

# OPERATION MANUAL



## **WHISPERWATT™ SERIES MODEL DCA15SPXU4F 60Hz GENERATOR (KUBOTA D1503-M DIESEL ENGINE)**

Revision #2 (01/24/18)

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**THIS MANUAL MUST ACCOMPANY THE EQUIPMENT AT ALL TIMES.**

|                                                                                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>WARNING</b>  |
| <b>CALIFORNIA — Proposition 65 Warning</b>                                                                                                                                           |
| Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.                                  |

## **DCA15SPXU4F 60 Hz Generator**

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### **NOTICE**

Specifications are subject to change without notice.

## SAFETY INFORMATION

Do not operate or service the equipment before reading the entire manual. Safety precautions should be followed at all times when operating this equipment. Failure to read and understand the safety messages and operating instructions could result in injury to yourself and others.

### SAFETY MESSAGES

The four safety messages shown below will inform you about potential hazards that could injure you or others. The safety messages specifically address the level of exposure to the operator and are preceded by one of four words: **DANGER**, **WARNING**, **CAUTION** or **NOTICE**.

### SAFETY SYMBOLS

#### **DANGER**

Indicates a hazardous situation which, if not avoided, **WILL** result in **DEATH** or **SERIOUS INJURY**.

#### **WARNING**

Indicates a hazardous situation which, if not avoided, **COULD** result in **DEATH** or **SERIOUS INJURY**.

#### **CAUTION**

Indicates a hazardous situation which, if not avoided, **COULD** result in **MINOR** or **MODERATE INJURY**.

#### **NOTICE**

Addresses practices not related to personal injury.

Potential hazards associated with the operation of this equipment will be referenced with hazard symbols which may appear throughout this manual in conjunction with safety messages.

| Symbol                                                                              | Safety Hazard              |
|-------------------------------------------------------------------------------------|----------------------------|
|    | Lethal exhaust gas hazards |
|    | Explosive fuel hazards     |
|    | Burn hazards               |
|   | Overspeed hazards          |
|  | Rotating parts hazards     |
|  | Pressurized fluid hazards  |
|  | Electric shock hazards     |

# SAFETY INFORMATION

## GENERAL SAFETY

### CAUTION

- **NEVER** operate this equipment without proper protective clothing, shatterproof glasses, respiratory protection, hearing protection, steel-toed boots and other protective devices required by the job or city and state regulations.



- **NEVER** operate this equipment when not feeling well due to fatigue, illness or when under medication.



- **NEVER** operate this equipment under the influence of drugs or alcohol.



- **ALWAYS** check the equipment for loosened threads or bolts before starting.
- **DO NOT** use the equipment for any purpose other than its intended purposes or applications.

### NOTICE

- This equipment should only be operated by trained and qualified personnel 18 years of age and older.
- Whenever necessary, replace nameplate, operation and safety decals when they become difficult read.
- Manufacturer does not assume responsibility for any accident due to equipment modifications. Unauthorized equipment modification will void all warranties.

- **NEVER** use accessories or attachments that are not recommended by MQ Power for this equipment. Damage to the equipment and/or injury to user may result.

- **ALWAYS** know the location of the nearest fire extinguisher.



- **ALWAYS** know the location of the nearest first aid kit.



- **ALWAYS** know the location of the nearest phone or **keep a phone on the job site**. Also, know the phone numbers of the nearest **ambulance, doctor** and **fire department**. This information will be invaluable in the case of an emergency.



## GENERATOR SAFETY

### DANGER

- **NEVER** operate the equipment in an explosive atmosphere or near combustible materials. An explosion or fire could result causing severe **bodily harm or even death**.



### WARNING

- **NEVER** disconnect any **emergency or safety devices**. These devices are intended for operator safety. Disconnection of these devices can cause severe injury, bodily harm or even death. Disconnection of any of these devices will void all warranties.

### CAUTION

- **NEVER** lubricate components or attempt service on a running machine.

### NOTICE

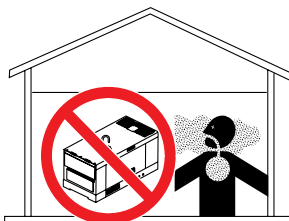
- **ALWAYS** ensure generator is on level ground before use.
- **ALWAYS** keep the machine in proper running condition.
- Fix damage to machine and replace any broken parts immediately.
- **ALWAYS** store equipment properly when it is not being used. Equipment should be stored in a clean, dry location out of the reach of children and unauthorized personnel

# SAFETY INFORMATION

## ENGINE SAFETY

### DANGER

- The engine fuel exhaust gases contain poisonous carbon monoxide. This gas is colorless and odorless, and can cause death if inhaled.
- The engine of this equipment requires an adequate free flow of cooling air. **NEVER** operate this equipment in any enclosed or narrow area where free flow of the air is restricted. If the air flow is restricted it will cause injury to people and property and serious damage to the equipment or engine.



### WARNING

- **DO NOT** place hands or fingers inside engine compartment when engine is running.
- **NEVER** operate the engine with heat shields or guards removed.
- Keep fingers, hands hair and clothing away from all moving parts to prevent injury.
- **DO NOT** remove the radiator cap while the engine is hot. High pressure boiling water will gush out of the radiator and severely scald any persons in the general area of the generator.
- **DO NOT** remove the coolant drain plug while the engine is hot. Hot coolant will gush out of the coolant tank and severely scald any persons in the general area of the generator.
- **DO NOT** remove the engine oil drain plug while the engine is hot. Hot oil will gush out of the oil tank and severely scald any persons in the general area of the generator.



### CAUTION

- **NEVER** touch the hot exhaust manifold, muffler or cylinder. Allow these parts to cool before servicing equipment.



## NOTICE

- **NEVER** run engine without an air filter or with a dirty air filter. Severe engine damage may occur. Service air filter frequently to prevent engine malfunction.
- **NEVER** tamper with the factory settings of the engine or engine governor. Damage to the engine or equipment can result if operating in speed ranges above the maximum allowable.
- Wet stacking is a common problem with diesel engines which are operated for extended periods with light or no load applied. When a diesel engine operates without sufficient load (less than 40% of the rated output), it will not operate at its optimum temperature. This will allow unburned fuel to accumulate in the exhaust system, which can foul the fuel injectors, engine valves and exhaust system, including turbochargers, and reduce the operating performance.



In order for a diesel engine to operate at peak efficiency, it must be able to provide fuel and air in the proper ratio and at a high enough engine temperature for the engine to completely burn all of the fuel.

Wet stacking does not usually cause any permanent damage and can be alleviated if additional load is applied to relieve the condition. It can reduce the system performance and increase maintenance. Applying an increasing load over a period of time until the excess fuel is burned off and the system capacity is reached usually can repair the condition. This can take several hours to burn off the accumulated unburned fuel.

- State Health Safety Codes and Public Resources Codes specify that in certain locations, spark arresters must be used on internal combustion engines that use hydrocarbon fuels. A spark arrester is a device designed to prevent accidental discharge of sparks or flames from the engine exhaust. Spark arresters are qualified and rated by the United States Forest Service for this purpose. In order to comply with local laws regarding spark arresters, consult the engine distributor or the local Health and Safety Administrator.

# SAFETY INFORMATION

## FUEL SAFETY



- **DO NOT** start the engine near spilled fuel or combustible fluids. Diesel fuel is extremely flammable and its vapors can cause an explosion if ignited.
- **ALWAYS** refuel in a well-ventilated area, away from sparks and open flames.
- **ALWAYS** use extreme caution when working with **flammable** liquids.
- **DO NOT** fill the fuel tank while the engine is running or hot.
- **DO NOT** overfill tank, since spilled fuel could ignite if it comes into contact with hot engine parts or sparks from the ignition system.
- Store fuel in appropriate containers, in well-ventilated areas and away from sparks and flames.
- **NEVER** use fuel as a cleaning agent.
- **DO NOT** smoke around or near the equipment. Fire or explosion could result from fuel vapors or if fuel is spilled on a hot engine.



## TOWING SAFETY



- Check with your local county or state safety towing regulations, in addition to meeting **Department of Transportation (DOT) Safety Towing Regulations**, before towing your generator.
- Refer to MQ Power trailer manual for additional safety information.
- In order to reduce the possibility of an accident while transporting the generator on public roads, **ALWAYS** make sure the trailer that supports the generator and the towing vehicle are mechanically sound and in good operating condition.
- **ALWAYS** shutdown engine before transporting



- Make sure the hitch and coupling of the towing vehicle are rated equal to, or greater than the trailer “gross vehicle weight rating.”
- **ALWAYS** inspect the hitch and coupling for wear. **NEVER** tow a trailer with defective hitches, couplings, chains, etc.
- Check the tire air pressure on both towing vehicle and trailer. **Trailer tires should be inflated to 50 psi cold.** Also check the tire tread wear on both vehicles.
- **ALWAYS** make sure the trailer is equipped with a **safety chain**.
- **ALWAYS** properly attach trailer’s safety chains to towing vehicle.
- **ALWAYS** make sure the vehicle and trailer directional, backup, brake and trailer lights are connected and working properly.
- DOT Requirements include the following:
  - Connect and test electric brake operation.
  - Secure portable power cables in cable tray with tie wraps.
- The maximum speed for highway towing is **55 MPH** unless posted otherwise. Recommended off-road towing is not to exceed **15 MPH** or less depending on type of terrain.
- Avoid sudden stops and starts. This can cause skidding, or jack-knifing. Smooth, gradual starts and stops will improve towing.
- Avoid sharp turns to prevent rolling.
- Trailer should be adjusted to a level position at all times when towing.
- Raise and lock trailer wheel stand in up position when towing.
- Place **chock blocks** underneath wheel to prevent **rolling** while parked.
- Place **support blocks** underneath the trailer’s bumper to prevent **tipping** while parked.
- Use the trailer’s swivel jack to adjust the trailer height to a level position while parked.

# SAFETY INFORMATION

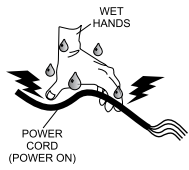
## ELECTRICAL SAFETY

### DANGER

- **DO NOT** touch output terminals during operation. Contact with output terminals during operation can cause **electrocution, electrical shock or burn.** 
- The electrical voltage required to operate the generator can cause severe injury or even death through physical contact with live circuits. Turn generator and all circuit breakers **OFF** before performing maintenance on the generator or making contact with output terminals.
- **NEVER** insert any objects into the output receptacles during operation. This is extremely dangerous. The possibility exists of **electrical shock, electrocution or death.** 
- Backfeed to a utility system can cause **electrocution** and/or property damage. **NEVER** connect the generator to a building's electrical system without a transfer switch or other approved device. All installations should be performed by a **licensed electrician** in accordance with all applicable laws and electrical codes. Failure to do so could result in electrical shock or burn, causing **serious injury or even death.** 

## Power Cord/Cable Safety

### DANGER

- **NEVER** let power cords or cables **lay in water.**
- **NEVER stand in water** while AC power from the generator is being transferred to a load.
- **NEVER** use **damaged** or **worn** cables or cords when connecting equipment to generator. Inspect for cuts in the insulation.
- **NEVER** grab or touch a live power cord or cable with wet hands. The possibility exists of **electrical shock, electrocution or death.** 

- Make sure power cables are securely connected to the generator's output receptacles. Incorrect connections may cause electrical shock and damage to the generator.

### NOTICE

- **ALWAYS** make certain that proper power or extension cord has been selected for the job. See Cable Selection Chart in this manual.

## Grounding Safety

### DANGER

- **ALWAYS** make sure that electrical circuits are properly grounded to a suitable earth ground (ground rod) per the National Electrical Code (NEC) and local codes before operating generator. **Severe injury or death by electrocution** can result from operating an ungrounded generator.
- **NEVER** use gas piping as an electrical ground.

## BATTERY SAFETY

### DANGER

- **DO NOT** drop the battery. There is a possibility that the battery will explode.
- **DO NOT** expose the battery to open flames, sparks, cigarettes, etc. The battery contains combustible gases and liquids. If these gases and liquids come into contact with a flame or spark, an explosion could occur. 

### WARNING

- **ALWAYS** wear safety glasses when handling the battery to avoid eye irritation. The battery contains acids that can cause injury to the eyes and skin. 
- Use well-insulated gloves when picking up the battery.
- **ALWAYS** keep the battery charged. If the battery is not charged, combustible gas will build up.
- **ALWAYS** recharge the battery in a well-ventilated environment to avoid the risk of a dangerous concentration of combustible gasses.

# SAFETY INFORMATION

- If the battery liquid (dilute sulfuric acid) comes into contact with **clothing or skin**, rinse skin or clothing immediately with plenty of water.
- If the battery liquid (dilute sulfuric acid) comes into contact with **eyes**, rinse eyes immediately with plenty of water and contact the nearest doctor or hospital to seek medical attention.

## ⚠ CAUTION

- **ALWAYS** disconnect the **NEGATIVE battery terminal** before performing service on the generator.
- **ALWAYS** keep battery cables in good working condition. Repair or replace all worn cables.

## ENVIRONMENTAL SAFETY/DECOMMISSIONING

### NOTICE

Decommissioning is a controlled process used to safely retire a piece of equipment that is no longer serviceable. If the equipment poses an unacceptable and unrepairable safety risk due to wear or damage or is no longer cost effective to maintain (beyond life-cycle reliability) and is to be decommissioned (demolition and dismantlement), be sure to follow rules below.

- **DO NOT** pour waste or oil directly onto the ground, down a drain or into any water source.
- Contact your country's Department of Public Works or recycling agency in your area and arrange for proper disposal of any electrical components, waste or oil associated with this equipment.
- When the life cycle of this equipment is over, remove battery and bring to appropriate facility for lead reclamation. Use safety precautions when handling batteries that contain sulfuric acid.
- When the life cycle of this equipment is over, it is recommended that the trowel frame and all other metal parts be sent to a recycling center.



Metal recycling involves the collection of metal from discarded products and its transformation into raw materials to use in manufacturing a new product.

Recyclers and manufacturers alike promote the process of recycling metal. Using a metal recycling center promotes energy cost savings.

## EMISSIONS INFORMATION

### NOTICE

The diesel engine used in this equipment has been designed to reduce harmful levels of carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NOx) contained in diesel exhaust emissions.

This engine has been certified to meet US EPA Evaporative emissions requirements in the installed configuration.

Attempting to modify or make adjustments to the engine emission system by unauthorized personnel without proper training could damage the equipment or create an unsafe condition.

Additionally, modifying the fuel system may adversely affect evaporative emissions, resulting in fines or other penalties.

### Emission Control Label

The emission control label is an integral part of the emission system and is strictly controlled by regulations.

The label must remain with the engine for its entire life.

If a replacement emission label is needed, please contact your authorized engine distributor.

# SPECIFICATIONS

**Table 1. Generator Specifications**

|                                                                       |                                                                 |
|-----------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Model</b>                                                          | DCA15SPXU4F                                                     |
| <b>Type</b>                                                           | Revolving field, self ventilated,<br>Drip-proof, single bearing |
| <b>Armature Connection</b>                                            | Series                                                          |
| <b>Phase</b>                                                          | 1Ø                                                              |
| <b>Standby Output</b>                                                 | 14.7 kW (14.7 kVA)                                              |
| <b>Prime Output</b>                                                   | 14 kW (14 kVA)                                                  |
| <b>1Ø Voltage (L-L/L-N)<br/>Voltage Selector Switch at 1Ø 240/120</b> | 120/240                                                         |
| <b>Power Factor</b>                                                   | 1.0                                                             |
| <b>Frequency</b>                                                      | 60 Hz                                                           |
| <b>Speed</b>                                                          | 1800 rpm                                                        |
| <b>Aux. AC Power</b>                                                  | Single Phase, 60 Hz                                             |
| <b>Aux. Voltage/Output</b>                                            | 4.8 Kw (2.4 kW x 2)                                             |
| <b>Dry Weight (Approx.)</b>                                           | 1,179 lbs. (535 kg))                                            |
| <b>Wet Weight (Approx.)</b>                                           | 1,367 lbs. (620 kg)                                             |

**Table 2. Engine Specifications**

|                             |                                                      |                                         |
|-----------------------------|------------------------------------------------------|-----------------------------------------|
| <b>Model</b>                | Kubota D1503M Tier 4                                 |                                         |
| <b>Type</b>                 | 4-Cycle, water-cooled, swirl combustion chamber type |                                         |
| <b>No. of Cylinders</b>     | 3 cylinders                                          |                                         |
| <b>Bore x Stroke</b>        | 3.23 in. x 3.63 in. (83 mm x 92.4 mm)                |                                         |
| <b>Displacement</b>         | 91.47cu. in. (1.5 liter)                             |                                         |
| <b>Rated Output</b>         | 18.4 HP at 1800 rpm                                  |                                         |
| <b>Starting</b>             | Electric                                             |                                         |
| <b>Coolant Capacity</b>     | 1.85 gal. (7.0 liters) <sup>1</sup>                  |                                         |
| <b>Lube Oil Capacity</b>    | 1.48 gal. (5.6 liters) <sup>2</sup>                  |                                         |
| <b>Lubricating Type Oil</b> | SAE30/SAE20/SAE10                                    |                                         |
| <b>Fuel Type</b>            | ASTM-D975-No.1/No.2-D/Ultra Low Sulfur Diesel Fuel   |                                         |
| <b>Fuel Tank Capacity</b>   | 16.4 gal. (62 liters)                                |                                         |
| <b>Fuel Consumption</b>     | 1.09 gal. (4.1 L)/hr at <b>full load</b>             | 0.80 gal. (3.0 L)/hr at <b>3/4 load</b> |
|                             | 0.64 gal. (2.4 L)/hr at <b>1/2 load</b>              | 0.41 gal. (1.6 L)/hr at <b>1/4 load</b> |
| <b>Battery</b>              | 12V 70Ah X 1                                         |                                         |

<sup>1</sup> Includes engine and radiator hoses

<sup>2</sup> Includes filters

# DIMENSIONS

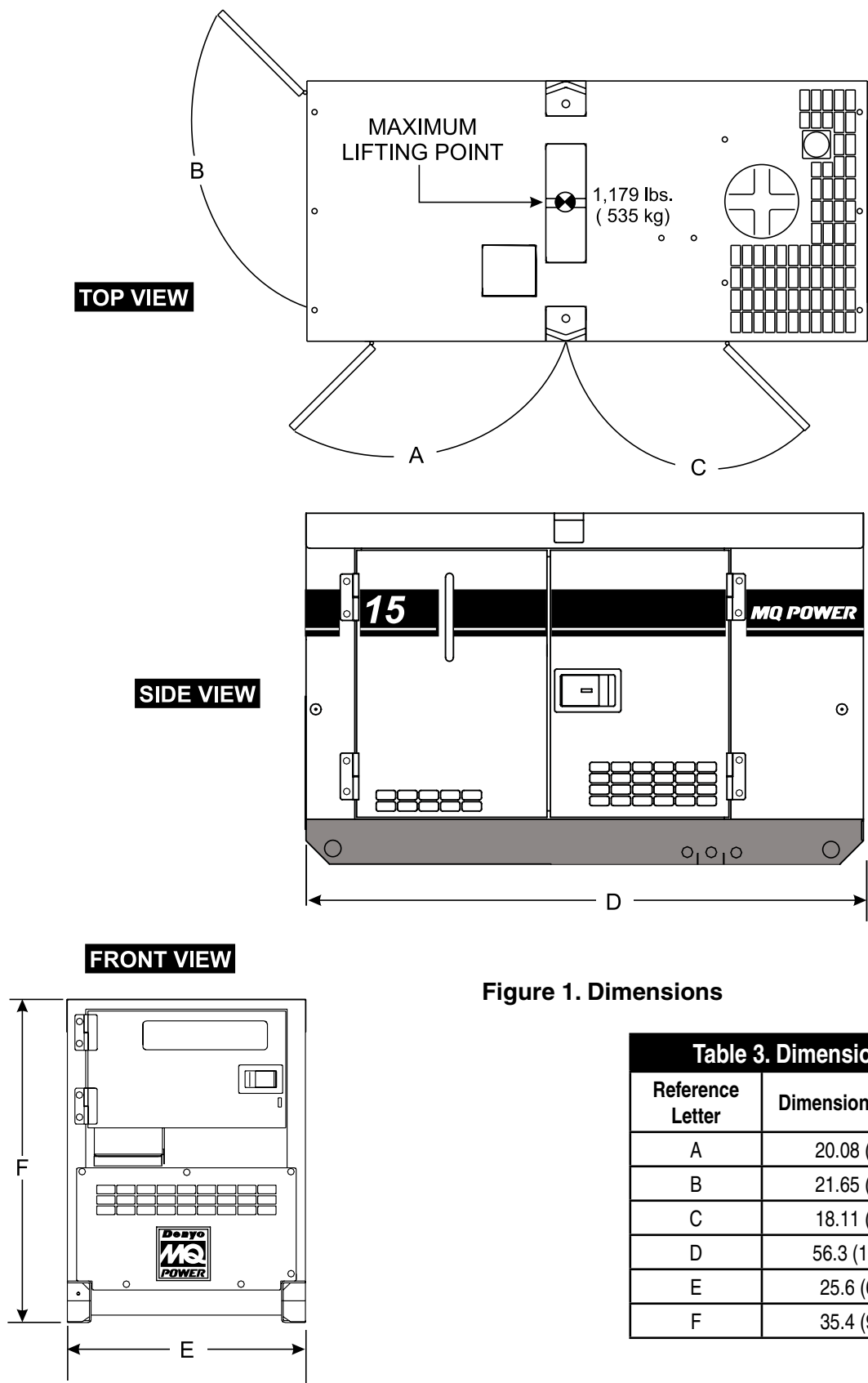


Figure 1. Dimensions

| Table 3. Dimensions |                    |
|---------------------|--------------------|
| Reference Letter    | Dimension in. (mm) |
| A                   | 20.08 (510)        |
| B                   | 21.65 (550)        |
| C                   | 18.11 (460)        |
| D                   | 56.3 (1,430)       |
| E                   | 25.6 (650)         |
| F                   | 35.4 (900)         |

# INSTALLATION

## CONNECTING THE GROUND

Consult with local Electrical and Safety Codes for proper connection based on condition of use.

### EXAMPLE of how to ground the unit if the condition of use requires such a device:

The ground terminal on the generator should always be used to connect the generator to a suitable ground when required.

The ground cable should be #8 size wire (aluminum) minimum. If copper wire is used, #10 size wire minimum should be used.

Connect one end of the ground cable terminal to the generator ground point (Figure 2). Connect the other end of the ground cable to a suitable earth ground (ground rod).

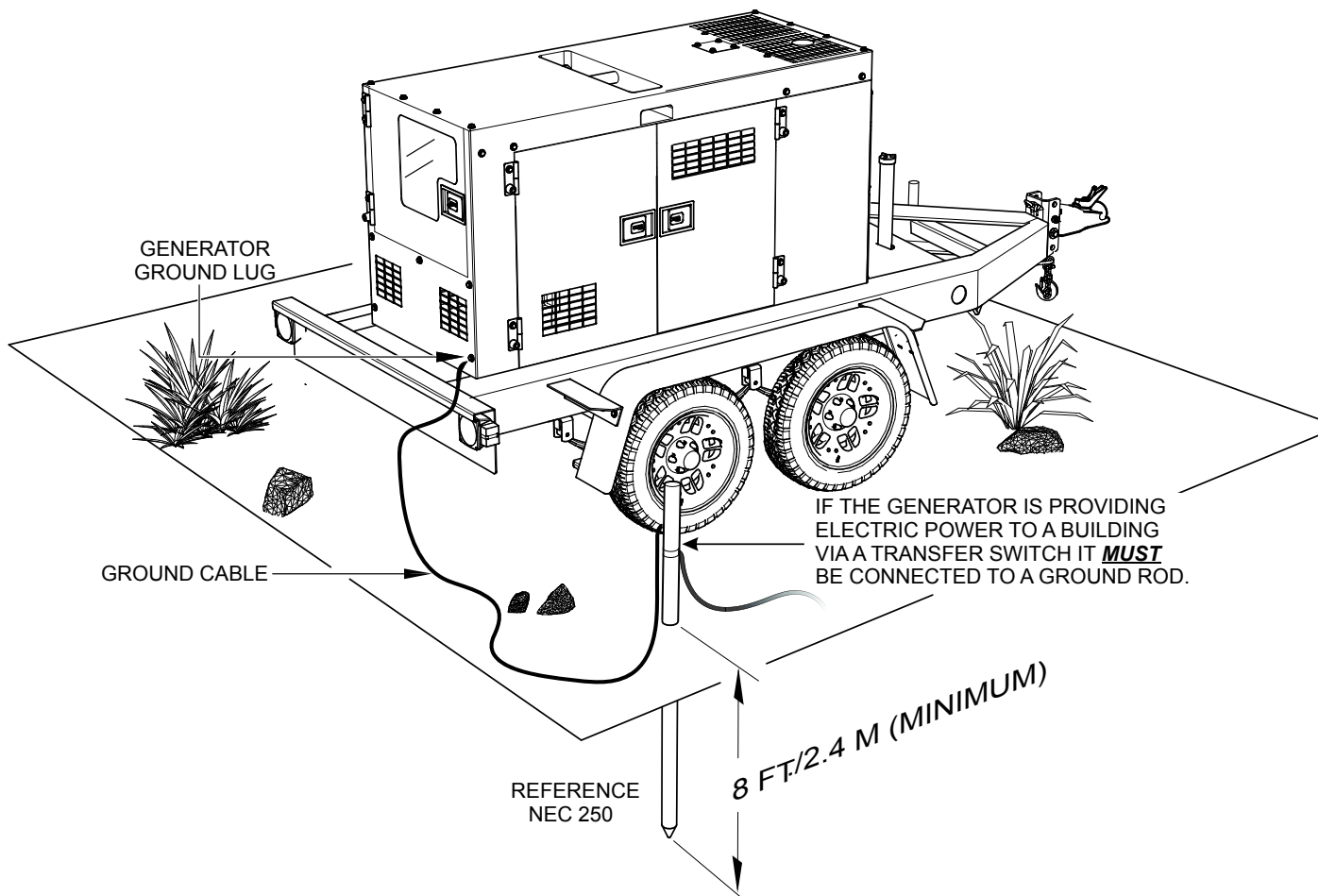


Figure 2. Typical Generator Grounding Application

## OUTDOOR INSTALLATION

Install the generator in a area that is free of debris, bystanders, and overhead obstructions. Make sure the generator is on secure level ground so that it cannot slide or shift around. Also install the generator in a manner so that the exhaust will not be discharged in the direction of nearby homes.

The installation site must be relatively free from moisture and dust. All electrical equipment should be protected from excessive moisture. Failure to do will result in deterioration of the insulation and will result in short circuits and grounding.

Foreign materials such as dust, sand, lint and abrasive materials have a tendency to cause excessive wear to engine and alternator parts.

### CAUTION

Pay close attention to ventilation when operating the generator inside tunnels and caves. The engine exhaust contains noxious elements. Engine exhaust must be routed to a ventilated area.

## INDOOR INSTALLATION

Exhaust gases from diesel engines are extremely poisonous. Whenever an engine is installed indoors the exhaust fumes must be vented to the outside. The engine should be installed at least two feet from any outside wall. Using an exhaust pipe which is too long or too small can cause excessive back pressure which will cause the engine to heat excessively and possibly burn the valves.

## MOUNTING

The generator must be mounted on a solid foundation such as concrete) and set firmly on the foundation to isolate vibration of the generator when it is running. The generator must set at least 6 inches above the floor or grade level (in accordance to NFPA 110, Chapter 54.1). **DO NOT** remove the metal skids on the bottom of the generator. They are to resist damage to the bottom of the generator and to maintain alignment.

## GENERATOR GROUNDING

### NOTICE

The Occupational Safety and Health Administration (OSHA) and the National Electrical Code (NEC) recommend that if the generator is providing electrical power to a structure (home, office shop, trailer or similar) it **must** be connected to a grounding electrode system, such as driven ground rod (Figure 2).

If applicable, to guard against electrical shock and possible damage to the equipment, it is important to provide a good **EARTH** ground, (Figure 2).

### NOTICE

**ALWAYS** check with State, Province, District and Municipalities for electrical grounding requirements before using generator.

Article 250 (Grounding) of the NEC handbook provides guidelines for proper grounding and specifies that the cable ground shall be connected to the grounding system of the building as close to the point of cable entry as practical.

NEC article 250 specifies the following grounding requirements:

1. Use one of the following wire types to connect the generator to earth ground.
  - a. Copper 10 AWG (5.3 mm<sup>2</sup>) or larger.
  - b. Aluminum 8 AWG (8.4 mm<sup>2</sup>) or larger.
2. When grounding of the generator (Figure 2) is required, connect one end of the ground cable to the ground lug on the generator. Connect the other end of the ground cable to the ground rod (earth ground).
3. NEC article 250 specifies that the earth ground rod should be buried a minimum of 8 ft. into the ground.

### NOTICE

When connecting the generator to any buildings electrical system **ALWAYS** consult with a licensed electrician.

## GENERATOR

This generator (Figure 3) is designed as a high quality portable (requires a trailer for transport) power source for telecom sites, lighting facilities, power tools, submersible pumps and other industrial and construction machinery.

### CONTROL OPERATING PANEL

The "Operating Panel" is provided with the following:

- Engine Warning Lamp Unit Assembly
  - Pre-Hea Alarm Lamp
  - Oil Pressure Alarm Lamp
  - Water Temperature Alarm Lamp
  - Battery Charging Alarm Lamp
- Engine Speed Control Switch
- Frequency Meter (Hz)
- AC Ammeter (Amps)
- AC Voltmeter (Volts)
- Voltage Regulator
- Ignition/Starter Switch
- Hour Meter
- Voltage Regulator
- 3-Pole, 70 amp Main Circuit Breaker
- "Control Box" (Located Behind Control Panel)
  - Automatic Voltage Regulator
  - Current Transformer
  - Over-Current Relay
  - Starter Relay

### OUTPUT TERMINAL PANEL

The "Output Terminal Panel" is provided with the following:

- 3-pole 70 amp main circuit breaker
- 1-pole 20 amp breaker (for GFCI receptacle)
- 1-pole 30 amp breaker (for L5-30R receptacle)
- 2-pole 30 amp breaker (for L6-30R receptacle)
- 2-pole 50 amp breaker (for CS6369 receptacle)
- 120V output receptacle (GFCI)
- 120V output receptacle (L5-30R)
- 240V output receptacle (L6-30R)
- 120/240V output receptacle (CS6369)
- Three output terminal lugs (UNV, 1Ø power)
- Ground Terminal

### OUTPUT TERMINAL PANEL

- Battery Charger (Option)
- Engine Block Heating Element (Option)
- Emergency Stop Switch (Option)

## OPEN DELTA EXCITATION SYSTEM

Each generator is equipped with the state of the art "Open-Delta" excitation system. The open delta system consist of an electrically independent winding wound among stationary windings of the AC output section.

There are four connections of the open delta A, B, C and D. During steady state loads, the power from the voltage regulator is supplied from the parallel connections of A to B, A to D, and C to D. These three phases of the voltage input to the voltage regulator are then rectified and are the excitation current for the exciter section.

When a heavy load, such as a motor starting or a short circuit occurs, the automatic voltage regulator (AVR) switches the configuration of the open delta to the series connection of B to C. This has the effect of adding the voltages of each phase to provide higher excitation to the exciter section and thus better voltage response during the application of heavy loads.

The connections of the AVR to the AC output windings are for sensing only. No power is required from these windings. The open-delta design provides virtually unlimited excitation current, offering maximum motor starting capabilities. The excitation does not have a "fixed ceiling" and responds according the demands of the required load.

## ENGINE

This generator is powered by a 3 cylinder, 4-cycle, water cooled, swirl combustion chamber type Kubota D1503M diesel engine. This engine is designed to meet every performance requirement for the generator. Reference Table 2 for engine specifications.

In keeping with MQ Power's policy of constantly improving its products, the specifications quoted herein are subject to change without prior notice.

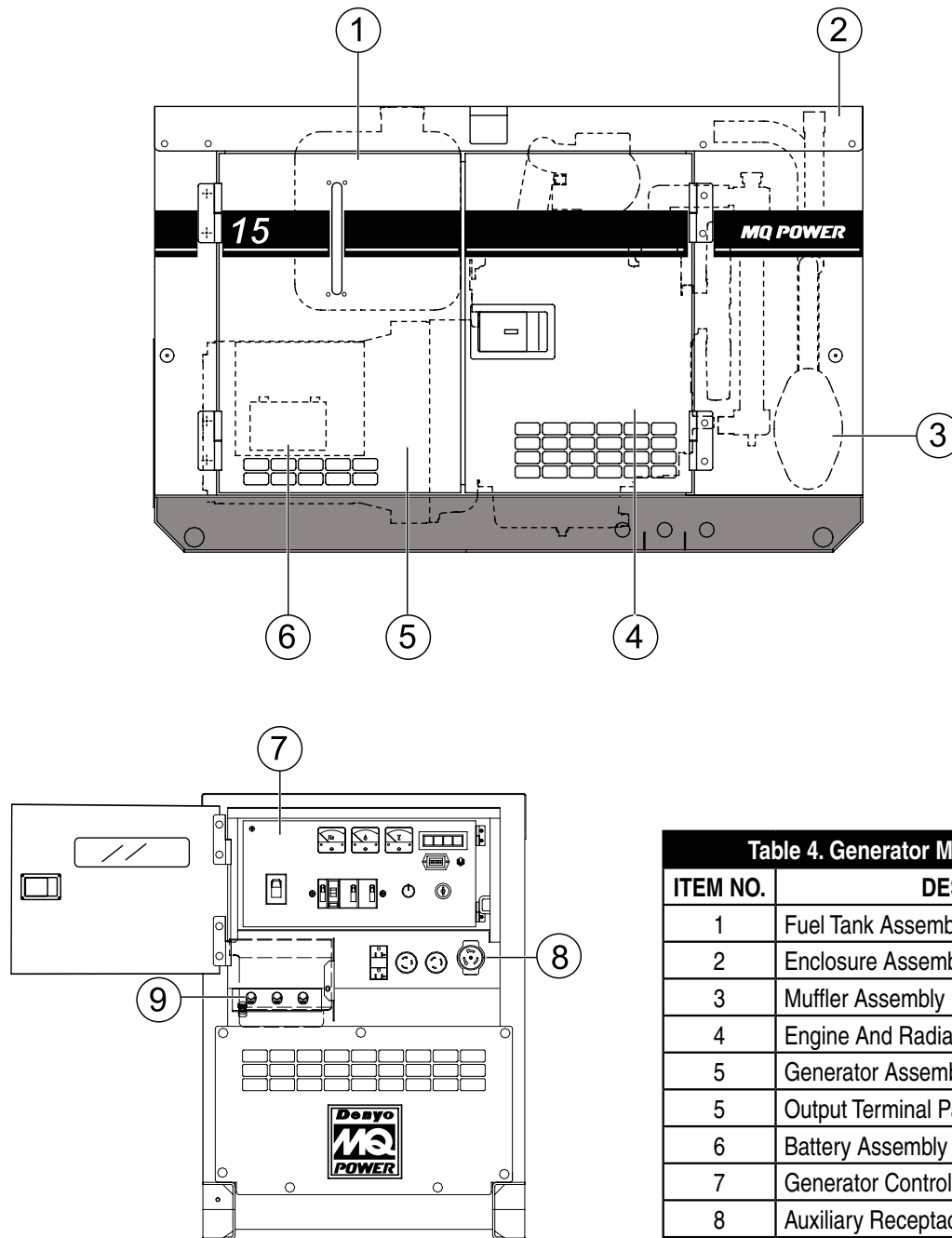
## ELECTRIC GOVERNOR SYSTEM

The electric governor system controls the RPMs of the engine. When the engine demand increases or decreases, the governor system regulates the frequency variation to  $\pm 0.25\%$ .

## EXTENSION CABLES

When electric power is to be provided to various tools or loads at some distance from the generator, extension cords are normally used. Cables should be sized to allow for distance in length and amperage so that the voltage drop between the generator and point of use (load) is held to a minimum. Use the cable selection chart (Table 6) as a guide for selecting proper extension cable size.

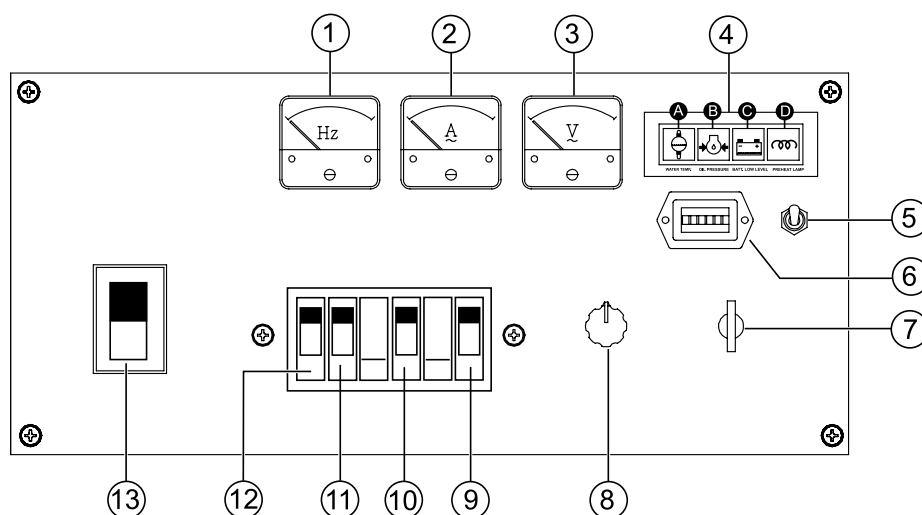
# MAJOR COMPONENTS



| Table 4. Generator Major Components |                                  |
|-------------------------------------|----------------------------------|
| ITEM NO.                            | DESCRIPTION                      |
| 1                                   | Fuel Tank Assembly               |
| 2                                   | Enclosure Assembly               |
| 3                                   | Muffler Assembly                 |
| 4                                   | Engine And Radiator Assembly     |
| 5                                   | Generator Assembly               |
| 5                                   | Output Terminal Panel Assembly   |
| 6                                   | Battery Assembly                 |
| 7                                   | Generator Control Panel Assembly |
| 8                                   | Auxiliary Receptacles Assembly   |
| 9                                   | Output Terminal Board (UNV)      |

**Figure 3. Major Components**

# ENGINE/GENERATOR CONTROL PANEL



**Figure 4. Engine/Generator Control Panel**

The definitions below describe the controls and functions of the Engine/Generator Control Panel (Figure 4).

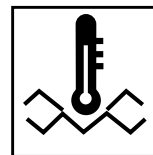
1. **Frequency Meter** — Indicates the output frequency in hertz (Hz). Normally 60 Hz.
2. **AC Ammeter** — Indicates the amount of current the load is drawing from the generator per leg selected by the ammeter phase-selector switch.
3. **AC Voltmeter** — Indicates the output voltage present at the **U, N and V Output Terminal Lugs**.
4. **Engine Warning Lamp Module** — This module displays the following engine alarms: oil pressure, water temperature, battery charging and pre-heat.

- A. **Low Oil Pressure Alarm Lamp** — During normal operation of the generator this lamp will remain OFF. When the ignition switch is placed in the RUN position to start the engine, the lamp will be ON. When the oil pressure rises after start-up the lamp will go OFF.

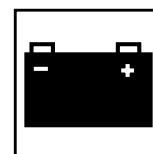


If this lamp is ever lit (**ON**) during normal operation of the generator, the emergency shutdown system will stop the engine automatically.

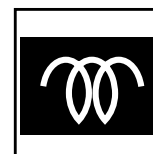
- B. **Water Temperature Alarm Lamp** — This lamp goes ON when the cooling water temperature rises abnormally. If the lamp goes ON during normal operation of the generator, the emergency shutdown system will stop the engine automatically.



- C. **Battery Charge Alarm Lamp** — This lamp is ON when the output voltage of the alternator drops below a set value. If this lamp is ON during normal operation, the emergency shutdown system will immediately stop the engine.



- D. **Pre-Heat Alarm Lamp** — The pre-heat lamp will be ON during the pre-heating cycle (cold weather conditions). When the pre-heat cycle is completed the lamp will turn OFF and the engine can be started. In addition this lamp displays engine trouble shooting faults via flashes (blinking). See engine trouble codes in the maintenance section of this manual.



## ENGINE/GENERATOR CONTROL PANEL

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5. **Engine Speed Switch** — This switch controls the speed of the engine low or high.
6. **Hour Meter** — Indicates amount of time generator has been in use.
7. **Ignition/Starter Switch** — Three position switch, stop, run and start. Insert ignition key to start and stop engine.
8. **Voltage Regulator Control** — Allows  $\pm 15\%$  manual adjustment of the generator's output voltage.
9. **Circuit Breaker** — Two-pole, 50 amp breaker, provided to protect the CS6369 receptacle.
10. **Circuit Breaker** — Two-pole, 30 amp breaker, provided to protect the L6-30R receptacle.
11. **Circuit Breaker** — Single-pole, 30 amp breaker, provided to protect the L5-30R receptacle.
12. **Circuit Breaker** — Single-pole, 20 amp breaker, provided to protect the GFCI receptacle.
13. **Main Circuit Breaker** — Three-pole, 70 amp main breaker, provided to protect the **U, N, and V** output terminal lugs from overload.

### NOTICE

Remember the **overcurrent relay** monitors the current flowing from the **U, N, and V output terminal lugs** to the load.

In the event of a short circuit or over current condition, it will automatically **trip** the 70 amp main breaker.

To restore power to the **output terminal panel**, press the reset button on the overcurrent relay and place the **main** circuit breaker in the **closed** position (**ON**).

# OUTPUT TERMINAL/CONTROL PANEL FAMILIARIZATION

## OUTPUT TERMINAL PANEL

The Output Terminal Panel (Figure 5) shown below is located on the left-hand side (below control panel) of the generator. Lift up on the cover to gain access output terminal lugs.

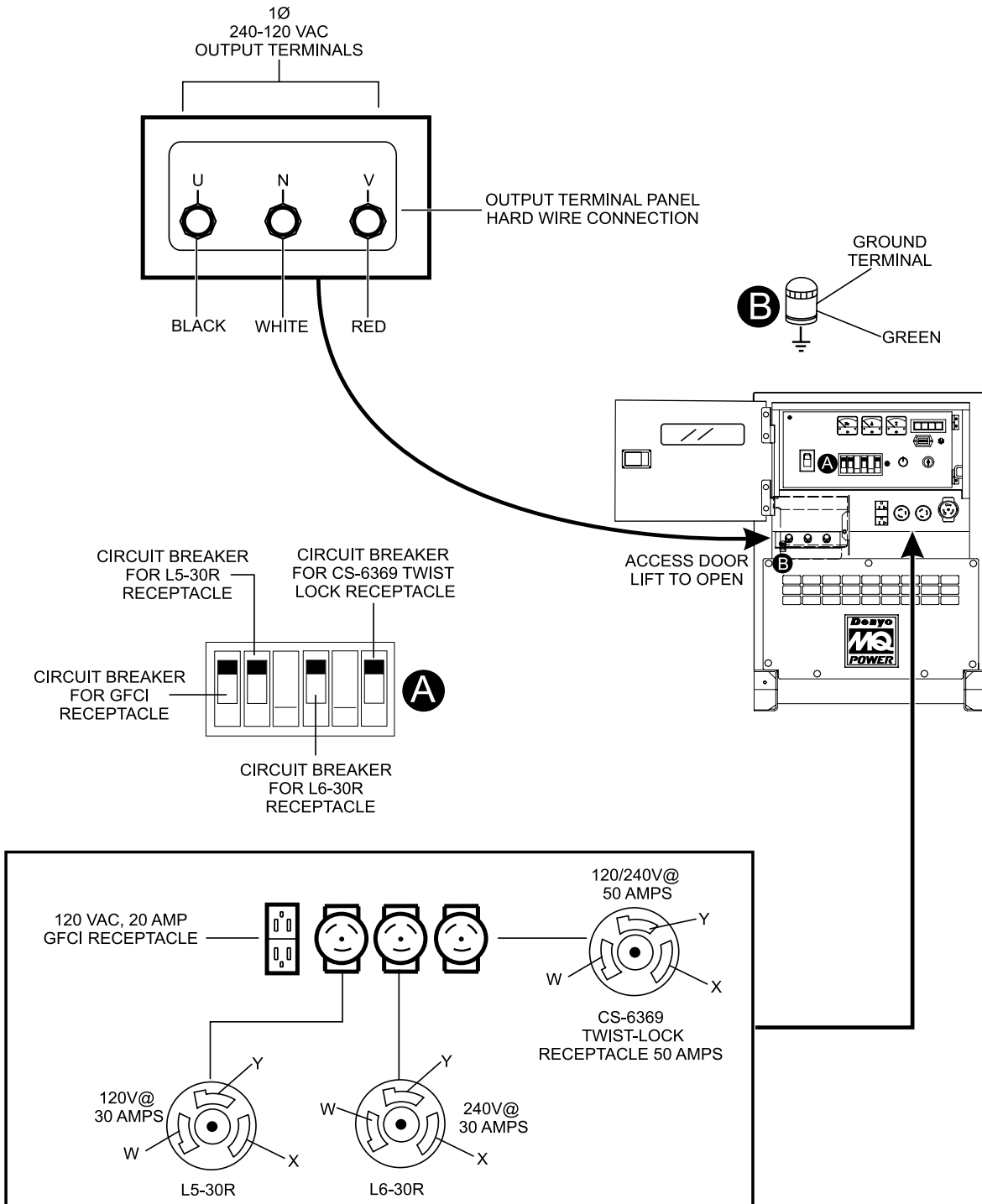


Figure 5. Output Terminal/Control Panel

# OUTPUT TERMINAL PANEL FAMILIARIZATION

## 120 VAC GFCI Receptacle

There is one 120 VAC, 20 amp GFCI (Duplex Nema 5-20R) receptacle provided on the output terminal panel. This receptacle is protected by a 20 amp circuit breaker. The breaker can be located on the control panel. Remember the load output (current) of both GFCI receptacles is dependent on the load requirements of the U, O, and V output terminal lugs.

Pressing the **reset** button resets the GFCI receptacle after being tripped. Pressing the **test button** (See Figure 6) in the center of the receptacle will check the GFCI function. Both receptacles should be tested at least once a month.

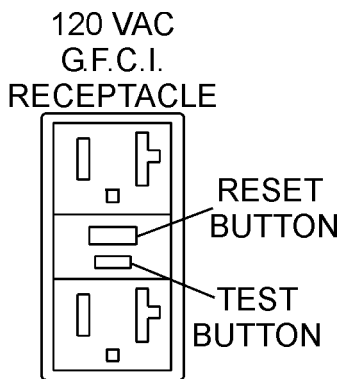


Figure 6. G.F.C.I. Receptacle

## Dual Voltage Twist Lock 120/240 VAC Receptacle

There is one 120/240V, 50 amp auxiliary twist-lock (CS-6369) receptacle (Figure 5) provided on the control panel. This receptacle can **only** be accessed when the main and associated circuit breaker are in the ON position.

### NOTICE

Remember the load output (current) on all **four** receptacles is dependent on the load requirements of the **output terminal lugs**.

## L6-30R Receptacle

There is one 240V, 30 amp auxiliary L6-30R receptacle (Figure 5) provided on the control panel. This receptacle can **only** be accessed when the main and associated circuit breaker are in the ON position.

## L5-30R Receptacle

There is one 120V, 30 amp auxiliary L5-30R receptacle (Figure 5) provided on the control panel. This receptacle can **only** be accessed when the main and associated circuit breaker are in the ON position.

## Voltage Regulator

Turn the **voltage regulator control knob** (Figure 7) on the control panel to obtain the desired voltage. Turning the knob clockwise will **increase** the voltage, turning the knob counter-clockwise will **decrease** the voltage.

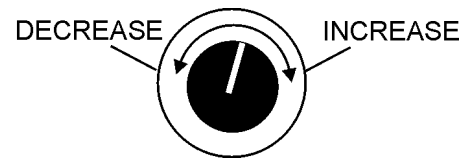


Figure 7. Voltage Regulator Control Knob

## UVO Output Terminal Access (Hard Wire Hookup Panel)

The **output terminal lugs** are protected by an insulated access cover (Figure 8). Remove the bolt that secures the access cover. Lift the access cover to gain access to the UVO output terminals.

After the load wires have been securely attached to the output terminal lugs, pull down down on the access cover and reinstall locking bolt.

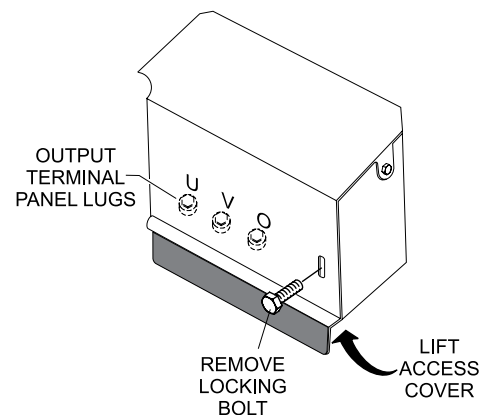


Figure 8. UVO Terminal Lugs Access Cover

# OUTPUT TERMINAL PANEL FAMILIARIZATION

## Connecting Loads

Loads can be connected to the generator by various methods, output terminal lugs, camlocks or the convenience receptacles (Figure 9). Make sure to read the operation manual before attempting to connect a load to the generator.

To protect the output terminals from overload, a 3-pole, 70A **main** circuit breaker is provided. Make sure to switch **ALL** circuit breakers to the **OFF** position prior to starting the engine.

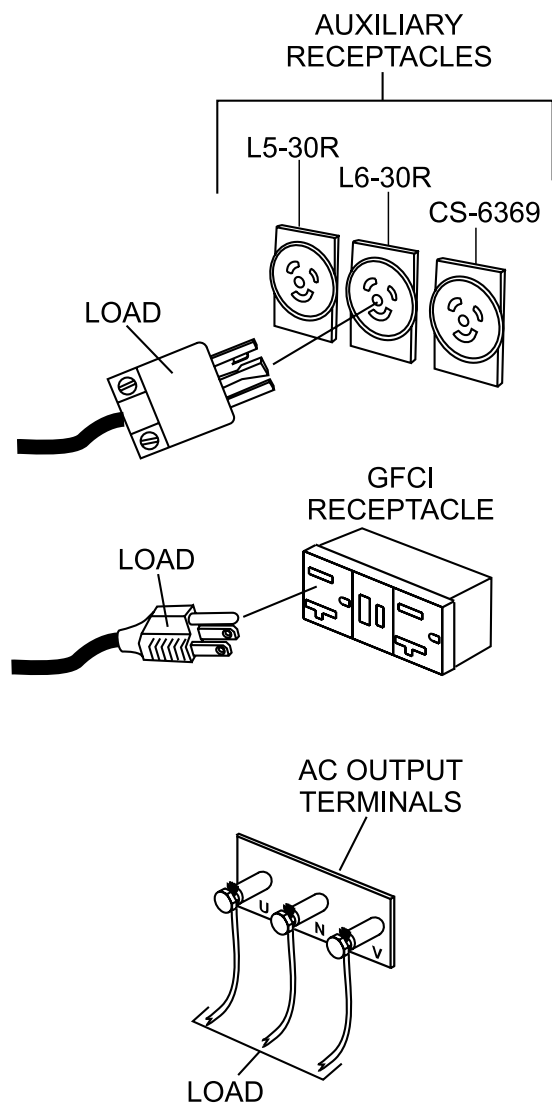


Figure 9. Connecting Loads

## Over Current Relay

An **over current relay** (Figure 10) is connected to the main circuit breaker. In the event of an overload, both the circuit breaker and the over current relay may trip. If the circuit breaker can not be reset, the **reset button** on the over current relay must be pressed. The over current relay is located in the control box.

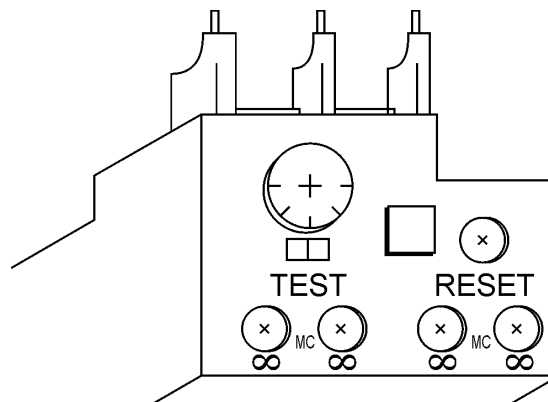


Figure 10. Over Current Relay

### NOTICE

Remember the **overcurrent relay** monitors the current flowing from the **U, N and V Output Terminal Lugs** to the load.

In the event of a short circuit or over current condition, it will automatically trip the 70 amp main breaker.

To restore power to the **Output Terminal Panel**, press the reset button on the overcurrent relay and place the **main** circuit breaker in the **closed** position (**ON**).

# LOAD APPLICATION

## SINGLE PHASE LOAD

Always be sure to check the nameplate on the generator and equipment to insure the wattage, amperage, frequency, and voltage requirements are satisfactorily supplied by the generator for operating the equipment.

Generally, the wattage listed on the nameplate of the equipment is its rated output. Equipment may require 130—150% more wattage than the rating on the nameplate, as the wattage is influenced by the efficiency, power factor and starting system of the equipment.

### NOTICE

If wattage is not given on the equipment's nameplate, approximate wattage may be determined by multiplying nameplate voltage by the nameplate amperage.

$$\text{WATTS} = \text{VOLTAGE} \times \text{AMPERAGE}$$

The power factor of this generator is 0.8. See Table 5 below when connecting loads.

**Table 5. Power Factor By Load**

| Type of Load                                | Power Factor |
|---------------------------------------------|--------------|
| Single-phase induction motors               | 0.4-0.75     |
| Electric heaters, incandescent lamps        | 1.0          |
| Fluorescent lamps, mercury lamps            | 0.4-0.9      |
| Electronic devices, communication equipment | 1.0          |
| Common power tools                          | 0.8          |

**Table 6. Cable Selection (60 Hz, Single Phase Operation)**

| Current in Amperes                                    | Load in Watts |              | Maximum Allowable Cable Length |          |          |          |
|-------------------------------------------------------|---------------|--------------|--------------------------------|----------|----------|----------|
|                                                       | At 100 Volts  | At 200 Volts | #10 Wire                       | #12 Wire | #14 Wire | #16 Wire |
| 2.5                                                   | 300           | 600          | 1000 ft.                       | 600 ft.  | 375 ft.  | 250 ft.  |
| 5                                                     | 600           | 1200         | 500 ft.                        | 300 ft.  | 200 ft.  | 125 ft.  |
| 7.5                                                   | 900           | 1800         | 350 ft.                        | 200 ft.  | 125 ft.  | 100 ft.  |
| 10                                                    | 1200          | 2400         | 250 ft.                        | 150 ft.  | 100 ft.  |          |
| 15                                                    | 1800          | 3600         | 150 ft.                        | 100 ft.  | 65 ft.   |          |
| 20                                                    | 2400          | 4800         | 125 ft.                        | 75 ft.   | 50 ft.   |          |
| CAUTION: Equipment damage can result from low voltage |               |              |                                |          |          |          |

### NOTICE

Motors and motor-driven equipment draw much greater current for starting than during operation.

An inadequate size connecting cable which cannot carry the required load can cause a voltage drop which can burn out the appliance or tool and overheat the cable. See Table 6.

- When connecting a resistance load such as an incandescent lamp or electric heater, a capacity of up to the generating set's rated output (kW) can be used.
- When connecting a fluorescent or mercury lamp, a capacity of up to the generating set's rated output (kW) multiplied by 0.6 can be used.
- When connecting an electric drill or other power tools, pay close attention to the required starting current capacity.

When connecting ordinary power tools, a capacity of up to the generating set's rated output (kW) multiplied by 0.8 can be used.

### DANGER

Before connecting this generator to any building's electrical system, a **licensed electrician** must install an **isolation (transfer) switch**. Serious damage to the building's electrical system may occur without this transfer switch.

# GAUGE READING/TERMINAL PANEL CONNECTIONS

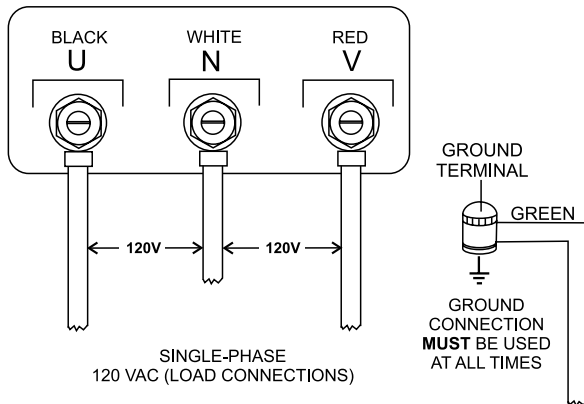
## UNV TERMINAL OUTPUT VOLTAGES

240/120V output voltages can be obtained using the **output terminal lugs**.

The voltage regulator (VR), Figure 12 allows the user to increase or decrease the selected voltage.

### 1Ø-120 Output Terminal Voltage

1. Connect the load wires to the output terminal lugs as shown in Figure 11.



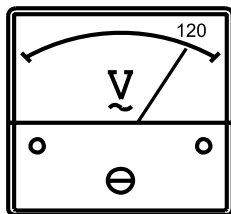
**Figure 11. Output Terminal Lugs  
1Ø-120V Connections**

2. Turn the voltage regulator knob (Figure 12) clockwise to increase voltage output, turn counterclockwise to decrease voltage output. Use voltage regulator adjustment knob whenever fine tuning of the output voltage is required.



**Figure 12. Voltage Regulator Knob**

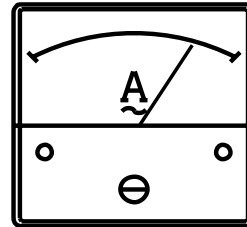
3. Observe that the output voltage either increases or decreases by monitoring the voltmeter (Figure 13) reading.



**Figure 13. AC Voltmeter**

## Ammeter Gauge

The ammeter gauge (Figure 14) on the generator control panel has been provided to help observe how much current (amps) is being supplied to the load from the output terminal lugs, GFCI receptacle or any auxilliary receptacles if installed.



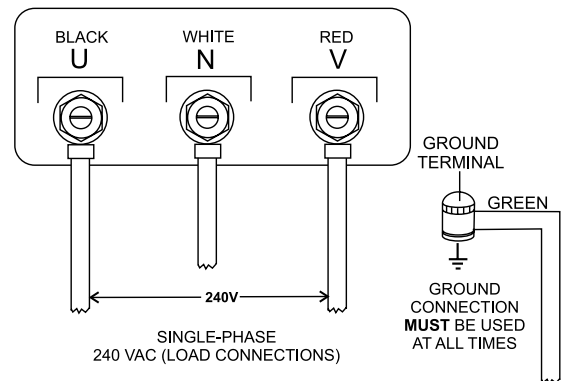
**Figure 14. Ammeter (Load)**

### NOTICE

The **ammeter gauge** will only show a reading when the output terminal lugs or auxilliary receptacles are connected to a load.

### 1Ø-240 Output Terminal Voltage

1. Connect the load wires to the output terminal lugs as shown in Figure 15.



**Figure 15. Output Terminal Lugs  
1Ø-240V Connections**

2. Turn the voltage regulator knob (Figure 12) clockwise to increase voltage output, turn counterclockwise to decrease voltage output.

### NOTICE

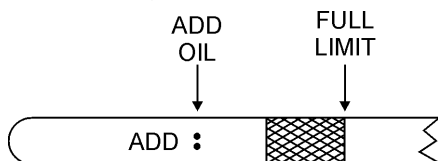
**ALWAYS** make sure that the connections to the UNV terminals are **secure** and **tight**. The possibility of arcing exists, that could cause a fire.

## CIRCUIT BREAKERS

Make sure to switch **ALL** circuit breakers to the **OFF** position prior to starting the engine.

## LUBRICATION OIL

Fill the engine crankcase with lubricating oil through the filler hole, but **DO NOT** overfill. Make sure the generator is level and verify that the oil level is maintained between the two notches (Figure 16) on the dipstick. See Table 7 for proper selection of engine oil.



**Figure 16. Engine Oil Dipstick**

When checking the engine oil, be sure to check if the oil is clean. If the oil is not clean, drain the oil by removing the oil drain plug, and refill with the specified amount of oil as outlined in the **Kubota Engine Owner's Manual**. Oil should be warm before draining.

Delo® engine oil is the recommended engine oil for this generator. When replacing engine oil please refill using Delo® 400 LE SAE 15W-40 (API CJ-4) engine oil.

| Table 7. Recommended Motor Oil |     |            |
|--------------------------------|-----|------------|
| °F                             | °C  | OIL: SAE   |
| 122                            | 50  | 10W/40     |
| 104                            | 40  | 10W/40     |
| 86                             | 30  | 10W/40     |
| 68                             | 20  | 10W/40     |
| 50                             | 10  | 10W/40     |
| 32                             | 0   | 10W/40     |
| -14                            | -10 | 5W/30      |
| -4                             | -20 | 5W/30      |
| -22                            | -30 | 5W/30      |
| -40                            | -40 | 5W/30      |
|                                |     | ARCTIC OIL |
|                                |     | 10W/40     |
|                                |     | 15W/30     |
|                                |     | 10W/30     |
|                                |     | 10W        |
|                                |     | 20W/40     |

## FUEL CHECK

### **! DANGER**



Fuel spillage on a **hot** engine can cause a **fire** or **explosion**. If fuel spillage occurs, wipe up the spilled fuel completely to prevent fire hazards. **NEVER** smoke around or near the generator.

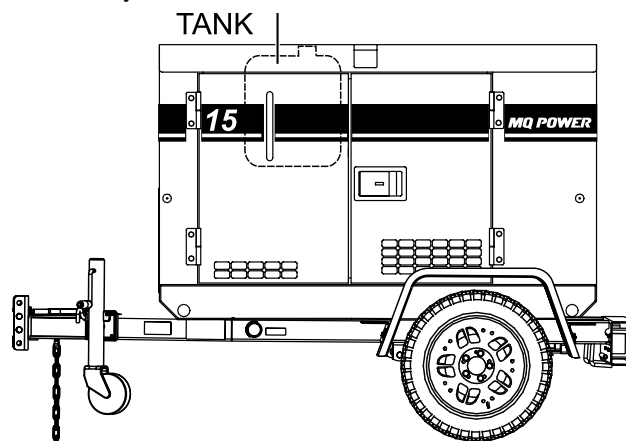
## Refilling the Fuel System

### **! CAUTION**

**ONLY** properly trained personnel who have read and understand this section should refill the fuel tank system.

This generator has an internal fuel tank (Figure 17) located inside the enclosure and may also be equipped with a trailer mounted fuel tank. **ALWAYS** fill the fuel tank with clean fresh **#2 diesel fuel**. **DO NOT** fill the fuel tank beyond its capacity.

Pay attention to the fuel tank capacity when replenishing fuel. The fuel tank cap must be closed tightly after filling. Handle fuel in a safety container. If the container does not have a spout, use a funnel. Wipe up any spilled fuel immediately.



**Figure 17. Fuel Tank**

## INSPECTION/SETUP

### Refueling Procedure:

#### WARNING



**Diesel fuel** and its vapors are dangerous to your health and the surrounding environment. Avoid skin contact and/or inhaling fumes.

3. **Level Tanks** — Make sure fuel cells are level with the ground. Failure to do so will cause fuel to spill from the tank before reaching full capacity (Figure 18).

#### CAUTION

**ALWAYS** place trailer on firm level ground before refueling to prevent spilling and maximize the amount of fuel that can be pumped into the tank.

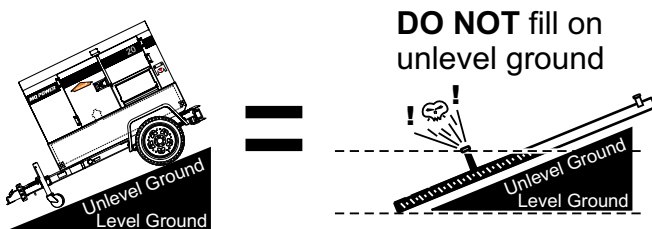


Figure 18. Only Fill on Level Ground

#### NOTICE

**ONLY** use #2 diesel fuel when refueling.

4. Remove fuel cap (located on top of generator) and fill fuel tank as shown in Figure 19.

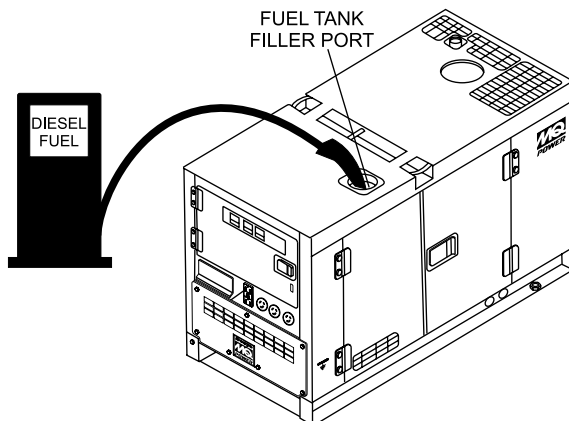


Figure 19. Fueling the Generator

5. **NEVER overfill fuel tank** — It is important to read the fuel gauge when filling trailer fuel tank. **DO NOT** wait for fuel to rise in filler neck (Figure 20).

FUEL GAUGE LOCATED  
ON CONTROL PANEL

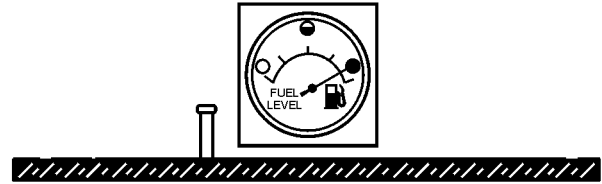


Figure 20. Full Fuel Tank

#### CAUTION

**DO NOT OVERFILL** fuel system. Leave room for fuel expansion. Fuel expands when heated (Figure 21).

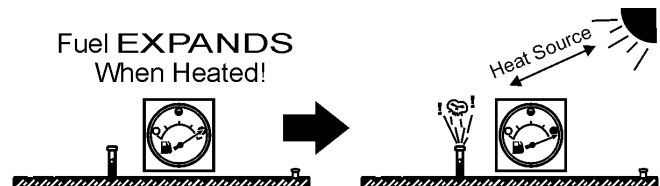


Figure 21. Fuel Expansion

### COOLANT (ANTIFREEZE/SUMMER COOLANT/WATER)

Kubota recommends antifreeze/summer coolant for use in their engines, which can be purchased in concentrate (and mixed with 50% demineralized water) or pre-diluted. See the **Kubota Engine Owner's Manual** for further details.

#### WARNING



If adding coolant/antifreeze mix to the radiator, **DO NOT** remove the radiator cap until the unit has completely cooled. The possibility of **hot!** coolant exists which can cause severe burns.

Day-to-day addition of coolant is done from the recovery tank. When adding coolant to the radiator, **DO NOT** remove the radiator cap until the unit has completely cooled. See Table 8 for engine, radiator, and recovery tank coolant capacities. Make sure the coolant level in the recovery tank is always between the “H” and the “L” markings.

**Table 8. Coolant Capacity**

|                     |                       |
|---------------------|-----------------------|
| Engine and Radiator | 1.85 gal (7.0 liters) |
| Reserve Tank        | N/A                   |

## Operation in Freezing Weather

When operating in freezing weather, be certain the proper amount of antifreeze (Table 9) has been added.

**Table 9. Anti-Freeze Operating Temperatures**

| Vol %<br>Anti-Freeze | Freezing Point |     |
|----------------------|----------------|-----|
|                      | °C             | °F  |
| 50                   | -37            | -34 |

## Cleaning the Radiator

The engine may overheat if the radiator fins become overloaded with dust or debris. Periodically clean the radiator fins with compressed air. Cleaning inside the machine is dangerous, so clean only with the engine turned off and the **negative** battery terminal disconnected.

### NOTICE

When the antifreeze is mixed with water, the antifreeze mixing ratio **must be** less than 50%.

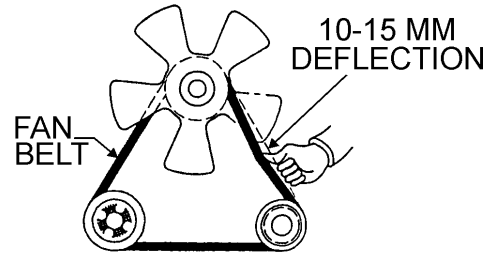
## AIR CLEANER

Periodic cleaning/replacement is necessary. Inspect air cleaner in accordance with the **Kubota Engine Owner's Manual**.

## FAN BELT TENSION

A slack fan belt may contribute to overheating, or to insufficient charging of the battery. Inspect the fan belt for damage and wear and adjust it in accordance with the **Isuzu Engine Owner's Manual**.

The fan belt tension is proper if the fan belt bends 10 to 15 mm (Figure 22) when depressed with the thumb as shown below.



**Figure 22. Fan Belt Tension**

### CAUTION



**NEVER** place hands near the belts or fan while the generator set is running.

## BATTERY

This unit is of negative ground **DO NOT** connect in reverse. Always maintain battery fluid level between the specified marks. Battery life will be shortened, if the fluid level is not properly maintained. Add only distilled water when replenishment is necessary.

**DO NOT** over fill. Check to see whether the battery cables are loose. Poor contact may result in poor starting or malfunctions. **Always** keep the terminals firmly tightened. Coating the terminals with an approved battery terminal treatment compound. Replace battery with only recommended type battery. The battery type used in this generator is BCI Group 24.

The battery is sufficiently charged if the specific gravity of the battery fluid is 1.28 (at 68° F). If the specific gravity should fall to 1.245 or lower, it indicates that the battery is dead and needs to be recharged or replaced.

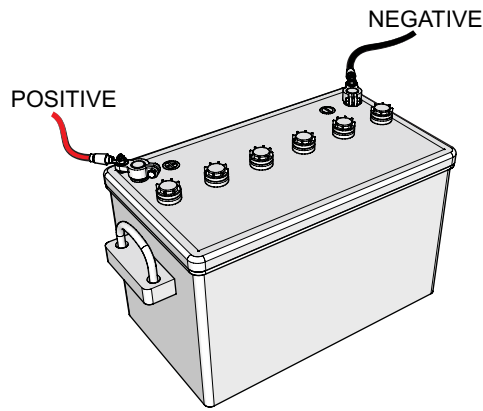
Before charging the battery with an external electric source, be sure to disconnect the battery cables.

## Battery Cable Installation

**ALWAYS** be sure the battery cables (Figure 23) are properly connected to the battery terminals as shown below. The **red cable** is connected to the positive terminal of the battery, and the **black cable** is connected to the negative terminal of the battery.

### CAUTION

**ALWAYS** disconnect the negative terminal **FIRST** and reconnect negative terminal **LAST**.



**Figure 23. Battery Connections**

When connecting battery do the following:

1. **NEVER** connect the battery cables to the battery terminals when the **ignition/starter switch** in **ON** position.
2. Place a small amount of battery terminal treatment compound around both battery terminals. This will ensure a good connection and will help prevent corrosion around the battery terminals.

### NOTICE

If the battery cable is connected incorrectly, electrical damage to the generator will occur. Pay close attention to the polarity of the battery when connecting the battery.

### CAUTION

Inadequate battery connections may cause poor starting of the generator, and create other malfunctions.

## ALTERNATOR

The polarity of the alternator is negative grounding type. When an inverted circuit connection takes place, the circuit will be in short circuit instantaneously resulting the alternator failure.

**DO NOT** put water directly on the alternator. Entry of water into the alternator can cause corrosion and damage the alternator.

## WIRING

Inspect the entire generator for bad or worn electrical wiring or connections. If any wiring or connections are exposed (insulation missing) replace wiring immediately.

## PIPING AND HOSE CONNECTION

Inspect all piping, oil hose, and fuel hose connections for wear and tightness. Tighten all hose clamps and check hoses for leaks.

If any hose (**fuel or oil**) lines are defective, replace them immediately.

# GENERATOR START-UP PROCEDURE

## BEFORE STARTING

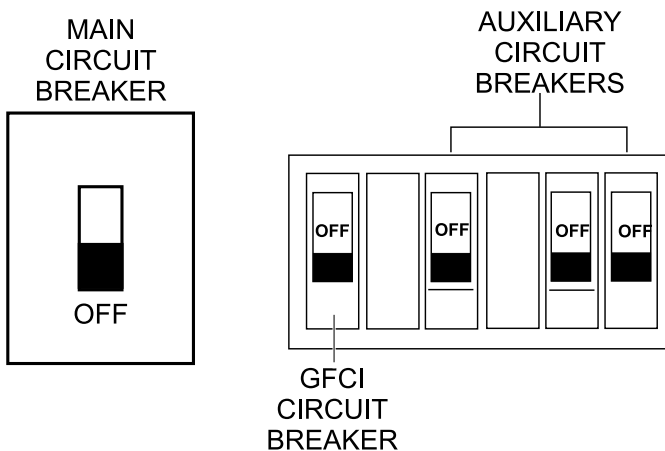
### CAUTION

The engine's exhaust contains harmful emissions. **ALWAYS** have adequate ventilation when operating. Direct exhaust away from nearby personnel.

### WARNING

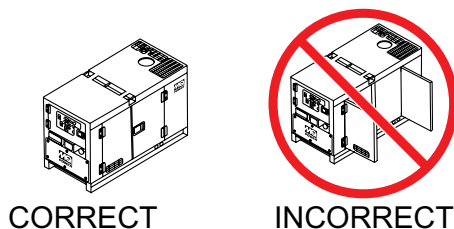
**NEVER** manually start the engine with the **main, GFCI or auxiliary** circuit breakers in the **ON** (closed) position.

1. Place the **main, G.F.C.I., and aux.** circuit breakers (Figure 24) in the **OFF** position prior to starting the engine.



**Figure 24. Main, Aux. and GFCI Circuit Breakers (OFF)**

2. Connect the load to the **receptacles** or the **output terminal lugs** as shown in Figure 9. Tighten terminal nuts securely to prevent load wires from slipping out.
3. Tighten terminal nuts securely to prevent load wires from slipping out.
4. Close all engine enclosure doors (Figure 25).



**Figure 25. Engine Enclosure Doors**

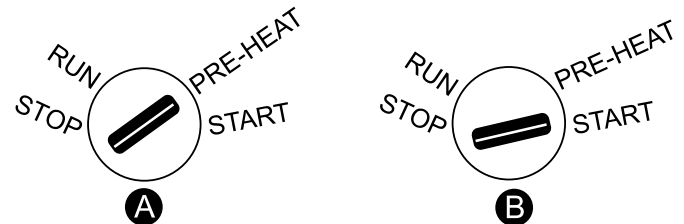
## STARTING

1. Place the engine speed switch (Figure 26) in the **LOW** (down) engine speed position.



**Figure 26. Engine Speed Switch (Low)**

2. Insert the ignition key into the ignition switch. Turn the key clockwise to the **PRE-HEAT** position (Figure 27A) and observe the pre-heat lamp. is **ON**.



**Figure 27. Ignition/Starter Switch**

3. When the **pre-heat lamp** has turned **OFF**, continue turning the ignition key clockwise to the **START** position (Figure 27B). When the engine starts, release the key. If engine fails to start within 10 seconds, wait 30 seconds and repeat this step.

### NOTICE

In cold weather conditions warm up the engine 5-7 minutes before placing into operation.

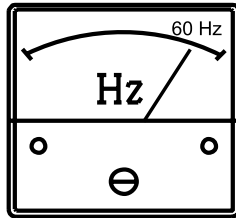
4. Once the engine starts, let it engine run for 1-2 minutes. Listen for any abnormal noises. If any abnormalities exists shutdown the engine and correct the problem.
5. If the engine is running smoothly, place the engine speed switch (Figure 28) in the **HIGH** (up) position.



**Figure 28. Engine Speed Switch (High)**

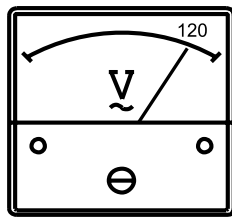
# GENERATOR START-UP PROCEDURE

6. The generator's frequency meter (Figure 29) should be displaying the 60 cycle output frequency in **HERTZ**.



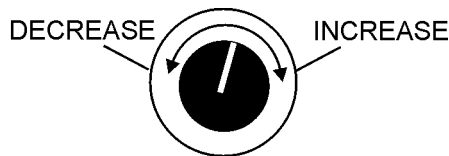
**Figure 29. Frequency Meter**

7. The generator's AC-voltmeter (Figure 30) will display the generator's output in **VOLTS**.



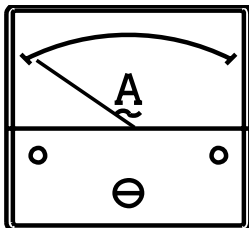
**Figure 30. Voltmeter**

8. If the voltage is not within the specified tolerance, use the voltage adjustment control knob (Figure 31) to increase or decrease the desired voltage.



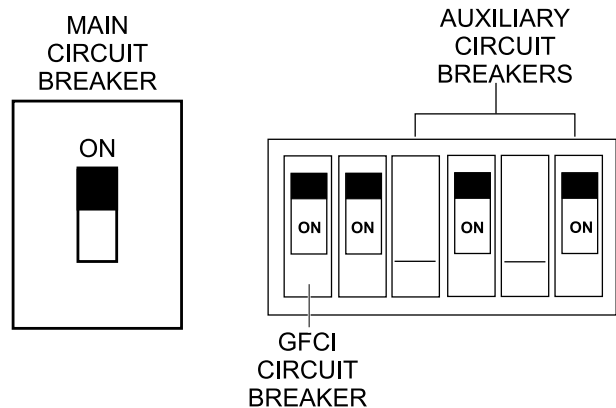
**Figure 31. Voltage Adjust Control Knob**

9. The ammeter (Figure 32) will indicate **zero amps** with no load applied. When a load is applied, the ammeter will indicate the amount of current that the load is drawing from the generator.



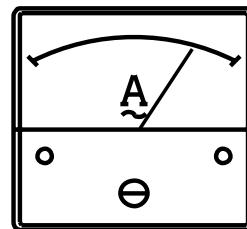
**Figure 32. Ammeter (No Load)**

10. Place the **main, GFCI, and aux.** circuit breakers in the **ON** position (Figure 33).



**Figure 33. Main, Aux. and GFCI Circuit Breakers (ON)**

11. Observe the generator's ammeter (Figure 34) and verify it reads the anticipated amount of current with respect to the load. The ammeter will only display a current reading if a load is in use.



**Figure 34. Ammeter (Load)**

12. The generator will run until manually stopped or an abnormal condition occurs.

# GENERATOR SHUTDOWN PROCEDURE

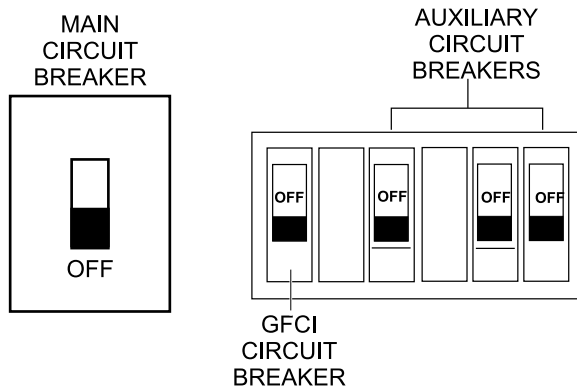
## WARNING

**NEVER** stop the engine suddenly except in an emergency.

### NORMAL SHUTDOWN PROCEDURE

To shutdown the generator, use the following procedure:

1. Place both the **MAIN, GFCI and LOAD** circuit breakers as shown in Figure 35 to the **OFF** position.



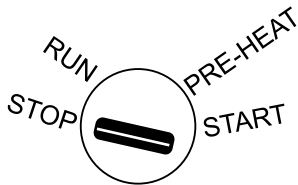
**Figure 35. Main, Aux. and GFCI Circuit Breakers (OFF)**

2. Place the speed control switch to the **LOW** (down) engine speed position as shown in (Figure 36) and let the engine cool for 3-5 minutes with no load applied.



**Figure 36. Engine Speed Switch (Low)**

3. Turn the ignition key counterclockwise to the **STOP** position. When the engine has stopped, **remove** key. Place key in a safe place where it will not be lost.



**Figure 37. Ignition/Starter Switch (Stop)**

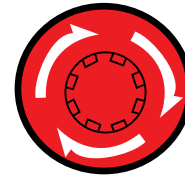
4. Remove all loads from the generator.
5. Inspect entire generator for any damage or loosening of components that may have occurred during operation.

### EMERGENCY SHUTDOWN PROCEDURE

1. Turn the ignition key counterclockwise to the **STOP** position. When the engine has stopped, **remove** key. Place key in a safe place where it will not be lost.
2. Place both the **MAIN, GFCI and LOAD** circuit breakers as shown in Figure 35 to the **OFF** position.

### Emergency Stop Switch (Option)

1. If equipped (option), push the **Emergency Stop Pushbutton Switch** (Figure 38).



**Figure 38. Emergency Stop Button**

### AUTOMATIC SHUT-DOWN SYSTEM

This unit is equipped with safety devices to automatically stop the engine in the event of low oil pressure, approximately 7.1 psi (49 kPa), or high water temperature, approximately 234°F (112° C), overspeed approximately (2,070 rpm).

The alarm lamps on the **Engine Warning Lamp Module** (Figure 4, item 4) illuminate to signify the reason for the engine shutdown.

| Table 10. Inspection/Maintenance |                                                                    | 10 Hrs<br>DAILY | 100 Hrs | 200 Hrs | 250 Hrs | 400 Hrs | 500 Hrs | 1000<br>Hrs |
|----------------------------------|--------------------------------------------------------------------|-----------------|---------|---------|---------|---------|---------|-------------|
| Engine                           | Check Engine Fluid Levels                                          | X               |         |         |         |         |         |             |
|                                  | Check Fuel Level                                                   | X               |         |         |         |         |         |             |
|                                  | Check Battery Acid Level                                           | X               |         |         |         |         |         |             |
|                                  | Check Fan Belt Condition                                           | X               |         |         |         |         |         |             |
|                                  | Check for Leaks                                                    | X               |         |         |         |         |         |             |
|                                  | Check for Loosening of Parts                                       | X               |         |         |         |         |         |             |
|                                  | Change Engine Oil * <sup>1</sup>                                   |                 | X       |         |         |         |         |             |
|                                  | Clean Air Filter                                                   |                 | X       |         |         |         |         |             |
|                                  | Replace Engine Oil and Filter * <sup>1</sup>                       |                 |         | X       |         |         |         |             |
|                                  | Drain Fuel Tank                                                    |                 |         | X       |         |         |         |             |
|                                  | Clean Unit, Inside and Outside<br>(Check Emission Carbon)          |                 |         | X       | X       |         |         |             |
|                                  | Replace Fuel Filter                                                |                 |         |         |         | X       |         |             |
|                                  | Replace Air Filter Element * <sup>3</sup>                          |                 |         |         |         |         | X       |             |
|                                  | Clean Radiator and Check<br>Coolant Protection Level* <sup>2</sup> |                 |         |         |         |         | X       |             |
|                                  | Check all Hoses and Clamps * <sup>4</sup>                          |                 |         |         |         |         | X       |             |
|                                  | Clean Inside of Fuel Tank                                          |                 |         |         |         |         |         | X           |
| Generator                        | Measure Insulation Resistance<br>Over 3M ohms                      |                 |         |         |         | X       |         |             |
|                                  | Check Rotor Rear Support<br>Bearing                                |                 |         |         |         |         | X       |             |

\*<sup>1</sup> During initial operation of a new engine, change oil and filter at 50 hours first time ONLY. Service interval depends on type of oil.

\*<sup>2</sup> Add "Supplemental Coolant Additives (SCA'S)" to recharge the engine coolant.

\*<sup>3</sup> Replace primary air filter element when restriction indicator shows a vacuum of 625 mm (25 in. H<sub>2</sub>O).

\*<sup>4</sup> If blowby hose needs to be replaced, ensure that the slope of the blowby hose is at least a 1/2 inch per foot, with no sags or dips that could collect moisture and/or oil.

\*<sup>5</sup> Accumulation of carbon (soot, unburned fuel) in the exhaust pipe line and muffler could cause not only system derates but also could lead to fire incident. To destroy the soot and unburned fuel, run the unit at rated power for some period of time until the exhaust gas become mostly colorless every 250 hours operation time. The carbon will be easier to be generated when the unit operates at less then 30% of rated power. In this case, perform the above procedures at shorter interval time.

\*<sup>6</sup> Applying a large load at one time to the unit when carbon deposits have accumulated in the exhaust system could produce fire/sparks which could lead to abnormal combustion. Therefore it is recommended to **apply the load gradually** and observe the exhaust gas color (colorless) during the process.

\*<sup>7</sup> Fire or sparks may emitt from the exhaust gas outlet during the **carbon emission accumulation check** (load). Make sure the area surrounding the unit is free from any **flammable** material.

## NOTICE

Before inspecting generator, check that the ignition/start switch is in the **STOP** position, and place all circuit breakers in the **OFF** position. Allow sufficient time for adequate cooling. When ready to restart, complete all steps in the Generator Startup Procedure section of this manual.

## GENERAL INSPECTION

Prior to each use, the generator should be cleaned and inspected for deficiencies. Check for loose, missing or damaged nuts, bolts or other fasteners. Also check for fuel, oil, and coolant leaks. Use Table 10 as a general maintenance guideline **Engine Side** (Refer to the Engine Instruction Manual).

## AIR CLEANER

Every 100 hours: Remove air cleaner element (Figure 39) and clean the heavy duty paper element with light spray of compressed air. Replace the air cleaner as needed.

### Air Cleaner with Dust Indicator

This indicator (Figure 39) is attached to the air cleaner. When the air cleaner element is clogged, air intake restriction becomes greater and the dust indicator signal shows **RED** meaning the element needs changing or service. After changing the air element, press the dust indicator button to reset the indicator.

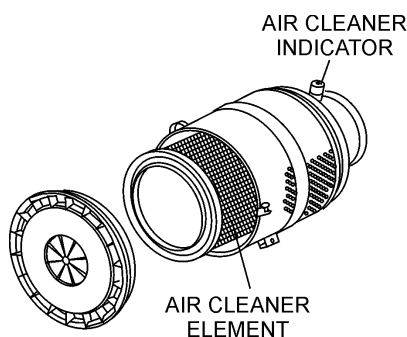


Figure 39. Air Cleaner/Indicator

## NOTICE

The air filter should not be changed until the indicator reads "**RED**". Dispose of old air filter. It may not be cleaned or reused.

If the engine is operating in very **dusty** or **dry grass** conditions, a clogged air cleaner will result. This can lead to a loss of power, excessive carbon buildup in the combustion chamber and high fuel consumption. Change air cleaner more **frequently** if these conditions exist.

## FUEL ADDITION

Add diesel fuel (the grade may vary according to season and locations).

### Removing Water from the Fuel Tank

After prolonged use, water and other impurities accumulate in the bottom of the tank. Occasionally inspect the fuel tank for water contamination and drain the contents if required.

During cold weather, the more empty volume inside the tank, the easier it is for water to condense. This can be reduced by keeping the tank full with diesel fuel.

### Cleaning Inside the Fuel Tank

Drain the fuel inside the fuel tank completely. Using a spray washer (Figure 40) wash out any deposits or debris that have accumulated inside the fuel tank.

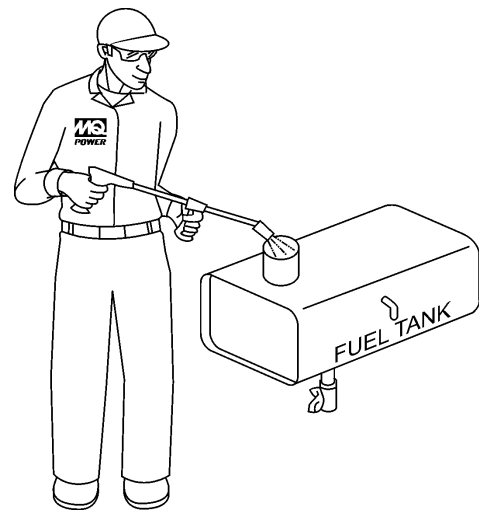


Figure 40. Fuel Tank Cleaning

## FUEL TANK INSPECTION

In addition to cleaning the fuel tank, the following components should be inspected for wear:

- **Rubber Suspension** — look for signs of wear or deformity due to contact with oil. Replace the rubber suspension if necessary.
- **Fuel Hoses** — inspect nylon and rubber hoses for signs of wear, deterioration and hardening.
- **Fuel Tank Lining** — inspect the fuel tank lining for signs of excessive amounts of oil or other foreign matter.

## REPLACING FUEL FILTER

- Replace the fuel filter cartridge with new one every 400 hours.
- Loosen the drain plug at the lower top of the fuel filter. Drain the fuel in the fuel body together with the mixed water. **DO NOT** spill the fuel during disassembly.
- Vent any air.

## AIR REMOVAL

If air enters the fuel injection system of a diesel engine, starting becomes impossible. After running out of fuel, or after disassembling the fuel system, bleed the system according to the following procedure. See the **Kubota Engine Manual** for details.

To restart after running out of fuel, turn the switch to the “**ON**” position for 15-30 seconds. Try again, if needed. This unit is equipped with an automatic air bleeding system.

## CHECK OIL LEVEL

Check the crankcase oil level prior to each use, or when the fuel tank is filled. Insufficient oil may cause severe damage to the engine. Make sure the generator is level. The oil level must be between the two notches on the dipstick as shown in Figure 16.

## REPLACING OIL FILTER (EVERY 200 HOURS)

- Remove the old oil filter.
- Apply a film of oil to the gasket on the new oil filter.
- Install the new oil filter.
- After the oil cartridge has been replaced, the engine oil will drop slightly. Run the engine for a while and check for leaks before adding more oil if needed. Clean excessive oil from engine.

## FLUSHING OUT RADIATOR AND REPLACING COOLANT (EVERY 500 HOURS)

- Open both cocks located at the crankcase side and at the lower part of the radiator and drain coolant. Open the radiator cap while draining. Remove the overflow tank and drain.
- Check hoses for softening and kinks. Check clamps for signs of leakage.
- Tighten both cocks and replace the overflow tank.
- Replace with coolant as recommended by the engine manufacturer.
- Close radiator cap tightly.
- Flush the radiator by running clean tap water through radiator until signs of rust and dirt are removed. **DO NOT** clean radiator core with any objects, such as a screwdriver.

### WARNING



Allow engine to **cool** when flushing out radiator. Flushing the radiator while hot could cause serious burns from water or steam.

## RADIATOR CLEANING

The radiator (Figure 41) should be sprayed (cleaned) with a high pressure washer when excessive amounts of dirt and debris have accumulated on the cooling fins or tube. When using a high pressure washer, stand at least 5 feet (1.5 meters) away from the radiator to prevent damage to the fins and tube.

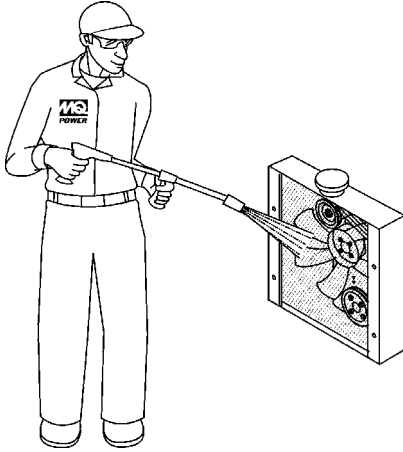


Figure 41. Radiator Cleaning

## GENERATOR STORAGE

For long term storage of the generator the following is recommended:

- Drain the fuel tank completely. Treat with a fuel stabilizer if necessary.
- Completely drain the oil from the crankcase and refill if necessary with fresh oil.
- Clean the entire generator, internal and external.
- Cover the generating set and store in a clean, dry place.
- Disconnect the battery.
- Make sure engine coolant is at proper level.
- If generator is mounted on a trailer, jack trailer up and place on blocks so tires do not touch the ground or block and completely remove the tires.

## ENGINE BLOCK HEATING ELEMENT AND INTERNAL BATTERY CHARGER 120 VAC INPUT RECEPTACLES (OPTIONAL)

This generator can be optionally equipped with two 120 VAC, 20 amp input receptacles located on the output terminal panel.

The purpose of these receptacles is to provide power via commercial power to the **engine block heating element** and **internal battery charger**.

These receptacles will **ONLY** function when commercial power has been supplied to them (Figure 42). To apply commercial power to these receptacles, a power cord of adequate size will be required (See Table 6).

When using the generator in **hot** climates there is no reason to apply power to jacket water heater. However, if the generator will be used in **cold** climates, it is always a good idea to apply power to the jacket water heater at all times.

To apply power to the engine block heating element, simply apply power to the heating element receptacle via commercial power using a power cord of adequate size.

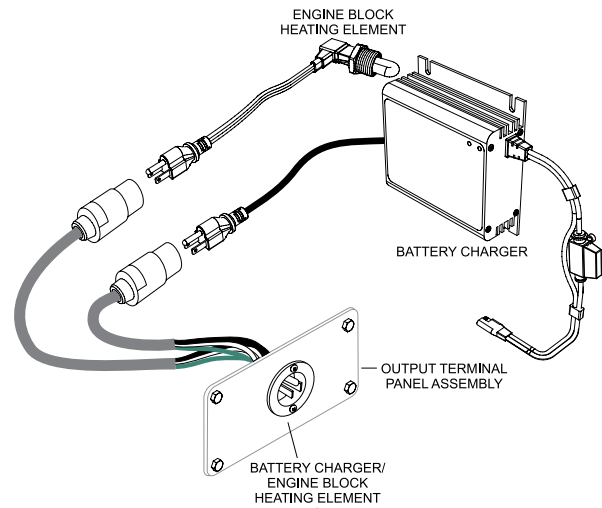


Figure 42. Battery Charger and Engine Block Heating Element Power Connections

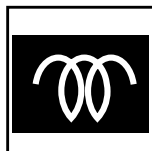
If the generator will be used daily, the battery should normally not require charging. If the generator will be idle (not used) for long periods of time, apply power to the battery charger receptacle via commercial power using a power cord of adequate size.

### NOTICE

If the generator will be idle (not used) for long periods of time and to ensure adequate starting capability, always have power applied to the generator's internal battery charger.

## ENGINE MALFUNCTION/FAILURE DIAGNOSTIC CODES

When an engine malfunction/failure has been detected the engine will be shut down and the error code will be displayed on the glow plug warning lamp by a series of flashing patterns.



The flashing patterns consist of a combination of one or more **long** flashes and one or more **short** flashes. Reference Table 11 for an explanation of the flashing pattern and the associated countermeasures.

**Table 11. Engine Fault Codes**

| Symptom                           | Fault Explanation                                               | Indication     | Solution                                                      |
|-----------------------------------|-----------------------------------------------------------------|----------------|---------------------------------------------------------------|
| Engine Speed Too High             | 115% or more of the rated engine speed                          | Long 1 Short 1 | Adjust engine speed to correct RPM.                           |
| Low Oil Pressure                  | Oil pressure switch on 7.1 PSI (49 kPa) Approx. Engine Shutdown | Long 1 Short 2 | Check engine oil level and switch.                            |
| Low Battery Voltage               | Insufficient Charge                                             | Long 1 Short 3 | Inspect or replace engine alternator/voltage regulator.       |
| High Water Temperature            | Overheat, 234°F (112° C). Approx., Engine Shutdown              | Long 1 Short 4 | Check coolant level and radiator. Also check Temp switch.     |
| Incorrect Crank Rotation          | Defective crank rotation sensor, disconnection or short circuit | Long 2 Short 1 | Replace sensor, check wiring.                                 |
| Engine will not start             | Disconnection, short circuit fuel solenoid                      | Long 2 Short 2 | Replace fuel solenoid, check wiring.                          |
| Water Temperature Icon Always OFF | Water Temperature Sensor Disconnected                           | Long 2 Short 4 | Check wiring or replace sensor                                |
| Temperature Icon Always ON        | Water Temperature Sensor Short                                  | Long 2 Short 5 | Check wiring or replace sensor.                               |
| Abnormal Battery Voltage          | No Charge, cable disconnected                                   | Long 2 Short 6 | Check or replace battery and engine alternator. Check wiring. |
| No Cranking                       | Regulator voltage exceeds 18 VDC or more                        | Long 2 Short 7 | Check or replace voltage regulator and battery                |

## TROUBLESHOOTING GENERATOR

Practically all breakdowns can be prevented by proper handling and maintenance inspections, but in the event of a breakdown, use Table 12 shown below for diagnosis of the Generator. If the problem cannot be remedied, consult our company's business office or service plant.

| Table 12. Generator Troubleshooting |                               |                                                     |
|-------------------------------------|-------------------------------|-----------------------------------------------------|
| Symptom                             | Possible Problem              | Solution                                            |
| No Voltage Output                   | AC Voltmeter defective?       | Check output voltage using a voltmeter.             |
|                                     | Is wiring connection loose?   | Check wiring and repair.                            |
|                                     | Is AVR defective?             | Replace if necessary.                               |
|                                     | Defective Rotating Rectifier? | Check and replace.                                  |
|                                     | Defective Exciter Field?      | Check for approximately 19 ohms across J & K on CN1 |
| Low Voltage Output                  | Is engine speed correct?      | Turn engine throttle lever to "High".               |
|                                     | Is wiring connections loose?  | Check wiring and repair.                            |
|                                     | Defective AVR?                | Replace if necessary.                               |
| High Voltage Output                 | Is wiring connections loose?  | Check wiring and repair.                            |
|                                     | Defective AVR?                | Replace if necessary.                               |
| Circuit Breaker Tripped             | Short Circuit in load?        | Check load and repair.                              |
|                                     | Over current?                 | Confirm load requirements and reduce.               |
|                                     | Defective circuit breaker?    | Check and replace.                                  |
|                                     | Over current Relay actuated?  | Confirm load requirement and replace.               |

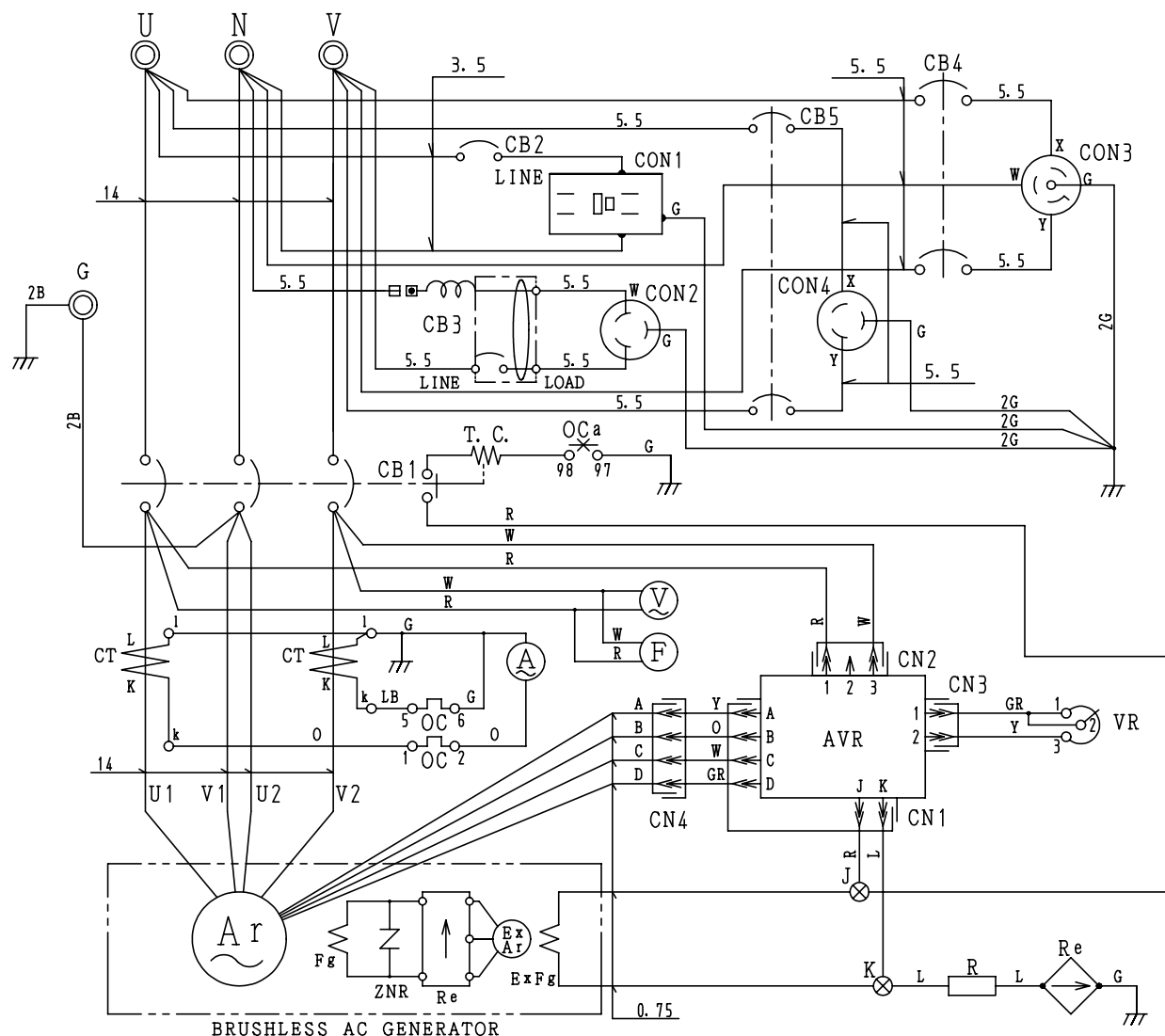
# TROUBLESHOOTING ENGINE

| Troubleshooting (Engine)                                                       |                                                                          |                                                                                                                           |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Symptom                                                                        | Possible Problem                                                         | Solution                                                                                                                  |
| Engine will not start or start is delayed, although engine can be turned over. | No Fuel reaching injection pump?                                         | Add fuel. Check entire fuel system.                                                                                       |
|                                                                                | Defective fuel pump?                                                     | Replace fuel pump.                                                                                                        |
|                                                                                | Fuel filter clogged?                                                     | Replace fuel filter and clean tank.                                                                                       |
|                                                                                | Faulty fuel supply line?                                                 | Replace or repair fuel line.                                                                                              |
|                                                                                | Compression too low?                                                     | Check piston, cylinder and valves. Adjust or repair per engine repair manual.                                             |
|                                                                                | Fuel pump not working correctly?                                         | Repair or replace fuel pump.                                                                                              |
|                                                                                | Oil pressure too low?                                                    | Check engine oil pressure.                                                                                                |
|                                                                                | Low starting temperature limit exceeded?                                 | Comply with cold starting instructions and proper oil viscosity.                                                          |
|                                                                                | Defective battery?                                                       | Charge or replace battery.                                                                                                |
|                                                                                | Air or water mixed in fuel system?                                       | Check carefully for loosened fuel line coupling, loose cap nut, etc.                                                      |
| At low temperatures engine will not start.                                     | Engine oil too thick?                                                    | Refill engine crankcase with correct type of oil for winter environment.                                                  |
|                                                                                | Defective battery?                                                       | Replace battery.                                                                                                          |
| Engine fires but stops soon as starter is switched off.                        | Fuel filter blocked?                                                     | Replace fuel filter.                                                                                                      |
|                                                                                | Fuel supply blocked?                                                     | Check the entire fuel system.                                                                                             |
|                                                                                | Defective fuel pump?                                                     | Replace fuel pump.                                                                                                        |
| Engine stops by itself during normal operation.                                | Fuel tank empty?                                                         | Add fuel.                                                                                                                 |
|                                                                                | Fuel filter blocked?                                                     | Replace fuel filter.                                                                                                      |
|                                                                                | Defective fuel pump?                                                     | Replace fuel pump.                                                                                                        |
|                                                                                | Mechanical oil pressure shutdown sensor stops the engine due to low oil? | Add oil. Replace low oil shutdown sensor if necessary.                                                                    |
| Low engine power, output and speed.                                            | Fuel tank empty?                                                         | Replace fuel filter.                                                                                                      |
|                                                                                | Fuel filter clogged?                                                     | Replace fuel filter.                                                                                                      |
|                                                                                | Fuel tank venting is inadequate?                                         | Ensure that tank is adequately vented.                                                                                    |
|                                                                                | Leaks at pipe unions?                                                    | Check threaded pipe unions tape and tighten unions as required.                                                           |
|                                                                                | Speed control lever does not remain in selected position?                | See engine manual for corrective action.                                                                                  |
|                                                                                | Engine oil level too full?                                               | Correct engine oil level.                                                                                                 |
|                                                                                | Injection pump wear?                                                     | Use No. 2-D diesel fuel only. Check the fuel injection pump element and delivery valve assembly and replace as necessary. |

## TROUBLESHOOTING ENGINE (CONTINUED)

| Troubleshooting (Engine) - continued                        |                                                  |                                                     |
|-------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------|
| Symptom                                                     | Possible Problem                                 | Solution                                            |
| Low engine power output and low speed, black exhaust smoke. | Air filter blocked?                              | Clean or replace air filter.                        |
|                                                             | Incorrect valve clearances?                      | Adjust valves per engine specification.             |
|                                                             | Malfunction at injector?                         | See engine manual.                                  |
| Engine overheats.                                           | Too much oil in engine crankcase?                | Drain off engine oil down to uppermark on dipstick. |
|                                                             | Entire cooling air system contaminated/ blocked? | Clean cooling air system and cooling fin areas.     |
|                                                             | Fan belt broken or elongated?                    | Change belt or adjust belt tension.                 |
|                                                             | Coolant insufficient?                            | Replenish coolant.                                  |
|                                                             | Radiator net or radiator fin clogged with dust?  | Clean net or fin carefully.                         |
|                                                             | Fan, radiator, or radiator cap defective?        | Replace defective part.                             |
|                                                             | Thermostat defective?                            | Check thermostat and replace if necessary.          |
|                                                             | Head gasket defective or water leakage?          | Replace parts.                                      |

# GENERATOR WIRING DIAGRAM

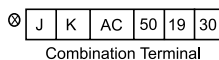


BRUSHLESS AC GENERATOR



| WIRING COLOR CODE |        |        |             |
|-------------------|--------|--------|-------------|
| SYMBOL            | COLOR  | SYMBOL | COLOR       |
| B                 | BLACK  | R      | RED         |
| L                 | BLUE   | W      | WHITE       |
| BR                | BROWN  | Y      | YELLOW      |
| G                 | GREEN  | LB     | LIGHT BLUE  |
| GR                | GRAY   | LG     | LIGHT GREEN |
| V                 | VIOLET | O      | ORANGE      |
| P                 | PINK   |        |             |

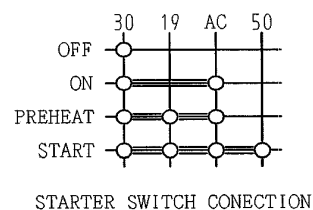
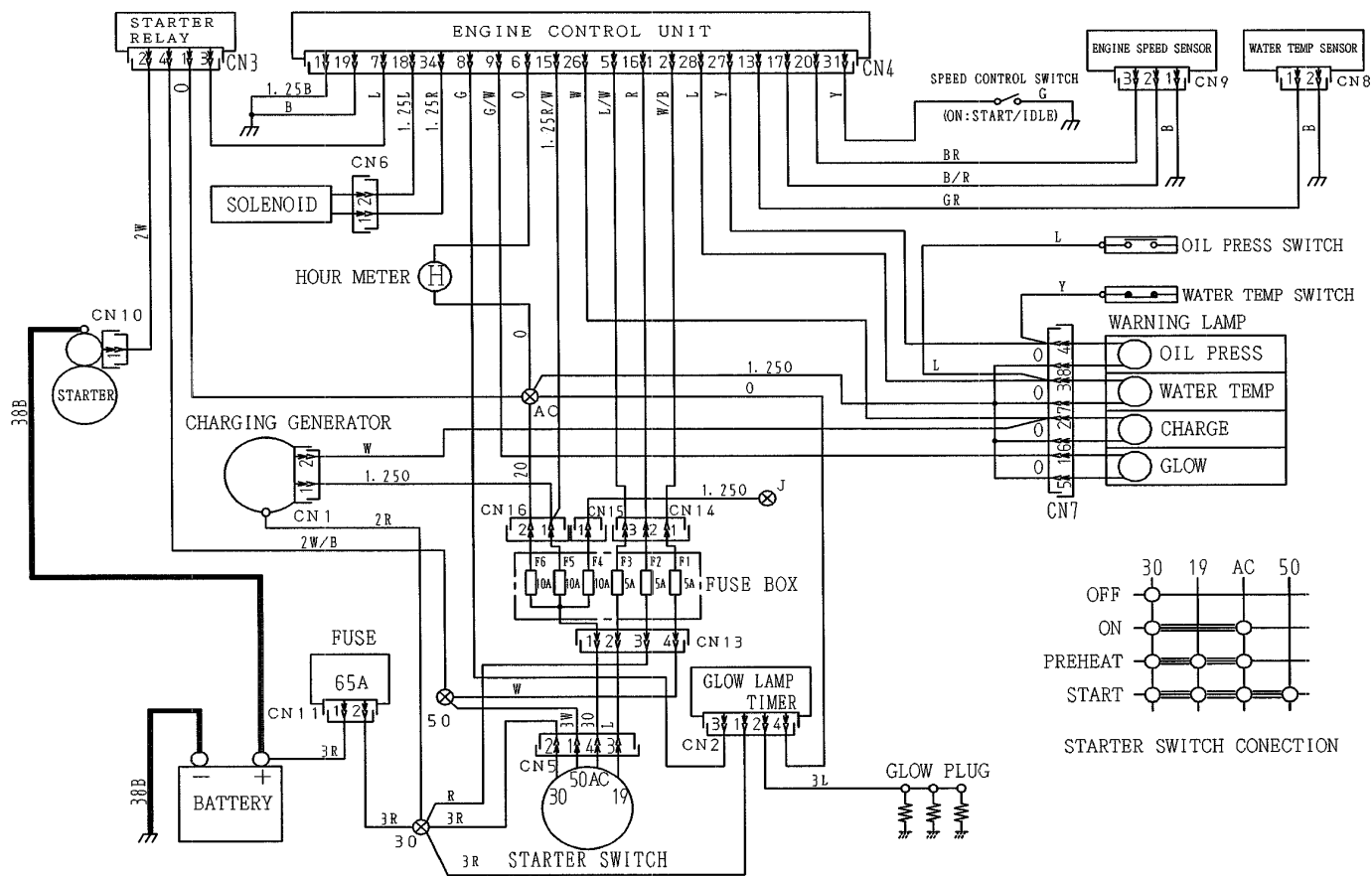
CONNECTOR  
View at Wiring Side



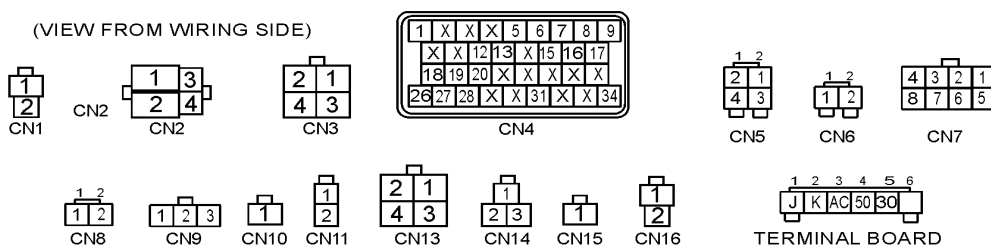
Note : No designation lead size : 1.25

| SYMBOL | DESIGNATION                  |
|--------|------------------------------|
| V      | AC.VOLTMETER                 |
| A      | AC.AMMETER                   |
| F      | FREQUENCY METER              |
| CT     | CURRENT TRANSFORMER, AMMETER |
| U.N.V  | OUTPUT TERMINALS             |
| AVR    | AUTOMATIC VOLTAGE REGULATOR  |
| VR     | VOLTAGE REGULATOR            |
| CB1    | CIRCUIT BREAKER 3P 70A       |
| CB2    | CIRCUIT BREAKER 20A          |
| CB3    | CIRCUIT BREAKER 30A          |
| CB4    | CIRCUIT BREAKER 50A          |
| CB5    | CIRCUIT BREAKER 30A          |
| R      | RESISTOR                     |
| Re     | RECTIFIER                    |
| CON1   | RECEPTACLE 20A, GFCI         |
| CON2   | RECEPTACLE 30A, L5-30R       |
| CON3   | RECEPTACLE 50A, CS-6369      |
| CON4   | RECEPTACLE 30A, L6-30R       |
| OC     | OVER CURRENT RELAY           |
| J, K   | COMBINATION TERMINAL         |
| G      | GROUND TERMINAL              |

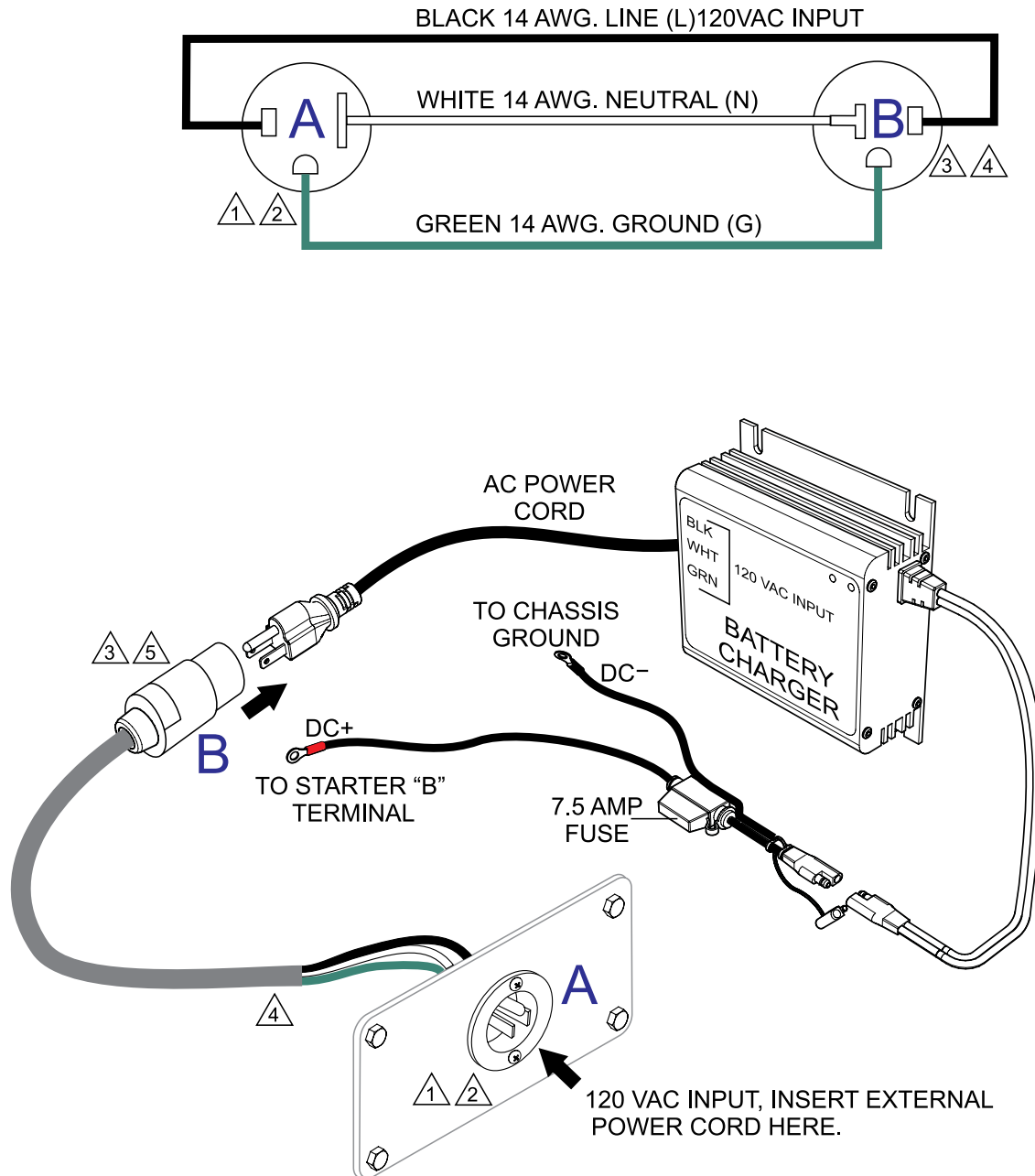
# ENGINE WIRING DIAGRAM



(VIEW FROM WIRING SIDE)



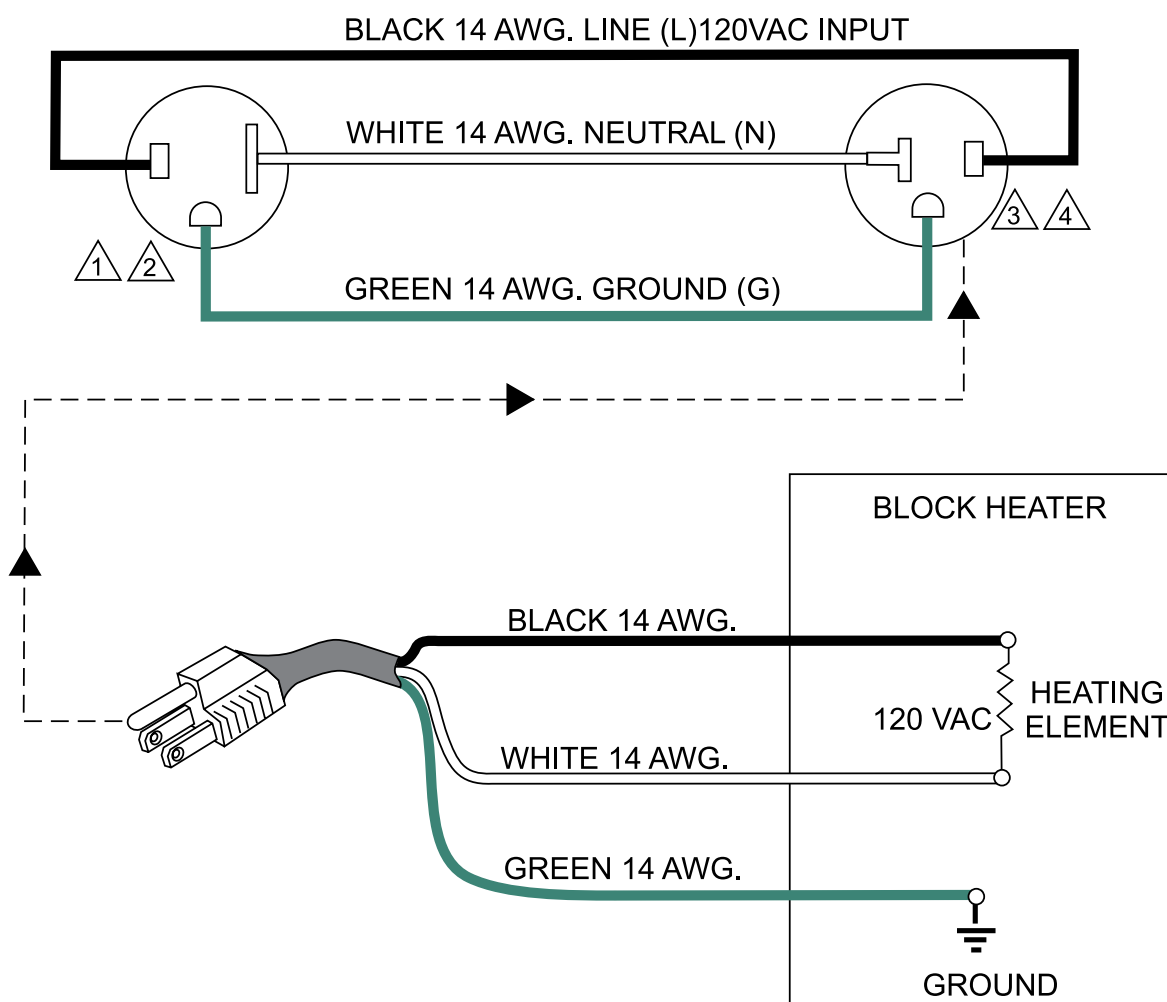
# BATTERY CHARGER WIRING DIAGRAM



## NOTES:

- ① NEMA 5-15, 15A, 120 VAC, P/N EE6176 (HBL5278C/HUBBLE RECEPTACLE).
- ② RECEPTACLE IS MOUNTED ON OUTPUT TERMINAL PANEL ASSY.
- ③ 20 AMP, 5-20R RECEPTACLE, P/N EE6131 (HBL5369C/HUBBLE RECEPTACLE).
- ④ CORD, CAROL 3/C 14 AWG., P/N EE56557.
- ⑤ RECEPTACLE IS MOUNTED UNDERNEATH CONTROL BOX.

# ENGINE BLOCK HEATER WIRING DIAGRAM



## NOTES:

- ① NEMA 5-15, 15A, 120 VAC (HBL5278C/HUBBLE RECEPTACLE)
- ② RECEPTACLE IS MOUNTED ON OUTPUT TERMINAL PANEL ASSY.
- ③ NEMA L5-20R, 20A, 125 VAC (HBL5369C/HUBBLE RECEPTACLE).
- ④ RECEPTACLE IS MOUNTED ADJACENT TO WATER HEATING ELEMENT.

# OPERATION MANUAL

## HERE'S HOW TO GET HELP

PLEASE HAVE THE MODEL AND SERIAL  
NUMBER ON-HAND WHEN CALLING

### **UNITED STATES**

#### ***Multiquip Corporate Office***

18910 Wilmington Ave.  
Carson, CA 90746  
Contact: mq@multiquip.com

Tel. (800) 421-1244  
Fax (310) 537-3927

#### ***MQ Parts Department***

800-427-1244  
310-537-3700

Fax: 800-672-7877

#### ***Service Department***

800-421-1244  
310-537-3700

#### ***Warranty Department***

800-421-1244  
310-537-3700

Fax: 310-943-2249

#### ***Technical Assistance***

800-478-1244

Fax: 310-943-2238

### **CANADA**

#### ***Multiquip***

4110 Industriel Boul.  
Laval, Quebec, Canada H7L 6V3  
Contact: infocanda@multiquip.com

Tel: (450) 625-2244  
Tel: (877) 963-4411  
Fax: (450) 625-8664

### **UNITED KINGDOM**

#### ***Multiquip (UK) Limited Head Office***

Unit 2, Northpoint Industrial Estate, Tel: 0161 339 2223  
Globe Lane, Fax: 0161 339 3226  
Dukinfield, Cheshire SK16 4UJ  
Contact: sales@multiquip.co.uk

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This manual MUST accompany the equipment at all times. This manual is considered a permanent part of the equipment and should remain with the unit if resold.

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