

McGraw-Edison

**Onan**

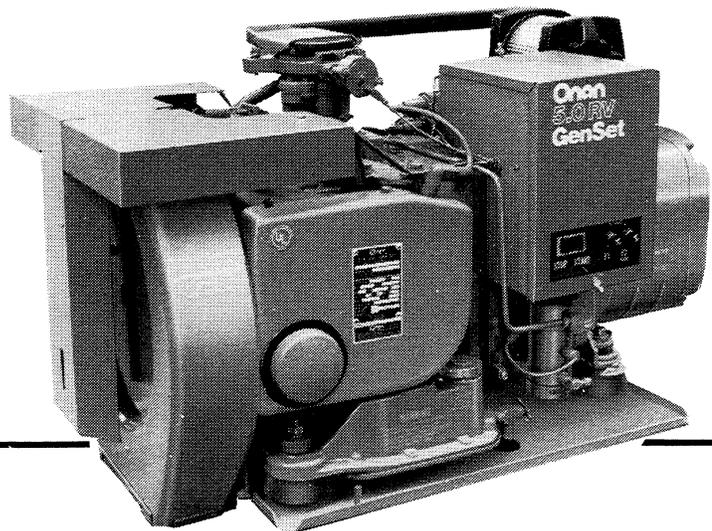
# Installation Guide

5.0 kW

BGA

Spec. 16004 Series  
**GenSet**

RV Electric Generating Set



# Safety Precautions

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The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

**WARNING** *This symbol is used throughout this manual to warn of possible serious personal injury.*

**CAUTION** *This symbol refers to possible equipment damage.*

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

Do not work on this equipment when mentally or physically fatigued.

- **Use Extreme Caution Near Gasoline. A constant potential explosive or fire hazard exists.**

Do not fill fuel tank near unit with engine running. Do not smoke or use open flame near the unit or the fuel tank.

Be sure all fuel supplies have a positive shutoff valve.

Fuel lines must be of steel piping, adequately secured and free of leaks. Use a flexible section of fuel line between generator set and stationary fuel line in the vehicle. This flexible section must be 100% NON-METALLIC to prevent electrical currents from using it as a conductor.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.

- **Guard Against Electric Shock**

Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

Always use an appropriately sized, approved double-throw transfer switch with any standby generator set. **DO NOT PLUG PORTABLE OR STANDBY SETS DIRECTLY INTO A HOUSE RECEPTACLE TO PROVIDE EMERGENCY POWER.** It is possible for current to flow from generator into the utility line. This creates extreme hazards to anyone working on lines to restore power.

Use extreme caution when working on electrical components. High voltages cause injury or death.

Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician.

- **Do Not Smoke While Servicing Batteries**

Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

- **Exhaust Gases Are Toxic**

Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped.

Be sure the unit is well ventilated.

- **Keep The Unit And Surrounding Area Clean**

Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Do NOT store anything in the generator compartment such as oil or gas cans, oily rags, chains, wooden blocks, portable propane cylinders, etc. A fire could result or the generator set operation (cooling, noise and vibration) may be adversely affected. Keep the compartment floor clean and dry.

- **Protect Against Moving Parts**

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be permitted because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep power shields and guards in position.

If adjustments *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

# Important Safety Precautions

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Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

## FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC-rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work-harden and break.

## EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.

- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

*Make sure exhaust is properly ventilated.*

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [-] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

## BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (-) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

## **DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS**

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

## **HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY**

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

## **ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH**

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocutation can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [-] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [-] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

## **MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)**

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

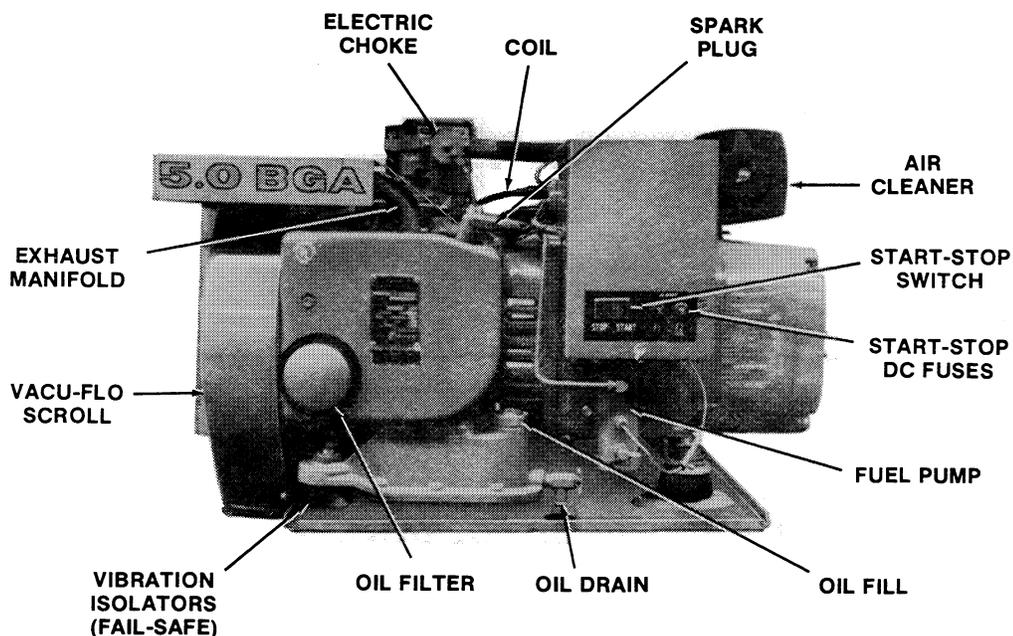
## **GENERAL SAFETY PRECAUTIONS**

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

**KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.**

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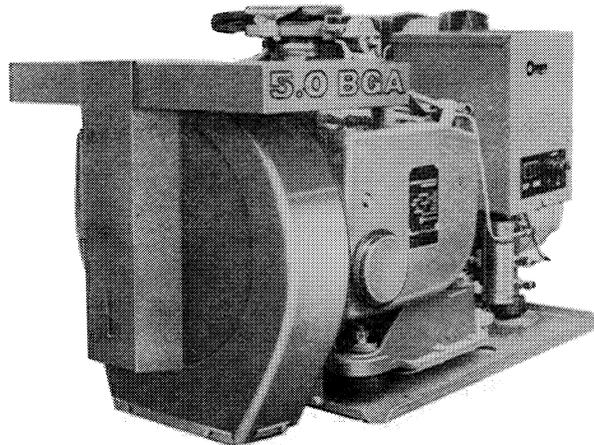
TYPICAL BGA FOR RECREATIONAL VEHICLES

# INTRODUCTION

This manual covers detailed installation procedures for the UL Listed/CSA Certified Onan model 5.0 BGA 1R recreational vehicle electric generating sets. Each Onan RV electric generating set MUST be installed properly if it is to operate reliably, quietly and most important safely, even though the set itself meets or exceeds all Listing Requirements. Being Listed and Certified means this electric generating set meets or exceeds all requirements of ANSI/NFPA 501C-1977 Chapter 4 (Electrical Systems) and Chapter 5 (Fire and Life Safety) and ANSI A198.1 as well as UL Subject 1248 and CSA Electrical Bulletin #946.

All Motor Home installations MUST comply with these specifications as well as Article S51, ANSI C1-1975/NFPA No. 70-1978 of the National Electrical Code. The Motor Home Manufacturer and/or the generator set installer MUST comply with above codes and any local codes which pertain to the generator set installation.

This manual provides detailed installation guidelines for this Onan model ONLY. For operation and maintenance procedures, refer to the individual Operator's manual which accompanies each set. The Operator's manual is #965-0121.



## **WARNING**

*TO PREVENT FIRE OR ACCIDENT HAZARD . . . THIS UNIT MUST BE INSTALLED ACCORDING TO THE MANUFACTURER'S DETAILED INSTALLATION PROCEDURES OBSERVING ALL MINIMUM CLEARANCES.*

*TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, ANY INSTALLATION AND ALL SERVICE MUST BE PERFORMED BY QUALIFIED PERSONNEL.*

# GENERAL SPECIFICATIONS

## ENGINE

Onan opposed 2-cylinder, 4-cycle, air cooled, gasoline fueled engine rated 10.0 bhp at 1800 rpm. Remote start, negative ground, 12-volt, motorized alternator cranking.

## ALTERNATOR

Onan-built, four-pole, revolving armature permanently aligned to engine. Generator produces 120 volts, 41.6 amps., 60 hertz, single phase AC, 5000 watt output. Reconnectible for 120/240 volt output - 20.8 amps each leg.

## CONTROL

Front mounted control featuring automatic electric choke and fuel pump, fused battery charging and Start Stop controls with remote start capability.

## RV ELECTRIC GENERATING SET

Some general specifications are listed below for reference purposes.

## SPECIFICATIONS

Height .....	18.85 in. (479 mm)
Length .....	32.63 in. (829 mm)
Width .....	18.00 in. (457 mm)
Weight .....	285 lbs. (129 kg)
Air Requirements	
Total (CFM) .....	Approx. 500 (14.15 m <sup>3</sup> /min)
Fuel Inlet Connection	
Size.....	1/4" Barb or 1/8 NPTF
Battery Voltage.....	12 Volts
Battery AMP-HR	
Minimum.....	74 (266.40 kC)
Battery Ground.....	Negative
RPM (At rated load 60 Hz) .....	1800

**NOTE:** Metric values are shown in parentheses.

# PRE-START CHECKS

This RV generator set is complete as received except for exhaust components and any other optional accessory items which are shipped loose with each set for installation later. After the initial installation is completed the following steps are necessary before actually starting the generator set for the first time.

1. Install the exhaust system.
2. Add oil to the engine.
3. Connect fuel line to engine from fuel supply tank.
4. Connect electrical leads to load circuits.
5. Connect the start stop remote switches (if used).
6. Connect battery leads between set and battery. Connect ground lead last.

**Vehicle chassis (frame) ground and the battery and generator set ground should all be electrically connected to be at 0 ground potential. All Onan units are designed for negative ground application.**

## **WARNING**

Do not smoke while servicing batteries. Lead acid batteries give off explosive gases while being charged.

## **FUEL SYSTEM**

With set running, check for leaks. Raw fuel will cause fumes which could EXPLODE. Check around carburetor and fuel pump inlets. Make sure fuel lines are not rubbing against anything which could cause breakage.

## **ELECTRICAL**

### **AC Output**

All AC leads (M1, M2, M3 and M4) terminate in generator set's junction box. These wires should be connected to distribution box with multistrand wire enclosed in a flexible conduit. Check all wires (to and from the generator set) for fraying and loose connections. For information on load connections refer to *ELECTRICAL LOADS AND CONNECTIONS* section following.

### **Battery Connections**

Battery positive (+) connects to start solenoid. Battery negative (-) connects to location on rear of generator. Check terminals on set for clean and tight connections.

## **WARNING**

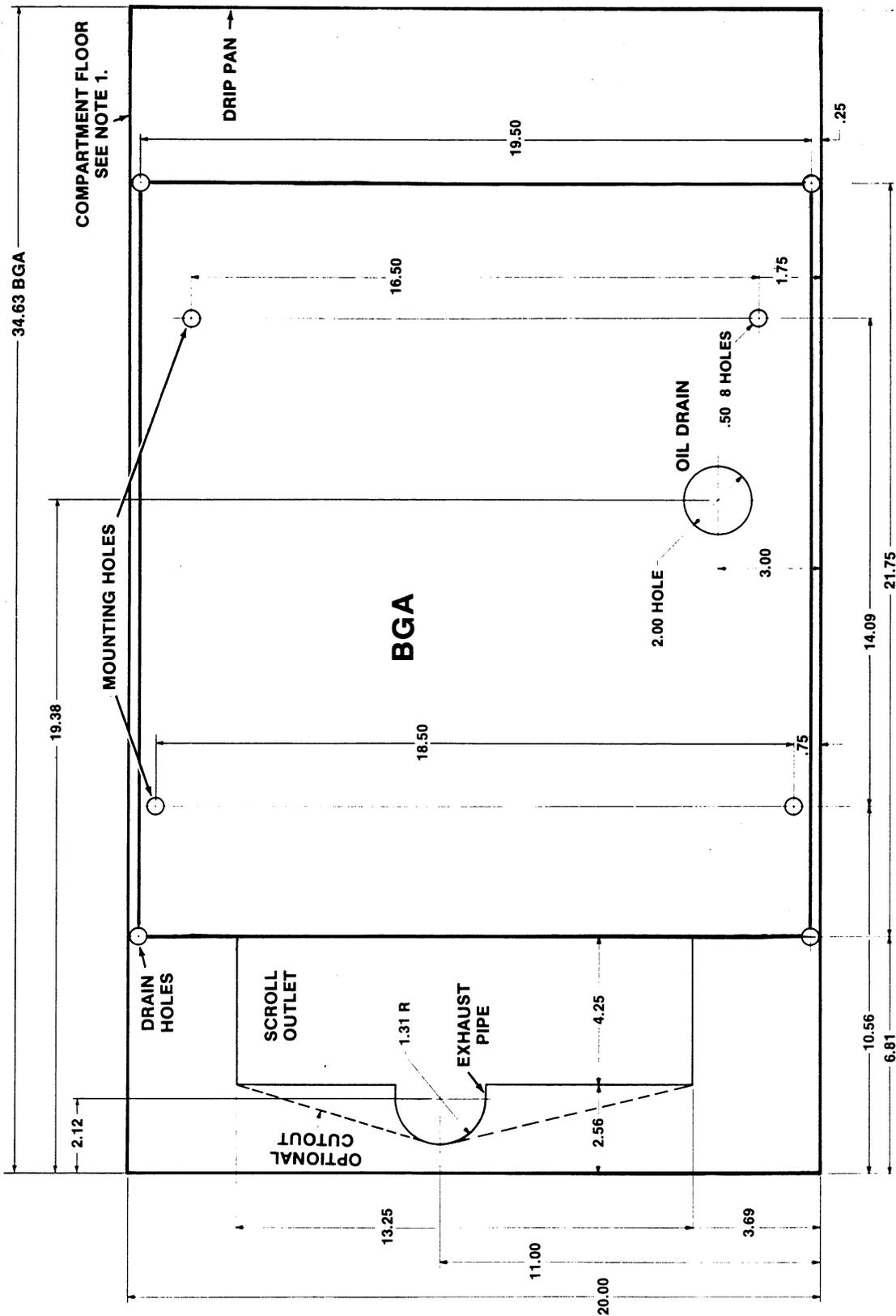
### **ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!**

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.



1. DIMENSIONING INCLUDES ONE INCH MINIMUM CLEARANCE REQUIRED BETWEEN SET AND INSULATION OR COMPARTMENT WALLS.
2. IF COMPARTMENT IS LARGER THAN MINIMUM SHOWN ALLOW EXTRA SPACE AT EXHAUST SHIELD AND OIL FILL SIDES.
3. ALLOW A MINIMUM OF 1/2 INCH CLEARANCE BETWEEN CARBURETOR AIR INTAKE SYSTEM AND INSULATION OR COMPARTMENT CEILING. MINIMUM HEIGHT - 19.4 INCHES

FIGURE 1. TYPICAL INSTALLATION COMPARTMENT SIZE AND MINIMUM DIMENSIONS

# COMPARTMENT SIZE AND LOCATION

## COMPARTMENT SIZE AND LOCATION

Compartment location is determined largely by:

1. Physical size.
2. Access opening.
3. Mounting support—most important of all.

### Physical Size

The area in the vehicle for the electric generating set must be large enough for the compartment, with specified minimum clearance between the electric generating set and compartment walls or ceiling (and acoustical material, if used). See Figure 1.

### ACCESS OPENING

Plan the location for an access opening large enough to permit set removal. Compartment door should be designed for easy removal or for easy access for operator or service personal.

### MOUNTING SUPPORT

Because of compartment weight, the most desirable mounting location is between the main frame members of the recreational vehicle. However, this is seldom possible. Most common installations are on the side of the vehicle and most difficult to reinforce. One side of the compartment is fastened to the frame and the opposite side secured to the body. Compartment floor must be metal.

Channel, box or angle iron can be used for a compartment frame with a sheet metal cover.

### COMPARTMENT

1. Compartment or installation area must be separated from living quarters by a vapor-tight wall.
2. Insulate the compartment with 26-gauge galvanized steel or a material of comparable strength, durability and fire resistance.

#### WARNING

Do not use flammable material directly above or around the electric generating set compartment. Heat transferred through the sheet metal compartment structure or other material can be HOT enough to discolor, char or ignite fiberboard, seat cushions, etc. Use of asbestos or other noncombustible temperature insulating material in high temperature areas may be necessary.

3. See Figure 1 for minimum clearances and compartment size.

4. DO NOT use absorbent sound proofing material on compartment floor. The floor should have minimal openings to reduce entrance of road dirt. Compartment floor must be so constructed as to prevent accumulation of oil, fuel or water in any corner. Drainage can be accomplished through the use of a 1/2" diameter hole near each corner or other suitable means.

#### WARNING

Be sure hole is not directly above muffler to prevent fire hazard.

Equip base with an oil drain hole to outside of compartment. It is recommended that the recreational vehicle manufacturer provide a raised edge or collar around exhaust pipe outlet to prevent gasoline leakage onto exhaust system to meet requirements of CSA #946.

### MOUNTING

Read the entire manual before mounting the generator set. Additional allowances should be made to allow easy access to the oil fill, drain and oil dip stick as well as the air cleaner element for service purposes.

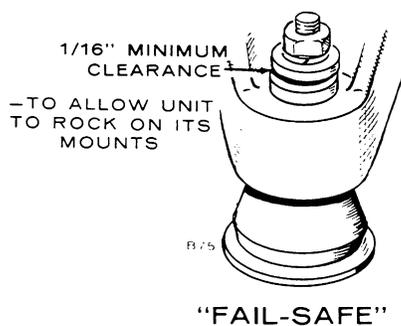


FIGURE 2. VIBRATION ISOLATORS

### VIBRATION ISOLATORS

Rubber vibration isolators are furnished with all Onan recreational vehicle models.

#### CAUTION

Use only the vibration isolators provided with the electric generating set, as they are designed to support unit's weight.

1. Onan mounts are a "through bolt" type which prevent the set from breaking loose if they are damaged.
2. Vibration isolators of the type shown (with snubbing washers) in Figure 2 must be installed properly to minimize vibration. Leave 1/16-inch minimum clearance between the snubbing washers as shown in Figure 2.

# VENTILATION AND ACOUSTICS

The most important factors of ventilation for an air-cooled mobile electric generating set are sufficient incoming cooling air and exhausting heated air. Before considering the installation problems, knowledge of how an Onan unit cools itself is needed.

## VACU-FLO COOLING

All Onan electric generating sets for recreational vehicles use Vacu-Flo cooling, a centrifugal fan in a scroll housing on the engine end (Figure 3).

1. It draws air from the generator end of the compartment, through the generator and over the cooling surfaces of the engine, then discharges the heated air out through the Vacu-Flo discharge opening.
2. All standard sets for recreational vehicles have the Vacu-Flo scroll positioned downward. Be sure nothing obstructs or restricts discharged airflow.

**WARNING** Never use discharged cooling air for heating since it can contain poisonous gases.

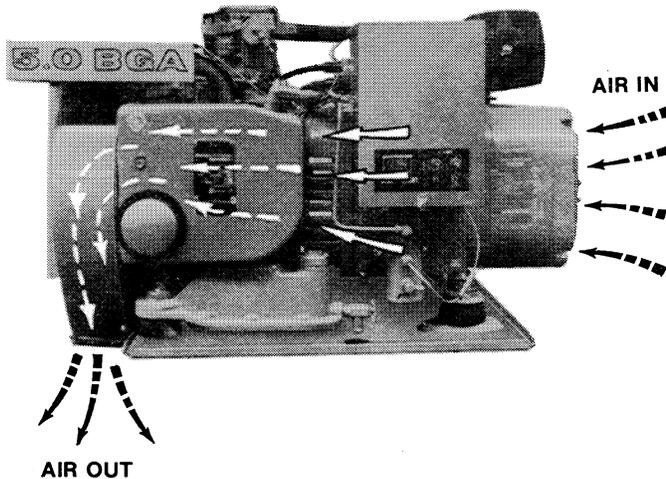


FIGURE 3. TYPICAL ONAN MOBILE COOLING SYSTEM

Allow for ducts or obstructions of airflow. Position of the air openings must permit airflow while the unit is running to purge the compartment of heated air. But on shutdown, the openings must allow for convection cooling of the compartment for heated air to escape.

## AIR REQUIREMENTS

Cooling air requirements for Onan electric generating sets vary with type and size. Special equipment is needed to measure it. Since the discharge area can't be changed, air inlet opening is *critical!* The 5.0 kW BGA running at 1800 rpm requires a minimum free air inlet area of 100 square inches with no restrictions and the air discharge is 480 cubic feet per minute.

The Onan UL tested air cleaner element is specifically designed to meet the combustion air requirements of the 5.0 BGA. This element should be replaced each 200 hours of operation and more often in extremely dusty conditions.

## RESTRICTED AIR OPENINGS

Sheet metal with louvers can be used over inlet areas. However, some provide only 60 percent free inlet area per square foot. Even the most efficient grille only provides about 90 percent free inlet area per square foot. The free inlet area of the material can be obtained from the manufacturer. Calculate the inlet area needed using the following information as a guide. See Figure 4.

Unrestricted air inlet requirements for this set is 100 square inches. The 100 square inches should be divided by the percent (%) of free air of the proposed louver to determine necessary surface area for this set.

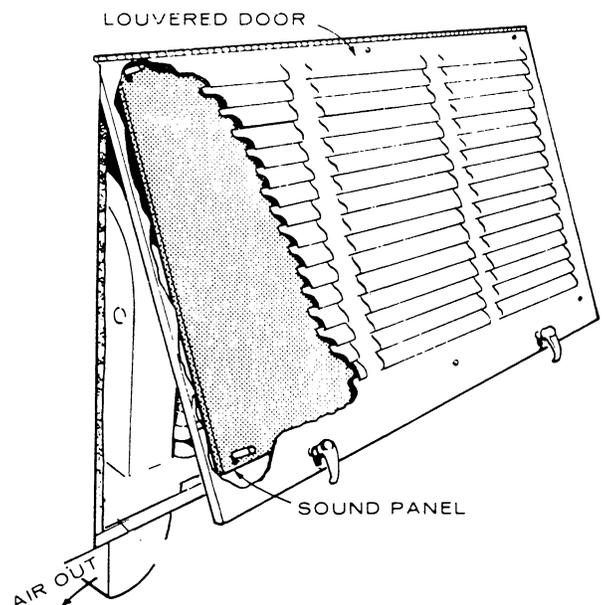


FIGURE 4. TYPICAL LOUVERED DOOR AIR INLET

## COMPARTMENT ACOUSTICAL LINING

1. Be sure all joints and corners of the compartment are vapor tight to coach interior before lining with acoustical material.

Lining the compartment does little if opening, cracks, door and joints are not sealed. Also make sure compartment door edge is sealed to eliminate noise-air leaks around the door perimeter.

2. Cover the sound reflective surfaces, back, top and sides (not compartment base) with fiberglass or other noncombustible acoustical material. It should be no less than one inch thick and approximately two pounds per square foot in density. Be sure adhesive used is also noncombustible. Test acoustical material and adhesive for heat effects before using.

3. Rather than using one single material of two pound per square foot density, a combination of materials can reduce noise even more. For example, a sheet of lead or viscoelastic material of one-half to one pound per square foot density and a layer of one inch acoustical material of two pound per square foot density, respectively, is far more superior.

4. To prevent line of sight noise, a sound panel (baffle) may be added behind louvered air inlet. The panel must be spaced to allow for minimum free air inlet of 100 square inches. See Figure 4.

**WARNING** Separate installation area or compartment from living quarters by a vapor-tight wall to prevent entrance of noxious fumes to interior.

**WARNING** Insulation must not reduce the minimum clearances as specified in Figure 1 to meet ANSI 198.1 and CSA #946 temperature rise requirements for recreational vehicles.

# FUEL SYSTEM

## RECOMMENDED FUEL

Use clean, fresh, unleaded or regular grade gasoline. Do not use highly leaded premium fuels. Using unleaded gasoline results in reduced valve and carbon cleanout maintenance.

If the use of unleaded gasoline is desired, use regular gasoline for the first 25 hours to allow the rings to seat well for best performance. Then use unleaded gasoline thereafter.

If regular gasoline is used continually, carbon and lead deposits must be removed from the cylinder heads as required because of engine power loss. Unleaded gasoline may be used safely after lead deposits have been removed.

### WARNING

Leakage of gasoline in or around the compartment is a serious fire hazard. The ventilation system should provide a constant flow of air to expel any accumulation of fuel vapor while the vehicle is in transit. Compartments must be vapor tight to the interior to keep fumes from within the vehicle.

## FUEL CONSUMPTION

It should be noted that under varying electrical loads, fuel consumption of engines for recreational vehicle generator sets varies accordingly. Average fuel consumption at rated 60 Hz load is .90 gallons per hour.

## FUEL LINES AND FUEL FILTERS

### Fuel Lines

1. Most electric generating set installations are designed to share the vehicle fuel supply tank with the vehicle engine. All connections to vehicle fuel system must be in accordance with chassis (vehicle) manufacturers' detailed installation instructions.
2. Install an approved flexible non-metallic and non-organic fuel line between the vehicle fuel system and the engine to absorb vibration.
3. Use of seamless steel tubing and flared connections are recommended for long runs between the fuel tank and the flexible connector to the generator set.
4. Run fuel lines at the top level of tank to a point as close to the engine as possible to reduce danger of fuel siphoning out of tank if the line should break.
5. Keep fuel lines away from hot engine or exhaust areas. This reduces chance of vapor lock.
6. Flexible line must be long enough to allow for 4" of set movement to prevent binding, stretching or breaking because of set movement.  
Install lines so they are accessible and protected from damage.  
Use metal straps without sharp edges to secure the fuel lines.
9. Do not run fuel line in conjunction with electrical wiring.

### Fuel Filters

Onan electric generating sets with electric fuel pumps have phenolic or screen filters within the fuel pump itself. Additional filters in the fuel line are unnecessary unless unusual operating conditions exist.

## FUEL SHUT OFF

The positive fuel shutoff prevents flooding of the generator set, when not in use, should the vehicle fuel tank become pressurized.

Operating the generator set from a tee in the main fuel line can cause erratic operation when vehicle is operated at highway speeds. The set's fuel pump has neither the capacity nor the power to overcome the draw of vehicle engine fuel pump.

## GASOLINE EVAPORATIVE CONTROL SYSTEMS

With the increasing emphasis on pollution controls, certain states are now requiring strict evaporative controls on vehicle gasoline supply systems. Manufacturers of RV chassis and vehicles in general have complied to new regulations for these areas by using special design gas tanks, filler tubes, filler gas caps and interconnecting vapor tubing from the vehicle gas tank through a special canister to the vehicle engine.

Because these systems are designed to operate in a critical pressure range, it is very important during connection of an electric generating set and building of the motor home, etc., the vehicle manufacturer's fuel supply design not be altered. The filler tube, fill limiter vent, canister, vapor lines and gas fill cap should not be changed, removed or replaced unless receiving recommendations and approval from the vehicle manufacturer. If not, serious vehicle engine and generator set operating conditions could result.

Always check the filler gas cap to make sure it has a pressure and vacuum relief valve. Also check to make sure it works.

If operating problems develop due to the fuel system, check the fill cap to make sure the vacuum and pressure relief valve is working properly.

Because various designs of such systems exist, Figure 5 shows a typical gasoline evaporative control system. By checking the vehicle chassis for a canister, vapor lines, etc., you should be able to identify whether or not it has an evaporative control system.

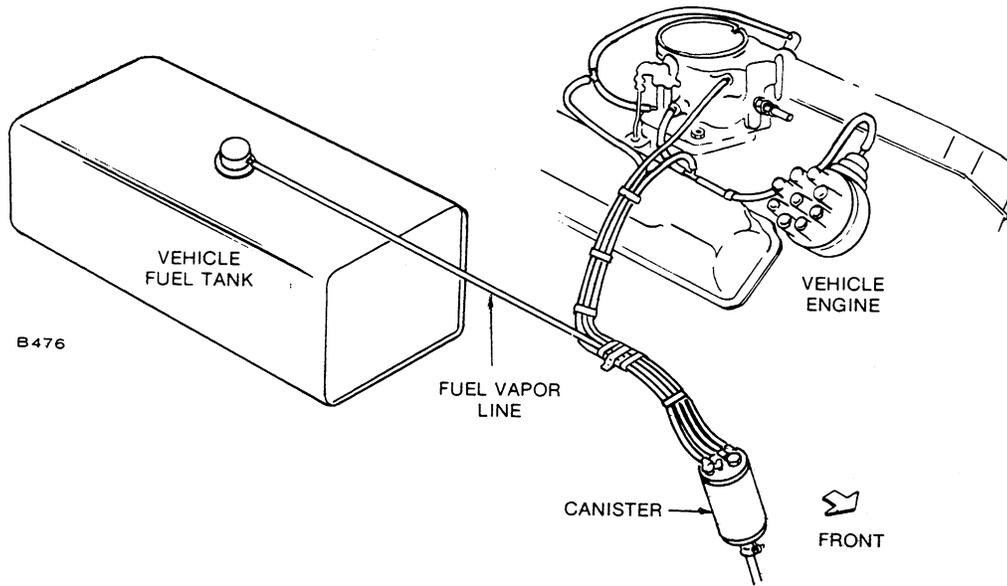


FIGURE 5. TYPICAL EVAPORATIVE CONTROL SYSTEM.

# EXHAUST SYSTEM

Plan each individual exhaust system carefully. A proper installation is not only gas tight, but usually quieter, too. Be sure to check all applicable recreational vehicle standards, local codes and regulations.

## WARNING

Plan the exhaust system carefully. Exhaust gases are deadly!

## CAUTION

Do not connect the electric generating set exhaust to the vehicle exhaust system. Water vapor from one engine can damage the other engine.

1. Where the exhaust system passes through the base or floor, leave adequate clearance as protection against exhaust pipe damage from vibration (Figure 6). The metal around the hole should be turned up or some type of collar used to prevent gas or oil from draining onto hot exhaust parts.
2. The exhaust system must be no closer than 1-1/2 inches from any combustible material, or be so located, insulated or shielded so it does not raise the temperature of any combustible material by more than 117°F (65°C) above the ambient air inlet temperature.

**IMPORTANT:** Certain states (particularly California) have state ordinances pertaining to the type and usage of exhaust muffler/spark arresters on internal combustion engines or engine driven equipment when used in a recreational vehicle such as electric generating sets. Be sure your installation meets all Federal, State and local codes pertaining to your unit. Failure to provide and maintain a spark arrester may be in violation of the law.

3. The exhaust system must extend a minimum of one inch beyond the perimeter of the vehicle. If

the generator set tailpipe is on the same side of the coach as the compartment, it should terminate aft of the air intake to prevent recirculation of exhaust fumes.

## WARNING

Do not terminate poisonous carbon monoxide exhaust gas under vehicle. Direct exhaust gases away from window and door openings. Keep all openings above or to the rear of exhaust pipes closed when generator set is operating.

4. Do NOT mount the exhaust pipe directly below the gasoline filler spout.
5. Use automotive type tail pipe hangers for hanging the exhaust system from vehicle undercarriage.

## CAUTION

If tail pipe deflector is used, be sure it is large enough to prevent excessive back pressure.

6. Position the clean-out plug within 45° of an imaginary line drawn vertically through the muffler (See "Muffler - Front View", below).

## EXHAUST SPARK ARRESTERS

Exhaust spark arresters are necessary for SAFE OPERATION. All require periodic clean-out (every 50 to 100 operating hours) to maintain maximum efficiency. Some state and federal parks require them. To clean spark arrester remove pipe plug in bottom of muffler. Run set under load for 5 minutes. Replace plug.

## WARNING

All exhaust shielding supplied with unit MUST be properly installed to prevent overheating of compartment walls or the possibility of fire.

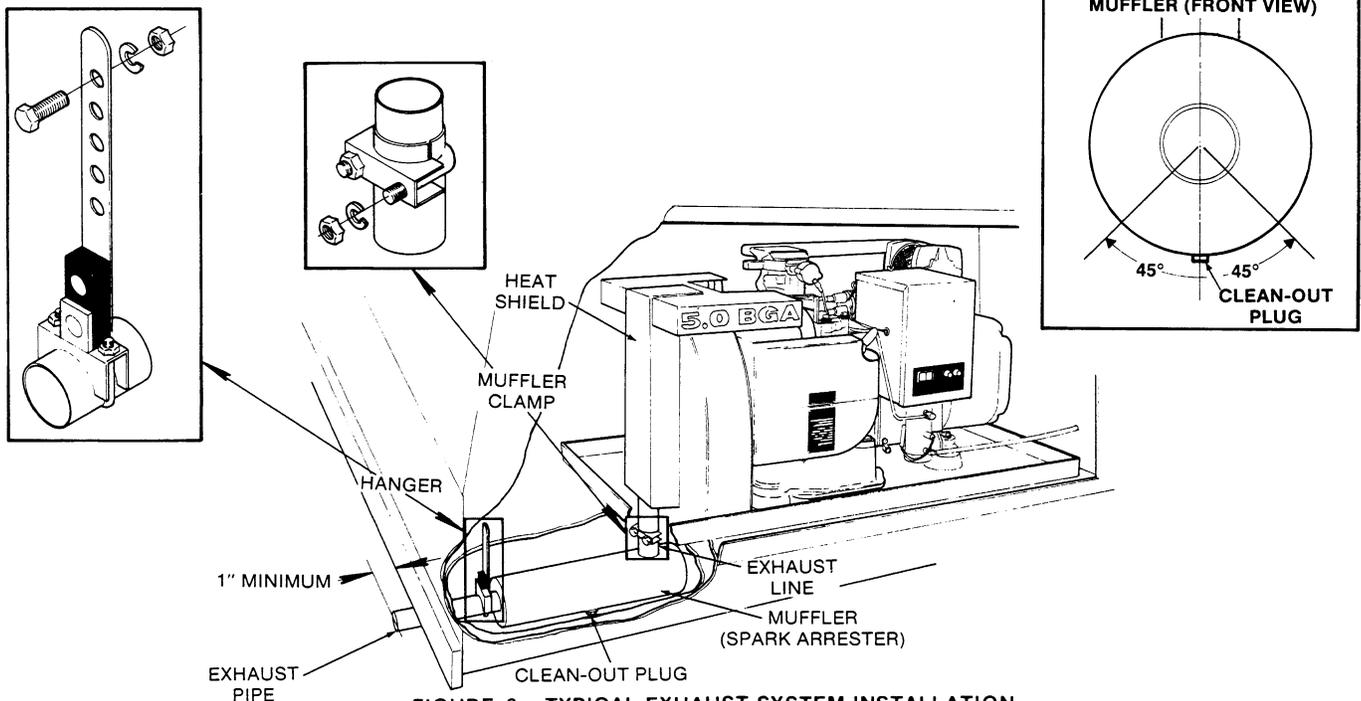


FIGURE 6. TYPICAL EXHAUST SYSTEM INSTALLATION

## **ASSEMBLY INSTRUCTIONS FOR INSTALLATION OF EXHAUST ACCESSORY KIT**

These exhaust shields and components **MUST** be properly installed to maintain the generator compartment temperature rise requirements within the limits of ANSI A 198.1 and CSA Electrical Bulletin #946 regulations and for proper operation of the generator set. The exhaust system must **NOT** raise the temperature of any combustible material by more than 117° F (65°C) above the ambient air inlet temperature. Proceed as follows:

1. After set is completely installed in generator set compartment, install the exhaust down pipe and secure with 5/16-18 bolts, nuts and washers supplied. Be sure to install asbestos gasket between exhaust manifold flanges to prevent leaks.
2. Install downpipe shield in place by engaging tab (on inside of shield) in the clamp (already positioned on downpipe) between the locking screw and the clamp. Tighten clamp locking screw securely.

3. Install and tighten top 1/4" bolt securely.
4. Recheck and tighten any loose bolts. If downpipe shield is loose, adjust clamp on downpipe and tighten securely.
5. Install and connect the muffler to the downpipe on underside of compartment floor using hanger bracket and u-bolt supplied. Tighten all connections securely.
6. Run the generator set for five minutes and check exhaust system (visually and audibly) for leaks or excessive noise.
7. Clean spark arrestor muffler every 100 hours of operation. Remove 1/8" pipe plug in bottom of muffler and run set for 5 minutes. Then replace pipe plug. Check exhaust system (visually and audibly) for leaks daily (at least every 8 hours of running time).

### **EXHAUST SYSTEM MODIFICATIONS**

If exhaust down pipe needs to be shortened, slots must be cut in down pipe after pipe is cut.

**Modifications of exhaust system (other than shortening of down pipe) will void the UL/CSA approval and warranty. Liability for damage or injury and warranty expenses due to any changes become the responsibility of the person making such changes.**

# ELECTRICAL LOADS AND CONNECTIONS

All of the following description pertains to alternating current Onan electric generating sets for recreational vehicles.

1. All wiring must meet applicable local electrical codes. Have a qualified electrician install and inspect the wiring.
2. Wires must be adequate size, properly insulated and supported in an approved manner.
3. Mount switches and controls securely to prevent damage from vibration and road shocks. All switches must be vibration-proof to prevent accidental opening or closing while the vehicle is in motion.
4. Install an approved junction box for feeder conductors from the electric generating set. It must have a blank cover and be inside compartment (not on set).

**WARNING** To prevent noxious gases from entering vehicle interior, seal any openings made in the set's compartment for conduit, wiring, etc.

## WIRE TYPES

Use multistrand wire which meets all applicable codes as feeder conductors, from electric generating set to compartment junction box. Many installers use multistrand wire throughout the vehicle to reduce the danger of breakage from vibration.

The conductors of the electric generating set shall have an ampacity not less than 115 percent of the nameplate current rating of the generator. Neutral conductors shall be the same size as the conductors of the outside legs.

Install generator load conductors in a flexible metallic conduit. Conduit must be connected either to the junction box on the compartment wall or to a panel board mounted on the outside of the compartment wall.

**CAUTION** Do not use solid metal conductors in compartment. They may develop metal fatigue from set movement and eventually break.

**WARNING** Because of fire hazard, do not tie electrical wiring to fuel line.

## DISCONNECT SWITCH

The feeder conductors from the set compartment must terminate in a double-pole, double-throw positive off switch device for 120 volt operation before the vehicle distribution panel. This assures the outside power source cannot be connected simultaneously with the electric generating set. For 120/240 volt operation, a 3-pole, double-throw,

positive off, switching device must be used. Neutral must be switched.

**WARNING** Use only approved power supply assemblies. Never remove grounding pin from power supply assembly. Incorrect or no ground may cause the recreational vehicle to be electrically "hot."

## RECONNECTIBLE, SINGLE-PHASE GENERATOR

Voltage selection on reconnectible single-phase generators is for use as 120/240 volts, 3 wire; or 120 volts, 2 wire. Use the connection for two wire service when used for motor starting such as air conditioning. Balance the load when connecting for three wire service. Current for any one output lead must not exceed nameplate rating. When two or more single-phase circuits are available, divide the load equally between them. See Figure 7.

## STARTING CONTROLS

Remote control Onan electric generating sets are designated by an "R" in the model number and allow the operator to start the set inside the vehicle, etc. See operator's manual for more specific information.

## LOAD CONNECTIONS

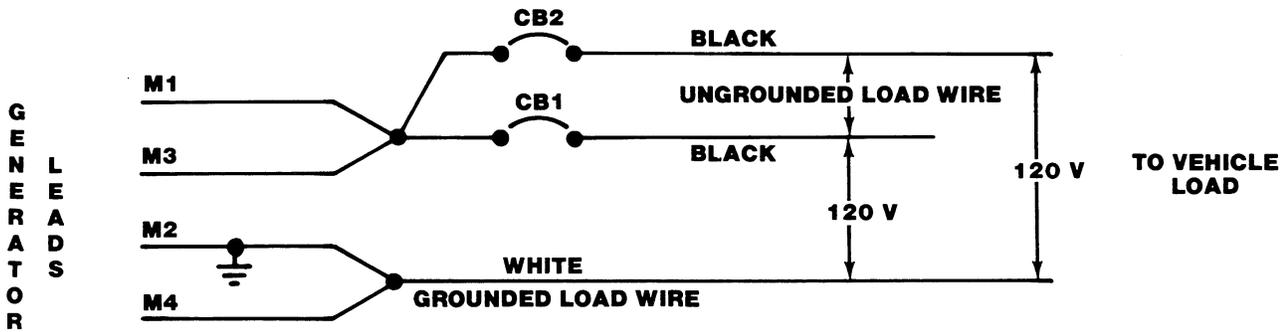
Generator set load wires M1, M2, M3 and M4 terminate within the junction box. Connect and join wires within junction box in an approved manner for desired voltage code. See Figure 7.

On motor homes which have provisions for using outside AC utility power (separate from the electric generating set) the neutral as well as the "Hot" lead MUST be completely isolated from the motor home when load or power is switched.

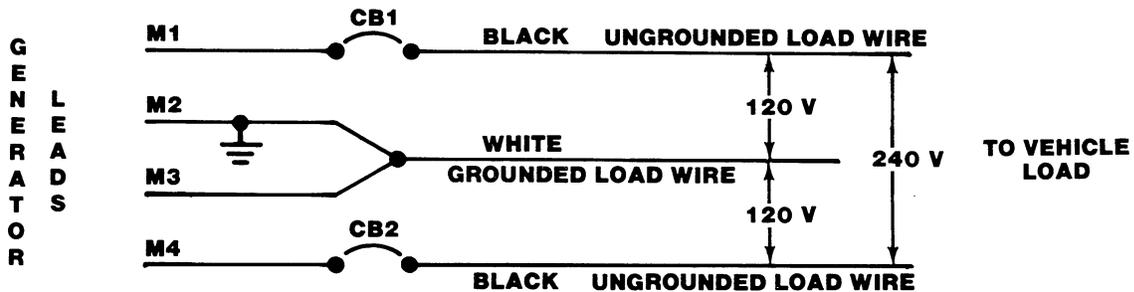
The operation of a typical transfer device is shown in Figure 8. In addition to the transfer device, an over current protection device (circuit breaker or fuse) shall be provided between the transfer device and the AC circuit in the motor home. The generator set field has inherent overload protection when any overload is applied; frequency will sag which causes output voltage to drop and in turn the generator set field drops to zero voltage. A ground fault circuit interrupter should be installed in the wiring system to protect all branch circuits.

**POWER REQUIREMENTS FOR APPLIANCES**

Appliance or Tool	Approximate Running Wattage
Refrigerator .....	600-1000
Electric broom .....	200-500
Coffee percolator.....	550-700
Electric frying pan.....	1000-1350
Hair dryer .....	350-500
Electric stove (per element) .....	350-1000
Electric iron.....	500-1200
Radio .....	50-200
Electric water heater.....	1000-1500
Space heater .....	1000-1500
Electric blanket.....	50-200
Television .....	200-600
Electric drill .....	250-750
Battery charger.....	Up to 800
Electric water pump .....	500-600
Air Conditioner.....	1400-2200
Converter .....	300-350
Microwave oven .....	700-1500



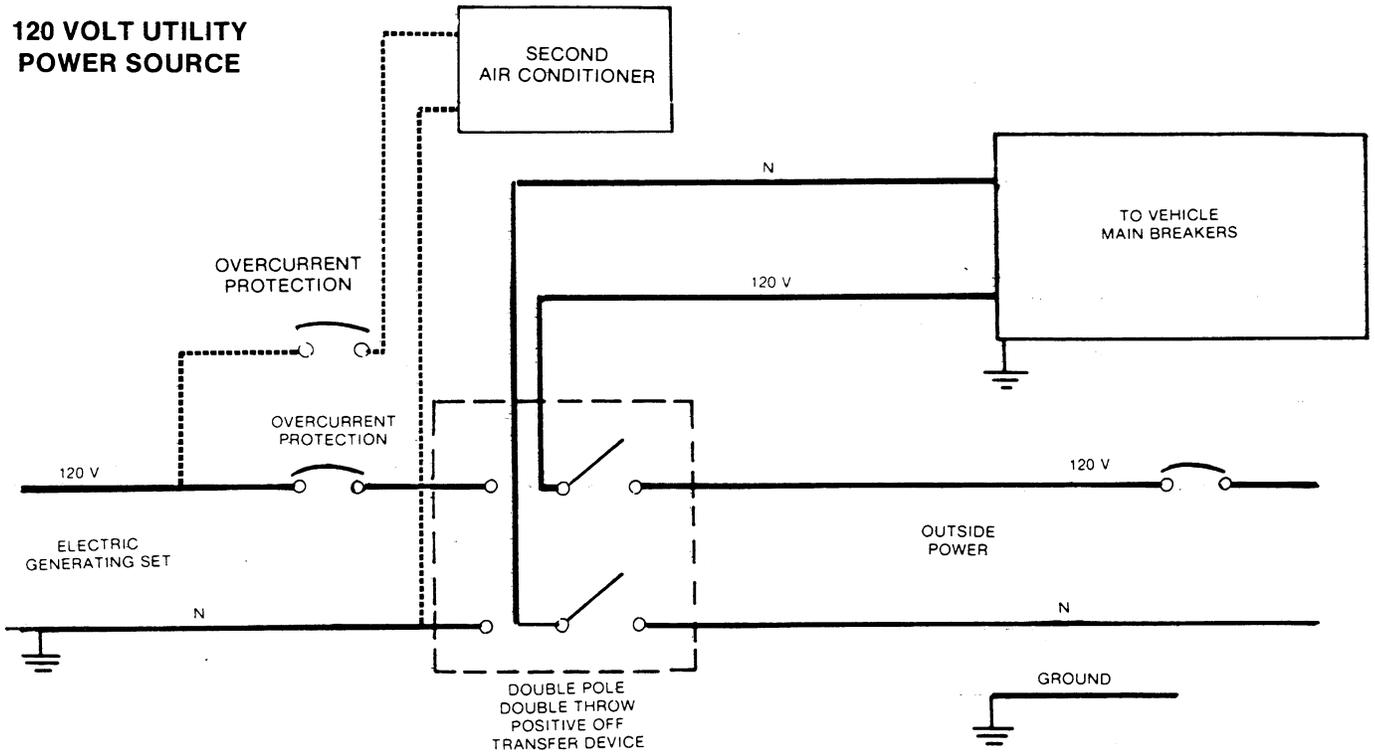
**120 VOLT LOAD WIRE CONNECTIONS**



**120/240 VOLT LOAD WIRE CONNECTIONS**

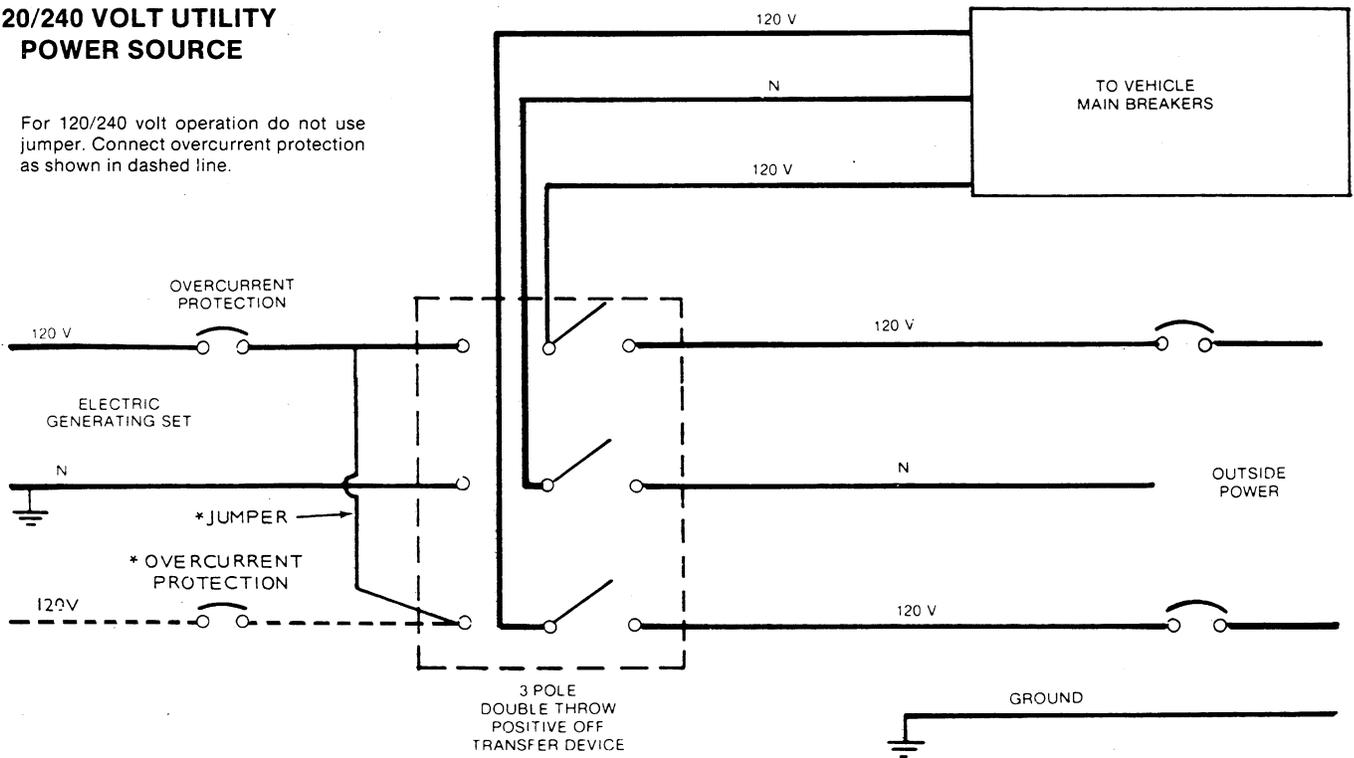
FIGURE 7. SINGLE-PHASE, "3C" VOLTAGE CODE GENERATOR CONNECTIONS

**120 VOLT UTILITY POWER SOURCE**



**120/240 VOLT UTILITY POWER SOURCE**

For 120/240 volt operation do not use jumper. Connect overcurrent protection as shown in dashed line.



**FIGURE 8. SCHEMATIC OF TRANSFER DEVICE AND OVERLOAD PROTECTION**

# BATTERIES

## BATTERY CARE

To increase battery life, the operator can perform a number of routine checks and some preventive maintenance.

1. Keep the battery case clean and dry.
2. Make sure the battery cable connections are clean and tight. Use a terminal puller when removing cables for any reason.
3. Coat the battery terminals with a mineral grease or petroleum jelly to reduce corrosion and oxidation.
4. Identify each battery cable to be positive or negative before making any connection. Always connect the ground (negative) cable last.
5. Maintain the electrolyte level by adding water (drinking quality or better) as needed for filling to split level marker. (The water ingredient of the electrolyte evaporates, but the sulphuric acid ingredient remains. Therefore, add water, not electrolyte.)
6. Avoid overcharging when recharging. Stop the boost charge when the specific gravity is 1.260 and the electrolyte is 80° F (26.7° C).

## BATTERIES AND BATTERY CABLES

In order for the electric generating set to crank efficiently under various operating conditions, the battery and battery cables must be correctly chosen and installed. Before selecting a battery, be sure the installation area is compatible and properly designed. The compartment for the battery must provide:

1. Rigid mounting support.
2. A location where accidental acid spills or leaks won't damage set, battery cables, etc.
3. Provide a minimum of 1.7 square inches at top and 1.7 square inches at bottom of battery for ventilation purposes.
4. Battery cable entry points should be sealed (vapor tight) if they enter or pass through living area.

**WARNING** Mount the battery in a separate compartment from the set or any spark-producing device to prevent fire or explosion.

**CAUTION** Never disconnect the battery with either engine running and never crank both engines simultaneously.

## BATTERY CABLES

For reliable starting, voltage drop from the battery terminals to the exciter cranking windings of the generator should not exceed 0.12 volts per 100 amperes of break-away current *while cranking*. Measure voltage at battery terminals and at start solenoid terminals *while cranking*. Disconnect spark plug wire during test. The battery cables in Table 1 will meet this condition if the grounding system is adequate. Connect the battery negative to ground with the same size cable as used for battery positive.

Be sure the frame connection (major frame member if possible) is sufficient to minimize resistance. Try to avoid a connection at a weld or mechanical joint.

For short distances, one negative battery cable can be used between set and battery rather than separate cables to chassis ground.

The 5.0BGA draws 75-100 amperes of cranking current.

The break-away current is 300 to 400 amperes.

The charging current varies from 1-2 amperes depending on battery condition (state of charge).

For additional information on installation contact your Onan Service Representative or request *Technical Bulletin T-012* from Onan.

Onan recommends using a separate battery for operation of the generator in addition to the regular vehicle starting battery.

TABLE 1. BATTERY CABLE RECOMMENDATIONS FOR RELIABLE COLD WEATHER STARTING

* CABLE LENGTH IN FEET (metres)	CABLE SIZE
0-10 (0-3)	2
11-15 (3-4.5)	0
16-20 (4.5-6)	000

\* - Distance from battery to set.

**WARNING** Do not disconnect battery cables from battery while generator set is cranking or running; sparks may cause an explosion.

TABLE 2. MINIMUM 12 VOLT BATTERY SIZE\*

Above 32° F (0° C)	Below 32° F (0° C)
360 Cold Cranking Amps (Approximately 70 Amp/Hr)	500 Cold Cranking Amps (Approximately 95 Amp/Hr)

\*Larger capacity batteries may be required if battery is also used to power other coach accessories.

# REMOTE ACCESSORIES

## INSTALLING STANDARD OR DELUXE REMOTE START CONTROLS 300-0985 AND 300-0986

The standard control includes a start-stop switch and indicator lamp. The deluxe control contains these items plus a running time meter and a battery condition meter. Install as follows:

1. Select control location. Using Figure 9 or 10 as a guide, drill screw holes and cut hole to accommodate remote switch in dash panel.
2. Following national local electrical codes and using #18 or larger insulated wires of predetermined length, connect remote control to generator set. Ensure that leads from remote control connect to corresponding terminals on generator set. Refer to Figure 11 for wiring connections.

**CAUTION** Do not route DC wires for remote control through conduit containing AC load wiring. Induced voltages may cause erratic operation.

3. Insert remote control in hole cutout and secure with woodscrews supplied with switch.

**WARNING**

Seal all holes that might allow noxious gases to enter motor home.

**CAUTION**

Ensure that leads from remote switch connect with corresponding terminals on generator set.

For sets without remote connector plug, connect terminals 1, 2, and 3 to corresponding terminals on generator set terminal block. Connect terminal #5 (if used) to B+ (on terminal block) or to battery connection on start solenoid. This connection should be protected with a 5 amp fuse. Connect terminal #6 to positive terminal on ignition coil and protect with a 5 amp fuse.

4. When wiring is complete, check for proper operation by starting and stopping set at the set control and by the remote start switch.

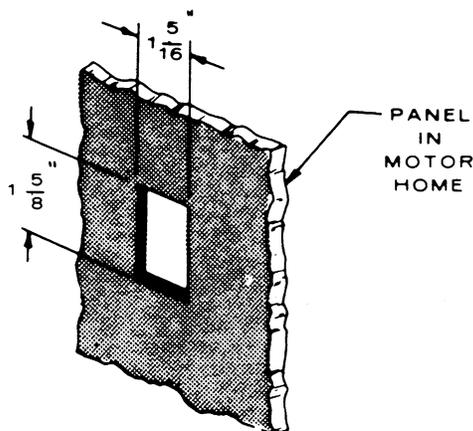


FIGURE 9. MOTOR HOME CUTOUT FOR 300-0985 STANDARD CONTROL PANEL

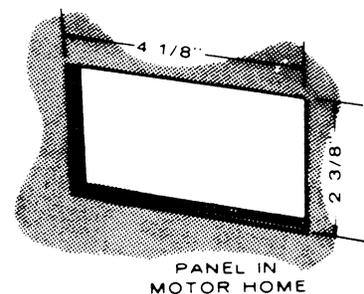


FIGURE 10. MOTOR HOME CUTOUT FOR 300-0986 DELUXE CONTROL PANEL

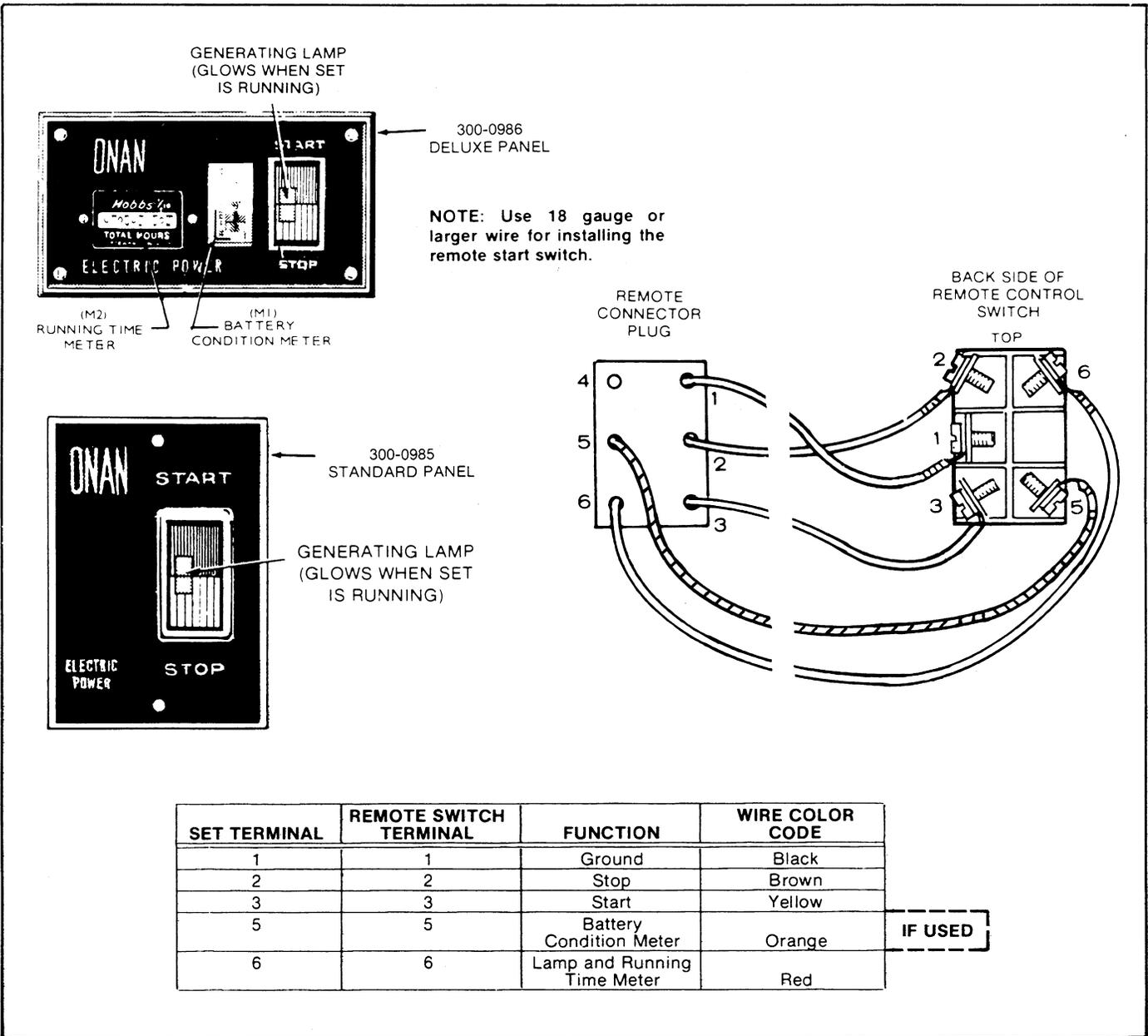


FIGURE 11. WIRING CONNECTIONS FOR 300-0985 AND 300-0986 REMOTE CONTROLS



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