Tescom
Generator

DIESEL GENERATOR MAINTENANCE AND OPERATION MANUAL

THANK YOU

Dear Tescom Generator User,

First of all, thank you for choosing Tescom Generator.

This Operation and Maintenance Manual has been prepared to ensure the safe and efficient operation of your generator set. It contains information and basic instructions for correct transport, assembly, operation and maintenance.

Before using your generator set, it is necessary to read the manual carefully and follow the instructions correctly in order to ensure your life and property safety.

Tescom Generator sets are designed for electricity generation according to the environmental and working conditions that specified or agreed in your contract. In case of any change in working conditions and / or environmental conditions, you should contact with Tescom Generator or the institutions authorized by Tescom Generator.

In order for you to use your generator set more efficiently, periodic maintenance of your generator should be done at recommended intervals by experienced and competent people. For this, you can contact with Tescom Generator or the institutions authorized by Tescom Generator about the periodic maintenance contract.

Your generator is covered by the warranty for 1 (one) year or 500 (five hundred) working hours (whichever period comes earlier) within the border of the country under the conditions specified in the warranty document. In case of changes made on the generator without the approval of Tescom Generator, using non-original spare parts and faults caused by external factors, your generator will be out of warranty.

This manual has been prepared for a wide range of products. In case the specified instructions and safety standards are updated, you can contact with After Sales Services Department of the Tescom Power Generator.

Tescom Generator, who is continuing the continuous improvement and development activities of its products, reserves the right to make changes in this operation and maintenance manual. We hope you use your generator set on healthy and beautiful days with uninterrupted energy.

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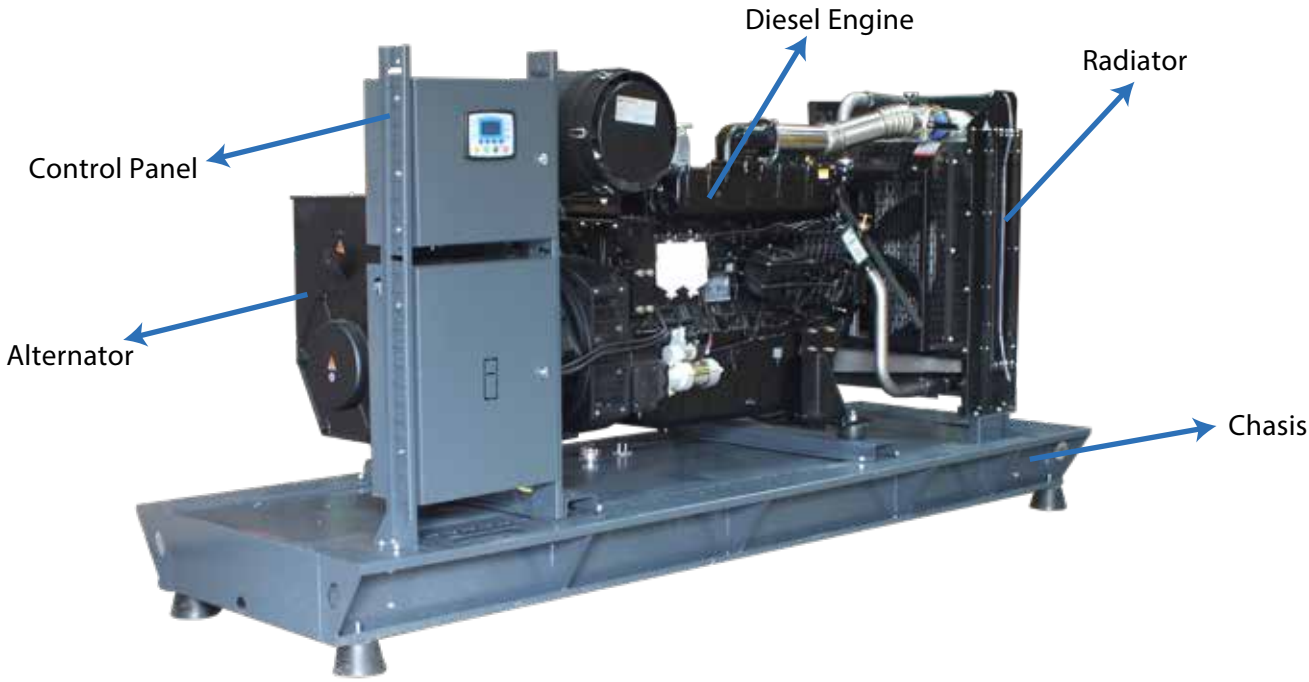
INTRODUCTION

1.1 DEFINITIONS ABOUT THE GENERATOR

Generators are complex electrical machines in whi ch the chemical energy stored in fuels is first converted into mechanical energy with internal combustion engines and then into electrical energy through alternators.

Generators can be diesel, gasoline, natural gas or hybrid depending on their fuel consumption. Diesel engines are widely preferred in generators used as utility backup.

The main components of diesel generators consist of the diesel engine, radiator (cooling group), alternator, control panel, and chassis that containing the fuel tank up to a certain power.



Parts of the Generator

1.2 BASIC ELECTRICAL CONCEPTS AND UNITS

Voltage (U): It expresses the potential of electrical energy, unit is volt.
In low voltage systems in Turkey, phase-to-phase voltages is 400 volts, and the phase-to-neutral voltage is 230 volts. Voltage values may differ according to the utility infrastructure of the countries. The output voltage of diesel generators to be integrated into the system and the voltage of utility must be the same.

Voltage is similar to pressure in mechanical concepts.

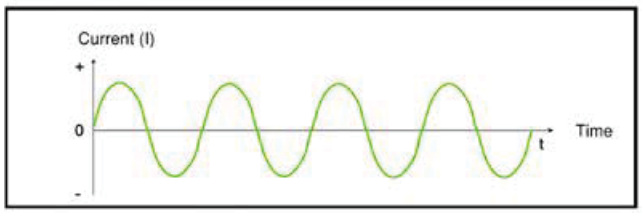
INTRODUCTION

Current (I): The amount of charge of an electric particle passing through a unit surface in 1 second, unit is amphere. It varies according to the magnitude of the electrical charge. Current is similar to flow in mechanical concepts.

Direct Current (DC): Its direction and intensity do not change depending on time.

Direct Current

Alternating Current (AC): Its direction and intensity are variable with respect to time; it has two components as frequency and amplitude. Electric utilities and generator systems backing them up provide alternating current.



Alternation Current Wave

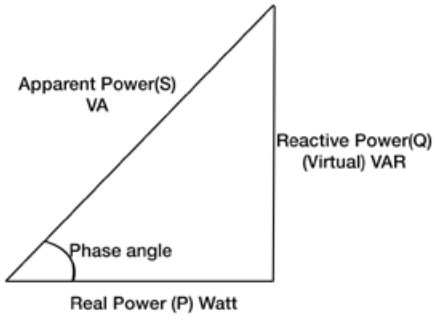
Frequency (Hz): The number of times an alternating current wave (sine curve) occurs in 1 second, unit is hertz. Frequency may vary as 50 Hz / 60 Hz according to countries. In Turkey, the utility frequency is 50 Hz.

Electrical Power Units:

Apparent power (S): The power representing the capacity and physical size of generators, transformers, and uninterruptible power supplies; its unit is kVA (kilovolt-ampere), which is the vector sum of active and reactive power.

Active power (P): Refers to the effective active power. The unit is kilowatt (kilowatt). Electric motors and other mechanical systems are referred to in kilowatts.

Reactive Power (Q): It is the inactive power component caused by the phase difference between current and voltage in electrical circuits containing coils or capacitors; its unit is kVAr (kilovolt ampere reactive).



Power Triangle

INTRODUCTION

1.3 CLASSIFICATION OF GENERATORS ACCORDING TO THEIR OPERATION TIME

●Standby Power (ESP – Emergency Standby Power)

It is the situation where the generator is used as a backup energy source and operates intermittently under variable loads; at the same time, It also refers to the maximum power that can be obtained from a gene - rator. Generators cannot be loaded above standby power; they are limited to 200 hours of work per year.

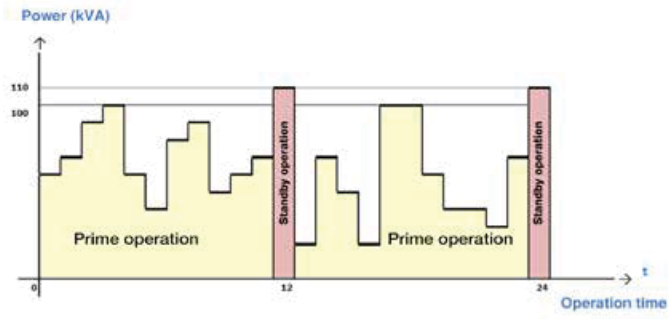
In practice, the most common use of diesel generators is standby applications.

Limited Time Running Power (LTP) is the case when a standby generator is allowed to operate up to 500 hours per year as needed (eg hospital) as a utility backup. However, the expected maintenance period should be decreased under such working situation.

● Prime Power (PRP)

It is the situation in which the generator works continuously under variable loads; It can operate continuously under variable loads for 365 days a year and 24 hours a day. It is recommended to choose according to prime power in locations where there is no utility energy.

The generator may be allowed to be loaded 10% more than prime power for 1 hour at any time interval in 12 hours of period.



Prime Operation

● Continuous Power (COP – Base Load)

It is the state of continuous operation of the generator under constant load; It can operate continuously under 100% load for 365 days a year and 24 hours a day. In reality, it is not common practice for diesel generators due to operating costs; It is mostly valid for units with natural gas engines or turbines.

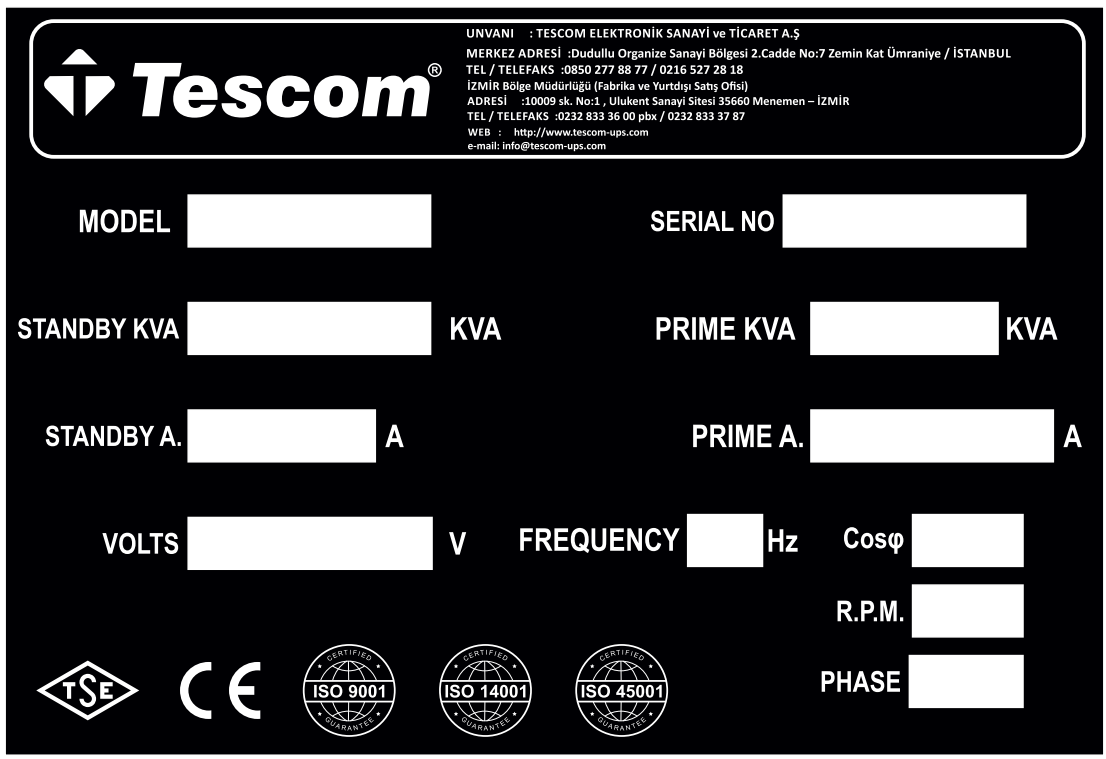
Continuous power is the power selection criterion in applications that provide combined heat and power generation in applications such as cogeneration and trigeneration; it is 20% lower than the main power.

1.4. ABOUT TESCOM GENERATOR SET

As a result of the knowledge and experience gained since 1996, Tescom Generator groups have been designed with the aim of providing sustainable performance by keeping all kinds of life and property safety at the forefront.

There is a "Tescom Generator set identification label" as shown in below picture on the chassis and / or cabinet of your generator set. This label contains information about your generator's manufacturing year, voltage, current, power, frequency, power factor, weight, motor and alternator.

You can easily got your service, spare parts, technical support requests that you send to our factory or authorized services, by using the reference information on the generator set identification label.



Tescom Generator Set Identification Label

SAFETY PRECAUTIONS

2.1 GENERAL

The generator set must be installed, operated and safety precautions must be followed in accordance with the maintenance and user manual. The generator set will serve safely only in this way.

Safe operation responsibility of the generator set is belongs to the people who install, use and maintain the generator set. When the safety precautions are followed, the risk of accidents will decrease.

The generator set should be used by people who have been trained or authorized in this area, and who have read and understood the maintenance and user manual.

Failure to follow the rules, instructions, methods and safety precautions in this book may increase the probability of malfunction, accident and injury; it may even result in death. Personal protective equipment should be used during manual operation and periodic maintenance or controls of the generator.

When the generator is in automatic (AUTO) position, taking into account that the engine can start and activate automatically at any time, unauthorized access to the generator site should be prevented.

Attention should be paid to the labels and warnings on the generator set. The generator set must be installed and operated in strict accordance with applicable standards, rules and regulations.

Before performing maintenance, repair or adjustment, the generator set should be turned OFF and precautions should be taken against the intervention of others.

Do not operate the generator set unless it is safe. In unsafe situations, immediately attach a danger warning sign on the generator set to prevent damage to other person / persons, disconnect the battery terminals and disconnect all cable connections and disable the generator set

This book and its supplements should be considered as a whole. Safety precautions are provided in the relevant chapters of this book.

Do not neglect to consult Tescom Generator or authorized services for incomprehensible issues.

READ THE USER'S MANUAL

USE INSULATED GLOVES WHILE WORKING THE PANEL

USE WORK GLASSES

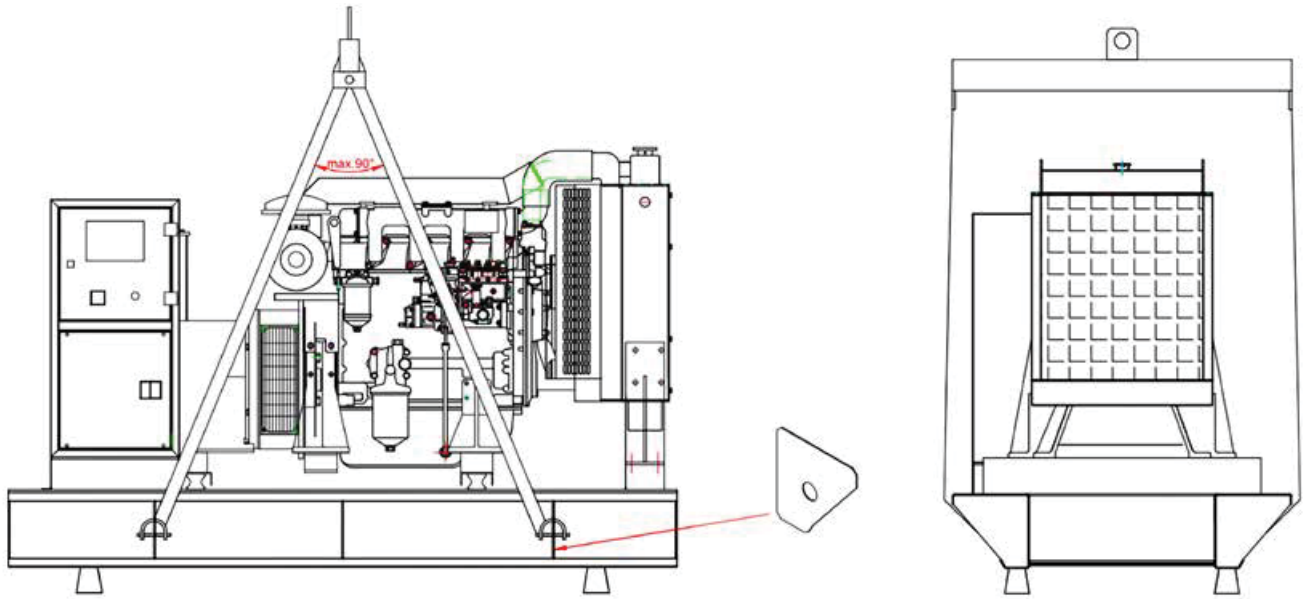
2.2 LIFTING AND TRANSPORT

Use the lifting lugs on the chassis to lift the generator set. Do not lift from the lugs on the engine and alternator.

Absolutely ensure the necessary checks for the lifting lugs or connection points before lifting, against welding cracks, ruptures, bending, cracks, rusted or lost quality parts, loose bolts and nuts.

Make sure that all lifting equipment and support materials are workable and will withstand a weight of at least 10% more than the gross weight of the generator set. Make sure that the lifting hook or locks are functional safety latches and are properly connected.

When the machine is lifted off the ground, use guide ropes or equivalent to prevent it from turning and shaking. Do not try to lift the generator set under strong winds.



Generator Lifting and Transport

When the generator set is suspended, keep the operator of the lifting device always in place and ready. Place the generator set on flat surfaces that allow more than 10% of its gross weight and have a bearing capacity and are not at risk of slipping. Make sure that the personnel are out of the generator set before closing and locking the doors.

Canopied type generators should be lifted from the chassis, not from the lugs on the cabin. In order to prevent the generator from being damaged during lifting, the ropes should be tied to the eyebolt of the crane with an apparatus (sling).

SAFETY PRECAUTIONS

The generator chassis is not suitable for pushing or pulling directly with a forklift when it is directly on the ground or when vibration shocks are mounted.

If the generator needs to be transported horizontally, suitable transport trolleys and professional apparatus should be placed under the chassis, and the generator should be moved with a forklift or crane support.

ATTENTION!
STAY AWAY FROM
OVER HEAD LOADS !

2.3 MOVING PARTS

ATTENTION!
MOVING PARTS

Keep your body, especially hands, arms, hair and clothing away from propellers, belts, pulleys and other moving and rotating part. Do not attempt to operate the generator set while the fan and other guards are removed.

In case of working around the generator set or in front of moving parts, wear tight clothes and collect your long hair.

Keep the access doors closed except for checking, maintenance, repair, adjustment, service, and starting or stopping the generator set.

Ensure that all personnel are at a certain safe distance from the generator set when it is started or out of service.

In order to minimize the possibility of slipping and falling, keep your hands, feet, ground and walking areas clean from fuel, oil, water, antifreeze or other liquids.

2.4 HOT SURFACES, SHARP EDGES AND CORNERS

ATTENTION!
HOT SURFACE

ATTENTION!
SHARP EDGE

Avoid body contact with hot oil, hot coolant, hot surfaces, sharp edges and corners.

Protect all parts of your body from hot exhaust pipes and gases.

When working inside, outside or around the generator set, wear protective clothing such as gloves, boots and helmets.

Keep the first aid book handy. In case of injury, seek medical assistance immediately. Do not neglect minor and cut injuries.

2.5 FIRE AND EXPLOSION

Refuel in accordance with the usage and norms from a fuel tank or service station designed for the purpose of use.
If fuel, oil, battery electrolyte or coolant buildup accumulates on the ground, clean them with sawdust or absorbent products.
Before adding fuel, checking the electrolyte level of the batteries or changing the oil, turn off the generator set and allow it to cool down. Keep sparks, flames and other sources of ignition away from the generator.

Do not smoke around the generator and do not allow smoking in the vicinity.

Do not allow the formation of fuel or oil film on the generator set, on the chassis or in the cabin if any. Wipe dirty surfaces using a liquid industrial cleaner.

ATTENTION!
DANGEROUS
FLAMMABLE MATERIAL

ATTENTION!
EXPLOSIVE GASES

FORBIDDEN TO USE
OPEN FLAME

NO SMOKING

Do not use flammable chemicals for cleaning.

Before connecting or disconnecting the battery, turn off or disconnect the connection to the battery charger.

Before starting repair or maintenance on the battery and its surroundings, disconnect the battery negative (-) pole. Put a danger warning sign on the battery connector to prevent others from reconnecting in any way.

Keep electrical cables, battery terminals and other terminals in good condition. If there is any cracked, cut or corroded cable, insulation in bad condition, or worn, discolored or rusted terminal, replace it with a new one.

Be sure to ground the bodies of conductive objects that exposed to draft, such as electrical materials and terminals, in order to prevent them from creating an ignition source by arcing.

Do not attempt to weld or repair damaged fuel tanks or pipes, replace them with a new one. If any leakage is detected in the fuel system, do not start the generator set and eliminate the leak.

Do not forget that the temperature of the exhaust gas, exhaust manifold and exhaust outlet is around 550 ° C, insulate the hot surfaces, do not approach these areas without making sure that the system is cool down, and avoid the contact of flammable materials with these areas.

SAFETY PRECAUTIONS

Before starting the welding process, remove heat-damaged or flammable materials from the environment. Keep oily rags, chemical waste, leaves, garbage or other flammable materials away from the generator set. Keep ABC class fire extinguishers close to the place where the generator set is located and check their occupancy routinely (at least once a year).

Do not let leaves and branches come into contact with the hot exhaust system of the generator set used in wooded and forested areas.

Do not attempt to install or operate generator sets in hazardous areas.

2.6 TOXIC AND IRRITATING SUBSTANCES

Inhaling engine exhaust gases is dangerous to humans. The exhaust gases of all generators in closed spaces must be disposed of in unmanned areas by means of sealed pipes in accordance with the relevant standards. Hot exhaust silencer and exhaust pipe should be kept away from flammable materials and should be protected for the safety of personnel. Do not operate your generator in closed areas with exhaust gas leakage.

Install and operate the generator set only in open or well-ventilated areas.

ATTENTION!
TOXIC AND IRRITATING SUBSTANCES

ATTENTION!
IRRITATING SUBSTANCES

Inside the cabinet of cabin type generators and when open type generators are installed in a low ceilinged room, it is recommended to make heat insulation with rock wool and aluminum embossing or heat insulation jacket in order to prevent possible contact with the exhaust system.

Make sure that the exhaust gas outlets are not given to personnel areas and places where there is a danger of going to these areas or near to air sunction ducts.

Fuels, oils, cooling fluids and battery electrolytes used in the generator set are industrial types; Necessary precautions should be taken to prevent accidental ingestion or skin contact. If it penetrates into the body, seek medical assistance immediately.

In case of contact with the skin, wash the contact area with water and soap.

While maintaining the batteries, wear an acid-proof apron and use a face protective mask or goggles. If the electrolyte has spilled on the skin or clothing, clean it immediately with plenty of water.

2.7 ELECTRIC

ATTENTION!
ELECTRIC
HAZARD

The wiring of the generator set should be made only by trained and authorized qualified electricians.

Make sure that the electrically powered parts of the generator set do not come into direct contact with the body or any uninsulated conductive object.

Before making all cable connections, dismantling and operating the generator set, make sure that the grounding has been done in accordance with the applicable regulations.

While the generator sets are standing in water or on wet ground, do not attempt to start the generator; Do not attempt to connect or disconnect the generator from the electricity

Before making or removing the electrical connections of the generator set, stop the engine, disconnect the supply of the battery charger and the battery connection. Disconnect the ungrounded conductor connections on the load side and leave them outside.

Prevent the direct contact of any part of your body with the moving parts of the electrical system on the generator set or indirectly through any hand tool or other conductive object. In the adjustment and repair of the electrical system of generator set, and stand on insulating surfaces with dry litter.

Re-install the generator set electrical connection terminal cover as soon as possible when the connections are made or removed; otherwise, do not operate the generator set.

When the generator set is out of service, lock and close all access doors of the generator.

Keep the towing vehicle or equipment carriers at least 3 meters away from electric cables and buried power cables connected to the generator set.

Perform repairs in clean, dry, well-lit and well-ventilated areas.

Connect the generator set only to receivers that comply with the electrical characteristics and are within the specified power capacity limit. Make electrical connections with conductors within the current carrying capacity limit in accordance with their norms.

2.8 NOISE

The sound intensity of diesel generators that are not equipped with a sound insulation cabin is between 90 - 110 dBA at a distance of 1 meter. Prolonged exposure to sound intensity of more than 85 dBA is dangerous to hearing.

EARMUFFS

For indoor generator sets, acoustic measurements should be made after installation and appropriate protective measures should be taken if necessary.

Earmuffs must be used while working at the generator site.

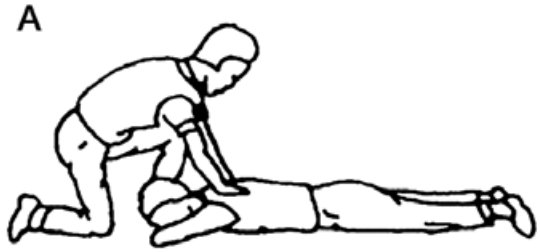
SAFETY PRECAUTIONS

2.9 FIRST AID IN ELECTRIC SHOCK

First of all, turn off the electricity immediately, do not touch the casualty with bare hands until the energy is cut off. If it is impossible, protect yourself with dry and non-conductive objects and completely remove the casualty from the conductor. Then follow the steps below in order.

a) Call the nearest health facility and seek medical assistance.
b) Lay the patient face down, with his head facing to one side and his head on his hands.
c) Remove objects from the patient's mouth such as dentures, tobacco, gum. Press firmly between the shoulders of patient's with the help of the palm of your hand. Make sure the tongue rests freely.
d) Kneel with one knee at the patient's head and the other foot at the patient's elbow.
e) Place the palm of your hands on the patient's shoulder and shoulder blades.
f) Push forward with your arms in a vertical position. Pressure should be light and provided without force (About 10-15 kg). Stay this way for 2.5 seconds.

A



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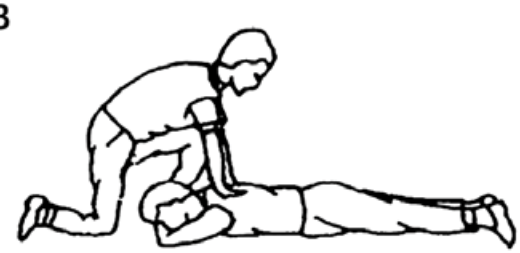
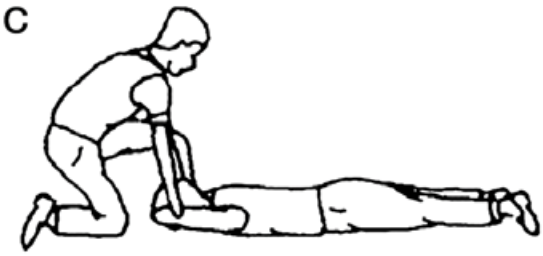


g) Release the pressure with your hands by sliding it over the patient's shoulders to the elbows (approximately 1 second). Following this, gently lift the patient's arms and shoulders by holding the elbows, and simultaneously stretch them back for about 2-3 seconds (see figure-C). Lower the patient's arms (see figure-D) and bring your hands back to the patient's shoulder blade.

C



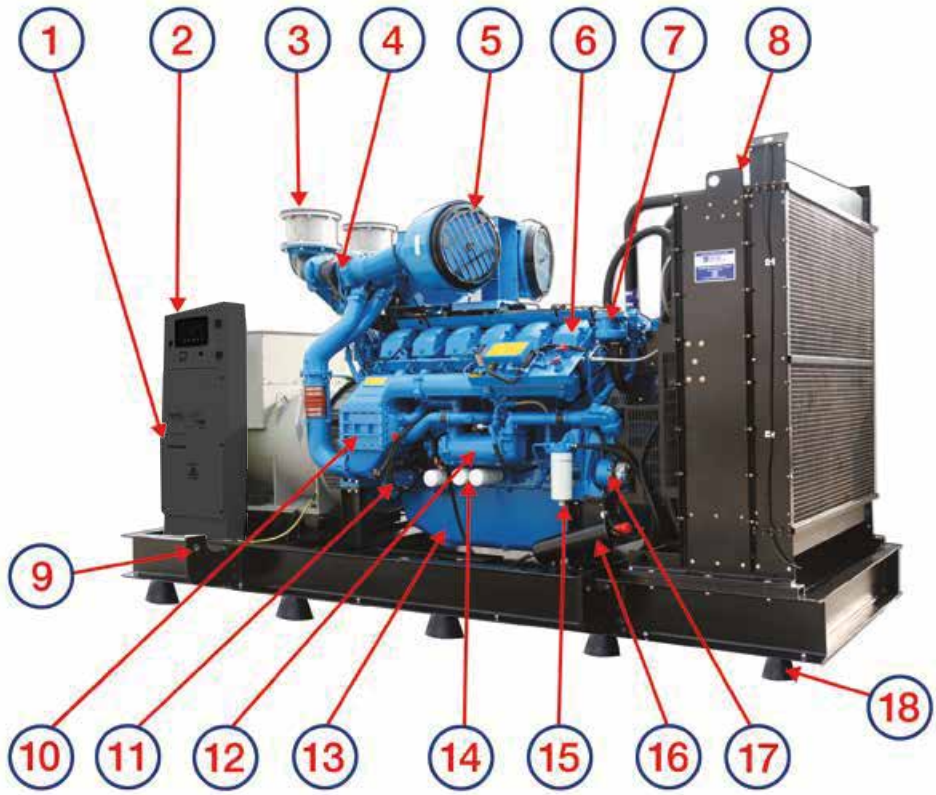
D

h) Repeat the steps so that each complete breath takes seven seconds.
i) While the artificial respiration is maintained, another person should assist in loosening the patient's clothing and keeping the patient warm.
j) If the patient stops breathing, continue for artificial respiration. Four hours or more time may be needed

Do not give fluid until the patient regains consciousness.

GENERATOR SET AND PARTS

Tescom Generator branded generators are manufactured using internationally accepted diesel engines and alternators with international standards. Diesel engine and alternator options are available in different brands and models according to their power and operating conditions. Generally, the components that make up the generator set are shown in the following image.



Jeneratör Seti ve Parçaları

1	Power Outlet / Switch Board
2	Control Panel
3	Compensator
4	Turbocharger
5	Air Filter
6	Cylinder Covers

7	Crankcase Breathing
8	Radiator
9	Lifting Eyes
10	Aftercooler
11	Starter Motor
12	Oil Cooler

13	Oil Pan
14	Oil Filter
15	Fuel Filter
16	Engine jacket water heater
17	Charge Alternator
18	Anti-Vibration Mounts

GENERATOR SET AND PARTS

3.1 DIESEL ENGINE

Tescom Generator uses heavy-duty diesel engines produced for generators that do not need to be modified in international standards.

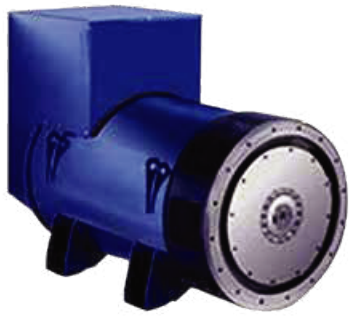
Diesel Engine

Engines with the following characteristics are used in the generator sets: precise speed regulation, low fuel consumption, four-stroke, atmospheric or turbo-charged depending on power, mechanical or electronic governor according to power, water-cooled.

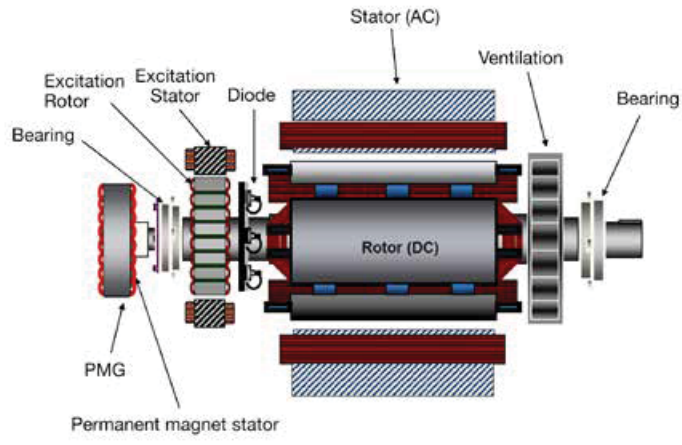
The electrical system of the diesel engines used is 12V or 24V direct current. 1 battery in generator groups with 12V electrical system and 2 batteries in groups with 24V, battery stand and connection cables are provided with the generator. Diesel engines are designed to operate safely and their filters are replaceable.

3.2 ALTERNATOR

Alternators used in Tescom Generators have following standards: single bearing, self-cooling, brushless, IP 21 and IP 23 protection standards. It is highly efficient, precisely regulated and self-warning as standard. Optionally, different voltage and frequency levels, dehumidifying winding heaters and thermal sensors can be provided.



General Structure of Alternator



Internal Structure of Alternator

3.3 CHASSIS AND FUEL SYSTEM

The daily fuel tank of Tescom Generators is in the chassis up to 1125 kVA standby power and is designed to operate for 6 - 8 hours at full load. The fuel suction and return connections of the generator are made and there is a mechanical and electronic fuel level indicator in the tank. An opportunity is provided for tank cleaning by using the fuel drain plug

Fuel temperature is an important factor for proper operation. High fuel temperature decreases the heat content per volume and engine output power due to expansion.

Chassis

Prismatic or cylindrical external fuel tanks are used above 1125 kVA standby power. For long service periods, main fuel tanks should be installed in addition to the daily fuel tank.

The connecting pipe from the main fuel tank to the daily fuel tank should be at least same size with daily tank feed pipe section or more. Fuel pipes should be black pipes, galvanized pipes should not be used.

The fuel used must be clean, there should be no water and corrosive liquids in the fuel. Otherwise, malfunctions may occur in the injector, fuel pump and actuator.

After filling the fuel tank and waiting for a while, it is recommended to drain the water and sediment that collection pan until the fuel flows. Hazardous wastes such as engine oil, antifreeze and fuel should be sent to authorized disposal companies.

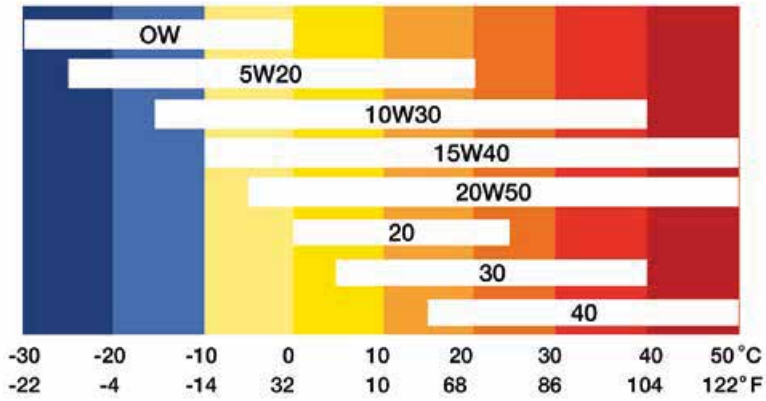
GENERATOR SET AND PARTS

3.4 LUBRICATION SYSTEM

The lubrication system of diesel engines is one of the most important parts of the engine. It ensures smooth operation of all moving parts in the engine and cooling of the engine at the same time. Correct engine maintenance (paying attention to oil change periods, filter change periods and the properties of the oil used) extends the life of the engine and reduces the operating cost of the engine.

Engines are lubricated with oils that form a protective layer between moving parts, such as bearings and piston rings / cylinder groups, by pumping oil to critical points of the engine by the oil pump. This oil layer separates metal surfaces from each other and reduces friction. By pumping oil into the engine, it is possible to maximize the power of the engine and reduce friction losses by reducing the friction between moving parts of the engine

The word viscosity describes how easily an engine oil flows.



Engine Oil Types According to Climatic Conditions

The viscosity of an oil is defined as its resistance to flow. Two numbers are used to describe the oil viscosity. The first number ends with the letter 'W' which means "Winter". This value shows the fluidity when the engine is first started and the oil is still cold. The second number is defined as the new fluidity of the oil after the engine reaches its normal operating temperature.

The smaller the number, the higher the fluidity. In other words, a 5W-30 oil used in the first start-up moments of the engine flows more easily than 10W-30 oil. At normal operating temperatures of the engine, a 10W-30 oil flows more easily than a 10W-40 oil. This change is important because the engine cools when stopped and the engine oil naturally thickens when it cools and becomes thinner with temperature.

Thin or low viscosity oils flow more easily to protect engine parts at low temperatures.

Thick or high viscosity oils are better at maintaining the durability of the film to protect the engine at high temperatures.

For engine oils to be used in extreme climatic conditions, the manufacturer onfirmation must be obtained.

3.5 SILENCER AND EXHAUST SYSTEM

The purpose of the engine exhaust system is to transport the poisonous gases and exhaust fumes, which are burned in the engine, out of the room without causing danger or discomfort, and to reduce the noise.

Exhaust Silencer

To reduce the noise level of the engine, a suitable exhaust silencer must be installed in the exhaust outlet line.

- Exhaust pipes should be as short and straight as possible to reduce back pressure.

- A flexible connection (compensator) should be placed between the exhaust manifold and the exhaust pipe system to prevent engine vibration from being transmitted to the exhaust pipe system and the building.

Compensator

- Exhaust pipes should be supported by surrounding structures so that the exhaust pipes do not weigh on the engine exhaust manifold and turbocharger outlet.

- The weight of the exhaust system should be given to the building. Steel construction or tension elements can be used for this task to carry the load to the ceiling or floor.

- Flap-type counter-weighted rain covers can be used in various applications to prevent rain from entering the open exhaust outlet.

- The exhaust outlets of more than one generator should not be combined using a single exhaust pipe.

- The turns in the exhaust installation should be made with circular radius patent elbows. It is not appropriate to make an elbow by cutting and welding the two pipes by joining them with 90 °.

GENERATOR SET AND PARTS

3.6 VIBRATION SHOCKS

Vibration shocks are used at the connection points of the engine-alternator set to the chassis and between the chassis and the ground in order to prevent the vibration on the ground and the loosening of the generator parts when the generator is running. Vibration shocks are selected according to the weight of the machine in order to minimize the vibration and use it without problems for a long time.

Rubber Vibration Shock
(Standard)

Steel Spring Vibration Shock
(Optional)

3.7 BATTERY

Lead acid type batteries supplied with Tescom Generator sets provide the electrical energy required for the starter motor and the control panel to feed during the first start of the engine. Batteries should be placed on battery stands as close to the generator as possible.

Battery

Batteries with low charge do not start well in cold weather. This is because more power is required to activate the cold motor.

Over time, oxidation may occur at the battery terminals and connection points.

Oxidation will corrode the battery terminals and prevent charging. Therefore, the daily control and maintenance of the battery is very important.

GENERATOR SET AND PARTS

Battery Maintenance:

- Keep the top side and terminals of the battery clean.
- Top covers of battery terminals and terminal connections must be installed. If there are no covers, anti-oxidizing oil should be applied.
- Terminals should be tightened with maximum 30 Nm at the correct torque. If over tightened, the terminals may crack.
- The electrolyte level should always be 10 mm above the plates, please check regularly.
- Acid should not be added to batteries with low electrolyte level, pure water should be added till the appropriate level.
- Make sure that the battery is not uncharged.

Pay attention to safety precautions while doing any work related to batteries. (See. 2.2.)

3.8 BATTERY CHARGE RECTIFIER

Buffer Battery Charger Rectifier

The charge levels of the batteries that store the electrical energy required for the generator control system and starter motors at any time may decrease while in standby. For this reason, "buffer battery charging rectifiers" are used, which are supplied with utility energy and located in the control panel.

The rectifiers can be of different values with 12 VDC or 24 VDC output depending on the voltage value of the motor installation.

3.9 ENGINE JACKET WATER HEATER

It is important that the generator motor in standby state should be warm during the initial start and load phase. In order to achieve this, "motor jacket water heater" fed by utility energy is used.

These heaters heat the engine cooling water in a thermostatically controlled manner, ensuring that the engine body is constantly at the specified temperature. When the generator is running, the heater is switched off.

Since the water capacity in high-power generator motors is high, water circulation pumps provide faster circulation of heated water in the engine body in order to provide more effective heating.

Engine Jacket Water Heater

GENERATOR SET AND PARTS

3.10 PANELS

3.10.1 AUTOMATIC CONTROL PANEL

Electronic control modules are used to control and monitor the generator operation. Automatic or manual selections are provided in standard control systems according to usage needs. The control panel mounted on the generator chassis monitors the utility and enable monitors the start, stop, running status and output value of the generator when necessary. In addition, it automatically stops the generator in case of low oil pressure, high engine temperature and other malfunctions.

Before starting the generator, the user should be familiar with the operation of the control panel and the duties of the elements on it. While the generator is running, the visuals on the panel should be observed from time to time. Thus, the generator can be intervened before problems occur in extraordinary situations.

Automatic Control Panel

3.10.2 3.10.2 AUTOMATIC TRANSFER PANEL

In automatic generators, automatic transfer panels are used in order to transfer the load between the utility and the generator. Automatic transfer systems are integrated at the bottom of the control panel in Tescom Power Generators that standby powers are up to 75 kVA.

Transfer Panel

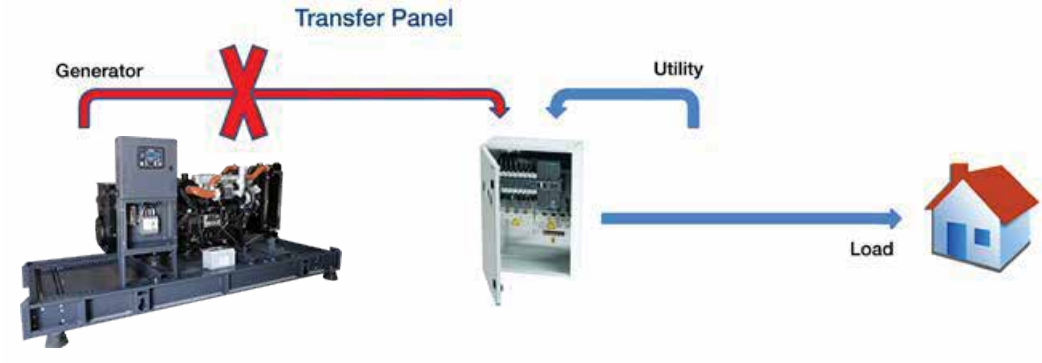
For the generators that powers are greater than 75 kVA, external (wall-mounted / free-standing) transfer panels are used. Automatic transfer panels can be provided with 3 poles (3P) and 4 poles (4P) optionally.

For the installations with residual current relays, 4P transfer systems should be used to prevent faulty trips.

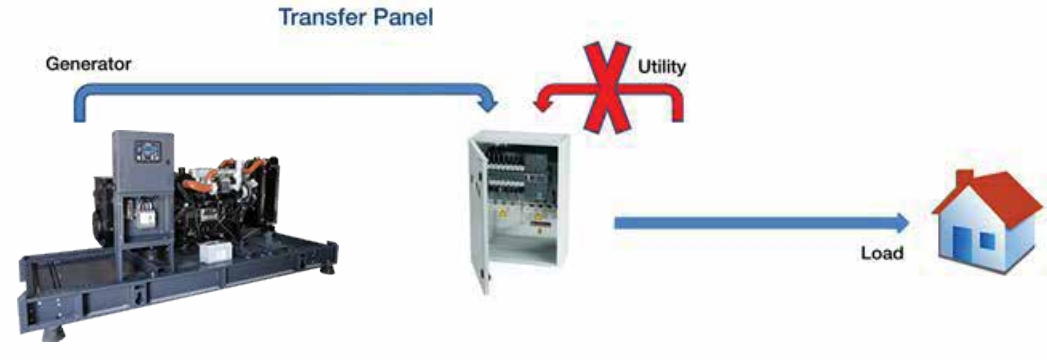
Transfer Panel

GENERATOR SET AND PARTS

The working principle of the automatic transfer panel is shown in the diagrams below.



Utility Power Available; Generator Not Activated



Utility Power Not Available; Generator Activated

3.10.3 PROTECTION SWITCH PANEL

Thermal magnetic switches are used to protect the generator operating under load against possible overload and short circuit.

Protection switches can be provided with 3 poles (3P) and 4 poles (4P) as an option.

Protection Switch Panel

SELECTION OF GENERATOR SITE AND INSTALLATION

The selection of the place where the generator set will be installed is very important for the high performance and safe operation of the generator. There should be sufficient ventilation where the generator set will operate. It must be protected against elements such as rain, snow, hail, flood water, sunlight, freezing cold, extreme heat, sandstorm and snowstorm. It must be protected against harmful airborne substances such as dust, oil fumes, steam that corrode or provide conductivity.

The generators are classified under two options according to their place for installation.

1) Open (without cabin) type
2) Canopied type

Canopied type units are generally operated outdoors. Rarely, as an alternative to room isolation, it is seen that a cabinet type generator is placed in the generator room.

In the area where canopied groups will be placed;

- The place where it will be placed should be suitable for the wet weight, size, static and dynamic loads of the generator.

- If the ground properties are not suitable, the base concrete must be made in the balance with the properties recommended by the manufacturer.

- There should be enough free space around it for opening the doors and for services.

- In the placement of more than one unit, cabin design should be made taking into account the hot air exhaust fresh air intake interaction between machines, and the layout should be properly designed.

- The distance to residential area is important due to the effect of noise and smoke.

In the area where open type groups will be placed;

- The place where it will be placed should be suitable for the wet weight, size, static and dynamic loads of the generator.

- If the ground properties are not suitable, the base concrete must be made in the balance with the properties recommended by the manufacturer.

- It is recommended to raise the generator set from the ground in places where water may accumulate and in humid environments such as boiler rooms.

- In order to carry the generator into the room, there must be a suitable transportation route that the generator can pass through.

- There should be enough free space around it for service.

-In order to supply fresh air at the required flow rate and speed to the generator room, there should be air intake shutters with appropriate cross-section.

SELECTION OF GENERATOR SITE AND INSTALLATION

- For the hot air to be thrown out of the room by the radiator fan, there should be flexible connection hoods and air outlet shutters with appropriate cross-section.

- In order for the engine to work efficiently and not to overheat, it is necessary to ensure that enough fresh air enters the environment where the generator set will operate and the hot air formed inside is discharged.

- In order to avoid pressure loss in the generator room, the fresh air intake cross section should be larger than the hot air discharge cross section, and shutters should be made to provide the direction of air flow towards the radiator from the back of the alternator.

- If the generator room is below ground level, the air inlet - air outlet louvers cannot be applied directly, so ventilation ducts should be manufactured in appropriate sizes for fresh air intake and hot air discharge.

- Exhaust piping should be installed in order to discharge the diesel engine exhaust gases out of the room, the height of the generator room should be at the recommended dimensions for the installation of the silencer and the exhaust system.

- Cabling, busbar installation, channels that will be required for external fuel piping, if any, and mechanical reserve spaces should be taken into consideration.

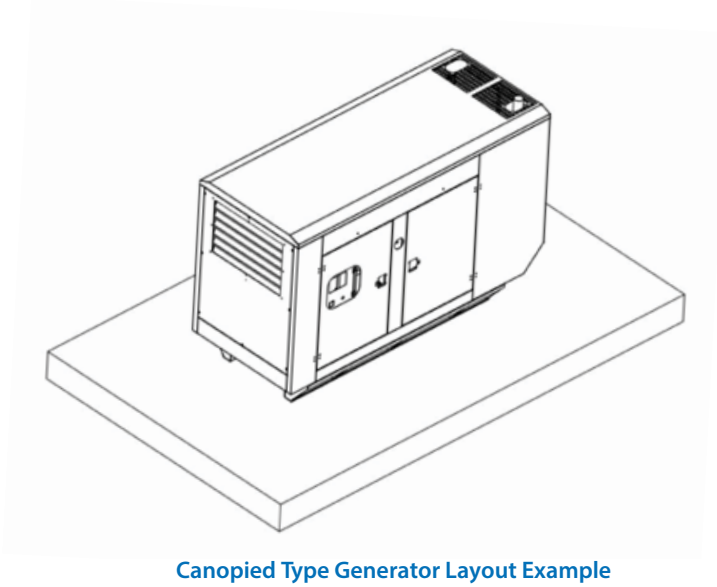
- The generator room must have infrastructure suitable for lighting and grounding techniques.

- In case the generator will be taken out completely for any reason in the future, there should be doors / lids of suitable size.

- Current fire regulations should be considered in generator installations.

- Access of unauthorized persons to the generator site should be restricted.

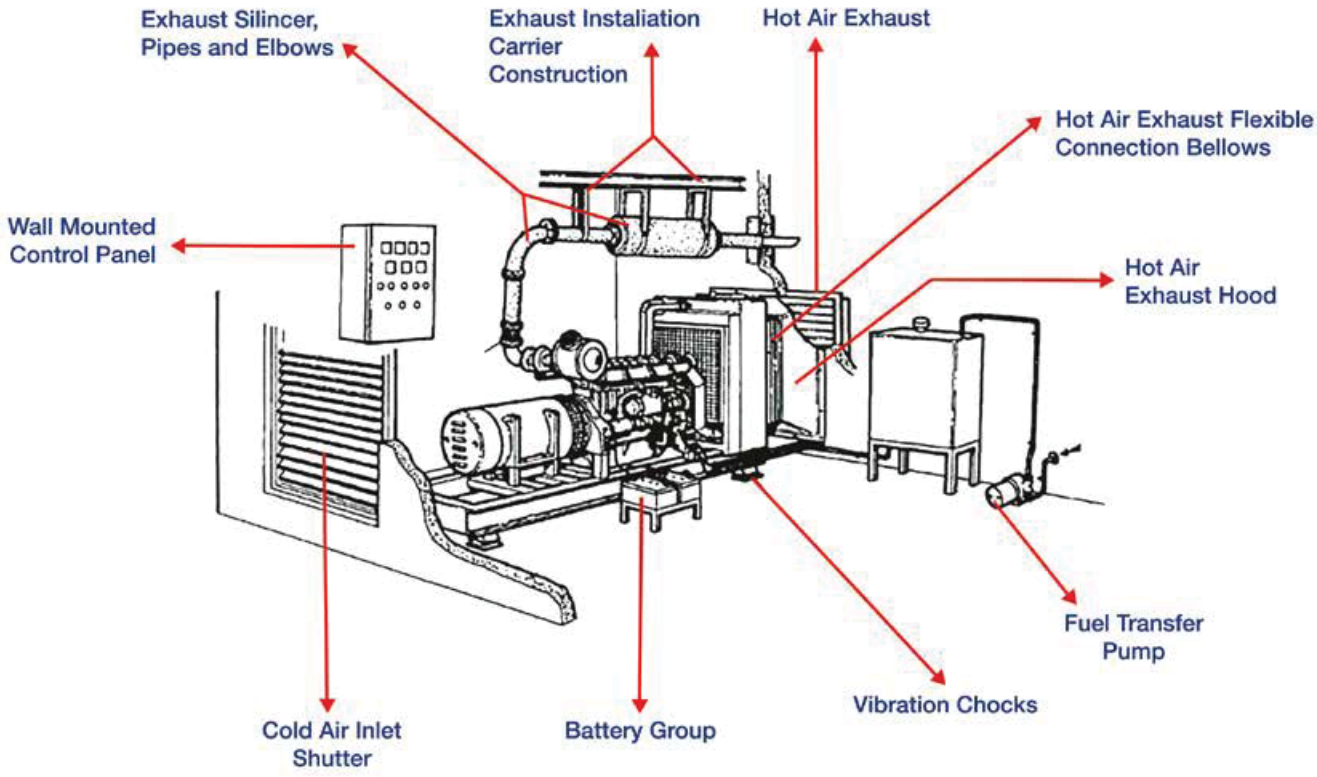
4.1 CANOPIED TYPE GENERATOR LAYOUT



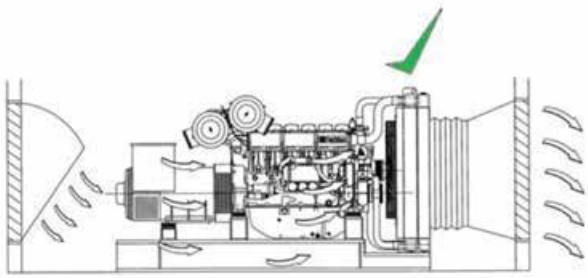
Canopied Type Generator Layout Example

SELECTION OF GENERATOR SITE AND INSTALLATION

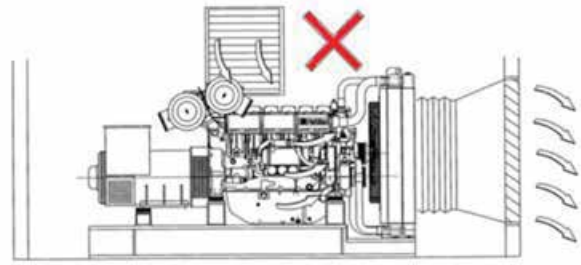
4.2 OPEN TYPE (WITHOUT CABIN) GENERATOR LAYOUT



Open Type Generator Layout Example



Proper Air Flow



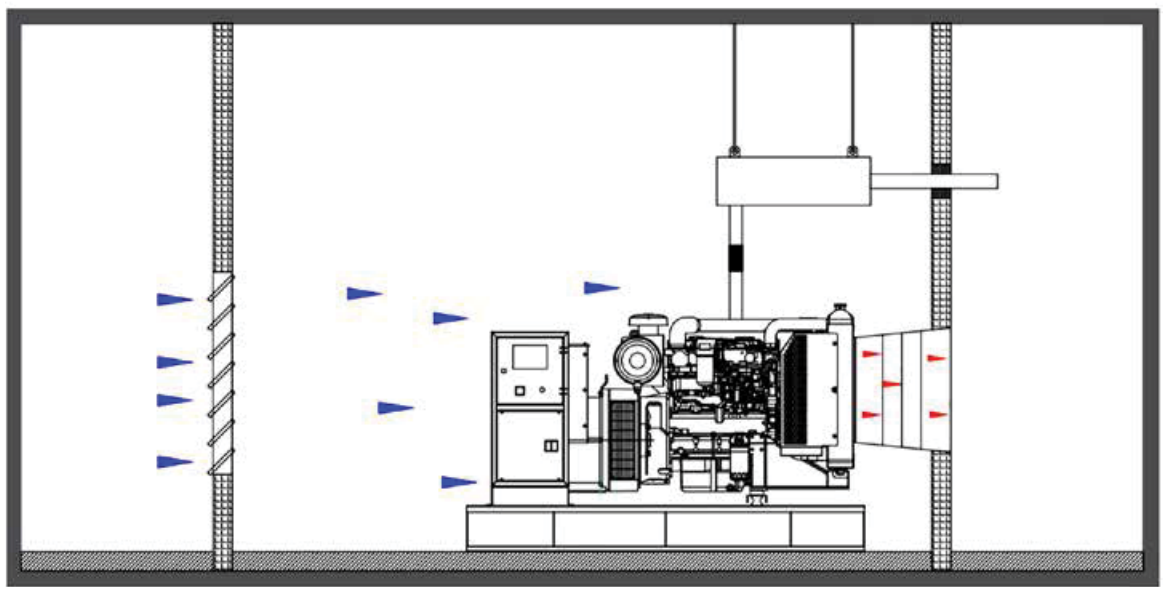
Improper Air Flow

SELECTION OF GENERATOR SITE AND INSTALLATION

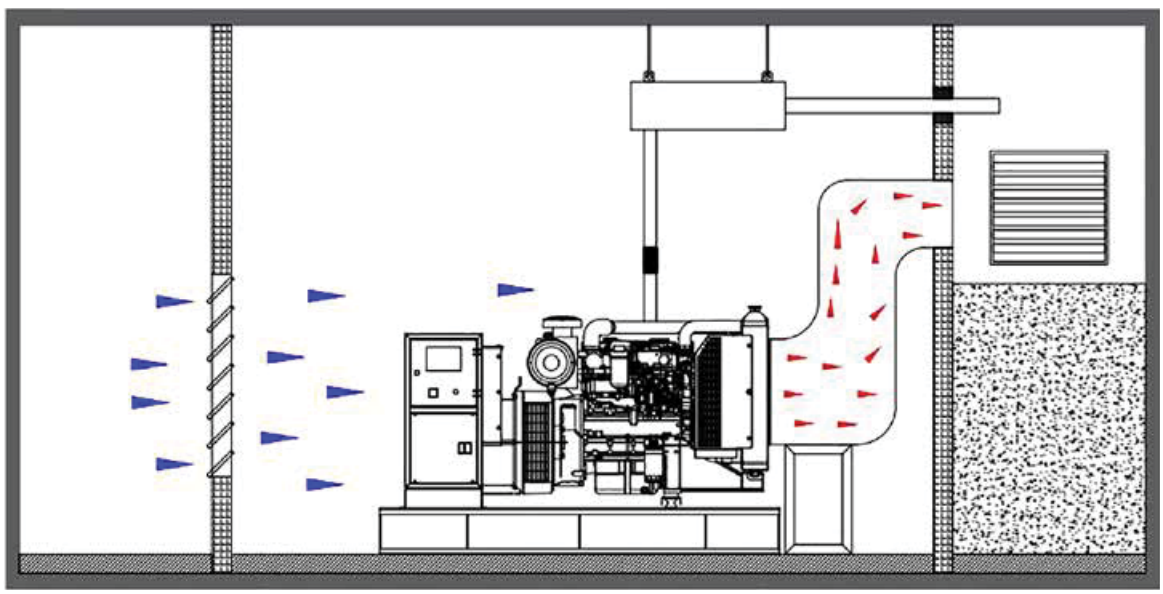
Notes:

- For distances longer than 50 meters, the voltage drop should be calculated and the recommended cable sections should be confirmed.

- In case the generator energy output is projected with a busbar installation instead of a cable, the alternator output should never be directly connected to the busbar line, the alternator output should be connected to the busbar interconnection box with cable or flexible busbar.



Generator Room Ventilation at the Same Level (Elevation) with Outdoor Environment



Generator Room Ventilation in Basement

SELECTION OF GENERATOR SITE AND INSTALLATION

4.3 ELECTRICAL CONNECTIONS AND OPERATION

The generator's electrical connections should be performed by qualified and trained persons and ensure that the safety precautions in section 2.7 are followed.

Power cables of the generator set should be calculated according to the load current, the operating voltage and the voltage drop that may occur in the distance between the load and the generator. The generator and transfer panel should be placed in a way that make cables as short as possible. In 3-phase systems, the phase sequence should be followed in the current utility connection, and after the generator connections are made, the phase sequence should be checked before the generator power is supplied to the load.

In order to provide generator - utility transfer, a 3-position changeover switch (1 -0-2) should be used in manual models, and an automatic transfer panel should be used in automatic models.

The generator set and the transfer panel must be grounded before commissioning. The generator should not be operated without grounding installation. Grounding is useful for protecting people against electrical hazards and for the efficient operation of electronic control devices.

Grounding is done by burying the copper electrodes of appropriate size and amount in the ground, and using copper conductors with appropriate cross-sections to connecting them to the designated place in the body of the generator set.

Grounding resistance should be aimed to be at most 2Ω. Energy and grounding cable sections are given in the cable selection table according to the generator power. There should be a terminal on the generator and panel where the grounding cable will be connected. If there is no terminal and the cable will be connected to the body, the paint of the place where the cable lug will contact should be scratched for ground continuity.

SELECTION OF GENERATOR SITE AND INSTALLATION

Table: Cable Selection Table

POWER				CABLE		
GENERATOR POWER (STANDBY) kVA	OUTPUT VOLTAGE (PHASE-PHASE) V	CosØ	NOMINAL CURRENT A	CABLE TYPE	CABLE SECTION (3 PHASE+NEUTRAL) mm²	GROUND SECTION mm²
12	400	0,80	17	NYY	4x2,5	1x6
15	400	0,80	22	NYY	4x4	1x6
22	400	0,80	32	NYY	4x6	1x6
27	400	0,80	39	NYY	4x10	1x10
33	400	0,80	48	NYY	4x10	1x10
45	400	0,80	65	NYY	4x16	1x10
55	400	0,80	79	NYY	3x25+16	1x10
75	400	0,80	108	NYY	3x35+16	1x10
88	400	0,80	127	NYY	3x50+25	1x10
110	400	0,80	158	NYY	3x50+25	1x25
125	400	0,80	180	NYY	3x70+35	1x25
150	400	0,80	216	NYY	3x95+50	1x25
175	400	0,80	252	NYY	3x120+70	1x25
200	400	0,80	288	NYY	3x150+70	1x35
225	400	0,80	324	NYY	3x185+95	1x35
250	400	0,80	360	NYY	2x(3x70+35)	1x35
275	400	0,80	396	NYY	2x(3x95+50)	1x35
300	400	0,80	432	NYY	2x(3x95+50)	1x50
330	400	0,80	475	NYY	2x(3x120+70)	1x50
385	400	0,80	554	NYY	2x(3x120+70)	1x70
400	400	0,80	576	NYY	2x(3x150+70)	1x70
450	400	0,80	648	NYY	2x(3x150+70)	1x70
500	400	0,80	720	NYY	3x(3x120+50)	1x70
550	400	0,80	792	NYY	3x(3x120+70)	1x95
600	400	0,80	864	NYY	3x(3x150+70)	1x95
660	400	0,80	950	NYY	3x(3x150+70)	1x95
715	400	0,80	1030	NYY	4x(3x120+70)	1x120
825	400	0,80	1188	NYY	5x(3x120+70)	1x120
900	400	0,80	1296	NYY	5x(3x120+70)	1x120
1000	400	0,80	1440	NYY	6x(3x120+70)	1x120
1125	400	0,80	1620	NYY	6x(3x120+70)	1x120
1250	400	0,80	1800	NYY	6x(3x150+70)	1x120
1385	400	0,80	1994	NYY	7x(3x150+70)	1x120
1500	400	0,80	2160	NYY	7x(3x150+70)	1x240
1650	400	0,80	2376	NYY	6x(3x240+120)	1x240
1900	400	0,80	2736	NYY	7x(3x240+120)	1x240
2050	400	0,80	2952	NYY	7x(3x240+120)	1x240
2250	400	0,80	3240	NYY	8x(3x240+120)	1x240
2500	400	0,80	3600	NYY	9x(3x240+120)	1x240

Notes:

- For distances longer than 50 meters, the voltage drop should be calculated and the recommended cable sections should be confirmed.

- In case the generator energy output is projected with a busbar installation instead of a cable, the alternator output should never be directly connected to the busbar line, the alternator output should be connected to the busbar interconnection box with cable or flexible busbar.

SELECTION OF GENERATOR SITE AND INSTALLATION

4.3.1 PLACEMENT OF THE TRANSFER PANEL

The points to be considered in the placement of the transfer panel are as follows:

- The transfer board should be clean, dry, well ventilated and away from excessive heat (cooled if necessary). When the ambient temperature exceeds 40 ° C, the capacity of the fuses and switches may decrease and they can open faster.

- There should be enough working space around the transfer panel.

- It is recommended to fix the transfer panel against seismic factors.

- The load to be connected to the generator should be distributed equally (symmetrically) to three phases as much as possible.

- The value of the current to be drawn from one phase should never exceed the nominal current value.

- If the transfer panel is separate from the generator, it is recommended to place it as close to the main distribution panel as possible. In this case, wiring costs can be saved.

- Energy cables of appropriate cross-section must be drawn from the generator and main distribution panel to the transfer panel. In addition, NYMHY (TTR) type control cable with a cross section of 7 x 2.5 mm^2 should be drawn from the generator control panel to the transfer panel.

4.3.2 STARTING THE GENERATOR

Before starting the generator, make the final checks of the generator set by observing the necessary safety precautions.

- Check engine oil, fuel and coolant levels and replenish if necessary.

- Switch the fuses in the panel and the load output switch, if any, to the open (O) position.

- Bleed the fuel system with the manual fuel automatic on the engine.

- Check the battery level and make battery connection, first connect the (+), then connect the (-) pole.

- Turn off the fuses in the panel, and if the emergency stop button is pressed, turn it on by turning to the right.

- After the control panel is powered on, press the bulb test button to check the warning light.

- To run the generator in test mode without load, press the TEST button in automatic models and the START button in manual models.

- While the generator is in test mode, check the voltage, frequency, oil pressure and coolant temperature values.

- If the generator is required to be activated continuously, the control module will remain in the automatic (AUTO) position.

SELECTION OF GENERATOR SITE AND INSTALLATION

- The generator control panel continuously controls the utility phases. The phase-neutral lower limit of the utility voltage is programmed as 180 volts and the upper limit as 250 volts. When the utility voltage goes out of these values or when the utility power is cut off, the generator starts automatically and the contac tors / switches in the transfer panel change positions and take the load.

- When the utility energy returns to normal, the automatic control panel monitors the utility energy for a while. If the utility energy is permanently at normal values, it first sends an opening command to the gene rator contactor / switch, then it transfers the load to the utility by closing the mains contactor / switch and turns off automatically after cooling operation.

- Generator start delay, cranking time, number of consecutive starts and waiting time, transfer delay times and cooling time are parameters that can be adjusted on the control module.

- There are status indicators and fault signals on the control panel. When one of the fault lamps turns on, it is understood that there is a problem with the generator set. In this case, the generator automatically stops and does not work. After the fault is resolved, reset the fault by pressing the OFF button on the control panel. Start the generator set in TEST mode and switch it to automatic (AUTO) mode. The generator will turn off automatically at the end of the set time.

Datacom Control Module (Standard)

Deep Sea Control Module (Optional)

ComAp ControlModule (Optional)

FAULT DETECTION

The engine is not giving enough power

- Fuel pipe blocked
- Fuel filter dirty
- The air filter is dirty
- Poor quality fuel
- Exhaust pipe is blocked
- Fuel control faulty
- The governor faulty

Diesel engine starts hard or does not start

- Starter motor cannot spin diesel
- The fuel circuit has made air
- Fuel control solenoid faulty
- The fuel filter is dirty
- The heater is not working
- Poor quality fuel
- Fuel control faulty
- Injector faulty or out of adjustment
- Battery charge level is low
- Battery cables have poor contact
- Starter motor defective
- Starter relay faulty

Electronic panel does not work at all

- Measure the DC voltage from the terminals voltage, turn off all the fuses in the board, then open them all starting with the DC supply fuse and retest.

Oil pressure is too low

- Oil viscosity is wrong
- There is a problem with the oil pump
- Oil sensor malfunctioning

Oil pressure is too high

- Oil viscosity is wrong
- Oil pressure indicator faulty

Engine temperature is too high

- Exhaust pipe is blocked
- The cooling fan is damaged
- The radiator cores are dirty or the inside of the pipe is blocked
- Ventilation flow is insufficient
- Water circulation pump is defective
- Air filter or tube clogged
- Injectors defective or out of adjustment
- Heating system malfunction

The engine does not stop

- Fuel return hose may be crushed or kinked.
- The valve may have been (unnecessarily) installed in the fuel return line and remained in the closed position.
- Selenoid malfunctioning

FAULT DETECTION

Alternator voltage high when loaded

- Voltage adjustment potentiometer not adjusted
- Automatic voltage regulator protection is activated
- Automatic voltage regulator faulty
- Automatic voltage regulator cable connection broken
- Diodes faulty

Variable voltage

- Engine speed variable
- Automatic voltage regulator cable disconnected
- Automatic voltage regulator out of adjustment or faulty

Black Smoke is Coming Out of Exhaust

- Air filter is dirty
- Bad quality fuel
- Exhaust is clogged
- Low engine temperature
- Valf setting is wrong
- Injector settings are wrong or malfunctioning
- Overload

Generator works but does not generate electricity

- The fuse of the automatic voltage regulator (AVR) may have blown
- Automatic voltage regulator faulty
- Alternator diodes blown
- Diode malfunctioning

Engine runs erratically

- Fuel pipe blocked
- Fuel governor faulty
- Fuel filter dirty
- Fuel pump malfunction
- The air filter is dirty
- There is air in the fuel system
- Clamps of fuel hoses loose
- Injectors faulty or not adjustment
- Valve adjustment is bad

The generator operates even though the utility electricity is not interrupted or continues to operate although the utility electricity is available

- The generator must be grounded, electronic systems may show instability in systems that are not grounded. Check it out.
- Utility voltages may be exceeded programmed limits, measure the phase voltages.
- Check that the device measures the utility voltages correctly by pressing the MENU button.
- Utility lower and upper voltage limits may be very narrow. Factory setting is 170/270 volts by switching to program mode.

MAINTENANCE OF GENERATOR

Periodic maintenance extends the service life of the generator. Generally, the generator and its location should always be kept clean. Materials such as water, fuel and oil should not be allowed to accumulate on and around the generator. There is a service warning lamp on the control panel of the generator group. When this lamp lights up, make sure the generator is serviced

General maintenance is required for the generator in the first 50 hours or once a year. Subsequent perio - dic maintenance should be done every 200 operating hours or once a year. (Whichever of these periods expires first is valid.)

- Check the oil, coolant, fuel and battery of the generator set once a week. While performing these checks, definitely turn the generator to OFF position on the control panel.

- The coolant level in the radiator is checked and completed if necessary. While doing this, the radiator is not filled completely, leaving space 2 cm below the upper chamber level for expansion.

- The amount of oil is checked by pulling the dipstick. The oil should be between the two lines on the stick.

- After making the checks, run your generator in TEST mode for 15 minutes. After 15 minutes of operation, press the automatic (AUTO) button on the control panel. The generator will automatically stop after 1 minute.

6.1 FIRST MAINTENANCE

Engine oil, oil filters and fuel filters are changed during 50 hours or first running-in maintenance; The air filter is cleaned and replaced if necessary. The machine's electrical connections and indicators are checked. It is checked whether there is any oil, fuel and water leakage on the engine. Radiator and fuel system hoses and clamps and straps are checked.

6.2 200 HOURS / ANNUAL MAINTENANCE

The operations performed in the first maintenance are repeated in the 200-hour maintenance. Battery maintenance is done, the tension of the belts is checked, if necessary, its gap is removed by stretching.

In addition to these maintenance, the water and antifreeze in the cooling system are completely drained and changed every 2 years.

Have your generator set maintained by authorized services and use original spare parts. Otherwise, damages caused by incorrect maintenance and spare parts will be out of warranty.

MAINTENANCE OF GENERATOR

6.3 PERIODIC MAINTENANCE

Periodic Maintenance Table

								INSPECTION AND MAINTENANCE IN 50 HOURS	Service
								DAILY OR EVERY 12 HOURS INSPECTION	User
								WEEKLY INSPECTION	User
								INSPECTION AND MAINTENANCE of EVERY 100 HOURS OR 6 MONTHS	Service
								INSPECTION AND MAINTENANCE of EVERY 200 HOURS OR YEAR	Service
								INSPECTION AND MAINTENANCE OF EVERY 500 HOURS OR 2 YEARS	Service
								INSPECTION AND MAINTENANCE of EVERY 1000 HOURS	Service
								INSPECTION AND MAINTENANCE of EVERY 2000 HOURS	Service
✓	✓	✓		✓				Check the radiator coolant	
	✓	✓	✓					Check the oil level fluid in the crankcase	
✓	✓	✓	✓	✓	✓	✓	✓	Check engine belts	
✓	✓	✓	✓	✓	✓	✓	✓	Check for water in the fuel front filter	
✓			✓					Check air filter, clean with compressed air if necessary	
✓				✓	✓	✓	✓	Change engine oil	
✓				✓	✓	✓	✓	Change the oil filter	
				✓	✓	✓	✓	Change fuel filter elements	
				✓	✓	✓	✓	Change air filter elements	
✓		✓		✓	✓	✓	✓	Run the generator for 15 minutes in idle or test position.	
✓		✓		✓	✓	✓	✓	Check engine oil pressure values on control panel	
✓		✓		✓	✓	✓	✓	Check the water temperature value on the control panel	
✓		✓		✓	✓	✓	✓	Controlling the alternator output voltage and frequency via the control panel	
				✓	✓	✓	✓	Check the crankcase breather pipe, clean if necessary	
							✓	Checking, if necessary testing and adjusting the fuel pump	
							✓	Checking injectors, testing and adjusting if necessary	
						✓	✓	Checking the turbocharger system	
✓	✓	✓	✓	✓	✓	✓	✓	Checking the charge status, connections and terminals of the battery group for oxidation and cleaning if necessary	
✓			✓	✓	✓	✓	✓	Checking the starter motor, charge alternator, relay and fuse connections	
✓	✓	✓	✓	✓	✓	✓	✓	Checking whether the engine jacket water heater is working	
					✓	✓	✓	Changing the engine coolant (water + antifreeze)	

Note: Whichever of working hours and time periods expires first applies.