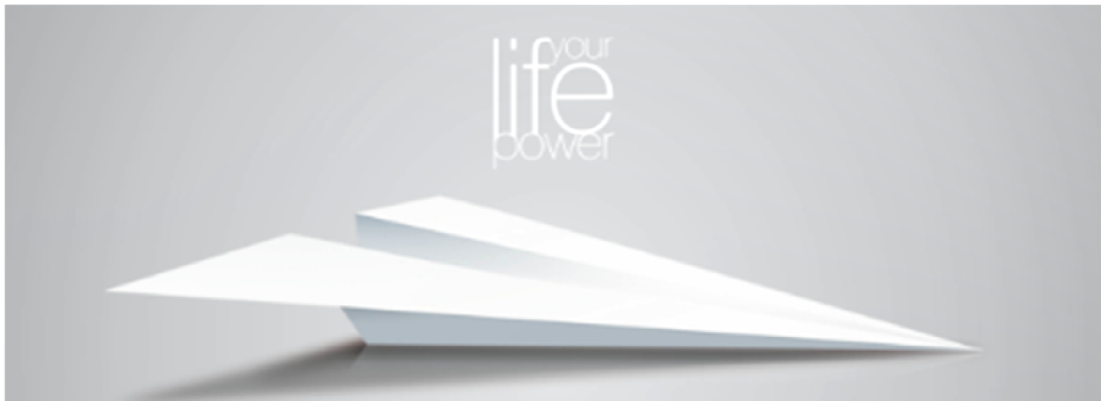


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DIESEL GENERATOR USER AND MAINTENANCE MANUEL

DEAR GENPOWER GENERATOR SET USER

Thank you for selecting Genpower generator and hope your works will not be unfinished.

Genpower production generator sets are produced in accordance with ISO 9001:2000 Quality Management System and " CE " norms and in an environment-friendly way with ISO 14001:2004 Environment Management System.

Our generators are delivered to our end users by being subjected to a careful quality control and tests are applied in every stage of production. We are attempting to continuously improve our product and provide a better service for you, with our staff specialized in their field of interests and in modern factory facilities.

Please read the operating manual carefully before initial starting of generator set and also recommend you have it be installed by our authorized service in order to avoid from any unfinished matter. This operating manual, for engine service – maintenance and alternator service – maintenance books are delivered together with generator set.

This operating and maintenance manual was prepared in order to ensure users to easily handle the generator and help them how they are going to make its maintenance. This is not a workshop repair manual. For further information about this manual please check the CD given with the genset before use this product.

The generator is under guarantee for 2 (two) years or 1000 operating hours provided the use of it in accordance with the matters stated in operating and maintenance manuals. Any repair or replacement of parts caused by any modification held on the generator without giving consent of the original manufacturer or by use of non-original parts are excluded from scope of guarantee.

We recommend you to make the periodical maintenance agreement with our authorized services which provide continuous service for 7 days / 24 hours in order to have much more performance and prolonged life -cycle of generator. Lifetime of this product is 10 (ten) years.

Please comply with attention and warning indicators on the generator set and take necessary safety measures mentioned in this manual for your safety and your surrounding lives.

Information included in this manual may not contain all features belonging to the generator.

Genpower has the right of making any amendment to improve the product quality without notifying.

GENPOWER JENERATÖR SAN. VE TİC. A.Ş.

"Keep this manual for later assistance"

1. PART: SAFETY MEASURES

1.1. INTRODUCTION

Generator groups produced by our company have been designed and conceived by prioritizing all sorts of safety of lives and property. Generators should be installed and used in accordance with maintenance and operating rules stated in this catalogue both in terms of using the generator economically for a long terms and ensuring continuous safety of life and property. Required safety measures should be taken in advance during the installation, usage and maintenance. Safe operating responsibility of the generator set belongs to people using and maintaining it. Provided that instructions, methods and safety rules in this manual are complied with, risk of accident will decrease. Otherwise, unexpected defects and accidents which may result within serious injured and death of people and damage on the equipment. Please have your generator used and maintained by well trained people who issued or authorized persons in order to prevent these occasions.

Please plan any part, machine or engine you are operating in a way to ensure easy access to every point. Take pre safety measures about how you can avoid from exposure to occasions like touching with rotating parts, burning and cut with sharp edges while checking out the engine. Ensure that covers of turbo compressor driving shaft, pump shaft, fan belts and winglets among engine components are fitted.

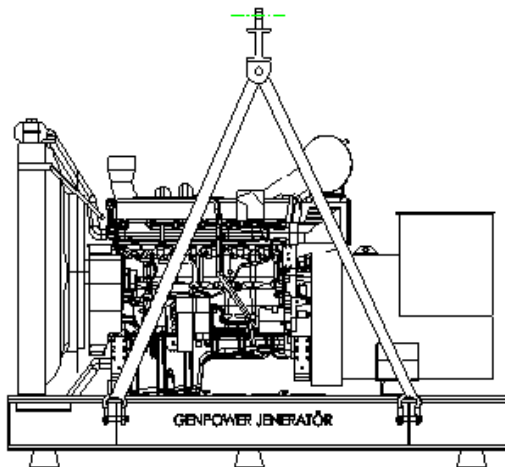
Never operate your generator when it is broken down and in unsafe conditions. Always isolate accumulator negative (-) lead terminal by separating from the accumulator. Bring attention of people by hanging a WARNING/CAUTION sign on the engine or its neighboring.

Never make any maintenance or repair while the generator set is operating. Turn off the generator and take all safety measures before any maintenance initiated.

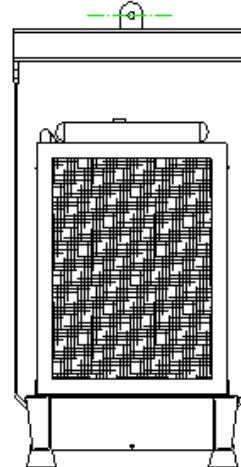
Never have unauthorized persons repaired and maintained, this will cause damage in your generator and also be out of from scope of guarantee. We recommend you to use our authorized services providing 7/24 service.

1.2. LIFTING AND TRANSPORTATION THE GENERATOR SET

ATTENTION! :Incorrect application for lifting the generator may cause serious damages.



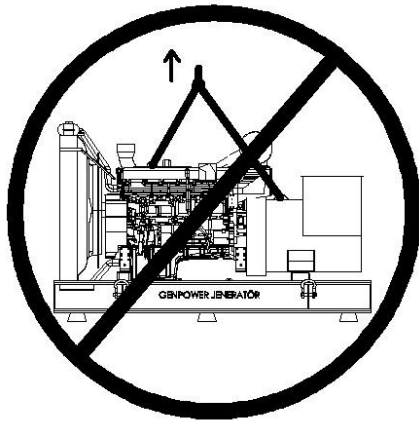
Şekil 1.1



Use lifting eyes are made for this purpose on the chassis in OPEN type generators. (Figure 1.1)

Never lift the generator by using the alternator and engine lifting eyes.

Lift it from lifting points (eyes) located on upper part of the cabin. (Figure 1.2).



Check whether or not lifting tools are proper to lift this weight before lifting the generator. You can find weight of the generator from group label on the generator or the generator set weight chart. The lifting capacity of tool should be at least 10% higher than total weight of generator.

Always use lockable hooks and eye bolts for lifting with crane. Lifting eye bolts should always be checked against welding cracks, breakages, loose screws and bolts which are rusted or worn, lost its qualification and **strength**. It should never be lifted with inappropriate eye bolts.

Lifting ropes or equipments to be used for the same purpose should be connected to the generator chassis to prevent the generator from rotating to right and left disorderly and to check it when contact of the generator is broken from the ground while lifting with crane.

Contact of rear wheels should not be broken when the generator is lifted while carrying with forklift and appropriate forklift should be used according to the **total** weight of generator. The generator can be pushed and pulled by using forklift. Prevent direct contact of forklift yoke with the generator chassis during these processes. You can use resisting wooden wedges between the forklift yoke and chassis for this **purpose**. Do not drag the generator on ground while pushing and pulling; instead you can slide by placing round iron or steel pipes between the chassis and ground for this.

All personnel should be kept away from the generator while lifting or carrying it.

Do not try to lift the generator in excessively windy weathers.

Check whether or not any personnel exist in generators with **canopy** and container before lifting them. Lock the doors and then lift.

Ensure that surface **ground to be installed of generator should be** flat, bowless and has the capacity to carry the **total** weight of generator. Do not lift the generator on places having more than 10% incline and risk of slip.

1.3. FIRE AND EXPLOSION

Fuel used in generators may combust and explode. Taking appropriate measures in storage of these materials decrease the risk of fire and explosion. BC and ABC class fire extinguishers should always be kept available in the generator room and relevant persons should be trained about them.

Keep generator room and the generator clean. If fuel, oil, cooling liquid and accumulator electrolyte **spilled around**, immediately remove them. Rub out contaminated surfaces with **industrial type** materials **and** do not use combustible chemicals.

Never use spray like ether or similar chemicals to operate diesel engine. **Starting** sprays used can explode in **intake** manifold. This may cause **badly** injury **and equipment damage**

Always ventilate the generator room by providing **sufficient** air flow.

If there is an accumulator **boost** charger **regulator** in the system, first **of all** separate accumulator **boost charger regulator** while **connecting** or **disconnecting** accumulator lead terminals.

First connect plus (+) and then minus (-) lead terminal while **connecting** the accumulator lead terminals in case of maintenance and repair **reasons**. Apply the reverse procedure while **disconnecting**.

Never allow occasions causing a spark and/or smoking which may cause combustion surrounding the fuel.

Avoid from the fuel supply while the generator is operating.

Do not operate the generator if there is a fuel **leakage** in the engine fuel system.

Do not attempt to repair damaged fuel tanks or those requiring repair with **arc welding** or similar methods while they are on the generator set and/or generator room.

Store used oil and fuel suction cloths, oils and fuel filters in a safe place. Oil **and** fuel clothes or cotton wastes may **cause** fire by themselves in some environments.

Accumulator compartments boxes are manufactured in a safe way. Do not allow any occasion which may cause bare flame or electric arc near the accumulators. Hydrogen gas emitted from the accumulators may cause very serious injuries since it is so combustive and inflammable. Never **disconnect** lead terminals, impact on and bend over them while the engine is **starting** or operating.

Never put combustive and inflammable materials surrounding of exhaust manifold and pipes.

Do not operate the generator in dangerous areas where explosive and combustive chemical substances exist.

Always install spark arrester on the outlet of exhaust pipe in generators to be operated in forested lands. Prevent contact of leaves and branches with exhaust pipe.

Have sufficient amount of **fulfilled** fire **extinguisher** present near to the generator.

1.4. MOVING COMPONENTS AND IRRITATING MATERIALS

As a general maintenance rule; ensure diesel engine is on STOP state or its covers are installed on it. Never operate engines **without protection guard** which are disassembled except the case that exceptional maintenance and settings must be performed. Coming close to an operating engine is a safety risk. Remember wide and loose clothes, long hairs may cause serious accidents by being put on rotating components. Putting tools or equipments down on operating engine due to incaution may lead to serious injuries in case of close contact to the engine. Avoid from touching with operating engine exhaust system, turbocharger compressed air pipes, hot oil, water and just stopped engine. Install materials for safety and protection purpose disassembled during the service on their places before **starting** the engine.

Never **start** the engine when its air filter is removed. Operating engine **without air filter** may cause serious personal injury and damage in turbocharger and in engine.

Avoid contact fuels, oils, cooling water and accumulator electrolyte used in the engine with your **bare** body. Wear **protection** gloves and oil proof clothes while engaging with these works. Oils, especially used oils **influence under the skin and so** may lead to irritation and eczema on skin. Thoroughly wash you skin after contact with oil and use protective creams. Always use face mask and acid proof clothes while **working** with the accumulator.

Never open the radiator cover or taps while the engine is **still** hot. Steam or hot water may splash around and so the system pressure declines. Ensure the pressure decline by slowly losing and opening the radiator cover. Keep you in safety while opening it by considering the direction steam or splash.

Hot oils may cause burns. Do not touch hot oil, your skin may burn. Ensure there is no pressure in the system before starting to work while operating with the lubrication system. Never start the engine while the engine oil filter is **removed**.

1.5. EXHAUST GASES

Breathing exhaust gases is toxic and dangerous. Operate the generator on OPEN air or in environments with a good air circulation.

Take attention that exhaust gas outlet points do not **exhaust** to human **living** areas or near to air intake channels.

Do not operate the generator in the exhaust system having gas **leakage**.

1.6. NOISE

Noise level in generators without **canopy** is higher than 100 dbA. Exposure to this noise for long time negatively affects human health and may cause hearing loss.

Always wear ear protector, if you will wait near to the generator for a long time.

1.7. ELECTRICITY

Have **your generator set be installed** and service **by well qualified specialist** electricians or technical services trained in this issue.

Have the generator grounded and measure grounding resistance to see whether the grounding is sufficient including the generators with trailers.

Avoid from operating the generator in watery and wet surface places. Make electric connections by getting on wooden or similar isolated materials to prevent electric shocks, if the ground is wet on the area where the generator is **to be installed**.

Avoid from cables or terminals having **live** electric current. Prevent contact terminals with body.

Stop the engine while disassembling load connection of the generator and **disconnecting** accumulator negative lead terminal while disassembling load connection of the generator.

Close connector **covers of** electrical connections before **starting** the generator after load connection.

Apply the generator on appropriate loads and electricity system according to the power **output** of generator and load characteristic.

Ensure that all electric equipments are dry and clean by protecting them from moisture. Replace carbonized, discolored and worn connection equipments.

Isolate all connections and edges of out of work cables. Separate them from live lines.

Make connections in accordance with internal installation regulations issued on this subject while connecting the generator to loads.

1.8. ELECTRIC SHOCK AND FIRST AID

1.8.1. WHAT IS FIRST AID?

In the event of an accident or life-threatening situation, the treatment without medicines is called first aid until the assistance of the medical staff is provided, in order to prevent life from getting worse or worse.

FIRST AID APPLICATION IS ABSOLUTELY NOT USED.

1.8.2. WHAT IS THE PURPOSE IN FIRST AID?

1. Protection and maintenance of life
2. Prevent deterioration of the situation
3. Facilitate the healing process

1.8.3. WHAT ARE THE FEATURES AND RESPONSIBILITIES OF THE FIRST AIDER?

- He must be calm and unhurried.
- Keep the patient calm.
- Determine whether there is a danger that evaluates the environment.

- Do not endanger the safety of his / her life.
- Organize the people in charge to inform health institutions, fire and security.
- Evaluate the condition of the patient and begin appropriate first aid.
- Ensure that the patient arrives at the health facility as soon as possible.

1.8.4. What are the basics of First Aid?

- Opening of the breathing passage
- Correcting the respiratory system.
- Ensuring activity of the circulatory system

1.8.5. First Aid In Electric Shock

- First ensure your own (first-aider) safety.
- Turn off the source of electricity, if possible.
- If not, move the source away from you and the person, using a dry, nonconducting object like plastic or wood.
- Begin CPR if the person shows no signs of circulation, such as breathing, coughing or movement.
- Apply a bandage. Cover any burned areas with a sterile gauze bandage,

1.8.6. First Aid for Carbon Monoxide Poisoning

- The patient is immediately moved to fresh air.
- Deep breathing is carried out in the fresh air.
- CRP is applied to patients who are unable to breathe or breathe.
- Cover the top of the body to prevent the patient from chilling.
- The patient shall be sent to the health center immediately

1.8.7. First Aid for Bleeding

- If the wound is on the arm or leg, raise limb above the heart, if possible, to help slow bleeding.
- Apply direct pressure on the cut or wound with a clean cloth, tissue, or piece of gauze until bleeding stops.
- Apply a tourniquet if the bleeding is severe and not stopped with direct pressure in 5 minutes.

1.8.8. First Aid for Minor Burnings

- **Cool the burn.** Hold the burned area under cool (not cold) running water or apply a cool, wet compress until the pain eases.
- Remove rings or other tight items from the burned area.
- Don't break blisters.
- **Bandage the burn.** Cover the burn with a sterile gauze bandage (not fluffy cotton)

2. PART: GENERATOR SET AND COMPONENTS

GENPOWER generators have been produced by using worldwide accepted diesel engines and alternators in international standards.

Each generator has a group identification plate. Serial number, qualifications, weights and manufacturing date of generators are written on this group plate. Use this serial number in spare parts, repair claims, interviews and at your demands.

Main components of the generator set are indicated below:

2.1. DIESEL ENGINE

Industrial type diesel engines produced for the generator complying with ISO 8528, ISO 3046 Standards and worldwide accepted are used in the generators.

In addition 4-cycle mechanic and electronic governor **controlled** engines, electronic control module (EDC, EMS series) engines produced with state-of-the art technology are also have sensitive speed regulation, low fuel consumption and water cooler.

Genpower Generator uses the original equipment installed by the producer firm in all engines it uses. **There is no** part added in any engine later **on**. Thus, maximum performance is provided in engines. Engines used have been designed according to heavy operating conditions and equipped with replaceable filters. All equipments to ensure a safe operation in diesel engine are provided with the generator.

Diesel engine electric system is with negative (-) chassis and 12 or 24 D.C. This system is composed of starter motor, battery charger alternator and accumulator rub. Ragged accumulators with one or two units of lead-calcium acid according to the operating tension are provided with the generator set.

Diesel engine cooling system is water cooled and composed of one radiator, one radiator cooling fan, one circulation pump and thermostat.

Detail information **regarding the** engines with electronic control module is extensively given in following **sections**. Moreover, original engine operating and maintenance-repair books are provided with the generator. You can find more detail information in these books.

2.2. ALTERNATOR

The alternators have been produced according to CEI EN 60034-1; VDE O530; BS 4999-5000; NEMA MG1.22; NF 51-100,111; OVE M-10 Standards and CE norms **are used** in GENPOWER GENERATOR gensets.

Alternators have bedding system which does not require maintenance. The other important specifications are IP-23 protection class, internally **cooling, brushless type, self excitation**, sensitive **output voltage** regulation, low harmonic distortion, and **high efficiency** alternators. They have been designed in a way to operate without problem for long time.

2.3. FUEL TANK AND CHASSIS

Fuel tank of generators with 880 kVA and less than has been designed to be integrated in the main chassis bed. Fuel tanks of those having greater power are provided with the generator as external type. As a design of fuel tank, it has fuel supply depot cap that provides air circulation, suction and return fuel lines connections, mechanical type analogue fuel level gage, fuel and accumulated water drain plugs. Chassis has been produced from ST 37-2, ST 37-3 steel sheet with high resistance by making chassis stress calculations.

2.4. VIBRATION WEDGES

Vibration wedges are used to prevent vibration passing on the ground by decreasing the engine vibration. Vibration wedges are selected according to weight of the machine and expansion estimations and placed between engine, alternator connection settings and chassis. Engine and alternator are connected to the chassis rigidly, and vibration wedges are placed between the chassis and ground in some models according to instruction of the engine producer firms.

2.5. CONTROL AND TRANSFER BOARDS

There are automatic, manual, back-up dual and synchronization boards to operate the generator safely and fit to purpose, and to protect the engine and alternator.

Transfer process in automatic generators is made in the control board up to 94 kVA and with external transfer board in generators with greater **output** power.

Thermic Magnetic Circuit Breakers are available on manual generators to put the engine into operation **without waiting heating period and also** to protect the alternator.

2.6. SILENCER AND EXHAUST SYSTEM

Silencer and exhaust system decrease the noise emerging from the engine and provide safe exhausting the carbon gases.

Exhaust silencer is provided together with OPEN type generators for assembly. Silencer is provided as assembled in the canopy with cabin type generators.

3. PART: ROOM DIMENTIONS AND INSTALLATION

3.1. INTRODUCTION

The location on which the generator will be installed is the most important stage of installation process to ensure the generator set operating properly and safely. Take and implement safety measures mentioned in the first part to perform a safe installation.

Install the generator set on locations which can protect the set from factors like rain, snow, hail, storm water, excessive moisture, direct sun light, excessive cold or hot weather **conditions**.

Install the generator set on locations which can provide protection against abrasive materials and hazardous materials providing conductivity like exhaust smoke, steam, oil steam, dust, mohair, thread.

Ensure room entrance is large enough for avoiding any problem when the generator is **moved** in and **moved** out when required.

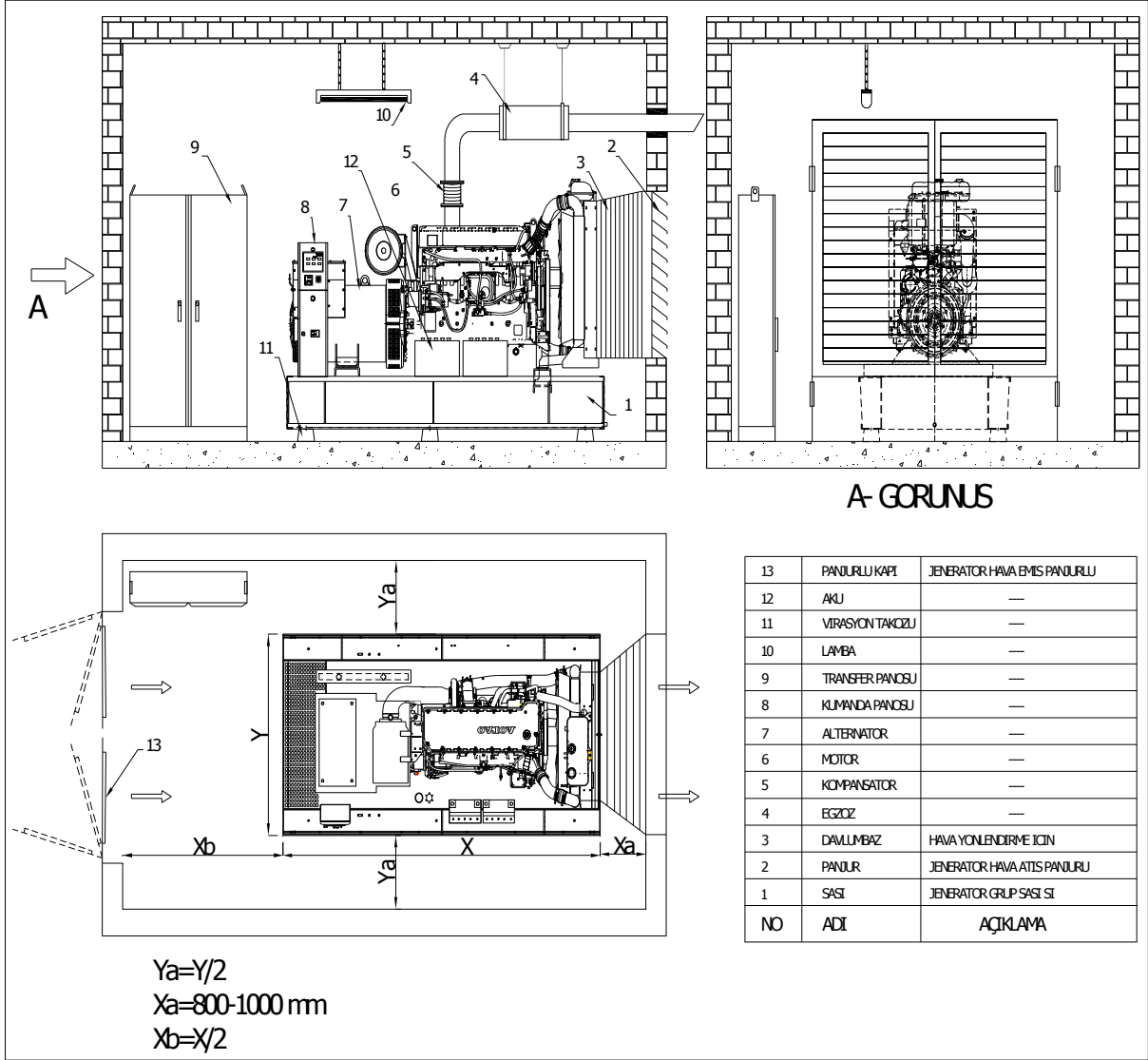
Equip the generator room with enough lighting lamps and electric outlets.

If the generator will be installed outside, it should be placed in a **canopy**, container or in room. **Canopy** can be selected optionally as sound **proof** or protection canopy.

Sound declining boards can be used especially in areas close to residence areas in order to decrease mechanic and exhaust noises coming from the engine and alternator.

Do not install the generator set on areas which may cause danger.

Assemble the fire extinguisher on a proper location on the generator set that it can be easily seen and **handle to fight against the fire on time**.



3.2. GROUND AND PLATFORM

A special base concrete is not required. A flat ground which can carry wet weight of the generator is adequate.

Vacuum conic wedges which will be placed between the generator chassis and ground and decrease transfer to the ground by absorbing vibrations occurred in the generator are provided **together with** the generator as standard. Mount these vibration wedges while placing the generator on ground **base**.

It is recommended to rise the generator set from the ground in wet ground places having the risk of flowage or in places like heating boilers rooms. Platform to be constructed for this should be suitable with **dimensions** of the generator and 300 mm higher from the surface. By this way, a dry ground can be provided for operating and maintaining the generator safely.

Wet weight and **dimensions** of the generator must be known to carry out concrete base. (check **the catalogue specified for your genset model**) Carrying capacity of base concrete should be strengthened with mat irons. Concrete debt is calculated with the following formula.

$$FD = \frac{W}{D \times B \times L}$$

FD : Foundation Debt (m)

W :Wet Weight of the Generator (kg)
D :Concrete density (kg/m²)
B :Foundation Width (m)
L :Foundation length (m)

Note: Take 300 mm wider than generator **dimensions** for foundation width and length.

CAUTION! : Improper or weak base concretes may cause undesired vibrations.

If the generator will be **installed** on the building’s roof, special attention should be taken for vibration isolation. We recommend use of helix arc type vibration isolators in such cases. Please contact with our **company** for more detail information.

3.3. VENTILATION OF GENERATOR ROOM

The main principle is to put out hot air produced by generator groups with radiator integrated to the engine in minimum level and to provide circulation by drawing required surrounding air.

The generator group should be installed in a proper way by taking into account the distance between the generator group and walls as seen in following Figure : A. The aim is to draw cool air from the possible lowest section of the generator room’s walls and push towards the radiator and then put out from generator room.

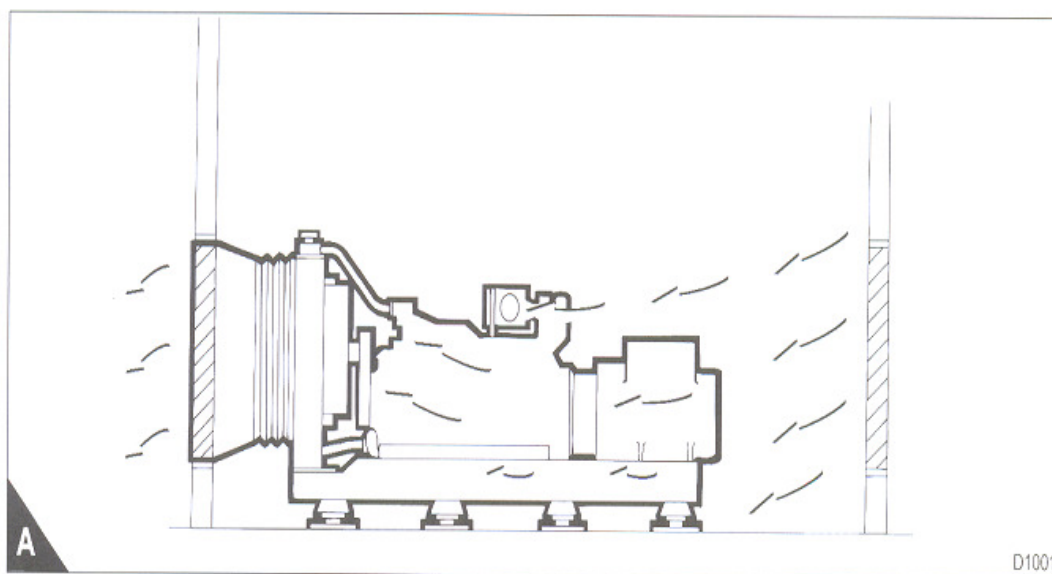


Figure-A

In case the radiator is assembled improperly, namely so close to the wall, some **volume** of hot air will hit the walls and **so will recirculate back into the room and radiator**. It must be put out of the radiator, **pushing out by engine fan**. **This will lead to insufficient cooling and could result in overheating problems.** The outlet opening in the wall should have a free flow area about 25% larger than the frontal area of the radiator matrix and be a of the same rectangular shape.

A sheet metal, air proof canvas or plastic duct should be fixed to between opening frame and radiator using a flexible connection to the radiator duct flange. Flexible duct is especially required if the generator is installed on the ground surface with vacuum wedges.

Likewise, radiator air intake side window should be 25% larger than the surface area of cooling radiator matrix and be the same rectangular shape.

A good example indicates this, is in the following Figure: B. For a radiator matrix frontal area of 1.44 m² the air outlet /inlet opening in the wall should have an area of 1.80 m², of a grille is fitted then opening should be increased to give 2.25 m².

The inlet and outlet openings should usually be fitted with a mesh grille, louvers, noise attenuating panels or inside outside ducting to close the air gaps. The louvers may be fixed or collapsible type. Collapsible types can be automated in such a way to automatically start up opening when the generator starts and close when the generator stops. Moving louvers opened and closed manually are suitable for manual generators, but should never be used in automatic generators.

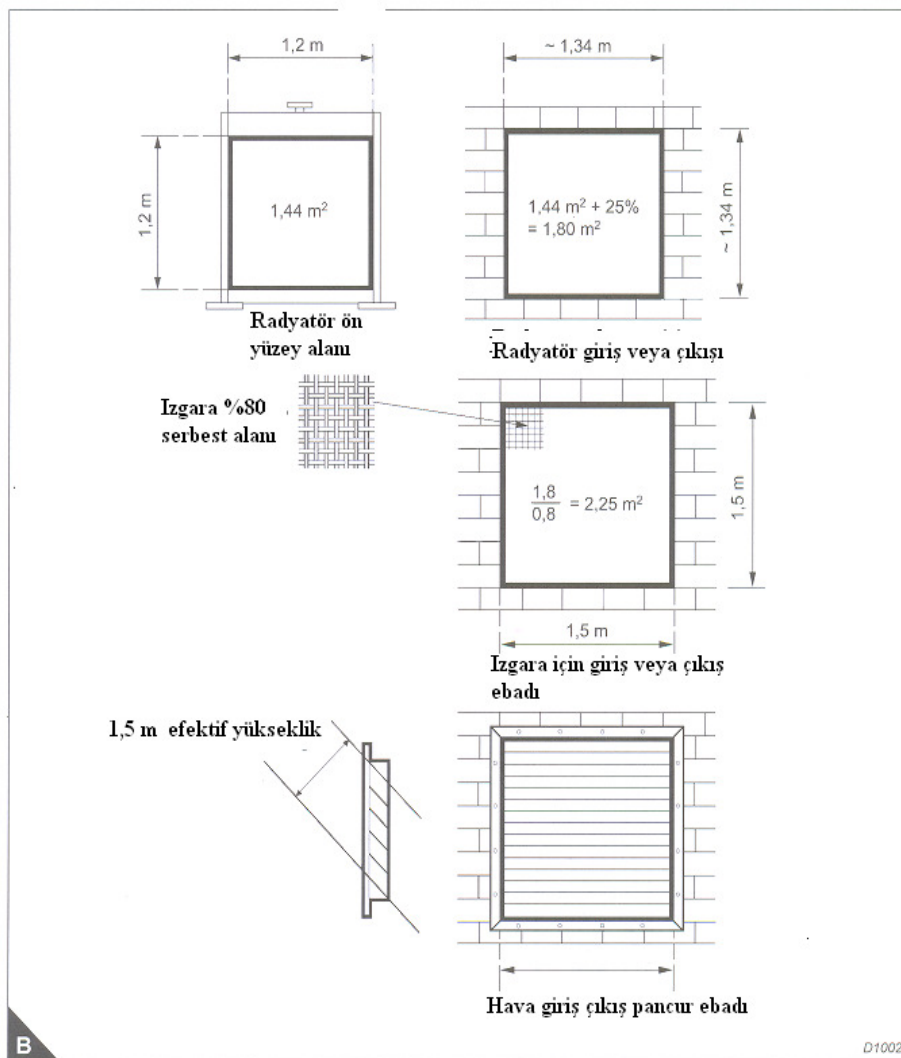


Figure-B

Radiator front surface area

Inlet or outlet size for Grille

Radiator inlet or outlet

1.5 m effective height

Grille 80% free area

Air inlet outlet louver size *****

Cooling air, required for the alternator, can be provided by drawing the environment air through air intake and outlet grilles of alternator. By this way, hot air occurred both on engine and alternator including the room temperature is drawn by fan and discharged to atmosphere through the radiator and outlet window.

Even though air intake window is preferred to be opened on lower part of wall, but sometimes it may not be possible. The over-wall type air ventilation systems, some amount of heat are accumulated at the top of room due to the heat radiated from engine and environment.

In such a case, raise of internal heat in the generator room is unavoidable. For this aim, filter suction air temperature is controlled and so load is decreased or started to be taken into account as derating.

If hot air discharged through the radiator cannot be put out directly, air ducting deflectors should be constructed in the duct to put out the heat atmosphere. Figure 4.3.1.

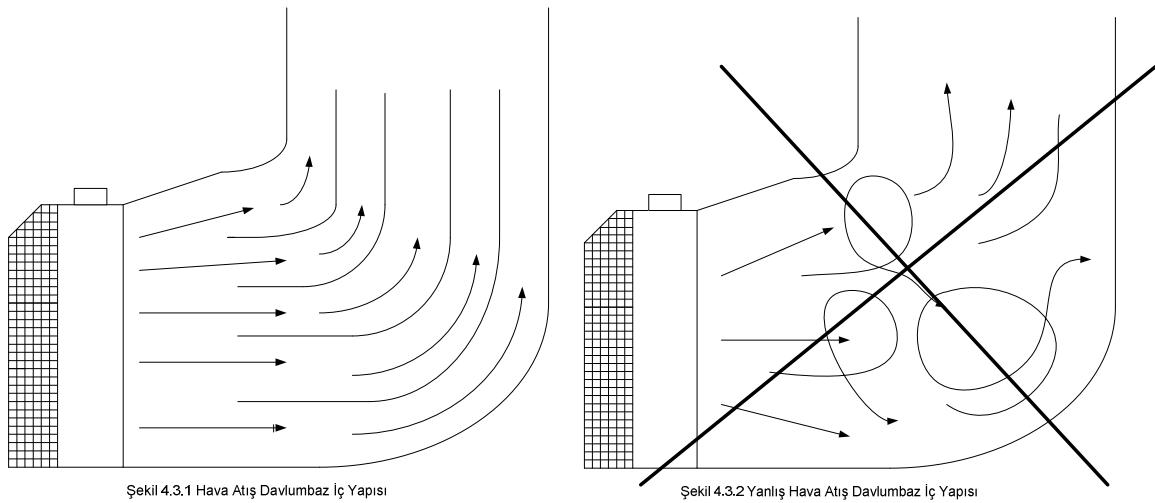


Figure 4.3.1 Internal Structure of Air **Duct**

Figure 4.3.2 Internal Structure of Incorrect Air **Duct**

3.4. EXHAUST SYSTEM

First function of the exhaust system is to put out exhaust gases coming in manifold to the external atmosphere from the engine and generator on a controlled sound level.

In case exhaust gas is put out by declining below a certain limit in a way preventing it to display any resistance to put out exhaust gas of the engine, the engine will give optimum performance.

Exhaust gas back pressure of the total exhaust system should not exceed recommended level in the engine exhaust outlet flange at start.

Excessive exhaust **back** pressure will cause complete weakness in the engine combustion chamber and internal wall of cylinder. As a result of this, it will cause power loose in the engine, high exhaust temperature and **carbon** soot **residual** formation in combustion chamber and exhaust pipes. If oily soot formation occurs, it will damage turbo charge turbine. This oily soot turns into hardened carbon deposits in time by accumulating on turbine hubcaps. Therefore, this causes problem by creating imbalance in turbo **charger** turbine **rotor** rotations.

Exhaust system assembly should be planned out of normal assembly. Main purpose should be as follows:

- Ensuring **back** pressure of the whole system below maximum limit. Ensuring discharge of gas from the lowest possible distance and by using minimum number of **elbow**. If more than one **elbow** will be used, **elbow inside** diameter should be taken greater than 50%.
- Supporting exhaust outlet **elbow** and turbo charge by suspending them in a way carrying their weight.
- Taking thermal expansion and contraction into account.
- Providing required flexibility by mounting compensator on exhaust outlet of the engine.
- Decreasing exhaust noise.

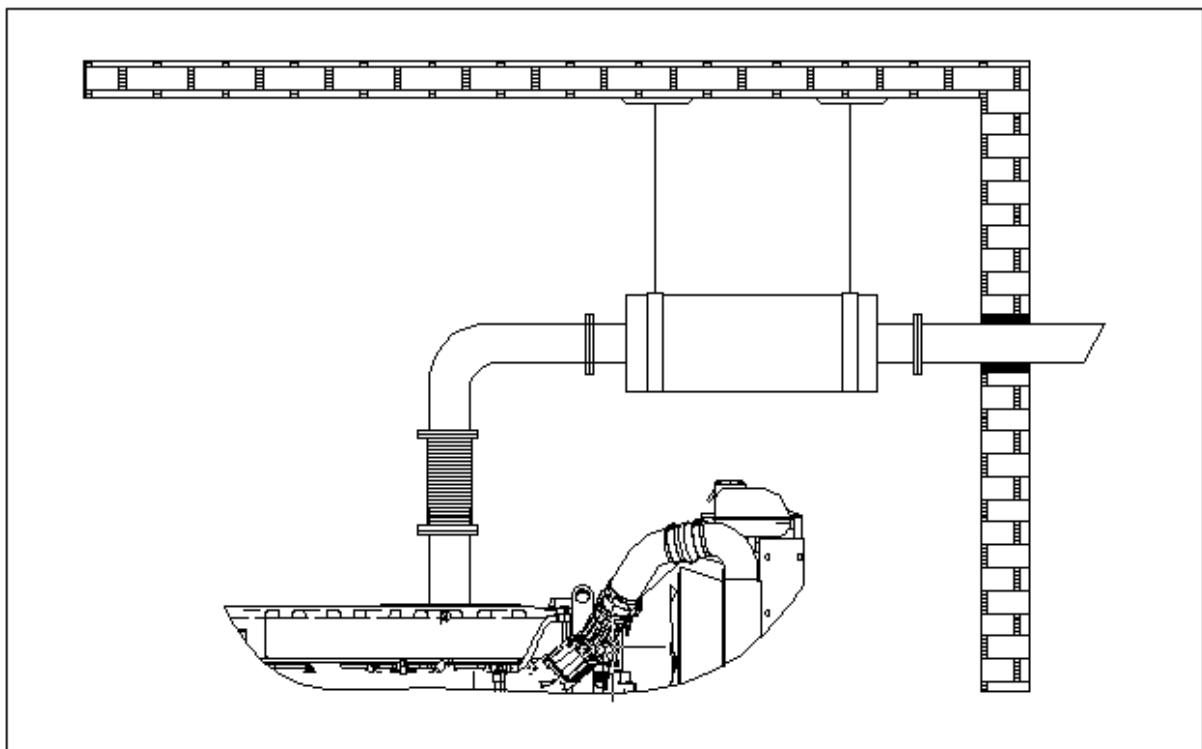
Turbo charger can only support small weights if exhaust crank is directly connected to turbo outlet and not supported from the engine. This matter implies that exhaust system should not be supported from exhaust crank. Supporting may be carried out from another suitable point on the generator group according to conditions.

If the engine is on anti-vibration wedges or a similar arrangement, a sideway motion will occur on the engine exhaust outlet crank flange when the engine starts or stops. Outlet flange can be assembled on its side if a flexible exhaust pipe is possible in practice.

If there is a possibility of quaking or moving back and forth between the engine and exhaust system, flexible connection should be possibly assembled on a location closest to the engine.

Similarly there will be a motion on the exhaust pipe due to the heat expansion. Using expansion quenching blowers (compensators) made of stainless steel is a method for damping the problem caused by expansion.

Actually damping blowers only take over deformations parallel to horizontal axis. Recommended application is connecting two separate short blowers between 250-400 mm on a straight exhaust pipe. By this way, angular motion caused by expansion will be decreased through absorbing by each blower.



It is recommended to make heat isolation in the exhaust system to decline heat spreading from the exhaust system to the generator room. Similarly, exhaust heat isolation to be made contribute to decrease engine noise level to some extent. (Figure 4.6)



It is recommended to isolate the exhaust system in order to eliminate any negative situation to be caused by fuel leaks to occur as a result of crack on the fuel pipe.

Floating clamps can be used in isolations made on locations where pipe flanges or flexible compensators exist. These floating clamps or pipe collets should be easily installed in a way not preventing the function of exhaust flexible piping system.

Caution! : Never isolate exhaust manifolds and turbo charges. If they are isolated, breakdown may occur due to inefficient operation in the engine and thermal stress emerged in the components.

Exhaust gas should be prevented from reentering through the engine air suction in the exhaust gas discharge and fresh air absorption circulation of the engine. re-circulation of exhaust gases causes decline in amount of oxygen which will realize burning in fresh air to enter in the engine and blockage in air filter due to soot in the exhaust gas in a short time.

Exhaust discharge pipes should be assembled on a location in a way to passing out from the same wall the radiator is mounted. Rain covers (cocks) are used in the horizontal assembly in order to prevent contamination and water droplets condensed on air to enter through the exhaust pipe or it is cut from lower section in the form of dovetail, throwing tail. Similarly, throwing tail should be turned towards a less important direction.

Water droplets are formed as a result of condensation due to a long period of operating in the exhaust pipe and this water enters in the engine. A discharge arrangement should be added on the lowest level of the piping to take water which may be accumulated with the aim of protection. Otherwise, corrosion or hydraulic locking may occur in the engine.

A simple hole can be made from the lowest level for water discharge or water can be discharged with a drain tube or can be accumulated in a container and then discharged in maintenance periods. This hole or drain should be opened on a suitable place in a way not leaking exhaust backward.

A damping or expansion silencer normally decreases the noise of exhaust gases. Noise decliner performance to be well obtained in the silencer installation can be ensured by avoiding from assembling it on the middle of piping system. If possible, the best assembly place for a silencer is made in a way falling to the 2/3 of the length of piping.

3.5. FUEL DISCHARGE SYSTEM

Caution! : Apply safety measures mentioned in Part 1 in locations containing fuel.

The generator engines require the use of modern high pressure and considerably clean fuels for a safe and proper operation. Fuel system should continuously provide fuel for the engine. In case fuel in determined nature is not used following circumstances will unavoidably occur: difficulty in starting, weak combustion occurrence, soot in injectors and combustion chambers, decrease in lifetime of the fuel system and filters, decrease in economical lifetime of the engine and void of warranty of the engine.

Genpower Generator recommends the use of ASTM or 2. 0 diesel fuel.

Viscosity: Recommended viscosity is 1.3 - 5.8

Cetane Number: 40 above 0 C, 45 below 0 C

Number of Sulphure: should not exceed 0.5% volume.

Water and Sediment: should not exceed 0.05% volume.

Density: Between 0.816 and 0.876 g/cc

Ash: should not exceed 0.02% volume.

Acid Amount: Should not exceed 0.1 MgKOH for each 100 ml.

High amount of Ash (Mineral residue amount in the fuel) causes oxidation in cylinders and injector.

Low cetane number causes difficulty in operation of the engine.

In case of a high amount of sulphure in fuel, sulphure residues turn into sulphuric acid during combustion, and this creates a danger and causes excessive wear.

Inappropriate viscosity causes excessive fuming combustion in the engine and decrease in power.

Fuel tank should be higher than the engine injector level especially in high **range output** power engines (800 kVA and above) which are fed with external fuel tank. **In case of fuel tank installation is over level of injectors' level, necessary** measures to prevent **flowing** of fuel should be taken **into consideration** while the engine is not **running**. Fuel on high temperatures returning **from injector bypass pipe** should be cooled down in a way not exceeding 55 ° C before **flowing** back to daily fuel tank. **Fuel system feeding pipe should have sufficient diameter to meet the engine's fuel consumption.** Fuel **bypass pipe diameter** should be smaller than the feeding pipe diameter.

Avoid from using plastic and other inappropriate materials including galvanized pipes and records in the generator fuel system piping work.

Pressure decline in filters, installation elements and valves should be taken into account while sizing the fuel pipe piping installation. Fuel pipes should be connected on the connection point to the pipes with flexible fuel hoses. Otherwise, cracks and leakages will occur in pipes in case of directly connected piping due to the generator vibration. Do not conduct fuel pipes from locations where hot water pipes, electric cables exist and keep them away from the exhaust system.

Isolate fuel pipes by taking weather conditions into account. External type fuel tank may be embedded in some cases in a way remaining below icing level of soil. Fuel can be prevented from freezing by this way.

Never use Teflon band type materials in the fuel line piping and component assembly processes. These bands may cause blockage in pumps and injectors by **entering** to the engine fuel system.

Caution! : Never connect the fuel return line to the fuel feeding line. Always ensure it returning to the fuel tank.

Automatic filling system is performed optionally. Automatic fuel filling can be performed with magnetic electronic level **float** system on daily fuel tank and **also gear type electrically** or **manually operated** pumps **for** providing fuel transfer. Please contact with your sale representative for more detail information.

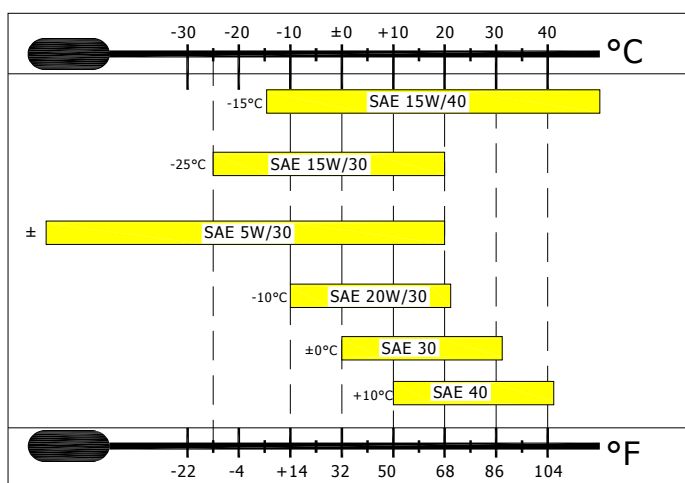
Fuel Pipe Recommendations according to Generator Power Ranges				
Generator Standby Power (kVA)	Maximum Length of Fuel Pipe (m)	Maximum Vertical Height (m)	Maximum Number of Fittings Components (m)	Recommended Pipe Diameter mm (inch)
40–700	6	1	6	25.4 (1")
800–1385	6	1	6	38 (1 1/2")
1401–2264	6	1	6	50.8 (2")

3.6. LUBRICATION

Lubrication system of diesel engines is one of the most important components of the generator set. Correct oil selection, oil and filter replacement periods will improve the performance and so increase the lifetime of the engine.

The American Petroleum Institute (API), The American Society of testing and materials (ASTM) and Society of automotive engineers (SAE) have collectively developed a system for classification and performance categories of lubrication oils and this system has been preserved.

If the operating environment temperature of engines is above **-15** degree, the oil required to be used is **15W/40** and it meets minimum the features of API CG–14.



In case sulphure ratio in the oil is lesser than 0.2%, engine oil should be replaced in every 500 operating hours. Oils containing greater amount of sulphure than stated percentage ratio, decrease the **interval** period of oil replacements. When API CF, CF–4, CG–4 type oils are used, oil replacement **interval** periods should not exceed 200 hours. If VDS, VDS–2, ACEA, E3 are used, oil replacement periods increase up to 400 hours.

Oil levels of **engines in services** should be checked in certain periods.

3.7. COOLING AGENTS

3.7.1. Cooling Agent Mixture

Appropriate Water – Antifreeze (Ethylene Glycol) mixture ratio approved to use in diesel engines is 50% ethylene-glycol and 50% clean soft water. Antifreeze should have features of ASTM D5345 or ASTM D4985. freezing point of 50% ratio antifreeze mixture is **-35 ° C** protection (freezing) degree of antifreeze used in pole conditions and composed of 60% ethylene glycol and 40% soft clean water mixture is **-40 ° C**.

Protection degree of an antifreeze composed of propylene glycol as an alternative chemical in case of mixing with water in 50% ratio is **-29 ° C**.

Caution: Mixtures containing menthol are not appropriate.

If antifreeze cannot be provided and ambient temperature is not expected to decline below + 10 ° C, 1 liter corrosion inhibitor in 1% ratio (0.5 liter) can be used by mixing with clean soft water. For example, a mixture can be obtained by mixing 50 liter of water with half (0.5) liter inhibitor. This substance should be used in accordance with written instructions of the manufacturer.

3.7.2. Water Quality

Clean soft water means water purified from its ions, purified water, rain water or water supplied from a resource and meeting following features.

Chlorines maximum -40 mg/liter, Sulphates maximum -100mg/ liter, total hardness maximum 170 mg/liter, Total solids maximum 340 mg/ liter and PH value between 5.5 and 9.0.

If soft water is not used, the engine may overheat due to **hard** deposit sediments to occur in the cooling system. This matter is especially important for the engines on which water is added frequently.

Caution: Unapproved products may cause serious problems for the cooling system. In case the ratio of corrosion protective inhibitor to be added in the cooling system is insufficient, it causes erosion (wear) and corrosion occurrence in the cooling system.

3.8. BATTERY

Main function of the accumulator on the generator are to provide electric current required for the starter motor during the first operation, to provide energy required in case energy necessity is not provided by the **charger** alternator and to protect the D.C. electric system by playing voltage regulating role in the system of the generator.

CHARGE STATUS	DENSITY	VOLTAGE (DC)
%100	1.28	12.72
%75	1.24	12.45
%50	1.20	12.24
%25	1.17	12.06
DISCHARGED	1.14	11.89

Accumulator must be definitely charged when the accumulator voltage decreased to 12.45V.

Charge process should be equal to one twenty (1 / 20) of the accumulator capacity. Up to one-twenty five (1/25) is allowed for 135 A/h or above capacities. Charging with high power decreases lifetime of the accumulator. For this reason, with low current and long period charge should be preferred. It will be beneficial to avoid from boost charging with high ampere in a short period, as far as possible.

Mains circuit feeded type battery charger regulators ensure the battery remaining always on charge in the automatic generator systems.

The partially charged batteries performance for starting an engine is a little possibility in the very cold temperatures environments. Because, power which should be consumed to drive the engine also increases in cold weathers. Partially charged batteries encounter with another danger especially in winter. Specific density of electrolyte will decline and approach to the freezing point of water during discharge. This will increase the risk of freezing in electrolyte.

CHARGE STATUS OF ACCUMULATOR	ELECTROLYTE DENSITY. (27C)	FREEZING POINT (° C)
%100	1.28 gr/cm ³	-70
%75	1.24 gr/cm ³	-45
%50	1.20 gr/cm ³	-25
%25	1.17 gr/cm ³	-15
DISCHARGE	1.14 gr/cm ³	-7,2

3.9.ELECTRIC CONNECTIONS

Have electric connections of the generator set connected by qualified and trained persons. We recommend you to use our authorized services for these works.

All electric connections should be made according to given projects. International standards and rules should be complied while making electric connections.

Energy cables operating tension of the generator set should be calculated according to complete load current and withdrawal form. Current carrying capacity of cables is indicated in relevant table.

Flexible cables should be used in the generator set connections by considering the vibration. Use of H07 RN-F type cable is appropriate for low tension (maximum 1000 V) composed of rubber covered flexible conductors. If the transfer board is located on distant segment, this system is probably expensive, so it should be used by mounting a terminal box on inter-location to make this more economical.

Cables will be laid among the generator set, transfer board and controller board in a way they are on possible shortest distances. If the transfer board is on a distant point, voltage drop estimation should be definitely conducted. Voltage drop is given in the following formula.

$$e = \frac{1,73 \times I \times L \times (R + X)}{100}$$

e: Voltage drop (Volt)

R: Resistance of Cable (ohm/km)

I: Line current (Ampere)

X: Reactance of cable (ohm/km)

L: Length of Line

Cross section (mm ²)	06/1 kV, NYY type Cable Current Capacity				
	On ground	On 25°C air	On 40°C air		
	Multiple stranded	Multiple stranded	Multiple stranded	Single stranded	HO7RN-F
2,5	36	25	22	25	21
4	46	34	30	33	28
6	58	44	38	42	36
10	77	60	53	57	50
16	100	80	7	76	67
25	130	105	94	101	88
35	155	130	114	123	110
50	185	160	138	155	138
70	230	200	176	191	170
95	275	245	212	228	205
120	315	285	248	267	245
150	355	325	283	305	271
185	400	370	322	347	310
240	465	435	400	-	-

Energy cable between recommended generator and energy cable between transfer board and/or load is given in table 4.15.

Cable Selection Table Recommended According to Generator Power in 40°C Ambient Temperature

Standby Power (kVA)	Maximum load current in 400 V (A)	Current Bearing capacity in 40°C weather (A)	For each phase PVC Isolated YVV (NYY) 0.6/1 kV (mm ²)	Standby Power (kVA)	Maximum load current in 400 V (A)	Current Bearing capacity in 40°C weather (A)	For each phase PVC Isolated YVV (NYY) 0.6/1 kV (mm ²)
10	14	25	2,5	358	517	534	2 X 120
15	22	33	4	400	578	610	2 X 150
22	32	42	6	412	595	610	2 X 150
30	43	57	10	450	650	801	3 X 120
33	48	57	10	500	723	801	3 X 120
45	65	76	16	506	731	801	3 X 120
66	95	123	35	550	795	915	3 X 150
80	116	123	35	559	808	915	3 X 150
88	127	135	50	630	910	1068	4 X 120
94	136	155	50	700	1012	1068	4 X 120
100	145	155	50	800	1156	1220	4 X 150
110	159	191	70	900	1301	1335	5 X 120
142	205	228	95	1125	1626	1735	5 X 185
150	217	228	95	1385	2001	2000	5 X 240
167	241	267	120	1500	2168	2400	6 X 240
200	289	305	150	1656	2393	2440	8 X 150
250	361	382	2 X 70	1875	2710	2800	7 X 240
275	397	456	2 X 95	2264	3272	3200	8 X 240
305	441	534	2 X 120				

Phase order direction should be determined in transfer board connections in the existing network connection before cutting power. After transfer board connections are completed, phase order should be rechecked before **transferring the energy** to the **loads in** installation.

Generator set and devices it will operate, control and transfer boards should be definitely grounded before putting the generator into operation. Grounding tension provides reference for the system tension. An improperly made grounding causes negative effects in the control and controller devices.

Caution! : Never operate the generator set before grounding.

Conductor Materials Grounding: Means connecting metal conductors on ground. Aim of this is to;

- Provide tension balance of the system due to the grounding.
- Decrease case of danger for human life.
- Ensure electronic controller and control devices to operate efficiently.
- Neutral point potential of the generator does not disorderly change as a reference.
- Tension between any phase and ground should not normally exceed phase voltage of the system.

Grounding is made with grounding electrolyte or plates.

3.10. GROUNDING ELECTRODE

Copper covered steel bars for hard surfaces and solid copper bars for normal surfaces. Grounding is provided by hammering one or more grounding electrodes on ground. It is generally preferred in small power or mobile generator systems.

3.10.1. GROUNDING PLATES

They are especially used in **stationary** type generators. It is made with galvanize covered copper plates. Use of more than one grounding plate is recommended in high power generators. Distance between plates should be at least in 20 m intervals in groundings made or to be made for different purposes.

3.10.2. GROUNDING LINE

Copper conductor with appropriate cross section used to make connection in grounding electrode. Grounding conductor should be properly selected according to standards and current bearing capacity. Connection of grounding conductor with grounding electrode or plate should be protected against possible defects. A proper grounding connection should have a low electric resistance on grounding point of lightening or leakage current. The best grounding resistance is between 1 ohm and 5 ohm. Resistance above 20 ohm will create danger and difference in potential. 15 mA and 50 Volt tension potential create danger for human health.

3.10.3. GROUNDING TERMINAL

Connecting the grounding line on a point determined on the generator set body. By this way, all components of the generator set will be grounded.

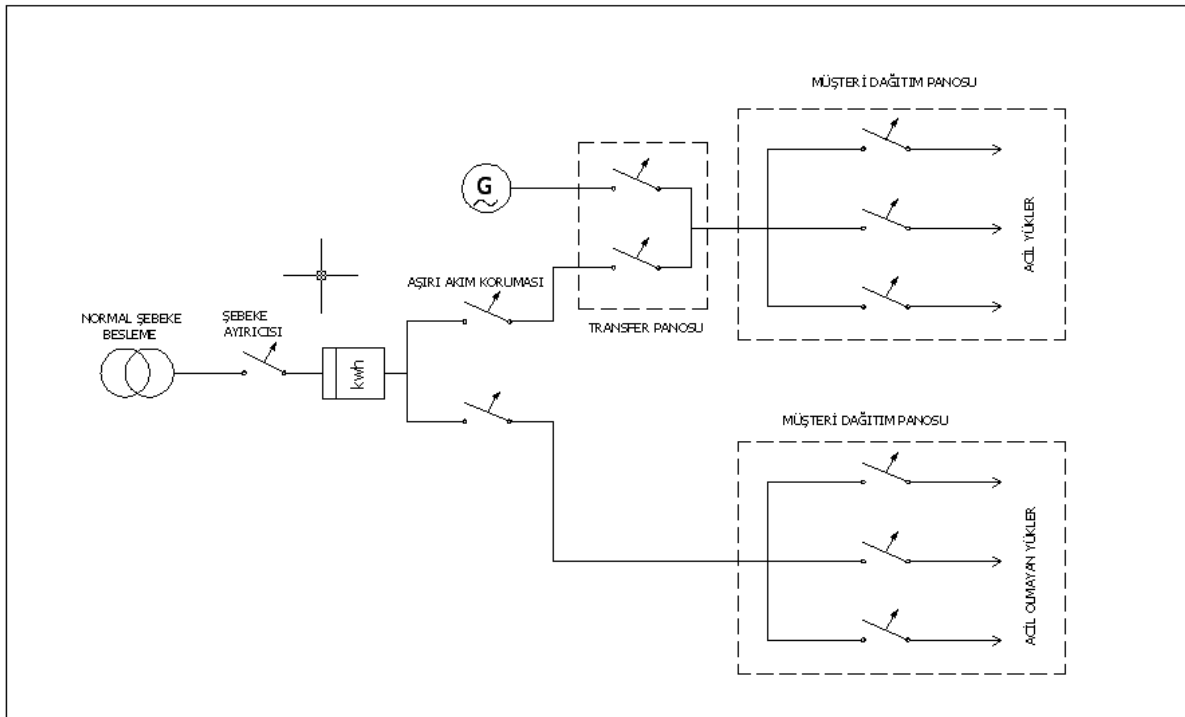
Caution! Never use devices without metal body grounding.

4. PART: CONTROL SYSTEMS

4.1. TRANSFER BOARDS

The **transfer** systems which **transfers mains** or generator energy **outputs** towards the loads and provide switching of them. Switching realizes transfer in appropriate circumstance by checking network and generator energy of the controller boards. Transfer system is realized with contactors or **motorized thermic magnetic circuit breakers (MCCB)** according to the power **consumption ranges**.

Power **range** of transfer boards should be on the minimum generator power according to power to be fed by the generator. As an example, a typical transfer board connection is as below. Loads to be fed by the generator on distribution board are classified as emergent and non-emergent loads. In some cases loads are not divided as emergent and non-emergent loads in distribution boards, and one-to-one loading is made in case of **mains** energy and partial loading is made in feeding with the generator. In such cases, contactor or MCCB used on the transfer board should be selected in accordance with the power of switch network power, since network power is greater than the power of generator.



If the transfer is made on the generator, 2 units of energy cables should be **laid** as network and load cables from the customer board.

If the transfer is made on external type board, take attention for following issues.

- Locate transfer board as closest as possible to the distribution board.
- The area where the transfer board will be placed should be a well ventilated, clean and dry environment free of moisture and damp.
- Ensure sufficient area remained for works around the transfer board.
- Never put foreign objects on the transfer boards.
- Lay rubber, oilcloth and similar materials providing isolation in front of transfer and distribution board.
- Use cable cross section appropriate with the generator and network power. (See part 4.10)
- **Connect** 8 X 2,5 mm² control cable between the transfer board and control board for control of **circuit breakers** used in the transfer board and for reference **voltage** tensions.
- Always ground transfer board.

4.2. CONTROL BOARDS

They manage processes of operating the generator set, checking engines and alternators and stopping the generator set in case of an alarm.

There are automatic and manual control boards. **All control processes of generator set are made with micro processor electronic control panels located on the control panel front door.**

4.2.1. AUTOMATIC CONTROL BOARDS

They are used for automatic transfer of the generator set and mains. They continuously monitor **mains** energy through the control panel. They deactivate the **mains** and put the generator set into operation in case **of mains cut** or goes beyond **the over and lower parameter set limits** or at least one phase is cut. They always monitor operation of the generator set and take **necessary** action in case of an alarm according to the importance of alarm. They stand by for the **next** mains cut by transferring load to the **mains** in case **mains** energy **returns** back and **comes up** in **the parameter set limits**.

4.3. OPERATING THE GENERATOR SET

Make the final general checking of the generator set which has been assembled in the framework of safety measures mentioned in previous sections.

- Check the engine oil and cooling liquid **levels**.
- Fill the fuel tank by complying with safety measures determined before.
- Check the accumulator charge. See maintenance section for more information.
- Remove any external objects out of necessity surrounding the generator if exist.
- Turn OFF the fuses (0) **position** in the board.
- If there is a switch on the load line, turn it OFF this switch (0) **position**.
- Deflate the fuel system with the hand primer located on the engine. See maintenance section for more information.
- First attach plus (+) and then minus (-) lead of the accumulator lead terminals.
- Turn fuses **OFF position** the board towards OPEN (1).
- If the emergency stops button is pressed **down for emergency or safety reasons**, open it by turning to the right.

- **At this condition** control panel will be energized.
- **Start the** generator by pressing **AUTO** or and **RUN** button.
- Check voltage and frequency of the generator. **Output voltage** should be 400 Volts, and frequency should be 50 Hz between phases. (If genset is mechanical governor controlled the Hz should be 51,5 – 52 Hz) .
- **After engine started**, check engine oil pressure and cooling liquid temperature.
- Check the phase order while the generator feeds the system. If it is not in the same direction with the **mains, exchange** two of the generator phase **to put** order and ensure them to be in the same direction with the mains
- Check the engine for oil, cooling liquid and fuel leakage.
- Stop the generator by pressing **OFF button** on the control panel in automatic models.
- If you required further information about control panel or programming the genset please visit our website or contact your sales representative.

5. PART: MAINTENANCE

General maintenance of the generator is described in this section. Please examine engine and alternator manuals provided with the generator set for more detail maintenance information due to the features of engines.

Always have authorized persons or authorized services maintained your generator set. Note that guarantee will be void in case of maintenance, repair and setting made by unauthorized services or persons.

Always use original spare parts in maintenance and repair. Never use non-original parts or those approved by Genpower in written form. Guarantee of the generator set will be void as a result of damages caused by non-original maintenance or repair parts.

Comply with safety measures mentioned in previous sections while performing the maintenance.

5.1. DAILY MAINTENANCE

Check the amount of cooling liquid in the radiator. Supplement if required. So not fill liquid in the radiator up to the duct, rather fill up to 2-2.5 cm below the upper tank. Indeed, leave some place for cooling liquid expanded in the radiator. Antifreeze must be definitely checked before cold weathers start and add required amount of antifreeze.

Check the amount of oil by pulling the **oil dipstick**. Oil level should be between two **marks present** on the **dipstick**. If it is lower than the normal level , add the same brand and viscosity oil to the engine from filling neck. Recheck the oil level after waiting for 15 minutes. Check out the oil pressure from the indicator on the board after the engine started. Control panel will give warning or stopping alarm if **oil pressure is under the manufacturer recommended pressure** limit. It should not be below recommended value.

Check the amount of fuel in the fuel tank to prevent it from **lowering than the level** which might cause air **entry-problem in to the fuel system**.

Visually check for oil, fuel and water leakage, if any.

5.2. INITIAL MAINTENANCE

Oil, oil filter and fuel filters are replaced in the first 50-hour or at the end of the first initial running-in maintenance. Check the air filter, clean and replace if required. Check all electronic connections. Check the engine for any oil, fuel and cooling liquid leakage. Check the hose clamps **and** belts in the cooling **system**.

5.3. MONTHLY OR "100" HOURS MAINTENANCE

Repeat all procedures applied in daily or 8 hours maintenance.

Apply **battery** maintenance.

Important note: Only pure **distilled** water is used in the battery. Never use acidic water. Water should be filled up to 1 cm above the plaques, should never be filled up to **battery cell neck**.

5.4. FOUR MONTHS OR "250" HOURS MAINTENANCE

Replace lubrication oil.

Replace oil, fuel and air filters.

Check driving belt for any break through or tensioning. **Re-adjust** its gap by tightening if required.

Check out fuel, lubrication and cooling system leakages.

Perform battery maintenance.

Check all electric connections **tightness**.

5.5. ONE YEAR OR "750" HOURS MAINTENANCE

Repeat all procedures applied in four months or "250" hours maintenance.

Check torque by tightening cylinder head **bolts** and nuts.

Check valve setting **clearance** and **adjust** required settings.

Discharge the water in the cooling system completely and install a new antifreeze.

Check oil pressure by starting the engine.

Check alternator and starter motor connections.

Check whether or not all displays **functioning** properly.

Remove injectors and reassemble after checking.

5.6. 250 - HOUR MAINTENANCE

Repeat all procedures in "750" hours maintenance.

Check injector and valve **clearance adjustment** settings **and is made adjustment if necessary**.

Check the cooling water system and **is completed whole** cleaning processes.

Check the starter and **battery** charger alternator.

Check and tighten assembly screws and nuts.

5.7. 2500 HOURS MAINTENANCE

Repeat all procedures in "1250" hours maintenance.

Replace **cooling liquid**, mixed **antifreeze + pure ,fresh cooling water**. Check for any leakage and connection components. Clean radiator cores, **fins** and **bleed any air accumulated in the system**.

Check the vibration **mounds** of **radiator**.

5.8. BATTERY MAINTENANCE

Comply with safety measures mentioned in previous sections while performing the **battery** maintenance.

Batteries used in the generator sets are lead-acid type **batteries** including a group of positive and negative electrode cells or plaques **dipped** in electrolyte (sulphuric acid).

Battery energy used is composed of chemical reaction occurred **between the** cells. This reaction has a recycling and the **battery** can be recharged and discharged **along the life of battery**.

Batteries used can be left on **static charge regulator is fed from mains** for a period of 4 years and then replaced.

Check the density of **battery** liquid with the battery hydrometer. The value measured in each cell should be about 1.28 in nominal temperature (in 20°C). (This is desired value in a 100% Charged **battery**)

Do not add **filtered** water in the battery, only add pure **distilled** water.

Keep the **battery** surface clean and always clean it to avoid from contamination. Remove the covers and add water in a way rising about 10 mm above from the plaques. Reinstall the covers. Dry the **battery** surface.

Check operating ambient temperature of the **battery** you use (approximately between -5 °C and +50 °C). **Battery** liquid may freeze in inappropriate temperatures and may fail to operate.

Oxidization occurs in **battery** lead terminals **by** time. Oxidation wears **battery** lead terminals and prevents charge. Remove the **battery cable** connections and clean oxidation with water, then reassemble connections and cover with lubricating grease and vaseline.

Put OFF the **battery line** fuses on the generator **control** board while **connecting** and **disconnecting battery** lead terminals **and also disconnect** the **static battery charge regulator**. First install **positive "+"** and then **negative "-"** lead terminal **cables of battery**.

Check tightness of the **battery** lead terminals, never **switch ON and turn the ignition switch to the start position** in case of a loose connection. Do not over tighten the terminals.

5.9. RADIATOR MAINTENANCE

Corrosion is the primary reason of breakdown in the **cooling** radiator. Always check the radiator hose connections for leakage.

Either discharge the radiator of a generator which will not be used for a long time or ensure that the radiator is protected. Fill the radiator with distilled or natural soft water or use by adding a certain amount of corrosion inhibitors into water.

Radiator in dusty or dirty environments cannot fulfill its task by blocking with contamination, engine steam, moisture, different particles, this causes decline in the engine performance. Low pressure steam should be used to remove deposits occurred in such cases. Or they should be removed by sinking in alkaline solution for 15-20 minutes and then cleaning with hot water.

Engine crankcase ventilation has an impact on blocking the radiators. This information has been explained in the crankcase ventilation section, please **read again**.

5.10. DISPOSAL OF MAINTENANCE ENVIRONMENTALLY HAZARDOUS WASTES

In the event of the risk of spreading of hazardous substances into the environment; the contaminated area should be cleaned with absorbent materials by cutting the liquid discharge as soon as possible. Contaminated absorbent materials, glands, filters and accumulators that occur during maintenance or for cleaning purposes must be collected in containers that will not leak and should be sent to licensed disposal companies.



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