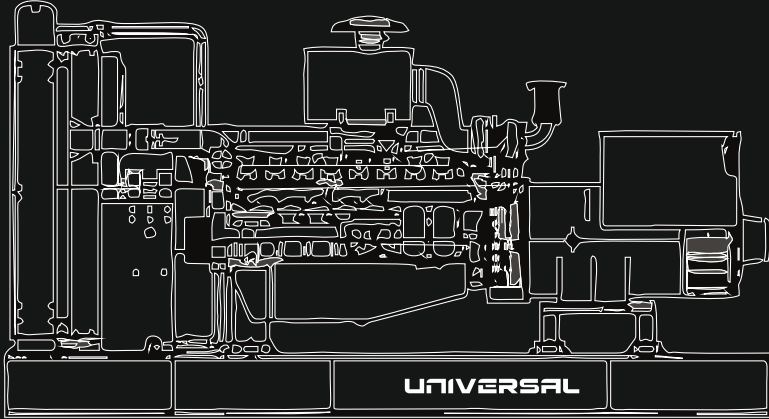


**DIESEL GENERATOR**  
**OPERATION & USER MANUAL**



**UNIVERSAL**

GENERATOR

*Enerji Hayattır*

**DEAR UNIVERSAL GENERATOR USER;**

First of all, thank you for choosing Universal Generator.

Universal Generator, which set out in 2004 with the slogan “Energy is Life!”, is one of the leading manufacturers in its sector, consisting entirely of domestic and national capital, actively participating in domestic and international projects, and produces reliable and high-quality generators with its advanced technology at every stage.

Your generator has been manufactured in our factory located in Ankara ASO 2 Organized Industrial Zone with the experience we have gained since 2004, in accordance with ISO 9001 Quality Management Systems, ISO 14001 Environmental Management Systems and OHSAS 18001 Occupational Health and Safety Management System, in accordance with CE norms and in accordance with EN ISO 8528, EN ISO 12100:2010, EN ISO 14120:2015, EN ISO 13851:201, EN ISO 13854:2019, EN 61000-6-2:2019, EN 61000-6-4:2019 and EN 60204-1:2018 standards.

This maintenance and usage manual has been prepared to help you operate the Universal Generator system correctly and during the installation phases. In order to ensure regular operation of the generator in dirty and dusty environments, more frequent maintenance is recommended. Maintenance, adjustment and repair of generators should be done by authorized services and authorized persons with original parts.

We provide you with uninterrupted service with our technical service teams that are on the job 24/7.

As long as you have our authorized services maintain them with original parts at certain intervals, you can get trouble-free service from our products.

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



TURKISH STANDARDS INSTITUTION CERTIFICATE OF CONFORMITY



ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFICATE



ISO 9001 QUALITY MANAGEMENT SYSTEM CERTIFICATE



CERTIFICATE OF CONFORMITY TO EUROPEAN UNION DIRECTIVE



OHSAS 18001 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM



2000/14/AT CERTIFICATE OF COMPLIANCE WITH NOISE REGULATIONS



AFTER SALES SERVICE COMPETENCE CERTIFICATE

**TABLE OF CONTENTS**

<b>1. INTRODUCTION</b> .....	<b>5</b>
1.1 GENERATOR LABEL & SERIAL NUMBER .....	5
<b>2. SAFETY PRECAUTIONS &amp; WARNINGS</b> .....	<b>6</b>
2.1 GENERAL WARNINGS .....	6
2.2 PLACEMENT, TRANSPORTATION AND LIFTING .....	7
2.2.1 CARRYING AND LIFTING WITH A FORKLIFT .....	7
2.2.2 LIFTING WITH CRANE .....	8
2.3 HOT SURFACES & SHARP EDGES .....	8
2.4 HAZARDOUS & CORROSIVE SUBSTANCES.....	9
2.5 FIRE & EXPLOSION.....	9
2.6 MECHANIC.....	10
2.7 NOISE & ENVIRONMENTAL WARNINGS.....	11
2.8 ELECTRICAL WARNINGS .....	11
<b>3. FIRST AID AGAINST ELECTRIC SHOCK</b> .....	<b>12</b>
<b>4. GENERATOR SPECIFICATIONS &amp; DESCRIPTIONS</b> .....	<b>14</b>
4.1 GENERAL DESCRIPTIONS .....	14
4.2 GENERAL PARTS OF GENERATOR.....	15
4.2.1 DIESEL ENGINE .....	15
4.2.2 ELECTRICAL SYSTEMS OF ENGINE .....	15
4.2.3 COOLING SYSTEM.....	15
4.2.4 ALTERNATOR.....	15
4.2.5 FUEL TANK & CHASSIS.....	16
4.2.6 VIBRATION ISOLATORS.....	16
4.2.7 SILENCER & EXHAUST SYSTEM.....	17
4.2.8 CONTROL SYSTEM .....	17
<b>5. INSTALLATION</b> .....	<b>18</b>
5.1 LOCATION SELECTION .....	18
5.2 PLATFORM & GROUND .....	19
5.3 VIBRATION ISOLATION .....	19
5.4 VENTILATION & COOLING .....	19
5.5 EXHAUST SYSTEM.....	20
5.6 FUEL SYSTEM.....	21
5.6.1 STORAGE OF DIESEL FUEL .....	21
5.7 ELECTRICAL CONNECTIONS.....	21
5.7.1 WIRING.....	21
5.7.2 PROTECTION.....	22
5.7.3 LOAD .....	22
5.7.4 POWER FACTOR .....	22
5.7.5 GROUNDING AND GROUNDING CONDITIONS.....	23
5.7.6 ISOLATION TESTING .....	23
5.7.7 ALTERNATOR CONNECTION .....	23
5.7.8 STARTER BATTERIES.....	24
5.8 FIRE PRECAUTIONS.....	24

<b>6. CONTROL SYSTEMS .....</b>	<b>25</b>
6.1 INTRODUCTION .....	25
6.2 MANUAL AND AUTOMATIC CONTROL CARDS .....	25
6.2.1 TRANS AUTO & TRANS MIDI FEATURES .....	26
6.2.2 CONTROL DEVICE STANDARD FUNCTION BUTTONS .....	27
<b>7. STARTING THE GENERATOR .....</b>	<b>29</b>
7.1 BASIC PROCEDURES TO BE CARRIED OUT BEFORE STARTING .....	29
7.2 PROCEDURES TO BE CARRIED OUT DURING STARTING .....	30
7.3 PROCEDURES TO BE CARRIED OUT AFTER STARTING .....	30
7.4 ENGINE JACKET WATER HEATERS .....	31
Figure 9 – Engine Jacket Water Heaters .....	31
7.5 AUTOMATIC TRANSFER SWITCHES .....	31
<b>8. GENERATOR MAINTENANCE .....</b>	<b>32</b>
8.1 GENERAL INFORMATIONS .....	32
8.2 DIESEL ENGINE MAINTENANCE .....	33
8.3 ALTERNATOR MAINTENANCE .....	33
8.4 RADIATOR MAINTENANCE .....	33
8.5 COOLANT .....	34
8.6 LUBRICATING OIL .....	34
8.7 FUEL .....	35
8.8 STARTER BATTERIES .....	35
8.9 LOW-LOAD USE .....	36
8.10 LONG-TERM STORAGE .....	37
8.11 STARTING AFTER STORAGE .....	38
<b>9. GENERAL MAINTENANCE SCHEDULE .....</b>	<b>39</b>
<b>10. TROUBLESHOOTING &amp; FIXING .....</b>	<b>40</b>
<b>11. WARRANTY .....</b>	<b>43</b>
11.1 GENERAL .....	43
11.2 WARRANTY CONDITIONS .....	43
11.2 LIMITATIONS .....	44
11.3 CLAIM SUBMISSIONS .....	44
<b>ANNEX-I .....</b>	<b>48</b>

## 1. INTRODUCTION

### 1.1 GENERATOR LABEL & SERIAL NUMBER

Figure 1 – Universal Generator Label

Universal Generator manufactures all its products in accordance with international ISO8528 standards and in high quality. Each generator set has its own label and is on the set. This label defines the serial numbers and main characteristics of the generator set. The label indicates the date of manufacture of the generator, generator output voltage, current, power in kVA, frequency, power factor, weight, dimensions and fuel tank capacity. This label information is required for spare part orders, warranty processing or service provision.

In order for the information on the label to be readable, the label must be protected from damage such as scratching, burning, etc.

**BEFORE USING THE UNIVERSAL GENERATOR SET, ALWAYS READ AND UNDERSTAND THE MAINTENANCE AND USER MANUAL.**



## 2. SAFETY PRECAUTIONS & WARNINGS

### 2.1 GENERAL WARNINGS

The generator set is designed and manufactured to be completely safe if installed and used correctly. The generator must be installed and used in accordance with the Maintenance and Operation Manual, Diesel Engine Maintenance & Operation Manual and Alternator Maintenance & Operation Manual, and safety precautions must be followed.

The responsibility for the safe operation of the generator set belongs to the persons who install, use and maintain the generator set. If the specified safety precautions are applied and safety measures are followed, the risk of accidents will be reduced. Before performing maintenance on the generator and before starting the generator, read and understand all the warnings in the book.

The generator must be installed and operated in accordance with the standards. If the procedures, instructions and safety precautions in this book are not followed, accidents and injuries are likely to increase.

Never operate the generator in a known unsafe condition. If there is an unsafe condition in the generator, place a danger warning and prevent the generator from operating until the unsafe condition is corrected by disconnecting the negative (-) pole of the battery.

Before servicing or cleaning the generator, disconnect the negative (-) pole of the battery.

Before attempting to repair or disassembling any part, ensure that the air, water or oil pressure in any part of the relevant system has dropped.

Do not interfere with the generator with torn or ripped clothes, wear protective glasses and clothes.

If the engine has been running and the block water is hot, do not open the radiator cap. Wait for the engine to cool down.

Avoid prolonged contact with fuel, oil, antifreeze and protective fluids. Contact may cause injuries.

To minimize the possibility of slipping and falling, keep hands, feet, floors and walking areas clean and free of oil, water, antifreeze or other liquids.



**⚠ WARNING ⚠**  
**INCORRECT USE MAY CAUSE SERIOUS ACCIDENTS AND LIFE RISKS. ALWAYS READ THE USER MANUAL BEFORE USING.**

## 2.2 PLACEMENT, TRANSPORTATION AND LIFTING



This section covers the placement, transportation and towing of the generator. Read this section carefully before placement. Take the following safety precautions into consideration.

### GENERAL WARNINGS

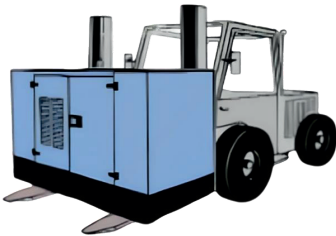
- ⚠ Do not lift the generator using the alternator and engine lifting rings.
- ⚠ Use the lifting rings on the chassis to lift the generator.
- ⚠ Make sure that the lifting equipment and support structures are capable of supporting the generator intact.
- ⚠ When the generator is lifted, make sure that all personnel and surrounding people are kept away from the generator.
- ⚠ Do not allow personnel to travel on the mobile generator, stand on the tow bar or between the mobile generator and the towing vehicle.
- ⚠ Do not install or operate the generator in an environment classified as hazardous unless it is specifically designed for this purpose.



### 2.2.1 CARRYING AND LIFTING WITH A FORKLIFT

Lifting, lowering and carrying the generator with a forklift must be done by authorized persons with a forklift license.

The capacity of the forklift to be used must be suitable for the weight of the generator.



The forklift forks must be kept at ground level and the forklift forks must enter under the generator chassis. The forklift must be brought as close to the generator as possible and the forklift forks must be raised from the ground to lift the generator off the chassis. During transportation of the generator to the location where it will be placed, the forklift forks must be moved backwards to ensure balanced transportation.

When placing the generator, the forks should be placed in a flat position and slowly dropped onto the ground, and the process should be completed by removing the forklift forks.

## 2.2.2 LIFTING WITH CRANE

Do not attempt to lift the generator set under strong winds.

Use the lifting lugs on the chassis to lift the generator set.



Before starting the lifting process, be sure to check the lifting lugs for the following;

- Weld cracks,
- Breaks and bends,
- Rusted or deteriorated parts,
- Loose nuts and bolts or deteriorated parts.

Make sure that all lifting equipment and support materials are in working order.

Make sure that the lifting hook or shackles have a functional safety latch and are properly attached.

Use guide ropes or equivalents to prevent the generator set from rotating and swinging when it is lifted off the ground.

Keep people away from under and around the generator set when it is suspended.

Place the generator set on flat surfaces that are resistant to 10% of its gross weight and have no risk of slipping.

- ▲ Make sure all personnel are outside the generator set before closing and locking the doors.

## 2.3 HOT SURFACES & SHARP EDGES

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

Protect all body parts from hot exhaust pipes and gases.

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

Keep a first aid book handy.

In case of injury, seek medical attention immediately.

Do not ignore minor cuts and bruises.



## 2.4 HAZARDOUS & CORROSIVE SUBSTANCES

### WHILE WORKING WITH CHEMICALS



**WEAR PROTECTIVE  
GLASSES**



**WEAR PROTECTIVE  
GLOVES**

- The oils, fuels, cooling water and battery electrolytes used in the generator are industrial type. If not used properly, it can cause serious damage.

Do not allow fuel, oil, coolant and battery electrolyte to come into contact with the skin, do not swallow them. If accidentally swallowed, seek medical help immediately. If fuel is swallowed, do not induce vomiting. In case of contact with the skin, wash the contact area with soapy water.

Do not wear clothes contaminated with fuel or oil.

Wear an acid-resistant apron, face mask and protective glasses when preparing the battery. If battery electrolyte spills on the skin or clothing, clean it with plenty of pressurized water.

Only operate the generator set in open or well-ventilated areas. If the machine is to be operated indoors, exhaust the engine exhaust gases to the outside environment.

Make sure that the exhaust gas outlets are not located in areas where personnel are present, in areas where there is a risk of going to these areas or near air intake ducts.

## 2.5 FIRE & EXPLOSION



- Fuel and smoke, which are part of the generator, are flammable and explosive substances.

- Taking appropriate precautions in storing the generator reduces the risk of fire and explosion.

- BC and ABC class fire extinguishers should be kept on hand.

The generator, generator room and floor should be kept clean. In case of fuel, oil, battery electrolyte or coolant spillage, collect and dispose of spilled fuel, oil, battery electrolyte or coolant formations by preventing them from coming into contact with the skin. Make sure that the generator room is properly ventilated.

Do not allow fuel oil film to form on the generator set, chassis or cabin if any. Wipe the contaminated surfaces with a liquid industrial cleaner. Do not use flammable chemicals for cleaning.

Before adding fuel, checking the battery electrolyte level or changing the oil, turn off the generator set and allow it to cool. Keep sparks, flames and other sources of ignition away. Do not smoke or allow drinking in the vicinity of the generator.

Do not store flammable liquids near the engine.

Before connecting or disconnecting the battery, disconnect the battery charger.

Keep electrical cables, battery terminals and other terminals in good condition. Replace cracked, cut, worn cables, poor insulation or old, discolored or corroded terminals with new ones.

Sparks or arcs can ignite fuel. To avoid arcing, make sure that grounded conductive objects are kept away from areas exposed to electricity such as terminals.

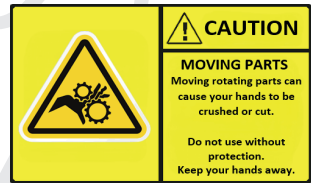
Do not attempt to weld or repair damaged fuel tanks or pipes in any way, replace them with new ones. If any leakage in the fuel system is noticed, do not operate the generator set and fix the leakage.

Refuel from a fuel tank designed for the intended use or from a service station in accordance with the usage and standards. Do not refuel while the engine is running.

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

## 2.6 MECHANIC

The generator is designed with guards to protect it from moving parts. However, precautions should be taken to protect personnel and equipment from other mechanical hazards while working in the generator area.



Do not operate the generator with the guards removed. Do not attempt to reach near or under the guard for maintenance or any other reason while the generator is running.

**ATTENTION: Some moving parts are not clearly visible.**

Keep hands, arms, long hair, loose clothing and jewelry away from moving parts.

If there is a generator room, keep the door closed and locked.

Avoid contact with hot fuel, hot cooling water, hot exhaust fumes, hot surfaces and sharp corners.

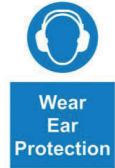


Wear gloves, hats, goggles and protective gloves when working in the generator room.

Do not open the radiator filler cap until the coolant has cooled down. Before completely opening the radiator cap, loosen it slowly to allow the high steam pressure to decrease.

## 2.7 NOISE & ENVIRONMENTAL WARNINGS

- ⚠ The sound intensity of generators equipped with sound insulation cabins is more than 105 dBA.
- ⚠ Long-term exposure to sound intensity of 85 dBA is hazardous to hearing.
- ⚠ Wear earplugs when working in the generator area.



Generator sets contain a number of components that may pose a risk to the environment. Some of these components are lubricating oil, diesel, gasoline, exhaust gas and battery. There may be local rules, regulations or restrictions regarding the use of mobile or stationary generator sets and the disposal of the above-mentioned materials that may pose a risk. It is the end user's duty to comply with the laws and regulations set by local authorities regarding the protection of the environment.



## 2.8 ELECTRICAL WARNINGS

The connection of the generator to the load must be made by an authorized electrician who is trained and qualified in this regard and in accordance with the relevant electrical codes and standards.

Before starting the generator, make sure that the generator is grounded.

Before connecting the load to the generator or disconnecting the load from the generator, stop the generator and disconnect the battery negative (-) terminal.

Do not attempt to connect the load or disconnect the load while standing on wet or wet ground.

Do not touch the conductors, connected cables and electrical parts on the generator with any part of your body or any uninsulated object.

After the load connection is made or the load connection is disconnected, replace the alternator terminal cover. Do not operate the generator unless the cover is securely installed.

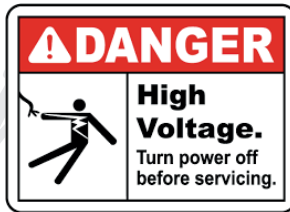
Connect the generator to loads and electrical systems that are suitable for its power and electrical characteristics.

Keep all electrical equipment clean and dry. Renew electrical installations where insulation is worn, cracked and broken. Renew worn, rusted and discolored terminals. Keep terminals clean and connections tight.

Insulate all connections and loose cables.

Use BC or ABC class extinguishers in electrical fires.

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



### **3. FIRST AID AGAINST ELECTRIC SHOCK**

#### **WARNINGS**

- ⚠ Do not touch a person who has been electrocuted with bare hands before turning off the power source.

If possible, turn off the power source. If not possible, unplug the power cord or move the power cord away from the person exposed to electricity. If these are not possible, stand on dry insulating material and preferably use an insulating material such as dry wood to move the person exposed to electricity away from the conductor.

If the victim is breathing, place the victim in the recovery position.

If the person exposed to electricity has lost consciousness, follow the steps below to revive them.

**1. Call the nearest health institution and call for medical help.**

**2. Lay the patient face down, head to one side and forehead on hands.**

**3. Open The Respiratory Tract.**

- Tilt the patient's head back and lift his chin up.
- Remove any objects that may have gotten stuck in the patient's mouth or throat (dentures, gum, cigarettes, etc.).
- Press firmly between the shoulders with the palm of your hand,
- Make sure the TONGUE is FREE.



**4. Do Breath Control.**

- Check whether the casualty is breathing by seeing, listening and feeling..



**5. Check patient's blood circulation.**

- Check the patient's pulse from the neck.

**IF PATIENT CANNOT BREATHE BUT HAS A PULSE**



- Cover the casualty's nose tightly.
- Take a deep breath and bring your lips together with the casualty's lips.
- Blow slowly through your mouth, watching for the rise of the ribcage. Then stop blowing and allow the ribcage to completely fall. Give the casualty an average of 10 breaths per minute.
- If the casualty is to be left alone to call for help,
- Give 10 breaths and return shortly and continue the exhalation process.
- Check the pulse after every 10 breaths.
- As soon as the casualty starts breathing, bring the casualty into the recovery position.

**IF PATIENT CANNOT BREATH AND HAS NO PULSE**

- Seek medical attention or call the nearest healthcare facility.
- Give the casualty two breaths and start heart massage.
- Place the palm of your hand 2 fingers above the junction of the ribcage.
- Place your other hand by locking your fingers.
- Keep your arms straight and press down 4-5 cm 15 times per minute.
- Repeat the process of giving 2 breaths and 15 heart massages until medical help arrives.
- If the casualty's condition improves, continue to give breaths by checking their pulse.
- Check their pulse after every 10 breaths.
- Place the casualty in the recovery position as soon as they start breathing.

**HEALING POSITION**



- Lay the casualty on their side.
- Keep the casualty's head tilted with the chin facing forward to ensure the airway is open.
- Ensure that the casualty does not roll forward or backward.
- Check their breathing and pulse regularly. If either stops, repeat the above procedure.
- Four hours or more may be needed.

**DO NOT GIVE LIQUID UNTIL THE PATIENTS BECOME CONSCIOUS.**

## 4. GENERATOR SPECIFICATIONS & DESCRIPTIONS

### 4.1 GENERAL DESCRIPTIONS

The generator is designed as a whole to ensure high quality and reliability. Each generator has some differences in the configuration and size of its main parts.

This section briefly describes the parts of the generator set. More detailed information is provided in the later sections of the user manual.

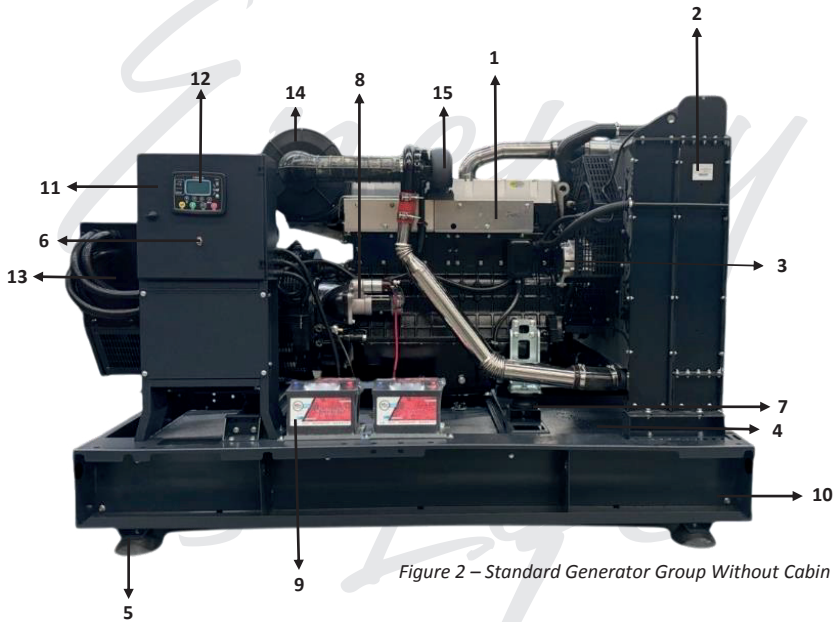


Figure 2 – Standard Generator Group Without Cabin

1. DIESEL ENGINE	4. FUEL TANK	7. ENGINE WEDGES	10. CHASSIS	13. ALTERNATOR
2. RADIATOR	5. VIBRATION WEDGES	8. START ALTERNATOR	11. CONTROL PANEL	14. AIR FILTER
3. CHARGE ALTERNATOR	6. LIGHTNING SWITCH	9. BATTERY/BATTERIES	12. CONTROL CARD	15. EXHAUST OUTLET

## **4.2 GENERAL PARTS OF GENERATOR**

### **4.2.1 DIESEL ENGINE**

All engines used in Universal Generator sets comply with ISO3046 standards. These engines designed for use in generator sets have mechanical or electronic type governors mounted on the fuel pump that provide low fuel consumption and precise speed adjustment and regulation. Depending on the diesel cooling type, they are oil, air or water cooled, have oil, fuel and air filter systems designed for heavy duty conditions that provide long-lasting or high-performance operation of the diesel, have limit and level sensors required for diesel protection, are 4-stroke and direct injection. The diesel engine is provided with all the necessary equipment for safe operation.

### **4.2.2 ELECTRICAL SYSTEMS OF ENGINE**

The engine electrical system is negative ground 12/24 V D.C. This system consists of an electric starter motor, battery and battery charging alternator. A fully maintenance-free type starter battery of appropriate power and number is provided for the 12/24 V electrical system. There is a buffer charger in the generator control panel to charge the battery when the generator is not running. In order for this device to operate and keep the battery constantly charged, a network connection must be made in the control panel.

See: Generator Control Panel

### **4.2.3 COOLING SYSTEM**

The engine cooling system is water cooled. A water cooled system consists of a radiator, fan, circulation pump and thermos. In order to prevent the generator engine from freezing in cold weather, antifreeze is added to the engine water and is filled to a temperature of -30°C at the factory. Antifreeze also prevents damages such as rust etc. in the engine block. Open the drain valve located at the bottom left of the radiator for the engine cooling water. Water will drain from the engine water drain fitting. When you drain the engine water and finish your work, be sure to close the valve before filling the water. Add suitable antifreeze to the engine water. The antifreeze ratio should be adjusted according to the temperature. Antifreeze should be used at the ratio specified by the manufacturer. Alternators have an internal fan to cool the alternator windings.

### **4.2.4 ALTERNATOR**

The output voltage and power of the generator is in accordance with the IP23 protection standard (protected against particles and dripping water), cage-protected, self-excited, self-regulated, H insulation class according to VDE0530 standard, brushless alternator with automatic voltage regulator. A connection box made of steel plate is mounted on the alternator.



*Figure 3 – Alternator Used in Generator Sets – Representative*

### 4.2.5 FUEL TANK & CHASSIS

The chassis is designed according to modular principles. Fuel tanks are manufactured from sheet steel in accordance with relevant standards. They are manufactured independently of the chassis and are designed to be mounted to the chassis from the connection points. Connections between the generator and the fuel tank are provided with appropriate apparatus. Fuel tanks mainly include the following;

- Fuel filling point and cover
- Fuel outlet valve
- Fuel return connection
- Tank drain plug

During Fuel Tank Cleaning;  
Make sure the fuel tank is completely empty.  
Disconnect the fuel hose connections between the fuel tank and the engine.

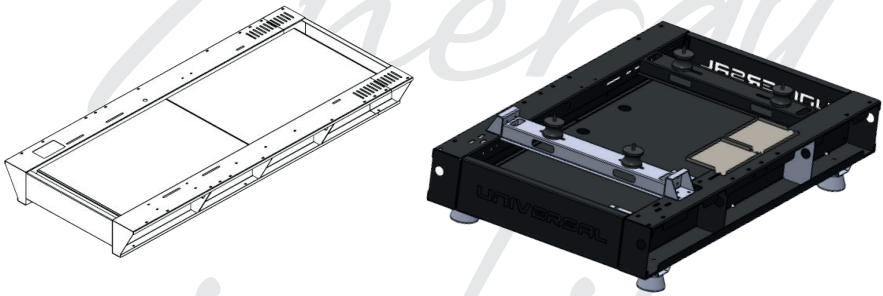


Figure 4 - Universal Generator Chassis

Images are representative. Chassis dimensions and basic components vary depending on the power of the generator set.

### 4.2.6 VIBRATION ISOLATORS

Universal Generator uses special vibration isolators in all of its generator sets to reduce the vibration of the engine and prevent the generator from transmitting vibration to the ground where it is placed.

Vibration isolators are specially selected and are mounted between the engine and alternator feet and the chassis. In addition, special anti-vibration wedges are placed between the chassis and the ground.



Figure 5 - Chassis Isolator



Figure 6 - Engine & Alternator Isolator

#### 4.2.7 SILENCER & EXHAUST SYSTEM

The exhaust system is used to reduce the noise coming from the exhaust manifold of the engine and to direct the toxic exhaust gases to the appropriate areas. Depending on the size of the generator, the exhaust system can be inside or outside the cabins. The exhaust system consists of flexible compensators, elbows and steel exhaust pipes that absorb vibration and expansion. Exhaust pipes are insulated with the highest quality insulation materials in a special way against heat due to their extreme temperatures.

#### 4.2.8 CONTROL SYSTEM

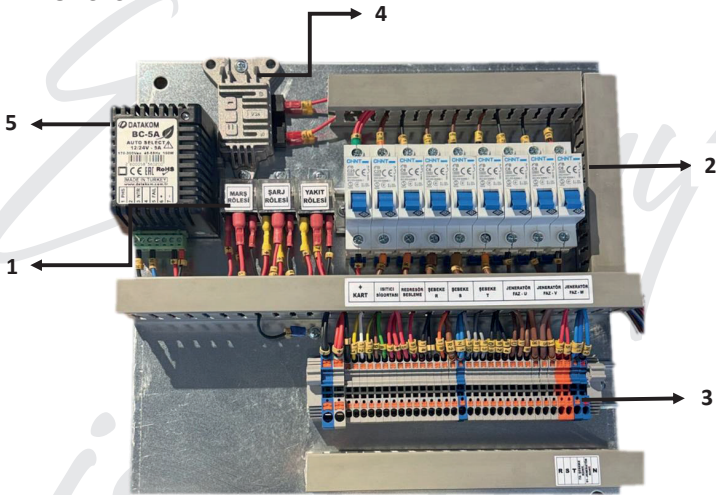


Figure 7 – Control System

1	2	3	4	5
RELAY GROUP	ELECTRICAL-FUSE GROUP	CONNECTION TERMINAL GROUP	CONNECTOR	BATTERY CHARGER RECTIFIER

Control systems have various models depending on customer needs and generator usage requirements.

All control systems are mounted in a special sheet metal box inside the generator cabin for easy access and also have locked doors within the scope of security measures.

## 5. INSTALLATION

### 5.1 LOCATION SELECTION

The most important stage of the installation process is to choose a suitable location for the generator set. In order to perform the installation safely, pay attention to all the warnings in the Maintenance and Operation Manual. If necessary, call our company for information.

If the generator is to be placed in a closed area, make sure that the ventilation of the generator room is sufficient so that the suction system, combustion system and cooling systems can work properly and efficiently.

If the generator is to be installed in a closed area, make sure that there is a suitable passage for the generator to pass through in order to carry the generator to the room.

Install the generator set in protected areas where it will not be exposed to factors such as rain, snow, hail, flood water, excessive humidity, direct sunlight, freezing and extremely high temperatures, dust, soil, sand or harmful substances that can be carried by wind. Make sure that it is protected against harmful substances carried by air such as abrasive or conductive dust, thread, smoke, oil smoke, steam and engine exhaust fumes.

In order for the generator set to cool itself and to allow for easy service and maintenance, there should be at least 1 meter of space around the generator and at least 2 meters of space above the generator.

In some cases, it may be necessary to remove major components such as the engine, alternator, radiator and chassis. Make sure that the area where it will be removed is clean, dry and has a good drainage system.

- If possible, place generator sets in places that are not accessible to unauthorized persons.
- If not possible, take precautions to prevent interventions from outside.
- Place generator sets in places where they cannot be reached by motor vehicles or work machines.
- Provide appropriate protective barriers against external impacts and shocks to the generator set.
- Do not install or use the generator set in an environment that is likely to pose a danger in any way.
- If the installation is to be done outdoors, protect the generator set from external weather conditions.



**Be sure to have warning signs in the area where the generator set will be installed.**

## **5.2 PLATFORM & GROUND**

The generator set can be placed on grounds such as soil, reinforced concrete platforms, buildings, steel constructions. It is useful to prepare the ground as a concrete platform reinforced with iron. The total weight of the generator set should not exceed the load-bearing limit allowed by the ground.

A platform of sufficient size, suitable for the dimensions of the generator set, provides the necessary support to reduce the movement and vibration of the machine as much as possible. This should generally be between 200-250 mm thick and at least equal to the dimensions of the generator set.

If desired, the platform can be made to isolate the rest of the ground against vibration.

If the generator set is to be installed in a place where there is a risk of flooding, moisture, etc. (e.g. boiler room), the platform should be made at least 300 mm above the ground. In this way, a safe and dry ground is provided for the generator set and the people who will provide service to it and operate it.

It is recommended that each machine platform be placed on the main foundation or embankment ground, independent of other foundations, concrete structures, walls or operating platforms.

## **5.3 VIBRATION ISOLATION**

In the production of the generator set, insulation materials are used in a way that transmits minimum vibration to the ground. (See: 4.2.6 Vibration Isolators).

A special reinforced concrete platform that prevents vibration reduces vibration by providing a hard and solid ground. The ground on which the foundation sits must be of a structure that can support the wet weight of the foundation and the generator. Special care must be taken for vibration isolation in generator rooms located on the roofs and floors of high buildings. Spring-type vibration isolators are usually required.

If the generator set is to be placed above the ground, the structure of the building must be capable of carrying the generator, fuel tank and other accessories.

## **5.4 VENTILATION & COOLING**

The engine, alternator, radiator and exhaust pipes radiate heat, causing the ambient temperature to increase. (The radiated heat can cause a high temperature change that will affect the performance of the generator set or service personnel.) The increase in temperature reduces the efficiency of the generator and negatively affects the operating performance of the generator. Therefore, sufficient ventilation must be provided to cool the engine, alternator and radiator.

In order to extend the life of the engine and keep its performance at an efficient level, care must be taken to ensure that the air coming to the generator is clean and as cool as possible. Depending on the conditions of the installation area, how the air is supplied may vary, and it may be necessary to channel the air from outside or another room.

Ventilation windows should be opened behind the alternator for cold air intake and directly in front of the radiator for hot air discharge.

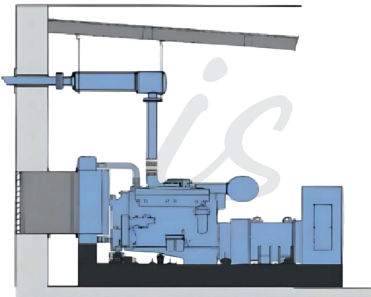
Make sure that hot air is definitely discharged from the room with a flexible connection placed between the radiator and the duct.

The dimensions of the ventilation windows should be calculated to ensure that the cooling air intake is sufficient. (If possible, the air inlet and outlet windows should be at least 1.5 times the size of the radiator area.)

Louvres should be installed on the windows to protect the air openings. These can be fixed or movable types. Movable types can be opened automatically when the generator set is running. Manually opened portable louvered windows may be acceptable in some cases. However, this is not acceptable for automatic Stand-By generators. (For cold climates, it is preferable to be mobile. When the generator is not running, the shutters can be closed, and thus the warm air that facilitates starting and loading remains in the room.)

## 5.5 EXHAUST SYSTEM

The purpose of the exhaust system is to reduce noise by directing the exhaust fumes outside the location or room where they are located, preventing them from causing danger and discomfort. A suitable exhaust silencer should be installed on the exhaust pipe to reduce the noise level of the engine. When designing the exhaust system, the main goal should be to avoid creating back pressure. Excessive back pressure in the exhaust system reduces engine power and increases operating temperature.



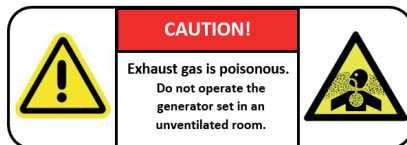
Because exhaust pipes emit heat, it is recommended that all pipes be positioned at least 250 mm away from flammable materials.

Inhaling exhaust gases is a potential death hazard. Exhaust systems must be installed correctly to prevent exhaust gases from accumulating. In addition, prolonged exposure to engine exhaust noise can damage hearing.

A generator set should never be operated with an exhaust system that is not fully installed. All personnel in the immediate vicinity of the generator set must wear earplugs.

The exhaust system's exit points to the outside environment should be selected in a way that will not cause toxic exhaust fumes to be drawn into the clean air ducts. These exit points cannot be given to closed environments, corridors, air ducts, and especially areas where there are living things.

When selecting exit points, attention should be paid to the direction of constant winds.



## **5.6 FUEL SYSTEM**

The main purpose of the fuel system is to provide clean and uninterrupted fuel to the engine. Make sure that the fuel system design is done correctly and the right materials are used.

### **5.6.1 STORAGE OF DIESEL FUEL**

The most preferred method for fuel supply is fuel storage. The fuel tank can be placed underground or above ground.

There should be a vent on the main tank to both release the air pressure caused by tank filling and to prevent the vacuum that forms in the tank as the fuel is consumed. A drain valve should be added to the lowest point of the tank to drain the water that will accumulate as a result of condensation.

Fuel lines can be made of steel pipe or any other material compatible with petroleum. Do not use galvanized pipe. The tank overflow pipe should also be made of the same material and one size larger..

## **5.7 ELECTRICAL CONNECTIONS**

Electrical installation connections and maintenance must be made by fully qualified, experienced and trained electrical technicians in accordance with relevant electrical codes and standards.

All electrical connections must be made in accordance with the diagrams provided by Universal Generator.

### **5.7.1 WIRING**

Electrical connections should be made with flexible cables due to vibrations on the generator. Cables should be placed in cable ducts and should be suitable for the generator output voltage and current.

When deciding on the cable section; tolerance should be given for conditions such as ambient temperature, placement method and proximity to other cables. In order for the cables to carry the current that will flow over them, they should be selected in accordance with the table values, ambient temperature and pulling method.

Cables should be selected in accordance with TSE or VDE standards. The accuracy of all connections should be checked carefully.

Another issue to be considered during cable selection is whether there are starting loads along with the distance between the load and the generator.

If the distance is too long, the voltage drop in the starting will increase a lot and the voltage on the load side may drop to undesirable levels. In order to prevent this, a load cable with a more suitable section can be selected with the help of the formula given.

$$e = 3 \times L \times I \times ( R \cos Q \times \sin Q )$$

e	Absolute Voltage Drop (Volt)
L	Length of the Line (m)
I	Line Current (A)
R	Resistance of the Cable ( ohm / m )
X	Reactance of the cable ( ohm / m )

### 5.7.2 PROTECTION

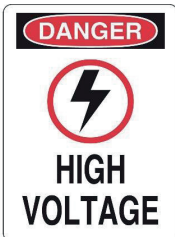
The cables connected to the distribution system and the generator are protected by a circuit breaker that will automatically cut off the connection in case of overload or short circuit.

### 5.7.3 LOAD

When planning the electrical distribution tank, it is very important to ensure that the generator is loaded in a balanced manner. If the load on one phase is greater than the load on the other phases, this will cause the alternator windings to overheat, the output voltage between the phases to be unbalanced, and the sensitive 3-phase devices connected to the system to be damaged. No phase current should exceed the nominal current of the generator. The existing distribution system can be rearranged to ensure that these loading conditions are met.

### 5.7.4 POWER FACTOR

If the load power factor is between 0.8 and 1.0, the generator will deliver the specified power and operate properly. If the load power factor is below 0.8, the generator will be overloaded. Power factor correction elements such as capacitors can be used to prevent this advanced power factor. However, in such cases, when the generator is applied to the load, the power factor correction elements should be disabled.



In order to bring the power factor to appropriate values, automatic power factor correction equipment can be installed if necessary. However, care must be taken to ensure that the system does not switch to capacitive value. Otherwise, this will cause voltage instabilities at the generator output and cause harmful overvoltages.

### 5.7.5 GROUNDING AND GROUNDING CONDITIONS

The generator body must be grounded. The ground connection must be flexible to prevent disconnection due to vibration. Grounding cables must meet standards and must be capable of carrying at least full load current.



Grounding must be done in accordance with applicable national and local standards, rules, regulations or other codes.

Grounding resistance should be below 20 Ohms. Values above 15mA and 50V contact voltage are dangerous to human health. Grounding plate or rod should be at least 20 meters away from each other if more than one grounding plate for different purposes is buried. Since the alternator chassis is connected to the generator chassis, the entire mass of the generator set is at the same potential.

### 5.7.6 ISOLATION TESTING

If your generator has not been used for a long time, the insulation resistance of the windings must be tested before starting. The insulation resistance must be greater than 1MΩ to ground. If the insulation resistance is less than 1MΩ, the alternator windings must be dried.

During the test, the Automatic Voltage Regulator (AVR) connection and all control connections must be disconnected. Rotating diodes must also be short-circuited or disconnected.

### 5.7.7 ALTERNATOR CONNECTION

Many alternators can be reconnected to provide different output voltages. When obtaining different terminal voltages by changing the alternator connection, the suitability of elements such as switches, current transformers, cables and measuring instruments should be checked.

If your generator has not been used for a long time, the insulation resistance of the windings should be tested before starting. The insulation resistance should be greater than 1MΩ to ground. If the insulation resistance is less than 1MΩ, the alternator windings should be dried.

During the test, the connection of the Automatic Voltage Regulator (AVR) and all control-purpose connections should be disconnected. Rotating diodes should also be short-circuited or disconnected.

### 5.7.8 STARTER BATTERIES

The electrical resistance on the starter circuit has a significant effect on the operation of the diesel engine. Therefore, the batteries should be placed as close as possible to the generator set, and the connections should be correct and not loose. (The batteries should be accessible for ease of service.)

Since the batteries must be in perfect condition to be able to start the generator set at any time, maintenance procedures must be carried out meticulously.

#### Connecting and Disconnecting

- First connect the battery (+) terminal. Then connect the battery (-) terminal.
- Start the removal process from the battery (-) terminal. Then, disconnect the (+) terminal connection.

#### Cleaning

- Keep batteries clean and dry. Dirt and oxidation on the battery or connection terminals will cause the battery voltage to drop and discharge.
- Disassemble and clean the terminals during maintenance. Use a wire brush for oxidation.

### 5.8 FIRE PRECAUTIONS

In installing a generator set, the following points should be taken into account:

- There should be an easy escape route for operating personnel in the room in case of any fire.
- To combat fire, a recommended fire extinguisher or fire suppression system that complies with fire regulations and standards for the building where the generator is located must be provided.
- Gravity-operated fire valves, which are mounted on the engine and operate via fusible links, should be placed in the fuel lines.
- The room must be kept clean and clear of accumulated garbage that could cause fire.



## 6. CONTROL SYSTEMS

### 6.1 INTRODUCTION

Universal Generator uses programmable microprocessor generator control units as standard in its sets, which can monitor all measurement values and alarm messages and provide protection.

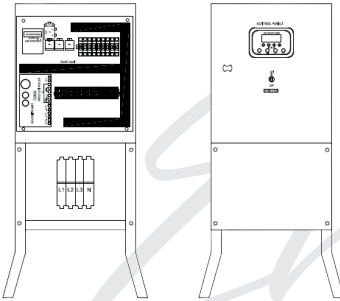


Figure 8 – Control Panel

Control systems enable the generator set to start, stop, monitor and protect various values. It provides flexible use in changing conditions with the help of programmable parameters.

There is a lighting button on the control panels that provides interior and cabin lighting.

There is a lock system on the covers of the control panels to prevent unauthorized interventions.

The control panels are made of A1 quality galvanized sheet metal and painted with electrostatic powder paint against rust.

In addition to standard control panels, sets suitable for various operating variations are also manufactured in accordance with customer demands and the operating conditions of the generator.

### 6.2 MANUAL AND AUTOMATIC CONTROL CARDS

Automatic Control Panels are used in applications where the generator is kept as a backup to the mains power and ensure that the generator is activated when the mains power is cut off.

Manual Control Panels allow the generator to be manually started and stopped in locations where mains power is not available. EMKO Trans-MidiAuto and Trans-AUTO are used as standard for both applications. The board varies depending on the number of pistons in the engines used in the generator sets.

Various control card options can be applied in line with the demands and needs of the customers. Control card options are optional and non-standard options are charged extra.



TRANS AUTO (STANDARD)



TRANS MIDI AMF (STANDARD)



TRANS AMF SYNCRO (OPTIONAL – SYNCHRONIZATION CARD)

## 6.2.1 TRANS AUTO & TRANS MIDI FEATURES

Trans AMF generator controllers are a state-of-the-art, economical generator controller that provides remote monitoring over the internet using plug-in communication modules. Its multifunctionality, support for various communication protocols and topologies, harmonic analysis, and detailed power measurements are its greatest advantages.

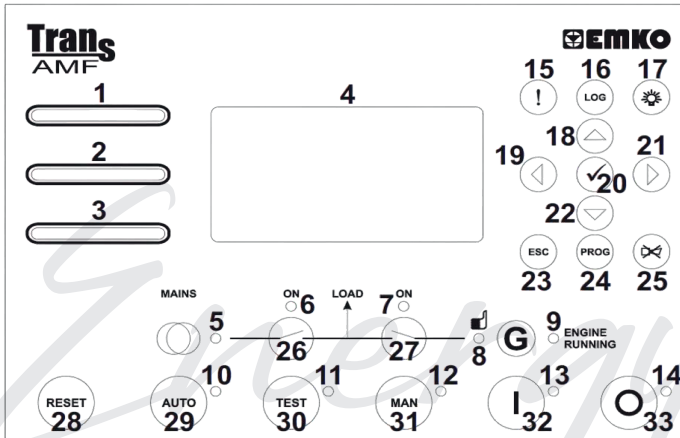


- 3-level program password
- Battery-backed real time clock
- 500x recording (trans amp)
- 300x recording (trans midi)
- 4 analog inputs (trans amf)
- 3 analog inputs (trans midi)
- 6 digital inputs (trans amf)
- 5 digital inputs (trans midi)
- Protection cancellation feature
- CANBUS-J1939 & MPU input
- Software upload via USB
- Excess power protection
- 3 programmed service alarms
- Mains energy meters
- Control possibility via SMS

- Current-voltage harmonic analysis
- Reverse power protection
- Multiple automatic test program
- 128 x 64 pixel graphic LCD
- Overcurrent IDMT protection
- Weekly work schedule
- Fuel fill meter
- Load shedding, dummy load
- Fine speed adjustment (some ECU's)
- Loading languages
- Multiple load shedding programs
- Automatic fuel pump control
- Fuel consumption counter
- 16 Amp / 250V MP / JK outputs

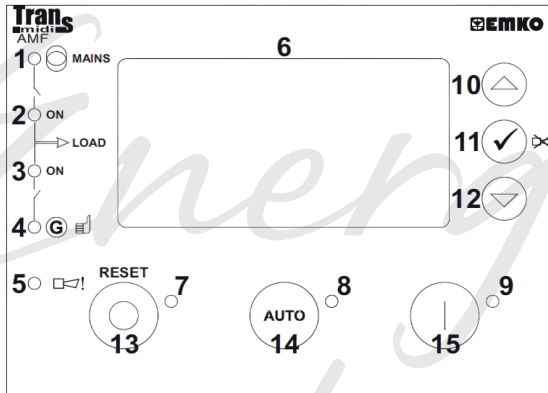
- NEMA 4X IP65 front panel
- Fuel fill & theft alarms
- Current unbalance protection
- 6 programmable digital outputs
- Current-voltage waveform
- Operating temperature: -20°C to 70°C
- Multiple nominal condition definitions
- Battery charging operation
- Voltage unbalance protection
- GPS connection (RS232)
- Automatic GSM location determination
- Idle speed con

**6.1.2 CONTROL DEVICE STANDARD FUNCTION BUTTONS**



1	This LED indicates that a "Shutdown" alarm has been detected.
2	This LED indicates that a "Warning" alarm has been detected.
3	This LED indicates that a "Maintenance" alarm has been detected.
4	This LCD display is used to display electrical measurements during normal operation and to edit/review programming parameters in programming mode.
5	This LED indicates that the mains voltage and frequency are within certain limits and that it is ready to take over the load.
6	This LED indicates that the load is powered by the mains.
7	This LED indicates that the load is powered by the generator.
8	This LED indicates that the Generator is within limits and ready to take over the load voltage and frequency.
9	This LED indicates that the engine is running.
10	This LED indicates that the unit is in AUTO mode.
11	This LED indicates that the unit is in TEST mode.
12	This LED indicates that the unit is in MANUAL mode.
13	In MAN, AUTO and TEST modes, this LED indicates whether the engine is running or not.
14	This LED indicates that the unit is in STOP mode.
15	Alert and Alarm messages shortcut key.
16	Event Logs shortcut button.
17	The LAMP TEST button causes all LED indicators to light up.
18	Used to display previous parameters in normal operation. In Prog. mode, functions as an up/increment button.
19	It is used to display the previous page during normal operation. In Prog. mode, it functions as the left button.
20	Used to enter the parameter editing section in programming mode and save the parameter value.
21	In normal use, it is used to display the next page. In Prog. mode, it serves as a replacement.
22	Used to display the next parameters in normal operation. In Prog. mode, functions as Down key/Decrease key.
23	The Escape key is used to exit the previous section in programming mode.
24	When this button is pressed, the device goes into PROGRAMMING Mode.
25	This button will silence the alarm horn when a fault is detected.
26	This button opens or closes the mains contactor and only works when manual mode is selected.

27	This button opens or closes the generator contactor, it only works when manual mode is selected.
28	This button will reset the controller after a fault is detected.
29	The AUTO button is used to change the unit's operating mode to AUTO Mode.
30	The TEST button is used to change the operating mode of the unit to TEST Mode.
31	The MAN button is used to change the unit's operating mode to MANUAL Mode.
32	The START button is used to start the engine when the unit is in Manual Mode.
33	The STOP button is used to change the unit's operating mode to STOP Mode. The generator is stopped.



1	This LED indicates that the mains voltage and frequency are within certain limits and that it is ready to take over the load.
2	This LED indicates that the load is powered by the mains.
3	This LED indicates that the load is powered by the generator.
4	This LED indicates that the Generator voltage and frequency are within limits and is ready to take over the load.
5	This LED indicates that an alarm has been detected.
6	Used to view measurements during operation and to edit/review parameters in prog. Mode.
7	This LED indicates that the unit is in STOP mode.
8	This LED indicates that the unit is in AUTO mode.
9	In MAN, AUTO and TEST modes, this LED indicates whether the engine is running or not.
10	In normal operation, it is used to display the previous page. In Prog. mode, it functions as an Up button/Increment button.
11	In programming mode, it is used to enter the parameter editing section, save the value, and display the next parameters. This button also silences the alarm horn when a fault is detected.
12	This button is used to display the next page in normal operation. In programming mode, it functions as a Down button (changing the cursor position) or a Decrease button (decreasing the parameter value).
13	The RESET/STOP button is used to change the unit's operating mode to Stop Mode. The RESET/STOP button resets the controller after a fault is detected. The generator is stopped.
14	The AUTO button is used to change the unit's operating mode to Automatic Mode.
15	The START button is used to start the engine when the unit is in Manual Mode.

## **7. STARTING THE GENERATOR**

### **7.1 BASIC PROCEDURES TO BE CARRIED OUT BEFORE STARTING**

Before starting the generator set, be sure to take into account the safety precautions described in the Maintenance User Manual. Make sure that the installation is complete and complete.

Make sure that the electrical connections are made in accordance with the technical diagrams and connections.

1. Visually and manually inspect the generator set for any leaks, breaks, breaks, cracks, etc. Do not start it if there is a problem.
2. Make sure that the generator set is protected against rain, dust, etc. The generator set must be on a flat and suitable surface.
3. Check the radiator air outlet hood, open it if it is blocked and remove anything that prevents air outlet in front of it. Keep the radiator front window shutters open.
4. Ensure that the generator can easily suck air in the area where it is located.
5. Check that the exhaust outlet is not blocked or blocked.
6. Check the engine oil level with the oil dipstick. If it is missing, add the appropriate oil. The oil should be close to the maximum level line.
7. Open the radiator cap and check the water level. If it is missing, add water. The water level should be 30 mm below the water filler neck.
8. Antifreeze should be present in the engine cooling water according to the coldest weather conditions of the region. A mixture of 50% antifreeze and 50% water is suitable for protection in every region. The antifreeze ratio should not exceed 50%.
9. Check the fuel level in the fuel tank. If insufficient, refuel.
10. Check the battery connection cables. Be sure to tighten loose battery terminals with a wrench and keep the terminals clean.
11. Check the air filter. Clean or replace if necessary.
12. Any object or living creature near the generator may prevent the generator from operating or cause injuries. Check and warn about this.
13. Emergency stop buttons should not be pressed, check.

## **7.2 PROCEDURES TO BE CARRIED OUT DURING STARTING**

The information in this section is for the purpose of informing the operator, detailed information can be obtained from Universal Generator or authorized technical services.

- **To Run the Generator Automatically,**

Check the emergency stop button.

Press the Auto button.

See that the signal lamp indicating that the automatic mode is selected is on.

- **To Run the Generator Manually,**

Check the emergency stop button.

Press the Run (I) button.

See that the signal light indicating that the manual mode is selected is on.

- **To Stop the Generator,**

To stop the system, press the stop button on the control panel.

The generator cools for 5 minutes and goes into standby mode.

To operate in automatic mode, check that the auto light is on.

- **To Run the Generator in Test Mode,**

Check the emergency stop button.

Press the test button.

Check that the lamp on the test button is on.

Even if there is a network, the system will be powered by the generator.

## **7.3 PROCEDURES TO BE CARRIED OUT AFTER STARTING**

Check if there is any unusual noise or vibration in the generator.

Check if there is a fuel leak in the fuel system.

Check the engine temperature and oil pressure conditions from the indicators on the generator control panel. The oil pressure should be at normal values 10 seconds after the generator starts.

Monitor the generator output voltage and frequency from the indicators on the generator control panel. For these operations, use the right-left and up-down keys on the control panel to check that the voltage between the phases is 400V and the voltage between the phase and neutral is 230V using the Voltmeter.

**The output voltage is factory set, do not try to change the voltage settings. Check that the frequency is 51-52 Hz.**

### 7.4 ENGINE JACKET WATER HEATERS

Engine jacket water heaters are placed in the engine's water system to ensure that the diesel engine starts easily and takes over the load more quickly. They are standard in automatic control systems.

The nominal power (kW) of the heaters varies according to the size of the engine used in the generator set. The heaters are installed at approximately 40°C and are used with a thermostat.

Engine jacket water heaters are automatically deactivated when the engine starts.

The network connection for the block water heater must be made at the location where the generator set is installed.

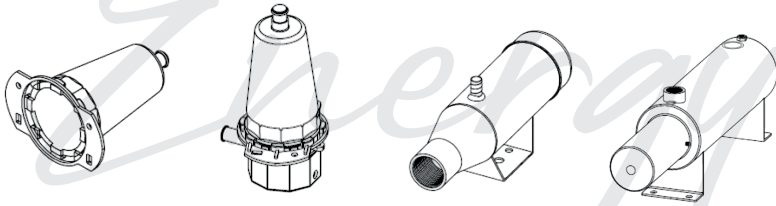


Figure 9 – Engine Jacket Water Heaters

### 7.5 AUTOMATIC TRANSFER SWITCHES

Automatic transfer switches are used to reliably transfer and control the output power of the generator set.

In order for automatic transfer switches to be used as intended, they must be capable of meeting the output power of the generator set to be used with them.

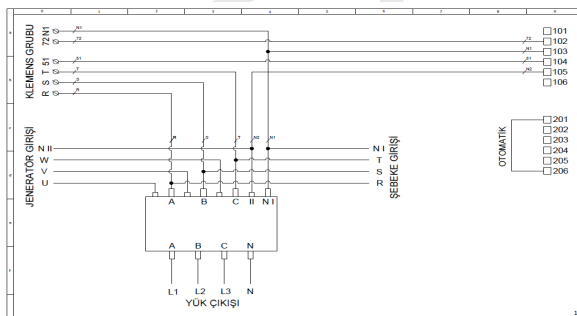


Figure 10 - Automatic Transfer Switches Connection Diagram

## 8. GENERATOR MAINTENANCE

### 8.1 GENERAL INFORMATIONS



In order to ensure that the generator set operates in a long-term and good performance, its maintenance must be done on time and completely. A good maintenance program extends the life of the generator. Generator sets that are maintained on time and completely will be ready for service at any time and the risk of possible failures will be minimized.

Maintenance and repair should only be performed by authorized and trained persons.

The results of the maintenance and repairs performed should be recorded in the periodic maintenance schedule.

The maintenance and checks to be performed on the generator set are specified in the periodic maintenance schedule.

All information regarding the engine and alternator is in the original user manuals of the engine and alternator located inside the generator set.

Do not remove the engine model label, alternator model label and the model label of the generator set from the generator.

Keep the generator drawing and connection diagrams, service record forms, Service and Maintenance Schedule and this manual.

Pay attention to access doors during adjustment and/or repair operations to the generator set. Take precautions against the access doors being closed or locked by others.



Before adding or changing oil, fuel and coolant, make sure that the generator set is not running.

Before starting to adjust the generator set and/or repair operations, cut off the power to the battery charger to prevent the generator set from running. Perform adjustments and/or repair operations only when the generator set is off.

**Only expert technical service personnel can perform adjustments and/or repairs that need to be made while the generator set is operating.**

## 8.2 DIESEL ENGINE MAINTENANCE

See Diesel Engine Maintenance and Operation Manual.

## 8.3 ALTERNATOR MAINTENANCE

Alternator maintenance and inspections should only be carried out by authorized personnel.

When performing maintenance and inspections, safety precautions should be taken and the alternator should not be in operation.

The frequency of alternator inspection and maintenance should be adjusted according to the operating condition and environmental conditions.

During the first start-up and after the next 500 operating hours or 1 year; abnormal noise, tightness of bolts and nuts, vibration, knocking, integrity of cable terminals, integrity of electrical connections should be checked. It should be examined whether there is a mechanical defect in the body or cooling fan.

If the alternator has not been used for a long time, it is recommended to perform a stator winding insulation test against ground before starting.



Alternators contain dangerous rotating parts.

When performing operations on the alternator, care should be taken against electric shocks.

## 8.4 RADIATOR MAINTENANCE

The radiator, which is one of the basic components of the generator set, can be used for many years without any problems in industrial conditions when its maintenance is done regularly and correctly.

- Do not work on the radiator while the radiator fan is running.
- Do not work on the radiator until it cools down and do not remove the hoses. The radiator coolant works under pressure and is very hot.
- The coolant should be filled completely into the radiator. Partial filling of the radiator will cause corrosion to spread more quickly. The radiator should be filled only with distilled or natural soft water or a certain amount of suitable corrosion inhibitors should be added to the water.
- If the radiator is located in dusty and dirty environments, it may cause the radiator to become clogged, reduce its performance and fail to perform its function. Deposits formed due to dust and dirt should be cleaned regularly. Low-pressure steam should be used for this cleaning process. In more difficult deposits that cannot be cleaned with low-pressure steam, the radiator can be immersed in an alkaline solution for 20-25 minutes and then washed with hot water.

**8.5 COOLANT**

Coolant protects the engine's cooling system from freezing and also from corrosion.

For coolant, water and additives (antifreeze) must be mixed in certain proportions.

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

If there is a risk of the engine freezing, use a mixture of 50% antifreeze and 50% clean and pure water. This mixture protects your engine from freezing down to -40° C.

At least 40% antifreeze must be used for effective corrosion protection.

**8.6 LUBRICATING OIL**

In order for the diesel engine to operate efficiently and healthily, the lubrication oil must be changed at specified periodic times.

To prevent damage to your engine, use oils specified by the engine manufacturer.

The characteristics of the oils to be used are specified in the "Engine Maintenance and Use" book provided with the generator.

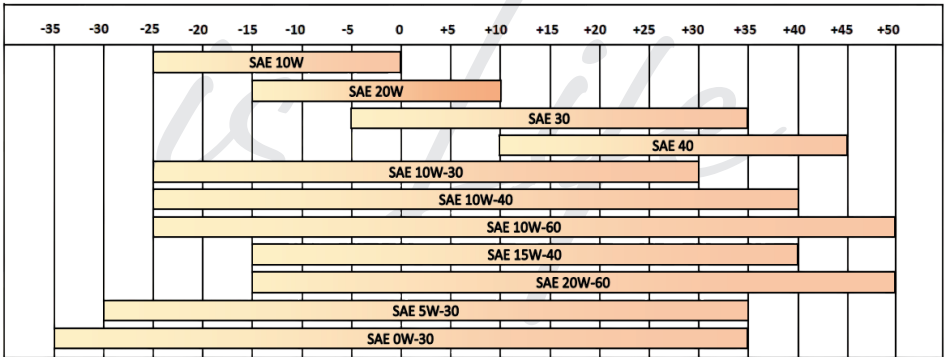


Figure 11 – Oil Norms That Can Be Used According to Ambient Temperature

**Drinking antifreeze, coolant and lubricating oil is dangerous.**

### 8.7 FUEL

For a safe and environmentally friendly operation, fuels that comply with the fuel specifications recommended below should be used.

Fuel temperature should not exceed 40°C.

**TYPE 1,2,3 DIESEL:**

EN590 - JIS K2204 - DIN 51601

**NO 1-D, 2-D / DMX-CLASS / CLASS-A1, A2:**

ASTM D975 - ISO 8217 - BS 2869

**If the sulfur content exceeds 0.5%, the oil change frequency should be increased.**

**The sulfur content should be in accordance with the standards in the country where the generator set will be used.**

LUBRICANT OIL CHANGE INTERVALS	FUEL SULFUR CONTENT (%)
NORMAL	< 0,5
0,75 FREQUENCY	0,5 – 1,0
0,50 FREQUENCY	< 1,0

Figure 12 – Lubricating Oil Change Intervals

### 8.8 STARTER BATTERIES

The batteries used in our generator sets are maintenance type batteries and require the addition of pure water. Since the internal resistance of the batteries is very low, the discharge period is very long (5miliohm).

The electrical energy used is formed by chemical reactions that occur in the cells in the battery. The chemical reactions that occur are reversible and thus the battery can be charged and discharged repeatedly.

Our batteries have a wide operating temperature. This temperature range is approximately between -20 °C and 60 °C.

There are special low pressure safety valves in our batteries.

The batteries can remain charged continuously for approximately 4 years. They should be replaced after the continuous charging period is completed.

The density of the battery fluid should be checked with a boomometer. At nominal temperature (15 °C), the reading value in each cell should be approximately 1.27.

When preparing electrolyte for the battery, distilled water should be used. It is also a correct practice to use distilled water for the water to be added to the battery daily.

When adding distilled water, first clean the top of the battery to prevent dirt formation and remove the covers. Add distilled water up to 5-10 mm above the plates. Reattach the removed covers and tighten the covers. After adding distilled water, completely dry the top of the battery.

If the temperature of the battery fluid is not at the appropriate values, it makes the battery unable to work. The appropriate temperature values for the battery fluid are approximately between -5 °C and 50 °C. At temperatures that are not in accordance with the values in this range, the battery fluid may freeze or boil. The operating temperature values of the battery used should be checked at certain intervals.



Flammable gases from batteries can cause fire. Do not smoke near batteries, do not create sparks or open flames.

Always handle batteries carefully and wash your hands after contact to protect yourself from possible acidic burns.

Check the charging systems together with the batteries.

Do not allow unauthorized personnel to be in the battery charging area, wear appropriate protective clothing..

## **8.9 LOW-LOAD USE**

It is not only dangerous to use the generator set above the category (ESP/PRP/COP) and capacity specified on the label values, but also dangerous to use it at low loads. This situation should be taken into consideration more when using generators with high power.

It should be avoided to operate generator sets at low load or without load. In cases of necessity, this period should be minimized.

If the weekly test run of the generator set must be done without load, it should be limited to 10 minutes.

The minimum allowed load amount is 30% of full power for StandBy (ESP) and Prime (PRP) category generator sets, while it is 25% of full power for the COP category.

In cases where sufficient load cannot be provided for the generator set, it is recommended to prevent negative effects by connecting a backup load (load bank).

The maintenance periods of generator sets operating at low load should be done in shorter periods than the period specified in the periodic maintenance schedule provided with the generator set.

It is recommended that the generator set be operated at 75% load for 4 hours once a year to burn off carbon deposits in the exhaust system. During operation, the load level should be gradually increased over four hours, starting from 0% load.

The problems and symptoms that may occur if the generator set operates below the specified minimum load limits are as follows:

- **Oil leakage occurs in the exhaust and air intake system as a result of long periods of operation at no load or low load:**  
Since the temperature inside the cylinders remains at a lower level than normal, the fuel coming into the cylinder does not burn completely. Unburned fuel and oil vapor condense in the exhaust system. Turbocharger oil seals cannot operate efficiently at low load and cause oil to flow into the intake and exhaust manifolds along with the air. As a result, oil leaks are seen in the exhaust and air intake manifolds.  
This situation is especially seen in Standby (ESP) generators where the weekly test run is performed without load.
- **Carbon deposits occur in the cylinder heads and exhaust manifold:**  
Unburned fuel, oil vapor and soot deposits contaminate the exhaust valves and seats in the cylinder heads, piston rings, exhaust manifold and injector nozzles, causing the engine to lose performance. It also clogs the exhaust silencer and pipes, causing the performance to decrease. In the later stages, this can cause serious damage to the engine.
- **It causes sulfuric acid concentration in the exhaust system and causes corrosive damage to the engine:**  
Due to the decrease in combustion performance, unburned fuel mixes with the oil in the cylinder and causes the oil in the crankcase to deteriorate. The deteriorated oil will cause premature wear of the rotating parts and bearings.  
The turbocharger bearings operating at very high speeds are primarily affected by the wear, which can cause oil leakage and damage.  
As a result of such operation, an oil consumption above the normal value occurs.

## **8.10 LONG-TERM STORAGE**

### **Storage up to 3-6 Months**

- Change the oil filter and engine oil.
- Change the fuel filter.
- Fill the fuel tank with fuel to the maximum fill level by draining water and sediment.
- Check the coolant level. If it does not contain the required amount of antifreeze, drain the coolant from the water filter and the entire system.
- Disconnect the battery connection cables and clean the battery.
- Keep the battery under constant charge.
- Check the electrical connections.
- Apply protective oil to the air intake line.
- Close the air inlet and exhaust outlet.
- Clean the generator with a damp cloth. Do not use pressurized water when cleaning the generator.
- Pack the generator cleanly and put a warning label on it.
- Store the generator in a dry place away from sun, wind, dust and rain, and where there is no temperature change.

**Storage up to 6 Months – 2 Years**

- Drain the engine oil.
- Fill the diesel engine preservative oil up to the maximum level on the dipstick.
- Immerse the fuel suction and return lines in a container containing 1/3 preservative oil and 2/3 diesel oil. Run the engine until you have used 2-3 liters of this mixture and then stop it.
- Drain the fuel system. Connect the fuel suction and return lines to their normal places.
- Completely drain and clean the fuel tank.
- Drain the preservative oil from the filter and engine.
- Apply preservative oil to the air intake manifold and turbocharger compressor.
- Close the air intake and exhaust outlet.
- Loosen the V-belts.
- Check the electrical connections.
- Disconnect the battery connection cables and clean the battery. Keep the battery under constant charge.
- Clean the generator with a damp cloth. Do not use pressurized water when cleaning the generator.
- Pack the generator cleanly and put a warning label on it. - Store the generator in a dry place away from sun, wind, dust and rain and where there is no temperature change.

**8.11 STARTING AFTER STORAGE**

- Open the packaging of the generator set that you have packed for storage, check the generator set manually and visually.
- Make sure that the generator installation is in accordance with the rules.
- Make sure that the operations to be performed before starting are completed.
- Renew the engine oil and oil filter.
- If the generator set is to be put into operation after a storage period longer than 6 months, clean the fuel tank and fill it with new fuel.
- Renew the fuel filter.
- Check the air filter, clean/renew if necessary.
- Check and tighten the V-belt and pulleys that you have loosened for the storage process.
- Check all hoses and pipes in the generator set, tighten their clamps and screws.
- Install any loose screws or plugs.
- Check the coolant level and antifreeze ratio.
- Make sure that the batteries are fully charged, make the battery connections.
- Disable the fuel solenoid end of the generator and turn it briefly with the starter motor.
- Run the generator without load until the engine warms up.
- Check for oil leaks, fuel leaks, water leaks, excessive vibrations and abnormal sounds.
- Run the generator under load and check again.

## 9. GENERAL MAINTENANCE SCHEDULE

UNIVERSAL GENERATOR  GENERAL MAINTENANCE GUIDE	FIRST START	DAILY	FIRST MAINTENANCE (50 HOURS / FIRST 6 MONTHS)	WORKING HOURS (PERIODIC)				TIME	
				200 HOURS	400 HOURS	1000 HOURS	2000 HOURS	EACH YEAR	EACH 2 YEAR
<b>ENGINE SYSTEM</b>									
Check for Oil Leakage	✓	✓							✓
Check the Oil Level	✓	✓		✓					
Change the Oil			✓	✓					✓
Change the Oil Filter			✓	✓					✓
Check the Block Water Heater	✓		✓	✓					
Check the Coolant Level	✓	✓							
Check for Coolant Leakage	✓	✓							✓
Check the Water / Antifreeze Ratio				✓					✓
Change Antifreeze						✓			✓
Check the Hose and Connection Clamps			✓	✓					✓
Check Radiator Cleanliness			✓	✓					✓
<b>FUEL SYSTEM</b>									
Check the Fuel Level		✓							
Check for Fuel Leakage		✓							✓
Change the Fuel Filter			✓	✓					✓
Check the Fuel Hoses	✓								✓
Drain the Water from the Fuel-Water Separator Filter			✓	✓					✓
Check the Injectors									✓
Clean the Fuel Tank						✓			✓
<b>ELECTRICAL SYSTEM</b>									
Check the Battery Charge Status	✓		✓	✓					✓
Check the Battery Charger and Charge Alternator	✓		✓	✓					✓
Clean the Battery and Terminals			✓	✓					✓
Check Oil Pressure, Water Temperature, Water Level Indicators	✓		✓	✓					✓
Check AVR and Governor Card Settings	✓		✓	✓					✓
Check the Cable Connections and Transfer Panel	✓		✓	✓					✓
Check the Generator Control Unit			✓	✓					✓
Check Generator Operating Functions	✓		✓	✓					✓
<b>OTHER SYSTEMS</b>									
Check Turbocharger						✓			✓
Clean the Air Filter, Replace if Necessary				✓					✓
Check Exhaust System for Leakage	✓			✓					✓
Check Exhaust Smoke Color	✓			✓					✓
Check the Belt Tensions	✓			✓					✓
Check the Fan Blades				✓					✓
Check Bolts and Nuts	✓						✓		✓
Check Compression Pressure if Necessary							✓		✓
Check the Vibration Pads	✓						✓		✓
<b>GENERAL SYSTEMS</b>									
Perform General Cleaning of the Generator	✓	✓		✓					✓
Check for Abnormal Noise During Operation	✓		✓	✓					✓
Check Crankcase Ventilation Line				✓					✓
Clean the Crankcase Ventilation Line				✓					✓



THE GENERAL MAINTENANCE SCHEDULE INCLUDES ONLY BASIC CHECKS.  
 FOR ENGINE AND ALTERNATOR MAINTENANCE POINTS, CHECK THE "ENGINE AND ALTERNATOR MAINTENANCE MANUAL".  
 TEST YOUR GENERATOR SET UNDER LOAD FOR 15 MINUTES ONCE A WEEK.  
 TO CONTINUE YOUR WARRANTY PERIOD, MAKE SURE TO HAVE THE FIRST GENERAL MAINTENANCE DONE AFTER 50 HOURS OR 6 MONTHS.  
 YOU HAVE INCREASED THE MAINTENANCE PERIODS DEPENDING ON THE ENVIRONMENT CONDITIONS WHERE THE GENERATOR IS  
 LOCATED, THE FUEL AND OIL QUALITY AND THE WORKING ORDER OF THE GENERATOR.

## 10. TROUBLESHOOTING & FIXING

Troubleshooting and inspections must be performed by trained and authorized persons.

Correct equipment must be used when performing operations.

Do not make any part changes or adjustments without authorized and trained personnel.

If you cannot get a result with this table, call Universal Generator authorized services.

PROBLEM	POSSIBLE REASONS	SOLUTIONS
If the engine turns slowly but does not start:	No fuel in tank	Refuel
	Batteries are discharged	Charge/Replace batteries
	Defective starter	Repair/Replace
	Oil specification is not suitable	Replace with suitable oil
	Air in the fuel system	Eliminate air
	Clogged oil filter	Replace
	Defective fuel injection pump	Adjust/Repair/Replace
	Defective manuel fuel lift pump	Repair/Replace
	Poor compression	Measure/Engine revision
	Defective control unit	Adjust/Replace
	Engine mechanical fault (piston, piston rings etc)	Engine revision
	Problem in control panel	Repair/Replace
	Problem with electrical connections	Repair
Engine does not start:	Defective starter	Repair/Replace
	Defective starter relay	Replace
	Batteries are discharged	Charge/Replace batteries
	Defective control unit	Adjust/Replace
	Generator in OFF position	Switch to normal position
	No fuel in tank	Refuel
	Air in the fuel system	Eliminate air
	Problem in fuel system	Repair/Replace
	Fuel specification is not suitable	Replace with suitable fuel
	Clogged air intake	Open valve
	Clogged air filter	Replace
	Emergency button is pressed	Switch to normal position
	Poor compression	Measure/Engine revision
	Engine mechanical fault (piston,piston rings etc)	Engine revision
	Problem with electrical connections	Repair
	Ambient temperature is too low	Warm up ambient/Engine

<b>Engine overheating:</b>	Inadequate fresh air inlet	Make it suitable
	Inadequate hot air outlet	Make it suitable
	Unsuitable blinds and paddle box	Make it suitable
	Clogged air filter	Replace
	Radiator is too dirty or clogged	Clean/Replace
	Defective injectors	Adjust/Replace
	Wrong type injectors	Replace
	Clogged intercooler	Clean/Replace
	Excessive lubricating oil	Replace
	Inadequate coolant level	Refill
	Cooling fan is not working properly	Repair
	Clogged water hoses	Check/Repair/Replace
	Belts are worn or loosen	Adjust/Replace
	Defective water pump	Repair/Replace
	Leakage in cooling system (water-air)	Check/Repair/Replace
	Defective engine thermostat	Check/Replace
	Excessive exhaust back pressure	Make it suitable
Overload	Decrease load level	
<b>Lubricating oil pressure is too high:</b>	Defective sensor	Replace
	Defective display	Replace
	Oil specification is not suitable	Replace with suitable oil
<b>Oil consumption too high:</b>	Oil leakage	Repair
	Low load or no load operation	Load higher than 30%
	Oil viscosity too low	Replace with suitable oil
	Excessive lubricating oil	Replace
	Defective oil cooler	Repair/Replace
	Engine mechanical fault (piston,piston rings etc)	Engine revision
	Problem with cylinder head cover	Repair/Replace
<b>Fuel consumption too high:</b>	Fuel leakage	Repair
	Fuel specification is not suitable	Use suitable fuel
	Poor compression	Measure/Engine revision
	Defective manual fuel lift pump	Repair/Replace
	Charge air is not cooled	Check/Repair
	Defective injectors	Adjust/Replace
	Clogged air filter	Replace
<b>Generator does not stop:</b>	Defective DC fuses	Repair
	Defective fuel solenoid	Adjust/Replace
	Mains supply problem	Measure mains voltage
	Defective control unit	Adjust/Repair/Replace
	Generator is cooling down	Wait/Check the timer
<b>Alternator does not produce output voltage (No load voltage is lower than the 10% of nominal voltage):</b>	Connections are loose	Check/Repair
	Excitation circuit is disconnected or short circuited	Check/Repair
	Defective rotating diodes or suppressor	Check/Repair
	Insufficient residual voltage	Apply external excitation
<b>Alternator does not produce output voltage ( No load voltage is lower than 20-30% of nominal voltage. Output voltage is not effected from the rotation of AVR potentiometer):</b>	Fuse (in AVR line) is broken	Replace
	Defective AVR	Check/Adjust/Replace
	Wrong connection of Excitor starter	Check
	Broken of exciter starter	İkaz statorunu kontrol ediniz/Tamir ediniz

<b>Output voltage is 50-70% of the nominal voltage:</b>	Defective AVR	Check/Repair/Replace
	Over excitation limitation	Adjust AVR potentiometer
	Fuse is broken	Replace
	Speed is lower than nominal	Check engine speed
	Voltage potentiometer is not adjusted	Adjust
<b>Not enough power:</b>	Engine is too cold	Warm up ambient/Engine
	Fuel specification is not suitable	Use suitable fuel
	High viscosity grade of oil	Replace with suitable oil
	Inadequate fuel	Provide enough fuel flowing
	Clogged fuel filter	Replace
	Clogged air filter	Replace
	Inadequate hot air outlet	Make it suitable
	Inadequate fresh air inlet	Make it suitable
	Defective injectors	Adjust/Replace
	Over-load	Decrease load level
	Defective manual fuel lift pump	Repair/Replace
	Defective turbocharger	Repair/Replace
	Defective fuel injection pump	Adjust/Repair/Replace
	Poor compression	Measure/Engine revision
Charge air is not cooled	Check/Repair	
<b>Output voltage is too high:</b>	Capacitive load	Eliminate consumer load
	Defective AVR	Check/Repair/Replace
	Voltage potentiometer is not adjusted	Adjust AVR potentiometer
<b>Unstable output voltage:</b>	Defective AVR	Check/Repair/Replace
	Engine speed is variable	Adjust engine speed
	Stability potentiometer is not adjusted	Adjust STAB potentiometer
<b>Blue smoke from exhaust:</b>	Oil specification is not suitable	Replace with suitable oil
	Excessive lubricating oil	Replace
	Excessive oil consumption	Check/Engine revision
	Engine mechanical fault (piston, piston rings etc)	Engine revision
	Low load or no load operation	Load higher than 30%
	Poor compression	Measure/Engine revision
<b>White smoke from exhaust:</b>	Engine is too cold	Warm up ambient/Engine
	Defective engine thermostat	Check/Replace
	Fuel specification is not suitable	Replace with suitable fuel
	Problem in cold start system	Check/Repair
	Defective injectors	Adjust/Replace
	Defective fuel injection pump	Adjust/Repair/Replace
<b>Black smoke from exhaust:</b>	Over-load	Decrease load level
	Wrong valve tip clearance	Adjust
	Defective injectors	Adjust/Replace
	Oil specification is not suitable	Replace with suitable oil
	Defective manual fuel lift pump	Repair/Replace
	Defective fuel injection pump	Adjust/Repair/Replace
	Clogged air filter	Replace
	Inadequate fresh air inlet	Make it suitable
	Poor compression	Measure/Engine revision
	Charge air is not cooled	Check/Repair

## **11. WARRANTY**

### **11.1 GENERAL**

Universal Generator products are under warranty in accordance with the conditions specified in the warranty procedure.

In order for your generator set to receive warranty service within the warranty period and not to be out of warranty, be careful to use it in accordance with the warranty procedures.

Keep the delivery note, invoice, warranty document and service record forms of your generator set. Record the periodic maintenance applied to your generator set in the "service tracking schedule". These documents must be presented when requested.

This warranty procedure is valid within the borders of Turkey and covers "real or legal persons who acquire the generator set for non-commercial or non-professional purposes" in accordance with the consumer definition in Law No. 4077.

### **11.2 WARRANTY CONDITIONS**

1. The warranty period starts from the date of ex-factory delivery of the generator set and is 2 years/1000 working hours. Whichever comes first is the determining period.
2. The entire product, including all its parts, is under the warranty of Universal Generator against manufacturing and product defects.
3. If the product malfunctions during the warranty period, the time spent in repair will be added to the warranty period.
4. The maximum repair period for the product is 30 working days. This period starts from the date of notification of the product's malfunction to the service station, or to one of the seller, dealer, agency, representative, importer or manufacturer/producer of the product if there is no service station. If the malfunction of the product is not repaired within 30 working days, the manufacturer, producer or importer must allocate another product with similar features to the consumer's use until the repair of the product is completed.
5. If the product malfunctions due to material, workmanship or assembly errors during the warranty period, it will be repaired without any charge for labor costs, replaced parts or any other fee.
6. Although the consumer exercises his/her right to repair the product;
  - a) The same fault reoccurring more than twice within 1 year, different faults occurring more than four times or the total of different faults occurring more than six times within the specified warranty period, as well as the failure to benefit from the product due to these faults, provided that the product is within the specified warranty period,
  - b) Exceeding the maximum time required for repair,
  - c) If the company does not have a service station, and it is determined by a report prepared by one of the seller, dealer, agency, representative, importer or manufacturer, that the fault cannot be repaired, the consumer may request a refund for the free replacement of the goods or a discount in proportion to the defect.
7. Malfunctions resulting from the use of the product contrary to the matters stated in the user manual are not covered by the warranty.
8. For any problems that may arise regarding the warranty certificate, you can apply to the General Directorate for the Protection of Consumers and Competition of the Ministry of Industry and Trade.

### **11.2 LIMITATIONS**

1. The Warranty Certificate without the seller's stamp and signature, sales date, invoice number and manufacturer's stamp is invalid.
2. The warranty is invalid on the date the Warranty Certificate is tampered with, the original serial number on the product is removed or tampered with.
3. Damages and malfunctions that may occur during loading, unloading and shipping after the product is delivered to the consumer are not covered by the warranty.
4. Damages and malfunctions caused by the device not using original spare parts are not covered by the warranty.
5. Malfunctions caused by natural events (lightning, flood, inundation, earthquake, fire, etc.) are not covered by the warranty.
6. Parts caused by network errors are not covered by the warranty.

### **11.3 CLAIM SUBMISSIONS**

1. Warranty service requests can be made to the authorized technical service that commissioned the generator set or to the Universal Generator support line.
2. During the notification, providing information about the generator set model, serial number, operating hours and the nature of the fault will allow you to receive a faster solution.
3. Warranty applications must be made within 5 working days from the date of the incident. Warranty applications made after the warranty period has expired will not be accepted.
4. If requested, the customer is obliged to prove the validity of the warranty by presenting all necessary documents.

PRODUCER'S			
NAME	ÜNİVERSAL JENERATÖR SANAYİ VE TİCARET LİMİTED ŞİRKETİ		
HEAD OFFICE	DUDULLU OSB MAH. DES 1 CAD. DES TİCARET MERKEZİ NO:3 D:17 ÜMRANİYE/İSTANBUL	PHONE(S)	+90 (216) 540 41 80 +90 (216) 540 41 90
FACTORY	ASO 283 OSB – ALCI OSB MAH. 2031. CAD. NO:30 SİNCAN/ANKARA	PHONE(S)	+90 (312) 640 10 60 +90 (312) 640 10 72
WEB	www.universal.com.tr		
E-MAIL	info@universal.com.tr		

DIESEL GENERATOR			
GENSET MODEL		GENSET SERIAL NO	
ENGINE MODEL		ENGINE SERIAL NO	
ALTERNATOR MODEL		ALTERNATOR SERIAL NO	

DEALER'S	
NAME	
ADDRESS	
PHONE	
DELIVERY LOCATION	
DELIVERY DATE	
STAMP & SIGN	

BUYER'S	
NAME	
ADDRESS	
PHONE	
SIGN	

### **WHICH CRITERIA SHOULD WE SELECT OIL?**

#### **5W-30:**

Thin and highly fluid, ideal for modern engines in cold climates. Provides excellent fuel economy and lubrication in cold temperatures.

#### **5W-40:**

Offers a slightly thicker consistency than 5W-30 at high temperatures. Suitable for engines operating in variable temperature conditions.

#### **10W-40:**

Oils thicker than 5W at cold temperatures make them slightly less ideal for freezing climates. Provides good protection for high-performance and older engines.

#### **15W-40:**

Heavier and more stable under heat, preferred in diesel engines and heavy vehicles. Performs well in hot climates.

#### **20W-50:**

Ideal for extreme heat conditions and older high-mile engines, the thickest oil in the visual. Provides strong protection against wear in high-stress conditions.

### **HOW IS MOTOR OIL SELECTION IN THE WORLD?**

#### **5W-30 and 5W-40:**

Most suitable for modern cars operating in cold climates or variable conditions.

#### **10W-40 and 15W-40:**

Popular options for older vehicles, diesel engines and hotter environments.

#### **20W-50:**


Ideal for older cars, high mileage engines or regions with excessive heat.

### **VISCOSITY IN MOTOR OIL**

VISCOSITY; is a term used for all liquids that expresses "RESISTANCE TO FLOW" and expresses the thickness of the oil. The purpose of using motor oils is to reduce friction of engine parts, prevent wear and provide heat insulation. Since oils with high viscosity are not fluid enough in cold weather, they cannot reach every part of the engine and protect the engine from wear. Low viscosity oils become thinner and deformed in hot weather.

### **LONG-TERM USE OF ENGINE OIL;**

The type of oil, its viscosity, the type of engine used, its type, operating temperature, pressure, cooling system, cleanliness, engine operating hours, replacement and waiting times are determined.



UNIVERSAL JENERATOR SAN. VE TİC. LTD. ŞTİ.  
ALCI OSB MAH. ASO 2&3 ORGANİZE SANAYİ BÖLGESİ  
2031. CADDE NO:30  
SİNCAN - ANKARA / TÜRKİYE