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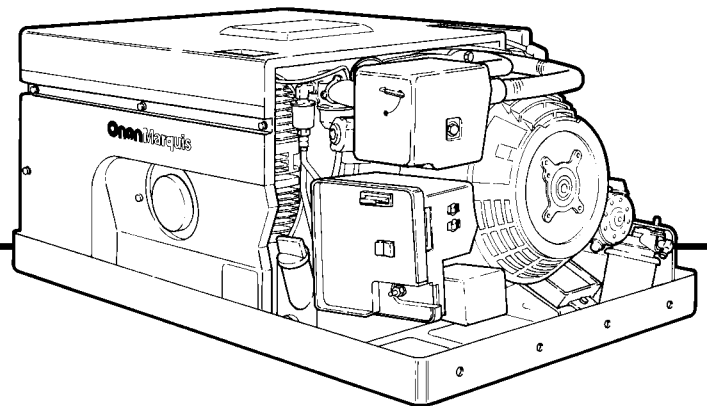


Installation Manual

BGM, NHM

RV GenSets

RV Electric Generating Sets





 **WARNING:** 
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

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Safety Precautions

Thoroughly read the **INSTALLATION MANUAL** before installing the genset. Safe operation and top performance can be obtained only with proper genset installation.

The following symbols in this Manual alert you to potential hazards to the operator, service person and equipment.

⚠ DANGER Alerts you to an immediate hazard which will result in severe personal injury or death.

⚠ WARNING Alerts you to a hazard or unsafe practice which can result in severe personal injury or death.

⚠ CAUTION Alerts you to a hazard or unsafe practice which can result in personal injury or equipment damage.

Electricity, fuel, exhaust, moving parts and batteries present hazards which can result in severe personal injury or death.

GENERAL PRECAUTIONS

- Keep ABC fire extinguishers handy.
- Make sure all fasteners are secure and torqued properly.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Before working on the genset, disconnect the negative (-) battery cable at the battery to prevent starting.
- Use caution when making adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Benzene and lead in some gasolines have been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale or contact gasoline or its vapors.
- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.

GENERATOR VOLTAGE IS DEADLY!

- Generator output connections must be made by a qualified electrician in accordance with applicable codes.
- The genset must not be connected to the public utility or any other source of electrical power. Connection could lead to electrocution of utility workers, damage to equipment and fire. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry and stand on a dry wooden platform on the ground or floor.

FUEL IS FLAMMABLE AND EXPLOSIVE

- Keep flames, cigarettes, sparks, pilot lights, electrical arc-producing equipment and switches and all other sources of ignition well away from areas where fuel fumes are present and areas sharing ventilation.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.
- Use approved non-conductive flexible fuel hose for fuel connections at the genset.

ENGINE EXHAUST IS DEADLY!

- Learn the symptoms of carbon monoxide poisoning in this Manual.
- Never sleep in the vehicle while the genset is running unless the vehicle has a working carbon monoxide detector.
- The exhaust system must be installed in accordance with the genset Installation Manual.
- Do not use engine cooling air to heat the vehicle interior.
- Make sure there is ample fresh air when operating the genset in a confined area.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not wear loose clothing or jewelry near moving parts such as PTO shafts, fans, belts and pulleys.
- Keep hands away from moving parts.
- Keep guards in place over fans, belts, pulleys, etc.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- When disconnecting or reconnecting battery cables, always disconnect the negative (-) battery cable first and reconnect it last to reduce arcing.

MBL-1

1. Introduction

GENERAL

This manual provides installation guidelines for the Onan® BGM and NHM generator sets. A genset cannot be operated reliably, quietly, and safely unless it is installed correctly. Read this entire manual before starting installation.

For operation and maintenance procedures, see the Operator's Manual, publication 965-0131, that accompanies each set.

When properly installed, this generator set meets or exceeds the following requirements:

- National Electrical Code, Article 551
- ANSI/RVIA EGS-1 - 1986, Generator Set Standard
- ANSI A119.2/NFPA 501C Standard for Recreational Vehicles
- CSA Electrical Bulletin 946

The RV manufacturer and/or the set installer must comply with local codes such as California Administrative Code Title 25, which applies to generator set installation. The RV installer bears sole responsibility for the selection of the appropriate generator set, installation design, and installation.

Consider the following requirements before installing the set. Each topic is covered in the following text.

- Level and supportive mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of circulated air
- Electrical connections
- Fuel installation
- Accessibility for maintenance and service
- Noise levels

INSTALLATION CODES AND SAFETY RECOMMENDATIONS

The following list of Installation Codes and Safety Recommendations applies to the installation and

operation of RV generator sets. The address of each agency is listed so that copies of the codes may be obtained for reference. Installation codes and recommendations are subject to change, and may vary by location or over time. The RV manufacturer and the genset installer bear sole responsibility for following all applicable codes and regulations.

- | | |
|---|---|
| 1. ANSI-A119.2
FMVSS 301 | Recreational Vehicle
Industry Association
14650 Lee Road
Chantilly VA 22021 |
| 2. NFPA 70 (N.E.C.)
NFPA-501C
NFPA 58 | National Fire Protection
Association
470 Atlantic Avenue
Boston MA 02210 |
| 3. CSA Electrical
Bulletin #946 | Canadian Standards
Association, Housing and
Construction Materials
Section
178 Rexdale Blvd.
Rexdale, Ontario, Canada
M9W 1R3 |
| 4. California
Administrative
Code - Title 25
Chapter 3 | State of California
Documents Section
P.O. Box 1015
North Highlands CA
95660 |

This manual contains information that is subject to change. For this reason, use only the installation manual supplied with the generator set for the installation.

⚠ *WARNING* Incorrect installation, service, or replacement of parts can result in severe personal injury, death and/or equipment damage. Service personnel must be qualified to perform electrical and/or mechanical component installation.

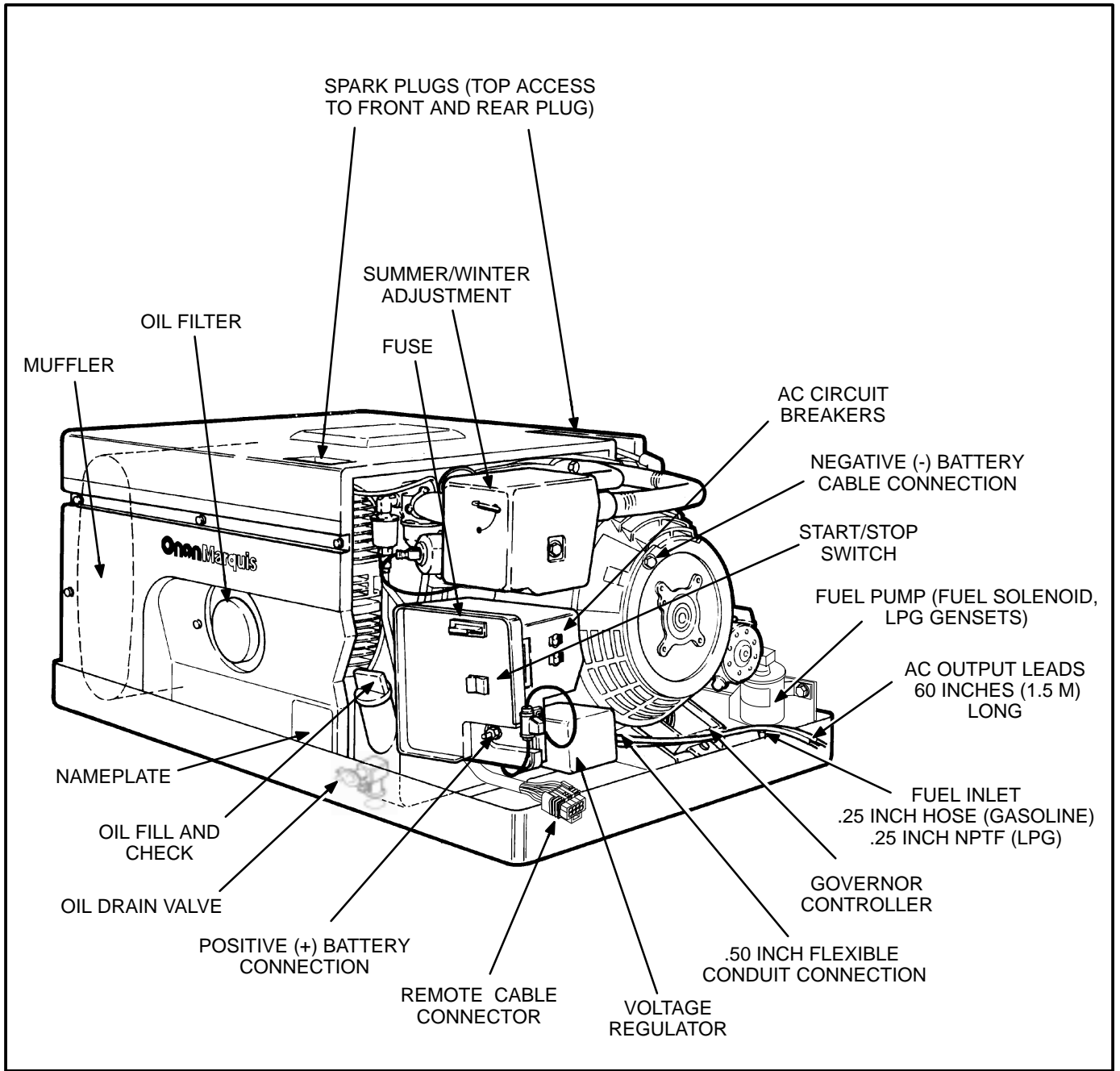


FIGURE 1-1. MARQUIS GENERATOR SET

2. General Specifications

MODEL	BGM	NHM	NHM
GENERATOR DETAILS			
Power (watts)	5000	6000	6800 (gasoline) 6500 (LPG)
Frequency (Hertz)	60	60	60
Voltage	120	120	120
Current (amperes)	41.7	50	56.7 (gasoline) 54.2 (LPG)
ENGINE DETAILS			
Engine Speed	1800 RPM	1800 RPM	1800 RPM
Oil Capacity (with filter)	3.5 quarts (3.8 l)	3.5 quarts (3.8 l)	3.5 quarts (3.8 l)
Fuel	Gasoline	Gasoline	Gasoline, LPG
Fuel Inlet Connection (gasoline) (LPG)	1/4 in. barb fitting	1/4 in. barb fitting	1/4 in. barb fitting 1/4 in. NPTF
Average Fuel Consumption: No Load (gasoline) (LPG) Half Load (gasoline) (LPG) Full Load (gasoline) (LPG)	0.4 gph (1.5 Lph) 0.7 gph (2.6 Lph) 1.0 gph (3.8 Lph)	0.4 gph (1.5 Lph) 0.6 gph (2.27 Lph) 1.3 gph (4.9 Lph)	0.4 gph (1.5 Lph) 0.5 gph (1.9 Lph) 0.7 gph (2.6 Lph) 1.0 gph (3.78 Lph) 1.3 gph (4.9 Lph) 1.6 gph (6.06 Lph)
LPG Vapor Supply Pressure (Range)-Vapor-Withdrawal Models Only			9 to 13 inch (229 to 330 mm) W. C. (water column)
Battery Requirements: Battery Cold Cranking Amps Cold Cranking Amps below 32° F (-0° C)	One, 12-volt 360 450	One, 12-volt 360 450	One, 12-volt 360 450

MODEL	BGM	NHM	NHM
GENERATOR SET DETAILS			
Weight	258 lb (116 kg)	272 lb (123 kg0	272 lb (123 kg0
Height	15.5 in. (394 mm)	15.5 in. (394 mm)	15.5 in. (394 mm)
Length	33.6 in. (854 mm)	33.6 in. (854 mm)	33.6 in. (854 mm)
Width	22.3 in. (566 mm)	22.3 in. (566 mm)	22.3 in. (566 mm)
Control Fuse	10 Ampere	10 Ampere	10 Ampere
Fuel Pump/Autochoke Fuse	10 Ampere	10 Ampere	10 Ampere
Air Requirement	450 ft ³ /min 12.6 m ³ /min	450 ft ³ /min 12.6 m ³ /min	450 ft ³ /min 12.6 m ³ /min
TUNE-UP SPECS			
Spark Plug Gap	0.025 in. (0.64 mm)	0.025 in. (0.64 mm)	0.025 in. (0.64 mm)
Timing (non-adjustable)	12° BTDC	12° BTDC	12° BTDC
Valve Lash: Intake Exhaust	0.005 in. (0.13 mm) 0.013 in. (0.33 mm)	0.005 in. (0.13 mm) 0.013 in. (0.33 mm)	0.005 in. (0.13 mm) 0.013 in. (0.33 mm)
Cylinder Compression (hot)	75-115 psi (517-793 kPa)	75-115 psi (517-793 kPa)	75-115 psi (517-793 kPa)

3. Mounting

GENERAL

Marquis generator sets are designed for compartment and underfloor mounting. Both methods use the set tray for support. Choose the appropriate manual section and carefully follow the instructions. **Read this entire manual and exhaust kit and other kit instructions before installing the genset.**

COMPARTMENT MOUNT

In a compartment mount, the set is installed on a frame that is part of the vehicle. This frame must be constructed according to safety-approved specifications (see Compartment Construction in this section).

Unless the set will be removed from underneath the vehicle, make the access opening large enough to remove the set. Allow extra clearance to access the following components:

- Oil fill
- Oil drain
- Oil filter
- Oil dipstick
- Air cleaner element
- Spark plugs
- Carburetor
- Start/Stop switch
- Circuit breaker
- DC fuse

Minimum compartment dimensions are shown in Figure 3-1. Clearances between the generator set and the compartment are included in these dimensions.

To minimize noise, line the entire genset compartment with a 1/2 to 1 inch (12.7 to 25.4 mm) thickness of self-extinguishing acoustical material, rated for 250° F (121° C) minimum. Adjust the compartment height, width and depth dimensions to fit the acoustical material. See Figures 3-1 and 3-2.

Allow for air intake and discharge at the bottom of the generator set. Air inlets to the set compartment must not allow dirt, rocks, water, or slush to reach the set. Minimize dust and salt entrance into the compartment. Make certain to protect the genera-

tor, control, choke, and governor areas. Use baffles to protect certain areas. (See *Ventilation and Acoustics* section.)

Compartment Construction

1. Install the generator set in its own compartment. See Figures 3-1 and 3-2.
2. If any part of the compartment is above the vehicle floor, separate the compartment from the vehicle interior and fuel supply with a vapor-tight wall.
3. Line the compartment walls with 26-gauge galvanized steel or a material of comparable strength and fire resistance (see NFPA 70, NEC and California Title 25 for complete details).

⚠ WARNING *Exhaust gases present the hazard of severe personal injury or death. Make the compartment walls vapor-tight to the interior of the vehicle to prevent exhaust fumes from entering.*

4. Construct the compartment floor to prevent oil, fuel or water accumulation. Provide openings in the compartment floor according to the Compartment Floor Plan, Figure 3-2.

Do NOT use absorbent soundproofing material on the compartment floor. The floor should have as few openings as possible, to reduce the noise level.

5. Secure the set mounting tray to the support frame, using four 3/8-16 UNC grade 5 screws (bottom mounting) or eight 5/16-18 UNC grade 5 screws (side mounting). The mounting bolts must not extend more than 1/4 inch (6 mm) through the mounting nut. See Figures 3-1 and 3-2. Torque 3/8" mounting screws to 35 ft lbs (47 N•m). Torque 5/16" mounting screws to 25 ft lbs (34 N•m).

⚠ CAUTION *If the unit mounting plate is not fastened securely to the vehicle compartment, road vibrations can damage the generator set components. Use screws long enough for at least 1-1/2 threads to extend through the weld nut. The mounting bolts must not extend more than 1/4 inch (6 mm) through the weldnut.*

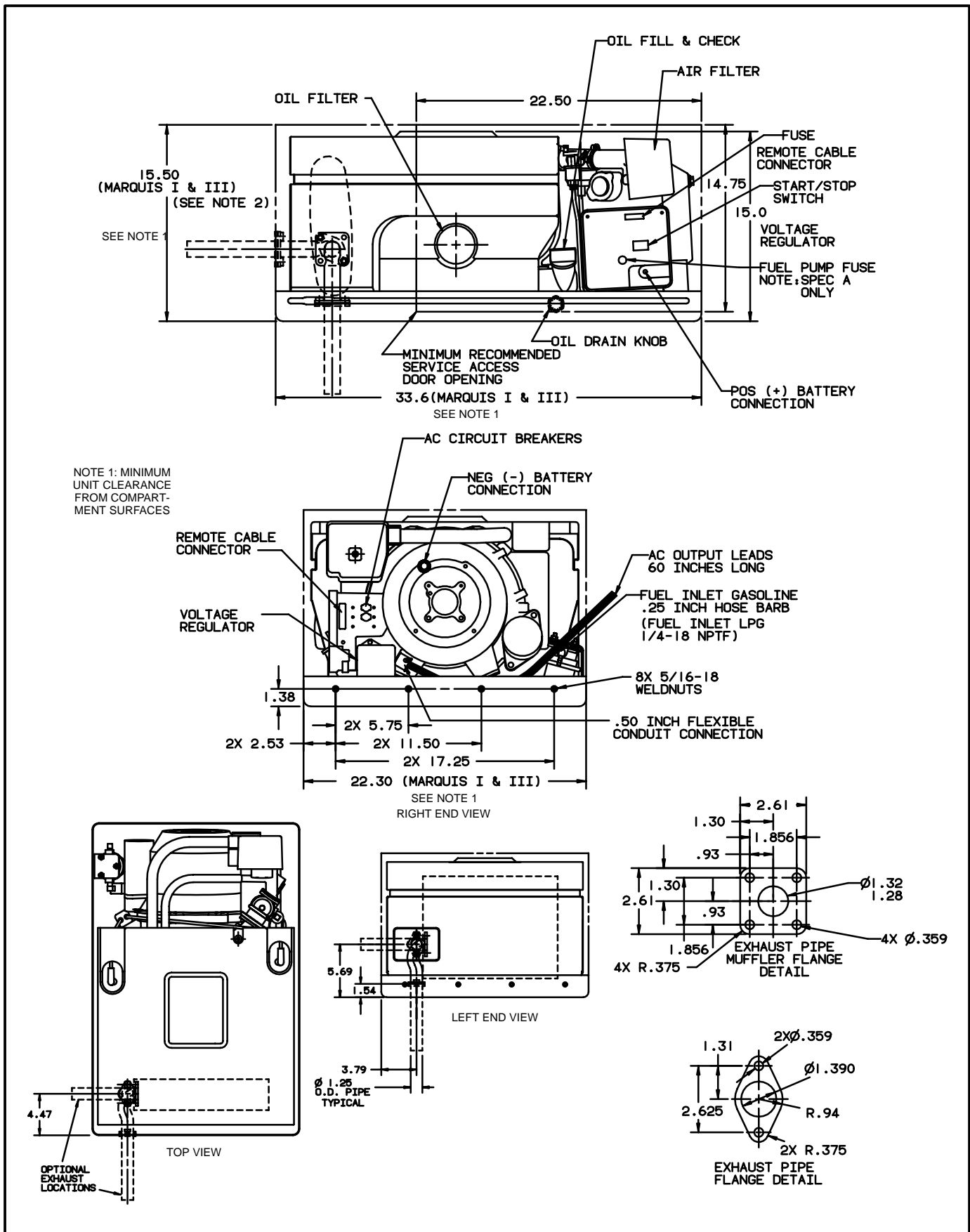


FIGURE 3-1. COMPARTMENT MOUNT OUTLINE

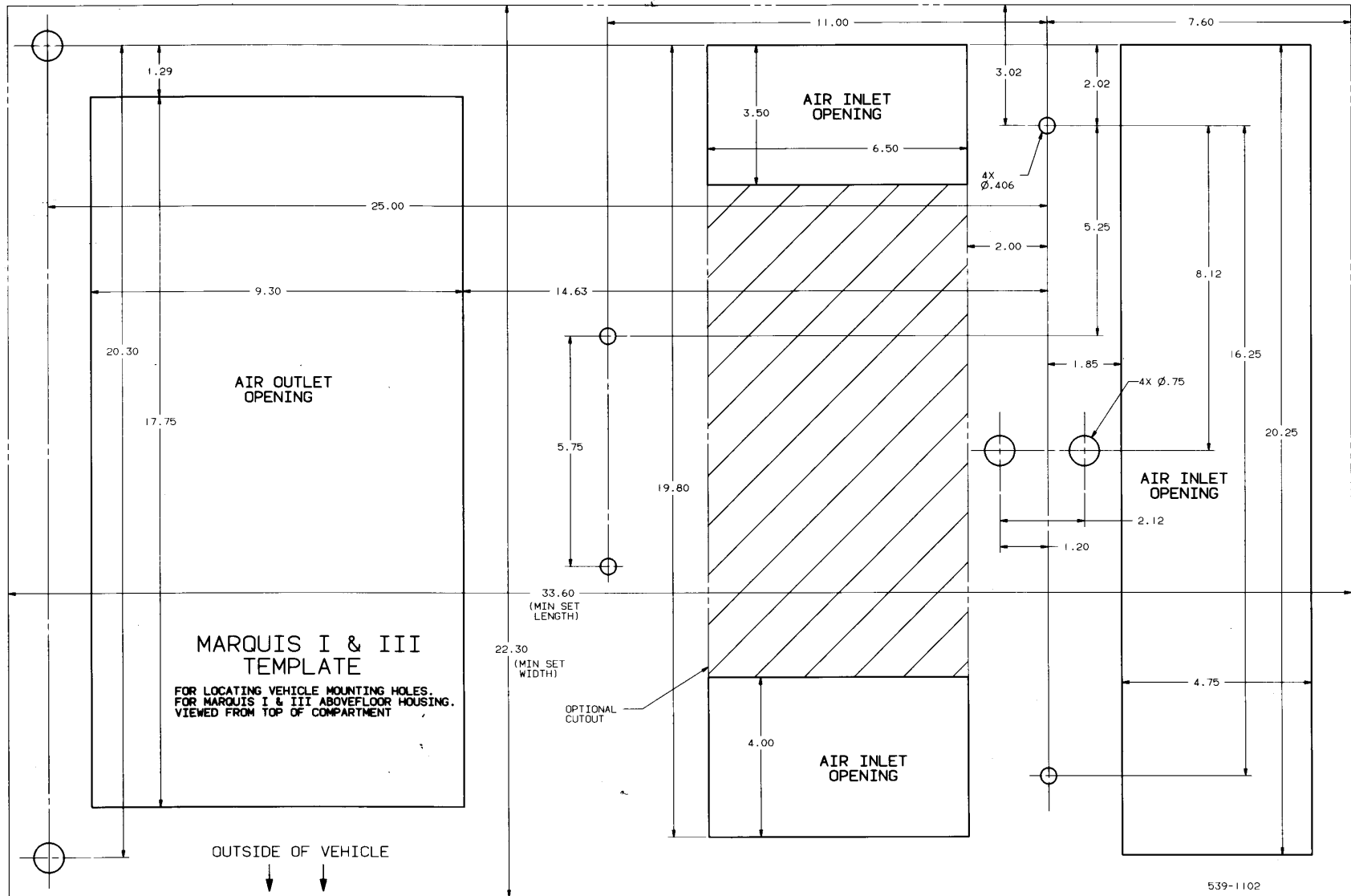


FIGURE 3-2. COMPARTMENT FLOOR PLAN

UNDER-FLOOR MOUNT

In an under-floor installation, the genset is mounted below the floor and outside the passenger compartment of the vehicle. This type of installation must comply with the Installation Codes and Safety Recommendations (see *Introduction* section). Read this section for general application information, and study the proper under-floor housing/exhaust kit instructions for more information on under-floor installations.

The vehicle structure must be able to support the weight of the generator set (see *Specifications* section) when subjected to road vibrations. The vehicle manufacturer and/or the installer must provide a structurally sound support frame, using tubing, angle brackets, or steel-reinforced plywood or other composition board. Plywood or particle board can be reinforced with 3-inch (76 mm) or larger washers or a full metal plate.

Line the floor above the set with 26-gauge galvanized steel or a material of comparable strength and fire resistance (see NFPA 70, NEC and California Title 25 for complete details).

Generator Set Location

Figure 3-3 shows the most common mounting areas for an underfloor mount. If the set is mounted on the curb side, location 1 or 2, protect its generator end from road splash and debris. If mounted on the driver's side, location 3 or 4, protect its engine end. If possible, drive the vehicle through mud and slush to test the installation. Refer to shaded areas of Figure 3-3.

The bottom air inlet opening to the generator set compartment must not admit dirt, rocks, water or slush. The entrance of dust and salt into the

compartment must be minimized. Baffles may be needed to protect certain areas. See the Ventilation section of this manual for more detailed information.

Access Opening: Provide an access opening to the generator set on the side of the vehicle. Make it large enough to check the following:

- Oil fill
- Oil drain
- Oil filter
- Oil dipstick
- Air cleaner element
- Spark plugs
- Carburetor
- Start/Stop switch
- Circuit breaker
- DC fuse

See Figure 3-1 for size and Figure 3-3 for locations.

Mounting Clearance: The compartment door must open the full width of the generator set in compartment mounts. Under-floor installations require that access be made from the bottom, or through a side door. Refer to the correct outline drawing when installing the set.

CAUTION *Failure to meet Onan review for modifications of mounting kits or for non-Onan kit installations can void the intent of NCT/CSA approval. Liability for damage or injury and warranty expenses becomes the responsibility of the person making the modifications.*

Exhaust Kit: Review the exhaust system kit installation instructions and check the components supplied in the kit. Plan clearances for shifting or removing exhaust components when the set is removed for inspection or maintenance.

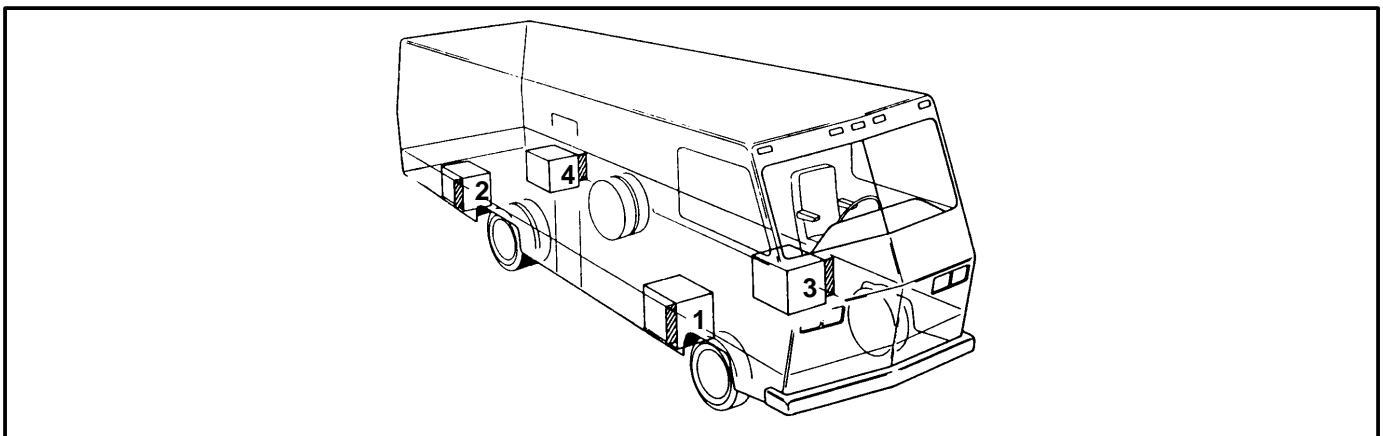


FIGURE 3-3. COMMON GENSET MOUNTING AREAS

4. Ventilation and Acoustics

VENTILATION

Ventilation of the Marquis genset requires:

- Sufficient incoming air (for combustion and cooling)
- Adequate exhaust of heated air

A centrifugal fan in a scroll housing on the engine (Figure 4-1) draws air from under the set into the generator end of the compartment, and through the generator (which has its own cooling fan) over the cooling surfaces of the engine. Then it discharges the heated air through the bottom outlet on the engine end of the set.

Make certain that nothing obstructs or restricts air intake and discharge. Air recirculation must be minimized.

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Because discharged cooling air can contain exhaust gas, never use discharged cooling air to heat the vehicle.*

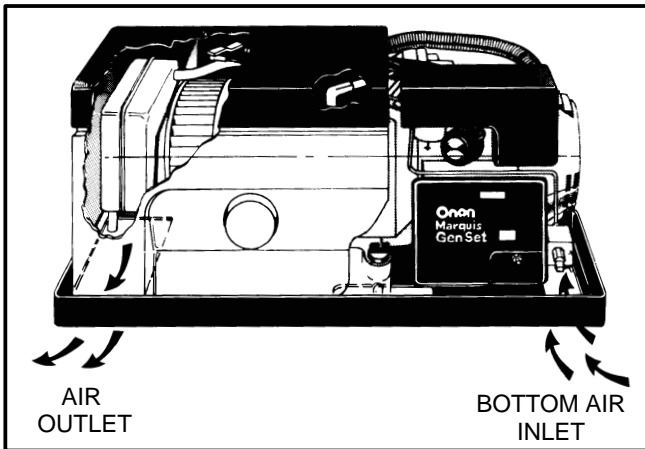


FIGURE 4-1. COOLING SYSTEM

When designing the air inlet and outlet for the set compartment (see Figure 3-2), allow for the restriction of grilles and ductwork: some expanded metal grilles provide as little as 60 percent free air inlet area per square foot. The most efficient grille provides only 90 percent free inlet area per square foot. Obtain the free inlet area of the grille material from the material supplier. Multiply the grille area by the free area percentage to get the free inlet area.

Air ducting must provide a direct free-airflow path to the generator set, with minimal bends. The duct must be smooth and non-restrictive to airflow.

⚠WARNING *Fuel and fuel leakage present the hazard of fire or explosion, which can cause severe personal injury or death. The ventilation system should provide a constant flow of air to expel any accumulation of fuel vapor. The generator set compartment must be vapor-tight to the vehicle interior, to keep fumes from entering the vehicle.*

ACOUSTICS

For maximum noise reduction, line the entire generator compartment with 1 inch (25.4 mm) thickness of sound absorbing material. Use the following guidelines to construct the housing.

- Make certain that all joints and corners of the compartment are vapor-tight to the interior/ cab of the vehicle. Lining the compartment is less effective if openings, cracks, doors and joints are not sealed. Seal the compartment door edge to eliminate noise leaks around the door perimeter.
- Cover the back, top and sides of the compartment (not the compartment base) with fiberglass or another self-extinguishing, sound-absorbent material. Sound insulation and adhesive should be rated at 200° F (90° C) minimum. See Figure 4-2 to design the set compartment for optimum noise reduction.
- A combination of materials can reduce noise more than a single material can. For instance, a sheet of lead combined with a layer of acoustical material is more effective than either alone.

⚠WARNING *High temperatures in the compartment can present the hazard of fire, which can result in severe personal injury or death. To meet ANSI and CSA temperature rise requirements for vehicles, the layer of insulation must not reduce the minimum compartment size specified in Figure 3-1.*

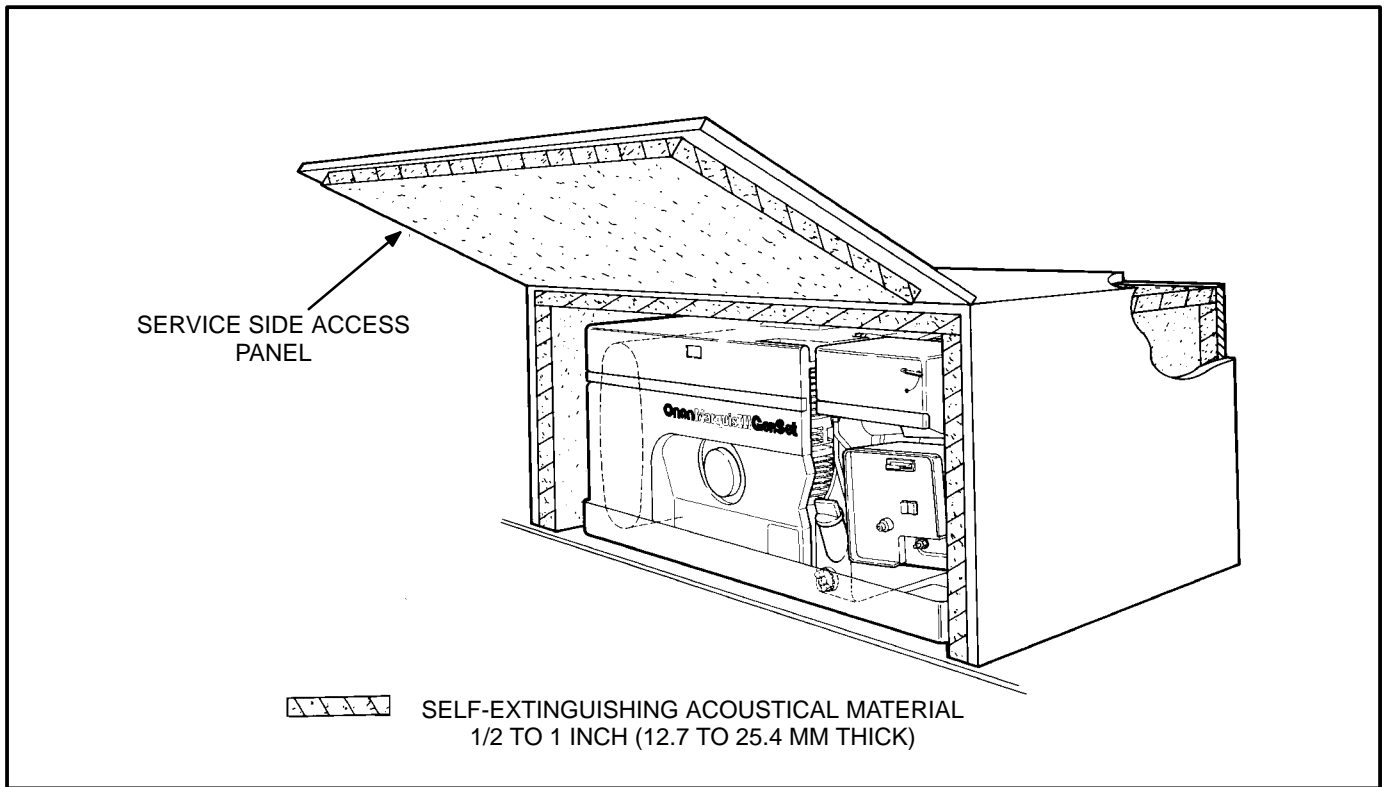


FIGURE 4-2. NOISE REDUCTION-COMPARTMENT DESIGN RECOMMENDATION

5. Exhaust System

GENERAL

Plan the exhaust system carefully. The exhaust system must be vapor-tight. Check all applicable standards, local codes and regulations. Study the following recommendations. See the instructions supplied with the exhaust kit for specific mounting procedures.

MUFFLER RECOMMENDATIONS

The Onan-installed spark arrester muffler is U.S. Forest Service-approved, and meets code requirements. Failure to provide and maintain a spark arrester may violate the law.

Liability for damage or injury, and warranty expenses due to use of unapproved mufflers or installation modifications becomes the responsibility of the person installing the substitute muffler or performing the modifications. Contact an Onan distributor for approved exhaust system parts.

EXHAUST INSTALLATION GUIDELINES

The exhaust system must be placed no closer than 3 inches (76 mm) from combustible material (wood, felt, cotton, organic fibers, etc.), or be so located, insulated or shielded that it does not raise the temper-

ature of any combustible material more than 117° F (65° C) above the ambient air inlet temperature.

The exhaust system must extend a minimum 1 inch (25 mm) beyond the perimeter of the vehicle. If the generator set tailpipe is on the same side of the coach as the compartment, terminate the tailpipe aft of the generator set air intake, or reduce the possibility of exhaust recirculation by directing the exhaust down and to the rear.

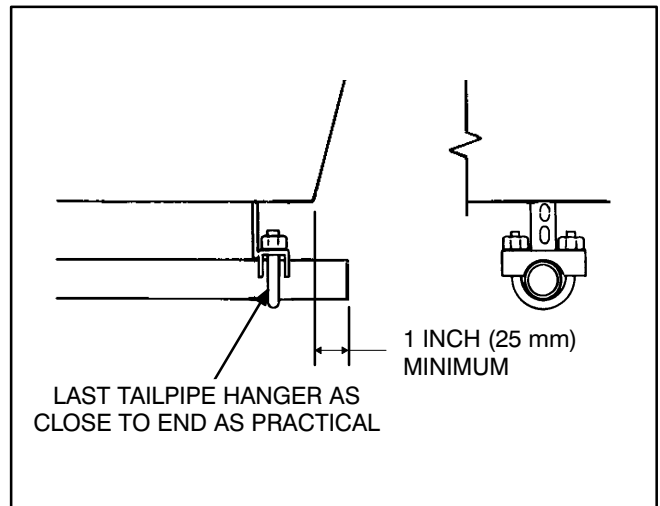


FIGURE 5-1. TERMINATING THE EXHAUST TAILPIPE

To reduce the chance of damaging the tailpipe and emitting exhaust gases under the vehicle, make certain that no part of the exhaust system intrudes into the departure angle or approach angle of the vehicle, unless it is protected by a skid bar or other protection device. The shaded areas in Figure 5-2 illustrate typical mounting locations.

⚠WARNING Exhaust gas presents the hazard of severe personal injury or death. Do not mount any portion of the exhaust system into the approach or departure angle unless it is adequately protected. Use only Onan-specified exhaust equipment with the generator set. Use a sufficient number of hangers to prevent dislocation of the system.

Do not terminate the exhaust tailpipe under the vehicle. Be aware that any vent, window or opening that can be opened and that is not permanently sealed from the vehicle living space can be an avenue for carbon monoxide. Do not terminate the tailpipe such that it is closer than 6 inches (153 mm) to any opening into the vehicle interior (door, window, vent). See Figure 5-2.

⚠WARNING Exhaust gas presents the hazard of severe personal injury or death. Do not terminate an exhaust pipe under the vehicle. The tailpipe must not terminate so that any vent, window, or opening into the living area is within the area shown in Figure 5-2. Keep all openings closed when the generator set is running.

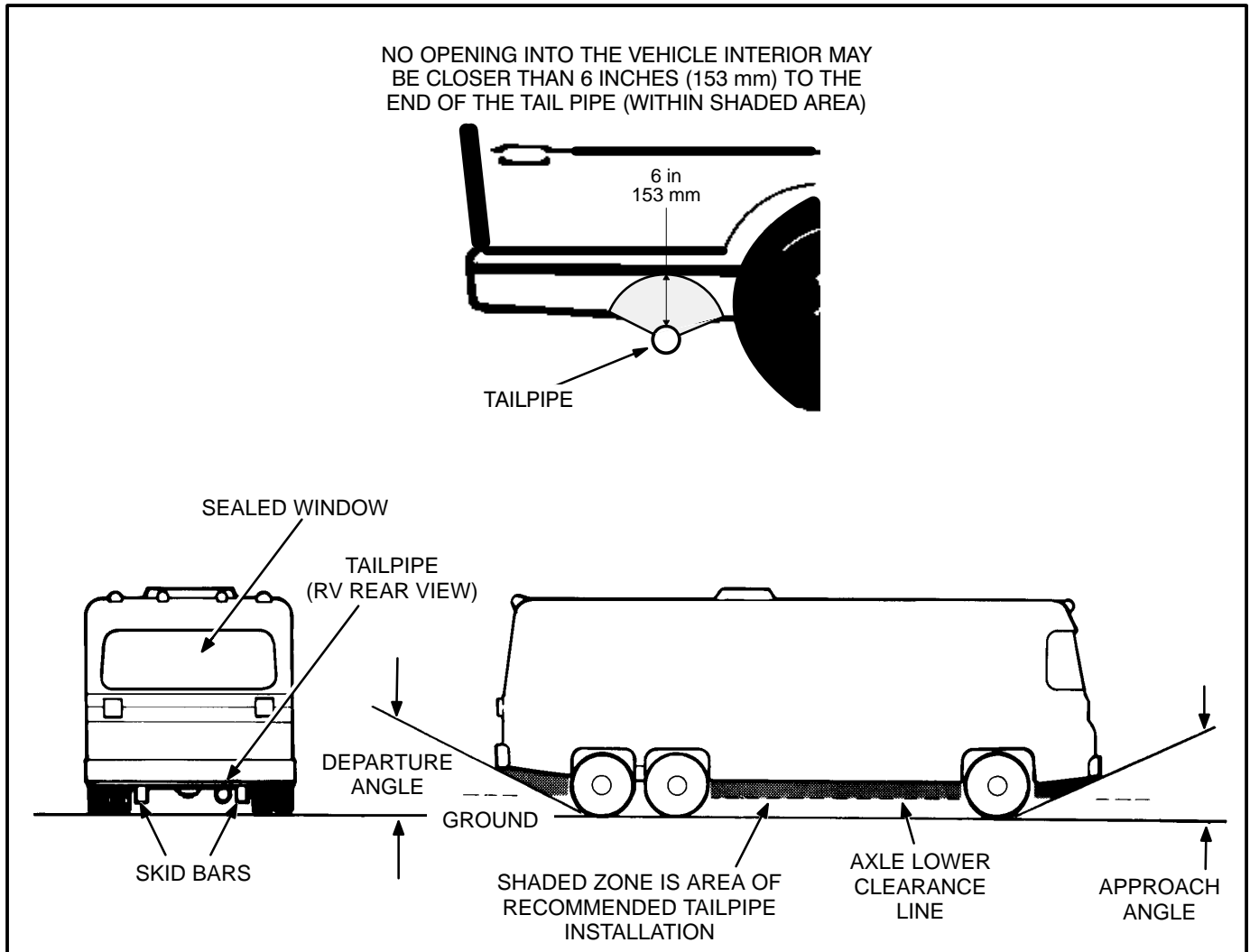


FIGURE 5-2. TAILPIPE INSTALLATION

TAILPIPE RECOMMENDATIONS

An exhaust tailpipe is not supplied with the genset, because length requirements vary between vehicle manufacturers. Refer to the following recommendations for information and safety considerations.

⚠ WARNING *Exhaust gas presents the hazard of severe personal injury or death. Do not use flexible exhaust tailpipe, because it can leak or break from road shock or vibration. Do not terminate the exhaust system under the vehicle. Direct exhaust gases away from any window, door, or compartment openings. Do not operate the generator set without an exhaust tailpipe.*

The exhaust pipe can leave the generator set in one of three directions (see Figures 3-1 and 5-3):

- Straight down through the bottom of the set (the most common configuration)
- Out the left side of the set (by rotating the exhaust tube on the muffler 90 degrees)
- Straight out the back of the set (with the use of an optional exhaust kit)

If the exhaust exits the side or the rear of the generator set, discard the original exhaust opening cover plate and install the appropriate optional cover plates that enclose the opening around the tailpipe. Cover plates are included with the optional exhaust kit, or they may be ordered separately.

The exhaust tailpipe can be attached to the set by two methods:

- An exhaust tailpipe can be constructed by welding a 1/4 inch plate steel mounting flange (see Figure 3-1 for flange dimensions) onto a minimum 1-3/8 inch O.D. 18-gauge rigid steel exhaust tailpipe.
- An optional exhaust tube kit, with a mounting flange welded to one end, can be bolted to the exhaust pipe on the set (or directly to the muffler when exhausting out the back of the set). The optional exhaust tube can be cut to the desired length. A 1-1/2 inch O.D. 18-gauge rigid

steel exhaust tailpipe (not supplied) can be slid over the exhaust tube and clamped in place with a U-bolt type automotive muffler clamp, marked 1-3/8 inch.

Place the exhaust gasket (supplied) between the exhaust flanges. Use 5/16-18 x 1 inch grade 5 bolts with a flat washer to connect the exhaust flanges. Tighten the flange mounting bolts to 25 ft-lbs (34 N•m).

Use double rubber, U-shaped, shock-mounted hangers to support the exhaust system. If the tailpipe extends beyond 1-1/2 feet (0.46 m) from the genset, attach an automotive tailpipe hanger for additional support. Support the exhaust system at or near the perimeter of the vehicle to prevent the pipe from being damaged and pushed up under the vehicle skirt. Attach hangers to steel framework, not wood or other floor materials.

⚠ CAUTION *Angular mounting of muffler and tailpipe hanger brackets can result in exhaust system damage. Properly mounted hanger brackets will absorb much road shock vibration and prolong the use of exhaust system components. Mount muffler and tailpipe hanger brackets directly above the component supported, not at an angle. Do not twist the rubber sections of any hangers.*

The exhaust back pressure under full load must not exceed 2 inches (51 mm) water column (WC) as measured within 6 inches (154 mm) of the muffler outlet flange.

⚠ CAUTION *Excessive exhaust back pressure can cause engine damage. If a tailpipe deflector is used, make sure it is large enough to prevent back pressure.*

Do not connect the genset to the vehicle engine exhaust system.

⚠ CAUTION *Interconnecting the engine exhaust systems will allow exhaust condensates and soot to migrate into the engine that is idle, causing engine damage.*

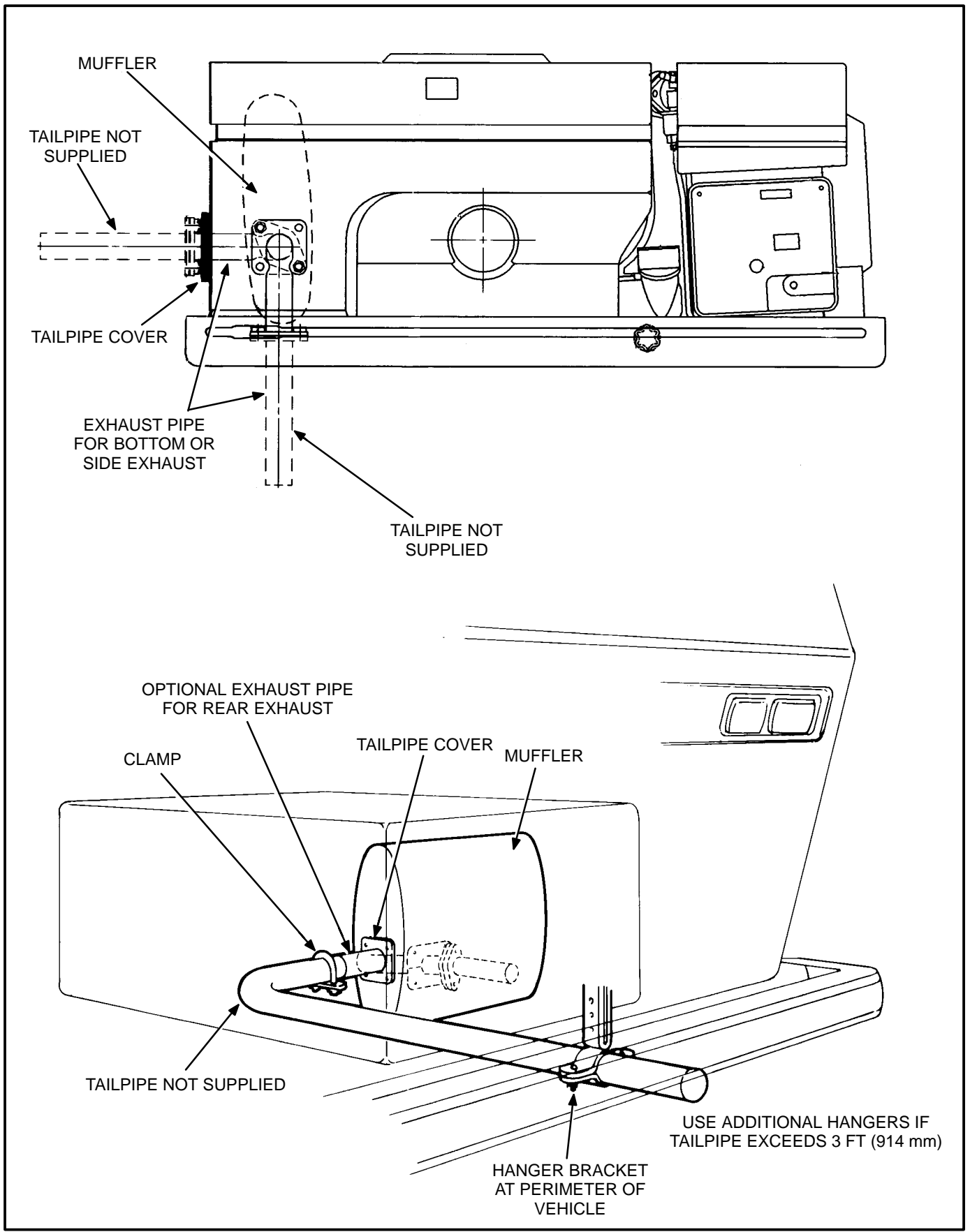


FIGURE 5-3. TYPICAL EXHAUST INSTALLATIONS

6. Fuel System

GENERAL

This section describes fuel system installations for recreational vehicles.

⚠ WARNING *Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Do not smoke or allow any flame, spark, pilot light, arc-producing equipment or other ignition sources around fuel or fuel components, or in the installation area. Keep a type ABC fire extinguisher nearby. The ventilation system must 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 vehicle interior to prevent any fumes from entering these areas.*

GASOLINE FUEL SYSTEM

Fuel System Provisions

On some vehicles, the genset can share the vehicle fuel supply tank with the vehicle engine. Connection to the vehicle fuel tank must be made according to the chassis (vehicle) manufacturer's detailed instructions. See *Fuel Line Installation*, in this section.

Onan recommends a separate fuel pickup tube or a separate fuel tank. Connection with the vehicle fuel line is not recommended.

The genset has a fuel shutoff valve as a safety feature. If the vehicle fuel tank becomes pressurized (3 psi maximum), the positive fuel shutoff prevents the set from being flooded when the set is not running.

If contaminated fuel is possible, Onan recommends an in-line fuel filter. Onan also recommends an in-

line manual fuel shutoff valve, to close the fuel line if the set is removed for service.

Recommended Fuel

Use clean, fresh unleaded gasoline having a minimum octane rating (Anti-Knock Index) of 87.

During some times of the year only mandated "oxygenated" gasolines may be available. These are acceptable for use, but not preferable. Leaded gasoline may be used but will result in the extra maintenance required for removing combustion chamber and spark plug deposits. Do not use gasoline or gasoline additives (de-icers) containing methanol because methanol can be corrosive to fuel system components.

⚠ CAUTION *Do not use gasoline or gasoline additives containing methanol because methanol can be corrosive to fuel system components.*

⚠ WARNING *Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Never fill the fuel tank when the engine is hot or is running. Do not permit any flame, spark, pilot light, cigarette or other ignition source near the fuel system.*

⚠ CAUTION *Lead deposits can cause engine damage if they are not removed before using unleaded gasoline. Do not alternate between leaded (regular) and unleaded gasoline.*

Fuel Consumption

Generator set fuel consumption varies proportionately to differing electrical loads. Refer to the *Specifications* section for approximate fuel consumption at no load, half load, and full load.

Fuel Line Installation

Vehicle fuel systems operate at a specified fuel pressure. For this reason, do not change or remove the fuel fill tube, fill limiter vent, vapor canister, vapor lines, filler cap and all parts of the fuel system without the approval of the vehicle manufacturer. Check the filler cap to make sure that the pressure vacuum relief valve functions properly: replace it if necessary.

If a separate connection is not supplied for the generator, add a second fuel pickup in the tank. This pickup should not extend below the bottom 1/4 of the tank, so the vehicle will run after the generator runs out of fuel.

Do not connect directly to the vehicle fuel line. This may cause the genset or the vehicle engine to run poorly. Consult the vehicle manufacturer for information on shared fuel supplies. Unauthorized fuel system modifications may cause dangerous operating conditions.

⚠️WARNING *Gasoline presents the hazard of explosion or fire, which can result in severe personal injury or death. Do not connect the generator set fuel line to the pressurized part of the vehicle fuel system. Flooding of the generator set engine and compartment can occur, resulting in a fire hazard.*

⚠️CAUTION *The generator set may starve for fuel when the vehicle is operated at highway speeds, if its fuel line is connected to the main fuel line with a tee. The generator set fuel pump has neither the capacity nor the power to overcome the draw of the vehicle engine fuel pump. For this reason, use a separate fuel line to the generator set, or a separate fuel tank.*

Install an approved flexible non-metallic (non-conductive) fuel line between the vehicle fuel system and the generator set, to absorb vibration. Flexible fuel line must be long enough to allow generator set movement, to prevent binding, stretching or breaking. Onan recommends seamless steel tubing and flared connections for long runs between the fuel tank and the flexible connector to the generator set.

Run fuel lines at the same height as the top level of the tank, to a point as close to the engine as possible. This reduces the danger of fuel siphoning out of the tank if the line should break.

Keep fuel lines away from hot engine or exhaust areas, to reduce the chance of vapor lock. Fuel lines should be accessible and protected from damage. Use metal straps without sharp edges to secure fuel lines. Do not run fuel lines where they may contact sharp or rough surfaces, or where they may be kinked, pinched, chaffed, or struck.

⚠️WARNING *Gasoline and LPG fuel may be accidentally ignited by electrical sparks, presenting the hazard of fire or explosion, which can result in severe personal injury or death. For this reason, when installing the generator set:*

- *Do not tie electrical wiring to fuel lines.*
- *Do not run electrical lines and fuel lines through the same compartment openings.*
- *Keep electrical and fuel lines as far apart as possible.*
- *Place a physical barrier between fuel lines and electrical lines wherever possible.*
- *If electrical and fuel lines must pass through the same compartment opening, make certain that they are physically separated by running them through individual channels, or by passing each line through a separate piece of tubing.*

LPG LIQUID WITHDRAWAL FUEL SYSTEM

Fuel System Provisions

On liquid withdrawal LPG gensets, the fuel solenoid valve contains a filter cartridge and a magnet, to trap dirt and contaminants. The solenoid valve and filter are shown in Figure 6-1. Figure 6-2 is a flow diagram of LPG fuel system components.

Recommended Fuel

Use clean, fresh HD-5 grade liquified petroleum gas or equivalent product consisting of at least 90 percent propane. Commercial liquified petroleum gas fuels may contain more than 2.5 percent butane which can result in poor fuel vaporization and poor engine starting in low ambient temperatures (below 32° F (0° C)).

Satisfactory performance requires that the LPG vapor (vapor-withdrawal models only) be supplied at a pressure within the range indicated in *Specifications*.

⚠WARNING *High LPG supply pressure (vapor withdrawal models only) can cause gas leaks which can lead to fire and severe personal injury or death. LPG supply pressure must be adjusted to Specifications by qualified personnel.*

Propane Fuel Lines and Supply Tank

⚠WARNING *LP gas (Propane) presents the hazard of fire or explosion that can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.*

Review all codes that apply to LPG generator set installation. Refer to paragraph 2-11 (LP-Gas Engine Fuel Installations) of NFPA Pamphlet 501C and paragraph 3-6.2.5 of NFPA 58 (Piping, Hose and Fittings). These sections deal with fuel tanks and lines, but do not cover all applicable codes and regulations. Obtain this pamphlet by writing to the address listed in the beginning of this manual.

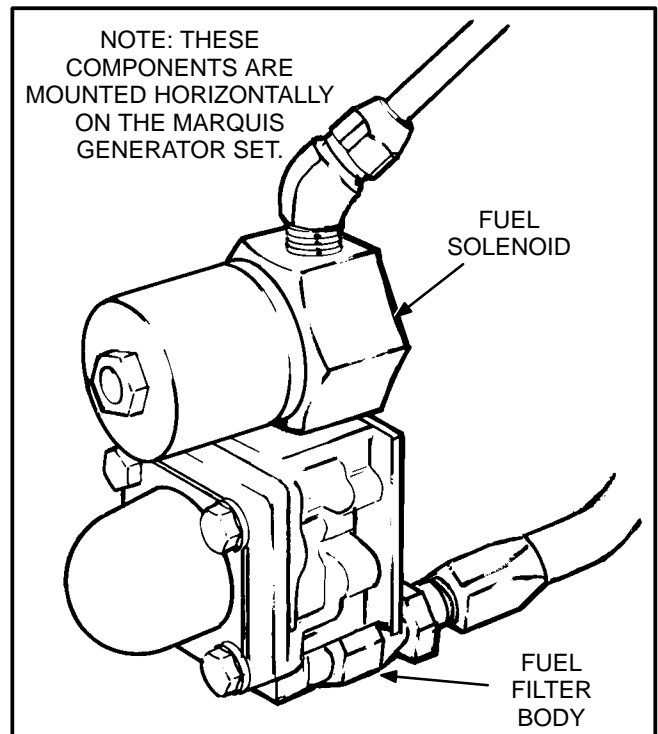


FIGURE 6-1. FUEL SOLENOID VALVE AND FILTER

When installing the fuel lines, keep these factors in mind:

- Install LPG fuel lines to be accessible, but protected from damage.
- Use metal straps without sharp edges to secure fuel lines.
- Keep fuel lines away from hot engine or exhaust areas.
- Do not run fuel lines next to electrical wiring.

Ensure that the LP tank is appropriately matched to the genset and other appliances if applicable.

An excess flow valve must be mounted internally to the LPG fuel supply tank(s), per NFPA 501C, Paragraph 2-2.7.7. This valve and the fuel lines must be sized so that the excess flow valve will close if the fuel line is completely severed (broken). For operation at the lowest ambient temperature, use a valve rated at 2.6 gallons per hour (9.9 l/hr) flow rate and 6.5 pounds per square inch (45 kPa) differential pressure. Consult the Natural LP Gas Association for information on the limits of excess flow valves.

Install an approved flexible non-metallic (non-conductive) fuel line between the vehicle fuel system and the genset, to absorb vibration. Seamless steel tubing and flared connections are best for long runs between the fuel tank and the flexible connector to the genset.

Mount a manual shutoff valve on the fuel supply tank. This valve must be fully open when operating the generator set, so that the excess flow valve will close if the fuel line is severed.

Install a hydrostatic pressure relief valve between the fuel tank manual shutoff valve and the fuel sole-

noid valve and filter assembly. This relief valve protects the fuel line from pressure buildup if the fuel tank manual shutoff valve and the fuel solenoid valve are closed at the same time.

Testing Fuel System for Leaks

Before operating the set, test the LPG fuel system for leaks. Refer to NFPA 501C, paragraph 2-4.18.2. Energize the fuel solenoid from a separate 12-volt DC source before testing the fuel system. Testing must conform to procedures listed in NFPA-58, or to the UL recommended test procedure, as follows:

After assembly and before initial operation, all fuel system connections, hose valves, regulators, and fittings must be tested and proven free of leaks using a soap-and-water (or equivalent) solution while the system is under gas or air pressure of at least 90 pounds per square inch (620 kPa).

Other approved methods of detecting leaks can be used if appropriate. This test shall NOT be made with a flame.

⚠WARNING *LPG fuel presents the hazard of explosion or fire which can result in severe personal injury or death. Do not smoke or allow any flame, spark, pilot light, arc-producing equipment or other ignition sources around fuel or fuel components.*

⚠WARNING *LPG leaks inside a garage or other inadequately ventilated space or near a pit or basement or other below-grade space can lead to explosive accumulations of gas because LPG “sinks” when it is released into the air. Check for and comply with all local ordinances regarding the garaging of vehicles with LPG engine fuel systems.*

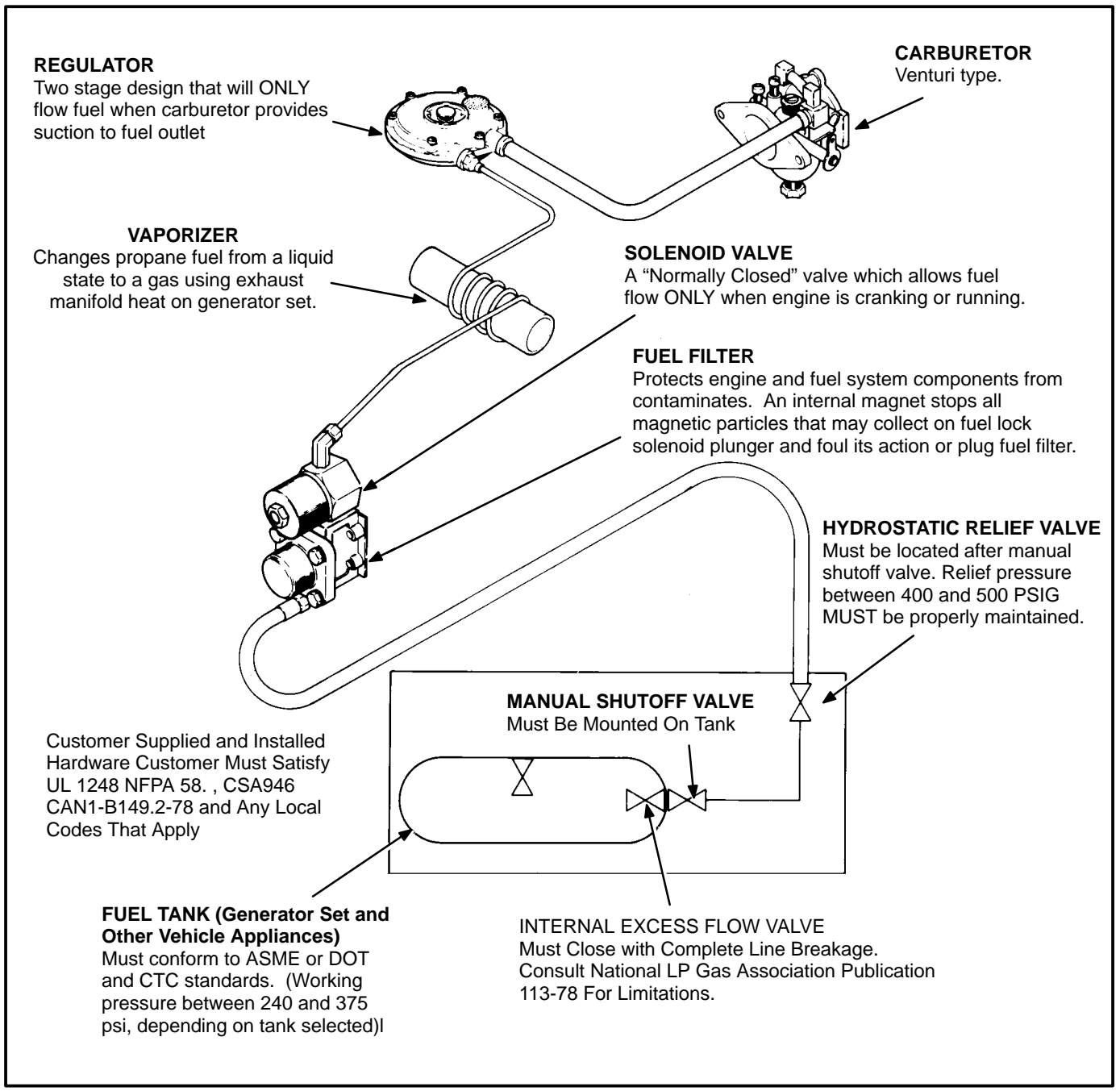


FIGURE 6-2. FLOW DIAGRAM OF LIQUID LPG FUEL SYSTEM

7. Electrical Connections

GENERAL

Installing the genset electrical system means:

- Connecting the load
- Connecting the battery
- Connecting a remote control (if used)

Connect the battery last, to avoid accidentally starting or short-circuiting the set during installation. Connect the positive (+) battery cable first and the negative (-) battery cable last to reduce the risk of arcing.

⚠WARNING *Accidentally starting the generator set during installation can cause severe personal injury or death. Do not connect the starting battery until instructed to do so in the Installation Checks and Start-Up section.*

All wiring must meet local electrical codes. For this reason, a qualified electrician should install and inspect the wiring.

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.

⚠WARNING *Gasoline and LPG fuel can be accidentally ignited by electrical sparks, presenting the hazard of fire or explosion, which can result in severe personal injury or death. For this reason, when installing the generator set:*

- *Do not tie electrical wiring to fuel lines.*
- *Do not run electrical lines and fuel lines through the same compartment openings.*
- *Keep electrical and fuel lines as far apart as possible.*
- *Place a physical barrier between fuel lines and electrical lines wherever possible.*
- *If electrical and fuel lines must pass through the same compartment opening, make certain that they are physically separated by running them through individual channels, or by passing each line through a separate piece of tubing.*

AC WIRING

Wire Types

The leads attached to the genset output must have a current rating not less than 115 percent of the nameplate current rating of the genset. The Onan-supplied AC feeder conductor insulation is rated at 125°C. Wires connected to the Onan feeder conductors must either meet this insulation rating, or be a larger size (see National Electrical Code, NFPA 70).

Use stranded wire for all load connections. Load wiring must be appropriately sized and insulated for the specified current rating. Grounding must comply with all codes.

Conduit

Install the generator load conductors in a flexible metallic conduit. Cut the conduit to length, leaving extra wire for the junction box connections. Connecting wires must be correctly sized and insulated for the current rating. Round off or cover the ends of the conduit, to prevent its sharp edges from cutting the insulation.

Run the conduit so that it does not interfere with the movement of the set. Use waterproof conduit wherever it is exposed to the elements.

Seal all openings made for conduit, so exhaust or fuel vapor cannot enter the living quarters. Flexible metal conduit must be sealed internally at the end where it terminates inside the junction box or panel board (flexible conduit is not vapor-tight along its length).

⚠WARNING *Exhaust gas and fuel fumes present the hazard of severe personal injury or death. To prevent exhaust gas and fuel fumes from entering the vehicle interior, seal all openings made for conduit, wiring, etc. Also seal the wiring within the conduit itself. Use a silicone/rubber based sealant.*

Wiring Disconnect Method

There must be no chance that an outside power source might be connected to the generator set. Feeder conductors from the set compartment must terminate in a 120-volt double-pole, double-throw, positive-off switching device mounted ahead of the vehicle distribution panel: or they must connect to a generator set receptacle box. Figures 7-1 and 7-2 show examples of the wire connection. Figure 7-3 shows the genset wiring diagram.

Line Circuit Breaker

The generator set has line circuit breakers mounted on the side of the control panel. The breakers provide short circuit and overload protection for the generator.

Load Connections

The generator output voltage and maximum current rating are specified on the generator nameplate.

Load wiring must be appropriately sized and insulated for the specified current rating. Grounding procedure must comply with codes.

A lead to be connected to an output feeder conductor shall not be more than two AWG sizes smaller than the output lead conductor and the insulation shall be:

- Rubber (with braid), neoprene, or thermoplastic, with a wall thickness of at least 0.030 inch (0.76 mm).
- Other material having the same or better electrical and mechanical properties.

⚠WARNING *Electrical shock can cause severe personal injury or death. Use only approved power supply assemblies. Never remove the grounding pin from assemblies. Incorrect ground or no ground can cause the vehicle to become electrically "hot". Equip the vehicle with adequate Ground-Fault Circuit Protection devices to meet the National Electrical Code (NFPA 70, 551-9[C]) and for personal safety.*

⚠WARNING *Gasoline fuel presents the hazard of fire or explosion, which can result in severe personal injury or death. Do not tie electrical wiring to fuel lines.*

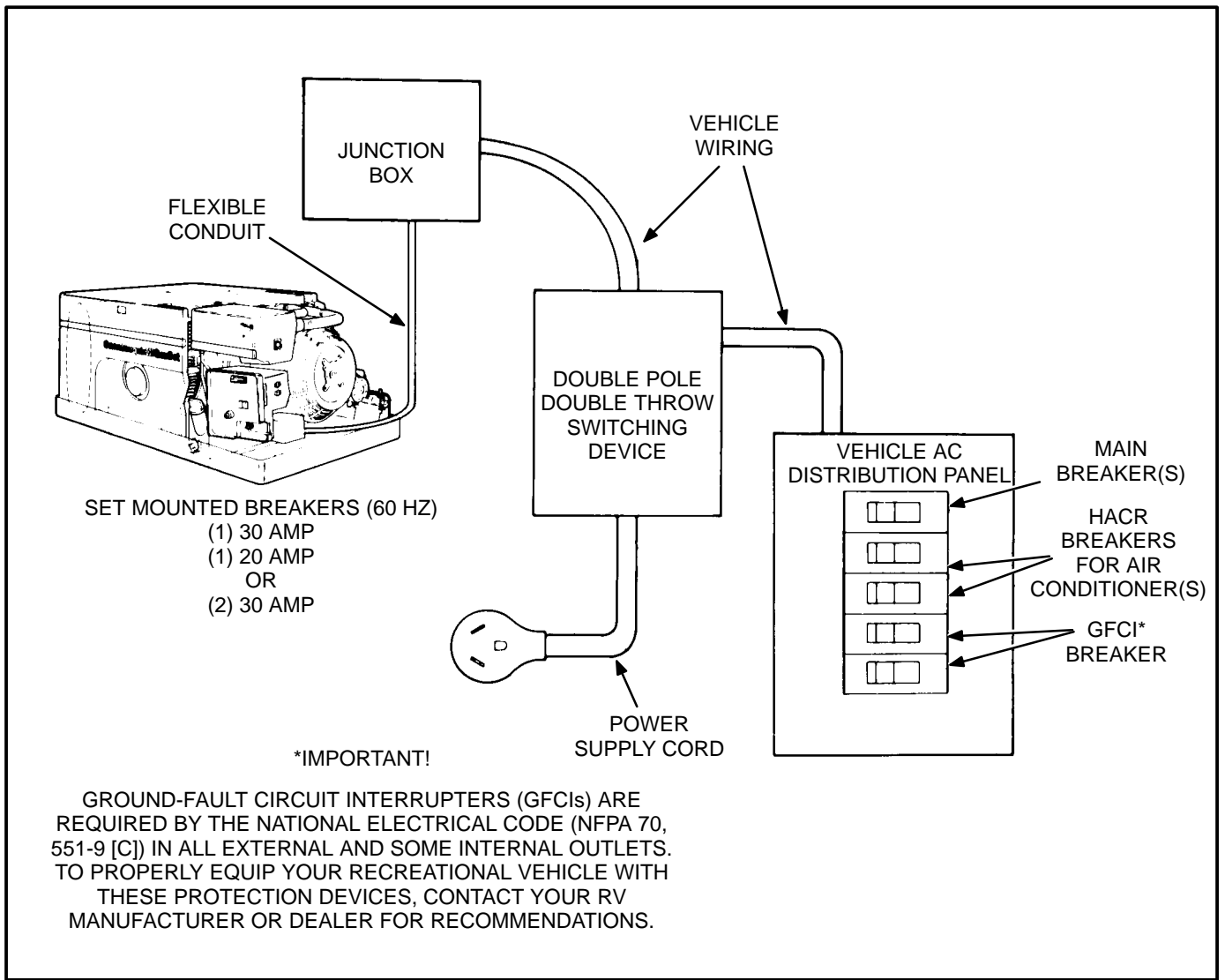


FIGURE 7-1. SWITCHING DEVICE WIRING FOR UTILITY POWER

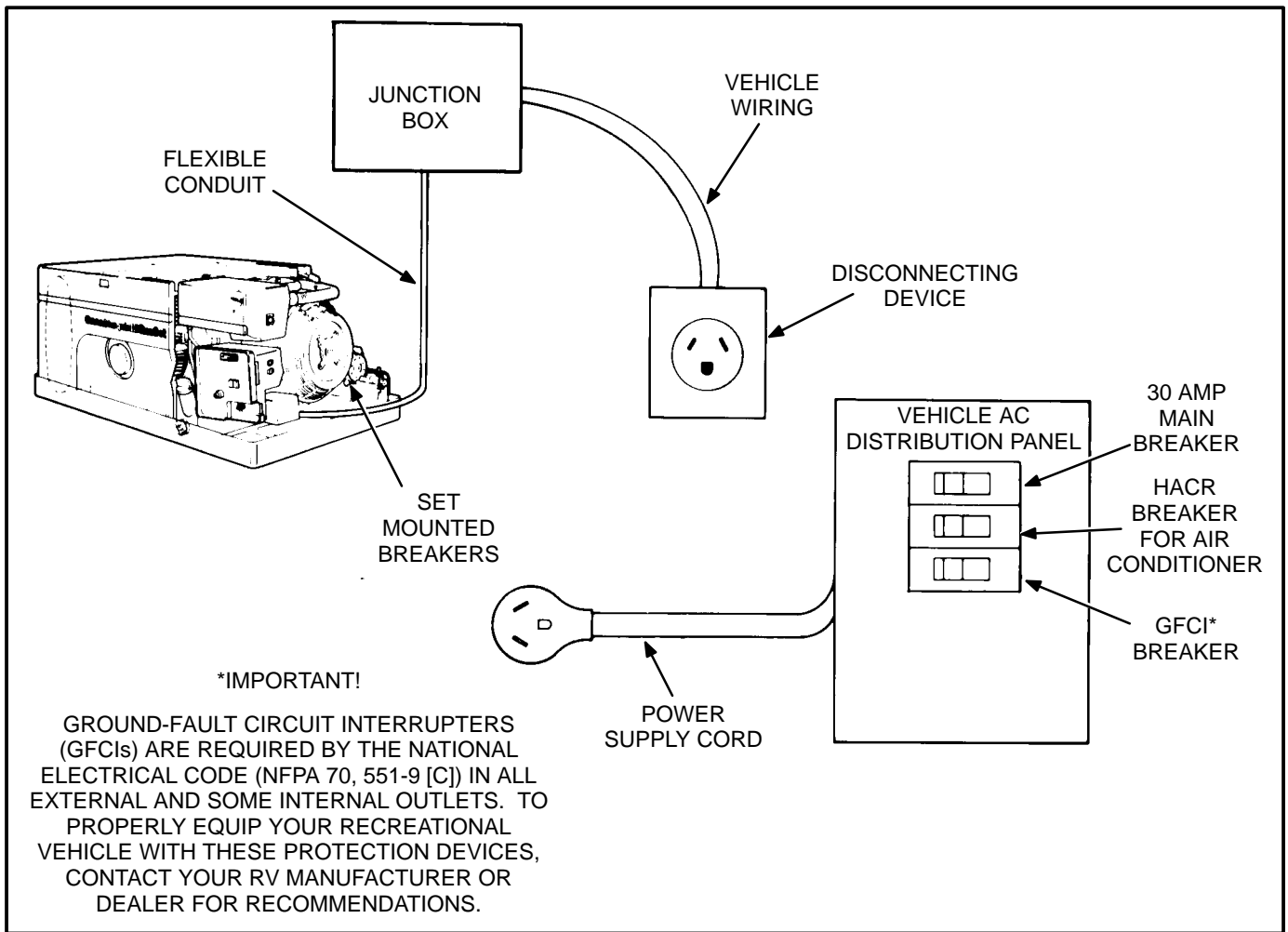


FIGURE 7-2. USING UTILITY POWER CORD FOR SWITCHING

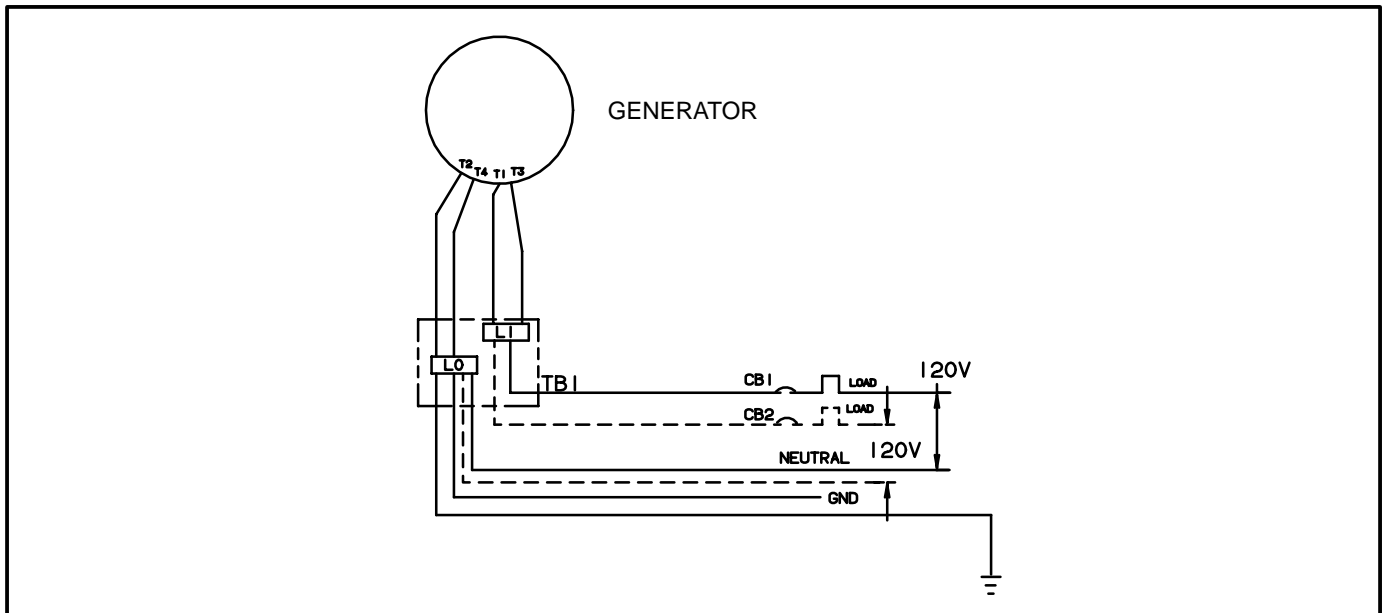


FIGURE 7-3. 60 HZ GENERATOR SET WIRING DIAGRAM

DC WIRING

Remote Control (Option)

Onan offers optional remote control kits that can be connected to the genset. There are three models available:

- Remote panel with start/stop switch and indicator lamp only (see Figure 7-4).
- Remote panel with start/stop switch, indicator lamp, and hour (elapsed time) meter (see Figure 7-5).
- Remote panel with start/stop switch, indicator lamp, and battery DC voltmeter (see Figure 7-6).

The location of the remote control panel can vary by application. Refer to the instructions supplied with the remote control kit for more installation information and important safety precautions.

Be sure to seal all openings made for wiring so exhaust or fuel vapors cannot enter the living quarters. If flexible metal conduit is used, it must be sealed internally at the end where it terminates. Flexible metal conduit is not vapor-tight along its length due to its construction.

⚠️WARNING *Inhalation of exhaust gas or ignition of fuel vapor can cause severe personal injury or death. Be sure to vapor-seal flexible metal conduit and all openings made during installation of the genset with a silicone/rubber based sealant.*

A remote control connector is located inside the housing (see Figure 1-2). Keep the connector inside the genset housing to keep it clean. Contact an Onan dealer for the proper remote connector plug and wiring harness assembly.

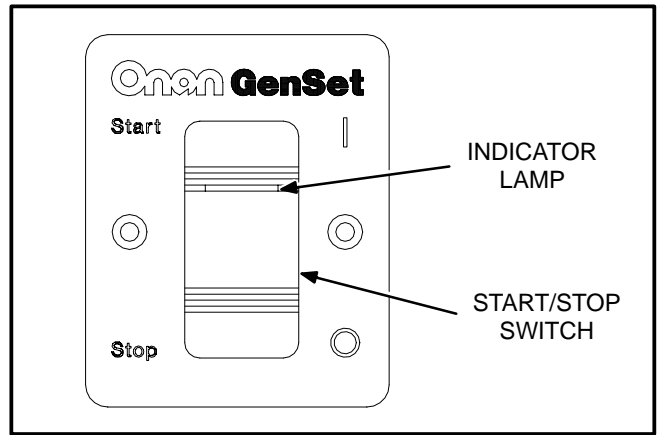


FIGURE 7-4. REMOTE PANEL WITH START/STOP SWITCH ONLY

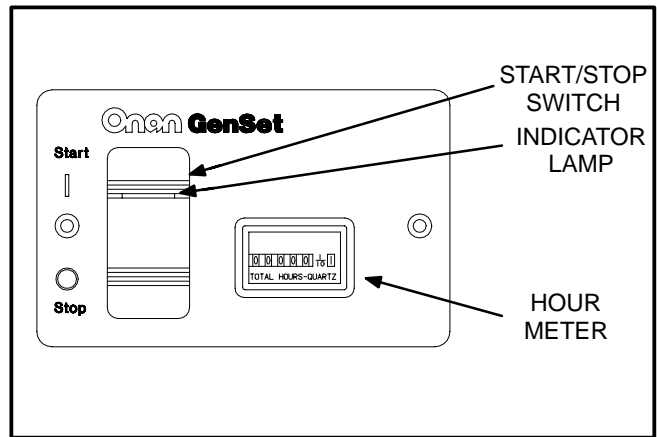


FIGURE 7-5. REMOTE PANEL WITH START/STOP SWITCH AND HOUR METER

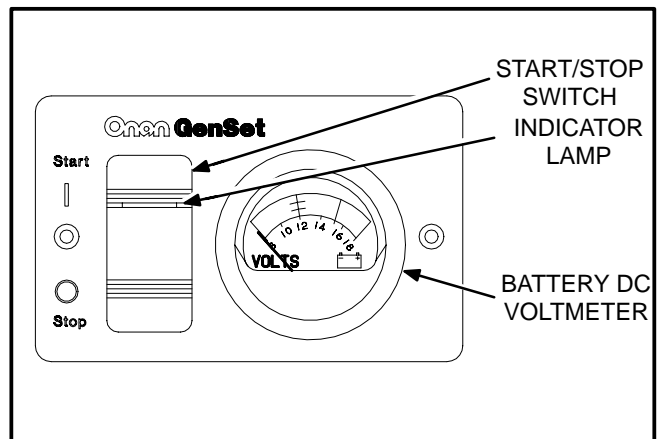


FIGURE 7-6. REMOTE PANEL WITH START/STOP SWITCH AND DC VOLTMETER

BATTERIES

To prevent accidental starting of the genset during installation, do not connect the battery cables at the battery until so instructed in the Initial Start and Checks section.

⚠WARNING *Accidental starting of the genset can cause severe personal injury or death. Do not connect the starting battery until so instructed in the Initial Start and Checks section.*

Onan does not recommend that the vehicle starting battery be used to operate the genset. Doing this can discharge the battery under some operating conditions.

Battery Capacity

The genset has a 12 VDC, negative-ground control and starting system. See Table 7-1 for minimum battery capacity requirements.

TABLE 7-1. COLD CRANKING AMPS FOR MINIMUM 12-VOLT BATTERY

ABOVE 32° F (0° C)	BELOW 32° F (0° C)
360 Cold Cranking Amps (Approx. 70 amp/hour)	450 Cold Cranking Amps (Approx. 95 amp/hour)

Battery Recharging

The genset is equipped with a 10-amp, regulated-voltage battery charger if electrical option **B183** was ordered. If the option was not ordered, other means will have to be provided for recharging the genset battery.

Battery Compartment

Mount the battery in its own compartment, away from the genset and any spark-producing device. For ventilation, provide the battery compartment with an opening of at least 1.7 in² (11 cm²) at the top and 1.7 in² (11 cm²) at the bottom.

Mount the battery on a rigid support structure, where leaks and accidental spills cannot damage the genset, fuel lines, and wiring.

⚠WARNING *Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries give off explosive gas, install the battery in a separate compartment from the genset and away from all flames, pilot light, arcing, or spark-producing devices.*

Battery Cables

Because of the high cranking currents involved, it is highly recommended that a negative (-) battery cable be run with the positive (+) battery cable between the battery and the genset. Size the cables according to Table 7-2. Total cable length is the sum of the lengths of the positive (+) and negative (-) cables. In other words, total cable length will be approximately twice the distance between the battery and the genset.

Alternatively, use rated cranking current as the basis for calculating battery cable size. Rated cranking current for these gensets is 180 amperes at 0°F (-18 °C). The cables should be sized so that voltage across the cranking motor terminals will be within 1 volt of the voltage across the battery terminals.

TABLE 7-2. CABLES FOR COLD WEATHER STARTING TO -20°F (-29°C)

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

* Total battery cable length including both positive (+) and negative (-) cables.

** #2 cable is acceptable up to 20 feet (6.1 m) if the battery capacity exceeds 1000 CCA.

Negative (-) Battery Connection. Connect one end of the negative (-) battery cable to the genset ground. Tighten the ground connection securely (see Figure 7-7).

Alternate Negative (-) Battery Connection. In cases where the distance from the battery to the genset is quite long, the vehicle frame (ground) can be used for the return cranking current:

1. Connect one end of a short, negative (-) battery cable (of the same size as the positive (+) battery cable) to the vehicle frame near the battery. (Do not connect the other end to the battery at this time.)
2. Connect one end of a short, negative (-) battery cable (of the same size as the positive (+) battery cable) to the vehicle frame near the genset. Connect the other end to the genset ground. See Figure 7-7.

NOTE: Make sure that the frame (ground) connections (to major frame members, if possible) are secure enough to minimize electrical resistance. Avoid making these connections at welds or mechanical joints.

Positive (+) Battery Connection. Connect one end of the positive (+) battery cable to the B+ post. Tighten the B+ connection securely (see Figure 7-7).

Route battery cables away from fuel lines and hot engine exhaust components. Battery cable should be accessible for inspection and replacement, pro-

tected from damage and secured to prevent chafing due to vibration.

⚠ WARNING *Routing battery cables with fuel lines can lead to fire and severe personal injury or death. Keep battery cables away from fuel lines.*

⚠ CAUTION *Failure to secure the battery cable terminals can result in personal injury and/or equipment damage from an electrical short. See that terminal connections are secure. If necessary, secure cables to prevent abrasion.*

Genset Bonding Terminal

The genset ground, as shown in Figure 7-7, is also the bonding terminal for grounding the genset to the vehicle frame (ground) when a continuous negative (-) battery cable is used from the battery directly to the genset. Connect an 8 AWG grounding wire from the vehicle frame to the genset ground.

NOTE: Make sure that the frame (ground) connections (to major frame members, if possible) are secure enough to minimize electrical resistance. Avoid making these connections at welds or mechanical joints.

⚠ WARNING *Failure to ground the genset properly can result in injury or death. The genset must be grounded to the vehicle frame.*

8. Initial Start and Checks

⚠️WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- *Dizziness*
- *Nausea*
- *Headache*
- *Weakness and Sleepiness*
- *Throbbing in Temples*
- *Muscular Twitching*
- *Vomiting*
- *Inability to Think Coherently*

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Never sleep in vehicle with the generator set running unless the vehicle interior is equipped with an operating carbon monoxide detector. Protection against carbon monoxide inhalation also includes proper exhaust system installation and visual and audible inspection of the complete exhaust system at the start of each generator set operation.

1-RV

PRE-START CHECKS

Before starting the generator set, perform these steps:

1. Perform the Installation Review described in this section.
2. Add oil to the engine. See the Operator's Manual (publication 965-0131) for the oil type and quantity.
3. Check that battery terminals and cable connectors are clean and dry. Connect the positive (+) battery cable to the POS (+) battery post first, then connect the negative (-) battery cable to the NEG (-) battery post. Always connect the negative (-) battery cable last to reduce the risk of arcing.

⚠️WARNING *Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any arc-producing devices in the battery area. Do not disconnect cables from the battery while the generator set is cranking or running. This causes arcing and can result in an explosion.*

4. See the Operator's Manual, and note the features of the individual system. Open the fuel supply valves to the generator set.

INITIAL START-UP/INSPECTION

Start Generator Set at Unit Control

⚠️WARNING *Exhaust gas presents the hazard of severe personal injury or death. Do not operate the generator set inside any room or building.*

1. Move the Start/Stop switch to the START position. The engine should crank and start. The unit may need more cranking at initial start than at subsequent starts, to prime the fuel system. If the genset fails to start, see the *Troubleshooting Guide* in the Operator's Manual.

2. After the set starts, check for fuel leaks. If any leaks are found, stop the set immediately, close off the fuel supply and have the leak(s) repaired. Make sure that the fuel lines do not touch anything that can damage them.

⚠WARNING *Fuel presents the hazard of explosion or fire which can result in severe personal injury or death. If a fuel leak is found, stop the generator set, and have the leak repaired immediately.*

⚠WARNING *A hot generator set can cause severe burns. Always allow the generator set to cool before performing service.*

3. Examine the exhaust system for leaks. If any leaks are found, stop the set and have the exhaust system repaired immediately.

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Do not operate the generator set if it is excessively noisy. Have it inspected and repaired immediately by an authorized Onan service center.*

4. Perform the Break-In Procedure described in the Operator's Manual.
5. Move the unit Start/Stop switch to the STOP position to stop the genset.

Start Generator Set at Remote Control

1. Move the Remote Start/Stop switch to the START position. The engine should crank and start. If it does not, see the *Troubleshooting Guide* in the Operator's Manual. Check all remote control connections, repair if necessary, and restart the set.
2. After the genset starts, check the battery condition meter (if equipped) to confirm its proper operation.
3. See the Operator's Manual for procedures to test set operation.
4. Operate the set with a normal load, monitoring fuel supply connections, exhaust system, set performance, and quality of noise reduction. If set performance is not acceptable, see the Service Manual for adjustment procedures, or contact an authorized Onan service center for assistance. If any genset systems require adjustment, disconnect the starting battery to prevent accidental start-up.

⚠WARNING *Accidental starting of the generator set during maintenance procedures can cause severe personal injury or death. Disconnect the generator set starting battery, negative (-) cable first, before performing maintenance.*

INSTALLATION REVIEW

⚠WARNING *Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Installing personnel must be qualified to perform electrical and mechanical component installations and service.*

Prior to initial start up of the generator set, check each of the following items. For a proper installation, each answer must be yes: if not, that aspect of the installation should be reworked or provision made to satisfy the requirement.

1. If the exhaust system is run into the angle of approach or departure (see Figure 5-1), is it protected from bottoming out by use of skid bars, rollers, etc. ?
2. Does the exhaust system extend to the perimeter of the vehicle, and does it not terminate below an openable window, door, or vent ?
3. Are all required exhaust clamps, hangers, and support straps in place per the Exhaust System section of this manual and the kit instructions ?
4. Do the hanger straps located at the perimeter and along the center line of the generator set have double U-shaped rubber isolators ?
5. Is the compartment metal-lined and sealed around all edges ?
6. Is a flexible section of non-conducting fuel line installed between the fuel inlet and the fuel line from the tank ?
7. Does the installation allow 1/2 inch (13 mm) free movement of the generator set on its mounts ?
8. Are all fuel connections and hose clamps tight?
9. Are air inlet and exhaust openings clear and sufficiently sized (see Mounting section) for proper airflow ?
10. Is the generator set protected from direct road splash from vehicle wheels ?
11. Can the following routine maintenance items be performed ?
 - Change oil and filter
 - Adjust carburetor
 - Start/stop the unit
 - Change air filter
 - Operate AC circuit breakers
 - Change spark plugs
12. Are fuel lines and electrical wires run separately ?
13. Are wiring holes into the inside of coach (including the inside of AC conduit) sealed to prevent passage of exhaust gases ?
14. Has a rubber boot been installed on battery plus (+) lead at the start solenoid connection in the control ?
15. Are all electrical leads connected and protected, and is the conduit adequately supported ?



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