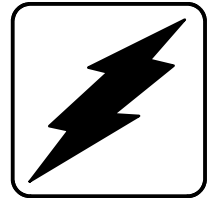


Operation and Installation

Residential/Commercial Generator Sets



Models:

8.5RMY

11RMY

with Sound Enclosure

Controller:

Decision-Maker™ 1

9001
IS **KOHLER**
POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER[®]
POWER SYSTEMS

TP-6049 9/02f

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Safety Precautions and Instructions

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. **SAVE THESE INSTRUCTIONS.**

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that **will cause severe personal injury, death, or substantial property damage.**

WARNING

Warning indicates the presence of a hazard that **can cause severe personal injury, death, or substantial property damage.**

CAUTION

Caution indicates the presence of a hazard that **will or can cause minor personal injury or property damage.**

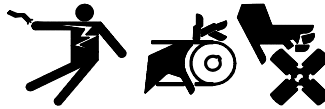
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting. Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Battery

WARNING



Sulfuric acid in batteries. Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

WARNING



Explosion. Can cause severe injury or death. Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.


Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.


Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Engine Backfire/Flash Fire

⚠ WARNING

Fire. Can cause severe injury or death. Do not smoke or permit flames or sparks near fuels or the fuel system.

Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner removed.

Exhaust System

⚠ WARNING

Carbon monoxide. Can cause severe nausea, fainting, or death. The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate the generator set where exhaust gas could accumulate and seep back inside a potentially occupied building.

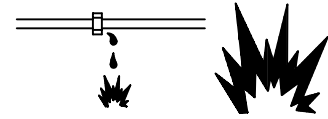
Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

Fuel System

⚠ WARNING



Explosive fuel vapors. Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

The fuel system. Explosive fuel vapors can cause severe injury or death. Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running because spilled fuel may ignite on contact with hot parts or from sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.

Explosive fuel vapors can cause severe injury or death. Take additional precautions when using the following fuels:

Propane (LP)—Adequate ventilation is mandatory. Because propane is heavier than air, install propane gas detectors low in a room. Inspect the detectors per the manufacturer's instructions.

Natural Gas—Adequate ventilation is mandatory. Because natural gas rises, install natural gas detectors high in a room. Inspect the detectors per the manufacturer's instructions.

Gas fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LP vapor gas or natural gas fuel system for leakage by using a soap and water solution with the fuel system test pressurized to 6–8 ounces per square inch (10–14 inches water column). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

Hazardous Noise

CAUTION



Hazardous noise. Can cause hearing loss.

Never operate the generator set without a muffler or with a faulty exhaust system.

Engine noise. Hazardous noise can cause hearing loss. Generator sets not equipped with sound enclosures can produce noise levels greater than 105 dBA. Prolonged exposure to noise levels greater than 85 dBA can cause permanent hearing loss. Wear hearing protection when near an operating generator set.

Hazardous Voltage/ Electrical Shock

WARNING	
<p>Hazardous voltage. Moving rotor. Can cause severe injury or death.</p> <p>Operate the generator set only when all guards and electrical enclosures are in place.</p>	

WARNING	
<p>Hazardous voltage. Backfeed to the utility system can cause property damage, severe injury, or death.</p> <p>If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.</p>	

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocutation is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

High voltage test. Hazardous voltage can cause severe injury or death. Follow the instructions of the test equipment manufacturer when performing high-voltage tests on the rotor or stator. An improper test procedure can damage equipment or lead to generator set failure.

Installing the battery charger. Hazardous voltage can cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).


Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Testing the voltage regulator. Hazardous voltage can cause severe injury or death. High voltage is present at the voltage regulator heat sink. To prevent electrical shock do not touch the voltage regulator heat sink when testing the voltage regulator.


(PowerBoost™, PowerBoost™ III, and PowerBoost™ V voltage regulator models only)

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

Heavy Equipment

⚠ WARNING

Unbalanced weight. Improper lifting can cause severe injury or death and equipment damage.
Do not use lifting eyes. Lift the generator set using lifting bars inserted through the lifting holes on the skid.


Hot Parts

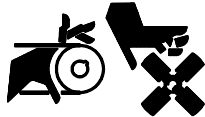
⚠ WARNING

Hot engine and exhaust system. Can cause severe injury or death.
Do not work on the generator set until it cools.

Servicing the generator. Hot parts can cause severe injury or death. Avoid touching the generator set field or exciter armature. When shorted, the generator set field and exciter armature become hot enough to cause severe burns.

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

Moving Parts

⚠ WARNING

Hazardous voltage. Moving rotor. Can cause severe injury or death.
Operate the generator set only when all guards and electrical enclosures are in place.

⚠ WARNING

Rotating parts. Can cause severe injury or death.
Operate the generator set only when all guards, screens, and covers are in place.

Tightening the hardware. Flying projectiles can cause severe injury or death. Loose hardware can cause the hardware or pulley to release from the generator set engine and can cause personal injury. Retorque all crankshaft and rotor hardware after servicing. Do not loosen the crankshaft hardware or rotor throbolt when making adjustments or servicing the generator set. Rotate the crankshaft manually in a clockwise direction only. Turning the crankshaft bolt or rotor throbolt counterclockwise can loosen the hardware.

Servicing the generator set when it is operating. Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

Notice

NOTICE
This generator set has been rewired from its nameplate voltage to
<div style="border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div>
<small>246242</small>

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

NOTICE

Hardware damage. The engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

NOTICE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. To indicate hardness, American Standard hardware uses a series of markings, and metric hardware uses a numeric system. Check the markings on the bolt heads and nuts for identification.

NOTICE

Canadian installations only. For standby service connect the output of the generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

This manual provides operation and installation instructions for model 8.5RMY and 11RMY generator sets equipped with sound enclosures. This manual covers both single-fuel systems and multi-fuel systems. To identify the generator set's fuel system, see Section 1.5, Service Views, and Section 6.7, Fuel Systems.

Information in this publication represents data available at the time of print. The manufacturer may provide this manual for models not listed on the front cover. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect the parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.

Nameplate

The following illustration shows a typical generator set nameplate. Copy the model, serial, and specification numbers from the nameplate into the spaces provided in the product information section on the inside front cover of this manual. See Section 1.5, Service Views, for the nameplate location.

KOHLER [®]					
KOHLER CO. KOHLER WI. USA					
MODEL:			SERIAL:		
SPEC:					
SERVICE DUTY:					
HZ:		RPM:			
VOLTAGE	AMPS	PHASE	KW	KVA	P.F.
GEN. MODEL:				BATT. V	
INSULATION: NEMA CLASS					
KW VARIES WITH BTU CONTENT OF FUEL					

EPA and California Emission Certification

An engine or generator set with one of the following identification labels is certified to meet Small Off-Road Engine (SORE) emission standards for EPA/CARB.

IMPORTANT ENGINE INFORMATION

THIS ENGINE MEETS EMISSION REGULATIONS FOR U.S. EPA PH1 SMALL ENGINES AND 2000-2001 CALIFORNIA SI SORES *

DISPLACEMENT:

FAMILY:

BUILD DATE :

REFER TO OWNERS MANUAL FOR SAFETY, MAINTENANCE SPECS AND ADJUSTMENTS. FOR SALES AND SERVICE IN US/CANADA CALL:
1-800-544-2444

THIS ENGINE IS CERTIFIED TO OPERATE ON

KOHLER[®]
POWER SYSTEMS

* Spark-Ignited Small Off-Road Engines


This engine/generator is certified to operate using natural gas or propane fuel.

This engine is certified with engine modifications made by the generator set manufacturer.

IMPORTANT ENGINE INFORMATION

THIS ENGINE MEETS U.S. EPA PHASE 1 AND CALIFORNIA 2006 AND LATER EMISSION CONTROL REGULATIONS FOR SI SORE

FAMILY
DISPL. (CC)
MODEL NO.
SPEC. NO.
SERIAL NO.



N11236

EMISSION COMPLIANCE PERIOD:
EPA: CARB: EXTENDED

THIS ENGINE IS CERTIFIED TO OPERATE ON:
PROPANE / NATURAL GAS

REFER TO OWNER'S MANUAL FOR SAFETY,
MAINTENANCE SPECS AND ADJUSTMENTS.
FOR SALES AND SERVICE IN US/CANADA,
CALL:
1-800-544-2444
WWW.KOHLERENGINES.COM

KOHLER engines
KOHLER CO. KOHLER, WISCONSIN USA

The Emission Compliance Period referred to on the Emission Control or Air Index label indicates the number of operating hours for which the engine has been shown

to meet CARB emission requirements. The following table provides the engine compliance period (in hours) associated with the category descriptor found on the certification label.

Emission Compliance Period (hours)			
CARB	Moderate, 125	Intermediate, 250	Extended, 500

Refer to the certification label for engine displacement.

The exhaust emission control system for the 8.5RMY and 11RMY (CH25) is EM.

Look for the identification label shown above to determine whether generator sets with single-fuel systems are emission-certified. All model 8.5RMY and 11RMY generator sets with multi-fuel systems are emission-certified and include one of the identification labels shown above.

Service Assistance

For professional advice on generator power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric
- Visit the Kohler Power Systems website at KohlerPowerSystems.com
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product
- Call toll free in the US and Canada 1-800-544-2444
- Outside the US and Canada, call the nearest regional office

Africa, Europe, Middle East

London Regional Office
Langley, Slough, England
Phone: (44) 1753-580-771
Fax: (44) 1753-580-036

Asia Pacific

Power Systems Asia Pacific Regional Office
Singapore, Republic of Singapore
Phone: (65) 264-6422
Fax: (65) 264-6455

China

North China Regional Office, Beijing
Phone: (86) 10 6518 7950
(86) 10 6518 7951
(86) 10 6518 7952
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai
Phone: (86) 21 6288 0500
Fax: (86) 21 6288 0550

India, Bangladesh, Sri Lanka

India Regional Office
Bangalore, India
Phone: (91) 80 3366208
(91) 80 3366231
Fax: (91) 80 3315972

Japan, Korea

North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

Latin America

Latin America Regional Office
Lakeland, Florida, USA
Phone: (863) 619-7568
Fax: (863) 701-7131

X:in:008:001a

1.1 Specifications

The generator set specification sheets provide specific generator and engine information. Refer to the spec sheet for data not supplied in this manual. Consult the generator set service manual, engine operation manual, and engine service manual for additional specifications. Obtain copies of the latest spec sheets, manuals, diagrams, and drawings from your local distributor/dealer.

1.2 Generator

The generator uses Kohler's unique PowerBoost™ voltage regulation system, which provides instant response to load changes.

PowerBoost™ ensures reliable motor starting and consistent voltage levels. PowerBoost™ utilizes a voltage excitation system that employs a winding independent of the main output windings to provide excitation voltage.

1.3 Engine

The generator set has a four-cycle, twin cylinder, air-cooled Kohler® engine. The engine operates on clean-burning natural gas or propane (LP) vapor. Engine features include:

- Efficient overhead valve design and full pressure lubrication for maximum power, torque, and reliability under all operating conditions.

- Dependable, maintenance-free electronic ignition.
- Precision-formulated cast iron construction of parts subjected to the most wear and tear.
- Field-convertible multi-fuel systems that allow fuel changeover from natural gas to LP vapor (and vice-versa) while maintaining CARB emission certification.

1.4 Controller

The generator set has a Decision-Maker™ 1 relay controller. For a specific description of the controller, see Section 2, Operation. Controller features include the following:

- Fault shutdowns
 - Overcrank
 - Overspeed
 - Low oil pressure
 - High engine temperature
- Running-time meter
- Switches and standard features
 - Switch, run/reset-off/auto (engine start)
 - Cranking, cyclic
- Line circuit breaker:
 - 8.5RMY: 40 amps
 - 11RMY: 50 amps
- Common fault lamp (on some controllers)

1.5 Service Views

This section includes two generator set service views. See Figure 1-1 and the descriptions below to determine which service view applies to your generator set.

Figure 1-2 shows **single-fuel** generator sets, which can be identified in two ways:

- Single-fuel model specification numbers begin with PA-. See the generator set nameplate for the spec number.
- Single-fuel models have the fuel valve shown in Figure 1-2, item 8.

Figure 1-3 Shows **multi-fuel** generator sets, which can be identified in two ways:

- Multi-fuel model specification numbers begin with GM. See the generator set nameplate for the spec number.
- Multi-fuel models have the multi-fuel block shown in Figure 1-3, item 10.

Spec Number Format	Fuel System	Service View
PA-xxxxxx	Single-fuel	Figure 1-2
GMxxxxxx	Multi-fuel	Figure 1-3

Figure 1-1 Service View Identification

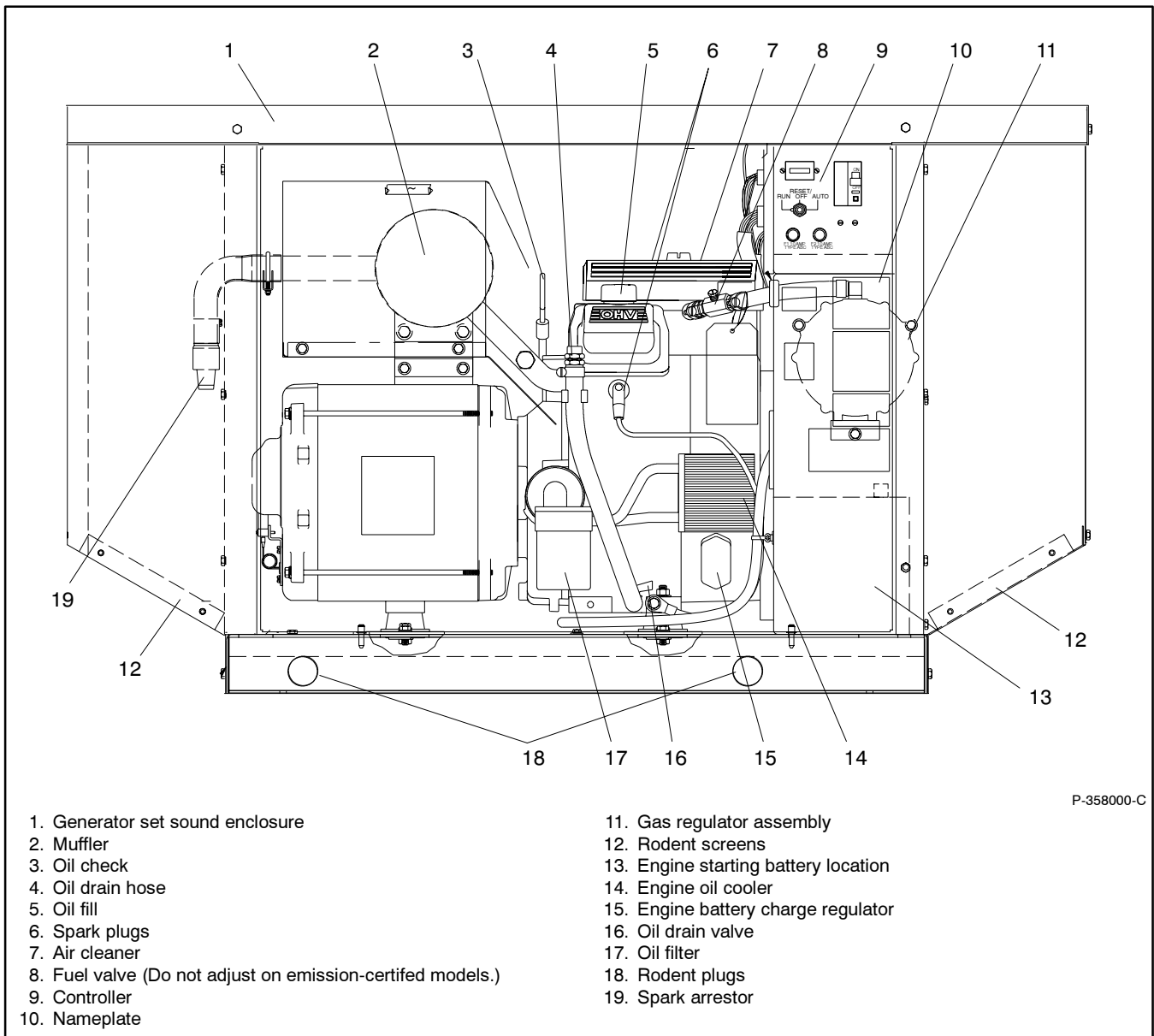


Figure 1-2 Generator Set Service View, Single-Fuel Systems (spec numbers PA-)

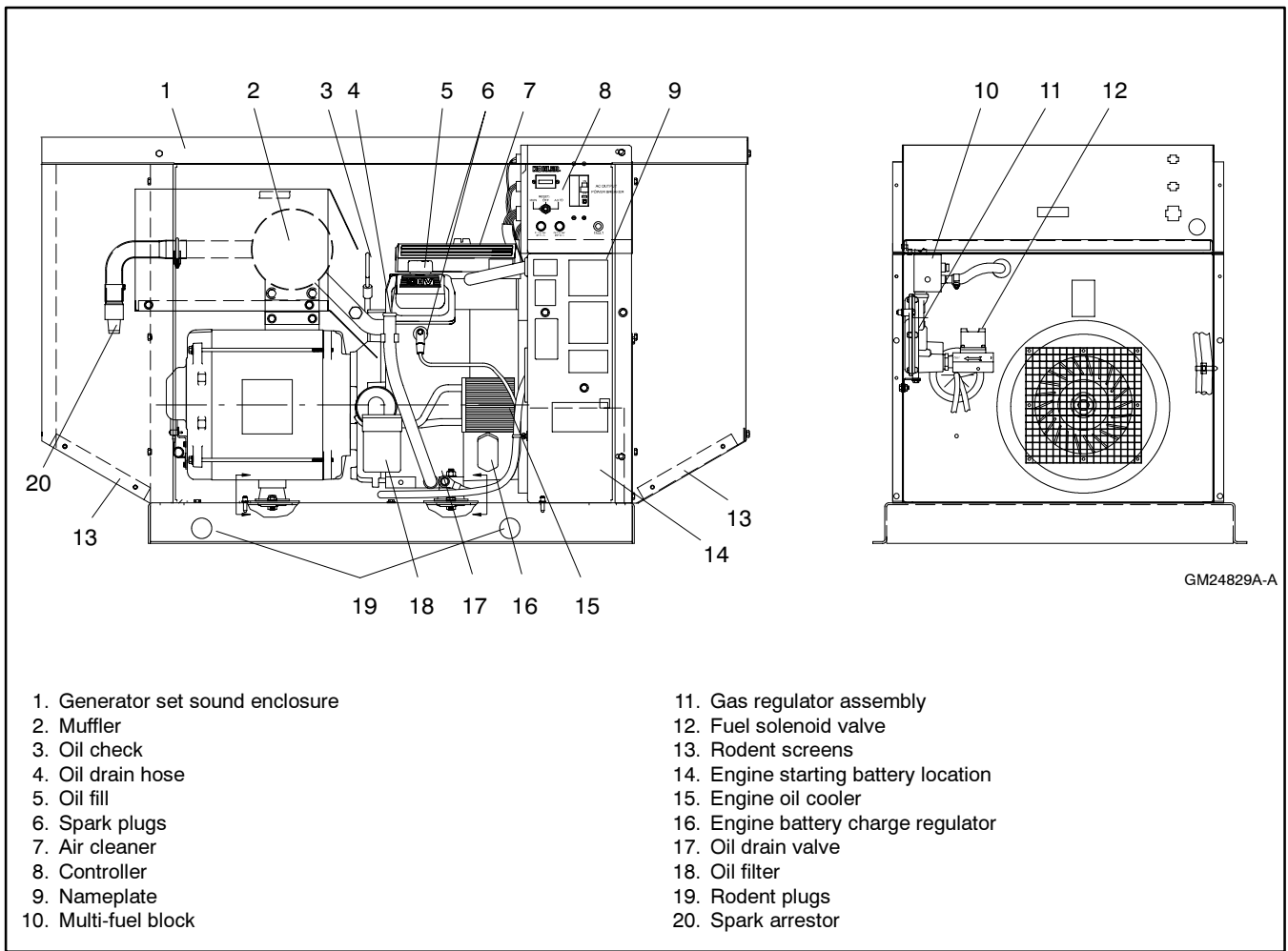


Figure 1-3 Generator Set Service View, Multi-Fuel Systems (spec numbers GMxxxxx)

Notes

2.1 Prestart Checklist

To ensure continued satisfactory operation, perform the following checks or inspections before or at each startup, as designated, and at the intervals specified in the service schedule. In addition, some checks require verification after the unit starts.

Air Cleaner. Check for a clean and installed air cleaner element to prevent unfiltered air from entering the engine.

Air Inlets. Check for clean and unobstructed air inlets.

Battery. Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.

Exhaust System. Check for exhaust leaks and blockages. Check the muffler and piping condition and check for tight exhaust system connections.

Inspect the exhaust system components (exhaust manifold, exhaust line, flexible exhaust, clamps, muffler, and outlet pipe) for cracks, leaks, and corrosion.

- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps and hangers. Tighten or replace the exhaust clamps and/or hangers as needed.
- Check that the exhaust outlet is unobstructed.

- Visually inspect for exhaust leaks (*blowby*). Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.

Oil Level. Maintain the oil level at or near, not over, the full mark on the dipstick.

Operating Area. Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.

x.op:001:002

2.2 Exercising the Generator Set

Operate the generator set under load once each week for one hour. If the generator set does not have a programmed exercise mode or an automatic transfer switch (ATS) with an exercise option, exercise the unit in the presence of an operator.

During the exercise period apply a minimum of 35% load based on the nameplate standby rating.

The operator should perform all of the prestart checks before starting the exercise procedure. Start the generator set according to the starting procedure in the controller section of this manual. While the generator set is operating, listen for a smooth-running engine and visually inspect the generator set for fluid or exhaust leaks. Check the air inlets and outlets and remove any items restricting the air flow.

2.3 Decision-Maker 1 Controller Operation

For identification of the Decision-Maker™ 1 controller's indicators and controls and their functions, refer to Figure 2-1.

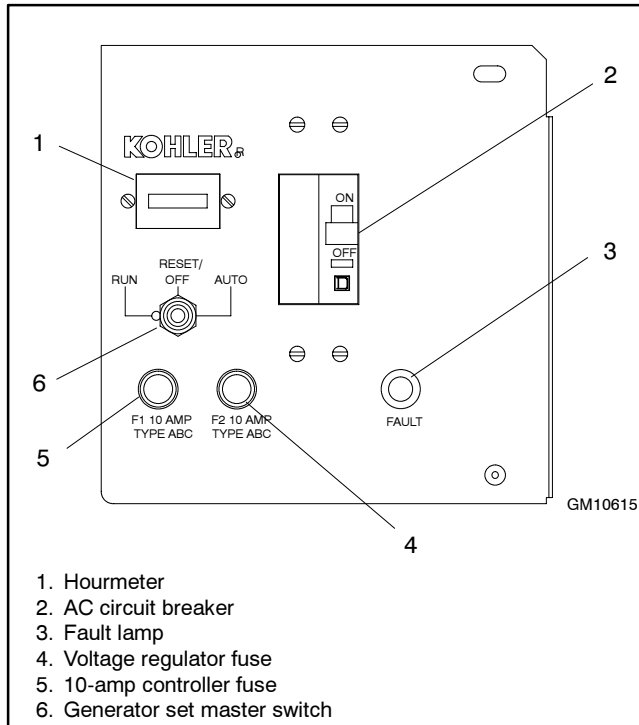


Figure 2-1 Decision-Maker™ 1 Controller (with Fault Lamp)

2.3.1 Controls and Indicators

The table in Figure 2-2 describes the controls and indicators located on the controller.

2.3.2 Starting the Generator Set

The following procedures describe the actions required to start the generator set.

Local Starting. Move the generator set to the RUN position to immediately start the generator set.

Auto (Automatic) Starting. Move the generator set master switch to the AUTO position to allow startup by the ATS or the remote start/stop switch (connected to controller terminals TB1-3 and TB1-4).

Note: The controller provides up to 30 seconds of cyclic cranking before the overcrank shutdown occurs.

Name	Description
Generator set master switch	Switch functions as the controller reset and generator set operation switch.
Hourmeter	Hourmeter records the generator set total operating hours for reference in maintenance scheduling.
Voltage regulator fuse, 10-amp	Fuse protects the voltage regulator circuitry.
Controller fuse, 10-amp	Fuse protects the controller circuitry from short circuits and overloads.
AC circuit breaker	Circuit breaker trips when a fault is detected in the AC output circuit.
Fault lamp	Lamp lights when a fault shuts the generator set down and remains lit until the generator set master switch is moved to the OFF/RESET position. See Section 2.3.4 for fault shutdown information.

Figure 2-2 Decision-Maker™ 1 Controls and Indicators

2.3.3 Stopping the Generator Set

The following procedures describe the actions required to stop the generator set.

Automatic Stopping

1. The ATS or other device disconnects the load from the generator set.
2. The generator set continues to run for a preset cooldown time if the ATS is equipped with an engine cooldown time delay.
3. The ATS or other device opens the connection between controller terminals TB1-3 and TB1-4. The generator set shuts down if the generator set master switch is in the AUTO position.

Local Stopping

1. **Cooldown.** Run the generator set at no load for at least 2 minutes to ensure adequate engine cooldown.
2. **Stopping.** Move the generator set master switch to the OFF/RESET position. The engine stops.

2.3.4 Fault Shutdowns

The generator set shuts down automatically under the fault conditions listed in Figure 2-3 and cannot be restarted until the fault condition is corrected. The generator set shutdown switches automatically reset when the problem is corrected. The high engine temperature switch automatically resets when the generator set cools.

After a fault shutdown leave the generator set master switch in the RESET/OFF position for a couple of seconds before attempting to restart the generator set.

Fault	Description
High engine temperature	Shutdown occurs 5 seconds after the fault. The high engine temperature shutdown does not function during the first 5 seconds after startup.
Low oil pressure	Shutdown occurs 5 seconds after the fault. The low oil pressure shutdown does not function during the first 5 seconds after startup. Note: The low oil pressure shutdown does not protect against low oil level. Check the oil level at the engine.
Overcrank	Shutdown occurs after 30 seconds of cyclic cranking. The factory sets the circuit board for three starting attempts of 8 seconds each (crank 8 seconds, wait 3 seconds, crank 8 seconds, wait 3 seconds, crank 8 seconds). The generator set also shuts down if the output line voltage is lost. Shuts down 1 second after the fault is detected.
Overspeed	Shutdown occurs immediately when the governed frequency on 50 and 60 Hz models exceeds 70 Hz.

Figure 2-3 Fault Shutdowns

2.3.5 Resetting the Controller after a Fault Shutdown

Use the following procedure to restart the generator set after a fault shutdown.

1. Disconnect the generator set from the load using the line circuit breaker or ATS. See the safety precautions at the beginning of this section before proceeding.
2. Correct the cause of the fault shutdown. See the safety precautions at the beginning of this section before proceeding.

3. Start the generator set by moving the generator set master switch to RESET/OFF and then to RUN.
4. Verify that the cause of the shutdown has been corrected by test operating the generator set.
5. Reconnect the generator set to the load using the line circuit breaker or ATS.
6. Move the generator set master switch to the AUTO position for startup by remote transfer switch or remote start/stop switch.

2.4 Circuit Protection

See Figure 2-1 for the line circuit breaker, controller fuse, and voltage regulator fuse locations.

Note: If the generator set circuit breaker trips or the fuses blow repeatedly, see Section 4, Troubleshooting, for possible causes.

Line Circuit Breaker. A line circuit breaker interrupts the generator output in the event of a fault in the wiring between the generator and the load. See Figure 2-4 for the circuit breaker ratings. If the circuit breaker trips, reduce the load and switch the breaker back to the ON position. With the breaker in the OFF position the generator set runs but the generator output is disconnected from the load.

Model	Circuit Breaker Rating, Amps
8.5RMY	40
11RMY	50

Figure 2-4 Line Circuit Breakers

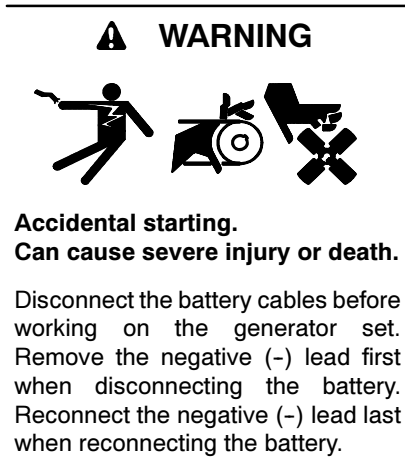
Controller Fuse. A replaceable 10-amp fuse protects the controller circuitry. If the generator set does not crank, check the battery and battery connections and then check the controller fuse. Replace the fuse if it is blown.

Voltage Regulator Fuse. A replaceable 10-amp fuse protects the voltage regulator circuitry. The generator set shuts down if the fuse blows. When the operator starts a generator set with a blown voltage regulator fuse, the generator set typically starts and then shuts down in 8 seconds.

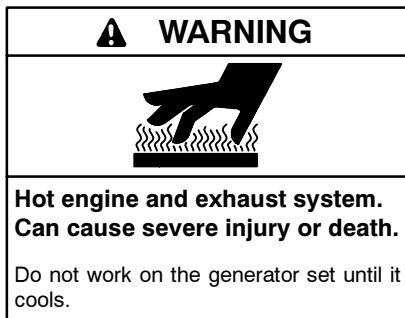
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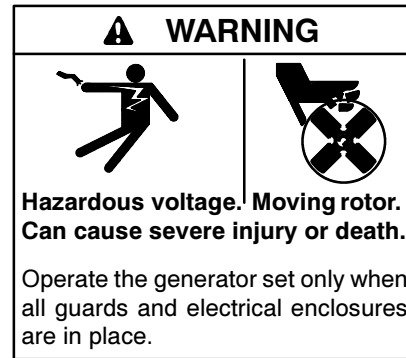
Section 3 Scheduled Maintenance



Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.



Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.



Servicing the generator set when it is operating. Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

3.1 Routine Maintenance

Refer to the service schedule following and the hourmeter located on the generator set controller to schedule routine maintenance. Have an authorized distributor/ dealer perform all generator set service. Perform maintenance on each item in the service schedule at the designated interval for the life of the generator set. Service units subject to extreme weather, long operating hours, or dusty or dirty conditions more frequently.

3.2 Service Schedule

Perform the items listed in the following service schedule at the designated intervals for the life of the generator set. For example, an item serviced every 100 hours of operation or 3 months must also be serviced after 200 hours or 6 months, 300 hours or 9 months and so on. Rough operation, lack of power, and excessive oil use indicate serious generator set problems. Have an authorized distributor/ dealer perform all generator set service.

System Component or Procedure	See Section	Procedure					Frequency	
		Visually Inspect	Check	Change	Clean	Test		
Fuel								
Flexible lines and connections		X		R			Quarterly	
Main tank supply level			X				Weekly	
Fuel piping		X					Yearly	
Lubrication 3.3								
Oil level		X	X				Daily or before use	
Crankcase breather*		X		X			Yearly or 500 hours	
Change oil				X			Yearly or 100 hours	
Replace filter*				X			Yearly or 200 hours	
Cooling 3.6								
Air ducts, louvers			X		X		Yearly	
Exhaust Line 3.7								
Leakage		X	X				Weekly	
Insulation, fire hazards		X					Yearly	
Hangers and supports		X					Yearly	
DC Electrical System 3.8								
Battery charger operation, charge rate (if equipped)		X					Monthly	
Remove corrosion, clean and dry battery and rack		X			X		Yearly	
Clean and tighten battery terminals		X	X				Yearly	
Battery electrolyte level and specific gravity†			X				Yearly	
AC Electrical System								
Visible wear or damage		X					Quarterly	
Wire abrasions where subject to motion		X	X				Six Months	
Tighten control and power wiring connections			X				Yearly	
Wire-cable insulation breakdown*		X					3 Years or 500 hours	
Engine And Mounting								
Visible wear or damage		X					Weekly	
Air cleaner service	3.5			R			Yearly or 100 hours	
Spark plugs	3.4			X			Yearly or 300 hours	
Remote Control System								
Compartment condition		X			X		Weekly	
Remote control						X	Monthly	
Run generator set						X	Weekly	
Generator								
Visible wear or damage	2.1	X					Quarterly	
Exercise generator set	2.2					X	Monthly	
Rotor and stator*		X			X		Yearly	
Measure and record resistance readings of windings with insulation tester (Megger, with SCR assembly or rectifier disconnected)						X	3 Years	
General Condition of Equipment								
Evidence of vibration, leakage, excessive noise, temperature, or deterioration		X	X		X		Weekly	
Interior of sound shield housing		X			X		Quarterly	
* Consult your local distributor/dealer for parts or service.		X Action						
† Not necessary for maintenance-free batteries.		R Replace as necessary						

Figure 3-1 Service Schedule

3.3 Lubrication System

See Section 3.2, Service Schedule, for oil change and oil filter replacement intervals. See Section 1.5, Service Views, for the oil drain, oil check, oil fill, and oil filter locations.

3.3.1 Low Oil Pressure Shutdown

The low oil pressure shutdown feature protects the engine against internal damage if the oil pressure drops below $24.1 \text{ kPa} \pm 13.8 \text{ kPa}$ ($3.5 \text{ psi} \pm 1.5 \text{ psi}$) because of oil pump failure or other malfunction. The shutdown feature does not protect against damage caused by operating with the oil level below the safe range; it is not a low oil level shutdown. Check the oil level regularly, and add oil as needed.

3.3.2 Oil Check

The generator set is shipped with oil. Before operating a new generator set, check the engine oil in the crankcase. See 1.5, Service Views. Verify that the oil level is at the F mark on the dipstick. Add oil that has a viscosity appropriate for the climate. See Section 3.3.3, Engine Oil Recommendation, for engine oil recommendations.

Do not check the oil level when the generator set is running. Shut down the generator set and wait several minutes before checking the oil level.

3.3.3 Engine Oil Recommendation

Use API (American Petroleum Institute) Service Class SG, SH, or SJ synthetic oil. Synthetic oil oxidizes and thickens less than other oils and leaves the engine intake valves and pistons cleaner. Select the viscosity based on the air temperature at the time of operation. See Figure 3-2.

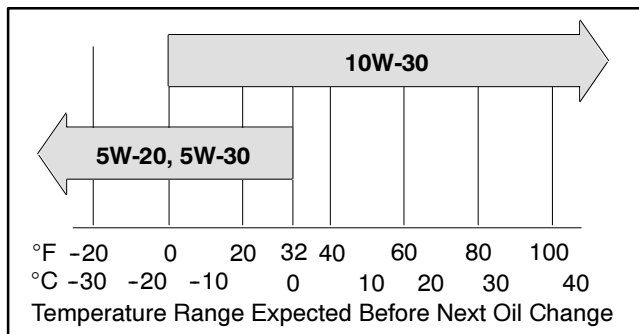


Figure 3-2 Engine Oil Selection

3.3.4 Oil Change Procedure

Drain the oil while it is still warm.

1. Drain the oil.

- Place the generator set master switch in the OFF position.
- Disconnect the power to the battery charger, if equipped.
- Disconnect the generator set engine starting battery, negative (-) lead first.
- Remove the housing side panel.
- Remove the oil drain hose from its retaining clip. Remove the cap from the oil drain hose and lower the hose into an oil collection container.
- Open the oil drain valve on the engine.
- Allow time for the engine oil to drain completely.
- Close the oil drain valve.
- Replace the cap on the oil drain hose. Replace the oil drain hose in its retaining clip.

2. Replace the oil filter.

- Remove the oil filter by rotating it counterclockwise with an oil filter wrench.
- Clean the gasket sealing surface of the oil filter adapter.
- Apply a light coat of clean oil to the rubber seal of the new oil filter.
- Install the new oil filter following the instructions provided with the filter.

Note: Dispose of all waste materials (engine oil, fuel, filter, etc.) in an environmentally safe manner.

3. Fill with oil.

- Remove the oil fill cap and fill the engine to the F mark on the dipstick. The engine oil capacity is 1.9 L (2.0 qt.). See Section 3.3.3, Engine Oil Recommendation, for oil selection.
- Reinstall the dipstick and the oil fill cap.
- Check that the generator set master switch is in the OFF position.

- d. Reconnect the generator set engine starting battery, negative (-) lead last.
- e. Reconnect the power to the battery charger, if equipped.
- f. Start and run the generator set for a minute to allow the oil pressure to reach the operating range.
- g. Stop the generator set, wait 1 minute, and then recheck the oil level. Add oil to bring the level up to the F mark on the dipstick.

4. Check for leaks.

- a. Check for oil leaks.
- b. Fix leaks and recheck the oil level.
- c. Reinstall the housing side panel.

3.4 Spark Plugs

Reset the spark plug gap or replace the plugs with new plugs as necessary.

1. Clean the area around the base of the spark plug to keep dirt and debris out of the engine.
2. Remove the spark plug and check its condition. Replace the spark plug if it is worn or if its reuse is questionable.
3. Check the spark plug gap using a wire feeler gauge. Adjust the gap to 0.76 mm (0.030 in.) by carefully bending the ground electrode. See Figure 3-3 and Figure 3-4.

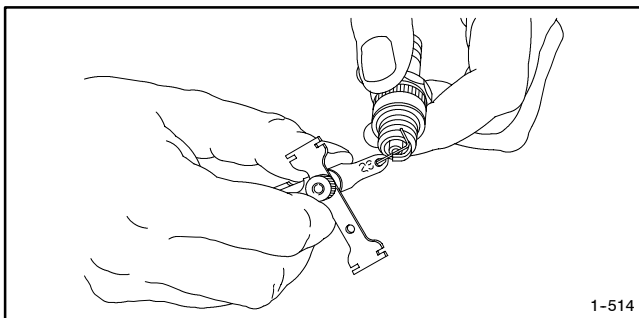


Figure 3-3 Checking the Spark Plug Gap

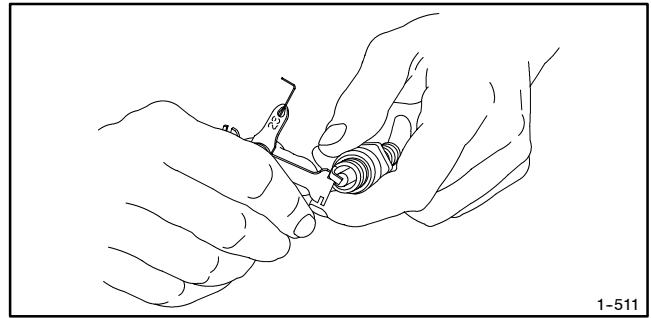


Figure 3-4 Adjusting the Spark Plug Gap

3.5 Air Cleaner Element and Precleaner

The engine has a replaceable high-density paper air cleaner element with an oiled foam precleaner. See Figure 3-5.

Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean.

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

3.5.1 Precleaner Service

Use the following procedure to wash and reoil the precleaner as indicated in the service schedule. Wash and reoil the precleaner more often under extremely dusty or dirty conditions.

1. Place the generator set master switch in the OFF/RESET position.
2. Disconnect the power to the battery charger, if equipped.
3. Disconnect the battery, negative (-) lead first.
4. Loosen the cover retaining knob and remove the cover. Remove the precleaner from the paper element. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out

excess water (do not wring). Allow the precleaner to air dry.

5. Saturate the precleaner with new engine oil. Squeeze out all of the excess oil.
6. Reinstall the precleaner over the paper element.
7. Reinstall the air cleaner cover. Secure the cover with the cover retaining knob.
8. Reconnect the power to the battery charger, if equipped.
9. Reconnect the generator set engine starting battery, negative (-) lead last.

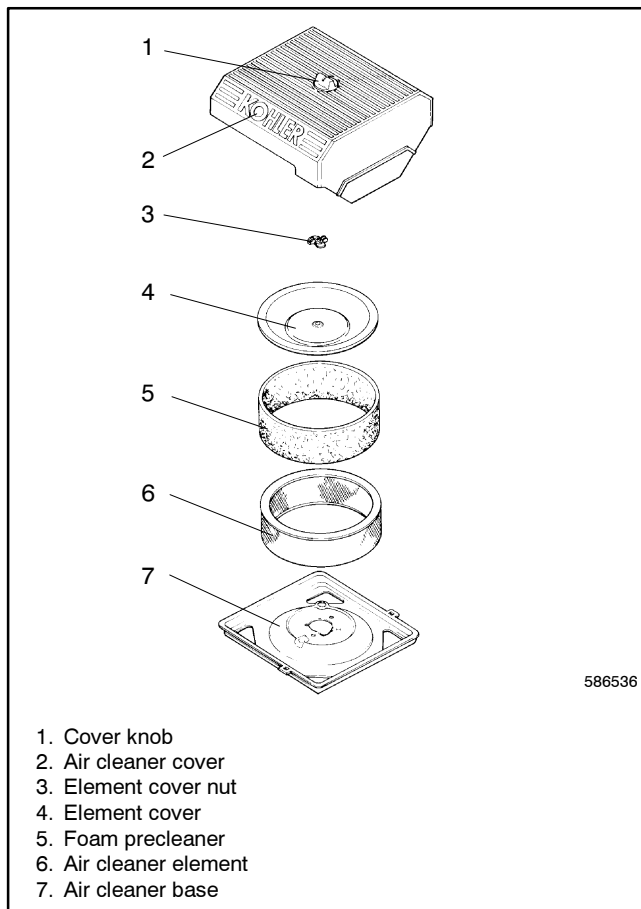


Figure 3-5 Air Cleaner Components

3.5.2 Paper Element Service

Use the following procedure to replace the paper element at the intervals specified in the service schedule. Replace the paper element more often under extremely dusty or dirty conditions.

1. Place the generator set master switch in the OFF/RESET position.
2. Disconnect the power to the battery charger, if equipped.
3. Disconnect the generator set engine starting battery, negative (-) lead first.
4. Loosen the cover retaining knob and remove the cover.
5. Remove the element cover nut, element cover, and the paper element with precleaner.
6. Remove the precleaner from the paper element.

Note: Do not wash the paper element or clean it with pressurized air, as this will damage the element.

7. Replace the element if it is dirty, bent, or damaged.
8. Check the air cleaner base. Make sure it is secure and not bent or damaged. Also check the element cover for damage and fit. Replace all damaged air cleaner components. Remove any loose dirt or debris from the air cleaner base. Wipe the base carefully so that no dirt drops into the intake throat. Check the condition of the rubber seal on the air cleaner stud and replace the seal if necessary.
9. Reinstall the paper element, precleaner, element cover, element cover nut, and the air cleaner cover. Secure the cover with the cover retaining knob.
10. Reconnect the power to the battery charger, if equipped.
11. Reconnect the generator set engine starting battery, negative (-) lead last.

3.6 Cooling System

The engine fan draws cooling air through the opening in the base next to the battery. The generator fan draws cooling air through an opening on the rear wall of the enclosure. The cooling air flows to the alternator at the far end of the unit and over the exhaust system. The air then mixes with the engine exhaust and is discharged at the cabinet outlet. To prevent generator set damage caused by overheating, keep the housing cooling inlets and outlets clean and unobstructed at all times. See Figure 3-6.

Note: Do not block the generator set cooling air inlet or mount other equipment above it. Overheating and severe generator damage may occur.

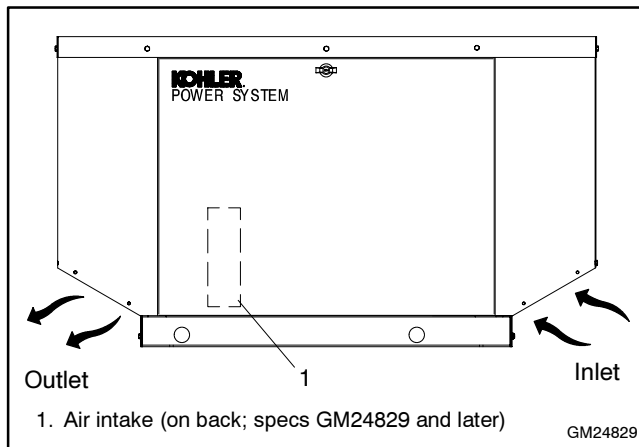


Figure 3-6 Cooling Air Intake and Exhaust

3.7 Exhaust System

Remove all combustible materials from the exhaust location. Combustible materials include building materials as well as natural surroundings. Keep dry field grass, foliage, and combustible landscaping material a minimum of 0.3 m (1 ft.) from the exhaust outlet.

Periodically inspect the exhaust system components (exhaust manifold, exhaust line, flexible exhaust, clamps, silencer, and outlet pipe) for cracks and corrosion.

- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps and hangers. Tighten or replace clamps and/or hangers as needed.
- Check for and remove loose insulation in the exhaust duct.
- Check that the exhaust outlet is clear.

3.8 Battery

⚠ WARNING



**Sulfuric acid in batteries.
Can cause severe injury or death.**

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Refer to this section for general battery information and maintenance. All generator set models use a negative ground with a 12-volt engine electrical system. Consult the generator set nameplate for the engine electrical system voltage. Consult the generator spec sheet for battery capacity recommendations for replacement purposes. Wiring diagrams provide battery connection information. See Figure 3-7 for typical battery connections, including multiple battery configurations.

Check the electrolyte level and specific gravity of batteries with filler caps. Maintenance-free batteries do not require electrolyte level checking or specific gravity testing.

Clean the battery and cables and tighten battery terminals using the service schedule recommendations. Clean the battery by wiping it with a damp cloth. Keep the electrical connections dry and tight.

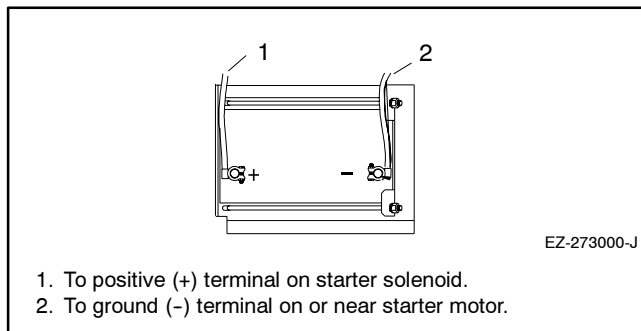


Figure 3-7 12-Volt Engine Electrical System Single Starter Motor, Typical Battery Connection

3.8.1 Cleaning the Battery

To prevent dirt and grime buildup, occasionally wipe the battery with a damp cloth.

To prevent corrosion, maintain tight, dry electrical connections at the battery terminals. To remove corrosion from battery terminals, disconnect the cables from the battery and scrub the terminals with a wire brush. Clean the battery and cables with a solution of baking soda and water. Do not allow the cleaning solution to enter the battery's cells. After cleaning, flush the battery and cables with clean water and wipe them with a dry, lint-free cloth.

After reconnecting the battery cables, coat the battery terminals with petroleum jelly, silicone grease, or other nonconductive grease.

3.8.2 Checking Battery Electrolyte Level

Check the battery electrolyte level before each startup. Remove the filler caps and verify that the electrolyte level reaches the bottoms of the filler holes; see Figure 3-8. Refill as necessary with distilled water or clean tap water. Do not add electrolyte. Install and tighten filler caps. After adding water to the battery in freezing temperatures, run the generator set 20-30 minutes to mix the added water and the battery electrolyte. Mixing the water and the electrolyte prevents the added water from freezing and damaging the battery.

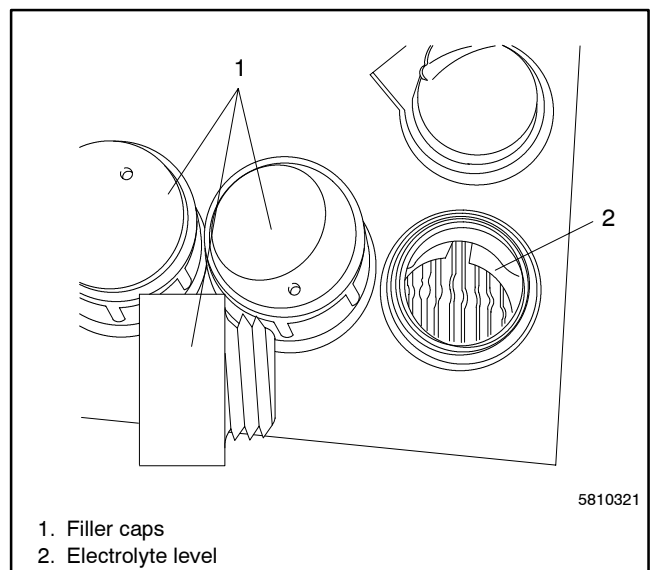


Figure 3-8 Checking Electrolyte Level

3.8.3 Checking Electrolyte Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. Use the hydrometer's test instructions, if available, or Figure 3-9 for bead-type testers.

Temperature affects specific gravity; correct the indicated hydrometer readings for temperature. If the hydrometer does not have a correction table, use Figure 3-10. A fully charged battery should have a specific gravity of 1.260 with the electrolyte at 26.7°C (80°F). Charge the battery if the specific gravity from cell to cell varies by more than 0.01. Charge the battery if the specific gravity is less than 1.215 with the electrolyte at 26.7°C (80°F).

3.8.4 Charging

Use a battery charger to maintain a fully charged battery when the generator set is used in a standby application. The engine battery-charging system charges the battery while the generator set is running.

Number of Beads Floating	Battery Condition
5	Overcharged
4	Full Charge
3	Adequate Charge
1, 2	Low Charge
0	Battery Dead

Figure 3-9 Electrolyte Testing Chart

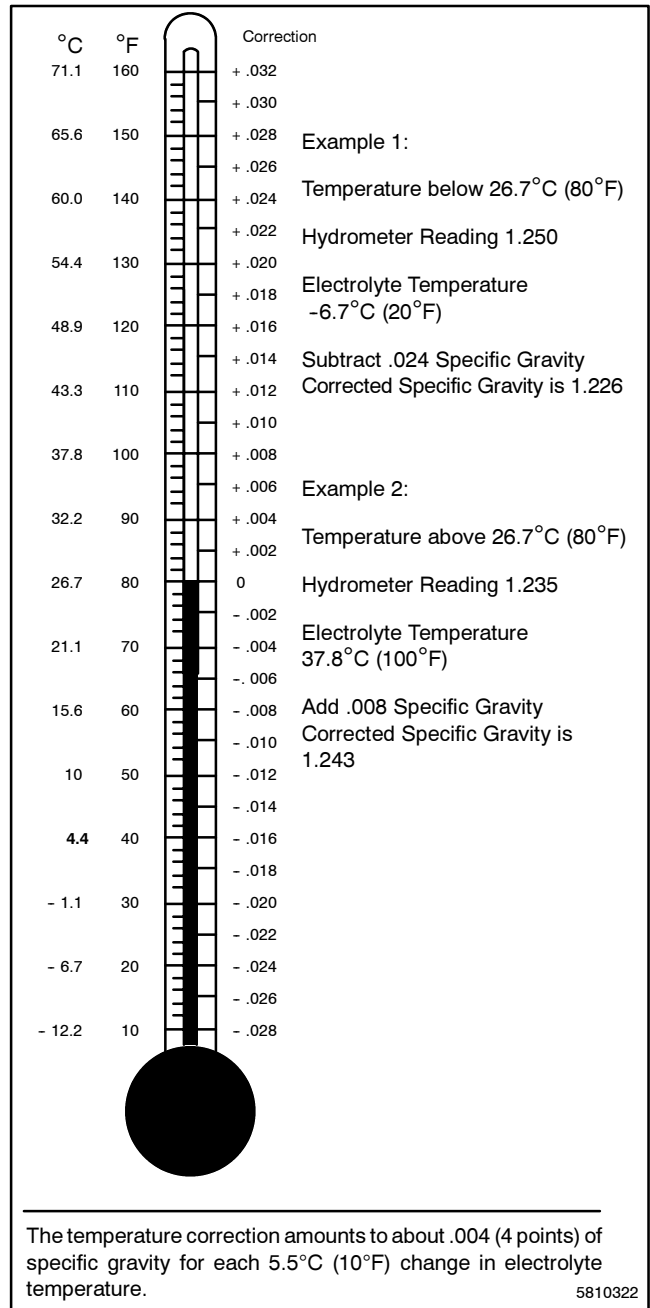


Figure 3-10 Specific Gravity Temperature Correction

3.9 Storage Procedure

Perform the following storage procedure before removing the generator set from service for three months or longer. Follow the engine manufacturer's recommendations for storage, if available.

Note: Run the generator set monthly whenever possible.

3.9.1 Lubricating System

1. Operate the generator set until it reaches operating temperature, or about 15 minutes.
2. Stop the generator set.
3. While the engine is still warm, drain the engine lubrication oil from the engine crankcase.
4. Refill the engine crankcase with oil. See Section 3.3.3 for oil recommendations.
5. Run the generator set for a few minutes to distribute the clean oil.
6. Stop the generator set.

3.9.2 Fuel System

1. Start the generator set.
2. With the generator set running, shut off the gas supply.
3. Run the generator set until the engine stops.
4. Place the generator set master switch in the OFF/RESET position.

3.9.3 Cylinder Lubrication

1. Remove the spark plugs.
2. Pour one tablespoon of engine oil into each spark plug hole. Install the spark plugs and *ground* the spark plug leads. *Do not connect the leads to the plugs.*
3. Toggle the generator set master switch to crank the engine two or three revolutions to lubricate the cylinders.

3.9.4 Exterior Preparation

1. Clean the exterior surface of the generator set.
2. Seal all openings in the engine with nonabsorbent adhesive tape.
3. Mask all areas to be used for electrical contact.
4. Spread a light film of oil over unpainted metallic surfaces to prevent rust and corrosion.

3.9.5 Battery

Perform battery storage last.

1. Place the generator set master switch in the OFF/RESET position.
2. Disconnect the battery, negative (-) lead first.
3. Clean the battery. Refer to Section 3.8.1 for the cleaning procedure.
4. Place the battery in a warm, dry location.
5. Connect the battery to a float/equalize battery charger, or charge the battery monthly using a trickle charger. Follow the battery charger manufacturer's recommendations.

Notes

Section 4 Troubleshooting

This section contains generator set troubleshooting, diagnostic, and repair information.

Use the following chart to diagnose and correct common problems. First check for simple causes such as a dead engine starting battery or an open circuit breaker. The chart includes a list of common problems, possible causes of the problem, and recommended corrective actions.

If the procedures in this manual do not explain how to correct the problem, contact an authorized distributor/dealer. Maintain a record of repairs and adjustments performed on the equipment. Use the record to help describe the problem and repairs or adjustments made to the equipment.

Note: Contact an authorized distributor/dealer if the corrective actions described in the following chart do not solve the problem.

Problem	Possible Cause	Corrective Action
The generator set does not crank.	Battery weak or dead Battery connections reversed or poor Controller fuse blown Generator master switch in the OFF position	Recharge or replace; check battery charger operation. Check battery charging circuit (circuit breaker, module, and wiring), if equipped. Check the connections. Replace the fuse. Move the master switch to the RUN position.
The generator set cranks but does not start, starts hard, lacks power, or operates erratically.	Air cleaner clogged Battery weak or dead Battery connection poor Spark plug wire connection loose Low oil pressure shutdown Fuel pressure insufficient Engine malfunction	Clean and/or replace the air cleaner. Recharge or replace the battery. Clean and tighten the battery connections. Check the spark plug wires. Check the oil level. Check the fuel supply and valves. Contact the distributor/dealer.
No AC output.	AC circuit breaker in the OFF position AC circuit breaker tripping because of overload AC circuit breaker tripping because of short circuit Voltage regulator fuse blown	Place the circuit breaker in the ON position. Reduce the load on the generator set. Correct the cause of the short circuit. Contact the distributor/dealer. Replace the fuse.
Low output or excessive drop in voltage.	Generator set overloaded	Reduce the load.
Generator set stops suddenly.	Low oil pressure shutdown Out of fuel Overcrank shutdown Controller fuse blown Overspeed shutdown Generator set master switch in the OFF/RESET position Engine malfunction	Check the oil level. Check fuel supply. Reset the controller. If the overcrank fault occurs again, contact the distributor/dealer. Replace the fuse. If the fuse blows again, contact the distributor/dealer. Reset the controller. If the overspeed fault occurs again, contact the distributor/dealer. Move the switch to the correct position (RUN or AUTO). Contact the distributor/dealer.

Figure 4-1 General Troubleshooting Chart

Notes

Section 5 Wiring Diagrams

5.1 Specification Numbers

At the time of print, this manual applied to the model numbers and specification (spec) numbers in Figure 5-1. On occasion the manufacturer may provide this manual with units that are not listed below, such as when similar new specs are created prior to the updated reprint or in other cases when the manual is a suitable substitute for a manual under development.

Model No.	Spec. No.	Controller Fault Lamp
8.5RMY	PA-195021	No
8.5RMY	PA-195025	Yes
8.5RMY	GM16902-GA1	Yes
8.5RMY	GM24829-GA1	Yes
11RMY	PA-195022	No
11RMY	PA-195026	Yes
11RMY	GM16902-GA2	Yes
11RMY	GM24829-GA2	Yes

Figure 5-1 Generator Set Specification Numbers

5.2 Controller Wiring Diagram Reference

Compare the front of the generator set controller with Figure 5-2. Use the version 1 diagrams for units that do not have a fault lamp on the front of the controller. Use the version 2 diagrams for units that have a fault lamp.

Figure 5-3 lists the wiring diagram numbers and locations.

Wiring Diagram Description	Controllers Without Fault Lamps (Version 1)		Controllers With Fault Lamps (Version 2)	
		Pg		Pg
Schematic Diagram	ADV-6297-D	23	ADV-6524-	25
Point-to-Point Wiring Diagram	GM10164-A	24	GM10619-	26

Figure 5-3 Controller Wiring Diagrams

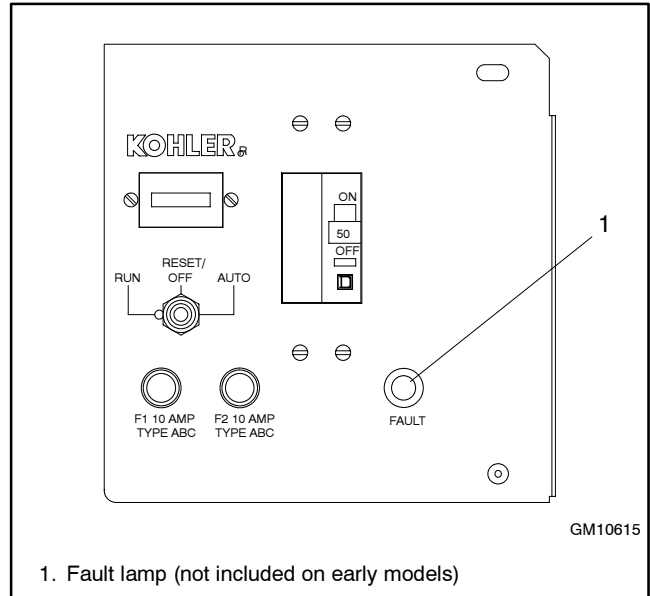
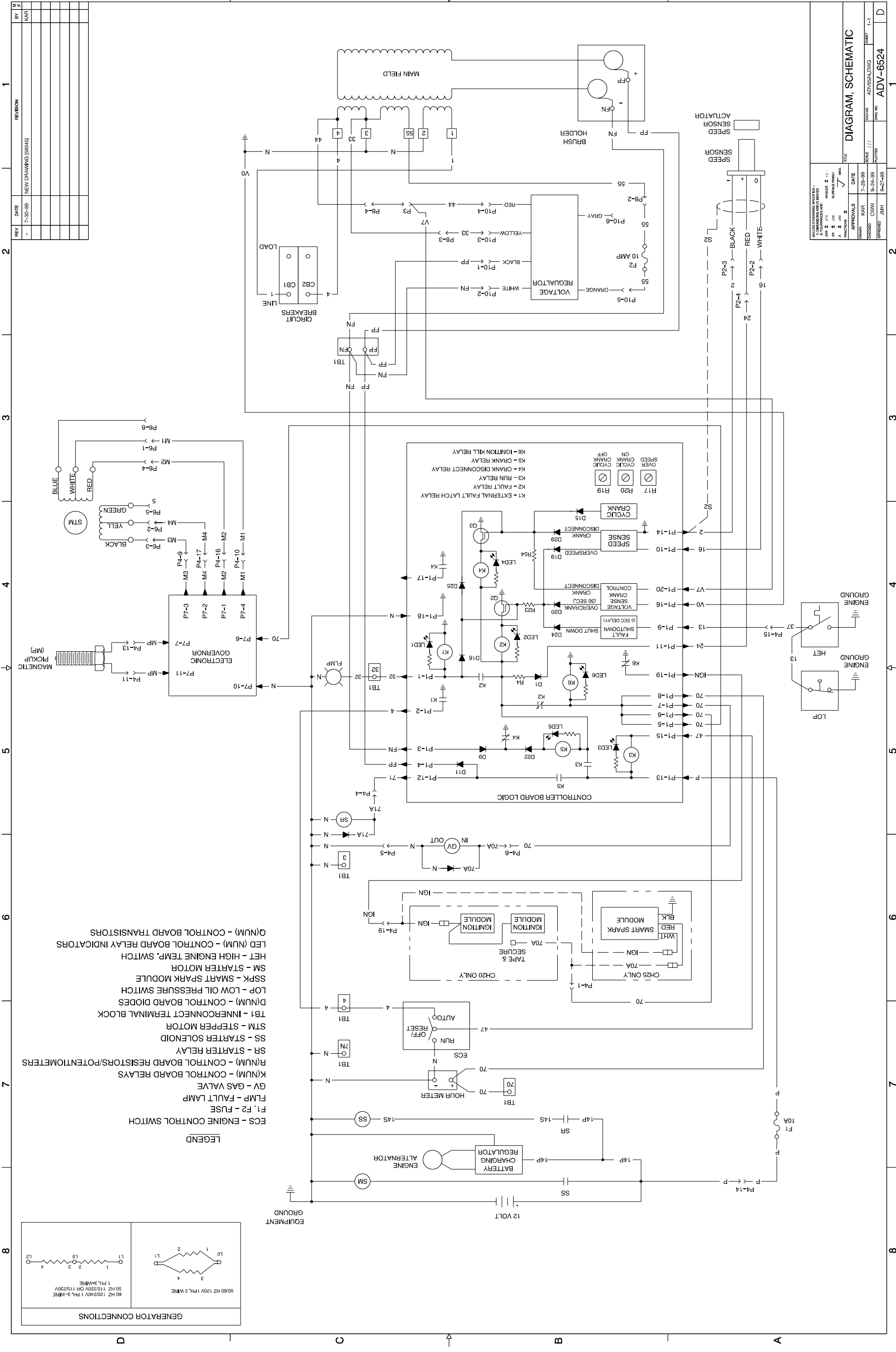


Figure 5-2 Controller

Notes

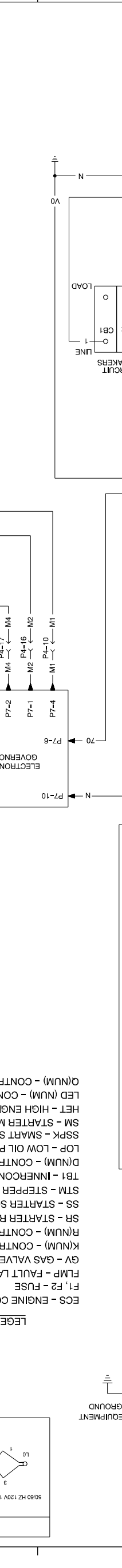


REV	DATE	REVISION	BY
-	7-30-88	NEW DRAWING (88049)	KAR

TITLE		DATE	BY	CHKD	APP'D	DATE	BY	CHKD	APP'D
DIAGRAM, SCHEMATIC		7-28-88	KAR			7-28-88	KAR		
DRAWN		7-28-88	KAR			7-28-88	KAR		
CHECKED		8-24-88	COW			8-24-88	COW		
DESIGNED		8-24-88	JMH			8-24-88	JMH		

REV	DATE	REVISION	BY
-	7-30-88	NEW DRAWING (88049)	KAR

ECS - ENGINE CONTROL SWITCH
 F1, F2 - FUSE
 FLM - FAULT LAMP
 GV - GAS VALVE
 K(NUM) - CONTROL BOARD RELAYS
 R(NUM) - CONTROL BOARD RESISTORS/POTENTIOMETERS
 SS - STARTER SOLENOID
 SR - STARTER RELAY
 STM - STEPPER MOTOR
 TB1 - TERMINAL BLOCK
 TB1 - INNERCONNECT TERMINAL BLOCK
 D(NUM) - CONTROL BOARD DIODES
 LOP - LOW OIL PRESSURE SWITCH
 SSM - SMART SPARK MODULE
 SM - STARTER MOTOR
 HET - HIGH ENGINE TEMP. SWITCH
 LED (NUM) - CONTROL BOARD RELAY INDICATORS
 Q(NUM) - CONTROL BOARD TRANSISTORS



Relay Controller, Schematic Diagram, ADV-6524-

6.1 General

Installation must comply with these installation instructions. Install the generator set to comply with state and local code requirements.

Use the specifications provided here only in the initial planning. Use the respective spec sheets, dimension drawings, and wiring diagrams for installation. Contact an authorized service distributor/dealer for the most current information.

Provide a 110- or 120-volt outlet connected to the utility power supply for the carburetor heater and battery charger, if used.

6.2 Air Requirements

The generator set requires correct air flow for cooling and combustion. The inlet and outlet openings in the sound enclosure housing provide the cooling and combustion air. Figure 6-1 shows the locations of the cooling air intake and exhaust vents. Do not block or otherwise interfere with the airflow through these openings.

Inspect the air inlet and outlet openings inside and outside the housing to ensure that debris does not block the air flow. Mount the generator so that the hot exhaust does not blow on plants or shrubs. Maintain a minimum of 0.3 m (1 ft.) between the exhaust outlet and combustible materials.

6.3 Exhaust Requirements

The exhaust system is complete for generator sets installed outdoors. Do not install this generator set indoors.

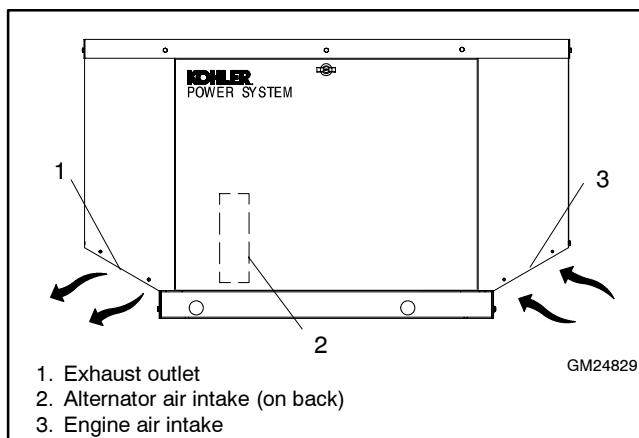
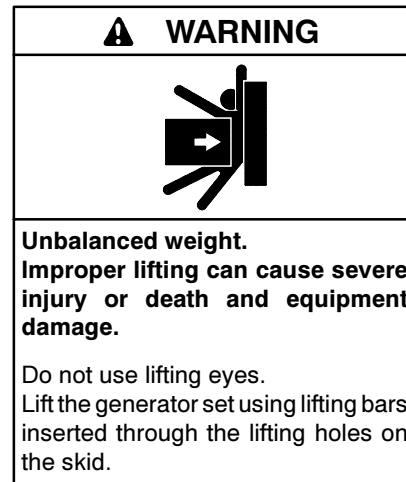


Figure 6-1 Cooling Air Intake and Exhaust

6.4 Weight



The generator set weighs approximately 182 kg (400 lbs.). Use lifting bars inserted through the holes in the skid to lift the unit. See Figure 6-2 for lifting hole locations.

6.5 Generator Set Inspection

Complete a thorough inspection of the generator set. Check for the following:

1. Inspect the generator set for loose or damaged parts or wires. Repair or tighten any loose parts before installation.
2. Check the engine oil. Fill, if necessary, with the recommended make and grade of oil. See Section 3.3.3 for engine oil recommendations.

6.6 Mounting

Do not install the generator set directly on the ground. Mount the generator set on a level pad. Use a simple concrete slab, precast base, or other non-combustible, stable material. The mounting pad should be at least 1320 mm (52 in.) long and 800 mm (31.6 in.) wide. Center the unit on the mounting pad.

Figure 6-2 shows the generator set dimensions, mounting hole locations, and fuel and electric stub-up locations. The drawing dimensions are shown in mm with inches in parentheses.

Secure the generator set and ensure that it does not move while operating.

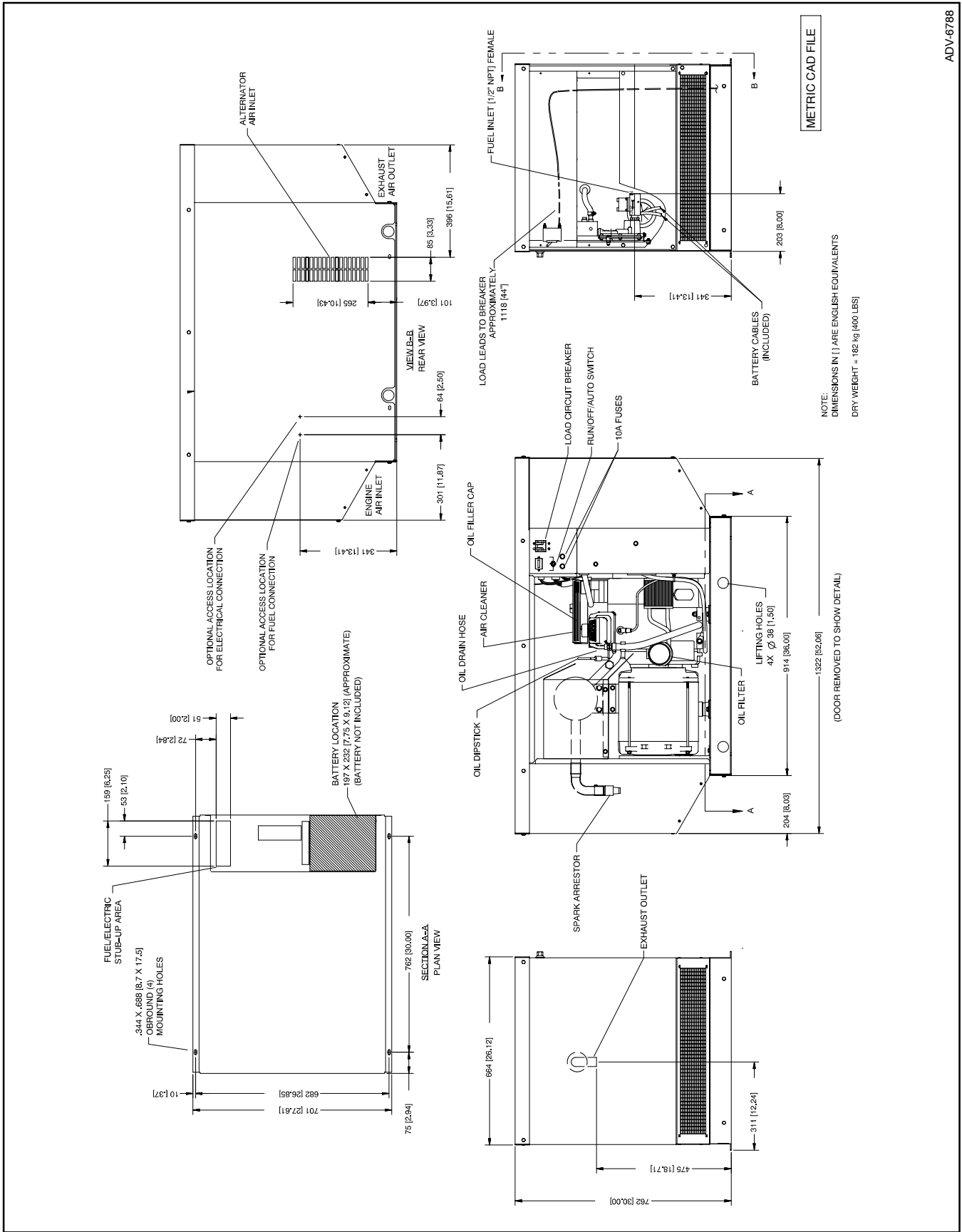


Figure 6-2 Generator Set Mounting Details and Dimensions

6.7 Fuel System

The generator set operates using natural gas or LP vapor fuel. The multi-fuel system allows conversion from natural gas to LP vapor (or vice-versa) in the field while maintaining emissions-standard compliance. A trained technician or authorized distributor/dealer can convert the fuel system. Generator sets with multi-fuel systems are CARB- and EPA-certified for both natural gas and LP vapor fuels.

6.7.1 Fuel Supply

Comply with local, state, and federal codes regarding the correct storage of fuel. Because of variable climates and geographical considerations, contact an authorized service distributor/dealer for fuel system planning and installation. Figure 6-2 shows the location of the fuel inlet connection, the fuel and electric stub-up area, and the rear panel access holes. Bring the fuel supply lines through either the bottom or the rear access openings. Protect all fuel lines from machinery or equipment contact, adverse weather conditions, and environmental damage.

Verify that the output pressure from the primary gas utility (or LP tank) pressure regulator is 1.7–2.7 kPa (7–11 in. water column) and that the utility gas meter flow rate is sufficient to supply the generator set plus all other gas-consuming appliances. Figure 6-3 shows the flow rate required for the generator set. Contact the natural gas utility for flow rate information or a gas meter upgrade.

6.7.2 Fuel Pipe Size

Ensure that the natural gas pipe size and length meet the specifications in Figure 6-4. Measure the pipe length from the primary gas pressure regulator to the pipe connection on the generator set fuel inlet. Add 2.4 m (8 ft.) to the measured length for each 90 degree elbow. Compare the pipe size and length with the chart in Figure 6-4. If the piping is longer than the maximum length shown for that size, replace it with the specified size before proceeding.

Contact the local LP provider for LP installation information.

Generator Set Model	Gas Flow Rate, Btu/hr.
8.5RMY	132,000
11RMY	192,000
12RMY	202,000

Figure 6-3 Natural Gas Flow Rate

Pipe Size	Maximum Pipe Length m (ft.)		
	8.5RMY	11RMY	12RMY
3/4 in. NPT	18.3 (60)	9.2 (30)	9.2 (30)
1 in. NPT	61 (200)	30 (100)	30 (100)
1 1/4 in. NPT	91.5 (300)	68.6 (225)	68.6 (225)

Figure 6-4 Maximum Natural Gas Pipe Length

6.7.3 Single-Fuel Systems

Generator sets with single-fuel systems are equipped with the fuel valve shown in Figure 6-5 and have specification numbers starting with PA-.

Single-fuel generator sets that have the decal shown in the Introduction section are emission-certified. The fuel systems on emission-certified single-fuel generator sets are not field-convertible or adjustable. The factory sets the fuel system for the specified fuel and seals it to prevent adjustments.

Note: Do not adjust or convert the fuel system on an emission-certified single-fuel generator set. Changing the fuel or adjusting the fuel systems on these units may violate federal or state laws.

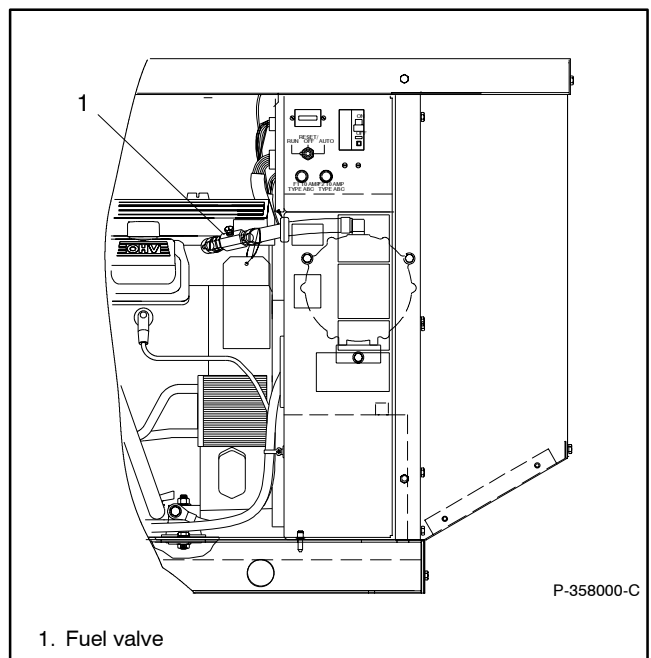


Figure 6-5 Single-Fuel Generator Set Fuel Valve Location

Single-fuel generator sets that are *not* emission-certified do not have the emission decal. An authorized distributor/dealer can convert the fuel system from natural gas to LP vapor (or vice-versa) on a non-certified unit. Converting the fuel system includes adjusting the fuel metering valve and checking the exhaust emissions. The generator set service manual explains the adjustment procedures.

6.7.4 Multi-Fuel Systems

Generator sets with multi-fuel systems are CARB- and EPA-certified for both natural gas and LP vapor fuels. Multi-fuel units are equipped with the fuel block shown in Figure 6-6 and have specification numbers beginning with GM. The multi-fuel system allows conversion from natural gas to LP vapor (or vice-versa) in the field while maintaining emissions-standard compliance. A trained technician or authorized distributor/dealer can convert the fuel system.

6.7.5 Fuel Conversion (multi-fuel models only)

Two fuel connections on the fuel block allow field-conversion between natural gas and LP vapor. The fuel metering valves are factory-set and sealed to comply with applicable emission standards and to provide the best possible hot and cold starting.

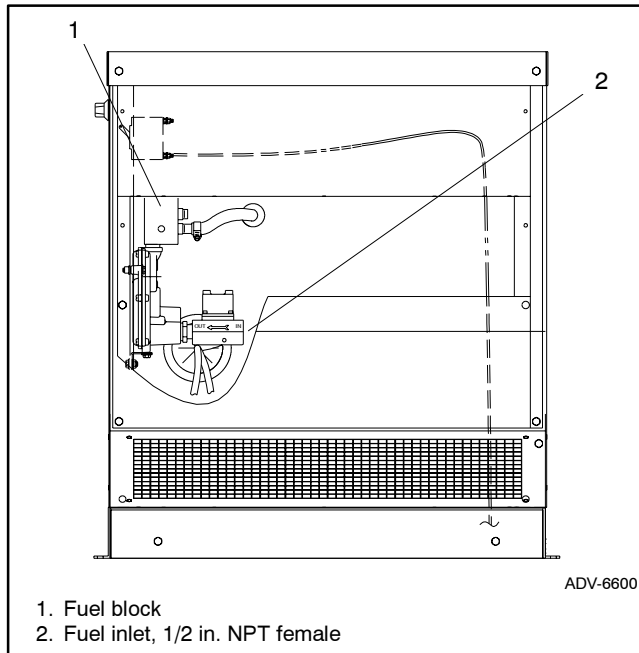


Figure 6-6 Multi-Fuel Generator Set Fuel Block Location, Air Inlet Side

Note: Do not adjust the factory-sealed fuel-metering adjustments on the fuel block. Changing the fuel-metering adjustments on multi-fuel units may violate federal or state laws.

The manufacturer ships the generator set with the fuel system connected for natural gas. To convert to LP gas, use the following procedure to move the fuel line from the natural gas outlet port to the LP outlet port in the fuel block (or from the LP outlet to the natural gas outlet to convert from LP to natural gas). See Figure 6-6 for the fuel block and fuel inlet locations.

⚠ WARNING

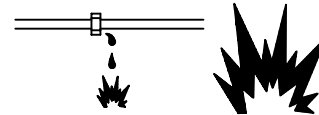


**Accidental starting.
Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ WARNING



**Explosive fuel vapors.
Can cause severe injury or death.**

Use extreme care when handling, storing, and using fuels.

Fuel Conversion Procedure for Multi-Fuel Systems

1. Place the generator set master switch in the OFF position.
 2. Disconnect the power to the battery charger, if equipped.
 3. Disconnect the generator set engine starting battery, negative (-) lead first.
 4. Turn off the fuel supply.
 5. Remove the hose clamp and fuel hose from the hose fitting in the fuel block. See Figure 6-7.
 6. Remove the hose fitting from the natural gas (or LP) outlet port in the fuel block.
 7. Remove the plug from the LP (or natural gas) port in the fuel block. Clean the plug with a dry cloth or brush, apply fresh pipe sealant, and install the plug into the natural gas (or LP) outlet port.
 8. Clean the hose fitting with a dry cloth or brush, apply fresh pipe sealant to the threads, and install the fitting into the LP (or natural gas) port.
- Note:** Do not adjust the fuel metering valves.
9. Slide the hose onto the hose fitting and secure it with the clamp.

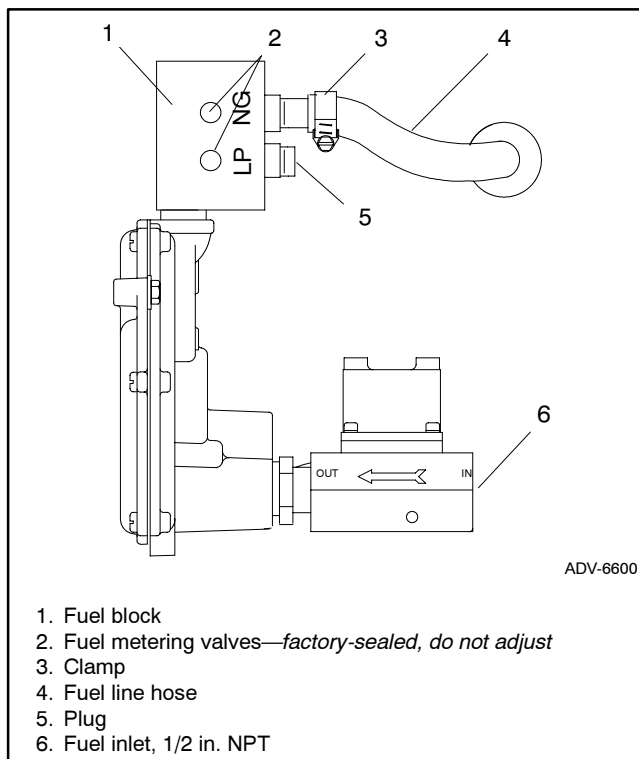


Figure 6-7 Fuel Block Connections, Natural Gas System Shown

10. Connect the new fuel supply.
11. Turn on the fuel supply and check for leaks using a gas leak detector.
12. Check that the generator set master switch is in the OFF position.
13. Reconnect the generator set engine starting battery leads, negative (-) lead last.
14. Reconnect power to the battery charger, if equipped.

6.8 Electrical Connections

6.8.1 Accessory Electrical Connections

Some accessories, including a run relay and a common fault relay, can be connected to the generator set. Contact an authorized service distributor/dealer for a list of accessories.

Have the accessories installed by an authorized distributor/dealer or a licensed electrician. Follow the installation instructions provided with each kit. Most accessories operate on 12 volts DC; some may require AC line voltage. Use separate conduit for AC and DC leads to reduce the possibility of electrical interference. Verify that the leads and conduit do not interfere with the operation of the generator set or obstruct the service areas. Verify that the electrical installation complies with the National Electrical Code (NEC) and all applicable local and state codes. See Section 5, Wiring Diagrams, for more information regarding generator set electrical connections.

6.8.2 AC Load Lead Connections

Have an authorized distributor/dealer or a licensed electrician make the following load connections. Connect the AC output leads in the controller compartment to the AC circuit breaker. Route AC and DC leads through the bottom of the generator set or through flexible conduit directly to the AC circuit breaker box. See Figure 6-2. Verify that the leads and conduit do not interfere with the operation of the generator set or obstruct the service areas.

See Figure 6-8 and Section 5, Wiring Diagrams, for the generator set electrical connections. Make the following AC connections:



1. Connect the output leads going to the transfer switch (L1/L2 black leads) to the AC circuit breaker load side (top).
2. Connect the L0 white leads from the ATS and the main panel to the neutral stud.
3. Connect the green lead to the equipment ground stud (labeled GRD).

Verify that the electrical installation complies with the National Electrical Code (NEC) and all applicable local and state codes.

NOTICE

Canadian installations only. For standby service connect the output of the generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

6.8.3 Battery

 WARNING

<p>Explosion. Can cause severe injury or death. Relays in the battery charger cause arcs or sparks.</p> <p>Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.</p>

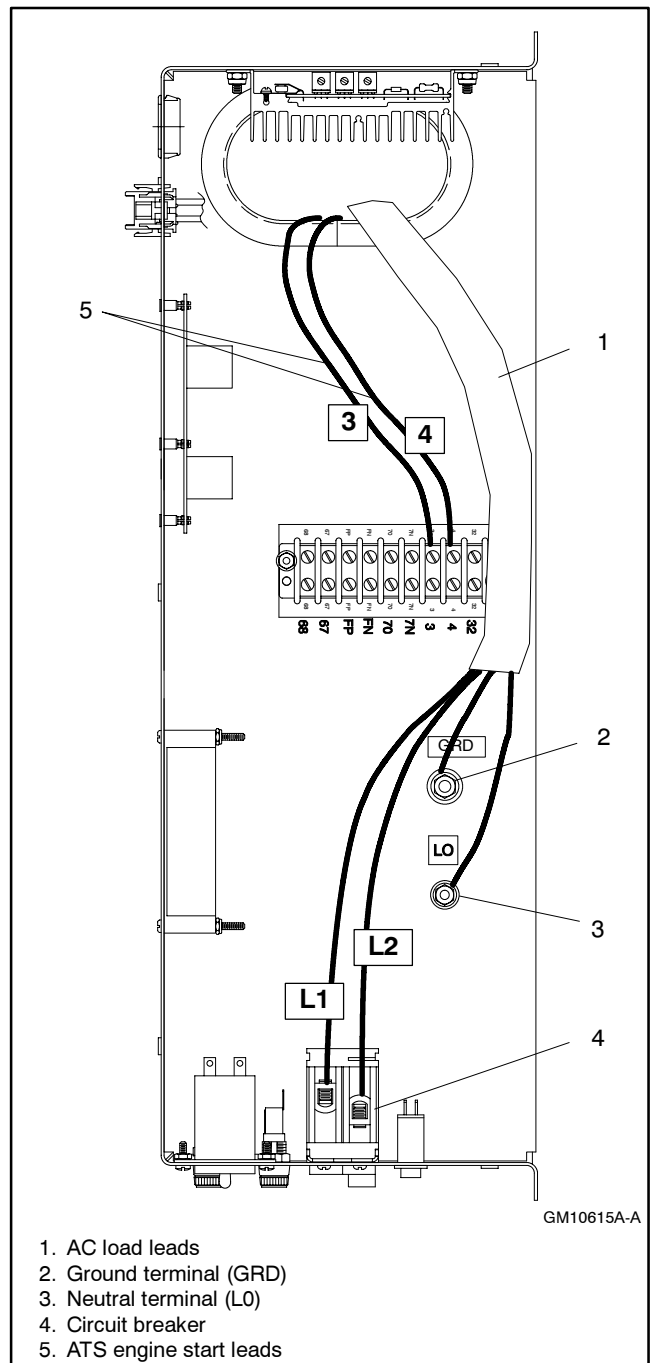


Figure 6-8 Typical Controller, Top View with Field-Installed Wiring

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Use a 12-volt battery with a minimum rating of 675 cold cranking amps at 0°F. The generator set uses a negative ground with a 12-volt engine electrical system. See Figure 6-9 for battery connections. Make sure that the battery is correctly connected and the terminals are tight.

Note: The generator set will not start and circuit board damage may occur if the battery is connected in reverse.

Figure 6-10 shows the location of the engine starting battery. Standard battery cables provide easy connection to the battery. Use the following procedure to install and connect the battery.

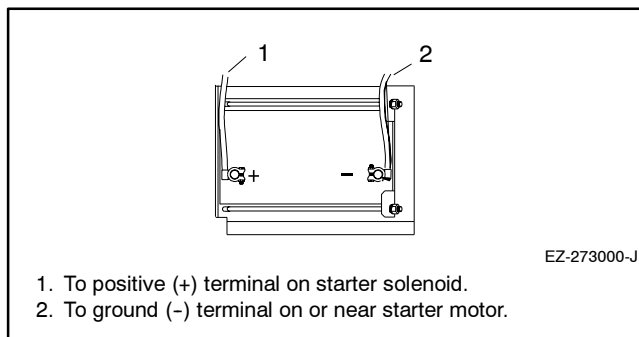


Figure 6-9 12-Volt Engine Electrical System Single Starter Motor Typical Battery Connection

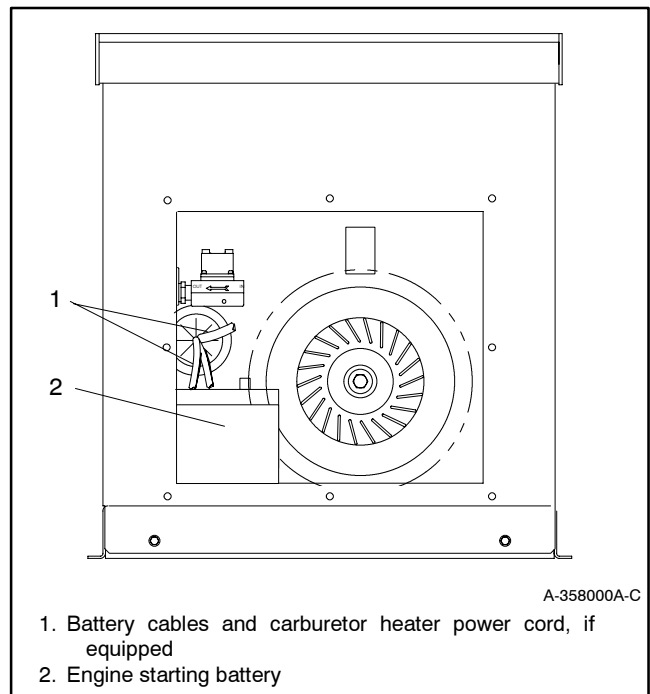


Figure 6-10 Battery Location, Engine End

Battery Installation Procedure

1. Ensure that the starting battery is fully charged before placing the battery in service.
2. Clean the battery posts and/or adapters if necessary.
3. Install the battery post adapters, if needed.
4. Place the battery in the housing.
5. Verify that the controller master switch is in the OFF position.
6. Connect the positive (+) lead to the engine starting battery.
7. Connect the negative (-) lead to the engine starting battery.

Refer to Section 3.8 for battery maintenance instructions.

6.8.4 Battery Charger

Generator sets that are not exercised regularly require an external battery charger to keep the starting battery fully charged. Obtain a battery charger from your generator set supplier. Observe the battery polarity when connecting the battery charger. Plug the battery

charger into a 110 or 120-volt outlet connected to the utility power.

6.8.5 Carburetor Heater

The generator set may be equipped with a carburetor heater. The carburetor heater prevents condensation and carburetor icing. The heater turns on when the temperature at the thermostat falls below approximately 4°C (40°F) and turns off when the temperature rises above approximately 16°C (60°F). The thermostat continuously senses temperature and controls the carburetor heater.

The heater requires a continuous source of 120 V power. The heater power cord and thermostat are located in the generator set housing air intake area/battery compartment. See Figure 6-10. Plug the carburetor heater into an outlet that has continuous 120 volt power.

Figure 6-11 shows the heater power cord running from inside the engine compartment to the air intake area/battery compartment. The heater thermostat is installed in the cord. Figure 6-12 shows the location of the thermostat on the power cord.

Note: Do not place the heater thermostat inside the generator set engine compartment. The thermostat must be exposed to the ambient air. The thermostat will shut off power to the heater when the ambient temperature reaches approximately 60°F (16°C).

Figure 6-11 shows the blower housing covers installed. The covers are not used on all units.

A DC version of the carburetor heater is available. Refer to the installation instructions provided with the DC carburetor heater kit.

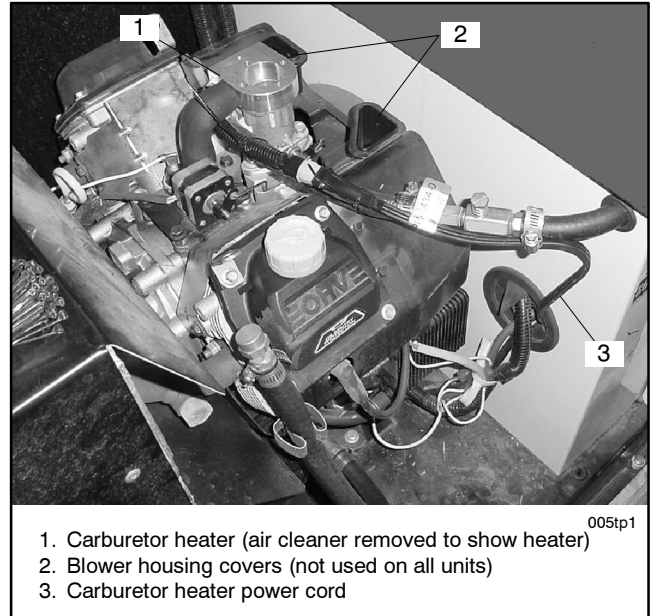


Figure 6-11 Carburetor Heater Power Cord

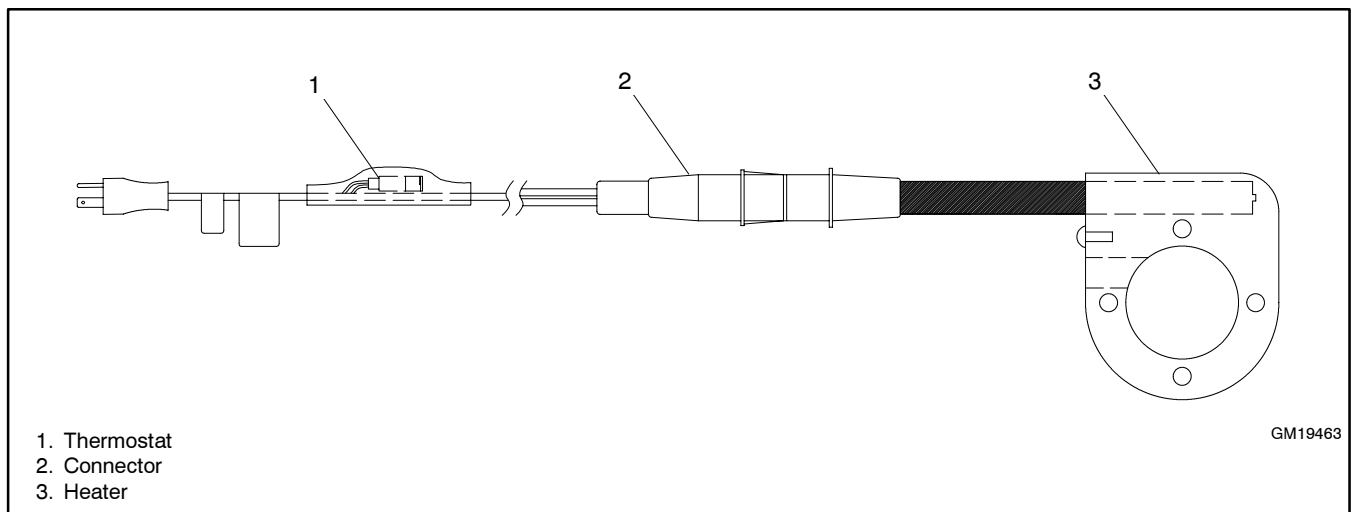


Figure 6-12 Carburetor Heater with Thermostat

6.9 Generator Reconnection

The generator set can produce a variety of voltages at either 50 or 60 Hz. See Figure 6-13. This section gives voltage reconnection instructions. For frequency adjustments, refer to the generator set service manual, TP-5867.

Verify that the installation complies with the National Electrical Code (NEC) and all applicable local and state codes.

Wires	60 Hz	50 Hz
3*	120/240	110/220
2†	240	220
2†	120	110
* Factory connection		
† Field reconnection		

Figure 6-13 Generator Connection Options

6.9.1 Voltage Reconnection

The following information illustrates the reconnection of 4-lead generator sets. Refer to the following connection schematics. Follow all the safety precautions and instructions at the beginning of this manual and in this section while performing the reconnection procedure.

Note: Order voltage reconnection decal 246242 from an authorized service distributor/dealer and affix the decal to the generator set after reconnecting to a voltage different from the nameplate.

⚠ WARNING

**Accidental starting.
Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ WARNING

**Hazardous voltage. Moving rotor.
Can cause severe injury or death.**

Operate the generator set only when all guards and electrical enclosures are in place.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocutation is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

6.9.2 Factory Connections, 110/220 Volt 50 Hz or 120/240 Volt 60 Hz

Generator sets are available from the factory connected for 110/220 Volt 50 Hz or 120/240 Volt 60 Hz. See Figure 6-14 for the factory connections.

Leads L1 and L2 are of different phases. Never connect leads L1 and L2 together. After connection adjust the voltage regulator to obtain the desired voltage.

Note: Use a circuit breaker manufacturer's two-pole circuit breaker. Two single-pole circuit breakers do not conform to NEC requirements when supplying a 220 or 240 volt load. This is true even if they are mechanically attached together.

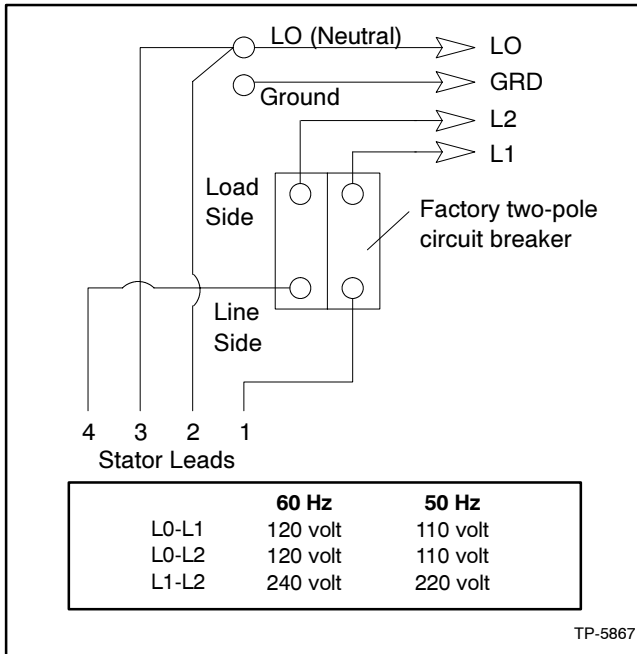


Figure 6-14 110/220 and 120/240 Volt, 3-Wire Configurations

6.9.3 Reconnection Options

The following reconnections can be made using the factory two-pole circuit breaker provided. It is the responsibility of the individual performing the reconnection to meet all the electrical codes.

See Figure 6-15 for four-lead reconnectable (single-phase) generator set voltage options.

60 Hz	50 Hz
120 Volt	110 Volt
120/240 Volt	110/220 Volt
240 Volt	220 Volt

Figure 6-15 Four-Lead, Single-Phase Generator Set Voltage Connection Options

110 and 120 Volt Configurations

When connecting stator phase leads, size output lead (L1) accordingly. Use a jumper lead with the same ampere rating as the output lead L1 on the side of the circuit breaker shown. After connection adjust the voltage regulator to obtain the desired voltage.

Note: Electrical Codes: The 110 and 120 Volt reconnection configurations require a jumper lead on one end of the circuit breaker. This configuration is acceptable per the National Electrical Code, NFPA #70. **Never jumper both the line and load ends of the circuit breaker. A jumper on both the line and load ends violates the National Electrical Code by paralleling the breaker poles.** On occasion local electrical inspectors have objected to a jumper on the load side of the circuit breaker. It is the responsibility of the individual who is reconnecting the output to make certain the reconnection satisfies the local inspector. The purchase and installation of a single pole breaker to replace the two-pole breaker may be necessary.

Note: Jumper Sizing: Use a jumper lead with the same ampere rating as the output lead L1 on the side of the circuit breaker shown.

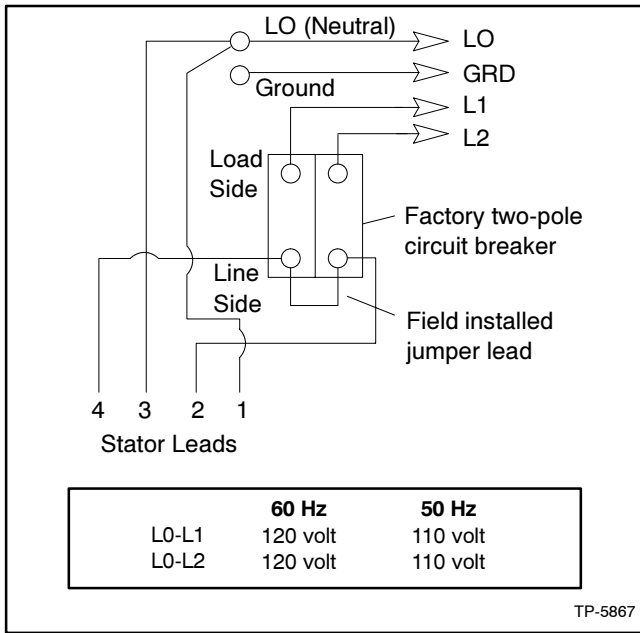


Figure 6-16 110 and 120 Volt, 3-Wire Configurations

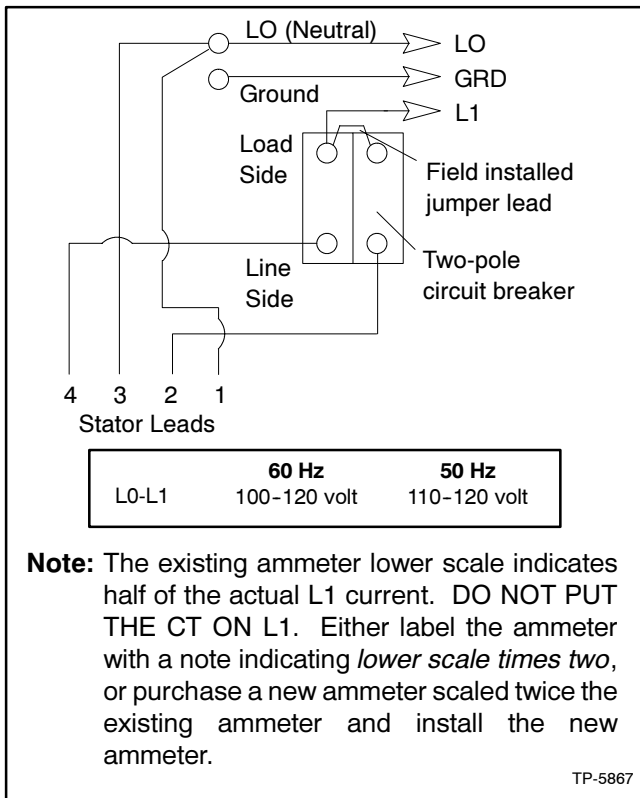


Figure 6-17 110 and 120 Volt, 2-Wire Configurations

220 and 240 Volt Configuration

A jumper lead is not used. After connection adjust the voltage regulator to obtain the desired voltage.

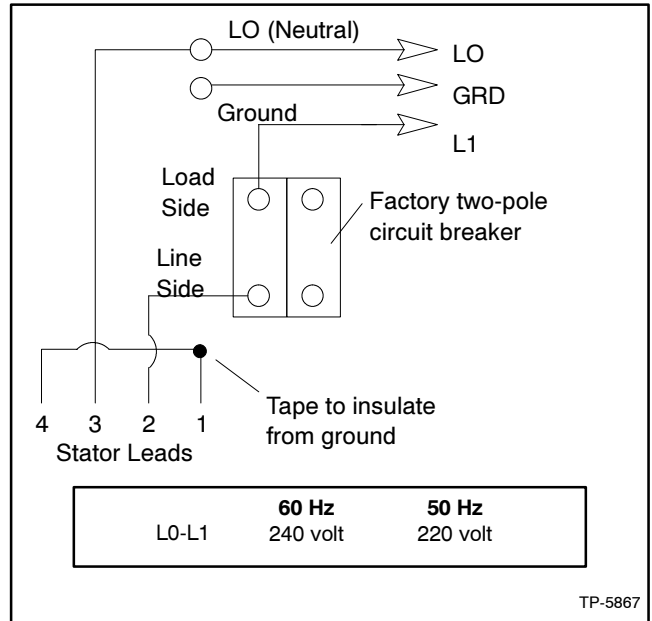


Figure 6-18 220 and 240 Volt, 2-Wire Configurations

6.10 Prestart Installation Check

Review the entire installation section. Inspect all wiring and connections to verify that the generator set is ready for operation. Check that there are no obstructions to the air inlet and outlet.

Complete the startup procedure and installation checklists supplied with the startup notification form. Return the form to the distributor/dealer or mail it directly to:

Kohler Power Systems
 Generator Warranty Administrator
 M.S. 072
 Kohler, Wisconsin 53044

Notes

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere	cfh	cubic feet per hour	E-Stop	emergency stop
ABDC	after bottom dead center	cfm	cubic feet per minute	etc.	et cetera (and so forth)
AC	alternating current	CG	center of gravity	exh.	exhaust
A/D	analog to digital	CID	cubic inch displacement	ext.	external
ADC	analog to digital converter	CL	centerline	F	Fahrenheit, female
adj.	adjust, adjustment	cm	centimeter	fglass.	fiberglass
ADV	advertising dimensional drawing	CMOS	complementary metal oxide substrate (semiconductor)	FHM	flat head machine (screw)
AHWT	anticipatory high water temperature	cogen.	cogeneration	fl. oz.	fluid ounce
AISI	American Iron and Steel Institute	com	communications (port)	flex.	flexible
ALOP	anticipatory low oil pressure	coml	commercial	freq.	frequency
alt.	alternator	Coml/Rec	Commercial/Recreational	FS	full scale
Al	aluminum	conn.	connection	ft.	foot, feet
ANSI	American National Standards Institute (formerly American Standards Association, ASA)	cont.	continued	ft. lbs.	foot pounds (torque)
AO	anticipatory only	CPVC	chlorinated polyvinyl chloride	ft./min.	feet per minute
API	American Petroleum Institute	crit.	critical	g	gram
approx.	approximate, approximately	CRT	cathode ray tube	ga.	gauge (meters, wire size)
AR	as required, as requested	CSA	Canadian Standards Association	gal.	gallon
AS	as supplied, as stated, as suggested	CT	current transformer	gen.	generator
ASE	American Society of Engineers	Cu	copper	genset	generator set
ASME	American Society of Mechanical Engineers	cu. in.	cubic inch	GFI	ground fault interrupter
assy.	assembly	cu. in.	cubic inch	GND, ⊕	ground
ASTM	American Society for Testing Materials	cw.	clockwise	gov.	governor
ATDC	after top dead center	CWC	city water-cooled	gph	gallons per hour
ATS	automatic transfer switch	cyl.	cylinder	gpm	gallons per minute
auto.	automatic	D/A	digital to analog	gr.	grade, gross
aux.	auxiliary	DAC	digital to analog converter	GRD	equipment ground
A/V	audiovisual	dB	decibel	gr. wt.	gross weight
avg.	average	dBA	decibel (A weighted)	H x W x D	height by width by depth
AVR	automatic voltage regulator	DC	direct current	HC	hex cap
AWG	American Wire Gauge	DCR	direct current resistance	HCHT	high cylinder head temperature
AWM	appliance wiring material	deg., °	degree	HD	heavy duty
bat.	battery	dept.	department	HET	high exhaust temperature, high engine temperature
BBDC	before bottom dead center	dia.	diameter	hex	hexagon
BC	battery charger, battery charging	DI/EO	dual inlet/end outlet	Hg	mercury (element)
BCA	battery charging alternator	DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)	HH	hex head
BCI	Battery Council International	DIP	dual inline package	HHC	hex head cap
BDC	before dead center	DPDT	double-pole, double-throw	HP	horsepower
BHP	brake horsepower	DPST	double-pole, single-throw	hr.	hour
blk.	black (paint color), block (engine)	DS	disconnect switch	HS	heat shrink
blk. htr.	block heater	DVR	digital voltage regulator	hsg.	housing
BMEP	brake mean effective pressure	E, emer.	emergency (power source)	HVAC	heating, ventilation, and air conditioning
bps	bits per second	EDI	electronic data interchange	HWT	high water temperature
br.	brass	EFR	emergency frequency relay	Hz	hertz (cycles per second)
BTDC	before top dead center	e.g.	for example (<i>exempli gratia</i>)	IC	integrated circuit
Btu	British thermal unit	EG	electronic governor	ID	inside diameter, identification
Btu/min.	British thermal units per minute	EGSA	Electrical Generating Systems Association	IEC	International Electrotechnical Commission
C	Celsius, centigrade	EIA	Electronic Industries Association	IEEE	Institute of Electrical and Electronics Engineers
cal.	calorie	El/EO	end inlet/end outlet	IMS	improved motor starting
CARB	California Air Resources Board	EMI	electromagnetic interference	in.	inch
CB	circuit breaker	emiss.	emission	in. H ₂ O	inches of water
cc	cubic centimeter	eng.	engine	in. Hg	inches of mercury
CCA	cold cranking amps	EPA	Environmental Protection Agency	in. lbs.	inch pounds
ccw.	counterclockwise	EPS	emergency power system	Inc.	incorporated
CEC	Canadian Electrical Code	ER	emergency relay	ind.	industrial
cert.	certificate, certification, certified	ES	engineering special, engineered special	int.	internal
		ESD	electrostatic discharge	int./ext.	internal/external
		est.	estimated	I/O	input/output
				IP	iron pipe

ISO	International Organization for Standardization	MS	military standard	RH	round head
J	joule	m/sec.	meters per second	RHM	round head machine (screw)
JIS	Japanese Industry Standard	MTBF	mean time between failure	rly.	relay
k	kilo (1000)	MTBO	mean time between overhauls	rms	root mean square
K	kelvin	mtg.	mounting	rnd.	round
kA	kiloampere	MW	megawatt	ROM	read only memory
KB	kilobyte (2 ¹⁰ bytes)	mW	milliwatt	rot.	rotate, rotating
kg	kilogram	μF	microfarad	rpm	revolutions per minute
kg/cm ²	kilograms per square centimeter	N, norm.	normal (power source)	RS	right side
kgm	kilogram-meter	NA	not available, not applicable	RTV	room temperature vulcanization
kg/m ³	kilograms per cubic meter	nat. gas	natural gas	SAE	Society of Automotive Engineers
kHz	kilohertz	NBS	National Bureau of Standards	scfm	standard cubic feet per minute
kJ	kilojoule	NC	normally closed	SCR	silicon controlled rectifier
km	kilometer	NEC	National Electrical Code	s, sec.	second
kOhm, kΩ	kilo-ohm	NEMA	National Electrical Manufacturers Association	SI	<i>Système international d'unités</i> , International System of Units
kPa	kilopascal	NFPA	National Fire Protection Association	SI/EO	side in/end out
kph	kilometers per hour	Nm	newton meter	sil.	silencer
kV	kilovolt	NO	normally open	SN	serial number
kVA	kilovolt ampere	no., nos.	number, numbers	SPDT	single-pole, double-throw
kVAR	kilovolt ampere reactive	NPS	National Pipe, Straight	SPST	single-pole, single-throw
kW	kilowatt	NPSC	National Pipe, Straight-coupling	spec, specs	specification(s)
kWh	kilowatt-hour	NPT	National Standard taper pipe thread per general use	sq.	square
kWm	kilowatt mechanical	NPTF	National Pipe, Taper-Fine	sq. cm	square centimeter
L	liter	NR	not required, normal relay	sq. in.	square inch
LAN	local area network	ns	nanosecond	SS	stainless steel
L x W x H	length by width by height	OC	overcrank	std.	standard
lb.	pound, pounds	OD	outside diameter	stl.	steel
lbm/ft ³	pounds mass per cubic feet	OEM	original equipment manufacturer	tach.	tachometer
LCB	line circuit breaker	OF	overfrequency	TD	time delay
LCD	liquid crystal display	opt.	option, optional	TDC	top dead center
ld. shd.	load shed	OS	oversize, overspeed	TDEC	time delay engine cooldown
LED	light emitting diode	OSHA	Occupational Safety and Health Administration	TDEN	time delay emergency to normal
Lph	liters per hour	OV	overvoltage	TDES	time delay engine start
Lpm	liters per minute	oz.	ounce	TDNE	time delay normal to emergency
LOP	low oil pressure	p., pp.	page, pages	TDOE	time delay off to emergency
LP	liquefied petroleum	PC	personal computer	TDON	time delay off to normal
LPG	liquefied petroleum gas	PCB	printed circuit board	temp.	temperature
LS	left side	pF	picofarad	term.	terminal
L _{wa}	sound power level, A weighted	PF	power factor	TIF	telephone influence factor
LWL	low water level	ph., ∅	phase	TIR	total indicator reading
LWT	low water temperature	PHC	Phillips head crimptite (screw)	tol.	tolerance
m	meter, milli (1/1000)	PHH	Phillips hex head (screw)	turbo.	turbocharger
M	mega (10 ⁶ when used with SI units), male	PHM	pan head machine (screw)	typ.	typical (same in multiple locations)
m ³	cubic meter	PLC	programmable logic control	UF	underfrequency
m ³ /min.	cubic meters per minute	PMG	permanent-magnet generator	UHF	ultrahigh frequency
mA	milliampere	pot	potentiometer, potential	UL	Underwriter's Laboratories, Inc.
man.	manual	ppm	parts per million	UNC	unified coarse thread (was NC)
max.	maximum	PROM	programmable read-only memory	UNF	unified fine thread (was NF)
MB	megabyte (2 ²⁰ bytes)	psi	pounds per square inch	univ.	universal
MCM	one thousand circular mils	pt.	pint	US	undersize, underspeed
MCCB	molded-case circuit breaker	PTC	positive temperature coefficient	UV	ultraviolet, undervoltage
meggar	megohmmeter	PTO	power takeoff	V	volt
MHz	megahertz	PVC	polyvinyl chloride	VAC	volts alternating current
mi.	mile	qt.	quart, quarts	VAR	voltampere reactive
mil	one one-thousandth of an inch	qty.	quantity	VDC	volts direct current
min.	minimum, minute	R	replacement (emergency) power source	VFD	vacuum fluorescent display
misc.	miscellaneous	rad.	radiator, radius	VGA	video graphics adapter
MJ	megajoule	RAM	random access memory	VHF	very high frequency
mJ	millijoule	RDO	relay driver output	W	watt
mm	millimeter	ref.	reference	WCR	withstand and closing rating
mOhm, mΩ	milliohm	rem.	remote	w/	with
MOhm, MΩ	megohm	Res/Coml	Residential/Commercial	w/o	without
MOV	metal oxide varistor	RFI	radio frequency interference	wt.	weight
MPa	megapascal			xfmr	transformer
mpg	miles per gallon				
mph	miles per hour				

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