



OPERATION MANUAL OF DIESEL GENERATING SETS



I. INTRODUCTION

Yicheong Generator Set is designed to be commissioned, when delivered, as soon as the necessary cooling water, antifreeze, fuel, lubrication oil and fully charged battery are provided.

With its long years of experience, Power World manufactures efficient, reliable and quality generating set.

This operating and maintenance manual is prepared to assist the operator in operation and maintenance of the generating set. Observing the advices and rules in this manual will ensure that the generating set operates in maximum performance and efficiency for a long time.

Care should be taken to perform more frequent maintenance in dirty and dusty environments in order to keep the generating set in good working condition.

Necessary adjustments and repairs should be made only by authorized and qualified persons.

2. SAFETY

2.1 GENERAL

The generating set is designed to be safe when used in the correct manner. However responsibility for safety rests with the personnel who install, use and maintain the set. If the following safety precautions are followed, the possibility of accidents will be minimized. Before performing any procedure or operating technique, it is up to the user to ensure that it is safe. The generating set should only be operated by personnel who are authorized and trained.

WARNING

- ! Read and understand all safety precautions and warnings before operating or performing maintenance on the generating set.
- ! Failure to follow the instructions, procedures, and safety precautions in this manual may increase the possibility of accidents and injuries.
- ! Do not attempt to operate the generating set with a known unsafe condition.
- ! If the generating set is unsafe, put danger notices and disconnect the battery negative (-) lead so that it cannot be started until the condition is corrected.
- ! Disconnect the battery negative (-) lead prior to attempting any repairs or cleaning inside the enclosure.
- ! Install and operate this generating set only in full compliance with relevant National, Local, or Federal Codes, Standards or other requirements.

2.2 INSTALLATION, HANDLING AND TOWING

Chapter 3 of this manual covers procedures for installation, handling, and towing of generating sets. That chapter should be read before installing, moving and lifting the generating set or towing a mobile set. The following safety precautions should be noted:

WARNING

- ! Make electrical connections in compliance with relevant Electrical Codes, Standards or other requirements. This includes requirements for grounding and ground/earth faults.
- ! For stationary generating sets with remote fuel storage systems, make sure such systems are installed in compliance with relevant Codes, Standards or other requirements.
- ! Engine exhaust emissions are hazardous to personnel. The engine exhaust for all indoor generating sets must be piped outdoors via leak-free piping in compliance with relevant Codes, Standards and other requirements. Ensure that hot exhaust silencers and piping are clear of combustible material and are guarded for personnel protection per safety requirements. Ensure that fumes from the exhaust outlet will not be a hazard.
- ! Never lift the generating set by attaching to the engine or alternator lifting lugs, instead use the lifting points on the baseframe or canopy.



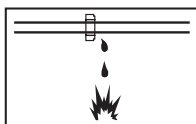
- ! Ensure that the lifting rigging and supporting structure is in good condition and has a capacity suitable for the load.
- ! Keep all personnel away from the generating set when it is suspended.

2.3 FIRE AND EXPLOSION

Fuel and fumes associated with generating sets can be flammable and potentially explosive. Proper care in handling these materials can dramatically limit the risk of fire or explosion. However, safety dictates that fully charged BC and ABC fire extinguishers are kept on hand. Personnel must know how to operate them.

WARNING

- ! Ensure that the generating set room is properly ventilated.
- ! Keep the room, the floor and the generating set clean. When spills of fuel, oil, battery electrolyte or coolant occur, they should be cleaned up immediately.
- ! Never store flammable liquids near the engine.
- ! Do not smoke or allow sparks, flames or other sources of ignition around fuel or batteries. Fuel vapours are explosive. Hydrogen gas generated by charging batteries is also explosive.
- ! Turn off or disconnect the power to the battery charger before making or breaking connections with the battery.
- ! To avoiding arcing keep grounded conductive objects (such as tools) away from exposed live electrical parts (such as terminals). Sparks and arcing might ignite fuel or vapours.
- ! Avoid refilling the fuel tank while the engine is running.
- ! Do not attempt to operate the generating set with any known leaks in the fuel system.

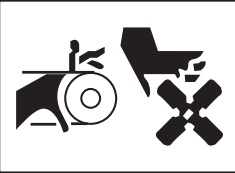


2.4 MECHANICAL

The generating set is designed with guards for protection from moving parts. Care must still be taken to protect personnel and equipment from other mechanical hazards when working around the generating set.

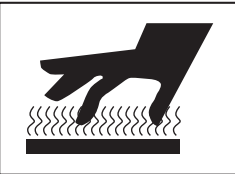
WARNING

- ! Do not attempt to operate the generating set with the safety guards removed. While the generating set is running do not attempt to reach under or around the guards to do maintenance or for any other reason.
- ! Keep hands, arms, long hair, loose clothing and jewellery away from pulleys, belts and other moving parts.



Attention: Some moving parts can not be seen clearly when the set is running.

- ! If equipped keep access doors on enclosures closed and locked when not required to be open.



- ! Avoid contact with hot oil, hot coolant, hot exhaust gases, hot surfaces and sharp edges and corners.
- ! Wear protective clothing including gloves and hat when working around the generating set.

- ! Do not remove the radiator filler cap until the coolant has cooled. Then loosen the cap slowly to relieve any excess pressure before removing the cap completely.

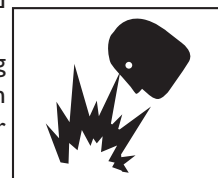


2.5 CHEMICAL

Fuels, oils, coolants, lubricants and battery electrolyte used in this generating set are typical of the industry. However, they can be hazardous to personnel if not treated properly.

WARNING

- ! Do not swallow or allow skin contact with fuel, oil, coolant, lubricants or battery electrolyte. If swallowed, seek medical treatment immediately. Do not induce vomiting if fuel is swallowed. For skin contact, wash with soap and water.
- ! Do not wear clothing that has been contaminated by fuel or lube oil.
- ! Wear an acid resistant apron and face shield or goggles when servicing the battery. If electrolyte is spilled on skin or clothing, flush immediately with large quantities of water.



2.6 NOISE

Generating sets that are not equipped with sound attenuating enclosures can produce noise levels in excess of 105 dBA. Prolonged exposure to noise levels above 85 dBA is hazardous to hearing.

WARNING

- ! Ear protection must be worn when operating or working around an operating generating set



2.6 ELECTRICAL

Safe and efficient operation of electrical equipment can be achieved only if the equipment is correctly installed, operated and maintained.

WARNING

- ! The generating set must be connected to the load only by trained and qualified electricians who are authorized to do so, and in compliance with relevant Electrical Codes, Standards and other regulations.
- ! Ensure that the generating set, including a mobile set is effectively grounded/earthed in accordance with all relevant regulations prior to operation.
- ! The generating set should be shutdown with the battery negative (-) terminal disconnected prior to attempting to connect or disconnect load connections.
- ! Do not attempt to connect or disconnect load connections while standing in water or on wet or soggy ground.
- ! Do not touch electrically energized parts of the generating set and/or interconnecting cables or conductors with any part of the body or with any non insulated conductive object.
- ! Replace the generating set terminal box cover as soon as connection or disconnection of the load cables is complete. Do not operate the generating set without the cover securely in place.
- ! Connect the generating set only to loads and/or electrical systems that are compatible with its electrical characteristics and that are within its rated capacity.
- ! Keep all electrical equipment clean and dry. Replace any wiring where the insulation is cracked, cut, abraded or otherwise degraded. Replace terminals that are worn, discolored or corroded. Keep terminals clean and tight.
- ! Insulate all connections and disconnected wires.



- ! Use only Class BC or Class ABC extinguishers on electrical fires.

2.8 FIRST AID FOR ELECTRIC SHOCK

WARNING

- ! Do not touch the victim's skin with bare hands until the source of electricity has been turned off.
- ! Switch off power if possible other wise pull the plug or the cable away from the victim.
- ! If this is not possible, stand on dry insulating material and pull the victim clear of the conductor, preferably using insulated material such as dry wood.
- ! If victim is breathing, turn the victim clear of the conductor, preferably using insulated material such as dry wood.
- ! If victim is breathing, turn the victim into the recovery position described below. If victim is unconscious, perform resuscitation as required:

OPEN THE AIRWAY

Tilt the victim's head back and lift the chin upwards.

Remove objects from the mouth or throat (including false teeth, tobacco, or chewing gum).



BREATHING

Check that the victim is breathing by looking, listening and feeling for the breath.



CIRCULATION




Check for pulse in the victim's neck.

IF NO BREATHING BUT PULSE IS PRESENT

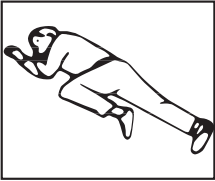
- 1 Pinch the victim's nose firmly.
- 2 Take a deep breath and seal your lips around the victim's lips.
- 3 Blow slowly into the mouth watching for the chest to rise. Let the chest fall completely. Give breaths at a rate of 10 per minute.
- 4 If the victim must be left to get help, give 10 breaths first and then return quickly and continue.
- 5 Check for pulse after every 10 breaths.
- 6 When breathing restarts, place the victim into the recovery position described later in this section.



IF NO BREATHING AND NO PULSE

- ① Call or telephone for medical help.
- ② Give two breaths and start chest compression as follows:
- ③ Place heel of hand 2 fingers breadth above ribcage/breastbone junction. 
- ④ Place other hand on top and interlock fingers. 
- ⑤ Keeping arms straight, press down 4-5 cm (1.5-2 inch) at a rate of 15 times per minute.
- ⑥ Repeat cycle (2 breaths and 15 compressions) until medical help takes over. 
- ⑦ If condition improves, confirm pulse and continue with breaths. Check for pulse after every 10 breaths.
- ⑧ When breathing restarts, place the victim into the recovery position described below.

RECOVERY POSITION

- ① Turn the victim onto the side. 
- ② Keep the head tilted with the jaw forward to maintain the open airway.
- ③ Make sure the victim cannot roll forwards or backwards.
- ④ Check for breathing and pulse regularly. If either stops, proceed as above.

WARNING

- ! Do not give liquids until victim is conscious.

3. Installation, Movement, Transport and Storage

3.1 General Principle

In case that the dimension and the relevant control system or power system has been confirmed, the installation plan can be worked out. The chapter is to discuss the important elements for safe and efficient installation.

3.2 Outer Canopy

It is easy to install and move if the generator set is with outer Canopy. The Canopies are all arranged for convenient transportation and easy installation, with the protection of parts to avoid the touch of the non-professionals.

3.3 Remove of the Generator Set

The bottom base of the generator set is designed specially for easy remove. The mistaken remove will result to the serious damage to the machine parts.

Please lift the machine with fork lift or make careful push or pull with stress on the bottom seat. If you push, please put wood logs between the forks and frame to avoid the injury to the frame and scatter the weight instead of pushing the frame with fork. In case that the generator needs to be transited frequently, an oil gliding track can be fitted in the machine frame with fork groove and suspender. For the smaller model, the groove for fork lift has been fitted in the bottom seat.

Warning:

- ! Please do not use the swing ring of the engine or AC generator to lift the machine.
- ! Please check if the suspender and holder are in good condition and the weight held by the suspender is proper.
- ! Please keep distance from it when the machine is lifted.

One single-spot suspender should be set up for the lift of the generator set and the standard machine with top-cover has been with single-pointed suspender equipment.

If the generator is lifted for installation, the extrude point on the bottom is set for the lift, please check if the connection is firm, if there is any crack on the seal, if the screw is tightened etc.. The lift point with rail to protect the machine is on the center of the weight (nearby the generator) instead of the center of the whole unit, in this way, it can be lifted straight. Once the machine is away from the ground, the cable should be used to prevent the steel cord from twisting or the machine from swing. Please don't lift the machine in the strong wind. The machine should be set on the flat place which can stand the weight of the machine.

The lift method is just for the installation lift. If the machine needs to be lift frequently, the single-spot suspender equipment should be fitted in. If the generator set is lifted by helicopter, the suspender ring is needed.

3.4 The Place for Installation

It is very important to select a good place to install the generator set. The key factors are as follows:

- Adequate ventilation
- Keep the parts from rainwater, snow, hail, flood, straight sunshine, ice temperature or overheat.
- Please don't expose the machine in the polluted air such as the ground dust, metal dust, fiber particles, fume, smoke, steam, and smog exhausted by engine or other pollution.
- Please avoid the machine to be smashed by the fell tree or pole or other items dropped from vehicles or crane.
- Keep enough space around the machine for the cooling and convenient repair, 1 meter away at least and 2 meters away from the top items.
- Make sure that there is a passage for the machine passing through to the installation room. The air exit should be loaded or unloaded easily in order to be used as the transit entrance.
- Please keep the non-manager away from the operation room.

If the generator set ought to be installed outside the architecture, it shall be equipped with all-weathered outer canopy or container-type outer canopy, which will be very useful for the generator set need to be install inside or outside the architecture temporarily.

3.5 Base and Shock Absorber

Before delivery of the generator set from the factory, the AC generator and engine shall be correctly installed on one hard bottom seat, therefore, when the machine is installed, you just only need to fix the machine on a sound base by screws.

3.5.1 Base: the best installation base is a block of strengthen concrete. The base can supply a hard support to the generator set to avoid the swing and chock. The standard concrete block is 150—200mm thick (6-8 inches), with square no less than the bottom seat of the machine. The ground under the base block should be trimmed to stand the weight of the base block and the machine. (If the generator set is to be set above the ground, the structure of the building must hold the weight of machine, the fuel and accessories etc.) The building must be in accordance with the local building regulation. If the ground is damp (such as in the boiler room), the base must be higher than the ground for power connection, maintenance, and reduction of erosion of the bottom seat metal.

3.5.2 Shock absorber: The shock absorber is installed between the engine/AC generator feet and the bottom seat to decrease the shock of the generator set passed to the building. Then, the bottom seat is fixed on the base block directly. As for the larger generator set, engine/AC generator is fixed on the bottom seat in rigidity with a separate shock absorber for customer's installation between the bottom seat and the base. In any case, the generator set must be fixed firmly on the ground to prevent from the movement (whatever going through shock absorber or not)

The outlet of the machine is also shock-damping, such as soft fuel pipe, soft vent pipe soft exhaust, soft cable pipe and other holders and connectors etc.

3.6 Input of Flammable Air for Engine

The air for the flaming in the engine must be clean and cool. Normally, the air filter is installed in the engine to filter the air around the generator set.

Nevertheless, the air has to be drawn in from other place or room because the air around the generator set is not applicable due to the dust and heat, in this case, please don't take the air filter away to install in other place as it will bring dirt into the engine. If it is necessary, please use the air input equipment approved by the manufacturer, otherwise, it will bring bad influence to the operation of the generator.

3.7 Cooling and Ventilation

Engine, AC generator and vent will emit heat, and the high temperature will influence the efficiency of the generator. So, the measures must be taken to cool down the motor and AC generator. The right air stream route is to flow from end of the engine, passing engine radiator, and then exhaust to outside from detachable vent pipe. If no vent pipe to exhaust the air, the hot air dispersed by the exhaust fan will go back to the radiator in shortcut and decrease the cooling effect.

The exit and entrance of the air must be big enough to let the air flow freely, about 1.5 times of the square of radiator.

The shutters must be put on the exit and entrance of air to protect the machine in the bad weather. The shutter can be fixed or movable and it is better to close the shutter when the machine is not in work in cold days to keep room warm and in favor of the engine charging. For the auto-start generator set, the shutter of it must be auto-open too, and then it can be open when the machine is started up automatically. Under the heat exchange and cooling system without radiator, the heat generated by the generator set must be exhaust to outdoors too.

3.8 Gas Exhaust

The gas exhaust is to let the harmful smoke, fog and smell outdoors and decrease the noise. A appropriate muffler matching the exhaust line can be installed indoors or outdoors to decrease the noise.

Warning

- ! All generator set installed indoors must use non-leaking exhaust pipe to let the gas out , and the installation of the exhaust pipe must in compliance with the relevant regulation and standard.
- ! Please make sure to keep the hot exhaust system in distance from the inflammable items.
- ! Please make sure the exhaust gas not to do harm to public.

During the design of the fume exhaust system, it is must be taken into the basic consideration that the anti-pressure must be within the limit because the over-strong anti-pressure will reduce greatly the efficiency and endurance of the engine and increase the fuel consumption badly. In order to reduce the anti-pressure, the exhaust pipe should be as short as it can, and the curving diameter must be 1.5 times of the inner diameter of the pipe in minimum in case of curve, and need the approval of the manufacturer if it is over 3m.

The standard for other exhaust system are as follows:

- An exhaust soft pipe is added to the connection of the smoke outlet of machine and the exhaust pipe.

The function of it is to reduce the shock passed to the exhaust system and building, allowing the angle windage due to the heat inflation of exhaust pipe and the installation.

- Make sure to keep the pipe not to be broken or leak during the installation of the muffler and pipe.
- The parts of the exhaust system installed indoors should be with heat insulation to reduce the heat emission and noise. The pipes and muffler must be kept far away from the inflammable item whatever indoors or outdoors.
- Any long pipes must be installed downward inclining, and fixed with exhaust valve at the lowest point in order to block the water into the engine and muffler.
- When the pipe is going through wall, it must be with jacket to absorb the shock and keep the inflammable items away from the heated pipes and leave inflation room for the extension or shrinking of the heated pipe.
- The end extended outdoors of the pipe must be in horizontal cut of 60 degree, in case of the vertical cut, it must be set with rainproof hat to prevent the rain and snow from the exhaust system.
- Exhaust pipe must not be connected to other generator's pipe or the pipes of oven and boiler.

3.9 Fuel

The fuel system must make a constant supply of clean fuel to the engine. The installation of it mostly includes one daily-use fuel tank, one large fuel vat and pump with the relevant equipment.

- ! The installation of the separate fuel tank of the fix generator set must be in conformity with the local standard and regulation.
- ! No smoke, flame or fire nearby the fuel. The volatilized fuel and oil will explode with flame etc.

3.9.1 Daily-use tank: The daily-use tank supplies fuel to the generator directly, so it is put in the generator room. For the small generator set, the steel-made or rubber-made daily-use tank is set in the bottom seat with fuel pipe connected to the diesel engine. The tank can supply fuel for the machine working for 8 hours in full charge. The super large tank's fuel can operate the machine for about 24 hours.

3.9.2 Large Fuel Vat: In order to extend the operation time of the generator set, one large separate fuel vat is needed especially for those generator set without regular fuel supply.

Usually, the large fuel vat is set outdoors for convenient fuel inserting and clean and checking, but not be exposed to the frozen area in winter as the oil will flow slowly because of the increased viscosity. The vat can be set on the ground or underground.

The large vat must be with vent hole to emit the pressure result from the oil injection or oil inflation, and prevent the vacuum because of the fuel consumption. The bottom of the vat is in round shape, set in 2 degree inclining for water storage and deposit. One valve is set at the bottom to exhaust water and dirt to a fix place. The vat underground should exhaust the water frequently.

The height difference of the large vat and the daily-use tank is very important. The limit vertical distance of electric oil pump is 4 meters, so the large vat bottom must not be lower than the daily-use tank for more than 4 meters.

3.9.3 Fuel Pass: The fuel pipe can be any steel tube or soft pipe applicable for any environment and compatible to the fuel.

Note:

! Fuel system cannot use lead-plate pipe.

The transport pipe of the fuel and the back pass must be wide as same as the outlet of the machine, while the overflow pipe must be larger in order to ensure the smooth flow of the fuel in case that the pipe is long and the surrounding is in low temperature. The soft pipe should be used to connect to the diesel engine to prevent the damage and fuel leak caused by the shock of machine.

The transportation pipe takes fuel for no less than 50 mm from the high end fuel tank and away from the exhaust valve.

The clean fuel is the most important to the life and stability of the engine, the first grade filter is set between the pump and engine filter. The valve for water and deposit is at the other end of the pump.

3.10 Fireproofing Measures

The following measurement must be considered during the installation of the generator set:

- The fire exit must be set in the room so that the operators can leave immediately in case of fire.
- BC/ABC grade fire extinguisher must be arranged.
- The fireproof valve of the temperature operation fuse can be connected to the diesel engine to cut down the fuel supply.

3.11 Start Battery

Warning

! No smoking, no fire or sparkle nearby the batteries as the hydrogen generated during the charging battery will may explode. The batteries must be placed nearby the engine and to be convenient for maintenance while too long cord will influence the start power.

3.12 Connection of Wire

The connection of the generator output and load must be operated by the qualified electric worker with rich experience, so do for the maintenance and repair.

Warning:

! The cord connection must be in conformity with the relevant electric standard and other requirement including the requirement of grounding and grounding failure protection.

3.12.1 Cord Connection: The cord connecting to the generator should be soft, and then the AC generator or the terminals of power switch will not be damaged by the movement of the machine. If the soft cord is no available due to the installation, one junction box can be fixed nearby the generator with the soft card connecting the connector and the machine. The connecting cord must be set in pipes or grooves but not fixed on the generator set. If the cord needs to curve, please take the minimum curve diameter for reference.

The power cord must match the output voltage and current of the generator. The temperature indoors, installation method and other cords beside must be taken in consideration. Then the cord is single copper core, the sealed jacket must be made in non-magnetic metal such as aluminum or copper, or non-metal materials such as Teflon. If the jacket is made of magnetic metal, the shortcut solution is to cut gaps on the jacket to keep current from backset.

All interface connection must be tight. And it is very important for the auto-switch and the generator's compounding operation if the phase is in line with AC electricity.

3.12.2 Protection: The connection to the generator and load is protected by the circuit breaker. The circuit breaker will cut the circuit in case of overload or short circuit.

3.12.3 Load: The load balance must be considered when designing the power supply system, don't make one phase's load much more than the load of the other phase as it will cause the overheat of the coils of generator. The unbalance of the phases will also damage the sensitive 3-phase equipment of the power system. To keep the current of one phase no more than the current of the generator. If it is needed to connect the generator set to the existing power branch, you must consider the new electricity distribution to balance the loads.

3.12.4 COS: The COS of the load must be calculated, the COS lower than 0.8 (inductance) will lead to generator's overloading. The best operation COS of the machine's output power is 0.8~1.

Please note that the occurrence of leading COS during the installation of the automotive or manual COS correctional equipment (such as capacitor) shall be prevented, because the leading COS will cause instable voltage and harmful high voltage. Generally speaking, all COS correctional equipment must be turned off, when the generator is supplying power.

3.12.5 Grounding: The standards of grounding are different in different area. The machine's base must be connected to the ground. The grounding cord is stretchable to avoid break caused by the shock as the shock absorber is set in the generator set.

The grounding cord or clip shall allow the full-load current of the generator and meet the local specifications.

3.12.6 The Re-connection of the AC Generator: Most of AC generators can make re-connection to matching different output voltages. Please check if other parts like circuit breaker, current switch, cord and ammeter are matching the new voltage before changing power voltage.

3.12.7 Compounding Operation: The standard generator need to be equipped particularly when it works in form of compounding operation.

3.12.8 Insulation Test: Please check the resistance data of coil at first after installation. Cut off the auto-transformer, make the rotation diode in short circuit or cut-off, and cut off all control circuit.

To use a 500V megohmmeter or other similar appliances to test the impedance from the terminal to ground after detach the cord between the middle point and ground. The insulation impedance should be over 5MΩ. If the insulation impedance is lower than 5MΩ, the coil must be improved.

3.13 Noise Elimination

The noise control is very important during the installation. There are many ways to control the noise level.

Warning:

Wear noise protection outfit during the operation or walking nearby the working generator set.

3.13.1 Exhaust Silencer: Different silencer have different effect, classified in to 4 grades as industrial environment, house living, high requirement, super high requirement.

3.13.2 Canopy: The canopy's function is rainproof and noise reduction. The canopys can be designed to apply to the special noise level.

3.13.3 Other ways to reduce noise: For the generator installed in building, there are many kinds of equipment for noise decrease such as noise elimination box, separate ventilation, fan muffler, and wall absorber materials.

3.14 Transit (Mobile Generator)

3.14.1 Prepare to transit: Please check all parts connected to the truck and the parts of generator set to see if they are worn out, erodent, broken, or loose. The traction force of truck must be over the weight of the generator set with the additional 10% safe coefficient.

Connect the truck and the mobile generator set, and then check if the connector is firm. Connect the indicator light, connect to the truck rounding the drag lever if there is iron chain, and connect the safe cable if possible.

If there is front screw jack, tighten it with bolt or lock for safety, and fix the front wheel on the highest position, ensuring to lift or lock the back stable jack.

Please make sure the tire's pressure is normal, all dynamos are working well, and all the reverberators are clean and working.

Please make sure the load cords and grounding cords are removed, windows, doors and tool box are closed and locked, make sure all external pipes are removed.

If there is hand-brake anchor, open it, and remove the logs used for fixing the wheel.

3.14.2 Haul: Please take care that the weight of the generator set must be not close to or over the traction force of the truck; otherwise, it will influence the agility and brake of the truck.

Warning:

! Please follow all regulations, standards and other traffic rules including the regulation of the equipment carried and the minimum/maximum speed.

! Please keep the brake system in good condition.

! It is prohibited that anyone riding on the machine or standing/riding on the drag lever or standing/walking between the truck and machine.

The inclining is not over the 15 degree (27%), keep away from the pits, rocks, block and soft or unstable ground.

Make sure it is cleared behind the truck when the truck is backward.

3.14.3 Berth: Stop the truck on the clean and dry place which can stand the weight of the machine and truck. If the truck has to be stopped on the slope, the truck must be across the slope and the slope's grade is not over 15 degree (27%), tighten the handbrake, hold the wheels with logs, put down the head jack and back jack, and truckle. Untie the iron chain, cords and connectors, and then drive way the truck.

3.15 Storage:

The long storage will give a decisive effect to the engine and AC generator, so the right storage method will minimize the effect.

3.15.1 The Storage of the Diesel: The storage is made step by step according to the instruction booklet of diesel, such as cleaning the diesel, changing new lubricant or storage.

3.15.2 The Storage of AC Generator: The warm air will flow into the machine when it is not in use. In order to minimize the coagulation of the warm air in the machine, please put the generator in the dry place and keep the coil dry with heating cord if possible.

When the generator set shall be moved from the storage place to installation place, the insulation degree shall be checked. If the value is lower than that before storage, the coil shall be dried. After drying treatment, if the value read by megohmmeter is lower than $1M\Omega$, which indicates that the insulation has broken and needs repair.

4.Operation

4.1 General Introduction

The generator set is equipped with a advanced electronic control which may be one of the following models: GU320B, DSE5110, DSE501K, DSE5220 etc., please make clear of which model in your machine. These control systems can give auto or manual control to the machine. The machine is set with protection circuit which will give warning even turn off the machine when problems appear.

The following steps are the preparation work before running the machine, the start-up and the stop of the machine for the first time, then normal start-up and stop of machine.

4.2 Checking Before Starting-up Machine (applicable to all control system)

Please check machine as follows:

Warning:

! Turn off the control panel before examination as the machine with auto control system will start up automatically without warning.

1. Switch off the power of control system and emergency stop switch

! Do not open the cover of the radiator when the cooling liquid is still hot. Do not insert too much cooling liquid into the hot cooling system, otherwise the system will be damaged seriously.

2. Examine the level of the Diesel fuel and cooling liquid, and fill it in case of lack.

Warning:

! No smoke or fire during injecting fuel into fuel tank

3. Examine fuel level and insert it if needed.

4. Examine the tightness of cooling fan of diesel and the belt of charging machine, and tighten it if it is loose.

5. Examine all soft pipes, check if the connectors are loose or worn out, tighten or change it if needed.

6. Check if the batteries are erodent, clean them if they are.

7. Check the level of battery liquid and insert distilled water if necessary. Add the preset battery liquid if the batteries are new and never charged.

8. Examine if there are lots of dust and dirt on the control panel and generator, the dust and dirt will lead to electric shock or cooling problems.

9. Examine the block indicator of the air filter, and change the new one if it is blocked.

10. Clear the place around the generator and remove the unsafe items to avoid danger or bad influence to the operation.

11. Observe and check if fuel system, cooling system and seal of lubricant are leaking.

12. Drain the agglomerated water regularly with drain valve of the exhaust system.

13. Make sure that the output circuit switch of AC generator is on OFF position.

14. Check the lubricant level and add if needed.

4.3 Initial Start-up/Stop—Auto Start-up Control Panel

The following steps are applicable to the initial start-up of the generator set with auto-switch control system, or the first start –up after stopping the operation for a period.

Attention:

Press emergency stop button or set the control switch on “STOP” position, the machine can be stopped anytime.

To restart the machine, loosen the emergency stop button and turn the button clockwise. And set the control switch on the manual “STOP” position, and reset the fault button to eliminate the fault warning.

1. make a check before start-up according to the steps in Chapter 4.2
2. Connect the battery to the engine, connect to Anode then Cathode.
3. After moisten the lubricate system, brake the accelerograph or cut off the switch of it, then press the “START” button of the main control to start up the machine until the oil pressure indicated on the appliance or main control panel.

If there is no indication of oil pressure after auto-rotation for 3 times, please stop the machine and check the reason.

Warning

- ! Continuously start-up of an abnormal oil system will lead to the unburned oil’s accumulation in the exhaust system which has potential explosive danger.
- 4. Fill the oil supply system with manual oil pump and exhaust the air in the oil filter. (see the diesel engine manual)

Start-up: set the main control on the manual start-up position and push down the start-up button. (In case that the machine is too cold, you can set the warm-up time in the main control program as the machine is equipped with ordered warmer.)

The diesel will start up automatically for 3 times until it is started up. If it is cannot be started, the control system will be set on the position of “Failure to Start” and the failure indicator on control panel will light.

Warning

- ! Demount the head of the exhaust line and disperse the unburned gas. Once the gas (white fog) is dispersed and exclude other fault, install the exhaust line again and start-up the machine.
- 6. Check if there is any abnormal noise or shock.
- 7. Check if the liquid and exhaust system are leaking.
- 8. Check if there is any abnormal indication on the control panel, especially very high temperature or very low oil pressure, the oil pressure should go into the normal range 10 seconds after start-up.
- 9. Check the voltage and frequency on the control panel. The voltage is the standard voltage set by the manufacturer, the load frequency of 50 cycles generator set is about 52 cycles, the load frequency of 60 cycles machine is about 62 cycles, (the cycle of electronic timing or electronic injection generator set can be preset on a ideal number close to the standard cycle).

There are 3 kinds of voltage adjustment ways: If there is voltage regulation potentiometer on the control panel, then regulate the voltage through the potentiometer; inching regulation can be made with one potentiometer in the automatic voltage transformer fixed in the terminal box of AC generator; Change the voltage output through changing the coil of AC generator, the coil head is in the terminal box.

Warning

- Please don’t turn on the open circuit when checking phase.
- 10. When the machine is generating voltage, put phase meter one end of the open circuit switch to check the phase. It should be operated by qualified professionals.

11. Stop: Push down the emergency stop button or “STOP” button on the main control, the machine will stop running.
12. When checking the remote control of start-up, release the emergency stop button and remote control stop button, then turn the control switch to the “AUTO” position. Input the remote control signal, the engine will be started, eliminate the remote control signal, the engine will stop.

Attention:

After receiving the stop instruction, the control system will make the engine running for a period of time before stopping it automatically according to cooling time.

13. Connect the load cable as the generator is ready for normal operation.

4.4 Normal Manual Start-up/Stop—Auto-start Control Panel

Attention:

- The machine will stop anytime pressing the emergency stop button or “STOP” button on control panel.
 - Before start up the machine again, reset the emergency stop button clockwise; meanwhile set the control on the “STOP” position, reset the fault button to eliminate the fault.
1. Make the check before starting the machine according section 4.2.

Attention:

- The machine cannot be started up if the fault light is still on. Press down the reset button on the control to restore the control system. Make sure the fault has been eliminated before trying to start up machine.
2. Manual start-up: make sure the emergency stop button and stop button of remote control have been reset. Set the control on the manual stop position, press down the start-up button until the machine is started. The diesel will automatically start up for 3 times until it is started, if the diesel cannot run, the control system is locked on “Fail to Start”, the failure indicator will be on.

Warning

- For the unburned gas accumulated in the exhaust line due to many times’ unsuccessful start may explode, demount the head or pipe of the exhaust line and disperse the white fog and exclude other fault, and then install the exhaust line again and start up the machine.

Start up Diesel

3. Check if there is any abnormal noise or shock.
4. Check if the liquid and exhaust system are leaking.
5. Check if there any abnormal indication on the control panel, especially very high temperature or very low oil pressure, the oil pressure should go into the normal range 10 seconds after start-up.
6. Set the output open circuit switch on the position of “ON” (handle upward)

Attention:

- Add the load

The initial added load is up to the cooling water temperature of the engine, when the cooling water temperature of engine is below 20°C, the initial load can be added to 50% of the standard output, when the cooling water temperature of engine reaches 80°C, the initial load can be added to 70-100% of the standard output power. It depends on the machine type, some generator set with big power (100KVA) can accept 100% initial load.

7. Stop: At first, turn down the output open circuit switch of AC generator (pull down), the machine is without load, then the machine run for several minutes more to cool. Then, press down the emergency stop button or “STOP” button of the control to stop the machine immediately.

In case of some urgency for prompt stop, press the emergency stop button without cutting off load.

4.5 Auto Start-up/Stop – Auto Start-up Panel

The following steps are applicable to the remote control start-up of the generator set with auto control system.

Attention:

- Press emergency stop button or set the control switch on “STOP” position, the machine can be stopped anytime.
- To restart the machine, reset the emergency stop button by turning the button clockwise, and press the fault reset button to eliminate the fault.

1. Check the machine before starting it according to section 4.2.

Attention:

The machine cannot be started up if the fault light is still on. Press down the reset button on the control to restore the control system. Make sure the fault has been eliminated before trying to start up machine.

2. Auto Start-up: Check if the emergency stop button and all stop buttons of remote control have reset. Set the control on “AUTO” position.

3. Set the output switch of generator set on the position of “ON”.

The machine is ready for auto start-up, press “START” button of the remote control, input the start signal, the machine will start to run, and the machine will stop by eliminating the start signal.

5. Maintenance and Repair

5.1 General Introduction

A good maintenance work is the key to ensure the long life of the generator set. The maintenance and repair must be made by qualified professionals. During the maintenance and repair, a record should be well done in favor of the future arrangement of maintenance procedure.

Generally speaking, the machine should be clean and avoid the liquid such as the fuel or lubricant to accumulate inside, any surface outside, as well as on/under/around any absorber. The machine should be cleaned with industrial water-solubility detergent, instead of the inflammable liquid. If the protection surface of the absorber materials is torn or probed, the absorber should be changed immediately to avoid liquid or oil filter and accumulate on the materials.

5.2 Precautionary Maintenance

The requirements of maintenance are different for different situation of the generator set. The maintenance can be done more frequently than the requirement of the chapter.

5.2.1 Daily Maintenance and the Maintenance after Every Operation: For the standby generator set, the work can be done one time every week, and check the machine overall with eyes everyday or before every start-up. The pre-start check stated in section 4.2 should be done now.

5.2.2 For those standby machines which are never started, they should be checked every 2 weeks, and run the machine for 5 minutes.

Warning

Do not operate the machine in low load for long time.

5.2.3 For those standby machines without load, they should be checked monthly, run the machine for 5 minutes and operate the machine with minimum 50% load for 1-2 hours.

5.2.4 Check the following every 6 months or 250 hours:

1. Examine all fault protection equipments with simulative fault.
2. Clean all exhaust holes of batteries.
3. Tighten all exhaust line joint.
4. Tighten all joint heads of electrical appliances
5. Make other special maintenance of diesel as stated in <Instruction of Diesel>
6. Start up the machine to observe if all appliances on control panel are working well.

5.2.5 Precautionary Maintenance of AC Generator: AC generator needn't daily maintenance, whereas regular examination and clean of coil is necessary.

5.3 Disassembly of Engine and AC generator

Disassemble Engine or AC generator in following steps:

1. Disconnect the circuit of supplying power to assistant equipment (such as heating water jacket).
2. Cut off battery charging circuit, remove the battery connection (take apart cathode firstly), remove the batteries if necessary.
3. If the generator is with cover, the screw for fixing cover need to be loosen, take apart the exhaust line , then remove the lid.

4. Take down all connecting cords before removing control panel with holder together, and make sure all cords can be connected again.
5. If both the diesel and AC generator need to be disassembled, they can be suspended by swing rings after taking down all fixing bolts on their base.

5.3.1 Disassemble Diesel Only

1. For the disassembly of diesel only, take away the soft line of circuit from the diesel.
2. The front of AC generator should be held with holder when taking apart the diesel if the AC generator has only one foot on the base.
3. Remove the base bolt of diesel. Loosen the fixing bolt of AC generator in favor of taking apart diesel.
4. Remove the protection cover of AV generator.
5. Hold the fan with hook or wooden holder, and be careful not to damage the blades.
6. Remove the joint bolt between diesel and AC generator.
7. Hook the end of the diesel with elevated crane or similar equipment.
8. Take down the joint bolt of the external canopy
9. Move the engine ahead until it is taken away from the AC generator and base completely.

5.3.2 Disassemble AC Generator Only

1. The back of diesel should be hold firmly if only AC generator is taken apart.
2. Remove the soft circuit line
3. Remove the bolt of fixing AC generator
4. Take down the fan protection cover of AC generator, support the front part of generator, fix the base center handle by one lever to limit moving to air gap and avoid the damage to the bearing and coils.
5. Take down the AC generator from diesel according to section 3.3.1.
6. Hold up the AC generator with crane or similar equipment, slide back the whole generator to base plate, and then suspend it away.

5.4 Maintenance of Engine

5.4.1 Maintenance of Radiator

Attention: erosion is the main reason for fault. It is because the air in water will accelerate the erosion. Keep the joint head of pipe from leakage, and inject water into radiator on the top to keep the system in "NO AIR".

The radiator should not be in the situation of partial water injection because it will accelerate erosion. For the generator in idleness, the water should be drained up or injected to full. If possible, use distilled water or natural soft water with adequate anti-erosion detergent.

Warning

The cooling liquid in radiator is usually very hot with pressure. Don't clean up radiator or remove pipes without cooling, and don't work on radiator or open the fan protection cover when the fan is running.

5.4.2 External Clean: In the dusty and dirty environment, the gaps of radiator will be blocked with chips and insects, which will influence the efficiency of radiator. For these light deposit, the clean-up can be made often with low-pressure water and cleanser, spray the steam or water to the front of radiator. Spray on the contrary direction will push the dirt into center. Use cloth to cover the diesel and AC generator when

adopting the clean method.

For the stubborn deposit, if the above method is not working, then take down the radiator and put it into hot alkali water for 20 minutes and wash it with hot water.

5.4.3 Internal Clean: If the hard water injection is adopted for some time or the generator worked for some time without using anti-erosion detergent because the joint head is leaking, the system will be blocked with water furring.

Please clean the water furring in the following steps:

1. Drain up the water from radiator system, and then disconnect the pipes for from diesel.
2. Prepare erosion elimination acid and clear water at the proportion of 4%, put the acid into water, and don't do it on contrary.
3. Mix it for several minutes, then heat the mixed solution up to 49°C (120°F) which is the top point, not higher than it.
4. Inject the solution into pipe through a filter cap or one branch, the bubble will be boiling. When the chemical reaction stops, fill the radiator with the heated solution.
5. Keep the solution in the system for a few minutes, then discharge the solution back into the original container from bottom pipe or drain outlet.
6. Check the internal side of water tank; repeat the above steps with increase the acid to 8% if there is still water furring.
7. After eliminating the water furring, balance the acid in following steps: fill the container with water, heat water to boiling point, and add daily use soda water at the following proportion: 500g soda matching 20L water (1 pound matching 4 gallon water), fill the radiator with the solution and let it flow back the original container.
8. Wash the radiator for a few times with the above methods, finally keep the solution in radiator for one hour at least after filling it. Drain up and wash it with hot clear water.
9. Check if the radiator is in leakage with water in 2 times of the normal working pressure before installing the radiator because eliminating water furring will lead to leak.
10. Add the necessary anti-erosion detergent and adequate anti-condensation detergent into the cooling liquid before running the machine.

5.5 Maintenance of AC Generator

It is suggested to make regular examination and clean though maintenance is seldom done.

Make a test of the insulation coil for the initial running. In case of standby generator, according to the humidity of the storage place, usually make a insulation test every 3-6 months, in high humidity area, install heater for dehumidification when the machine is not in use in order to keep coil dry.

Make regular check of the air filter if it is installed on the generator depending on the surrounding condition. If the air filter needs to be cleaned, take down the materials of the filter and dip it in water or wash it: you may add some cleanser until the materials are cleaned. Dry it completely before installation.

In addition, make regular cleaning of the internal and external sides of generator, the frequency of cleaning is dependent on the environment around the machine. The steps of cleaning are as follows:

Cut off all power, rub off all dirt, dust, oil mass, water and other liquid, clean up the vent net, as these dirt will make coil overheat or damage the insulation if they go into coil. Remove the dust and dirt with vacuum, and do not clean by blowing or high pressure spray.

5.6 Generator's Maintenance and Repair Table

DIESEL GENERATOR MAINTENANCE TIME TABLE

CHECK ITEMS	DAILY	50 HOURS/ MONTHLY	250 HOURS/ 3 MONTHS	400 HOURS/ 6 MONTHTHS	600 HOURS / ANNUALLY	1200 HOURS /3 YEARS	NEEDED
Check the fuel level, lubricant level and water level	▲						
Check fuel filter	▲						
Check lubricant driving output bearing (PTO)	▲						
Check air filter clean indicator	▲						
Check PTO and the bearing of clutch axes		▲					
Check fire extinguisher		◇					
Check start-up storage battery			▲				
Change oil and oil filter			★				
Check V-shape belt tension			▲				
Check PTO and clutch connection			▲				
Adjust valve gap				▲			
Check the connection of PTO and clutch axes lever					▲		
Clean cranking box exhaust pipe					▲		
Check intake pipe and connection					▲		
Change fuel filter					★		
Analyze cooling water content					◇		
Check/repair intake system					▲		

Check cooling system					▲		
Generator adjustment						◇	
Check the rev of diesel and adjust if necessary						▲	
Regulate engine valve gap						▲	
Check fuel system						▲	
Check turbine pressure enhancer						▲	
Check crankshaft shock absorber						◇	
Clean cooling system, change thermostat						◇	
Check cooling system pressure						◇	
Check air filter and change if necessary							★

Remark:

1. The maintenance period of the diesel generator is calculated by working hours and calendar, whichever is sooner.
2. According to the actual operation, the diesel generator can be checked and repaired at advance. The maintenance period and maintenance contents are adjusted depending on the usage, performance of machine and the capability of fuel and lubricant.
3. The standby diesel generator is required to keep prompt start-up and good operation, so make regular repair and exam with the following trial running.

Trial running of machine	Run for 5-10 minutes with adequate loading every week	Exam: Start-up, lube pressure, exhaust color, shake etc.
	Run for 15-30 minutes with adequate loading every month	

4. The meaning of the above table:

▲: exam and repair, clean, adjust

★: change

◇: contact the manufacturer or supplier if customer cannot repair.

□: heavy repair, dismantle of new machine or the machine sealed for a long time, and the necessary examination after the initial 50 hour's operation

6. ENGINE TROUBLESHOOTING

The starter motor turns the engine too slowly:

- Battery capacity too low
- Bad electrical connection
- Fault in starter motor
- Wrong grade of lubrication

The engine does not start or difficult to start:

- Starter motor turns engine too slowly
- Fuel tank empty
- Fault in fuel control solenoid
- Restriction in a fuel pipe
- Fault in fuel lift pump
- Dirty fuel filter element
- Air in fuel system
- Fault in atomisers
- Cold start systems used incorrectly
- Fault in cold start system

Misfire:

- Restriction in a fuel pipe
- Fault in fuel lift pump
- Dirty fuel filter element
- Air in fuel system
- Fault in atomisers or atomisers of an incorrect type

The pressure of the lubrication oil is too low:

- Wrong grade of lubrication
- Not enough lubrication oil in sump
- Defective gauge
- Dirty lubrication oil filter element

High fuel consumption:

- Restriction air filter/cleaner or induction system
- Fault in atomisers or atomisers of an incorrect type
- Fault in cold start system
- Wrong type or grade of fuel used
- Restricted movement of engine speed control
- Restriction in exhaust pipe
- Engine temperature is too low
- Incorrect valve tip clearances

Black exhaust smoke:

- Restriction air filter/cleaner or induction system
- Fault in atomisers or atomisers of an incorrect type
- Fault in cold start system
- Wrong type or grade of fuel used
- Restriction in exhaust pipe
- Engine temperature is too low
- Incorrect valve tip clearances
- Engine over load

Blue or white exhaust smoke:

- Wrong grade of lubrication
- Fault in cold start system
- Engine temperature is too low

The engine knocks:

- Fault in fuel lift pump
- Fault in atomisers or atomisers of an incorrect type
- Wrong type or grade of fuel used
- Fault in cold start system
- Engine temperature is too high
- Incorrect valve tip clearances

The engine runs erratically:

- Fault in fuel control
- Restriction in a fuel system
- Fault in fuel lift pump

- Restriction in fuel tank vent
- Wrong type or grade of fuel used
- Restriction in exhaust pipe

Not enough power:

- Restriction in a fuel pipe
- Fault in fuel lift pump
- Dirty fuel filter element
- Air in fuel system
- Restriction air filter/cleaner or induction system
- Fault in atomisers or atomisers of an incorrect type
- Restriction in exhaust pipe
- Restriction in fuel tank vent
- Wrong type or grade of fuel used
- Restricted movement of engine speed control
- Engine temperature is too high or low

- Dirty fuel filter element

- Restriction air filter/cleaner or induction system
- Air in fuel system
- Fault in atomisers or atomisers of an incorrect type
- Fault in cold start system
- Restriction in fuel tank vent
- Restricted movement of engine speed control
- Engine temperature is too high
- Incorrect valve tip clearances

Vibration:

- Fault in atomisers or atomisers of an incorrect type
- Restricted movement of engine speed control
- Engine temperature is too high
- Fan damaged
- Fault in engine mounting or flywheel housing

The pressure of the lubrication oil is too high:

- Wrong grade of lubrication oil
- Defective gauge

The engine temperature is too high:

- Restriction air filter/cleaner or induction system
- Fault in atomisers or atomisers of an incorrect type
- Fault in cold start system
- Restriction in exhaust pipe
- Fan damaged
- Too much lubrication oil in sump
- Restriction in air or water passages of radiator
- Insufficient coolant system

Crankcase pressure:

- Restriction in breather pipe
- Vacuum pipe leaks or fault in exhauster

Bad compression:

- Restriction air filter/cleaner or induction system
- Incorrect valve tip clearances

The engine starts and stops:

- Dirty fuel filter element
- Restriction air filter/cleaner or induction system
- Air in fuel system

The engine shuts down after approximately 15 seconds:

- Bad connection towards oil pressure switch/coolant temperature switch

7.ALTERNATOR? TROUBLESHOOTING

Symptom	Possible Cause	Corrective Action
Alternator does not excite	Blown fuse Insufficient residual voltage No residual voltage Connections are interrupted	Replace fuse Increase speed by 15% For an instant apply on the (+) and (-) terminals of the electronic regulator a 12 V battery voltage with 30 ohm resistor in series respecting the polarities.
After being excited alternator does no excite	Connections are interrupted	Check connection cables as per attached drawings.
Low voltage at no load	Voltage potentiometer out of setting Intervention of protection Winding failure	Reset voltage Check engine speed Check windings
High voltage at no load	Voltage potentiometer out of setting Failed regulator	Reset voltage Substitute regulator
Lower than rated voltage at load	Voltage potentiometer out of setting Intervention by protection Failed regulator Rotating bridge failure	Reset voltage potentiometer Current to high, power factor lower than 0.8; Speed lower than 4% of rated speed Substitute regulator Check diodes, disconnect cables
Higher than rated voltage at load	Voltage potentiometer out of setting Failed regulator	Reset voltage potentiometer Substitute regulator
Unstable voltage	Speed variation in engine Regulator out of setting	Check regularity of rotation Regulate stability of regulator by acting on stability potentiometer