coolant                                |                   |                     |                       |                        |                      | ●                      |
| Clean inside fuel tank                        |                   |                     |                       |                        |                      | ●                      |

## 7. Troubleshooting

When performing any troubleshooting, follow the guideline below. For detailed troubleshooting procedures about engine and alternator, refer to engine and alternator operator's manual.

Keeping engine oil level, making battery connections clean and tight, checking fuel level, not overloading etc. will prevent most shutdowns.

Contact our authorized distributor to ask for help for complicated maintaining and replacing operation.

### WARNING

- 1) *Performing troubleshooting should be carried out by a licensed engineer.*
- 2) *Before performing any troubleshooting, stop engine and always allow engine to cool because hot engine parts can cause severe burns.*

## 7.1 Generator set trouble

| Trouble                                    | Cause   | Solution                                      |
|--|---|---|
| Low engine oil pressure                    | 1.Lubricant oil is insufficient                         | 1. Add lubricant oil                          |
|  | 2.Oil hose has leak                                     | 2.Tighten or change oil hose                  |
|  | 3.Oil filter is clogged                                 | 3.Change oil filter                           |
|  | 4.Wrong oil is used                                     | 4.Change to proper kind oil                   |
| High coolant temperature                   | 1.Coolant is insufficient                               | 1.Add coolant                                 |
|  | 2.Coolant pipe has leak                                 | 2.Tighten or change coolant pipe              |
|  | 3.Fan belt is loose                                     | 3.Tighten the belt                            |
|  | 4.Radiator core is clogged                              | 4.Clean radiator core                         |
|  | 5.Water temp sensor is defective                        | 5.Repair or change the sensor                 |
|  | 6.Engine thermostat is defective                        | 6.Repair or change the thermostat             |
| Low fuel level                             | 1.Fuel is insufficient                                  | 1.Add fuel                                    |
|  | 2. Fuel pipe has leak                                   | 2.Tighten or change fuel hose                 |
|  | 3. Fuel tank has leak                                   | 3.Repair or change fuel tank                  |
|  | 4. Fuel filter is clogged                               | 4.Drain water/sediment or change fuel filter  |
| Power drops after running a period of time | 1.Air filter element is clogged and air is insufficient | 1.Clean or change air filter element          |
|  | 2.Fuel filter is clogged and fuel is insufficient       | 2. Drain water/sediment or change fuel filter |
|  | 3.Engine ignition time is incorrect                     | Adjust the ignition time as required          |



## 7.2 Engine trouble

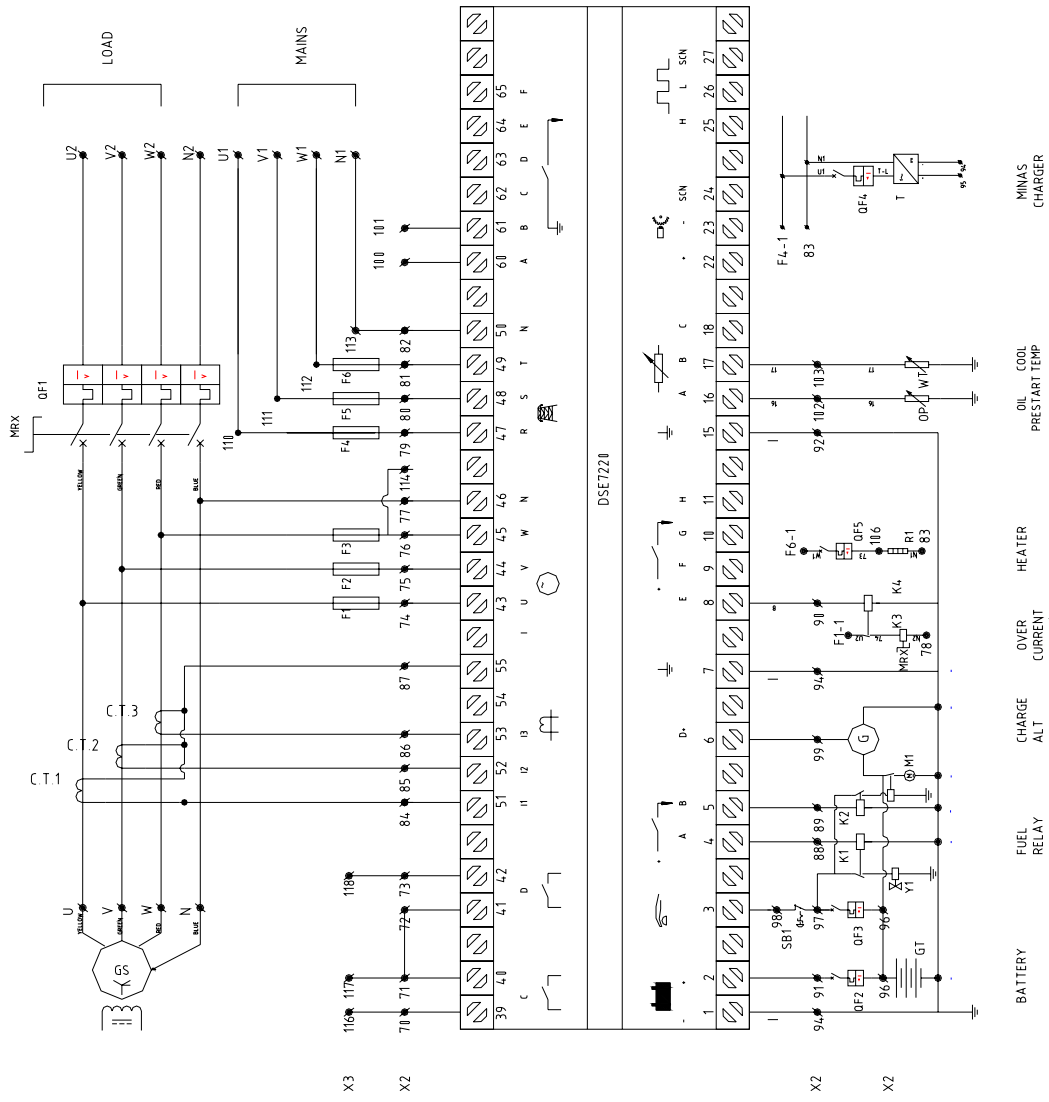
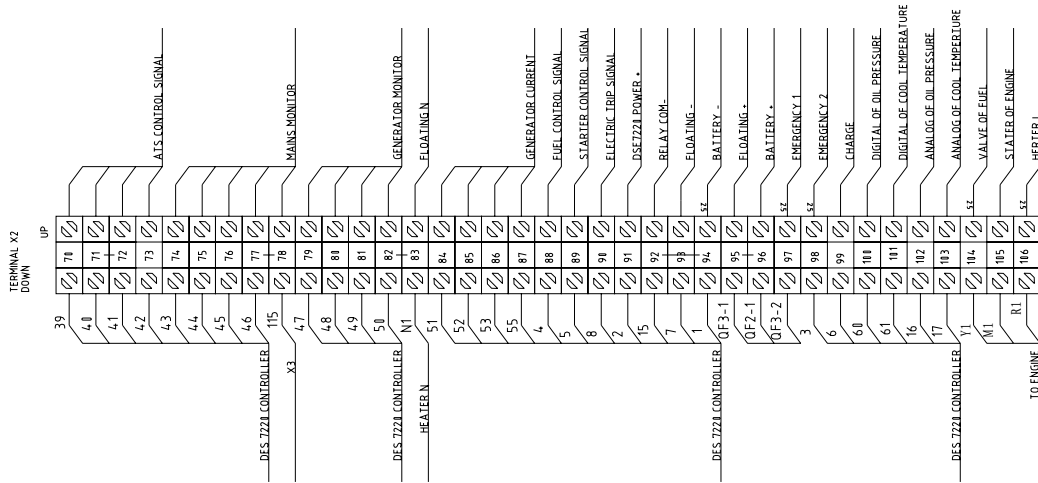
| Trouble  | Cause                                   | Solution  |
|--|---|---|
| Starter motor can not drive or speed is low    | 1.Battery switch is off                 | 1.Turn the switch to on   |
|  | 2.Battery output is weak                | 2.Change the battery  |
|  | 3.Battery is deteriorate                | 3.Change the battery  |
|  | 4.Battery terminal is loose             | 4.Tighten the terminal  |
| Starter motor drives, but engine can not start | 1.Fuel is insufficient                  | 1.Check fuel system and add fuel if necessary   |
|  | 2.Fuel hose has leak                    | 2.Tighten or change fuel hose   |
|  | 3.Fuel filter is clogged                | 3.Drain water/sediment or change fuel filter  |
|  | 4.Gauze filter is clogged               | 4.Clean or change gauze filter  |
|  | 5.Air is mixed in fuel line             | 5.Extract the air   |
| Engine starts but stalls at once               | 1.Fuel hose has leak                    | 1.Tighten or change fuel hose   |
|  | 2.Fuel filter is clogged                | 2.Drain water/sediment or change fuel filter  |
|  | 3.Gauze filter is clogged               | 3.Clean or change gauze filter  |
|  | 4.Air is mixed in fuel line             | 4.Extract the air   |
|  | 5.Lubricant oil is insufficient         | 5.Check oil level, add oil as required  |
|  | 6.Air filter element is clogged         | 6.Clean or change air filter element  |
| Output is insufficient                         | 1.Fuel is insufficient                  | 1.Check fuel system and add fuel if necessary   |
|  | 2.Overheating of moving parts           | 2.Check to see if lubricating oil filter is working properly                              |
|  | 3.Air filter element is dirty           | 3.Clean or change air filter element  |
|  | 4.Injection pump wear                   | 4.Check the fuel injection pump element and delivery valve assembly, replace if necessary |
| Muffler release black smoke                    | 1.Fuel is of very poor quality          | 1.Select good quality fuel  |
|  | 2.Air filter element is clogged         | 2.Clean or change air filter element  |
|  | 3.Loads total exceeds the rated current | 3.Adjust the loads to meet the rated output   |
| Engine surge at idle                           | 1.Fuel is insufficient                  | 1.Add fuel  |
|  | 2.Air is mixed in fuel line             | 2.Extract the air in fuel system and check for suction leaks                              |
|  | 3.Idle speed is set too low             | 3.Check and adjust low idle screw   |
|  | 4.Fuel filter is clogged                | 4.Drain water/sediment or change fuel filter  |

### 7.3 Alternator trouble

| Trouble   | Cause  | Solution  |
|---|--|---|
| No voltage or voltage is insufficient while generator set running | 1.Winding is cut                             | 1.Intertwist the cut winding and weld firmly        |
|   | 2.Wiring terminal is loose                   | 2.Tighten the wiring terminal                       |
|   | 3.Wiring terminal is defective               | 3.Clean or replace the defective terminal           |
|   | 4.Speed is too low                           | 4.Check the speed and keep the rated speed          |
| Voltage is unstable   | 1.Speed is unstable                          | 1.Keep the rated speed                              |
|   | 2.AVR is defective                           | 2.Check AVR and change if necessary                 |
| Alternator overheats  | 1.Overload running                           | 1.Reduce load                                       |
|   | 2.Vent-pipe inside the alternator is clogged | 2.Blow and clean the inner                          |
| Voltage is too high   | 1.Speed is too high                          | 1.Keep the rated speed                              |
|   | 2.AVR is defective                           | 2.Check AVR and change if necessary                 |
| Voltage is too low while running without load                     | 1.Speed is too low                           | 1.Keep the rated speed                              |
|   | 2.AVR is defective                           | 2.Check AVR and change if necessary                 |
| Voltage is correct without load, but too low under load           | 1.Speed setting is incorrect                 | 1.Check and adjust the speed                        |
|   | 2.Short circuit on the rotor                 | 2.Check resistance of the circuit                   |
|   | 3.Armature of excitation is defective        | 3.Check resistance of the circuit                   |
| Voltage disappears while running                                  | 1.Winding of magnetic field is cut           | 1.Check the cut winding, intertwist and weld firmly |
|   | 2.Rotor of excitation is defective           | 2.Check rotor, repair it and change if necessary    |
|   | 3.AVR is defective                           | 3.Check AVR and change if necessary                 |

## 7.4 Control system trouble

| Trouble  | Cause   | Solution                                       |
|--|---|--|
| Main breaker can not be turn to on   | 1.The main breaker position is between on and off     | 1.Once turn the breaker to off, turn it to on  |
|  | 2.Short circuit on the load                           | 2.Check and repair the load circuit            |
| Control module can not run   | 1.Control module cable is disconnected to the battery | 1.Connect the module cable to the battery      |
|  | 2.Battery power is insufficient                       | 2.Charge the battery with the utility power    |
|  | 3.The fuse is damaged                                 | 3.Change the fuse                              |
| Voltage drops quickly when connecting to the load                                      | 1.Loads total exceeds the rated current               | 1. Decrease the loads to meet the rated output |
|  | 2.Loads sharing to each terminal is unbalanced        | 2.Balance the loads sharing to each terminal   |
|  | 3.AVR of alternator is defective                      | 3.Check AVR and change it if necessary         |
|  | 4.Use wrong frequency                                 | 4.Adjust the frequency to the load frequency   |
| Frequency is stable, but voltage is unstable   | 1. AVR of alternator is defective                     | 1.Check AVR and change it if necessary         |
| After connecting to the load, voltage and frequency is stable, but current is unstable | 1.Customer load is unstable                           | 1.Check and adjust the customer load           |
| Voltage can not go up to the rated value   | 1.AVR of alternator is defective                      | 1.Check AVR and change it if necessary         |
|  | 2.Frequency is low                                    | 2.Adjust frequency as required                 |
| Voltage exceeds the rated value  | 1. AVR of alternator is defective                     | 1.Check AVR and change it if necessary         |





Diesel electric engine series number

|   |   |
|---|---|
| Purchase date                                   | For the first time opening machine<br>Debugging date  |
| Machine main 'or' operation<br>name and address | Sells the generator merchant<br>Retails business name |



Refers can cause the danger which the product either the related equipment damages or the unsafe method 'or' operation



Refers can cause the danger which the product either the related equipment or the unsafe method 'or' operation



Refers can cause the serious personnel to injure even the possible casualties danger or the unsafe method 'or' operation



Will refer causes the personnel casualty the direct danger