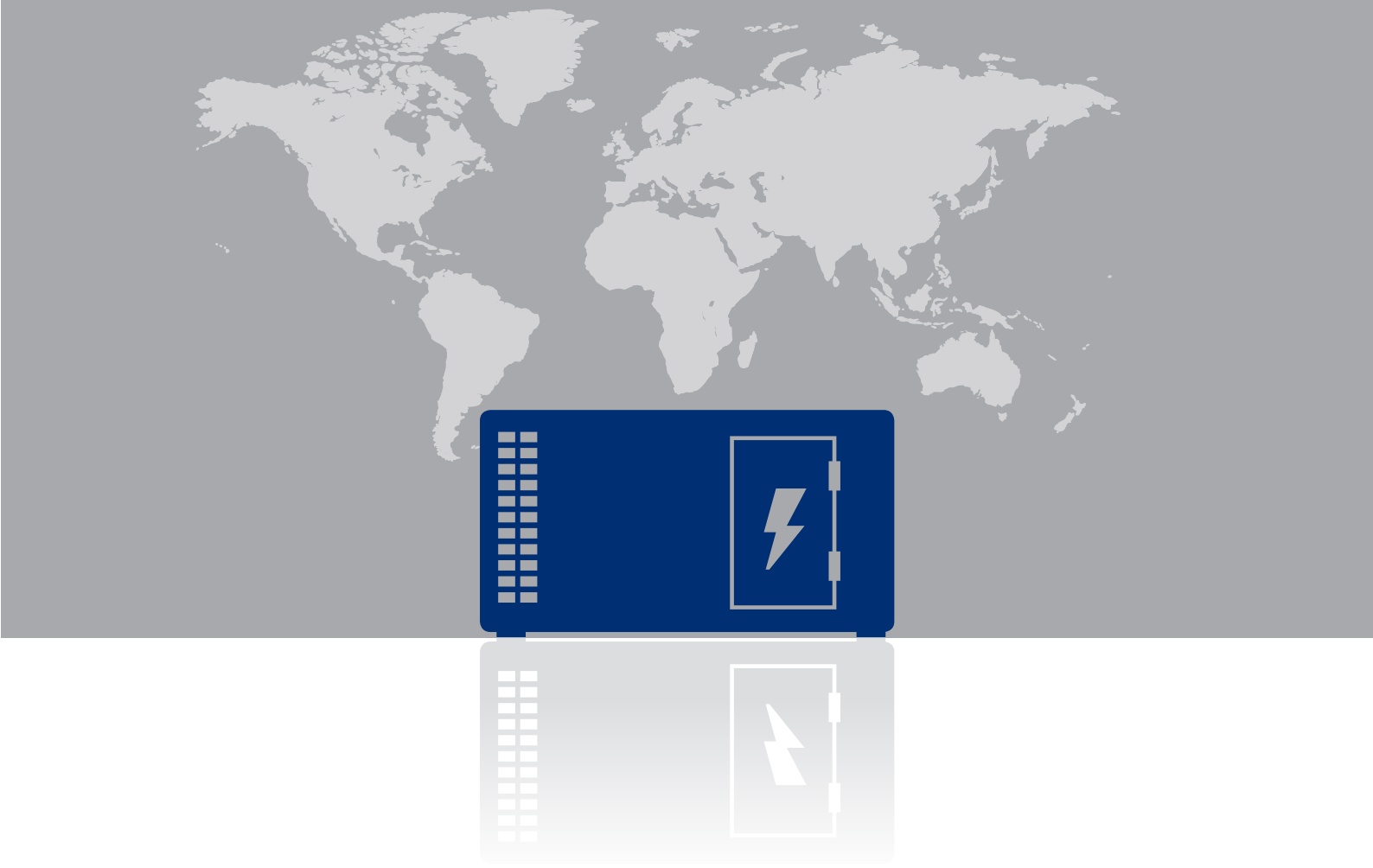
TEKSAN USA



OPERATION AND MAINTENANCE MANUAL FOR **DIESEL GENERATOR SETS**

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Dear TEKSAN User

Thank you for your choice of Teksan Generator.

TEKSAN, sustains all its activities at its modern facilities, according to its principle of providing reliable products and services at high quality with CE norms and "ISO 9001:2000; Quality Management System" certification. Your generator set is subjected to several test and quality controls at every stage of production. There are several test and control procedures carried out on the time interval between the very first "assembling" step and the very last "delivery" step. TEKSAN products are also manufactured environment friendly at norms with "ISO 14001; 2004 Environment Management System" certification.

Our documents are being prepared carefully with the help of the academic education we have received and also the knowledge and experience we have obtained from being in this business for the last 30 years. As a standard TEKSAN documentation, the "Operation and Maintenance Manuals" for your "Diesel Engine", "Alternator" and "Generator Set" must have been delivered to you together with your generator set. Your duty as our customer, is to read, understand and remember all information shared in these documents before using your generator set. This will help you avoid any possible accidents that may be harmful for you, people around you or the generator set itself.

You may also sign for a "Periodical Maintenance Agreement" and get regular, complete and economical maintenance and reparation services from TEKSAN Dealers, and receive good quality service for your product.

Please let us know about your wishes and suggestions in order to contribute to our product and service quality.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions that should be followed during installation and maintenance of the generator and batteries.

UL2200 CERTIFICATE

TS ISO 8528–5 CERTIFICATE

ISO9001 QUALITY MANAGEMENT SYSTEMS CERTIFICATE

ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEMS CERTIFICATE

ISO 45001 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEMS

CERTIFICATE EAC EURASIA CUSTOMS UNION CERTIFICATE

CONFORMITY OF EUROPE

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1. Safety Precautions

1.1. General Instructions

Before installing or running the generator set, it is a responsibility for the user or operator to read the whole documentation that is included within the generator set. ("Generator Set Operation and Maintenance Manual", "Diesel Engine Operation and Maintenance Manual" and "Alternator Operation and Maintenance Manual"). All the safety instructions stated in these manuals must be provided in order for a safe operation.

The person who is in charge for installing, maintaining or using the generator set, is the only responsible for anything that risks the safety of operation. For this reason, these people must follow and obey all the instructions stated in all provided documentation, so that the risk of accident shall be minimized.

Because of this responsibility to take, the people who will install, maintain or use the generator set, must be trained and authorized about the procedures for installation, usage and maintenance. Any disorder or disobeying about these procedures, rules, instructions, methods or measures in manuals, will increase the probability of failure and accidents that may end up with injuries or maybe death.

Pay attention to all labels and warnings on the generator set. Install and operate the generator set fully in conformity with the related standards, rules and regulations. Furthermore, the local rules and regulations should be followed too.

Make sure that the generator set is at OFF position before performing any maintenance, repair or setting activity. In this way, you will be isolating the generator set from any unauthorized access.

Do not start the generator set until you are definitely sure that it is absolutely safe to run it. Under any unsafe condition, disconnect all the battery cables.

Use required safety equipment during periodical inspections and maintenances

This manual and the appendices are integral in total. All safety instructions are clearly stated in the relevant sections of this manual.
Also remember that you can always get in contact with TEKSAN and ask for advice about any issue that is not understood clearly.

	General Danger warning sing		Crushing hazard warning sing. Keep your hands and clothes clear from rotating parts (belts, pulleys, gears etc..).
	Protective Earth Ground connection point		Crushing hazard warning sing. Keep your hands and clothes clear from rotating parts (belts, pulleys, gears etc..).
	Hazardous voltage warning sing. Contact will cause electric shock or burn. Turn off and lock out power before servicing.		Use diesel fuel only. Do not smoke and do not use any open flame.
	Hot Surface warning sing. Hot surface caution. Burn hazard. Do not touch.		Read and understand operator's manual before using this machine. Failure to follow operating instructinos could result in death or serous injury.

1.2. Lifting and Handling

1.2.1. Using Slings

Use the lifting lugs located on the generator set, while you are trying to lift or move the generator set.

Before lifting the generator set, be sure that you have checked all the lifting lugs or any connection points for any welding cracks, breakages, twists or rust that may cause any problem during the lifting process.

Make sure that all lifting equipment and supporting components are in a good condition, so that they can resist a load 10% more than the gross weight of the generator set as a minimum (extra margin for any snow, ice, mud or attached spare parts/ equipment on set).

Make sure that all the lifting hooks or locks have functional safety clips and all of them are connected correctly. Be sure to use guide ropes or equivalents in order to prevent any rotation or swing action, when the machine is lifted and there is no contact left between the machine and the ground.

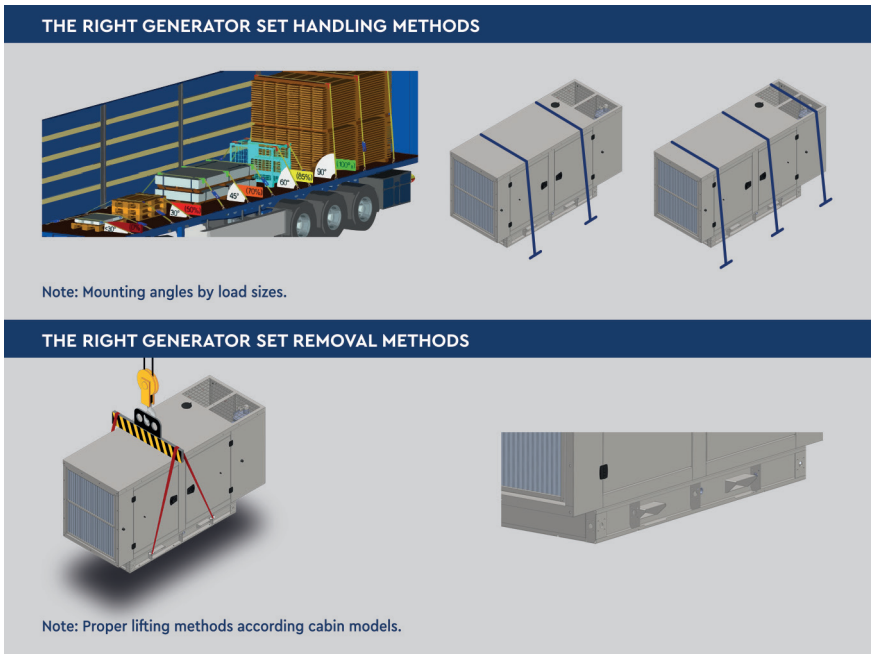
Do not try to lift the generator set if there is a strong blowing wind around.

Once the generator set is lifted, be careful about the people around and keep them at a safe distance.

Once the generator set is lifted, also be sure that the operator of the lifting machine is always ready to handle any case of emergency.

Always be sure that the generator set is placed on a flat surface. This surface to be selected, has to be able to resist a weight 10% more than the gross weight of the generator set. Also be sure that there is not any risk of sliding, after you put down the generator set.

Before closing and locking the doors of the generator set, be sure that there is nobody left inside the canopy or container.



1.2.2. Using Forklift

Unauthorized personnel shall not ride on forklifts.

Only trained and qualified personnel shall operate forklifts.

All forklifts shall be strictly maintained in accordance with the manufacturer's recommendations.

Ensure that forklift has enough capacity to handle the generator set safely and properly.

Then lower the forklift forks into the forklift pockets under the baseframe of the generator set slowly and carefully. Once the forklift forks are completely inside the pockets, then raise the level of forklift forks slowly around 15–20 cm and so the generator set shall be lifted from the ground. After being completely sure that the lifted generator set has no contact with the floor, then drive the forklift carefully to the place that the generator set will be dropped off.

For unloading the forklift and putting the generator set to its place safely, lower the forks once again slowly and safely and then remove the forks carefully out from the pockets so the generator set shall sit on its place safely.

1.3. Moving Parts

Keep your body (especially hands, arms and hair) and clothes away from gearwheels, pulleys, belts or other moving and rotating parts.

Do not attempt to run the generator set, if any protection cover of fans or other moving parts is removed.

Be sure that your clothes completely fit on you, if you are working around a generator set that is running. Also tie your hair if it is long.

Keep all the access doors closed, excluding the cases of starting up, control, maintenance, repair or service. Before starting the generator set, be sure that everyone around is at a definite safety distance.

In order to minimize the risk of accidents due to sliding or falling, keep your hands, feet or the ground clean of fluids like fuel, diesel, grease, anti-freeze or water.

1.4. Hot Surfaces, Sharp Edges And Corners

Avoid anyone from touching the hot grease, hot coolant, any hot surface, sharp edge and corners. Keep your hands or any part of your body, at a safe distance to the hot exhaust pipes and gases.

While working inside, outside or around a generator set, wear protective clothes and accessories like gloves, boots and helmets.

Keep a first aid kit close to you and seek for medical help urgently in case of any personal injury. Do not neglect any small cuts or injuries.

1.5. Fire And Explosion

Be sure that the fuel that will be used is a well-designed combination of appropriate ingredients, according to its purpose of use and all related norms and standards.

Keep the floor clean around the generator set in order not to face any accidents due to slippery floor covered with grease, battery electrolyte or coolant.

Shut down the generator set long before any maintenance activity like refuelling it, checking the battery electrolyte level, checking or changing the lubrication oil. So that the engine can get cooled before doing any maintenance on it.

Keep any spark, flame or other combustibles away from the generator set. Do not smoke and allow smoking around the generator set.
Do not let any formation of waste oil or fuel layer on the generator set. Clean any dirt on the engine, alternator, base frame or canopy with an industrial cleaner. Be sure not to use combustive chemicals for cleaning purposes.

Before connecting or disconnecting the batteries, be sure to remove the charger connections on batteries.

Remove the connections from negative (-) poles of the batteries before any maintenance. Also place a warning on the battery for preventing any short-circuit accidents.

In order for preventing any possible incorrect connections that may be done by anyone unauthorized, be sure to attach a warning notice on the battery connections.

Keep any cables, battery terminals or other electrical equipment in a good condition. Replace any cracked, broken or defective cables, terminals, isolators or any electrical equipment.

Provide a proper grounding for all the conductors and electrical equipment that is directly exposed to electricity. This will prevent the accidents due to any arc or spark occurrences caused by the electrical current flowing through or around them.

If any leakage has been inspected on or around the fuel tank or pipes, never start the generator set before resolving the leakage problem. Do not attempt to repair the damaged fuel tanks or pipes but change them directly with the new ones.

Always keep in mind that the temperature of the exhaust gas, exhaust manifold and the exhaust outlet pipes is up around 550oC. Due to this fact; provide the necessary insulation to all hot surfaces and keep yourself and any flammable material away from these hot points.

Be sure to keep any flammable material away from the generator set before doing any welding work on the generator set. Also take any dirty (oil, fuel, etc...) cloth pieces, chemical waste, leaf, garbage or any other flammable material away from the generator set.

Before any maintenance or service activity, be sure that there is at least one full and well-maintained fire extinguisher around the generator set.

If there are any trees or wood around the generator set, avoid contacts of leaves and branches with the generator set's hot exhaust system.

Do not install or run the generator sets in places that are not approved or prescribed as dangerous.

1.6. Hazardous and Substances

The generator set must be installed and operated in outdoor or well-ventilated areas.

Do not install or operate the generator set, unless there is a proper ventilation. Also be sure that the ventilation windows stated in the previous sections of this manual are provided.

If the generator set will be operating at an indoor place, be sure to provide a proper exhaust outlet system so that the exhaust gases can be released outdoor. Also provide a proper ventilation window for any natural gas leakage emergency case.

Be careful that the exhaust gas outlet is not redirected to indoor places, living areas, ventilation or fresh air suction points of any machine.

Any material used for the engine (lubrication oil, grease, coolant, battery electrolyte, etc...) are industrial chemicals, so any of them must be kept away from any part of your body. If there is any of these chemicals on any part of your body by accident or somehow, you have to wash this exposed part/area using plenty of soap and water.

Wear a uniform that is resistant to acid and a glass for covering you face while maintaining the batteries. If any part of your clothes or skin is exposed to the acidic electrolyte solution inside the batteries, then wash this exposed part using plenty of soap and water.

1.7. Environmental Protection

Generator sets have some potential risks for the environment such as lubrication oil, fuel, exhaust gas, battery.

There may be local set of rules, regulations or limitations about the usage of diesel generator sets and also about the disposal of the environment-risky materials listed above.

It is the customer's / user's responsibility to be aware of these rules or regulations and also to obey and conform with these rules while using and maintaining diesel generator sets.

Disposal Of Waste / Risky Material For Environment

- Be sure that there is no lubrication oil spilled around while changing the engine oil or keeping the used oil in your stocks.
- Keep the engine lubrication oil that has been drained, at a safe place and be sure to deliver it to authorized organizations for properly disposal.
- Keep also the oil and fuel filters that have been replaced from the engine, at a safe place and again be sure to deliver it to authorized organizations for properly disposal.
- Do not throw the damaged or dead batteries to trash and again be sure to deliver them also to the authorized organizations for properly disposal.
- Be sure to collect and keep all these wastes and damaged parts inside an isolated and fireproof waste tank.
- Be sure to prevent any fuel or oil from leaking and spilling around to environment.
- Be sure to check and conform with your "Local Environmental Regulations" before getting your generator set started and operated.

1.8. Fire and Explosion

Cable classification and connections of a generator set should be made and checked by only trained and qualified electricians.

Do not touch the electrical hardware of the generator set directly with you bare hands or with the help of any conducting material.

Before connecting or disconnecting power cables, or before starting the generator set, make sure that the generator set is properly grounded in accordance with all related rules and regulations.

Do not run, connect or disconnect the generator set underwater or on a wet ground. Remind the conductivity of water.

Before establishing any electrical connection to the generator set; first stop the engine, then remove the supply connection from the charger input, then remove all battery connections and finally remove all non-grounded conductor connections at the load side.

Avoid touching the electrical and moving parts of the generator set with bare hands or any tool. Also be sure that you are standing on a dry and insulated ground if you have to touch them (electrical installation or equipment) for any repair or maintenance purposes.

Be sure to keep the insulators at the alternator output on their places. Put them back to their places right after any connection or disconnection activity. Do not run the generator set if these insulators are not mounted on their places.

Close and lock all the doors if the generator set is out of service, so nobody unauthorized can get in the generator set.

Keep the towing truck and equipment at least 3 meters away from the generator set and the power cables.

Perform any repair, maintenance or service activity in clean, dry, well illuminated and ventilated areas.

Be sure that the load connected is proper, according to the loading characteristic and capacity of the generator set. Do not load the generator set more than its loading capacity. Also ensure that the power cables used between the load side and generator set are at proper rating and specifications in accordance with related rules and regulations.

Never connect or disconnect electrical cables or equipment in case of gas leakage on supply line or the generator set.

1.8.1. First and In Case Of Possible Electrical Shock Accidents

If you witness an electrical accident it is important to respond quickly but with caution at the same time. So do not touch the victim until being sure that the electricity is switched off, otherwise you may receive an electric shock too. If you are not able to switch off the electricity, you can try to rescue the victim by using some dry and dielectric equipment as an alternative.

After taking the patient to a safe place far from the electrical installation.

1. Call for emergency service or any medical support.
2. Keep patient lying down at a prone position. (A) Put the head on arms and turn it to one side for allowing any possible fluid drainage.
3. Remove all objects like denture, tobacco or chewing gum out from the patient's mouth in order to provide an ease on breathing or any possible fluid drainage. Using your palms, firmly press between the shoulders of patient.
   Be sure that the patient's tongue is released.
4. Kneel down in such a position that your knee is near the patients head and your other foot is close to his/her shoulder. (B)
5. Put your hands on the patient's shoulders and place your palms on his/her scapula.
6. Push your arms forward in a vertical position. Slightly apply pressure (10–15 kg.) on the patient's scapula for 2,5 secon ds.

A

B

7. Release the pressure by sliding your hands over the patient's shoulder to his/her elbows in around 1 second. Then lift up the patient's arms and shoulders slightly by holding from his/her elbows. Just after holding the arms and shoulders for a short time, push them backwards for around 2,5 seconds for stretching (C). After all, release the patient's arms back (D) and put your hands back onto the patient's scapula.

C

D

8. Repeat all these steps in order to help the patient for breathing.
9. At the meantime someone is doing these movements for helping the patient to breathe, anyone else must;
   a.Loose the clothes on the patient for making the patient breathe easier,
   b.Keep the patient warm until the patient feels better.
10. If the patient stops breathing, apply artificial respiration and go on doing it until the patient breathes again. It may take up to 4 hours.

DO NOT GIVE ANY LIQUID IF THE PATIENT IS STILL UNCONSCIOUS

2. General Definitions

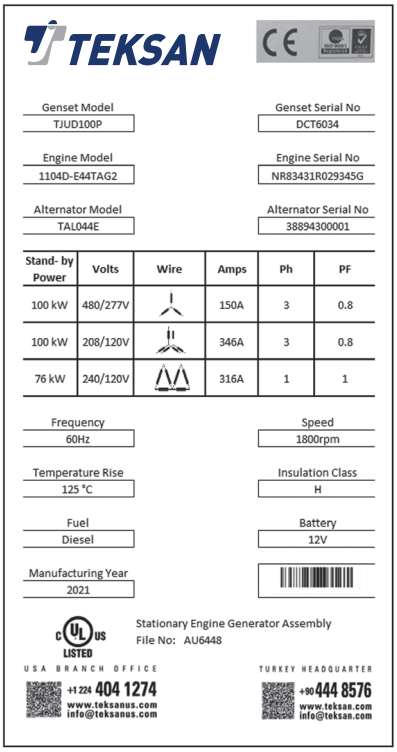
2.1. Identifying Sets

Generator sets and its main pieces (engine, alternator) do have nameplates on them for easing the identification process for the user.

A brief information about the generator set (model codes, serial numbers, etc...) can be found on these identification nameplates.

An example of "generator set nameplate" can be seen in the picture on the right.

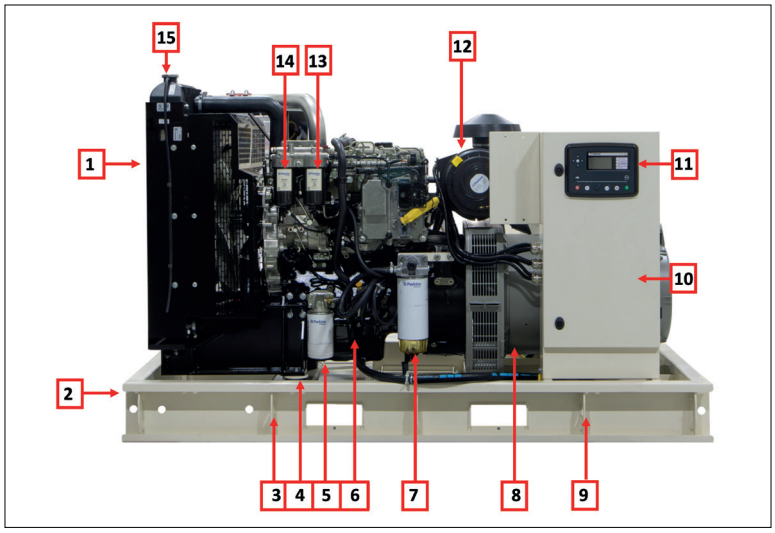
The customer / user has to provide the supplier the "serial number" of the subjected generator set while requesting any spare parts or while applying for a warranty case about that generator set.



2.2. Generator Set

TEKSAN produces reliable generator sets at high quality in accordance with ISO8528 standards. Generator set specifications, options, electrical and mechanical drawings are all recorded and followed under the unique serial number of the generator set.

Main components of the generator set are shown in the figure below.



1	Radiator	9	Lifting Lug
2	Baseframe	10	Control Panel
3	Lifting Lug	11	Controller Device
4	Vibration Isolator	12	Air Filter
5	Oil Filter	13	Fuel Filter
6	Engine	14	Fuel Filter
7	Primary Fuel Filter/Water Seperator	15	Radiator Cap
8	Alternator		

Figure: Main components of a diesel generator set. Illustration is given for reference only.

2.2.1. ENCLOSED Generator Sets

Teksan manufactures canopies for outdoor installation with the following features and specifications;

- Weather and sound proof capability,
- High level of noise reduction,
- Sheet metal structure painted with electrostatic powder paint,
- High durability against corrosion and rust,
- Assembly of the parts is carried out with screws with no-welding, so the replacement of the damaged parts are easier.
- Ease of transportation with lifting lugs,
- Exhaust silencer,
- Emergency stop button fitted outside the canopy,
- Fresh air inlets for adequate ventilation of the generator set,
- Hot air outlet from the top for discharging the hot air and exhaust gas from the same direction,
- Rain cap in exhaust silencer outlet,
- Radiator filling cap,
- Cable entry area for easy installation.

2.2.2. Container Type Generator Sets

Teksan manufactures containers for outdoor installation with the following specifications;

- Interior surface of canopy is covered with non-flammable noise isolation foams.
- Improved sound insulation performance with the sound insulation cells and sections at the air inlet and outlet of the container.
- Various container dimensions depending on the rating of the generator set.
- Exhaust silencers are fitted inside canopies. For some models exhaust silencers may be fitted on the canopy due to limited space inside canopy. The internal structure of exhaust design is proper for a silent ambient.
- One emergency exit door that is close to the side of the radiator for providing a more easy access to the generator. Also a cabinet door is located when transfer switch will be inside container in some systems.
- The fuel tank is put inside a separate section in the container in some models if sub-base fuel tank is not available on the base frame.
- Anti-vibration rubber pads mounted in between base frame and canopy.
- There are four lifting lugs available on a standard container for lifting it from its top.
- In order to increase the strength of the container, the exterior surface is formed with trapezoidal sheets.

2.3. Diesel Engine

Teksan uses the diesel engines those are manufactured with latest technology, in accordance with ISO3046 standards and designed for generator sets.

The diesel engines used; are designed for low fuel consumption, with 4-stroke type, direct injection, with all needed limiting and level sensors, with diesel electronic or mechanical type governor mounted on fuel pump for sensitive speed adjustment or regulation.

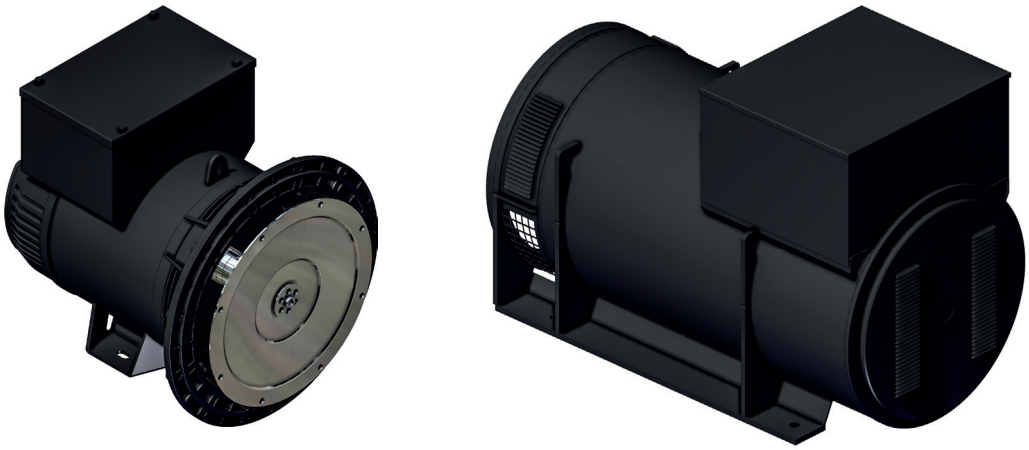
The engines used, may have oil, air or water type cooling systems, depending on customer request and the diesel engine. There are also oil, fuel, air filters which are designed for heavy operation conditions, which provide the engine a long lifetime with a high performance. All the equipment that is needed for the diesel engine for operating safely and reliably, is provided along with the generator set.

2.4. Alternator

Alternators used on TEKSAN generator set are designed in compliance with the standards IEC600341, CEI23, BS4999, BS5000, VDE0530, NF51100, NF51111, OVEM10 and NEMA MG 1.22.

Their insulation systems are in compliance with CE regulations and have UL certification.

They have brushless type self-excitation systems which do not require any maintenance action. They provide a precise voltage regulation under steady-state and linear loading conditions.



Further information can be found inside the engine and alternator manuals which are supplied together with the generator set.

2.5. Fuel Tank

Teksan can provide base frame fuel tank or free standing fuel tank dependent on model preferences of the customer.

Fuel tanks are manufactured of plate steel or other suitable materials.

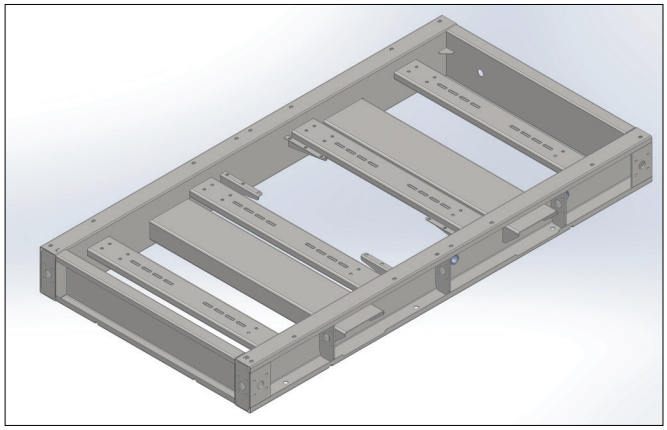
Teksan ensures that the fuel tanks are all manufactured in accordance with relevant standards. Teksan fuel tanks are equipped with:

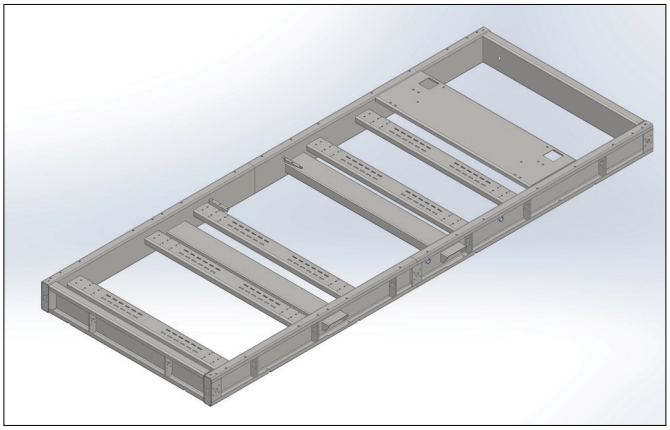
- UL-142 (US) and ULC S601–07 (Canada) Listing
- Stub-up area with bolt-on removable panel
- Baffle located between engine supply and return
- Engine supply and return dip tubes
- Primed and finish painted,
- Basin drain, 1/2", plugged
- Emergency pressure relief vents, UL listed
- Normal atmospheric vent, 2" with 10" riser
- Fill cap, lockable, 2", with 8" riser
- Fuel in basin switch, side mount; 35% Low level switch
- Level gauge, direct reading
- Lifting plates included

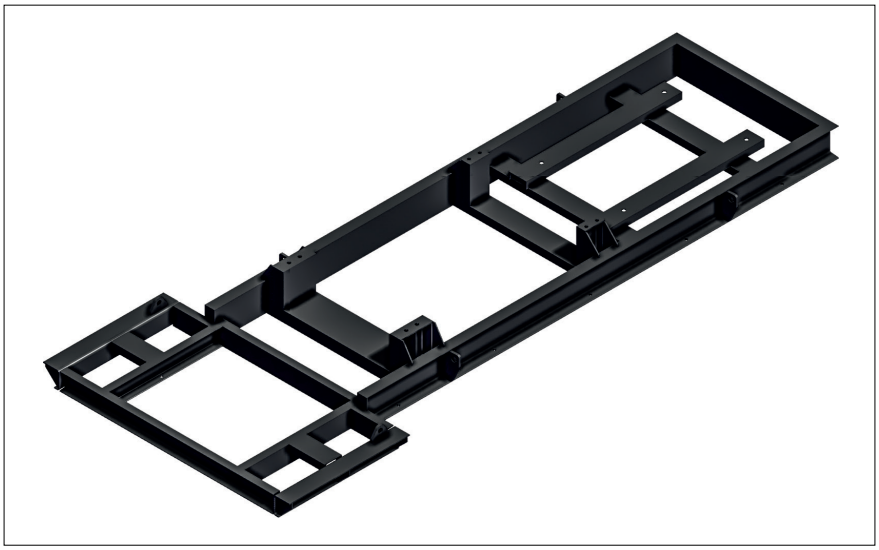
It is highly recommended to install a fuel filter and/or a water separator on the outlet line of these fuel tanks.

2.6. Base Frame

The base frame on which generator set is placed, has been manufactured using proper steel plate or special profiles based on the necessary dynamic, static and vibration calculations in order for providing high resistance. Teksan produces the base frames for all ranges in accordance with international standards.





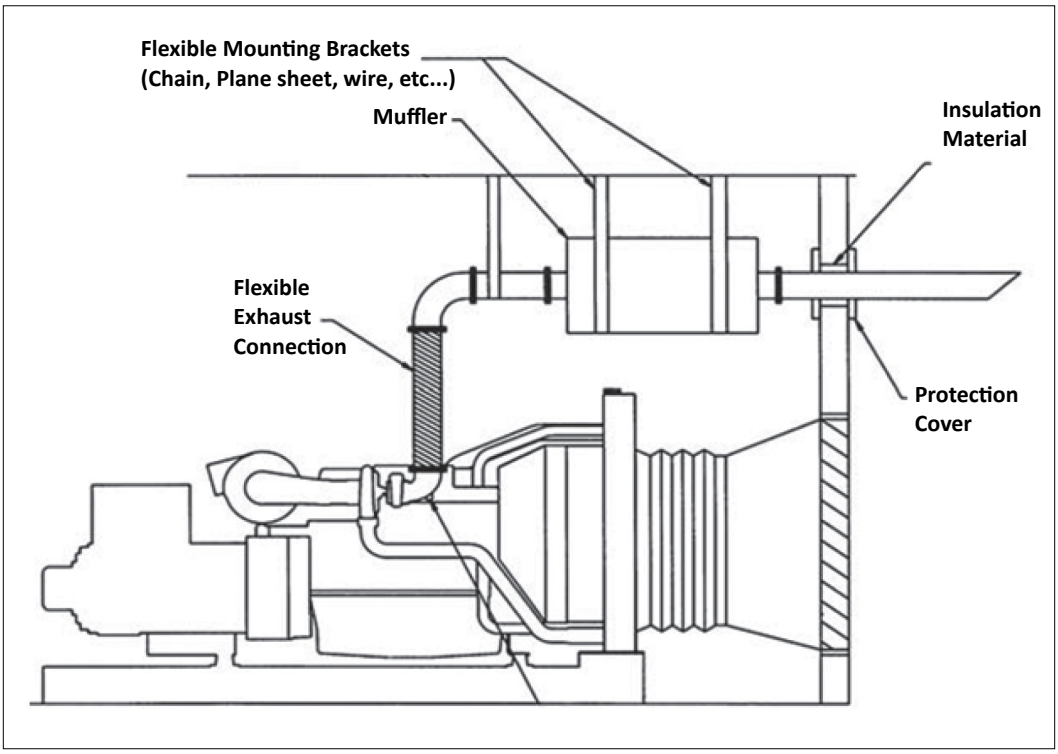


2.7. Vibration Isolators

Vibration insulators are used in order to decrease the negative effects of vibrations caused by the rotational movement of the engine and alternator. These insulators which also prevent the vibration to be transferred from base frame to the ground, are placed between engine/alternator and base frame. Specially chosen vibration isolators are mounted between the engine, alternator and base frame. Alternatively in bigger generator sets, vibration isolators are mounted between the base frame and floor.

2.8. Exhaust System and Silencer

An exhaust system should be designed to decrease the noise coming from exhaust manifold and dispel the exhaust gases to the atmosphere. Exhaust system consists of flexible compensator that absorbs vibration and expansion, steel pipes, bend, silencer and mounting equipment. Further details on exhaust systems can be found in "Installation" section of this manual.



2.9. Control Systems

Various control systems are developed for ensuring the protection of the generator set against failures, load transfers and the reliability of the operation for the generator set.

Control system designs can vary according to the customer requirements and assembling requirements. The main types of control systems are Manual, Automatic, Standby, and Parallel working systems. All control systems are mounted on steel panels containing a lockable door for easy reaching and service.

Further technical information about the control systems of the generator sets can be found in "Control Systems" section of this manual and the manual of the controller.

3. Installation

3.1. Selecting Room Location

The selection and preparation of the location that the generator set will be placed is the most important step of installation. So please make sure that the generator set is installed at a place that is selected and prepared fully in conformity with the instructions in this manual. Also remember that you can call us for any further information of confirmation about this issue.

If the generator will be placed on an upper floor not the basement or ground, the responsibility of static load distribution belongs to customer. The customer should get an approval from an authority about this issue before installation.

Install generator set in such a place that it will not be directly exposed to harsh environmental conditions as rain, snow, hail, flood, humidity, excessive sunlight, extremely low or high temperature, dust, soil, sand or wind.

The place that the generator set will be installed must be, clean, dry, well illuminated and ventilated, free of corrosive or conductive pollutant substances like dust, lint, smoke, oil vapor, exhaust smoke, etc...

Be sure to leave enough blank space around the generator set, in order to ease future maintenance or repair activities Remember that it can be necessary to disassemble the main parts like engine, alternator or the base frame in some cases.

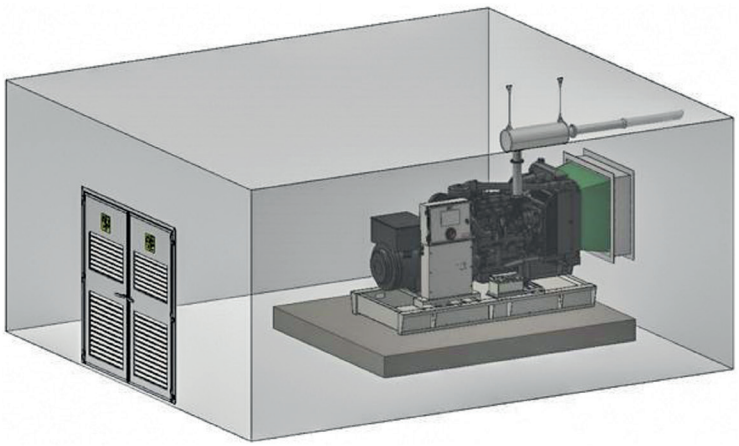
The base ground that the generator will be settled, must be clean dry and must have a well drainage system.

Put the generator set at such place that nobody unauthorized can access it, or at least take necessary precautions about it.

Place generator sets at such places that they will not be affected by the operation of any other machines.

Do not install or run the generator set at any place that has any possibility of risk in terms of safety of operation. Also provide the necessary precautions (canopy option) or protections against bad weather conditions if it will be placed outside.

The doors of the room that the generator set will be placed in, must be at an enough size for the main parts (engine, alternator, radiator, etc....) to pass through. Also ventilation windows can be built portable or mobile for this purpose.



3.2. Ground and Platform

A generator set can be placed on foundations like platform, soil, building or steel construction. The weight of the generator set must not be more than the load carrying capacity of the ground.

It is recommended to build a concrete (strengthened with iron) platform for the generator set. Generally, the platform is built at same horizontal sizes with the generator set and around 150–200 mm. thickness. A platform built at a proper size depending on generator set size, will prevent the set from moving and reduce the negative effects of vibration on engine.

If necessary, the platform can be constructed with such technical specifications that the floor is completely insulated from the generator set against the negative effects of vibration.

If the generator set will be placed in such places that have the risk of flooding, then the thickness of the platform to be built must be 300 mm. at least. This will ensure a dry and safe operation area for generator set and the people working on it.

It is recommended to build standalone platforms for every single generator set. It also should be built separately from any other building structures as other platforms, walls, etc..

3.3. Vibration

TEKSAN generator sets are designed for the minimum vibration transmission to the ground. For this purpose, rubber vibration insulators are placed between the engine/alternator and the base frame. In applications with higher power ratings, the insulators may be placed under the base frame for more efficiency in terms of vibration insulation.

If the generator set is placed on an upper floor, this vibration analysis of the generator and the base ground must be done more carefully. In these types of applications, special insulation system designs may be needed with special insulators. The base ground has to withstand the total weight of the generator set, and its accessories and the negative effects of the uninsulated vibration.

Get the generator set fixed tightly to the ground or platform with steel connection bolts in order to prevent it from moving around and giving damage to the electrical installation, fuel line, exhaust system, or any equipment around it.

3.4. Cooling and Ventilation

The heat radiated by engine can cause high temperature changes which can affect the performance of the generator set.

The fresh air incoming, must be clean and cool as possible. Thus the performance and the lifetime of the engine will be increased. This fresh air can be supplied directly from the installation area, but sometimes it may be necessary to build ventilation channels and bring fresh air from outside.

Also ensure that the fan between the radiator and the engine can easily push out the hot air caused by the engine, alternator or the radiator. This way the room can be ventilated and the generator set can be cooled efficiently.

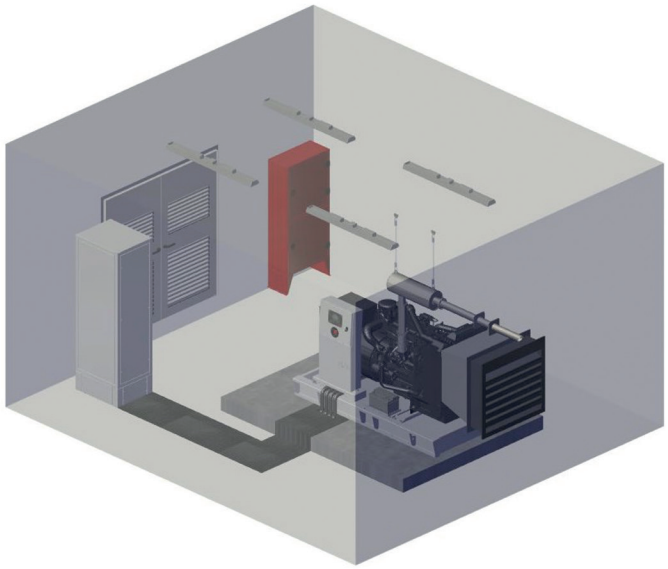
At least two ventilation windows must be built for air intake and outlet. The fresh air intake window should be just before the alternator and the hot air outlet window should be just after the radiator.

Ensure that hot air is being removed from the generator room with a flexible duct connection.

The cooling air flow required can be provided by calculating the dimensions of the air inlet and outlet louvers. Windows area of the room should not be less than the area of radiator matrix. If possible, the air inlet and outlet area should be %150 of the radiator matrix.

In order for the protection of air channels, stationary or moving shutter systems can be built within these windows. For an automatic generator set; an automatically moving shutter system which is designed to open automatically when the engine starts, is the best solution for this purpose. However, manually opened moving shutters can be acceptable in some manual mode generator set applications.

The layout drawing below, is just showing a typical generator set installation. It is for guidance purpose only.
Every generator set installation case or design must be studied carefully and individually.



3.5. Exhaust System

While designing an exhaust system, avoiding back pressure is very important. Excessive exhaust back pressure can contribute to poor engine performance and increasing working temperature.

If any twist or curve is needed on the exhaust line, be sure that the radius of the elbow used on the turning point is more than the 150% of the inner radius of exhaust pipes.

The design of an exhaust system is mainly dependent on site, room or building in which the generator set is settled. But be sure to use the shortest and minimum curved path for piping, in order for minimizing the back-pressure.

Make sure that all piping is tightly fixed, supported and kept at a safe distance from places with too much vibration. Since the exhaust pipes will heat up to very high temperatures, put them at least 250 mm. away from any flammable material. It is also recommended to cover or coat the exhaust pipes with high-thermal isolation materials.

At the end of vertical exhaust lines, there must be used a rain protection cap, which can be easily opened with the gas pressure at the exhaust outlet.

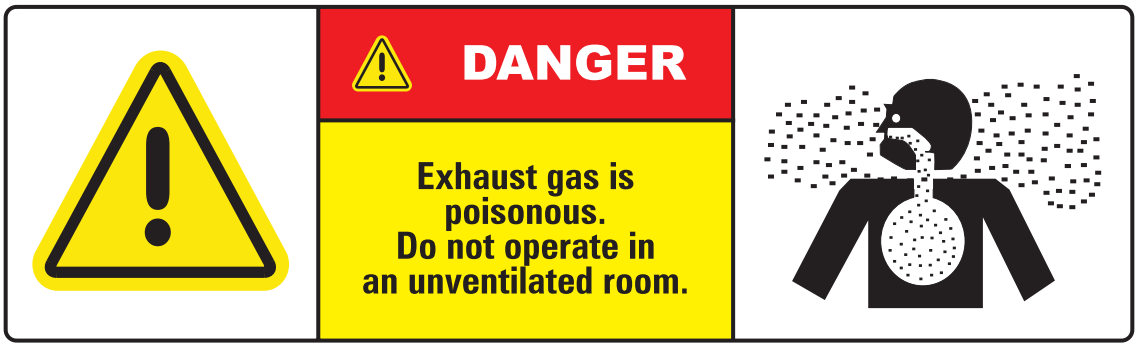
At the very lowest point of any vertical or horizontal exhaust lines, there should be an outlet for draining water out from the line. Thus no water can reach into the silencer or engine.

Placing the muffler at a closest possible location to the engine, will help you decrease the sound level in exhaust pipes. There may be placed another muffler at the end of the line, if the exhaust line is too long. Every engine must have its own, separate exhaust system. No multiple engines shall be connected to a single exhaust line system. Because the exhaust gas, soot or the condensation inside exhaust lines can be harmful for any engine when it is not running.

The exhaust line system should be integrated with the exhaust outlet of the engine with a flexible connection.

Breathing exhaust gases is harmful for human health, it may even be deathful. Also exposure to the high level noise caused by the engine, may cause permanent hearing problems. So the exhaust system of a generator set must be designed and installed well. Any staff around the generator set, should wear ear plugs. The generator set should never be operated with an incomplete exhaust system.

The exhaust outlet points must be selected carefully in order for ensuring that the exhaust gas coming out from the engine, does not go back in through the fresh air inlets. These outlets must not be put into any closed areas, passages, corridors, air channels, ventilation or illumination spaces of buildings, open or closed balconies, elevator hoist ways, any place in that the flow of the exhaust gas may be blocked by the wind or anything else, any place that supplies fresh air for any other machine, the yards between the buildings and especially the habitats of any living creatures.



3.6. Fuel System

Main purpose of the fuel system is to supply clean fuel into the diesel engine continuously. Ensure that the fuel system has been designed correctly and with suitable materials.

It is recommended to use a fuel filter and/or a water separator at the fuel tank outlet line.

Here are some important points to be considered while designing a fuel system properly;

- Using of suitable materials manufactured for fuel
- The distance between the fuel supply and return points/lines of a fuel tank, should be at a proper level around 300 mm. at least.
- Fuel pipes or lines should be designed and built with seamless black steel, proper plastic or copper pipes. Galvanized or any improper type of pipes should not be used on fuel lines.
- The inner walls of the tank must not be painted or coated.
- The hoses to be used on fuel lines, must be selected properly and carefully.

The fuel to be used should be clean for a reliable operation and longer life time of the engine.

Auxiliary fuel tanks can be used if fuel pressure value caused by the main fuel tank's location is out of producer's pressure limits.

Fuel level in the tank should not be at a height 4 meter higher or 3 meter lower than the fuel lift pump. Valves, check valves or any other equipment must not be installed on the fuel return line between engine and fuel tank.

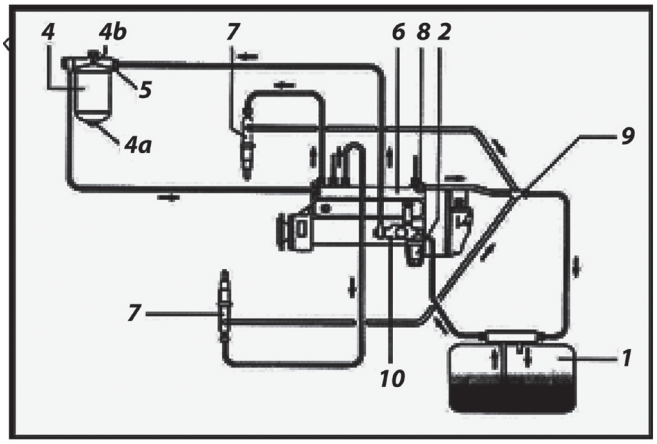
Allowed maximum fuel inlet temperature given by manufacturer should be taken into account while designing a fuel tank or a fuel line. The rise of fuel temperature causes some changes on fuel viscosity, density and combustion quality, so engine performance and exhaust emission will be affected negatively.

Since the fuel supplied to the engine should not consist any air inside it, the fuel lines must be designed so as not to keep air inside.

Warning!

Do not allow smoking or any existence of sparks/flames around the fuel tank, fuel line or the engine.

1. Fuel Tank
2. Strainer
3. Fuel Filter
4. Fuel Filter Assy
   4.a. Fuel Water Drain Plug
   4.b. Air Bleeding Plug (For fuel filter)
5. Fuel Pipe Connector
6. Injection Pump
7. Injection
8. Fuel Pressure Relief Valve
9. Fuel Return Pipe
10. Fuel Feed Pump



3.6.1. Storage Of Diesel Fuel

The most preferred method for providing a continuous fuel supply for the engine is fuel storage in tanks. The fuel tanks can be installed under or above the ground.

There must be an air outlet point on the main fuel tank. The air pressure occurring while filling the tank and the vacuum occurring during the fuel usage will be emptied by this air outlet point. Also a valve or a drainage point must be used at a bottom point of the fuel tank, in order to be able to drain the water that may occur because of condensation.

The fuel tank should be buried at a proper depth, so that the fuel should be protected against the frosty climate conditions.

Another important point to be taken into account while using a main fuel tank is this; the difference of height between the main and daily tanks. Noting that the standard electrical fuel lift pumps have a maximum pumping capacity up to 5 meters, the difference of height between 2 tanks should not be exceeding this pumping height capacity of the pump. Also note that too much use of horizontal pipes or elbow pipes will be decreasing the fuel pressure on the suction line. For all these reasons; the locations of the fuel tanks and the piping to be done between them, should be calculated and established well and carefully. The size of the fuel supply and return lines should never be less than the sizes of the fuel connecting points on the engine and even they may need to be increased to larger sizes in case for long-duration operations or in case of low ambient temperatures.

Fuel line pipes should be made from steel or a material suitable for petroleum. Do not use galvanized pipes. Tank over flow pipe must be made from the same material and must be one size larger.

The fuel return lines should always enter the tank from a point above than the highest fuel level expected and there should be no interruptions or valves on the fuel return line. In order to avoid any possible airlock problems, the fuel return line should be designed and piped with minimum length and with minimum elbow/bending points. Also in order to be sure that the fuel supplied for the engine is clean enough, the fuel to be supplied to engine should not be taken from a height lower than 50 mm the base of the tank.

In order to avoid any possible risks to be caused by the vibrations on the generator set, the fuel lines should be built with flexible pipes at the inlet points of the generator set.

3.7. Electrical Connections and Field Wiring

Electrical connections must be designed, made and repaired by qualified and trained technicians.

All electrical connections and wiring must be done in compliance with the diagrams or the drawings provided by TEKSAN.

All the connection, wiring and grounding processes must be made fully in compliance with the related international, national and local specifications, standards, rules and regulations.

All the cables that will be used for wiring, must be selected at proper ratings and specifications according to the current, voltage, temperature values and the wiring method.

All the electrical connections on the generator set must be made by using flexible cables. This will protect the electrical equipment like conductors, alternator or circuit breakers from the negative effects of the vibration caused by the engine.

If it is not possible to use flexible cables directly, then use a terminal box close to the generator set and make flexible connections to this terminal box.

All connections must be checked very carefully before commissioning the generator set. Checking the connections, conditions and phase orders of all cables, is very important for automatic and synchronous generator set applications.

Control panels are specially manufactured to be mounted on the wall.

The connections between the generator set and the load distribution panel, must be protected against any possible overcurrent and overloading problems by use of fuses or circuit breakers.

It is important to load the generator set under balanced loading conditions. If the load connected to one phase is much more or less than the other two phases and the difference between them is more than 30%, then this will cause overheating issues on the alternator windings or any other failures on 3-phase systems.

Be sure that the current drawn from all phases do not exceed the rated and calculated amount.

There are different types of loads which require special consideration and because of this, before connecting the generator set to an existing electrical system, the system may be required to be revised.

Power factor (cos Ø) of the load connected, must be well determined. If it is inductive and lower than %80 (0,8) then it will cause overloading problems on the generator set. Capacitive power factor values, may cause overvoltage problems on alternator windings.

The power factor must be inductive and at least %80 (0,8) for providing the optimum operating conditions for generator set.

In order for having the power factor at a desired level, it may be necessary to use additional power factor correction systems.

However, the power factor correction system must be well-designed so that the power factor can stay in the desired limits. If the power factor becomes too capacitive, it may cause voltage instabilities and over voltage problems.

Electrical Ratings and Circuit Breaker Table

	480/277 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD9P	9	13,5	XT2N 125-25A LS/I	1SDA074901R1	25	15	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD13P	13	19,5	XT2N 125-25A LS/I	1SDA074901R1	25	20	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD20P	20	30,1	XT2N 125-60A LS/I	1SDA074902R1	60	31	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD25P	25	37,6	XT2N 125-60A LS/I	1SDA074902R1	60	38	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD28P	28	42,1	XT2N 125-60A LS/I	1SDA074902R1	60	43	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD30P	31	46,6	XT2N 125-60A LS/I	1SDA074902R1	60	48	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD50P	50	75,2	XT2N 125-125A LS/I	1SDA074904R1	125	80	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD55P	57	85,7	XT2N 125-125A LS/I	1SDA074904R1	125	90	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD60P	60	90,2	XT2N 125-125A LS/I	1SDA074904R1	125	90	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD65P	64	96,2	XT2N 125-125A LS/I	1SDA074904R1	125	100	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD80P	80	120,3	XT2N 125-125A LS/I	1SDA074904R1	125	125	25kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD100P	100	150,4	XT4N 250-225A LSI	1SDA075422R1	150	157	25kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD125P	125	187,9	XT4N 250-225A LSI	1SDA075422R1	225	191	25kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD150P	150	225,5	XT4N 250-225A LSI	1SDA075422R1	225	225	25kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD160P	160	240,6	XT4N 250-250A LSI	1SDA075423R1	250	250	25kA	KXT4CUAL3	3/0-350 kcmil (1 Hole)
TJUD175P	180	270,6	XT5N400-400A LSI	1SDA102453R1	400	276	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD180P	180	270,6	XT5N400-400A LSI	1SDA102453R1	400	276	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD200P	200	300,7	XT5N400-400A LSI	1SDA102453R1	400	300	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD250P	250	375,9	XT5N400-400A LSI	1SDA102453R1	400	384	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD275P	275	413,5	XT5N600-600A LSI	1SDA102454R1	600	420	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD300P	300	451,1	XT5N600-600A LSI	1SDA102454R1	600	462	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD315P	320	481,1	XT5N600-600A LSI	1SDA102454R1	600	492	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD350P	350	526,2	XT5N600-600A LSI	1SDA102454R1	600	540	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD400P	405	608,9	XT6N800-800A LSI	1SDA102841R1	800	616	35kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD450P	455	684,1	XT6N800-800A LSI	1SDA102841R1	800	696	35kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD500P	500	751,8	XT6N800-800A LSI	1SDA102841R1	800	760	35kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD530P	530	796,9	XT6N800-800A LSI	1SDA102841R1	800	800	35kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD550P	550	827,0	XT7S1000-1000A LSI	1SDA102903R1	1000	850	50kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD600P	600	902,1	XT7S1000-1000A LSI	1SDA102903R1	1000	920	50kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL750P	750	1127,7	XT7S1200-1200A LSI	1SDA102904R1	1200	1140	50kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL800P	820	1232,9	E2.2B-A 1600 LSI	1SDA077229R1	1600	1280	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL865P	895	1345,7	E2.2B-A 1600 LSI	1SDA077229R1	1600	1360	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL900P	900	1353,2	E2.2B-A 1600 LSI	1SDA077229R1	1600	1360	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL1000P	1000	1503,6	E2.2B-A 1600 LSI	1SDA077229R1	1600	1520	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)

Electrical Ratings and Circuit Breaker Table

	208/120 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD9P	9	31,2	XT2N 125-60A LS/I	1SDA074902R1	60	33	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD13P	13	45,1	XT2N 125-60A LS/I	1SDA074902R1	60	45	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD20P	20	69,4	XT2N 125-125A LS/I	1SDA074904R1	125	70	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD25P	25	86,7	XT2N 125-125A LS/I	1SDA074904R1	125	90	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD28P	28	97,2	XT2N 125-125A LS/I	1SDA074904R1	125	100	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD30P	32	111	XT2N 125-125A LS/I	1SDA074904R1	125	115	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD50P	52	180,4	XT4N 250-225A LSI	1SDA075422R1	225	184	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD55P	57	197,8	XT4N 250-225A LSI	1SDA075422R1	225	202	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD60P	60	208,2	XT4N 250-225A LSI	1SDA075422R1	225	213	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD65P	64	225,5	XT4N 250-225A LSI	1SDA075422R1	225	225	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD80P	85	294,9	XT5N400-400A LSI	1SDA102453R1	400	300	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD100P	105	367,8	XT5N400-400A LSI	1SDA102453R1	400	384	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD125P	130	451,1	XT5N600-600A LSI	1SDA102454R1	600	456	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD150P	150	520,5	XT5N600-600A LSI	1SDA102454R1	600	552	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD160P	160	555,2	XT5N600-600A LSI	1SDA102454R1	600	570	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD175P	172	607,2	XT6N800-800A LSI	1SDA102841R1	800	600	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD180P	180	631,5	XT6N800-800A LSI	1SDA102841R1	800	640	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD200P	200	694	XT6N800-800A LSI	1SDA102841R1	800	704	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD250P	250	867,4	XT7S1000-1000A LSI	1SDA102903R1	1000	880	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD275P	275	954,2	XT7S1000-1000A LSI	1SDA102903R1	1000	960	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD300P	300	1040,9	XT7S1200-1200A LSI	1SDA102904R1	1200	1056	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD315P	315	1093	XT7S1200-1200A LSI	1SDA102904R1	1200	1104	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD350P	350	1214,4	E2.2B-A 1600 LSI	1SDA077229R1	1600	1232	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD400P	405	1405,3	E2.2B-A 1600 LSI	1SDA077229R1	1600	1440	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD450P	444	1561,4	E2.2B-A 1600 LSI	1SDA077229R1	1600	1552	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD500P	488	1734,9	E2.2N-A 2000 LSI	1SDA077289R1	2000	1700	50kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUD530P	530	1734,9	E2.2N-A 2000 LSI	1SDA077289R1	2000	1840	50kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUD550P	560	1734,9	E2.2N-A 2000 LSI	1SDA077289R1	2000	2000	50kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUD600P	610	2116,6	E4.2S-A 2500 LSI	1SDA077999R1	2500	2125	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL750P	750	2602,3	E4.2S-A 3200 LSI	1SDA078009R1	3200	2624	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL800P	800	2775,8	E4.2S-A 3200 LSI	1SDA078009R1	3200	2784	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL865P	865	3001,3	E4.2S-A 3200 LSI	1SDA078009R1	3200	3040	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL900P	900	3122,8	E4.2S-A 3200 LSI	1SDA078009R1	3200	3200	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL1000P	1000	3469,8	E4.2H-A 3600 LSI	1SDA077929R1	3600	3492	65kA	BUSBAR	350 kcmil*10 Dia Holes

Electrical Ratings and Circuit Breaker Table

	240/120 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD9P	9	27,1	XT2N 125-60A LS/I	1SDA074902R1	60	29	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD13P	13	39,1	XT2N 125-60A LS/I	1SDA074902R1	60	40	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD20P	20	60,1	XT2N 125-125A LS/I	1SDA074904R1	125	65	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD25P	25	75,2	XT2N 125-125A LS/I	1SDA074904R1	125	80	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD28P	28	84,2	XT2N 125-125A LS/I	1SDA074904R1	125	85	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD30P	32	96,2	XT2N 125-125A LS/I	1SDA074904R1	125	100	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD50P	52	156,4	XT4N 250-225A LSI	1SDA075422R1	225	158	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD55P	57	171,4	XT4N 250-225A LSI	1SDA075422R1	225	173	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD60P	60	180,4	XT4N 250-225A LSI	1SDA075422R1	225	184	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD65P	64	195,5	XT4N 250-225A LSI	1SDA075422R1	225	196	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD80P	85	255,6	XT5N400-400A LSI	1SDA102453R1	400	261	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD100P	105	318,8	XT5N400-400A LSI	1SDA102453R1	400	320	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD125P	130	390,9	XT5N600-600A LSI	1SDA102454R1	600	402	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD150P	150	451,1	XT5N600-600A LSI	1SDA102454R1	600	462	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD160P	160	481,1	XT5N600-600A LSI	1SDA102454R1	600	492	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD175P	172	526,2	XT5N600-600A LSI	1SDA102454R1	600	540	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD180P	180	547,3	XT5N600-600A LSI	1SDA102454R1	600	552	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD200P	200	601,4	XT6N800-800A LSI	1SDA102841R1	800	616	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD250P	250	751,8	XT7S1000-1000A LSI	1SDA102903R1	1000	770	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD275P	275	827	XT7S1000-1000A LSI	1SDA102903R1	1000	850	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD300P	300	902,1	XT7S1000-1000A LSI	1SDA102903R1	1000	920	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD315P	315	947,2	XT7S1000-1000A LSI	1SDA102903R1	1000	950	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD350P	350	1052,5	XT7S1200-1200A LSI	1SDA102904R1	1200	1080	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD400P	405	1217,9	E2.2B-A 1600 LSI	1SDA077229R1	1600	1280	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD450P	444	1353,2	E2.2B-A 1600 LSI	1SDA077229R1	1600	1360	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD500P	488	1503,6	E2.2B-A 1600 LSI	1SDA077229R1	1600	1472	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD530P	530	1593,8	E2.2B-A 1600 LSI	1SDA077229R1	1600	1600	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD550P	560	1684	E2.2N-A 2000 LSI	1SDA077289R1	2000	1700	50kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUD600P	610	1834,3	E2.2N-A 2000 LSI	1SDA077289R1	2000	1840	50kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL750P	750	2255,3	E4.2S-A 2500 LSI	1SDA077999R1	2500	2250	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL800P	800	2405,7	E4.2S-A 2500 LSI	1SDA077999R1	2500	2425	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL865P	865	2601,2	E4.2S-A 3200 LSI	1SDA078009R1	3200	2624	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL900P	900	2706,4	E4.2S-A 3200 LSI	1SDA078009R1	3200	2720	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL1000P	1000	3007,1	E4.2S-A 3200 LSI	1SDA078009R1	3200	3040	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)

Electrical Ratings and Circuit Breaker Table

	600/347 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD9P	9	10,8	XT2N 125-25A LS/I	1SDA074901R1	25	12	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD13P	13	15,6	XT2N 125-25A LS/I	1SDA074901R1	25	16	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD20P	20	24,1	XT2N 125-25A LS/I	1SDA074901R1	25	25	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD25P	25	30,1	XT2N 125-60A LS/I	1SDA074902R1	60	31	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD28P	28	33,7	XT2N 125-60A LS/I	1SDA074902R1	60	36	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD30P	31	37,3	XT2N 125-60A LS/I	1SDA074902R1	60	40	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD50P	49	58,9	XT2N 125-60A LS/I	1SDA074902R1	60	60	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD55P	56	67,4	XT2N 125-125A LS/I	1SDA074904R1	125	70	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD60P	64	77	XT2N 125-125A LS/I	1SDA074904R1	125	80	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD65P	64	77	XT2N 125-125A LS/I	1SDA074904R1	125	80	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD80P	80	102,2	XT2N 125-125A LS/I	1SDA074904R1	125	105	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD100P	100	120,3	XT2N 125-125A LS/I	1SDA074904R1	125	125	18kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD125P	125	150,4	XT4N 250-225A LSI	1SDA075422R1	225	157	18kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD150P	150	180,4	XT4N 250-225A LSI	1SDA075422R1	225	184	18kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD160P	160	192,5	XT4N 250-225A LSI	1SDA075422R1	225	195	18kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD175P	180	216,5	XT4N 250-225A LSI	1SDA075422R1	225	218	18kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD180P	180	216,5	XT4N 250-225A LSI	1SDA075422R1	225	218	18kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD200P	205	246,6	XT4N 250-250A LSI	1SDA075423R1	250	250	18kA	KXT4CUAL3	3/0-350 kcmil (1 Hole)
TJUD250P	260	306,7	XT5N400-400A LSI	1SDA102453R1	400	308	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD275P	275	330,8	XT5N400-400A LSI	1SDA102453R1	400	340	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD300P	288	360,9	XT5N400-400A LSI	1SDA102453R1	400	368	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD315P	320	384,9	XT5N400-400A LSI	1SDA102453R1	400	388	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD350P	350	421	XT5N600-600A LSI	1SDA102454R1	600	432	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD400P	400	481,1	XT5N600-600A LSI	1SDA102454R1	600	492	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD450P	455	547,3	XT5N600-600A LSI	1SDA102454R1	600	552	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD500P	500	601,4	XT6N800-800A LSI	1SDA102841R1	800	616	20kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD530P	530	637,5	XT6N800-800A LSI	1SDA102841R1	800	640	20kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD550P	548	661,6	XT6N800-800A LSI	1SDA102841R1	800	680	20kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD600P	600	721,7	XT6N800-800A LSI	1SDA102841R1	800	736	20kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUL750P	750	902,1	XT7S1000-1000A LSI	1SDA102903R1	1000	920	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL800P	800	962,3	XT7S1000-1000A LSI	1SDA102903R1	1000	970	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL865P	880	1058,5	XT7S1200-1200A LSI	1SDA102904R1	1200	1080	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL900P	900	1082,6	XT7S1200-1200A LSI	1SDA102904R1	1200	1104	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL1000P	1000	1202,8	E2.2B-A 1600 LSI	1SDA077229R1	1600	1232	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)

- 600/367 V WYE connection is available only special/dedicated winding alternator.

Electrical Ratings and Circuit Breaker Table

	240/120 V – 1 Ph 12 Leads		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD9P	9	37,5	XT2N 125-60A LS/I	1SDA074902R1	60	40	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD13P	12,5	52,1	XT2N 125-60A LS/I	1SDA074902R1	60	55	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD20P	19,2	80,0	XT2N 125-125A LS/I	1SDA074904R1	125	80	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD25P	24	100,0	XT2N 125-125A LS/I	1SDA074904R1	125	100	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD28P	27,5	114,6	XT2N 125-125A LS/I	1SDA074904R1	125	115	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD30P	30	125,0	XT2N 125-125A LS/I	1SDA074904R1	125	125	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD50P	52	216,7	XT4N 250-225A LSI	1SDA075422R1	225	225	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD55P	57	237,5	XT4N 250-250A LSI	1SDA075423R1	250	242	65kA	KXT4CUAL3	3/0-350 kcmil (1 Hole)
TJUD60P	60	250,0	XT4N 250-250A LSI	1SDA075423R1	250	250	65kA	KXT4CUAL3	3/0-350 kcmil (1 Hole)
TJUD65P	64	266,7	XT5N400-400A LSI	1SDA102453R1	400	276	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD80P	80	333,3	XT5N400-400A LSI	1SDA102453R1	400	340	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD100P	105	437,5	XT5N600-600A LSI	1SDA102454R1	600	450	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD125P	125	520,8	XT5N600-600A LSI	1SDA102454R1	600	522	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD150P	140	583,3	XT5N600-600A LSI	1SDA102454R1	600	600	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD160P	150	625,0	XT6N800-800A LSI	1SDA102841R1	800	640	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD175P	165	687,5	XT6N800-800A LSI	1SDA102841R1	800	696	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD180P	175	729,2	XT6N800-800A LSI	1SDA102841R1	800	736	65kA	KXT6CUAL3X400	2/0-400 kcmil (3 Hole)
TJUD200P	200	833,3	XT7S1000-1000A LSI	1SDA102903R1	1000	850	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD250P	230	958,3	XT7S1000-1000A LSI	1SDA102903R1	1000	970	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)

Electrical Ratings and Circuit Breaker Table

	240/120 V – 1Ph 4 Leads		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD9P	9	37,5	XT2N 125-60A LS/I	1SDA074902R1	60	40	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD13P	13	54,2	XT2N 125-60A LS/I	1SDA074902R1	60	55	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD20P	21	87,5	XT2N 125-125A LS/I	1SDA074904R1	125	90	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD25P	26	108,3	XT2N 125-125A LS/I	1SDA074904R1	125	110	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD28P	29	120,8	XT2N 125-125A LS/I	1SDA074904R1	125	125	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD30P	30	125,0	XT2N 125-125A LS/I	1SDA074904R1	125	125	65kA	KXT2CUAL1	14 AWG-1/0 (1 Hole)
TJUD50P	53	220,8	XT4N 250-225A LSI	1SDA075422R1	225	225	65kA	KXT4CUAL2	4 AWG-300 kcmil (1 Hole)
TJUD55P	56	233,3	XT4N 250-250A LSI	1SDA075423R1	237	250	65kA	KXT4CUAL3	3/0-350 kcmil (1 Hole)
TJUD60P	63	262,5	XT5N400-400A LSI	1SDA102453R1	400	270	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD65P	63	262,5	XT5N400-400A LSI	1SDA102453R1	400	270	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD80P	80	333,3	XT5N400-400A LSI	1SDA102453R1	400	340	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD100P	100	416,7	XT5N600-600A LSI	1SDA102454R1	600	420	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD125P	125	520,8	XT5N600-600A LSI	1SDA102454R1	600	522	65kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)

Electrical Ratings and Circuit Breaker Table

	480/277 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD300H	300	451	XT5N600-600A LSI	1SDA102454R1	600	462	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD325H	325	489	XT5N600-600A LSI	1SDA102454R1	600	492	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD350H	350	526	XT5N600-600A LSI	1SDA102454R1	600	540	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD400H	395	594	XT5N600-600A LSI	1SDA102454R1	600	600	35kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUL750H	750	1128	XT7S1200-1200A LSI	1SDA102904R1	1200	1140	50kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL800H	800	1203	XT7S1200-1200A LSI	1SDA102904R1	1200	1200	50kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL900H	900	1353	E2.2B-A 1600 LSI	1SDA077229R1	1600	1360	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL800B	820	1233	E2.2B-A 1600 LSI	1SDA077229R1	1600	1280	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL900B	858	1290	E2.2B-A 1600 LSI	1SDA077229R1	1600	1392	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL1000B	1000	1504	E2.2B-A 1600 LSI	1SDA077229R1	1600	1520	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL1250B	1250	1879	E2.2N-A 2000 LSI	1SDA077289R1	2000	1900	50kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)

Electrical Ratings and Circuit Breaker Table

	208/120 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD300H	300	1041	XT7S1200-1200A LSI	1SDA102904R1	1200	1056	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD325H	325	1128	XT7S1200-1200A LSI	1SDA102904R1	1200	1152	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD350H	350	1214	E2.2B-A 1600 LSI	1SDA077229R1	1600	1232	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD400H	395	1371	E2.2B-A 1600 LSI	1SDA077229R1	1600	1392	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL750H	750	2602	E4.2S-A 3200 LSI	1SDA078009R1	3200	2624	65kA	2x(KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL800H	810	2811	E4.2S-A 3200 LSI	1SDA078009R1	3200	2880	65kA	2x(KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL900H	900	3123	E4.2S-A 3200 LSI	1SDA078009R1	3200	3200	65kA	2x(KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL800B	795	2758	E4.2S-A 3200 LSI	1SDA078009R1	3200	2784	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL900B	855	2967	E4.2S-A 3200 LSI	1SDA078009R1	3200	3040	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL1000B	1000	3470	E4.2H-A 3600 LSI	1SDA077929R1	3600	3492	65kA	BUSBAR	400kcmil*10 Dia holes
TJUL1250B	1250	4337	TBA	TBA	TBA	TBA	TBA	TBA	TBA

Electrical Ratings and Circuit Breaker Table

	240/120 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD300H	300	902	XT7S1000-1000A LSI	1SDA102903R1	1000	920	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD325H	325	977	XT7S1000-1000A LSI	1SDA102903R1	1000	1000	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD350H	350	1052	XT7S1200-1200A LSI	1SDA102904R1	1200	1080	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUD400H	395	1188	XT7S1200-1200A LSI	1SDA102904R1	1200	1200	65kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL750H	750	2255	E4.2S-A 2500 LSI	1SDA077999R1	2500	2300	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL800H	800	2406	E4.2S-A 2500 LSI	1SDA077999R1	2500	2425	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL900H	900	2706	E4.2S-A 3200 LSI	1SDA078009R1	3200	2720	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL800B	800	2406	E4.2S-A 2500 LSI	1SDA077999R1	2500	2425	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL900B	855	2571	E4.2S-A 3200 LSI	1SDA078009R1	3200	2624	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL1000B	1000	3007	E4.2S-A 3200 LSI	1SDA078009R1	3200	3040	65kA	2 x (KXT7CUAL4X500)	500 kcmil (8 Hole)
TJUL1250B	1250	3759	TBA	TBA	TBA	TBA	TBA	TBA	TBA

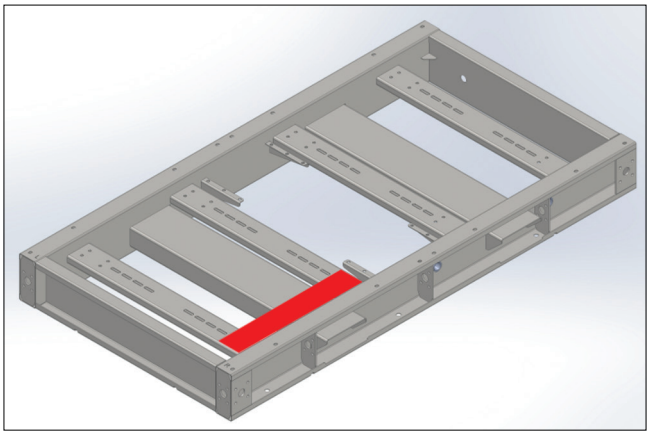
Electrical Ratings and Circuit Breaker Table

	600/347 V		CIRCUIT BREAKER DATA						
GENSET MODEL	ESP (kW)	ESP (A)	Product Name	Product Code	Rated Current (In)	Set Current (A)	Interrupting Rating	Lug Parts #	Lug Size
TJUD300H	300	361	XT5N400-400A LSI	1SDA102453R1	400	388	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD325H	325	391	XT5N400-400A LSI	1SDA102453R1	400	400	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD350H	350	421	XT5N600-600A LSI	1SDA102454R1	600	432	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUD400H	395	475	XT5N600-600A LSI	1SDA102454R1	600	480	18kA	KXT5CUAL2X500	2/0-500 kcmil (2 Hole)
TJUL750H	750	902	XT7S1000-1000A LSI	1SDA102903R1	1000	920	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL800H	800	962	XT7S1000-1000A LSI	1SDA102903R1	1000	970	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL900H	900	1083	XT7S1200-1200A LSI	1SDA102904R1	1200	1104	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL800B	820	986	XT7S1000-1000A LSI	1SDA102903R1	1000	1000	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL900B	856	1030	XT7S1200-1200A LSI	1SDA102904R1	1200	1056	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL1000B	1000	1203	XT7S1200-1200A LSI	1SDA102904R1	1200	1200	25kA	KXT7CUAL4X500	500 kcmil (4 Hole)
TJUL1250B	1250	1504	E2.2B-A 1600 LSI	1SDA077229R1	1600	1520	42kA	KXT7CUAL4X500	500 kcmil (4 Hole)

Table 310.15 (B) (16) (formerly Table 310.16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)*			
Temperature Rating of Conductor [See Table 310.104 (A).]			
	60°C (140°F)	75°C (167°F)	90°C (194°F)
"Size AWG or kcmil"	Types TW, UF	"Types RHW, THHW, THW, THWN, XHHW, USE, ZW"	"Types TBS, SA, SIS, FEP, FEPB, MI,RHH, RHW-2, THHN, THHW, THW-2, THWN-2,U-SE-2, XHH, XHHW, XHHW-2, ZW-2"
COPPER			
18	–	–	14
16	–	–	18
14**	15	20	25
12**	20	25	30
10**	30	35	40
8	40	50	55
6	55	65	75
4	70	85	95
3	85	100	115
2	95	115	130
1	110	130	145
1/0	125	150	170
2/0	145	175	195
3/0	165	200	225
4/0	195	230	260
250	215	255	290
300	240	285	320
350	260	310	350
400	280	335	380
500	320	380	430
600	350	420	475
700	385	460	520
750	400	475	535
800	410	490	555
900	435	520	585
1000	455	545	615
1250	495	590	665
1500	525	625	705
1750	545	650	735
2000	555	665	750

* Refer to 310.15 (B) (2) for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).
** Refer to 240.4 (D) for conductor overcurrent protection limitations.

Allowable Ampacities of Insulated Conductors	
Copper Conductors Temperature Rating of Conductor 90°C	
"Size AWG or kcmil"	"TYPES RHH, RHW-2, XHHW, XHHW-2, XHH, THHW, THWN- 2, THW-2, THHN, USE-2"
14	25
12	30
10	40
8	55
6	75
4	95
3	110
2	130
1	150
1/0	170
2/0	195
3/0	225
4/0	260
250	290
300	320
350	350
400	380
500	430



BOLT SIZE	TIGHTENING TORQUE		
	8.8 rank	10.9 rank	12.9 rank
M10	36.1 ft*lb	53.1 ft*lb	62.0 ft*lb
M12	63.4 ft*lb	92.9 ft*lb	106.9 ft*lb

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	480/277 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD9P	9	13,5	10 AWG	10 AWG
TJUD13P	13	19,5	10 AWG	10 AWG
TJUD20P	20	30,1	10 AWG	10 AWG
TJUD25P	25	37,6	8 AWG	8 AWG
TJUD28P	28	42,1	8 AWG	8 AWG
TJUD30P	31	46,6	8 AWG	8 AWG
TJUD50P	50	75,2	4 AWG	4 AWG
TJUD55P	57	85,7	4 AWG	4 AWG
TJUD60P	60	90,2	4 AWG	4 AWG
TJUD65P	64	96,2	2 AWG	2 AWG
TJUD80P	80	120,3	2 AWG	2 AWG
TJUD100P	100	150,4	2/0 AWG	2/0 AWG
TJUD125P	125	187,9	3/0 AWG	3/0 AWG
TJUD150P	150	225,5	4/0 AWG	4/0 AWG
TJUD160P	160	240,6	250 kcmil	250 kcmil
TJUD175P	180	270,6	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD180P	180	270,6	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD200P	200	300,7	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD250P	250	375,9	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD275P	275	413,5	2 x (3/0 AWG)	2 x (3/0 AWG)
TJUD300P	300	451,1	2 x (4/0 AWG)	2 x (4/0 AWG)
TJUD315P	320	481,1	2 x (4/0 AWG)	2 x (4/0 AWG)
TJUD350P	350	526,2	2 x (300 kcmil)	2 x (300 kcmil)
TJUD400P	405	608,9	2 x (350 kcmil)	2 x (350 kcmil)
TJUD450P	455	684,1	2 x (350 kcmil)	2 x (350 kcmil)
TJUD500P	500	751,8	3 x (250 kcmil)	3 x (250 kcmil)
TJUD530P	530	796,9	3 x (300 kcmil)	3 x (300 kcmil)
TJUD550P	550	827,0	4 x (250 kcmil)	4 x (250 kcmil)
TJUD600P	600	902,1	4 x (250 kcmil)	4 x (250 kcmil)
TJUL750P	750	1127,7	4 x (300 kcmil)	4 x (300 kcmil)
TJUL800P	820	1232,9	4x (350 kcmil)	4 x (350 kcmil)
TJUL865P	895	1345,7	4x (350 kcmil)	4 x (350 kcmil)
TJUL900P	900	1353,2	4x (350 kcmil)	4 x (350 kcmil)
TJUL1000P	1000	1503,6	4x (400 kcmil)	4 x (400 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	208/120 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD9P	9	31,2	10 AWG	10 AWG
TJUD13P	13	45,1	8 AWG	8 AWG
TJUD20P	20	69,4	6 AWG	6 AWG
TJUD25P	25	86,7	4 AWG	4 AWG
TJUD28P	28	97,2	2 AWG	2 AWG
TJUD30P	32	111,0	2 AWG	2 AWG
TJUD50P	52	180,4	2/0 AWG	2/0 AWG
TJUD55P	57	197,8	3/0 AWG	3/0 AWG
TJUD60P	60	208,2	3/0 AWG	3/0 AWG
TJUD65P	64	222,1	4/0 AWG	4/0 AWG
TJUD80P	85	294,9	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD100P	105	364,3	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD125P	130	451,1	2 x (4/0 AWG)	2 x (4/0 AWG)
TJUD150P	150	520,5	2 x (300 kcmil)	2 x (300 kcmil)
TJUD160P	160	555,2	2 x (300 kcmil)	2 x (300 kcmil)
TJUD175P	172	596,8	2 x (350 kcmil)	2 x (350 kcmil)
TJUD180P	180	624,6	2 x (350 kcmil)	2 x (350 kcmil)
TJUD200P	200	694,0	3 x (250 kcmil)	3 x (250 kcmil)
TJUD250P	250	867,4	4 x (4/0 AWG)	4 x (4/0 AWG)
TJUD275P	275	954,2	4 x (250 kcmil)	4 x (250 kcmil)
TJUD300P	300	1040,9	4 x (300 kcmil)	4 x (300 kcmil)
TJUD315P	315	1093,0	4 x (300 kcmil)	4 x (300 kcmil)
TJUD350P	350	1214,4	4 x (350 kcmil)	4 x (350 kcmil)
TJUD400P	405	1405,3	4 x (400 kcmil)	4 x (400 kcmil)
TJUD450P	444	1540,6	4 x (500 kcmil)	4 x (500 kcmil)
TJUD500P	488	1693,2	6 x (300 kcmil)	6 x (300 kcmil)
TJUD530P	530	1839,0	6 x (350 kcmil)	6 x (350 kcmil)
TJUD550P	560	1943,1	6 x (350 kcmil)	6 x (350 kcmil)
TJUD600P	610	2116,6	8 x (300 kcmil)	8 x (300 kcmil)
TJUL750P	750	2602,3	8 x (350 kcmil)	8 x (350 kcmil)
TJUL800P	800	2775,8	8 x (400 kcmil)	8 x (400 kcmil)
TJUL865P	865	3001,3	8 x (500 kcmil)	8 x (500 kcmil)
TJUL900P	900	3122,8	8 x (500 kcmil)	8 x (500 kcmil)
TJUL1000P	1000	3469,8	10 x (350 kcmil)	10 x (350 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient			
GENSET MODEL	240/120 V		"Cable Section Single Core for Each Phase (AWG)"
	ESP (kW)	ESP (A)	
TJUD9P	9	27,1	10 AWG
TJUD13P	13	39,1	8 AWG
TJUD20P	20	60,1	6 AWG
TJUD25P	25	75,2	4 AWG
TJUD28P	28	84,2	4 AWG
TJUD30P	32	96,2	2 AWG
TJUD50P	52	156,4	2/0 AWG
TJUD55P	57	171,4	2/0 AWG
TJUD60P	60	180,4	2/0 AWG
TJUD65P	64	192,5	3/0 AWG
TJUD80P	85	255,6	2 x (2/0 AWG)
TJUD100P	105	315,7	2 x (2/0 AWG)
TJUD125P	130	390,9	2 x (3/0 AWG)
TJUD150P	150	451,1	2 x (4/0 AWG)
TJUD160P	160	481,1	2 x (4/0 AWG)
TJUD175P	172	517,2	2 x (300 kcmil)
TJUD180P	180	541,3	2 x (300 kcmil)
TJUD200P	200	601,4	3 x (3/0 AWG)
TJUD250P	250	751,8	3 x (300 kcmil)
TJUD275P	275	827,0	4 x (4/0 AWG)
TJUD300P	300	902,1	4 x (4/0 AWG)
TJUD315P	315	947,2	4 x (250 kcmil)
TJUD350P	350	1052,5	4 x (300 kcmil)
TJUD400P	405	1217,9	4 x (350 kcmil)
TJUD450P	444	1335,2	4 x (350 kcmil)
TJUD500P	488	1467,5	4 x (400 kcmil)
TJUD530P	530	1593,8	4 x (450 kcmil)
TJUD550P	560	1684,0	6 x (300 kcmil)
TJUD600P	610	1834,3	6 x (350 kcmil)
TJUL750P	750	2255,3	8 x (300 kcmil)
TJUL800P	800	2405,7	8 x (350 kcmil)
TJUL865P	865	2601,2	8 x (350 kcmil)
TJUL900P	900	2706,4	8 x (350 kcmil)
TJUL1000P	1000	3007,1	8 x (450 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	600/347 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD9P	9	10,8	10 AWG	10 AWG
TJUD13P	13	15,6	10 AWG	10 AWG
TJUD20P	20	24,1	10 AWG	10 AWG
TJUD25P	25	30,1	10 AWG	10 AWG
TJUD28P	28	33,7	10 AWG	10 AWG
TJUD30P	31	37,3	10 AWG	10 AWG
TJUD50P	49	58,9	6 AWG	6 AWG
TJUD55P	56	67,4	6 AWG	6 AWG
TJUD60P	64	77,0	4 AWG	4 AWG
TJUD65P	64	77,0	4 AWG	4 AWG
TJUD80P	80	96,2	2 AWG	2 AWG
TJUD100P	100	120,3	2 AWG	2 AWG
TJUD125P	125	150,4	2/0 AWG	2/0 AWG
TJUD150P	150	180,4	2/0 AWG	2/0 AWG
TJUD160P	160	192,5	3/0 AWG	3/0 AWG
TJUD175P	180	216,5	4/0 AWG	4/0 AWG
TJUD180P	180	216,5	4/0 AWG	4/0 AWG
TJUD200P	205	246,6	250 kcmil	250 kcmil
TJUD250P	260	312,7	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD275P	275	330,8	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD300P	288	346,4	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD315P	320	384,9	2 x (3/0 AWG)	2 x (3/0 AWG)
TJUD350P	350	421,0	2 x (3/0 AWG)	2 x (3/0 AWG)
TJUD400P	400	481,1	2 x (250 kcmil)	2 x (250 kcmil)
TJUD450P	455	547,3	2 x (300 kcmil)	2 x (300 kcmil)
TJUD500P	500	601,4	3 x (3/0 AWG)	3 x (3/0 AWG)
TJUD530P	530	637,5	3 x (3/0 AWG)	3 x (3/0 AWG)
TJUD550P	548	659,2	3 x (3/0 AWG)	3 x (3/0 AWG)
TJUD600P	600	721,7	3 x (250 kcmil)	3 x (250 kcmil)
TJUL750P	750	902,1	4 x (4/0 AWG)	4 x (4/0 AWG)
TJUL800P	800	962,3	4 x (250 kcmil)	4 x (250 kcmil)
TJUL865P	880	1058,5	4 x (300 kcmil)	4 x (300 kcmil)
TJUL900P	900	1082,6	4 x (300 kcmil)	4 x (300 kcmil)
TJUL1000P	1000	1202,8	4 x (350 kcmil)	4 x (350 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient			
GENSET MODEL	240/120 V – 1Ph (12 Leads)		"Cable Section Single Core for Each Phase (AWG)"
	ESP (kW)	ESP (A)	
TJUD9P	9	37,5	8 AWG
TJUD13P	12,5	52,1	8 AWG
TJUD20P	19,2	80,0	4 AWG
TJUD25P	24	100,0	2 AWG
TJUD28P	27,5	114,6	2 AWG
TJUD30P	30	125,0	1/0 AWG
TJUD50P	52	216,7	4/0 AWG
TJUD55P	57	237,5	250 kcmil
TJUD60P	60	250,0	300 kcmil
TJUD65P	64	266,7	2 x (2/0 AWG)
TJUD80P	80	333,3	2 x (2/0 AWG)
TJUD100P	105	437,5	2 x (4/0 AWG)
TJUD125P	125	520,8	2 x (300 kcmil)
TJUD150P	140	583,3	2 x (350 kcmil)
TJUD160P	150	625,0	3 x (4/0 AWG)
TJUD175P	165	687,5	3 x (4/0 AWG)
TJUD180P	175	729,2	3 x (250 kcmil)
TJUD200P	200	833,3	4 x (4/0 AWG)
TJUD250P	230	958,3	4 x (250 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient			
GENSET MODEL	240/120 V – 1Ph (4 Leads)		"Cable Section Single Core for Each Phase (AWG)"
	ESP (kW)	ESP (A)	
TJUD9P	9	37,5	8 AWG
TJUD13P	13	54,2	6 AWG
TJUD20P	21	87,5	4 AWG
TJUD25P	26	108,3	2 AWG
TJUD28P	29	120,8	2 AWG
TJUD30P	30	125,0	1/0 AWG
TJUD50P	53	220,8	4/0 AWG
TJUD55P	56	233,3	250 kcmil
TJUD60P	63	262,5	2 x (1/0 AWG)
TJUD65P	63	262,5	2 x (1/0 AWG)
TJUD80P	80	333,3	2 x (2/0 AWG)
TJUD100P	100	416,7	2 x (3/0 AWG)
TJUD125P	125	520,8	2 x (300 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	480/277 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD300H	300	451,1	2 x (4/0 AWG)	2 x (4/0 AWG)
TJUD325H	325	488,7	2 x (4/0 AWG)	2 x (4/0 AWG)
TJUD350H	350	526,2	2 x (300 kcmil)	2 x (300 kcmil)
TJUD400H	395	593,9	2 x (350 kcmil)	2 x (350 kcmil)
TJUL750H	750	1127,7	4 x (300 kcmil)	4 x (300 kcmil)
TJUL800H	800	1202,8	4 x (350 kcmil)	4 x (350 kcmil)
TJUL900H	900	1353,2	4 x (350 kcmil)	4 x (350 kcmil)
TJUL800B	820	1232,9	4 x (350 kcmil)	4 x (350 kcmil)
TJUL900B	858	1290,1	4 x (350 kcmil)	4 x (350 kcmil)
TJUL1000B	1000	1503,6	4 x (400 kcmil)	4 x (400 kcmil)
TJUL1250B	1250	1879,5	6 x (350 kcmil)	6 x (350 kcmil)

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	208/120 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD300H	300	1040,9	4 x (300 kcmil)	4 x (300 kcmil)
TJUD325H	325	1127,7	4 x (300 kcmil)	4 x (300 kcmil)
TJUD350H	350	1214,4	4 x (350 kcmil)	4 x (350 kcmil)
TJUD400H	395	1370,6	4 x (350 kcmil)	4 x (350 kcmil)
TJUL750H	750	2602,3	8 x (350 kcmil)	8 x (350 kcmil)
TJUL800H	810	2810,5	8 x (400 kcmil)	8 x (400 kcmil)
TJUL900H	900	3122,8	8 x (500 kcmil)	8 x (500 kcmil)
TJUL800B	795	2758,5	8 x (500 kcmil)	8 x (500 kcmil)
TJUL900B	855	2966,6	8 x (500 kcmil)	8 x (500 kcmil)
TJUL1000B	1000	3469,8	10 x (350 kcmil)	10 x (350 kcmil)
TJUL1250B	1250	4337,2	TBA	TBA

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	240/120 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD300H	300	902,1	4 x (4/0 AWG)	4 x (4/0 AWG)
TJUD325H	325	977,3	4 x (250 kcmil)	4 x (250 kcmil)
TJUD350H	350	1052,5	4 x (300 kcmil)	4 x (300 kcmil)
TJUD400H	395	1187,8	4 x (350 kcmil)	4 x (350 kcmil)
TJUL750H	750	2255,3	6 x (400 kcmil)	6 x (400 kcmil)
TJUL800H	810	2435,8	8 x (350 kcmil)	8 x (350 kcmil)
TJUL900H	900	2706,4	8 x (350 kcmil)	8 x (350 kcmil)
TJUL800B	800	2405,7	8 x (500 kcmil)	8 x (500 kcmil)
TJUL900B	855	2571,1	8 x (500 kcmil)	8 x (500 kcmil)
TJUL1000B	1000	3007,1	8 x (400 kcmil)	8 x (400 kcmil)
TJUL1250B	1250	3758,9	TBA	TBA

Recomended Single Core Cable Cross Section at 40˚C ambient				
GENSET MODEL	600/347 V		"Cable Section Single Core for Each Phase (AWG)"	"N Phase Cable Section (AWG)"
	ESP (kW)	ESP (A)		
TJUD300H	300	360,9	2 x (2/0 AWG)	2 x (2/0 AWG)
TJUD325H	325	390,9	2 x (3/0 AWG)	2 x (3/0 AWG)
TJUD350H	350	421,0	2 x (3/0 AWG)	2 x (3/0 AWG)
TJUD400H	395	475,1	2 x (4/0 AWG)	2 x (4/0 AWG)
TJUL750H	750	902,1	4 x (250 kcmil)	4 x (250 kcmil)
TJUL800H	800	962,3	4 x (250 kcmil)	4 x (250 kcmil)
TJUL900H	900	1082,6	4 x (300 kcmil)	4 x (300 kcmil)
TJUL800B	820	986,3	4 x (250 kcmil)	4 x (250 kcmil)
TJUL900B	856	1106,6	4 x (300 kcmil)	4 x (300 kcmil)
TJUL1000B	1000	1202,8	4 x (350 kcmil)	4 x (350 kcmil)
TJUL1250B	1250	1503,6	4 x (400 kcmil)	4 x (400 kcmil)

3.7.1. Starter Batteries

The electrical resistance on the starting circuit, is a very important parameter for the operation of the diesel engine. Therefore, the batteries must be placed at a closest possible location to the generator set. This way the battery connections will be shorter and the resistance of them will be lower. Also any loose connections must be checked and fixed for this same purpose. (The batteries must be placed at a serviceable and accessible location.)

Batteries must always be maintained well and kept in a good condition, so that the generator set can be ready to run at any time. Maintenance activities to be done on batteries are briefly explained in the relevant sections below.

Servicing of batteries is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

When replacing batteries, use the same number and the following type batteries: Fully closed, maintenance free lead-acid batteries.

CAUTION – Do not dispose of battery or batteries in a fire. The battery is capable of exploding.

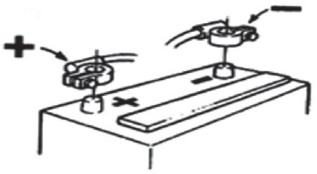
CAUTION – Do not open or mutilate the battery or batteries. Released electrolyte has been known to be harmful to the skin and eyes and to be toxic.

CAUTION – A battery presents a risk of electrical shock and high short circuit current. The following precautions are to be observed when working on batteries:

(1) Remove watches, rings, or other metal objects,
(2) Use tools with insulated handles.

GENSET MODEL	BATTERY		
	CCA	Size	Type
TJUD9P	350 A	(1) 47 Ah	NS60
TJUD13P	350 A	(1)47 Ah	NS60
TJUD20P	700 A	(1) 75 Ah	LB3
TJUD25P	700 A	(1) 75 Ah	LB3
TJUD28P	700 A	(1) 75 Ah	LB3
TJUD30P	700 A	(1) 75 Ah	LB3
TJUD50P	700 A	(1) 75 Ah	LB3
TJUD55P	700 A	(1) 75 Ah	LB3
TJUD60P	700 A	(1) 75 Ah	LB3
TJUD65P	700 A	(1) 75 Ah	LB3
TJUD80P	700 A	(1) 75 Ah	LB3
TJUD100P	700 A	(1) 75 Ah	LB3
TJUD125P	860 A	(1) 102 Ah	L5
TJUD150P	860 A	(1) 102 Ah	L5
TJUD155P	860 A	(1) 102 Ah	L5
TJUD175P	860 A	(1) 102 Ah	L5
TJUD180P	860 A	(1) 102 Ah	L5
TJUD200P	860A	(1) 102 Ah	L5
TJUD300H	860 A	(2) 102 Ah	L5
TJUD325H	860 A	(2) 102 Ah	L5
TJUD350H	860 A	(2) 102 Ah	L5
TJUD400H	860 A	(2) 102 Ah	L5
TJUD750H	(2) 860 A	(4) 102 Ah	L5
TJUD800H	(2)860 A	(4) 102 Ah	L5
TJUD900H	(2) 860 A	(4) 102 Ah	L5

GENSET MODEL	BATTERY		
	CCA	Size	Type
TJUD250P	860 A	(2) 102 Ah	L5
TJUD275P	860 A	(2) 102 Ah	L5
TJUD300P	860 A	(2) 10 2Ah	L5
TJUD315P	860 A	(2) 102 Ah	L5
TJUD350P	860 A	(2) 102 Ah	L5
TJUD400P	860 A	(2) 102 Ah	L5
TJUD450P	860 A	(2) 102 Ah	L5
TJUD500P	860 A	(2) 102 Ah	L5
TJUD525P	860 A	(2) 102 Ah	L5
TJUD550P	860 A	(2) 102 Ah	L5
TJUD600P	(2) 860 A	(4) 102 Ah	L5
TJUD750P	(2) 860 A	(4 102 Ah	L5
TJUD800P	(2)860 A	(4) 102 Ah	L5
TJUD865P	(2) 860 A	(4) 102 Ah	L5
TJUD900P	(2) 860 A	(4) 102 Ah	L5
TJUD1000P	(2) 860 A	(4) 102 Ah	L5
TJUD800B	(2) 860 A	(4) 102 Ah	L5
TJUD900B	(2) 860 A	(4) 102 Ah	L5
TJUD1000B	(2) 860 A	(4) 102 Ah	L5
TJUD1250B	(2) 860 A	(4) 102 Ah	L5



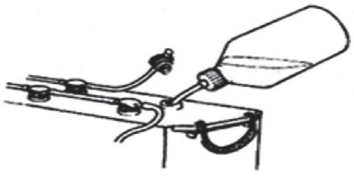
Connecting and disconnecting

While connecting battery cables, first connect the positive (+) terminal, then connect the negative (-) terminal.

While disconnecting battery cables, first remove the negative (-) connection, then remove the positive (+) connection.

Cleaning

Keep the batteries clean and dry. Any dirt or oxidation left on the battery, terminals or connections will cause discharge and voltage drop on batteries.



Remove and clean the pole heads while maintenance, use a wire brush for cleaning the oxidation. Reconnect the cables tightly back to the poles and use grease on these connections to postpone the oxidation.

Attention

The batteries must always be kept under a buffer charge.

The batteries on the generator sets that will be stored for a long time, must be removed and kept charged. Otherwise, the battery plates will be corrupted and the batteries will be out of service.

3.8. Noise Control

Reducing the sound level is a key factor in today's generator set technologies. TEKSAN generator sets are designed and manufactured for providing an optimum sound level by regarding this fact.

Extra additional equipment may be installed to the generator set systems for minimizing the sound level. Some of the precautions taken against high sound levels are, sound insulated canopies or rooms, exhaust silencers, acoustic shutter windows or hoods.

The solutions and precautions against high sound levels are really dependent on varying environmental conditions. So it is strictly recommended to get professional help when designing special sound reduction systems.

The sound level of a non-insulated diesel generator set is around 100–110 dB from 1 meters. The lowest possible sound level (also by regarding the economic facts) in generator set applications, is around 65–75 dB. Sound level reduction is a really important parameter for generator set applications used in hospitals, schools, residential areas, offices etc...

Exposure to a sound level higher than 85 dB for a long time, may cause hearing problems. So it is recommended to wear ear plugs around a running generator set.

Teksan generator sets are met the noise level norms given in EU 2000–14-EC standards which is valid for the generator sets under 500kVA.

3.9. Fire Precautions

Take all the precautions stated in section "1.5" (Fire and Explosion) against any fire and explosion possibility. There must be an emergency escape route and scenario in case of any fire and explosion possibility.

A fire alarm system and an extinguisher in accordance with the legal regulations and standards about fire and explosion, must be provided around the generator set.

The room in which the generator set installed, must be free of any flammable material or any accumulated garbage by considering any fire possibility.

The fuel line must be adequately secured with free fall type shut of valves.

Do not allow smoking in the room that the generator set is installed in. Also keep any arc, spark or flame away from here.

3.10. Earthing

In many electrical systems, the non-active parts and the parts connected to these non-active ones, must be attached to the ground with the help of a conductor or an electrode. This principle is called is called earth grounding.

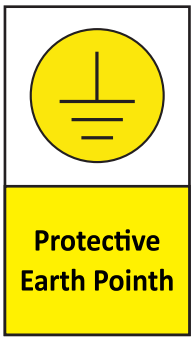
The parts and the equipment that are directly exposed to electrical voltage, must be well-insulated in order to ensure the durability and safety of the electrical system and staff around it. However there can be some electrical failures due to defection, corrosion, leaking points on these insulation systems.

Non-grounded conductors in an electrical system, may be a risk for both the system and the people around it. If all the equipment is connected to each other and to the ground properly, then any leakage on system can flow to ground through this connection and will not cause any problem.

The grounding must be done in accordance with the related international and local regulations. The grounding resistance must not be more than 20 Ohms.

The electricity may be harmful for human beings if it is rated more than 15 mA and 50 V.

The electrodes buried to the ground for grounding purposes must be at least 20 meter away from another electrode.



4. Control System

4.1. Introduction

Programmable microprocessor based controller units are used in TEKSAN generator sets as a standard. These controllers are capable of monitoring any electrical or mechanical changes or parameters on the generator set. They also provide all necessary mechanical and electrical protections for the generator set.

The control systems in general, allow the user to run or stop the generator set. They also monitor and control the measurement and protection circuits installed on the generator set. Since the controller unit is programmable, it also provides flexibility in terms of usage under different conditions.

The control panels used on TEKSAN generator sets, are manufactured using A1 quality steel sheets and coated with electrostatic powder paint in order for preventing corrosion. Manual (TJM), automatic (TJA) and synchronization (TJPS) control panels are manufactured as a standard in TEKSAN. But it is also possible to design customized control panels for different purposes or scenarios of usage.

Further details about the controller unit can be found in the additional manuals provided with the generator set.

4.2. DSE7310 & 7320 Control Panels

The DSE7000 series is designed to provide differing levels of functionality across a common platform. This allows the generator OEM greater flexibility in the choice of controller to use for a specific application.

The DSE7000 series module has been designed to allow the operator to start and stop the generator, and if required, transfer the load to the generator either manually (via fascia-mounted push-buttons) or automatically. Additionally, the DSE7320 automatically starts and stops the generator set depending upon the status of the mains (utility) supply.

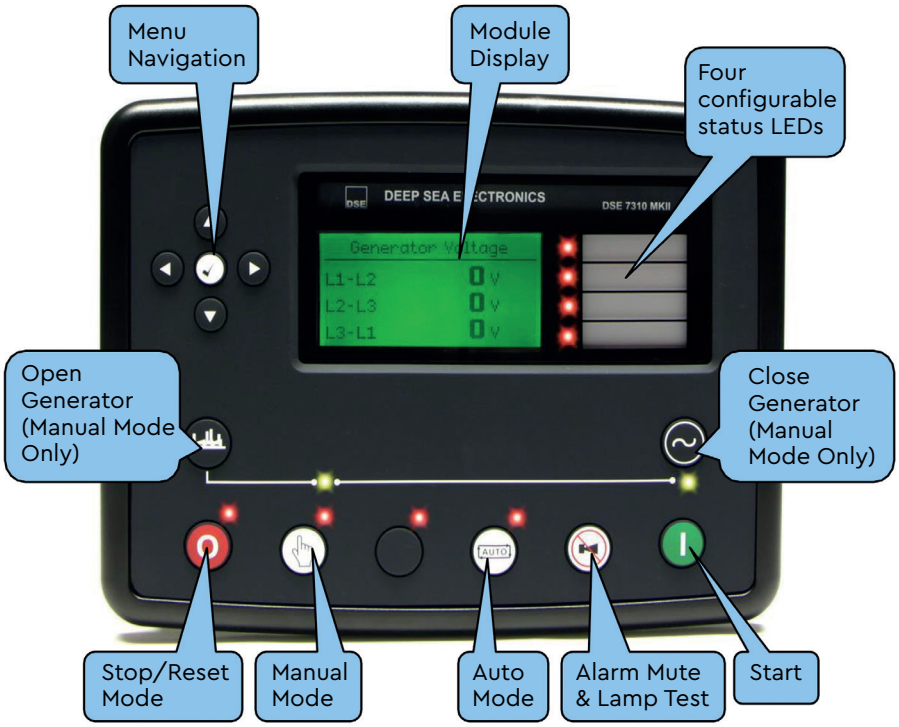
The user also has the facility to view the system operating parameters via the LCD display.

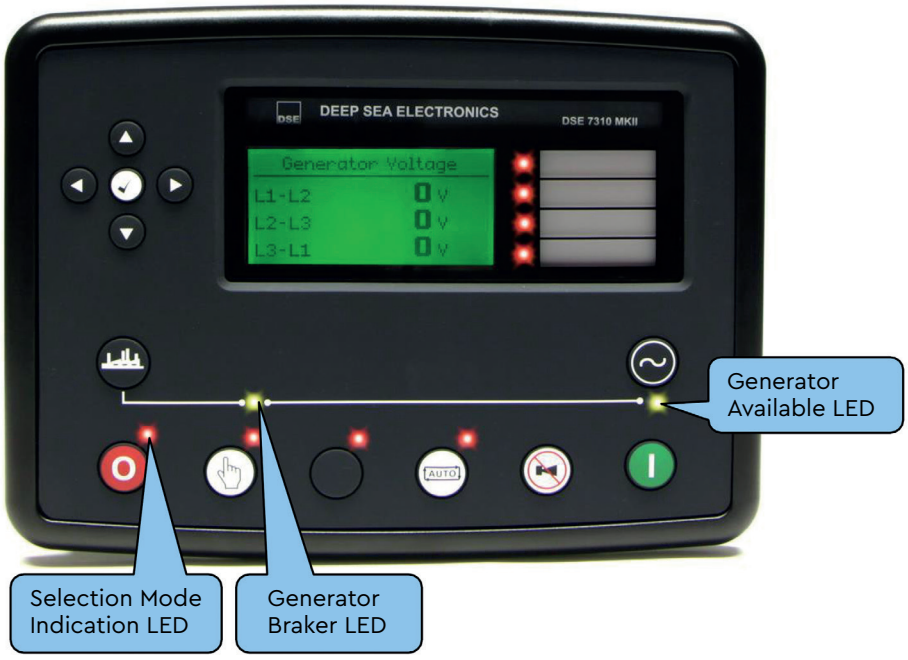
The DSE7000 module monitors the engine, indicating the operational status and fault conditions, automatically shutting down the engine and giving a true first-up fault condition of an engine failure by a COMMON AUDIBLE ALARM. The LCD display indicates the fault.

Using a PC and the Configuration Suite software allows alteration of selected operational sequences, timers and alarms.

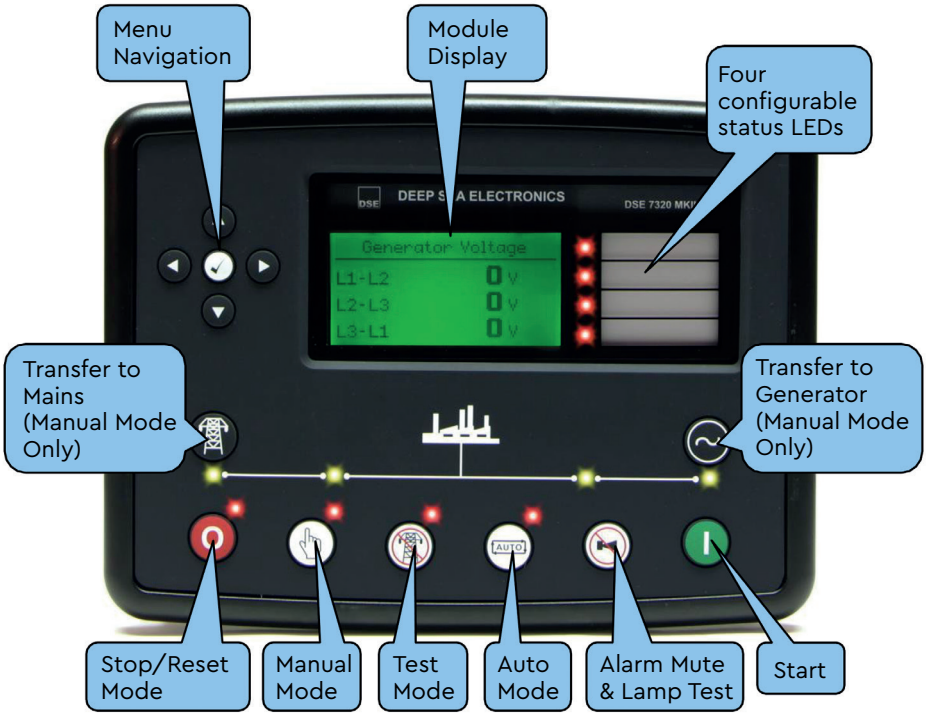
Control of the module is via push buttons mounted on the front of the module with **Stop/Reset Mode**, **Manual Mode**, **Test Mode** (DSE7320 MKII Only), **Auto Mode** and **Start** functions.
For normal operation, these are the only controls which need to be operated.

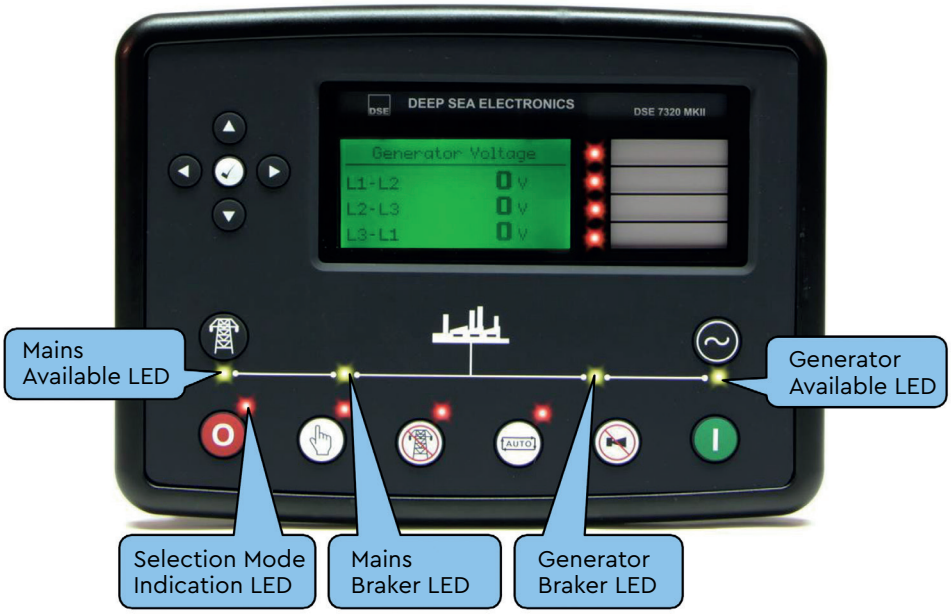
DSE7310 MKII





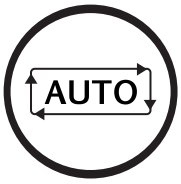
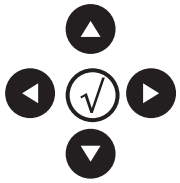
DSE7320 MKII





4.3. Control Push Buttons

ICON	DESCRIPTION
	**Stop/ Reset Mode** This button places the module into its **Stop/ Reset Mode** . This clears any alarm conditions for which the triggering criteria has been removed. If the engine is running and the module is put into **Stop/ Reset Mode** , the module automatically instructs the genarator off load **("Close Generator Output"** becomes inactive (if used on)) and place the mains on load **("Close Mains Output"** becomes active (DSE 7320 MKII)). The fuel supply de- energises and the engine comes to a standstill. Should any form of start signal be present when in **Stop/ Reset Mode** the generator remains at rest.
	**Manual Mode** This button places the module into its **Manual Mode** . Once in **Manual Mode** , the module responds to the **Start** button to start the generator and run it off load. To place the generator on load use the **Transfer to Generator** buttons. The module automatically instructs the changeover device to take the mains off load **("Close Mains Output"** becomes inactive (if used on DSE7320 MKII)) and place the generator on load **("Close Generator Output"** becomes active (if used)). To place the generator off load, use the **Transfer the Mains** or **Open Generator** buttons. The module automatically instructs the changeover device to take the generator off load **("Close Genarator Output")** becomes inactive (if used on)) and place the mains on load **("Close Mains Output"** becomes inactive (DSE 7320 MKII). Additional digital inputs can be assigned to perform these fuctions. If the engine is running off-load in **Manual Mode** and on load signal becomes active, the module automatically instructs the changeover device the changeover device to take the mains off load **("Close Mains Output"** becomes inactive (if used / on DSE7320MKII) and place the generator on load **("Close Genarator Output"** becomes active (if used). Upon removal of the on load signal, the generator remains on load until either selection of the **Stop/Reset Mode** or **Auto Mode** .
	**Test Mode (DSE7320 MKII Only)** Thes button places the module into its **Test Mode** . Once in **Test Mode** , the Module responds to the **Start** button to start the generator. Once the set has started and becomes available, it is automatically placed on load (Close Mains Output becomes inactive (if used on DSE7320 MKII) and Close Generator Output becomes active (if used)). The generator remains on load until either the **Stop/Reset Mode** or **Auto Mode** is selected.

ICON	DESCRIPTION
	Auto Mode This button places the module into its **Auto Mode** . This mode allows the module to control the function of the generator automatically. The module monitors numerous start requests and when one has been made, the set is automatically started. Once the generator is available, the mains is taken off load **("Close Mains Output"** becomes inactive (if used on DSE7320 MKII)) and the generator is placed on load **("Close Generator Output"** becomes active (if used)). Upon removal of the starting signal, the module starts the Return Delay Timer and once expired, takes the generator off load **("Close Generator Output"** becomes inactive (if used on)) and place the mains on load **("Close Mains Output"** becomes active (DSE7320 MKII)). The generator then continues to run for the duration of the Cooling Timer until it stops. The module then waits for the next start event.
	**Alarm Mute / Lamp Test** This button silences, the audible alarm in the controller, de-activates the audible Alarm output (if configured) and illuminates all of the LEDs on the Module' s facia as a lamp test function.
	**Start** This button is only active in the **Stop/Reset Mode** , **Manual Mode** and **Test Mode** . Pressing the **Start** button in **Stop/Reset Mode** powers up the engine's ECU but does not start the engine. This can be used to check the status of the CAN communication and to prime the fuel system. Pressing the **Start** button in **Manual Mode** or **Test Mode** starts the generator and runs it off load in **Manual Mode** or on load in **Test Mode** .
	**Menu Navigation** Used for navigating the instrumentation, event log and configuration screens.

ICON	DESCRIPTION
	**Transfer To Generator** The **Transfer To Generator** button controls the operation of the generator load switch is only active in the **Manual Mode** once tehe generator is available. **'Normal' Breaker Button Control** Pressing the **Transfer To Generator** button when the Generator is available and off load, the Mains load switch is opened (**"Close Mains"** becomes inactive) and the Generator load switch is closed (**"Close Generator"** becomes active). Further presses of the **Transfer To Generator** button have no effect. **"Alternative" Breaker Button Control** Pressing the **Transfer To Generator** button when the Generator is available and off load , the Mains load switch is opened (**"Close Mains"** becomes inactive) and the Generator load switch is closed (**"Close Generator"** becomes active). Further presses of the **Transfer To Generator** button opens and closes the Generator load switch (**"Close Generator"** changes state) and leaves the Mains load switch in the open position (**"Close Mains"** remains inactive).
	**Open Generator (DSE7310 MKII Only)** The **Open Generator** button is only active in the **Manual Mode** and allows the operator to open the generator load switch. Pressing the **Open Generator** button when the Generator is on load, the generator load switch is opened (**"Close Generator"** becomes inactive). Further presses of the **Open Generator** button have no effect.
	**Transfer To Mains (DSE7320 MKII Only)** The **Transfer to Mains** button controls the operation off the mains load switch and is only active in **Manual Mode** . **Normal Breaker Button Control** Pressing the **Transfer to Mains** button when the Mains is available and off load, the generator switch is opened (**"Close Generator"** becomes inactive) and the mains switch is closed (**"Close Mains"** becomes active). Further presses of the **Transfer to Mains** button have no effect. **Alternative Breaker Button Control** Pressing the **Transfer to Mains** button when the Mains is available and off load, the generator load switch is opened (**"Close Generator"** becomes inactive) and the mains load switch is closed (**"Close Mains"** becomes active). Further presses of the **Transfer to Mains** button opens and closes the mains load switch (**"Close Mains"** changes state) and leaves the generator load switch in the open position (**"Close Generator"**) remains in.

DSE7310 & 7320 Specifications

- 4-Line back-lit LCD text display
- Front panel editing with PIN protection
- 9 configurable inputs
- 8 configurable outputs
- Configurable timers and alarms
- 3 configurable maintenance alarms
- Multiple dates and time scheduler
- Configurable event log (250)
- Tier 4 CAN engine support
- Integral PLC editor
- Fuel usage monitor and low fuel alarms
- kW & kVAr protection
- LED and LCD alarm indication
- Power monitoring (kWh, kVAr, kVAh, kVArh)
- Load switching (load shedding and dummy load outputs)
- Automatic load transfer (DSE7320)
- Unbalanced load protection
- Independent Earth Fault trip
- True dual mutual standby with load balancing timer (DSE7310 only)
- USB connectivity
- Fully configurable via DSE Configuration Suite PC software
- Configurable display languages
- Remote SCADA monitoring via DSE Configuration Suite PC software
- User selectable RS232 and RS485 communications
- Advanced SMS messaging (additional external modem required)
- Start & stop capability via SMS messaging
- Real-time clock provides accurate event logging
- Multiple dates and time scheduler
- Ethernet communications (via DSE855 module), provide advanced remote monitoring

4.4. Basic Procedures To Be Followed Before Operation

Safety precautions explained in the Operation and Maintenance Manual must be taken into account before running the generator set.

Ensure that the installation is done completely and properly.

All electrical connections must be complying with the technical rules and diagrams.

The following procedures should be followed at every time before running a generator set. The staff that is responsible for the operation of the generator set should be fully trained on these procedures.

1. Check the generator set manually and visually for a last time before starting it up. Do NOT start the generator set if you see any leakage of liquids, cracked or broken parts, disconnected cables or parts, etc...
2. The generator set must be placed on a smooth and proper surface. It should also be protected against any external effects like rain, dust etc...
3. Check the fresh air inlet and hot air discharge windows or ducts. Be sure that they are not closed or blocked.
4. Check the exhaust outlet and be sure that it is not closed or blocked.
5. Check the quality and level of the engine lubrication oil. Change or fill it if necessary.
6. Check the coolant level and antifreeze ratio. Change or refill it if necessary. Remember that the antifreeze ratio changes depending on the lowest ambient temperature. Be sure that the amount of added antifreeze and water is at a proper ratio.
7. Check the fuel tank and fuel level and refill if necessary.
8. There are two types of batteries used on generator set systems; lead-acid and dry (maintenance free) types. If it is a lead acid type battery, check the electrolyte level and charge if necessary. If it is a dry type battery, then just clean and charge it.
9. Check the air filter and be sure that it is not too dirty or blocked. Change it if necessary.
10. Any unprotected object around the generator set may prevent the operation of the generator set or cause injuries during operation. Check if there is any unprotected object around the generator set and put it away to a safer distance.
11. Switch the generator set circuit breaker to OFF position.
12. Switch all the fuses inside the control panel to OFF position.
13. Make the battery pole connections.
14. Switch all the fuses inside the control panel back to ON position.
15. Check all the emergency stop buttons and be sure that they are all at ON position.
16. Bleed the air out from fuel system and filters by using priming pump. Look at the Diesel Engine Maintenance Book for the details.
17. Run the generator set manually from the control unit.

18. Check if there is any abnormal noise or vibrations on the generator set.

19. Check if there is any leakage of liquids like water, oil, fuel, etc...

20. Observe the temperature and pressure values from the controller screen or the gauges. Be sure that they are in allowed limits.

21. Observe the voltage, current or frequency values from the controller screen. Be sure that they are in allowed limits.

22. Check the phase sequence of the generator set. If they are not same with the mains sequence, then change cable connections.

23. If all the results of all these checks are normal, you can finally run your generator set on load. Also be sure that you are not exceeding the capacity of your generator set in terms of loading capacity.

- Safety precautions explained in the Operation and Maintenance Manual must be taken into account before running the generator set after all the necessary installation is done completely and properly.
- Always ensure that both mobile and stationary generator earthings are correctly done to avoid the possibility of death or injury.
- When removing the battery disconnect the negative (-) lead first and when putting a battery onto service on a generating set, connect the negative lead last due to fact that battery system is earthed from the negative (-).
- The generator set will not start if any emergency stop button is pushed, switch all ON by pulling clockwise.
- The fuel, lubrication oil and the coolant quality level has to be comply with the standards prescribed by the manufacturer.
- Ensure a proper grounding for the generator set. It may be important in terms of any possible electrical problems.
- Do NOT start or stop the generator set when it is still under load (when the load breaker is at ON position).
- The daily, weekly, monthly, yearly or running-hour-related maintenance periods of the generator set must be followed and obeyed carefully in order for the efficiency and safety of operation.

4.5. Battery Charger

Battery charging devices are used for keeping the batteries charged at all times, even when the generator set has not been running for a long time. A charger is a standard equipment in control panels and supplied by a mains connection.

The speed of charge depends on the capacity of the batteries (Ampere x Hours) and the remaining charge in batteries. Initial charge current will be high but it will decrease with time during the charge process.

Protect the battery charger device against any heavy weather conditions like rain or snow. Be sure that the electrical wiring and connections and the grounding of the equipment are done properly.

Turn off the battery charger device before removing any battery connection, for avoiding any arc or spark possibility.

Battery charger devices should be used according to related instructions. They must not overcharge the batteries. If the temperature of batteries rise above 52°C, then it may cause damage on the batteries. This fact must be taken into consideration especially in tropical countries, the charger and the batteries must be located at a cool and shaded place.

Other than this charger devices, there can be used a charger generator on the engine for charging the batteries. Check the pulley and belts installed on the charger generator. Change them with new ones if they are defected.

4.6. Engine Jacket Water Heaters

There can be used heaters on the engine's cooling water circuit, in order to ease starting up and taking load actions generator engine.

These heaters are used as standard in automatic generator set applications, but it can also be installed on manual systems optionally.

There are thermostats available installed on these heaters and they are set approximately up to 40°C. Nominal power ratings of heaters may differ depending on the size of engine.

TPS Heater System				
Phase	Single Phase		Fluid Type	Water / Coolant Mix
Voltage	120 V		Heat Power	0.5 kW / 1 kW / 1.5 kW / 1.8 kW
Ingress	IP41		Temp. Control	100–120 °F (38–49 °C), fixed
Min/Max Ambient Temp	-40/40 °C (-40/104 °F)		Max Pressure	90 psi (620 kPa)
Certification	UL-C/US recognized		Inlet / Outlet	0.625" hose barb (15.9 mm)

GENSET MODEL	ENGINE MODEL	POWER SUPPLY			HEATIG SYSTEM		
		V	Ø	Hz	Model	Power	Pcs
TJUD9P	403D-11G	120 V	1	60 Hz	**TPS051GT10-000**	500 W	1
TJUD13P	403D-11G	120 V	1	60 Hz	**TPS051GT10-000**	500 W	1
TJUD20P	404D-22G	120 V	1	60 Hz	**TPS101GT10-000**	1000 W	1
TJUD25P	404D-22TG	120 V	1	60 Hz	**TPS101GT10-000**	1000W	1
TJUD28P	404D-22TG	120 V	1	60 Hz	**TPS101GT10-000**	1000 W	1
TJUD30P	404D-22TAG	120 V	1	60 Hz	**TPS101GT10-000**	1000 W	1
TJUD50P	1104D-44TG1	120 V	1	60 Hz	**TPS151GT10-000**	1500 W	1
TJUD55P	1104D-44TG1	120 V	1	60 Hz	**TPS151GT10-000**	1500 W	1
TJUD60P	1104D-E44TG1	120 V	1	60 Hz	**TPS151GT10-000**	1500 W	1
TJUD65P	1104D-E44TG1	120 V	1	60 Hz	**TPS151GT10-000**	1500 W	1
TJUD80P	1104D-E44TAG1	120 V	1	60 Hz	**TPS151GT10-000**	1500 W	1
TJUD100P	1104D-E44TAG2	120 V	1	60 Hz	**TPS151GT10-000**	1500 W	1
TJUD125P	1106D-E70TAG2	120 V	1	60 Hz	**TPS181GT10-000**	1800 W	1
TJUD150P	1106D-E70TAG2	120 V	1	60 Hz	**TPS181GT10-000**	1800 W	1
TJUD160P	1106D-E70TAG3	120 V	1	60 Hz	**TPS181GT10-000**	1800 W	1
TJUD175P	1106D-E70TAG4	120 V	1	60 Hz	**TPS181GT10-000**	1800 W	1
TJUD180P	1106D-E70TAG4	120 V	1	60 Hz	**TPS181GT10-000**	1800 W	1
TJUD200P	1106D-E70TAG5	120 V	1	60 Hz	**TPS181GT10-000**	1800 W	1

CTM Heater System				
Phase	Single Phase 1 Ø		Fluid Type	Water / Coolant Mix
Voltage	120 V /240 V		Heat Power	1 kW / 1.5 kW / 2.5 kW
Ingress	IP44		Temp. Control	100–120 °F (38–49 °C), fixed
Min/Max Ambient Temp	-40/40 °C (-40/104 °F)		Max Pressure	3.5 gpm @ 4 psi
Certification	UL-C/US recognized		Inlet / Outlet	0.625" (16 mm) hose barb

GENSET MODEL	ENGINE MODEL	POWER SUPPLY			HEATIG SYSTEM		
		V	Ø	Hz	Model	Power	Pcs
TJUD250P	1706D-E93TAG1	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD275P	1706D-E93TAG2	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD300P	1706D-E93TAG2	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD315P	1706D-E93TAG2	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD350P	2206D-E13TAG2	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD400P	2206D-E13TAG3	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD300H	DP126CAK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD325H	DP126CAK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD350H	DP126CBK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD400H	DP126CCK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	1
TJUD750H	DP222CAK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	2
TJUD800H	DP222CBK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	2
TJUD900H	DP222CCK	240 V	1	60 Hz	**CTM25210-N00**	2500 W	2

CKM Heater System				
Phase	Single Phase 1 Ø		Fluid Type	Water / Coolant Mix
Voltage	240 V		Heat Power	4 kW / 5 kW / 6 kW
Ingress	NEMA 2		Temp. Control	100°F – 120°F (38°C – 49°C), fixed
Min/Max Ambient Temp	-40°F/104°F (-40°C/40°C)		Max Pressure	125 psi (860 kPa)
Certification	UL/C-US recognized		Inlet / Outlet	SAE J1926/1:1 5/16–12 (SAE #16 STOR)

GENSET MODEL	ENGINE MODEL	POWER SUPPLY			HEATIG SYSTEM		
		V	Ø	Hz	Model	Power	Pcs
TJUD450P	2506D-E15TAG1	240 V	1	60 Hz	**CKM1040260-000**	4000 W	1
TJUD500P	2506C-E15TAG3	240 V	1	60 Hz	**CKM1040260-000**	4000 W	1
TJUD525P	2506C-E15TAG3	240 V	1	60 Hz	**CKM1040260-000**	4000 W	1
TJUD550P	2506C-E15TAG4	240 V	1	60 Hz	**CKM1040260-000**	4000 W	1
TJUD600P	2806C-E18TAG3	240 V	1	60 Hz	**CKM1060260-000**	6000 W	1
TJUL750P	2806C-E18TTAG7	240 V	1	60 Hz	**CKM1060260-000**	6000 W	1
TJUL800P	5008C-E30TAG4	240 V	1	60 Hz	**CKM1060260-000**	6000 W	1
TJUL865P	5008C-E30TAG4	240 V	1	60 Hz	**CKM1060260-000**	6000 W	1
TJUL900P	5008C-E30TAG4	240 V	1	60 Hz	**CKM1060260-000**	6000 W	1
TJUL1000P	5008C-E30TAG5	240 V	1	60 Hz	**CKM1060260-000**	6000 W	1
TJUD800B	12M33G8D2/6^	240 V	1	60 Hz	**CKM1060260-000**	6000 W	2
TJUD900B	12M33G8D2/6^	240 V	1	60 Hz	**CKM1060260-000**	6000 W	2
TJUD1000B	12M33G8D2/6^	240 V	1	60 Hz	**CKM1060260-000**	6000 W	2
TJUD1250B	12M33G12D2/6^	240 V	1	60 Hz	**CKM1060260-000**	6000 W	2

5. Maintenance

5.1. General

Maintaining the generator set properly and periodically is a key factor in terms of efficiency, durability and safety of operation. It also necessary for being sure that the generator set is always ready for operation and minimizing any risk of failure on the generator set.

The parts to be controlled or to be replaced during a maintenance activity, have been declared in the "Generator Set Maintenance Schedule". Any further details about this issue can also be looked up from the manuals supplied with both the engine and generator. Be sure to perform all maintenance activities according to the recommended parts.

All the documentation including service registration forms, model and serial number nameplates, drawings or diagrams, spare part lists, maintenance schedules and the manuals supplied with the generator set, must be kept in a good condition. Remind that all these documentations may be needed during any service or repairing activity. The staff who will perform any maintenance or repair activity on the generator set, must be trained and authorized.

- Be sure that there is nobody left around or inside the generator set before running it or performing any maintenance or repair activity on it. Keep all the doors locked after finishing any repair or maintenance activity.

- Be sure that the engine is stopped before performing any maintenance activities like lubrication oil fill-up, coolant fill-up or changing battery electrolytes.

ATTENTION!

- Also remove the AC supply connection of the charger device and the battery (-) connection from the battery pole before starting to work on the engine. This will prevent the engine from starting without your control. Also place a warning around the connections you have removed, so nobody around touches or re-connects them.

- Always be sure to make the necessary changes on the generator set when it is stopped. Stop it for making changes, make the necessary changes and run it again. Do not forget that only some qualified technicians which have a deep expertise on related issues,

Can make changes on a running generator set.

5.2. Maintenance of the Diesel Engine

Please see the detailed instructions in "Diesel Engine Operation and Maintenance Manual" supplied with the diesel engine.

5.3. Maintenance of the Alternator

Any maintenance or repair activity to be performed on alternator, must be carried on by trained and qualified technicians. Also be sure that the alternator is not running and all necessary precautions are taken before taking action.

The maintenance intervals are specified depending on the alternator, operation mode and environmental conditions. In general the alternator must be checked for any vibration, detonation, abnormal sound before commissioning and one (1) year (or after 500 running hours) after it. Also the tightness of all electrical or mechanical connections and any defections on the alternator body or the cooler fan must be checked during these maintenance activities.

Alternator bearings can be used up to 20.000 running hours under normal conditions, but some factors like improper lubrication, very high ambient temperature or high levels of vibration will be decreasing this lifetime period.

The recommended check and change period for the lubricant (grease) is 4.000 hours. Some recommended lubricant (grease) types are as follows; Mobilux 3 (MOBIL OIL), Alvania 3 (SHELL), GR MW 3 (AGIP), Beacon 3 (ESSO).

The temperature at the alternator bearings level must not exceed 60°C. In case of any doubt about corrosion on bearings, the operating temperature must be measured and checked. Check the coupling, if the temperature is rising up to 80°C during operation. If it is normal but the bearings change colour to blue, then the bearings must be replaced with a new one. Any dismantled bearing must be replaced with a new and equivalent one, it is not recommended to re-install and use any dismantled bearing. Heating the bearing up to 80°C will ease the assembling process.

Check the mechanical connection and the centering between the coupling of alternator and the flywheel of engine. Make sure that all bolts on this connection are properly tightened. Sealants like "Loctite – Type 242" can be used on this connection for providing extra strength.
Generally, alternators are manufactured with a single bearing. For this manner, the user must be very careful while lifting or carrying it. Because the rotor can drop down if the alternator is lifted, so the rotor must be fixed before lifting.

It is strongly recommended to perform an insulation test on stator windings, if the alternator has not running for a long time. Be sure to remove all the terminal connections on AVR before this insulation test. If the measured resistance between the stator winding and the ground is lower than 5 Megaohms, then the alternator must be cleaned, dried and maintained properly. Related industrial cleaners can be used for this cleaning purpose.

Wait for some time after applying cleaner on windings, then blow compressed air to remove this volatile substance on it.

Please see the detailed instructions in **"Alternator Operation and Maintenance Manual"** supplied with the alternator.

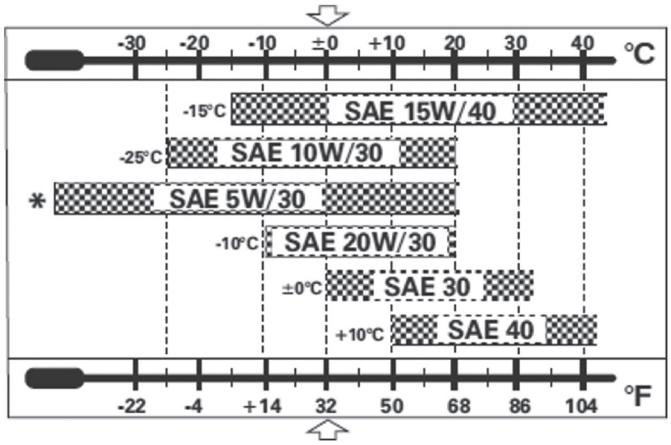
5.4. Lubrication Oil

The lubrication oil must be changed periodically in specified intervals for obtaining the best performance and lifetime for engine. The lubricant and this changing period is specified by the engine manufacturer, so be sure to comply with these standards, specifications and instructions about lubrication, otherwise the engine may be damaged.

Use a reputable brand of lubricant in accordance with API standards.

The quality and specifications of the oil to be used may vary depending on environmental conditions, so be sure to use a proper lubricant. In some cases, if the temperature is lower than a minimum level, the engine may lose its cold start capability so it is not advised to run the engine for a long time in such conditions.

Any further details about the lubrication system, lubricant specifications and intervals for changing the lubricant, can be found on the "User and Maintenance Manual" supplied with engine.



5.5. Coolant

Coolants are mixtures of water, antifreeze and any other chemicals for several purposes. The main purpose of using this mixture is cooling the engine. But with addition of antifreeze and other chemicals, this mixture prevents the cooling water from freezing and protects the cooling system against corrosion.

Use 50% antifreeze (glycol) and 50% pure water as coolant mixture if there is any risk of freezing. By using this mixture throughout the whole year, the engine will be protected at temperatures down to -40°C.

For ensuring an effective protection against corrosion, it is recommended to use at least 40% antifreeze inside the coolant mixture.

Even it can be possible to decrease the freezing point of the coolant inside the engine down to -56°C, it is not recommended to decrease it further since it may cause a decrease on the cooling performance of the engine.

In order for more precise ratios, the mixture should be mixed in a separate tank before filling into cooling system.

Any further details about the cooling system, coolant specifications and intervals for changing the coolant, can be found on the "User and Maintenance Manual" supplied with engine.

Drinking this coolant mixture of water, antifreeze and some other chemicals, is dangerous.

5.6. Fuel

The fuel to be used on your generator set, should be complying with the standards and specifications below in order for a reliable and environment friendly operation.

* EN590 * ASTM D975 NO 1-D, 2-D
* JIS K2204 TYPE 1,2,3 * ISO 8217 DMX-CLASS
* DIN 51601 DIESEL FUEL * BS 2869 CLASS-A1, A2

The temperature of the fuel to be used, should not be exceeding 40˚C.

NOTE: More details about the required fuel specification can be found in the Engine Operation and Maintenance Manual. Sulphur content of fuel must meet the legal norms in each country. If the Sulphur content exceeds 0.5%, then the engine oil must be changed more frequently.

Diesel Fuel Recommended Physical Properties Specifications	
Viscosity (ASTM D445)	1.3 to 5.8 centi strokes (0.05 to 0.23 in per second) at 104°F (1048F)
Cetane Number (ASTM D613)	40 Minimum above 32°F (0°C) 45 Minimum above 32°F (0°C)
Sulphur Content	Not to exceed 0.5 mass percent
(ASTM D1796)	Not to exceed 0.05 volume percent
Density (ASTM D287)	42 to 30 API GRAVITY AT 60°F (0.816 to 0.876 g/cc at 15°C)
Cloud Point (ASTM D287)	10°F (6°C) below lowest ambient temperature at which the fuel is expected to operate
Ash (ASTM D482)	Not to exceed 0.02 mass percent (0.05 mass percent with lubricating oil blending)
Lubricity	3100 grams or greater

Fuel Sulphur Content (%)	Oil Change Interval
> 0,5	NORMAL
0,5 – 1,0	0,75
> 1,0	0,5

5.7. Maintenance of Batteries

Different types of batteries can be used in generator sets. Maintenance free batteries are used in TEKSAN products. They are completely enclosed and does not require any pure water addition.

Discharge duration is long for batteries on TEKSAN products, because their internal resistance is very low (5 milliohm).

Since the batteries are completely based on oxygen recombination principle, no waste gas is formed and there is no gas release on these batteries. They are also equipped with special low-pressure safety valves for this same reason.

Operating temperature range for these batteries is very wide (approximately between -20°C and 60°C).

Chemical energy is converted to electric energy in batteries, so there are several chemical reactions in battery cells. Since these chemical reactions are reversible, the batteries can be charged and discharged many times.

These batteries can be used (charged/discharged) up to approximately 4 years, they must be replaced after then.

Another widely used battery type is lead acid type, which is formed of positive and negative electrodes immersed into the electrolyte (sulphuric acid) inside cells between sheet plates.

Check the density of battery liquid with a hydrometer. The proper readings should be around 1,27 under nominal conditions and temperature (15°C).

Pure or distilled water is used in electrolyte solution, so the water to be added into the battery must also be pure water. Keep the batteries clean for a better performance.

Clean the top cover of the battery before lifting it for any purpose. Add pure or distilled water up to a height 5–10 mm above plates, close and tighten the top cover. Dry the top cover and keep it clean and dry.

Check the operation range of batteries before installation, especially in terms of temperature (between -5°C and 50°C). Inappropriate selections will affect the operation, performance and lifetime of battery due to freezing or boiling issues.

ATTENTION!

- Do not smoke or have any spark/flame around the batteries, they may be releasing flammable gases.
- Handle batteries with care and wash your hands after touching them for protection against acid burns.
- Wear protective clothes before changing or maintaining the batteries.
- Keep anyone unauthorized, away from the batteries and its charging system.
- Do not forget to check the charging system together with the batteries.
- Batteries should always be kept under a buffer charge. Batteries that are not charged for a long time, may break.

5.8. Maintenance of Radiator

The radiator installed on your generator set is designed and manufactured for functioning properly for long years, if the necessary and recommended maintenance activities are performed properly and periodically.

Here are some recommendations about the operation and maintenance of your radiator;

- The coolant liquid inside the radiator is at high pressure and temperature, so be careful when opening the cap or any draining points.
- Do not perform any repair or maintenance activity on the radiator until it is cooled down to a safe temperature.
- Do not perform any repair or maintenance activity on the radiator while the cooler fan is running or the any protective covers on it are removed.
- Corrosion is the very first reason for many problems seen on radiators, be sure to check it in case of any failure.
- Be sure that there is no leakage on the radiator, any inlet/return line or any hose connections.
- Radiators should be filled and kept completely full. This will prevent any failures due to corrosion. Partially filling radiators may cause corrosion inside the radiator. For this same reason, all the liquid must be drained if the radiator will not be running or will be stored for a long time.
- The water to be used in a radiator, must be pure, distilled or soft for preventing corrosion. Also additive chemicals can be used in the coolant mixture for preventing corrosion.
- If the radiator is running at a dirty and dusty ambient, then its cells may be blocked with dust, dirt, steam or different particles. This will affect the operation, performance and the lifetime of the radiator and cause overheating issues.
- The radiator must be cleaned properly and periodically for the reason above. Low pressure steam should be used for this cleaning purpose. The radiator can be immersed into an alkaline solution in case of any stronger sediments. The radiator must be washed with hot water after waiting at least 20 minutes inside this solution.

5.9. Light Load Operation (Wet Stacking)

Besides overloading, running a generator set under too light loading conditions can also be harmful for the generator set. Running the generator set below a specified loading rate may cause damage on engine and reduce its reliability. This fact must be taken into consideration, especially in higher capacity generator set applications.

Any generator set to be used in a standby application must be loaded not less than 30% of its full capacity.

Any generator set must not be running under no-load or low-load conditions for a long time. If you really have to run it in such conditions, then the duration shall be minimized. For example; if the weekly test will be performed without load, then it should not take more than 10 minutes.

Any engine which has operated under a 30% or less loading condition for 1 hour, must be operated with a 60% load for 30 minutes in order for the engine to re-gain its performance.

For burning and cleaning any remaining carbon compounds inside the engine and exhaust system, any generator set must be operated with a 75% load and for a 4 hours duration every year. The load level must be increased gradually. If the sufficient loading rate cannot be provided for the generator set, then a dummy load can be connected to it.

Maintenance intervals must be more frequent for the generator sets running under low loading conditions. For example the air filter must be replaced every year, the oil filters must be changed every 6 months if a generator set is running in standby mode and under low loading conditions.

Here are some problems that may occur in case of running the generator set under low loading conditions;

Oil Leakage at Exhaust or Air Inlet Systems

- Since the temperature inside cylinders will be less than normal level, the fuel delivered to cylinders cannot be combusted properly. Unburned fuel and oil steam become condensed in the exhaust system.
- Also the turbocharger oil seals cannot function properly due to this lower temperature, so the oil will be leaking with air to the air inlet and exhaust systems.
- Due to these two reasons above, oil leakage problems can be seen on air inlet and exhaust manifolds and so the oil consumption of the engine will be higher than normal.

This situation is faced especially on Standby(ESP) generator sets which are operated with no load during weekly test running.

Carbon Accumulation on Cylinder Covers and Exhausts Manifolds

In case of operating the diesel engine under low load for a long time, the combustion process is performed under low temperature. As a result of this low quality combustion, there may be oil steam and soot contaminated at cylinder covers, valves, piston rings, exhaust manifold and injector nozzles. This all will lead up to a lower engine performance and possibly a serious damage on the engine later.

Corrosive Damage

If the temperature of the engine body is not at a proper value, then the lubrication inside the engine will not be done properly so this will cause more corrosion on moving components.

Deterioration Of Lubrication Oil

Due to loss of combustion performance, unburned fuel mixing with oil in the cylinder makes the oil deteriorated. Spoiled oil causes early abrasion of the moving parts and bearings.

Abrasion will firstly affect the bearings of turbocharger operating at very high speed and this situation results in oil leakage and damage.
By this operation, oil consumption in the engine dramatically raises.

White Smoke

If the fuel cannot be combusted in cylinders properly, then it can be thrown out from the exhaust line as a white smoke.

5.10. Long Term Storage

If the generator set will not be used or will be stored for a long time, some protective precautions must be taken since this non-operating or storage duration will have negative effects on engine, alternator and other equipment. Running the generator set directly without any controls after this long duration, may cause damage on all these main parts.

There must be taken some additional precautions if the generator set will be stored for a duration more than 3 months. However if the storage duration is 3 months or less, then it will be enough to cover the generator set with a protective packing material and store it in a dry and clean place. It also should be operated at least once in every 15 days.

In order not to face any problems on re-commissioning after this storage duration, the generator set must be operated for a while (until it reaches to its nominal operating temperature; 75°C) and checked for any failures before storage. The procedures to be followed (by an authorized technician) before any long storage duration are as follows;

Storage Between 3 And 6 Months

- Change the engine oil and oil filters,
- Check the coolant level and rating in cooling system, re-fill or re-rate if necessary,
- Change the fuel filter. Drain the water or any residue from the fuel tank and fill with fuel up to maximum level.
- Test the generator set for a final time and stop it after the test is finished,
- Remove all battery connections, clean and remove the batteries. Be sure to keep the batteries under charge,
- Clean generator set completely with a damp cloth. Do not use pressurized water for cleaning purposes,
- Check all the electrical connections and apply moisture repellent spray on all electrical system and equipment,
- Apply protective (moisture repellent) spray/oil to electrical system and its components.
- Apply protective (moisture repellent) spray/oil to air intake canals.
- Loosen the V-belts,
- Close/block the air intake and exhaust outlet channels,
- Pack the generator set properly and place a warning label on it.
- Keep the packed generator set at a dry, clean place and ensure that it will not be directly exposed to harmful environmental conditions like dust, wind, sun, rain, snow and sudden temperature changes.
- Drain the engine oil.
- Fill with diesel engine protective oil up to maximum level of the oil dipstick.
- Immerse the fuel intake and return canals to a pot which contains 1/3 protective oil (JIS K2246 NP9) and to a pot that contains 2/3 diesel oil mixture.
- Run the engine until it consumes 2 liters of this mixture and then stop.
- Drain the fuel system and connect the fuel intake and return canals to their normal location.
- Drain the fuel tank and clean.
- Drain the protective oil from the engine and filter.
- Spray protective oil to air intake manifold.
- Spray protective oil to compressor side of the turbocharger.
- Disassemble the cylinder head covers. Spray protective oil to valve, valve spring, valve guide, cylinder head and rocker arm, then close the cylinder head cover again.
- Seal air inlet and exhaust outlet.
- Loosen the V-belts.
- Disconnect the battery cables. Clean the battery and leave it under charge continuously.
- Clean the generator completely with a wet cloth. Do not use pressurized water.
- Check the electrical connections and terminals.
- Spray the moisture repellent to electrical system and its components.
- Cover the entire generator and post a warning sign on it.
- Store the generator in a dry place where there is no temperature changes. Generator should be protected from sun light and rain.

Re-Commissioning After Storage

- Remove the cover from the generator and remove sealing from air inlet and exhaust outlet.
- Inspect all sections of the engine.
- Pay attention that the installation made basis on the rules and the commissioning procedures are completed before running the generator.
- Refresh the engine oil and filter.
- Clean the fuel tank and fill with new fuel.
- Replace fuel filter.
- Clean the air filter, if necessary replace it.
- Control and tighten the V-belt and pulleys.
- Disassemble the turbo lubricating pipe and lubricate the bearings. Then, rotate the turbo manually.
- Control valve tip clearances, if necessary adjust them. (For storage more than 6 months)
- Disassemble the cylinder head covers. Lubricate the valve, valve spring, valve guide, cylinder head and rocker arm, then close the cylinder head covers again.
- Check all the hoses and pipes, tighten clamps and screws.
- If there is any disjointed screw or plug, assemble them.
- Check the coolant level and ratio of anti-freeze. If it is drained before the storage, then fill it with a mixture of new 50% anti-freeze and 50% water.
- If it is realized that there is moisture in the storage ambient, stator winding isolation test should be done before operating the alternator. Before this process, AVR cable connections should be disconnected. If the measured value is less than 5 megaohm, then alternator should be cleaned, dried and tested again.
- Before the cranking, rotate the engine 2–3 cycles manually.
- Check that batteries are fully charged.
- Disconnect the fuel solenoid connection and rotate the engine for a short term via starter.
- Run the generator under no load until it warms.
- Check for excessive vibration, noise, oil-fuel-water leakage.
- Run the generator set under load and test it again.

5.11. General Maintenance Schedule

DIESEL GENERAOR SET GENERAL MAINTENANCE SCHEDULE	Daily	Start up	First Maintenance (50 hours / 6 months)	Engine Running Hours				Periodically	
				200 hours	400 hours	1000 hours	2000 hours	Every Year	Every 2 Year
ENGINE LUBRICATION SYSTEM									
Check the Oil Level	✓	✓		✓					
Change Oil			✓	✓				✓	
Change Oil Filters			✓	✓				✓	
Check whole Lubrication System for any Oil Leakage	✓	✓						✓	
ENGINE COOLING SYSTEM									
Check the water heater blocks		✓	✓	✓					
Check whole Cooling System for any Coolant Leakage	✓	✓						✓	
Check the Coolant Level	✓	✓		✓					
Check the Antifreeze / Water Ratio		✓		✓				✓	
Check the Cleanliness of Radiator		✓		✓				✓	
Change the Coolant						✓			✓
Check the hose and clamp connections				✓				✓	
AIR INLET AND EXHAUST SYSTEM									
Check whole Air System for any Leakage (hoses, clamps, etc..)		✓		✓				✓	
Check the Turbocharger						✓			✓
Clean or Change Air Filters					✓				✓
Check whole Exhaust System for any Leakage (pipes, spiral, etc.)		✓		✓				✓	
Check the Colour of Exhaust Smoke		✓		✓				✓	
FUEL SYSTEM									
Check the Fuel Level	✓								
Change the Fuel Filter			✓	✓				✓	
Check whole Fuel System for any Fuel Leakage	✓	✓						✓	
Drain the Water inside "Water Seperator Filter"			✓	✓				✓	
Clean the Fuel Tank					✓			✓	
Check the Injector Nozzles						✓			✓
ELECTRICAL SYSTEM									
Check the Batteries and their Charge Levels		✓	✓	✓				✓	
Clean the Batteries and their Poles			✓	✓				✓	
Check the Battery Charger and Charging Alternator		✓	✓	✓				✓	
Check all the Pressure, Temperature Sensors and Gauges		✓	✓	✓				✓	
Check the Settings of AVR Card and Governor Card		✓	✓	✓				✓	
Check the Power Cables, Transfer Panel and its Connections		✓	✓	✓				✓	
Check the Control Panel and Generator Set Controller Unit		✓	✓	✓				✓	
MISCELLANOUS									
Check the Tensions of V-belts		✓		✓				✓	
Check the Radiator Fan and its Blades				✓				✓	
Check any Screws or Bolts used for Assembling Purposes		✓				✓		✓	
Check the Compression Pressure (if necessary)							✓	✓	
Check the settings of Valve Gaps						✓			✓
Check the Vibration Insulators		✓				✓		✓	
Perform a General Cleaning on whole Generator Set	✓		✓	✓				✓	
Check for any Abnotmal Noise when the Engine is Running	✓	✓	✓	✓				✓	
Check and Clean the Oil Pan Breather Hose				✓				✓	

- This table shows basic maintenance activities, please check the engine and alternator maintenance manuals for more details.
- Test your generator set on load for a 15 minutes duration, at least once in every week.
- You must definitely get the first maintenance (at 50 hour/6 months) done, in order for the continuity of your warranty coverage.
- The maintenance periods may change due to reasons about ambient, lubricant or fuel quality or operating category.

6. Troubleshooting

6.1. General

- The following inspections and corrective actions should be performed by a well-trained and authorized staff, by using appropriate equipment.
- Do not change any settings or replace any part without a full-knowledge on related issues.
- You can find any further details in the troubleshooting sections of "Operation and Maintenance Manuals" supplied with the engine, alternator and any other equipment used on generator set.
- If you cannot get a solution by using the table below, feel free to contact TEKSAN or its authorized dealers any time.

PROBLEM	POSSIBLE CAUSES	REMEDY
Engine turns slow, but does not start	Batteries are de-charged	Charge / Replace
	Defective starter	Repair / Replace
	Oil specification is not suitable	Replace with suitable oil
	No fuel in tank	Refuel
	Air in the fuel system	Eliminate air
	Fuel selenoid is inoperative	Repair / Replace
	Clogged oil filter	Replace
	Defective manuel fuel lift pump	Repair / Replace
	Defective fuel injection pump	Adjust / Repair / Replace
	Poor compression	Measure / Engine revision
	Engine mechanical fault (piston, piston ring etc.)	Engine revision
	Defective control unit	Ddjust / Replace
	Problem in control panel	Repair / Replace
	Problem with electrical connections	Repair
Engine does not start	Batteries are de-charged	Charge / Replace
	Defective starter	Repair / Replace
	Defective starter relay	Replace
	Defective control unit	Adjust / Replace
	Emergency button is pressed	Switch to normal position
	Generator in OFF position	Switch to normal position
	No fuel in tank	Refuel
	Problem in fuel system	Repair / Replace
	Air in the fuel system	Eliminate air
	Fuel specification is not suitable	Use suitable fuel
	Clogged air intake	Open valve
	Clogged air filter	Replace
	Poor compression	Measure / Engine revision
	Engine mechanical fault (piston, piston ring etc.)	Engine revision
	Ambient temperature is tool low	Warm up Ambient / Engine
	Problem with electrical connections	Repair
Generator does not stop	Mains supply problem	Measure mains voltage
	Defective DC fuses	Repair
	Defective control unit	Adjust / Repair / Replace
	Defective fuel selenoid	Adjust / Replace
	Generator is cooling down	Wait / Checj the timer

PROBLEM	POSSIBLE CAUSES	REMEDY
Engine overheating	Clogged air filter	Replace
	Defective injectors	Adjust/ Replace
	Wrong type injectors	Replace
	inadequate fresh air inlet	Make it suitable
	inadequate hot air outlet	Make it suitable
	Unsuitable blinds and paddle box	Make it suitable
	Radiator is too dirty or clogged	Clean/Replace
	Clogged intercooler	Clean/Replace
	inadequate Coolant level	Refill
	Cooling fan is not working properly	Repair
	Belts are worn or loosen	Adjust/Replace
	Excessive lubricating oil	Replace
	Clogged water hoses	Cheek/Repair
	Defective water pump	Repair/Replace
	Defective engine thermostat	Cheek/Replace
	Leakage in cooling system (water-air)	Repair/Replace
	Overload	Decrease load level
	Excessive exhaust back pressure	Make it suitable
Lubricating oil pressure is too high	Oil specification is not suitable	Replace with suitable oil
	Defective sensor	Replace
	Defective display	Replace
Too much blue smoke	Oil specification is not suitable	Replace with suitable oil
	Excessive lubricating oil	Replace
	Low or no load operation	Load higher than 30%
	Excessive oil consumption	Cheek/Engine revision
	Poor compression	Measure/Engine revision
	Engine mechanical fault /piston, piston ring etc.\	Engine revision
Too much white smoke	Problem in cold start system	Cheek/Replace
	Engine is too old	Warm up Ambient/Engine
	Defective engine thermostat (temperature is not increasing)	Cheek/Replace
	Oil specification is not suitable	Replace with suitable oil
	Defective fuel injection pump	Adjust/Repair/Replace
	Defective injectors	Adjust/Replace
Too much black smoke	Overload	Decrease load level
	Oil specification is not suitable	Replace with suitable oil
	Wrong valve tip clearance	Adjust
	Defective injectors	Adjust/Replace
	Defective manual fuel lift pump	Repair/Replace
	Defective fuel injection pump	Adjust/Repair/Replace
	Poor compression	Measure/Engine revision
	Clogged air filter	Replace
	Inadequate fresh air inlet	Make it suitable
	Charge air is not cooled	Cheek/Repair
Oil consumption too high	Excessive lubricating oil	Replace
	Oil viscosity too low	Replace with suitable oil
	Oil leakage	Repair
	Low or no load operation	Load higher than 30%
	Engine mechanical fault (piston, piston ring etc.)	Engine revision
	Defective oil cooler	Repair/Replace
	Problem with cylinder head cover	Repair/Replace

PROBLEM	POSSIBLE CAUSES	REMEDY
Fuel consumption too high	Fuel leakage	Repair
	Defective manual fuel lift pump	Repair/Replace
	Fuel specification is not suitable	Use suitable fuel
	Poor compression	Measure/Engine revision
	Charge air is not cooled	Check/Repair
	Clogged air filler	Replace
	Effective injectors	Adjust/Replace
Not enough power	High viscosity grade of oil	Replace with suitable oil
	Fuel specification is not suitable	Use suitable fuel
	Clogged air filler	Replace
	Engine is too cold	Warm up Ambient/Engine
	Inadequate fuel	Provide enough fuel flowing
	Clogged fuel filler	Replace
	Inadequate fresh air inlet	Make it suitable
	Inadequate hot air outlet	Make it suitable
	Defective manual fuel lift pump	Repair/Replace
	Defective fuel injection pump	Adjust/Repair/Replace
	Defective injectors	Adjust/Replace
	Overload	Decrease load level
	Defective turbocharger	Repair/Replace
	Charge air is not cooled	Check/Repair
	Poor compression	Measure/Engine revision
Alternator does not produce output voltage (No load voltage is lower than the 10% of nominal voltage)	Connections are loose	Check/Repair
	Defective rotating diodes or suppressor	Check/Replace
	Excitation circuit is disconnected or short circuited	Check/Repair
	Insufficient residual voltage	Apply external excitation
Alternator does not produce output voltage	Fuse (in AVR line) is broken	Replace
	Defective AVR	Check/Adjust/Replace
	Broken off exciter stator connection	Check/Repair
	Wrong connection of Exciter stator	Check
Output voltage is 50–70 % of the nominal voltage	Speed is lower than nominal	Check engine speed
	Voltage potentiometer is not adjusted	Adjust
	Fuse is broken	Replace
	Defective AVR	Check/Adjust/Replace
	Over excitation limitation	Adjust AMP pot
Output voltage is too high	Voltage potentiometer is not adjusted	Adjust voltage pot
	Capacitive load	Eliminate Condenser load
	Defective AVR	Check/Adjust/Replace
Unstable output voltage	Engine speed is variable	Adjust engine speed
	Stability potentiometer is not adjusted	Adjust STAB pot
	Defective AVR	Check/Adjust/Replace

7. Warranty

This warranty applies to new TEKSAN Generator Sets ("Product") to be free from defects in material and workmanship in production for the limited time indicated below. TEKSAN will, at its discretion, repair or replace any part(s) that, upon examination, inspection, and testing by TEKSAN, or its approved service provider, is found to be defective under normal use and service, in accordance with the warranty period when generator set is properly installed, operated, and maintained, according to TEKSAN's instructions.

Emissions warranty coverage, if applicable, is detailed in a separate emissions warranty statement.

Limited Warranty Period: The warranty start date is the date of initial start-up and the warranty period is 24 months or 1000 hours whichever occurs first. Warranty period is limited by 30 months from the date of shipment ex-works TEKSAN.

Accessories Warranty Period: The Accessories Coverage Period for a Warrantable Defect in cords, receptacles, cord reels, gas flex pipes, housing lights, space heaters, battery charger, engine heater, relay(s) and associated equipment ("Accessories") is twelve (12) months from the date of initial start-up.

An original consumer ("Owner") who purchases a TEKSAN Product is entitled to a coverage under this Limited Warranty. This warranty is not transferable.

TEKSAN Responsibilities:

If a defect in material or workmanship is found during the warranty period (provided the Buyer/Owner has fulfilled its due contractual obligations), TEKSAN Generator will, during normal working hours and through a place of business of a TEKSAN Dealer or other source approved by TEKSAN:

• Replace or repair, at TEKSAN's discretion, the defective parts with a new or remanufactured replacement part.
• Provide reasonable labor and travel costs to correct the defect as agreed with TEKSAN.
• Provide Maintenance items that are contaminated or damaged by a warrantable failure.

TEKSAN's obligation to repair or replace defective parts does not include responsibility for reimbursement of incidental or consequential costs. Any repaired product shall be warranted for the remaining original warranty period only.

Parts or Product replaced shall become the property of TEKSAN

Owner Responsibilities:

The Owner will be responsible for the following and TEKSAN will not reimburse for the following:

- Notify TEKSAN or its authorized distributor or dealer promptly (not more than 5 working days) of the discovery of failure and making the Product available for repair.
- Comply with TEKSAN's or its authorized representative's reasonable directions regarding the timing, sequence, and location of warranty repairs and make the Product available for inspection.
- Install, operate, commission, and maintain the Product in accordance with the applicable Owner's manual and/or any other manuals specified by TEKSAN including without limitation handling, inspection, servicing, or operating instructions.
- Perform all required maintenance and maintain and provide proof that all required maintenance has been performed.
- Provide evidence for the date of commissioning and start-up.
- Promptly return to TEKSAN all parts replaced under this Limited Warranty if requested by TEKSAN.
- Comply with TEKSAN's long term storage guidelines, if applicable, and maintain and provide proof of compliance.
- Routinely exercise the Product in accordance with operating instructions.
- Provide sufficient access and reasonable ability to remove the Product from the installation in the event of a warrantable failure.

- Incremental costs and expenses associated with Product removal and reinstallation resulting from non-standard installations.
- Costs associated with rental of generating sets used to replace the Product being repaired.
- Costs associated with labor overtime and premium shipping requested by the owner.
- All downtime expenses, fines, all applicable taxes, and other losses resulting from a warrantable failure.
- Reimburse TEKSAN for all costs incurred in providing warranty service where, following examination, the request or claim for warranty coverage proves to be unfounded or excluded, as well as all incidental costs including those incurred investigating the claim.
- Original spare parts and consumable items (oil, fuel, filter, belt etc.) approved by Teksan should be used.
- Generator set control unit should be programmed, set or changed under Teksan approval.
- Run and stop the generator set stated as in the maintenance and operation handbook. Do not stop the generator set under load. This may damage engine valves and its components, alternator exciter windings, rotating diodes, suppressor and voltage regulator card.

Limitations

TEKSAN is not responsible, and this Limited Warranty is not available under any circumstances, for any of the following:

- Failure of Owner to fulfill its obligations under 'Owner's Responsibilities'
- Inappropriate use relative to designated power rating and/or improper sizing.
- Inappropriate use relative to application guidelines. (Use for prime power applications, trailer mounted etc.)
- Inappropriate use of an EPA-SE application generator set relative to EPA's standards.
- Damage caused other than those resulting from a defect in material or factory workmanship of the Product.
- Damage caused by improper and/or unauthorized installation, handling, lack of maintenance, faulty repairs not performed by an authorized TEKSAN service representative.
- Damage caused by external action, negligence, natural disasters, accidents, incorrect use, improper handling or storage, inadequate corrosion-proofing, incorrect assembly or installation, or modification of the Product.
- Damage caused by operation with improper fuel or contaminated fuels, coolants, or lubricants.
- Damage caused by operation at speeds, loads, conditions, modifications, or installation contrary to published specifications or recommendations.
- Damage caused by abuse or neglect such as: operation without adequate coolant or lubricants; over fueling; over speeding; lack of maintenance to lubricating, cooling or air intake systems; late servicing and maintenance; improper storage, starting, warm-up, run-in, or shutdown practices, or for progressive damage resulting from a defective shutdown or warning device.
- Damage caused by shipping. Manufacturer is not responsible for loose connections caused by vibrations during shipment to job site. All connections must be checked during start-up.
- Damage caused by any act of God or external cause such as, but not limited to, collision, fire, theft, freezing, vandalism, riot or wars, lighting, earthquake, hurricane, terrorist acts or nuclear holocaust, or any other matters which are reasonably beyond the manufacturer's control.
- Damage caused by improper storage before and after the installation.
- Damage related to rodent and/or insect infestation.
- Damage caused by constant light load on diesel engine (wet stacking)
- Normal wear and tear, routine tune-ups, adjustments, periodic service.
- Starting batteries. Labor charges and travel expenses related to battery service.
- Engine fluids, shop supplies such as adhesives, cleaning solvents, and rags.
- Radiators replaced rather than repaired.

- Enclosures that are rusting due to improper installation, location in a harsh or saltwater environment or scratched where integrity of paint applied is compromised. Steel enclosure is only covered against rust and corrosion for the first year of the warranty provision. Cost of original installation and start-up, cost of standard maintenance (i.e. tune-ups, associated part(s), adjustments, loose/leaking clamps
- Products that are modified or altered, replacement parts and accessories not authorized by TEKSAN in writing.
- Rental equipment used while warranty repairs are being performed (i.e. rental generators, cranes, hoist etc.)
- Any special access fees required gaining access to TEKSAN product not limited to but including, lodging, training or safety policy, planes, ferries, railroad, buses, helicopters, snowmobiles, snow-cats, off-road vehicles or any other mode of transport or living quarters deemed abnormal.
- Any expenses incurred investigating performance complaints unless the problem is caused by defective TEKSAN materials or workmanship.
- Use of the Product for purposes other than those for which it was intended, including without limitation use of the Product under extraordinary operating conditions not made known to TEKSAN in writing at the time of the order.
- Telephone, facsimile, cellular phone satellite, internet, or any other communication expenses.
- Any failed components warranted by the OEM (i.e., engine, generator, sub-base fuel tank, etc.). These components shall be covered under the perspective manufacturers' warranties. All warranty claims for defects in material and /or workmanship on TEKSAN product components should be directed through TEKSAN. (OEM) Warranties may vary and are subject to change. TEKSAN shall have no liability under OEM warranties.
- Additional expenses for repair after normal business hours, i.e., overtime or holiday labor rates.
- Room and board expense due to overnight service conditions, unless approved by TEKSAN in advance.
- Any labor time that is determined to be excessive by TEKSAN: e.g., such as two or more persons performing a one-person job.
- Travel time and mileage exceeding 300 miles round trip.

In order to obtain performance of a TEKSAN warranty obligation, the Owner should contact the nearest TEKSAN authorized distributor, dealer, or service outlet for instructions. To find the location of the nearest TEKSAN authorized distributor, dealer, or service outlet call 224–404–1274 or write to: TEKSAN USA Warranty Department, 901 Mittel Drive, Wood Dale, IL 60191.

TEKSAN USA SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL, AND/OR CONSEQUENTIAL DAMAGES OF ANY KIND including, but not limited to, incidental and/or consequential labor costs, installation charges, telephone charges, or transportation charges in connection with the replacement or repair of defective parts. TEKSAN shall not be liable for any claim greater in amount than the purchase price of the product.

This is our exclusive written warranty. We make no other express warranty nor is anyone authorized to make any on our behalf.

Any implied warranties which are allowed by law, shall be limited in duration to the terms of the express warranty provided herein. Some jurisdictions do not allow limitations on how long an implied warranty last, so the above limitation may not apply to purchaser/owner. TEKSAN's only liability shall be the repair or replacement of part(s) as stated above. In no event is TEKSAN liable for any incidental or consequential damages, even if such damages are a direct result of TEKSAN's negligence. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. You agree to make no claims against TEKSAN based on negligence. This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

Declaration of Conformity

CE

We hereby confirm that, this machine has been manufactured in accordance with the Machinery Directive (2006/42/EC), Low Voltage Equipment Directive (2014/35/EU) and Electromagnetic Compatibility Directive (2014/30/EU).

TEKSAN

TEKSAN JENERATÖR ELEKTRİK SANAYİ VE TİCARET A.Ş.
Yenidoğan Mah. Edebali Cad. No:12 34791 Sancaktepe / İstanbul – TURKEY
Tel: +90 216 312 05 50 (Pbx)
Fax: +90 216 312 69 09
http://www.teksan.com
info@teksan.com

Description of machine	**: Diesel Engine Powered Generating Set**
Type of machine	**: From 8 kVA to 3550 kVA**
The standards that the product complies with above EU directives	**: EN ISO 8528-13, EN 60204, ISO 8528**
The CE mark was first applied in	**: 2004**

This declaration ceases to be valid if the maintenance and operating book is not read and caution marks on the machine are not obeyed; if a modification is made to the machine/equipment that has not been agreed with us, or if the machine equipment is not used in accordance with its designated purpose.

The technical documentation required to demonstrate that the product meets the requirements of the above mentioned directives has been complied by the signatory below and is available for inspection by the relevant enforcement authorities.

The product described above complies with the essential requirements of the directives specified.

Authorized representative;

TEKSAN
TEKSAN JENERATÖR ELEKTRİK SANAYİ ve TİCARET A.Ş.
Yenidoğan Mah. Edebali Cad. No:12
34791 Sancaktepe / İSTANBUL
A.Kurumlar V.D.: 836 006 6804

Name ***:Dr. Oğuz CAN***
Position ***:General Manager***
Date and Place of the declaration: 18.12.2023-Istanbul/Turkey

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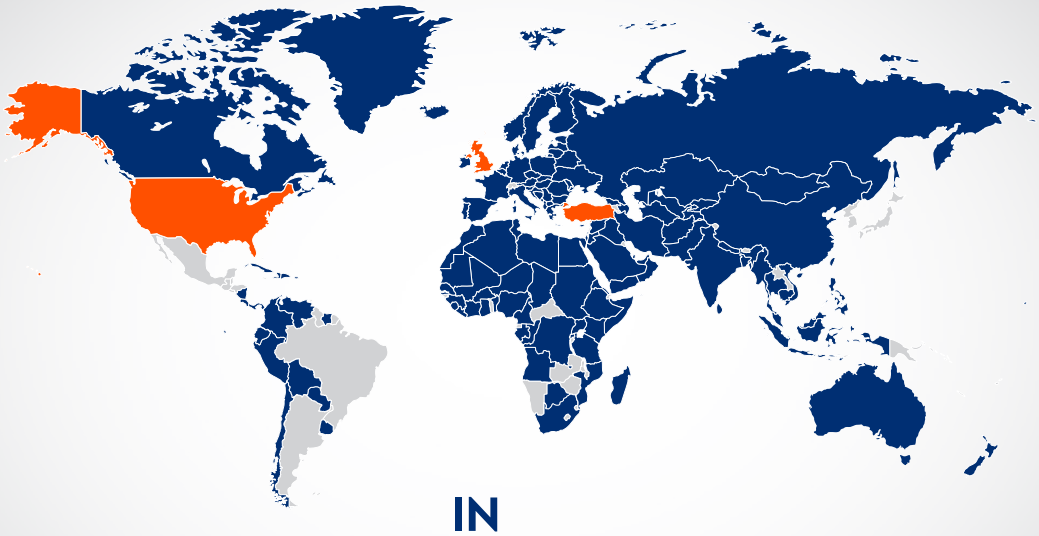
WE ARE YOUR EVERLASTING COMPANY



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