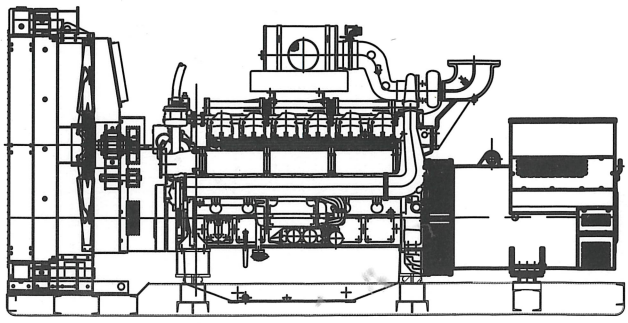
Generating Set

Technical Operation

And Maintenance Manual



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1 INTRODUCTION

INTRODUCTION

This generating set is one of a family of heavy duty industrial generating sets designed to be ready to run when it arrives, requiring only the addition of coolant with antifreeze, fuel oil and battery acid. Years of diesel generating set experience has gone into the set to produce a quality source of electrical power that is efficient and reliable.

This technical operation and maintenance manual has been prepared to assist in maintenance and operation of the generating set. Using this manual in conjunction with the Engine Manual, will help to ensure that the generating set keeps operating at maximum performance and efficiency for a long life. Please note that in dirty or dusty or dusty environments more attention must be paid to frequent servicing to keep the set running properly.

Always ensure that adjustments and repairs are done by personnel who are authorized to do the work and have been properly trained.

Every generating set is uniquely defined by a model number and serial number indicated on a rating plate generally affixed to the alternator housing .This information is required when service or warranty work is required. See Section 3.1 for further information.

2 SAFETY

SAFETY

2.1 General

The generating set is designed to be safe when used in the correct manner. Responsibility for safety, however, rests with the personnel who install, use and maintain the set. The following safety precautions, if followed, will minimize the possibility of accidents. 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 authorised 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, fit 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, if equipped.

! Install and operate this generating set only in full compliance with relevant National, Local, or Federal Codes, Standards or other requirements.

! Make sure all personnel are out of the generating set canopy or container, if equipped, before closing and latching enclosure doors.

! Do not permit personnel to ride in or on the mobile generating set. Do not permit personnel to stand or ride on the drawbar or to stand or walk between the generating set and the towing vehicle.

! Do not install or use the generating set in any classification of hazardous environment unless it has been specifically designed for that environment.

2.2 Installation, Handing, and Towing

Chapter 4 of this manual covers procedures for installation, handing, and towing of generating sets, That chapter should be read before installing the generating set, moving/ 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 exhaust for all indoor

generating sets must be piped outdoors via leak-free piping in compliance with relevant Codes, Standards and other requirements. Ensure hot exhaust silencers, piping and turbochargers, if equipped, 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. Use a sling with a "spreader bar "connected to the base frame.

! Ensure 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.

! When towing a mobile generating set, observe all Codes, Standards or other regulations and traffic laws. These include those regulations specifying required equipment and maximum and minimum speeds. Ensure brakes, if fitted, are in good order.

2.3 Fire and Explosion

Fuels 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 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.

! Store oily rags in covered metal containers.

! 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.

! Keep grounded conductive objects, such as tools, away from exposed live electrical parts, such as terminals, to avoid arcing. 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.

! The excessive build-up of unburned fuel gases in the exhaust system can create a potentially explosive condition. This build-up can occur after repeated failed start attempts, air flap valve testing, or hot engine shutdown. Open exhaust system purge plugs, if equipped, and allow the gases to dissipate before attempting to restart the generating set.

2.4 Saftey Protection

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 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.

! Keep access doors on enclosures, if equipped, 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 have 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.

! Study carefully the engine maintenance manual, and select the coolant that correspond to the local temperature condition. When temperature is below zero degree centigrade, be sure to use the appropriate coolant.

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.

2.7 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 authorised to do so, and in compliance with relevant Electrical Codes, Standards and other regulations. Where required, their work should be inspected and accepted by the inspection agency prior to operating the generating set.

! Ensure 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 energised 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.

! Be sure all electrical power is disconnected from electrical equipment being serviced.

! 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, discoloured 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 tuned off.

- Switch off power if possible.
- Otherwise pull the plug or pull 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 unconscious, perform resuscitation as required:

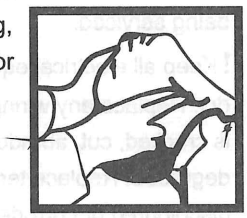
OPEN THE AIRWAY:

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

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

BREATHING:

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



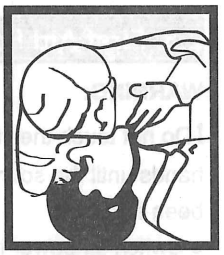
CIRCULATION:

1. 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.

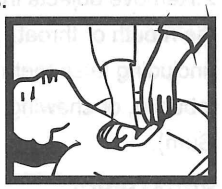
5. Check for pulse after every 10 breaths.

6. When breathing restarts, place the victim into the recovery position described later in this section.

IF NO BREATHING AND NO PULSE:

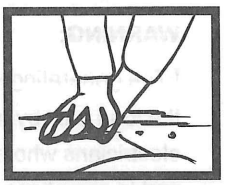
1. Call or telephone for medical help.

2. Give two breaths and start chest compression as follows:

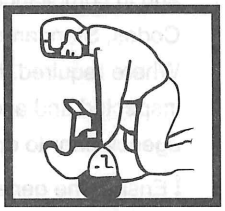


3. Place heel of hand 2 fingers breadth above ribcage/breastbone junction.

4. Place other hand on top and interlock fingers.



5. Keeping arms straight, Press down 4-5 cm(1.5-2 inch)15 times at a rate of 80 per minute.

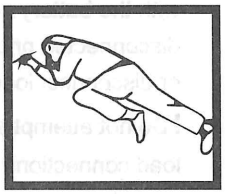


6. Repeat cycle(2 Breaths,15 compressions) Until medical help takes over.

7. If condition improves, confirm pulse and continue with 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 GENERAL SPECIFICATION

GENERAL SPECIFICATION

3.1 Generator Units Specification and Identification

This generator design is a complate combination and provides outstanding and reliable performance. The chart 3.1 whichis a drawing of standard generator construction, shows all the main parts. However, the main body structure of different models may have the slight difference. This section gives a brief showing to this generator main part, details will be shown in the following sections.

Each generator all has a label plate which basically fixed on the control panel cabinet. The information on the label plate is used to identify the generator and its operating characteristic. These information include model, factory serial no., output voltage, frequency, output rating which represented by KVA or KW, and power factor. In order to provide references, this information is also shown in the technical data sheet enclosed in this manual. The factory serial no. is unique and needs to be quoted when purchasing of spare parts or requesting for maintenance service.

3.2 Diesel Engine

The diesel engine, which is specially designed and manufactured for the generator units, provides power with the generator units. Its performance is safe and reliable. The diesel engine together with air filter is 4 strokes compression ignitions used in heavy industry to provide stabel power. Some diesel engine have turbo charger, and the mechanical or electronic speed regulator can precisely control the rotating speed of the diesel engine.

3.3 Engines Electrical Power System

The engine electrical power system is either 12 or 24 volts cathodes earths DC power supply system, including a starting motor, the bettery and the battery support. For some large-scale generators, this system possibly be fixed on the floor nearby the generator. Most generators have one or two maintenance free batteries. Details will be shown in the section 9. The other kinds of battery can also be used here as the customer's demand.

3.4 Cooling System

The engine's cooling system includes a radiator, an axial fan and a thermostat. The Alternator is equipped with the independent fan to cool its part. Note: air first passes through the Alternator, and then through radiator.

3.5 Alternator

The output power is generated by a noncarbon brushed and sele-stabled alternator with a water peotection cover. Is installed on the side and the control panel.

3.6 Fuel Tanks and Base frame

Both the engine and the Alternator together with a fuel tank are installed on the steel base frame to run the machine for 8 hours. Where a fuel tank is not provided with the

base frame, an external fuel tank must be provided.

3.7 Vibration Isolation

This generator has the vibration isolation, which is installed between carriage and chassis and used to reduce the vibration during starting. But in large-scale generator, the engine/the alternator is usually installed on the chassis while the vibration isolation are installed between carriage and basis by the customers.

3.8 Damper and Gas Exhausting system

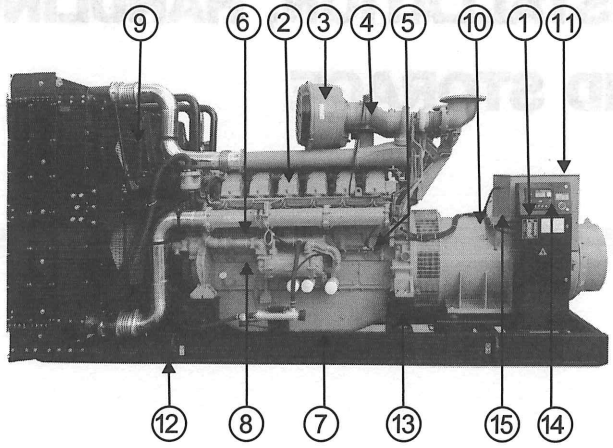
The damper and gas exhausting system is provided with the main body to be installed to reduce the moise level and exhaust the gas to the outdoor.

3.9 Control System (Identification)

There are several kinds of control systems and control screen, only one for each machine to control operation and output for protecting the machine from incorrect operation.

3.10 Power Source Air Switch

In order to protect the Alternator, the matched switch should be installed in the independent switch box, in certain situations, the switch may be installed with convey system or the control screen.



Item	Description
①	Genset Nameplate
②	Diesel Engine
③	Air Filter
④	Turbo-supercharger (only fit some types)
⑤	Engine Voltmeter (only fit some types)
⑥	Start Motor
⑦	Battery/Battery Frame

Item	Description
⑧	Motor For Battery Charging(install on other side)
⑨	Coolant Water Tank
⑩	Alternator
⑪	Container For Connecting Electrical
⑫	Diesel Fuel Tank And Genset Base (only fit some types)
⑬	Vibration Absorber
⑭	Control Panel Output Power Source Air
⑮	Air Switch of Output Source

Figure 3.1: Toutside View

4 INSTALLATION, HANDLING, AND STORAGE

INSTALLATION, HANDLING, AND STORAGE

4.1 General

This section discusses factors important in the effective and safe installation of the generating set. Further information is available in the Generating Set Installation Manual which is available upon request.

4.2 Enclosures

Installation and handling is greatly simplified when the generating set has been equipped with an enclosure. Two basic types is available. This first type is a close fitting canopy enclosure. This can be a weatherproof version which designed for sound attenuation. The other enclosure type is a walk-in type container, similar to a shipping container. It can also be weatherproof or sound attenuated. These enclosures provide a self contained generating set system that is easily transportable and requires minimal installation. They also automatically give protection from the elements and protection from unauthorized access.

4.3 Moving the Generating Set

The generating set base frame is specifically designed for ease of moving the set. Improper handling can seriously damage components. During transporting the generator set, make sure to secure the transportation vehicle in a solid stable condition and should be covered with canvas in case of rainy weather.

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 forklift. Always use wood between forklift and the frame to spread the load and prevent damage. If the set will be regularly moved, it should be fitted with the optional "Oil Field Skid" which provides forklift pockets in the base frame along with eyes for pulling. The smaller sets have forklift pockets in the base frame as standard.

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.

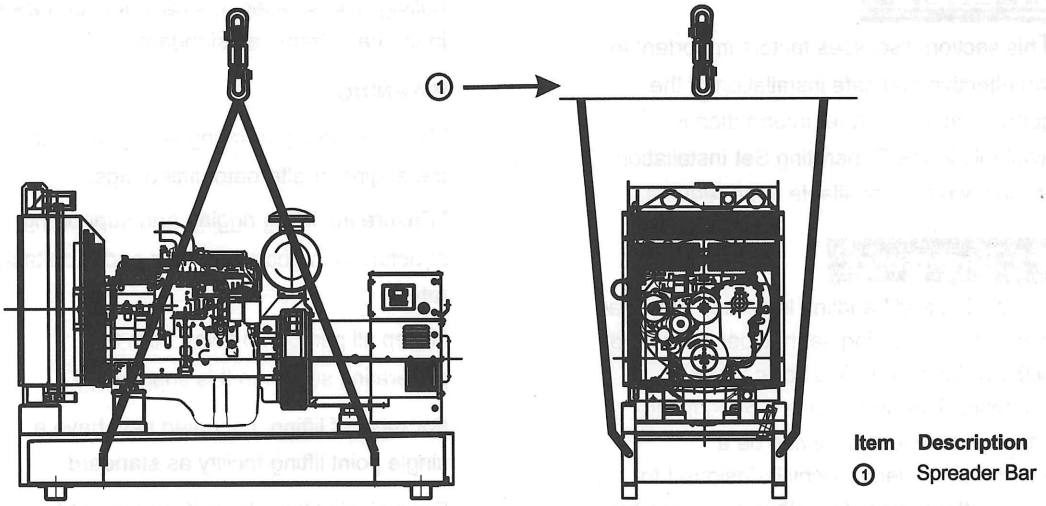
! Keep all personnel away from the generating set when it is suspended.

For ease of lifting, canopied sets have a single point lifting facility as standard.

For a single lift such as lifting the set to install it, the lift points provided on the base frame may be used. Points of attachment should be checked for cracked welds or loose nuts and bolts before lifting. A spreader bar is required to prevent damaging the set (see Figure 4.1).It should be positioned over the center of gravity (nearer the engine), not the center of the set, to allow a vertical lift. Guide ropes should be used to prevent twisting or swinging of the set once it has been lifted clear off the ground-do not attempt to lift in high winds. Place the generating set down on a level surface capable of supporting its weight. This manner of lifting should only be used for a single lift for installation.

Generating sets to be air lifted by helicopter should be lifted by sling lifting ring. When in position, uninstalled the supporting pocket for the forklift from the base frame

Figure 4.1: Proper Lifting Arrangement for Installing the Set



Item	Description
①	Spreader Bar

4.4 Location

Selecting a location for the generating set can be the most important part of any installation procedure. The following factors are important in determining the location:

- Adequate ventilation.
- Protection from the elements such as rain, snow, sleet, wind driven precipitation, flood water, direct sunlight, freezing temperatures, or excessive heat.
- Protection from exposure to airborne contaminants such as abrasive or conductive dust, lint, smoke, oil mist, vapor, engine exhaust fumes or other contaminants.
- Protection from impact from falling objects such as trees or poles, or from motor vehicles or lift trucks.
- Clearance around the generating set for cooling and access for service: at least 1 metre(3.3 feet)around the set and at least 2 metres(6.6 feet)headroom above the set.
- Access to move the entire generating set into the room. Air inlet and outlet vents can often be made removable to provide an access point.
- Is prohibited unauthorized personnel.

If it is necessary to locate the generating set outside of the building, the generating set should be enclosed in a weatherproof canopy or container-type housing which is available for all sets. These enclosures are also useful for temporary installations inside or outside the building.

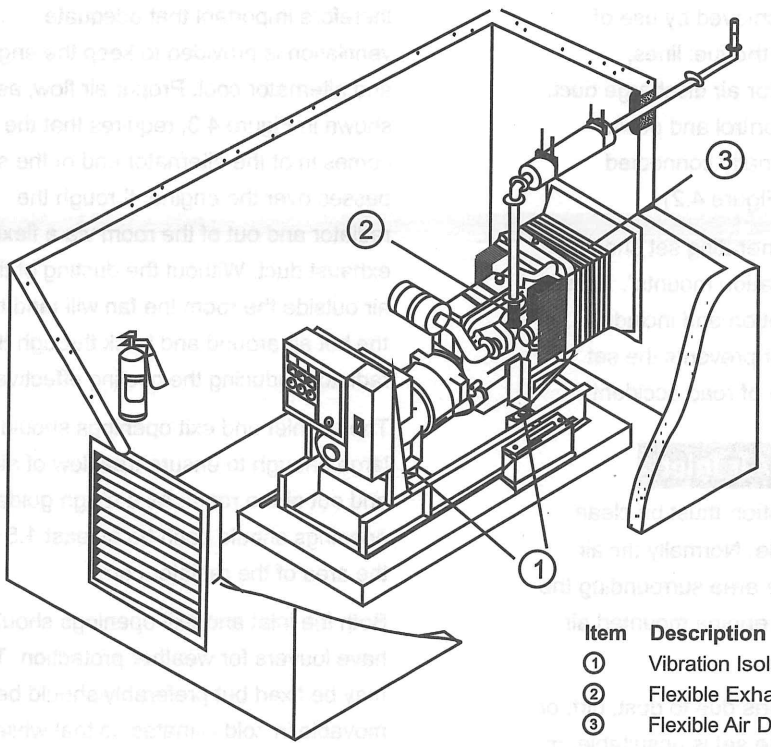
4.5 Foundations and Vibration Isolation

The generating set is shipped assembled

on a rigid base frame that precisely aligns the alternator and engine and needs only be bolted down to a suitably prepared surface (see Figure 4.2).

4.5.1 Foundation: A reinforced concrete pad makes the best foundation for the generating set. It provides a rigid support to prevent deflection and vibration. Typically the foundation should be 150 mm to 200 mm (6 to 8 inches) deep or at least as wide and long as the generating set. The ground or floor below the foundation should be properly prepared and should be structurally suited to carry the weight of the generating set.(If the generating set is to be installed above the ground floor the building structure must be able to support the weight of the generating set,fuel storage and accessories.) Relevant building codes should be consulted and complied with. If the floor may be wet from time to time, such as in a boiler room, the pad should be raised above the floor. This will provide a dry footing for the generating set and for those who connect .service or operate it. It will also minimize corrosive action on the base frame.

Figure 4.2: Typical Installation Highlighting Vibration Techniques



Item	Description
①	Vibration Isolators
②	Flexible Exhaust Coupling
③	Flexible Air Discharge Duct

4.5.2 Vibration Isolation: To minimize engine vibrations being transmitted to the building, the generating set is fitted with vibration isolators. On small and medium sized sets these isolators are fitted between the engine/alternator leg and the base frame. This allows the frame to be rigidly bolted to the foundation. On larger sets the coupled engine/alternator is rigidly attached to the base frame and the vibration isolators are supplied loose for fitting between the base frame and the foundation. In all cases the sets should be securely bolted to the ground (either through the base frame or through the vibration isolators) to prevent movement.

Vibration isolation is also required between the generating set and its external connections. This is achieved by use of flexible connections in the fuel lines, exhaust system, radiator air discharge duct, electrical conduit for control and power cables and other externally connected support systems(see Figure 4.2)

On mobile sets the generating set should be mounted using "captivation mounts". These mounts minimize vibration and include a captivation feature that prevents the set breaking away in case of road accident.

4.6 Combustion Air Inlet

Air for engine combustion must be clean and as cool as possible. Normally the air can be drawn from the area surrounding the generating set via the engine mounted air filter.

However, in some cases due to dust, dirt, or heat, the air around the set is unsuitable. In these cases an inlet duct should be fitted. This duct should run from the source of clean air (outside the building, another room, etc.) to the engine mounted air filter. Do not remove the air filter and mount it at a remote location as this can increase the possibility of dirt leaking through the ductwork and into the engine inlet. To ensure that this type of installation will not have a detrimental effect on the operation of the generating set, the design of the inlet duct should be approved by the factory.

4.7 Cooling and Ventilation

The engine, alternator, and exhaust piping radiate heat which can result in a temperature high enough to adversely effect the performance of the generating set. It is therefore important that adequate ventilation is provided to keep the engine and alternator cool. Proper air flow, as shown in Figure 4.3, requires that the air comes in at the alternator end of the set, passes over the engine, through the radiator and out of the room via a flexible exhaust duct. Without the ducting of the hot air outside the room the fan will tend to draw the hot air around and back through the radiator, reducing the cooling effectiveness.

The air inlet and exit openings should be large enough to ensure free flow of air into and out of the room. As a rough guide the openings should each be at least 1.5 times the area of the radiator core.

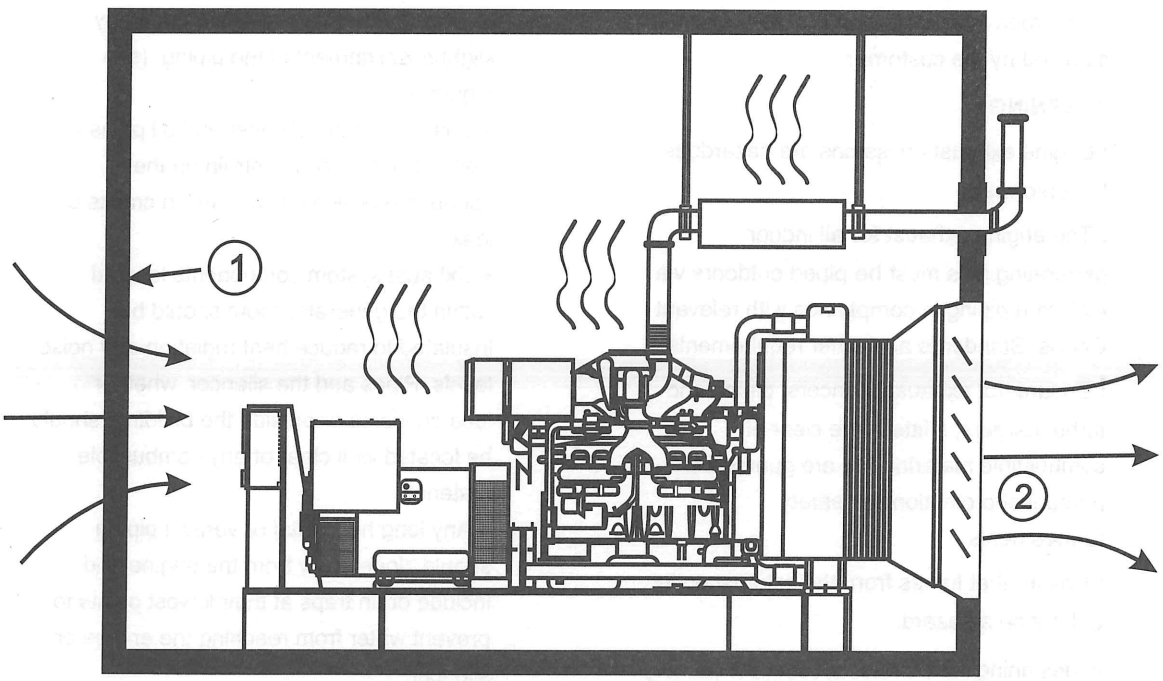
Both the inlet and exit openings should have louvers for weather protection. These may be fixed but preferably should be movable in cold climates so that while the

generating set is not operating the louvers can be closed. This will allow the room to be kept warm which will assist starting and load acceptance. For automatic starting generating sets, if the louvers are movable they must be automatically operated. They should be programmed to open immediately upon starting the engine. The force of radiator air should not be depended upon to open the louver vanes unless the system has been specifically designed for this.

When a remote radiator or heat exchanger cooling system is used, the radiated heat from the generating set must still be removed from the room.

4.8 Exhaust

The purpose of the engine exhaust system is to direct the exhaust outside to a location and height where the fumes and odors will not become an annoyance or hazard, and to reduce noise. A suitable exhaust silencer must be incorporated into the exhaust piping to reduce the noise level from the



Item	Description
①	Air Inlet Opening
②	Air Exit Opening

Figure 4.3: Air Ventilation

engine. It can be fitted either inside or outside the building (see Figure 4.4). Canopied generating sets include exhaust system within the enclosure.

Open generating sets will generally be supplied with a loose industrial class silencer, a stub pipe and a bellows (if required). An optional "Overhead Mounting Kit" includes a bend, silencer support brackets and a bellows (if not standard).An optional"Silencer Installation Kit"includes the wall sleeve, bend and rain cap for directing the exhaust outside (see Figure 4.4). In all cases, the straight sections of pipe and screw rods for the support brackets are supplied by the customer.

WARNING:

! 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 hot exhaust silencers, piping and turbochargers, if fitted, 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.

In designing an exhaust system, the primary consideration is to not exceed the allowable back pressure permitted by the engine manufacturer. Excessive back pressure seriously affects engine output, durability and fuel consumption. To limit the back pressure the exhaust piping should be as short and straight as possible. Any required bends should have a curve radius of at least 1.5 times the inside diameter of the pipe. Any designed exhaust extensions over 3 metres should be approved by the factory.

Other exhaust design criteria are as follows:

- Exhaust components including turbochargers can be very hot and must be guarded where they could be accidentally touched.
- A flexible connection between the exhaust manifold and the piping system should be used to prevent transmission of engine vibration to the piping and the building and to allow for thermal expansion and any slight misalignment of the piping. (see Figure 4.2)
- Ensure that the silencer and all pipes are well supported to limit strain on the connectors which could result in cracks or leaks.
- Exhaust system components located within the generator room should be insulated to reduce heat radiation and noise levels. Pipes and the silencer, whether located inside or outside the building, should be located well clear of any combustible material.
- Any long horizontal or vertical piping should slope away from the engine and include drain traps at their lowest points to prevent water from reaching the engine or silencer.
- On generating sets above 150 kVA the silencer installation must include a purge plug for venting of the exhaust system in the event of difficult starting. The plug should be located adjacent to the exhaust flange and positioned to allow access.

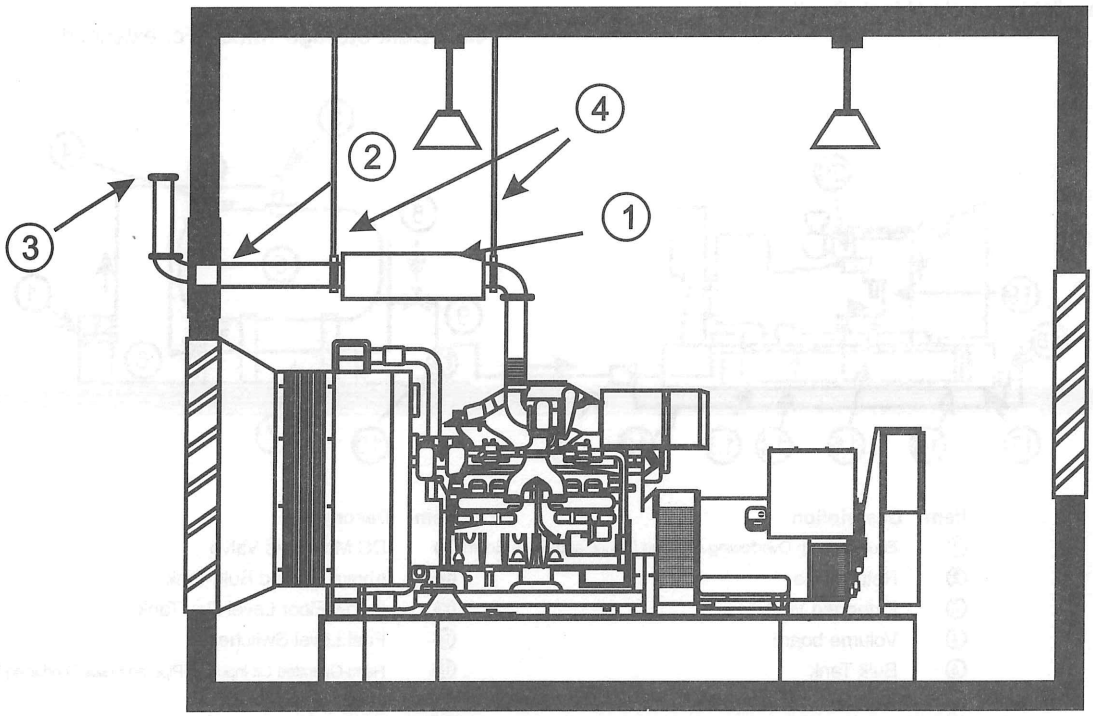
• Where the pipe goes through a wall there should be a sleeve in the opening to absorb vibration and isolate combustible material from the hot pipes (see Figure 4.4). There may also be an expansion joint in the pipe to compensate for lengthwise thermal expansion or contraction.

• The outer end of the exhaust pipe, if horizontal, should be cut at 60° to the horizontal or should be fitted with a rain hood or cap, if vertical, to prevent rain or snow from entering the exhaust system.

• The exhaust pipe must not be connected to exhausts from other generating sets or other equipment, such as a furnace or boiler.

4.9 Fuel System

must be capable of delivering a clean and continuous supply of fuel to the engine. For most installations, this will include a small day tank (usually incorporated in the base frame), a bulk storage tank and the



Item	Description
①	Exhaust Silencer
②	Wall Sleeve and Expansion Joint
③	Rain Cap
④	Silencer/Pipework Supports

Figure 4.4: Typical Exhaust System Installation

associated pumps and plumbing, (see Figure 4.5)

WARNING:

! For stationary generating sets with remote fuel storage systems, make sure such systems are installed in compliance with relevant Codes Standards or other requirements.

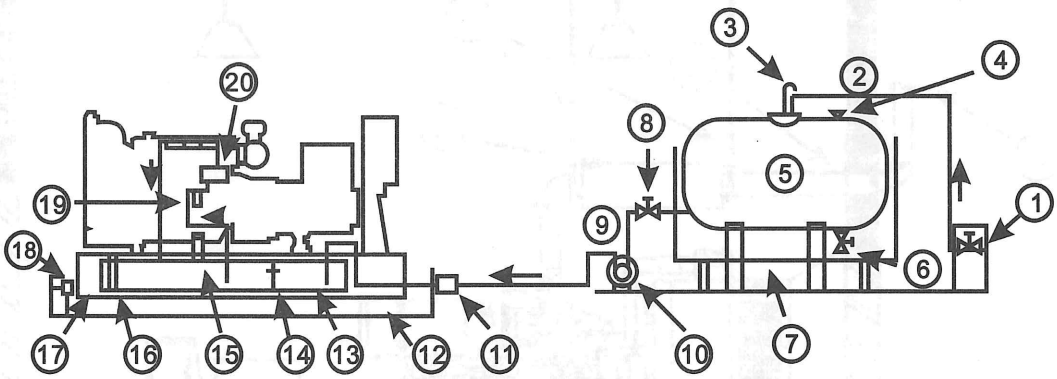
! Do not smoke or allow sparks, flames or other sources of ignition around fuel. Fuel vapors and oil vapors are explosive.

4.9.1 Day Tank: Day tanks provide a readily available supply of fuel directly to the generating set and should therefore be located within the generator room. The steel base frame of all but the largest sets are designed with a steel or polyethylene day tank built in with the engine fuel lines connected. These "base tanks" provide for at least 8 hours operation at full load or approximately 24 hours if an extended capacity base tank has been fitted.

WARNING:

! Never connect a remote fuel system to polyethylene fuel tanks incorporated in the base frame on smaller generating sets.

4.9.2 Bulk Storage Tanks: For extended



Item	Description	Item	Description
①	Equipped with Overflowing Alarming Device and Gage Board	⑪	DC Motorised Valve
②	Return Line	⑫	Above Ground Bulk Tank
③	Extended Vent	⑬	Below Floor Level Day Tank
④	Volume board	⑭	Fuel Level Switches
⑤	Bulk Tank	⑮	Hand-Operated Oil Inputting Pipe and Gas Conducing Pipe
⑥	Grease Emission Vale	⑯	Level Gauge
⑦	Trough Box	⑰	Vent
⑧	Export Valve	⑱	Leaking Alarming Device
⑨	Supply Line to Day Tank	⑲	Strainer
⑩	AC Fuel Pump	⑳	High Pressure Diesel-powered Pumps

Figure 4.5: Typical Layout with Fuel System

operation, a separate bulk fuel storage tank is required. Especially for standby generating sets it is not advisable to depend on regular delivery of fuel. The emergency that requires use of the standby set may be interrupted for the delay of the delivery of fuel.

The bulk tank should generally be located outside the building where it will be convenient for refilling, cleaning and for inspection. It should not, however, be exposed to freezing weather because fuel flow will be restricted as viscosity increases with cold temperatures. The tank may be located either above or below ground.

A vent must be installed on the bulk tank to relieve the air pressure created by filling the tank or created by evaporation and expansion. It will also prevent a vacuum as the fuel is consumed. The tank bottom should be rounded and placed on a 2°tilt to assure a concentrated settling of water and sediment. A sludge drain valve should be installed at the low point to allow removal of water and sediment on a regular basis. Underground tanks should have this water and sediment pumped out regularly.

4.9.3 Fuel Lines: The fuel lines can be of any fuel compatible material such as steel pipe or flexible hoses that will tolerate any environmental conditions.

WARNING:

! Do not use galvanized pipe or fittings for the fuel system.

Fuel delivery and return lines should be at least as large as the fitting sizes on the engine, and overflow piping should be one size larger. For long piping or low ambient temperatures the size of these lines should be increased to ensure adequate flow. Flexible piping should be used to connect to the engine to avoid damage or leaks caused by engine vibration.

The fuel delivery line should pick up fuel from a point no lower than 50 mm (2") from the bottom at the high end of the tank (away from the drain plug).

4.10 Fire Precautions

When designing the generating set installation the following points should be considered:

- The room should be designed so that there is an easy escape route for operating personnel in the event of fire within the room.
- Supply a Class BC or Class ABC fire extinguisher and /or fire extinguishing system.
- Gravity operated fire valves released by temperature operated fusible links mounted above the engine can be installed in the fuel lines.

4.11 Starting Batteries

WARNING:

! Do not smoke or allow sparks, flames or other sources of ignition around batteries. Hydrogen gas generated by charging batteries is explosive.

The starting batteries should be located as close as possible to the generating set while still being accessible for servicing. This will prevent electrical losses from long cables that could impact on the engine starting capability of the batteries.

4.12 Electrical Connection

Onsite electrical installation will generally consist only of connection up the site load to the generating set output terminals. Only fully qualified and experienced electrical technicians should carry out electrical installation, service and repair work.

WARNING:

! Make electrical connections in compliance with relevant Electrical Codes, Standards or other requirements. This includes requirements about grounding and ground/earth faults.

4.12.1 Cabling: Due to movement of generating sets on their vibration mounts, the electrical connection to the set should be made with flexible cable. This will prevent transmission of vibrations and possible damage to the alternator or circuit breaker terminals. If flexible cabling can not be used throughout the installation then a link box should be installed close to the set with a flexible connection to the set.

The cable should be protected by laying it in a duct or cable tray. However, the duct or tray should never be rigidly connected to the generating set. When bending cable, reference must be made to the recommended minimum bending radius.

The cable must be suitable for the output voltage of the generating set and the rated current of the set. In determining the size, allowances should be made for ambient temperature, method of installation, proximity of other cables, etc. When single core cables are used the gland plates must be of non-ferrous material such as aluminum, brass or a non-metallic material such as tufnol. Alternatively slots can be cut between gland holes of cables to prevent circulating (eddy) currents in magnetic gland plates.

All connections should be carefully checked for integrity. Phase rotation must be checked for compatibility with the installation. This is vitally important when connection is made to an automatic transfer switch, or if the machine is to be paralleled.

4.12.2 Protection: The cables connecting the generating set with the distribution system are protected by means of a circuit breaker to automatically disconnect the set in case of overload or short circuit.

4.12.3 Loading: When planning the electrical distribution system it is important to ensure that a balanced load is presented to the generating set. If loading on one phase is substantially higher than the other phases it will cause overheating in the alternator windings, imbalance in the phase to phase output voltage and possible damage to sensitive 3 phase equipment connected to the system. Ensure that no individual phase current exceeds the current rating of the generating set. For connection to an existing distribution system, it may be necessary to reorganize the distribution system to ensure these loading factors are met.

4.12.4 Power Factor: The power factor (cos Φ) of the connected load should be determined. Power factors below 0.8 lagging (inductive) can overload the generator. The set will provide its kilowatt

rating and operate satisfactorily from 0.8 lagging to unity power factor (1.0).

Particular attention must be given to installations with automatic or manual power factor correction equipment such as capacitors to ensure that a leading power factor is never present. This will lead to voltage instability and may result in damaging over voltages. Generally, whenever the generating set is supplying the load any power factor correction equipment should be switched off.

4.12.5 Grounding Requirements: Regulations vary for different locations. The frame of the generating set must be positively connected to an earth ground. Since the set is mounted on vibration isolators, the ground connection must be flexible to avoid possible breakage due to vibration. On the majority of self contained sets the ground connection is located inside the circuit breaker box.

Ground connection cables or straps should have at least full load current carrying capacity and meet applicable regulations.

4.12.6 Alternator Reconnection: Most alternators can be reconnected to suit different output voltages. The reconnection procedures are given in the Alternator Manual. Ensure that all other components such as circuit breakers, current transformers, cables and ammeters are suitable before operating at a different voltage.

4.12.7 Parallel Running: Extra equipment must be fitted for the standard generating sets to be operated in parallel with other generating sets or with mains power.

4.12.8 Insulation Test: Before starting the generating set after installation, test the insulation resistance of the windings. The Automatic Voltage Regulator (AVR) should be disconnected and the rotating diodes either shorted out with temporary links or disconnected. Any control wiring must also be disconnected.

A 500V Megger or similar instrument should be used. Disconnect any earthing conductor connected between neutral and earth and megger an output terminal to earth. The insulation resistance should be in excess of 5MΩ to earth. Should the insulation resistance be less than 5MΩ the winding must be dried out. See the Alternator Manual for procedure.

4.13 Acoustic Silencing

Control of generating set noise is becoming very important in most installations. There is a range of options available to control the noise level.

WARNING:

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

4.13.1 Exhaust Silencers: As discussed in Section 4.8 the exhaust silencer will decrease sound levels from the engine. Varying degrees of sound attenuation are available from different types of silencers. These levels are often described by terms such as industrial, residential, critical or supercritical.

4.13.2 Enclosures: Section 4.2 discusses enclosures that are available in either weatherproof or sound attenuating versions. These enclosures can be designed to meet a specific sound level requirement.

4.13.3 Other Sound Attenuation: For installations in buildings there are other types of equipment such as acoustic louvers, splitter vents and fan silencers, as well as sound absorbing wall coverings, that can be used to reduce the noise levels of generating sets.

4.14 Towing (Portable Generating Sets)

4.14.1 Preparing to Tow: Inspect all components of the coupling equipment on the towing vehicle and the generating set for defects such as excessive wear, corrosion, cracks, bent metal, or loose bolts. Ensure that the towing vehicle is rated for towing a load of at least the weight of the mobile generating set plus a 10% safety factor.

Couple the towing vehicle to the trailer and ensure the coupling device is engaged, closed and locked. Attach electrical connector for indicator lights, etc. Attach chains, if provided, by crossing them under the drawbar and attaching to the towing vehicle. Attach any "break away" safety wire, if fitted.

Fully retract the front screw jack, if equipped, and secure with the pin or locking device. Lock the front castor wheel, if equipped, in the full up position. Ensure that the rear stabilizer jacks, if equipped, are raised and locked.

Inspect tyres for condition and proper inflation. Check all tail lights, if equipped, are operating properly and that all reflectors are clean and functional.

Ensure load and grounding/earthing cables are disconnected and that all windows, access doors, and tool box covers are closed, latched and locked. Ensure any external fuel pipes are disconnected.

Release trailer parking brakes, if equipped, and remove any blocks or chocks under the wheels.

4.14.2 Towing: Whenever towing a mobile generating set, remember that the set may approach or exceed the weight of the towing vehicle so manoeuverability and stopping distance will be affected.

WARNING:

! When towing a mobile generating set, observe all Codes, Standards or other regulations and traffic laws. These include those regulations specifying required equipment and maximum and minimum speeds.

! Ensure brakes, if fitted, are in good order.

! Do not permit personnel to ride in or on the mobile generating set. Do not permit personnel to stand or ride on the drawbar or to stand or walk between the generating set and the towing vehicle.

Avoid gradients in excess of 15° (27%) and avoid potholes, rocks or other obstructions and soft or unstable terrain.
Ensure the area behind and under the mobile set is clear before reversing.

4.14.3 Parking: Park the set on a dry level area that can support it's weight. If it must be located on a slope, park it across the grade so that it does not tend to roll downhill. Do not park the set on grades exceeding 15° (27%).

Set the parking brake and block or chock both sides of all wheels. Lower front screw jack, castor wheel and /or rear stabilizer jacks, as fitted.
Unhook chains, if equipped, from the towing vehicle, disconnect electrical connection, disconnect the coupling device and move the towing vehicle clear of the mobile generating set.

4.15 Storage

Long term storage can have detrimental effects on both the engine and alternator. These effects can be minimized by properly preparing and storing the generating set.

4.15.1 Engine Storage: The engine should be put through an engine "preservation" procedure that includes cleaning the engine and replacing all the fluids with new or preserving fluids. See the Engine Manual for the proper procedure.

4.15.2 Alternator Storage: When an alternator is in storage, moisture tends to condense in the windings. To minimize condensation, store the generating set in a dry storage area. If possible use space heaters to keep the windings dry.

After removing the generating set from storage, perform an insulation check as discussed in Section 4.12.8. If the readings are lower than prior to storage, it may be necessary to dry out the windings. See the Alternator Manual for procedures.

If the megger reading is below 1MΩ after drying, the insulation has deteriorated and should be reconditioned.

4.15.3 Battery Storage: While the battery is stored, it should receive a refreshing charge every 12 weeks (8 weeks in a tropical climate) up to a fully charged condition.

5 OPERATION

OPERATION

5.1 General Specification

This generator has both the advanced electronic controller and simple instrument control system for different demands. Referring to the control system specification for each system and its function.

The operator can control the generator manually or automatically through the control system, which is equipped with the protection circuit, when something bad happened it will send out the warning or even stop the machine. Referring to the control system specification for each system.

The following steps are on what we should do before starting the machine, during fist starting and stopping machine,and then normal starting and stopping machine.

5.2 Inspection Before Starting (be suitable for all control systems)

The following inspections should be made before starting:

WARNING:

! Because we can remote control the generator units with automatically control system, therefore we should switch off the control screen before the inspection.

1. Switch off the controlling switch power source and the emergency stop power

! When refrigerant is still heat, do not open the radiator cover. Do not mix a great number of refrigerants in the cooling system, otherwise serious damage would occur.

Note:

※ The diesel engine can normally consume 0.25% to 1% lubrication machine oil.

2. Checking the diesel engine machine oil and the refrigerant level, fill oil when necessary.

WARNING:

! When fill the fuel toward the oil tank, do not smoke or use open fire.

! Check the fuel level, fill when necessary.

! Check the diesel engine cooling fan and check whether the battery charger belt loose or not, tighten it when necessary.

! Check all hoses and see whether the joints are loosen or worn, tighten or change when necessary.

! Check the electrode and see whether it is corrode, clean it when necessary.

! Check the battery acid level, fill with distilled water when necessary, if the battery is a new one, has never been charged, fill the battery acid prepared in advance.

! Check the control screen and generator and see whether there is much dusts and contamination, which can cause electric shock or cooling problem.

! Check the air filter indicator and see

whether it was blocked, change a new filter when necessary.

! The surroundings around the generator must be cleaned up, take away the insecure objects, which may disturb operation and cause danger. Be sure that the cooling system is not blocked.

! Check the fuel system, the cooling system and the oil seal, see whether there is any leakage.

There is water releasing system in the fuel discharging system to regularly release the water condensation.

! Be sure that output circuit of the Alternator is always in "OFF" condition.

5.3 Primary Start / Stop-Key is used to start the control screen

The following steps are used to start the generator for the first time, or to start the generator after a long time of being repaired.

Note:
* Turn the key to the "0" (OFF) position, stop the machine any time. (As far as some simple units, just move the stop handle on the engine.)

1. Complete checking before operation as 5.2
2. Connects the battery to the generator, positive electrode first, and then cathode, turn on the power switch and the emergency stop switch.

Lubricate the diesel engine lubrication system. The first step is switch off power source, then start the engine by pressing the starting button, to turn on the starting motor in order to start up the engine.

If the engine doesn't start, wait for 15 second and try again. If after 3 consecutive attempt trying to start the engine without success, the engine has to be inspected for any malfunction.

WARNING:
! Continuously start the fuel system will cause the combustion gas's agglomeration in the gas exhausting system, even cause the potential explosion.
4. Fill the fuel oil into the oil system with the hand-pump, and release the air in the fuel filter. (For details, see Diesel Engine Manual).

5. Starting: Turn the key from position "0" to "1" then press the pre-heat button (if installed). Hold for 7 seconds to preheat the inhaled gas and press again the start button after 7 seconds to start up the engine.

Do not start the engine continuously for more than 5-7 seconds even the engine doesn't start. The interval for each attempt should be between 10-20 second. If still unsuccessful in starting the engine for 3 times, refer to this manual for the cause or refer to the Diesel Engine Manual.

WARNING:
! If can not start the machine for many times, the unburned fuel gas will gather in the gas exhausting system. Release this

unburned gas by opening the joint of the exhaust pipe. After releasing the unburned white gas, the problem that cause the failure to start and also be solved. Reinstall the joint and start again.

When engine has already been started

6. Check if there is abnormal noise or abnormal vibration.

7. Check the liquid or gas exhausting system for leakage.

8. Check if there is abnormal signal in the control screen, in particular when the temperature is high and the oil pressure is low. The oil pressure should be in normal condition after running the machine for 10 seconds.

9. Check the output voltage and frequency through the control screen. The output voltage has been rated in the factory, therefore should indicate the rated voltage. In the unload condition, the frequency of the 50-cycled machine should be similar to that of the 52-cycled machine, while the 60-cycled is similar to the 62-cycled. (The cycle of the speed adjusting units and spraying units electronically should be rated in an ideal value).

The adjustment should be made by qualified electrician or technical personnel, there are 3 voltage regulating methods that ear be adopted.

• If the control screen is equipped with the voltage regulator, may through it to adjust resistance and voltage.

• A adjustment can be made through the potentiometer of the volt regulator in the Alternator terminal box.

• If want to change completely the output voltage, should change the output winding connection in termination box of the Alternator. For details, please refer to Alternator Manual.

WARNING:
! When check phase, switch off the circuit breaker.

10. When the generator has produced the voltage, uses the phase checker to check the phase is whether correct, connect the phase instrument next to break switch of the generator. This inspection should be made by qualified technical personnel.

11. Stop: turn the key to the "0" (OFF) position, the machine will immediately stop.

WARNING:
! Before connect or disconnect the loaded cable, must stop the machine and disconnect cathode wiring of the battery.

12. Now connect the loaded cable, ready to generate normally.

5.4 Normall Start / Stop-Key is used to start the control screen

Note:

Turn the key to the "0" position, the generator will stop at any time.

1. Complete the check before running machine as 5.2.

2. Turn the key from "0" to "1" the spoon, check if the battery voltmeter is normal, 12-volts batteries usually indicate 12-14 volt after being charged, 24-volts batteries, 24-28 volt. And then press the start button.

Note:

If any error indicated on the screen, diesel engine will not start, turn the key back to the"0"(OFF)position, restart it after resolving the problem.

WARNING:

! When running the diesel engine, is running do not press the start button.

Starting: Turn the key from position "0" to "1" then press the pre-heat button (if installed). Hold for 7 seconds to preheat the inhaled gas and press again the start button after 7 seconds to start up the engine.

Do not start the engine continuously for more than 5-7 seconds even the engine doesn't start. The interval for each attempt should be between 10-20 second. If still unsuccessful in starting the engine for 3 times, refer to this manual for the cause or refer to the Diesel Engine Manual.

WARNING:

! If can not start the machine for many times, the unburned fuel gas will gather in the gas exhausting system. Release this unburned gas by opening the joint of the exhaust pipe. After releasing the unburned white gas, the problem cause the failure to start will also be solved. Reinstall the joint and start again as steps mentioned above.

When engine has already been started

4. Check if there is abnormal noise or abnormal vibration.

5. Check if the liquid or the gas exhausting system for leakage.

6. Check there is abnormal signal in the control screen, the oil pressure should be in normal condition after running the machine for 10-15 seconds.

7. Switch on for providing power.

Note:

Now load with steps based on the operating temperature. When the generator temperature is lower than 20 Celsius degree, load 50% rated output power first, when the temperature reach 80 Celsius degree, load 70-100% rated output power, Based on the model, some units of 100KVA, may load 100% rated power at the beginning.

8. Stop: Want to stop the machine, switch off the generator by pushing the handle downward, and run the generator in unloaded condition to cool. Then returns the key to the "0" (OFF) position, the machine will stop immediately.

If want to shut down the machine for accident, turn the key to"0" (OFF) position without unloading or press the red emergency stop button.

Note:

When problems occurred, turn the key to the "0" (OFF) position will reset the

protection circuit. before starting the unit again make sure all the problems has been solved.

5.5 Primary Start / Stop- Automatically start of the control screen

The following steps are used to start the generator manually or automatically for the first time, or to start the generator after a long time being serviced. Different controller varies in different operation. For details, refer to various Controller Description.

Note:

Press the emergency stop button or press Stop button, can stop the machine any time.

Before restarting the machine, loose the emergency stop button by just turning it clockwise, and then press the MAN button maring the machine in the manual operating condition

1. Complete checking before operation as 5.2.

2. Connects the battery to the generator, positive electrode first, and then cathode.

3. Lubricate the diesel engine lubrication system. Then start the engine units by pressing the start button until oil pressure is shown on lither the oil gauge or on the rain control board.

After three consecutive start, if there is still no oil pressure indication, you should stop and find the reason.

WARNING:

! Continuously start will cause fuel system inabnormal condition, and cause the combustion gas's agglomeration in the gas exhausting system, even cause potential explosion.

4. Fill the fuel oil into the oil system with the hand-pump, and release the air in the fuel filter. (For details, see Diesel Engine Manual).

5. Start: set the main controller in Manually Start position, and press Start button.(If the machine is too cool, may preheat it, if pre-heater is available)

Start the diesel engine three times until it got Started. If the engine cannot be started, the"fail to start" indicator will be on. If so, please refer to Diesel Engine Manual for the reason.

WARNING:

! If the machine cannot be started after many times, release this unburned gas by opening the joint of the exhaust pipe. After releasing the unburned white gas, the other problem that cause the failure to start is also be solved. Reinstall the joint and start again.

When engine has already been started

6. Check if there is abnormal noise or abnormal vibration.

7. Check the liquid or the gas exhausting system for ceakage.

8. Check if there is abnormal signal in the control screen, in particular when the temperature is high and the oil pressure is low. The oil pressure should be in normal condition after running the machine for 10 seconds.

9. Check the output voltage and frequency from the control screen. The output voltage has been rated in the factory, therefore should indicate the rated voltage. In the unload condition, the frequency of the 50-cycled machine should be similar to that of the 52-cycled machine, while the 60-cycled is similar to the 62-cycled. (The cycle of the speed adjusting units and spraying units electronically should be rated in an ideal value).

• The adjustment should be made by qualified electrician or technical personnel, there are 3 voltage regulating methods that can be adopted.

• If the control screen is equipped with the voltage regulator, may through it to adjust resistance and voltage.

• Adjustment can be made through the potentiometer of the volt regulator in the Alternator terminal box.

WARNING:

! When check phase, switch off the breaker.

10. When the generator has produced the voltage, connect the phase instrument next to break switch of the generator to check the phase. This inspection should be made by qualified technical personnel.

11. Stop: turn the key to the "0" (OFF) position the machine will stop immediately.

12. Check the remote-start equipment, loose the emergency stop button and press AUTO button, which make the machine, be in auto condition.

Input the remote-start signal, the engine will start as steps mentioned above, while clear this signal, the engine will stop.

Note:

* For cooling, the machine will still run for a while before stopping completely.
To stop the machine, clear the remote-start signal or press the emergency stop button.

WARNING:

! Before connect or disconnect the loaded cable, must stop the machine and disconnect cathode wiring of the battery.

13. Now connect the loaded cable, ready to generate normally.

5.6 Normal Start/Stop-Automatically start the control screen

Note:

* Press the emergency stop button or the STOP button, the generator will be stopped at any time.

* Before restarting the machine, turn the emergency stop button clock wise back to its original position; press the STOP button and RESET button "0" at the same time for resolving problems.

1. Complete the check before running machine as section 5.2.

Note:
* Cannot start the machine if the fail indicator light is on. Reset the control system by pressing the RESET button. Be sure that resolve all problems before starting the machine.

2. Start by hand: Be sure that the emergency stop button and remote-stop button are on their original position. Make the controller be in manual position, press start button to start.

The diesel engine will start three times automatically or until it got started. If cannot start the engine, the "fail to start" indicator will be on. If so, please refer to Diesel Engine Manual for the reason.

WARNING:

! If can not start the machine for many times, the unburned fuel gas will gather in the gas exhausting system. Release the unburned gas by opening the joint of the exhaust pipe. After releasing the unburned white gas, the problem cause the failure to start can also be solved. Reinstall the joint and start again as steps mentioned above.

When engine has already been started

3. Check if there is abnormal noise or abnormal vibration.

4. Check the liquid or the gas exhausting system for leakage.

5. Check if there is abnormal signal in the control screen, the oil pressure should be in normal condition after running the machine for 10-15 seconds.

6. Switch on the output break switch of the Alternator (Hand up toward).

Note:

* Now load the engine.

Load according to the operating temperature. When the generator temperature is lower than 20 Celsius degree, load 50% rated output power first, when the temperature reach 80 Celsius degree, load 70-100% rated output power Based on the model, some units of 100KVA, may load 100% rated power at the beginning.

7. Stop: Switch off the generator by turning the handle downward, run the generator in unloaded condition for a few minutes for cooling. Then press the emergency stop button or "0" button, the machine will stop immediately.

In some emergency case, we can stop the machine by pressing the emergency stop button without unloading the machine.

5.7 Automatically Start/Stop-Automatically start the control screen

The following steps are for the generator equipped with auto control system to start the machine automatically.

Note:

Press the emergency stop button or the STOP button, the generator will immediately be stopped.

* Before restarting the machine, turn the emergency stop button clock wise back to its original position; press the RESET button for resolving problems.

1. Complete the check before running machine as 5.2.

Note:

Cannot start the machine if the fail indicator light is on. Reset the control system by pressing the RESET button. Be sure to resolve all problems before starting the machine.

2. Auto start: Check if the emergency stop button and stop button of all remoter are in their original position. Set controller to auto position.

3. Switch on the break switch of the Alternator.

Ready to start, just input the start signal by remoter or controller with AMF function thet detects grid failure. Cancel this signal for stopping the generator, idle running the generator for a while for cooling, and then stop the generator.

6 GENERATING SET MAINTENANCE

GENERATING SET MAINTENANCE

6.1 General

A good maintenance programme is the key to prolong the life span of the generating set. Maintenance and service should only be carried out by qualified technicians. Records of this work should be kept to aid in developing an efficient maintenance programme log.

In general, the generating set should be kept clean. Do not permit liquids such as fuel or oil film to accumulate on any internal or external surfaces or under or around any acoustic materia. Wipe down surfaces using an aqueous industrial cleaner, Do not use flammable solvents for cleaning purposes.

Any acoustic material with a protective covering that has been torn or punctured should be replaced immediately to prevent accumulation of liquids or oil film within the material.

6.2 Preventative Maintenance

Depending on the application of the generating set, requirement for preventative maintenance will vary. The preventative maintenance requirements associated wit the engine are detailed in the Engine Manual which should be reviewed in conjunction with this section. Maintenance intervals for the engine may be more frequent than those shown in this section.

6.2.1 Daily or at Each Startup:

(For standby sets these procedures may be performed weekly.)A walk around inspection should be performed on a daily basis and prior to starting the engine. The pre-start checks contained in Section 5.2 should be performed during this walk around. Procedures for performing the checks on the engine can be found in the Engine Manual which may contain additional requirements to those in Section 5.2.

6.2.2 Every Two Weeks:

(For standby sets that have not been run.)Perform an operational check on the generating set by starting and running the set for only 5 minutes.

WARNING:

! Do not run diesel engines at low loads for long periods.

6.2.3 Every Month:

(For standby sets that have not been run on load.)Perform an operational and load check on the generating set by starting and running the set on at least 50% load for 1 to 2 hours.

6.2.4 Every Six Months or 250 Hours:

Repeat the daily procedures plus the following:

1. Check all control system safety devices by electrically simulating faults.

2. Clean all battery cap vents.

3. Tighten all exhaust connections.

4. Perform other engine maintenance as specified in the Engine Manual.

5. Start the engine and observe the instrument panel to ensure that all gauges and meters are operating properly.

6. If a spark arrestor has been fitted, This should be removed and thoroughly cleaned to remove any carbon build-up.

6.2.5 Alternator Preventative Maintenance:

There is no routine maintenance required on the alternator, however periodic inspection of the alternator winding condition and periodic cleaning is recommended. See Section 8.2, Alternator Maintenance, and the Alternator Manual.

6.2.6 Engine preventative Maintenance:

See the Engine Manual provided with this manual for information on regular maintenance required to keep the engine operating efficiently.

6.3 Removal of Engine and/or Alternator

The following procedures should be used for removal of the engine and/or alternator:

1. Isolate and disconnect electrical power supply to auxiliary equipment such as water heater.

2. Isolate the battery charger supply. Disconnect the battery (negative lead first) and remove if necessary.

3. If the generating set is in a canopy, remove the fixing bolts on each side, disconnect the exhaust system and then remove the canopy.

4. Isolate and disconnect the control panel and remove together with stand from the generating set, ensuring that all cables have been adequately identified to facilitate reconnection.

5. If the engine and alternator are both to be removed, they may be lifted out as one unit using the lifting eyes provided on both the engine and alternator. First the bolts holding the engine/alternator to the base frame have to be removed.

6.3.1 Engine Removal Only:

1. If only the engine is to be removed, the wiring loom should first be removed from the engine.

2. If the alternator is fitted with only one set of feet then the front end of the alternator will have to be firmly supported before removing the engine.

3. Remove the bolts holding the engine to the base. It may also be advantageous to loosen the alternator mounting bolts.

4. Remove the alternator fan guards.

5. Support the rotor assembly using a sling or wooden supports taking care not to damage the fan.

6. Remove the bolts between the flexible coupling and the engine flywheel.

7. Support the rear of the engine using an overhead crane or similar device.

8. Remove the coupling housing bolts.

9. The engine is now moved forward until it

is clear of the alternator and may be lifted away from the base.

6.3.2 Alternator Removal Only:

1. If only the alternator is to be removed, the rear of the engine must be firmly supported.

2. Remove the wiring loom.

3. Remove the bolts holding the alternator to the base frame. Loosen the engine bolts as well.

4. Remove the alternator fan covers and support the rotor and the front of the alternator. Ensure that the rotor is positioned with a pole at the bottom center line. This is to avoid any damage to the bearing or exciter by limiting the rotor movement to that of the air gap.

5. Uncouple the alternator from the engine as per Section 6.3.1.

6. Support the alternator using a sling or similar device and slide the complete alternator back on the base before lifting.

7 ENGINE DESCRIPTION AND MAINTENANCE

ENGINE DESCRIPTION AND MAINTENANCE

7.1 Engine Description

7.1.1 General: The engine that powers the generating set is an industrial, heavy duty diesel engine that has been selected for its reliability and efficiency in operation. It is specifically designed and optimized to power generating sets .The engine is either a 4 stroke or 2 stroke compression ignition type with all the accessories necessary to provide a reliable power supply. Full details of the engine and associated equipment is provided in the Engine Manual. This section gives a brief discussion of the major systems and how they are integrated into the generating set.

If regular preventative maintenance is performed as per the Engine Manual, the diesel engine will continue to provide reliable power for many years.

7.1.2 Cooling System:
The engine cooling system is comprised of a radiator, high capacity pusher fan, a mechanically driven water pump and a thermostat. The fan is a pusher type that pushes the air through the radiator. This system provides for cooling of the surface heat of the engine and alternator, and internal cooling of the engine by the water circulating in the radiator. The alternator also has an integral fan that circulates cool air inside the housing. The thermostat maintains coolant temperature at a level for efficient operation of the engine.

In cold weather, jacket water heater, Oil heater and air heater is capable of improving and ensuring the start up of the engine. All such installation should be at all time connected with power.

.7.1.3 Engine Governing:
The engine governor is either a mechanical or electronic device designed to maintain a constant engine speed in relation to load requirements. The engine speed is directly related to the frequency of the alternator output, so any variation in engine speed will effect the frequency of the power output.

The governor senses engine speed and controls the fuel rate. As load increases on the alternator the governor will increase fuel flow to the engine. As load is reduced the governor reduces fuel flow.

7.1.4 Fuel System:
On most generating sets, the engine fuel system is connected directly to a fuel tank that is built into the base frame. This tank is designed to provide sufficient fuel for approximately 8 hours operation at full load unless an extended capacity tank has been fitted. In this case approximately 24 hours operation is possible.

The base tank is provided with fittings to facilitate either manual or automatic filling from a larger bulk storage tank. See Section 4.9 for a discussion of the entire fuel system.

On larger sets, the base frame does not include a fuel tank so the engine fuel system must be connected to a separate tank located next to the set.

7.1.5 Exhaust System:

Exhaust systems are provided to reduce the noise level of the engine and to direct the exhaust gases to where they will not be a hazard.

On smaller sets the exhaust silencer and piping are mounted directly on the engine. On larger engines the exhaust system is supplied loose for installation on site.

7.1.6 Air Flap Valve:

An air flap valve, if fitted, prevents overspeeds due to ingestion of gas or fumes by cutting off the air supply. Functional testing of these combustion air intake valves should not be performed on engines on load. A functional test should only be carried out when the engine is not running. If it is necessary to demonstrate air valves closing when the engine is running this should be done at no load. The engine should absolutely not be restarted immediately afterwards.

WARNING:

! The closing of the air flap valve while the engine is running can cause oil carry over into the exhaust system which is highly volatile. The engine should be left for a period of time to allow these gases to dissipate.

7.1.7 Starting Aids:

Ethyl Ether starting aids are not recommended. They will reduce the efficient working life of the engine.

7.2 Engine Maintenance

The Engine Manual supplied with this manual contains detailed information on maintaining the engine. It also includes a comprehensive Trouble Shooting guide for engine faults.

7.3 Radiator Maintenance

7.3.1 General Notes:

Corrosion in the radiator can be a prime cause of failure. This is prompted by air in the water. Always ensure pipe connections are free of leaks and bleed air from top of the radiator regularly to keep the system "air free".

Radiators should not be left standing in a partially filled condition. Radiators left partly filled with water will suffer much more rapidly from the effects of corrosion. For an inoperative generating set, either drain the radiator completely or ensure that it is maintained full. Wherever possible, radiators should be filled with distilled or naturally soft water, dosed with suitable corrosion inhibitors.

WARNING:

! Radiator coolant is normally very hot and under pressure. Do not work on the radiator or disconnect pipework until it has cooled. Do not work on the radiator or remove any guarding while the fan is in motion.

7.3.2 External Cleaning:

In dusty or dirty conditions the radiator fins can become blocked with loose debris, insects, etc. and this fouling will have an effect on the performance of the radiator.

For regular removal of light deposits use a low pressure steam jet. More difficult

deposits may need a detergent with a low pressure hot water hose. Spray steam jet or water from the front of the radiator towards the fan. Spraying in the opposite direction will force debris further into the core. Covering the engine/alternator during this process will keep them clean.

Stubborn deposits, which cannot be removed by the above methods may require removal of the radiator and immersion in a heated alkali degreasing solution for about 20 minutes and then washing off with a hot water hose.

7.3.3 Internal Cleaning:

If, due to leaky joints for instance, indiscriminate topping-up with hard water has been carried out for some time, or if the generating set has been run without inhibitors the system may become fouled by scale.

To descale the radiator, use the following procedure:

1. Drain the water system and disconnect and blank off the pipe connections to the engine.

2. Prepare a 4% solution of inhibited acid solvent and fresh water. Add the acid to the water, never vice versa.

3. Allow several minutes for mixing, then heat the solution to 49℃ (120℉) maximum.

4. Run the solution slowly into the radiator via the filler cap or a branch in the manifold. Effervescence will occur. When it ceases, fill the radiator completely with the heated solvent.

5. Allow to stand for several minutes; then drain the solvent back into the original container through the bottom manifold or drain plug.

6. Examine the interior of the headers. If scale remains repeat the process outlined above with the solvent strength increased to 8%.

7.After descaling the acid solution has to be neutralized as follows: Fill the mixing container with fresh water, heat to boiling point then add common washing soda crystals at the following strength:0.5kg of soda to 20 litres water(1 lb. soda to 4 gallons water).Fill the radiator with this solution, then drain it back into the container.

8. Flush the radiator in the manner several times, finally leaving the radiator full for at least an hour. Drain until empty and wash out the radiator with hot fresh water.

9. Before putting the radiator into service again, fill with water and apply a test pressure equal to twice that of the working pressure. Examine carefully for any leaks which may have been revealed by descaling.

10. Prior to recommissioning, the coolant must be dosed with any necessary corrosion inhibitors and/or the correct proportion of antifreeze.

※ For details, please refer to Engine manual.

8 ALTERNATOR DESCRIPTION AND MAINTENANCE

ALTERNATOR DESCRIPTION AND MAINTENANCE

8.1 Alternator Description

8.1.1 General: The alternator fitted on the generating set is of brushless self-excitation type which eliminates the maintenance associated with slip rings and brushes. The control system consists of an automatic voltage regulator, protective circuits and the necessary instruments to allow monitoring of the output of the generating set.

8.1.2 Construction/Major Components: The alternator unit is completely self-contained and is designed and constructed to provide trouble free operation, ease of maintenance and long service life.

The stator core is produced from insulated low loss electrical grade sheet steel laminations. These are built and welded under a fixed pressure to give an extremely rigid core to withstand vibrations and load impulses. The complete wound stator is, after impregnation, pressed into the frame and pinned into position.

A high grade precision machined shaft carries the rotor assembly which comprises the cooling fan. The rotor is mechanically wedged to the alternator rotating field systems, the exciter rotator/rotating diode system and supported on the winding end allow an over speed of up to 2250 RPM. The complete rotor assembly is dynamically balanced to ensure vibration-free running.

At the drive end of the rotor assembly a cast-aluminium centrifugal fan draws cooling air through screened/louvered covers at the non drive end and discharges it through similar side mounted covers at the drive end.

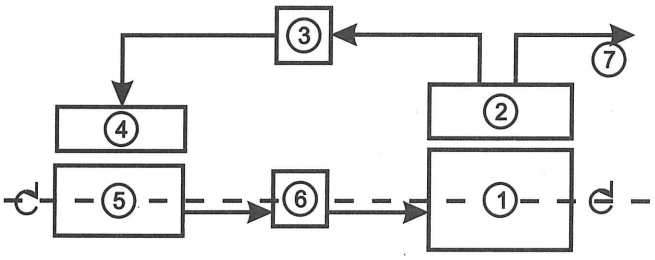
8.1.3 Alternator Method of Operation: The electrical power produced by the generating set is derived from a closed loop system consisting principally of the exciter rotor, the main revolving field and the automatic voltage regulator (see Figure 8.1).

The process begins when the engine starts to rotate the internal components of the alternator. The residual magnetism in the main rotor (item 1) produces a small alternating voltage (AC) in the main stator (item 2). The automatic voltage regulator (item 3) rectifies this voltage (converts it to DC) and applies it to the exciter stator (item 4).

This DC current to the exciter stator creates a magnetic field which, in turn, induces an AC voltage in the exciter rotor (item 5). This AC voltage is converted back to DC by the rotating diodes (item 6).

When this DC voltage appears at the main rotor, a stronger magnetic field than the original residual field is created which induces a higher voltage in the main stator.

This higher voltage circulates through the system inducing an even higher DC voltage back at the main rotor. This cycle continues to build up the voltage until it approaches the proper output level of the generating set. At this point the automatic voltage regulator begins to limit the voltage being passed to the exciter stator which, in turn, limits the



Item	Description
①	Main Rotor
②	Main Stator
③	Automatic Voltage Regulator
④	Exciter Stator
⑤	Exciter Rotor
⑥	Rotating Diodes
⑦	Power Output

Figure 8.1: Block Diagram of Alternator Operation

overall power output (item 7) of the alternator.
This build-up process takes place in less than one second.

8.1.4 Automatic Voltage Regulator: The Automatic Voltage Regulator (AVR) maintains a no load to full load steady state voltage to tight tolerances. The AVR has a volts/hertz characteristic which proportionally reduces the regulated voltage at reduced speeds. This feature aids the engine during sudden large additions of load.

8.2 Alternator Maintenance

Although maintenance is rarely required, periodic inspection and cleaning is recommended.

Perform a winding insulation test according to procedures provided in the Alternator Manual before the initial start, after generating set storage, and every 3 to 6 months depending on humidity levels (more often in higher humidity). upon inspection disconnect the AVR from the control panel. In high humidity areas, installing space heaters to operate when the generating set is not running will help keep the windings dry.

The alternator air filters, if fitted, should be inspected regularly depending on site conditions. If cleaning is necessary, remove the filter elements from the filter frames. Immerse or flush the element with a suitable detergent agent until the element is clean. Dry the elements thoroughly before refitting. Additionally the alternator unit should be cleaned on a regular basis. The frequency of such cleaning depends on the environmental conditions of the operating site. The following procedure should be followed when cleaning is necessary: Disconnect all power. Wipe dust, dirt, oil, water and any other liquids from the external surfaces of the alternator unit and from the ventilation screens. These materials can work their way into the windings and may cause overheating or insulation breakdown. Dust and dirt is best removed using a vacuum cleaner. Do not use compressed air, steam or high pressure water!

The separate Alternator Manual provided with this manual contains more detailed information on alternator maintenance. It also includes a trouble shooting guide for alternator faults.

※ For details, please refer to Alternator manual.

9 OPERATION AND MAINTENANCE DIRECTIVE FOR MAINTENANCE FREE BATTERY

BATTERY DESCRIPTION AND MAINTENANCE

9.1 Scope of utilization

9.1This product is good for the starting of the diesel engine, ignition and illumination. When the starter battery is used for other purpose, please contact your service hotline.

Safety warning

1、The electrolysis within the starter battery is having strong corrosive effect to metal, cotton products, stone and soil, use cautiously.

2、Hydrogen will result when starter battery is in use and on recharge condition, it will explode with flammable environment. Take precaution steps as follow:

※Starter battery should be in ventilated area when in use or under maintenance;

※Smoking or flammable products are not allowed during maintaining the starter battery;

※When the starter battery is recharged with high electric current, stop the installation process until after ten minutes that the hydrogen within the starter battery has been totally diffused;

※Make sure the vent of the starter battery are unimpeded and frequent checking is necessary.

3、Take good care when handling the starter battery to avoid any injuries.

9.2 Product features

Since this starter battery is with highly advance maintenance free technology and with very good capability, no water is required when in use.

Instructions

1、Before using the starter battery, please check the voltage at the battery terminal, if the voltage is with 12.6V or above then it is functional, otherwise it needs to be recharged before use. Approach for recharging:

Storage: Three month with liquid within the starter battery. Recharge is necessary after this period.

When recharging the maintenance free battery, 16V constant voltage is employed with maximum allowable current of 0.25C20A, until the charging current reaches zero value and that remains stable for 2-3 hours. Description: C20 refers to the

capacity of the battery. If the battery is of 54Ah it will mean the 54Ah capacity for 20 hours and the allowable electric current is 0.25 x 54 = 14A.

※ 3 hours before recharging, pay attention, observe and adjust the charging electric current to avoid damaging the battery.

2、The starter battery should have equipped with charge indicator which denotes all the parameter and description and is not allowed to be scraped.

3、The starter battery has both the "+" and "-" which is the positive and negative connecting terminal, the positive terminal should be connected first.

※Damage will incur if connected oppositely

4、Leakage of electrolysis if battery is placed up side down or sliding.

9.3 Maintenance

1、Attention should be given when in us not having the battery with over utilized with the electric capacity and should recharge is situation occurs, charging method is seen in appendix.

Appendix 1

2、If the battery is not used for a long period of time, the negative terminal cable should be disconnected or take off the battery. After a period of time if the battery is not in use, it should be fully recharged before use and frequent inspection is necessary. Recharge when the voltage is at a low level.

3、Never use the battery terminal for short circuit ignition to test if the battery is having enough charge.

4、Always keep the battery terminal connection clean and secure to ensure the good contact.

5、Always keep the vent of the battery from blockage and frozen during winter time as this will increase the pressure within the battery which will result of the shell to be broken.

6、Metal tools or other conductive material should not be placed near the terminal connection in order to avoid contact of the two poles which will cause short circuit and result in damaging the battery and the connecting terminal.

7、Scrapped battery should be handled by distributor or through qualified recycle agent.

- Temperature too high when in use
- Recharging the battery too long using high electric current
- Other electrical appliance which increase additional loading
- The belt of the engine is not tight enough
- High static leakage
- Too high or too low of the electric current pressure of the voltage regulator when recharging
- Frequent starting
- Without removing the negative pole connection when not in use for a long time

9.4 Wrong recharging/ list of troubleshooting

Fault	Phenonmenon	Solution
No charging voltage	Main failure	Inspect main connection
	Fuse failure	Change fuse
	Charger failure	Change charger
Low charging voltage	Low voltage	Inspect charger voltage set up/ charger failure
High charging voltage	High voltage	Inspect charger voltage set up/ charger failure
After main connected fuse still burns	Short circuit	Inspect charger voltage set up/ charger failure

10 CONTROL SYSTEM SPECIFICATION AND FAULT ELIMINATION

CONTROL SYSTEM SPECIFICATION AND FAULT ELIMINATION

10.1 Control System Specification

10.1.1 Specification: A design-advanced electronic control system is being Installed In the generator to control and monitor this machine. Different control systems are used for different generators. A separated document will be attached for different control systems.

These control systems consist of two parts, a control panel and a Alternator output circuit switch, which work together.

The control screen provides the method to start or to stop the generator, monitors its running and the output. In some emergency case, for example, the oil pressure is too low or the temperature of the refrigerant is too high, the machine will stop automatically. Different generators may require different series.

The alternator output circuit switch is used to protect the output when short-circuits or overload occurred. It also provides a power distribution method for the generator output.

10.1.2 Control screen: Before starting, the operator must know the instruments and indicators in the screen very well. When running the machine, the operator should observe the instruments and the main screen to find any abnormal indication.

If any equipment is added in the control screen, the chart mentioned in this manual may be slightly different from the practical one. The following specification will show you each component's function. There will not be any of the gauges mentioned below if the controlled has already got built-in monitors

A) AC voltmeter -- show the output voltage, which is different for the different alternator termination box connection, the different auto voltage regulating and the different voltage selection switch position. However, should not change it when running the generator. When excitation fault occurred in alternator, the output voltage reading will drop to approximately 20-40 volt. If the generator is running, while there is no reading in voltmeter, you should make sure that the selection switch of the AC voltmeter is not in the OFF position.

B) AC voltmeter selection switch - provides the phase-phase volt. OFF position is used to adjust to O position when runing.

C) AC Ampere Meter - shows the DC currentwhich is transporting, and is subject to the load. To measure the current of phases, use the ampere meter selection switch. If the generator is running, while there is no reading in voltmeter, the ampere meter selection switch may possibly be in OFF position.

D) Ampere Meter Selection Switch - chooses the phase to be measured, OFF position is used to adjust to 0 position when running the machine.

E) The Frequency Meter-shows the output frequency of the generator. When the diesel engine, which is under the control of the adjuster, runs in a relatively stable speed, the normal output frequency should be 50HZ or 60HZ (full load the generator). If not full load

the generator, the frequency may possibly be slightly higher and this is than the normal, which is subject to the down degree of the meter. In fact, the frequency should be 52Hz or 62Hz in unload condition, after loading, the frequency will be down, when at full load, the frequency should be 50Hz or 60Hz.

F) Running Timetable -- show the total running hours of the generator.

G) Diesel Engine Water Temperature Gauge -- connected to the sensor of the engine to measure the temperature of the engine refrigerant. The normal operating temperature should approach 85℃ (185℉).

H) DC Battery Voltmeter - show the charge situation of the battery. When the engine is not running, the normal battery voltage is 12-14 volt (12 volts batteries) or 24-28 volt (24 volts batteries). When start, show 70%the normal value or so. After running the volt value should be back to the normal value. If the charge battery of the alternator is being charged, the volt of the generator in running condition is always higher than that in Stop condition.

I) Diesel Engine Oil Pressure Gauge -- used to monitor the engine oil pressure from the beginning. The normal oil pressure should be approximately 35-60P, S, I/60HZ. After the engine warms up, the oil pressure will increase greatly.

J) Fault Indicator -- indicator's light show the reception of order. The red light show the system will stop while the yellow light means warning.

K) Main Control Switch -- a three-phrase switch used to control the functions of the generator

Start

Used to activate the starts function by hand, start and run the engine (by hand)

Stop

Used to stop the engine and not activate the auto start, reset the fault protection also.

AUTO

Control system makes the preparation to start and run the engine automatically

L) Emergency Stop Button a red button, stop the engine and lock the start unit immediately. Before restart the engine, turn clockwise the red button.

10.2 Instruction to Find and Eliminate Fault in the control system

Fault	Phenomenon	Way to clear the fault
Diesel Engine Start (only for manual-start screen)	Fail to start when turning the key to	1. Check the key 2. Check the indicator, reset if necessary after eliminating the fault 3. Check the volt on the control screen. If no reading in the screen, check the fuse. If the volt is too low, recharge the battery by another charger, and reconnect (note: be sure that the key is in the ZERO position when connect or disconnect the wire)
Diesel Engine Start (only for auto-start screen)	Fail to start by inputting the START signal by hand or by remot control	1. Check if all emergency stop buttons are repositioned (including control remotely button), If Remote Control to Stop is available check if it has been connected to the terminal (of the Remote Control to Stop). 2. Check if all control switches are in OFF position. 3. Check the indicator, reset if necessary after eliminating the fault. 4. Check the volt on the control screen. If no reading in the screen, check the fuse. If the volt is too low, recharge the battery by another charger, and reconnect. Note: be sure that the key is in the ZERO position when connect or disconnect the wire. 5. Check the magnetism on starting motor, connect the negative of the battery with DC voltmeter. Turn the control switch to the START position. If volt was measured, the motor or magnetism must be faulty, should be changed; if no volt is measured, check if the connection on the screen is loose or short circuited or change the control panel
Diesel Engine Start malfunction (for all control screen)	Start the diesel engine, but fail to run the machine. or stop running after 20 seconds	1. Check the fuel level 2. Check if the magnetism connection is loaded. 3. Check the fuse next to the alternator 4. Check if block occurred in the fuel pipe or in the filter 5. That white smog goes out of the gas exhausting system shows the fuel has gone into the engine, but fails to run the machine. Refer to Diesel Engine Manual. 6. If the temperature outside is too low, use heat start if it is available 7. Check if oil pressure sensor is blocked.

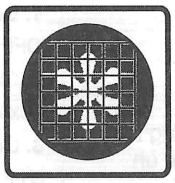
Fault	Phenomenon	Way to clear the fault
The battery volt with low, alert (auto system, attachment)	Low volt alert indicator light	1. Check the battery volt. 12V Battery, above 12V, while 24V battery above 24V 2. If the battery volt is too low when the generator is not running, recharge the battery by another charger or using the running diesel engine to recharge 3. That the battery volt is too low while the generator is running indicates the failure to charge by diesel engine. Shut down to check the fan belts 4. If the belt is not loose, check the charger. Refer to Diesel Engine Manual 5. If fail to store electric power, change the battery 6. Once the problem has been solved, press the reposition button
Alert, when not in auto mode	Alert indicator light, which not occur in auto mode	1.Check if the control switch is in AUTO position 2.Check if the emergency stop button is repositioned 3.Once the reason that cause alert has been found, press the reposition button
High temperature alert of the diesel engine	High water temperature pre-alert	1. Check if the diesel engine is overloaded 2. Check if the radiator and ventilation system is blocked 3. Check if the surrounding temperature is within the designed parameter 4. If we still haven't found the problem, shut down, check if the belt is loose 5. Check the water sensor 6. Refer to Diesel Engine Manual 7. Once the reason that cause alert has been found, press the reposition button
Low oil pressure alert	Low oil pressure pre-alert	1. Check the oil pressure sensor 2. Shut down and check the machine oil ASAP 3. Refer to Diesel Engine Manual 4. Once the reason that cause alert has been found, press the reposition button
Fail to charge the battery, alert, (auto system, attachment)	Alert indicator light	1. Check if the charger is ON 2. Refer to low battery volt alert mentioned above 3. Battery charger malfunction 4. Once the reason that cause alert has been found, press the reposition button

Fault	Phenomenon	Way to clear the fault
No voltage when running the generator (all control system)	No volt reading in the AC volt meter on control panel	**1.** Check if the selection switch of the volt meter is in OFF **2.** Check the fuse, which is usually in the terminal box of the alternator (control cabinet) **3.** Check the volt by another volt meter, if it is OK, check the wire connection, change the volt meter if necessary. **4.** Check AVR and diode, refer to Alternator Manual **5.** Check if the rotating speed of the diesel engine is OK
The generator is running, but with no loading	The generator is running, but fail to supply power	**1.** Check if the switch is in ON position (HAND goes upward) **2.** Check if the generator generate AC power, if not, check as that mentioned above
Fail to stop the engine manually(All control system)	Press OFF, but the engine is still running	**1.** Check if the switch is in proper position **2.** Check the fuel electromagnetism and stop electromagnetism are normal, change if necessary.
Fail to stop with the engine is in auto mode	Fail to stop the engine by remoter	**Note:** In auto control system, the engine will not stop immediately after receiving the signal from the remoter. The engine will run for another some time to cool its body. **1.** Cooling time 5 min. **2.** Check if the engine stop after pressing the emergency stop button or OFF button **3.** Check the fuel electromagnetism and stop electromagnetism are normal, change if necessary.

HAZARD LABEL LEGEND

Some or all of these hazard warning labels will appear on your generating set:

DO NOT TAMPER WITH UNLESS YOU HAVE READ THE INSTRUCTION MANUAL

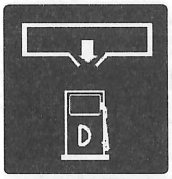


USE FAN GUARDS

ELECTRIC SHOCK HAZARD

HOT EXHAUST GAS

DIESEL FUEL WARNING



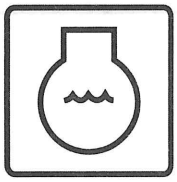
DIESEL FUEL SUPPLY LINE

PROTECTIVE EARTH (GROUND)

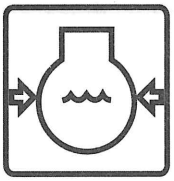
NO SMOKING

EMERGENCY/ PANIC EXIT

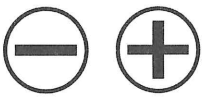
HOT SURFACES



ENGINE COOLANT



ENGINE COOLANT PRESSURE



DC ELECTRIC TERMINALS

AC ELECTRIC TERMINALS

Generating Set Information

Model : _____ **Serial No. :** _____

1. Date of Delivery: _____

2. Date of Setting: _____

3. Date of Finishing: _____

4. Date of Commissioning: _____

5. Result of Commissioning: _____

_____

_____

_____

6. Client Attitude: _____

_____

_____

_____

_____

7. Comments: _____

_____

_____

_____

_____

Generating Set Units Running Record

Model : _____ **Serial No. :** _____

Running Date	Running Time		Total Running Time	Volt (V)	A Phase Current (A)	B Phase Current (A)	C Phase Current (A)	Frequency (Hz)	Power (KW)	Battery Volt (V)	Oil Pressure (bar)	Water Temperature (°C)	Water Tank Volume	Indoor Temperature (°C)	Color of Smoke	Running Condition	Operator
	Start	Stop															

Note: Record the Running Data Hourly

Generator Units Maintenance Record

Model : _____ **Serial No. :** _____

Date	Running Time	Maintenance Items									Maintenance Result	Operator
		Change Machine Oil	Change Refrigerant	Change Diesel Filter	Change Machine Oil Filter	Change Air Filter	Change Water Filter	Fill Diesel	Fill Battery Liquid	Check the Protective Equipment		

Generator Units Fault Record

Model : _____ **Serial No. :** _____

Date	Running Time	Fault	Reason of the Fault	Way to Clear the Fault	Operator

Generator Units Repair Record

Model : _____ **Serial No. :** _____

Date	Running Time	Fault	Reason of the Fault	Operator

Generator Units Fault Record

Model : _____ **Serial No. :** _____

Date	Running Time	Fault	Reason of the Fault	Way to Clear the Fault	Operator