

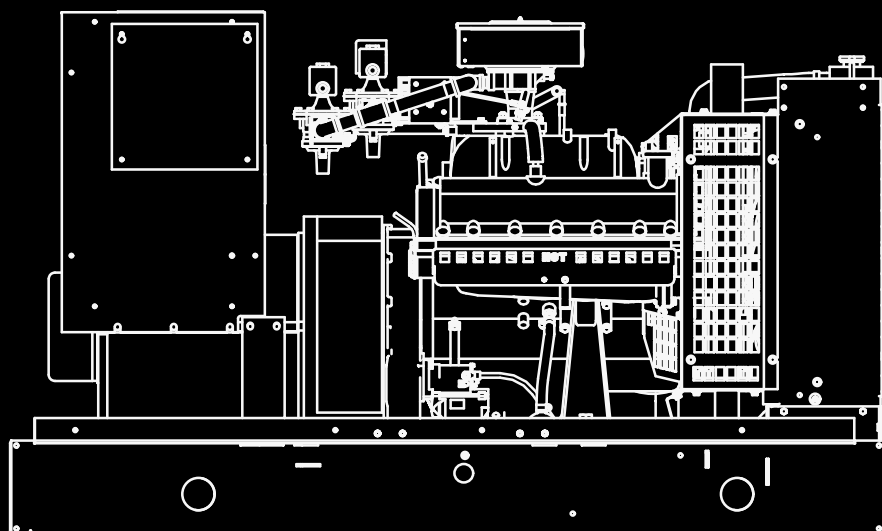
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Installation Manual

Detector™ Control Generator Sets



**Models
GGHE, GGHF**

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WARNING:



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

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IMPORTANT SAFETY INSTRUCTIONS

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 copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Natural gas is lighter than air, and will tend to gather under hoods. Propane is heavier than air, and will

tend to gather in sumps or low areas. NFPA code requires all persons handling propane to be trained and qualified.

- 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. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag 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.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- 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 covers models produced under the Cummins®/Onan® and Cummins Power Generation brand names.

This manual provides installation instructions for the generator set models listed on the front cover. This includes the following information:

Mounting Recommendations - for fastening generator set to base and space requirements for normal operation and service.

Mechanical Connections and Electrical Connections - covers most aspects of the generator set installation.

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.

Installation Checklist – reference checks upon completion of installation.

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.), additional information is required. Review standard installation practices. For engineering data specific to the generator set, refer to the *Specification* and *Data Sheets*. For application information, refer to Application Manual T-030, “Liquid Cooled Generator Sets”.

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 your nearest Cummins Power Generation 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, maintained, 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.

2. Specifications

MODEL	GGHE/GGHF
Engine Onan Modified Ford V-10	WSG-1068
Generator kW Rating	See Genset Nameplate for rating information.
Engine Fuel Connection Inlet/Outlet Size	Refer to Generator Outline Drawing
Fuel or a combination of two fuels	Propane (Liquid or Vapor) Natural Gas
Fuel Flow (Inlet Pressure) Minimum: NG/LPG Maximum: NG/LPG Vapor withdrawal LPG Liquid withdrawal	7.0 inch H ₂ O (1.7 kPa) 13.6 inch H ₂ O (3.4 kPa) 312 psi (2,153 kPa)
Exhaust Connection Backpressure (Max. Allowed)	3 inch NPT 20 inch H ₂ O (5.0 kPa)
Electrical System Starting Voltage Battery Charging Alternator (Max. Rating)	12 Volts DC 37 A
Cooling System Capacity with Standard Radiator	8.5 Gal (32.2 L)
Lubricating System Oil Capacity with Filters Standby Power (Normal Oil Filter) Prime Power (Heavy Duty Oil Filter)	6.5 Qts (6.2 L) 11 (10.4 L)
Tune-up Specifications Spark Plug Gap	0.044 (1.1 mm)
Battery Ground Required Battery Voltage Group Number CCA (minimum) Cold Soak @ 0° F (-18° C)	Negative 12 Volts DC 31 660

FUEL CONSUMPTION (STANDBY/PRIME/60HZ)

MODEL	GGHE	GGHF
Standby cfh (m3/hr) LPG (Vapor or Liquid) Natural Gas	313 (8.86) 798 (22.34)	366 (10.36) 898 (25.43)
Full Load cfh (m3/hr) LPG (Vapor or Liquid) Natural Gas	277 (7.84) 705 (19.95)	320 (9.06) 807 (22.84)

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3. Mounting the Generator Set

GENERAL

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 generator set air
- Non-combustible mounting surface
- 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 service entrance. Exhaust must not be able to enter or accumulate around inhabited areas.

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.

WARNING

INCORRECT INSTALLATION, SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE TRAINED AND EXPERIENCED TO PERFORM ELECTRICAL AND MECHANICAL COMPONENT INSTALLATION.

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.

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. Where required by building codes or special isolation needs, generator sets may be mounted on rubber pads or mechanical spring isolators. The use of unapproved isolators may result in harmful resonances and may void the genset warranty.

Mount the generator set on a substantial and level base such as a concrete pad. A non-combustible material must be used for the pad.

Use 5/8 inch or 16 mm 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). The 1-1/2 x 6 inch pipe inserted over the mounting bolts allows minor adjustment of the bolts to align them to the holes in the subbase or vibration isolator.

ACCESS TO SET

Generally, at least 1 meter (3 feet) of clearance should be provided on all sides of the generator set for maintenance and service access. (Increase clearance by width of door if optional housing is used.) A raised foundation or slab of 150 mm (6 inches) or more above floor level will make servicing easier.

Lighting should be adequate for operation, maintenance and service operations and should be connected on the load side of the transfer switch so that it is available at all times.

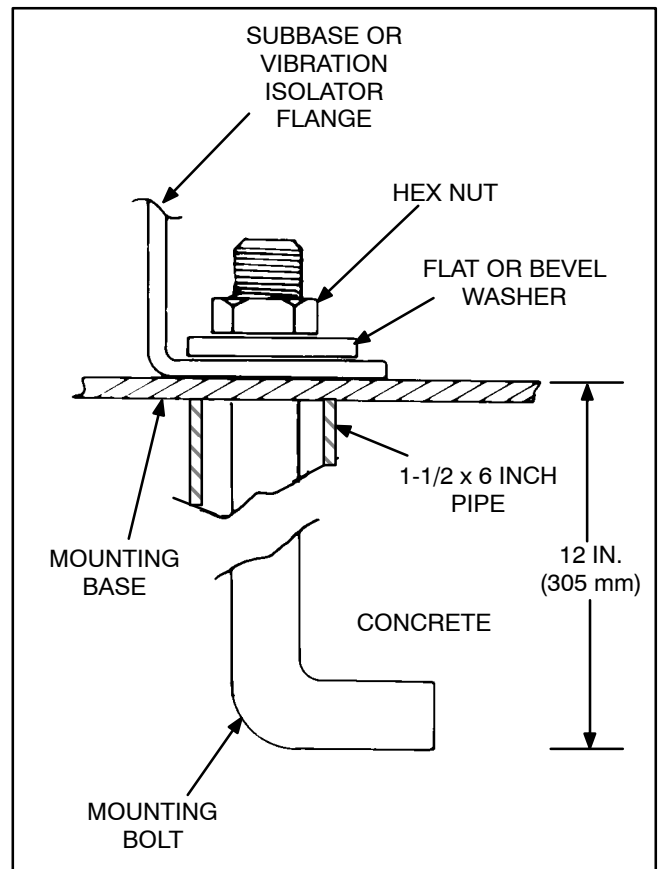


FIGURE 3-1. BOLT DIAGRAM

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.

All pipe threaded fuel system fittings, including container fittings, must be assembled using a pipe joint sealing compound designed for use with LPG/NG.

FUEL SYSTEM

Gensets can be equipped to operate on:

- LPG (vapor or liquid withdrawal)
- NG (natural gas) or
- Combination (NG/LPG)

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

Fuel Lines – Routing

A flexible fuel hose(s) or section of flexible fuel hose(s) must be used between the engine's fuel system and fuel supply line to protect the fuel system from damage caused by vibration, expansion and contraction.

⚠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.*

Installation of the fuel hose must be done according to all applicable codes and standards, and installa-

tion recommendations provided by the manufacturer. The flexible hose used must be approved by the hose manufacture for use with the genset fuel type and product application.

Support fuel lines to restrain movement and prevent chaffing or contact with sharp edges, electrical wiring and hot exhaust parts.

⚠WARNING *Sparks and hot surfaces can ignite fuel, leading to severe personal injury or death. Do not route fuel lines near electrical wiring or hot exhaust parts.*

Fuel lines must be routed and secured to maintain a 2 inch (51 mm) minimum clearance from electrical wiring and hot exhaust parts.

Natural Gas/LPG Vapor/LPG Liquid Fuel System

⚠WARNING *Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other sources of ignition well away from genset and areas sharing ventilation. Keep a type ABC fire extinguisher handy.*

NFPA Standard No. 58 requires all persons handling and operating LPG to be trained in proper handling and operating procedures.

Gaseous-fuel supply system design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance must comply with the applicable codes. See NFPA Standards No. 37, No. 54 and No. 58.

Most codes require both manual and electric (battery-powered) shutoff valves ahead of the flexible fuel hose(s). The manual valve should be of the indicating type. The electric valve should be wired so that the valve is closed when the genset is off.

Install a dry-type fuel filter ahead of the service pressure regulator to protect the sensitive pressure regulating components and orifices downstream from rust, scale and other solid substances carried along in the gas stream.

See *Specifications* section for natural gas/LPG fuel inlet size. The recommendations in *Application Manual T-030*, should be followed in regard to fuel supply system pipe sizes, manual shutoff valves, fuel filters and gas pressure regulators.

Fuel Pressure

⚠WARNING *High gas supply pressure can cause gas leaks which can lead to fire and severe personal injury or death. Gas supply pressure must be adjusted to Specifications by qualified personnel.*

The gas pressure regulators in each line provide constant gas pressure at the gas mixer under varying load conditions. There are pressure test ports on both sides of the regulator for measuring supply and regulated fuel pressures (NG or LPG systems). When measuring supply pressure, the most accurate reading would be on the input side of the solenoid valve.

Mixer side: The NG gas pressure should be approximately 5 inches WC (1.3 kPa) at full load.

The LP gas pressure will be approximately negative 0.5 inches WC (0.13 kPa) at no load and a negative pressure of 1.0 inch WC (0.249 kPa) at full load.

Supply side: The minimum pressure refers to supply pressure under rated load (maximum gas flow).

For LPG (vapor withdrawal) and NG, the maximum permissible fuel supply pressure is 13.6 inches WC (3.4 kPa) and the recommended minimum is 7 inches WC (1.7 kPa).

For LPG (liquid withdrawal), the maximum permissible fuel supply pressure is 312 psi (2,153 kPa) under any operating condition.

⚠WARNING *Gaseous fuel leaks into an inadequately ventilated space can lead to explosive accumulations of gas. Natural gas rises when released into the air and can accumulate under overhanging hoods and inside housings and buildings. LPG sinks when released into the air and can accumulate inside housings, basements and other below-grade spaces. Precautions must be taken to prevent gas leaks and the accumulation of gaseous fuel in the event of a leak.*

Check Gas Leaks and Correct

All fuel-system connections, including the container with associated valves and fittings, must be tested for leaks with a soap and water solution or equivalent, while the system is under pressure. LP gas pressure should not be less than 90 psi (621 kPa) at the inlet of the primary regulator for this test.

EXHAUST SYSTEM

⚠️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.*

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 or sheltered areas, windows, doors and vents.*

For indoor installation, the exhaust system must use sealed joint type fittings, (for example NPT fittings) to provide a tighter exhaust system. Use of slip type fittings (secured with a muffler clamp) may allow leakage of exhaust gases into the building.

⚠️WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to provide a tight exhaust system. Use NPT or equivalent type fittings for all indoor installations.*

Use an approved thimble (Figure 4-1) where exhaust pipes pass through wall or partitions. Insulated wall/roof thimbles are used where exhaust pipes pass through a combustible roof or wall. This includes structures, such as wood framing or insu-

lated steel decking, etc. Uninsulated wall/roof thimbles are used where exhaust pipes pass through a non-combustible wall or roof, such as concrete. 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.*

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 prevent weight from being applied to engine exhaust outlet.

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

The exhaust system design should meet local code requirements.

Liability for injury, death, damage, and warranty expense due to use of unapproved mufflers or modifications to the exhaust system becomes the responsibility of the person installing the unapproved muffler or performing the modification. Contact a Cummins Power Generation distributor for approved exhaust system parts.

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** (away from engine) 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 4-2).

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. Before installing insulation on exhaust system components, check the exhaust system for leaks while operating the genset under full load and correct all leaks.

⚠ 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.*

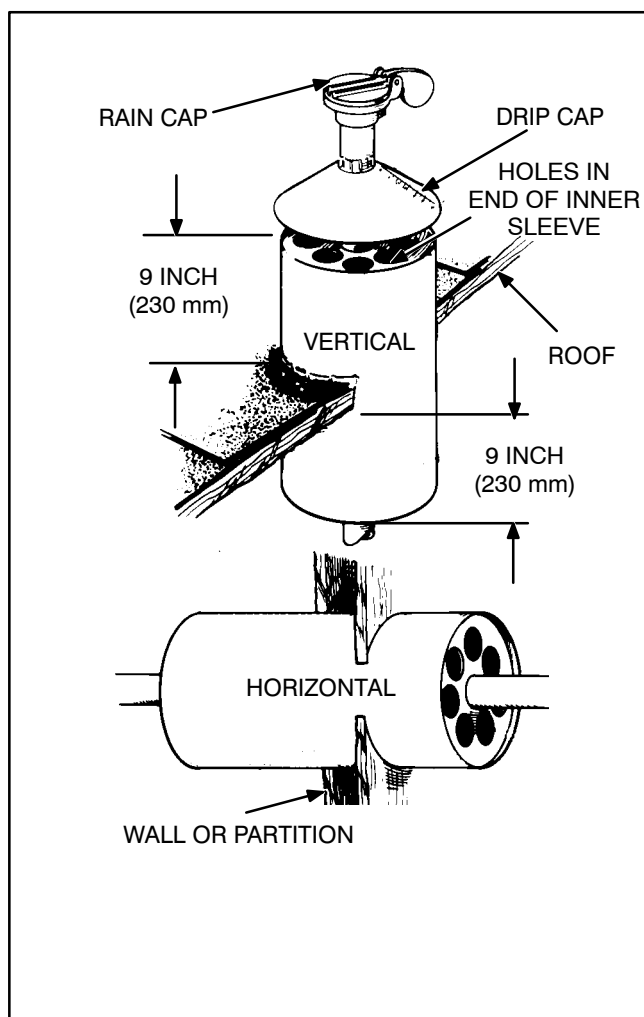


FIGURE 4-1. MOUNTING EXHAUST THIMBLE

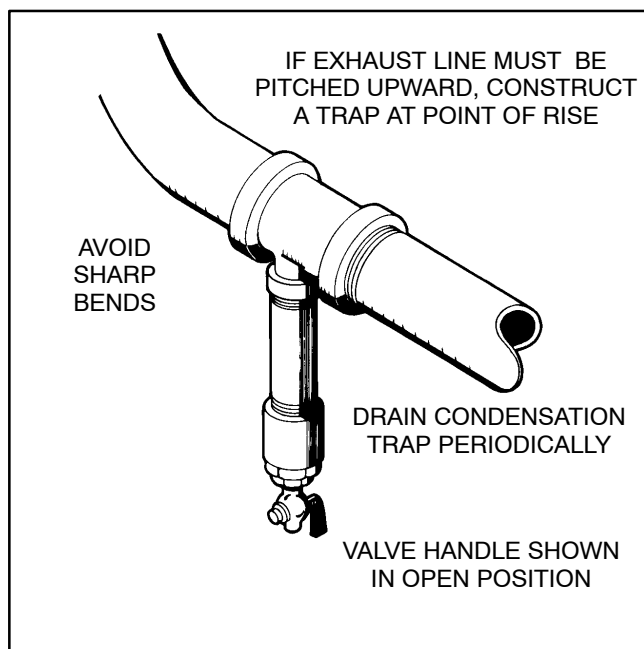


FIGURE 4-2. CONDENSATION TRAP

VENTILATION AND COOLING

Generator sets dissipate heat and fumes that must be removed by proper cooling and ventilation.

Generator sets in factory-mounted housings for outdoor installation are designed for proper cooling and ventilation.

Indoor installations require careful design with respect to cooling and ventilation. In an indoor installation, all radiator cooling air must be discharged to the out-of-doors. Duct adapter kits are available. See Figure 4-4 for a typical indoor installation.

⚠ WARNING *Engine or radiator cooling air may carry deadly carbon monoxide gas which can cause asphyxiation and death. All engine or radiator cooling air must be discharged to the out-of-doors. Do not use it for heating a room or compartment.*

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 genset *Data Sheet* for the air-flow requirements and allowed airflow restriction.

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 4-3.

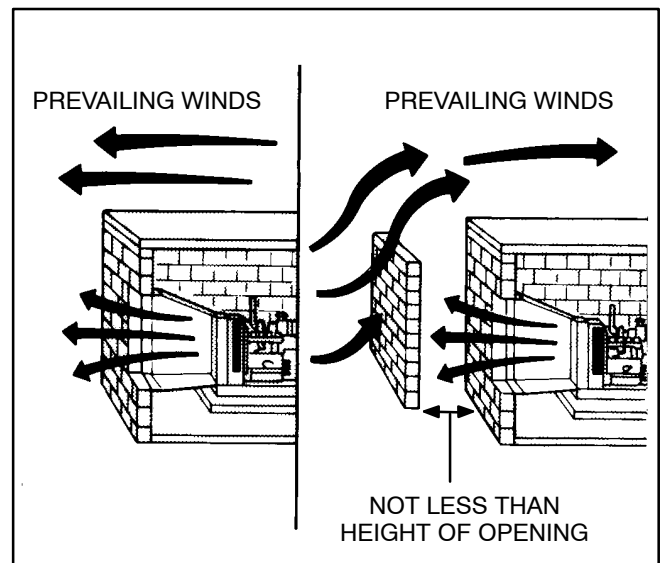


FIGURE 4-3. WIND BARRIER

Dampers

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

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 generator set engine is still cold, increasing the engine efficiency.

Radiator Set Requirements

Radiator set cooling air is drawn past the control end of the set by a pusher fan that blows air through the radiator (Figure 4-4). Locate the air inlet to the rear of the set. Make the inlet vent opening 1-1/2 times larger than the radiator area.

Louvers and screens over air inlet and outlet openings restrict air flow and vary widely in performance. A louver assembly with narrow vanes, for example, tends to be more restrictive than one with wide vanes. The effective open area specified by the louver or screen manufacturer should be used.

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.

Attach a canvas or sheet metal duct to 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.

Remote Radiator Cooling (Optional) substitutes a remote mounted radiator and an electrically driven fan in place of mounted components. Removal of the radiator and the fan from the set reduces noise levels without forcing dependence on a continuous cooling water supply (necessary with heat exchanger cooling). 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 or remote mounted radiator.

Engine Coolant Heater (Optional)

An optional engine coolant heater is available to keep the engine warm for improved starting and code compliance. Connect the heater to a power source that will be energized when the engine is NOT running.

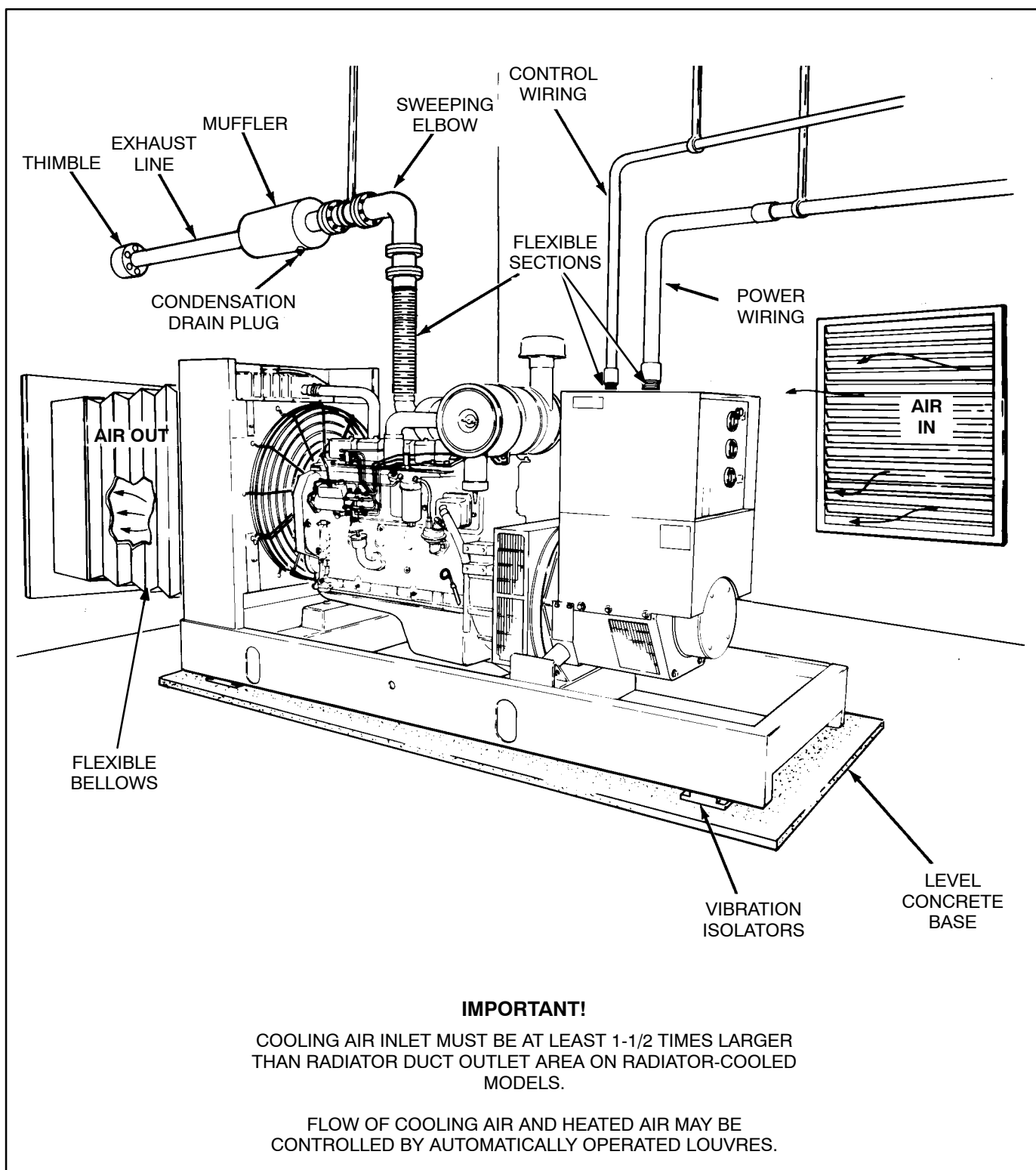


FIGURE 4-4. TYPICAL GENERATOR SET INSTALLATION

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5. DC Control Wiring (Detector Control)

CONTROL WIRING

The generator set control panel box contains connection points for remote control and monitor options. These connection points are located on the engine control monitor board (ECM), the time-delay module and the optional auxiliary relay board (ARB). (Note that if the optional ARB is installed, no remote monitor connections are attached to the ECM. The ARB provides all remote monitor connection points.)

⚠ CAUTION *Stranded copper wire must be used for all customer connections to the control panel box. Solid copper wire may break due to gen-set vibration.*

The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 18 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 16 gauge stranded copper wire.

⚠ CAUTION *Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.*

⚠ WARNING **HAZARDOUS VOLTAGE** *Touching uninsulated high voltage parts inside the control panel box can result in severe personal injury or death. Control wire installation must be done with care to avoid touching uninsulated live parts.*

Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

ENGINE CONTROL MONITOR BOARD (ECM-A11)

The heart of the engine control system is the engine monitor (A11). It is a printed circuit board assembly mounted on the back wall of the control box (Figure 5-1). It starts and stops the engine in response to the control panel switches, engine sensors and remote control signals.

Remote Monitor Connections

The Detector™ control provides the capability of attaching a remote monitor panel. Connections are made on the terminal blocks **TB1** and **TB2** located on the ECM board.

Terminal block **TB3** provides an alternative direct connection to the ECM for the RUN/STOP/REMOTE switch for troubleshooting or if desired, customer connection.

TB3-1 = REMOTE

TB3-2 = RUN

TB3-3 = STOP

A detailed connection diagram for the ECM board is provided in Section 9. (If the optional ARB is installed, remote monitor connections attach to the ARB, not the ECM.)

Remote Start Connections

Connect remote start switch between A11-TB1-9 (B+) and A11-TB1-6 (RMT).

Function Selection Jumpers

ECM board has seven selection jumpers that can be repositioned to provide the following timed or non-timed warnings or timed or non-timed shutdowns with warnings, and control of the SWITCH OFF indicator:

W1 Jumper Position (jumper **W8** must be in the **B** position):

A Non-timed warning under **FLT 2** conditions.

B Non-timed shutdown under **FLT 2** conditions.

C Timed warning under **FLT 2** conditions.

D Timed shutdown under **FLT 2** conditions.

A Non-timed warning under **FLT 1** conditions.

B Non-timed shutdown and under **FLT 1** conditions.

C Timed warning under **FLT 1** conditions.

D Timed shutdown under **FLT 1** conditions.

W6 Jumper Position:

A Warning under **Pre-High Engine Temperature** conditions.

B Shutdown under **Pre-High Engine Temperature** conditions.

W7 Jumper Position:

A Warning under **Pre-Low Oil Pressure** conditions.

B Shutdown under **Pre-Low Oil Pressure** conditions.

W8 Jumper Position:

A Warning while running or during standby under **FLT 2** conditions.

B Allows selection of functions with **W1** jumper.

W9 Jumper Position:

A Warning while running or during standby under **FLT 1** conditions.

B Allows selection of functions with **W2** jumper.

W10 Jumper Position (**SWITCH OFF** Indicator):

A Flashing (standard)

B Constant ON

C OFF

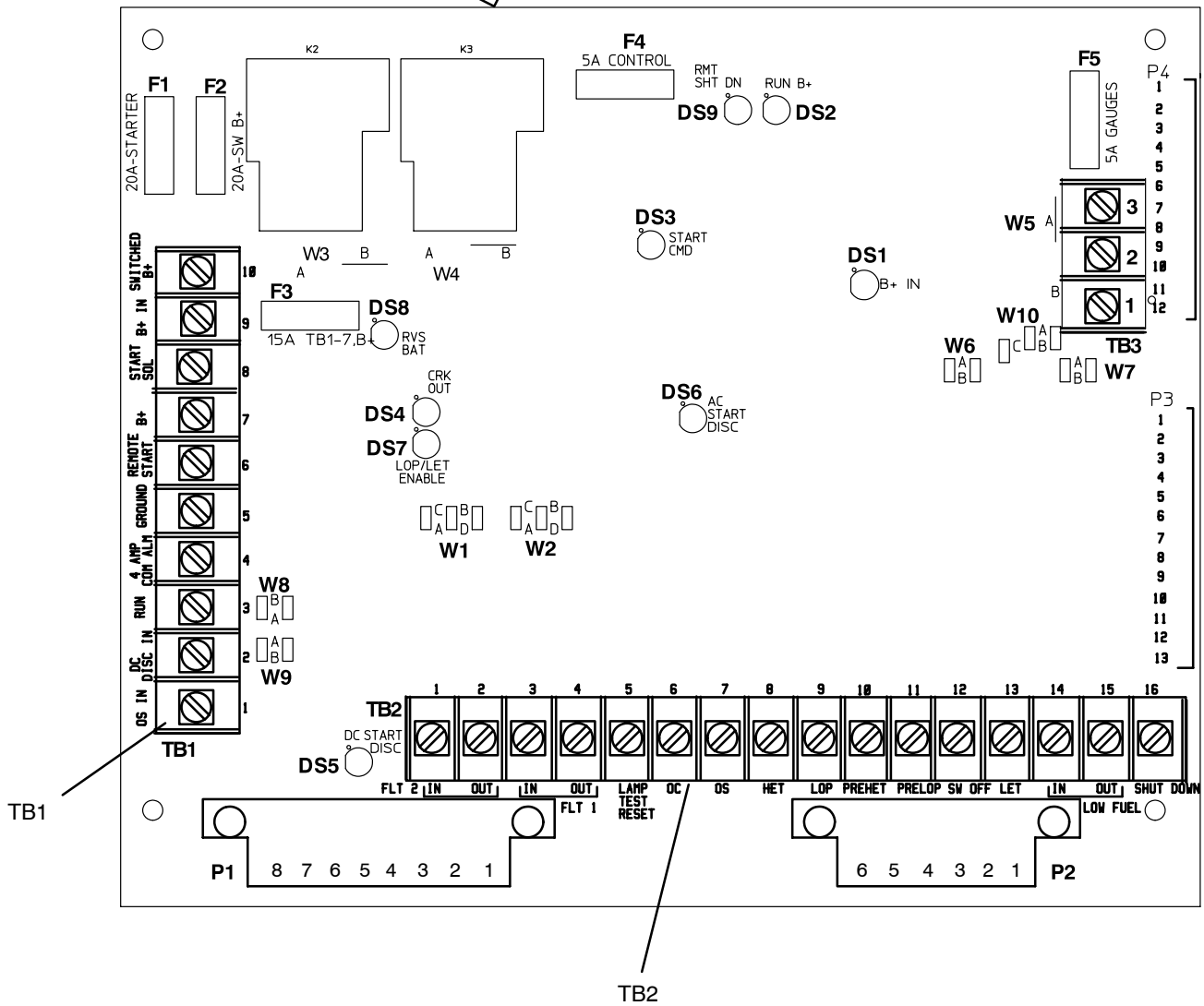
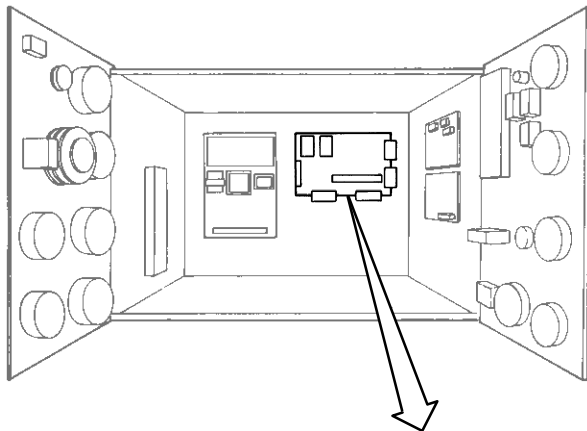


FIGURE 5-1. ENGINE CONTROL MONITOR BOARD (ECM)

AUXILIARY RELAY BOARD (OPTIONAL)

The following describes the design/functional criteria for the auxiliary relay board (ARB) with a Detector™ control. The board is mounted directly over the ECM using standoffs and has access holes for the fuses located on the ECM. A detailed connection diagram for the ARB is provided in Section 9.

Terminal Blocks:

- **TB1** – ARB TB1 and engine monitor TB1 are identically numbered and provide the same remote control connection points. Note that additional terminals are provided for terminals 5, 7, and 10 of ARB TB1.
- **TB2 through TB5** – Connection points for relays K1 through K3. TB2 provides the N/O and N/C connections (three form 'C' contacts for each relay). TB3 through TB5 provide the common connection points (TB3 for K1, TB4 for K2 and TB5 for K3).
- **TB6 and TB7** – Connection points for fault relays K4 through K15. Three terminals are provided for each relay, which are labeled COM, N/C, N/O.

Plug-In Relays (K1, K2, K3): The ARB can be equipped with one to three 3-pole, double-throw relays. These relays (K1, K2, K3) are field changeable plug-in relays for easy field addition and replacement.

Each relay can be operated as a RUN, COMMON ALARM, or ISOLATED COIL with the changing of a jumper.

The relay contact ratings are:

- 10 amps at 28 VDC or 120 VAC, 80% PF
- 6 amps at 240 VAC, 80% PF
- 3 amps at 480 VAC, 80% PF

Jumper Positions for Plug-In Relays: Jumpers W1, W2 and W3 perform the same functions for their respective relays, W1 for relay K1, W2 for relay K2, and W3 for relay K3. They can be located in any of 3 positions (A, B, C) independently of each other.

- **Jumper Position A (Run)** – The relay operates as a Run relay, energizing when SW B+ is applied from the engine monitor.
- **Jumper Position B (Common Alarm)** – The relay operates as a Common Alarm relay. The relay energizes any time there is an engine shutdown.
- **Jumper Position C (Isolated)** – The relay operates as an Isolated relay. The relay coil is energized by a customer applied B+ signal through the terminal block; TB3-1 for relay K1, TB4-1 for relay K2, and TB6-1 for relay K3.

Jumpers W11, W12, and W13 perform the same functions for their respective relays; W11 for relay K1, W12 for relay K2, and W13 for relay K3. They can be located in two different positions (A, B) independently of one another.

- **Jumper Position A** – The relay operates isolated from the board. The customer provides the circuit completion through terminal block; TB3 for relay K1, TB4-5 for relay K2, and TB6-5 for relay K3. The customer can operate the relay with switched ground logic or use this relay in the middle of more complex logic circuits if needed.
- **Jumper Position B** – The relays operate with the coils connected to ground through the board connections. The coil will require a B+ signal to energize with the jumper in this position.

Fault Relays (K4 through K15): These relay modules are used to operate a remote alarm annunciator that has an independent power source. This allows the use of either AC or DC for alarm drives. The relays are energized through the latching relays on the engine monitor and provided N/O and N/C contacts for each external alarm connection.

The 12 relays with form 'C' contacts are rated:

- 10 Amp, 120 VAC
- 10 Amp, 30 VDC

TIME-DELAY MODULE (A15) (OPTIONAL)

The start delay module is adjustable from 5 to 15 seconds and the stop delay from 30 seconds to 30 minutes. Turn the delay adjusting potentiometers clockwise to increase delay and counterclockwise to decrease delay.

Remote Control Connections

Remote control connections are made at the terminal block (TB1) that is located on the time-delay module (Figure 5-3). Connect one or more remote switches across the remote terminal (TB1-5) of the time-delay module and the B+ terminal of the ECM (A11).

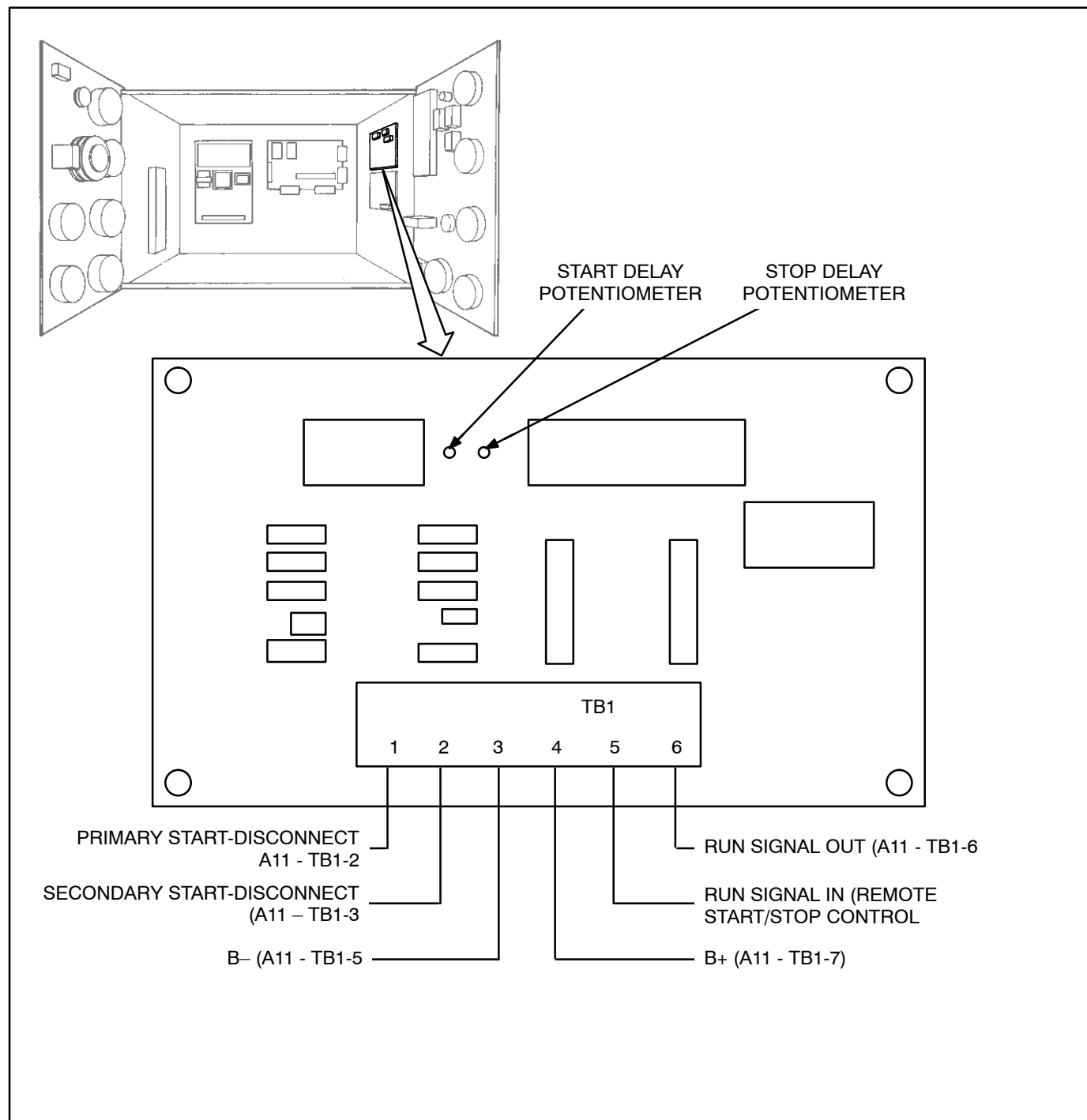


FIGURE 5-3. PREHEAT/TIME-DELAY MODULE

6. AC Electrical Connections

GENERAL

This section provides the procedure that is used to connect the AC electrical system of the genset.

Before making any AC electrical connections, make certain the generator set cannot be accidentally started. Place the control panel run switch in the OFF position. Turn off or remove AC power from the battery charger and then remove the negative (–) battery cable from the set starting battery.

⚠WARNING *Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.*

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

⚠CAUTION *Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.*

⚠WARNING *Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.*

⚠WARNING *Each of the operations described in this section should be done only by persons trained and experienced in electrical maintenance. Improper procedures may result in property damage, bodily injury or death.*

Connecting the genset AC electrical system involves:

- Installation of transfer switch
- Generator output voltage selection
- Load cable connection
- Standard and optional AC equipment connections (e.g., control box heater, coolant heater, etc.).

Local regulations often require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. All connections, wire sizes, materials used, etc. must conform to the requirements of 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.*

Before starting the genset, check to make sure that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the genset are properly connected.

⚠WARNING *Backfeed to utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after building main switch is opened.*

TRANSFER SWITCH

If the installation is for standby service, a transfer switch must be used for switching the load from the normal power source to the genset (see Figure 6-1). Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

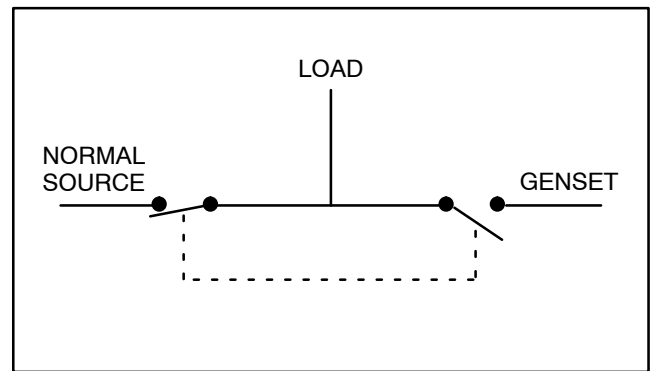


FIGURE 6-1. TYPICAL LOAD TRANSFER FUNCTION

AC WIRING

Generator Voltage Connections

The available generator output voltages and maximum current ratings 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 to the nameplate voltages as shown on the Reconnection Diagram located on the side access cover of the control housing. Many of the voltages listed will require reconfiguration of the generator output leads on the connection terminal block. This reconfiguration must only be done by service personnel that are trained and experienced to perform electrical installation. The generator set was adjusted to produce a specified voltage during production verification testing prior to shipment. The installer must always check the stator lead terminal block connections and perform any necessary reconnect to obtain the voltage required.

Some generator sets are capable of producing a wide range of voltages and connection configurations, others have specific limited capabilities. Refer to wiring diagram and generator voltages (from the nameplate) when reviewing the voltage connection information and use the wiring diagram supplied with your generator set when actually performing load connections.

⚠ CAUTION *Reconfiguring generator sets to higher voltages can exceed the voltage capability of the specific generator windings and damage the generator and also decrease line current, rendering line circuit breakers too large. Consult with your distributor before performing reconnection for a different voltage.*

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

Load Connections

Flexible conduit and stranded conductors must be used for connections to take up movement of the generator set.

All loads are connected to the generator by bolting **stranded** load wires to the appropriate terminals on the generator reconnection terminal block or circuit breaker lugs. 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).

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.

Current Transformers (Detector Control)

Current transformers (CT's) are required on gensets that contain AC meters. The CT's must be installed as noted in the following CT Installation Requirements.

Refer to the Reconnection Diagram to identify the output leads/phase that must be routed through each CT, and also appropriate transformer post selection for meter sensing leads. The transformers are labeled CT21, CT22 and CT23 on the reconnection wiring diagram. (The Reconnection Diagram is located on the upper side cover of the control housing.)

CT Installation Requirements:

- A. The CT has a dot on one side. This dot must be facing toward the generator (conventional current flowing into the dot). A dot is also used to indicate pin 1 of the CT.
- B. CT21 – U load leads (A phase),
CT22 – V load leads (B phase)
CT23 – W load leads (C phase)
- C. Route the appropriate load wires through each CT.
- D. The CT's have dual secondaries (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 2 for high voltage gensets or to pin 3 for low voltage gensets. (Refer to Reconnection Diagram.)

Grounding

The following is a brief description of system and equipment grounding of permanently installed AC generators within a facility wiring system. It is important to follow the requirements of the local electrical code.

Figure 6-2 illustrates typical system grounding for a 3-pole and a 4-pole automatic transfer switch (ATS). In the 3-pole ATS, note that the generator neutral is connected to the ATS and is NOT bonded to ground at the generator. In the 4-pole ATS system, a grounding electrode conductor and a bonding jumper are used to connect the generator neutral to ground. In some installations, a CT may be required for ground fault monitoring (refer to Figure 6-2 for CT location).

Make sure the genset is grounded to earth in one location only. On generators without a circuit breaker, ground to the point indicated on the top of the generator. On gensets with circuit breakers, use the ground lug provided in the circuit breaker box.

⚠ WARNING *Electric current can cause severe personal injury or death. Bonding and grounding must be done properly. 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.

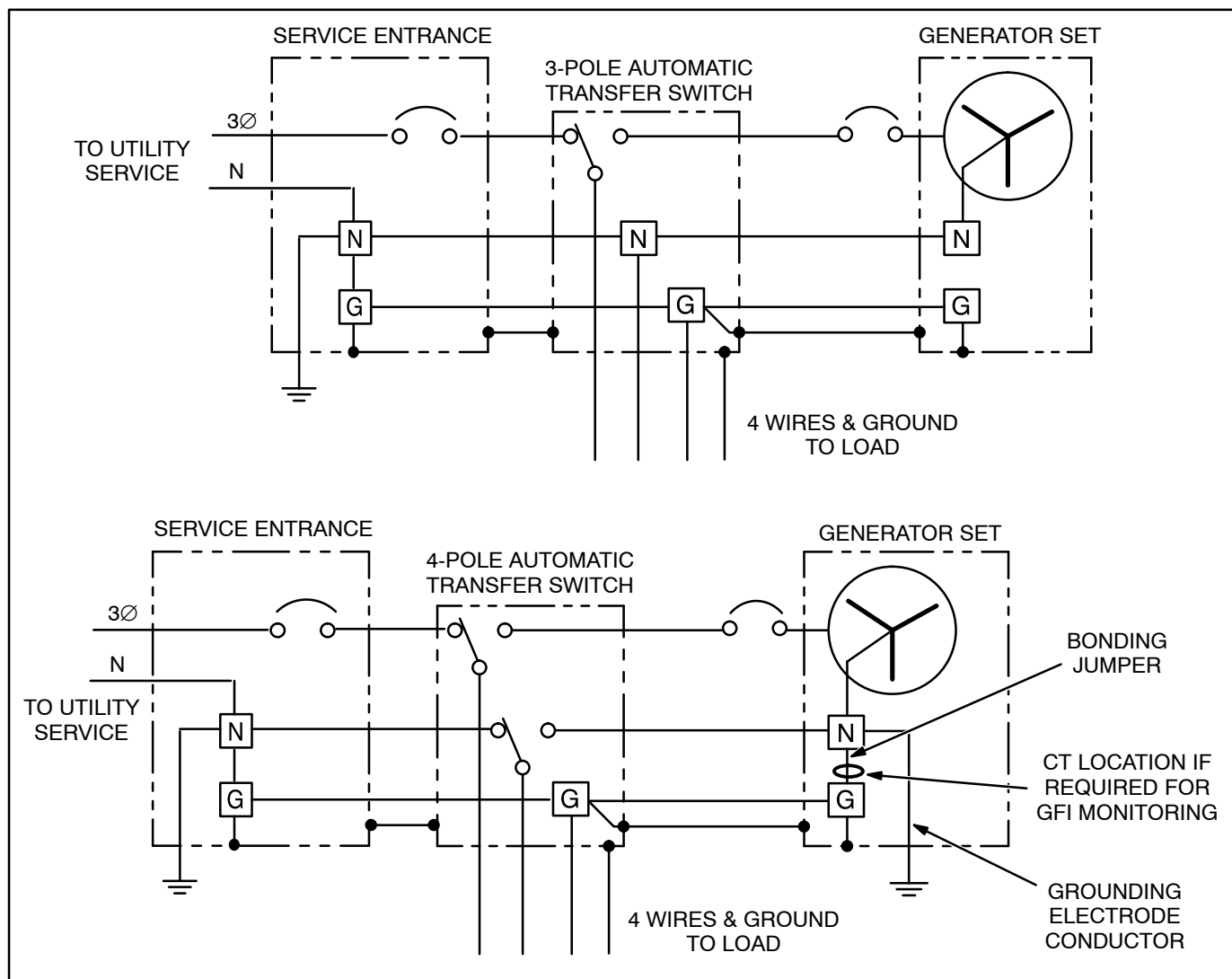


FIGURE 6-2. TYPICAL SYSTEM GROUNDING ONE-LINE DIAGRAMS

CONTROL HEATER (OPTIONAL)

A control heater (Figure 6-3) provides a means of humidity /temperature control for the Detector control box interior. It protects the components when

the generator set is subjected to varying ambient air conditions during extended periods of non-use.

The heater is equipped with a power cord that terminates with a 120V or 240V NEMA plug.

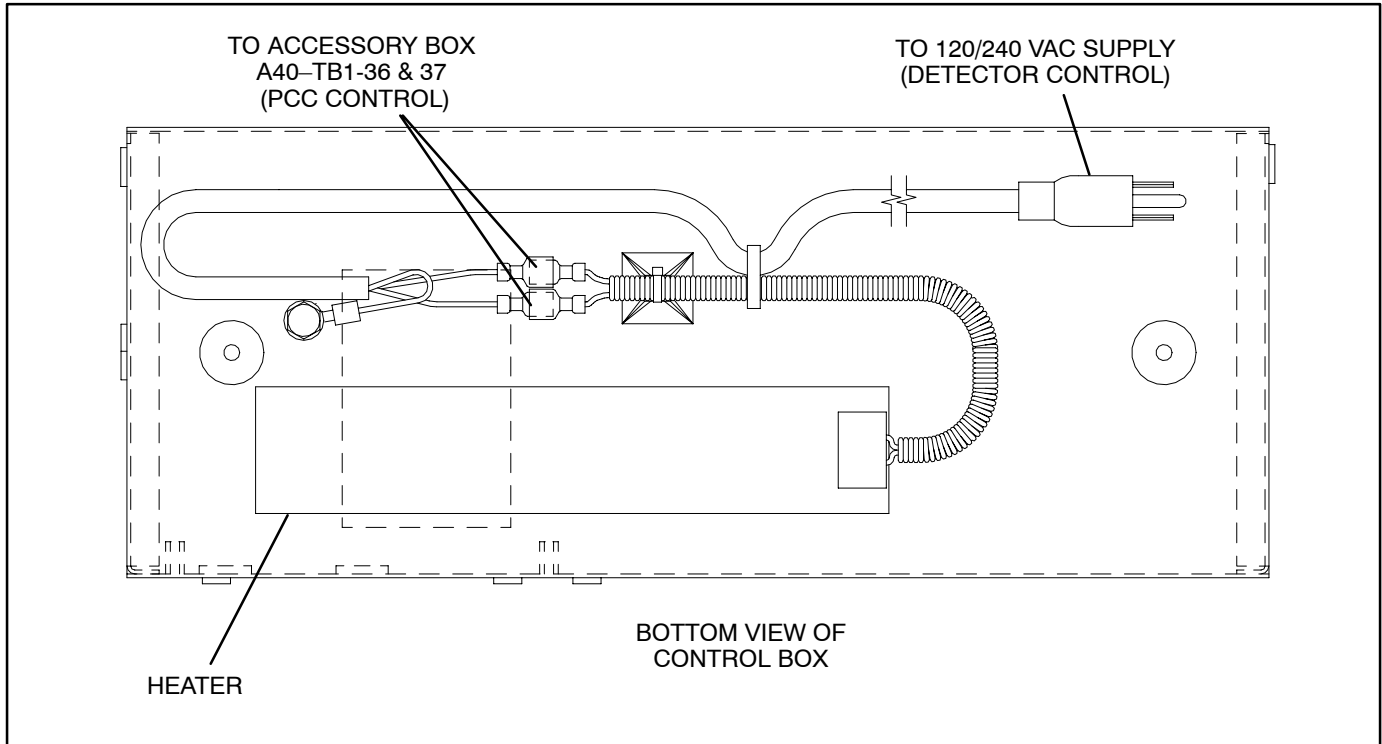


FIGURE 6-3. OPTIONAL CONTROL HEATER

COOLANT HEATER (OPTIONAL)

Coolant heaters keep the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces startup time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

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

Figure 6-4 shows a typical coolant heater. Connect the heater to a source of power that will be on during

the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

A battery charger is required to prevent battery discharge. The heater control relay draws 83 mA of current when the heater(s) is off. The heater is off when the engine has reached the proper temperature or the engine is running.

⚠ CAUTION *Do not connect AC power to the heater before connecting battery cables. Heater will run continuously without DC power and can overheat and damage heater.*

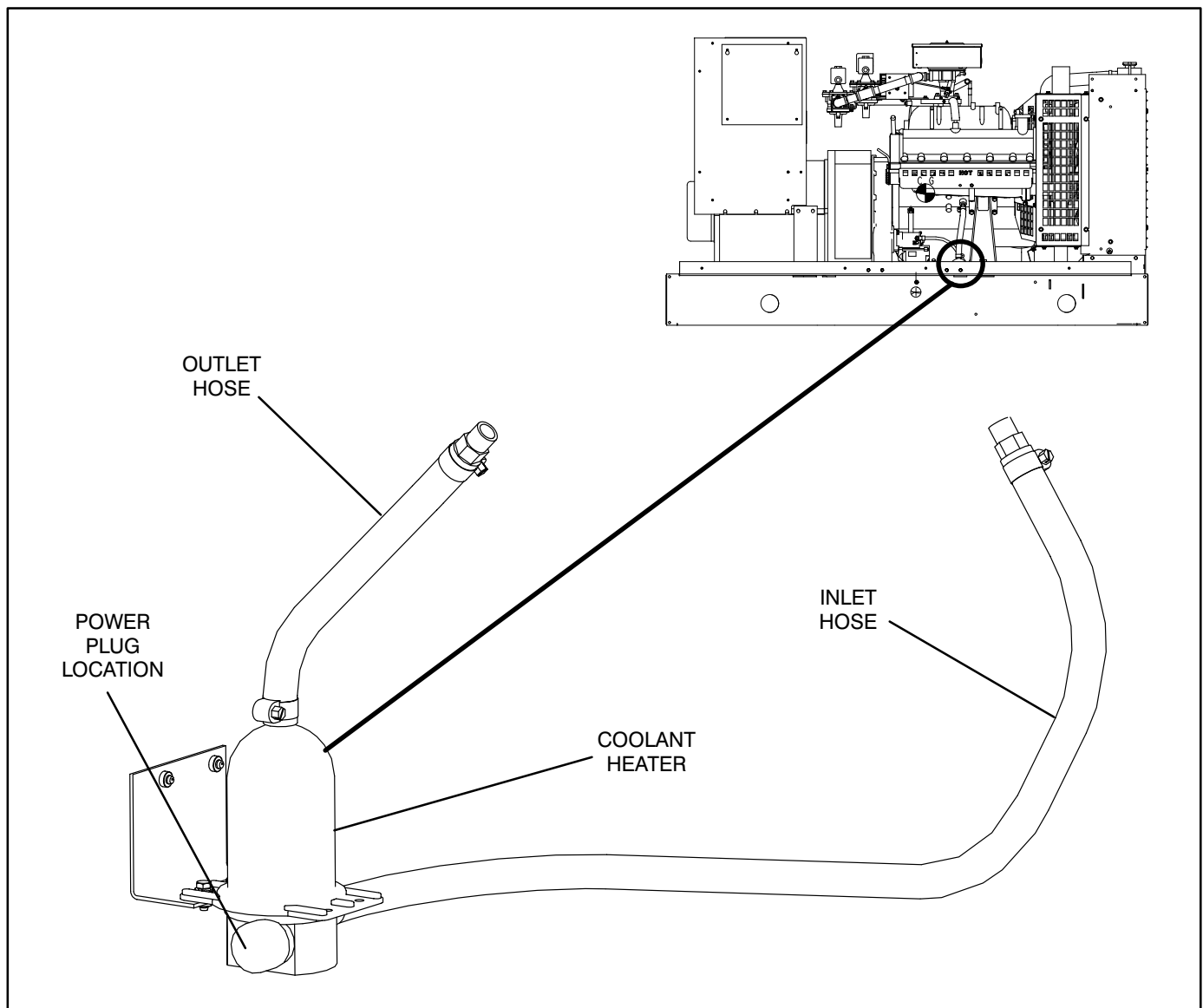


FIGURE 6-4. COOLANT HEATER

GENERATOR HEATER (OPTIONAL)

A generator heater(s) is used to help keep the generator free of condensation when the generator set is not running. During cool and humid conditions, condensation may form within a generator, creating flashing and shock hazards.

⚠ WARNING *Water or moisture inside a generator increases the possibility of flashing and electrical shock, which can cause equipment damage and severe personal injury or death. Do not use a generator which is not dry inside and out.*

Figure 6-5 illustrates the installation of two heater elements. Connect the heater(s) to a source of power that will be on during the time the engine is not running. Power connections are made to the terminal block in the heater terminal box. Be sure the voltage rating is correct for the heater element rating.

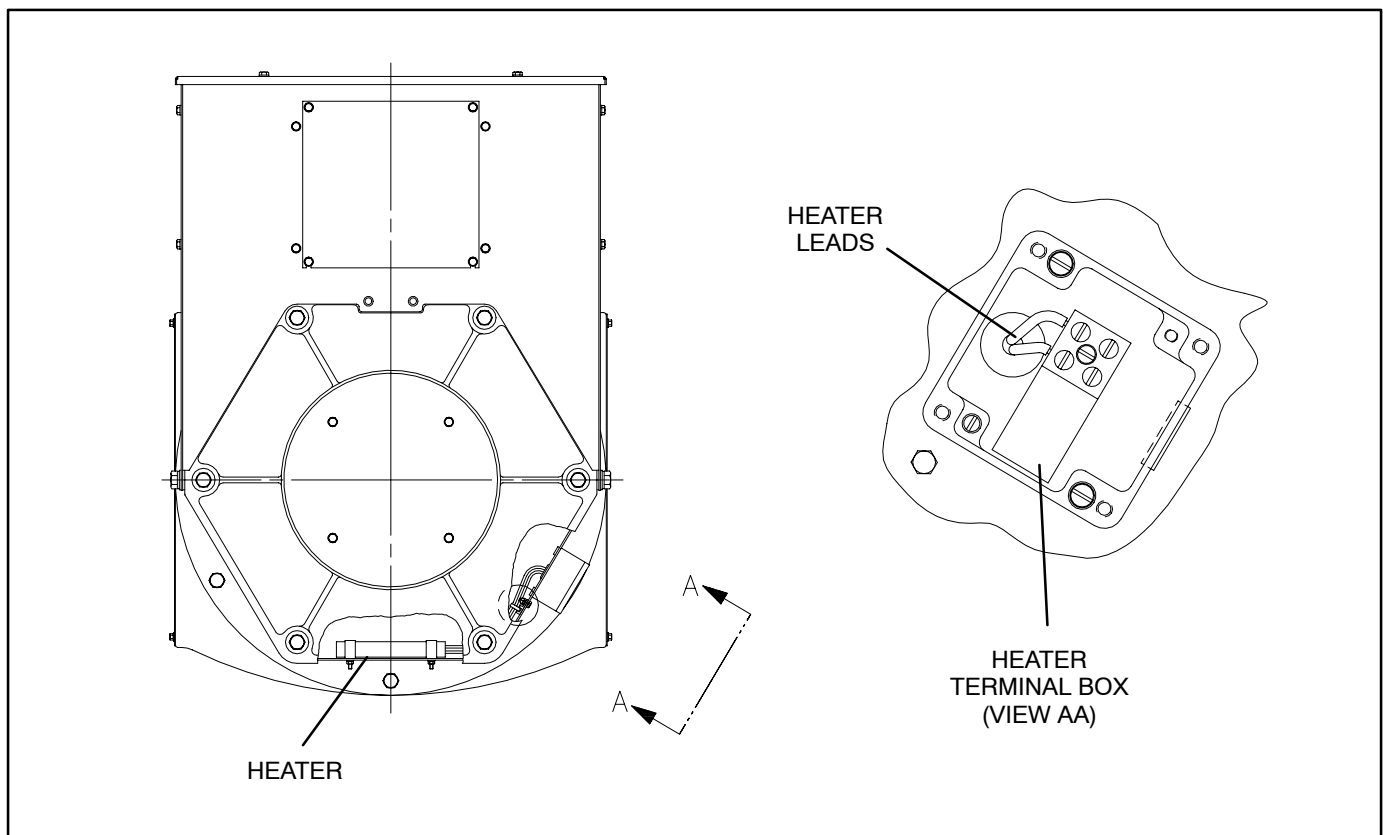


FIGURE 6-5. TYPICAL GENERATOR HEATER INSTALLATION

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7. Prestart Preparation

GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 8*.

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

⚠️WARNING *Accidental starting of the generator set can cause severe personal injury or death. Make sure that the Run/Off/Auto switch on the control panel is set to the Off position before connecting the battery cables.*

Starting the unit requires a 12 volt battery. 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 battery charger.

⚠️WARNING *Ignition of explosive battery gases can cause severe personal injury or death. Always connect negative (–) battery last to prevent arcing.*

⚠️WARNING *Ventilate battery area before working on or near battery. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.*

STARTING

Refer to the generator set *Operator's* manual for important safety precautions and recommended procedures to start the genset and to confirm proper operation. Start the generator set and verify all engine and generator gauges are displaying the correct values.

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8. Installation Checklist

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.

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.
- ☐ Fuel supply line shutoff valves are installed to prevent fuel flow in case of leaks.
- ☐ 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.

9. Wiring Diagrams

GENERAL

This section consists of the schematic and connection wiring diagrams referenced in the text. The following drawings are included.

- Page 9-2 – Customer Connections at the Engine Monitor Board
- Page 9-3 – Customer Connections at the Auxiliary Relay Board
- Page 9-4 – Accessory Interconnect Diagram

TB1-10 (SWITCHED B+ OUTPUT) FUSED AT 20 AMPS, ENERGIZED WHEN THE START SIGNAL IS APPLIED AND DE-ENERGIZED AT SHUTDOWN (NORMAL AND FAULT)

TB1-9 (B+ INPUT) BATTERY POSITIVE (+) CONNECTION

TB1-8 (START SOLENOID) FUSED AT 20 AMPS

TB1-7 (B+ OUTPUT) OUTPUT TO TIME DELAY START/STOP MODULE A15 (WHEN USED), FUSED AT 15 AMPS, AVAILABLE WHEN THE STARTING BATTERIES ARE CONNECTED

TB1-6 (REMOTE START) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED), CONNECT REMOTE START CONTACT OF THE AUTOMATIC TRANSFER SWITCH TO TERMINAL TB1-5 OF MODULE A15 (WHEN USED) OR TB1-6 OF EMB

TB1-5 (GROUND)

TB1-4 (COMMON ALARM B+ OUTPUT) 4 AMP RATED DEVICE MAXIMUM

TB1-3 (RUN) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED)

TB1-2 (DC DISCONNECT) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED)

TB2-1 (FAULT 2) GROUND INPUT FROM SENDER

TB2-2 (FAULT 2) GROUND OUTPUT TO LIGHT/RELAY*

TB2-3 (FAULT 1) GROUND INPUT FROM SENDER

TB2-4 (FAULT 1) GROUND OUTPUT TO LIGHT/RELAY*

TB2-5 (REMOTE RESET) MOMENTARY CONTACT TO GROUND

TB2-6 (OVERCRANK FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-7 (OVERSPEED FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-8 (HIGH ENGINE TEMPERATURE FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-9 (LOW OIL PRESSURE FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-10 (PRE-HIGH ENGINE TEMPERATURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-11 (PRE-LOW OIL PRESSURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

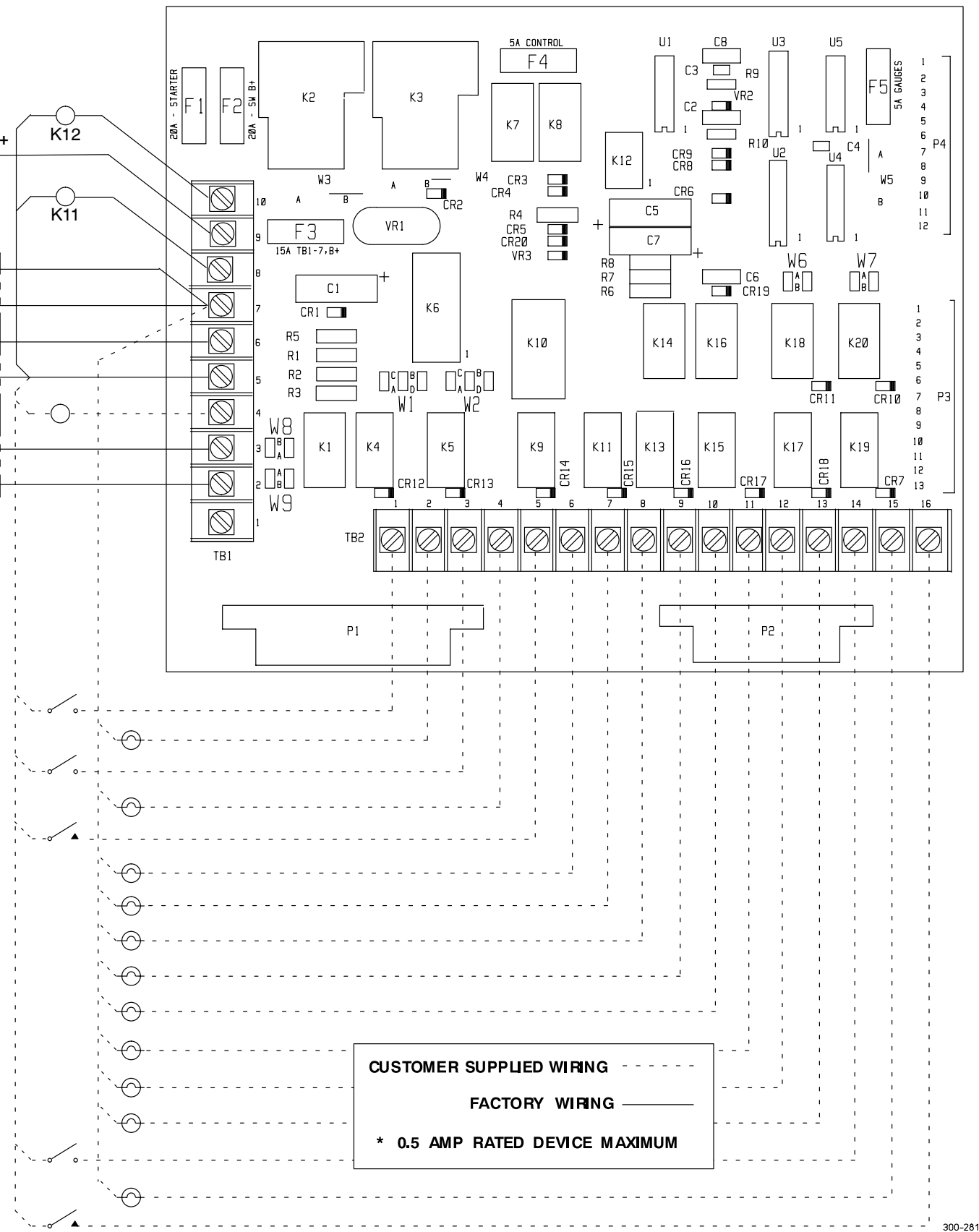
TB2-12 (SWITCH OFF WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-13 (LOW ENGINE TEMPERATURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-14 (LOW FUEL WARNING) GROUND INPUT FROM SENDER

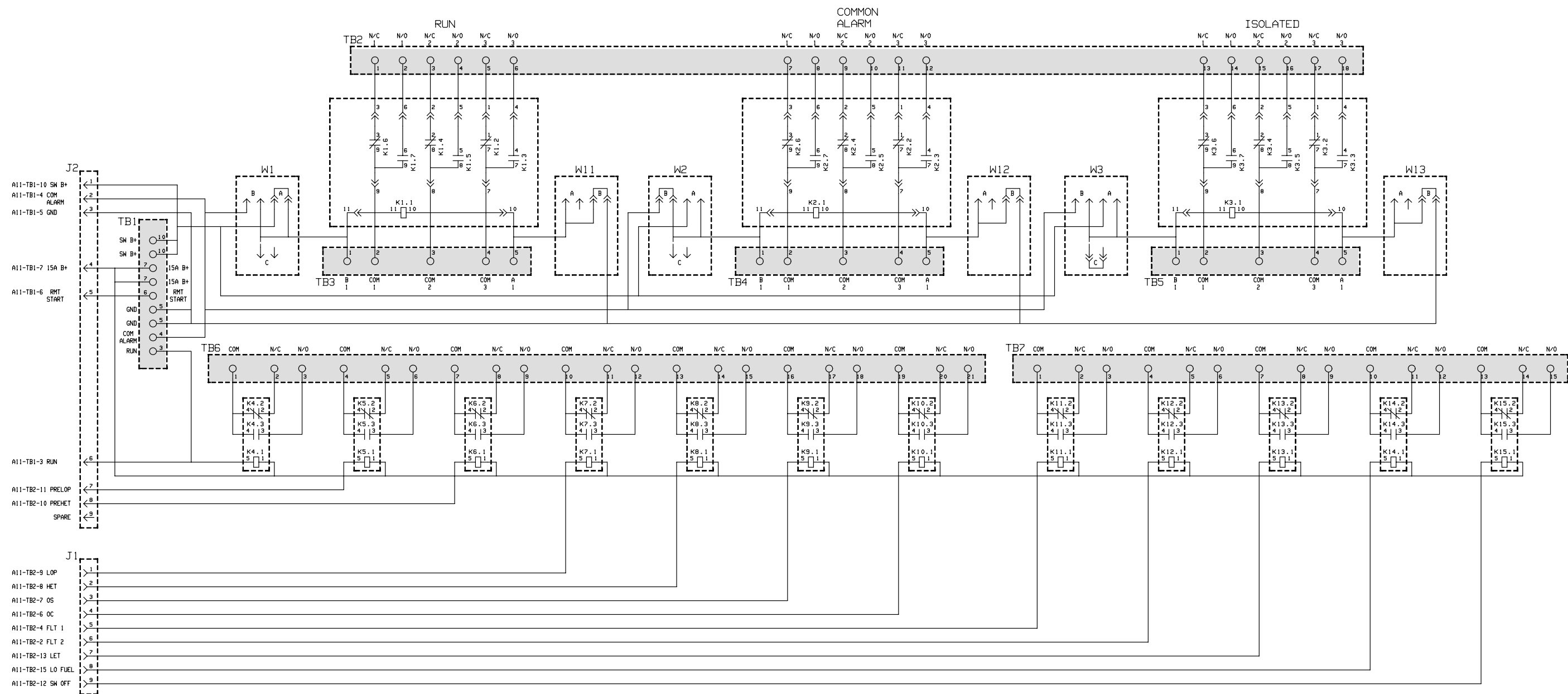
TB2-15 (LOW FUEL WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-16 (EMERGENCY SHUT DOWN) MOMENTARY CONTACT TO GROUND



300-2811

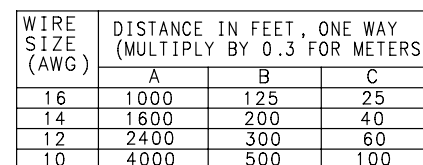
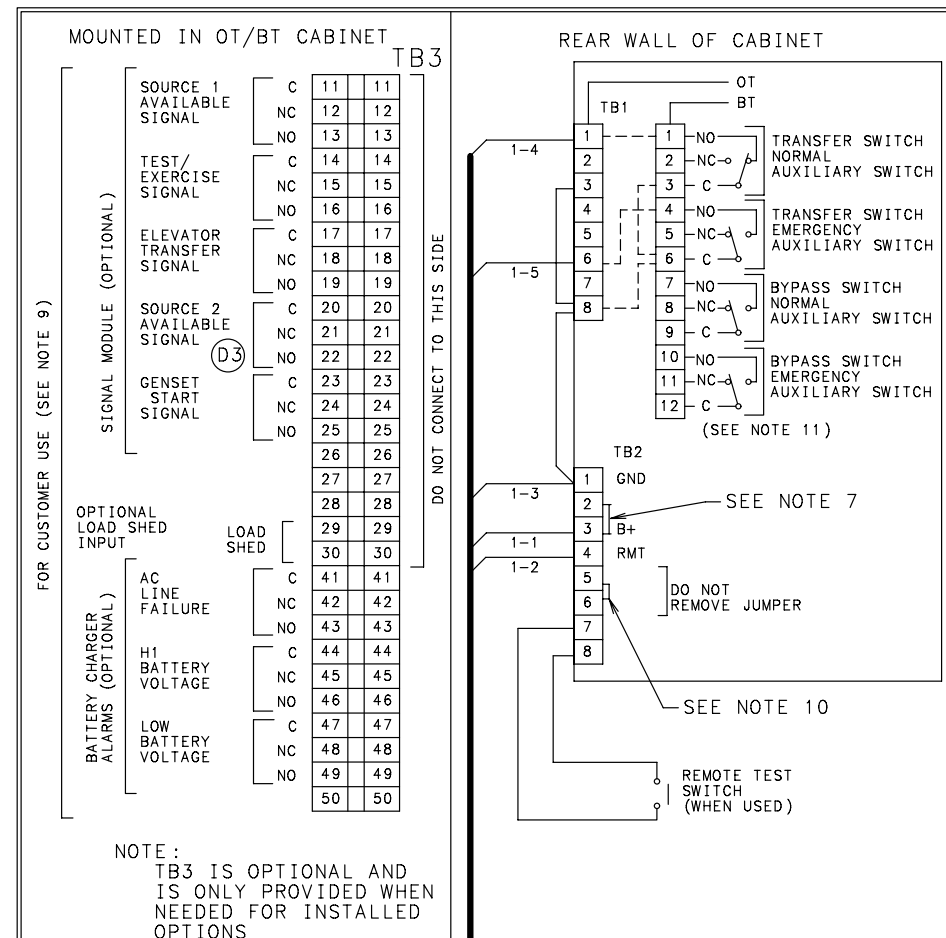
CUSTOMER CONNECTIONS AT THE ENGINE MONITOR BOARD (DETECTOR CONTROL)



THE TERMINALS IN THE SHADED BOXES ARE FOR CUSTOMER CONNECTIONS

CUSTOMER CONNECTINS AT THE AUXILIARY RELAY BOARD (DETECTOR CONTROL)

OT & BT 2 WIRE START
UTILITY TO GENSET



- No. 630-1345 sh 3
Rev. J
Modified 11/96

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