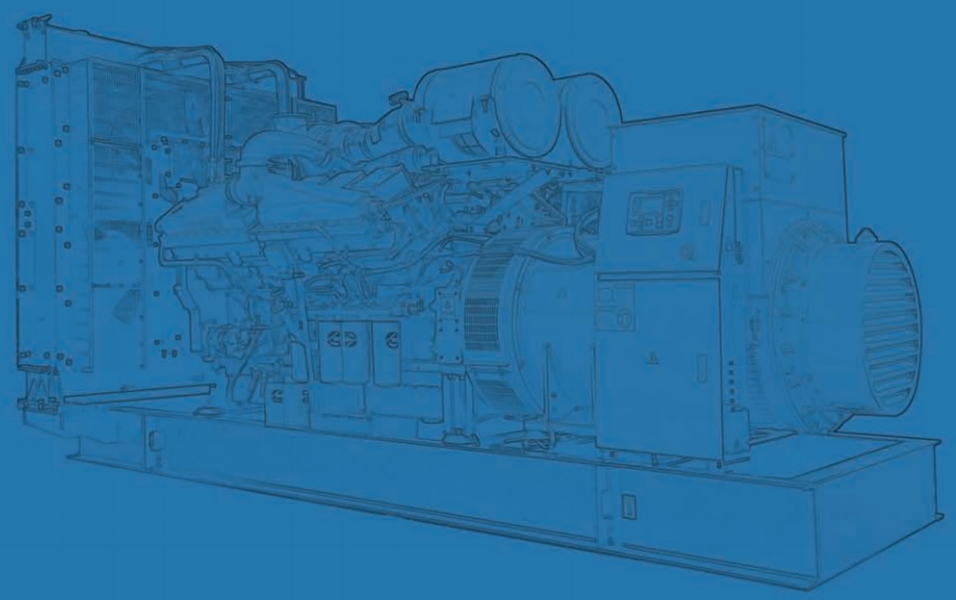
DIANBIDA POWER

Operator Service Manual



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⚠ WARNING The operator must read and understand all the instructions in this manual before operating the machine.

Table of Contents

1. INTRODUCTION

Owners, Users, and Operators:
We appreciates your choice of our product for your application. Our number one priority is user safety which is best achieved by our joint efforts. We feel that you can make a major contribution to safety if you as the equipment users and operators:

Comply with OSHA, Federal, State, and Local Regulations.
Read, Understand, and Follow the instructions in this and other manuals supplied with this product.
Use Good, Safe Work Practices in a common sense way.
Only have trained operators — directed by informed and knowledgeable supervision — operating this product.

If there is anything in this manual that is not clear or which you believe should be added, please send your comments to our company.

THE SAFETY ALERT SYMBOL IS USED TO ALERT YOU TO POTENTIAL PERSONAL INJURY HAZARDS. OBEY ALL SAFETY MESSAGES THAT FOLLOW THIS SYMBOL TO AVOID POSSIBLE INJURY OR DEATH.

2. DESCRIPTION OF EQUIPMENT

The engine/generator assembly consists of a diesel engine combined with an electrical generator. This assembly is firmly bolted together to form an integral unit and does not require anything other than routine maintenance.

The engine is equipped with a 24-volt starter (12volt starter optional) and can be wired for remote starting capability at the control panel.

A dry-element air cleaner is standard equipment to ensure a clean air supply, and a fuel/water separator is included for additional fuel system protection.

A governor on the engine provides a stable operating speed under varying load conditions, and the generator is equipped with a solid-state voltage regulator to stabilize the output voltage under these same conditions. Figures and schematics of both the governor and regulator are provided in the ***ENGINE and GENERATOR OPERATOR'S MANUALS***.

An automatic shutdown system is incorporated in the generator set to sense low oil pressure and/or high coolant temperature, and in either case the engine/generator assembly will automatically cease operation.

A diesel fuel tank is incorporated within the base of the unit to ensure an uninterrupted operating cycle under full load. The engine/generator assembly is mounted to the base using high durometer vibration isolators.

The enclosure for the generator set is constructed from 12 or 14-gauge sheet metal to ensure maximum rigidity, and is bolted together to allow easy access to major components if necessary. Four lockable, hinged access doors are provided for routine operation and maintenance.

The enclosure on the Super Quiet Generator is specifically designed for a high degree of sound attenuation. This allows the generator set to be operated in noise-sensitive environments. The

interior of the enclosure is coated with sound

dampening polymer foam that is highly effective in noise suppression and is impervious to water, fuel, and oil.

A high ambient temperature radiator and a critical grade exhaust silencer are contained within the enclosure as standard equipment.

A center-point lifting attachment is located in the top of the enclosure to allow crane lifting of the entire unit.

3. GENERAL SAFETY

HAZARD CLASSIFICATION

A multi-tier hazard classification system is used to communicate potential personal injury hazards. The following signal words used with the safety alert symbol indicate a specific level of severity of the potential hazard. Signal words used without the safety alert symbol relate to property damage and protection only. All are used as attention getting devices throughout this manual as well as on decals and labels fixed to the machinery to assist in potential hazard recognition and prevention.

⚠ DANGER

Red - Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING

Orange - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury

⚠ CAUTION

Yellow with safety alert symbol - Indicates a potentially hazardous situation which, if not avoided,

may result in minor or moderate injury.

CAUTION

Yellow without safety alert symbol - Indicates a situation which, if not avoided, may result in property or equipment damage.

NOTICE

Green - Indicates important installation, operation or maintenance information.

Hazardous voltage. Will cause serious injury or death.

Hot exhaust. Can contain carbon monoxide. Will cause serious injury or death.

Read all manuals that shipped with your equipment. Maintenance is done more easily and safely when you know what you're doing.

Keep all guards in place.

Wear hearing protection when you are near this equipment.

Lockout and Tagout. Equipment may be energized. Lockout and tagout all energy sources prior to performing maintenance adjustments.

⚠

ACCIDENT PRECE NTION

Use protective clothing and safety equipment. Always wear approved safety equipment such as gloves, safety boots, safety hard hat, goggles, ear protection, and dust masks when necessary. Wear protective clothing that is snug and belted where required.

⚠

UNAUTHORIZED WELDING

UNAUTHORIZED WELDING CAN CAUSE STRUCTURAL FAILURE OR PERSONAL INJURY.

DO NOT weld on any structural member.

Any unauthorized welding or repair procedure will void the warranty.

⚠

FUELINH

ALWAYS handle fuel with care. It is highly flammable.

ALWAYS stop engine before refueling. Fill fuel tank outdoors.

DO NOT replace fuel lines with materials different from those supplied as original equipment.

FIRES CAN CAUSE SEVERE PERSONAL INJURY OR MACHINE DAMAGE.

Prevent fires by keeping the generator and its surrounding area clean.

DO NOT refuel while smoking or when near open flame or sparks.

DO NOT refuel the engine when it is hot. Allow to cool for several minutes before refueling.

DO NOT spill fuel inside the engine compartment. If fuel has leaked, wipe it up and have leak repaired before next use.

ALWAYS Have a fire extinguisher nearby. Be sure the extinguisher is properly maintained and be familiar with its use. Extinguishers rated ABC by the NFPA are appropriate for all applications

EXHAUST GASES ARE TOXIC. DO NOT USE INDOORS UNLESS PROPERLY VENTILATED AN EXHAUST SCRUBBER IS USED.

Check exhaust system regularly for leaks and ensure that the exhaust manifolds are secure and not warped. Make sure the unit is well ventilated.

ELECTRICAL SAFETY THIS EQUIPMENT USES HIGH VOLTAGE CIR-CUITS CAPABLE OF CAUSING SERIOUS IN-JURY OR DEATH. EXERCISE EXTREME CAU-TION AROUND ANY

ELECTRICAL COMPO-NENT WHILE OPERATING THIS UNIT.

Always ground the unit according to local codes

A grounding lug has been added to the base frame for your convenience.

Beware of cut or damaged power cords. Have a qualified electrician replace any damaged cords immediately.

DO NOT TOUCH HOT PARTS.
The exhaust manifold and tail pipe are very hot. Parts of the engine are also hot. Use protective gloves when handling hot parts.

BATTERY HAZARDS LEAD ACID BATTERIES CAN BE DANGER-OUS. THE SULFURIC ACID IN THE BATTERY CAN CAUSE SEVERE SKIN AND EYE BURNS. THE HYDROGEN GAS EMITTED DURING CHARGING CAN EXPLODE IF AN ARC OR FLAME IS PRESENT.

DO NOT smoke while servicing the battery.
DO NOT smoke while servicing the battery.
Disconnect the negative terminal of the battery when working on the engine or other parts to prevent accidental arcing. Disconnect the negative cable at the end away from the battery.

DO NOT removes the vent caps when charging the battery.

Always wear eye protection when servicing the battery.

If acid gets on skin or eyes, immediately flush under running water and obtain medical attention.

KEEP ALL BODY PARTS AND CLOTHING AWAY FROM MOVING PARTS.

Loose jackets, shirts, sleeves, jewely and especially

neckties should not be worn while working on or running the unit.

Only remove guards or protective devices from unit temporarily to gain access for maintenance. Always replace guards immediately after servicing. Never remove guards while unit is operating.

Keep your hands away from moving parts, particu-larly clear of the radiator fan and alternator belts when the engine is running.

NEVER CLIMB ON TOP OF THE CABINET.

NEVER REMOVE THE RADIATOR CAP WHILE THE ENGINE IS RUNNING OR WHILE THE ENGINE IS HOT.

Check the oil level in the engine crankcase, and add as required.

USE CLASS API, CC OR CD GRADE ENGINE OIL. REFER TO ENGINE MANUAL FOR VISCOSITY AND QUANTITY.

If the battery is not a maintenance free battery,

check the electrolyte level in the battery and add distilled water if necessary.

Check fuel/water separator for water in the fuel system. Drain water from separator if necessary.

Check fuel level in the fuel tank and add as required. Check to insure the fuel tank vent is “open” and not clogged.

USE DIESEL FUEL ONLY

Verify that the generator main circuit breaker is in the “**OFF**” position.

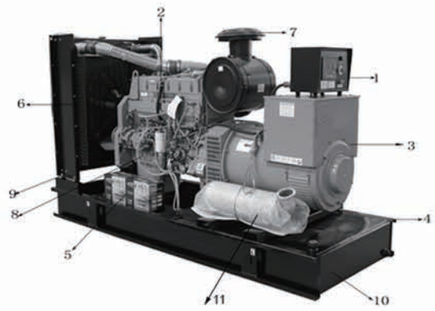
Make sure the generator set is properly grounded. This is accomplished by connecting the grounding lug provided at the rear of the generator set
enclosure to a mechanical earth ground with a minimum 2/0 size #4 bare electrical cable. If this differs from your local code, always follow the local code for grounding.

THIS GENERATOR SET PRODUCES VOLT-AGES THAT CAN CAUSE SEVERE SHOCK OR DEATH! ONLY QUALIFIED ELECTRICIANS SHOULD PERFORM ELECTRICAL WORK.

4. GENERAL DESCRIPTION

4.1 GENERATING SET DESCRIPTION AND IDENTIFICATION
Our Generating Set has been designed as a complete package to provide superior performance and reliability.
Figure1.1 indentifies the major components. This figure is of a typical generating set. However, every set will be slightly different due to the size and configuration of the major components. This section briefly describes the parts of the generating set. Further information is provided in later sections of the manual.

4.2 MAJOR COMPONENTS



- Control Panel（1）
- Engine （2）
- Alternator（3）
- Base Frame（4）
- Battery（5）
- Radiator（6）
- Air Filter（7）
- Fuel Filter（8）
- Shock Absorber（9）
- Fuel Tank（10）
- Silencer/Muffler（11）

4.3 DIESEL ENGINE
The diesel engine powering the generating set has been chosen for its reliability and the fact that it has been specifically designed for powering generating sets. The engine is of the heavy duty industrial type with 4 stroke compression ignition and is fitted with all accessories to provide a reliable power supply.

These accessories include, among others, a cartridge type dry air filter (item 7) and a mechanical or an electronic engine speed governor.

4.4 ENGINE ELECTRICAL SYSTEM
The engine, electrical system is 12 volts or 24 volts DC, negative ground/earth. This system includes an electric engine starter, a battery and a battery charging (item 9) alternator (item3). For 12 volts electrical system one battery is given. For 24 volts system two lead-acid batteries are given. Other types of batteries may be fitted if they were specified.

4.5 COOLING SYSTEM

The engine cooling system is either air cooled or water cooled. The air cooled system consists of a high capacity fan to pull cool air across the engine to cool it. The water cooled system is comprised of a radiator (item 8), a pusher fan and a thermostat. The alternator has its own internal fan to cool the alternator components.

4.6 ALTERNATOR

The output electrical power is normally produced by a screen protected and drip-proof, self-exciting,

self-regulating, brushless alternator (item 4) fine tuned to the output of this generating set. Mounted on the top of the alternator is a sheet steel terminal box.

4.7. FUEL TANK AND BASEFRAME

The engine and alternator are coupled together and mounted on a heavy duty steel base frame. This base frame includes a fuel tank with a capacity of approximately 8 hours operation at full load.

4.8. VIBRATION ISOLATION

The generating set is fitted with vibration isolators which are designed to reduce engine vibration being

transmitted to the foundation on which the generating set is mounted. These isolators are fitted between the engine/alternator feet and the base frame.

4.9. SILENCER AND EXHAUST SYSTEM

An exhaust silencer is provided loose for installation with the generating set. The silencer and exhaust system reduce the noise emission from the engine and can direct exhaust gases to safe outlets.

4.10. CONTROL SYSTEM

One of several types of control system and panels

may be fitted to control the operation and output of the set and to protect the set from possible malfunctions.

5. INSTALLATION, HANLING AND STORAGE

5.1 GENERAL

Once the size of the generating set and any associated control systems or switchgear have been established, plans for installation can be prepared. This section discusses factors important in the effective and safe installation of the generation set.

5.2 CANOPY

- All canopy parts are designed with modular principles without welding assembly.
- All metal canopy parts are painted by electrostatic polyester powder paint.
- Exhaust silencer is protected against environmental influence and an emergency stop push button is installed on canopy.
- Canopy enables easy lifting, maintenance and operation. It also protects the genset from unauthorized usage and environmental influences.

5.3 MOVING THE GENERATING SET

The generating set base frame is specifically designed for ease of moving the set. Improper handing can seriously damage components.

Using a forklift, the generating set can be lifted or carefully pushed/pulled by the base frame. If pushing, do not push the base frame directly with fork. Always use wood between forks and the base frame to spread the load and prevent damage.

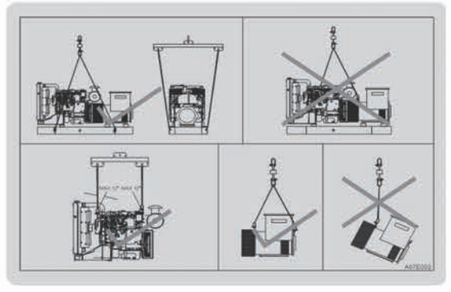
WARNING

! Never lift the generating set by attaching to the engine or alternator lifting lugs.

! Ensure the lifting rigging and supporting structure is in good condition and is suitably rated.

! Keep all personnel away from the generating set when it is suspended.

! If the generating set is going to be lifted, it should be lifted by the lifting points fitted on canopied sets and most open sets.



5.4 Installation Checklist

The following factors must be considered before commencing the installation

·level, weight load and vibration transmission characters of the foundation
·sufficient cooling air
·sufficient fresh air intake
·cooling air exhaust
·engine emission exhaust
·electric connection
·operation and maintenance space
·noise standard
·vibration isolator

5.4.1 Genset Location

The genset is located in relativity to the position of other systems such as ventilation duct, exhaust duct, wiring, fuel pipes, etc.. The genset shall be as nearer to the main power switchgear as possible.

5.4.2 Foundation

Genset be attached to the concrete floor

If the genset is to be attached to the concrete floor, a concrete block must be built on the floor on which the genset will be installed.

The concrete block shall be a steel-reinforced concrete structure which can withstand a pressure test that lasts 28 days with a pressure strength of above 2,500 psi (173kpa) . The block rises at least 6 inches (150 mm) above the floor and extends for at

least 6 inches (150mm) from every side of the genset base frame. “J” or “L” bolts must be preinstalled to the block to anchor the genset or vibration isolating pads.

If the environment is extremely sensitive to vibration or noise, the genset shall be fixed

NOTE: ALL FOUNDATIONS MUST BE SOLID AND SMOOTH ENOUGH. FOR CONCRETE STRUCTURES, NO FURTHER TREATMENT IS NEEDED AS THEY USUALLY SATISFY THE PHYSICAL REQUIREMENT.

5.4.3 Genset Fixation and Vibration Isolation

- Some gensets are equipped with built-in anti-vibration mechanism that consists of rubber vibration isolators inserted between the genset body and the steel base frame. Therefore, unless in extremely sensitive environment where extra vibration isolators are needed between the steel base and the installation foundation, the steel base can be directly fixed onto the surface of the installation foundation.
- For gensets without built-in anti-vibration mechanism, vibration isolators must be used between the steel base frame and the installation foundation.
- Vibration isolators can reduce the noises and vibration transmitted to the foundation. Several

kinds of vibration isolators are used of which the

spring isolator is 98% efficient, fiberglass isolator is 75-85% efficient, and rubber isolator is 50-80% efficient. In places where the environment or geology pose a stricter requirement on anti-vibration performance, 25-30mm wide ditches must be dug around the installation foundation and an extra vibration damping layer be added to the bottom of the

foundation. The damping layer is a 200mm thick mixture of cement, cinder and bitumen, sitting on a firm surface. The body of the installation foundation is built on top of the damping layer.

- The genset steel base frame must be fixed to the ground with M18 bolts to prevent displacement.

5.4.4 Maintenance Space

There must be enough space around the genset to allow maintenance operations. Each side of the genset, except where the radiator is located, shall be at least 1.5m away from the wall. The height of the genset room is usually over 4.5m with the ceiling being 1.5m or further away from the genset top. This is the minimum special requirement considering hoisting actions and ventilation. The base shall be at least 150mm above the floor.

5.4.5 Mechanical Connection of the Genset

Exhaust System

The exhaust system is supposed to discharge waist gases into the atmosphere and keep it away, together with dust and noise, from the buildings and human crowds. For genset, in order to achieve rated

power output, backpressure in the exhaust system must be considered carefully. Requirements for the exhaust system include the following:

The exhaust backpressure of the whole exhaust system does not exceed the maximum value as described in the parameters list for the diesel engine.

- Components of the exhaust system shall not exert too much stress on the exhaust manifold or turbocharger due to gravity, inertia, relative

motion between components and thermal expansion.

The exhaust system shall be able to prevent ground spills, rainwater, flush water and other sources of liquids from entering the diesel engine or turbocharger.

- Ensure that the diesel emission do not impair the function of the air filter and cooling system nor exert any harm on the surroundings and operation staff.

5.4.6 Layout and Installation of Exhaust Piping

- Corrugated stainless steel pipes must be used to link the engine exhaust outlet to the exhaust pipe or as elbow where the pipe makes a turn. The pipes are mounted on incombustible flexible suspension hanging from the ceiling or supported by ground flexible frame to absorb thermal expansion, genset movement and vibration.
- For multiple gensets, each genset must have its own exhaust system with the outlets being exposed to the atmosphere. No check valves are allowed.
- Make the piping as short and horizontal as

possible with a minimum total length and number of bends. Each section of pipe should not be too long or bend too sharply. There should be no

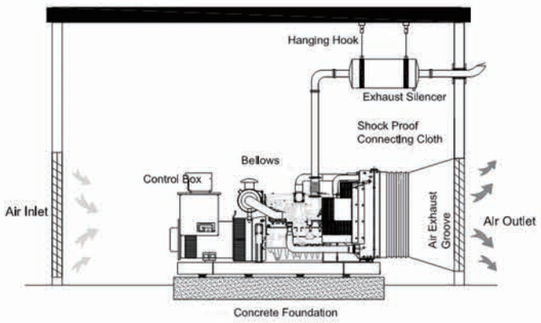
more than 3 elbows the bend radius of which is at least three times the pipe diameter.

Requirements on pipe size:

For the first 9m of pipes connected to the engine exhaust outlet, the pipe inner diameter shall be the same as the engine exhaust outlet; for the next 6m of pipes, the inner diameter shall

increase by 2.54cm. Flowingly, for every 9m of pipes, the diameter increases by 2.54cm until a

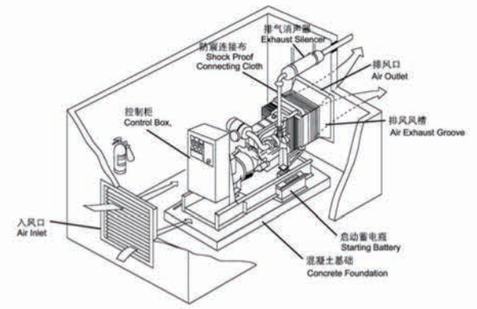
maximum pipe length of 27m. The equivalent length of elbows is calculated in the following way: One 90° elbow=(2.5-3) times the outer diameter of the pipe.



- For horizontal pipes, the slant grade shall be 0.3-0.5%, leading outside the building with the low end placed remotely from the engine. A deposit drain is to be used at the lowest point and a condensation drain be used directly under vertical pipes.
- Protections must be used at the outlet of the exhaust system to repel rainwater. For outlet that is routed straight upwards, automatic rain caps shall be used.
- When the exhaust pipes piece through flammable roofs, walls or other partitions, insulation sleeve and wall seals must be used for heat insulation. The inner diameter of the sleeve shall be 25 mm larger than the outer diameter of the exhaust pipe and insulation materials are to be inserted in between.
- Try to locate most of the exhaust pipes outside the genset room to reduce heat radiation. Exhaust pipes inside the room shall be insulated with 50mm thick high density insulation materials protected by aluminum

panels. The minimum space between the exhaust pipes and flammable materials is 300mm.

- The exhaust system shall be placed in a high leeward position.



6. Fuel System

The fuel system is to provide adequate good quality diesel to the diesel engine. The diesel must be clean, less than 60 ℃, containing no water, corrosive liquids and paraffin wax, without too much air and with enough heat value. Before being drawn into the day tank, the diesel must be pretreated with 48 hours of sedimentation. Diesel stored in the standby fuel tank shall be refreshed within 18 hours or

proper amount of anti-corrosion agent must be added. Since the anti-corrosion agent can reduce fuel economy and the genset starting performance, we recommend not using it.

below 2.5m.

6.1 *Fuel Tank*

1 The fuel tank must be big enough to allow the genset to run at full load for rated hours plus 5% room for thermal expansion.

- For simple installation, the fuel tank must be placed in such a position so that the highest level of the fuel is not more than 2.5m higher then the genset base frame, or a bobber tank/auxiliary tank must be used.
- The fuel tank must be clean with no rust or corrosion. It is usually made of terne plate, parkerized plate, reinforced plastic or aluminum sheet. Galvanized sheet is not allowed as it scales in contact with the fuel and causes clogging in the fuel filter and injector.
- The fuel intake of the fuel pump shall be placed in the center of the tank, 25mm above the bottom. This will make the pumping easier and avoid sucking up water and impurities.
- The inlet of the fuel pump shall always be positive static head. The fuel tank outlet shall be at least 0.5m higher than the genset base level. However the fuel tank shall not be too high so as to exert a higher pressure on the inlet of the fuel pump than the fuel pump can withstand. In applications that pose strict requirement on the starting performance of the genset, e.g. the gensets work in parallel or quick starting is required in emergencies, the fuel tank/storage shall be placed in such a position so that the lowest level of the fuel is 150mm higher than the pump inlet. This will prevent accumulation of air in the fuel pipe when the genset is on load.

The fuel returnduct connections must not be positioned too high as to exceed the sucking capacity of the fuel pump. Normally the height is

6.2 *Fuel Pipe*

- Fuel pipes connected to the engine shall be made of flexible hose to absorb genset displacement and vibration.
- Diesel must be carried in black mild steel pipe. Cast iron or aluminum pipe is prohibited since they have a relatively loose structure and have a risk of fuel leakage.
- Do not use galvanized sheet to make the fuel pipe, joints and tank. The sulfur in the fuel will combine with the condensation liquid in the tank to form sulfuric acid, corroding the galvanized layer and causing clog in the fuel pump and filter.
- Appropriate fuel pipe size shall be selected to keep the flow resistance within a reasonable range. The pipe size shall be at least the same as the inner diameter of the fuel pump inlet. If the fuel tank is far from the engine, the pipe size shall increase and try to use as less elbows and joints as possible.
- Whether the engine is running or standing by, leak, even the slightest, shall be avoided of the fuel system. Air may enter the fuel through the leak and cause instability of the engine and lower the power output.
- During the installation of the fuel system, be every cautious of moisture and pollutants such as dust. Clean every component of the fuel system before installation.

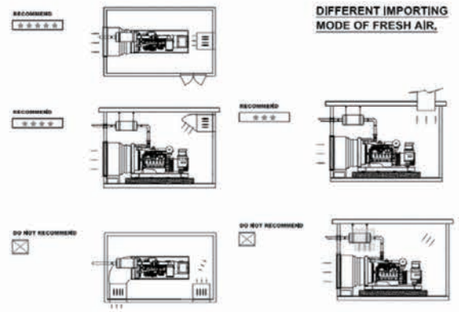
7. Cooling and Ventilation System

Cooling and ventilation system is extremely important for the genset room. There must be enough air flowing through the genset room to supply engine combustion and cooling. To allow the engine to work at its best, the temperature rise in the

room shall be between 10-15^{o}C with the ambient temperature in the room being no higher than 40^{0}C. If the ambient temperature is above 40^{0}C, the air must be taken in from the atmosphere via duct.

There are four types of cooling system

- ☐ Engine mounted (standard) radiator
- ☐ Remote mounted radiator
- ☐ Engine mounted heat exchanger cooling system



7.1 Engine mounted (standard) radiator

Our generator set is usually provided with an engine mounted radiator. The genset must be placed in a room with good ventilation where the fan draws in the air across the radiator and discharge it outdoors through the exhaust pipe connected to the radiator. Arrangements in this system are as the following:

- In rooms where the air is sufficient, the hot air exhaust shall have a ventilation area 1.25 to 1.5 times that of the radiator. If metal louver or grid is installed on the outlet, please ensure the ventilation area is sufficient.
- When installing the genset, try to locate the radiator as close to the hot air exhaust as possible so that hot air will not be circulated in the room. If no wind duct is used, we recommend that the distance between the radiator and hot air exhaust does not exceed 150mm or canvas/thin-walled wind duct shall be applied and the distance between the radiator exhaust surface and air barrier be at least 2m. If the distance is too short, exhausted hot air will be reflected by the barrier to heat the water tank, resulting in increased temperature of coolant.
- The wind duct inside must be smooth and free from obstacles, leaks, holes and sharp bends. The change of duct section dimension shall be gradual, sometimes with the help of diversion plates to reduce pressure loss. If the air flow pressure difference is too great and can't be altered, electric blower shall be used to enforce air flow.
- Air inlet shall allow the air to flow across the genset. It shall be located lower than the air exhaust to facilitate air convection and help suck the air into the room.
- Fresh air temperature around the radiator shall not exceed the rated environment temperature for the chosen radiator type (40^{0}C or 50^{0}C). If the temperature is too high, measures must be taken to cool down the genset room.
- The system must be able to prevent rain and snow from infiltrating. In cold regions, heat preservation must be applied to rooms where standby gensets or seldom-operated gensets are located. The preservation method may be the use of air damper.
- In cold regions, the coolant for genset automatically run upon fault of the main power supply shall be treated to increase anti-freeze ability. The coolant may be an even mixture of

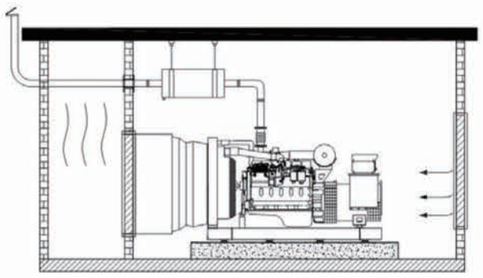
cooling water and 40-60% ethylene glycol. Meanwhile, submerged thermostat-controlled

coolant heaters (supplied by utility power) shall also be used. When the genset is standing by, the heater shall be able to sense the environment and coolant temperature and heat

the coolant automatically to maintain the coolant temperature between 5^0C to 40^0C.

- The cooling system must be equipped with an anti-corrosion water treatment device (water filter). The water filter contains anti-corrosion additives which help maintain certain level of chemical intensity in the coolant to protect it

from corrosion. The water filter will also clean the coolant by stopping and depositing impurities during the continuous circulation of the coolant. However, a thorough cleaning for the whole system is still required within every 30 days/250 hours.



7.2 Remote Mounted Radiator

When good ventilation is not available in the genset room, a remote mounted radiator system can be used. However, considerations must be given on anti-freezing of the ductwork and the surplus of fresh air to carry out the heat and support engine combustion.

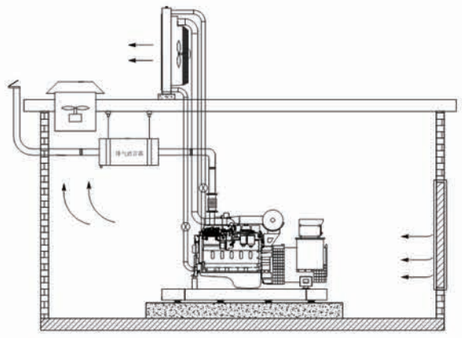
- The coolant flow resistance outside the engine (including piping, equipment and radiator

friction pressure loss) and the static head (the high of the liquid based on the central line of the crank) shall not exceed the stated value in the engine handbook.

- Excessive static head (water pressure) would damage the seal of the coolant pump; excessive flow resistance (pressure loss) would result in overheating of the engine. If the coolant friction is greater than the rated value, a backup water tank and a electric water pump are required.

The backup water tank should have a capacity equal to over 15% of the system coolant amount;

if the remote radiator is 3m or more higher than the genset crank central line, an auxiliary tank or depressurizing valve shall be used to avoid damage to the coolant pump seal.



7.3 Engine Mounted Heat Exchanger

The engine, circulation pump, heat exchanger and cooling tower/pond comprise a closed pressure circulation cooling system. Engine coolant and raw water are in separated pipes. This type cooling system requires less space than remote mounted type and considerations must still be given on ductwork anti-freezing and air supply for

- There must be enough raw water to absorb the heat from the coolant. The temperature of the

raw water after heat exchange should not be over 60^0C.

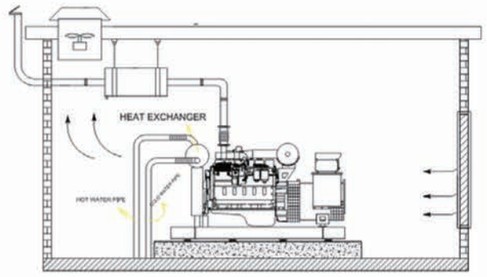
- Full consideration must be given to the water pressure on the water inlet of the heat exchanger. If the pressure is higher than the designed pressure bearing capacity of the heat exchanger, depressurizing valve or tank must be used.
- A cooling system with the combination of cooling tower and heat exchanger can avoid problems such as water pollution and freezing.
- When designing the coolant circulation system,

customers must consider the necessity of installing filtering devices such as filter or filter mesh. The turbidity of the circular water shall not

be more than 50mg/L. No oil contaminant and impurities are allowed. A thorough cleaning of the whole system must be conducted within every 30 days or 250 hours.

- The hot water circulation pump shall coordinate with the cooling tower in terms of working ability. The rated flux carried by the pump shall be close to the handling capacity of the cooling tower and the rated pumping pressure shall meet the nominal pressure at the water intake of the cooling tower. If the height difference between the cooling tower water intake and the

engine water drainage pump is between 2.5m to 3.5m (for specific parameters, please refer to the technical handbook of the engines), circulation pump may not be necessary. In this case, connect the water outlet of the engine heat exchanger directly to the inlet of the cooling tower.



8. Genset Electric Connection

After finishing mechanic connections, customers may start electric connection according to the drawings we provide. Genset electric connection includes load connection, control circuit connection and battery connection.

Only qualified electricians are allowed to conduct connection work and they must be tested and

verified before starting. All connections, cape sizing and layout must comply with relevant electric codes.

8.1 Alternate Current Circuit

8.1.1 Load Connection

The genset and the load shall have corresponding phases no matter what kind of connection forms is used, triangle or star formats.

8.1.2 Load Balance

When the genset is connected to the load, please balance the load so that the same amount of current

passes through each connection terminal. If the genset is connected to a single phase load and a three-phase load simultaneously, particular attention must be given to load balance. If the current in every phase is approximately the same (within 10% difference) and the current on the line does not exceed the rated value, the genset can be

connected to any combination of single phase and three-phase loads. During operation, please check the amperometer on the control panel to keep watch on the current through each terminal.

8.1.3 Grounding

Grounding means connecting the metal components of the genset and/or the genset circuit to the ground. The design and installation of the grounding system are subject to many factors such as requirements on grounding fault protection for compound transformer and the actual location of the generator. When installing the grounding system, please consult qualified electric engineer. Normally, the internal combustion generator set designing codes require that TN-S system is used with three phase four cords cable and direct neutral point grounding. The neutral N wire is separated from the protective PE wire everywhere in the system. They work with the gradual creep age protection phase to ensure safe use of the electricity. However, when using this system, attentions must be paid to the following:

- The protective zero line shall never be disconnected.
- Equipment within the same electric circuit are not allowed to be protected for some part by grounding and for some part by zero.
- Expected specifications of the PE wire:

The section of the PE wire shall be no smaller than that of the working zero line and use bicolor wires of Yellow/Green. PE wire connected to electric equipment shall be insulated multi-cord copper wire with a section of at least 2.5mm^2. The zero line shall be connected securely to electric equipment using bronze joint pins. Hinge connection is not allowed. The connecting terminal of electric equipment shall be galvanized or treated with anti-corrosion oil. The zero line shall be end fixed to the cable harness in the power distribution box. Joints are not allowed elsewhere.

- Grounding Resistance

>100KVA low voltage genset R<4 ohm

< 100KVA low voltage genset R<10 ohm

Electric protective grounding R<4 ohm

Zero line regrounding R<4 ohm

Grounding short circuit Id>4000A R<2000/Id

Grounding short circuit Id<500A 10 ohm>R<120/Id

8.2 Direct Current Circuit

8.2.1 Direct Current Circuit Connections

Control wires must be laid in a conduit isolated from alternate current cables or the alternate current may sense wrong signals from the direct current circuit and destabilize or even halt the engine. Direct current circuit must be connected according to the drawing provided with the genset.

8.2.2 Battery Connection

- The battery can only be connected after all other processes so that the genset would not be mistakenly started during the course of installation. When connecting the battery, be sure that the (−) polarity be connected at last to reduce the risk of electric arc.
- The start system is powered by 24 volt battery current which is usually provided by two 12 volt batteries in series. Ensure that the positive and negative polarities are linked correctly. If the battery is distant from the genset, please increase the size of the start cable.
- Don't put tools or metal objects on the top of the battery neither let them fall on it. Try to use tools with an insulated handle. If the batteries are seldom used (e.g. as emergency backup), they may discharge and fail to start the genset. To solve this problem, our company provides a utility power float charger with the automatic type genset to maintain the electricity in the battery. When disconnecting the battery, the utility power to the battery charger must be cut off before disengaging the charge terminal. When fixing the battery to the genset, connect the grounding terminal at last while disconnecting it first when removing the battery.

9. OPERATING INSTRUCTIONS

STARTING THE ENGINE/ GENERATOR SET

NEVER ATTEMPT TO START THE GENERA-TOR SET WITH ANY OF THE CIRCUIT BREAK-ERS "ON". THESE BREAKERS ARE LOCATED ON THE DISTRIBUTION PANEL. STARTING WITH THE BREAKERS "ON" CAN CAUSE DAMAGE TO THE GENERATOR.

Once setup procedures are completed, the generator set is ready to be started. Start the unit according to the following steps:

☐ Place the toggle switch in **"ON"** position then press the **MANUAL ("MAN") BUTTON** on the genset Controller. The unit will start an automatic timing sequence . After the timing sequence the engine will attempt to start. Make sure all debris and obstructions have been cleared from moving parts and electrical terminals. The generator will only make 3 attempts at starting before it must be reset with the switch.

☐ Now that the generator set is running, allow five minutes for warm-up time.

☐ Listen for any unusual sounds or excess vibrations that could signal problems and require immediate shutdown of the unit. Should unusual sounds be detected, shut the unit down, and contact Our Service.

☐ Once the engine has been started and running smoothly, Once the engine is running, the Warm Up timer, if selected is initiated, allowing the engine to stabilize before accepting the load .The following gauges should be monitored. All gauges will be displayed on the LCD screen on the control panel.

Oil Pressure Gauge -This gauge should read 30 psi or higher.

Coolant Temperature Gauge -This gauge should read between 170-200 degrees F.

DC Voltmeter -This gauge should read at least 12 volts DC to indicate the diesel engine's alternator is charging properly.

AC Voltmeter -This gauge should reflect the proper voltage selected for this operation.

AC Ammeter -The reading on this gauge should be zero since the main breaker is in the "OFF" position. Once a load is applied to the generator, the ammeter will produce an appropriate reading.

9.1 LOADING INSTRUCTIONS

If all readings are correct, an electrical hookup can be made to the generator set. To make the electrical hookup to the generator set, observe the following set of procedures:

SHUT DOWN THE GENERATOR SET BY PRESSING THE EMERGENCY BUTTON ON THECONTROL PANEL. SWITCH THE POWER SWITCH TO THE "OFF" POSITION BEFORE MAKING ANY ELECTRICAL CONNECTIONS. THE MAIN GENERATOR BREAKER SHOULD BE IN THE "OFF" POSITION.

- ☐ Shut down the generator set.
- ☐ Connect the desired electrical apparatus to the generator set, while making sure no other power source is connected to the same apparatus.
- ☐ Restart the engine and monitor the gauges as outlined in the "*Operating Instructions*" section under "*Starting the Engine/Generator Set*".

- ☐ Turn the required generator circuit breakers to the **"ON"** position.
- ☐ Monitor the AC Ammeter - If the needle deflects severely to the right and stays there, immediately turn the required generator circuit

breakers to the **"OFF"** position.

SEVERE DEFLECTION OF THE AMMETER INDICATES A WIRING PROBLEM OR AN OVERLOAD PROBLEM. CONTINUED OPERA-TION UNDER THIS CONDITION WILL CAUSE DAMAGE TO THE GENERATOR AND/OR

CONNECTED APPARATUS.

THIS GENERATOR SET PRODUCES VOLT-AGES THAT CAN CAUSE SEVERE

SHOCK OR DEATH! ONLY QUALIFIED

CTRICANS ⚠ SHOULD PERFORM ELECTRICAL WORK.

THIS EQUIPMENT USES HIGH VOLTAGE CIRCUITS CAPABLE OF CAUSING SERIOUS INJURY OR DEATH! EXCERCISE EX-TREME CAUTION AROUND ANY ELECTRICAL COMPONENT WHEN OPERATING THIS UNIT

DO NOT OPERATE THE UNIT UNLESS VOLTAGE HAS BEEN CHECKED AT DISTRIBUTION LUGS AND RECEPTACLES. CALL THE SERVICE IF YOU HAVE ANY QUESTIONS.

INSTALLATION AND ANY WORK PERFORMED ON THIS UNIT SHOULD BE DONE ONLY BY A QUALIFIED ELECTRICIAN.

⚠

DO NOT REMOVE OR COVER ORIGINAL SAFETY AND OPERATION DECALS. REPLACE

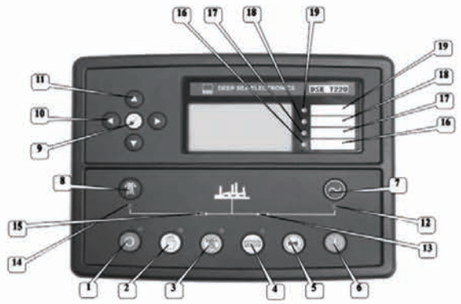
ANY DAMAGED DECALS BEFORE USING THIS EQUIPMENT!

9.1.1. Control System Introduction and Operation Explanation

9.1.1.1 Function Introduction

A. Electricity parameter and engine working condition parameter are displayed by liquid crystal;
B. Electric energy quality monitoring, engine working condition off-limit alarm and outage protection;
C. Automatically start when mains supply faults, and with two breakers (generator breaker and mains supply breaker) electrical interlock function.

9.1.1.2 DSE7220 Control System panel Drawing



9.1.2.1 Controller Panel Explanation

Keys:

1)：For stopping the diesel generator sets ,Fault reset

2) :manual mode of diesel generator set

3) :test of city power supply failure simulation

4) :automatic mode of diesel generator sets

5) :Mute

6) :start of diesel generator set (under manual mode)

7) :generating power switch

8) :city power switch （under function of AMF）

9) :enter and confirm

10) :The left and right menu navigation buttons ,Cycle selection menu

11) :up and down ,Cycle selection menu

9. 1.2.2LED explain

12）diesel generator work well ， green LED lighting
13）generating power switch ， green LED lighting
14）city power supply ， green LED lighting
15）city power switch ， green LED lighting
16）public alarm ， green LED lighting
17）low oil pressure alarm ， green LED lighting
18）high water temperature alarm ,green LED lighting
19)automatic mode indication，green LED lighting
Attention ： 16-19 LED should custom according to the actual need ， here what we mentioned is just example

9. 1.2.3 mode selection ：

1）press ， control panel is under stop/reset

2) press ,control panel is under manual mode ,the diesel generator set under situation of standby ,if need start the generator set ,press

3) Press ,control panel is under automatic mode ,the diesel generator set under situation of standby ,when the city power supply is cut off ,the generator set runs automatic

4) press ,control panel is under test mode ,diesel generator set is under situation of simulating city power supply failure ， start the generator set

automatic

9. 1.2.4 mode of operating :

1.start the diesel generator set under manual mode ,

72XXseries is always on the mode of stop/reset when the control panel gets power :1)the lamp of（1） (stop/reset) lighting ,generator set is under situation of stop ,the （6） is no use ; press the （2） , control panel changes into manual mode , the lamb （2） lights , and then press （6） , start the diesel generator set under manual mode , if need stop , press （1）

2.start the diesel generator set under automatic mode ,

If need 72XXseries to be under automatic mode ,press (4) automatic start,the diesel generator set is under situation of automatic standby ,if the outside signal (the signal of remote without origin) put in effectively,generator set start the Jigger automatic,(we often custom the line for automatic start No 60# ,you can check the line picture of control panel), when the outside signal cut off , the diesel generator set cool down and stop , the time is 60 seconds , of the diesel generator set work with problem , press （1）

3.Test mode

Press（3） , diesel generator set is under situation of simulating city power supply failure , the generator set generates power after automatic start , if need stop , press （1）

10. MAINTENANCE

10.1 MINIMUM MAINTENANCE PROCEDURES

The following maintenance intervals are only suggested by generator factory. You should always check your

engine owner's manual for specific information. Should you find any discrepancies between the Generator Manual and the Engine Manufacturer's Manual always follow the Engine Manufacturer's Manual.

Every 8 Hours of Operation:

Check the crankcase oil and fill as required.
Check the fuel tank level and fill as required.

EXPLOSION HAZARD. NEVER ADD FUEL TO THE UNIT WHILE IT IS RUNNING. THIS CON-STITUTES A SEVERE FIRE HAZARD THAT CAN CAUSE DAMAGE TO THE UNIT AND IN-JURY TO THE OPERATOR.

Daily:

Check the engine and generator for any loose bolts, connections, and fittings.
Check the coolant levels and fill as required.
Check the fuel/water separator for the presence of water contamination. Drain as required.

WATER CONTAMINATED FUEL WILL CAUSE SEVERE DAMAGE TO THE INJECTION AND FUEL PUMPS.

BURN HAZARD NEVER REMOVE THE

RADIA-TOR CAP OR CHECK ELECTOLYTE LEVELS ON A HOT UNIT. THIS COULD RESULT IN SEVERE BURNS TO THE OPERATOR.

Note: Use a 50% solution of water and antifreeze for the engine coolant. Refer to your engine manufacturer's maintenance manual for specific

antifreeze information.

DAILY
Oil Level and Condition
Oil Leakage Check
Oil Pressure Gauge Reading
Oil Pressure Warning Lamp
Fuel Leakage Check
Drain Water From Fuel Filter
Coolant Level and Condition
Coolant Leakage Check
Radiator Filler Cap

Fan Belt Tension Check
Coolant Temperature Reading
Electrolyte Level Check
Battery Cleaning
Battery Charge Condition
Ammeter Reading
Charge Warning Lamp

Preheating Condition Check
Engine Vibration and Noise Levels
Exhaust Smoke Condition

50 HOURS
Change Oil and Filter

250 HOURS
Change Oil and Filters

500 HOURS
Change Oil and Fuel Filter
Replace Fuel Filter
Injection Nozzle Check
Clean Radiator Surface

750 HOURS
Replace Engine Oil

1000 HOURS
Change Oil and Filter
Replace Fuel Filter
Injection Nozzle Check
Coolant System Circuit Cleaning
Starter and Alternator Check and Cleaning
Cylinder Compression Pressure
Valve Clearance Check
Feed Pump Strainer Cleaning
Clean Radiator Surface

1250 HOURS
Replace Engine Oil

Water Pump Grease Change
Coolant System Circuit Cleaning
Starter and Alternator Check and Cleaning

1500 HOURS
Change Oil and Filter

Replace Fuel Filter

Injection Nozzle Check
Clean Radiator Surface
Positive Crankcase Ventilation Valve Cleaning

10.2 CLEANING

The Generators employ various electronic controls that may be damaged by liquid spray washing or high pressure washing. Follow these procedures to prevent any damage to these components.

DO NOT SPRAY WATER INTO THE UNIT WHILE IT IS RUNNING. THIS MAY RESULT IN INJURY

OR DEATH BY ELECTRIC SHOCK.

Exterior Cleaning:

The exterior housing may be washed by most conventional cleaners and methods.
The exterior housing may be waxed using any conventional automotive wax.

Interior Cleaning:
Using a damp cloth covered with a mild soap, carefully clean around any electric controls, generator, and thermostats.
The base and housing foam may be cleaned with a damp cloth covered with mild soap.

10.3 CARE AND SERVICING AIR FILTERS

A common belief in air filtration is that new clean

filters are the best. In reality, a filter is the least efficient it will ever be when it is first installed. Filter paper is specially designed paper that is woven with a series of small openings that allows air to pass through it and dust to be stopped. As small particles of dust are trapped in the paper, the holes become smaller and the efficiency increases.

Engine air filtration systems using staged precleaners, keep large particles of dust from the air stream, which would bridge across the element and cause premature filter failure. The most common cause of engine failure due to dust ingestion is over servicing.

DO NOT USE VISUAL INSPECTION TO DETER-MINE FILTER FAILURE.

Use a dust load indicator (vacuum gauge) to determine when the filter should be changed. These are available in many configurations but should trigger when 10-15 inches of water column over the clean element is reached. When you remove a filter from the canister, the seal is broken and loose particles of dust can fall into the outlet and be drawn

into the engine the next time it starts. Leave the inner (safety) element installed, as this will protect against loose debris entering the engine.

General cleaning of cartridges should be accomplished by either a light brushing or mild air pressure application.

NEVER DIRECT A HIGH-PRESSURE AIR STREAM DIRECTLY INTO A FILTER PACK AS IT MAY RESULT IN MEDIA BREAKDOWN. NEVER TAP A FILTER TO REMOVE DIRT AS THIS COULD DAMAGE THE SEALING SUR-FACES.

Carefully remove any loose dust from the canister

using a vacuum and then wipe with a damp cloth.

NEVER BLOW AIR INTO THE CANISTER AS IT MAY FORCE DIRT INTO THE ENGINE.

Make sure the sealing areas of the canister and the element are clean and free of defect before installing the element. The safety element should be changed sparingly (every three or four filter changes) and extreme care should be taken to not allow dirt to enter the engine when the safety element is removed.

NEVER WASH THE CANISTER WITH HIGH PRESSURE WATER AS IT COULD DAMAGE OR BREAK THE PRECLEANER ROTOR.

11. TROUBLESHOOTING GUIDE

The engine/generator set is tested and set at the factory for proper operation in the field. These units should never require additional adjustments in the field. If needed, adjustments should only be made by a qualified service technician; otherwise the manufacturer's warranty may become void.

11.1 Engine

Fault Type	Fault Description and Reason	Remedy
Diesel engine can not start	☐ Fuel system failure: The diesel engine doesn't ignite when rotated by the electric motor and there is no fuel in the fuel return pipe.	
	• air in the fuel system	Check whether the fuel pipe joints are loosened; vent the air in the fuel. Unfasten the vent screw on the fuel injection pump and fuel filter; pump the fuel with the hand pump, until there is no air bubbles in the overflowing fuel; tighten the vent screw, continue pumping; when fuel flows into the return pipe, tighten the hand pump.
	• Fuel pipe clogged	Check and ensure that the fuel pipes are not clogged.
	• Fuel filter Clogged	Clean the filter or replace the filter insert
	• Fuel pump doesn't work or fails while working.	Check the fuel pump and the fuel intake pipe
	• Insufficient fuel injection, failed injection or fuel not atomized	Replace injector assembly
	• Injection pump speed governing lever placed in wrong position	When starting the engine, place the lever in such a position that the engine rotates at 600-800 r/min at no-load
	Electric starting system failure	
	• Misconnection of electric wires or inadequate grounding	Check that the electric wires are firmly and reliably connected
	• Insufficient battery capacity	Replace with a well-charged battery or use batteries in parallel.

Fault Type	Fault Description and Reason	Remedy
Inadequate output power of the diesel engine	• Fuel pump rod rack choked	Open the peep hole on the pressure fuel pump and move the acting rack to see whether there is any obstruction. For pressure fuel pump equipped with electronic speed governor, if no rod rack gets choked, jump out Terminal 1# and 6# on the control panel. Meanwhile the speed actuator shall be in the "maximum fuel" position and click sounds shall be easily audible. This will help staff decide whether there is fault with the electronic speed governor control panel.
	• Electronic speed governor failure	Please follow the testing procedures specified in the handbook for the electronic speed governor (actuator, control panel, speed censor) and find out the reason.
	• Fuel injection advance angle too earlier or too late, or even 180^0 apart. Engine not ignited or extinguished after brief ignition.	Check whether the scribed lines on the splicing tray of the fuel pump drive shaft are correct and secured. Adjust if necessary.
	Incorrect valve timing	Check the valve timing
	Long starting time or misfiring in cold environment	Use appropriate auxiliary starting devices as per required by the environment temperature to facilitate the starting of the engine.
	☐Fuel system fault: cannot increase rev and output power even when the throttle is increased	
	• Fuel pipe or filter is intruded by air or gets clogged.	Vent the air or replace fuel filter insert as aforementioned
	• Fuel supplied by the pump does not get atomized	Repair or replace assembly:
	• Inadequate atomization of the injector or injecting pressure too low	Check atomizing or adjust injection pressure. Check whether the injector assembly shall be replaced
	☐ Air intake and exhaust systems fault: the exhaust smoke has a higher temperature and worse color than normal.	

Fault Type	Fault Description and Reason	Remedy
	• Air filter clogged	Wash the air filter element or wipe off the dust on it. Replace it if necessary. Check that the engine oil level is normal.
	• Exhaust pipes clogged or pipe joints too long, or elbows having a small bend radius or more elbows than necessary	Clean off the carbon deposits in the exhaust pipe, reinstalling the pipe, reduce the number of elbows, enlarge elbow bend radius.
	☐ Engine block overheating; ambient temperature too high; oil and coolant temperature too high; exhaust temperature too high	Check the cooler and radiator, clear off furring; Check relevant piping to ensure there is no pipe that is too slim; If the ambient temperature is too high, improve room ventilation to cool it down.
Abnormal sounds when the diesel engine is running	☐ Drive gear wearing, enlarged clearance: abnormal sounds from the front cover; collision noises heard when the engine suddenly slows down	Adjust gear clearance; replace the gear if it is worn out
	☐No oil between the rocker adjusting screw and the pushrod spheric seat: squeaks of dry friction heard from the cylinder head.	Remove the cylinder head case and add oil
	☐ Enlarged intake and release valve clearance: rhythmic noises from the cylinder head.	Adjust valve clearance
	☐ Black smoke:	
	• the engine overloaded	Reduce the load to rated level
	• Uneven fuel supply among the cylinders	Adjust fuel injection pump
	• Inappropriate valve clearance and/or bad seal results in gas leakage and incomplete combustion	Adjust valve clearance; check the conical seal surface and remove any defect
	☐ White smoke:	

Fault Type	Fault Description and Reason	Remedy
Abnormal exhaust smoke color	• Inadequate atomization of the fuel, fuel liquid drops, injection pressure too low.	Check the injector assembly; reprocess or replace it; adjust the injection pressure to rated level
	• Incomplete combustion in individual cylinder (esp. in winter) when the engine is just started	Increase engine speed and load by an appropriate extend and let the engine run for a prolonged period
	• Air filter clogged, obstructing air intake.	Check and clean air filter element
	• Piston ring choked or excessive wear; reduced flexibility; piston ring chamfer installed in wrong location, causing oil intrusion into the combustion chamber	Check piston ring and replace it if necessary
	• Engine constantly runs at low load (below 40% of rated output) : enlarged clearance between piston and cylinder jacket, causing oil intrusion into the combustion chamber	Increase the load appropriately
	• Excessive amount of oil in the oil pan	Reduce the amount of oil until the oil level drops down to rated level.
		Fill oil according to the markings on the dipstick.
Abnormal engine oil pressure	Engine oil pressure drops and can not return to normal even through adjustment of the pressure control valve. Meanwhile, the readings on the pressure gauge fluctuates:	
	• Oil pipe leakage	Check and repair, tighten screw nuts
	• Air intrusion into the oil pump; lack of oil in the oil pan	Replace the oil after topping up the oil to rated level
	• Serious oil leakage in such locations as the crankshaft thrust bearing, oil seal of the flanged end of the crankshaft, camshaft bearing and connection rod axial bush	Check all the parts and replace any if it is worn out

Fault Type	Fault Description and Reason	Remedy
	• Rupture of the connecting oil pipe between rocker shafts; no oil injector is installed to lubricate the drive bearing or the oil injector is displaced from its fixed position.	Check , repair or replace
	• oil cooler or oil filter clogged; rupture of cooler pipe; leakage on the seal gasket or gasket damaged.	Clean, weld or replace the filter element. If aluminum bits are found in centrifugal oil filter，it means that the alloy layer on the connecting rod axial bush is ripped off. Check for the bush and replace it if necessary; check and replace seal gasket
	□ No oil pressure, the pointer of the oil pressure gauge is motionless:	
	• Oil pressure gauge damaged	Replace
	• Oil passage clogged	Clean after check and repair
	• Oil pump severely damaged or choked because of unskilled installation	Check and repair; adjust the clearance; test the pump for performance
	• Oil pressure control valve fails, the spring damaged	Replace the spring; rub the seal surface of the control valve
Over high oil temperature and excessive fuel consumption	□ The reading on the oil temperature gauge is beyond rated value; it doesn't drop much even after enhanced cooling. Black smoke is seen from the exhaust.	
	• Diesel engine overloaded	Reduce load
	• Oil cooler or radiator clogged	Wash cooler or radiator piping
	• Inadequate coolant or wind flow from the fan	Ensure that the coolant flows unobstructed; adjust the tension of the V belt to let the water pump and fan reach rated speed.

Fault Type	Fault Description and Reason	Remedy
	• Inadequate oil	Top up the oil to rated level
	• The temperature gauge doesn't work rightly	Check and adjust or replace
	☐ Oil level in the oil pan drops quickly; the color of the oil is dark; white smoke is seen from the oil refilling hole on the vent pipe and black smoke is seen from the exhaust pipe:	
	• Oil of inappropriate grade is used	Chose the right grade of oil as specified by the genset producer
	• Piston ring gets stuck or worn out; cylinder jacket gets worn out so that oil intrudes into the combustion chamber, combusting gas intrudes into the crankshaft case	Replace piston ring; replace cylinder jacket if necessary
	• Oil return hole of the piston oil control ring gets clogged with carbon deposits	Clear off the carbon deposits
	• The elastic sealing of the turbocharger (if equipped) fails to function	Check the elastic air sealing for ability to continue function; replace if necessary
	• Engine operates at low load for long periods	Increase the load appropriately
Oil level in the oil pan rises	The coolant infiltrates into the engine oil; yellow bubble floats on the oil; water vapor condenses on the surface of the vent pipe filter element:	
	☐ Cylinder jacket water tight gasket damaged, resulting in water leakage	Replace the water tight gasket
	☐ Cylinder head gasket damaged, resulting in water leakage	Use new gasket

Fault Type	Fault Description and Reason	Remedy
	☐ For wet oil cooler, the cooler element damaged, resulting in the mixture of cooling water and oil	Check the cooler element, repair or replace
	☐ Cooling water infiltrates from the fresh water pump into the oil pan	Check the water tight ring, repair or replace; rub the sealing surface
	•Leakage of water on the fresh water pump shaft and sea l gasket	
	• Water tight rubber ring of the fresh water pump damaged	
Outlet water too hot	☐ There is air in the water pipe: litter or no water flows through the outlet pipe, resulting in rising water temperature.	Unfasten the water temperature gauge joint on the water pipe, vent the air until water flows unobstructed. Then tighten all joints on the water piping.
	☐ There isn't enough water being circulated. At high loads, the outlet water would become very hot and engine oil would also be too hot.	
	• Fresh water pump or cooling fan doesn't rotate fast enough	Adjust the tension of the V belt until it meets requirement.
	• The rotor blades of the fresh water pump gets damaged	Replace
	• The clearance is too wide between the rotor blade and the pump case(壳体).	Adjust the clearance until it meets requirement
	• In open circulation system, the water supply end is so low that the water pump is unable to suck up the water.	Lift the water supply end.
	• In closed circulation system, the radiator lacks water	Add cooling water
	• Water pipes get clogged	Clean the pipes, clear off fouling
	• In closed circulation system, the radiator surface is covered with dirt, affecting the heat emission.	Clean the surface of the radiator

Fault Type	Fault Description and Reason	Remedy
	• Thermostat doesn't work.	Replace
	• Water temperature gauge doesn't work	Repair or replace
	• Cracks on the shoulder of the cylinder jacket: the cooling water in the radiator bubbles.	Replace the cylinder jacket
Outlet water too cold	☐ In open circulation system, the raw water intrudes into the engine	Install a water mix tank
	☐ Thermostat doesn't work well or gets damaged	Replace
	☐ Ambient temperature is low or the load is low	Increase the load properly
	☐ Water temperature gauge doesn't show correct data	Check or replace
Oil foul on the cooling water	The element of wet oil cooler gets damaged	Repair or replace
Electric starting system	☐ Starter motor doesn't work	
	• poor contact at electric connections	Clean and tighten electric connections
	• poor contact at brushes	Clean the commutator or replace the brush
	• starter motor short circuit	Eliminate short circuit
	• Inadequate charging of the battery or battery capacity too small	Charge the battery or use more batteries in parallel; replace battery if necessary
	• poor contact on electromagnetic switch contact points	Check the contact points and abrade them with sand paper

Fault Type	Fault Description and Reason	Remedy
	☐ Starter motor gear gets choked with the flywheel ring gear or starter motor gear can't be Disengaged:	
	• starter motor not in parallel to the center of the flywheel ring gear	Reinstall the starter motor and parallel it to the flywheel ring gear center
	• sintered electromagnetic switch contacts	Check the contacts; file, abrade and singe them
	☐ Starter motor continues running after start button is released:	
	• the moving contacts of the electromagnetic switch sintered with the connection screw	Check and repair
	• starter motor governing screw not adjusted properly	Readjust the screw
	☐ Abnormal noises with the alternator	
	• loose or broken bearings	Replace the bearings
	• collision between rotor and stator	Rub off the collision surface with a file
	☐ Battery refuses charging; or unable to provide strong current while voltage drops sharply; white lead sulfate crystals appear on the plates:	Repair or replace the battery
	☐ When charging, the battery temperature is high; the voltage is low; the electrolyte proportion is low; bubbles are too small towards the end of charging or come out too late; short circuit inside the battery.	If inside short circuit is caused by excessive deposits at the bottom of the battery, discharge the battery completely, pour out the electrolyte, rinse the battery several times and recharge it. If inside short circuit is caused by other reasons, dismantle the battery and have the separators/plates repaired or replaced

11.2 Alternator

Fault Description	Remedy	Result	Check/Reason
Without no-load voltage when started	Connect Terminal "E+" and "E-" to a 4-12V new battery, and maintain it for 2-3 seconds. (Pay attention to polarities)	When the battery is removed, voltage reaches the rated level.	Magnet field loss
		When the battery is removed, voltage is established but doesn't reach rated level.	☐ Check AVR reference signal connection
			☐ Diode fault
			☐ Exciting armature short circuit
		When the battery is removed, no voltage is established.	☐ AVR fault
			☐ exciter field winding wiring open circuit (check the winding)
			☐ main rotor winding wiring open circuit (check the resistance)
Voltage too low	Check the rev	The rev is correct	☐ Check AVR wiring (AVR might have failed)
			☐ Field winding wiring short circuit
			☐ rotating diode damaged
			☐ main rotor winding wiring open circuit (check the resistance)
		The rev is too low	Increase the rev(do not adjust the AVR voltage-potentiometer before the rev reaches rated level)

Fault Description	Remedy	Result	Check/Reason
Voltage too high	Adjust AVR voltage-potentiometer	Adjustment fails	AVR failure
Voltage Oscillation	Adjust AVR steady-state potentiometer)	If the adjustment fails, try normal/fast mode (ST2)	☐ Check the rev: possibility of nonperiodical oscillation
			☐ Loose connection
			☐ AVR failure
			☐ Engine rev is too low at loads or LAN configuration too high
The voltage is correct at no load while too low at load.	Let the alternator run at no load, check the voltage between "E+" and "E-" on AVR	The direct current voltage between "E+" and "E-" SHUNT/PMG <10V	Check the rev (or LAN configuration too high)
		The direct current voltage between "E+" and "E-" SHUNT/PMG >15V	☐ Rotating diode failure
			☐ Main rotor short circuit, check resistance
			☐ Exciter armature failure, check resistance
Voltage disappears during operation	Check AVR, varistor, and rotating diode; replace any failing components	Voltage does not return to rated level	☐ Exciter field winding wiring open circuit
			☐ Exciter rotor failure
			☐ AVR failure
			☐ Main rotor open circuit or short circuit.