



# **Installation Manual**

DFM

DFP

**GenSets**

**Diesel-Driven**

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**960-0602**

10-86

Printed in U.S.A.

# Safety Precautions

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.

Read your manual and become thoroughly acquainted with it and your equipment before you start your unit. These recommendations and the following safety precautions are for your protection.

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.



***This symbol if used warns of immediate hazards which will result in severe personal injury or death.***



***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***



***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

## General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove any debris from set and keep the floor clean and dry.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the generating set are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- Do not wear loose clothing in the vicinity of moving parts, or jewelry while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts; cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.
- Do not work on this equipment when mentally or physically fatigued.
- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Bleed the system pressure first.

## Protect Against Moving Parts

- Keep your hands away from moving parts.
- Before starting work on the generator set, disconnect batteries. This will prevent starting the set accidentally.

## Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME in the vicinity of the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be adequately secured and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.

## 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.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DO NOT tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches.
- 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. Inspect exhaust system daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

## Keep the Unit and Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- 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.

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# Introduction

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## ABOUT THIS MANUAL

This manual provides installation instructions for the DF Series generator sets. This includes the following information:

- **Mounting** — Recommendations for fastening generator set to base and space requirements for normal operation and service.
- **Mechanical Connections** — Location of connection points for fuel, exhaust, ventilation, and cooling.
- **Electrical Connections** — Location of electrical connection points for the control, generator, and starting system.
- **Prestart** — Checklist of items or procedures needed to prepare generator set for operation.
- **Initial Startup** — Test complete system to ensure proper installation, satisfactory performance, and safe operation. Refer to Operators Manual for troubleshooting information.

This manual DOES NOT provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), review standard installation practices, or specify system materials, additional information is required. For engineering data specific to the generator set, refer to the DF Series specification and product data sheets. For generator application information about generator set installation, refer to the following Onan Technical Bulletins.

T-009/T-017 — Selecting Onan Generator Sets  
T-030 — Installation Information for  
Liquid-Cooled GenSets

Bulletin T-030 is a particularly useful installation reference and is shipped with this manual. Bulletin T-009/T-017 is included in the Onan Power Systems Manual or may be obtained separately on request from an authorized Onan distributor.

## INSTALLATION OVERVIEW

These installation recommendations apply to typical generator set installations with standard model generator sets. Whenever possible, these recommendations also cover factory designed options or modifications. However, because of the many variables in any installation, it is not possible to provide specific recommendations for every situation. If there are any questions not answered by this manual, contact an Onan distributor for assistance.

## Application and Installation

A standby power system must be carefully planned and correctly installed to ensure proper operation. This involves two essential elements: application and installation.

Application (as it applies to generator set installations) refers to the design of the complete standby power system. The generator set is a single component in an integrated power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, and cooling, exhaust, and fuel systems. Each component must be correctly designed so the complete system will function as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers are responsible for the design of the complete standby system and for selecting the materials and products required.

Installation refers to the actual set-up and assembly of the standby power system. The installers set-up and connect the various components of the system as specified in the system design plan. The complexity of the standby system normally requires the special skills of qualified electricians, plumbers, sheetmetal workers, etc. to complete the various segments of the installation. This is necessary to ensure all components are assembled using standard methods and practices. Figure 1 shows a typical installation and Table 1 lists the equipment installation specifications.

## Safety Considerations

The generator set has been carefully designed to provide safe and efficient service. However, the overall safety and reliability of the complete system is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

# Specifications

**TABLE 1. EQUIPMENT INSTALLATION SPECIFICATIONS**

| <b>SYSTEMS</b>  | <b>200 DFP</b>  | <b>250 DFM</b>  | <b>275 DFM</b>  | <b>300 DFM</b>  |
|---|---|---|---|---|
| <b>Fuel System</b><br>Inlet Fitting Size<br>Return Fitting Size<br>Fuel Pump<br>(Lifting Capacity)              | 7/8-14 UNF-2A<br>3/4-16 UNF-2A<br>5 feet (1.525 m)        | 7/8-14 UNF-2A<br>3/4-16 UNF-2A<br>5 feet (1.525 m)        | 7/8-14 UNF-2A<br>3/4-16 UNF-2A<br>5 feet (1.525 m)        | 7/8-14 UNF-2A<br>3/4-16 UNF-2A<br>5 feet (1.525 m)        |
| <b>Exhaust System</b><br>Exhaust Connection<br>(in. pipe thread)<br>Exhaust Backpressure<br>(Maximum Allowable) | 5 inches NPT<br>41 inches H <sub>2</sub> O<br>3 inches Hg | 5 inches NPT<br>41 inches H <sub>2</sub> O<br>3 inches Hg | 5 inches NPT<br>41 inches H <sub>2</sub> O<br>3 inches Hg | 5 inches NPT<br>41 inches H <sub>2</sub> O<br>3 inches Hg |
| <b>Electrical System</b><br>Starting Voltage<br>Battery   | 24 Volts DC<br>Two, 12-Volt Group 8D                      | 24 Volts DC<br>Two, 12-Volt Group 8D                      | 24 Volts DC<br>Two, 12-Volt Group 8D                      | 24 Volts DC<br>Two, 12-Volt Group 8D                      |

**⚠ WARNING**

**INCORRECT INSTALLATION, SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL COMPONENT INSTALLATION.**

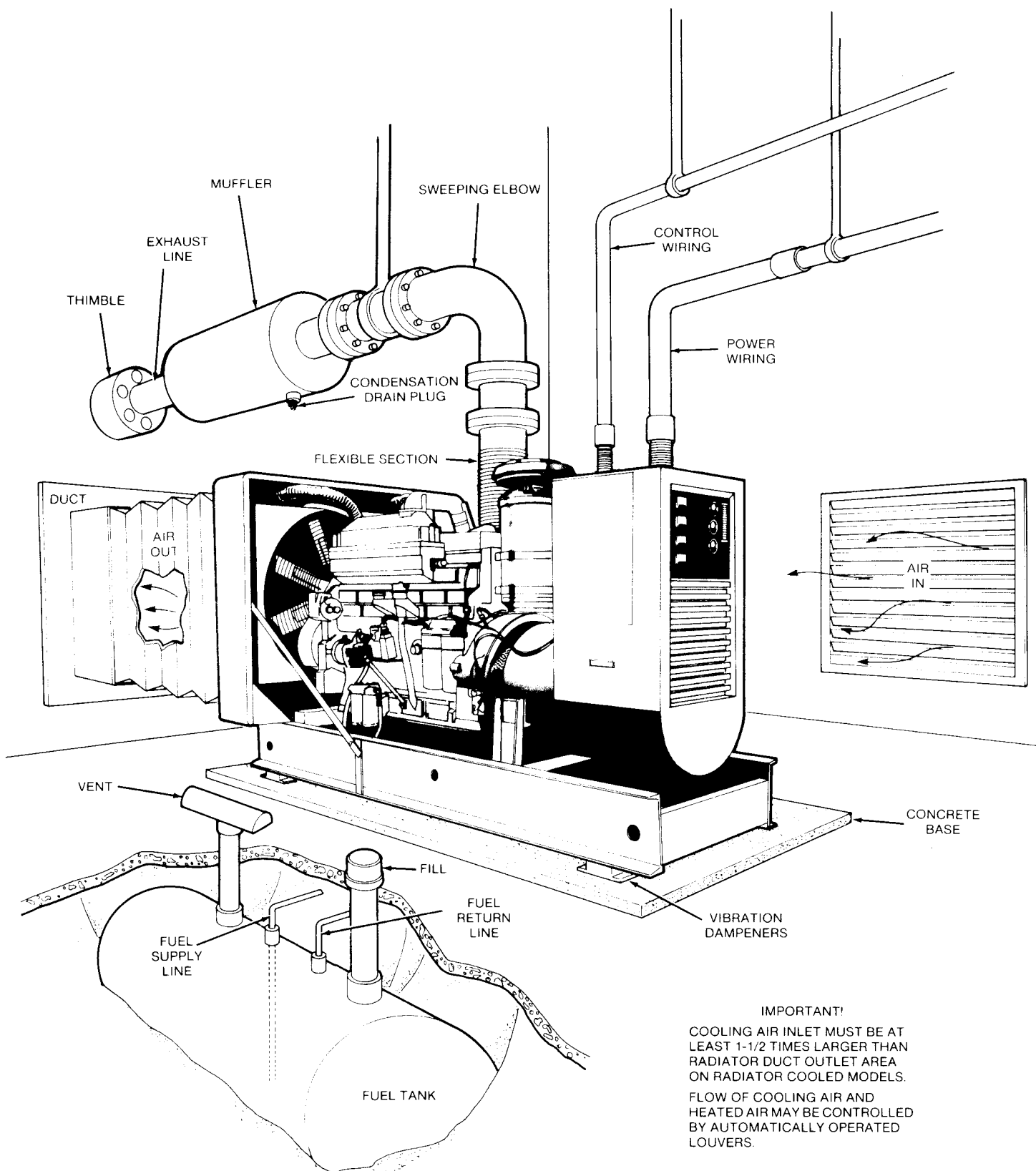


FIGURE 1. TYPICAL INSTALLATION

# Mounting the Generator Set

## GENERAL

Most generator set installations must be engineered to ensure the generator set will function properly under the expected load conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire ordinances, and other applicable regulations. Refer to Onan Technical Bulletin, T-030, for further installation information.

Requirements to be considered prior to installation:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation

## LOCATION

Generator set location is decided mainly by related systems such as ventilation, wiring, fuel, and exhaust. The set should be located as near as possible to the main power fuse box.

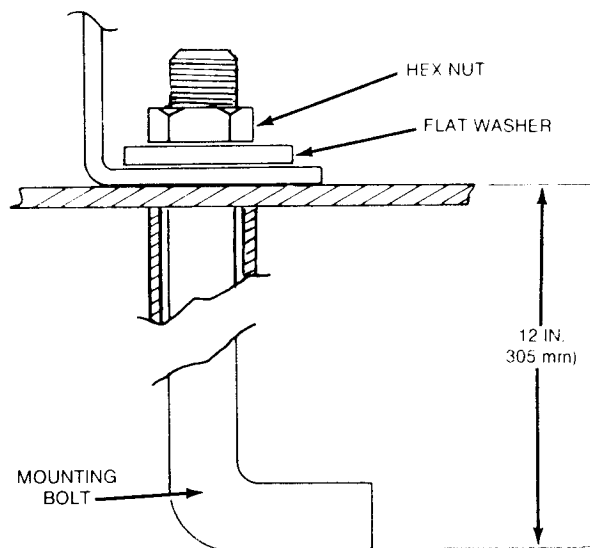
Provide a location away from extreme ambient temperatures and protect the generator set from adverse weather conditions. An optional housing is available for outside operation.

## MOUNTING

Generator sets are mounted on a steel skid that provides proper support. The engine-generator assembly is isolated from the skid frame by rubber mounts that provide adequate vibration isolation for normal installations. For critical installations, install vibration isolators between the skid base and foundations.

Mount the generator set on a substantial and level base such as a concrete pad. For proper spacing of mounting bolts and set mounting dimensions, see specific generator set specification sheet.

Use 3/4-inch diameter, anchored mounting bolts to secure the generator set skid to the floor to prevent movement. Secure the skid using a flat washer and hexagon nut for each bolt (see Figure 2).



M-1627

FIGURE 2. BOLT DIAGRAM

## ACCESS TO SET

Plan for access to the generator set for servicing and provide adequate lighting around the unit. For convenience in general servicing such as the radiator, fan belt, and changing the crankcase oil; the surface of the mounting base should be at least 6 inches (152 mm) above the floor.

# Mechanical Connections

The generator set mechanical system installation includes connecting the fuel, exhaust, ventilation and cooling systems. Before starting any type of fuel installation, Onan recommends all pertinent state and local codes be complied with and the installation must be inspected before the unit is put in service.

## FUEL SYSTEM

Cummins engines used on the DF series generator sets normally use ASTM No. 2 Diesel fuel. They will, however, operate on diesel fuels within the specifications delineated in the Cummins engine manual.

### General

In all fuel system installations, cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture, dirt or contaminants of any kind. Clean all fuel system components before installing.

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Onan can supply copper fuel lines with brass fittings if required. Never use galvanized fuel lines or fittings with diesel fuel as it tends to flake off and contaminate the fuel. Use a flexible section of tubing between the engine and fuel supply line to withstand vibration.

**CAUTION** *Never use galvanized fuel lines, fittings or fuel tanks with diesel fuel systems. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce a sulfuric acid. The zinc coating on galvanized lines or tanks reacts with the acid and flakes off to contaminate the fuel.*

An electric solenoid shutoff valve in the supply line is always desirable and required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery ignition circuit to open the valve during generator set operation.

### Supply Tank

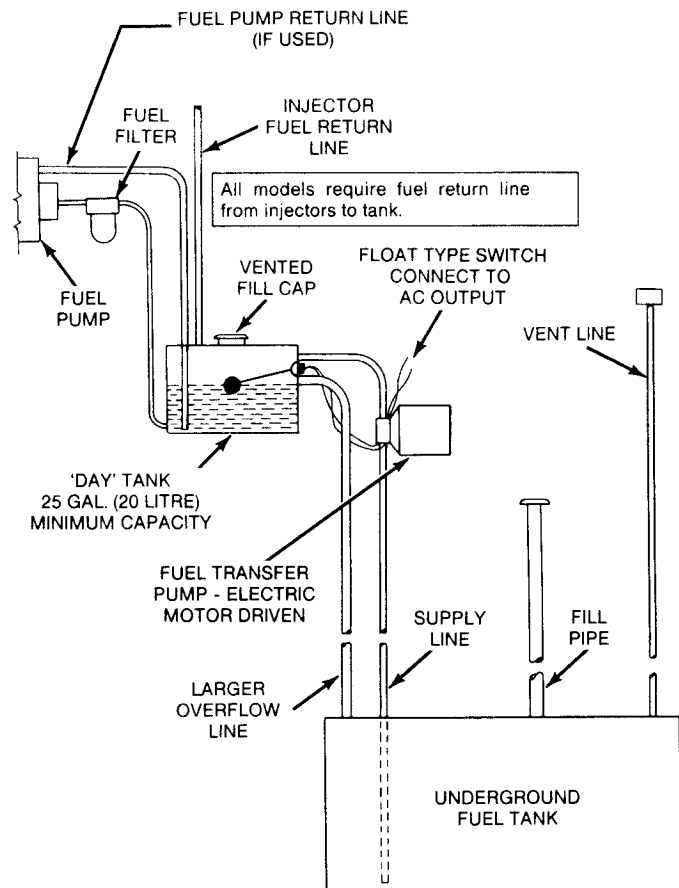
Locate the fuel tank as close as possible to the generator set and within the 5 foot (1.5 metre) lift capacity of the fuel pump if possible. Choose a tank that has sufficient capacity to keep the generator running continuously at full load for at least 36 hours.

**WARNING** *Fuel leaks create fire and explosion hazards which can result in severe personal injury or death. Always use flexible tubing between engine and the fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet applicable codes.*

A typical underground fuel system consists of a main fuel tank, vent and fill pipes, fuel supply line, and fuel return line (see Figure 1). If the tank is installed below the lift capabilities of the standard fuel transfer pump, a day tank and auxiliary pump will also be required. If an overhead tank is installed, a day tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components. Refer to Technical Bulletin T-030 for examples of fuel supply systems that require a day tank.

### Day Tank (If Used)

Day tanks are fuel transfer tanks which are used when the standard engine fuel pump does not have the capacity to draw the fuel from the supply tank; or the supply tank is overhead and presents problems of high fuel head pressure for the fuel return. See Figure 3.



ES-1214-1

FIGURE 3. DAY TANK (TYPICAL)



**Supply Tank Lower Than Engine:** With this installation, the day tank is installed near the generator set and within the engine fuel pump lift capability, but below the fuel injection system. Install an auxiliary fuel pump as close as possible to the supply tank to pump fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the auxiliary fuel pump.

The supply tank top must be below the day tank top to prevent siphoning from the fuel supply tank to the day tank.

Provide a return line from the engine injection system return connection to the day tank (near the top). Provide a day tank overflow line to the supply tank in case the float switch fails to shut off the fuel transfer pump.

**⚠ WARNING** *Spilled fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Provide an overflow line to the supply tank from the day tank.*

**Supply Tank Higher Than Engine:** Install the day tank near the generator set and within the engine fuel pump lift capability, but below the fuel injection system. Use fuel line at least as large as the fuel pump inlet. The engine fuel return line must enter the day tank.

Include a shutoff solenoid in the fuel line between the fuel supply tank and the day tank. It stops fuel flow when the generator set is off.

## Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections by the factory. Flexible lines for connecting between the engine and the stationary fuel line are supplied as standard equipment. Refer to Table 1, *SPECIFICATIONS* for the fitting sizes.

## EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlet away from air inlets to avoid exhaust gases from re-entering the enclosure. Exhaust installations are subject to various detrimental conditions such as extreme heat, infrequent operation, and light loads. Regularly inspect the exhaust system both visually and audibly to ensure the entire system remains fume tight and safe for operation.

**⚠ WARNING** *Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to ensure a tight exhaust system.*

Use an approved thimble (Figure 4) where exhaust pipes pass through wall or partitions. Refer to the National Fire Protection Association Bulletin, Volume 4, section 211 covering Standards for Chimneys, Fireplaces and Vents for suggested code requirements. Build according to the code requirements in effect at the installation site.

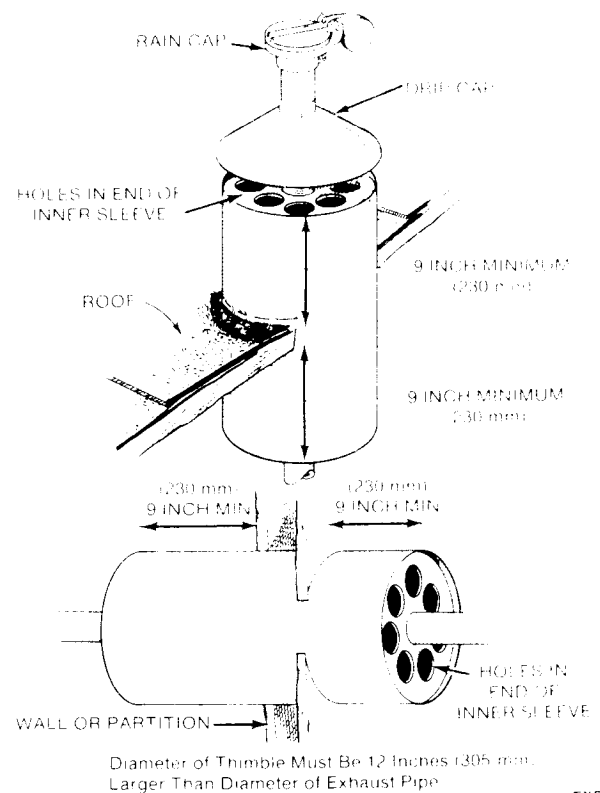


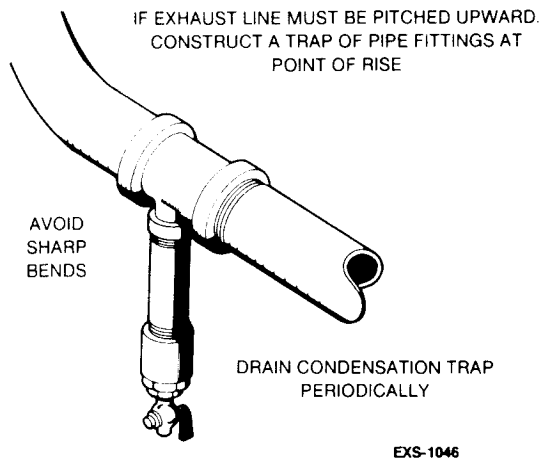
FIGURE 4. EXHAUST THIMBLE (TYPICAL)

**⚠ WARNING** *Inhalation of exhaust gases can result in severe personal injury or death. Do not use exhaust heat to warm a room, compartment, or storage area.*

Onan has rain caps available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

**⚠ CAUTION** *Weight applied to the engine manifold can result in manifold damage. Support the muffler and exhaust piping so no weight or stress is applied to the engine exhaust manifold.*

Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for mufflers, and tailpipe. Pitch a horizontal run of exhaust pipe **DOWNWARD** to allow any moisture condensation to drain away from the engine. If an exhaust pipe must be turned upward, install a condensation trap at the point where the rise begins (see Figure 5).



**FIGURE 5. EXHAUST CONDENSATION TRAP (TYPICAL)**

Shield or insulate exhaust lines if there is a danger of personal contact. Allow at least 12 inches (305 mm) of clearance if the pipes pass close to a combustible wall or partition.

## VENTILATION SYSTEM

Generator sets create considerable heat that must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for the required airflow. Refer to Onan Technical Bulletin, T-030, for additional application information.

### Vents and Ducts

For indoor installations, locate vents so incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement (see Figure 1 for a typical installation).

Size the vents and ducts so they are large enough to allow the required flow rate of air. The "free area" of ducts must be as large as the exposed area of the radiator. Refer to the DFM and DFP series Product Data Sheets for the airflow requirements.

Wind will restrict free airflow if it blows directly into the air outlet vent. Locate the outlet vent so the effects of wind are eliminated.

For operation outside a building, a shelter housing with electrically operated louvers is available as an option. Transformers connected across the generator output supply current to the motors.

When the generator is operating, current in the transformers actuate the motors and open the louvers. The louvers are held open for the duration of the set operation, then are closed by return springs when the set is shut down.

## Dampers

Dampers are used in any system to block the airflow through the vents when the generator set is not running. This is sometimes necessary in cold climates to keep the generator enclosure at a normal temperature.

## Radiator Set

Radiator set cooling air is drawn past the rear of the set by a fan which blows air through the radiator. Locate the air inlet to the rear of set and near the floor. Make the inlet vent opening 1-1/2 times larger than the radiator.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The effective opening area should be 1.3 times as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to airflow. Use a duct of sheet metal and canvas between the radiator and the air outlet opening to prevent recirculation of heated air and provide for flexible connection.

## Heat Exchanger

Heat exchanger cooled sets do not use a conventional radiator. Instead, a constantly changing water flow cools the heat exchanger which in turn cools the engine coolant. Sufficient air movement and fresh air must be available to disperse heat radiated from the heat exchanger.

To provide sufficient airflow, ventilation fans may be required. Size the fans to remove all heat rejected to the room by the generator set, exhaust pipes and other heat producing equipment. Maintaining a temperature differential of 20° to 30°F (11° to 17°C) is usually satisfactory.

## COOLING SYSTEMS

A set mounted radiator with engine driven fan is standard on the generator set. Optional cooling systems include remote radiator cooling and heat exchanger cooling.

The following sections briefly cover the installation requirements for each system. Refer to Technical Bulletin T-030 for more detailed information.

### Standard Radiator Cooling

The standard radiator cooling system (see Figure 1) uses a set mounted radiator with an engine driven pusher type fan to cool the generator set. Air is pulled from the generator end of the set across the engine and then forced through the radiator. An air duct adapter flange surrounds the radiator grill to allow mounting of the air discharge duct. Refer to the section on Ventilation for location and sizing of ducts and vents.

### Remote Radiator (Optional)

Remote radiators can be located a horizontal or a vertical distance, from an engine. The horizontal distance is limited by the capability of the engine driven water pump and the maximum external Friction Head pressure. The vertical distance is limited to the maximum Static Head pressure which can be imposed on coolant system gaskets and seals without leakage of coolant from coolant system components. The Friction and Static Head pressures of each GenSet are included in their Product Data Sheet.

The two key design considerations in a remote radiator installation are the vertical distance (X) from the engine centerline to the radiator top and the horizontal distance (Y) from the engine front to the radiator centerline (see Figure 6). These distances determine if any additional equipment is required such as a surge tank, auxiliary pump, or hot well. Because of the many design considerations, all remote radiator installations must be engineered to insure that the system will function properly. Follow the instructions of the consulting engineer when installing a remote radiator system. Additional information is contained in Technical Bulletin T-030.

### Heat Exchanger (Optional)

This cooling system uses a shell and tube type heat exchanger instead of the standard radiator and fan (see Figure 7). Engine jacket coolant circulates through the shell side of the heat exchanger, while the cooling water is pumped through the tubes. Engine coolant and raw water do not mix. This type of cooling separation is necessary when the raw water contains scale forming lime, or other impurities.

This system can reduce set enclosure airflow requirements and noise levels. Proper operation depends on a constant supply of raw water for heat removal. Adjust the flow to maintain water temperature between 165° and 195°F (74° and 91°C) while viewing the water temperature gauge. The engine coolant side of the system can be protected from freezing; the raw water side cannot be protected.

All heat exchanger cooled sets must be connected to a pressurized supply of cold water. Make connections to the set with flexible pipe to absorb vibration. On the cool water line, install a solenoid valve to shut off the flow when the set is shut down and a rate of flow valve to control engine temperature. This valve can be either manual or automatic. Actual rate of flow will depend on inlet water temperature.

Adjust the valve to maintain water temperature between 165° to 195° F (74° to 91°C) while operating the unit at full load.

Before filling cooling system, check all hardware for tightness. This includes hose clamps, capscrews, fittings and connections. Use flexible coolant lines with heat exchanger or remote mounted radiator.

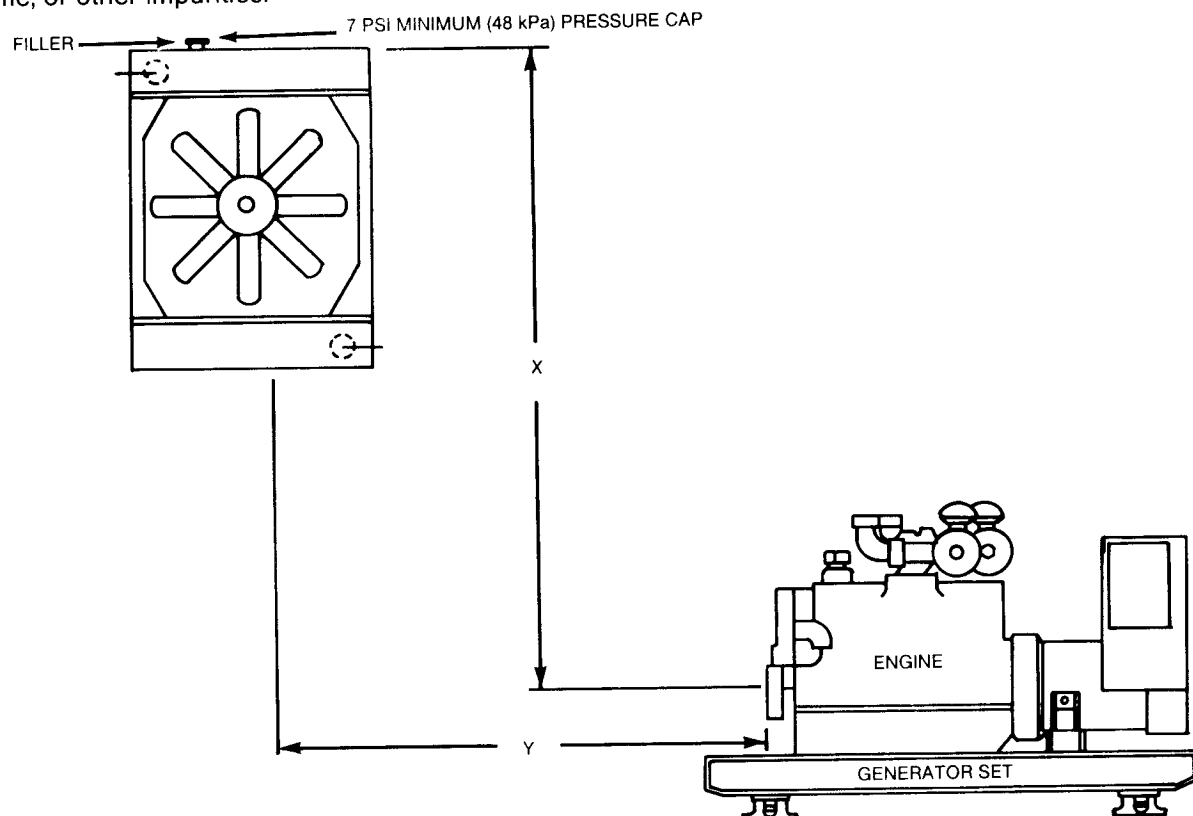


FIGURE 6. REMOTE RADIATOR INSTALLATION

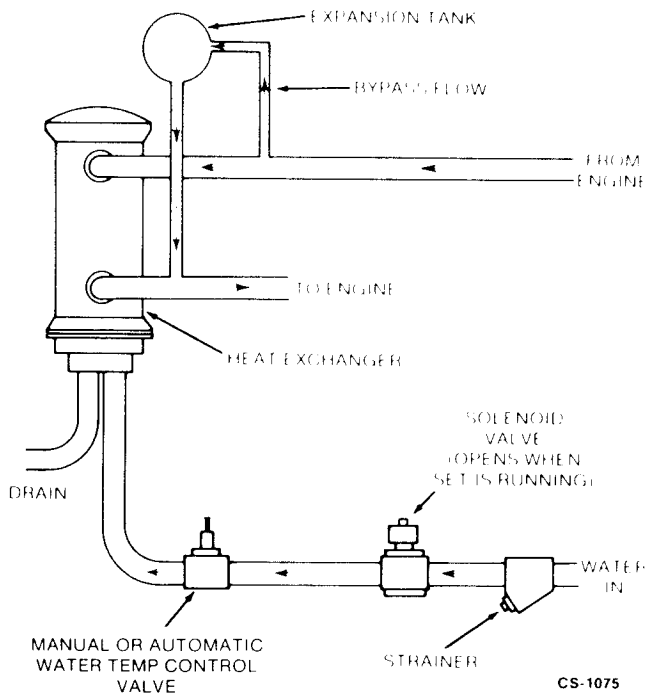


FIGURE 7. TYPICAL HEAT EXCHANGER

### Coolant Filter

One spin-on type corrosion filter (Figure 8) is standard equipment. This precharge filter is compatible with plain water and all ethylene glycol base permanent anti-freeze coolants. Refer to engine manufacturer's manual for instructions if a methoxy propanal base anti-freeze is desired. Replace filter periodically as recommended in **MAINTENANCE** section of Operators Manual.

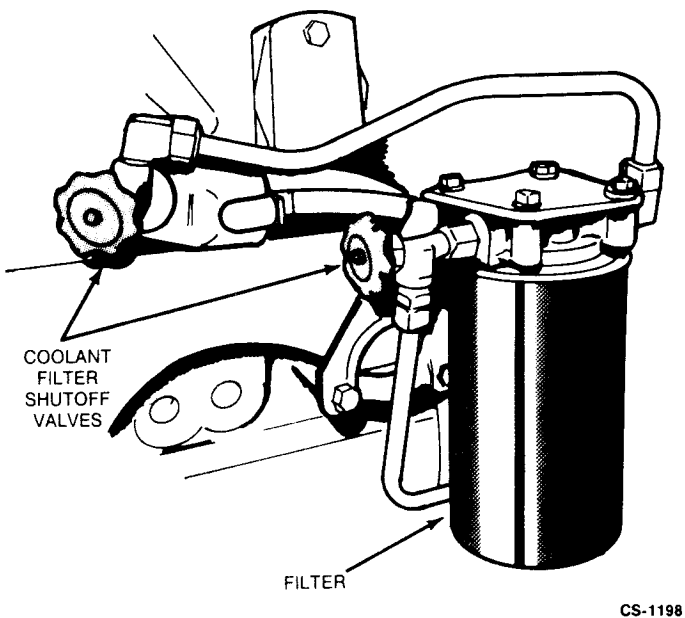


FIGURE 8. TYPICAL COOLANT FILTER

### Coolant Heater (Optional)

A coolant heater is used to keep engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces start-up time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

**CAUTION** *The heater must not be operated while the cooling system is empty or when the engine is running or damage to the heater will occur.*

Figure 9 shows the the heater line connections. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

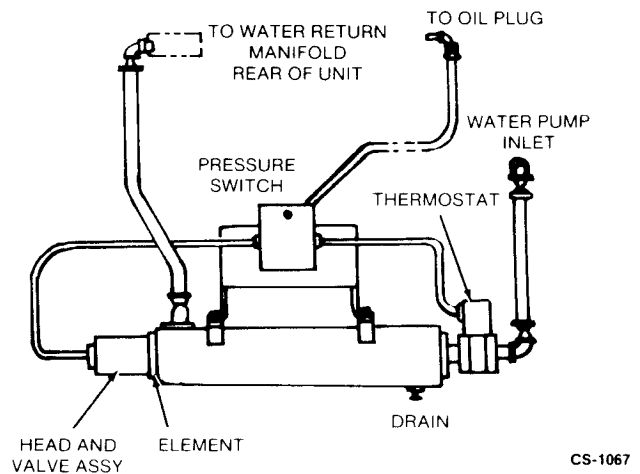


FIGURE 9. TYPICAL COOLANT HEATER

# Electrical Connections

## GENERAL

The generator set electrical system installation includes connecting the load, installing the control wiring, and connecting the batteries. The batteries should be connected last to avoid accidental starting of the unit during installation.

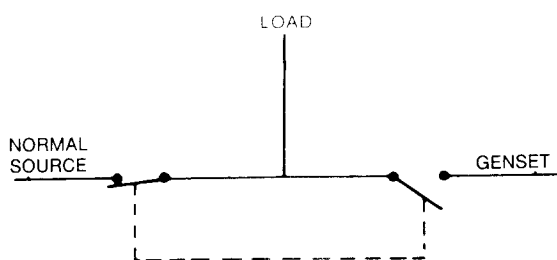
Most local regulations require wiring connections be made by a licensed electrician and the installation must be inspected and approved before operation. All connections, wire sizes, etc. must conform to the requirements of all electrical codes in effect at the installation site.



**Improper wiring can result in fire and severe personal injury or death.**

## TRANSFER SWITCH

If the installation is for standby service, a transfer switch is required for switching the load from the normal power source to the generator set (see Figure 10). Either a manual or automatic transfer switch may be used. Follow the installation instructions provided with the transfer switch when connecting the load and control wiring. Onan supplied transfer switches match the generator rating.



SC-1101

**FIGURE 10. LOAD TRANSFER SWITCH  
(TYPICAL FUNCTION)**

## AC WIRING

### Generator Voltage Connections

The generator output voltages and maximum current rating is specified on the generator nameplate. Line-to-neutral voltage is always the lower voltage shown on the nameplate and line-to-line voltage is the higher rating.

Generators can be divided into two groups, reconnectible and non-reconnectible. The reconnectible type generator can be wired to give one of several possible voltages. Non-reconnectible type generators produce only one specific voltage and cannot be wired to give a different voltage without extensive modifications. The following sections explain the connection procedure for each voltage code.

**Non-reconnectible Generators (Voltage Code 5D, 6D, 7, or 9X):** These generators are wired at the factory for a specific voltage (see Figure 11) and are not intended for reconnection. The voltage and corresponding current rating (amperes) are shown on the nameplate. For these generators, proceed to **LOAD CONNECTIONS**.

**Reconnectible Generators (Voltage Code 17 or 517):** Generators with voltage codes 17 (for 60 hertz) and 517 (for 50 hertz) are three phase and can be reconnected for the voltages shown in Figure 11. (If voltage and code are other than 17 or 517, see "Non-reconnectible Generators"). Most of these generators must be reconnected by the installer to give the voltage required for the installation. Before shipping, the factory tests the generator set output by connecting the generator to produce a particular test voltage.

**Reconnection Bars:** Several reconnection bars are provided that can be bolted or unbolted (see Figure 12) to the main bus bars (L0, L1, L2, and L3). Bus bars and reconnection bars are made of tin plated aluminum to resist electrolytic corrosion. Select the voltage required and bolt the reconnection bars to the bus bars. Torque the bolts to 17-19 foot pounds (23-26 newton metres).

**Connecting the Load:** All loads are connected to the generator by bolting the load wires to the appropriate bus bars in the control box as indicated in Figure 11. The bus bars are stamped L0, L1, L2, and L3 to indicate the neutral and line connections (Figure 12). Use a section of flexible conduit at the control box to permit movement.

| NAMEPLATE VOLTAGE CODE | VOLTAGE  | PHASE | FREQUENCY                                    | GENERATOR CONNECTION | GENERATOR CONNECTION SCHEMATIC DIAGRAM | GENERATOR CONNECTION WIRING DIAGRAM |
|------------------------|--|-------|--|----------------------|--|-------------------------------------|
| 5D<br>6D               | 120/240<br>240/480   | 3     | 60   | SERIES DELTA         |  | 5D & 6D NOT RECONNECTABLE<br>       |
| 17<br>517              | 120/208<br>127/220<br>139/240<br>110/190<br>115/200<br>120/208<br>127/220            | 3     | 60<br>60<br>60<br>50<br>50<br>50<br>50       | PARALLEL WYE         |  |                                     |
| 7<br>17<br>517         | 220/380<br>240/416<br>254/440<br>277/480<br>220/380<br>230/400<br>240/416<br>254/440 | 3     | 60<br>60<br>60<br>60<br>50<br>50<br>50<br>50 | SERIES WYE           |  | 7 NOT RECONNECTABLE<br>             |
| 9X                     | 347/600  | 3     | 60   | SERIES WYE           |  | 9X NOT RECONNECTABLE<br>            |

SINGLE PHASE — NOT AVAILABLE

YB SERIES GENERATORS

FIGURE 11. OPTIONAL VOLTAGE CONNECTIONS

## Load Balancing

When connecting loads to the generator set, balance the loads so the current flow from each line terminal (L1, L2, and L3) is about the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading can be used as long as each line current is about the same, within 10 percent of median value, and no line current exceeds the nameplate rating of the generator. Check the current flow from each line after connections by observing the control panel ammeter, or using an ammeter at the bus bar load terminals.

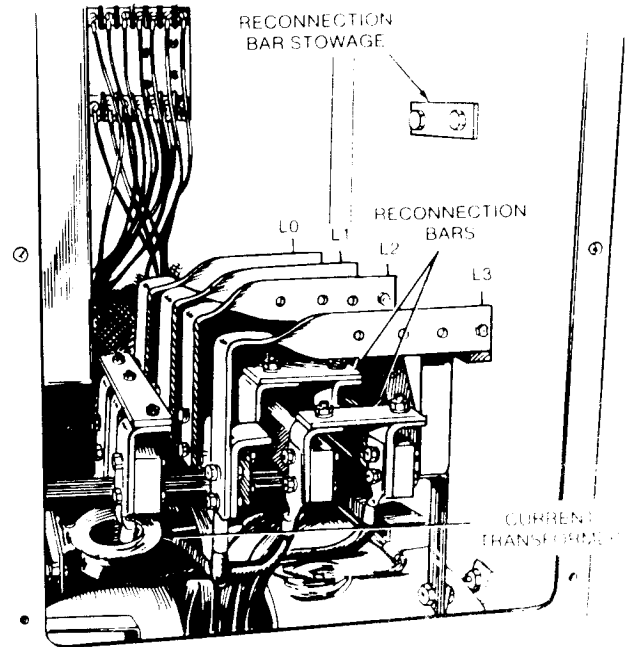
## Grounding

Grounding involves making a conducting connection between the metal parts of the generator set or one of its electrical circuits and the earth. The design and installation of a grounding system is affected by many factors such as the use of multiple transformers, ground fault protection requirements, and physical location of the generator. Follow the recommendations of the consulting engineer when installing the grounding system.

### **⚠WARNING**

**Contact with electrical equipment can result in severe personal injury or death. It is extremely important that bonding and equipment grounding be properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.**

Typical requirements for bonding and grounding are given in the National Electrical Code, 1984 Article 250. All connections, wire sizes, etc. must conform to the requirements of the electrical codes in effect at the installation site.

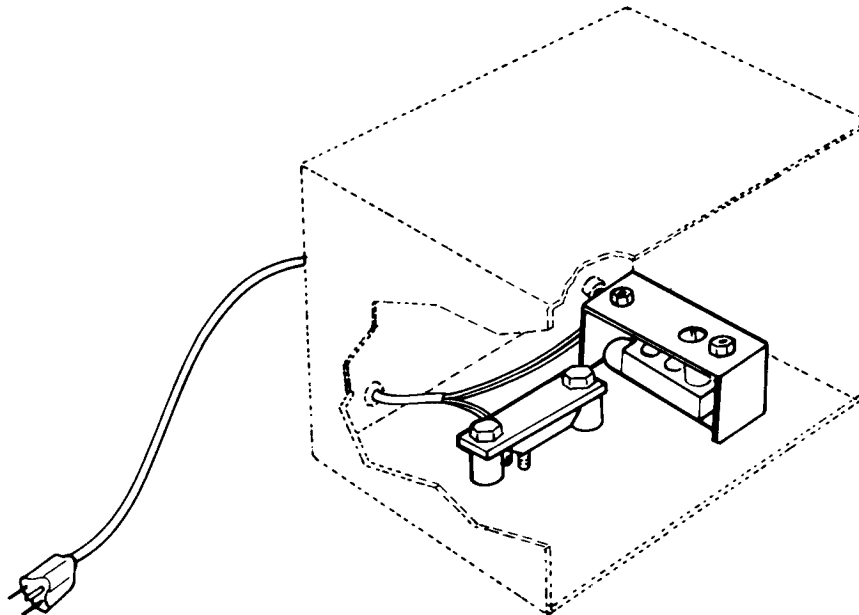


ES-1337

FIGURE 12. RECONNECTION BARS

## Control Heater (Optional)

A control heater provides a means of humidity/temperature control of the control box interior to protect the components and ensure their effectiveness when the generator set is subjected to varying ambient air conditions during extended periods of non-use (see Figure 13). The element is controlled by an adjustable thermostat.



ES-1563-3

FIGURE 13. CONTROL HEATER

## DC WIRING

### Remote Control Connections

Provisions are made inside the control box for addition of optional remote starting and alarms. Connections are made on the terminal block (TB1) located on the engine monitor circuit board (A-11). Connect one or more remote switches across remote terminal and B+ terminal (see Figure 14).

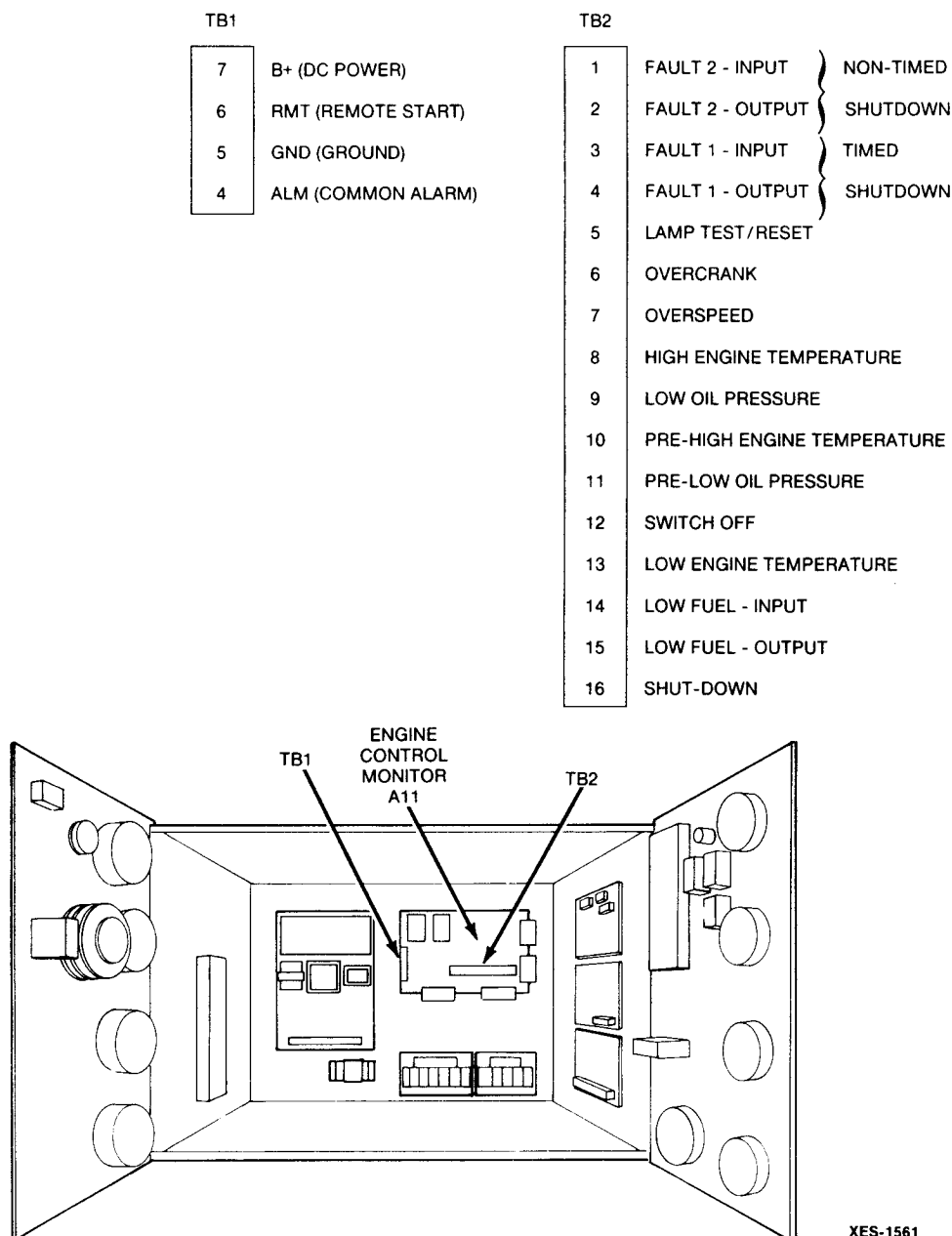
If the distance between the generator set and remote stations is less than 1000 feet (305 m), use 18 gauge stranded copper wire. If the distance is 1000 to 2000 feet (305 to 610 m), use 16 gauge stranded copper wire. Always run control circuit wiring in a separate conduit from the AC power cables to avoid inducing currents that could cause problems within the control.

### Remote Monitor Connections

Provisions are made inside the control box for addition of optional remote monitoring on these generator sets employing optional Detector 12 Control (12 light panel). Connections are made on the terminal block (TB2) located on the engine monitor circuit board (A11).

#### **CAUTION**

**Do Not install DC control wiring in the same conduit as the AC power. AC voltage induced currents can create operational problems with electronic solid-state devices.**



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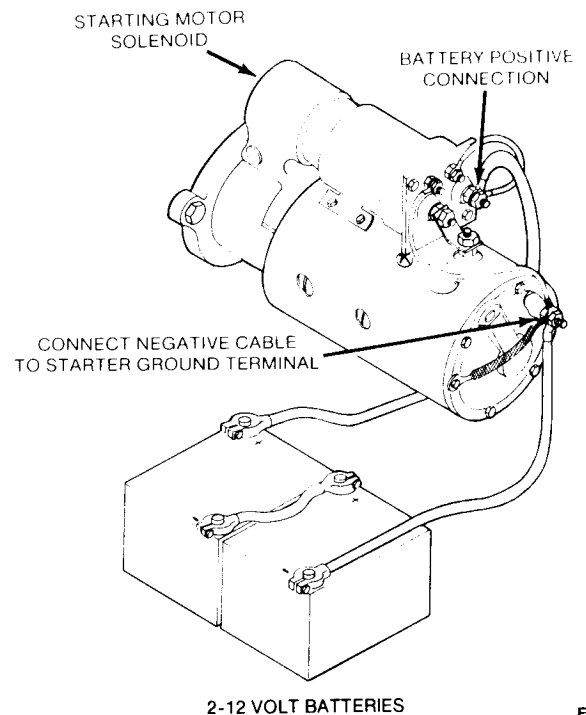
FIGURE 14. REMOTE CONTROL AND REMOTE MONITOR CONNECTIONS



## Battery Connections

Starting the unit requires 24-volt battery current. Use two 12-volt (see *SPECIFICATIONS*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as shown in Figure 15. Normal installation battery cables are included. Increase the cable size if batteries are located remotely from generator set. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a special float charger.

**⚠ WARNING** *Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.*



ES-1256

**FIGURE 15. BATTERY CONNECTIONS**

# Prestart Preparations

Before attempting the initial starting of the generator set, be sure it is serviced and ready for operation. Fill the coolant, lubrication and fuel systems and prime the lubrication and fuel systems.

## COOLANT

Engine coolant is drained prior to shipment. Before starting, fill the coolant system with the recommended coolant per the Operators Manual *MAINTENANCE* section, Coolant instructions.

## LUBRICATION

Engine lubrication is drained prior to shipment. Before starting, fill and prime the lubrication system with oil as follows:

1. Remove oil inlet line from turbo-charger housing (Figure 16), fill bearing housing with clean engine lubricating oil; replace line, secure.
2. Fill crankcase to "L" (low) mark on dipstick (Figure 17).
3. Remove plug from head of oil filter housing (Figure 16) and connect a hand or motor-driven priming pump from a source of clean lubricating oil to the plug boss in filter housing.
4. Prime until a 30 psi (207 kPa) pressure is obtained.
5. Disconnect wire from fuel solenoid valve (Figure 18), close throttle and crank engine while maintaining an external prime pressure of 15 psi (103 kPa), for 15 seconds.
6. Remove external priming equipment, replace plug in filter housing and torque to 15 to 20 ft. lb. (20 to 27 N•m).
7. Reconnect wire to fuel shut-off valve.
8. Complete oil fill to "H" (high) mark on dipstick.

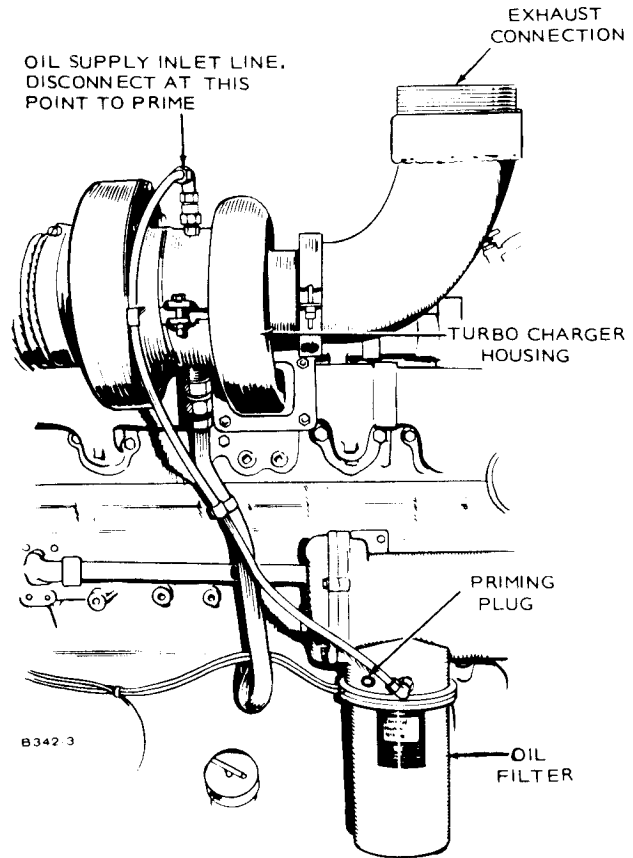


FIGURE 16. PRIMING TURBOCHARGER

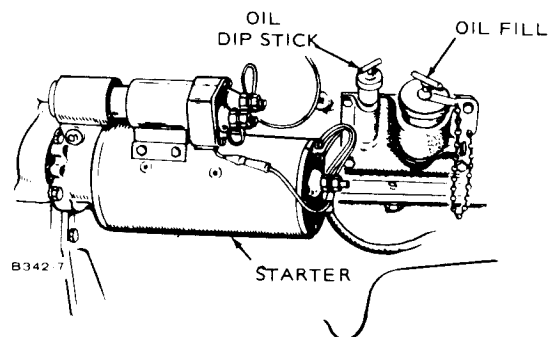


FIGURE 17. OIL FILL AND DIPSTICK LOCATION

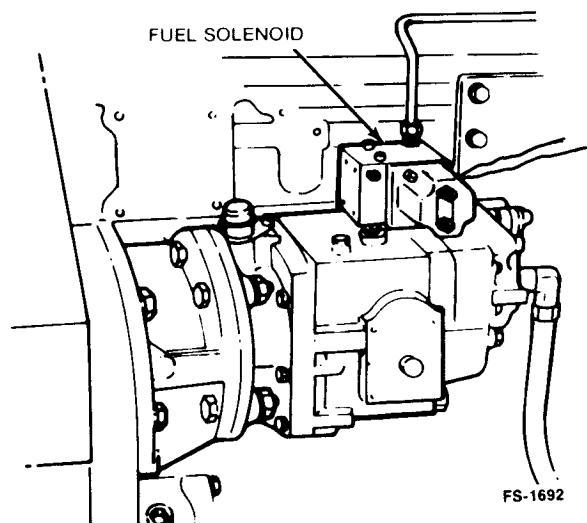


FIGURE 18. FUEL SOLENOID VALVE LOCATION

## FUEL SYSTEM

Engine fuel may not be primed at the fuel filters after shipment. To verify and reprime the fuel system perform the following procedure:

1. Remove each fuel filter (Figure 19) and fill with clean fuel.
2. Put a light coat of fuel on the sealing gasket.
3. Install and tighten by hand until the gasket just touches the filter head.
4. Tighten the filter an additional one-half to three-fourths of a turn.

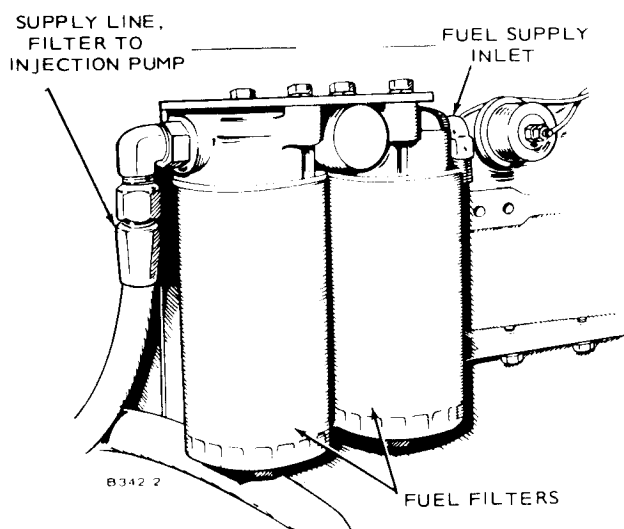


FIGURE 19. FUEL FILTERS

## VENTILATION

Verify all air vents and ducts are open and free of any obstructions. Verify dampers, if used, operate properly.

## EXHAUST SYSTEM

Check the exhaust system for proper installation. Verify there is at least 12 inches (305 mm) clearance between exhaust pipes and any combustible materials.

## ELECTRICAL SYSTEM

Verify all electrical connections are secure and all wiring is complete. Replace and secure any access panels that may have been removed during installation.

### Battery Connections

Use two 12-volt batteries for a normal installation. Connect positive battery cable before connecting negative battery cable to prevent arcing.

Service the battery as necessary. If an automatic transfer switch is not used or is installed without a built-in charge circuit, connect a separate trickle charger to the battery.

### Load Connections

Check that load cables from generator set are properly connected to either a transfer switch or circuit breaker panel.

## MECHANICAL CHECK

Check the generator set for loose or damaged components and repair or replace as required.

# Initial Start and Checks

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Before putting the generator set under load conditions, verify the generator set will perform correctly by checking the following areas.

## STARTING

Move the Run/Stop/Remote switch on the engine control panel to the RUN position. The starter should crank the engine and the engine should start within a few seconds. If after a few seconds of cranking the engine fails to start or starts, runs, and then stops and the fault lamp lights, refer to the Troubleshooting chart in the Operators Manual.

## ENGINE GAUGES

Check the following while the generator set is operating.

### Oil Pressure Gauge

The oil pressure should be in the range of 50 to 70 psi (345 to 483 kPa) when the engine is at operating temperature.

### Water Temperature Gauge

The water temperature should be in the range of 165° to 195°F (74° to 91°C) depending on the load and ambient temperature.

### DC Ammeter

The maximum charge rate for the set mounted battery charging alternator is 35 amperes. Charge rate should taper to zero following start-up as battery becomes charged.

## AC METERS (IF EQUIPPED)

Note the AC instruments on the control panel. The frequency meter and voltmeter should indicate rated nameplate frequency and voltage. Turn the control panel Voltage Adjust control (if equipped) for nameplate voltage. Use the Phase Selector Switch to read each of the line-to-line voltages.

If unit does not have control instruments or a Voltage Adjust control on the front panel, proceed to Generator Voltage Checks section of this manual.

Check the following while the generator set is operating.

### Frequency Meter

The generator frequency should be stable and the reading should be the same as the nameplate rating (50 or 60 Hz).

### AC Voltmeter

Turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2 on single phase sets; L1-L2, L2-L3, and L3-L1 on three phase sets). Read the AC voltmeter using the upper or lower scale as indicated by the scale indicator light. At no load, the line-to-line voltage should be the same as the set nameplate rating.

### AC Ammeter

Turn the phase selector switch to each phase selection shown on the amperes scale (L1 and L2 on single phase sets; L1, L2, and L3 on three phase sets). Read the ammeter using the upper or lower scale as indicated by the scale indicator light. At no load, the current readings should be zero. With a load applied, each line current should be approximately the same and no line current should exceed the set nameplate rating.

## ENGINE MONITOR INDICATOR LAMPS

Move the Run/Stop/Remote switch on the engine panel to the stop position. Hold the Reset/Lamp Test switch in the Test position. All indicator lamps should light. Verify all of the lamps are on and then release the switch. Contact an Onan distributor if any lamps require replacement.

## GENERATOR VOLTAGE CHECKS

Generator voltage checks consist of two possible procedures dependent on generator set meters (Detector AC Option).

The generator voltage may be adjusted within 5% of the rated nameplate voltage through external control panel mounted or internal voltage regulator mounted potentiometers. The internal potentiometer also adjusts the range of the external potentiometer.

Move the Run/Stop/Remote switch on the engine control panel to the Run position. Check the following while the generator set is operating.

### Generator Voltage Adjust (Detector AC Option)

This procedure pertains to generator sets equipped with Detector AC option only. The AC option consists of meters, switches and a voltage adjusting R21 potentiometer on the control front panel.

1. Operate Phase Selector switch to read generator output current and voltage and perform the following steps:
  - A. Insert a screwdriver into the Voltage Adjust R21 potentiometer located on the front of the generator set control and using a wrench carefully loosen the locking nut.

- B. While observing the voltmeter, slowly turn the screwdriver clockwise to increase voltage or counterclockwise to decrease voltage, and adjust to the rated nameplate voltage.

If correct voltage cannot be attained through this adjustment, proceed to Voltage Regulator Adjustment procedure.

- C. After setting correct voltage, retighten locking nut being careful not to change the adjustment.

2. Operate Phase Selector switch to the Off position.

### Voltage Regulator Adjustment

This procedure pertains to generator sets equipped with Detector AC option only. The procedure performs the adjustment range centering of voltage adjust R21 potentiometer located on the control front panel.

1. Operate Phase Selector switch to read generator output current and voltage and perform the following steps:
  - A. Insert a screwdriver into the Voltage Adjust R21 potentiometer located on the front of the generator set control and using a wrench carefully loosen the locking nut.
  - B. Turn screwdriver to set adjustment screw to the mid-position and retighten locking nut being careful not to change the adjustment.

**⚠WARNING** *High voltages in the control present an electrical shock hazard which can cause severe personal injury or death. Proceed with care!*

- C. Open control panel doors, locate VRAS-2 (upper left), and refer to Figure 20 to locate R32 potentiometer.

- D. While observing the voltmeter, insert a screwdriver into R32 potentiometer and slowly turn to increase or decrease voltage until adjusted to the rated nameplate voltage.

2. Close control panel doors and operate Phase Selector switch to the Off position.

### Generator Voltage Adjust (Without Detector AC Option)

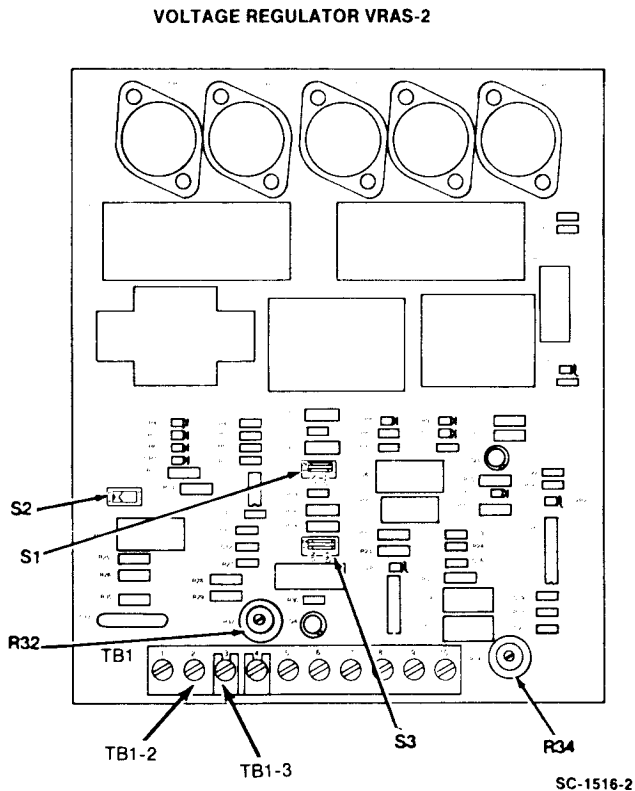
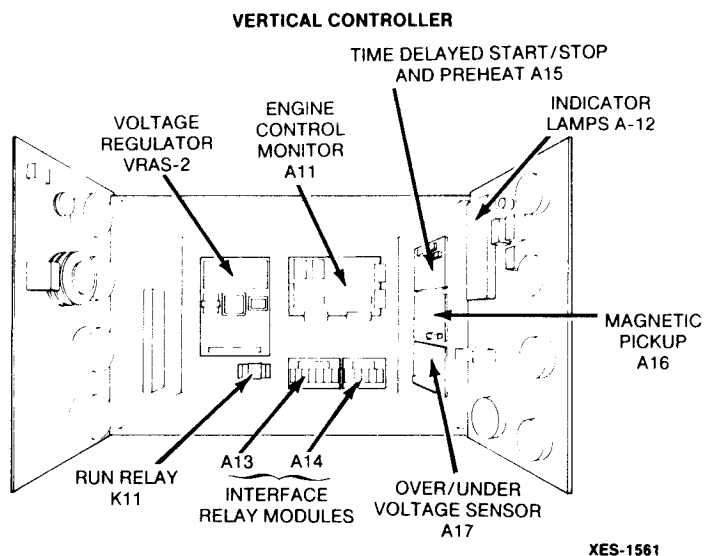
This procedure pertains to the voltage adjustments of a generator set that does not have the Detector AC option.

**⚠WARNING** *High voltages in the control present an electrical shock hazard which can cause severe personal injury or death. Proceed with care!*

1. Open control panel doors, locate VRAS-2 (upper left), and refer to Figure 20 to locate terminal board TB1 and T32 potentiometer.
2. Connect an accurate 2% voltmeter to VRAS-2 terminal board TB1-2 and TB1-3 terminals (Figure 20).
3. While observing the voltmeter, insert a screwdriver into R32 potentiometer and slowly turn to increase or decrease voltage until adjusted to the rated nameplate voltage.
4. Disconnect voltmeter from TB1 and close control panel doors.

### GENERATOR FREQUENCY CHECK

The generator frequency is a result of engine speed, which is automatically controlled. If generator frequency is below specification contact an Onan distributor.



**FIGURE 20. VRAS-2 VOLTAGE REGULATOR ASSEMBLY**

**TABLE 2. VRAS-2 SWITCH SETTINGS**

| STABILITY RANGE |      | REGULATION MODE       |      |      |                       |      |      |                     |      |      |
|-----------------|------|-----------------------|------|------|-----------------------|------|------|---------------------|------|------|
|                 |      | 60 Hz TORQUE-MATCHING |      |      | 50 Hz TORQUE-MATCHING |      |      | NON-TORQUE-MATCHING |      |      |
| S1-1            | S1-2 | S2                    | S3-1 | S3-2 | S2                    | S3-1 | S3-2 | S2                  | S3-1 | S3-2 |
| ON              | ON   | POS 2                 | OFF  | ON   | POS 2                 | ON   | ON   | POS 2               | OFF  | OFF  |

- Switch S1 - Selects the overall range of operation for the regulator. Refer to Table 2.
- Switches S2 and S3 - Determine the mode of regulation (Torque-Matched, or Non-Torque-Matched). Refer to Table 2.
- Potentiometer R32 - Provides adjustability to increase or decrease generator voltage to achieve proper setting.
- Potentiometer R34 - Is adjusted at the factory to set the frequency breakpoint, and does not require further adjustment.

## EXHAUST SYSTEM

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, muffler, turbocharger and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. Make sure exhaust pipes are not heating surrounding areas excessively. If any leaks are detected, have them corrected immediately.

**▲WARNING** *Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Repair any leaks immediately.*

## FUEL SYSTEM

With the generator set operating, inspect the fuel supply lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks, and abrasions and make sure they are not rubbing against anything that could cause breakage.

**▲WARNING** *Leaking fuel will create a fire hazard that can result in severe personal injury or death if ignited by a spark. If any leaks are detected, have them corrected immediately.*

## DC ELECTRICAL SYSTEM

With the generator set off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance that can hinder starting. Clean and reconnect the battery cables if loose. Always connect the negative battery cable last.

**▲WARNING** *Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.*

## COOLING SYSTEM

When the engine is first started, remove the pressure cap and monitor the coolant level. As trapped air is expelled from the system, the coolant level will drop and additional coolant should be added. Replace the pressure cap when the coolant level is stable.

**▲WARNING** *Contact with hot coolant can result in severe burns. Allow cooling system to cool before releasing pressure and removing the radiator cap.*

## MECHANICAL ADJUSTMENTS

With the generator set stopped, check for loose belts and fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately.

With the set running, listen for any unusual noises that may indicate mechanical problems and check the oil pressure frequently. Investigate anything that indicates possible mechanical problems. Refer to the Operators Manual for any necessary adjustments.







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