generator

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ARKEN GENERATOR GENERAL MAINTENANCE & OPERATION MANUAL

PLEASE READ AND FOLLOW THE INSTRUCTIONS GIVEN IN THE GENERAL MAINTENANCE AND USER MANUAL BEFORE USING THE GENERATOR SET!

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Dear User,

We would like to thank you for choosing our company and our product.

Arken Generator operates in its modern facilities, providing safe and high quality products and services under ISO 9001 Quality Management System and CE standards. Your generator set is subject to quality control and testing in each phase of manufacturing-through assembly to delivery; and is manufactured environmental and people friendly in accordance with ISO 14001 and OHSAS 18001 Quality Systems.

Our documents are meticulously prepared with extensive academic background and 20 years of experience. General Maintenance & User Manual, Diesel Engine Maintenance and User Manual and Alternator Maintenance and User Manual including the danger, warning and safety measures have been delivered to you with your generator set. Before using your generator, we kindly request from you to read, understand and keep all documents carefully for your and others safety of life and property.

You can use your product economically while rendering a hassle free service by having the control and maintenance completely performed at regular intervals through signing Support Service Agreement.

We will continue to provide an uninterrupted service to you with our technical service teams that are ready at work for 7days - 24hours.

Please inform us about your requests and suggestions for you contribution to our product and service quality (info@arkenjenerator.com)

1 SAFETV MEASURES

1. GENERAL FRAMEWORI<

Generator set must be installed and used properly in acccordance with General Maintenance and Operation Manual, Diesel Engine Maintenance and Operation Manual and Alternator Maintenance and Operation Manual and safety precautions must be observed. Generator set shall only give a reliable service in this manner.

The people who install, use and perform maintenance procedure are responsible tor safe operation of the generator set. Observance of safety precautions will reduce the risk of accidents.

Generator set should be used by people who are trained or authorized in this regard and read and observed the General Maintenance and Operation Manual. Failure to comply with the rules, instructions , methods and safety precautions in this book may increase the possibilities of accidents and injuries , and even cause tor death.

Observe the label and instructions over the generator set; install and operate the generator set fully in accordance with the current standards, rules and regulations.

Before maintenance, repair and setting procedures switch the generator to OFF position (OFF) and isolate against interference by others.

Do not operate the generator set unless it is safe. in unsafe conditions, in order to prevent damage to other persons immediately attach a warning alert on the generator set, disconnect the batter y terminals and disconnect all cable connections for deactivation.

This book and the attachments are integrated. Safety measures are specified in relevant sections of the book. Please refer to the Arken Generator for incomprhensive issues.

WARNING

Carefully read the operation and maintenance manual. Improper use can lead to serious accidents and hazards.

2. LIFTINCi AND HANDLINCi

Use the lifting lugs ta remove the Generator Set.

Before lifting, be sure ta check the lifting lugs ar the junction points against welding cracks, ruptures, bending, pieces in which their cracks are rust-filled ar lost their quality, and loose bolts and nuts.

Make sure that all lifting equipment and support material are operative and they are leaned on a weight at least 10% more than the weight of the generator set's bit weight (snow, ice, mud ar stacked parts and equipment weights).

Be sure that the lifting hooks ar buckles are functional safety latches and properly connected. Use guide ropes ar equivalent in order ta prevent rotation and quaking as the machine's floor contact is stopped when lifted.

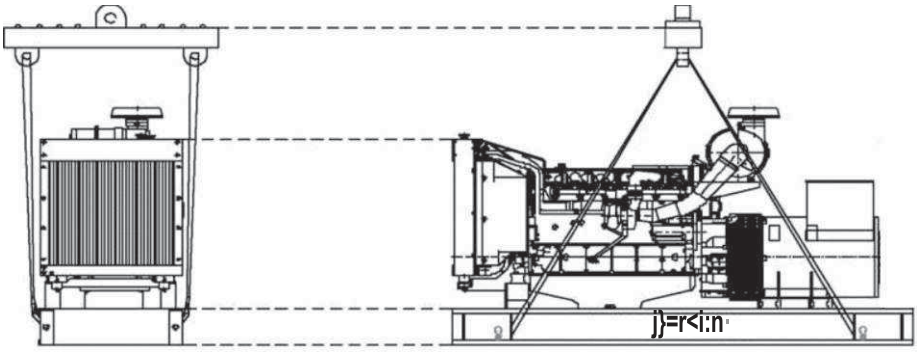
Do not try ta lift thegenerator set under strong wind blows.

I<eep people away from the bottom side and surrounding area of the generater when the generator set is suspended.

When the generator set is suspended, always keep the lifting device operator in place and ready.

Place the generator set on flat surfaces which allow more than 10% of the gross weight of the generator and have endurance capacity without danger of slipping.

Before locking the gates off, make sure that ali personnel are left aut of the generator set.



The removal of the generator set

2.1 Towing of Trailer Cienerators

Make sure that the towing apparatus and the parts over the towing vehicle (and even, if available chain adjustments, brake and / or electricity interconnections), the moving parts including coupling points of the trailer generator set are not active during the maneuvers and do not restrict the maneuvers of the towing vehicle.

Make sure that the tires; are conformed with the standards, to be in good condition and with air pressure to be chosen and specified according to loading capacity. Do not modify the size and type of tire. in addition, be sure that the wheel bolts, nuts, and all such parts are screwed according to the specified torque.

If available, make sure that all the headlights, signal lights, brake lights, fog lights are working properly, and their glasses and lenses are clean and operable.

Do not allow people to stand or move over the check valve or generator set. l<eep hands and fingers away from the pinch points. Do not attempt to pull the trailer generator set by hand.

If possible, park or place the trailer generator set on dry floored areas. Secure all the wheels with chock.

Do not exceed the permissible speed limit while towing the trailer generator set. Obey ali the laws, directives and regulations that define traffic rules.

3. ROTATINCi PARTS

I<eep your body, especially the hands, arms, hair, and clothes away from propellers, belts, pulleys and other moving and rotating parts.

Do not attempt to operate the generator set with fan guards and other guards removed.

in case of working close to moving parts or around the generator set, wear tight fitting clothes and tie the long hair back.

I<eep the access doors closed except for the cases of controlling, maintenance, repair, adjustment, servicing, or operating or stopping the generator set.

Ensure that all personnel are kept at a safe distance away from the set except the times the generator set is operative or in service.

I<eep your hands, your feet, floors, walking areas free of oil, water, antifreeze or other fluids in order to minimize the possibilities of slipping and falling.

4. HOT SURFACES AND SHARP EDCiES

Avoid contact of hot oil, hot coolant, hot surfaces, sharp edges and corners with the body. Protect all parts of your body from hot exhaust pipes and gases.

Wear protective clothes, such as gloves, boots and helmets, while working inside, outside and around the generator set.

I<eep first aid manual on hand, in case of injury, seek medical care immediately. Do not neglect minor cuts and injuries.

5. FiRE AND EXPLOSION

Perfarm refuelling that is sutiable far use and comfarms with norms from a fuel tank designed in accordance with the intended use or service station.

in the event of farmation of fuel, oil, battery electrolyte or the cooling fluid over the floor, clean them all.

Turn off the generator set and allow the set to cool down befare adding fuel, checking electrolyte level of batteries or changing the oil. Keep the set away from sparks, flames and other sources of lighters. Do not smoke and do not allow smoking in the surronding area.

Do not allow farmation of fuel, lubricating film over the generator set, on the chassis or if available in the cabin. Wipe the contaminated surfaces by using liquid industrial cleaners. Do not use flammable chemicals far cleaning purposes.

Befare connecting or disconnecting the battery, shut down or disengage the link of battery charger.

Befare starting maintenance or repair over or around the battery, disengage the battery negative (-) pole; put a warning label onto the battery connection in order to prevent others to make reconnection in any way.

I<eep the electrical cables, battery terminals and other terminals in good condition. Replace any cracked, cut, frayed cords, insulators in poor condition or weared, discolored or corroded terminals.

Ground the bodies of conductive objects exposed to electric current such as electrical equipment and terminals, in order to avoid them to become lighter source by arcing.

Do not attempt to weld or repair the damaged fuel tanks or pipes in anyway, replace them with new ones. in case of observing any leakage in the fuel system, do not operate the generator set and eliminate the leakage.

it should be beared in mind that the temperatures of exhaust gas, the exhaust manifald and the outlet are approximately 550 ° C and hot surfaces must be isolated; unless being sure that the system has been cooled down, approaching to these areas and contact with inflammable materials within these areas should be avoided.

Befare welding processes, keep clear the environment from the materials that can be damaged or likely to be inflamed due to tempeture. I<eep lubricated rags, chemical waste, leaves, trash or other inflammable materials away from the generator set.

During servicing or operation of the generator set, keep fully charged fire extinguishers at a closer place.

Do not let leaves and branches to come into contact with hot exhaust system of the generator set used in woodland or farest land.

Do not attempt to install or operate generator sets in places that are classified as danger areas.

6. TOXIC SUBSTANCES AND IRRITANT ACiENTS

Operate the generator set only at open or well-ventilated areas.
If the machine is to be operated indoors, dispose of the exhaust gases to the external environment.

Make sure that the exhaust gas outlets are not directed to the areas where the personnel are located, to the areas with danger of diffusing or next to the air intake ducts.

The fuels, lubricants, coolants, and battery electrolytes used in the generator set are industrial type. Necessary measures should be taken in order to avoid the penetration into the body and / or the contact with the skin accidentally. in the event of penetration into the body seek immediate medical help. in case of contact with skin, wash the area with soap and water.

During the maintenance of the battery, wear acid resistant apron and use face protection or goggles. If electrolite is spilled on your skin or clothing, wash your skin immediately with clean water.

7. ENVIRONMENTAL PROTECTION

Generator sets involve a group of components that may pose a risk to the environment. The main ones of these are lubricating oil, diesel fuel, gasoline, exhaust gas, battery and etc.

A number of specific local rules, regulations or restrictions might apply for the use of mobile or stationary generator sets and disposal of above-mentioned materials that could pose a risk.

it is the end user's responsibility to comply with the laws and regulations set by the local authorities for the issue of protection of the environment.

Disposal of waste

* Avoid spilling of the engine lubricating oils to the environment during the changing or storage processes.
* Store the used lubricating oils in a safe place and deliver them to the companies or institutions authorized for this issue.
* Store the replaced parts such as oil filter, fuel fitler and ete. in a safe place and deliver them to the companies or institutions authorized for this issue.
* Do not dispose of batteries that are new or ended their life cycle, and deliver them to the companies or institutions authorized for this issue.
* Use fire-resistant tanks for placing or storing the waste.
* Avoid the dispersion or spillage of the fuel to the environment.
* Consider that the exhaust gas emissions rates should be conformed with local regulations and if required, take precautionary measures.

8. ELECTRIC

The generator set wiring should only be performed by trained and authorized qualified electrician.

Make sure that the electrical parts of the generator set do not come into contact directly with the body ar any uninsulated conductive object.

Make sure that grounding is performed in accordance with the applicable regulations before operating, connecting and disengaging of all cable connections of the generator set.

Do not attempt ta run, engage ar disengage the electrical connection of generator sets standing ona wet floor ar in the water.

Stop the engine and cut off the power supply of the battery charger and the battery connection before connecting ar disengaging the electrical connections of the generator set. Remove and leave aut the conductor connections that are not grounded at the load side.

Avoid contact of moving parts of the electrical system on the generator set directly with any part of the body, ar indirect contact through a hand tool ar any other conductive object. Stand on insulating surfaces by obtaining a dry base far adjustments and repairs of the generator set's electrical system.

As the connections are made, reinstall the generator set's electrical connection terminal housing as quickly as possible. Otherwise, do not operate the generator set.

Lock ali access doors when the generator set is aut of service.

Keep the towing vehicle ar equipment carriers at least 3 m away from the cables and buried power cables connected ta the generator set.

Do the repairs at clean, dry, well-illuminated and well-ventilated areas.

Connect the generator set only with receivers that are compatible with electrical characteristics and within the specified the power capacity limit. Make the the electrical connections with conductors comply within the limits of current-carrying capacity.

8.1. First Aid for Electric Shock

Until the power cuts off do not touch the CASUALTY WITH BARE HAND AND SHUT THE POWER OFF IMMEDIATELY. If this is not possible, protect yourself with the help of dry and nonconducting objects and pull the casualty away from the conductor completely.

1. Call the nearest health institution and seek medical care.
2. Bring the patient to prone position so that his head faced to one side and the forehead rested on his hands.

3. Take the objects, such as DENTAL PLATE, TOBACCO, CHEWING GUM out of patient's mouth. Press down firmly between the shoulder area with your palms, make sure that the TOUNGE IS SET FREELY.

4. Kneel down as one of your knees will be next to the patient's head and your other leg next to the patient's elbow level.

5. Place your palms onto the patient's shoulder bones.

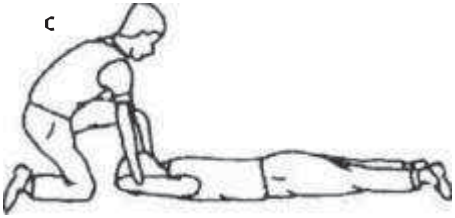
6. Push your arms forward so that your arms come to the vertical position. Pressure should be smooth and applied without force. (10-15 kg is enough). Keep this position approximately for 2.5 seconds.

A

B

7. Release the pressure by sliding from the shoulders to the elbows of the patient with your hands (approximately 1 sec). Following this, by holding the elbows, lift the patient's arms and shoulders slightly, at the same time stretch the patient backwards (about 2.5 secs). (See C) Lower the patient's arms (see D) and take your hands back again so that your hands will be over the patient's shoulder bones.

C



D

8. Repeat the steps so as every full breathing takes seven seconds.
9. During artificial respiration some other person should help,
   a. to loosen the patient's clothing,
   b. for keeping the patient warm.
10. If the patient stops breathing, continue to give artificial respiration. A time of four hours or more may be needed.

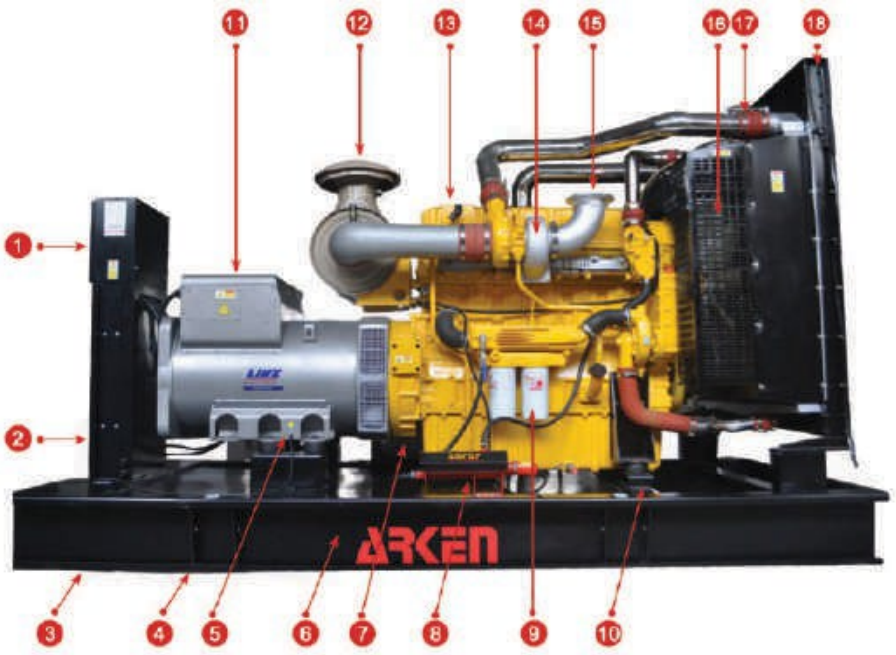
DO NOT GIVE LIQUID UNTIL THE PATIENT RECOVERS HIS CONSCIOUSNESS!

2 GENERAL DEFINITIONS

1. CiENER.ATOR. SET

Arken generator produces all of its products in accordance with the international 1S08528 standards with high-quality. Each set has a label belongs to its own and this label is placed over the set. The serial number and the main characteristics of the generator set are described on this label.

The following figure shows the main components of the generator set.



1	Control Panel	7	Battery	13	Oiesel Engine
2	**Junction-Box**	8	Block Water Heater	14	Turbocharger
3	Chassis	9	Oil Filler	15	Exhaust Outlet
4	Lifting Lug	10	Vibration Isolators	16	Cooling Fan
5	Grounding Point	11	Alternator	17	Radiator Cap
6	Fuel Tank	12	AirFilter	18	Radiator

2. DIESEL ENGINE

4-stroke with direct injection industrial type diesel engines; comformed to ISO3046 standards; designed for the latest technology generator sets; with low fuel consumption; with mechanical or electronic type governor mounted to fuel pump that provides precise speed control and regulation; with oil, air or water-cooled depending on the type of diesel cooling; with oil, fuel and air filter system designed according to heavy operating conditions that provides long-lasting and high-performance operation of the diesel; with limit and level sensors required for diesel protection, are used. The diesel engine is provided with all the equipment that is necessary to ensure the safe operation.

3. SYNCHRONOUS ALTERNATOR

Alternators; manufactured in accordance with IEC 60034-1; CEI 2-3; BS 4999-5000, VDE 0530; NF 51 -100.111; OVE M-10; NEMA MG1.22 standards and CE norms; state-of-the-art technology product; high-efficient; with maintenance-free bearing system; has brushless self-excited voltage regulation system provides precise setting and regulation of voltage; passed the test stages; designed to ensure trouble-free operation, ease of maintenance and long service life are used.

You can find all the technical details of the engine and alternator in the original DIESEL ENGINE MAINTENANCE AND OPERATION MANUAL, and ALTERNATOR MAINTENANCE AND OPERATION MANUAL that are provided with GENERAL MAINTENANCE AND OPERATION MANUAL.

4. FUEL TANI<

Arken Generator uses daily fuel tank inside the chassis for the generator sets up to 800kVA. Legged type external fuel tank is provided for greater power sets.

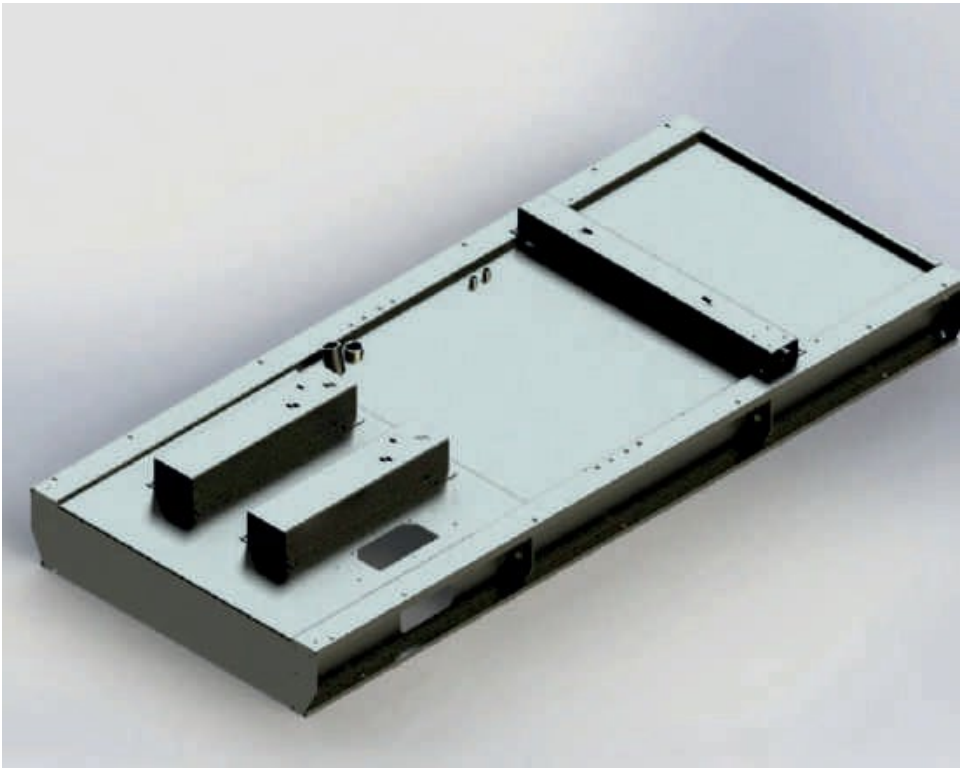
Fuel tanks are manufactured from steel sheet or other suitable materials in accordance with the relevant standards. Arken fuel tanks are mainly comprised of the following;

* Fuel filler point and cover
* Tank ventilation
* Fuel outlet vaive
* Fuel return connection
* Tank drain plug
* Residue and ete. accumulating part
* Fuel level sight gauge
* Level contact (Dptional)
* Automatic filling (Dptional)

A primary fuel filter or a water separator filter to be mounted over the fuel supply line between the tank and diesel engine is recommended.

5. CHASSIS

Arken generator makes its own chassis production based on international standards for all generator sets. The chassis are designed and manufactured from plate sheet or profile content so as to provide high strength against vibration and stress.

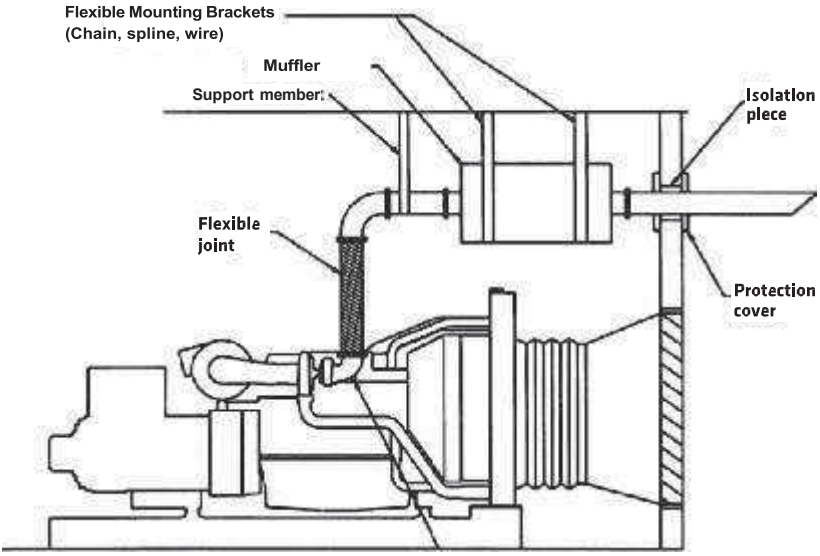


6. VIBRATION ISOLATORS

Arken generator sets are equipped with vibration isolators designed to reduce vibration transmitted to the ground by the rotating mass. Vibration isolators are specially selected and they are mounted between the engine, the alternator pier and the chassis. As an alternative, far large-size models, vibration isolators are mounted between the main frame and floor.

7. EXHAUST SVSTEM AND MUFFLER

The exhaust system is installed to reduce the noise of the engine exhaust manifold and to direct toxic exhaust gases into the appropriate areas. The exhaust system comprises of of flexible compensator, steel pipe, elbow, silencer and mounting materials that absorb vibrations and expansions. Details are provided under **"INSTALLATION"** section.



8. PROTECTION SVSTEMS

Various systems have been developed for performing a safe and reliable service, to protect the system against failures and for the transfer of load.

Control systems are manufactured with various types depending on customer demands and installation requirements. These are mainly, Manual, Auta, Stand-By and Parallel operation systems. AII control systems are mounted into steel boxes equipped with a locked door far easy access and service.

You find technical information about your generator set's control system in the **"4. CONTROL SVSTEMS"** section and in the **"ATTACHED BOOKLET"**.

3 INSTALLATIONS

1. PLACE SELECTION

Selecting a suitable place far the generator set is the most important stage of the installation process. Observe every warning in the General Maintenance and Operation Manual ta make a safe installation. Cali our company ta obtain information when necessary.

Install the generator set ta protected areas that will not exposed ta factors such as rain, snow, hail, flood, excess humidity, direct sunlight, freezing cold and overtemperature, dust, soil, sand ar harmful substances carried with wind.

Install your generator set ta areas that are clean, dry, well-illuminated, spacious, not too hat and that are not exposed to contaminants, corrosive or conductive dust carried with wind, lint, smoke, oil mist, motor exhaust fume ar other pollutants.

in order ta facilitate maintenance and controlling processes, keep a sufficient distance ta be able ta walk easily around the generator set. in some cases, the main components such as the engine, alternator, chassis and radiator may need ta be removed.

The place must be clean and dry, and needs ta have a good drainage system.

If possible, place the generator sets ta places where unauthorized persons cannot access ar take measures against interventions.

Place generator sets to areas where effects of motor vehicles or heavy machinery can not interfere. If possible, make appropriate protective barriers.

Do not install and use the generator set in an environment likely to be pose a danger in anyway. If the installation will be in an open area, protect the the generator set against weather conditions. (Protective cabinets may be used upon request)

The doors at the generator's location should be sized ta allow moving the generator set and its main equipment aut. Air inlet and outlet ducts can be made movable ar portable.

2. FLOOR AND PLATFORM

Generator set can be placed on floors such as platform, dirt surface, building and steel construction. The total weight of the generator set must not exceed the load bearing capacity of the floor.

The preparation of the floor in the form ofa ferrous reinforced concrete platform is the best. A platform with enough size and proper to the dimensions of the generator set provides the necessary support to reduce the vibration and movement of the machine as much as possible. The platform must be 150-200 mm thick and at least equal to the dimensions of the generator set.

If desired, the platform can be constructed so as the remaining part of the floor can be isolated against vibration.

If the generator set will be installed in a place with a risk of inundation or moisture, and ete. (eg: boiler room); the platform height should be at least 300 mm from the floor. Thus, a safe and dry ground is provided far the generator set and the people who are servicing and operating the set.

Placing of each machine platform on the main foundation ora firm ground independent from other foundations, concrete structures, walls or operation platforms is recommended.

3. VIBRATION

Generator set has been designed so as to transmit minimum vibration to the floor. Vibration insulators have been placed between the engine and alternator and chassis. Far large size generators, vibration isolators are located under the main frame.

Vibration insulation of the generator rooms on the roofs and at the floors of the high-rise buildings should be properly considered. Generally, spring-type vibration isolators are required. it must be absolutely ensured that the structures are capable of supporting, generator sets, fuel tanks and the equipment.

Secure generator sets to the floors and platforms with joint bolts or equivalent and prevent them from moving so as not to face with any event that could give harm to the electrical connections, fuel storage system, the exhaust system, environment and living beings.

4. COOLINCi AND VENTILATION

The heat emitted by the engine can lead to extreme changes in temperature that could impact the performance of the generator set or the service personnel.

in order to eliminate the heat emitted from alternator, engine and cooling water of the radiator from the system by means ofa repellent fan mounted between the engine the radiator, place it into a room or area with adequate ventilation.

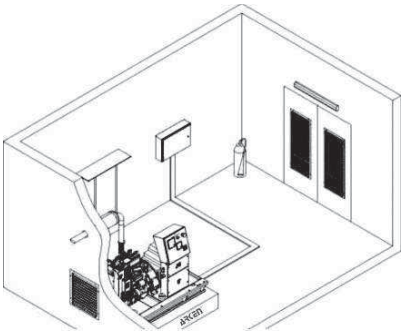
The air supplied to the generator should be clean and as cool as possible. This fact greatly affects the service life and performance of the engine. Normally, this air can be obtained through the surrounding the area of installation, but in some cases, conditions of the place where the machine is located, may make it necessary to flow the air from outside or from another room.

Ventilation Windows should be opened to the back of the alternator for cold air intake and to the front of the radiator for hot air outlet.

Make sure that the hot air is bled from the room completely through a flexible connection placed between the radiator and the channel.

Sufficient size of cooling air intake should be ensured by calculating the dimensions of the ventilation windows. Windows space must be at least as large as radiator fins' space. However, if possible, air intake from an area with 150% of the radiator space should be performed.

In order to protect air openings, louvers must be installed for the windows. They may be fixed or movable type. Movable types can be opened automatically as the generator set starts to operate. Manually opened portable louvers can be considered in some cases. However, this does not apply for automatic standby generators.



This layout drawing shows a typical installation ofa generator set. The drawing is only for guidance. The details of each unit to be installed should be calculated and the installation should be designed according to the requirements of the placement area.

5. EXHAUST SYSTEM

When designing the exhaust system, to prevent back pressure should be the main aim. Excessive back pressure over the exhaust system reduces engine power and inueases the operating temperature.

For the areas in which there is need for using exhaust elbow for the exhaust system, keep the elbow radius size up to 150% of the inner radius of the pipe. Since many of the exhaust system designs are designed based on the physical characteristics ofa building ora room that they located, in order to avoid inueasing the back pressure by exhaust pipes, the shortest and the least returned way should be selected.

Make sure that ali pipesarewell-supported and far from points of high vibration. Since the exhaust pipes radiates heat, placing of ali the pipes at least 250 mm away from the flammable materials are rernmmended. Insulating with high temperature insulators or applying proper insulating materials for the exhaust pipes will help in preventing hazards.

A protection cap against rain activating with exhaust pressure to be used in vertical extension exhaust pipes should be instalied.

There must be water drain hole at the bottom point of any horizontal or vertical extension exhaust pipe. Thus, water can not reach the engine and to the muffler as well.

You can reduce the sound level of exhaust pipe by positioning the muffler as close as to the engine. in case of diffusion of the exhaust gas to longer distances an additional muffler can be mounted to the outlet. Each machine must have its own exhaust system. Since exhaust gas, soots and condensation lead ta permanent damage on the inactive machine, more than one generator set should not be rnnnected to the same pipe.

Exhaust system must be integrated into the motor exhaust outlet through a flexible rnnnection.

Inhaling of exhaust fumes causes a danger for death. Exhaust systems to must be installed rnrrectly in order to prevent the accumulation of exhaust gases. Prolonged exposure ta the engine's exhaust sound also leads to loss of hearing. A generator set should not be operated without instaliing the exhaust system rnmpletely. AII personnel around the generator set must wear earplugs.

Outlet points of the exhaust system to the external environment should be selected sa as not to draw toxic exhaust fumes into the clean air vents. This outlet points cannot be directed to closed areas, rnrridors, air ducts and particularly to the areas of living beings. During the selection of outlet points, the direction of constant wind blows should be taken into consideration.

6. FUEL SVSTEM

The main purpose of the fuel system is ta supply clean and uninterrupted fuel ta the engine. Make sure that the fuel system is designed correctly and the proper materials are used. A primary fuel filter ara water separator filter ta be mounted over the fuel supply line between the fuel tank and engine is recommended.

During the design of the fuel system, the following points should be considered:

* Proper use of material
* Use ofa black steel, suitable plastic ar copper pipe
*Notta use galvanized ar improper pipes
* Not ta place cloth ar likely materials onto the tank fuel filler neci< far filtering the fuel
*Notta paint the inner surface of the tank
*Notta use of improper hoses

Far safe operation and long lasting engine, clean fuel must used.

If the fuel pressure rate exceeds the limits of the manufacturer due ta the location of main fuel tank, a proper system can be installed and an auxiliary fuel tank can be mounted.

The fuel level approximately not more than 4 m above and 3 m lower from the height of the fuel supply pump is recommended.

Ava ive, check vaive, vane and ete. should never be installed onto the fuel return line from engine ta the tank.

When designing the fuel tank, fuel intake temperature rate determined by the manufacturer should be considered. Increase in the fuel temperature affects the fluidity, density, and combustion quality and asa result of this, engine performance and exhaust emission are affected adversely.

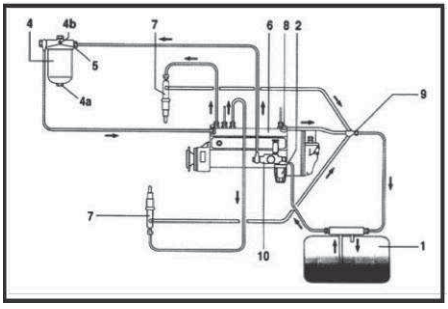
Fuel supplied ta the engine should not contain air bubbles. Far this reason, the fuel lines should be designed sa as not ta ingress air.

If the fuel tank is mounted on a mobile generator set, panels should be designed ta reduce the volatility of fuel in the tank.

Caution!

Open flames, sparks, ar smoking pose a risk of fire in the areas where fuel is stored ar exists.

The principle of the fuel system



1. Fuel Tank
2. Filter
3. Fuel Filter Cartridge
4. Fuel Filter Housing

4a. Water drain tap
4b. Bleeder screw

5. Fuel pipe fitting
6. Fuel injection pump
7. Injector
8. Fuel pressure relief valve
9. Fuel return line
10. Fuel feed pump

6.1. Diesel Fuel Storage

The most preferred method far supplying the fuel is the storage of the fuel. The fuel tank can be placed above ar under the ground.

A vent hole should be available in order ta the bleed the air pressure farmed in the main tank caused by filling of the tank and ta prevent vacuum in the tank due ta the fuel consumption. A drain valve should be attached in order ta drain the water accumulated at the bottom of the tank asa result of condensation.

Embedding the tank below the frost line allows the prevention of seasonal effects.

Another point to be taken into consideration in the placement of the main tank is the difference of height between the main tank and the auxiliary tank (daily tank). Vertical lifting capacity of the standard electrical pump is 5 m. Do not place the fuel tank to the heights exceeding the pump lifting capacity. in addition, do not neglect the possibilities of pressure fal ls induced by the extreme horizontal distances and elbows. The fuel distribution line supplying fuel to the engine and the fuel return line delivering more fuel back to the tank must not be smaller than the inlets over the engine. in order to provide adequate flow far long-term operation or low ambient temperatures, the dimensions of these lines must be increased.

Fuel lines can be made of steel tubes ar any material proper to oil. Do not use galvanized pi pes. Tank bleeding pipes should be made of same material at the same size.

The fuel return line must return back ta the tank from its top side and must not contain any shut-off valve. This line should be designed with the minimum number of elbows and slope in order to avoid air entrainment in the system. Fuel should not be supplied from a point 50 mm lower according ta the bottom of the tank.

in order to prevent the damage to be occured by vibration of the generator, flexible tubing should be used at access points of the generator set.

7. ELECTRICAL CONNECTIONS

Only trained and qualified electricians should be authorised ta carry aut the connection of electrical installation ar repair work.

AII electrical connections must be made according ta the schemes provided by Arken Generator.

in order ta operate the generator set, all connections should be fully compatible with applicable international, national and local standards, rules, regulations, and with the requirements including earthing and earthing failures.

Cables that are used must be proper ta the voltage rate. The cables shold selected according ta the table values, ambient temperature and the method of drawing in order ta identify the current ta be passed through.

The electrical connections ta the generator set must be made with flexible cable, in order not ta damage vibration conductors, alternator or circuit breaker elements.

it using flexible cable completely is not suitable, a junction box can be placed close ta generator by means ofa flexible connection.

AII connections must be checked very carefully. The direction of phase return path must be checked whether it is appropriate far the installation or not. This has a vital significance tor the automatic transfer panel ar it generators will be operated as parallel.

The control panel can be mounted onto the wall.

The cables connecting the generator set ta the electrical load distribution board must be protected with circuit breaker, fuse, or other means ta disengage the generator set against any overload or short-circuit.

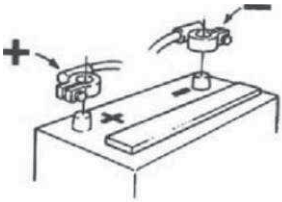
During the distribution system planning, ensuring the connection ofa balanced electrical load ta the generator set is important. An excessive load over a phase compared ta other two phases will result in overheating of the alternator windings, the imbalance between the phases and a possible damage over the precise three-phase installation that is connected ta the system. Make sure that the calculated current rate drawn by the generator does not exceed any drawn phase current. If a generator set will be connected ta an existing installation, a re-arrangement far the electrical system may be required. The connected load's power factor (cos phi) should be identified. Power factors under 0.8 lead ta extreme loading over the generator. The generator set will work safely with power factor value of 0.8. in order ta regulate the power factor far appropriate values, automatic power factor correction equipment can be established. However, it must be considered that the system should not exceed the capacitive value. Otherwise, this situation will cause the generator output voltage instabilities and the occurance of hazardous excessive voltage.

7.1. Starter Batteries

The electrical resistance over the starter circuit has a significant impact on the operation of the diesel engine. Therefore, the batteries can be placed as close as to the generator set, it should be ensured that the connections are correct and not loose
(Batteries must be accessible for ease of service).

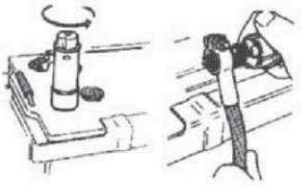
The maintenance procedures should be carried out delicately due to the necessity of being in excellent condition of the batteries to run the generator set at any moment. Battery charging system and battery maintenance are described in the relevant sections.

Connection and removal
First connect the battery (+) lead. Then connect the battery (-) terminal. Begin the disengaging process from the battery (-) terminal. Then disconnect the (+) pole connection.

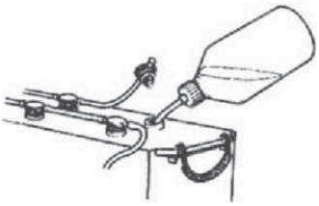


Cleaning
I<eep the batteries clean and dry. Dirt and oxidation formed over the battery or the terminals cause the battery voltage to drop and discharge the battery.

Remove and clean the terminals during maintenance. Use a wire brush for oxidation. After connecting and tightening the cables again apply Grease onto the terminals to retard oxidation.



Adding distilled water
The electrolyte level of the batteries that requires maintenance should be checked from time to time. If the fluid level is decreased by 5-10 mm, fiil up with distilled water. Then, charge the battery approximately for 30 minutes.



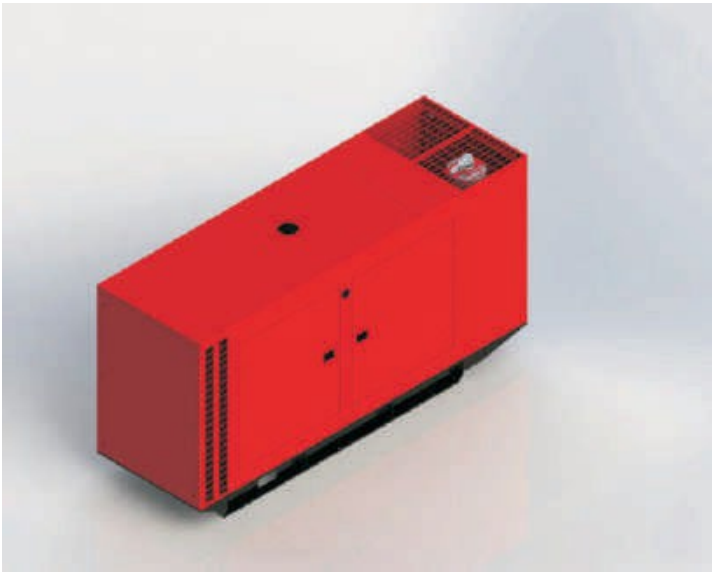
NOTE: See the user manuals for special maintenance methods of maintenance-free or dry-type batteries.

8.S0UND C0NTR0L

Arken generator has proven itself with its quality and experience on generator sets sound insulation that has a great importance for reducing noise pollution today.

Your generator set can be fitted with equipment that reduces the sound propagations. Some of them are; sound isolation cabins, room isolation, super exhaust silencers, acoustic louver windows and hoods. Every environment has variable requirements, so that we recomend you to contact with us for precise installations.

Sound propagations of diesel generator sets (without sound insulation) are between 100 dB and 110 dB from 1m distance. The lowest attainable sound pressure level is between 65 dB and 75 dB from 1m distance. The sound insulation has much more importance for hospitals, schools, residential areas, offices and ete. Being in environments with more than 85 dB sound pressure level fora long time can cause hearing problems. Use earplugs at areas where the generator set is running.



9. MEASURES TD BE TAI<EN ACiAINST FiRE

The following points should be taken into account far the installation of a generator set;

* in case of any fire outbreak in a room, there must be a convenient escape route far the company staff.
* A fire extinguisher or fire extinguishing system must be provided in accordance with the Fire Code and standards and according to the place or building where the generator is located.
* □rop weight fire valves that activate via fusible links mounted on the motor must be placed onto the fuel lines. The room should be kept clean and free from masses of waste that cause to start fire.

10. CiROUNDINCi

Equalizing the inactive sections and their connected parts in electrical installations with the ground by means of an electrode is called grounding. Far electrical system's persistency and to protect human life, the contact surfaces are isolated. However, far various reasons, failure or defects in the form of distortion against the ground are always unavoidable far these parts.

in this case, the surfaces that the conductor contacts are exposed to electric leakage potential. Potential voltage formed against the ground eliminates the risk of current flow from human to the ground in case of contact by connecting of all conductive parts with one another and with an effective earthing.

Perform the grounding in accordance with the current national and local standards, rules, regulations or other directives. Grounding resistance should be less than 20 ohms. Contact voltage rates above SDV and 15mA are dangerous far human health. in the event of embedding more than one grounding plates or rods far different purposes, the distance between them should be a minimum of 20 meters. The total mass of the generator set has an equivalent patential by connecting the alternator body to the generator chassis.

4 CONTROL SVSTEMS

1. INTRODUCTION

Arken Generator sets use generator control units with standard programmable micro-processor that are capable of monitoring of all measured values and alarm messages and provide protection.

Control systems unsure the running and swicthing off the generator set and monitoring and maintaining a variety of values. They provide a convenient use through programmable parameters according to changing conditions. Control panels are made of A1 quality type steel plate that is protected against corrosion with surface treatment and electrostatic powder paint. Along with the ARI<-M (Manual), ARI<-A (Auta) and ARI<-S (Synchronization) standard control panels, different sets are alsa manufactured in accordance with the customers' requests and business operations in terms of various operating scenarios. Here, only ARI<-0500 "Manual" and "Automatic" control panels will be discussed. You can contact us to obtain necessary information about our different applications.

2. MANUAL CONTROL PANEL -ARK-M

it is designed far use when the power goes off or far the cases in which the generator set is activated or deactivated by the user.

The control and protection procedures are perfarmed by the programmable ARI<-0500 device. Operating modes are selected by pressing the desired key on the front panel.

OFF: in this position, the engine shuts off immediately.

AUTO: it is used far automatic operation of the generator. As the REMOTE START signal comes on, the engine is started according to programmed times. A waiting time is elapsed between each cranking. As the generator starts to run, cranking is cut off immediately. As L1-L2-L3-phase voltages reach the limits, first the engine warm-up time and then the generator contactor time are waited to elapse and the generator contactor is energized.

One of the auxiliary relay outputs can be assigned as Generator Contactor signal.

As REMOTE START signal goes off, engine runs as long as the mains waiting time. Then the generator releases the contactor. If a cooling time is given, the generator runs as long as the duration of cooling time. At the end of time, CONTACT output is de-energized and the diesel stops. The device stays ready to activate the generator with a new REMOTE START signal.

If the weekly operating schedule interrupts the operation of the generator, AUTO led will flash and the generator does not run. TEST: it is used far starting the generator or holding the generator in emergency backup position as long as there is no REMOTE START signal. Everything works just like in AUTO position. However, unless there is REMOTE START signal, generator does not draw the contactor, as the REMOTE START signal comes on, generator draws the contactor (if the emergency backup is selected). As REMOTE START signal goes off, the generator releases the contactor but the engine continues to run. To stop the generator, switching to AUTO or OFF mode is required.

3. AUTDMATICCONTRDL PANEL -ARK-A

it is designed far automatic activation or deactivation of generator sets to be used as a stand by far mains power.

Electric network monitoring, control and protection procedures are perfarmed by the programmable ARl<-0500 generator control unit. Operating modes are selected by pressing the desired key on the front panel.

OFF: in this mode if the mains phases are within the programmed limits, the mains draws the contactor. lf the generator is running, it is shut-off immediately.

AUTO: it is used far automatic transfer of the generator and the mains. in case of one of the mains phases exceed the limits, the mains release the contactor. At the end of waiting time the engine is cranked according to programmed times. A waiting time is elapsed between each cranking. As the generator starts to run, cranking is cut off immediately. As ali of L1-L2-L3-phase voltages reach the limits, first the engine warm-up time and then the generator contactor time are waited to elapse and the generator contactor is energized.

As all of the mains phases are entered into the limits, it is waited until the mains waiting time is elapsed. Then the generator releases the contactor and the mains draw the contactor. If a cooling time is given, the generator runs more as long as the duration of cooling time. At the end of time CONTACT output is de-energized and the diesel stops. The device stays ready to activate the generator at a new electric grid blackout.

If the weekly operating schedule interrupts the operation of the generator, AUT□led will flash andan equivalent operation to OFF position is performed.

TEST: it is used far trying the generator or holding the generator in emergency backup position when there is electric network. Everything works just like in AUTO position. However, as long as the electric network exists, generator does not draw the contactor, if there is electricity cut off, the mains releases the contactor and the generator draws the contactor (if the emergency backup is selected). As the power comes back on, the load is tranferred to the mains again but the generator continues torun. To stop the generator, switching to AUTO or OFF mode is required.

LDAD TEST: it is used to test the generator at load. As this position is selected, the generator runs and increases the load.

4. SVNCHR0NIZATI0N PANELS

Arken generator provides alternative solutions far energy projects via using synchronization systems designed by its own. This system formed by combining more than one generator together far your high kVA requests; provides considerable advantages in comparison ta a single generator with same power. These advantages are; low cost, low initial investment budget, flexibility, ease of maintenance and service, ease of delivery and supply of spare part and being a secure system.

Special synchronization control panels are designed far these solutions. The designed panels are mainly used far the fallowing applications:

* Synchronous operation of more than one generator sets with each other.

* Synchronous operation ofa single generator set with electric network

* Synchronous operation of more than one generator sets with electric network

* Synchronous operation of more than one generator sets with multiple electric network

5. BASIC PROCEDURES BEFORE START-UP

Observe safety precautions described in the General Maintenance & Operation Manual before operating the generator. Make sure that the installation is made completely and precisely.

Make sure that the electrical connections are performed in accordance with the technical instructions and schemes.

The following procedure should be used in every operation of the generator set. People, who will use the generator set, must be trained far this issue.

1. Inspect the generator set (engine and alternator) manually and visually in general. Do not operate it if there are any leaks, broken parts, cracks and ete.
2. The generator set should be on an ideal and level surface. it should be protected against conditions such as precipitation, dust and ete.
3. Inspect fresh air intake and hat air outlet windows ar ducts are not closed ar clogged.
4. Check that the exhaust outlet is closed ar clogged.
5. Check the engine oil level and, if necessary, add oil.
6. [heci< the coolant level and anti-freeze level and, if necessary fili up. Anti-freeze level must be adjusted according ta the coldest conditions of the region.
7. Check the fuel tank and fuel level and if necessary add fuel.
8. The batteries can be maintenance-free ar lead-acid type batteries. [heci< the electrolyte level if it is lead-acid type battery and charge it. Clean and charge, if it is maintenance-free type.
9. [heci< the air fi iter against excessive contamination ar clogging and if necessary replace it.
10. Any object ar anyone around the generator may obstruct the operation of the generator set ar cause injury. Please check and warn them.
11. Make sure that the power output is switched ta CLOSE (OFF) position.
12. Ensure that the fuses are swithed ta [LOSE (OFF) position.
13. Make cable connections ta the battery terminals.
14. Bleed the air from fuel system and fuel filter completely by using a fuel priming pump. Far details, refer ta the DIESEL ENGiNE SERVI[E-MAINTENAN[E 8001<.
15. Switch the fuses ta OPEN (ON) position.
16. [heci< the Emergency Stop Buttan is at open position.
17. Run the generator manually via the control unit.

18. Check abnormal noise and vibration.
19. Check any water, oil, fuel and ete. leakage.
20. Look on the temperature and oil pressure gauges.
21. Check the voltage and frequency values.
22. Check direction of generator and electric grid phase return paths. Stop the generator, if return paths are not in the same direction with the electric grid and change the generator phases direction.
23. If ali values are normal, you can run the generator at electrical load. Do not use the generator set other than capacity specified on the label.

CAUTION !

* Observe safety precautions described in the General Maintenance & Operation Manual before operating the generator.
* Make sure that the installation is made completely and precisely.
* Proper grounding of both stationary and mobile generator sets prevents the possibility of death or personal injury in the event of power failure.
* Since the battery system has negative grounding, first (-) terminal should be removed and for reconnection, the negative (-) terminal should be connected at last.
* While the safety stop buttan is pressed, generator does not run in automatic or manual position.
* Switch on the emergency stop buttan by turning it clockwise.
* Never start-up or stop your generator set while power output switch is at OPEN (ON) position.
* The generator set's maintenance and controls according to daily, weekly, annual and working hours schedule should be carefully followed.

6. BATTERV CHARGER

Battery charger is designed to keep starter batteries always charged even the generator is not operated fora long time. Generator is supplied from the power grid at stand by position. Battery charger is available in automatic control panels as standard.

Charging speed depends on the state of the battery ampere-hour- Ah (size) and the current state of the charge.

The initial charging current will be reduced as the battery is charged.

Do not operate the battery charger in the environments that are not protected against rain or snow. Ensure that the power grid supply connection is correct and perform the right grounding.

Before removing the battery turn off the battery charger, and avoid any spark or flame. Surrounding dense smoke can cause the battery to explode.

By following the instructions, battery charger must be used properly, should not be overcharged and batteries should not be damaged. If a lead-acid type battery temperature rises to 52 °C, the battery will be damaged. Care must be taken ta charge the batteries especially in tropical countries; the charging environment should be cool and shady.

There is a battery charging generator ta charge the batteries of diesel engine with battery chargers that run with mains power.

Check the pulleys and V-belts rotating the charging alternator. Replace If they are defected replace and adjust belt tension if loosen.

Check that the warning light and power supply cable connections of the charging alternator are correct and firm.

7. BLOCK WATER HEATERS

Heaters can be placed over the engine water system ta ensure convenient operation and quick drawing of the load of the diesel engine. Heaters are available in automatic control systems as standard. They can be used in manual control systems upon request.

Heaters are used with thermostat adjusted approximately ta 40 °(. Heaters' rated powers (kW) vary according ta the engine capacity. Heaters of 0.8-2kW are placed into the generators under 800kVA. Heaters of 3-12kW with water pump can be used for large-sizes (800 kVA and above) and in cold climates. AII of these heaters are automatically de-activated as the engine starts-up.

8. TRANSFER BOARDS

Transfer boards are used ta control and for safe transfer of the generator set output power. For this reason, the generator set should have sufficient capacity ta meet the standards of the output power. Contactor, motor circuit breaker and ete, are used on boards of auto-activated generator sets. The control of switching components in automatic control systems must be performed by the generator control unit. Far manual generator sets that are activated by hand, inverter switches can be used together with thermal-magnetic circuit breaker located at power output.

Standard wiring diagrams of transfer board are given in the "Attached Booklet".

5 MAINTENANCE

1. iN GENERAL

Implementing a good maintenance program is the most important factor far the long-term operation and useful economic life of your generator set. At the same time, your generator set will be ready ta give service at any moment and failure risks will be minimized. Carry aut and have your maintenance made based on these programs.

AII the maintenance and controls ta be perfarmed are specified in General Maintenance Schedule and they are alsa available in the original ENGiNE MANUAL and ALTERNATOR MANUAL in detail.

A copy of all generator service registration farms, model and serial numbers tag, drawings and connection schemes, spare parts lists, service and maintenance schedule and this manual should be maintained. These records will serve as reference far the service and will be helpful far the diagnosis ofa further problem.

Maintenance and repairs should only be perfarmed by authorized and trained personnel.

CAUTION !

If the generator set is large enough to take a person inside, before making adjustments and maintenance, inform other staff members and secure all the access doors against closing or locking up by others. Stop the engine before changing or adding of fuel, oil, and coolant and battery electrolyte.

Before starting the repairs and adjustments in order to prevent the generator to run, cut off the battery charger supply and disconnect battery negative (-) terminal. in order to prevent any re-connection by others puta warning sign on the battery connection.

Make the adjustments only when the generator set is switched off. Make the adjustments if needed, and then re-run the generator to control adjustments. Adjustments during operation should only be performed by specialized technical service personnel.

2. DIESEL ENGiNE MAINTENANCE

See **DIESEL ENCiINE MAINTENANCE AND OPERATION MANUAL.**

3. ALTERNATOR MAINTENANCE

Maintenance and inspections must be carried aut by authorized personnel when alternator is not running and through taking safety measures.

Maintenance and inspection frequency must be set according ta the environment and working conditions.

in general, during the first run and then after 500 operating hours ar after one year; vibration, knocking, abnormal noise, cable terminals and connections firmness, tightness of bolts and nuts must be checked.

Alternator Bearings can be used far 20.000 hours under normal conditions. Unqualified and improper grease, extremely hat environment and vibration shorten the life of bearing. Recommended grease replenishment period is 4000 operating hours.

The lubricating greases of MOBiL **DiL:** MOBILUX 3, SHELL: ALVANIA3, AGIP: GR MW 3, ESSO: BEACON 3 can be used.

Bearing temperature during operation must not exceed 60°C. When a bearing wear is suspected, the operating temperature must be measured and checked. Ouring operation, if the temperature reaches up ta 80°[; check the coupling. **If** the coupling is normal and bearing color turn into blue, bearing must be replaced.

When a bearing is removed, it must be replaced with the same new one, the ex-part must not be used. The new bearing assembly process is made easier as the bed is heated up ta 80°[.

[heci< the mechanical connections and alignment between the alternator coupling and the engine flywheel. [heci< the tightness of the connection bolts. **If** loosened, ta tighten again use LOCTITE -Type 242 cryogenic liquid.

Pay attention when lifting andcarrying the alternators since they have single bedding in general. When lifting the alternator, rotor may be removed and fallen down. Fasten the rotor befare this operation.

Befare restarting the alternators used fara long time, a stator winding insulation test against the ground would be useful ta make. Befare this operation, AVR wiring must be disconnected. If a value is measured below 5 Megaühm, the alternator must be cleaned, dried and re-measured. The cleaning process should be done with electrosol -coil cleaning fluid, after this volatile liquid is dried up, compressed air should be directed gently.

CAUTION !

Alternators have dangerous rotating parts and electric shock risk.

4. LUBRICATING OIL

Lubricating oil must be changed according ta specified perios in order ta run the diesel engine properly. Use engine oils specified by the manufacturer; otherwise the engine could be damaged.

When using the oil, the viscosity should be selected according ta the ambient temperature. Although, sometimes falling below the temperature limit affects cold start ability, this will not damage the engine. However, the engine must not be run fara long time.

5. COOLANT

The coolant is obtained by mixing certain amounts of water and additives, and protects the engine cooling system against freezing and corrosion.

If there is a risk of freezing, use a mixture of 50% antifreeze (etylen-glycol) and 50% clean and distilled water. This mixture protects the engine from freezing up ta -40°[. This mixture is used throughout the year.

Far an effective corrosion protection, anti-freeze should be used at least 40% ara mixture must be obtained by using the agents prescribed by the engine company.

The coolant's freezing point in the engine can be reduced ta -56 °[. Increasing the amount of antifreeze further impairs the protection against frost and may cause the motor ta be damaged by disrupting the heat transfer of the engine.

Before adding water and antifreeze ta the engine, prepare the mixture in a separate place and mix it thoroughly.

CAUTION! Drinking antifreeze ar obtained mixture is dangerous.

6. FUEL

Fara reliable and environmental friendly operation, fuels that comply with the specifications recommended below must be used. Fuel temperature should not exceed 40 °[.

- **EN 590**
- **JISK2204 TYPE 1,2,3**
- **DiN 51601 DIESEL FUEL**
- **ASTM D975 No 1-D.2-D**
- **ISO 8217 DMX-CLASS**
- **BS 2869 CLASS-AI,A2**

Note: If the sulfur content is very low there will be a 5% power loss and 2-3% increase in fuel consumption.

Sulphur content: it must comply with requirements of the country. If the rate exceeds 0.5%, the oil change interval should be reduced.

Fuel-Sulphur Content {%)	Motor Dil Change Interval
< 0.5	Normal
0.5-1.0	At 0.75 frequency
>1.0	At 0.50 frequency

7. BATTERV MAINTENANCE

Batteries used generator sets are in different types. in Arken generators maintenance-free type batteries are used. They are completely closed, and do not require any addition of distilled water.

Since its internal resistance is very low, discharge time is too long.

it has a wide operating temperature rate (approximately from -20 °C to 60°()

The electric power used is obtained from chemical reactions realized inside the cells. This reaction is recycled and the battery can be charged and discharged over and over again.

Batteries remain permanently charged approximately 4 years. After this period they are replaced.

Another type of commonly used batteries are lead acid type batteries in which they are a combination of cells or plates with a group of positive and negative electrodes dipped into electrolyte (sulphuric acid).

Check the battery fluid's density with a battery hydrometer. The reading in each celi should be approximately 1.27 at nominal temperature rate (15 °().

The most proper water to be used for the preparation of the electrolyte is distilled water. This also applies to the water to be added daily to the battery.

in order to avoid contamination, clean the top of the battery and remove the caps. Add distilled water about 5-10 mm above the plates. Reinstall and tighten the caps. Dry the upper part of the battery. Check the operating temperature values of the battery that you use (approximately between -5 °(and 50 °(). The battery fluid may freeze or boil under suboptimal temperatures. For this reason, it becomes inoperative.

CAUTION !

* Batteries release flammable gases. Do not smoke, avoid sparks or open flames around the batteries.
* Always hold the batteries carefully and to prevent possible acidic burns wash your hands after contacting.
* Wear suitable protective clothing
* Do not allow unauthorized personnel around battery charging area
* Check the charging systems together with batteries.

8. RADIATOR MAINTENANCE

The radiator, provided together with the engine radiator, are designed and manufactured ta operate smoothly under industrial conditions far years, as long as the maintenance is perfarmed. General information about the methods of radiator maintenance will be given.

* Radiator coolant normally works under pressure and it is extremely hat.
* Do not work on the radiator ar remove the radiator hoses until it cools down.
* Do not work on the radiator and remove the guard when the fan is operating.
* Corrosion over the radiator is the primary cause of failures. Always make sure that whether there is a leak ar not in the radiator hose connections.

The radiator must be filled up full. Partial filling of the radiator will lead ta rapid spread of corrosion. Far a non-operative generator, drain the radiator completely ar make sure that the radiator is protected. Radiator can only be filled with distilled water ar soft natural water ara certain amount of proper corrosion inhibitors must be added ta the water. Radiator in dusty and dirty environments may not fulfill its duty due ta clogging by dirt, engine fumes, humidity, various particles and ete.; this contamination degrades the performance of the radiator.

* Low pressure steam must be used far cleaning the deposit farmations regularly. Far tougher residues, radiator can be dipped into alkaline solutions up ta 20 min and then washed with hat water.

9. LOW-LOAD OPERATION

Using the generator set over the category (ESP/PRP/COP) and capacity specified in the label values is as disadventegous as using it at low-load.

This condition should be considered further in particular far the use of high-capacity generators.

The minimum allowable load far generator sets under ESP and PRP category is 30% of the full power. This is 25% far COP.

Operating the generator sets at no-load ar low-load should be avoided ar this period should be decreased ta the minimum level.

If weekly-test run should have ta be perfarmed at no-load, the test must be limited ta 10 minutes. it is recommended ta run the engine, operating at 30% ar at no-load far 1 hour; at load of 60% ar more far 30 minutes ar longer.

it is recomended ta run the generator set at 75% load and far 30 minutes ar longer every year far 4 hours.

it should be monitored at regular intervals whether there is oil leakage ar not, the exhaust manifald and muffler should be removed, and checked and cleaned against carbon accumulation.

If a sufficient load to the generator set can not be supplied, connecting a dummy load for preventing adverse effects is recommended.

Maintenance periods of generator sets running at low-load should be performed at periods shorter than the time specified in the schedule. in addition, replacing the oil and fuel filters in every six months is recommended. Fuel injectors and turbocharger should be checked every two years.

Symptoms and problems that may occur due to performing an operation under specified minimum load limits:

Oil leal<age at exhaust system and air intal<e system

As a result of no-load or low-load operation fora long time;

* As the temperature cylinders will be remained lower than the normal level, the fuel entering into the cylinder is not fully combusted. Non combusted fuel and oil vapors are condensed in the exhaust system.
* The turbocharger oil seals do not work efficiently at low-load and this will cause the oil to enter into intake and exhaust manifolds with the air.

As a result of this, oil leakages occur at air intake and exhaust manifolds. This leads to unsightly oil drippings from exhaust manifold junction points.

This is especially seen on Standby (ESP) generators in which the weeldy test runs are made at no-load.

Carbon accumulation on cylinder covers and exhaust manifold

Non combusted fuel, oil vapor and soot deposits will cause degradation of engine performance by contaminating exhaust valves and seats at cylinder covers, piston rings, exhaust manifold and injector nozzles.

it alsa causes to decrease the performance by clogging the exhaust muffler and pipes. This can result in serious engine damage at further stages.

Abrasive damage

Low exhaust temperature causes concentration of sulfuric acid at exhaust system and leads an abrasive damage to the engine.

Deterioration of lubricating oil's characteristics

Non combusted fuel due to poor combustion performance causes deterioration of the characteristics of the oil in the crankcase by mixing with the oil in the cylinder. The deteriorated oil will cause early wear of rotating parts and bearings.

The turbocharger bearings running at extreme high-speed are primarily influenced by abrasion that may cause oil leakage and damage. There will be more oil consumption than the normal value as a result of such running.

Whitesmoke

Non-combusted fuel will be discharged in the form of white smoke from the exhaust.

10. LONG-TERM STORAGE

I<eeping the generator set out of service or storing ata place fora long-time have adverse effects over the engine, alternator and equipment. and torun in this way causes the parts to be damaged. This procedure should be implied for generator sets that will not be used for 3 months. For the storage less than 3 months, it would be sufficient to keep the generator set in a protective packaging in a dry place and to operate fora short-time at least in every 15 days. The following procedures should be performed by a qualified technician by considering the safety measures. Before the stand-by procedure, run your generator set until it reaches up to the nominal operating temperature (approximately 75 degrees) and check it against any malfunction. This process must certainly be carried out in a timely manner to obviate problems during activation.

Storage up to 3-6 Months

* Replace engine oil and oil fi iter
* Check the coolant level and antifreeze ratio. If it does not contain a sufficient amount of antifreeze, drain the water from water fi iter and from the whole system.
* Replace fuel fi iter. Drain water and sediment from the fuel tank and refuel to the maximum level.
* Stop the generator after you have tested.
* Disconnect the battery cables. Clean the battery and keep under constant charging.
* Completely clean the generator with a damp cloth. Do not use water jet.
* Check electrical connections and terminals.
* Spray moisture-repellant spray on the electrical system and connections.
* Spray protective oil on air suction line.
* Loosen V-belts
* Close the air inlet and the exhaust outlet.
* Pack the generator and put warning label over the package.
* I<eep the generator in a dry place that is not exposed to dust, wind, sun, precipitation and thermal changes.

Storage for more than 3 months (2 years)

* Drain the engine oil.
* Fiil up with diesel engine protective oil {JIS 1<2246 NP10) to the maximum level of oil dipstick.
* Dip the fuel suction and return line into container including 1/3 of protective oil {JIS 1<2246 NP9) and 2/3 of diesel oil mixture.
* Run the engine until it consumes 2 liters of this mixture and then stop the engine.
* Drain the fuel system and re-connect suction and return lines into their places.

* Drain the fuel tank and clean it.
* Drain the protective oil from engine and fi iter.
* Spray protective oil on air intake manifold.
* Spray protective oil on turbocharger compressor side.
* Unscrew rocker covers and spray protective oil on the valve, valve springs, valve guide, cylinder head cover and pistons, and fasten and close the covers back again.
* Close the air inlet and the exhaust outlet.
* Loosen V-belts
* Disconnect the battery cables. Clean the battery and keep under constant charging.
* Completely clean the generator with a damp cloth. Do not use water jet.
* Check electrical connections and terminals.
* Spray moisture-repellant spray on the electrical system and connections.
* Spray protective oil on air suction line.
* Loosen V-belts
* Close the air inlet and the exhaust outlet.
* Pack the generator and put warning label over the package.
* Keep the generator in a dry place that is not exposed to dust, wind, sun, precipitation and thermal changes.

Activation processafter storage

* Unpack the generator, remove the air intake and exhaust outlet covers.
* Inspect the generator set visually and by your hand.
* Make sure that the generator installation is performed in accordance with the rules and the pre-start procedures are completed.
* Renew engine oil and oil fi iter.
* Clean the fuel tank and fiil up with new fuel (far more than six months storage).
* Renew the fuel filter.
* Clean the air fi iter, replace if necessary.
* Check and tighten V-belts and pulleys.
* Removing lubricating pipe of the turba and lubricate bearings. in the meantime, manually rotate the turba rotor.
* Check the valve clearances. Adjust if necessary.
* Unscrew rocker covers and spray protective oil on the vaive, valve springs, valve guide, cylinder head cover and pistons, and fasten and close the covers back again.
* Check all hoses and pipes, fasten clamps and screws.
* If there is any detached screw or plug, re-attach.
* Check the coolant level and anti-freeze ratio. If drained before storage, fili up with new 50% water mixture.
* If humidity is detected at storage environment, a stator winding insulation test should be performed before starting the alternator. Before the operation AVR wiring must be disconnected. If a value of less than 5 ohms is measured, the alternator must be cleaned and dried, and then re-measured.
* Turn the engine by 2-3 turns by your hand before cranking.
* Check that the batteries are fully charged.
* Make the battery connections.
* By disabling fuel solenoid end, switch on the generator with starter motor fara short-time.
* Run the generator without load until the engine warms up. Check the engine against excessive vibration, sound and oil-fuel -water leakages.
* Run the generator at load and check again.

6 FAULT DETECTION AND TROUBLESHOOTING

This inspection and processes must be performed by trained and authorized persons and the right equipment must be used. Do not make any adjustment or replacement of parts without having any knowledge. This table is available in more detail in the Engine and Alternator Maintenance and Operation Manuals. If you cannot obtain a result through this table, please call Arken authorized services.

PROBLEM	POSSIBLE CAUSES	SOLUTION
Engine turns slowly, but not running	Batteries are discharged	Charge/Replace
	The starter motor failure	Repair/Replace
	Oil specification is inappropriate	Change with appropriate oil
	No fuel	Add
	Air in the fuel system	Bleed air
	Fuel solenoid is not working	Repair/Replace
	Fuel filter is clogged	Replace
	Fuel priming pump failure	Repair/Replace
	Fuel injection pump failure	Adjust/Repair/Replace
	Compression pressure is insufficient	Measure/Engine overhaul
	Engine mechanical failure (piston, rings, etc.)	Engine Overhaul
	Control unit failure	Set/Replace
	Control panel problem	Repair/Replace
	Electrical connections problem	Replace
Engine is not running	Batteries are discharged	Charge/Replace
	Starter motor failure	Repair/Replace
	Starter relay failure	Replace
	Control unit failure	Set/Replace
	Emergency stop button is pressed	Switch to normal pos.
	Generator is at off position	Switch to normal pos.
	No fuel	Add
	Problem in fuel system	Repair/Replace
	Air in fuel system	Bleed air
	Fuel specification is inappropriate	Use appropriate oil
	Air intake is clogged	Open the flap
	Air filter is clogged	Replace
	Compression pressure is insufficient	Measure/Engine Overhaul
	Engine mechanical failure (piston, rings, etc.)	Engine Overhaul
	The ambient is very cold	Warm up the ambient/engine
	Electrical connections problem	Repair

Generator does not stop	Mains power problem	Control mains input voltage
	Fuses blown	Repair
	Control unit failure	Set/Repair/Replace
	Stop solenoid failure	Set/Replace
	Generator is performing cooling	Wait/Check the time

PROBLEM	POSSIBLE CAUSES	SOLUTION
Engine overheating	Air filter is clogged	Replace
	Injectors are defective	Adjust/Replace
	Wrong type of injectors	Replace
	Inadequate supply of fresh air	Optimize
	Insufficient hot air discharge	Optimize
	Inappropriate blinds / hood	Optimize
	Excessively contaminated or clogged radiator	Clean/Replace
	Intercooler is clogged	Clean/Replace
	Cooling water is insufficient	Add
	Cooling fan is not working properly	Repair
	Belts worn or loose	Adjust/Replace
	Excessive lubrication oil	Replace
	Water hoses are clogged	Control/Repair
	Water pump is faulty	Repair/Replace
	Motor thermostat failure	Control/Replace
	Cooling system (water-air) leakage	Repair/Replace
	Overload	Reduce load
	Excessive exhaust gas back-pressure	Optimise
	Lubrication oil specification is inappropriate	Replace
Lubricating oil pressure is too high	Censor failure	Replace
	Indicator is faulty	Replace
	Lubrication oil specification is inappropriate	Change with appropriate oil
	Excessive lubrication oil	Replace
Blue exhaust gas output	No-load/Low-load operation	Load over 30%
	Excessive oil consumption	Measure/Engine Overhaul
	Compression pressure is insufficient	Engine Overhaul
	Engine mechanical failure (piston, rings, etc.).	Control/Replace
	Cold start system failure	Warm up Ambient/Engine
	Engine is too cold	Control/Replace
	Motor thermostat is defective (temperature does not rise)	Replace
White exhaust gas output	Fuel specification is inappropriate	Replace
	Fuel injection pump failure	Adjust/Repair/Replace
	Injectors are defective	Adjust/Replace

	Overload	Reduce Load
	Fuel specification is inappropriate	Replace
	Valve clearances are not adjusted	Adjust
	Injectors are defective	Adjust/Replace
	Fuel priming pump failure	Repair/Replace
	Compression pressure is insufficient	Measure/Engine Overhaul
	Air filter is clogged	Replace
	Inadequate supply of fresh air	Optimize
	Charge air is not cooled down	Control/Repair
	Excessive lubricating oil	Replace
	Use of low-viscosity engine oil	Optimize
	Oil leakage	Repair
	No-load/Low-load operation	Load over 30%
	Engine mechanical failure (piston, rings, etc.)	Measure/Engine Overhaul
	Oil cooler failure	Repair/Replace
	Cylinder head problem	Repair/Replace

PROBLEM	POSSIBLE CAUSES	SOLUTION
	Batteries are discharged	Charge/Replace
	The starter motor failure	Repair/Replace
	Oil specification is inappropriate	Change with appropriate oil
Fuel over-consumption	No fuel	Add
	Air in the fuel system	Bleed air
	Fuel solenoid is not working	Repair/Replace
	Fuel filter is clogged	Replace
	Fuel system problem	Repair/Replace
	Air in fuel system	Bleed air
	Fuelspecification is inappropriate	Use appropriate fuel
	Air intake is clogged	Open the flap
	Air filter is clogged	Replace
	Compression pressure is insufficient	Measure/Engine Overhaul
Motor output power loss	Engine mechanical failure (piston, rings, etc.)	Engine Overhaul
	Ambient is too cold	Warm up Ambient/Engine
	Electrical connections problem	Repair
	Mains power problem	Control mains input voltage
	Fuses blown	Repair
	Control unit failure	Adjust/Repair/Replace
	Stop solenoid failure	Adjust/Replace
	Generator is performing cooling process	Wait/Check the time

Alternator does not produce voltage (no-load voltage is lower 10% than nominal voltage)	Loose connections	Control/Repair
	Rotating diodes or supressor failure	Control/Replace
	Exciter circuit short-circuit or disconnected	Control/Repair
	Insufficient voltage reference	Apply external warning
	Fuseis blown (at AVR line)	Replace
	AVR failure	Control/Adjust/Replace
Alternator does not produce voltage (no-load voltage is lower 20-30% than nominal voltage. Voltaj insentivie to AVR potentiometer rotation)	Exciter stator link is broken	Control/Repair
	Exciter stator is connected incorrectly	Control
	Speed is lowerthan nominal	Control Engine Speed
	Voltage potentiometer is not set	Set
	Fuse is blown	Replace
Voltage is at 50-70% of nominal value	AVR failure	Control/Adjust/Replace
	Over exciter limitation	Adjust AVR pot
	Voltage pot. Is not set	Adjust Voltage (V) pot
	Capacitive load	Remove load capacitor
Output voltage is too high	AVR failure	Control/Adjust/Replace
	Engine speed is variable	Adjust Engine speed
	Stability pot is not adjusted	Adjust STAB pot
Instable output voltage	AVR failure	Control/Adjust/Replace

7 WARRANTY

Arken Generator products are covered under the scope of guarantee in accordance with the terms and instructions specified in the guarantee procedure. In order to receive guarantee service and not to be excluded from the guarantee coverage of your generator set within the warranty period, act in accordance with this procedure.

Keep invoices, warranty certificate, dispatch note and service registration forms of your generator set. These documents must be presented when requested.

Obligations of Arken Generator

* The warranty period is 1 (one) year or 1.000 hours of operation - whichever comes first- from the date of invoice.

* The complete part of the product, including all components is covered by our company's warranty against manufacturing and product defects.

* Malfunction of product within the warranty period due to defects both in terms of material and workmanship and as well as assembly; will be repaired without requesting any charge under labor costs, under the cost of replaced parts or under any other name.

* Arken is obliged to deliver the maintenance and operation manuals together with the product.

Obligations of the Customer

* The issues included in General Maintenance and Operation Manual, Diesel Engine Manual and Alternator Manual provided with the generator set should be observed. The damages due to failure to comply the issues included in these manuals are excluded from the scope of guarantee. In case of losing any of these books, the customer is obliged to obtain the book as soon as possible.
* Installation approval and commissioning process of the generator set should be performed by Arken or an authorized service technician. On the contrary case, the guarantee shall be invalid.
* The intervention of third parties, other than the technical services of Arken, should not be allowed under any circumstances. Otherwise, the guarantee shall be invalid.
* The placement and installation of generator set should be performed in accordance with installation principles specified by Arken. Failures due to improper installation shall not be covered under the scope of guarantee.
* The periodic maintenance, inspection and adjustments specified in General Maintenance and Operation Manuals should be carried out exactly. In case of failure to perform any of them, the guarantee shall be invalid.
* Spare parts and consumables (engine oil, filters, antifreeze, belts, injector nozzle, etc.)that are naturally weared or needed to be replaced depending on the generator set's operating hours or the period of being in use, are excluded from warranty coverage, and the replacements are charged.
* Specific and sufficient amounts of lubricating oil, antifreeze or additives specified in General Maintenance and Operation Manual must be used. In the event of the use of oil and anti-freeze with different characteristics and Standard that are dirty and lost their characteristic features, the warranty shall be invalid. In case of not using anti-freeze, the warranty shall be invalid.

* Diesel (diesel fuel) specifications that are mentioned as fuel in manuals must be used for diesel generator sets. The guarantee shall be invalid in case of using biodiesel, JP4, JP8, kerosene-based fuels, fuel oil, gasoline and etc., and also fuels that are dirty, aqueous and including chemical additives.
* Batteries must be stored under protection and should not be discharged. Batteries that are deformed, broken, and lost their features due to being discharged and overcharged are excluded from the guarantee covarege.
* Attachments and modifications over the generator set's control system-manual, automatic, synchronization panels, transfer boards, equipment and etc. - must be carried out by Arken. On the contrary case, the warranty shall be invalid.
* Generator control unit programs must be set up or changed by Arken technical officer. On the contrary case, the warranty shall be invalid.
* Operate and stop the generator sets as described in the general maintenance and operation manuals. Do not operate and stop under load. This may lead the engine valves and components, alternator excitation windings, rotating exciter diodes, suppressor and voltage regulator card to be damaged. The damages occurred due to this condition are excluded from the coverage.
* Original spare parts and consumable materials (oil, fuel, filters, belts, etc.)approved by Arken should be used during the warranty period. The guarantee is terminated in case of using spare parts and supplies that are not approved.
* The guarantee shall be invalid in case of deleting, removal or changing the labels of the generator set.
* Generator set should be used according to the category (Standby) and declared value indicated on its label. Faults due to imbalanced loads exceeding the declared value at different operating category, are excluded from the guarantee coverage.
* The generator set should not be used under 30% load for a long time. Faults caused by operating under no-load or low-load specified in the general maintenance and operation manual are out of warranty.
* Natural disasters, earthquakes, snowstorm, landslides, fire, flood, inundation or damages resulting from the power grid are excluded from the scope of the guarantee.

Manufacturer Company	
ARKEN JENERATÖR A.Ş.	
Registered Office Address: Tevfikbey Mah. Dr. Ali Demir Cad. Kobi İşm.N:51/2 SEFAKÖY KÜÇÜKÇEKMECE /İSTANBUL/TÜRKİYE	
Phone: 212 424 0 275	Fax: 212 424 0 285
Web: www.arkengenerator.com	

Product Details	
Type: Genset	Brand: ARKEN
Genset model:	Genset serial no:
Engine model:	Engine serial no:
Alternator model:	Alternator serial no:
Dealer Company's	
Title:	
Address:	
Phone:	Fax:
Invoice Date and No:	Dealer Authorized Person Name & Signature:
Delivery Date:	

Buyer Company's	
Title/ Name Surname:	
Address:	
Phone:	Fax:
E-mail:	Buyer Authorized Person Name & Signature:

Arken Jeneratör AŞ

Haraççı Mah. Dolmabahçe Cad. No:22
Arnavutköy - İstanbul / TÜRKİYE

tel +90 212 **424 0 275**
faks +90 212 **424 0 285**

mail info@**arkenjenerator**.com
web www.arkengenerator.com