# OPERATION MANUAL

# WHISPERWATT™ SERIES
# MODEL
# DCA600SSV4F3
## 60 Hz GENERATOR
## (VOLVO PENTA TWD1672GE DIESEL ENGINE)

INSTRUCTION MANUAL NO. C4844304614

Revision #5 (11/25/25)

To find the latest revision of this publication or associated parts manual, visit our website at:
www.mqpower.com

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


WARNING
CANCER &
REPRODUCTIVE HARM
www.P65Warnings.ca.gov
P/N 38707

# DCA600SSV4F3
# 60 Hz Generator

## SAFETY DECALS

Safety decals are attached to the generator as shown in Figure 1. Keep these safety decals clean at all times. When the safety decals become worn or damaged, contact your nearest dealer or the Multiquip Parts Department.

**NOTICE**

For safety decal part numbers, refer to the associated parts manual.

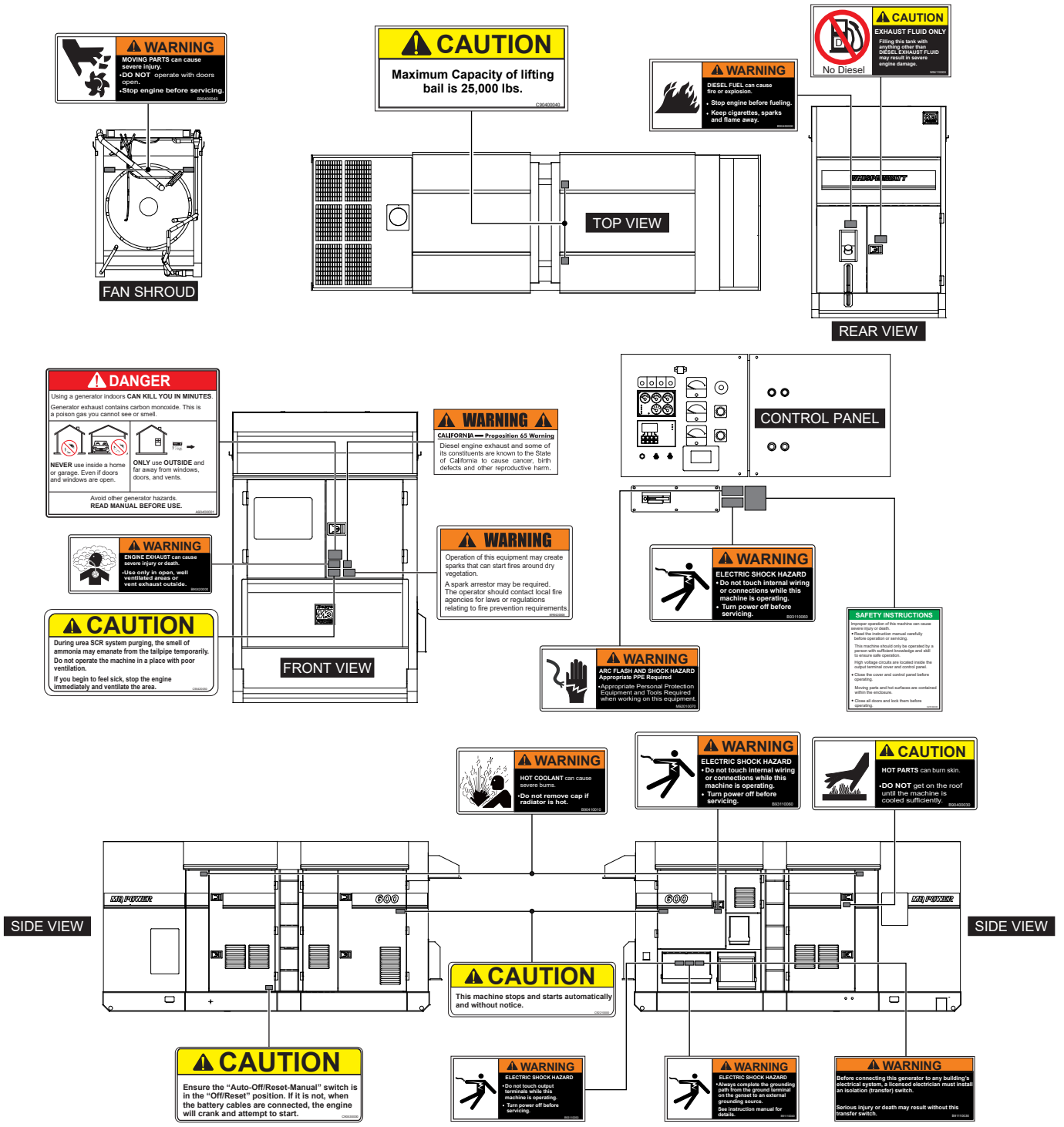



**Figure 1. Safety Decals**

Do not operate or service the generator before reading the entire manual. Safety precautions should be followed at all times when operating this generator. 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 generator 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 |

## GENERAL SAFETY

**⚠ CAUTION**

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

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

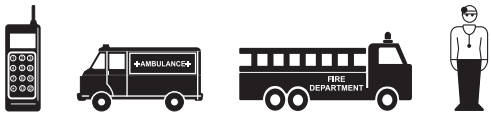
- **ALWAYS** check the generator for loosened threads or bolts before starting.
- **NEVER** use the generator for any purpose other than its intended purposes or applications.

***NOTICE***

- This generator 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 to read.
- Manufacturer does not assume responsibility for any accident due to equipment modifications. Unauthorized modification of the generator will void all warranties.
- **NEVER** use accessories or attachments that are not recommended by MQ Power for this generator. Damage to the generator and/or injury to the 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 generator 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** generator.

***NOTICE***

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

## 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 generator 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.

- When operating the generator outdoors, **DO NOT** place the generator near doors, windows or vents that could allow carbon monoxide to enter and build up in occupied spaces.

**⚠ WARNING**

- **NEVER** place hands or fingers inside the engine compartment when the 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.

- **NEVER** operate the generator with the doors open. Stop the engine before servicing.
- **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** drain the engine oil while the engine is hot. Hot oil will gush out and severely scald any persons near the generator.
- Operation of the generator may create sparks that can start fires around dry vegetation. A spark arrestor may be required. The operator should contact local fire agencies for laws or regulations relating to fire prevention requirements.

**⚠ CAUTION**

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

***NOTICE***

- **NEVER** run the engine without an air filter or with a dirty air filter. Severe engine damage may occur. Service the air filter frequently to prevent engine malfunction.
- **NEVER** tamper with the factory settings of the engine or engine governor. Damage to the engine or generator 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 30-35% 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.

## FUEL SAFETY

**⚠ DANGER**

- **NEVER** 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.
- **NEVER** fill the fuel tank while the engine is **running** or **hot**.
- **NEVER** overfill the fuel tank. Spilled fuel can 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.
- **NEVER** 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

**⚠ CAUTION**

- 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 the 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 that the trailer that supports the generator and the towing vehicle are both mechanically sound and in good operating condition.
- **ALWAYS** shut down the 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 the towing vehicle and the trailer. ***Inflate trailer tires as indicated on side wall of tire.*** Also check the tire tread wear on both vehicles.
- **ALWAYS** make sure the trailer is equipped with **safety chains**.
- **ALWAYS** properly attach the trailer's safety chains to the 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 the type of terrain.
- Avoid sudden stops and starts. These can cause skidding or jackknifing. Smooth, gradual starts and stops will improve towing.
- Avoid sharp turns to prevent rolling.
- The trailer should be adjusted to a level position at all times when towing.
- Raise and lock the trailer wheel stand in the upright position when towing.
- Place ***chock blocks*** underneath the wheels 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.

## ELECTRICAL SAFETY

**⚠ DANGER**

- **NEVER** touch the output terminals during operation. Contact with the 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 the generator and all circuit breakers **OFF** before performing maintenance on the generator or making contact with the output terminals.

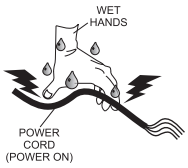
- **NEVER** insert any objects into the output receptacles during operation. This is extremely dangerous. The possibility exists of **electrical shock, electrocution or death**.

- 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 the generator. Inspect the insulation for cuts.




- **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 the proper power or extension cord has been selected for the job. See the 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 the 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.

- **NEVER** 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 gases.
- 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 the rules below:

- **NEVER** 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 the battery and bring it to an 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 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.

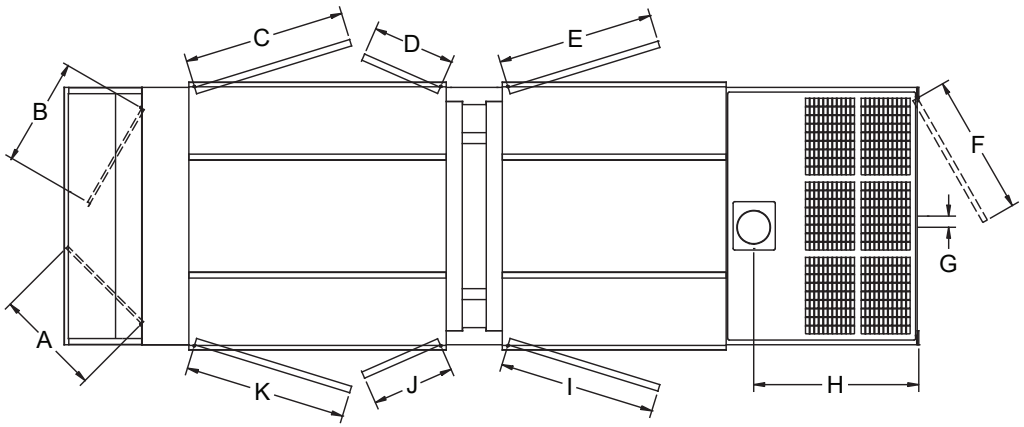
| Table 1. Generator Specifications | |
|---|---|
| **Model** | DCA600SSV4F3 |
| **Type** | Revolving field, self-ventilated, open protected type synchronous generator |
| **Armature Connection** | Star with neutral |
| **Phase** | 3 |
| **Standby Output** | 528 kW (660 kVA) |
| **Prime Output** | 480 kW (600 kVA) |
| **3Ø Voltage (L–L)** | 208, 220, 240, 416, 440, 480<br>(Reconnectable) |
| **1Ø Voltage (L–N)** | 120, 127, 139, 240, 254, 277<br>(Adjustable) |
| **Voltage Change-Over Board Tie Bolt Torque** | 1088.6 lbf·in (123.0 N·m) |
| **Power Factor** | 0.8 |
| **Frequency** | 60 Hz |
| **Speed** | 1,800 rpm |
| **Aux. AC Power** | Single phase, 60 Hz |
| **Subtransient (2/3 Pitch)** | 0.067 |
| **Transient (2/3 Pitch)** | 0.171 |
| **Synchronous (2/3 Pitch)** | 1.451 |
| **Zero Sequence Reactance (2/3 Pitch)** | 0.007 |
| **Overload Protection (2/3 Pitch)** | OCR / main circuit breaker |
| **Aux. Voltage/Output** | 120V / 4.8 kW (2.4 kW × 2) |
| **Dry Weight** | 17,574 lb. (7,971 kg) |
| **Wet Weight** | 19,117 lb. (8,671 kg) |

| Table 2. Engine Specifications | | |
|---|---|---|
| **Model** | Volvo Penta TWD1672GE | |
| **Type** | 4-cycle, water-cooled, direct injection, turbocharged with water-cooled charge air cooler | |
| **No. of Cylinders** | 6 | |
| **Bore × Stroke** | 5.66 in. × 6.49 in. (144 mm × 165 mm) | |
| **Displacement** | 984 cu. in. (16.12 liters) | |
| **Rated Output** | 713 hp at 1,800 rpm | |
| **Starting** | Electric | |
| **Coolant Capacity** | 26.1 gal. (99 liters)[1] | |
| **Lube Oil Capacity** | 12.7 gal. (48 liters)[2] | |
| **Lube Oil Type** | Volvo VDS-3 | |
| **DEF Tank Capacity** | 84.5 gal. (320 liters) | |
| **Fuel Tank Capacity** | 52.8 gal. (200 liters) | |
| **Fuel Type** | #2 diesel fuel (ultra low sulfur diesel fuel only) | |
| **Fuel Consumption** | 31.7 gal. (120 L)/hr. at **full load** | 24.4 gal. (92.4 L)/hr. at **3/4 load** |
| | 17.9 gal. (68.0 L)/hr. at **1/2 load** | 11.3 gal. (42.7 L)/hr. at **1/4 load** |
| **Battery** | 12V 200Ah × 2 (24V system) | |

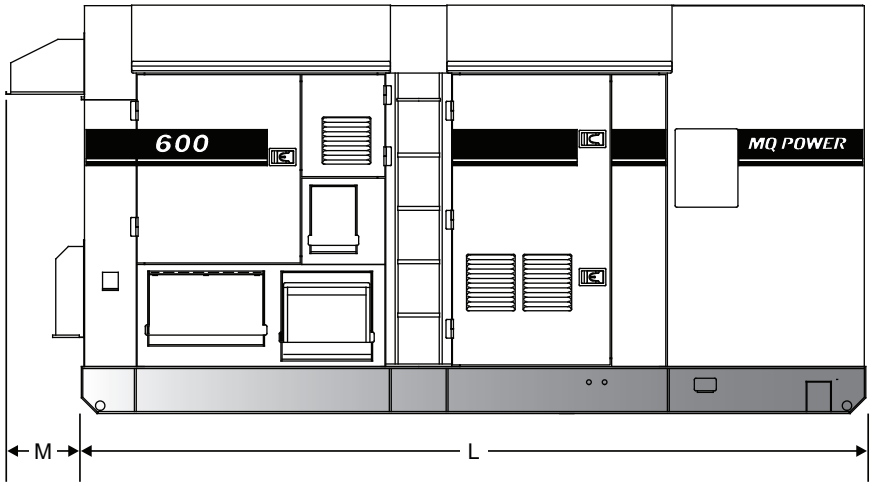
[1] Includes engine, radiator and sub tank with hoses.

[2] Includes filters.

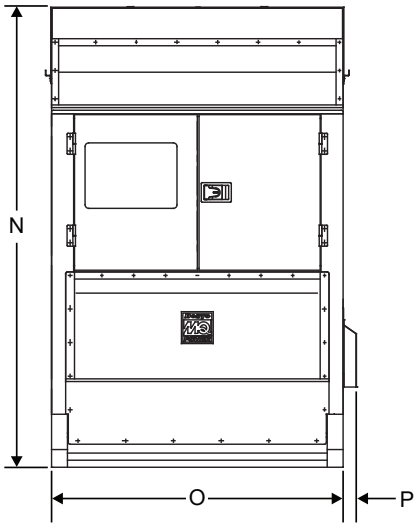
**TOP VIEW**




**SIDE VIEW**




**REAR VIEW (CONTROL PANEL VIEW)**




| Table 3. Dimensions | | | |
|---|---|---|---|
| **Reference Letter** | **Dimension in. (mm)** | **Reference Letter** | **Dimension in. (mm)** |
| A | 26.97 in. (685 mm) | I | 39.57 in. (1,005 mm) |
| B | 27.36 in. (695 mm) | J | 20.87 in. (530 mm) |
| C | 40.94 in. (1,040 mm) | K | 40.94 in. (1,040 mm) |
| D | 20.87 in. (530 mm) | L | 196.85 in. (5,000 mm) |
| E | 39.57 in. (1,005 mm) | M | 18.90 in. (480 mm) |
| F | 35.43 in. (900 mm) | N | 102.49 in. (2,603 mm) |
| G | 2.82 in. (72 mm) | O | 64.96 in. (1,650 mm) |
| H | 41.67 in. (1,058 mm) | P | 2.95 in. (75 mm) |

**Figure 2. Dimensions**

## GENERATOR GROUNDING

**ALWAYS** refer to Article 250 (Grounding and Bonding) of the National Electrical Code (NEC).

> ***NOTICE***
>
> **ALWAYS** check with state, province, district, and municipalities for electrical grounding requirements before using the generator.

**EXAMPLE of how to ground the unit (Figure 3) if the condition of use requires such a device:**

### Connecting The Ground

Consult with local electrical and safety codes for proper connection based on condition of use. Refer to the Conductor Grounding Table, Article 250 of the NEC handbook.

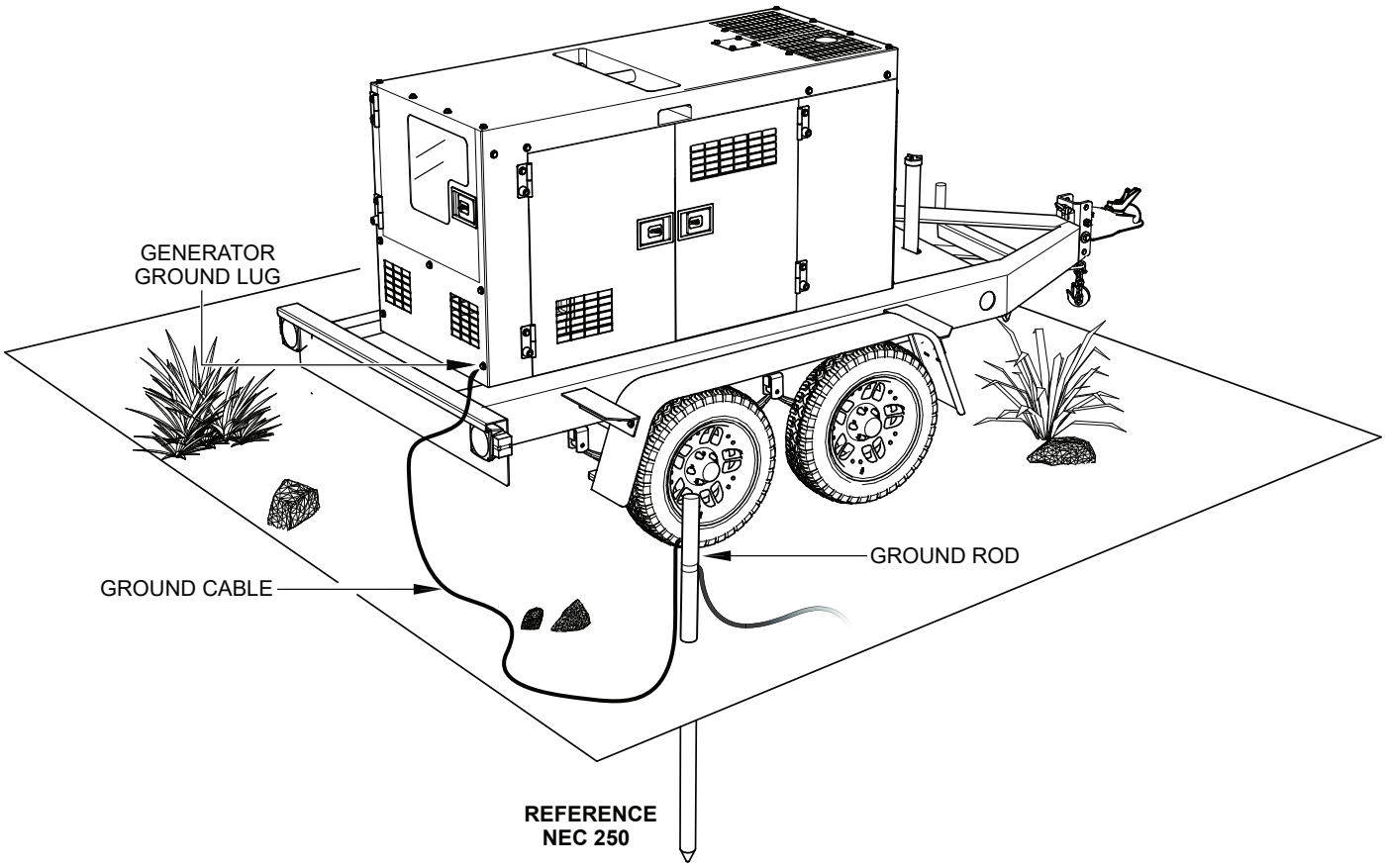



**Figure 3. Typical Generator Grounding Application**

> ***NOTICE***
>
> Trailer-mounted generators are the sole responsibility of MQ Power.

## OUTDOOR INSTALLATION

Install the generator in an 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 so 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 be mounted at least 6 inches above the floor or grade level as referenced in the National Fire Protection Association handbook (NFPA 110, Chapter 7, Section 7.4).

**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

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

## CONTROL AND OPERATION PANEL

The **control and operation panel** is provided with the following:

- ECU Controller with Gauge Unit Assembly
  - Oil Pressure Gauge
  - Water Temperature Gauge
  - Tachometer
  - Charging Voltmeter
  - Generator Load Gauge
  - Fuel Level Gauge / Low Fuel Warning Lamp
  - DEF Level Gauge / Refill DEF Lamp
  - Emission Aftertreatment System (EATS) Error Lamp
  - EATS System Malfunction Lamp
  - Emission Related Malfunction Lamp
- Pre-Alarm Lamp
- Air Filter Alarm Lamp
- Engine Speed Switch
- Battery Switch (Located in engine compartment)
- Auto Start/Stop Switch
- Shutdown Lamp
- Frequency Meter (Hertz)
- AC Ammeter (Amps) / Ammeter Change-Over Switch
- AC Voltmeter (Volts) / Voltmeter Change-Over Switch
- Voltage Regulator
- Panel Light / Panel Light Switch
- Hour Check Button
- 3-Pole, 1600-Amp Main Circuit Breaker
- **Control Box** (Located behind generator control panel)
  - Automatic Voltage Regulator
  - Current Transformer
  - Overcurrent Relay
  - Voltage Rectifier
  - Starter Relay
  - Voltage Change-Over Board
  - FT4 Display (CIM)

## OUTPUT TERMINAL PANEL

The **output terminal panel** is provided with the following:

- Two 120-Volt Output Receptacles (GFCI), 20A
- Two GFCI Circuit Breakers, 20A
- Four Output Terminal Boards (3Ø Power)
- Ground Terminal
- Engine Block Heater (Option)
- Battery Charger (Option)
- Cam-Lok Connectors (Option)

## OPEN-DELTA EXCITATION SYSTEM

Each generator is equipped with a state-of-the-art, **open-delta** excitation system. The open-delta system consists 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 provide 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 to the demands of the required load.

## ENGINE

This generator is powered by a 4-cycle, water-cooled, turbocharged Volvo TWD1672GE diesel engine. This engine is designed to meet every performance requirement for the generator. Refer to 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 speed (RPM) of the engine. When the engine demand increases or decreases, the governor system regulates the frequency variation to ± 0.25%.

## EXTENSION CABLES

When electrical 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 8) as a guide for selecting the proper extension cable size.

***NOTICE***

When the paralleling option is employed, the Basler DGC-2020HD controller must be installed. The factory-installed ECU-845 controller cannot be used for paralleling.

## PARALLELING

Paralleling is the sharing of a load between two or more generator sets.

## LOAD SHARING

Load sharing is defined as the proportional division of the **kW** and **kVAR** total load between multiple generator sets in a paralleled system.

Load sharing is essential to avoid overloading and stability problems on the system's generator sets.

## ACTIVE POWER (KW) LOAD SHARING

When generator sets operate in parallel, the engine speed governor of each generator set determines the proportional sharing of the total active power requirements (kW) of the systems.

The kW load sharing is achieved by increasing or decreasing fuel to the system's engines. As the fuel to the engine of one generator set in a group is increased, it will not lead to an increase in speed and hence frequency (as it would if it were operating alone), but will lead to an increase in the proportion of the total kW load that it will deliver.

As the fuel to the engine of one generator set in a group is decreased, it will not lead to a decrease in speed and hence frequency (as it would if it were operating alone) but it will lead to a decrease in the proportion of the total kW load that it will deliver.

The control system of the generator sets (via the engine speed control system) monitors and controls the sharing of the total kW load in proportion to the relative rating of the engines on the system's generator sets.

## REACTIVE POWER (KVAR) LOAD SHARING

When generator sets operate in parallel, the alternator field excitation system of each generator set controls the proportional sharing of the total reactive power requirements (kVAR) of the system.

The kVAR load sharing is achieved by increasing or decreasing the field excitation to the system's alternators.

As the field excitation of one generator set in a group is **increased** (i.e. over excited) it will **not** lead to an increase in voltage (as it would if it were operating alone) but will lead to an increase in the proportion of the total kVAR load it will deliver and a decrease in its power factor.

As the field excitation of one generator set in a group is **decreased** (i.e. under excited) it will **not** lead to a decrease in voltage (as it would if it were operating alone) but will lead to a decrease in the proportion of the total kVAR load it will deliver and an increase in its power factor.

An undesirable circulating reactive current (cross current) will flow in the system if the excitation of the alternators is not matched.

## ETHERNET COMMUNICATION

Ethernet is the preferred communication method for paralleling. This method supports breaker negotiation to avoid simultaneous breaker closures, kW load sharing and kVAR sharing, soft load transfers, and on and off loading.

The ethernet ports are located at the output bus splash panel area. There are two identical ports—either one can be used. Using a standard ethernet cable, interconnect the units to be paralleled and or sequenced.

## LOAD MANAGEMENT

These generators are set up to automatically manage load based on demand. Load management is only functional in **Auto mode**. While in Auto mode, if the auto-start contacts are closed, load management is active by default. Load management will only run the number of units needed to support the load.

If the load demand is small, only one generator will run while the other generators remain in Standby mode. If the load increases above 80% of its capacity, it will start the next generator. The next generator priority is based on the time remaining on the maintenance timer.

Generators with more time until scheduled maintenance will take priority over units that are almost due for maintenance. Once the second unit starts, it will synchronize and parallel in, then ramp up to share the load. If the load levels drop below 35% of its combined rating, the generator that is no longer needed will ramp off, shut down and wait in standby mode.

## SEQUENCING

**NOTICE**

Ethernet communication is required when the generators are configured for the Sequencing mode of operation.

These generators are capable of sequencing for control of balanced maintenance schedules. As described above, these generators can start and stop as demand raises or lowers. In addition, if a unit gets to the point of maintenance, it will ramp off and start the next generator to relieve it based on the time remaining on the maintenance timer.

After maintenance is performed, the maintenance timers should be reset to the recommended service interval. This is usually 250 hours depending on the engine oil type.

## MAINTENANCE INTERVAL

Maintenance intervals are factory set for 250 hours. The maintenance interval timer will count down to zero, indicating that it is time for the unit to be serviced.

Once the timer counts down to zero, a pre-alarm will appear indicating that the unit is due for maintenance. To reset the maintenance interval back to the default time of 250 hours, press and hold the **Reset button** for ten seconds.

To reset the maintenance interval using the Reset button, the **Maintenance Due pre-alarm** must be active, and the Basler controller must display the **Overview (main) screen**.

If the maintenance timer has not yet expired and it is desired to reset the unit back to 250 hours, navigate back to the **Settings menu**. Settings Menu->System Parameters->Engine Statistics->Hours To Maintenance.

## ALARM SILENCE

**Pre-Alarm Silence** allows the user to suppress the toggling of the alarm screen when a new pre-alarm becomes active. While a pre-alarm is active, press the **Alarm Silence button** to suppress the fault display.

This happens to be a very handy function whenever the **Maintenance Interval pre-alarm** occurs. Right after the pre-alarm occurs, it will begin toggling between the pre-alarm and the **Overview screen**.

While in this mode, pressing the **Reset button** does not reset the maintenance interval. In order to reset the maintenance interval, the Overview screen must be selected.

Press the Alarm Silence button to stop the toggling between the pre-alarm and the Overview screen.

Once the Overview screen is selected, reset the maintenance interval by pressing and holding the Reset button for 10 seconds.

## THREE PHASE 480V/208V PARALLEL WIRING VIA OPTIONAL CAM-LOKS

### Required Equipment (User Supplied)

- Conductor cables
- CAT5E or better shielded cable
- Power distribution panel

The following procedure is intended to assist the user with the parallel wiring configuration for the generator using the optional cam-lok connector panel.

**NOTICE**

Only a **qualified service technician** or **licensed electrician** with proper training should perform this installation. Follow all shop safety rules when performing this installation.

### Preparation

1. Make sure the generator is turned **OFF** and the engine is cool.
2. Disconnect any loads connected to the generator.
3. Place the main circuit breaker in the **OFF** position.
4. Place the generator in an area free of dirt and debris. Make sure it is on secure, level ground.
5. Disconnect the **negative** battery cable from the battery.

### 3-Phase 480-Volt AC Parallel Wiring Configuration

Use appropriately sized cables when connecting two generators to the power distribution panel. Refer to the NEC handbook for correct sizing of cables. Contact a licensed electrician for correct electrical wiring configuration.

**DANGER**

To prevent arcing, make sure cables are securely tightened at the power distribution panel. The possibility exists of the unit catching on fire thus causing equipment damage and severe bodily harm.

**NOTICE**

When connecting load cables to the power distribution panel, be sure to select correctly sized load cables to handle the full-load amperage of both generators (in parallel).

### 3-Phase 208-Volt AC Parallel Wiring Configuration

Use appropriately sized cables when connecting two generators to the power distribution panel. Refer to the NEC handbook for correct sizing of cables. Contact a licensed electrician for correct electrical wiring configuration.

### Ethernet Cable Connection

1. Connect a shielded CAT5E ethernet cable between port 1 on both generators as shown in Figure 4.

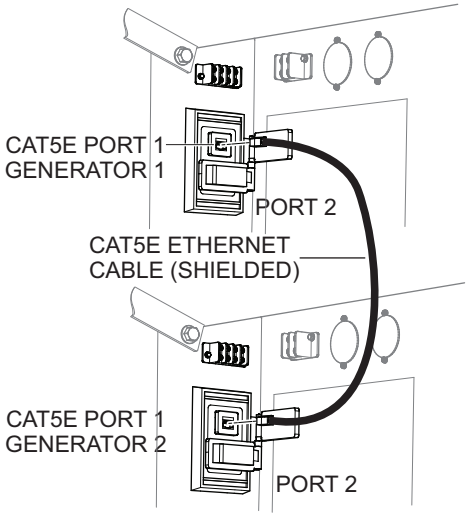


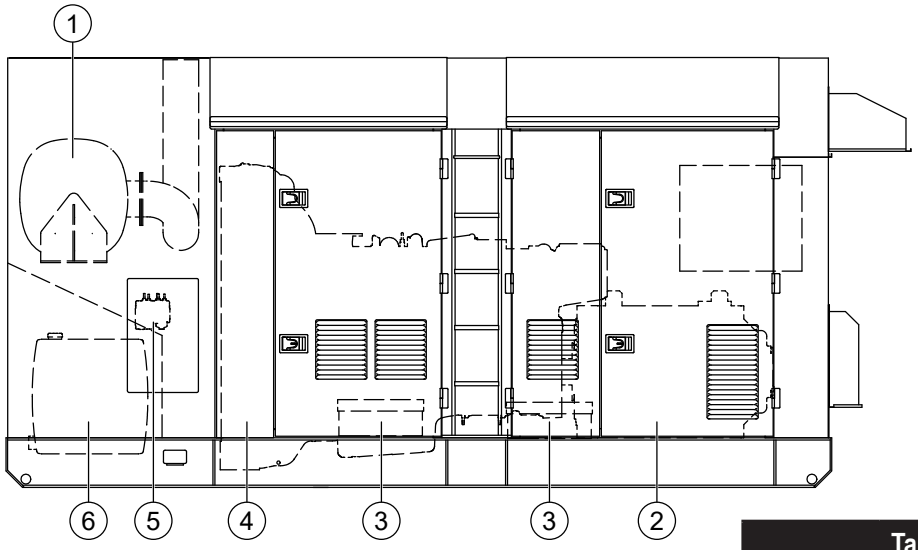

**Figure 4. Ethernet Cable Connection**

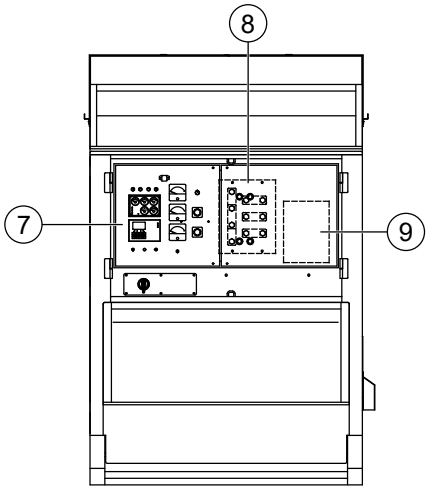
2. Refer to Table 4 for additional ethernet port connections.

**Table 4. Ethernet Cable Connections**

| Generator 1 | Generator 2 |
|---|---|
| Port 2 | Port 1 |
| Port 1 | Port 2 |
| Port 2 | Port 2 |

3. Reconnect the battery.
4. Start the generator as shown in the ***Generator Start-Up Procedure*** section of this manual.




| Table 5. Major Components | |
|---|---|
| **ITEM NO.** | **DESCRIPTION** |
| 1 | Muffler Assembly |
| 2 | Generator Assembly |
| 3 | Battery Assembly |
| 4 | Engine and Radiator Assembly |
| 5 | Aftertreatment Control Module Assembly |
| 6 | DEF Tank Assembly |
| 7 | Control and Operation Panel Assembly |
| 8 | Voltage Change-Over Board Assembly |
| 9 | Main Circuit Breaker Assembly |
| 10 | Emergency Stop Switch Assembly |
| 11 | Fuel Tank Assembly |
| 12 | Output Terminal Panel Assembly |

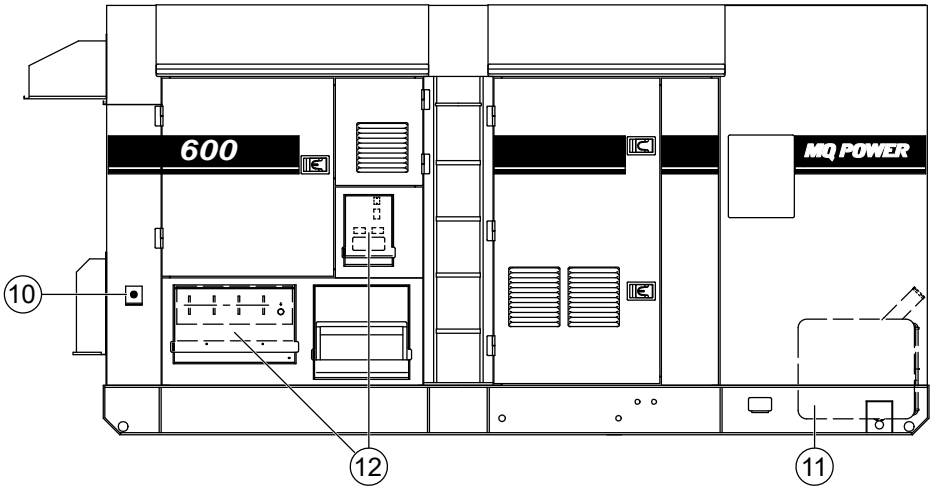



**Figure 5. Major Components**

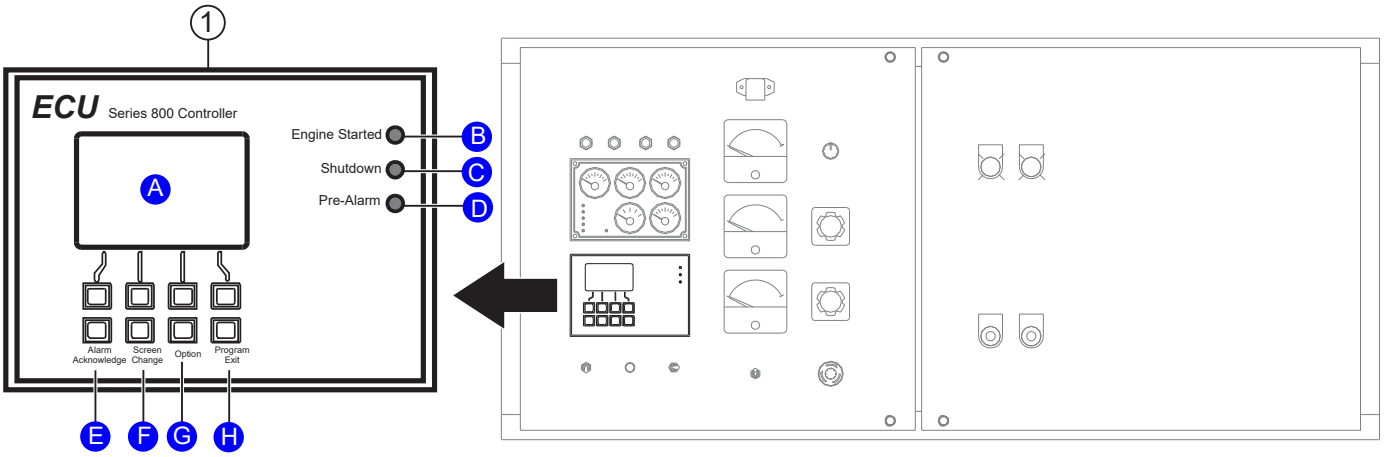



**Figure 6. Engine Control Unit (ECU-845)**

The definitions below describe the controls and functions of the **engine control unit (ECU)**. See Figure 6.

1. **ECU-845 Controller** — This engine-generator controller displays parameters and diagnostic trouble codes for the engine.

   The controller also displays symbols and indications related to the exhaust gas after-treatment system (DOC/SCR), including the diesel exhaust fluid (DEF) level in the DEF tank.

   a. **ECU Display Screen** — Engine fault diagnostic messages are shown on this LCD screen.

   b. **Engine Started Lamp** — When lit, indicates the engine is operating normally.

   c. **Engine Shutdown Lamp** — When an engine failure has occured this lamp will flash, indicating the engine has shut down. The diagnostic trouble code will be displayed on the LCD screen.

   d. **Pre-Alarm Lamp** — When an engine failure has occurred this lamp will flash, indicating a pre-fault engine condition and the possibility of engine shutdown.The diagnostic trouble code will be displayed on the LCD screen.

   e. **Alarm Acknowledge Button** — When the engine experiences a fault, the Pre-Alarm lamp or the Shutdown lamp will start flashing. Pushing this button will confirm the fault message and the flashing lamp will change to a solid lamp display. The fault message will be displayed on the screen. When multiple engine faults occur, the lamp will continue flashing until all fault messages are confirmed. The flashing lamp will change to a solid lamp display and all current confirmed fault messages will scroll across the screen.

   f. **Screen Change Button** — When this button is pushed during operation, the screen (Figure 7) will cycle through main and secondary parameter screens.

| | VOLTS | | AMPS |
|---|---|---|---|
| **UO** 277 | **UV** 480 | **U** 722 |
| **VO** 277 | **VW** 480 | **V** 722 |
| **WO** 277 | **WU** 480 | **W** 722 |
| | **480 kW** | 600 **kVA** |
| | 60.0 **Hz** | 00100.0 **h** |

ENGINE GENERATOR SYSTEM OK

**Figure 7. Generator Parameter Screen**

> ***NOTICE***
>
> The screen shown in Figure 7 represents the phase voltages for each phase to neutral (UO, VO and WO) and the line voltages between each phase (UV, VW and WU).

   g. **Option Button** — This button is not active. Do not use.

   h. **Program/Exit Button** — Push this button from the home screen to enter the main menu.

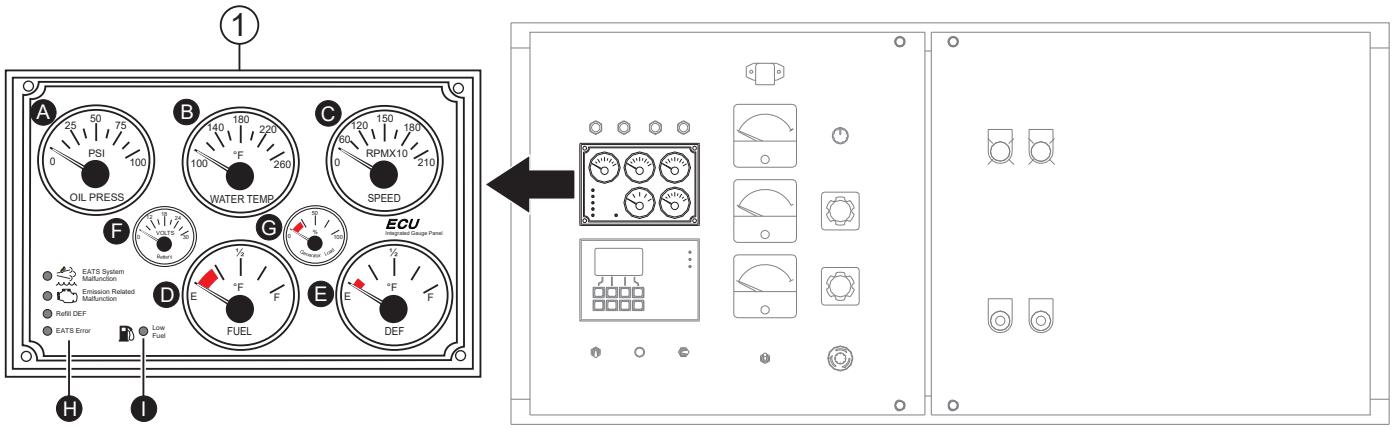



**Figure 8. Gauge Unit Assembly**

The definitions below describe the readouts and functions of the **gauge unit assembly** (Figure 8).

1. **Gauge Unit Assembly** — This assembly houses the various engine monitoring gauges. These gauges indicate: oil pressure, water temperature, charging voltmeter, generator load, fuel level, DEF level and engine speed RPM (tachometer).

    a. **Oil Pressure Gauge** — During normal operation, this gauge should read approximately 44 psi (300 kPa). When starting the generator, the oil pressure may read a little higher but after the engine warms up, the oil pressure should return to the correct pressure range.

    b. **Water Temperature Gauge** — During normal operation this gauge should read between 185° and 207°F (85°–97°C).

    c. **Tachometer** — Indicates engine speed in RPM for 60 Hz operation. This meter should indicate 1,800 RPM when the rated load is applied.

    d. **Battery Voltmeter Gauge** — During normal operation this gauge indicates a minimum 14 VDC.

    e. **Generator Load Gauge** — Indicates the generator load rate. It is recommended the load be above the red area (20%) for maintaining sufficient exhaust temperature.

    f. **Fuel Gauge** — Indicates the amount of diesel fuel available. The red area in the gauge indicates a low fuel level (20%).

    g. **DEF Gauge** — Indicates the amount of diesel exhaust fluid available. The red area in the gauge indicates a low DEF level (10%).

    h. **Exhaust System State Indicator Lamps** — Lamps illuminate when the engine is at Exhaust System State or DEF state. Refer to the ***Maintenance*** section of this manual for more detailed information.

    i. **Low Fuel Warning LED** — When ON (lit) indicates that the fuel level is low.

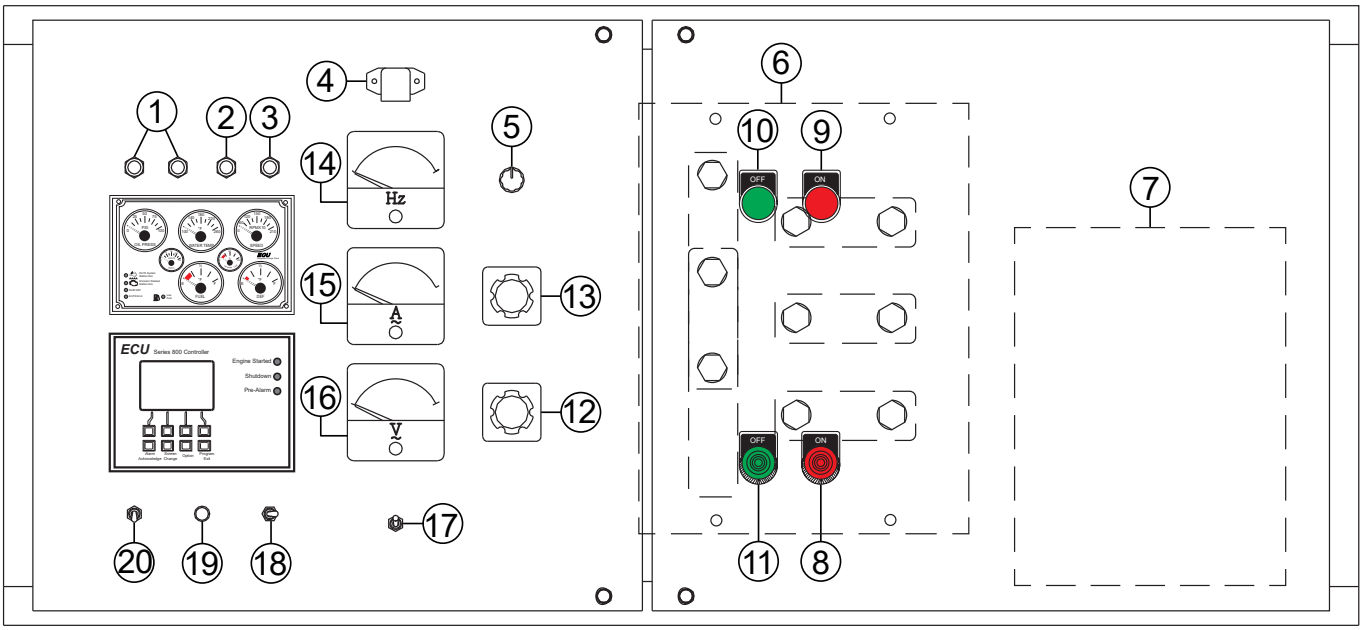



**Figure 9. Control And Operation Panel**

The definitions below describe the controls and functions of the **control and operation panel** (Figure 9).

1. **Air Filter Alarm Lamp** — This yellow LED turns on when the air filter element is clogged. If the lamp turns on during operation, clean or replace the element immediately.
2. **Pre-Alarm Lamp** — This yellow LED turns on when engine or generator failure occurs during operation. Confirm the existing warning message displayed on the engine-generator controller by pushing the Alarm Acknowledge button. The lamp will turn off when all warning messages have been confirmed.
3. **Shutdown Lamp** — This red LED turns on when the unit shuts down due to engine failure.
4. **Panel Light** — For operation at night, the panel light illuminates the control panel for ease of reading meters and gauges.
5. **Voltage Regulator** — Allows ± 15% manual adjustment of the generator's output voltage.
6. **Voltage Change-Over Board** — Six jumper plates that allow the generator to be configured for 3-phase, 240 or 480 VAC output. Located inside the control box.
7. **Main Circuit Breaker** — This 3-phase, 1600-amp, main circuit breaker is provided to protect the U, V, and W output terminal lugs from overload. Located inside the control box.
8. **Circuit Breaker ON Switch** — Closes the main circuit breaker contacts.
9. **Circuit Breaker ON Lamp** — Illuminates (red) when the main circuit breaker contacts are closed.
10. **Circuit Breaker OFF Lamp** — Illuminates (green) when the main circuit breaker contacts are open.
11. **Circuit Breaker OFF Switch** — Opens the main circuit breaker contacts.

12. **Voltmeter Change-Over Switch** — Allows the AC voltmeter to indicate phase-to-phase voltage between any two phases of the output terminals, or to be switched off.
13. **Ammeter Change-Over Switch** — Allows the AC ammeter to indicate the current flowing to the load connected to any phase of the output terminals, or to be switched off. This switch does not affect the generator output in any fashion, it is for current reading only.
14. **Frequency Meter** — Indicates the output frequency in hertz (Hz). Normally 60 hertz.
15. **AC Ammeter** — Indicates the amount of current the load is drawing from the generator per leg as selected by the ammeter change-over switch.
16. **AC Voltmeter** — Indicates the output voltage present at the U,V, and W output terminal lugs.
17. **Engine Speed Switch** — This switch controls the speed of the engine, low or high.
18. **Auto Start/Stop Switch** — Use this switch to start and stop the engine. The engine will start immediately when this switch is set to the Manual position. To stop the engine after operation or to perform fault inspections, set the switch to the center Off/Reset position and the engine will stop. For remote starting, set the switch to the Auto position.
19. **Hour Check Button** — With the engine stopped, press and hold this button to display engine functions such as total running hours, fuel level, and diagnostic trouble codes on the engine-generator controller and gauge unit assembly.
20. **Panel Light Switch** — Use this switch to turn the panel light on or off. Make sure the panel light switch is in the OFF position when the panel light is not needed.

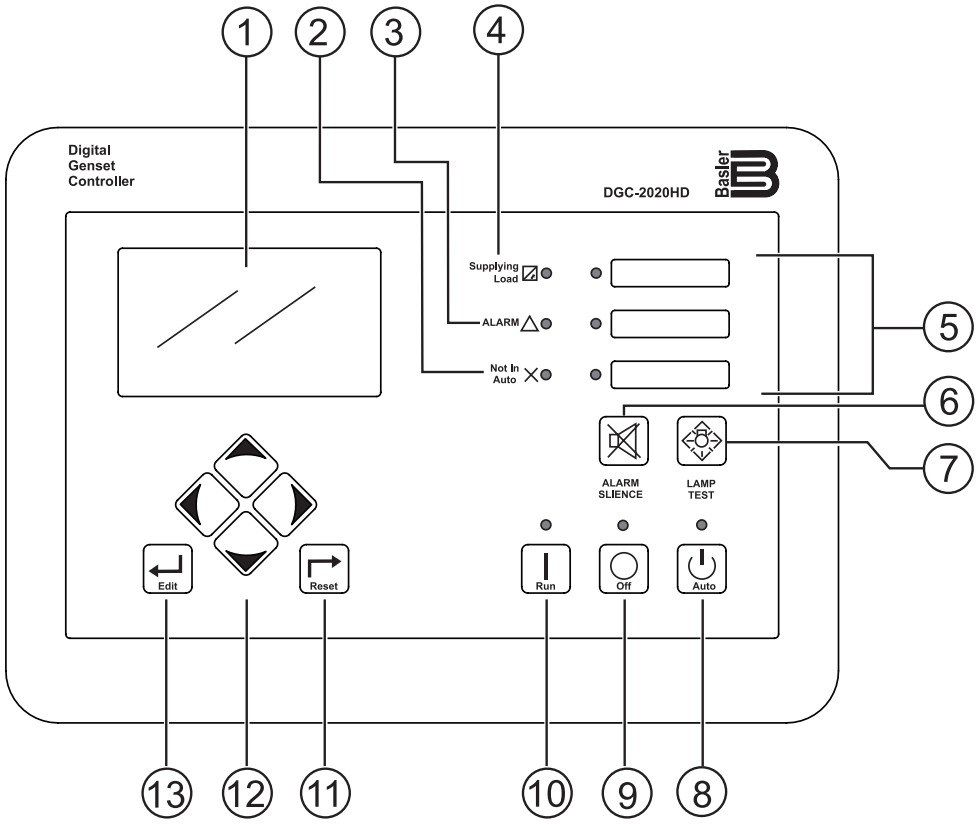



**Figure 10. Basler DGC-2020HD Controller**

***NOTICE***

The Basler DGC-2020HD controller is an **option**. It replaces the standard ECU-845 controller when paralleling is to be employed.

The definitions below describe the controls and functions of the digital genset controller (Figure 10).

1. **LCD Display** — Display consists of an LCD color touch screen. The backlit, 272 × 480 pixel, color LCD serves as the local information source for metering, alarms, pre-alarms and protective functions. Touch-screen capability provides convenient navigation through metering and settings. Display operation is maintained down to –4°F (−20°C).
2. **Not In Auto Indicator** — This red LED lights whenever the DGC-2020HD is **not** operating in **Auto mode**.
3. **Alarm Indicator** — This red LED lights continuously during alarm conditions and flashes during pre-alarm conditions.
4. **Supplying Load Indicator** — This green LED lights whenever the generator current is greater than the emergency power supply (EPS) threshold current.
5. **Voltage Selection Indicators** — These three LEDs light to indicate the selected voltage. The **upper** lamp indicates **3-phase, 480-volt** operation. The **middle** lamp indicates **3-phase, 240-volt** operation. The **lower** lamp indicates **idle running** operation.
6. **Alarm Silence Pushbutton** — Press this button to open the relay output programmed as the horn output.
7. **Lamp Test Pushbutton** — Press this button to test the DGC-2020HD indicators by exercising all LCD pixels and lighting all LEDs.
8. **Auto Pushbutton and Mode Indicator** — Press the **Auto button** to place the DGC-2020HD in **Auto mode**. The green **Auto Mode LED** lights when Auto mode is active.

   While in Auto mode, if the unit's auto-start contacts are connected to a transfer switch and the contacts between the terminals are closed, the unit will start and automatically close the circuit breaker.

   If running in parallel, the Basler controller will command the unit to start and close the breaker based on load demand. If a failure occurs with another generator in the paralleled system, the controller will start and synchronize, then close the motorized breaker to electrically lock the unit in parallel.

   If the bus is dead it will immediately close the circuit breaker to provide power to the load(s). If the bus is already hot from another generator it will first synchronize, then close its breaker, then slowly ramp up to share load if load is present.
9. **Off Pushbutton and Mode Indicator** — Press this button to place the DGC-2020HD in **Off mode**.The red **Off Mode LED** lights whenever the DGC-2020HD is in Off mode.
10. **Run Pushbutton and Mode Indicator** — Press this button to place the DGC-2020HD in **Run mode**. The green **Run Mode LED** lights whenever Run mode is active.
11. **Reset Pushbutton** — Press this button to cancel a settings editing session and discard any settings changes. When pressed momentarily, this button resets the **Breaker Management pre-alarms**. This button is also used to reset the maintenance interval when pressed for 10 seconds while viewing **Hours Until Maintenance** or the **Maintenance Due pre-alarm**.
12. **Arrow Pushbuttons** — These four buttons are used to navigate through the front panel display menus and to modify settings.
    - The **Left Arrow and Right Arrow buttons** are used to navigate through the menu levels. Press the **Right Arrow button** to move **downward** through the menu levels and press the **Left Arrow button** to move **upward** through the menu levels.
    - The **Up Arrow and Down Arrow buttons** are used to move among items within a menu level. Press the **Down Arrow button** to move to items lower on the list. Press the **Up Arrow button** to move to items higher on the list.
    - During a settings editing session, the Up Arrow and Down Arrow buttons are used to increase and decrease the value of the selected setting. The Right Arrow and Left Arrow buttons move to different digits.
13. **Edit Pushbutton** — Press the **Edit pushbutton** to start an editing session and enable changes to the DGC-2020HD settings. At the conclusion of an editing session, press this button again to save the setting changes.

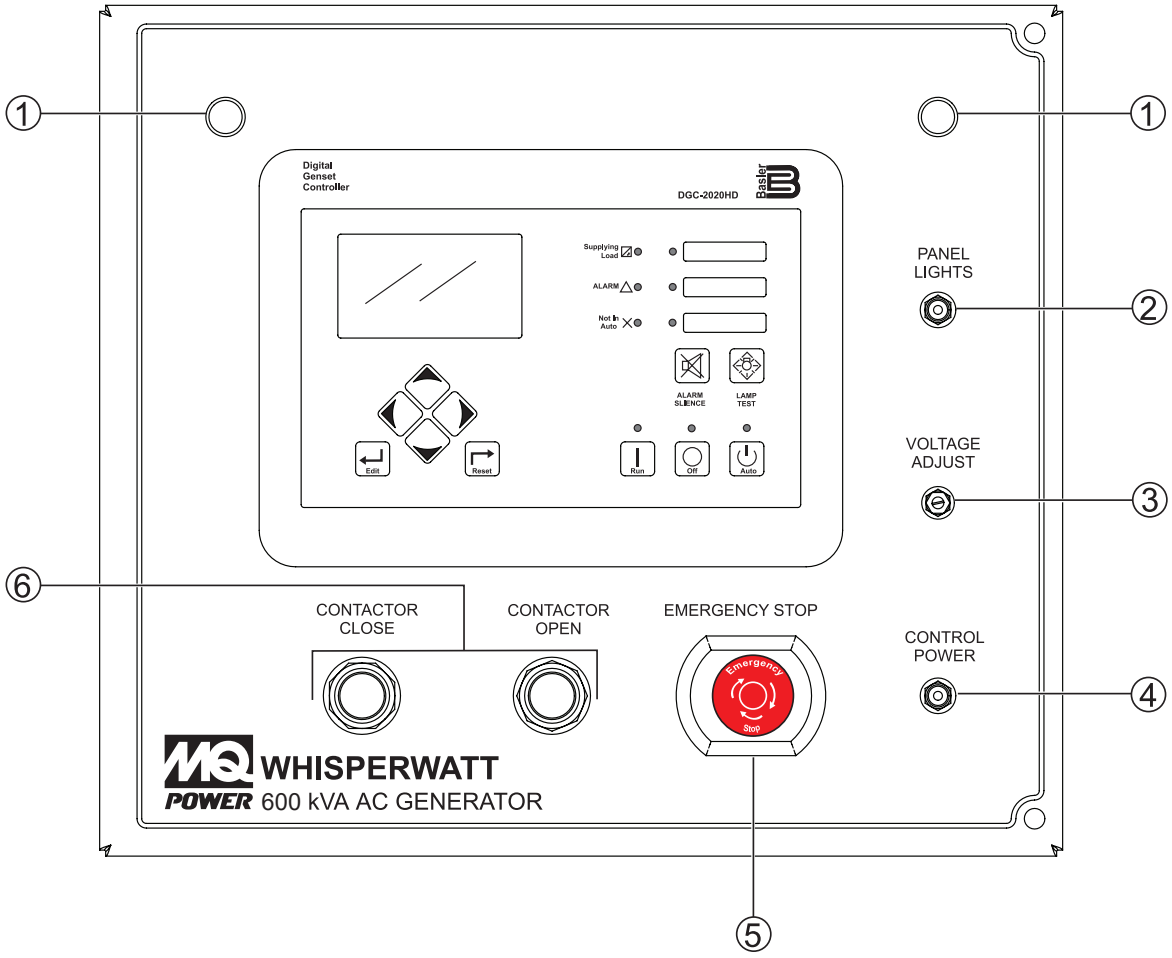



**Figure 11. Paralleling Panel Components**

The definitions below describe the controls and functions of the paralleling panel (Figure 11).

1. **Panel Lights** — For operation at night or in dark areas, the panel lights illuminate the paralleling panel for ease of viewing.

2. **Panel Light Switch** — Activates/deactivates the control panel lights.

3. **Voltage Adjust Potentiometer** — Used for fine-tuning the voltage up or down. The adjustment sends a signal to the controller to offset the system rated voltage (trim voltage). It is important that all machines are set to the same value when paralleling.

   When first turning on the control power, the controller will begin its boot sequence much like a computer does. After completing the boot sequence, the unit will be ready to run or be placed in Auto mode for auto-start applications.

4. **Control Power Toggle Switch** — The control power toggle switch is a master power switch for the digital controller. The switch has a latch feature that prevents powering down of control power while the engine is running.

5. **Emergency Stop Button Switch** — The **Emergency Stop pushbutton switch** is used to stop the engine in case of emergency or to lock out operation during service. The Emergency Stop button **should not be used for routine stopping of the engine**.

   Actuation of the Emergency Stop button while the control power is on will illuminate the light on the button and display 'Emergency Stop' on the controller screen. Actuating the Emergency Stop button will de-energize all controller outputs and cause the engine to stop, as well as trip the circuit breaker. This condition is a latched condition that must be reset prior to restarting the engine.

   The procedure for resetting the emergency stop requires several actions. Rotate the Emergency Stop button to release the spring latch. To clear the latch, press the **Off button** to place the controller in **Off mode**. While in Off mode, press the **Reset button** to clear the **E-STOP** fault.

   For units with manually operated breakers, the breaker will need to be reset by toggling the handle down, then turning back to the **ON** position. On models with spring-charged breakers, resetting the breaker is not necessary.

6. **Contactor Operation (Manual Mode)** — For manual-run applications, user action is required to get the generator power to the output bus. Depending on the model, some utilize contactors in series with toggle-handle circuit breakers and others have spring-charged automatic circuit breakers.

   On the spring-charged types, the buttons on the breaker itself are not intended for circuit breaker operation. For instructional purposes both will be referred to as 'contactor.'

   There are two pushbuttons on the control panel for controlling the contactor. There is a green **Close Contactor button** to close the contactor and a red **Open Contactor button** to open the contactor. These buttons illuminate to show the contactor status. If the contactor is open, the red Open Contactor button will be illuminated. If the contactor is closed, the green Close Contactor button will be illuminated.

   These buttons can sometimes be multifunctional depending on the situation. For stand-alone operation the buttons simply close and open the contactor as expected. For paralleling the buttons can act a little different.

   When the bus is already hot from another generator, pressing the green **Online button** will initiate a synchronizing sequence before closing the contactor. There will be an image of a synchroscope on the controller display and when the voltage and phases are matched, the contactor will close.

   If there is already load on the bus, the unit will slowly ramp up load until it is sharing equally with the other generator(s). While sharing load with other generator(s), press the red Open Contactor button **once** to initiate a ramp-down sequence. The unit will begin to ramp down and will automatically open its contactor when at a low level of load. Pressing the red Open Contactor button **twice** will immediately open the contactor.

## OUTPUT TERMINAL PANEL

The **output terminal panel** (Figure 12) shown below is provided for the connection of electrical loads. Lift up on the covers to gain access to receptacles and terminal lugs.

***NOTICE***

**Terminal O** is **neutral bonded** to the ground from the factory.

| Table 6. Output Terminal Bolt Torque | |
|---|---|
| U, V, W, O | 221.3 lbf·in (25.0 N·m) |
| Ground | 1,088.6 lbf·in (123.0 N·m) |

## OUTPUT TERMINAL FAMILIARIZATION

The output terminal panel is provided with the following:

- Two (2) 120-volt GFCI receptacles @ 20 amps
- Two (2) 20-amp GFCI circuit breakers
- Four (4) output terminal boards (U, V, W, O)
- Ground Terminal
- Auto-Start Contact Terminal Block

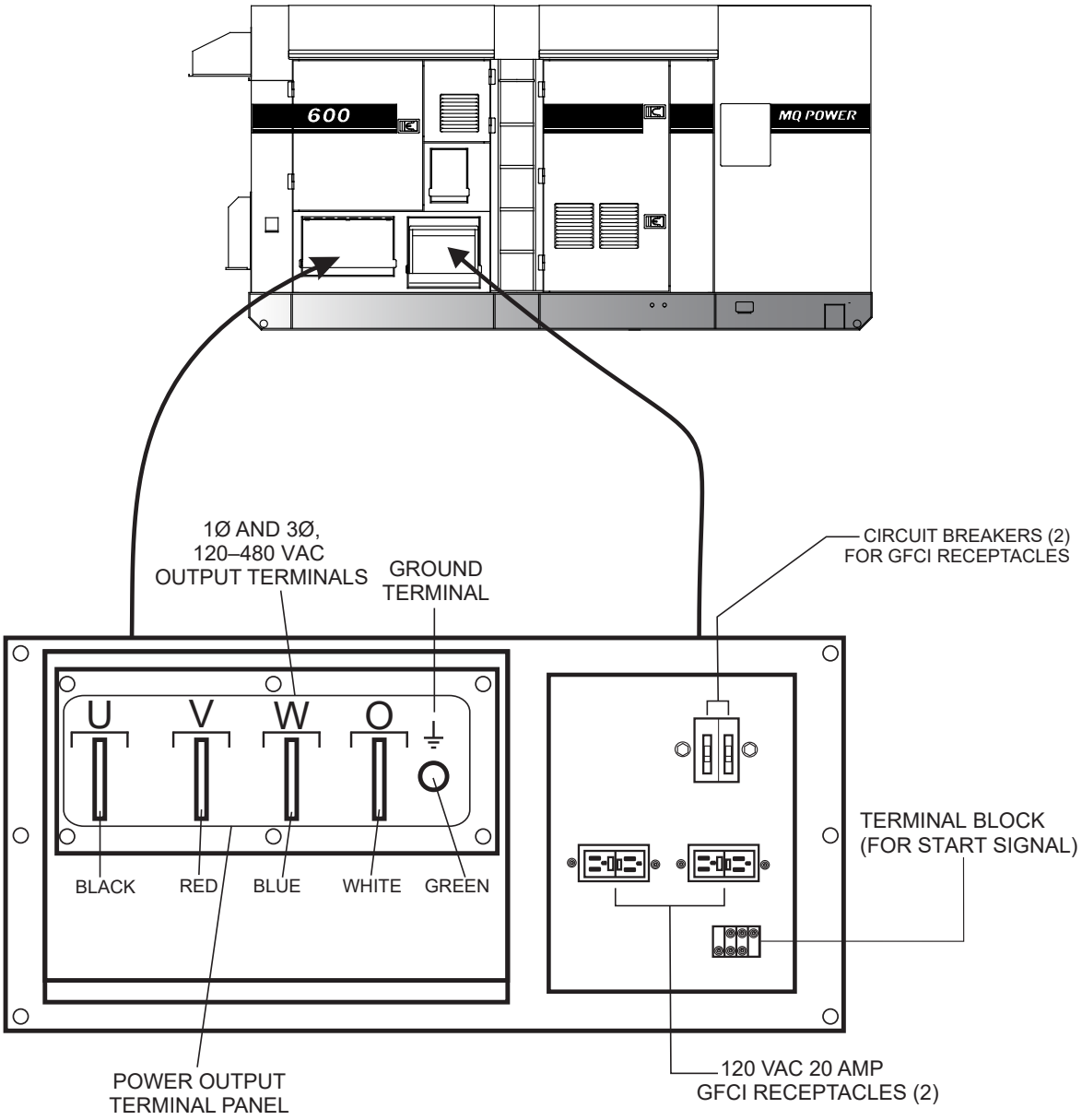



**Figure 12. Output Terminal Panel**

### 120-Volt AC GFCI Receptacles

**NOTICE**

It is recommended that the GFCI receptacles be tested when the generator is initially uncrated. The receptacles should then be tested daily at start-up.

There are two 120-volt, 20-amp GFCI (duplex NEMA 5-20R) receptacles provided on the output terminal panel. These receptacles can be accessed in any voltage change-over board position. Each receptacle is protected by a 20-amp circuit breaker. These breakers are located directly above the GFCI receptacles. Remember that the load output (current) of both GFCI receptacles is dependent on the load requirements of the U, V, and W output terminal lugs.

Press the **Reset button** (Figure 13) in the center of the GFCI receptacle to reset the receptacle after it has been tripped. Press the **Test button** to check the GFCI function. Both receptacles should be tested at least once a month. Refer to the ***Maintenance*** section in this manual for further testing of the GFCI receptacles.

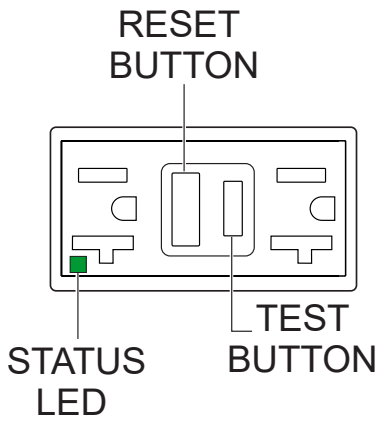
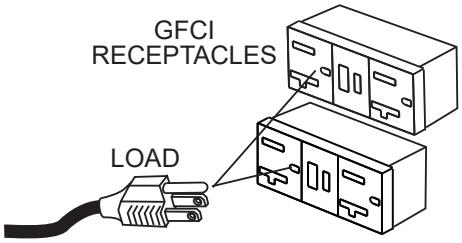



**Figure 13. 120-Volt GFCI Receptacle**

### CONNECTING LOADS

Loads can be connected to the generator (Figure 14) via the **UVWO** terminal lugs or the convenience receptacles. Be sure to read the operation manual before attempting to connect a load to the generator.

To protect the UVWO output terminals from overload, a 3-pole, 1600-amp, main circuit breaker is provided. Be sure to switch **all** circuit breakers to the **OFF** position prior to starting the engine.



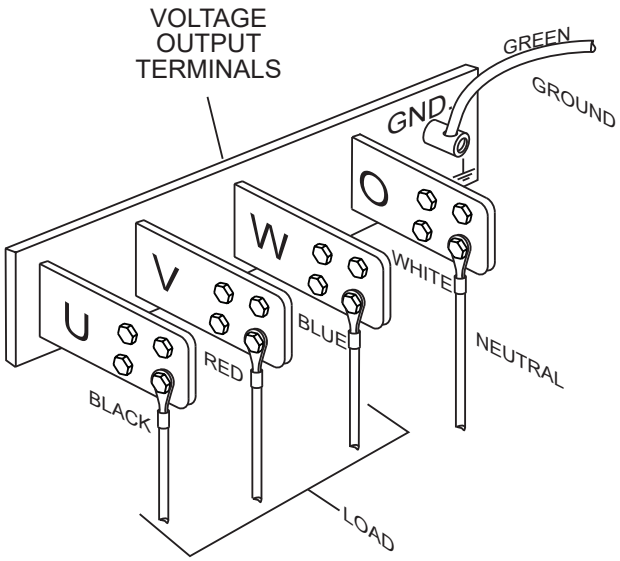




**Figure 14. Connecting Loads**

### OVERCURRENT RELAY

An **overcurrent relay** (Figure 15) is connected to the main circuit breaker. In the event of an overload, both the circuit breaker and the overcurrent relay may trip. If the circuit breaker cannot be reset, the **Reset button** on the overcurrent relay must be pressed. The overcurrent relay is located inside the control box.

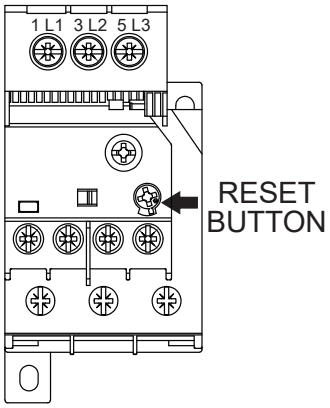



**Figure 15. Overcurrent Relay**

## SINGLE-PHASE LOAD

Always be sure to check the nameplate on the generator and equipment to ensure that 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 provided on the equipment's nameplate, approximate wattage may be calculated by multiplying the nameplate voltage by the nameplate amperage.

WATTS = VOLTAGE × AMPERAGE

The **power factor** of this generator is **0.8**. See Table 7 below when connecting loads.

**Table 7. 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 8. Cable Selection (60 Hz Single-Phase Operation)**

| Current (Amps) | Load (Watts) | | Maximum Allowable Cable Length (Feet) | | | |
|---|---|---|---|---|---|---|
| | At 120 Volts | At 240 Volts | #10 Wire | #12 Wire | #14 Wire | #16 Wire |
| 2.5 | 300 | 600 | 1,000 | 600 | 375 | 250 |
| 5 | 600 | 1,200 | 500 | 300 | 200 | 125 |
| 7.5 | 900 | 1,800 | 350 | 200 | 125 | 100 |
| 10 | 1,200 | 2,400 | 250 | 150 | 100 | |
| 15 | 1,800 | 3,600 | 150 | 100 | 65 | |
| 20 | 2,400 | 4,800 | 125 | 75 | 50 | |
| CAUTION: Equipment damage can result from low voltage. | | | | | | |

**NOTICE**

The cable selection table is a general guideline. **ALWAYS** consult local and national electrical codes when sizing cables.

## THREE-PHASE LOAD

When calculating the power requirements for 3-phase power, use the following equation:

$$KVA = \frac{VOLTAGE \times AMPERAGE \times 1.732}{1000}$$

**NOTICE**

If 3-phase load (kVA) is not provided on the equipment nameplate, approximate 3-phase load may be calculated by multiplying voltage by amperage by 1.732.

**NOTICE**

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

An inadequately sized 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 8.

- 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.

**PowerBalance®** (Figure 16) is an optional load management solution that helps protect the engine generator from problems resulting from sustained low-load operations (defined as less than 30% of the generator full-load rating).

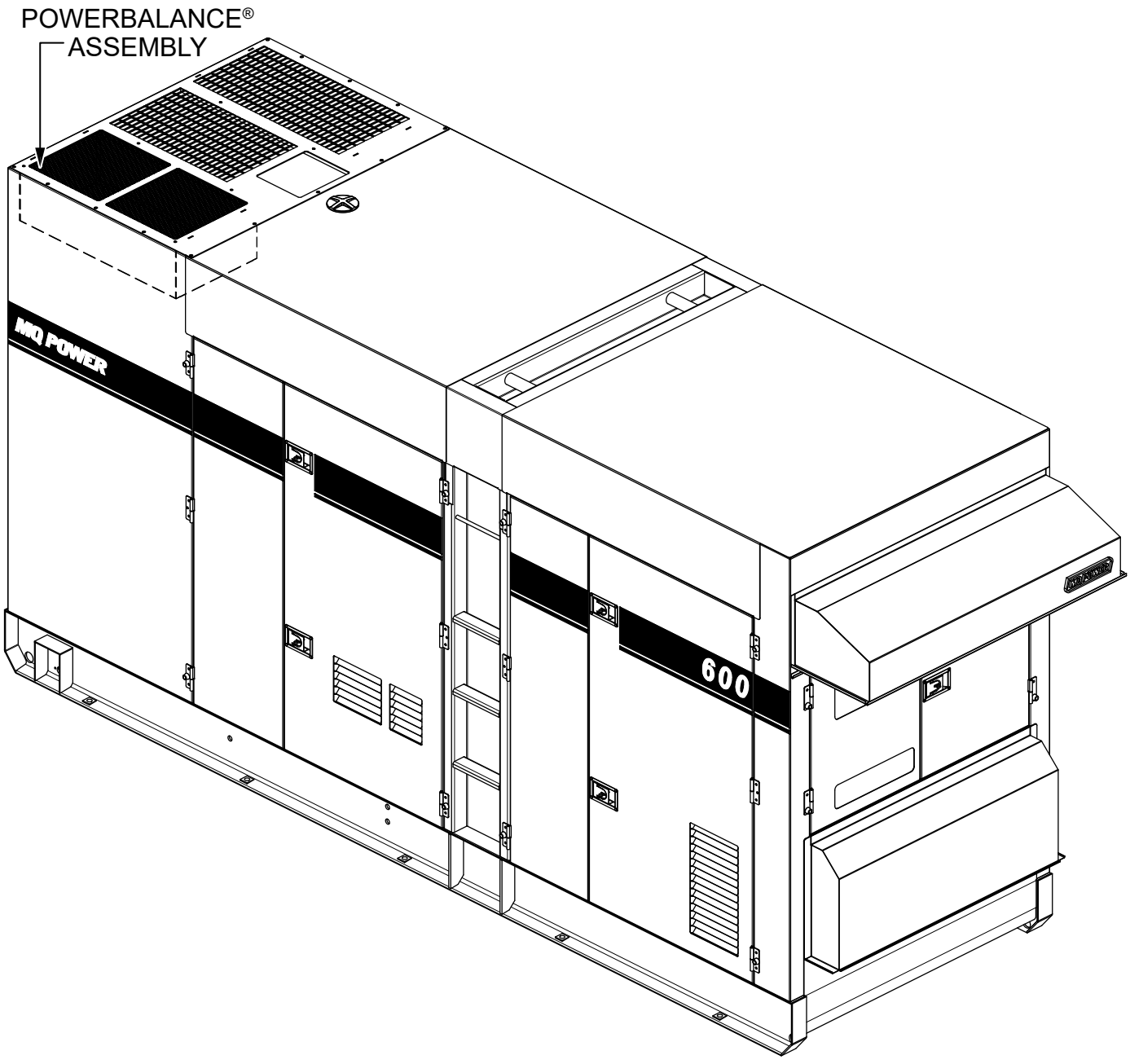



**Figure 16. PowerBalance®**

- PowerBalance® continuously monitors engine load. The load management controller senses and increases engine load automatically using resistive coils when the controller determines that the temperature and/or load is too low.
- When additional load demands are placed on the generator that bring it to an optimum level, PowerBalance® will automatically deactivate this additional load and remain ready for reactivation should exhaust temperatures drop.

## GENERATOR OUTPUT VOLTAGES

A wide range of voltages (Table 9) is available for many different applications.

**Table 9. Available Voltages**

| UVWO Output Terminal Lugs | Voltage Change-Over Board 3-Phase 240/139V Position | | | Voltage Change-Over Board 3-Phase 480/277V Position | | |
|---|---|---|---|---|---|---|
| 3Ø Line-Line | 208V | 220V | 240V | 416V | 440V | 480V |
| 1Ø Line-Neutral | 120V | 127V | 139V | 240V | 254V | 277V |

## VOLTAGE CHANGE-OVER BOARD

Voltages are selected by applying six jumpers to the **voltage change-over board** (Figure 17), which is located on the control box behind the generator control panel. This board is provided for ease of voltage selection.

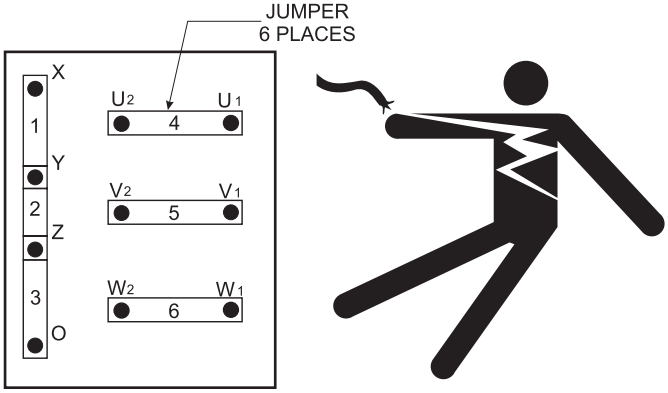



**Figure 17. Voltage Change-Over Board**

**⚠ WARNING**

**NEVER** attempt to place jumper plates on the **voltage change-over board** while the generator is in operation. There exists the possibility of **electrocution**, **electrical shock**, **or burn**, **which can cause severe bodily harm or even death!**

***NOTICE***

Make sure the tie bolts securing the voltage change-over board bus bars are **secure** and **tight**. The possibility exists of arcing that could cause a fire. Torque bolts to 1088.6 lbf·in (123.0 N·m).

## VOLTAGE REGULATOR

To obtain some of the voltages listed in Table 9 will require a fine voltage adjustment using the **voltage regulator** (Figure 18) located on the control panel.


**Figure 18. Voltage Regulator**

Turn the voltage regulator to obtain the desired voltage. Turning the knob **clockwise** will **increase** the voltage. Turning the knob **counterclockwise** will **decrease** the voltage.

## GENERATOR AMPERAGE

Table 10 shows the **maximum amps** the generator can provide. **DO NOT** exceed the maximum amps as listed.

**Table 10. Generator Maximum Amperage**

| Rated Voltage | Maximum Amps |
|---|---|
| Single phase 120 volts | 1,333.3 amps (4 wire) |
| Single phase 240 volts | 666.7 amps (4 wire) |
| Three phase 208 volts | 1,443.4 amps |
| Three phase 240 volts | 1,443.4 amps |
| Three phase 480 volts | 721.7 amps |
| **Main Line Circuit Breaker Rating** | |
| 1,600 amps | |
| **Overcurrent Relay Trip Set Point** | |
| 1,443.4 amps (240V)<br>720 amps (480V) | |

## HOW TO READ THE AC AMMETER AND AC VOLTMETER GAUGES

The AC ammeter and AC voltmeter gauges are controlled by the AC ammeter and AC voltmeter change-over switches.

Both of these switches are located on the control panel and **DO NOT** affect the generator output. They are provided to indicate how much power is being supplied at the UVWO terminal lugs.

Before taking a reading from either gauge, configure the **voltage change-over board** (Figure 19) to produce the desired output voltage.

**NOTICE**

Make sure the tie bolts securing the voltage change-over board bus bars are **secure** and **tight**. The possibility exists of arcing that could cause a fire. Torque bolts to 1088.6 lbf·in (123.0 N·m).

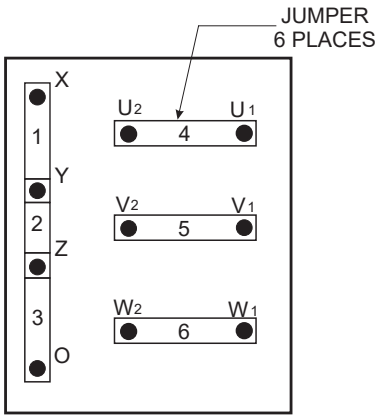



**Figure 19. Voltage Change-Over Board (3-Phase 240-Volt Configuration)**

### AC Voltmeter Gauge Reading

Place the **AC voltmeter change-over switch** (Figure 20) in the WU position and observe the phase-to-phase voltage reading between the W and U terminals as indicated on the **AC voltmeter gauge** (Figure 21).

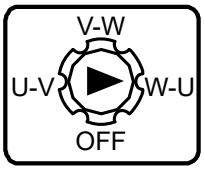



**Figure 20. AC Voltmeter Change-Over Switch**

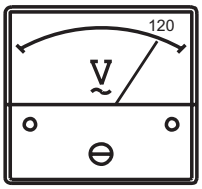



**Figure 21. AC Voltmeter Gauge (Voltage Reading On WU Lug)**

### AC Ammeter Gauge Reading

Place the **AC ammeter change-over switch** (Figure 22) in the U position and observe the current reading (load drain) on the U terminal as indicated on the **AC ammeter gauge** (Figure 23). This process can be repeated for terminals V and W.

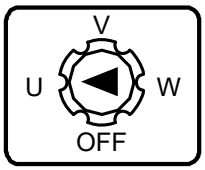



**Figure 22. AC Ammeter Change-Over Switch**

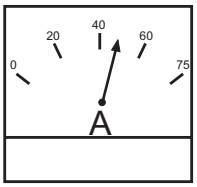



**Figure 23. AC Ammeter Gauge (Amperage Reading On U Lug)**

**NOTICE**

The ammeter gauge will only show a reading when the output terminal lugs are connected to a load and in use.

## UVWO TERMINAL OUTPUT VOLTAGES

Various output voltages can be obtained using the UVWO output terminal lugs. The voltages at the terminals are dependent on the placement of the jumper plates (6) on the **voltage change-over board** (Figure 24) and the adjustment of the **voltage regulator**.

The voltage change-over board determines the range of the output voltage and can be configured in two different positions that provide 6 different output voltages at the UVWO output terminals. The generator is shipped from the factory in the 240-volt configuration. The voltage regulator allows the user to increase or decrease the selected voltage.

***NOTICE***

Make sure the tie bolts securing the voltage change-over board bus bars are **secure** and **tight**. The possibility exists of arcing that could cause a fire. Torque bolts to 1088.6 lbf·in (123.0 N·m).

***NOTICE***

**ALWAYS** make sure that the connections to the output terminals are **secure** and **tight**. The possibility exists of arcing that could cause a fire. Torque UVWO tie bolts to 221.3 lbf·in (25.0 N·m). Torque the Ground tie bolt to 1088.6 lbf·in (123.0 N·m).

### 3-Phase 240-Volt UVWO Terminal Output Voltages

1. Jumper the voltage change-over board for 240-volt operation as shown in Figure 24.

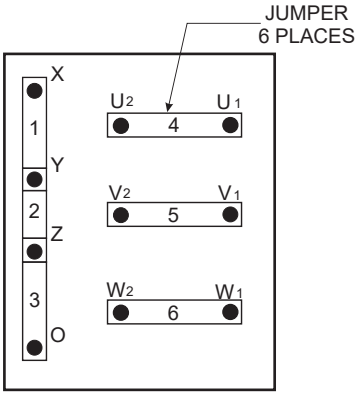



**Figure 24. Voltage Change-Over Board (240-Volt Configuration)**

2. Connect the load wires to the UVWO terminals as shown in Figure 25.

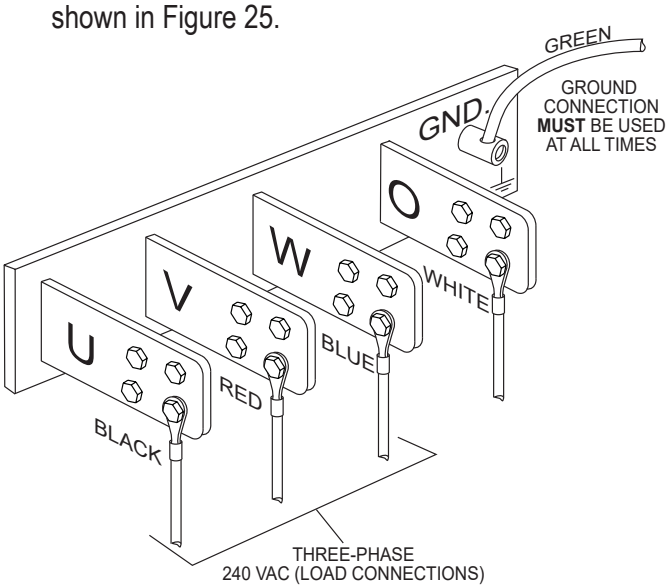



**Figure 25. UVWO Terminal Lugs (3-Phase 240-Volt Connections)**

3. Turn the **voltage regulator** (Figure 26) clockwise to increase voltage output as needed. Turn counterclockwise to decrease voltage output.


**Figure 26. Voltage Regulator**

### Single-Phase 240-Volt UVWO Terminal Output Voltages

1. Make sure the voltage change-over board is jumpered for 240-volt operation as shown in Figure 24.
2. Connect the load wires to the UVWO terminals as shown in Figure 27.

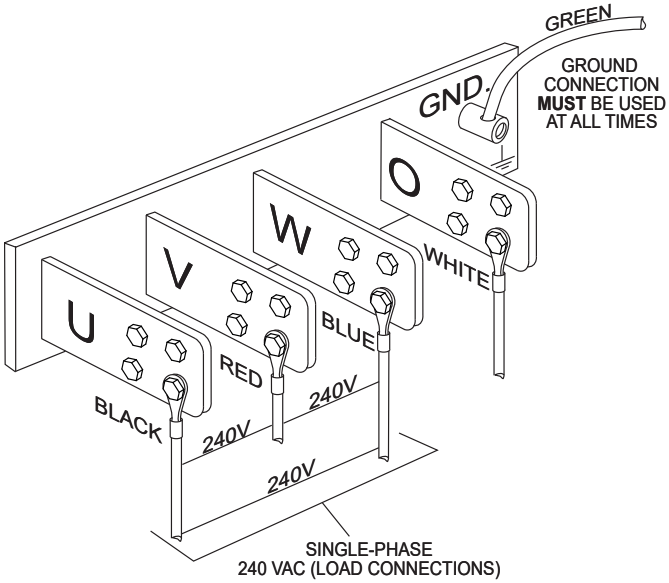



**Figure 27. UVWO Terminal Lugs (Single-Phase 240-Volt Connections)**

### Single-Phase 139-Volt UVWO Terminal Output Voltages

1. Make sure the voltage change-over board is jumpered for 240-volt operation as shown in Figure 24.
2. Adjust the voltage regulator (Figure 26) for an output of 208 volts to obtain 120 volts at the UVWO terminals.
3. Connect the load wires to the UVWO terminals as shown in Figure 28.

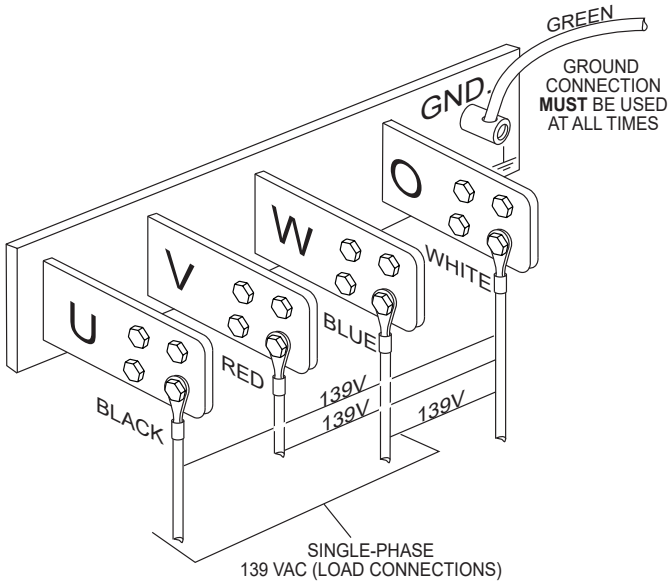



**Figure 28. UVWO Terminal Lugs (Single-Phase 139-Volt Connections)**

### 3-Phase 480-Volt UVWO Terminal Output Voltages

1. Jumper the voltage change-over board for 480-volt operation as shown in Figure 29. This configuration uses 6 jumper plates in 3 different positions. Remember that there are 2 jumper plates at every position. Every jumper plate ***must*** be used.

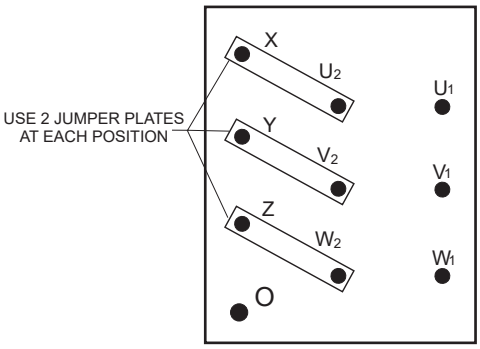



**Figure 29. Voltage Change-Over Board (480-Volt Configuration)**

2. Connect the load wires to the UVWO terminals as shown in Figure 30.

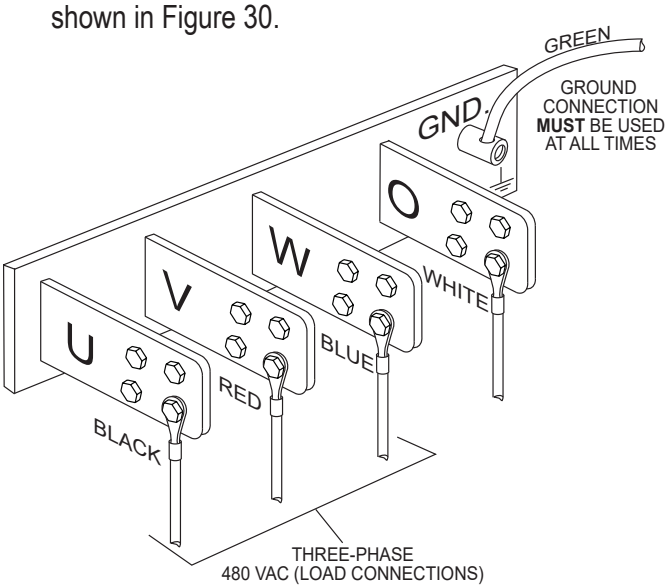



**Figure 30. UVWO Terminal Lugs (3-Phase 480-Volt Connections)**

### Single-Phase 480-Volt UVWO Terminal Output Voltages

1. Make sure the voltage change-over board is jumpered for 480-volt operation as shown in Figure 29.
2. Connect the load wires to the UVWO terminals as shown in Figure 31.

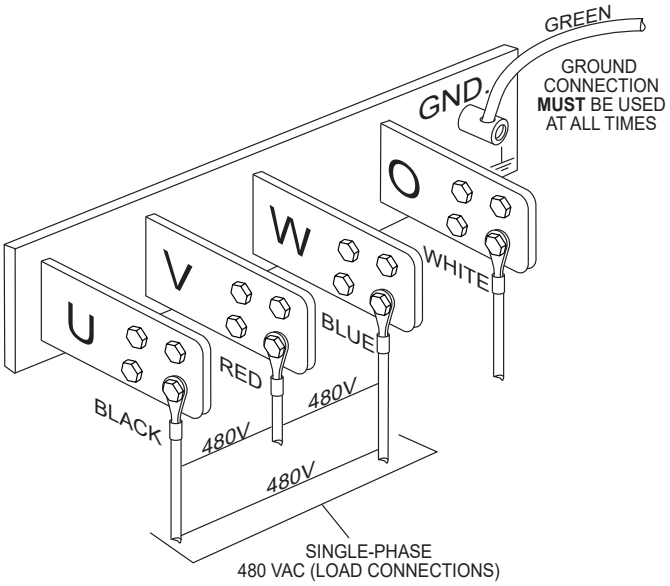



**Figure 31. UVWO Terminal Lugs (Single-Phase 480-Volt Connections)**

### Single-Phase 277-Volt UVWO Terminal Output Voltages

1. Make sure the voltage change-over board is jumpered for 480-volt operation as shown in Figure 29.
2. Connect the load wires to the UVWO terminals as shown in Figure 32.

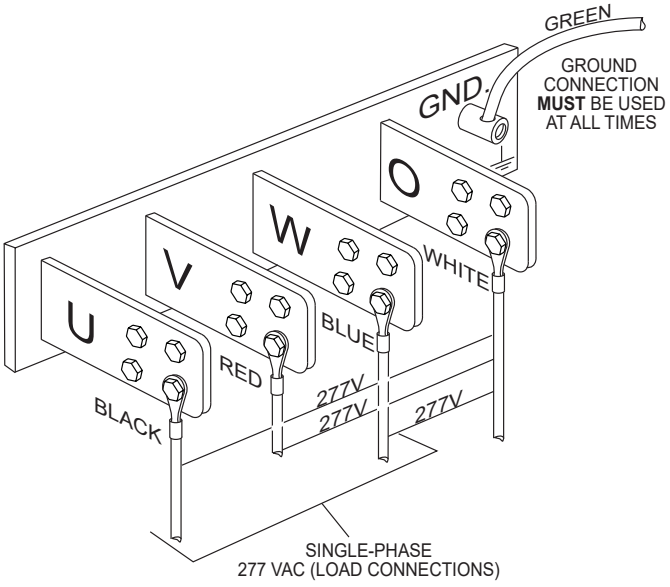



**Figure 32. UVWO Terminal Lugs (Single-Phase 277-Volt Connections)**

## ENGINE OIL CHECK

1. To check the engine oil level, place the generator on secure, level ground with the engine stopped.
2. Remove the dipstick from its holder (Figure 33) and wipe it clean.

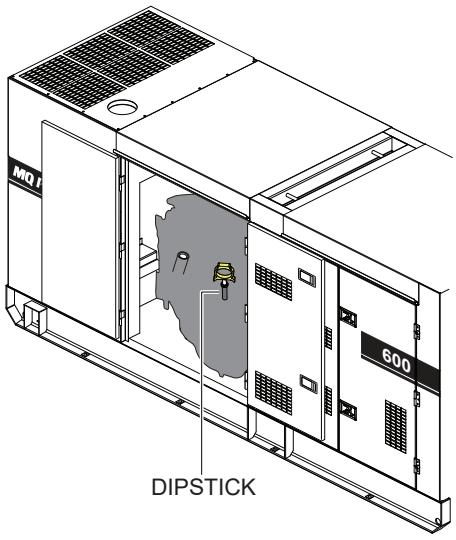



**Figure 33. Engine Oil Dipstick**

3. Reinsert the dipstick, then remove the dipstick from its holder. Check the oil level shown on the dipstick (Figure 34).

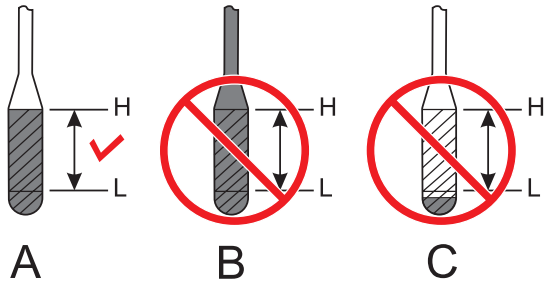



**Figure 34. Engine Oil Dipstick**

4. Verify that the engine oil level is maintained between the **H** and **L** markings on the dipstick as shown in Figure 34**A**.
5. If the engine oil level is low (Figure 34**C**), remove the cap from the oil filler port (Figure 35) and fill to a safe operating level (max) as indicated by the dipstick (Figure 34**A**). Fill with recommended type oil as listed in Table 11. Maximum oil capacity is 12.7 gallons (48 liters).

> ***NOTICE***
>
> When adding engine oil, **DO NOT** overfill (Figure 34**B**).

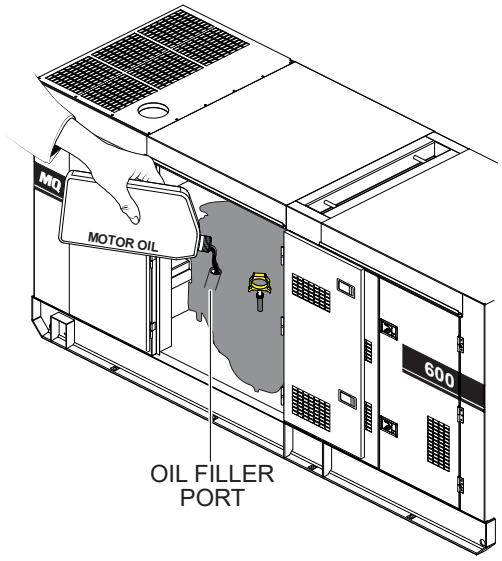
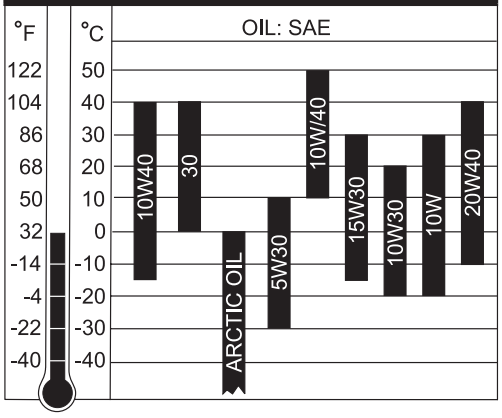



**Figure 35. Engine Oil Filler Port**

6. When checking the engine oil, be sure to check if the oil is clean. If the oil is not clean, drain the oil as described in the maintenance section of this manual.
7. Allow enough time for any added oil to make its way to the oil pan before rechecking.

**Table 11. Recommended Motor Oil**



## 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. **ALWAYS** shut down the engine prior to cleaning up any spilled fuel.

***NOTICE***

**ALWAYS** check the DEF tank level when adding fuel.

### Refilling The Fuel System

***NOTICE***

**DO NOT** refuel while the engine is running.

**CAUTION**

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

When equipped with a trailer or skid, the generator may have a **double fuel tank system** (Figure 36), which consists of an **internal fuel tank** and a **trailer-mounted fuel tank**.

**ALWAYS** fill the fuel tank with clean, fresh, **#2 diesel fuel**. Pay attention to the fuel tank capacity when replenishing fuel. **DO NOT** fill the fuel tank beyond its capacity.

Close the **fuel filler cap** (Figure 36) 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**.

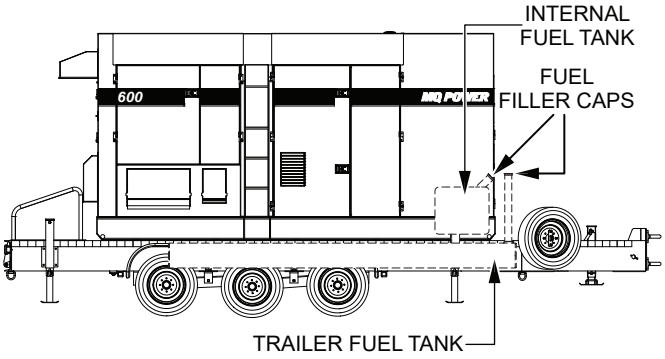



**Figure 36. Double Fuel Tank System**

### Refueling Procedure

***NOTICE***

**ALWAYS** fill the fuel tank with clean, fresh **#2 diesel fuel**. **NEVER** fill the fuel tanks beyond their capacities.

**WARNING**

**Diesel fuel** and its vapors are dangerous to your health and the surrounding environment. Avoid inhalation of fumes and contact with skin.

1. **Level the tanks.** Make sure fuel tanks are level with the ground. Failure to do so will cause fuel to spill from the tank before reaching full capacity (Figure 37).

**CAUTION**

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

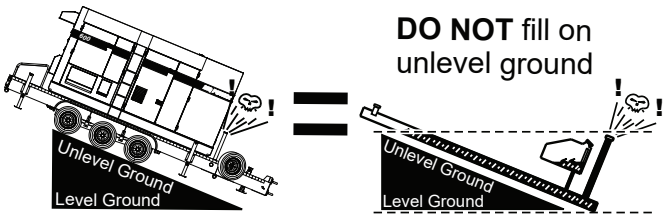



**Figure 37. Only Fill On Level Ground**

***NOTICE***

**ALWAYS** fill the trailer tank first with **#2 diesel fuel** before filling the secondary internal tank. Fuel from the secondary internal tank will eventually drain into the primary trailer tank.

2. **Fill the trailer fuel tank first.** The trailer fuel tank is the primary fuel tank and has a larger fuel capacity. The fuel in the trailer will be filtered and sent to the engine. **ALWAYS** fill the trailer fuel tank first (Figure 38).

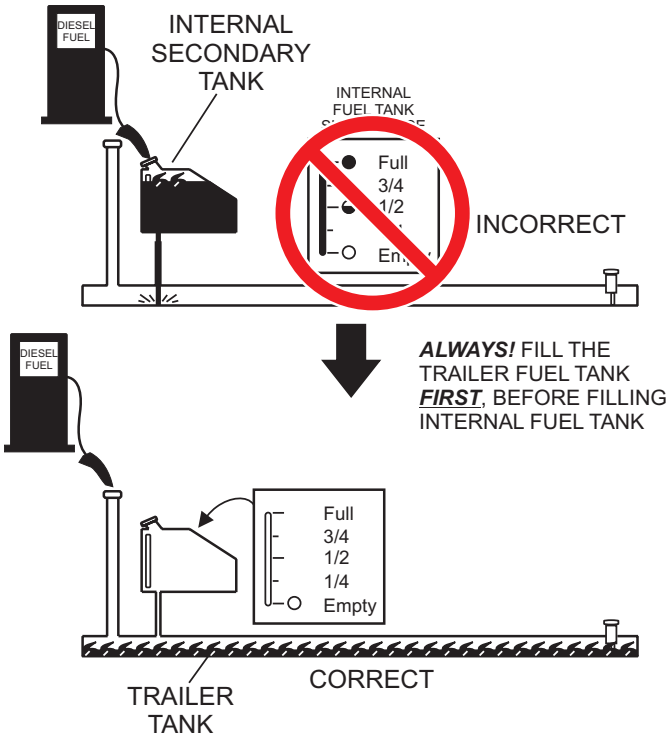



**Figure 38. Fuel Tank Fill Order**

3. **NEVER overfill the fuel tank.** It is important to read the **fuel gauge** (Figure 39) while filling the trailer fuel tank. **DO NOT** wait for fuel to rise inside the filler neck.

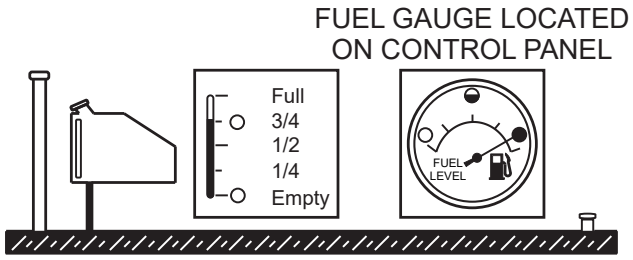



**Figure 39. Trailer Fuel Gauge**

**CAUTION**

**DO NOT** overfill the fuel system. Leave room for fuel expansion. Fuel expands when heated (Figure 42).

4. Once the trailer tank is full, the secondary, internal tank can be filled (Figure 40). Notice how the level rises inside the trailer filler tube when the internal tank is filled. Figure 41 illustrates a full fuel system.

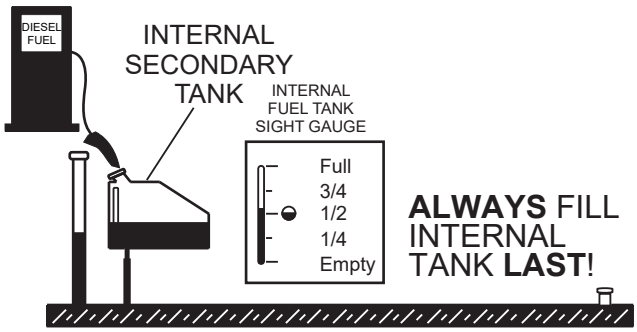



**Figure 40. Filling Internal Secondary Fuel Tank**

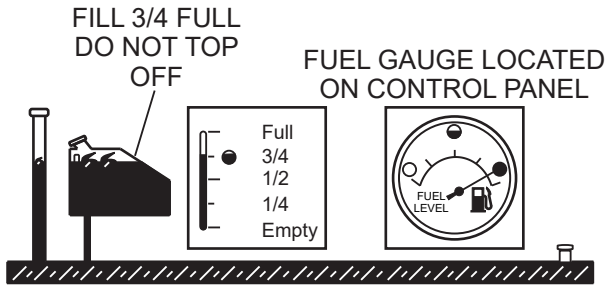



**Figure 41. Full Fuel System**

5. Fuel from the engine return line will drain into the secondary internal fuel tank. This fuel will eventually drain into the primary trailer tank in order to return to the engine.

**CAUTION**

It is recommended to only fill the internal secondary tank to 3/4 full in order to avoid spillage and to allow for fuel return and fuel expansion (Figure 42).

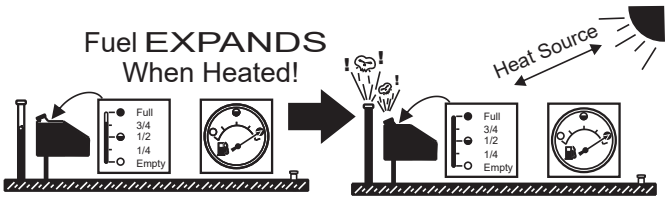



**Figure 42. Fuel Expansion**

## DIESEL EXHAUST FLUID

**Diesel exhaust fluid (DEF)** is an aqueous solution made with 32.5% high-purity urea carbamide and 67.5% **deionized water**. DEF is used as a consumable in **selective catalytic reduction (SCR)** in order to lower $NO_X$ concentration from diesel exhaust emissions.

**ALWAYS** check the DEF level when refueling. Prior to initial start-up, completely fill the DEF tank with DEF fluid. **DO NOT** overfill.

### DEF Refilling

***NOTICE***

**ONLY** fill the DEF tank with ***diesel exhaust fluid***. Any other type of fluid may cause severe engine damage.

1. Make sure the engine is **OFF**.
2. Remove the **filler cap** from the DEF tank (Figure 43).

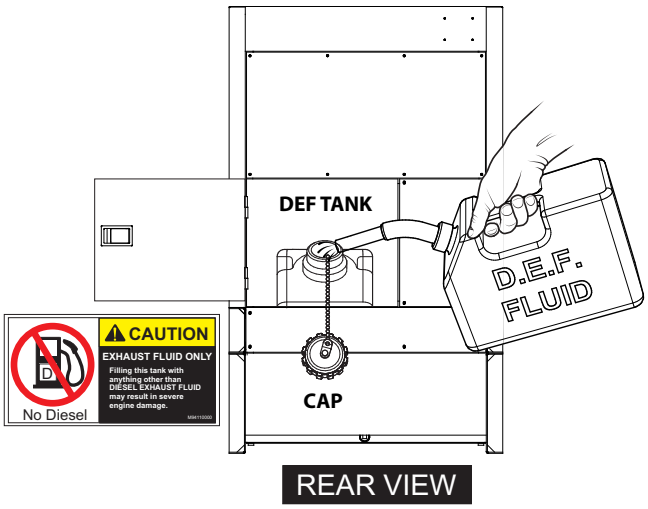



**Figure 43. Filling The DEF Tank**

3. Add diesel exhaust fluid to the tank. **DO NOT** overfill.
4. Reinstall the DEF tank cap. Tighten securely.

### DEF Refilling (Continuous Operation)

It is recommended to **shut down the engine** prior to refilling the DEF tank. However, during special applications where shutdown is not possible, it is recommended to **ONLY** refill the DEF tank when the fluid level has been consumed down to 50%.

The DEF level sending unit requires a gradual DEF level decrease during continuous operation to validate proper operation. Failure of this sensor to report the decrease could result in an engine shutdown. An engine service technician would be required to remedy the shutdown.

## COOLANT

Volvo recommends pre-diluted Volvo Penta Coolant VCS (yellow). See the **Volvo engine owner's manual** for further details.

**⚠ WARNING**

When 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 performed at the reserve tank. When adding coolant to the radiator, **DO NOT** remove the radiator cap until the unit has completely cooled. See Table 12 for engine/radiator and reserve tank coolant capacities.

**Table 12. Coolant Capacity**

| | |
|---|---|
| Engine and Radiator | 26.1 gallons (99 liters) |
| Reserve Tank | 2 quarts (1.9 liters) |

***NOTICE***

Check the coolant level daily. Normally, only the coolant level in the reserve tank needs to be checked. However, the radiator cap should be opened once a week to verify that coolant is visible (full) inside the radiator.

Verify that the coolant level in the **coolant reserve tank** is between the **MIN** and **MAX** markings on the **sight glass** as shown in Figure 44.

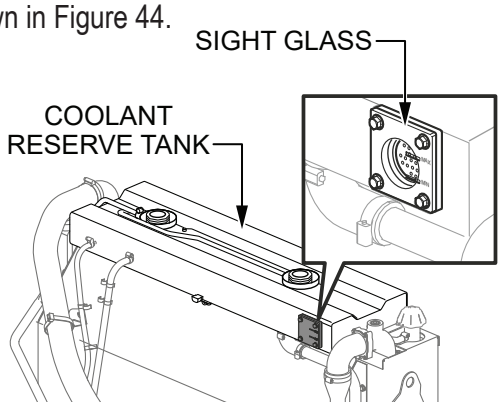



**Figure 44. Coolant Reserve Tank**

## Operation In Freezing Weather

When operating in freezing weather, be certain the proper amount of antifreeze (Table 13) has been added.

**Table 13. Antifreeze Operating Temperatures**

| Volume % Antifreeze | Freezing Point | |
|---|---|---|
| | °C | °F |
| 40 | –24 | –11 |
| 50 | –37 | –34 |

## CLEANING THE RADIATOR

**WARNING**

Cleaning inside the machine is dangerous, so clean the radiator only with the engine turned **OFF** and the **negative** battery terminal disconnected.

The engine may overheat if the radiator becomes overloaded with dust or debris. Clean the radiator with water and a mild detergent. Remove guards as necessary to access the radiator. Use a **soft brush** (Figure 45) for cleaning. Be careful to not damage the radiator vanes. Reinstall all removed parts when finished.

***NOTICE***

**DO NOT** use a high-pressure power washer to clean the radiator.

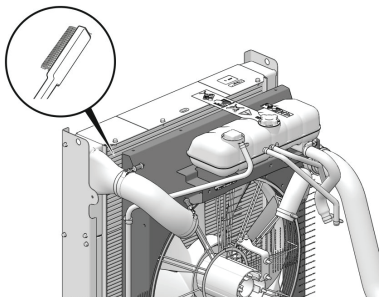


**Figure 45. Cleaning The Radiator**

## ENGINE AIR CLEANER

Periodic cleaning/replacement of the air cleaner is necessary. Inspect the air cleaner in accordance with the ***Maintenance*** section of this manual.

## FAN BELT TENSION

A slack fan belt may contribute to overheating or insufficient charging of the battery. Inspect the fan belt for damage and wear and adjust it in accordance with the **Volvo engine owner's manual**.

The fan belt tension is correct if the belt bends 3 to 4 mm when depressed with the thumb as shown in Figure 46.

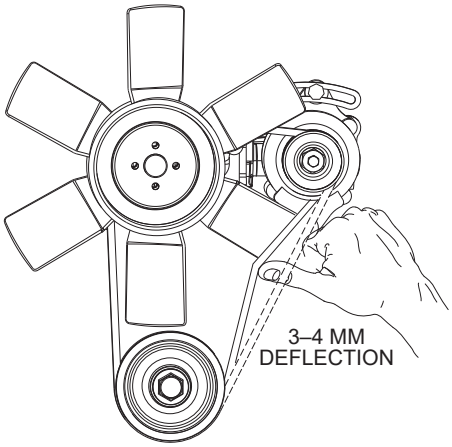



**Figure 46. Fan Belt Tension**

**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** overfill. Check to see whether the battery cables are loose. Poor contact may result in malfunctions or poor starting. **ALWAYS** keep the terminals firmly tightened. Coat the terminals with an approved battery terminal treatment compound. Replace the battery only with the recommended type of battery.

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, the battery is dead and needs to be recharged or replaced.

Be sure to disconnect the battery cables before charging the battery with an external electrical source.

### Battery Cable Installation

Connect the two 12-volt batteries **in series** (24-volt system) as shown in Figure 47. Make sure the battery cables are properly connected to the battery terminals. Connect the **red cable** to the **positive terminal** of one battery, and connect the **black cable** to the **negative terminal** of the other battery.

**⚠ CAUTION**

**ALWAYS** disconnect the negative terminal first and reconnect the negative terminal last.

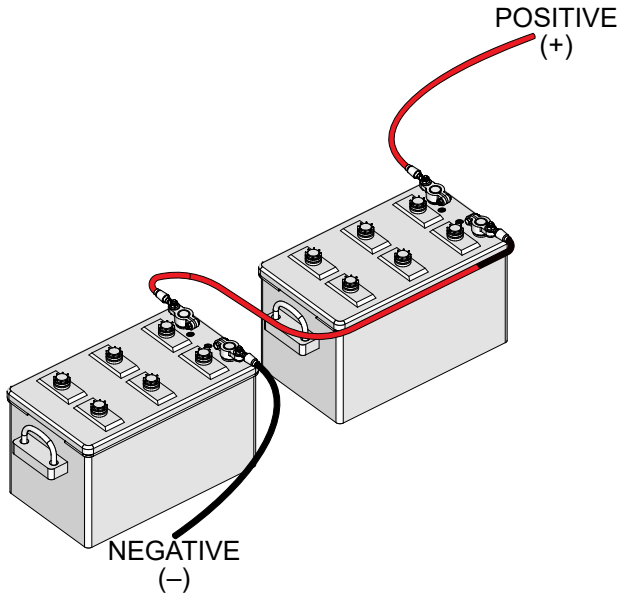



**Figure 47. Battery Connections**

When connecting the batteries:

1. **NEVER** connect the battery cables to the battery terminals while the **Auto Start/Stop switch** is in either the **AUTO** or **MANUAL** position. **ALWAYS** make sure that this switch is in the **OFF/RESET** position when connecting the batteries.
2. Place a small amount of battery terminal treatment compound around both battery terminals. This will ensure a good connection and help prevent corrosion around the battery terminals.

***NOTICE***

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

***NOTICE***

Inadequate battery connections may cause poor starting of the generator or other malfunctions.

### Battery Switch

Located in the engine compartment, the **Battery switch** (Figure 48) connects and disconnects the battery. Place the switch in the **ON** position prior to starting the generator. When the generator is not in use, place the switch in the **OFF** position.

***NOTICE***

**NEVER** place the Battery switch in the **OFF** position **while the engine is running**. The engine may not be able to be stopped by normal operation, and damage to the equipment may result.

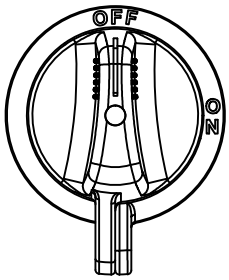



**Figure 48. Battery Switch**

### 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 in alternator failure.

***NOTICE***

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

### PIPING AND HOSE CONNECTIONS

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

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

## 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 or auxiliary circuit breakers in the **ON** (closed) position.

1. If applicable, perform the following:
   - To ensure good starting, apply commercial power to the internal battery charger receptacle via commercial power. An external power cord will be required. This capability is an **option**.
   - In cold weather conditions, apply commercial power to the engine block heater receptacle via commercial power. An external power cord will be required. This capability is an **option**.
2. Make sure the voltage change-over board has been configured for the desired output voltage.

***NOTICE***

Make sure the tie bolts securing the voltage change-over board bus bars are **secure** and **tight**. The possibility exists of arcing that could cause a fire. Torque bolts to 1088.6 lbf·in (123.0 N·m).

3. Place the **Battery switch** (Figure 49) in the **ON** position.

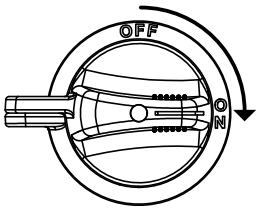



**Figure 49. Battery Switch (ON)**

4. Press the **Main Circuit Breaker OFF switch** (Figure 50).


**Figure 50. Main Circuit Breaker OFF Switch**

5. Verify that the **Main Circuit Breaker OFF lamp** (Figure 51) is lit **(ON)**.

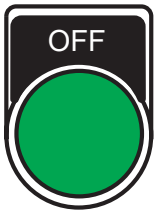



**Figure 51. Main Circuit Breaker OFF Lamp (ON)**

6. Place the **GFCI circuit breakers** (Figure 52) in the **OFF** position.

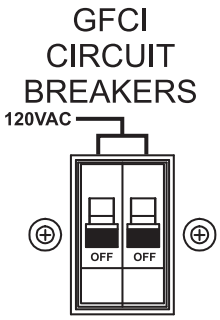
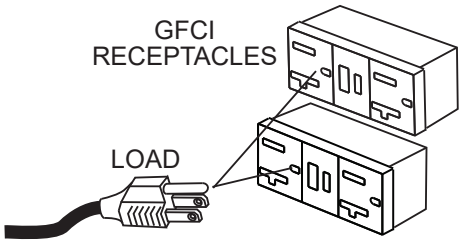



**Figure 52. GFCI Circuit Breakers (OFF)**

7. Connect the load to the UVWO terminals or auxiliary receptacles as shown in Figure 53. These load connection points can be found on the output terminal panel. To access the UVWO busbar terminals or other power receptacles, unlock the access cover and lift the door.

**NOTICE**

**ALWAYS** make sure that the connections to the output terminals are **secure** and **tight**. The possibility exists of arcing that could cause a fire. Torque UVWO tie bolts to 221.3 lbf·in (25.0 N·m). Torque the Ground tie bolt to 1088.6 lbf·in (123.0 N·m).



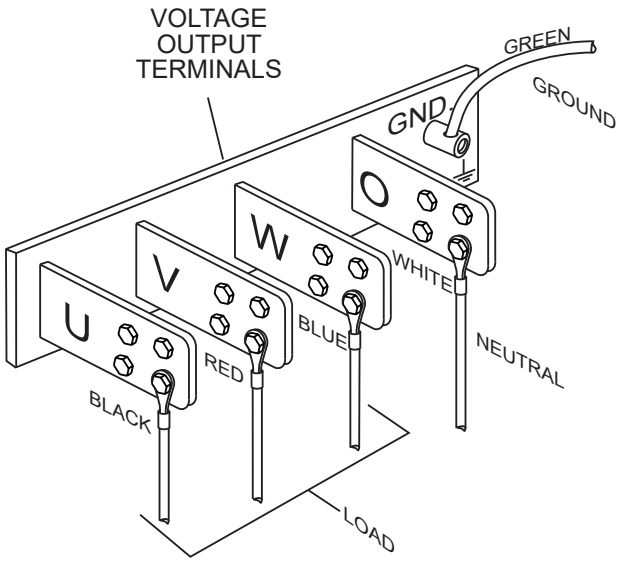




**Figure 53. Load Connections**

8. Close all engine enclosure doors (Figure 54).

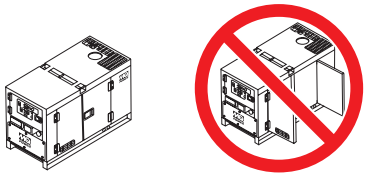



**Figure 54. Engine Enclosure Doors**

## STARTING (MANUAL)

1. Place the **Engine Speed switch** in the **LOW** position (Figure 55).


**Figure 55. Engine Speed Switch (Low)**

2. Place the **Auto Start/Stop switch** in the **MANUAL** position to start the engine (Figure 56). Once the engine starts, let the engine run for 1–2 minutes. Listen for any abnormal noises.

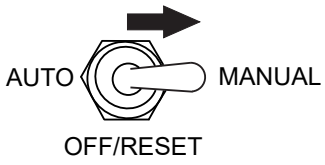



**Figure 56. Auto Start/Stop Switch (Manual)**

3. Once the engine starts, let the engine run for 1–2 minutes. Listen for any abnormal noises. If any abnormalities exist, shut down the engine and correct the problem. If the engine is running smoothly, place the engine speed switch (Figure 57) in the **HIGH** (up) position.


**Figure 57. Engine Speed Switch (High)**

4. The **frequency meter** (Figure 58) displays the 60-cycle output frequency in **hertz**.

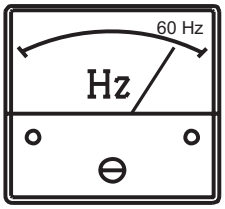



**Figure 58. Frequency Meter**

5. The **AC voltmeter** (Figure 59) indicates the phase-to-phase voltage of the generator's output terminals.

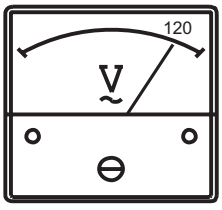



**Figure 59. AC Voltmeter**

6. If the voltage is not within the specified tolerance, use the **voltage regulator** (Figure 60) to increase or decrease the desired voltage.

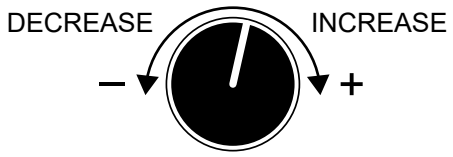



**Figure 60. Voltage Regulator**

7. The **AC ammeter** (Figure 61) 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.

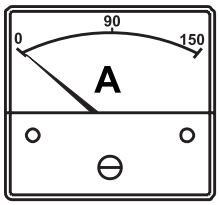



**Figure 61. AC Ammeter (No Load)**

8. The **engine oil pressure gauge** (Figure 62) indicates the oil pressure of the engine. Under normal operating conditions this gauge should indicate approximately 44–94 psi.


**Figure 62. Oil Pressure Gauge**

9. The **coolant temperature gauge** (Figure 63) indicates the coolant temperature. Under normal operating conditions, this gauge should indicate approximately 167°–194°F (75°–90°C).

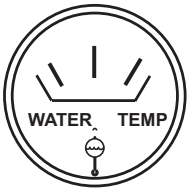



**Figure 63. Coolant Temperature Gauge**

10. The **engine tachometer** (Figure 64) indicates the speed of the engine while the generator is operating. Under normal operating conditions, this gauge should indicate approximately 1,000 rpm when the **engine speed switch** is in the **LOW** position, and 1,800 rpm when the engine speed switch is in the **HIGH** position.

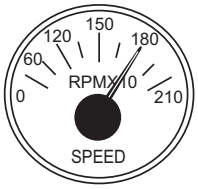



**Figure 64. Engine Tachometer**

11. Press the **Main Circuit Breaker ON switch** (Figure 65).


**Figure 65. Main Circuit Breaker ON Switch**

12. Verify that the **Main Circuit Breaker ON lamp** (Figure 66) is lit **(ON)**.


**Figure 66. Main Circuit Breaker ON Lamp (ON)**

13. Place the **GFCI circuit breakers** in the **ON** position (Figure 67).

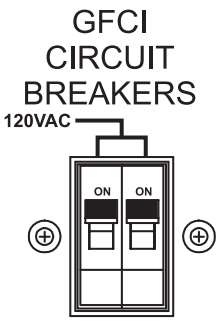



**Figure 67. GFCI Circuit Breakers (ON)**

14. Verify that the generator's ammeter (Figure 68) 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.

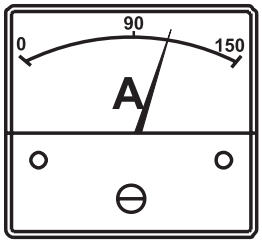



**Figure 68. Ammeter (Load)**

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

## STARTING (AUTO MODE)

**NOTICE**

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.

**NOTICE**

**ALWAYS** have power applied to the generator's internal battery charger (if equipped) when connecting the generator to an isolation (transfer) switch. This will ensure that the engine will not fail due to a dead battery.

**NOTICE**

When the generator is set to **AUTO** mode, in the event of commercial power falling below a prescribed level the generator will **automatically start** by means of a contact closure generated automatically by a transfer switch.

**NOTICE**

The Engine Speed switch **must** be set to the **HIGH** position when running in **AUTO** mode. Failing to set the switch to the proper position can result in damage to the generator when it turns on.

**WARNING**

When running the generator in **AUTO** mode, remember that the generator can start up at any time without warning. **NEVER** attempt to perform any maintenance while the generator is in **AUTO** mode.

When starting the generator in **AUTO** mode, use the **manual start-up procedure** except where noted below.

1. Perform steps 1–8 of the ***Before Starting*** section of the ***Generator Start-Up Procedure (Manual)***.
2. Place the **Engine Speed switch** (Figure 69) in the **HIGH** position.


**Figure 69. Engine Speed Switch (High)**

3. Place the **Auto Start/Stop switch** (Figure 70) in the **AUTO** position.


**Figure 70. Auto Start/Stop Switch (Auto)**

4. Once the start signal is received (the remote-start contacts are closed), the pre-heating process will begin. When the pre-heating process has completed, the engine will start automatically and accelerate to rated speed. When the remote-start contacts are opened, the engine will stop.
5. If the engine fails to start, perform the manual starting procedure.

## NORMAL SHUTDOWN PROCEDURE

**WARNING**

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

1. Place the load's ON/OFF switch in the **OFF** position.
2. Place the **GFCI circuit breakers** in the **OFF** position (Figure 71).

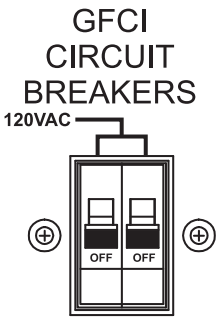



**Figure 71. GFCI Circuit Breakers (OFF)**

3. Press the **Main Circuit Breaker OFF switch** (Figure 72).


**Figure 72. Main Circuit Breaker OFF Switch**

4. Verify that the **Main Circuit Breaker OFF lamp** (Figure 73) is lit **(ON)**.

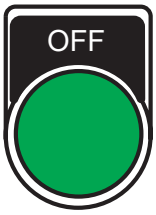



**Figure 73. Main Circuit Breaker OFF Lamp**

5. Place the **Engine Speed switch** in the **LOW** position (Figure 74).


**Figure 74. Engine Speed Switch (Low)**

6. Allow the engine to cool by running it at low speed for 3–5 minutes with no load applied.
7. Place the **Auto Start/Stop switch** (Figure 75) in the **OFF/RESET** position.


**Figure 75. Auto Start/Stop Switch (OFF/Reset)**

***NOTICE***

**DO NOT** place the Battery switch in the **OFF** position immediately after the engine stops. Wait for at least 2 minutes before placing the Battery switch in the **OFF** position.

8. Place the **Battery switch** (Figure 76) in the **OFF** position.

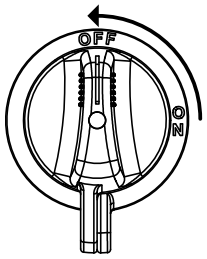



**Figure 76. Battery Switch (OFF)**

9. Remove all loads from the generator.
10. Allow sufficient time for adequate cooling. Then inspect the entire generator for any damage or loosening of components that may have occurred during operation.

## EMERGENCY SHUTDOWN PROCEDURE

***NOTICE***

The **Emergency Stop switch** should only be used to stop the engine in case of an emergency or to lock out operation during service. The Emergency Stop switch should **NEVER** be used for routine stopping of the engine.

1. To stop the engine in the event of an emergency, push the **Emergency Stop switch** (Figure 77). This switch is located on the side of the generator next to the output terminal panel.

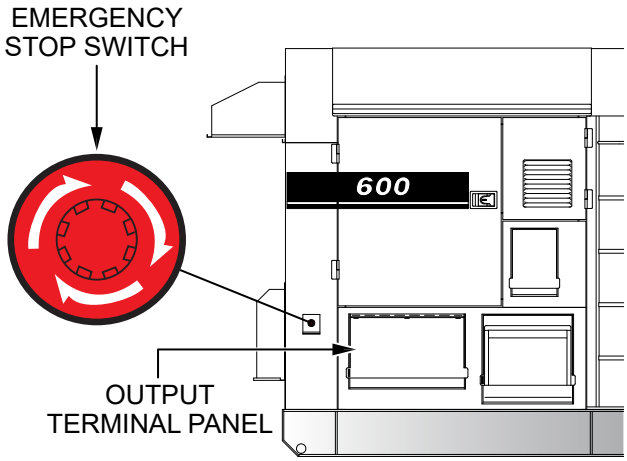



**Figure 77. Emergency Stop Switch**

2. Press the **Main Circuit Breaker OFF switch** (Figure 72).
3. Verify that the **Main Circuit Breaker OFF lamp** (Figure 73) is lit **(ON)**.

| Table 14. Inspection/Maintenance | | Daily | Every 500 Hours | Every 1,000 Hours | Every 2,000 Hours |
|---|---|---|---|---|---|
| Engine | Check Engine Oil and Coolant Levels | X | | | |
| | Check Fuel Filter / Water Bowl | X | | | |
| | Check Battery Fluid Level | X | | | |
| | Check Air Cleaner | X | | | |
| | Check for Leaks | X | | | |
| | Visual Walk-Around Inspection | X | | | |
| | Check Coolant Antifreeze Mixture | | X | | |
| | Clean Air Cleaner Element | | X | | |
| | Drain Bottom of Fuel Tank | | X | | |
| | Drain Bottom of Fuel Pre-Filter | | X | | |
| | Replace Engine Oil and Oil Filter*[1] | | X | | |
| | Check Drive Belt, Belt Tensioner and Idler Wheels | X | X | | |
| | Replace Fuel Filter Elements | | | X | |
| | Check Electrical Ground Connection | | | X | |
| | Clean Radiator and Check Cooling System | | | X | |
| | Clean Inside Fuel Tank | | | X | |
| | Check All Hoses and Clamps | | | X | |
| | Check Engine Mounts | | | X | |
| | Replace Air Cleaner Element*[2] | | | X | |
| | Check and Adjust Engine Valve Clearance | | | (X) | X |
| | Replace Drive Belts | | | | X |
| | Check/Correct DEF Leakage | X | | | |
| | Replace DEF Filter (in Supply Module, Def Tank)*[3] | | | | X |
| | Replace DEF Tank Breather Filter | | | | X |
| | Flush and Refill Cooling System | Every 4 years or 8,000 hours | | | |
| Generator | Measure Insulation Resistance Over 3M Ohms*[4] | | X | | |
| | Check Rotor Rear Support Bearing | | | X | |
| | Inspect Voltage Change-Over Board Bus Bars and Tie Bolts and Re-Torque Tie Bolts*[8] | | X | | |
| Complete Machine | Inspect Acoustic Insulation | | X | | |

*1 During the initial operation of a new engine, change oil and filter between a minimum of 100 hours and a maximum of 200 hours. Service interval depends on type of oil.

*2 Replace the air cleaner element when the restriction indicator shows a vacuum of 635 mm (25 in.) $H_20$.

*3 When replacing the DEF tank's filter, make sure to disconnect all harnesses and hoses, and pull out the DEF tank.

*4 Make sure to disconnect the O – Earth line and turn off the SW2 before performing the measurement. Refer to the ***Generator Wiring Diagram***.

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

*6 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 **appy the load gradually** and observe the exhaust gas color (colorless) during the process.

*7 Fire or sparks may emit 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.

*8 Torque bolts to 1088.6 lbf·in (123.0 N·m).

## 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 14 as a general inspection and maintenance guideline. For more detailed engine maintenance instructions, refer to the Volvo engine owner's manual.

## ENGINE AIR CLEANER

The air cleaner (Figure 78) provided with this Volvo diesel engine is equipped with a replaceable, high-density, paper air filter element. The air cleaner is also equipped with an inner (secondary) element that is used as a backup filter should the primary element become damaged. Check the air cleaner daily or before starting the engine. Replace the air cleaner as needed.

***NOTICE***

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 the air cleaner more frequently if these conditions exist.

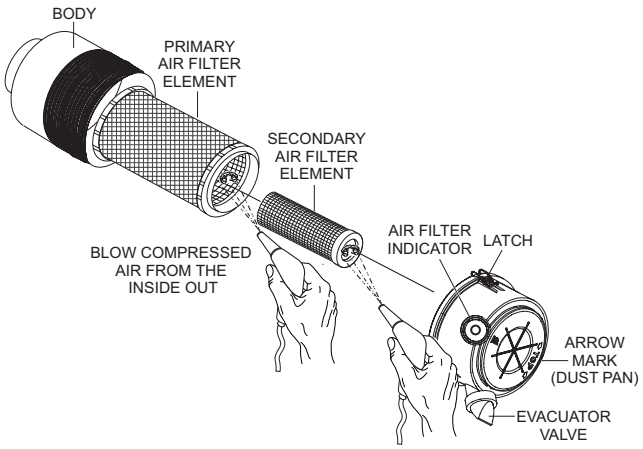



**Figure 78. Engine Air Cleaner**

### Primary And Secondary Air Cleaner Elements

**Every 250 hours:** Remove the air cleaner elements and clean them with a light spray of compressed air.

**⚠ CAUTION**

Wear protective equipment such as approved safety glasses or face shields and dust masks or respirators when cleaning air filters with compressed air.

1. Release the latches that secure the cover to the air cleaner body (Figure 78).
2. Remove the **air cleaner cover** (Figure 78) and set it aside.
3. Remove both the primary and secondary air cleaner elements (Figure 78).
4. Check for and correct heavy buildup of dirt and debris along with loose or damaged components.

***NOTICE***

Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

5. To clean the **primary element** (paper air filter) as shown in Figure 78, tap the filter element several times on a hard surface to remove dirt, or blow compressed air, not to exceed 30 psi (207 kPa, 2.1 kgf/cm$^2$), through the filter element from the inside out.
6. Clean the **secondary element** (paper air filter) as described in step 5.
7. Replace both elements if they are damaged or excessively dirty.
8. Clean the inside of the **air cleaner body** (Figure 78).
9. Reinstall the primary and secondary air filter elements back into the air cleaner body.
10. Reinstall the air cleaner cover and secure it with latches.

***NOTICE***

**DO NOT** run the engine with the air cleaner removed or without an element.

### Air Cleaner Restriction Indicator

The air cleaner is equipped with a **restriction indicator** (Figure 79). As the air cleaner element becomes clogged, air intake restriction increases and the indicator signal shows **RED**, indicating that the element needs to be replaced. After replacing the air filter element, press the restriction indicator button to reset the indicator.

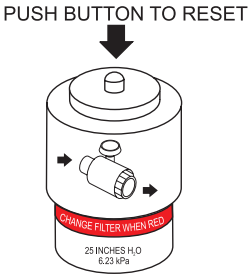



**Figure 79. Air Cleaner Restriction Indicator**

**NOTICE**

The air cleaner element should not be changed until the indicator displays **RED**. Dispose of the old element. It cannot be cleaned or reused.

## ENGINE FUEL FILTER

**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. **ALWAYS** shut down the engine prior to cleaning up any spilled fuel.

Inspect the **engine fuel filter** daily. If the fuel filter has collected a significant amount of water and sediment at the bottom of the cup, it should be drained off immediately.

### Draining Fuel Filter Condensate

1. Place an appropriate container underneath the fuel filter to collect the condensate (water) and fuel as it drains.
2. Loosen the **drain nipple** (Figure 80) in the base of the **fuel prefilter** to begin draining.

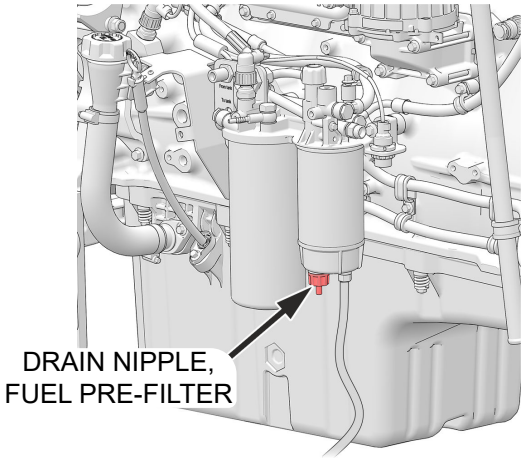



**Figure 80. Fuel Prefilter Drain Nipple**

3. Tighten the drain nipple when fuel without water starts to drain out.

### Fuel Filter Replacement

**NOTICE**

**DO NOT** fill the new fuel filter with fuel before assembly. There is a risk of system contamination that can cause malfunctions or damage.

1. Clean around the **fuel filter** (Figure 81).

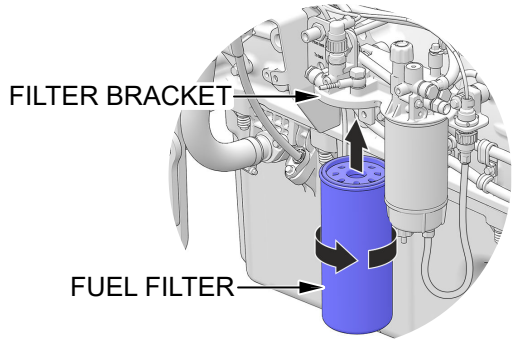



**Figure 81. Fuel Filter Replacement**

2. Using a filter wrench, remove the fuel filter. Collect any spilled fuel in an appropriate container.

3. Clean the filter mating surface on the **filter bracket** (Figure 81).
4. Lubricate the seal on the new fuel filter with diesel fuel and install the new fuel filter. Tighten the fuel filter in accordance with the instructions on the fuel filter.
5. If necessary, vent the fuel system. Refer to the ***Bleeding the Fuel System*** section.

## Fuel Prefilter Replacement

1. Remove the **cable** (Figure 82) from the **water trap sensor**.

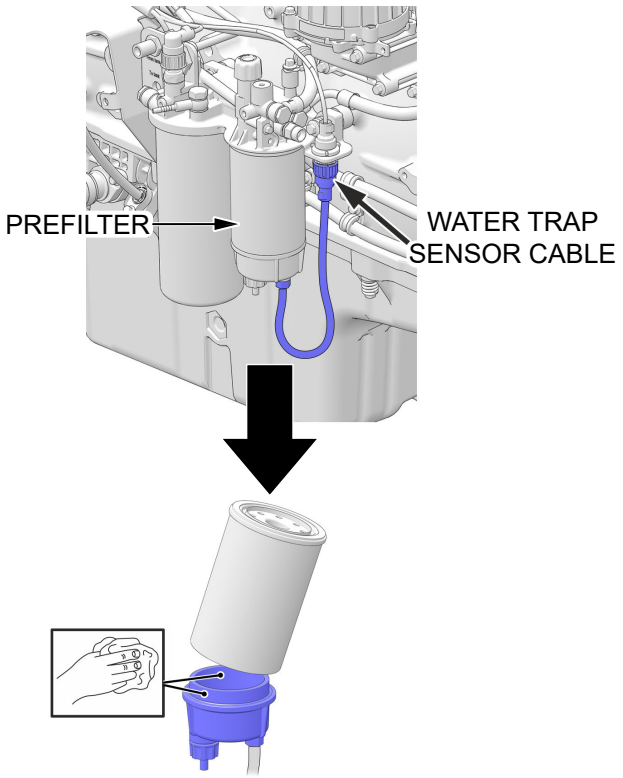



**Figure 82. Fuel Prefilter Replacement**

2. Remove the **prefilter** (Figure 82) from the filter housing. Collect any spilled fuel in a suitable container.
3. Remove the lower part of the water trap from the prefilter.
4. Clean the lower part of the water trap with a soft rag. Check that the drain hole in the lower part is not blocked.
5. Install a new seal on the lower part and lubricate the seal with diesel fuel. Reinstall the lower part of the filter.
6. Lubricate the seal with diesel fuel. Screw the filter onto the filter bracket by hand until the rubber seal just touches the mating surface. Then tighten another 1/2 turn. **DO NOT** overtighten.
7. Connect the cable to the water trap sensor.
8. If necessary, vent the fuel system. Refer to the ***Bleeding the Fuel System*** section.

## Bleeding The Fuel System

1. Check that there is sufficient fuel in the tank, and that any fuel taps are open.
2. Release the **hand pump** (Figure 83) on the fuel bracket by pushing down and twisting the plastic handle.

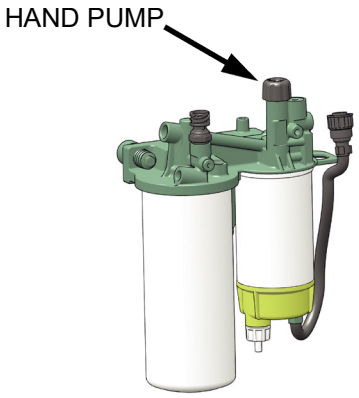



**Figure 83. Bleeding The Fuel System**

3. Vent the fuel system by pumping with the hand pump. Air is vented to the tank via the fuel return pipe. No breathing nipples need to be opened.
4. Lock the hand pump by pushing down and twisting the plastic handle.
5. Start the engine and allow it to idle fast for about 10 minutes.
6. Perform a leakage and function check.

## CLEANING INSIDE THE FUEL TANK

If necessary, drain the fuel inside the fuel tank completely. Using a spray washer (Figure 84), wash out any deposits or debris that have accumulated inside the fuel tank.

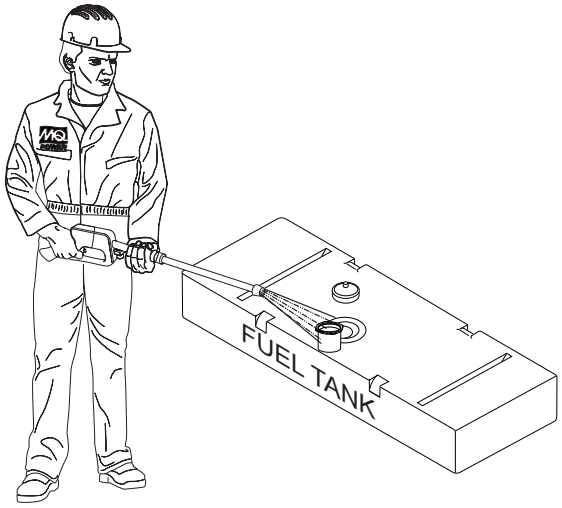



**Figure 84. Cleaning The Fuel Tank**

## FUEL TANK INSPECTION

In addition to cleaning the fuel tank, inspect the following components 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, or hardening.
- **Fuel Tank Lining** — Inspect the fuel tank lining for signs of excessive amounts of oil or other foreign matter.

## DRAINING THE ENGINE OIL

1. Run the engine until the engine coolant reaches a temperature of 140°F (60°C). Turn the engine off.
2. Remove the oil dipstick from its holder.
3. Remove the **oil drain plug** (Figure 85).

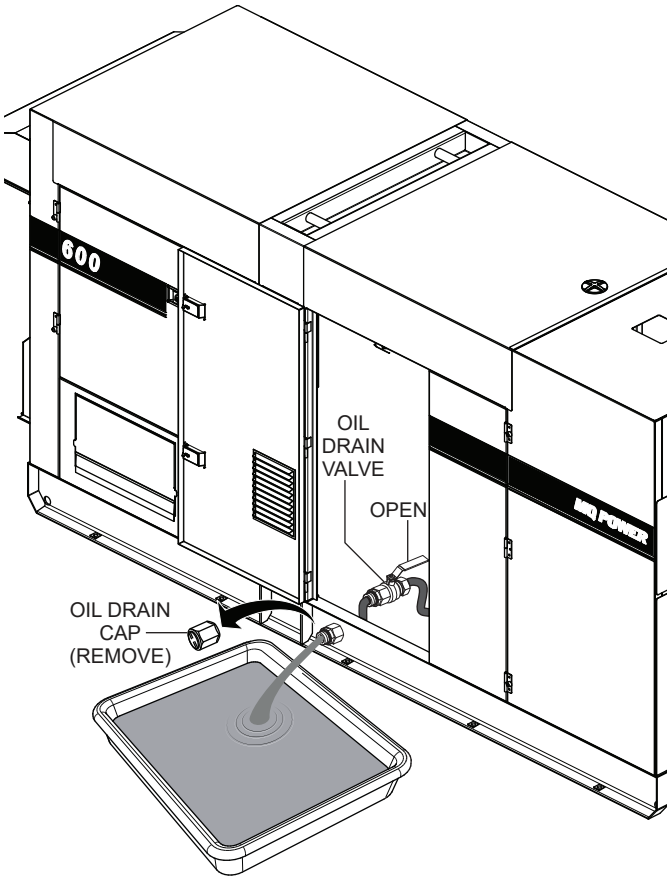



**Figure 85. Draining The Engine Oil**

4. Place the **oil drain valve** in the **OPEN** position and allow the oil to drain into a suitable container (Figure 85).
5. After the engine oil has been completely drained, reinstall the oil drain plug and tighten securely.
6. Place the oil drain valve in the **CLOSED** position.

## ENGINE OIL FILTER REPLACEMENT

1. Clean the area around the **oil filter bracket** (Figure 86).

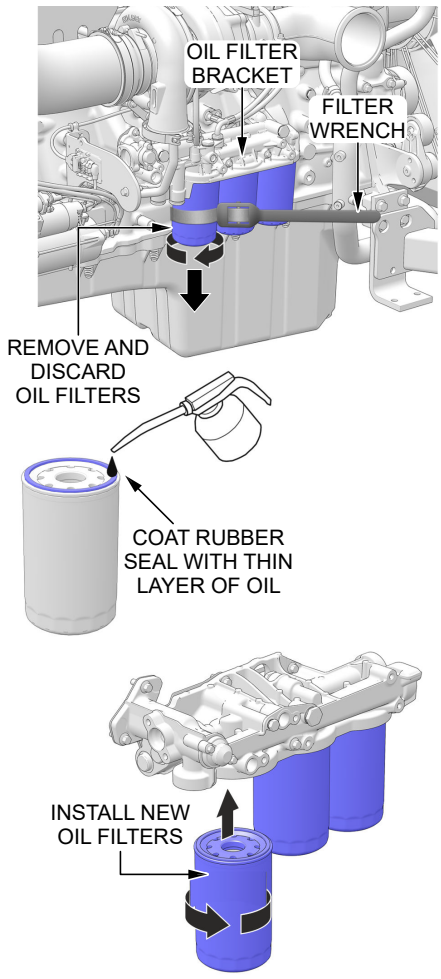



**Figure 86. Oil Filter Replacement**

2. Using a **filter wrench**, remove all engine oil filters (Figure 86).
3. Clean the mating surface of the oil filter bracket. Make sure that no pieces of old oil seal are left behind. Carefully clean around the inside of the protective rim on the oil filter bracket.
4. Coat the rubber seal (gasket) surface of the new oil filters with clean 15W-40 engine oil (Figure 86).
5. Install the new oil filters first by hand until they make contact with the filter head surface. Tighten another 3/4 turn using a filter wrench.
6. Fill the engine crankcase with high-quality detergent oil classified "For Service CI-4." Fill to the upper limit of the dipstick. **DO NOT** overfill. Refer to Table 2 for engine oil capacity.
7. Run the engine for several minutes. Watch for oil leakage. Shut the engine down and allow it to sit for several minutes. Top off the oil to the upper limit on the dipstick.

## DRAINING THE ENGINE COOLANT

**WARNING**

**DO NOT** remove the pressure caps from the radiator while the engine is hot! Wait until the coolant temperature is below 120°F (50°C) before removing the pressure caps.

Heated coolant spray or steam can cause severe scalding and personal injury.

1. Remove the **radiator pressure cap** (Figure 87) and both **expansion tank caps** only if the coolant temperature is below 120°F (50°C).

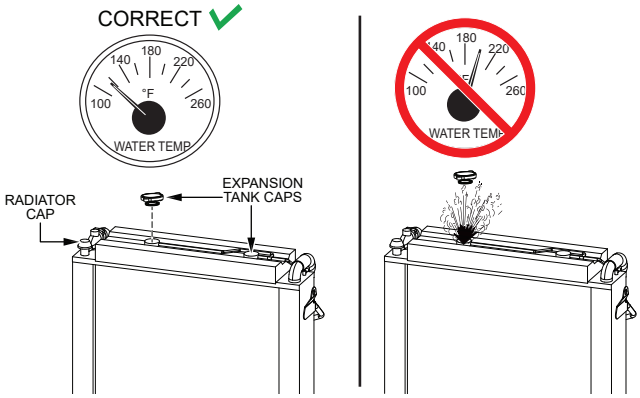



**Figure 87. Radiator And Expansion Tank Caps**

2. Open the cabinet door and remove the **coolant drain bolt** and **O-ring** (Figure 88), then allow the coolant to drain into a suitable container.

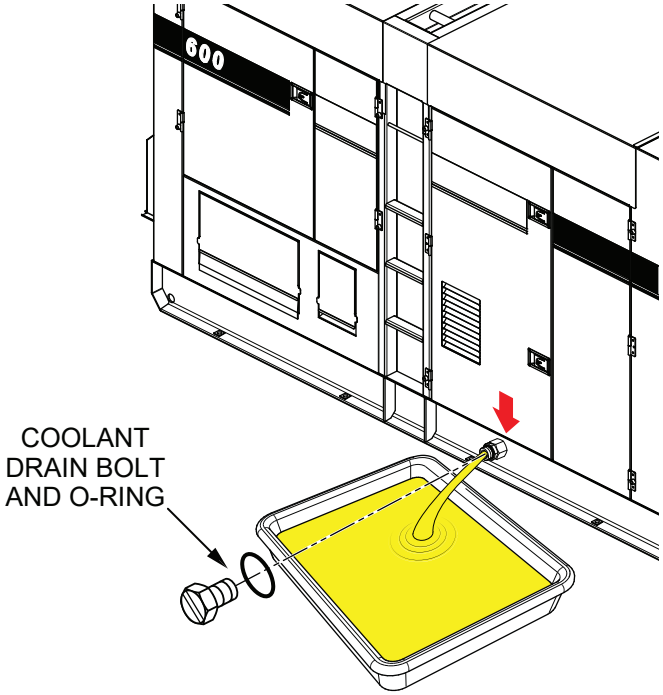



**Figure 88. Draining The Engine Coolant**

## FLUSHING OUT THE RADIATOR AND REPLACING COOLANT

**WARNING**

Allow the engine to **cool** before flushing out the radiator. Flushing the radiator while it is hot can cause serious burns from hot water or steam.

- Open both cocks located at the crankcase side and the lower part of the radiator, and drain the 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 recommended by the engine manufacturer.
- Close the radiator cap tightly.
- Flush the radiator by running clean tap water through radiator until signs of rust and dirt are removed. **DO NOT** clean the radiator core with any objects such as a screwdriver.

## Cleaning The Radiator

The radiator should be cleaned with water and a mild detergent when excessive amounts of dirt and debris have accumulated on the cooling fins or tubes. Use a soft brush. Be careful to not damage the radiator fins.

***NOTICE***

**DO NOT** use a high-pressure power washer (Figure 89) to clean the radiator.

**Figure 89. No High-Pressure Power Washing**

## DRIVE BELT (DAILY)

### Drive Belt Tension

A slack drive belt may contribute to overheating or insufficient charging of the battery. Adjust the drive belt in accordance with the **Volvo engine owner's manual**.

### Drive Belt Inspection

1. Inspect the **drive belt** (Figure 90) for damage and wear. Horizontal cracks (across the belt) are acceptable. Vertical cracks (direction of belt ribs) that intersect with horizontal cracks are not acceptable.

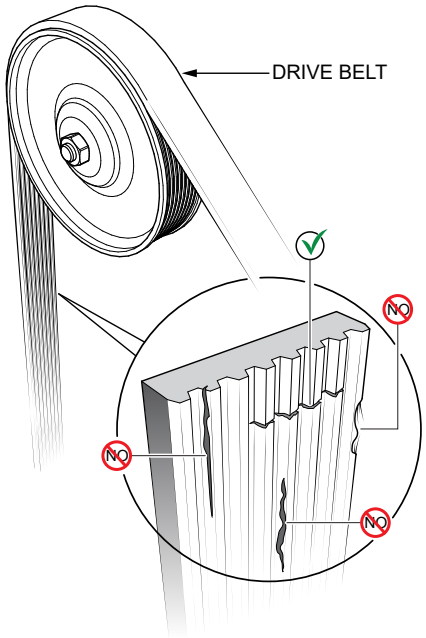



**Figure 90. Drive Belt Inspection**

2. Examine the belt and determine if it is **oil soaked** or **glazed** (a hard shiny appearance on the sides of the belt). Either of these two conditions can cause the belt to run hot, which can weaken it and increase the danger of it breaking.
3. If the drive belt exhibits any of the above wear conditions, replace it immediately.

## TESTING THE GFCI RECEPTACLES

**NOTICE**

The GFCI receptacles are designed to interrupt power when a ground fault exists to prevent injuries and shock hazards. **DO NOT** use a GFCI receptacle if the test below fails. Consult a qualified electrician for repair or replacement of the GFCI receptacle. Test the GFCI receptacles **at least once a month**.

1. Start the generator as shown in the start-up procedure in this manual.
2. Place a **GFCI circuit breaker** (Figure 91) in the **ON** position.

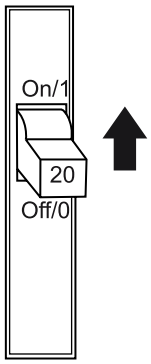



**Figure 91. GFCI Circuit Breaker**

3. Verify that the **status LED** on the corresponding **GFCI receptacle** (Figure 92) is **ON (GREEN)**.

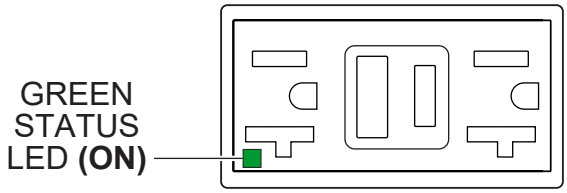



**Figure 92. GFCI Receptacle (ON)**

4. Press the **TEST** button (Figure 93) on the GFCI receptacle and verify that the status LED turns **OFF**.

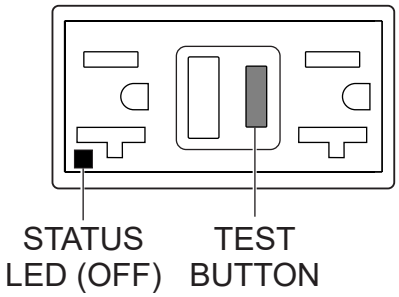



**Figure 93. GFCI Receptacle (OFF)**

5. Press the **RESET** button (Figure 94) to restore power to the GFCI receptacle and verify that the status LED is **ON (GREEN)**.

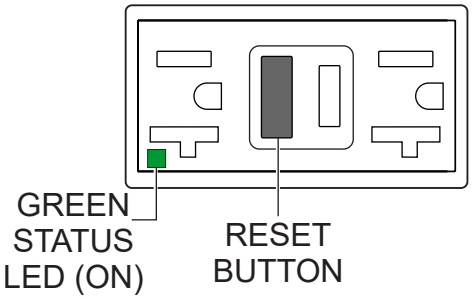



**Figure 94. GFCI Receptacle (ON/Restore)**

6. If the status LED (Figure 95) is **flashing (RED)**, **DO NOT** use the GFCI receptacle and replace it immediately.

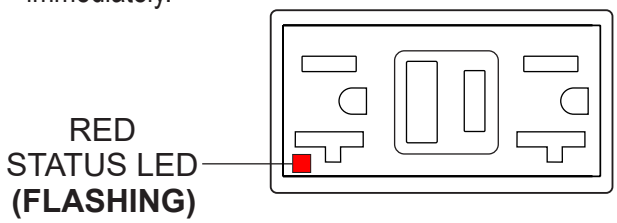



**Figure 95. GFCI Receptacle (Red Flashing LED)**

7. Repeat the above procedure for the other GFCI receptacle.

## 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 generator and store in a clean, dry place.
- Disconnect the battery.
- Make sure engine coolant is at the proper level.
- If the generator is mounted on a trailer, jack the trailer up and place it on blocks so the tires do not touch the ground, or block and completely remove the tires.

## OPTIONAL ENGINE BLOCK HEATER AND INTERNAL BATTERY CHARGER 120 VAC INPUT RECEPTACLES

This generator can be equipped with an **engine block heater** and an **internal battery charger** as **options**. These components are provided with electrical power cords to connect to a commercial power source.

The engine block heater and internal battery charger both require 120 VAC in order to operate. A receptacle (Figure 96) has been provided on the output terminal panel to allow commercial power to be applied.

These units will **only** function when commercial power has been supplied to them. When using extension cords, refer to Table 8 for the correct size and length.

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

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.

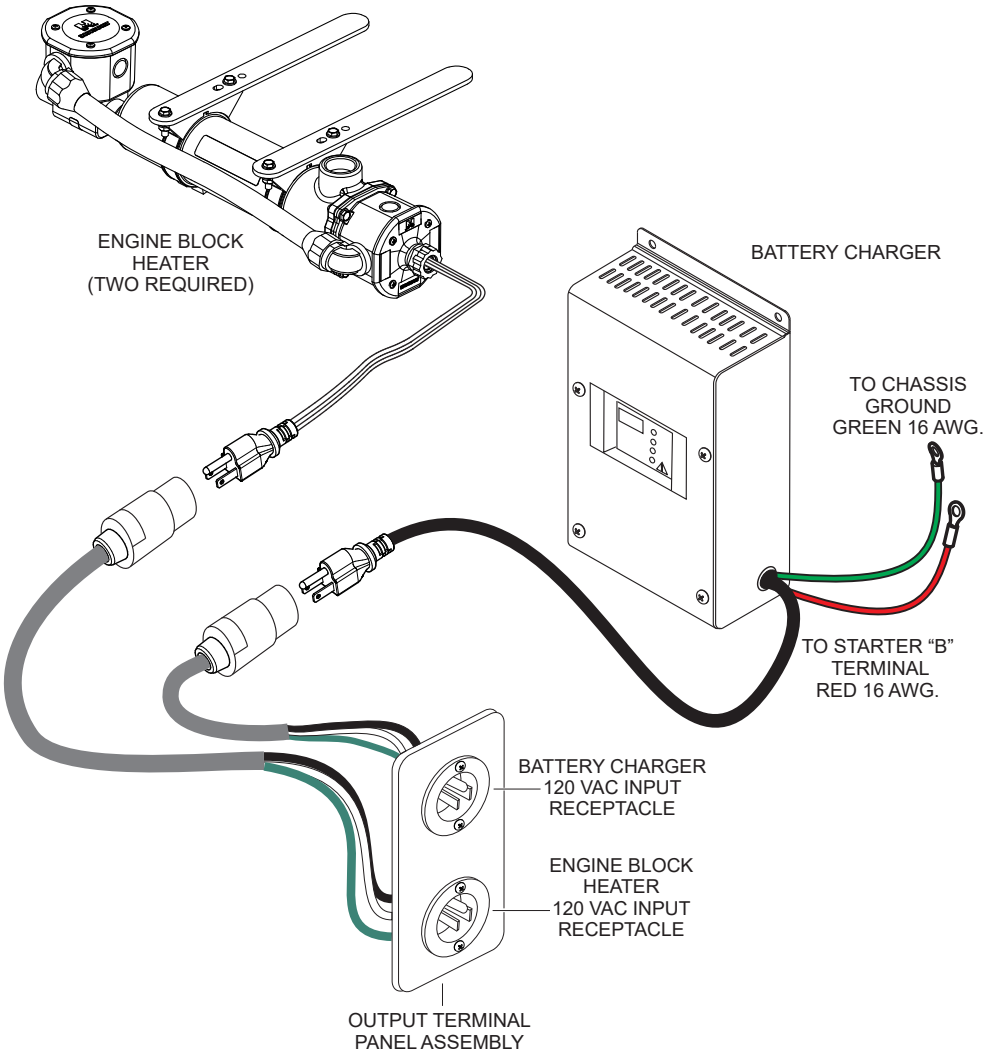



**Figure 96. Battery Charger And Engine Block Heater (Options)**

## EMISSION CONTROL

The emission control system employed with this diesel engine consists of a **diesel oxidation catalyst (DOC)** and a **selective catalytic reduction (SCR)** catalyst as an exhaust gas after-treatment system that helps reduce harmful gases and destroy the organic fraction of particulate matter produced from the exhaust gas to meet the requirement for EPA Tier 4 (Final) regulations.

The DOC device (Figure 97) helps filter out large amounts of harmful nitrogen oxides ($NO_X$) and particulate matter (PM) which are emitted by diesel engines. These exhaust emissions pose serious environmental and health risks. It is important to maintain and service the DOC emission safety device on a periodic basis.

### Diesel Oxidation Catalyst (DOC)

The DOC (Figure 97) does not filter particles, it oxidizes them. This catalyst (honeycomb-like structure) uses a chemical process to break down pollutants in the exhaust stream into less harmful components. In general this catalyst collects/burns accumulated particulates. The DOC contains palladium and platinum which serve as catalysts to oxidize hydrocarbons and carbon monoxide.

## PREVENTIVE MAINTENANCE PROGRAMS

Most challenging to a rental organization is the fact that a customer's power assumptions may not meet the minimum load requirements of the power equipment selected. When in doubt, it is always recommended to apply a **load bank application** to the equipment following a longer rental period.

Equipment on extended, long-term contracts needs periodic on-site inspection. If possible, interview the operator and survey the equipment hooked up to the generator to estimate load conditions.

Preventive maintenance and a few extra steps prevent downtime and protect your investment and business. A well-planned preventive maintenance program will reward you with years of service.

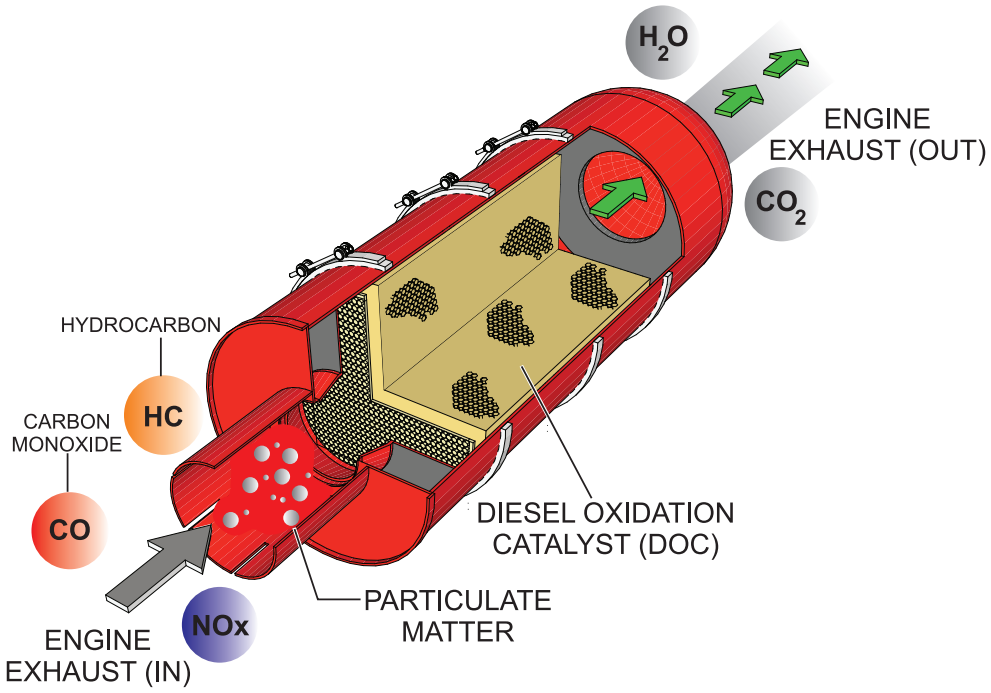



**Figure 97. Diesel Oxidation Catalyst (DOC)**

## SELECTIVE CATALYTIC REDUCTION (SCR)

Diesel engines can be run with a lean burn air-to-fuel ratio, to ensure the full combustion of soot and to prevent the exhaust of unburnt fuel. The excess of air necessarily leads to generation of nitrogen oxides ($NO_x$), which are harmful pollutants, from the nitrogen in the air. **Selective catalytic reduction (SCR)** is used to reduce the amount of $NO_x$ released into the atmosphere.

## DIESEL EXHAUST FLUID (DEF)

**Diesel exhaust fluid (DEF)** is injected from a separate tank into the exhaust pipeline, where the aqueous urea vaporizes and decomposes to form ammonia and carbon dioxide. Within the SCR catalyst, the $NO_x$ are catalytically reduced by the ammonia ($NH_3$) into water ($H_2O$) and nitrogen ($N_2$), which are both harmless; these are then released through the exhaust.

If the **diesel exhaust fluid (DEF) symbol** is displayed (Figure 98) during ECU controller operation, it indicates one or more of the following conditions:

- DEF tank level is below 10%. Refer to Table 15, DEF Level System Action System.
- DEF quality is poor. Check the DEF tank level and check active **diagnostic trouble codes (DTC)**.

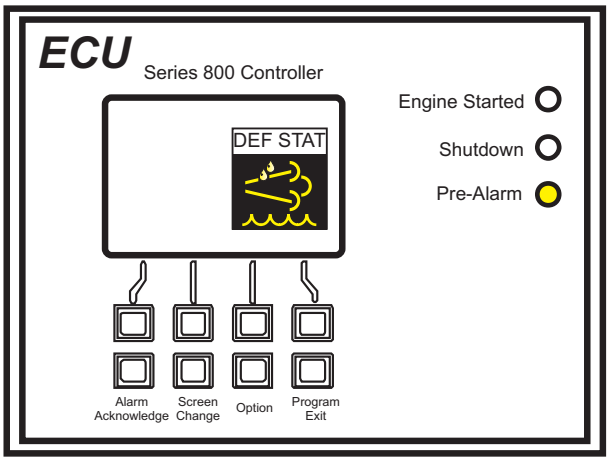



**Figure 98. ECU DEF State Pre-Alarm**

The amount of fluid in the DEF tank will be shown on the ECU controller main screen during operation. The symbol shown in Figure 99 indicating the level of fluid in the DEF tank will be shown on the ECU screen.

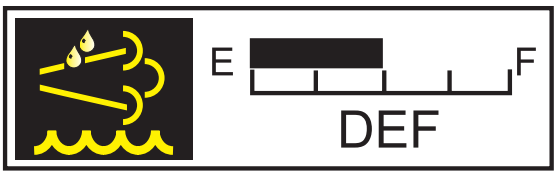



**Figure 99. DEF Tank Level Gauge**

***NOTICE***

The unit will enter emergency shutdown 30 minutes after the DEF level has reached 10% or when other emergency protective measures are necessary. When this condition exists, the unit can only run at low idle.

**Table 15. DEF Level System Action**

| **DEF Level** | Over 20% | Below 20% | Below 10% | After 30 Minutes |
|---|---|---|---|---|
| **Controller Message** | — | REAGENT TANK LEVEL LOW | REAGENT TANK LEVEL LOW | REAGENT TANK LEVEL LOW |
| **SCR System Pop-Up** | — | REFILL DEF | REFILL DEF | REFILL DEF |
| **DEF Symbol** | — | ON | Flashing | Flashing |
| **Pre-Alarm Lamp** | — | ON | ON | — |
| **Shutdown Lamp** | — | — | — | ON (Engine Shutdown) |

## INDUCEMENT

When the system senses improper usage, such as no supply of DEF, use of poor quality DEF, problems with DEF dosing, or disconnection of sensors, a warning will be issued before the situation becomes critical. If the warnings are ignored and the unit enters intermittent operation, the emergency shutdown will activate. The three warning levels are shown in Table 16:

**Table 16. DEF Inducement**

| Stage | Controller Message | SCR System Pop-Up | Malfunction Indicator | Emission Indicator | Pre-Alarm Lamp | Shutdown Lamp |
|---|---|---|---|---|---|---|
| Stage 1 Warning Level 1 | INCORRECT REAGENT QUALITY<br>ABSENCE OF REAGENT DOSING<br>TAMPERING | EATS ERROR |  |  | ON | — |
| Stage 2 Warning Level 2 | INCORRECT REAGENT QUALITY<br>ABSENCE OF REAGENT DOSING<br>TAMPERING | EATS ERROR |  <br>Slow Flashing |  | ON | — |
| Stage 3 Shutdown[1] | INCORRECT REAGENT QUALITY<br>ABSENCE OF REAGENT DOSING<br>TAMPERING | EATS ERROR |  <br>Fast Flashing |  | — | ON |

[1]When emergency shutdown occurs, inspection and repair should generally be performed promptly.

## PROTECTION DEVICES

### Automatic Shutdown System

This unit is equipped with engine protection devices that automatically shut down the engine if any of the faults shown in Table 17 occur. The **Shutdown LED** on the ECU controller will turn on just before the shutdown and will stay on after the shutdown. Messages will appear on the ECU display.

After the automatic shutdown, check all diagnostic trouble codes (DTC) displayed on the ECU controller. Refer to the ***Troubleshooting (Diagnostics)*** section of this manual.

Place the **Auto Start/Stop switch** in the **OFF/RESET** position. In addition, place all circuit breakers in the **OFF** position. Before troubleshooting, allow sufficient time for adequate cooling. Before attempting to restart the generator, perform an overall inspection of the generator and correct the problem that caused the shutdown. If necessary, contact your nearest Multiquip dealer for additional technical support.

Restart the generator as described in the ***Generator Start-Up Procedure (Manual Start)*** section of this manual.

***NOTICE***

Although the unit is equipped with engine protection devices, regularly scheduled preventive maintenance is strongly advised.

**Table 17. Automatic Engine Shutdown System**

| Operating Parameter | ECU Shutdown LED | Operating Condition/Set Point |
|---|---|---|
| Low Oil Pressure | ON | Set point: 39.9 psi (275 kPa) |
| High Water Temperature | ON | Set point: 225°F (107°C) |
| Engine Overspeed | ON | Exceeds approx. +15% of rated speed |
| Low Coolant Level | ON | Falls below specified level |

## FAULT DIAGNOSTICS

The engine controller of this generator diagnoses problems (faults/errors) that arise from the engine control system and the engine itself.

1. With the engine stopped **(OFF)**, press and hold the **Hour Check button** (Figure 100) located on the control panel.

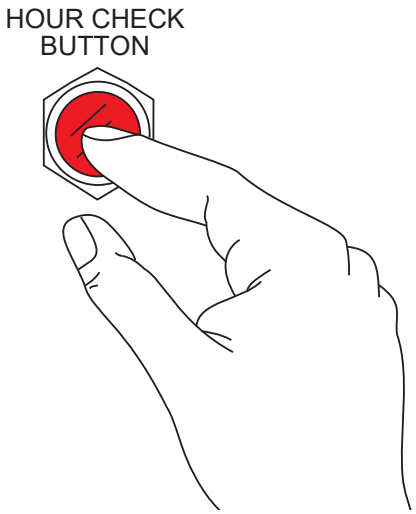



**Figure 100. Hour Check Button**

2. While keeping the Hour Check button pressed, place the **Auto Start/Stop switch** (Figure 101) in the **MANUAL** position.


**Figure 101. Auto Start/Stop Switch (Manual)**

3. The **Hour Check menu screen** will be displayed on the ECU controller.
4. Release the Hour Check button and press the **Program/Exit button** (Figure 102) on the ECU controller to return the controller to the main screen.

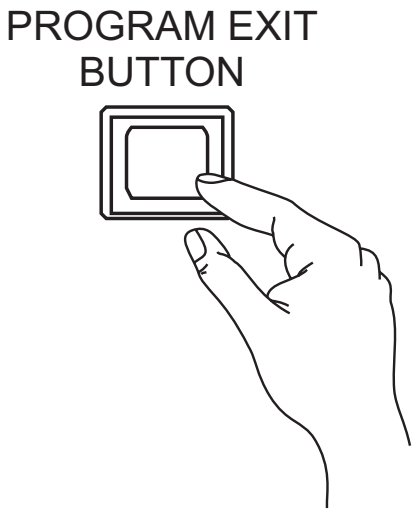



**Figure 102. Program Exit Button**

5. Press the **Program/Exit button** on the ECU controller and select **Fault Diagnostics mode**. This mode enables fault diagnostics as follows:

- **DM1 Active Faults** — Displays active fault messages and codes.
- **DM2 Messages and Codes** — Displays messages and codes which previously occurred that are recorded in the engine control module (ECM).
- **Last Shutdown** — Displays the messages and codes that caused the most recent shutdown.

6. After performing diagnostic tests, place the Auto Start/Stop switch in the **OFF/RESET** position.

Practically all breakdowns can be prevented by proper handling and maintenance inspections, but in the event of a breakdown, use Table 18 below for diagnosis of the generator. If the problem cannot be remedied, consult our company's business office or service plant.

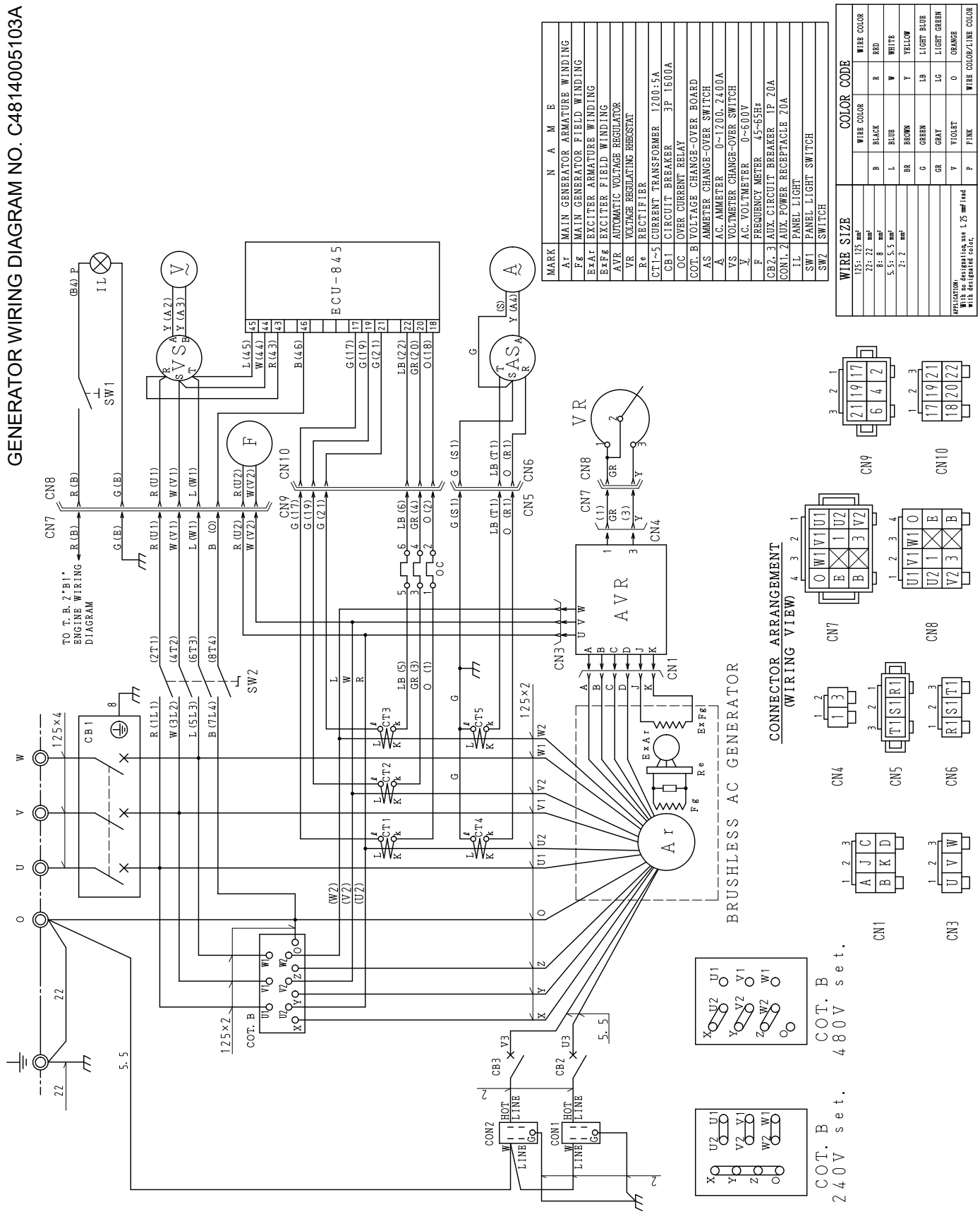
**Table 18. Generator Troubleshooting**

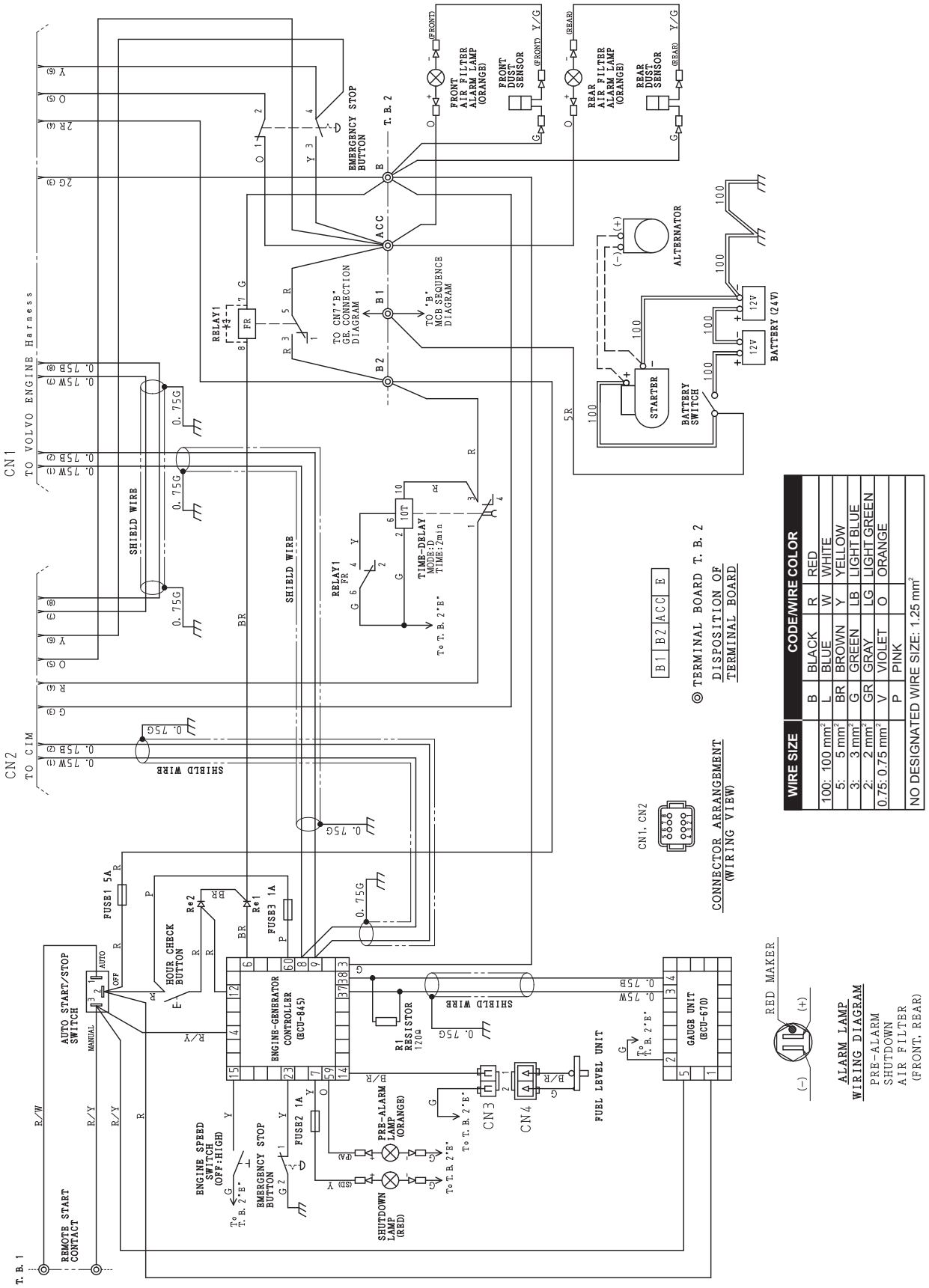
| Symptom | Possible Problem | Solution |
|---|---|---|
| No Voltage Output | Defective AC voltmeter? | Check output voltage using a voltmeter. |
| | Loose wiring connection? | Check wiring and repair. |
| | Defective AVR? | Replace if necessary. |
| | Defective rotating rectifier? | Check and replace. |
| Low Voltage Output | Low engine speed? | Check and adjust. |
| | Loose wiring connection? | Check wiring and repair. |
| | Defective AVR? | Replace if necessary. |
| High Voltage Output | Loose wiring connection? | Check wiring and repair. |
| | Defective AVR? | Replace if necessary. |
| Circuit Breaker Tripped | Short circuit in load? | Check load and repair. |
| | Over current? | Confirm load requirement and reduce. |
| | Defective circuit breaker? | Check and replace. |
| | Overcurrent relay actuated? | Confirm load requirement and reset. |

| 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 as 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? | Add fuel. |
| | Fuel filter clogged? | Replace fuel filter. |
| | Fuel tank venting is inadequate? | Ensure 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 | | |
|---|---|---|
| **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 upper mark on dipstick. |
| | Entire cooling air system contaminated or 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 NO. C4814005103A

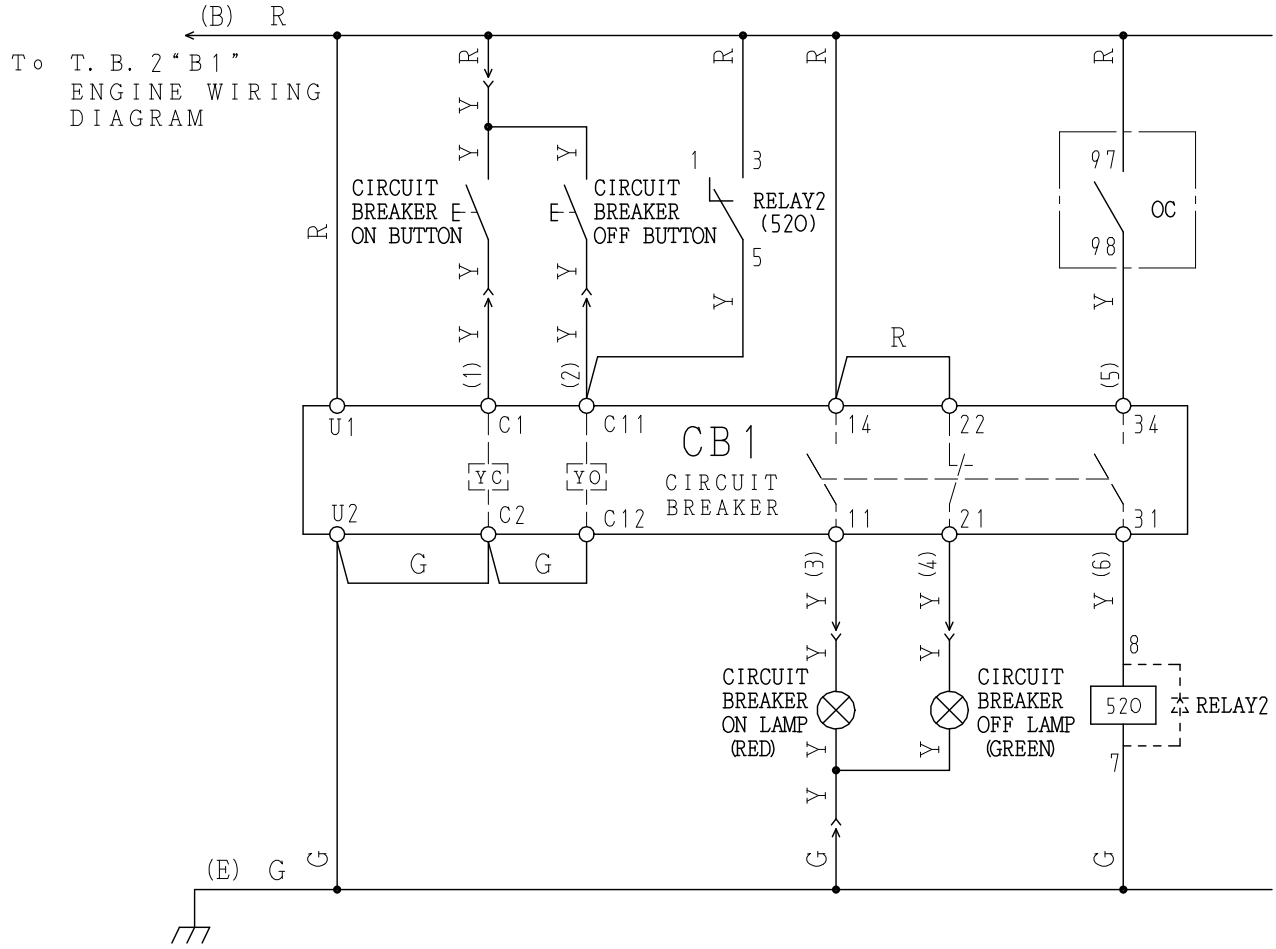





| WIRE SIZE | CODE/WIRE COLOR | | |
|---|---|---|---|
| | B | BLACK | R RED |
| 100: 100 mm² | L | BLUE | W WHITE |
| 5: 5 mm² | BR | BROWN | Y YELLOW |
| 3: 3 mm² | G | GREEN | LB LIGHT BLUE |
| 2: 2 mm² | GR | GRAY | LG LIGHT GREEN |
| 0.75: 0.75 mm² | V | VIOLET | O ORANGE |
| | P | PINK | |
| NO DESIGNATED WIRE SIZE: 1.25 mm² | | | |

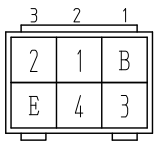
ENGINE WIRING DIAGRAM NO. C4814106813

# MCB SEQUENCE DIAGRAM (C4814209104)

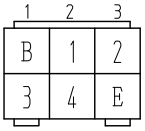



: REFER TO GENERATOR CONNECTION DIAGRAM

Control box side




Control panel side



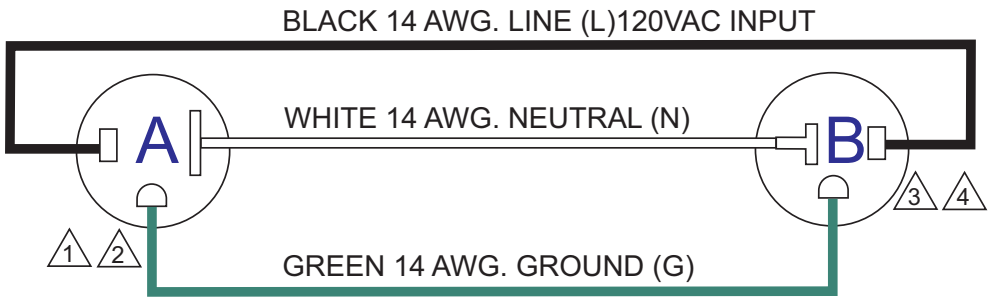

CONNECTOR ARRANGEMENT
(WIRING VIEW)

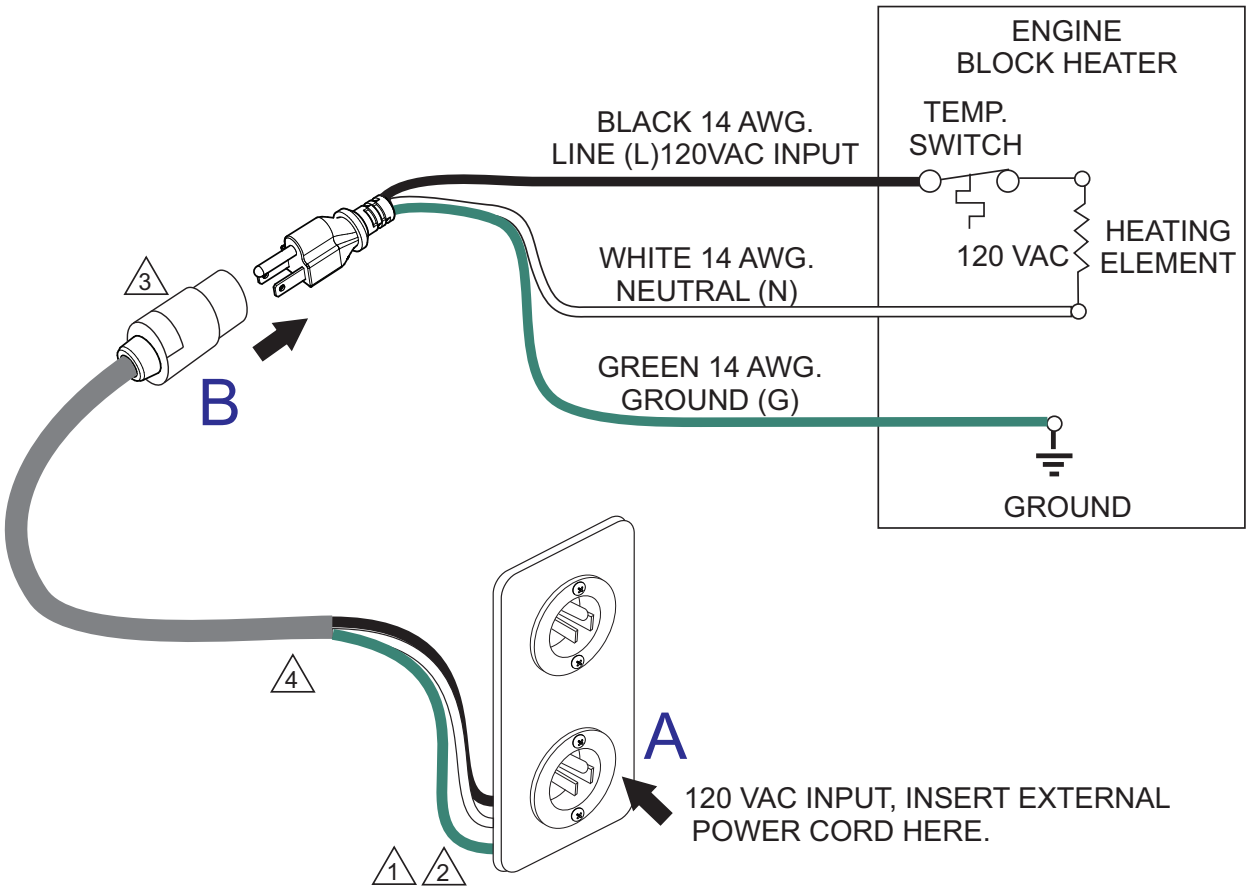
WIRE SIZE : 1.25mm²

| COLOR CODE | | | |
|---|---|---|---|
| | WIRE COLOR | | WIRE 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 | WIRE COLOR/LINE COLOR | |

MCB SEQUENCE DIAGRAM NO. C4814209104

# ENGINE BLOCK HEATER WIRING DIAGRAM (OPTION)

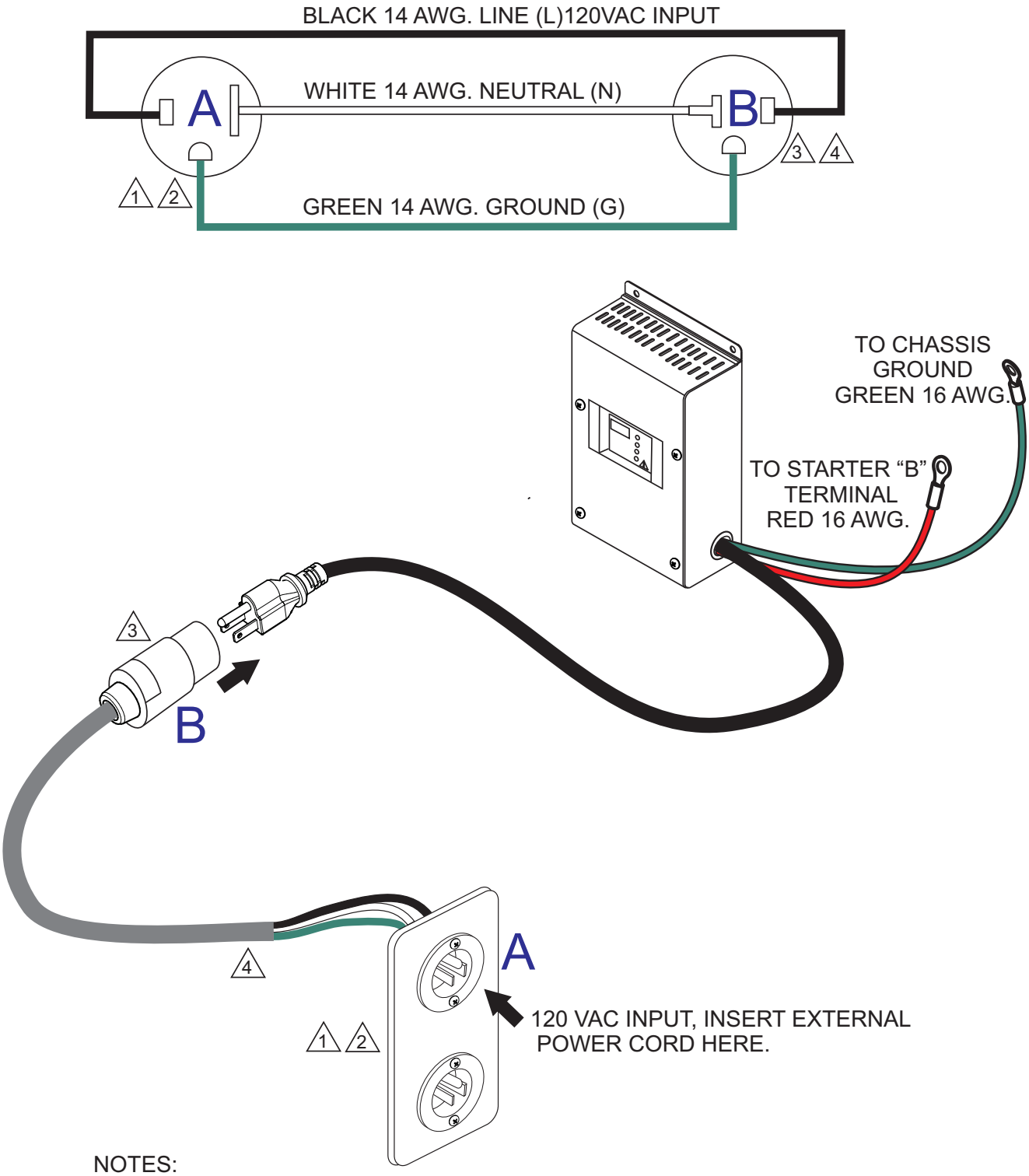



NOTES:

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.

# BATTERY CHARGER WIRING DIAGRAM (OPTION)




NOTES:

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3. 20 AMP, 5-20R RECEPTACLE, P/N EE6131 (HBL5369C/HUBBLE RECEPTACLE).
4. CORD, CAROL 3/C 14 AWG., P/N EE56557.

# OPERATION MANUAL

# HERE'S HOW TO GET HELP

PLEASE HAVE THE MODEL AND SERIAL NUMBER ON HAND WHEN CALLING


## UNITED STATES

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Cypress, CA 90630
E-MAIL: mq@multiquip.com
WEBSITE: www.multiquip.com

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***Multiquip***

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Laval, Quebec, Canada H7L 6V3
E-MAIL: infocanada@multiquip.com

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

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Dukinfield, Cheshire SK16 4UJ
E-MAIL: sales@multiquip.co.uk




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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