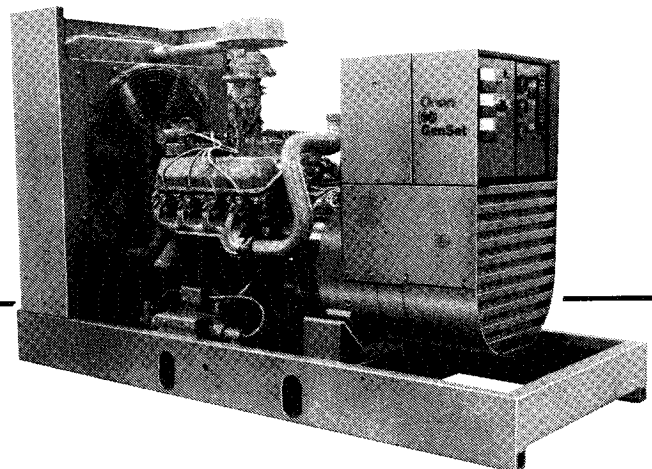


Onan

Installation Manual

EN, ENT GenSets



928-0603
2-91

Printed in U.S.A.

Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

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

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

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

FUEL AND FUMES ARE FLAMMABLE. Fire and explosion can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.

- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- 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 surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

GENERAL SAFETY PRECAUTIONS

- 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. Allow the generator set to cool and bleed the system pressure first.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

Table of Contents

| TITLE | PAGE |
|--------------------------------------|--------------------|
| SAFETY PRECAUTIONS | Inside Front Cover |
| INTRODUCTION | 2 |
| About this Manual | 2 |
| Installation Overview | 2 |
| SPECIFICATIONS | 3 |
| MOUNTING THE GENERATOR SET | 4 |
| General | 4 |
| Location | 4 |
| Mounting | 4 |
| Access to Set | 4 |
| MECHANICAL CONNECTIONS | 5 |
| Fuel System | 5 |
| Exhaust System | 5 |
| Ventilation and Cooling System | 6 |
| ELECTRICAL CONNECTIONS | 9 |
| AC Wiring | 9 |
| DC Wiring | 12 |
| INITIAL START AND CHECKS | 14 |
| Starting | 14 |
| Engine Gauges | 14 |
| AC Meters | 14 |
| Engine Monitor Indicator Lamps | 14 |
| Generator Voltage Checks | 14 |
| Generator Frequency Check | 15 |
| Exhaust System | 17 |
| Fuel System | 17 |
| DC Electrical System | 17 |
| Cooling System | 17 |
| Mechanical Adjustments | 17 |

IMPORTANT

DEPENDING ON YOUR LOCATION AND INTENDED USE, FEDERAL, STATE OR LOCAL LAWS AND REGULATIONS MAY REQUIRE YOU TO OBTAIN AN AIR QUALITY EMISSIONS PERMIT BEFORE BEGINNING INSTALLATION OF YOUR GENSET. BE SURE TO CONSULT LOCAL POLLUTION CONTROL OR AIR QUALITY AUTHORITIES BEFORE COMPLETING YOUR CONSTRUCTION PLANS.

Introduction

ABOUT THIS MANUAL

This manual provides specific installation instructions for the EN generator set. 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.
- Initial Startup — Test complete system for proper installation, satisfactory performance, and safe operation.

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 EN specification and product data sheets. For general application information about generator set installation, refer to the following Onan Technical Bulletins.

| | |
|-------------|--|
| T-009/T-017 | — Selecting Onan Generator Sets |
| T-015 | — Application Information for Gaseous Fuels |
| T-030 | — Installation Information for Liquid-Cooled GenSets |

Bulletins T-015 and T-030 are particularly useful installation references and are shipped with this manual. Bulletin T-009/T017 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.

⚠ WARNING

INCORRECT 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 SERVICE.

Application and Installation

A standby power system must be carefully planned and correctly installed for 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 so all components are assembled using standard methods and practices.

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 INSTRUCTIONS

| SYSTEMS | 60 EN | 70 EN | 75 ENT |
|---|--|--|--|
| Fuel System Inlet Size Natural Gas Propane Vapor Gasoline | 3/4 inch NPT 3/4 inch NPT 1/8 inch NPT | 3/4 inch NPT 3/4 inch NPT 1/8 inch NPT | 1 inch NPT 3/4 inch NPT N/A |
| Exhaust System Connection Size Backpressure (Maximum allowable) | 3 inch NPT 20.4 inches H ₂ O | 3 inch NPT 20.4 inches H ₂ O | 2-1/2 inch NPT 20.4 inches H ₂ O |
| Electrical System Starting Voltage | 12 Volts DC | 12 Volts DC | 12 Volts DC |

Mounting the Generator Set

GENERAL

Most generator set installations must be engineered so 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.

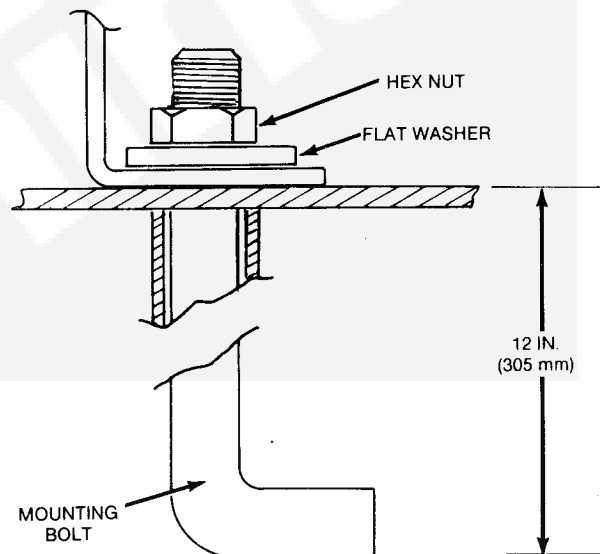
Provide a location away from extreme ambient temperatures and protect the generator set from adverse weather conditions. An optional housing is available for outside operation.

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.

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 1).



M-1627

FIGURE 1. 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

Fuels under pressure (such as natural gas or LPG) must be controlled by a positive shut off valve, preferably automatic, in addition to any valve integral with the carburetor or gas regulator equipment.

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

Fuel Connections

Sets can be equipped to operate on gasoline only; LPG (liquid or vapor); and gasoline/natural gas, gasoline/LPG, and LPG/natural gas combinations.

Identification tags are attached to the fuel supply line and fuel return line connections at the factory. Flexible lines for connecting between the engine and the stationary fuel line are supplied as standard equipment. Refer to the Specifications section for the fitting sizes. Refer to Technical Bulletin T-015 for typical fuel system schematics and regulator selection tables.

Natural Gas: Gas piping should be sized to ensure that gas pressure at the carburetor is a minimum of 3 inches H₂O with the engine running at rated speed and rated load. If the pressure is excessive, install a suitable pressure reducing regulator. Use a short length of approved flexible connection between the supply pipe and the set regulator inlet.

Be sure to comply with all local regulations such as:

- Recommended electric shutoff valve
- Manual shutoff valve at the fuel source
- Supply line filter

Gasoline Fuel: Connection of gasoline fuel inlet line requires a 1/8 inch pipe fitting to an adapter.

Fuel lift should not exceed 6 feet (2m). Horizontal distance between set and fuel tank should not exceed 50 feet (15 m). Use 3/8 inch tubing up to 25 feet (7.6 m), 1/2 inch tubing up to 50 feet (15 m).

Combination Gas-Gasoline: Combination gas-gasoline sets are designed for normal operation on gas fuel, with provision for emergency operation on gasoline. Both gas and gasoline procedures must be followed. A reservoir tank is sometimes provided, so a fuel return line may be necessary.

EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlet away from any air inlets so exhaust gases will not re-enter 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 so 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 provide a tight exhaust system.*

Use an approved thimble (Figure 2) where exhaust pipes pass through wall or partitions. Refer to NFPA 37, Section 6-3, "Stationary Combustion Engines and Gas Turbines" for accepted design practices. Build according to the code requirements in effect at the installation site.

⚠ 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.*

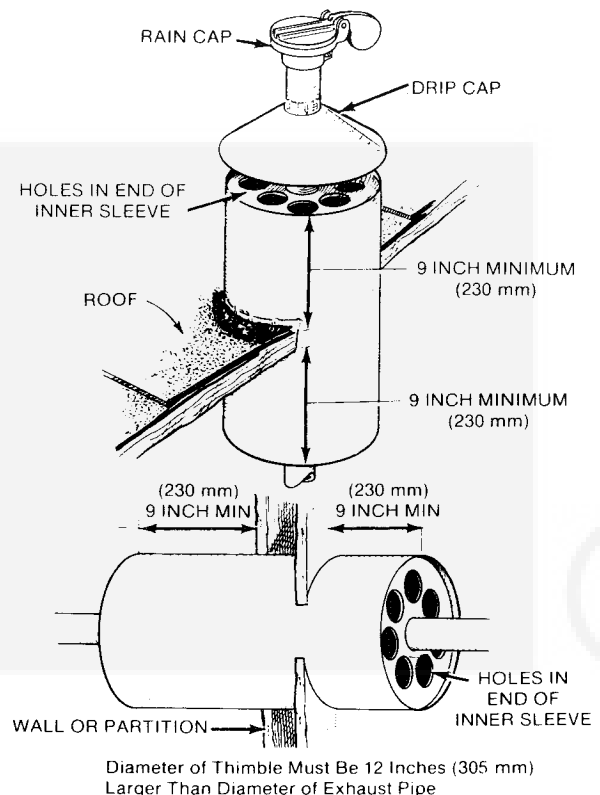


FIGURE 2. EXHAUST THIMBLE

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 3).

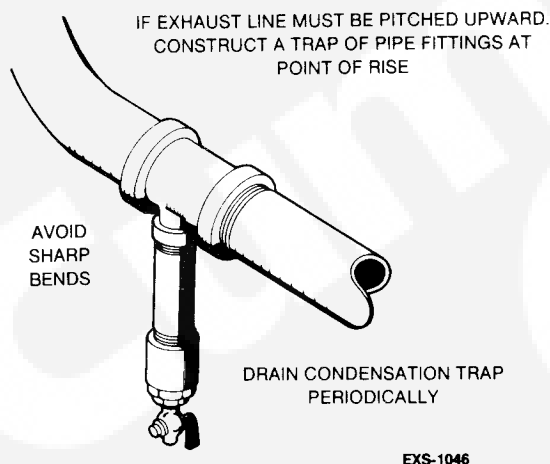


FIGURE 3. EXHAUST CONDENSATION TRAP

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 AND COOLING 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.

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.

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 EN 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 transformer 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

Damper or louvers protect the GenSet and equipment room from the outside environment. Their operation of opening and closing should be controlled by the operation of the GenSet(s). There are four main categories of dampers:

1. Automatic - The dampers open any time the GenSet runs.
2. Manual - This damper is opened and closed manually.
3. Thermostatically controlled - This damper is controlled by thermostats which sense either water or air outlet temperatures.
4. Fixed - This damper is permanently open and can not be closed.

In cooler climates, movable or discharge dampers are used. These dampers allow the heated air to be recirculated back to the equipment room. This enables the equipment room to be heated while the GenSet engine is still cold, increasing the engine efficiency.

Radiator Set Requirements

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

Locate the cooling air outlet directly in front of the radiator and as close as possible. The outlet opening must be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to airflow.

The radiator has an air discharge duct adapter flange. Attach a canvas or sheet metal duct to the flange and the air outlet opening using screws and nuts so duct can be removed for maintenance purposes. The duct prevents recirculation of heated air. Before installing the duct, remove the radiator core guard.

Standard Radiator Cooling uses a set mounted radiator and engine drive pusher type fan to cool engine water jacket. Air travels from the generator end of the set, across the engine and out through the radiator. An integral discharge duct adapter flange surrounds the radiator grille.

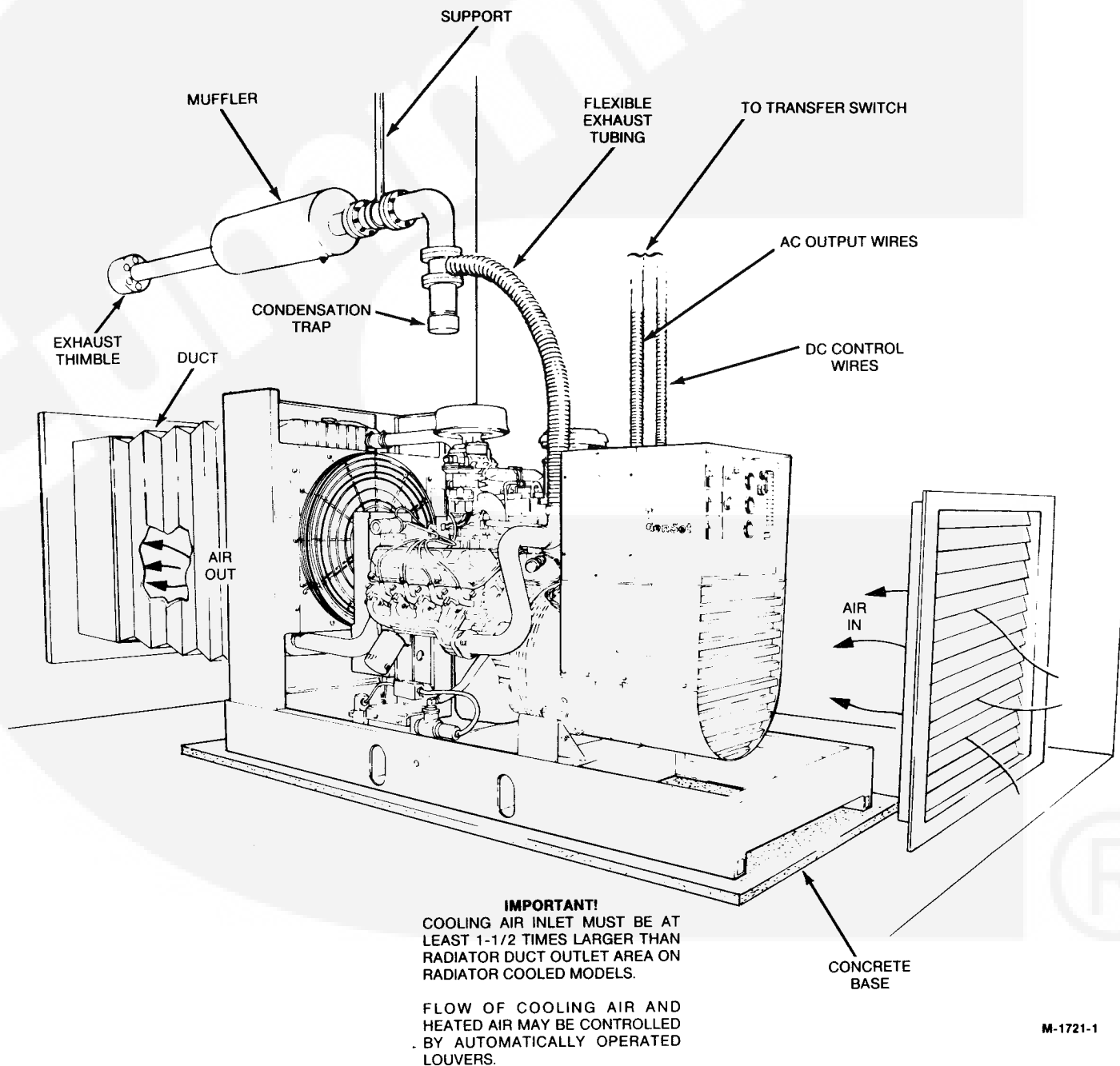


FIGURE 4. TYPICAL INSTALLATION

Remote Radiator Cooling (optional), substitutes a remote mounted radiator and an electrically driven fan for the set mounted components. Removal of the radiator and fan from the set reduces noise levels without forcing dependence on a continuous cooling water supply. The remote radiator system must be completely protected against freezing.

This system must be designed to meet specific requirements of the application.

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

Remote radiator plumbing will vary with installation. Follow recommendations in T-030. See product data sheet for friction head and static head limits.

Water Jacket Heater (optional) can be installed to keep the engine warm for starting under adverse weather conditions. Figure 5 shows the mechanical installation for the heater. Connect the heater to a power source that will be on when the engine is NOT running. Refer to the Electrical Connections section to ensure the voltage rating is correct for the heater element.

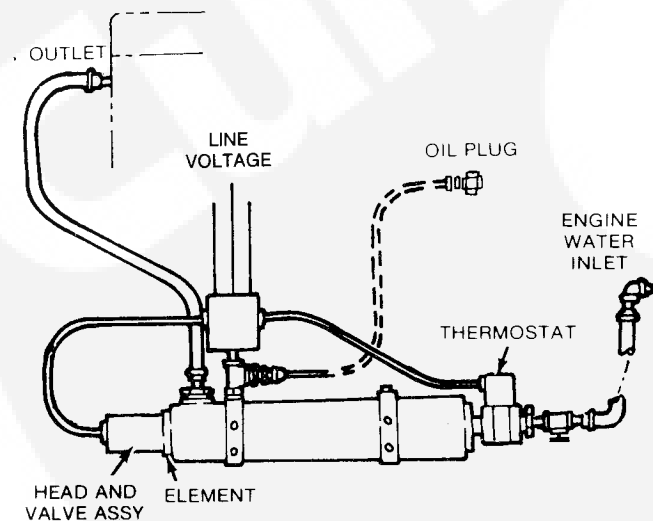
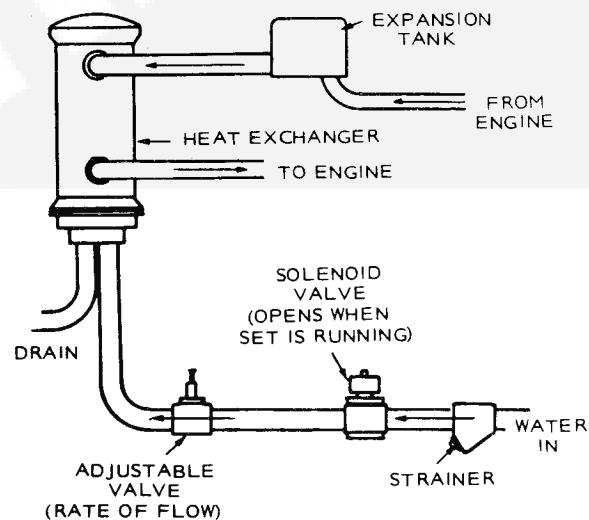


FIGURE 5. WATER JACKET HEATER

Heat Exchanger Cooling (optional) uses a shell and tube type heat exchanger instead of the standard radiator and fan (see Figure 6). 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.



CS-1323

FIGURE 6. TYPICAL HEAT EXCHANGER COOLING SYSTEM

Electrical Connections

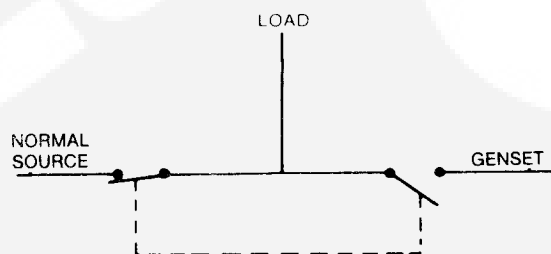
The generator set electrical system installation includes connecting the load, installing the control wiring, and connecting the batteries. The batteries should be connected last to avoid accidental starting of the unit during installation.

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.

⚠ WARNING *Improper wiring can result in fire and severe personal injury or death. Do not allow electrical wiring to touch the fuel line.*

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 7). 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 can supply transfer switches to match the generator rating if required.



SC-1101

**FIGURE 7. 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 Codes E, F and H): These generators are wired at the factory for a specific voltage and are not intended for reconnection. The voltage and corresponding current rating (amperes) are shown on the nameplate.

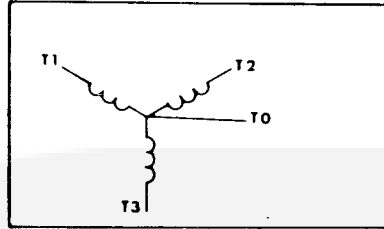
Reconnectible Generators (Voltage Codes L and Z): Generators with codes L (for 60 Hertz) and Z (for 50 Hertz) are three phase generators that can be reconnected for any of the voltages shown in Figure 8. Refer to the set nameplate for the corresponding current rating (amperes).

Load Connections

The 12 lead generators with load connection wires ARE NOT connected together in the output box when shipped from the factory. These 12 wires are labeled T1 through T12 and must be brought together before making load connections. Proceed as follows:

1. Remove the right or left panel from output box.
2. Bolt the load wires to the appropriate generator lead wires in the output box according to Figure 8 for required voltage.
3. Insulate the connections.

220/380 VOLT, 3 PHASE, 60 HERTZ (CODE F)
 347/600 VOLT, 3 PHASE, 60 HERTZ (CODE H)

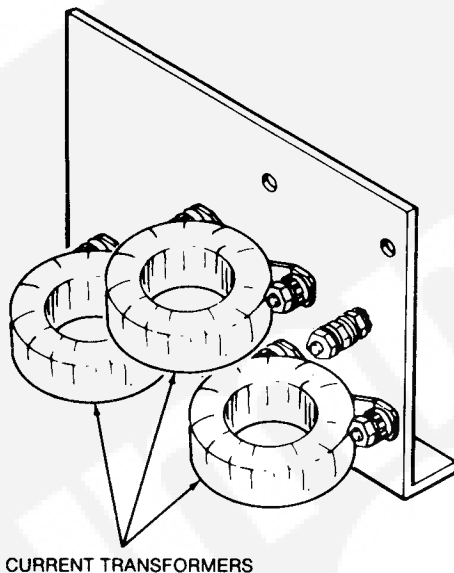


| NAMEPLATE VOLTAGE CODE | | | | GENERATOR CONNECTION | GENERATOR CONNECTION SCHEMATIC DIAGRAM | GENERATOR CONNECTION WIRING DIAGRAM (WITH CURRENT TRANSFORMERS WHEN USED) |
|------------------------|---------|-------|----|----------------------|--|---|
| VOLTAGE | PHASES | HERTZ | | | | |
| L | 120/240 | 1 | 60 | DOUBLE DELTA | | |
| | 115/230 | 1 | 50 | | | |
| | 110/220 | 1 | 50 | | | |
| E | 240/480 | 3 | 60 | SERIES DELTA | | |
| | 120/240 | 3 | 60 | | | |
| | 115/230 | 3 | 50 | | | |
| Z | 110/220 | 3 | 50 | | | |
| L | 120/208 | 3 | 60 | PARALLEL WYE | | |
| | 127/220 | 3 | 60 | | | |
| | 139/240 | 3 | 60 | | | |
| Z | 110/190 | 3 | 50 | | | |
| | 115/200 | 3 | 50 | | | |
| | 120/208 | 3 | 50 | | | |
| L | 240/416 | 3 | 60 | SERIES WYE | | |
| | 254/440 | 3 | 60 | | | |
| | 277/480 | 3 | 60 | | | |
| Z | 220/380 | 3 | 50 | | | |
| | 230/400 | 3 | 50 | | | |
| | 240/416 | 3 | 50 | | | |
| | 254/440 | 3 | 50 | | | |

98C2193

FIGURE 8. GENERATOR VOLTAGE CONNECTIONS

When installing sets with the optional AC ammeter, the generator output leads must be routed through a current transformer for proper meter operation (See Figure 9). The transformers are identified CT21, CT22, and CT23 (three phase only) on the wiring diagram and electrical schematics. Refer to Figure 8 to identify the output leads that must be routed through each transformer. Use a cable tie to secure the loose transformer to the generator output leads.



CURRENT TRANSFORMERS

ES-1702

FIGURE 9. CURRENT TRANSFORMERS

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.

Grounding

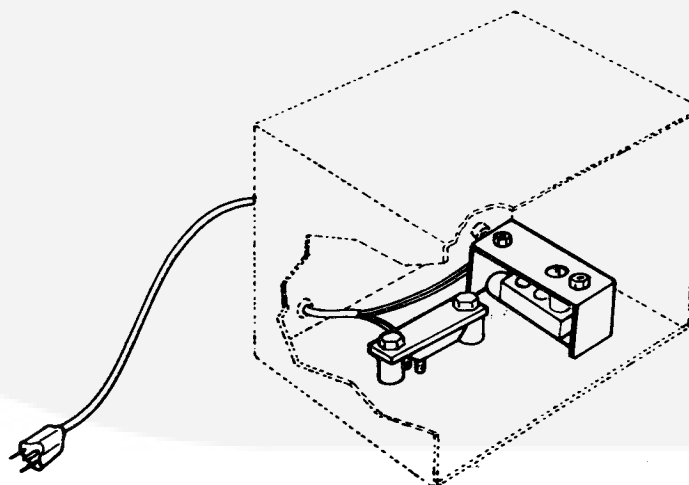
Grounding involves making a conducting connection between the metal parts of the generator set or one of its electrical circuits and the earth. The design and installation of a grounding system is affected by many factors such as the use of multiple transformers, ground fault protection requirements, 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 done properly. All metallic parts that could become energized under abnormal conditions must be properly grounded.

Control Heater (Optional)

A control heater provides a means of humidity/temperature control of the control box interior to protect the components when the generator set is subjected to varying ambient air conditions during extended periods of non-use (see Figure 10). The element is controlled by an adjustable thermostat.



ES-1563-3

FIGURE 10. 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 (A11). Connect one or more remote switches across remote terminal and B+ terminal (see Figure 11).

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

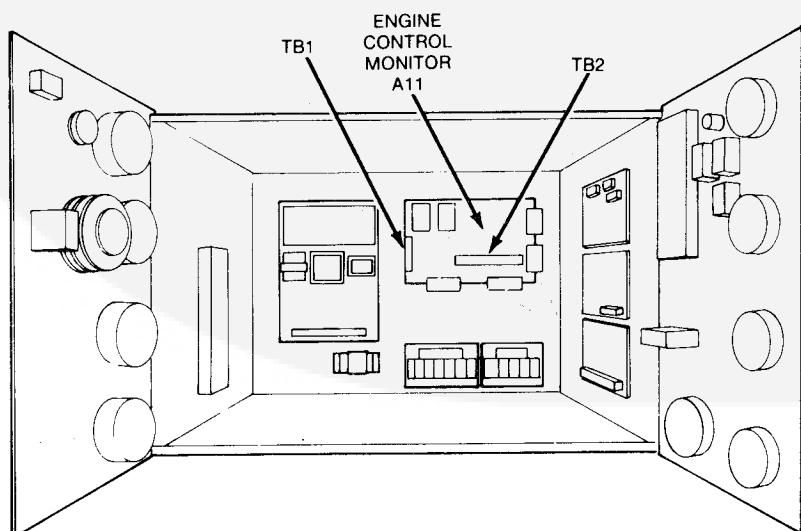
Do Not install DC control wiring in the same conduit as the AC power. AC voltage induced currents can create operational problems with electronic solid-state devices.

TB1

| | |
|---|--------------------|
| 7 | B+ (DC POWER) |
| 6 | RMT (REMOTE START) |
| 5 | GND (GROUND) |
| 4 | ALM (COMMON ALARM) |

TB2

| | | |
|----|-----------------------------|-------------|
| 1 | FAULT 2 - INPUT | } NON-TIMED |
| 2 | FAULT 2 - OUTPUT | |
| 3 | FAULT 1 - INPUT | } TIMED |
| 4 | FAULT 1 - OUTPUT | |
| 5 | LAMP TEST/RESET | } SHUTDOWN |
| 6 | OVERCRANK | |
| 7 | OVERSPEED | |
| 8 | HIGH ENGINE TEMPERATURE | |
| 9 | LOW OIL PRESSURE | |
| 10 | PRE-HIGH ENGINE TEMPERATURE | |
| 11 | PRE-LOW OIL PRESSURE | |
| 12 | SWITCH OFF | |
| 13 | LOW ENGINE TEMPERATURE | |
| 14 | LOW FUEL - INPUT | |
| 15 | LOW FUEL - OUTPUT | |
| 16 | SHUT-DOWN | |



XES-1561

FIGURE 11. REMOTE CONTROL AND REMOTE MONITOR CONNECTIONS

Battery

Starting the unit requires 12 volt battery current. Use one 12 volt (see specification) battery for a normal installation. Connect the battery as in Figure 12.

▲WARNING *Ignition of battery gases can cause severe personal injury. Always connect battery negative last to prevent arcing.*

Necessary battery cables are on unit. Service battery as necessary. Infrequent set use (as in emergency standby service) may allow battery to self-discharge to the point where it cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Onan automatic transfer switches include such a battery charging circuit.

▲WARNING *Do not smoke while servicing the batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.*

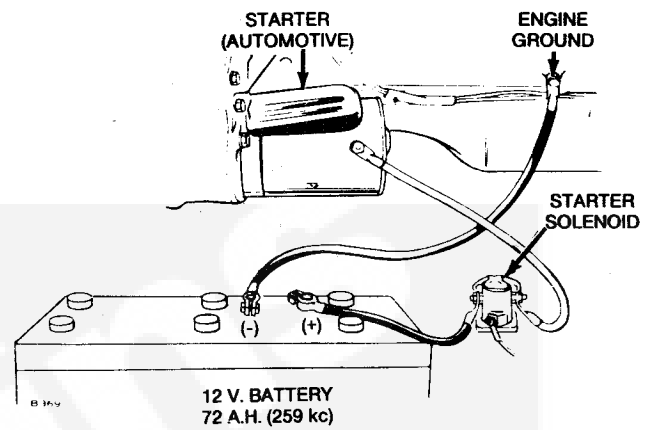


FIGURE 12. BATTERY CONNECTION

Initial Start and Checks

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 read 30 to 55 psi (207 to 380 kPa) when the engine is at operating temperature.

Water Temperature Gauge

The water temperature should be in the range of 165° to 195°F (83° 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 except the Run lamp 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. Refer to Safety Precautions.*

- C. Open control panel doors, locate VRAS-2 (upper left), and refer to Figure 13 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. It applies to any voltage (shown in Figure 8) except series Wye connections.

▲WARNING *High voltages in the control present an electrical shock hazard which can cause severe personal injury or death. Proceed with care following Safety Precautions given on inside front cover of this manual.*

1. Open control panel doors, locate VRAS-2 (upper left), and refer to Figure 13 to locate terminal board TB1 and R32 potentiometer.
2. Connect an accurate 2% voltmeter to VRAS-2 terminal board TB1-2 and TB1-3 terminals (Figure 13).
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.

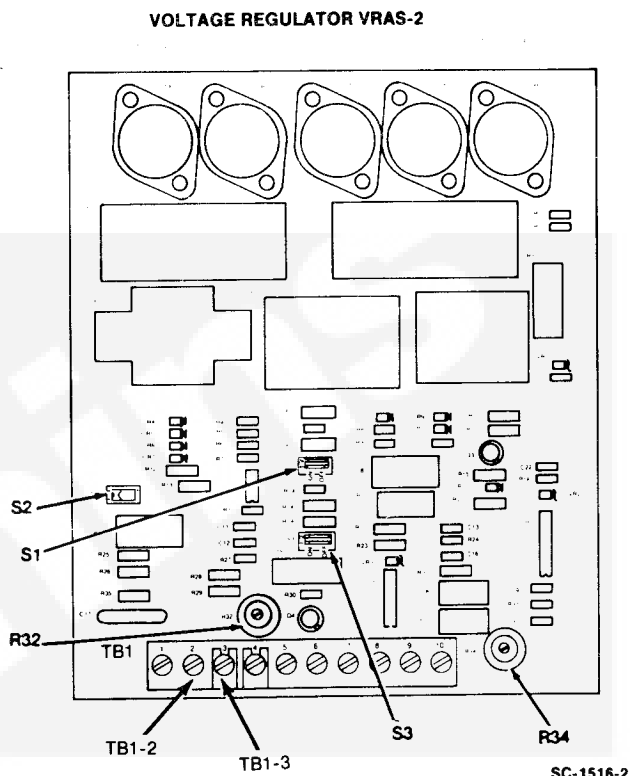
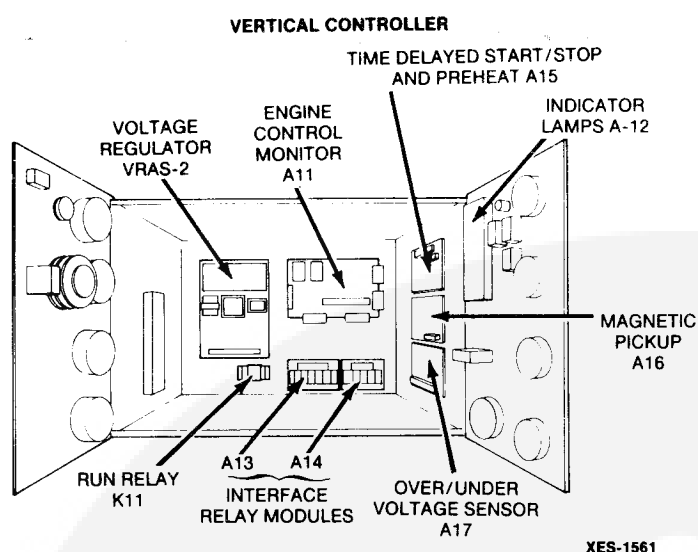


FIGURE 13. VRAS-2 VOLTAGE REGULATOR ASSEMBLY

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 | OFF | 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. Shut down the generator set and repair any leaks immediately.*

FUEL SYSTEM

With the generator set operating, inspect the fuel supply lines, filters, and fittings for leak. 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, cigarette, pilot light, open flame, or other ignition source. If any leaks are detected, shut down the generator set and 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

Before coolant has warmed up, 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 Operator's Manual for any necessary adjustments.



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