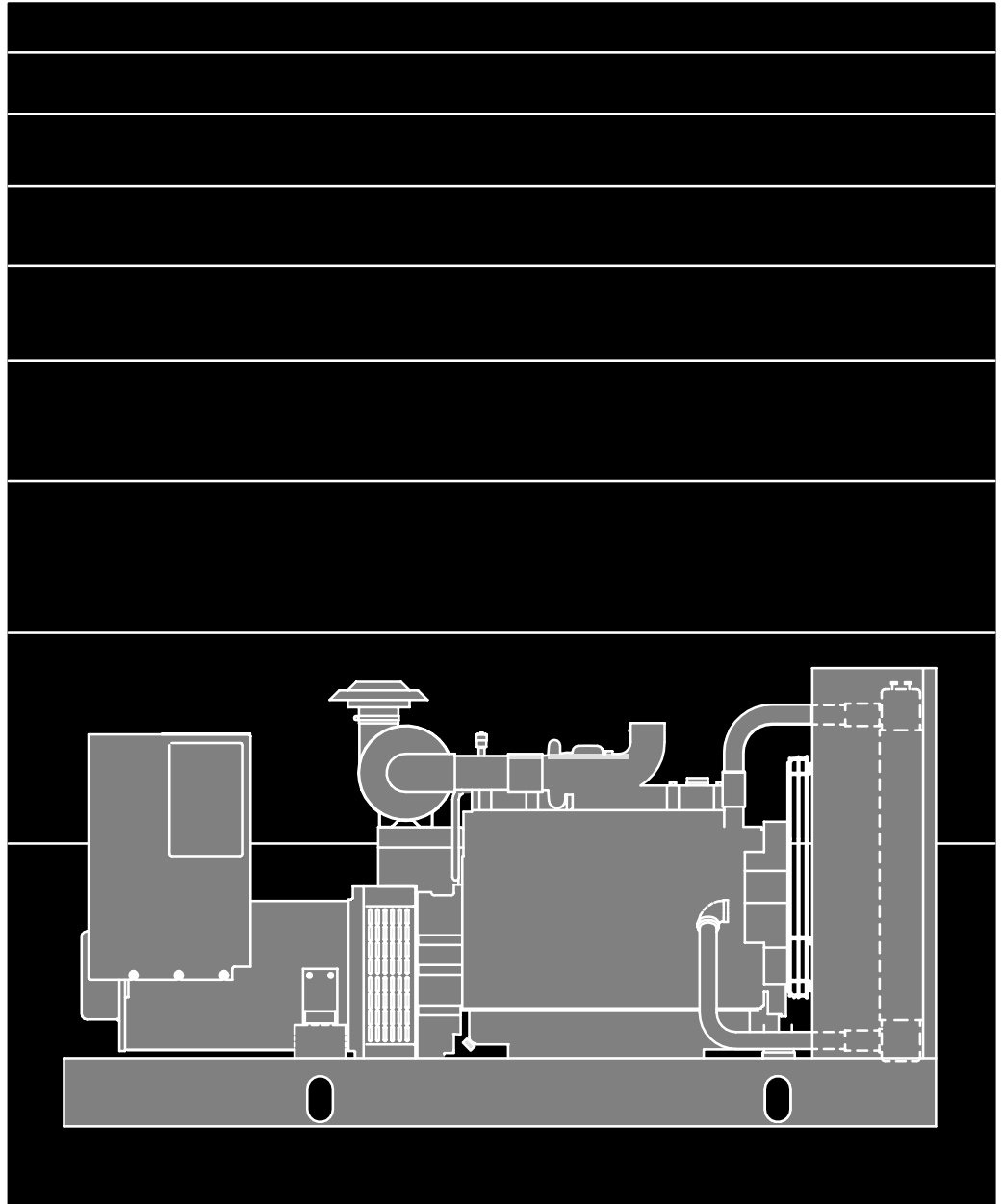




# Installation Manual

**DGBB, DGBC, DGCA, DGCB, DGDA,  
DGDB, DGEA, DGFA, DGFB**

## **GENERATOR SETS**



Printed in U.S.A.

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# IMPORTANT SAFETY INSTRUCTIONS

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**SAVE THESE INSTRUCTIONS** – This manual contains important instructions that should be followed during installation and maintenance of the generator and batteries.

**Before operating the generator set (genset)**, 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, explosion, and personal injury or death 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, arcing equipment, 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 zinc coated or copper fuel lines with diesel fuel.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

## EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.
- Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

## 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 battery charger from its AC source, then 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.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

## DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause an engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. Do not operate a genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Cummins Power Generation distributor for more information.

## **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. Do not wear jewelry. Jewelry can short out electrical contacts and cause shock or burning.
- 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 and lock 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.
- 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.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10).
- Make sure that rags are not left on or near the engine.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.
- 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.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breathe or ingest or come into contact with exhaust gases.
- Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.
- Wear hearing protection when going near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator, turbo charger and exhaust system.

**KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE**

# 1. Introduction

---

## ABOUT THIS MANUAL

This manual provides installation instructions for the DG 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 specification and product data sheets. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets", available from Onan.

## INSTALLATION OVERVIEW

These installation recommendations apply to typical 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 a Cummins/Onan distributor for assistance.

## 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 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 when properly installed and operated. 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.

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## 2. Specifications

Genset Model	35 DGBB 40 DGBC	50 DGCA 60 DGCB	80 DGDA 100 DGDB	125 DGEA 150 DGFA 175 DGFB
<b>Coolant Capacity</b> Engine and Radiator	5.5 gallons (21 litres)		6.5 gallons (25 litres)	6.75 gallons (26 litres)
<b>Oil Capacity</b>	11.5 quarts (11 litres)		17.3 quarts (16 litres)	20 quarts (19 litres)
<b>Fuel Pump</b> Inlet Fitting Size Return Fitting Size Maximum Fuel Lift	5/8 Inverted Flare 0.18 O.D. Tube 5 feet (1.525 m)		5/8 Inverted Flare 0.18 O.D. Tube 5 feet (1.525 m)	5/8 Inverted Flare 0.31 O.D. Tube 4 feet (1.22 m)
<b>Exhaust</b> Outlet Size Maximum Allowable Back Pressure	3 inch O.D. 41 inches H <sub>2</sub> O		3 inch O.D. 41 inches H <sub>2</sub> O	4 inch O.D. 41 inches H <sub>2</sub> O
<b>Electrical System</b> Starting Voltage Battery Cold Cranking Amps	24 Volts DC Two, 12-Volt 625		24 Volts DC Two, 12-Volt 800	24 Volts DC Two, 12-Volt 900

### 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.



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# 3. 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. Consider these requirements before 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 foundation.

Mount the genset 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 a hex nut for each bolt (Figure 3-1).

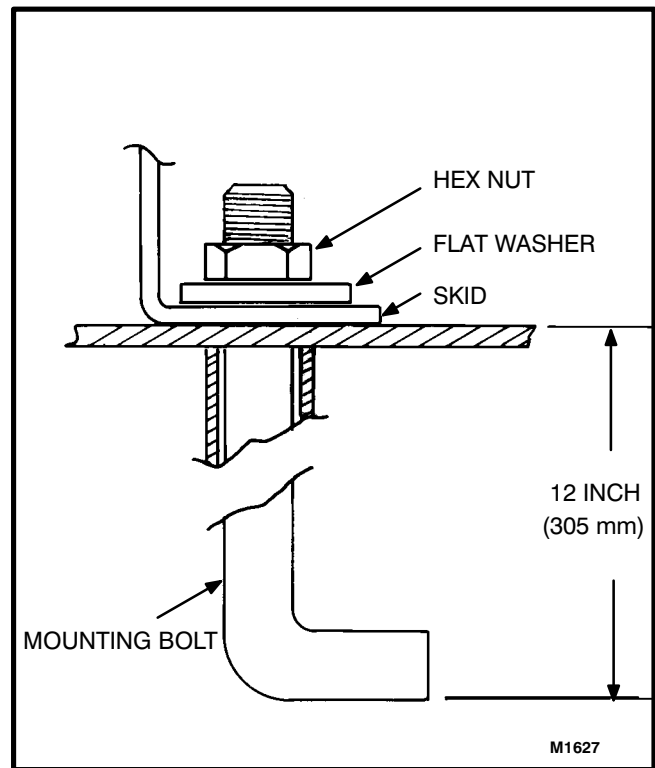


FIGURE 3-1. BOLT DIAGRAM

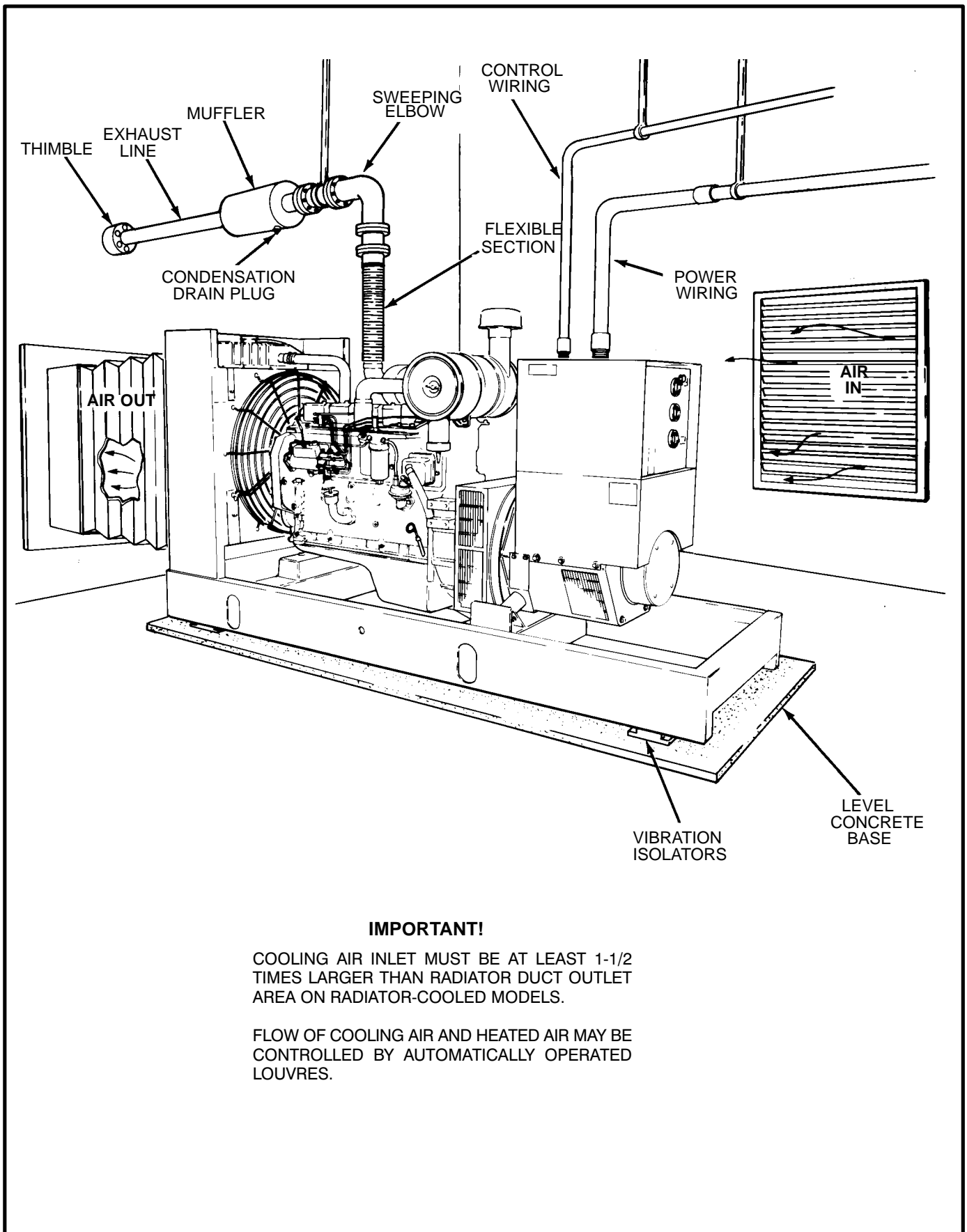


FIGURE 3-2. TYPICAL INSTALLATION

## ACCESS TO SET

Plan for access to the genset 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.

## VIBRATION ISOLATORS

### Installation and Adjustment Procedure

1. Place the vibration isolators (Figure 3-3) on the genset support structure. The isolators should be shimmed or grouted to ensure that all of the isolator bases are within 0.25 inch (6 mm) elevation of each other. The surface that the isolator bases rest on must also be flat.
2. Loosen the side snubber lock nuts so that the top plate of the isolator is free to move vertically and horizontally. Be sure that the top plate is correctly aligned with the base and springs.
3. Place the genset onto the isolators while aligning the skid's mounting with the threaded isolator hole. The top plates will move down and ap-

proach the base of the isolator as load is applied.

4. Once the genset is in position, the isolators may require adjusting so that the set is level. The isolators are adjusted by inserting the leveling bolt through the skid and into the isolator (the leveling bolt's locking nut should be threaded up towards the bolt head).

The leveling bolt will adjust the clearance between the top plate and the isolator base. A nominal clearance of 0.25 inch (6 mm) or greater is desired. This will provide sufficient clearance for the rocking that occurs during startup and shutdown. If the 0.25 inch (6 mm) clearance is not present, turn the leveling bolt until the desired clearance is achieved.

5. The genset may not be level yet; therefore, adjust the leveling bolts until the set is level and sufficient clearance still remains. Once all isolators have been set, lock the leveling bolt in place with the lock nut.
6. The snubber nuts may remain loose and therefore provide better isolation between the genset and support structure.

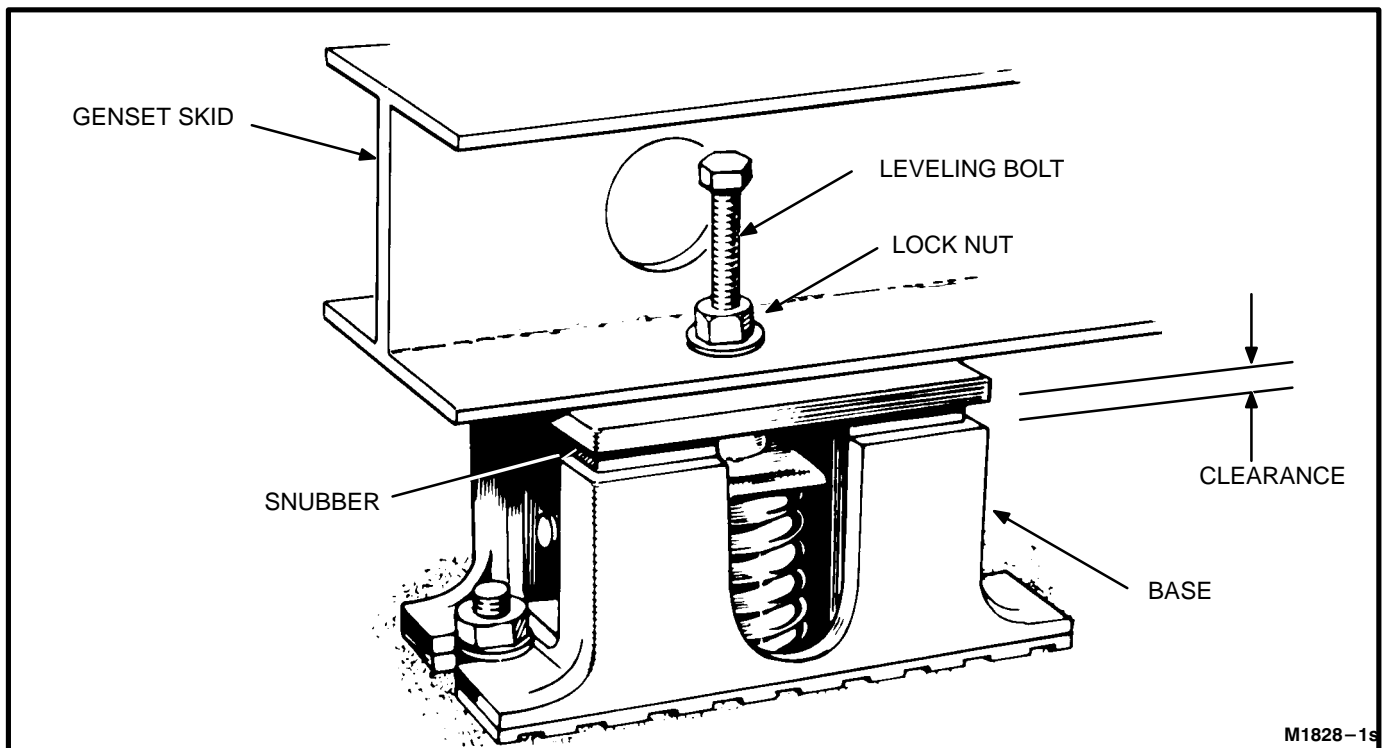


FIGURE 3-3. VIBRATION ISOLATORS

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# 4. Mechanical Connections

## GENERAL

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

## FUEL SYSTEM

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

In all fuel system installations, cleanliness is of the upmost 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. Use a flexible section of tubing between the engine and fuel supply line to provide vibration isolation. Refer to

your generator set outline drawing for sizes and locations.

**CAUTION** Never use galvanized or copper fuel lines, fittings or fuel tanks. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfuric acid. The molecular structure of the copper or galvanized lines or tanks reacts with the acid and contaminates the fuel.

An electric solenoid valve in the supply line is recommended for all installations and required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery run circuit to open the valve during genset operation.

## Supply Tank

Locate the fuel tank as close as possible to the genset and within the 5 foot (1.5 m) lift capacity of the fuel pump. Install a fuel tank that has sufficient capacity to keep the genset operating continuously at full load for at least 36 hours. Refer to product Specification sheet for fuel consumption data.

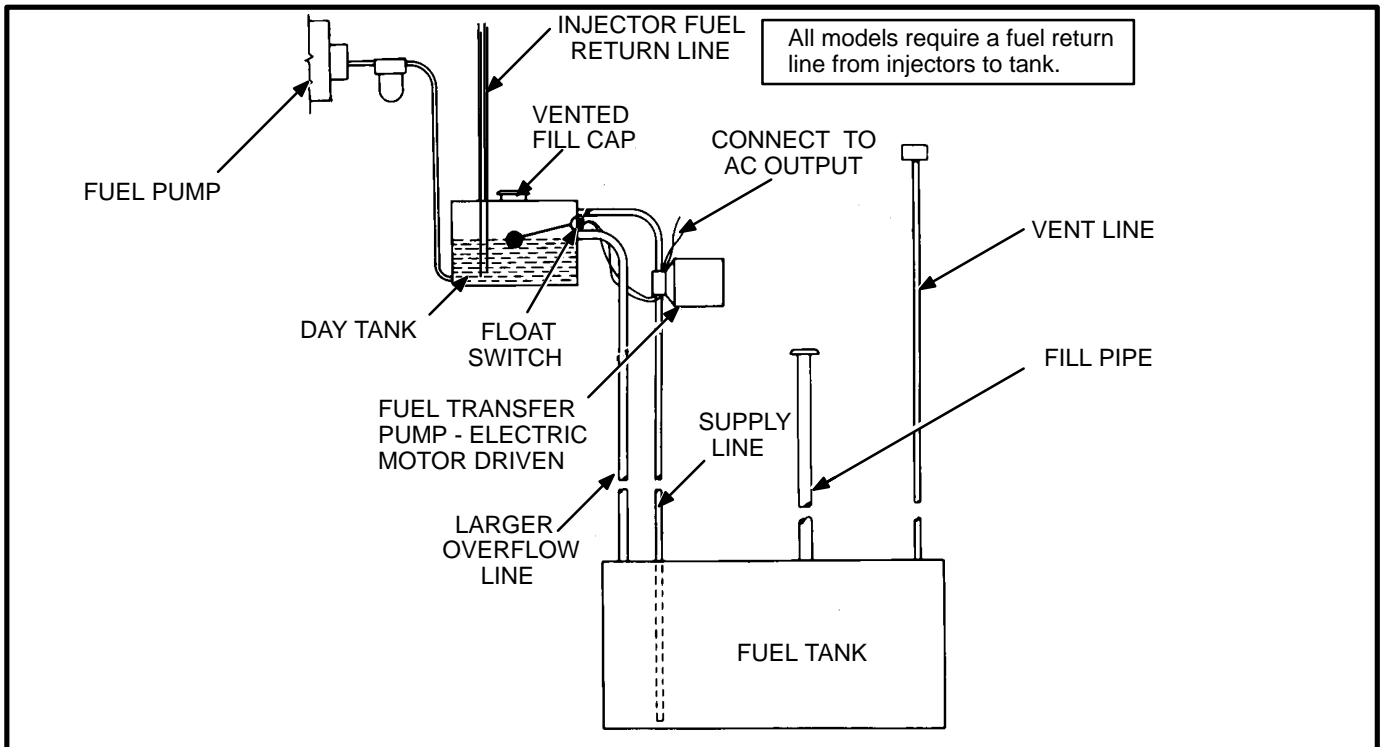


FIGURE 4-1. TYPICAL FUEL SUPPLY INSTALLATION

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

If the main fuel tank is installed below the lift capabilities of the standard fuel transfer pump, a transfer tank (referred to as a day tank) and auxiliary pump will also be required. If an overhead main fuel tank is installed, a transfer tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components.

### Day Tank (If Used)

Fuel day tanks 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.

**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 to the day tank.

Provide a return line from the engine injection system return connection to the day tank. Plumb the return line to the bottom of day tank as shown in Figure 4-1. 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, 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 valve in the fuel line between the fuel supply tank and the day tank to stop 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 *Specifications* for the fitting sizes.

## EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlets away from any air inlets to avoid gases 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 see that 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. Terminate exhaust pipe away from enclosed areas, windows, doors and vents.*

Use an approved thimble (Figure 4-2) 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** *Hot exhaust pipes can start a fire and cause severe injury or death if improperly routed through walls. Use an approved thimble where exhaust pipes pass through walls or partitions.*

**⚠ 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.*

Rain caps are 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.

Use a section of flexible exhaust pipe between the engine and remainder of exhaust system. Support exhaust system to minimize weight applied to engine exhaust outlet elbow/turbocharger connection.

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

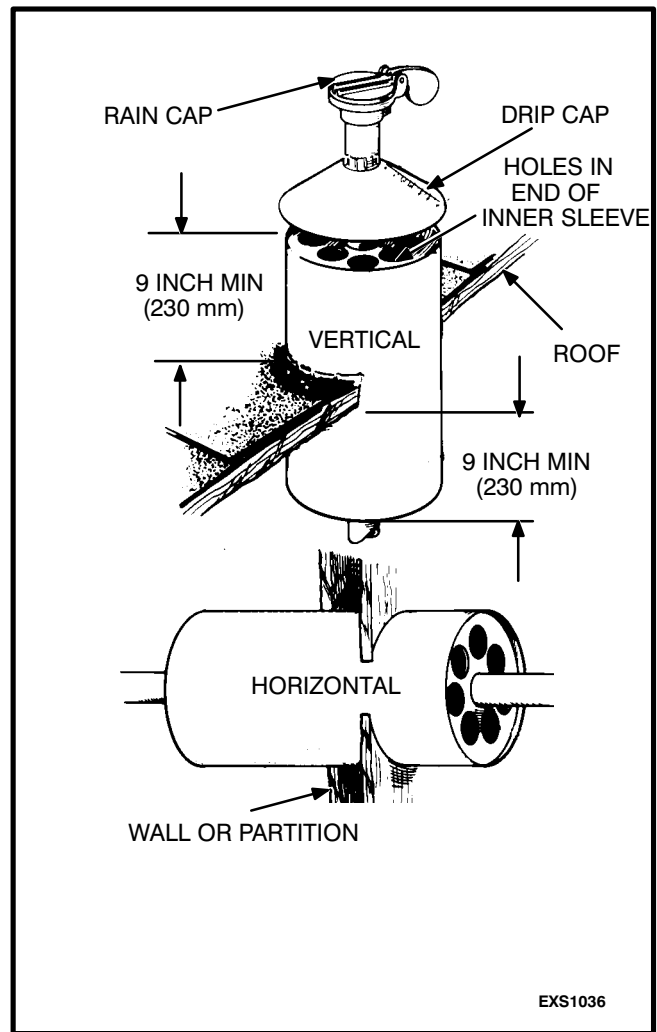


FIGURE 4-2. MOUNTING EXHAUST THIMBLE



Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for muffler 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 (Figure 4-3).

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

**⚠WARNING** *Exhaust pipes are very hot and they can cause severe personal injury or death from direct contact or from fire hazard. Shield or insulate exhaust pipes if there is danger of personal contact or when routed through walls or near other combustible materials.*

### VENTILATION AND COOLING

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 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 DG 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. See Figure 4-4.

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.

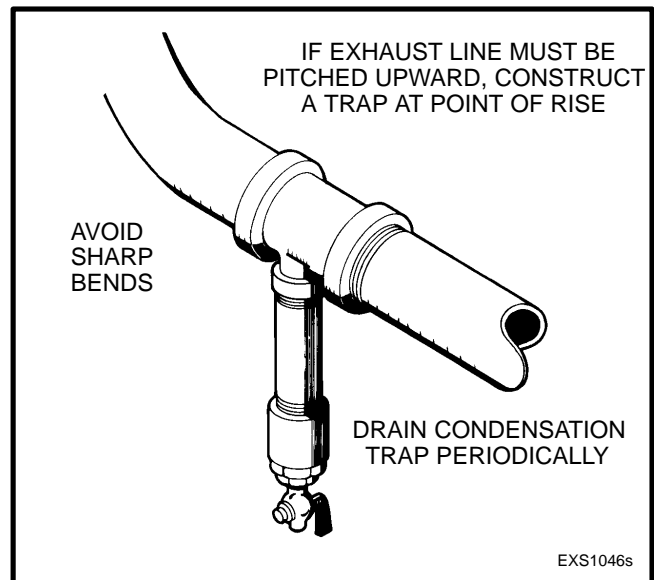


FIGURE 4-3. CONDENSATION TRAP

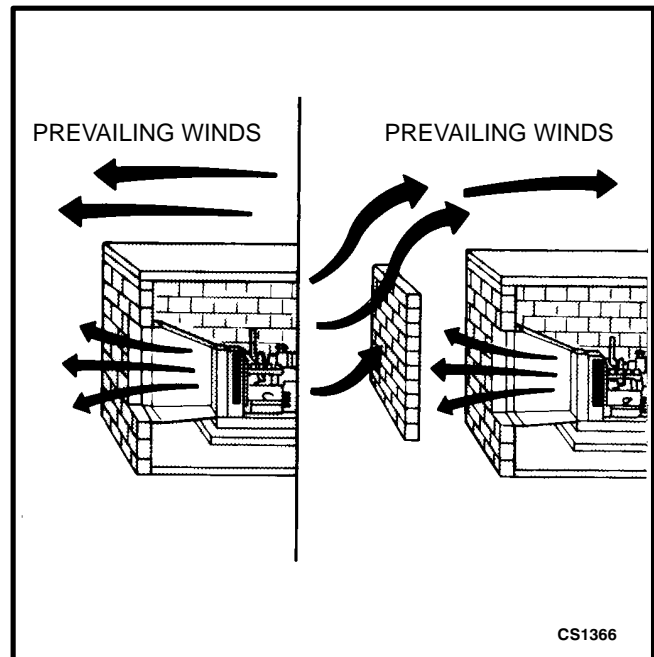


FIGURE 4-4. WIND BARRIER

## Dampers

Dampers or louvres protect the genset and equipment room from the outside environment. Their operation of opening and closing should be controlled by operation of the genset.

In cooler climates movable or discharge dampers are used. These dampers allow the 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 pusher fan that blows air through the radiator (Figure 4-5). 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 circulation of heated air. Before installing the duct, remove the radiator core guard.

**Standard Radiator Cooling** uses a set mounted radiator and engine pusher fan to cool the 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 the fan from the set reduces noise levels without forcing dependence on a continuous cooling water supply. The remote radiator installation must be completely protected against freezing.

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

**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 mounted radiator.**

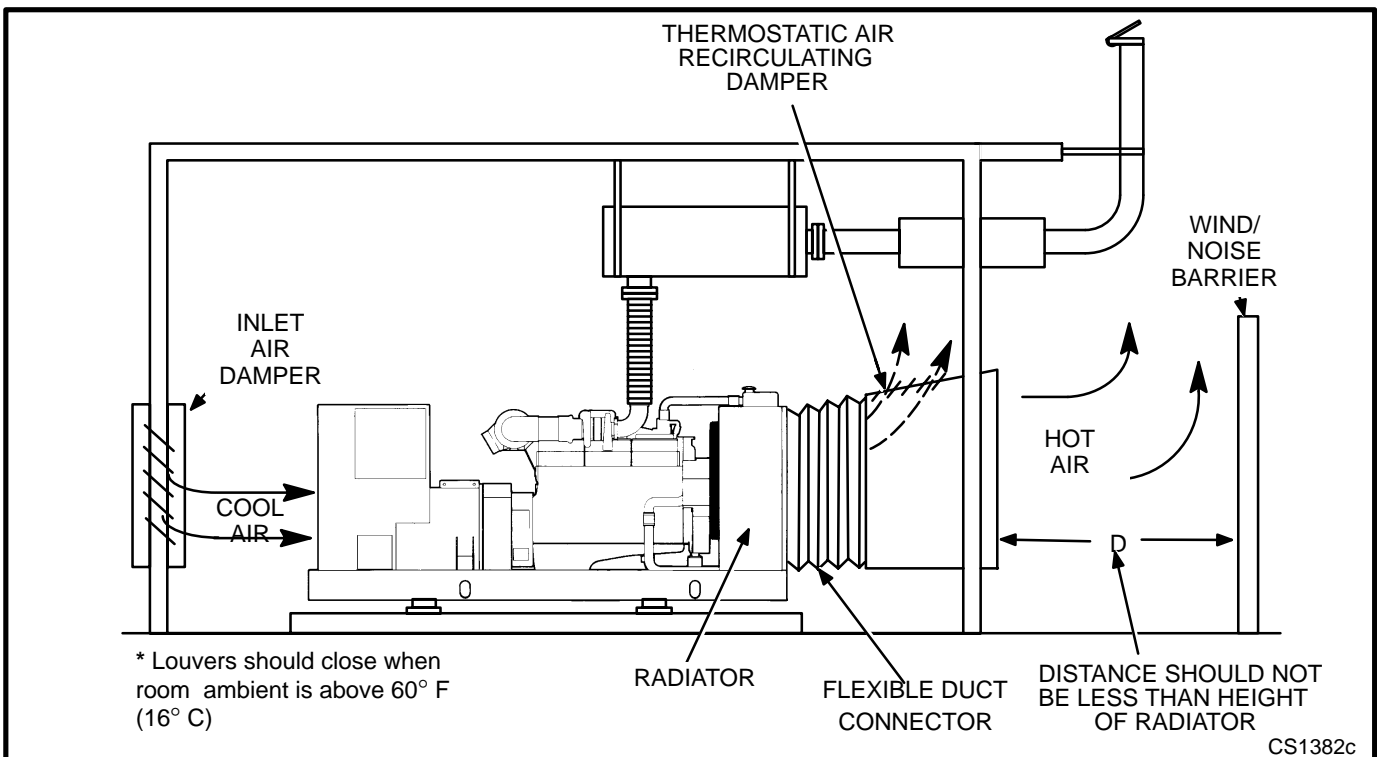


FIGURE 4-5. TYPICAL RADIATOR SET INSTALLATION

### Water Jacket Heater (Optional)

An optional water jacket heater can be installed to keep the engine warm for starting under adverse weather conditions. Connect the heater to a power source that will be on when the engine is NOT running.

### Heat Exchanger (Optional)

The optional heat exchanger (Figure 4-6) uses a shell and tube type heat exchanger instead of the standard radiator and fan. 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 engine coolant temperature between 165° F and 195° F (74° C 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.

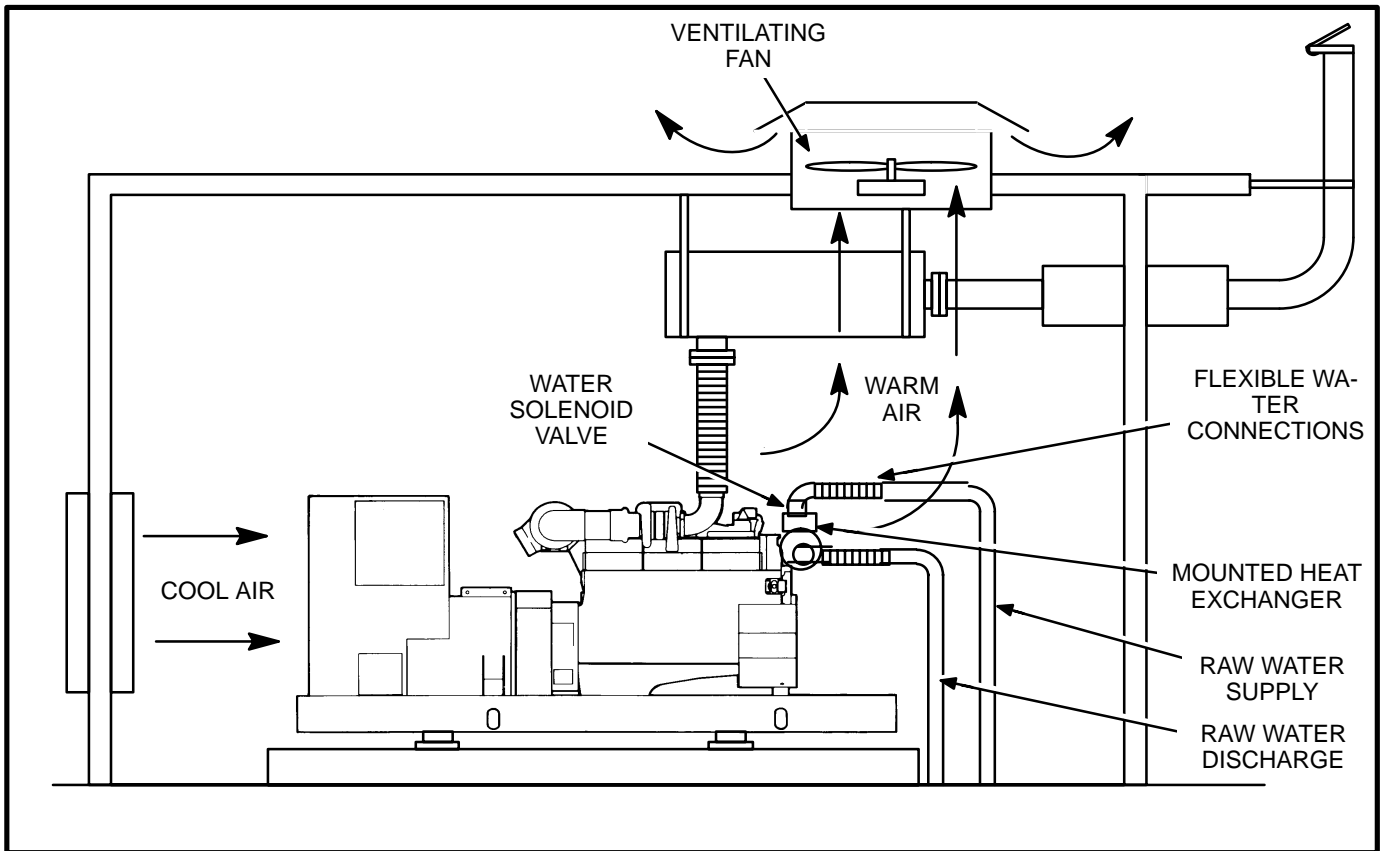


FIGURE 4-6. TYPICAL HEAT EXCHANGER INSTALLATION

# 5. Electrical Connections

## GENERAL

The genset electrical system includes connecting the load, installing the control wiring and connecting the batteries. Connect the batteries last to avoid accidental starting of the unit during installation.

**⚠️WARNING** *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*

*Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.*

**⚠️CAUTION** *To prevent arcing, always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

Most local regulations require that wiring connections be made by a licensed electrician and the installation 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 cause a fire or electrocution, resulting in severe personal injury or death and/or property and equipment damage.*

## 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 (Figure 5-1). Either a manual or automatic switch can be used. Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

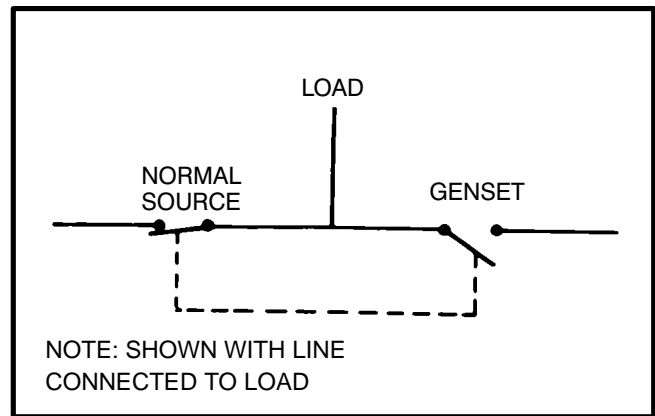


FIGURE 5-1. TYPICAL LOAD TRANSFER SWITCH

## AC WIRING

### Generator Voltage Connections

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

These generators can be configured for the voltages shown on wiring diagram. Most of these voltages must be reconnected by the installer to give the voltage required by the installation. Before shipping, the factory tests the generator set output by connecting the generator to produce a particular test voltage. The generator may be connected at the factory to produce a specified voltage per customer order. The installer must always check the stator lead terminal block connections and perform any necessary reconnect to obtain the voltage desired.

Refer to wiring diagram when reviewing the voltage connection information and use the electrical schematic supplied with your generator set when actually performing load connections.

**⚠ CAUTION** *Reconnecting factory connected generator sets to lower voltages can reduce set ratings, and also render line circuit breakers too small. Consult with your distributor before performing reconnection for a different voltage.*

### Load Connections

**Connecting the Load:** All loads are connected to the generator by bolting the load wires to the appropriate terminals on the generator terminal block. The terminals are stamped U, V, W and N to indicate the line and neutral connections. (Reference: U, V, and W correspond with L1, L2 and L3; and N with L0, respectively).

When installing sets with AC meters, the generator output leads must be routed through current transformers for proper meter operation. The transform-

ers are labeled CT21, CT22 and CT23 on the wiring diagram. Refer to Wiring Diagram to identify the output leads that must be routed through each current transformer, and also appropriate transformer post selection for meter lead harness connection. Use cable ties to secure the loose transformers to the generator output leads.

### 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.*

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

## DC WIRING

### Remote Control Connections

Provisions are made inside the control box for adding optional remote starting stations 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. Refer to Figure 5-2.

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 adding optional remote monitoring on these gensets employing optional Detector 12 (12 lamp panel). Connections are made on the terminal block (TB2) located on the engine monitor circuit board A11. Refer to Figure 5-2.

**⚠ 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.

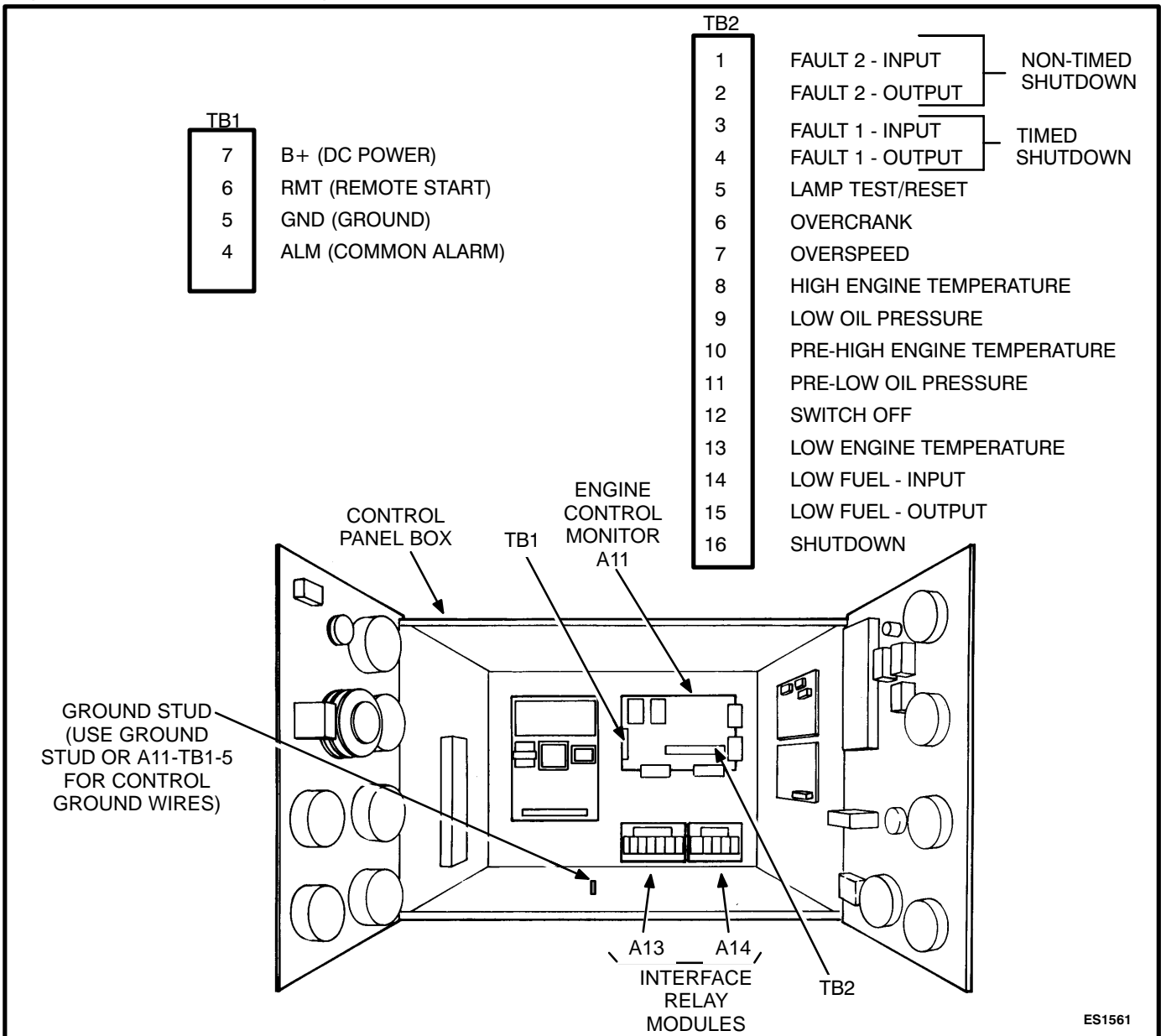


FIGURE 5-2. REMOTE CONTROL AND REMOTE MONITOR CONNECTION POINTS

## Battery Connections

Starting the unit requires 24 volt battery current. Use two, 12 volt (Type 8D) batteries for a normal installation (Figure 5-3). Connect the batteries in series (negative post of first battery to the positive post of the second battery) as shown in Figure 5-3.

Necessary battery cables and rack are on the unit. Service batteries as necessary. Infrequent 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** *Ignition of explosive battery gases can cause severe personal injury. Always connect battery negative (-) last to prevent arcing.*

**⚠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.*

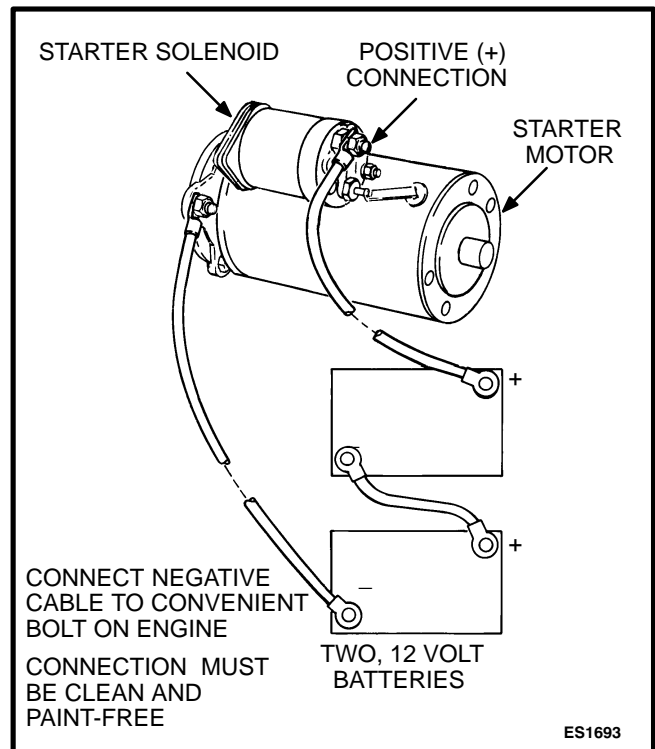


FIGURE 5-3. BATTERY CONNECTIONS

## CONTROL HEATER (OPTIONAL)

A control heater provides a means of humidity /temperature control of the control box interior. It protects the components and ensures their effectiveness when the generator set is subjected to varying ambient air conditions during extended periods of non-use. The element is controlled by an adjustable thermostat (Figure 5-4).

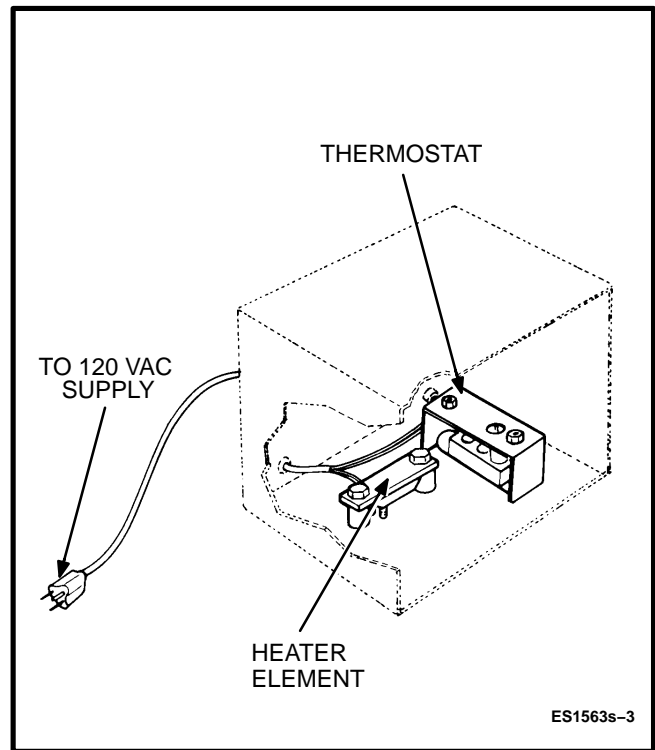


FIGURE 5-4. OPTIONAL CONTROL HEATER

# 6. Prestart Preparation

## GENERAL

Before attempting the initial start of the generator set, be sure it is serviced and ready for operation. Refer to the *Maintenance* section of the Operator's Manual for the recommended procedures for adding oil, coolant or fuel.

## LUBRICATION

Engine oil is drained prior to shipment. Before starting, fill the crankcase with the recommended oil.

## COOLANT

Engine coolant is drained prior to shipment. Before starting, fill the cooling system with the recommended coolant.

## FUEL

Open all manual shutoff valves and make sure fuel system is primed.

## VENTILATION

Verify all air vents and ducts are open and free from 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 combustible materials.

## MECHANICAL CHECKS

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

## ELECTRICAL SYSTEM

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

## Battery Connections

Use two, 12 volt batteries connected in series 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 installed without a built-in charge circuit, connect a separate trickle charger.

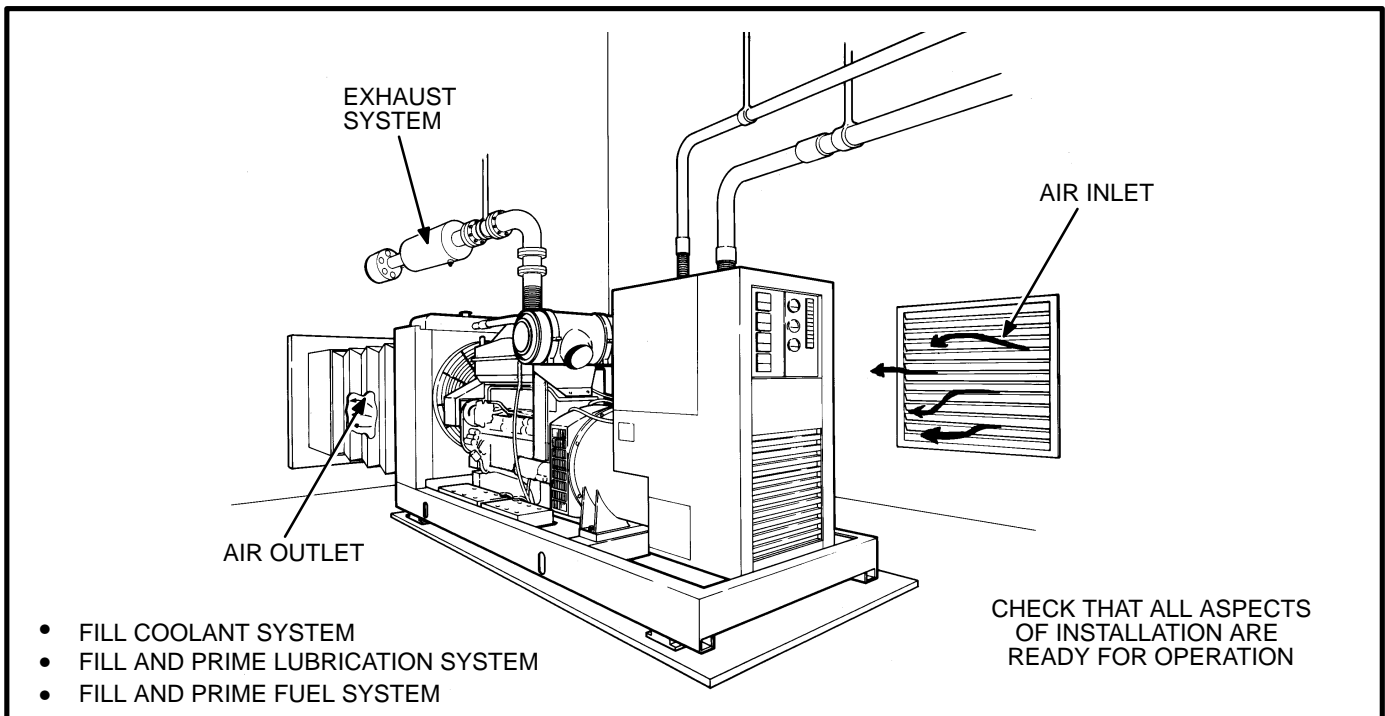


FIGURE 6-1. TYPICAL INSTALLATION



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# 7. Initial Start and Checks

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Before putting the generator set under load conditions, verify the 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, refer to Troubleshooting charts in the Operator's Manual.

## ENGINE GAUGES

Check the following while the genset is operating:

### Oil Pressure Gauge

The oil pressure should be in the range of 25 to 45 psi (172 to 275 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 Voltmeter

This is a voltage reference gauge, indicating condition of the batteries and also of the battery charging circuit. Gauge should read approximately 24 to 28 volts while set is running. If reading is high or low, check batteries and the battery charging circuit.

## 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.

### Frequency Meter

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

### 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 reading.

## 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 the lamps are on and then release the switch. Contact your authorized service center if any lamps require replacement.

## EXHAUST SYSTEM

With the genset 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 injury or death. Inspect exhaust system visually and audibly for leaks daily. Repair any leaks immediately.*

## FUEL SYSTEM

With the genset 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 gases can cause explosion and fire, resulting in severe personal injury or death. Do not smoke while servicing the batteries.*

## COOLING SYSTEM

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

## MECHANICAL ADJUSTMENTS

With the generator 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 can indicate mechanical problems. Check the oil pressure frequently. Refer to Operator's or Service Manual for required adjustments.

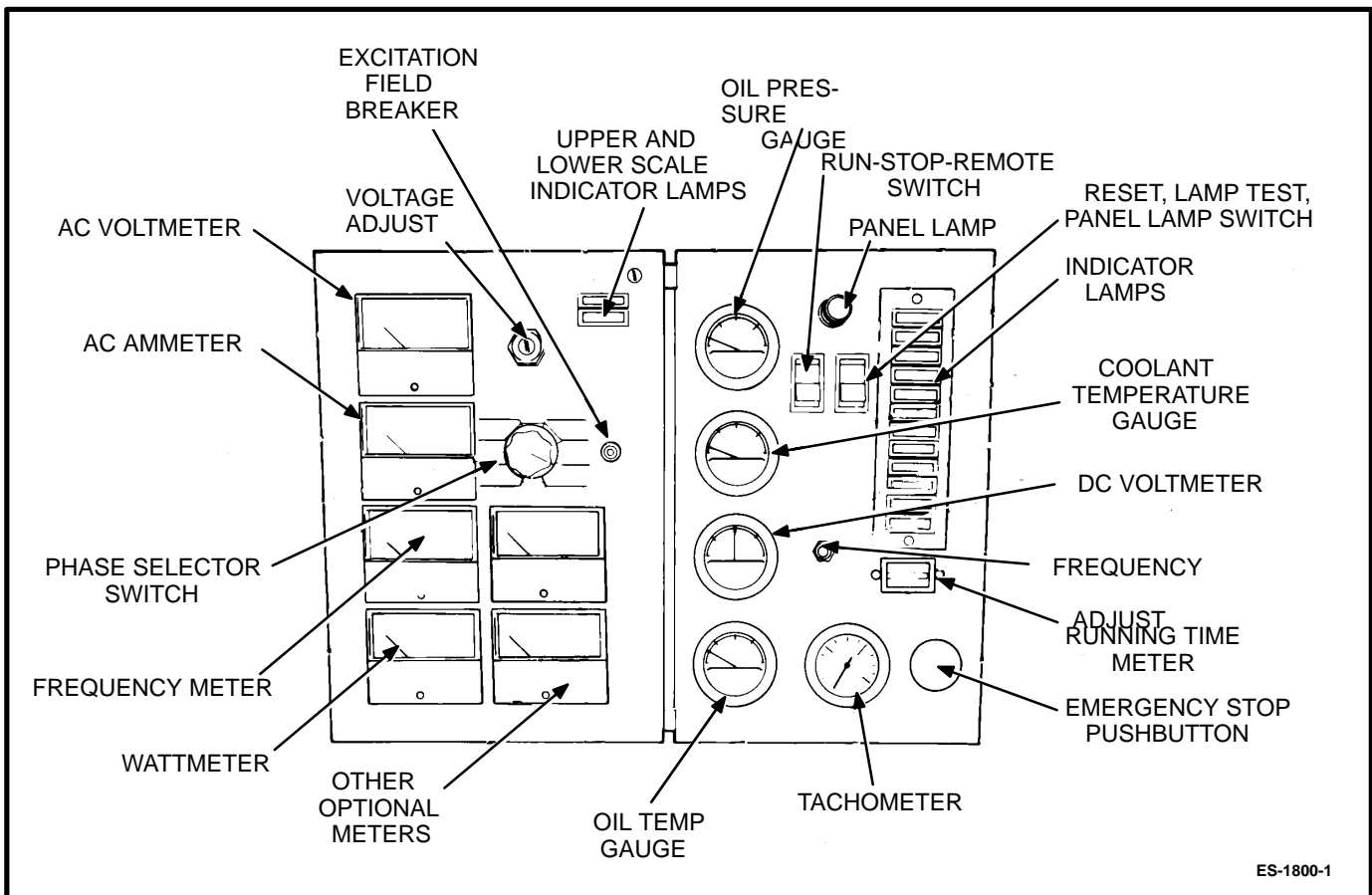


FIGURE 7-1. CONTROL PANEL WITH OPTIONS

# 8. Installation Checklist

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## GENERAL

- Generator set wattage capacity is sufficient to handle maximum anticipated load.
- At least 3 feet of clearance (or greater for housing door) is provided around entire generator set for servicing and ventilation.
- Generator set is located in an area not subject to flooding.
- All operating personnel have read and are familiar with Operator's Manual.
- All operators have been thoroughly briefed on preventive maintenance procedures.
- All operators have read and understand all Important Safety Instructions in Operator's Manual.

## GENERATOR SET SUPPORT

- Floor, roof or earth on which the generator set rests is strong enough and will not allow shifting or movement. Observe local codes on soil bearing capacity due to freezing and thawing.
- Generator set is properly supported and retained to approved base.
- Supporting base is large enough and is of non-combustible material – extends 6-inches all around set.

## COOLING AIR FLOW

- Generator set air inlet is faced into direction of strongest, prevailing winds.
- Air inlet openings are unrestricted and at least 1–1/2 times larger than air outlet area.
- Cooling air outlet is on downwind side of building (if not, wind barrier is constructed).
- Proper ducting material (sheet metal, canvas) is used between radiator and air outlet.

## DIESEL FUEL SYSTEM

- Fuel tanks meet or exceed all Local, State or National codes.
- Fuel lines are properly installed, supported and protected against damage.
- Approved flexible fuel line is installed between main fuel supply line and generator set's fuel system, near the generator set, to protect the fuel system from damage caused by vibration, expansion and contraction.
- Strainer or fuel screen (100 to 120 mesh) is installed in the fuel supply line to protect the fuel lift pump, day tank transfer pump or float valve seat from fuel supply tank debris.
- Fuel supply line shutoff valves are installed to prevent fuel flow in case of leaks.
- No shutoff valves are installed on engine fuel return line.
- External fuel pumps are connected and operational at all times (generator set started or shut down).
- Fuel system is properly primed.
- No fuel leaks are found in supply line or engine fuel system.

## EXHAUST SYSTEM

- Operators are thoroughly briefed on the dangers of carbon monoxide gas.
- Areas around set are well ventilated. No possibility of exhaust fumes entering building doors, windows, or intake fans.
- Exhaust gases are piped safely outside and away from building.
- The correct length of approved rigid pipe is connected to the generator set flexible pipe using approved securing methods with no weight resting on engine exhaust components. There are no bends in flex section.
- Condensation drain is provided in lowest section of exhaust piping.
- Exhaust piping is insulated to guard against burns to personnel.
- Exhaust piping passing through walls or ceilings have approved fire-proof materials and are in compliance with all codes.
- Exhaust piping is large enough in diameter to prevent excessive back pressure on engine.

## AC AND DC WIRING

- Wire sizes, insulation, conduits and connection methods all meet applicable codes.
- AC and DC wires are separated in their own conduit to prevent electrical induction.
- All load, line and generator connections are proper and correct.
- Flexible conduit between generator set and building or surrounding structure.

## GENERATOR SET PRESTART

- Generator set engine is properly serviced with oil and coolant.
- Batteries are properly installed, serviced and charged.
- Battery charger and engine coolant heater are connected and operational.
- All generator set covers and safety shields are installed properly.
- All fuel and coolant shutoff valves are operational.

**Cummins Power Generation**  
1400 73rd Avenue N.E.  
Minneapolis, MN 55432  
1-800-888-6626  
763-574-5000 International Use  
Fax: 763-528-7229

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