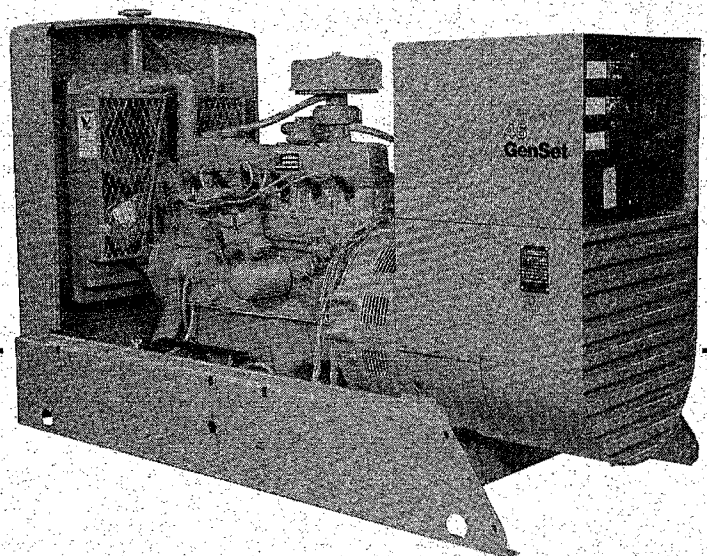




# **Installation Manual EK-EM GenSets**



**928-0602**  
SPEC R  
4/86  
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.

**⚠ DANGER** *This symbol if used 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.*

## 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.



## Product Support Bulletin

Date: 9/1/93 Page 1 of 1 Bulletin No. 585

Subject: OIL LEVEL

Ref. File #

Model(s) or Series: EN SERIES GENSETS WITH SERIAL NUMBERS PRIOR TO MARCH OF 1993 Effective: IMMEDIATELY

Generators powered by the Ford LSG875 engine may exhibit a low oil reading on the dipstick after changing oil.

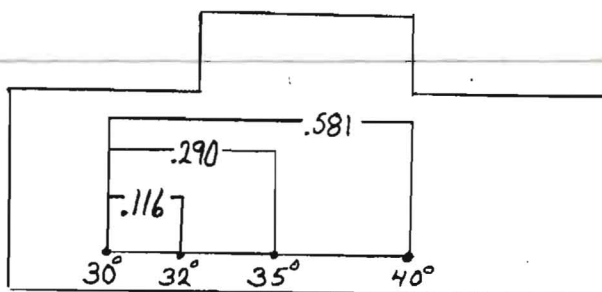
The cause is the dipstick not fully seating on the tube housing due to a restriction at the spot weld area of the tube and bracket. While this will not affect engine operation, it may be a customer concern. Replace the tube with Ford part number E4JL6754BA.

This is not a campaign; standard warranty applies.

### Tech Tip

When timing EN series generators, it is necessary to use an advance-style timing light due to certain fuels requiring degrees of advance past the Ford mark of 30.

If a standard light must be used, mark the damper with the appropriate divisions for that advance requirement.



*Kirk Straight*

Kirk Straight  
Technical Service Representative  
Industrial Products

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# Initial Start and Checks

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

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 EK-EM 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 35 to 60 psi (240 to 415 kPa) when the engine is at operating temperature.

### Water Temperature Gauge

The water temperature should be in the range of 180° 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, connect an accurate external voltmeter. If necessary, adjust R32 on VRAS-2 Voltage Regulator board for nameplate voltage (see Figure 15).

**⚠ WARNING** *High voltages are present within the control cabinet that can cause severe personal injury or death. Proceed with care!*

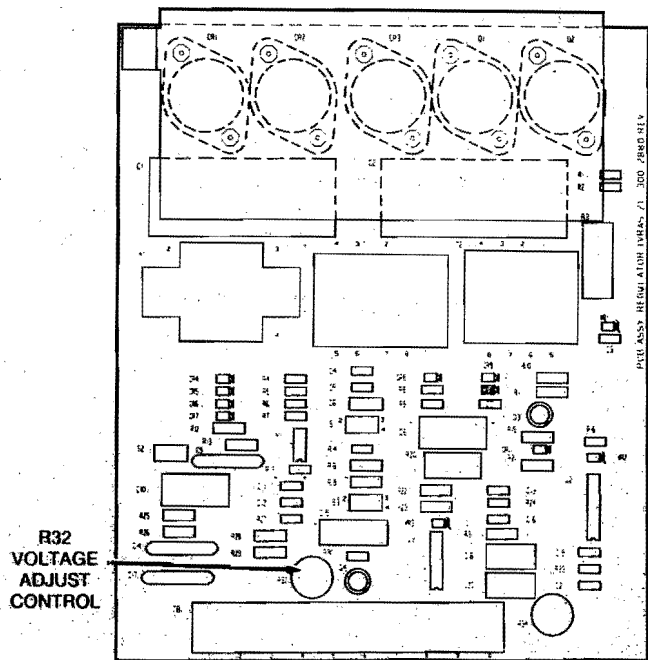


FIGURE 15. VRAS-2 VOLTAGE REGULATOR ASSEMBLY

## **Installation Options**

Several fuel system options have a significant effect on the installation requirements for the generator set. The standard model generator set has a gasoline carburetor and fuel system. Optional fuel systems include LP gas (liquid or vapor), natural gas, and several two-fuel combinations. The installer must be aware of the different installation requirements for each of these options. Refer to the appropriate section of this manual for the specific requirements for each system.

## **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.

## **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.

## Battery Connections

The generator set requires one 12-volt battery, available from Onan as an option, see Figure 14 for a normal installation. The necessary battery cables and battery rack are included with the unit.

When shipped with a generator set, the battery must be serviced and charged. Follow the battery manufacturer's instructions.

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

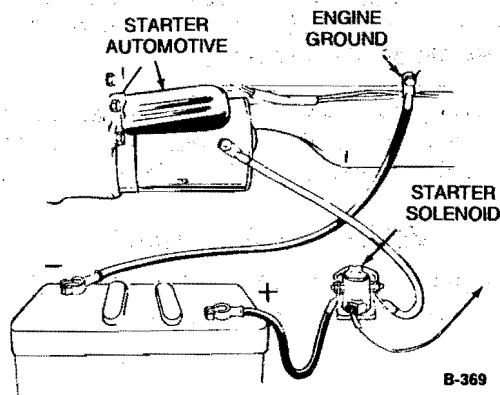


FIGURE 14. BATTERY CONNECTION

Infrequent set use (as in emergency standby service) may allow battery to self-discharge to the point it cannot start the unit. If an automatic transfer switch is being installed with no built-in charge circuit, connect a separate trickle charger. Some Onan automatic transfer switches include a battery charging circuit.

During installation, connect the battery last to avoid accidental starting of the unit. Connect the positive cable first and the negative cable last.

If the battery is installed outside the skid base, use battery cables that are of sufficient size to handle high current loads during cranking. Refer to Table 1 for recommended cable dimensions.

TABLE 1. CABLE SIZE

CABLE LENGTH	4 ft. 1.24 m	5 ft. 1.55 m	7 ft. 2.17 m	9 ft. 2.8 m	11 ft. 3.4 m	14 ft. 4.3 m
CABLE SIZE	2	1	0	00	000	0000

**⚠ WARNING** *Sparks can ignite battery gases and result in an explosion and severe personal injury. Do not disconnect battery cables from battery while generator set is cranking, running, or while the battery is being charged.*

# 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.

To prevent movement, mount the generator set on a substantial and level base such as a concrete pad. Use 5/8-inch diameter, anchored mounting bolts, flat washers and hexagon nuts to secure the generator set skid to the floor (see Figure 1).

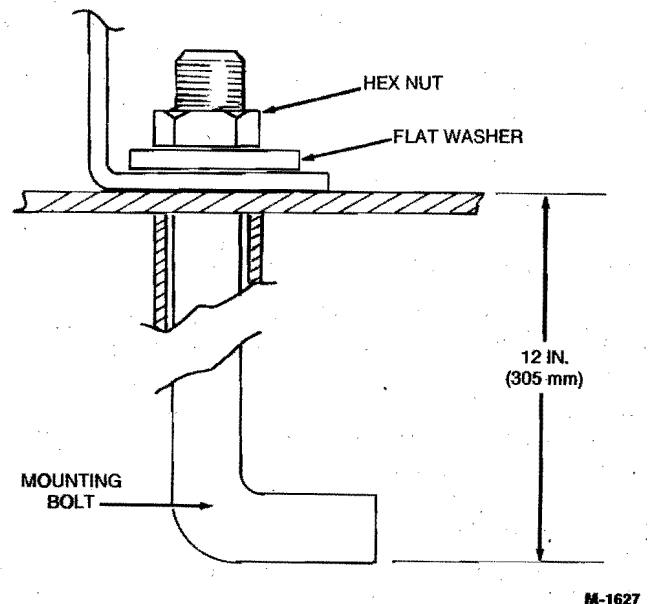


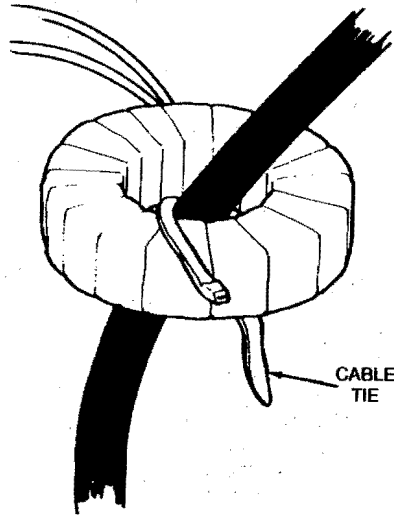
FIGURE 1. BOLT DIAGRAM

## 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. If the generator set is enclosed in the optional housing, provide at least enough clearance to remove the access panels.



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 10). The transformers are identified CT21, CT22, and CT23 (three phase only) on the wiring diagram and electrical schematics. Refer to Figure 9 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.



ES-1624

FIGURE 10. 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 properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.*

## Voltage Regulator

The solid-state regulator (VRAS-2, see Figure 11) controls AC output voltage from the generator at a predetermined level. Voltage is plus or minus 3 percent from no load to full load. Random voltage variation is plus or minus 1 percent for constant loads.

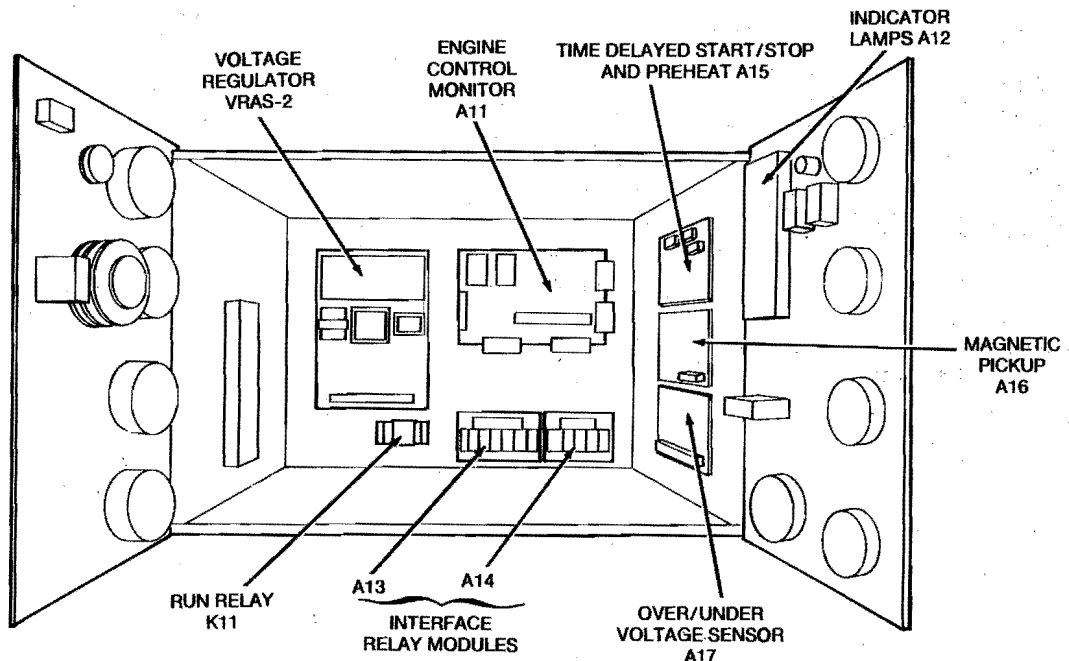


FIGURE 11. CONTROL BOX INTERIOR

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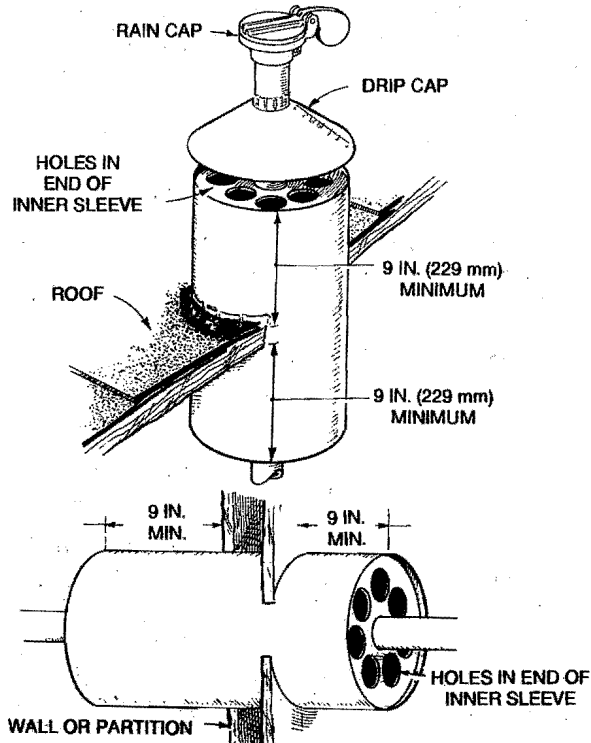
## EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlet away from any 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 3) where exhaust pipes pass through walls 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.

**▲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.*



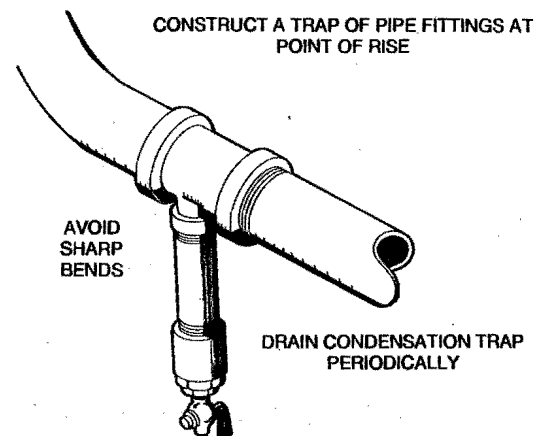
EXS-1036

FIGURE 3. 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 4).



EXS-1046

FIGURE 4. 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.

# Electrical Connections

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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 connect electrical wiring to the fuel line.***

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. 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.

## **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.

**Non-Reconnectible Generators (Voltage Codes 3 or 9X):** 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 15 and 515):** Generators with codes 15 (for 60 Hertz) and 515 (for 50 Hertz) are three phase generators that can be reconnected for any of the voltages shown in Figure 9. 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 9 for required voltage.
3. Insulate the connections.

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 EK and EM 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 louvres 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 louvres. The louvres 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. Refer to Onan Technical Bulletin, T-030, for additional application information.

### 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 driven 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.

**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 set enclosure airflow requirements and noise levels without forcing dependence on a continuous cooling water supply. The remote radiator system can 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. All systems must comply with the following conditions:

1. Make all connections to the set and to the radiator with flexible pipe.
2. Install an auxiliary circulating pump if the horizontal distance between the engine and pump exceeds 15 feet (4.57 m).
3. Install a hot-well system to relieve excess engine water jacket pressure if the top of the radiator is more than 15 feet (4.57 m) above the centerline of the engine crankshaft.

**Water Jacket Heater (optional)** can be installed to keep the engine warm to ensure starting under adverse weather conditions. Figure 6 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.

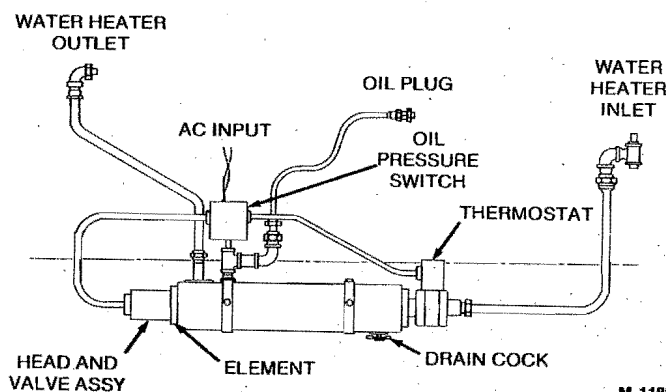


FIGURE 6. WATER JACKET HEATER

**Heat Exchanger Cooling (optional)** 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.

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 EK and EM 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.

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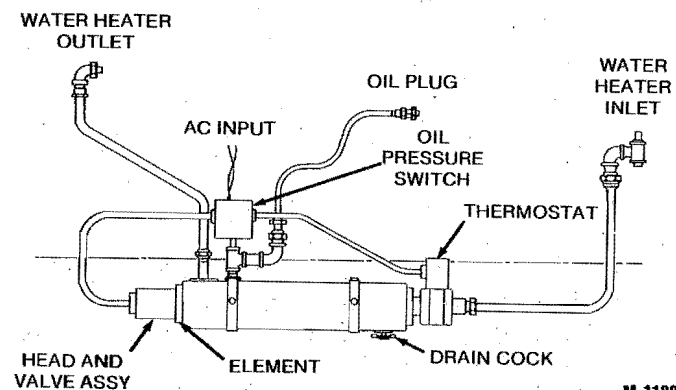


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Most local regulations require wiring connections be made by a licensed electrician and the installation must be inspected and approved before operation. All connections, wire sizes, etc. must conform to the requirements of all electrical codes in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

## **⚠ WARNING**

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

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. 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.

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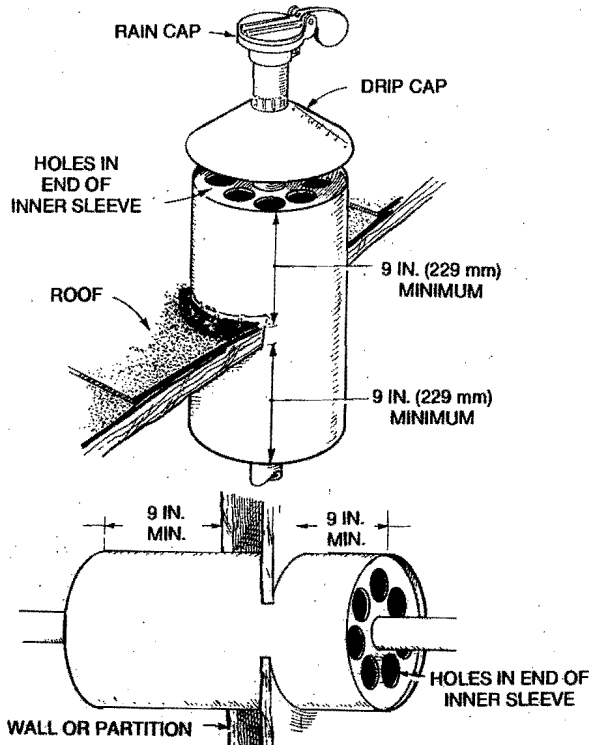
## EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlet away from any 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 3) where exhaust pipes pass through walls 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.

**▲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.*



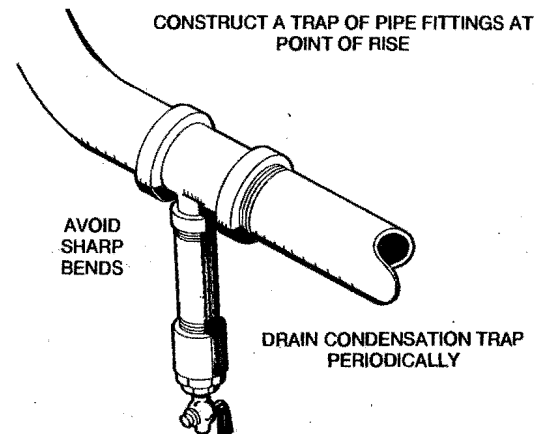
EXS-1036

FIGURE 3. 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 4).

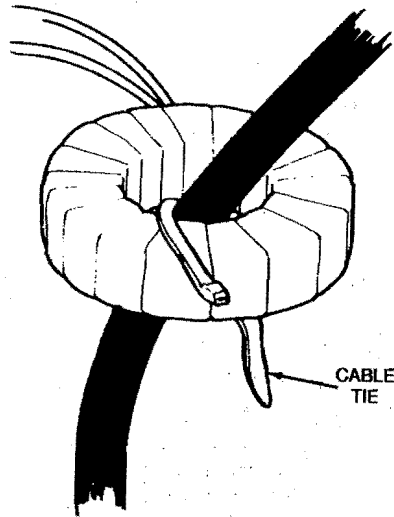


EXS-1046

FIGURE 4. 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.

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 10). The transformers are identified CT21, CT22, and CT23 (three phase only) on the wiring diagram and electrical schematics. Refer to Figure 9 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.



ES-1624

FIGURE 10. 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 properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.*

## Voltage Regulator

The solid-state regulator (VRAS-2, see Figure 11) controls AC output voltage from the generator at a predetermined level. Voltage is plus or minus 3 percent from no load to full load. Random voltage variation is plus or minus 1 percent for constant loads.

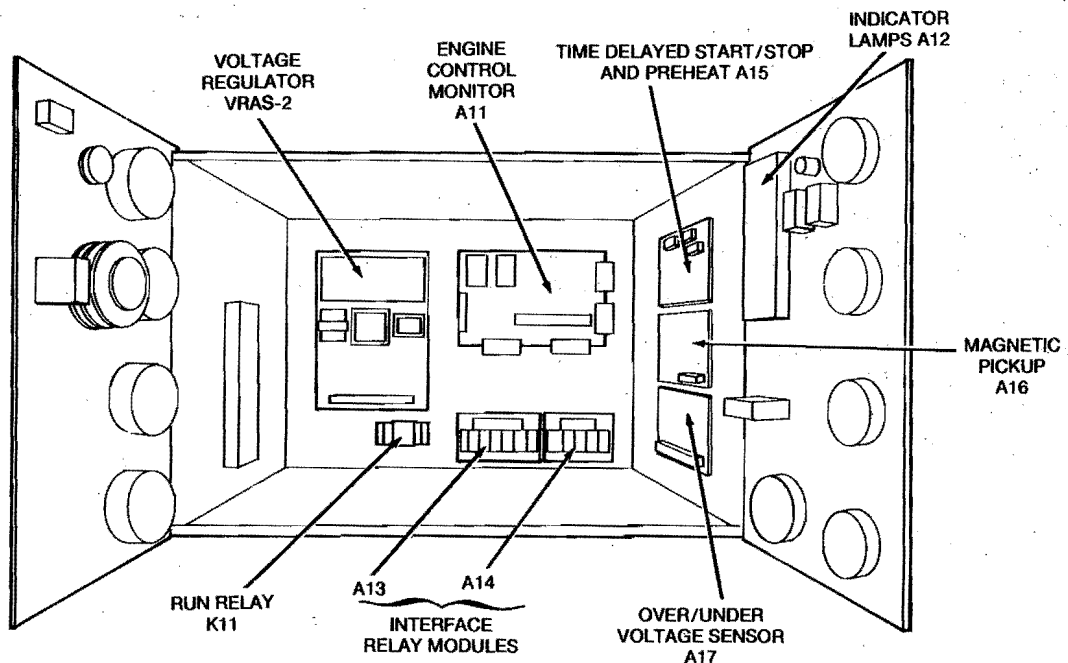


FIGURE 11. CONTROL BOX INTERIOR

ES-1561-1



# 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.

To prevent movement, mount the generator set on a substantial and level base such as a concrete pad. Use 5/8-inch diameter, anchored mounting bolts, flat washers and hexagon nuts to secure the generator set skid to the floor (see Figure 1).

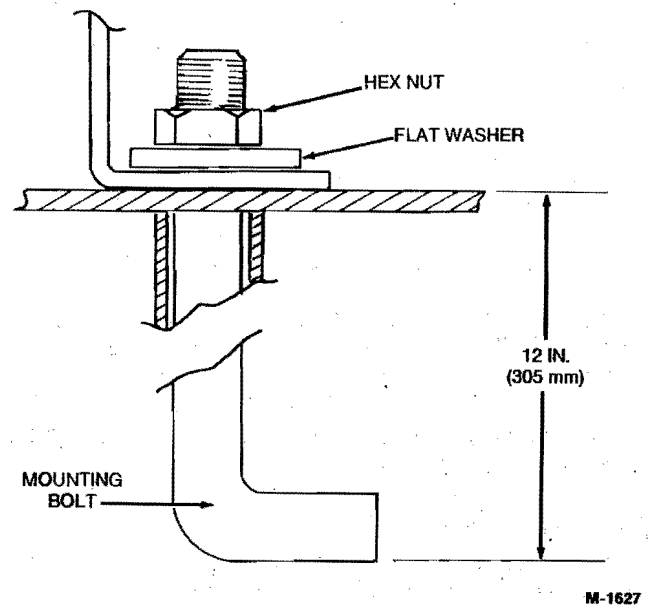


FIGURE 1. BOLT DIAGRAM

## 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. If the generator set is enclosed in the optional housing, provide at least enough clearance to remove the access panels.

## Battery Connections

The generator set requires one 12-volt battery, available from Onan as an option, see Figure 14 for a normal installation. The necessary battery cables and battery rack are included with the unit.

When shipped with a generator set, the battery must be serviced and charged. Follow the battery manufacturer's instructions.

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

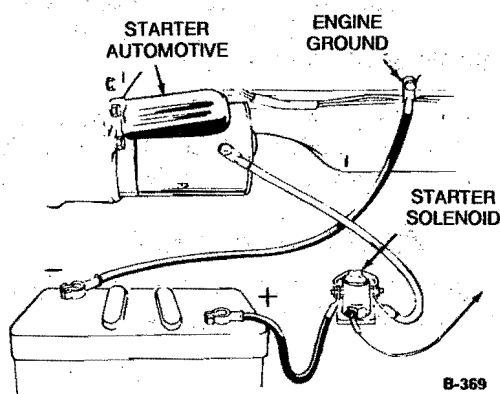


FIGURE 14. BATTERY CONNECTION

Infrequent set use (as in emergency standby service) may allow battery to self-discharge to the point it cannot start the unit. If an automatic transfer switch is being installed with no built-in charge circuit, connect a separate trickle charger. Some Onan automatic transfer switches include a battery charging circuit.

During installation, connect the battery last to avoid accidental starting of the unit. Connect the positive cable first and the negative cable last.

If the battery is installed outside the skid base, use battery cables that are of sufficient size to handle high current loads during cranking. Refer to Table 1 for recommended cable dimensions.

TABLE 1. CABLE SIZE

CABLE LENGTH	4 ft. 1.24 m	5 ft. 1.55 m	7 ft. 2.17 m	9 ft. 2.8 m	11 ft. 3.4 m	14 ft. 4.3 m
CABLE SIZE	2	1	0	00	000	0000

**⚠ WARNING** *Sparks can ignite battery gases and result in an explosion and severe personal injury. Do not disconnect battery cables from battery while generator set is cranking, running, or while the battery is being charged.*

## **Installation Options**

Several fuel system options have a significant effect on the installation requirements for the generator set. The standard model generator set has a gasoline carburetor and fuel system. Optional fuel systems include LP gas (liquid or vapor), natural gas, and several two-fuel combinations. The installer must be aware of the different installation requirements for each of these options. Refer to the appropriate section of this manual for the specific requirements for each system.

## **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.

## **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.

# Initial Start and Checks

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

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 EK-EM 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 35 to 60 psi (240 to 415 kPa) when the engine is at operating temperature.

### Water Temperature Gauge

The water temperature should be in the range of 180° to 195° F (83° to 91° C) depending on the load and ambient temperature.

### DC Ammeter

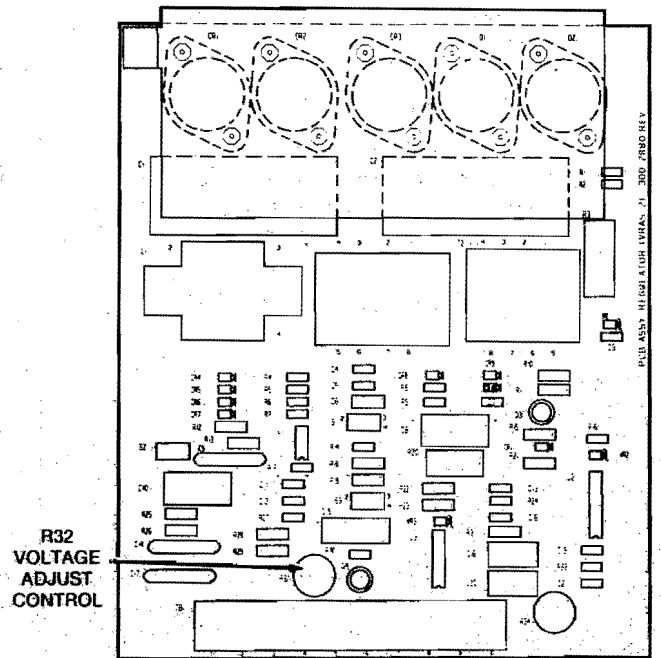
The maximum charge rate for the set mounted battery charging alternator is 35 amperes. Charge rate should taper to zero following start-up as battery becomes charged.

## 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, connect an accurate external voltmeter. If necessary, adjust R32 on VRAS-2 Voltage Regulator board for nameplate voltage (see Figure 15).

**⚠ WARNING** *High voltages are present within the control cabinet that can cause severe personal injury or death. Proceed with care!*



SC-1507

FIGURE 15. VRAS-2 VOLTAGE REGULATOR ASSEMBLY

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