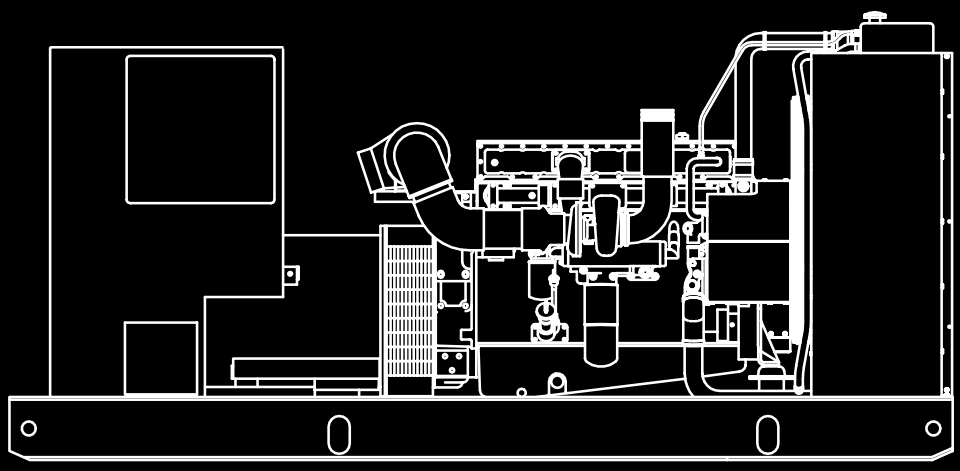
**Caution: This document contains mixed page sizes (8.5 x 11 or 11 x 17), which may affect printing. Please adjust your printer settings according to the size of each page you wish to print.**

Power Generation

# Installation Manual

## PowerCommand® Control
### 3100 Series
## Detector™ Control

## Generator Sets



## Models

**DFAA, DFAB, DFAC, DFBC, DFBD, DFBE, DFBF, DFCB, DFCC**
**DFCE, DFEB, DFEC, DFED, DFFA, DFFB, DFGA, DFGB, DFGE**
**DFGC, DFJA, DFJB, DFJC, DFJD, DFLA, DFLB, DFLC, DFLE**
**DFLD, DFMB, DQAA, DQAB, DQBA, DQBB**

960-0619D 6-2003
(Supercedes 960–0615)

Printed in U.S.A.

# Table of Contents

## California

## Proposition 65 Warning

**Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.**

# 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 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.

## MEDIUM VOLTAGE GENERATOR SETS

## (601V to 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

## 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 breath 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 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 contains separate *DC Control Wiring* and *Prestart Preparation* sections for gensets using the PowerCommand® Control 3100 (PCC) and the optional Detector™ control (Figure 1-1). Refer to the *Table of Contents* for specific information relating to your genset. All other sections apply to both versions.**

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".

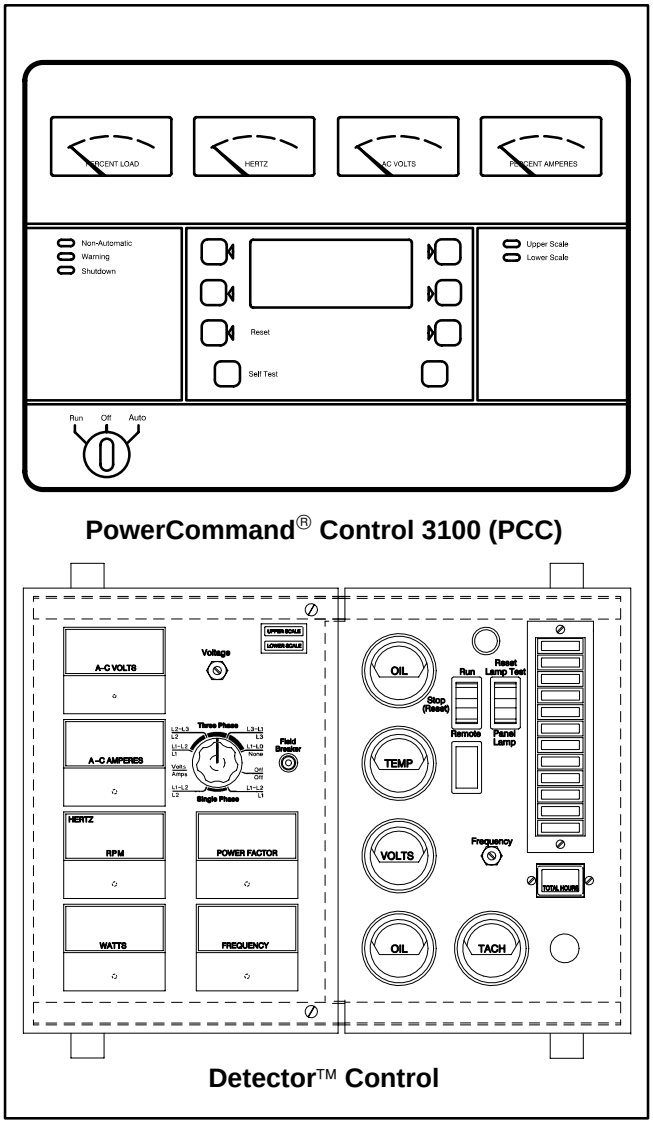



**FIGURE 1-1. CONTROL PANEL CONFIGURATIONS**

## 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 | DFAA/DFAB/DFAC | DFBF | DFCB/DFCC | DFCE |
|---|---|---|---|---|
| **Cummins Diesel Series** | LTA10 | NT855 | NTA855 | NTA855 |
| **Generator kW Rating** | See Genset Nameplate for rating information. | | | |
| **Cooling System**<br>Capacity with Standard Radiator | 13 Gal (49 L) | 13.5 Gal (51 L) | 13.5 Gal (51 L) | 15 Gal (57 L) |
| **Oil Capacity*** | 9.5 Gal (36 L) | 10.5 Gal (40 L) | 10.5 Gal (40 L) | 10 Gal (38 L) |
| **Engine Fuel Connection**<br>Inlet/Oultet Thread Size | Refer to Generator Outline Drawing | | | |
| **Fuel Flow**<br>Max. Fuel Inlet Restriction<br>Max. Fuel Return Restriction | 4 in. Hg. (13.5 kPa)<br>6.5 in. Hg. (22 kPa) | 4 in. Hg. (13.5 kPa)<br>6 in. Hg. (20.3 kPa) | | |
| **Exhaust**<br>Outlet Size<br>Max. Allowable Back Pressure<br>$H_20$<br>kPa | 4 in. NPT<br><br>41<br>10.2 | 5 in. NPT<br><br>41<br>10.2 | 6 in. NPT<br><br>41<br>10.2 | 6 in. NPT<br><br>41<br>10.2 |
| **Electrical System**<br>Starting Voltage<br>Battery<br>Group number<br>CCA (minimum)<br>Cold Soak @ 0° F (-18° C) | 24 Volts DC<br>Two, 12 Volt<br>8D<br><br>1400 | | | |

***** Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

**FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)**

| MODEL | DFAA | DFAB | DFAC | DFBF | DFCB | DFCC | DFCE |
|---|---|---|---|---|---|---|---|
| US gph (L/hr) | 13.9 (52.7) | 15.6 (59) | 16.8 (63.7) | 20.4 (77) | 22.5 (85) | 24.4 (92.5) | 29.1 (110) |

| MODEL | DFEB | DFEC | DFED |
|---|---|---|---|
| **Cummins Diesel Series** | KTA19 | KTA19 | KTA19-G4 |
| **Generator kW Rating** | See Genset Nameplate for rating information. | | |
| **Cooling System**<br>Capacity with Standard Radiator | 24 Gal (91 L) | | |
| **Oil Capacity*** | 12 Gal (45 L) | | |
| **Engine Fuel Connection**<br>Inlet/Oultet Thread Size | Refer to Generator Outline Drawing | | |
| **Fuel Flow**<br>Max. Fuel Inlet Restriction<br>Max. Fuel Return Restriction | 4 in. Hg. (13.5 kPa)<br>6.5 in. Hg. (22 kPa) | | |
| **Exhaust**<br>Outlet Size<br>Max. Allowable Back Pressure<br>$H_20$<br>kPa | 5 in. NPT<br><br>40.8<br>10.2 | 6 in. NPT<br><br>40.8<br>10.2 | 6 in. NPT<br><br>40.8<br>10.2 |
| **Electrical System**<br>Starting Voltage<br>Battery<br>Group number<br>CCA (minimum)<br>Cold Soak @ 0° F (-18° C) | 24 Volts DC<br>Two, 12 Volt<br>8D<br><br>1400 | | |

***** Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

**FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)**

| MODEL | DFEB | DFEC | DFED |
|---|---|---|---|
| US gph (L/hr) | 28.9 (109.5) | 31 (117.5) | 34 (128.9) |

| MODEL | DFGA/DFGB | DFGE |
|---|---|---|
| **Cummins Diesel Series** | VTA28-G5 | VTA28-G7 |
| **Generator kW Rating** | See Genset Nameplate for rating information. | |
| **Cooling System**<br>Capacity with Standard Radiator | 44 Gal (167 L) | |
| **Oil Capacity*** | 22.25 Gal (84 L) | |
| **Engine Fuel Connection**<br>Inlet/Oultet Thread Size | Refer to Generator Outline Drawing | |
| **Fuel Flow**<br>Max. Fuel Inlet Restriction<br>Max. Fuel Return Restriction | 4 in. Hg. (13.5 kPa)<br>6.5 in. Hg. (22 kPa) | |
| **Exhaust**<br>Outlet Size<br>Max. Allowable Back Pressure<br>$H_20$<br>kPa | 5 in. NPT<br><br>41<br>10.2 | |
| **Electrical System**<br>Starting Voltage<br>Battery<br>Group number<br>CCA (minimum)<br>Cold Soak @ 0° F (-18° C) | 24 Volts DC<br>Two, 12 Volt<br>8D<br><br>1400 | |
| * Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications. | | |

**FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)**

| MODEL | DFGA | DFGB | DFGE |
|---|---|---|---|
| US gph (L/hr) | 37.4 (141.7) | 44.2 (167.5) | 58.5 (221) |

| MODEL | DFJA | DFJB/DFJC | DFJD |
|---|---|---|---|
| **Cummins Diesel Series** | KTA38 | KTA38 | KTA38 |
| **Generator kW Rating** | See Genset Nameplate for rating information. | | |
| **Cooling System**<br>Capacity with Standard Radiator | 81.5 Gal (308 L) | 85.3 Gal (323 L) | 68.9 Gal (337 L) |
| **Oil Capacity***<br>Standby<br>Prime | 34 Gal (129 L)<br>41 Gal (155 L) | | |
| **Engine Fuel Connection**<br>Inlet/Oultet Thread Size | Refer to Generator Outline Drawing | | |
| **Fuel Flow**<br>Max. Fuel Inlet Restriction<br>Max. Fuel Return Restriction | 4 in. Hg. (13.5 kPa)<br>6.5 in. Hg. (22 kPa) | | |
| **Exhaust**<br>Outlet Size<br>Max. Allowable Back Pressure<br>$H_20$<br>kPa | 6 in. NPT<br><br>41<br>10.2 | | |
| **Electrical System**<br>Starting Voltage<br>Battery<br>Group number<br>CCA (minimum)<br>Cold Soak @ 0° F (-18° C) | 24 Volts DC<br>Four, 12 Volt<br>8D<br><br>1400 | | |
| * Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications. | | | |

**FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)**

| MODEL | DFJA | DFJB | DFJC | DFJD |
|---|---|---|---|---|
| US gph (L/hr) | 54.9 (208) | 57.8 (219) | 61.1 (231.6) | 70.1 (265.7) |

| MODEL | DFLB | DFLC/DFLD | DFLE | DFMB |
|---|---|---|---|---|
| **Cummins Diesel Series** | KTA50 | KTA50 | | KTTA50 |
| **Generator kW Rating** | See Genset Nameplate for rating information. | | | |
| **Cooling System** Capacity w/Standard Radiator – Gal (L) | 92 (348) | 102 (386) | | 102 (386) |
| **Oil Capacity*** Standby – Gal (L) | 44.7 (169 ) | | | |
| Prime – Gal (L) | 58.7 (222 ) | | | |
| **Engine Fuel Connection** Inlet/Oultet Thread Size | Refer to Generator Outline Drawing | | | |
| **Fuel Flow** Max. Fuel Inlet Restriction | 4 in. Hg. (13.5 kPa) | | | |
| Max. Fuel Return Restriction | 6.5 in. Hg. (22 kPa) | | | |
| **Exhaust** Outlet Size | 6 in. NPT | | 6 in. NPT | 6 in. NPT |
| Max. Allowable Back Pressure $H_20$ | 41 | | 27 | 41 |
| kPa | 10.2 | | 6.7 | 10.2 |
| **Electrical System** Starting Voltage | 24 Volts DC | | | |
| Battery | Four, 12 Volt | | | |
| Group number | 8D | | | |
| CCA (minimum) Cold Soak @ 0° F (-18° C) | 1400 | | | |

***** Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

**FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)**

| MODEL | DFLB | DFLC | DFLD | DFLE | DFMB |
|---|---|---|---|---|---|
| US gph (L/hr) | 77.2 (292.6) | 87.3 (330.9) | 77.4 (293) | 103.6 (392.6) | 103.3 (391.5) |

| MODEL | DQAA/DQAB | DQBA/DQBB |
|---|---|---|
| **Cummins Diesel Series** | M11 | N14 |
| **Generator kW Rating** | See Genset Nameplate for rating information. | |
| **Cooling System**<br>Capacity with Standard Radiator | 13 Gal (49 L) | 13.5 Gal (51 L) |
| **Oil Capacity*** | 9.5 Gal (36 L) | 10 Gal (38 L) |
| **Engine Fuel Connection**<br>Inlet/Oultet Thread Size | Refer to Generator Outline Drawing | |
| **Fuel Flow**<br>Max. Fuel Inlet Restriction<br>Max. Fuel Return Restriction | 4 in. Hg. (13.5 kPa)<br>6.5 in. Hg. (22 kPa) | 4 in. Hg. (13.5 kPa)<br>6 in. Hg. (20.3 kPa) |
| **Exhaust**<br>Outlet Size<br>Max. Allowable Back Pressure<br>$H_20$<br>kPa | 4 in. NPT<br><br>41<br>10.2 | |
| **Electrical System**<br>Starting Voltage<br>Battery<br>Group number<br>CCA (minimum)<br>Cold Soak @ 0° F (-18° C) | 24 Volts DC<br>Two, 12 Volt<br>8D<br><br>1400 | |
| * Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications. | | |

**FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)**

| MODEL | DQAA | DQAB | DQBA | DQBB |
|---|---|---|---|---|
| US gph (L/hr) | 13.9 (52.7) | 17.1 (64.8) | 20.8 (78.8) | 23.7 (89.8) |

# 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.

Requirements to be considered prior to 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

**⚠ CAUTION** ***Model DFLE 50°C radiator-cooled genset only: The alignment of the cooling system fan drive must be checked after the genset is mounted. Failure to check fan drive alignment can result in severe fan/radiator damage. Refer to Section 11 for alignment procedure.***

## 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 vibration isolators to the base. Secure the vibration isolators to the skid using flat or bevel washer and hexagonal nut for each bolt (see 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.

Locate the isolators as shown on the generator set *Outline Drawing* referenced in the *Data Sheet*.

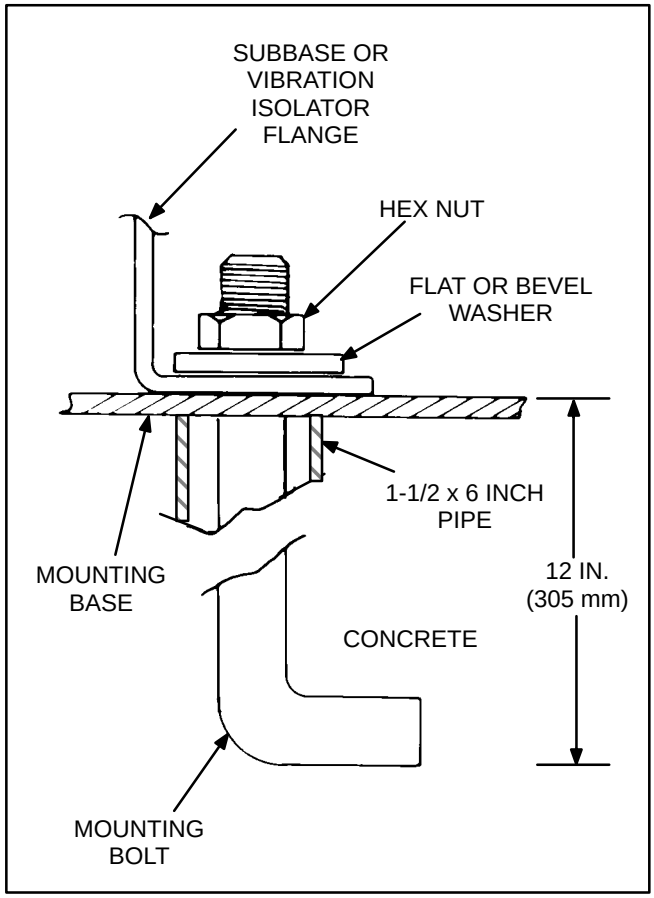



**FIGURE 3-1. BOLT DIAGRAM**

## 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.

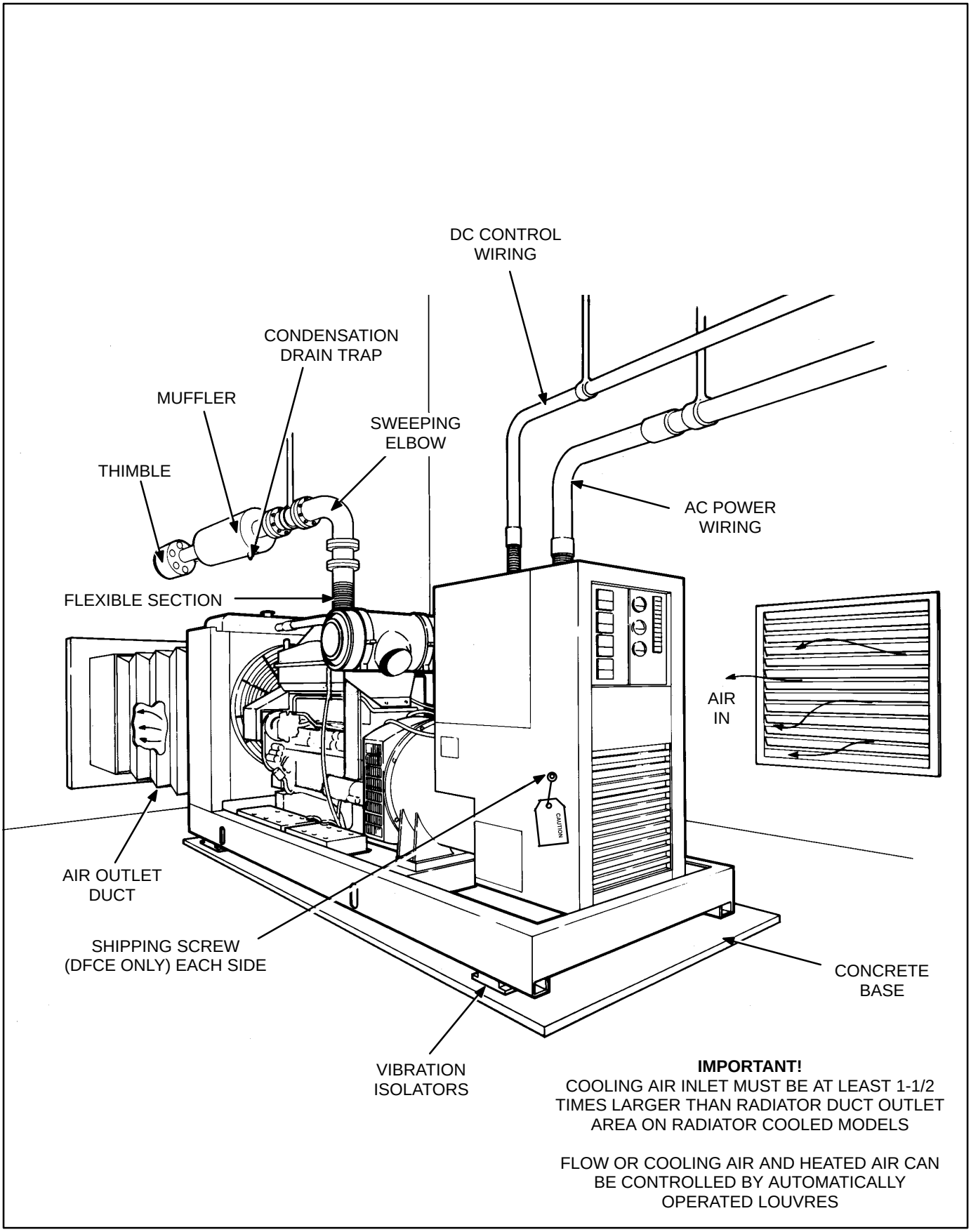



**FIGURE 3-2. TYPICAL INSTALLATION**

## 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 and level.
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 approach 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.

   **Model DFLE 50°C radiator-cooled genset only: Make sure radiator skid and engine/alternator skid are level with each other after adjusting isolators. If not level, proper fan belt alignment cannot be achieved (Section 11).**

5. The genset may not be level yet; therefore, adjust the leveling bolts until the set is level and sufficient clearance still remains. (Clearance on all isolators should be roughly equal). 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.
7. Model DFCE only: With the genset in position and secured to the isolators, remove the two controller cabinet shipping screws (see Figure 3-2).

   **⚠ CAUTION** ***Remove shipping screws (two) prior to genset operation. Genset operation with shipping screws in place will damage control components.***

8. Model DFLE 50°C radiator-cooled genset only: With the genset in position and secured to the isolators, check the alignment of the cooling system fan drive (refer to Section 11).

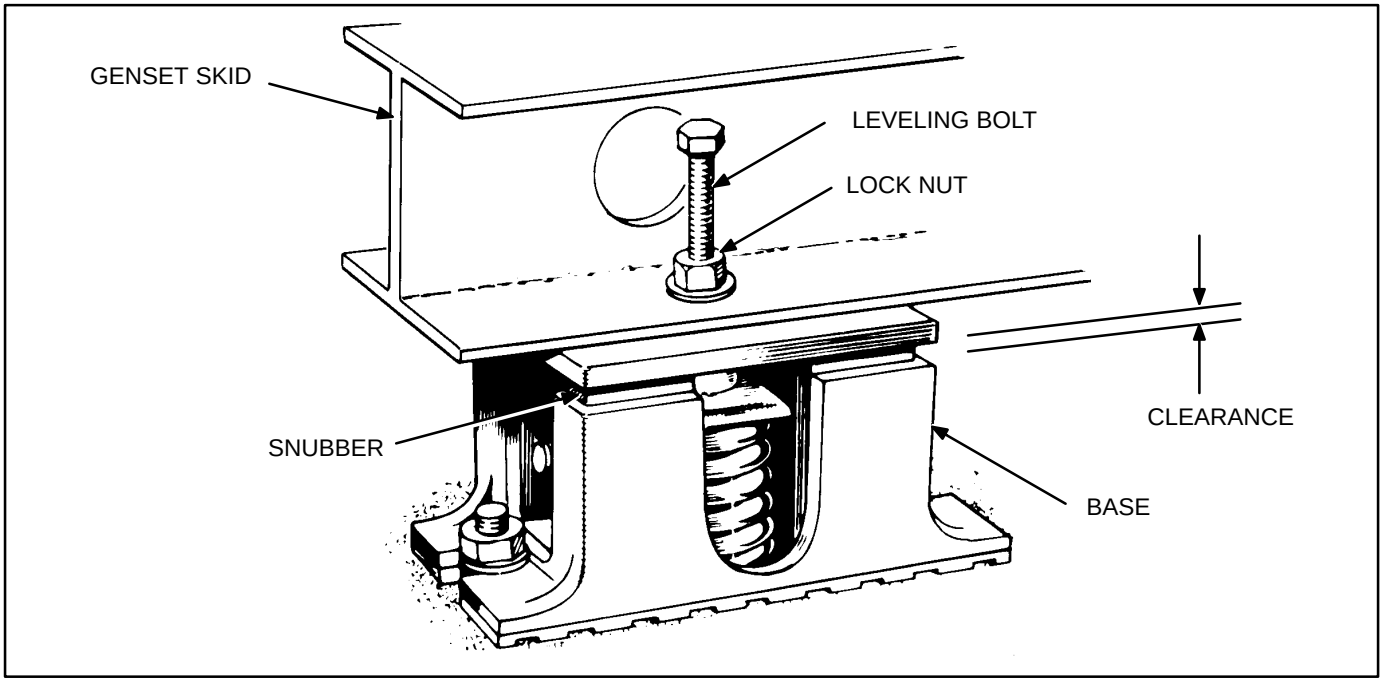



**FIGURE 3-3. VIBRATION ISOLATORS**

## ALIGNING GENERATOR WITH ENGINE (750 kW GENSETS AND LARGER)

Proper alignment of the generator and engine assemblies is necessary to avoid premature wear and improper operation of the genset. Review the following alignment conditions and procedures for aligning the generator assembly to engine flywheel housing.

### Angular Misalignment

Angular misalignment is the result of the generator bearing center axis not aligning with axis of the engine crankshaft. This condition creates an angle between the generator shaft axis and the crankshaft axis. The cause of this type of misalignment is usually shimming error.

### Axial Misalignment

Axial misalignment is the result of the generator shaft axis not aligning with engine crankshaft axis. The tolerances in the bolted flywheel and drive disc connection may add up to displace the generator axially relative to the crankshaft axis.

### Misalignment Symptoms

If the assembly is allowed to run under these conditions, the discs must flex in alternate directions twice for each engine revolution. It is important to minimize the amount of disc flexing since, if it is excessive, the drive disc will crack. Although perfect bearing alignment is desirable, it is more important to keep disc deflection to the very minimum possible. This procedure assumes that the pilot bore of the drive discs are in the exact center and the flywheel counterbore (pilot) has no practical runout. Under these conditions, perfect Angular alignment will be attained when no deflection of the discs is measured.

Excessive Axial alignment will cause more generator vibration than Angular misalignment.

**Axial misalignment needs to be checked only when an objectionable vibration is present.**

Either type off misalignment may be present in a generator set assembly, with angular misalignment being the most common problem. Angular alignment may also be effected by set installation conditions and/or mishandling during shipping of the genset.

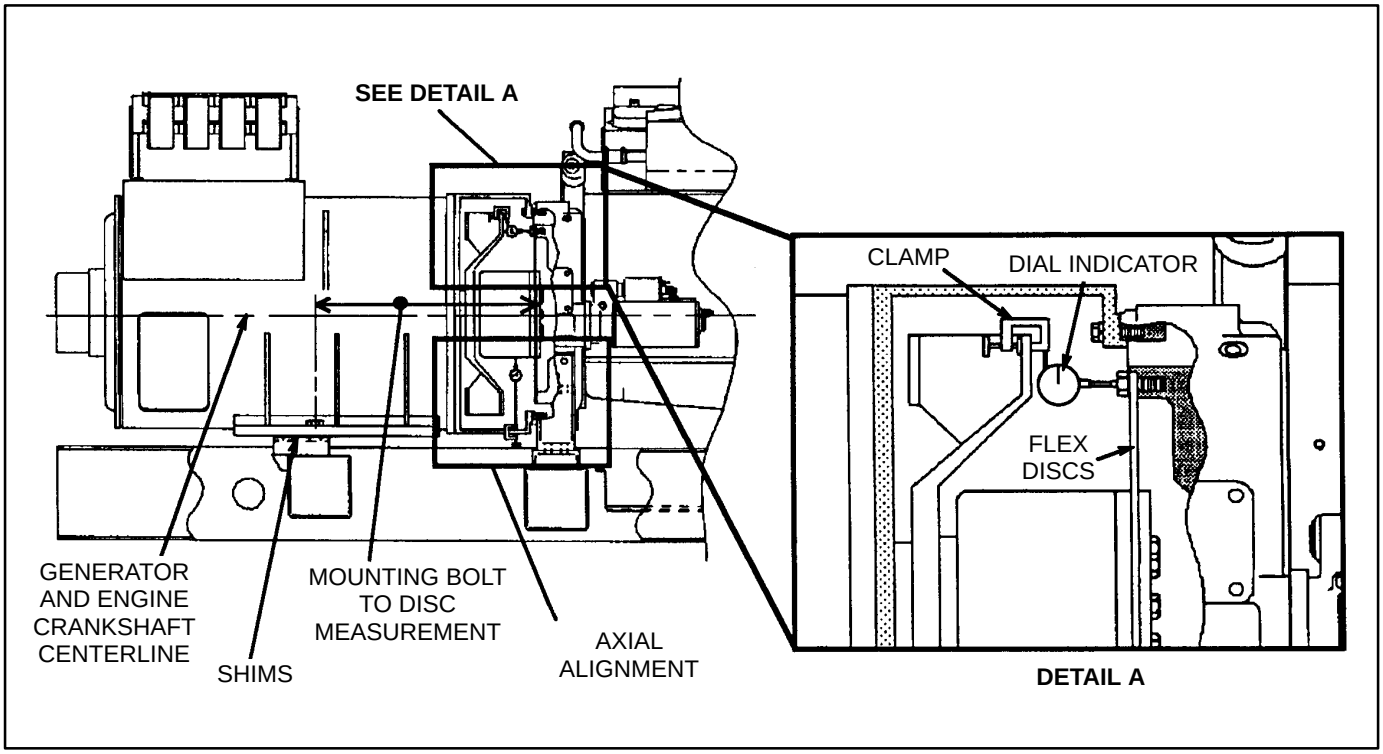



**FIGURE 3-4. ANGULAR ALIGNMENT MEASUREMENT**

## Angular Alignment Procedure

**⚠WARNING** ***Accidental starting of the generator set during this procedure presents the hazard of severe personal injury or death. Make sure to disconnect the negative (-) battery cable(s) before beginning.***

Fasten a dial indicator to either the generator shaft or the cooling fan with the sensing point resting on the capscrew head or the flat surface of the drive disc at the bolt circle diameter, see Figure 3-4. Bar the engine over in a clockwise rotation as viewed from engine flywheel. Do not allow it to roll back on compression at the end of the travel of each reading. It is unnecessary to zero the indicator since the total indicator reading (T.I.R.) of the deflection measurement to the bolt heads is what is required. T.I.R. will be the sum of the maximum positive and negative dial indicator readings as the engine completes one revolution.

**⚠ CAUTION** ***Do not bar engine over by prying on fan blade. This may damage the blade and result in premature, sudden blade failure.***

Sample Generator Runout Readings: When taking the deflection readings described, make a diagram similar to the example shown in Figure 3-5, with a total indicator reading of .025". (The highest positive value of +.010" and the largest negative value of -.015".) The indicator is closer to the top and further away at the bottom. This example indicates that the generator bearing is high. Since the side readings are equal, the generator is centered side to side. To lower the generator, remove equal shims from under both generator mounting feet. To approximate the amount of shims to remove or add:

1. Measure the distance between the center of the generator shaft to the point the indicator is measuring at. (For example; a SAE 18 Disc coupling distance is 10.7").
2. Measure the distance from the generator side of the flex discs to the center of the generator mounting bolt, refer to Figure 3-4. (For example; a HC6 Frame's distance is 28.4".)
3. Compare the distance measured in steps 1 and 2. (28.4" vs 10.7" or a 2.65 to 1 ratio.) Multiply this ratio times one half the T.I.R. (In our example, .025" divided by 2 is .0125". This, times 2.65 equals .033". Therefore, remove .033" of shims from under both mounting feet.)

In general, the T.I.R. should not be more than .001" for each inch of radius (center of shaft to indicator axis). If we use our example of 10.7 inches, then the maximum T.I.R. would be .011". This would only require a correction of .014" from the T.I.R. of .025". (A reading of +.002 at the top and –.009 at the bottom would fall within the satisfactory range.)

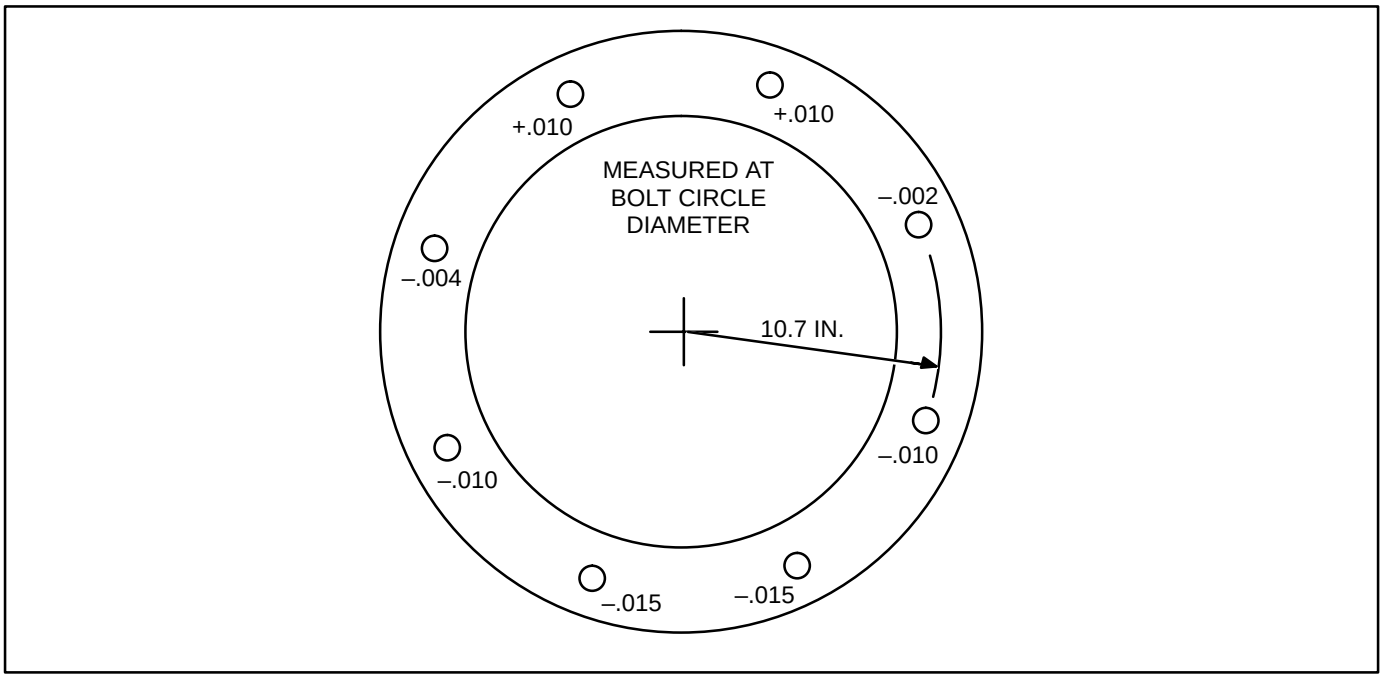



**FIGURE 3-5. ANGULAR ALIGNMENT MEASUREMENT READINGS (EXAMPLE)**

## Axial Alignment Procedure

**Axial misalignment needs to be checked only when an objectionable vibration is present.**

If excessive vibration remains after the angular alignment, check for concentric alignment of the generator shaft/engine crankshaft axis.

Fasten dial indicator holding device to skid base, engine block, or generator shell with a magnetic base or clamp and position so the sensor point of indicator rests on the generator shaft hub, see Figure 3-6. Bar the engine over in a clockwise rotation as viewed from engine flywheel, through a couple of rotations. Record indicator readings in eight equally spaced points around the shaft diameter. This will provide a T.I.R. for Axial shaft misalignment.

The maximum allowable T.I.R. runout is subjective, the optimal T.I.R. for runout would be .000 inches, however that may not be attainable. The recommendation of this procedure will be to reduce the measured T.I.R. runout by one half. Specific out-of-tolerance runout levels are difficult to establish due to the varying surface quality of the generator shaft's drive disc mounting hub.

The goal of the Axial alignment is to reduce the vibration level of the genset while it is operating. A small improvement in the T.I.R. runout may have dramatic effects in the mechanically measured or physically observed vibration levels.

To correct for an out-of-tolerance T.I.R. indication, remove the capscrews connecting drive discs and flywheel. Mark the drive discs and flywheel with respect to each other. Rotate either the engine or generator so that drive discs holes are repositioned 180 degrees from their original location. Put the drive discs capscrews back in and retorque. Recheck shaft alignment as before. If shaft T.I.R. runout remains unchanged then discs should be rotated to either 30, 60 or 90 degrees from original location to correct the out-of-tolerance condition. If the T.I.R. does not improve after repositioning, a closer inspection of the flywheel pilot and drive disc runouts is required. This will help determine the cause of the Axial misalignment.

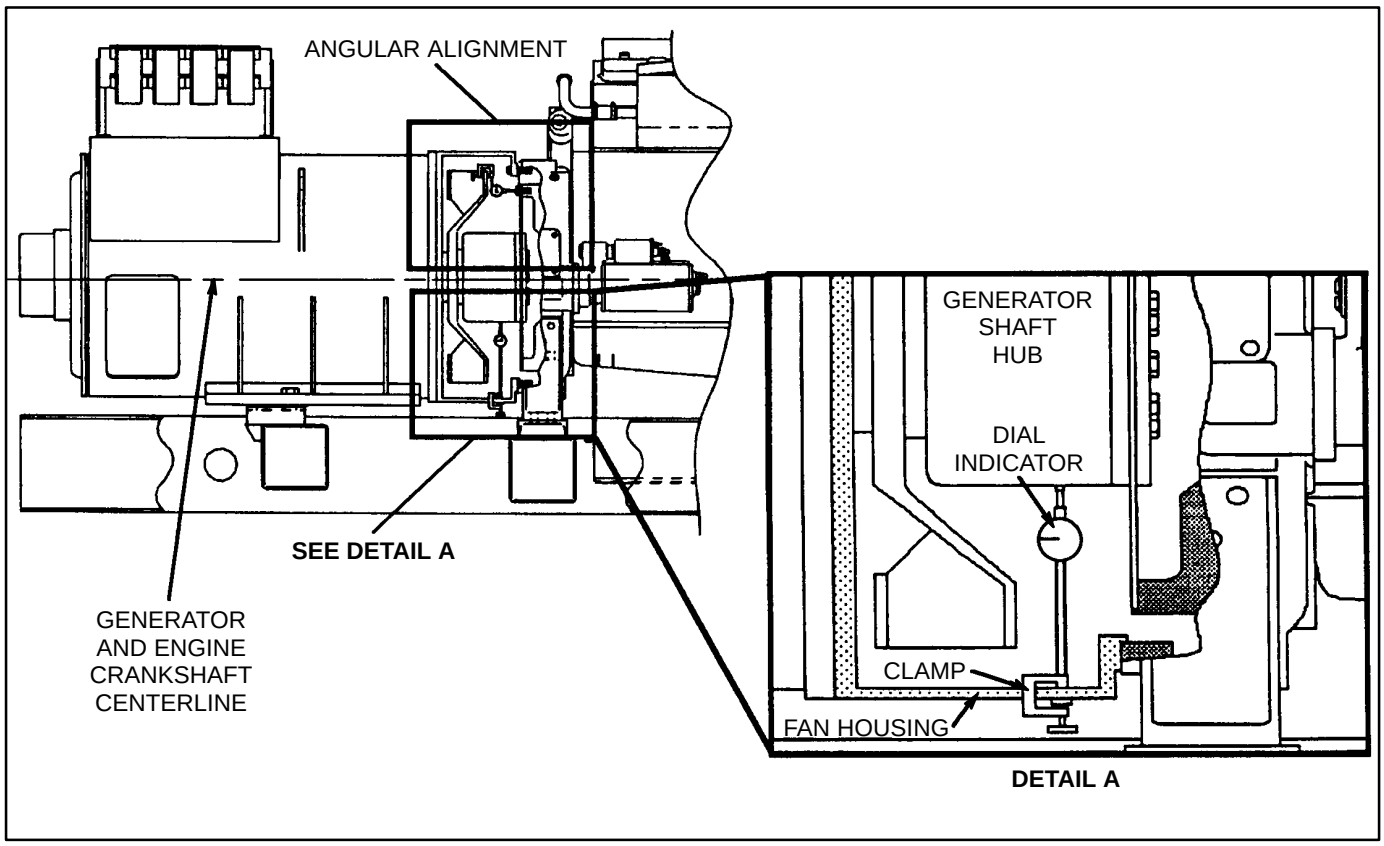



**FIGURE 3-6. AXIAL ALIGNMENT MEASUREMENT**

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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 normally use ASTM No. 2 diesel fuel. They will, however, operate on alternate diesel fuels within the specifications shown in the Cummins engine *Operation and Maintenance 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 into the fuel system. Clean all fuel system components before installing.

**A fuel filter/strainer/water separator of 100-120 mesh or equivalent (approximately 150 microns nominal) must be fitted between either the main tank and day tank or between the main tank and the engine.**

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Buried fuel lines must be protected from corrosion.

**⚠ 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 genset "Switched B+" circuit to open the valve during generator set operation.

Separate fuel return lines to the day tank or supply tank must be provided for each generator set in a multiple-set installation to prevent the return lines of idle sets from being pressurized. Fuel return lines must not contain a shutoff device. Engine damage will occur if the engine is run with the return fuel lines blocked or restricted.

**⚠ CAUTION** ***Never install shutoff device in fuel return line(s). If fuel return line(s) is blocked or exceeds fuel restriction limit, engine damage will occur.***

**Fuel Return Restriction (or Pressure) Limit:** Fuel return drain restriction (consisting of friction head and static head) between the engine injector return line connection and the fuel tank must not exceed the limit stated in the model-specific genset *Data Sheet*.

### 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 and return line(s) to protect the fuel system from damage caused by vibration, expansion and contraction. Flexible lines for connecting between the engine and the stationary fuel lines are supplied as standard equipment.

**⚠ 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 and return 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 installation recommendations provided by the manufacturer. The supplied flexible hose is 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 1/2 inch (12.7 mm) minimum clearance from electrical wiring and a 2 inch (51 mm) minimum clearance from hot exhaust parts.

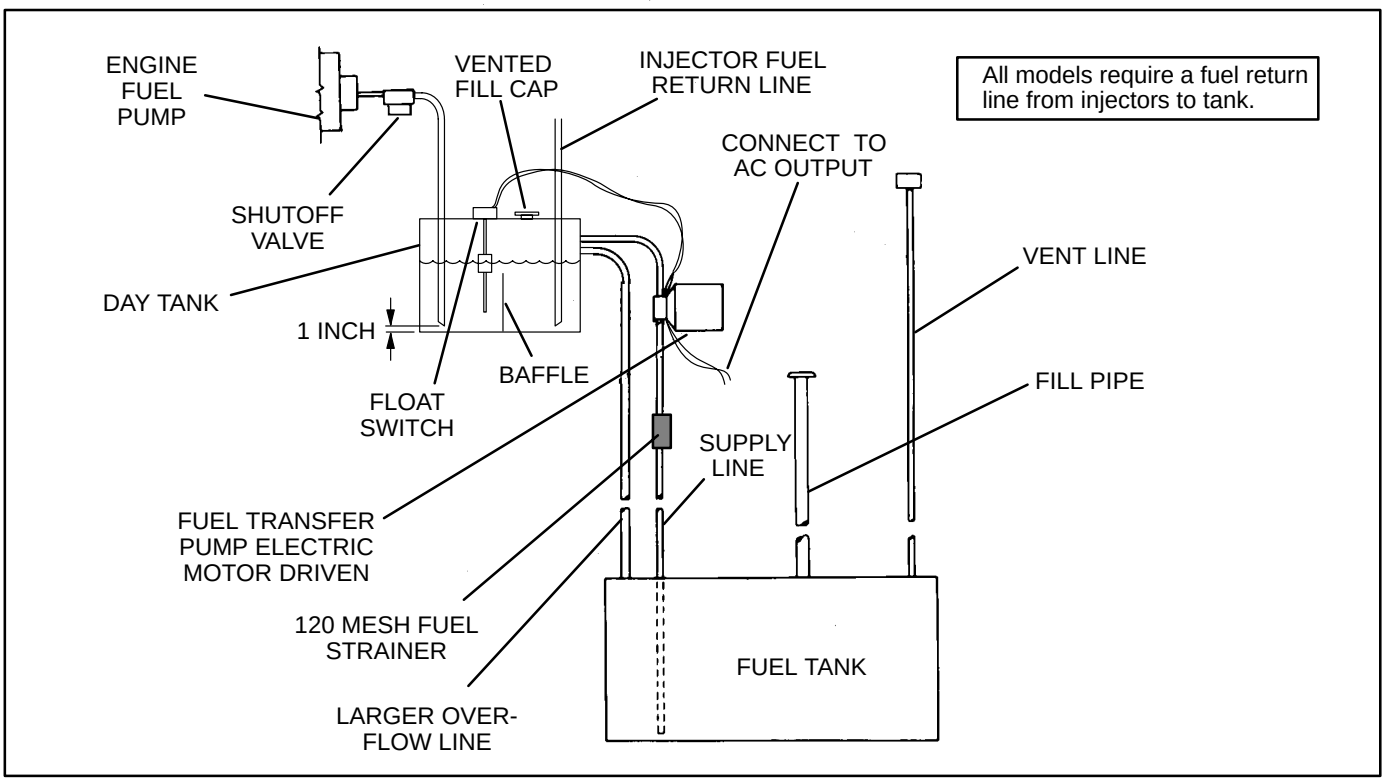



**FIGURE 4-1. TYPICAL FUEL SUPPLY INSTALLATION**

## Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections.

## Supply Tank

Locate the fuel tank as close as possible to the generator set and within the restriction limitations of the fuel pump.

Install a fuel tank that has sufficient capacity to supply the genset operating continuously at full rated load for the planned period of operation or power outage. Refer to *Data Sheet* for fuel consumption data.

If the fuel inlet restriction exceeds the defined limit due to the distance/customer-supplied plumbing between the genset and the main fuel tank, 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.

**For critical start applications, where generator sets are paralleled or must satisfy emergency start-time requirements, it is recommended that a fuel tank or reservoir be located such that the lowest possible fuel level is not less than 6 inches (150 mm) above the fuel pump inlet. This will prevent air from accumulating in the fuel line while the set is in standby, eliminating the period during startup when it has to be purged.**

**Fuel Inlet Pressure/Restriction Limit::** Engine performance and fuel system durability will be compromised if the fuel inlet pressure or restriction limits are not adhered to. Fuel inlet pressure or restriction must not exceed the limits stated in the model-specific genset *Data Sheet*.

## Day Tank (If Used)

Fuel day tanks are used when fuel inlet restriction limits can not be met, or the supply tank is overhead and presents problems of high fuel head pressure for the fuel inlet and return lines.

***Supply Tank Lower Than Engine:*** With this installation, the day tank is installed near the generator set, below the fuel injection system and within the fuel inlet restriction limit. Install an auxiliary fuel pump, 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.

**⚠WARNING** ***Spilled fuel can create environmental hazards. Check local requirements for containment and prevention of draining to sewer and ground water.***

## 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 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 4-2) 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 insulated 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.***

**⚠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 prevent weight from being 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.***

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 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 4-3).

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. 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.***

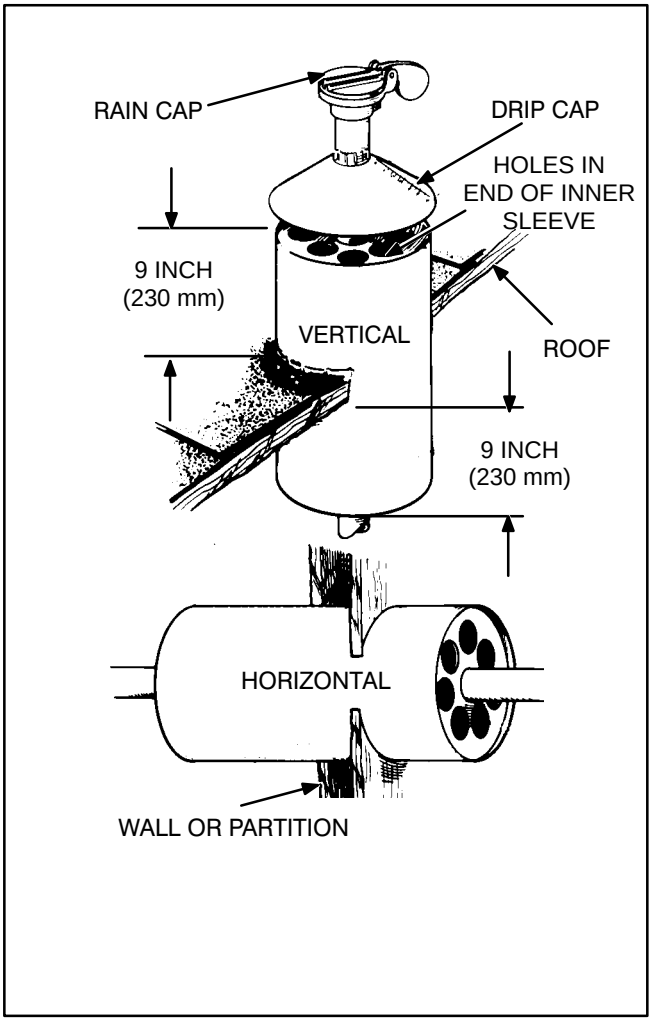



**FIGURE 4-2. MOUNTING EXHAUST THIMBLE**

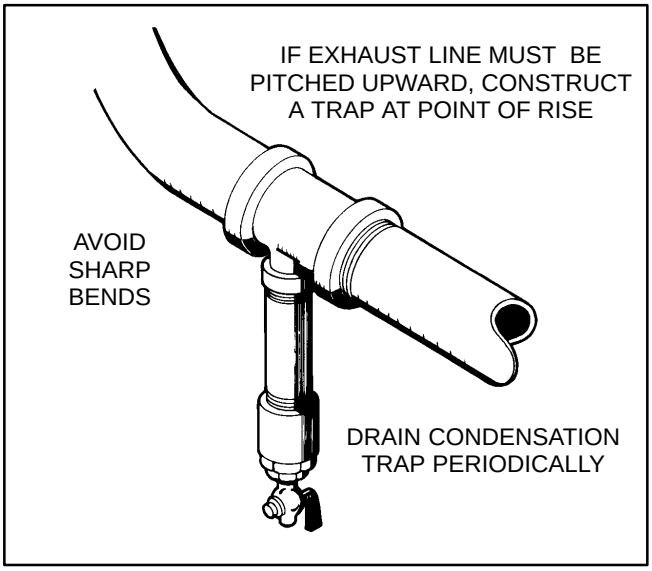



**FIGURE 4-3. CONDENSATION TRAP**

## 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 4-5 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 airflow 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 4-4.

### 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.

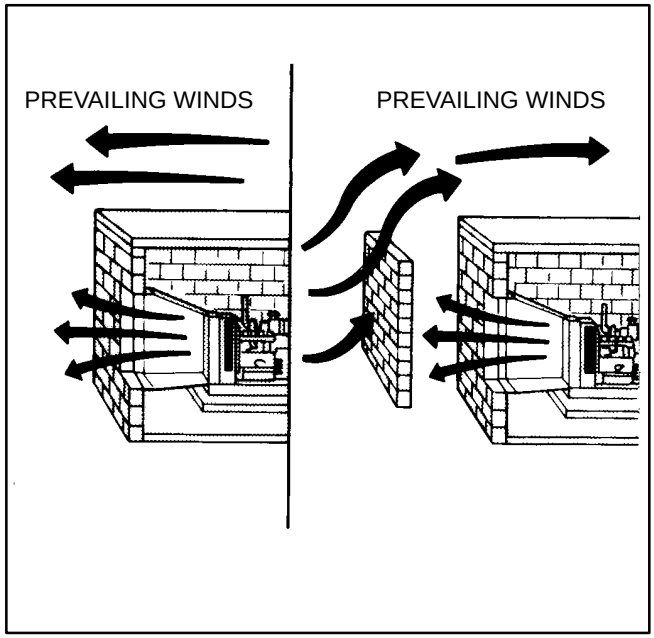



**FIGURE 4-4. WIND BARRIER**

## Engine Coolant Heater (Optional)

An optional 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.

## Set Mounted Radiator Cooling

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

**⚠ CAUTION** ***Model DFLE 50°C radiator-cooled genset only: The alignment of the cooling system fan drive must be checked before genset operation. Failure to check fan drive alignment can result in severe fan/radiator damage. Refer to Section 11 for alignment procedure.***

Radiator set cooling air is drawn past the control end of the set by a pusher fan that blows air through the radiator (Figure 4-5). Locate the air inlet to the rear of the set. Make the inlet vent opening 1-1/2 to 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 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.

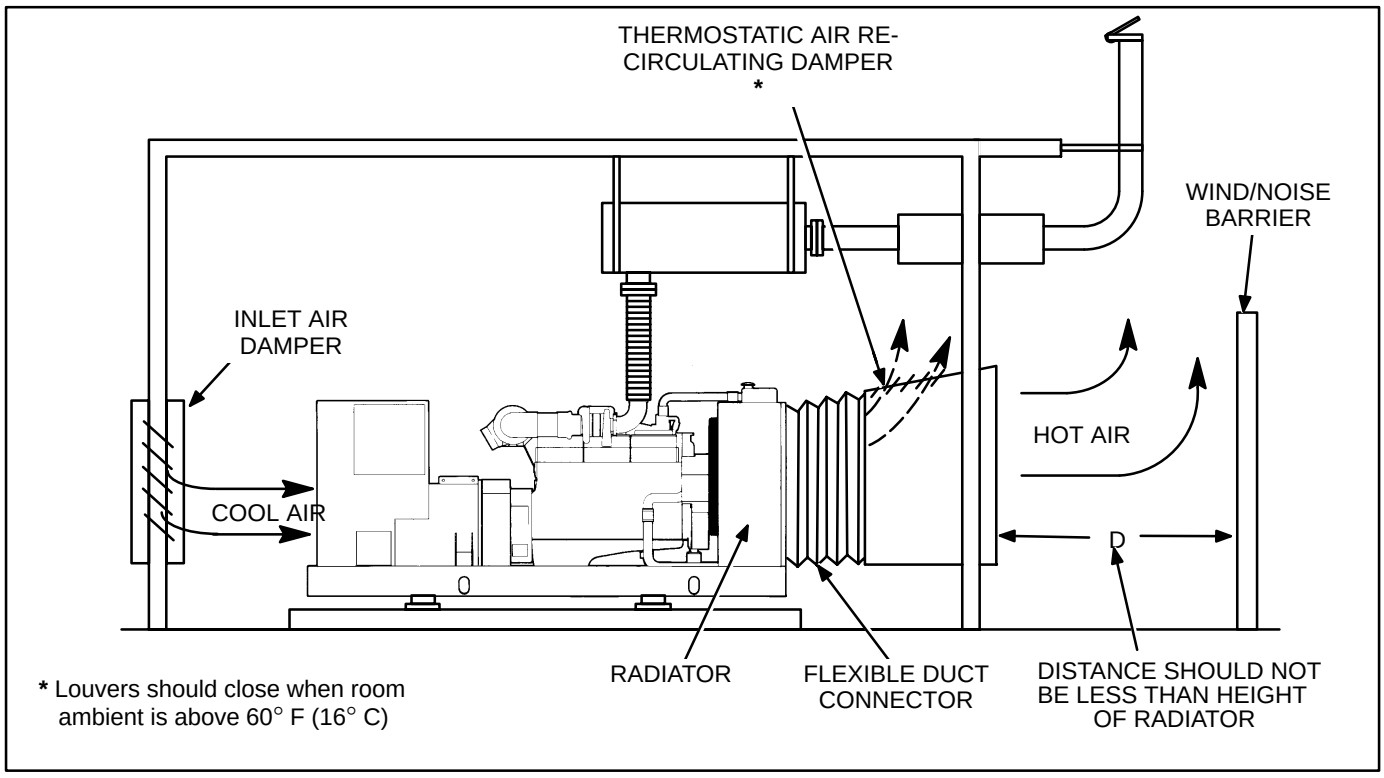



**FIGURE 4-5. TYPICAL RADIATOR SET INSTALLATION**

**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.**

## 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 system may 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 between165° 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.

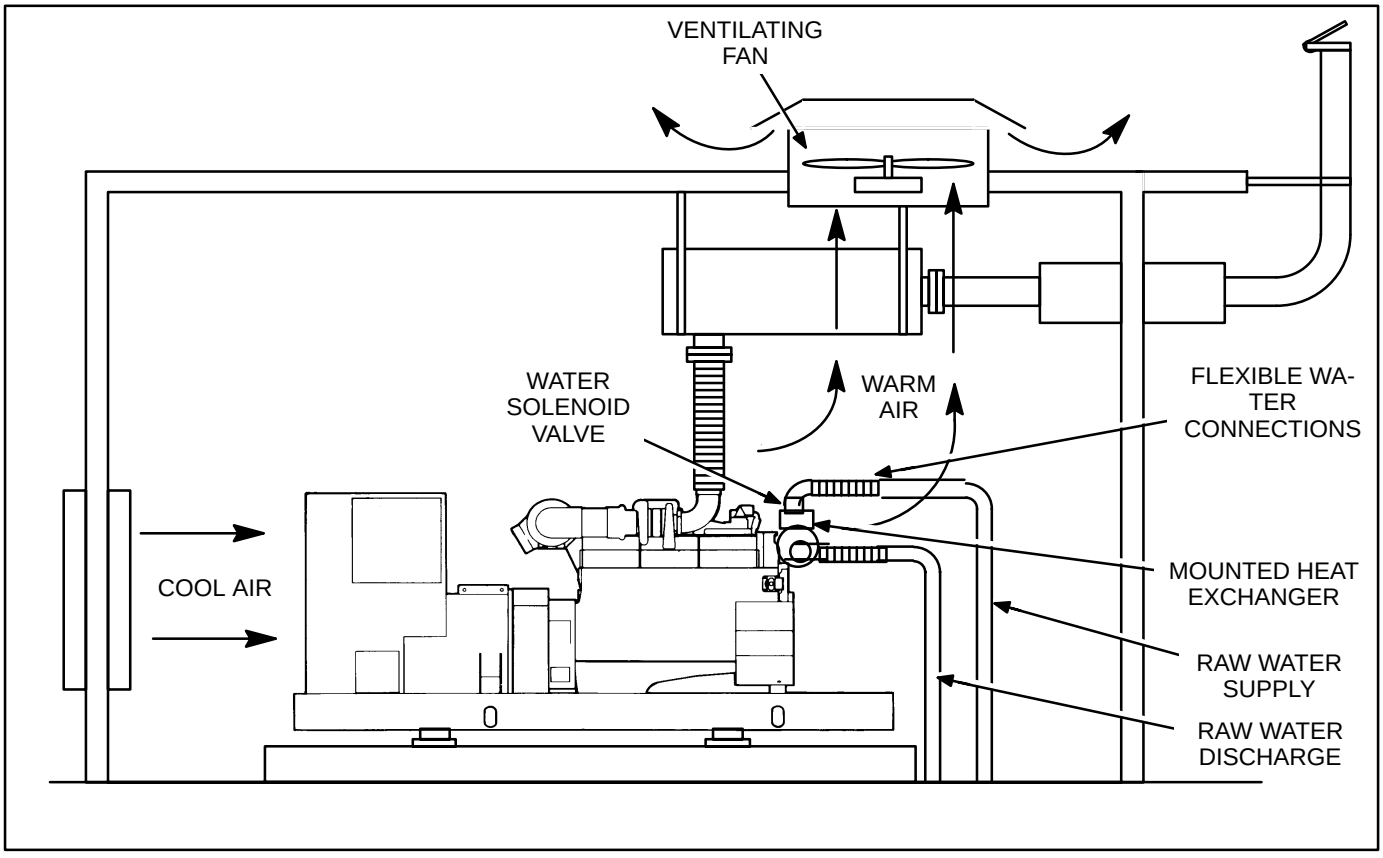



**FIGURE 4-6. TYPICAL HEAT EXCHANGER INSTALLATION**

# 5. DC Control Wiring (PCC)

## CONTROL WIRING

The generator set accessory box (Figure 5-1), which is located on the backside of the control housing, contains connection points for remote control and monitor options.

**⚠ CAUTION** ***Stranded copper wire must be used for all customer connections to the Accessory Box. Solid copper wire may break due to genset vibration.***

## TB1 REMOTE MONITOR/CONTROL CONNECTIONS

Customer monitor/control connections are attached to terminal block TB1 (Figure 5-1). Optional equipment such as a remote annunciator panel, sensing devices used to monitor genset operation, remote start/stop switches, control box heater, battery charger and etc. are attached to TB1. Refer to PCC Customer Connections diagram in Section 12.

### TB1 Wiring

**⚠ 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.***

**Digital Connections:** Connection points, other then relayed outputs, network, switched B+ and B+ are considered digital connections to terminal strip TB1. The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 20 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 18 gauge stranded copper wire.

**Relay Connections:** Due to the wide variety of devices that can be attached to the relay outputs of TB1, the electrical contractor must determine the gauge of the **stranded copper** wire that is used at this installation site. Refer to PCC Customer Connections diagram in Section 12 for the relay specifications.

**Network Connections:** Refer to 900-0366 *PowerCommand Network Installation and Operation* manual for the type/gauge wire to use for these connections.

**Switched B+:** (Fused at 10 amps.) Same as Relay Connection description.

**B+:** (Fused at 20 amps.) Same as Relay Connection description.

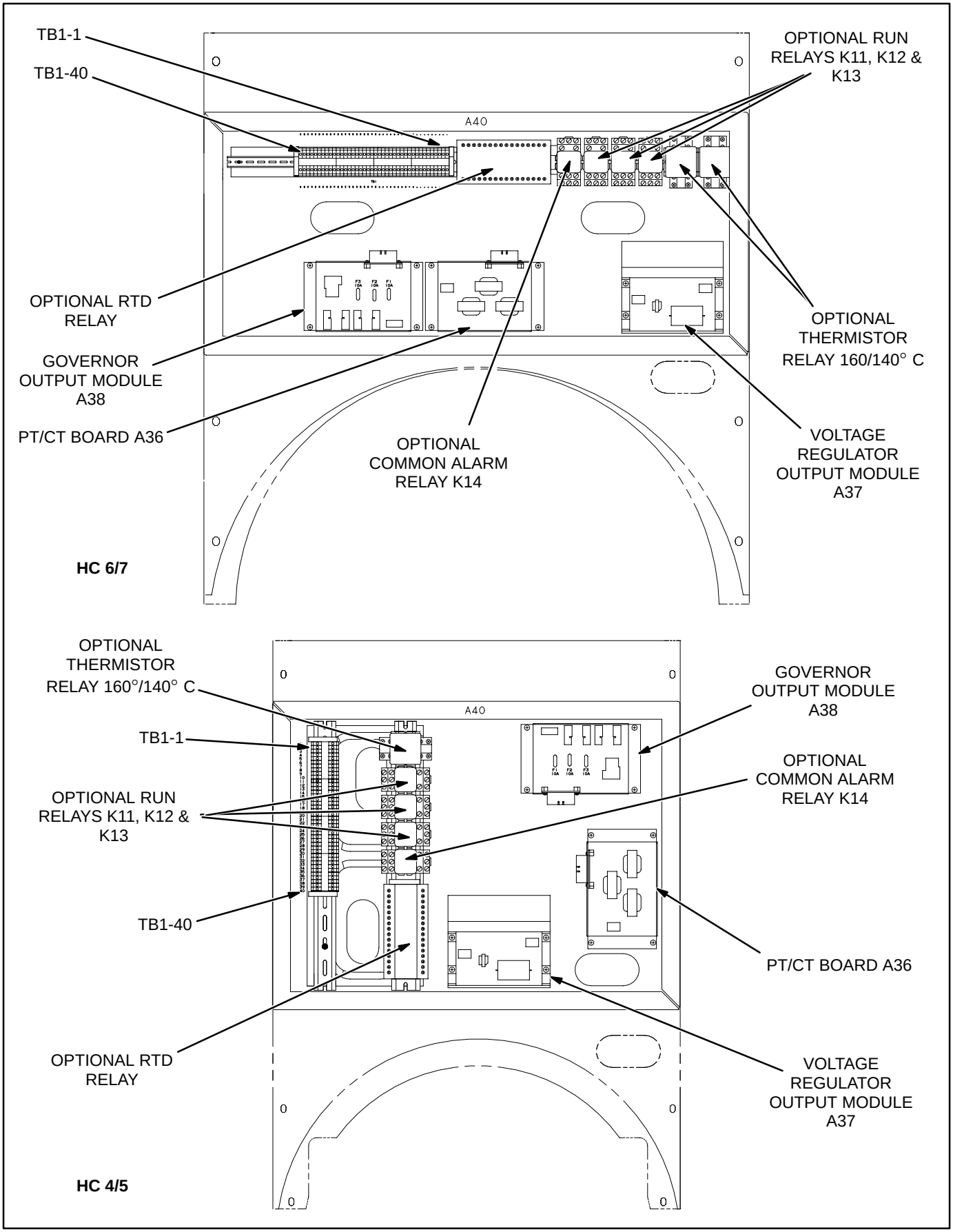



**FIGURE 5-1. ACCESSORY BOX**

## RUN RELAYS (K11, K12, K13)

The optional run relays are rail mounted inside the accessory box (Figure 5-1). The rail mount allows you to easily remove and replace the snap-on relays. The generator set can be equipped with one, two or three run relays.

The three-pole, double-throw run relays (Figure 5-2) are used to control auxiliary equipment such as fans, pumps and motorized air dampers. The run relays are energized when the generator set control receives a start signal.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

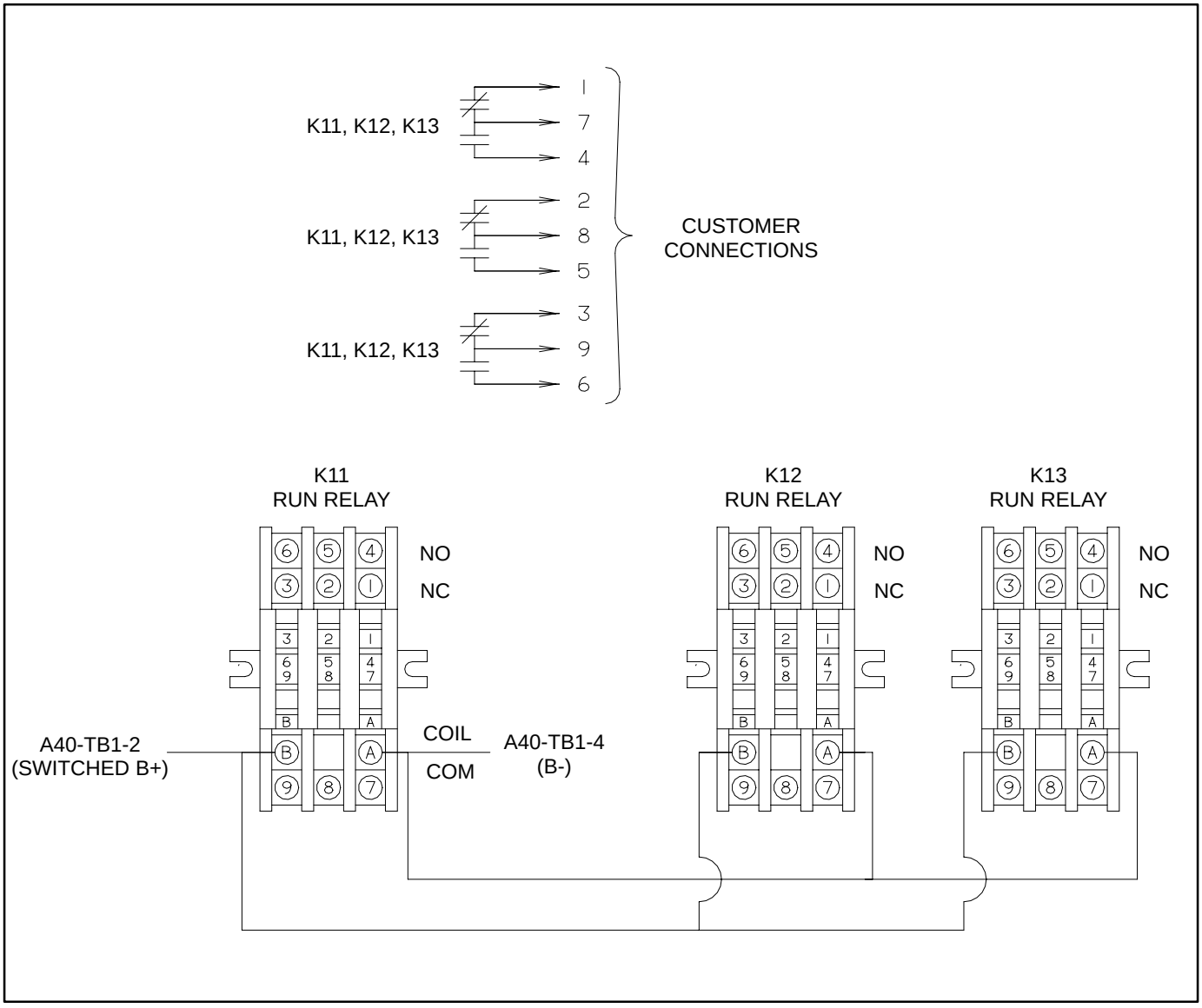



**FIGURE 5-2. OPTIONAL RUN RELAYS (K11, K12, K13)**

## ALARM RELAY (K14)

The optional alarm relay is rail mounted inside the accessory box (Figure 5-1). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 5-3) is often used to energize warning devices such as audible alarms. Any generator set warning or shutdown will energize the alarm relay.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

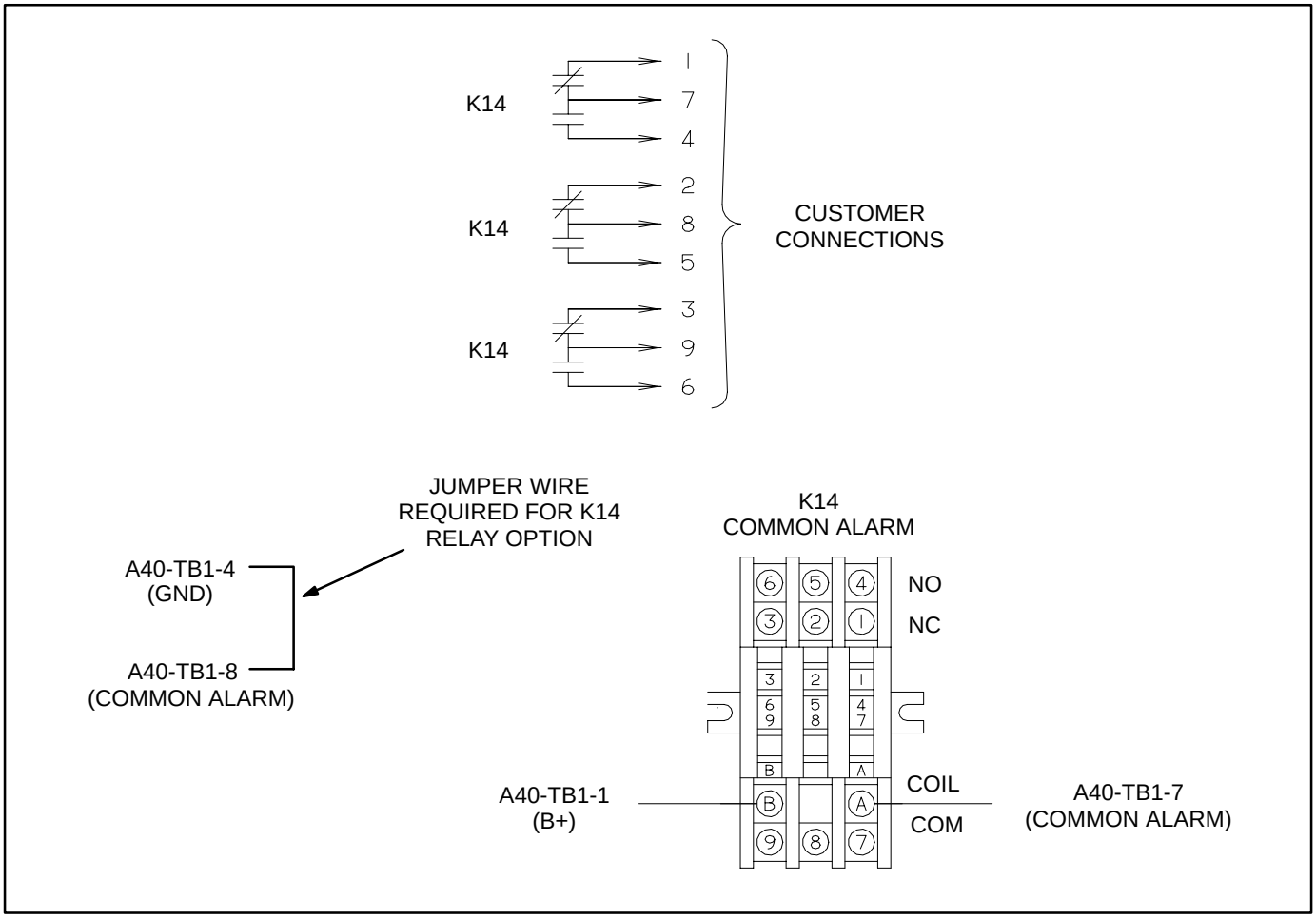



**FIGURE 5-3. OPTIONAL ALARM RELAY (K14)**

## RTD RELAY (OPTIONAL)

The optional RTD relay is rail mounted inside the accessory box (Figure 5-1). This relay is used to monitor six separate temperature zones in the generator windings using resistive temperature detectors (RTDs). The relay determines the sensed temperature and acts to isolate, alarm, or initiate corrective action.

The RTD relay (Figure 5-4) compares the six inputs to the predetermined setpoint (temperature setpoint is factory adjusted). If one or more of the inputs exceed the setpoint, the output relay is energized. LED's indicate the state of the output relay (green for normal, red for tripped). Additional red LED's are used to indicate which inputs exceed the setpoint.

The relay terminals 11, 12 and 14 are for customer connection. These terminals can be attached to any one of the four Customer Fault inputs on TB1 to provide a warning/shutdown condition or to other customer warning devices.

The contacts are rated:

- 240 VAC, 5 amps non-inductive
- 24 VDC, 25 amps resistive

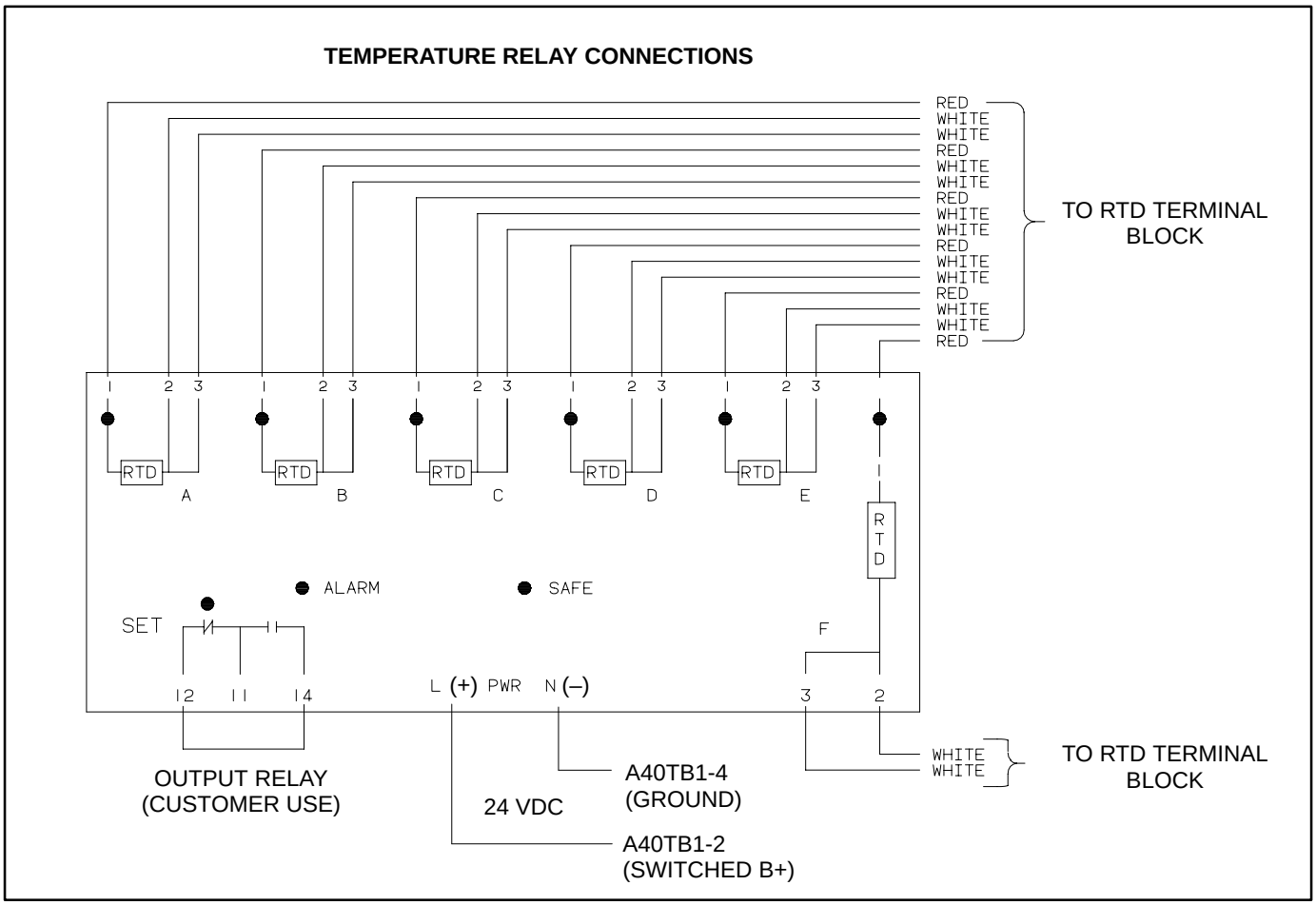



**FIGURE 5-4. RTD RELAY (OPTIONAL)**

## THERMISTOR RELAY (OPTIONAL)

The optional thermistor relays are rail mounted inside the accessory box (Figure 5-1). Each relay monitors three thermistors (one per phase) that are connected in series inside the generator. One series or chain of thermistors are rated at 140° C and the other at 160° C. The 140° C relay is commonly used in a pre-alarm circuit. The relay will energize (trip) when the thermistor chain resistance reaches 3000 ±500 ohms.

The relay terminals 1, 2 and 3 are for customer connection and are normally connected to a breaker shunt trip or a load shed circuit (Figure 5-5).

The contacts are rated:

- 3 amps at 250 VAC
- 1 amp at 480 VAC

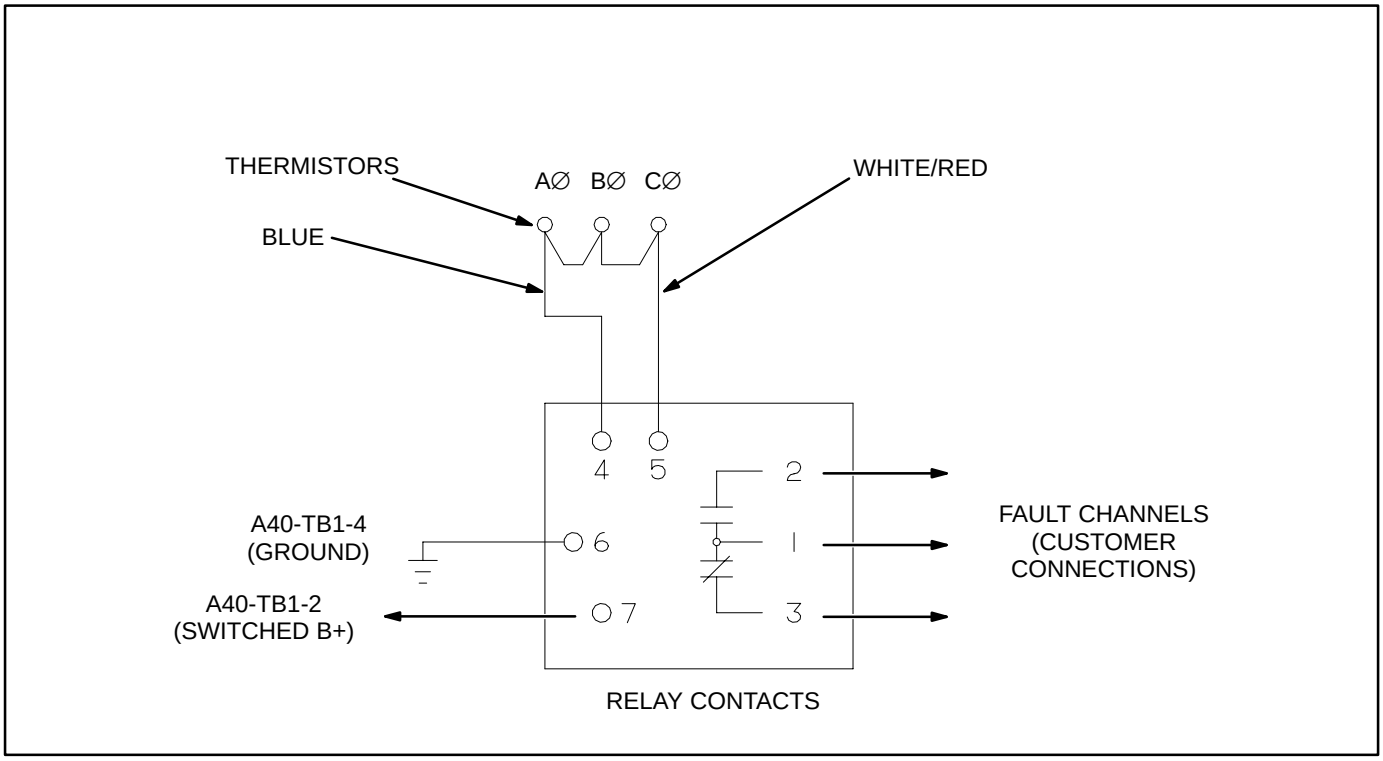



**FIGURE 5-5. THERMISTOR RELAY (OPTIONAL)**

# 6. 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 genset 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.***

***For your protection, 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 6-1). 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 12. (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

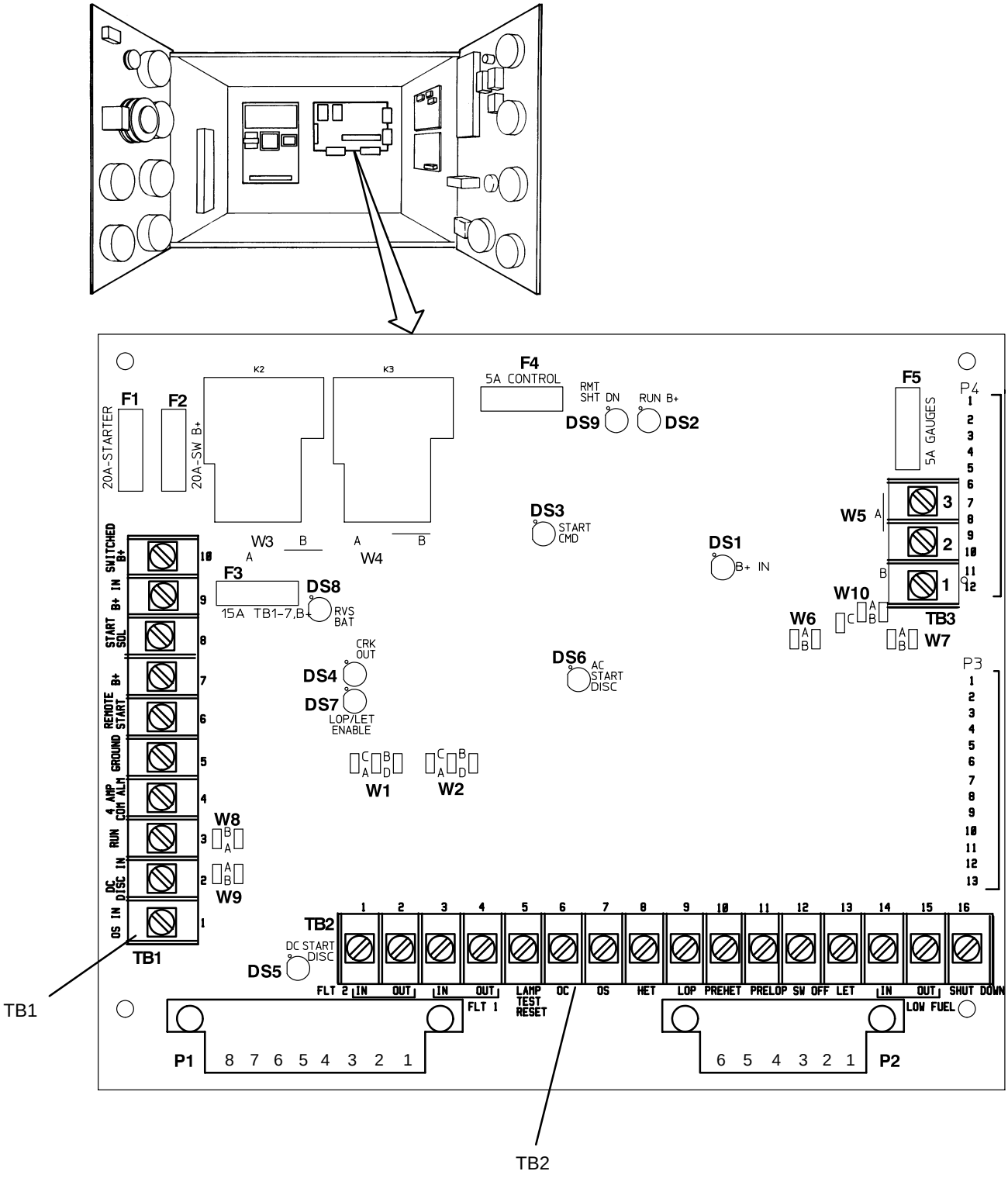



**FIGURE 6-1. ENGINE CONTROL MONITOR BOARD (ECM)**

## 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 12.

***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. This signal is provided from the engine.

- **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 TB5-1 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 TB5-5 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

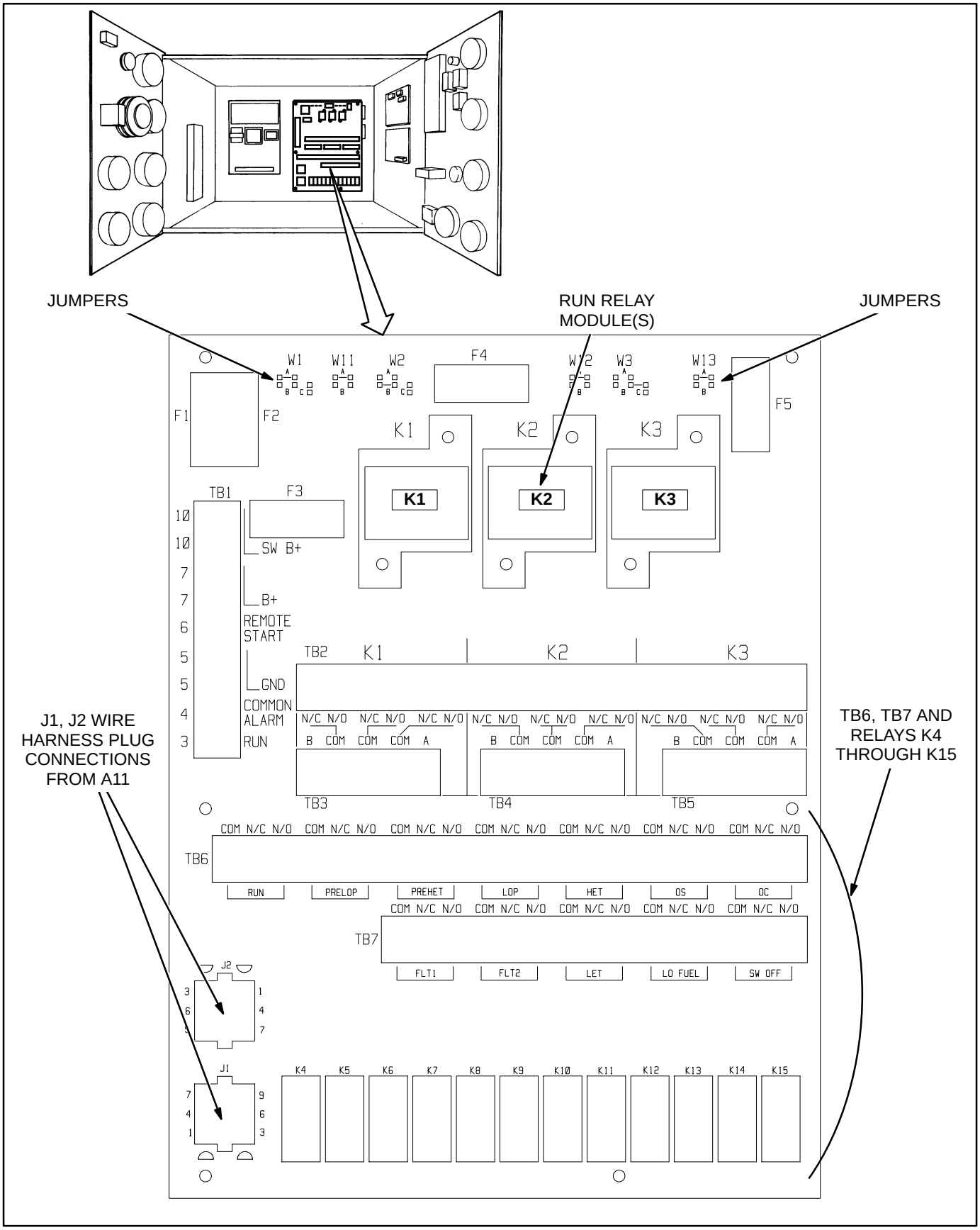



**FIGURE 6-2. AUXILIARY RELAY BOARD (ARB)**

## TIME-DELAY MODULE (A15)

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 6-3). 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).

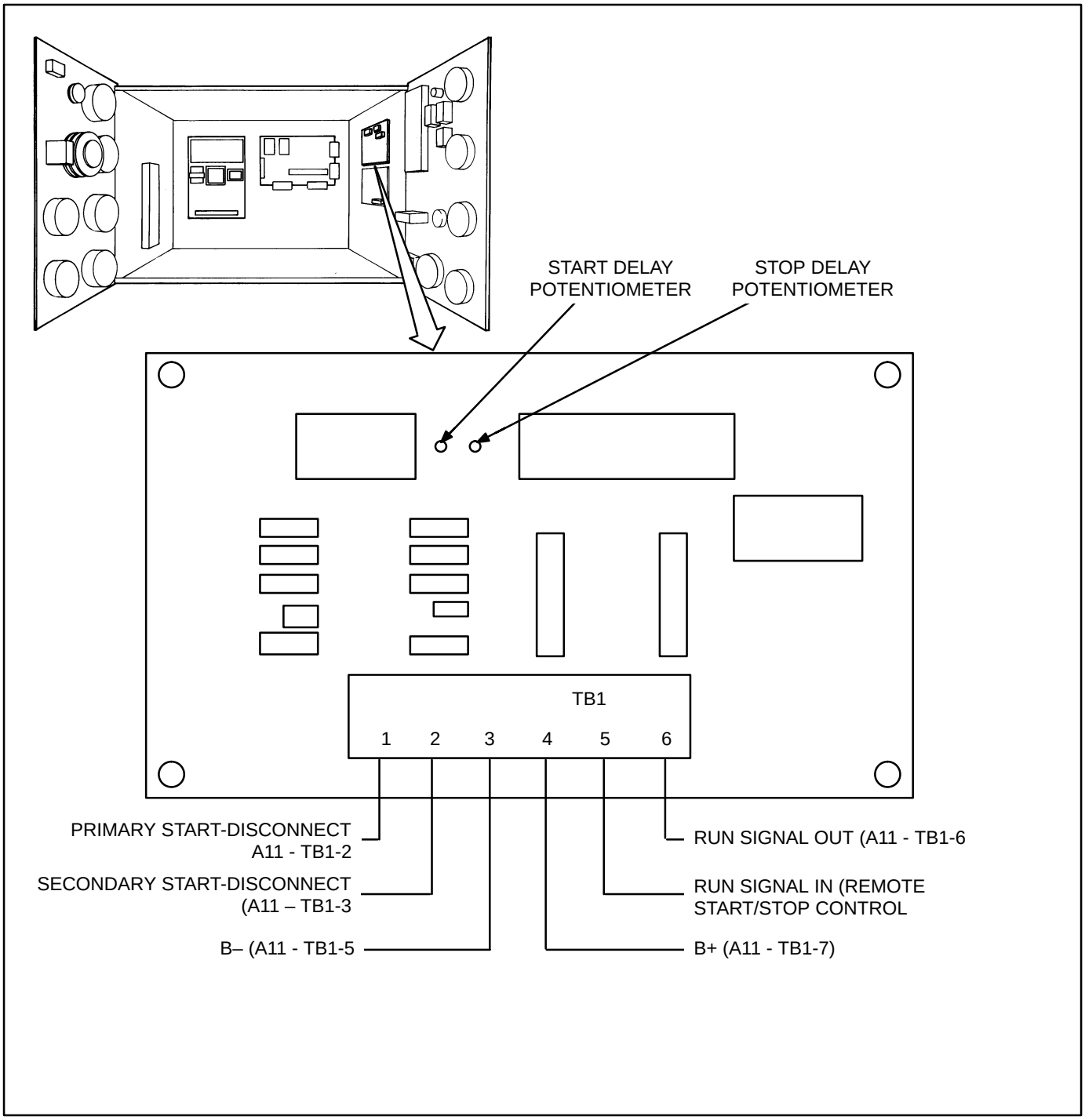



**FIGURE 6-3. PREHEAT/TIME-DELAY MODULE**

## RTD RELAY (OPTIONAL)

The optional RTD relay is used to monitor six separate temperature zones in the generator windings using resistive temperature detectors (RTDs). The relay determines the sensed temperature and acts to isolate, alarm, or initiate corrective action.

The preferred mounting location of the RTD relay is the outside back wall of the control box. The second location would be the inside back wall of the output box.

The RTD relay (Figure 6-4) compares the six inputs to the predetermined setpoint. If one or more of the inputs exceed the setpoint, the output relay is energized. LED's indicate the state of the output relay (green for normal, red for tripped). Additional red LED's are used to indicate which inputs exceed the setpoint.

The relay terminals 11, 12 and 14 are for customer connection. These terminals can be attached to Customer Fault inputs on TB2 of the Engine Control Monitor board to provide a warning/shutdown condition or to other customer warning devices.

The contacts are rated:

- 240 VAC, 5 amps non-inductive
- 24 VDC, 25 amps resistive

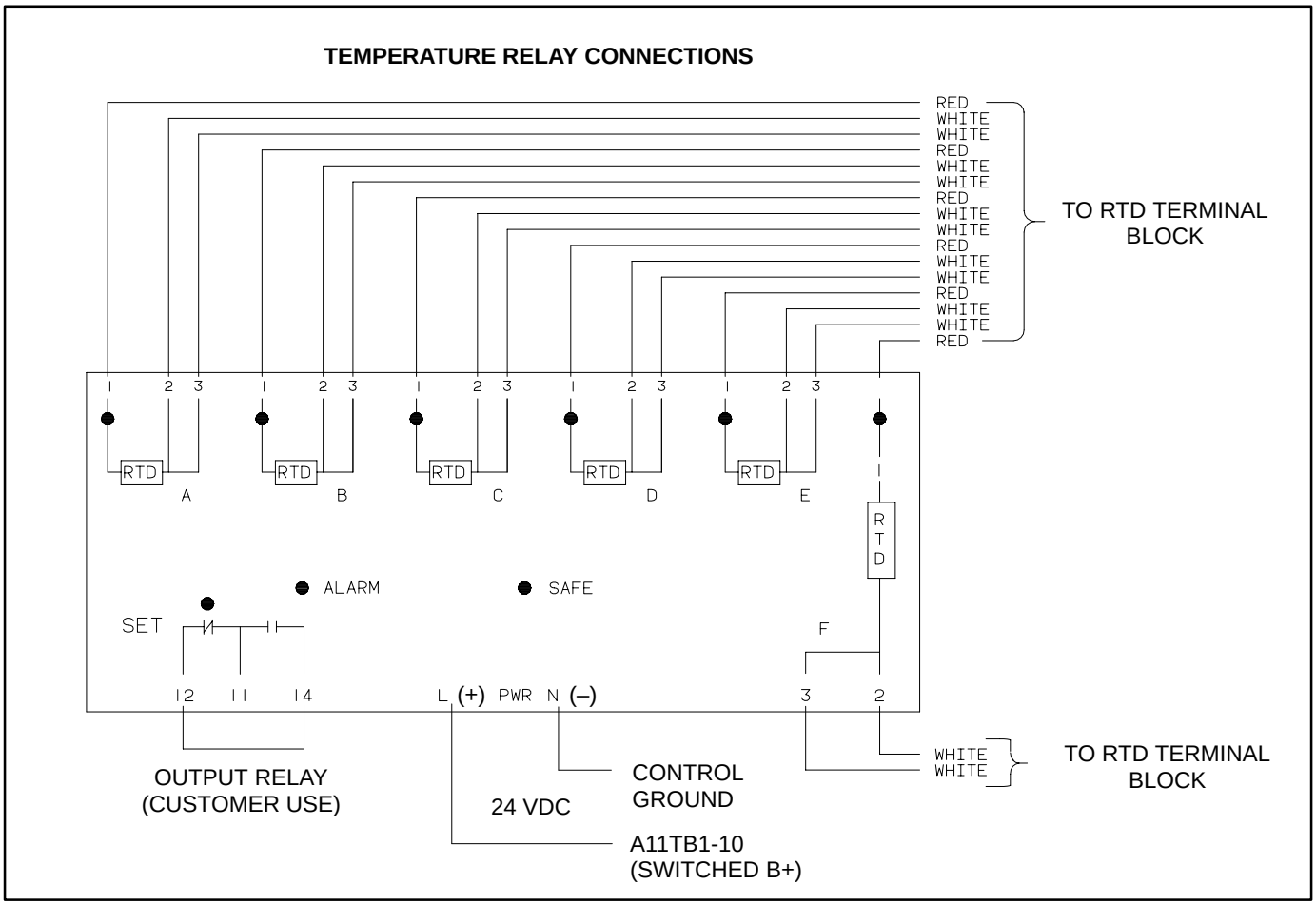



**FIGURE 6-4. RTD RELAY (OPTIONAL)**

## THERMISTOR RELAY (OPTIONAL)

The generator set can contain one or two thermistor relays (Figure 6-5). The preferred mounting location of the thermistor relay is the outside back wall of the control box. The second location would be the inside back wall of the output box.

Each relay monitors three thermistors (one per phase) that are connected in series inside the generator. One series or chain of thermistors are rated at 140° C and the other at 160° C. The 140° C relay is commonly used in a pre-alarm circuit. The relay will energize (trip) when the thermistor chain resistance reaches 3000 ±500 ohms.

The relay terminals 1, 2 and 3 are for customer connection and are normally connected to a breaker shunt trip or a load shed circuit.

The contacts are rated:

- 3 amps at 250 VAC
- 1 amp at 480 VAC

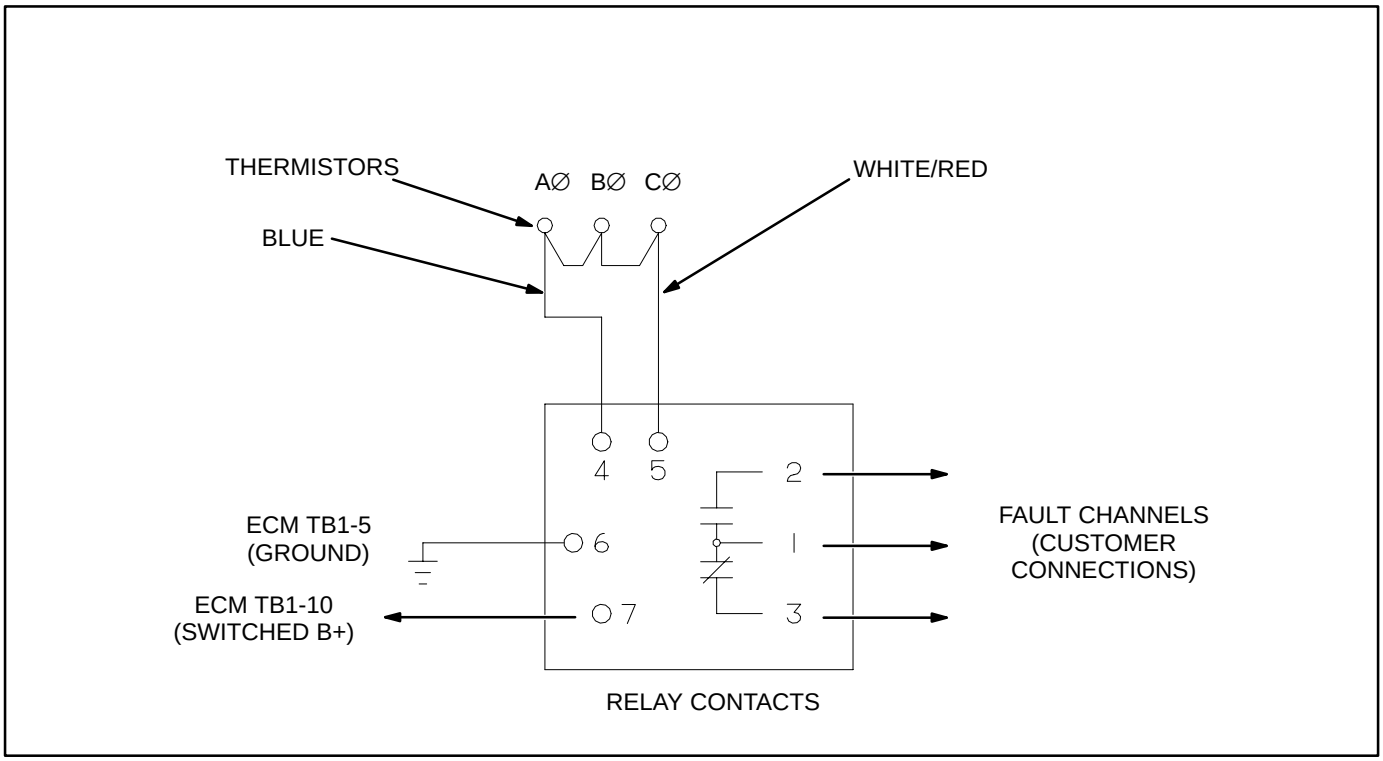



**FIGURE 6-5. THERMISTOR RELAY (OPTIONAL)**

# 7. 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.***

Connecting the genset AC electrical system involves:

- Generator insulation check
- 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.***

## INSULATION RESISTANCE (MEGGER) & POLARIZATION INDEX (PI) TESTING

Megger and PI testing **must** be performed on all medium voltage (601 through 15,000 volts) generator sets before initial start-up. PI testing for low voltage (less than 600 volts) generator sets is recommended by Onan.

These tests are used to verify that the windings are dry before the generator set is operated and develops a base line for future test comparison.

Before these tests can be performed on medium voltage generator sets, you must first perform the generator grounding procedure.

### Generator Set Grounding Procedure

Prior to performing service or inspection procedures that may expose personnel to conductors normally energized with voltages greater than 600 volts, the following generator set grounding procedure must be followed.

**⚠WARNING** ***No person should attempt to perform these procedures unless they are fully trained in medium voltage grounding procedures and have the necessary safety tools and equipment. Persons who attempt these procedures without these qualification are at risk of severe injury or death due to high voltage electrical shock.***

1. Open, lock-out and tag-out all sources of power to the immediate work area.
2. Disable the starting system of the generator set:
   a. Disconnect the battery charger from its AC source.
   b. Remove the negative battery cable from the battery.
   c. Install a lockout device on the battery cable end. (For engines equipped with an air-powered starting system, close air valve and install valve locking device.)
3. Put on high voltage gloves with leather protectors.
4. Using two pre-tested voltage detection devices (of the proper rating), verify de-energized condition in the work area. (Retest voltage detection devices immediately after verification of de-energized condition.)
5, Remove the metal cover from the generator output box to gain access to generator load terminals.
6. Securely install the Grounding Cluster ground clamp to a verified “grounded” conductor.

   **⚠WARNING** ***Hazardous voltage. Can cause severe personal injury or death. After DC voltage from the test equipment has been applied to the windings and ground, there will be a definite static charge on the windings. Reconnect Grounding Cluster to remove static charge from the winding after each generator test.***

7. With the Grounding Cluster in place, you are protected from all static and/or induced charges that may have been present in the generator stator.

   Leave grounds connected for one minute to insure static charge dissipation. Remove ground cluster and perform PI and/or any other tests required on the stator winding. Reconnect grounds if additional generator service is necessary.
8. When work on the generator set is complete, remove the Grounding Cluster in the reverse order of installation.
9. After getting clearance from all personnel involved in the lock-out/tag-out procedure, remove all lock-out devices in reverse order of installation.

## Megger and PI Test

**⚠WARNING** ***Medium-voltage, 601 to 15,000 volts, present special hazards of severe personal injury or death. Even after genset shutdown, an electrical shock hazard may exist. Service personnel must be well trained and qualified to work with distribution voltages.***

**⚠WARNING** ***Windings of medium voltage (601 through 15,000 volts) generator sets must be dry before the generator is operated. Failure to ensure dry windings before start-up may result in catastrophic failure, severe personal injury and death.***

**Megger Test:** The megger test consists of applying voltage for up to one minute. The highest resistance values shown in Table 7-1 should be obtained for a new generator with dry windings. For a set that has been in service, the resistance reading should not be less than the lower value shown.

**PI Test:** The PI test consists of applying a voltage between the winding and ground for ten minutes and recording resistance values at one minute and at ten minutes. The PI is the ratio of a ten minute reading in megohms divided by a one minute reading in megohms. A ratio of two or greater is considered good for new and in-service sets.

If low readings are obtained, investigate the cause and correct before the generator set is returned to service.

1. Perform the *Generator Set Grounding Procedure*.
2. Disconnect plug **J10** from the voltage regulator output stage module and the AC control input leads from the generator output terminals. The AC control leads are marked 4, 5, 6, 7 and 8. Refer to the reconnection diagram, which is located on the upper side cover of the control housing.
3. If the RTD (resistive thermal device) option is installed, ground all six resistive thermal device temperature leads. Each RTD has three leads, one red and two white leads. Total of 18 leads must be grounded.

**Main Stator:**

4. Remove and separate the neutral leads of the generator from the generator load terminal marked “N”.
5. Connect the megger between one phase of the stator and ground while grounding the other two phases and conduct the test. Refer to Table 7-1 for megger voltage selection and required resistance values.

   Repeat this step in turn for the other two phases.

**Main Rotor:**

6. Disconnect the main rotor and voltage suppressor leads from terminals **F1+** and **F2–** on the rotating rectifier assemblies and isloate them from ground. Tag and mark each lead with its terminal number (**F1+** or **F2–**).
7. Connect the megger between one of the rotor leads and ground and conduct the test. Refer to Table 7-1 for megger voltage selection and required resistance values.

**TABLE 7-1. GENERATOR INSULATION RESISTANCE**

| GENERATOR VOLTAGE | MEGGER VDC SETTING | MINIMUM RESISTANCE (MEG) | |
|---|---|---|---|
| | | MAIN STATOR | MAIN ROTOR |
| 600 VAC or less | 500 | 5.0 – 1.0 | 5.0 – 1.0 |
| 601 thru 5000 VAC | 2500 | 400 – 50 | |
| | 1000 | | 5.0 – 1.0 |
| 5001 thru 15000 VAC | 5000 | 1000 – 200 | |
| | 1000 | | 5.0 – 1.0 |

## 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 7-1). Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

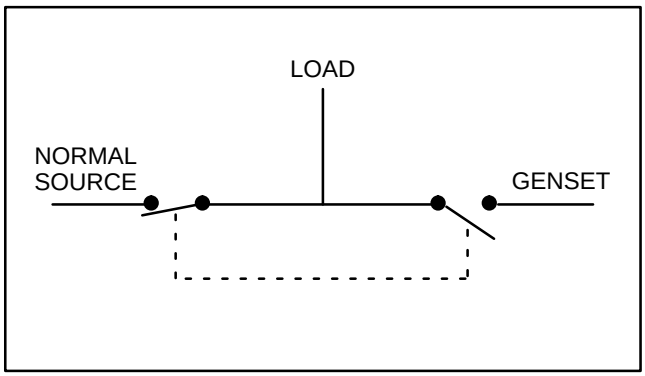



**FIGURE 7-1. TYPICAL LOAD TRANSFER FUNCTION**

## 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

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

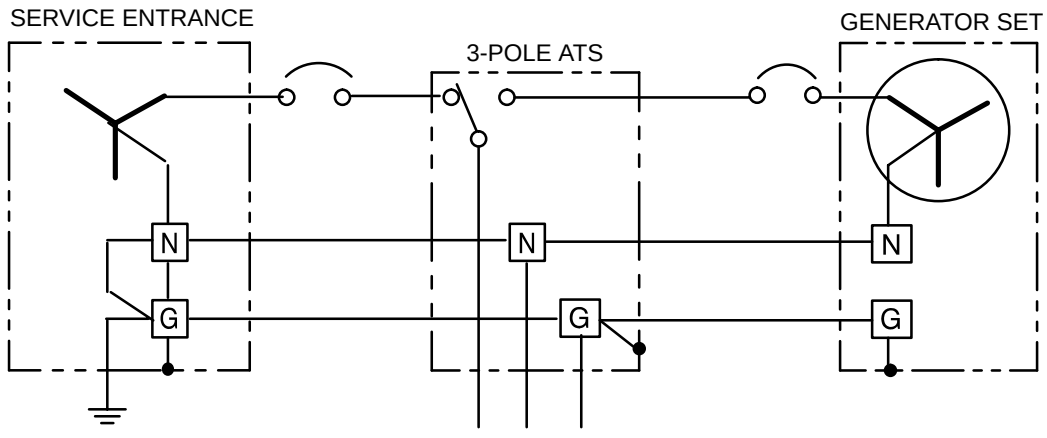
The following is a brief description of system and equipment grounding of permanently installed AC generators within a facility wiring system. It is important to follow the requirements of the local electrical code.

Figure 7-2 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.

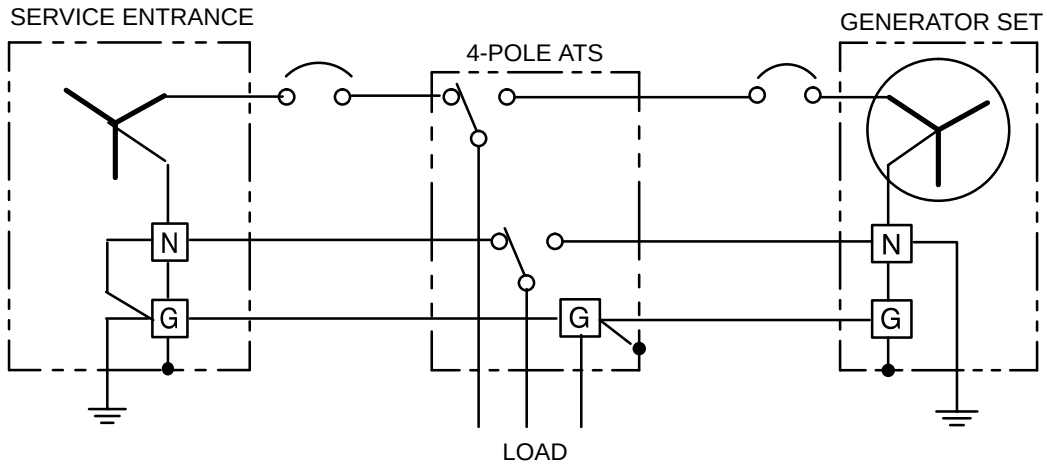
Make sure the genset is grounded to earth in one location only. On generators without a circuit breaker, ground to the point indicated on the top of the generator. On gensets with circuit breakers, use the ground lug provided in the circuit breaker box.

**⚠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.




THREE-PHASE, FOUR-WIRE UTILITY, THREE-POLE ATS




THREE-PHASE, FOUR-WIRE UTILITY, FOUR-POLE ATS

**FIGURE 7-2. TYPICAL SYSTEM GROUNDING ONE-LINE DIAGRAMS**

## CONTROL HEATER (OPTIONAL)

A control heater (Figure 7-3) provides a means of humidity /temperature control of the control box interior. It protects the components when the generator set is subjected to varying ambient air conditions during extended periods of non-use.

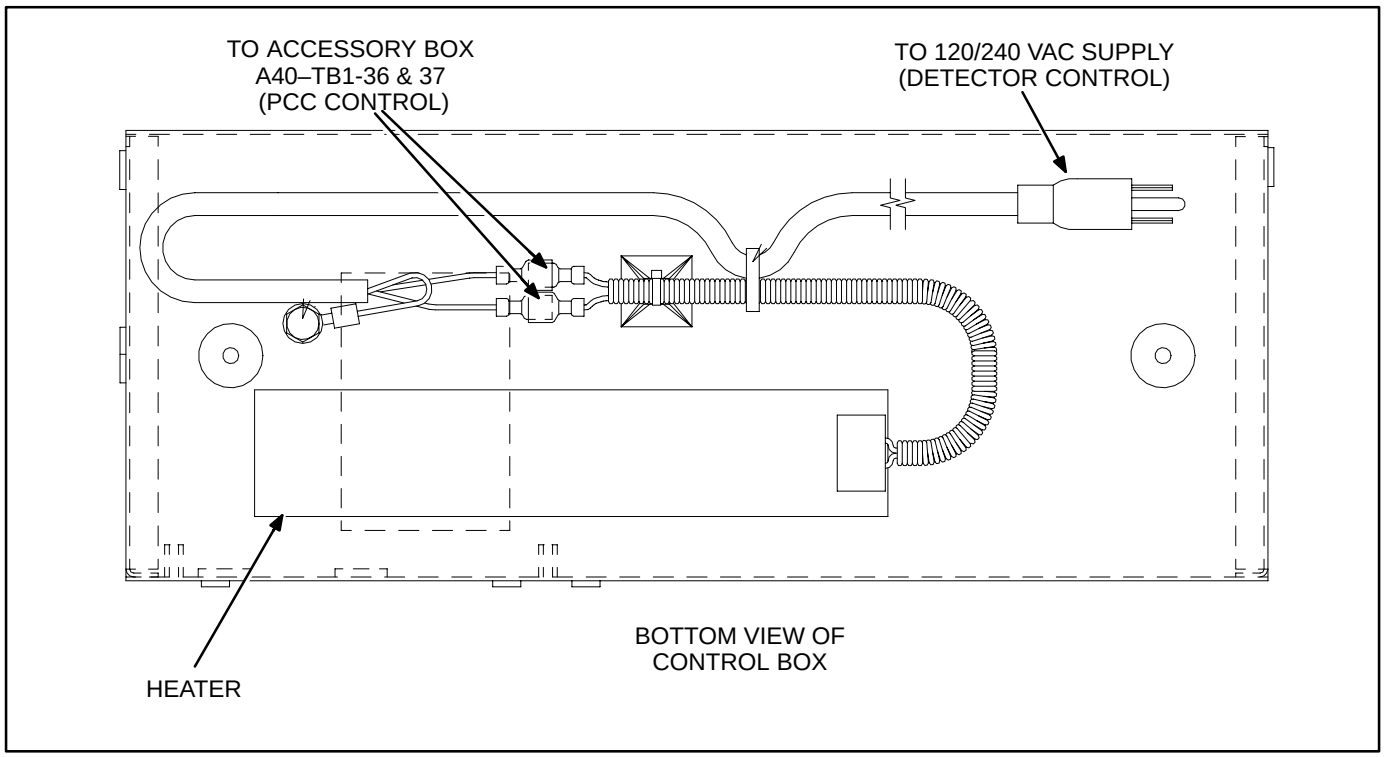



**FIGURE 7-3. OPTIONAL CONTROL HEATER**

## COOLANT HEATER

The coolant heater keeps 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 7-4 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 supply voltage and circuit amperage is correct for the heater element rating.

Refer to the Single/Dual Coolant Heater Diagram in Section 12 for coolant heater power connections/ voltage selections.

**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.***

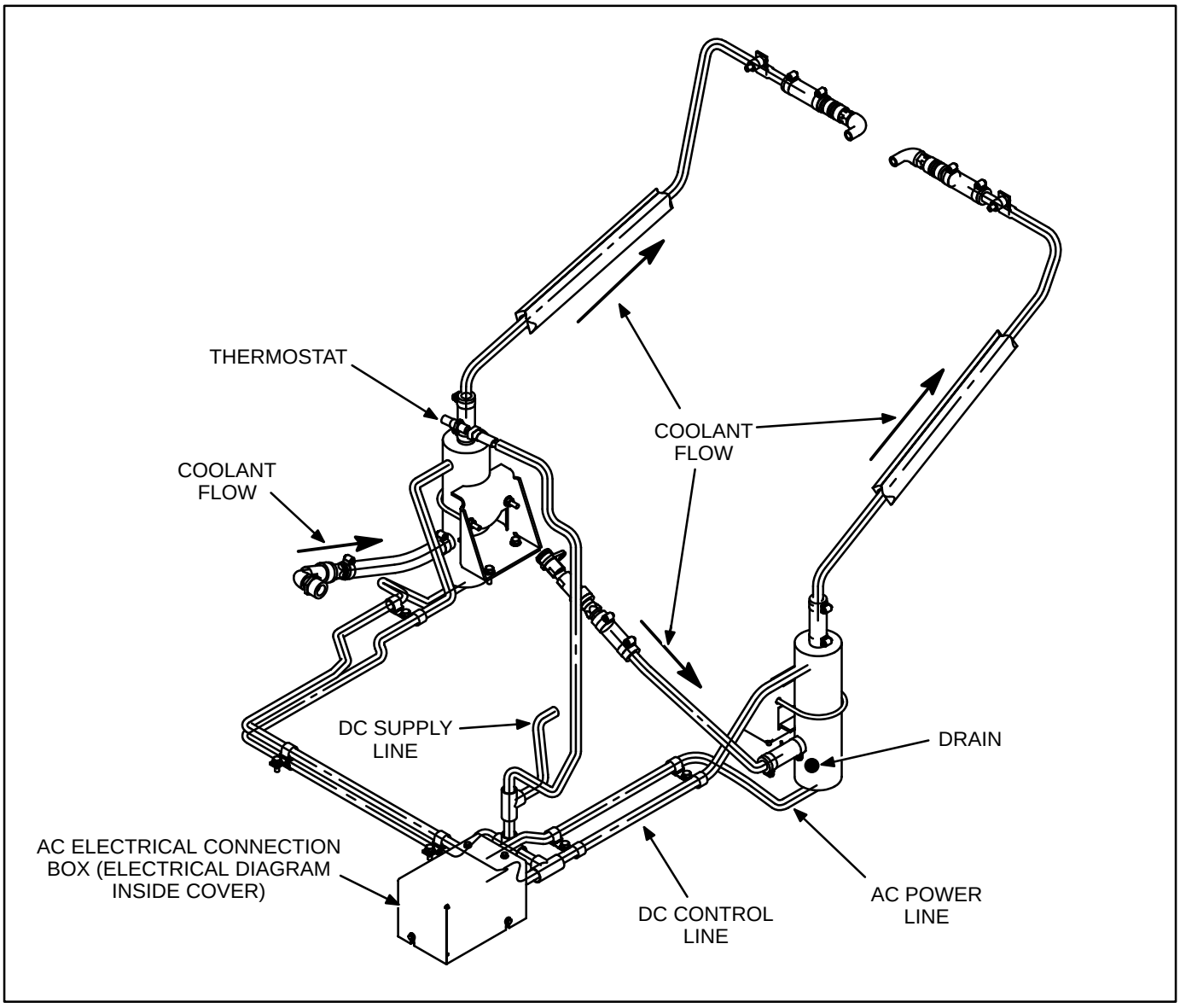



**FIGURE 7-4. TYPICAL COOLANT HEATER**

## GENERATOR HEATER

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 can form within a generator, creating flashing and a shock hazard.

**⚠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 7-5 illustrates the installation of two heater elements. Connect the heater(s) terminals to a source of power that will be on during the time the engine is not running. Be sure the supply voltage and circuit amperage is correct for the heater element rating.

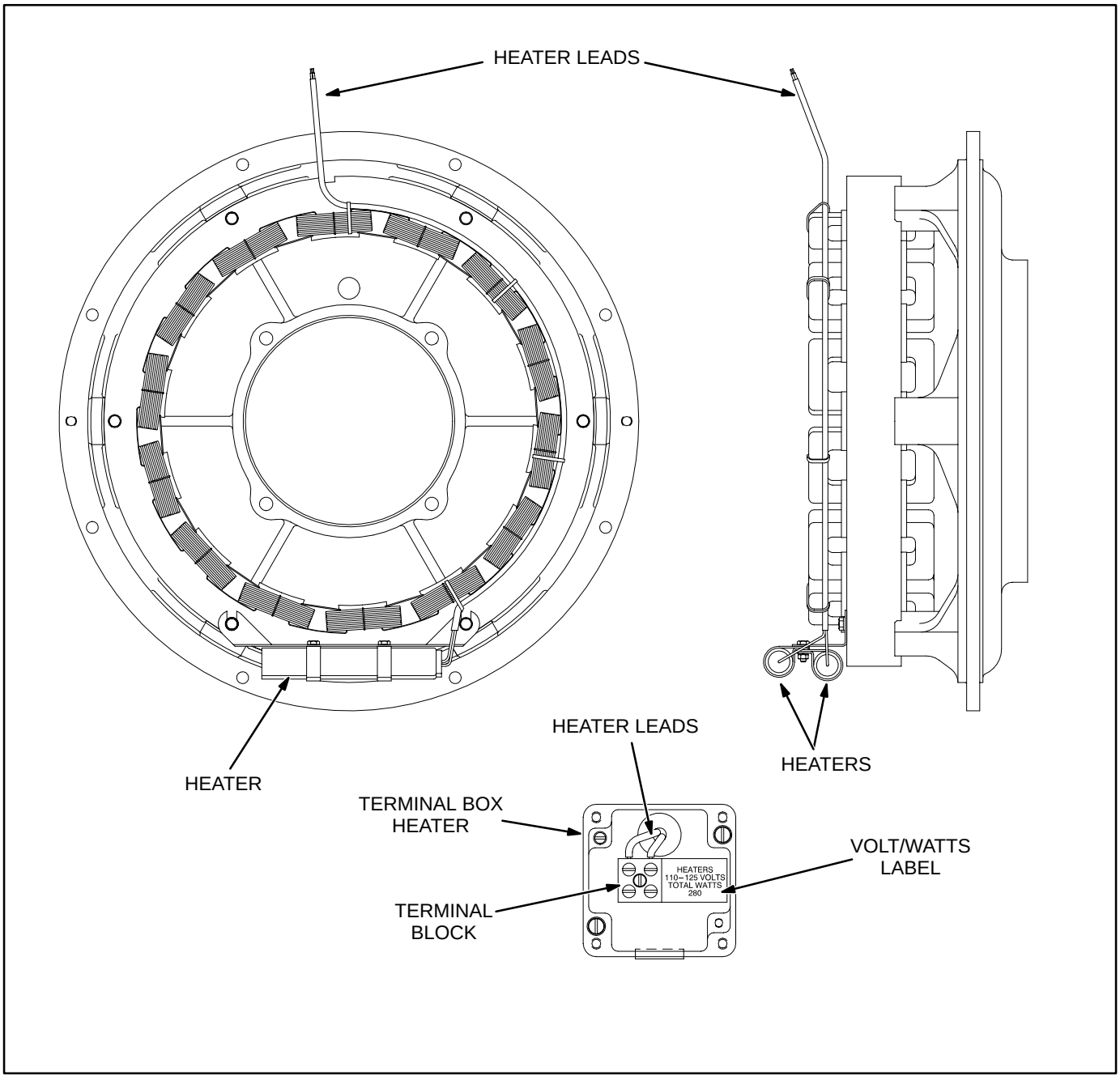



**FIGURE 7-5. TYPICAL GENERATOR HEATER INSTALLATION**

## FUEL TRANSFER PUMP

A fuel transfer pump and control are available when a sub-base or in-skid day tank are provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the day tank.

**⚠WARNING** ***Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited. Installation and service must be performed by trained and experienced persons in accordance with the applicable codes.***

***Do not smoke near fuel and keep flames, sparks, pilot lights, arcing switches and equipment, and other sources of ignition well away.***

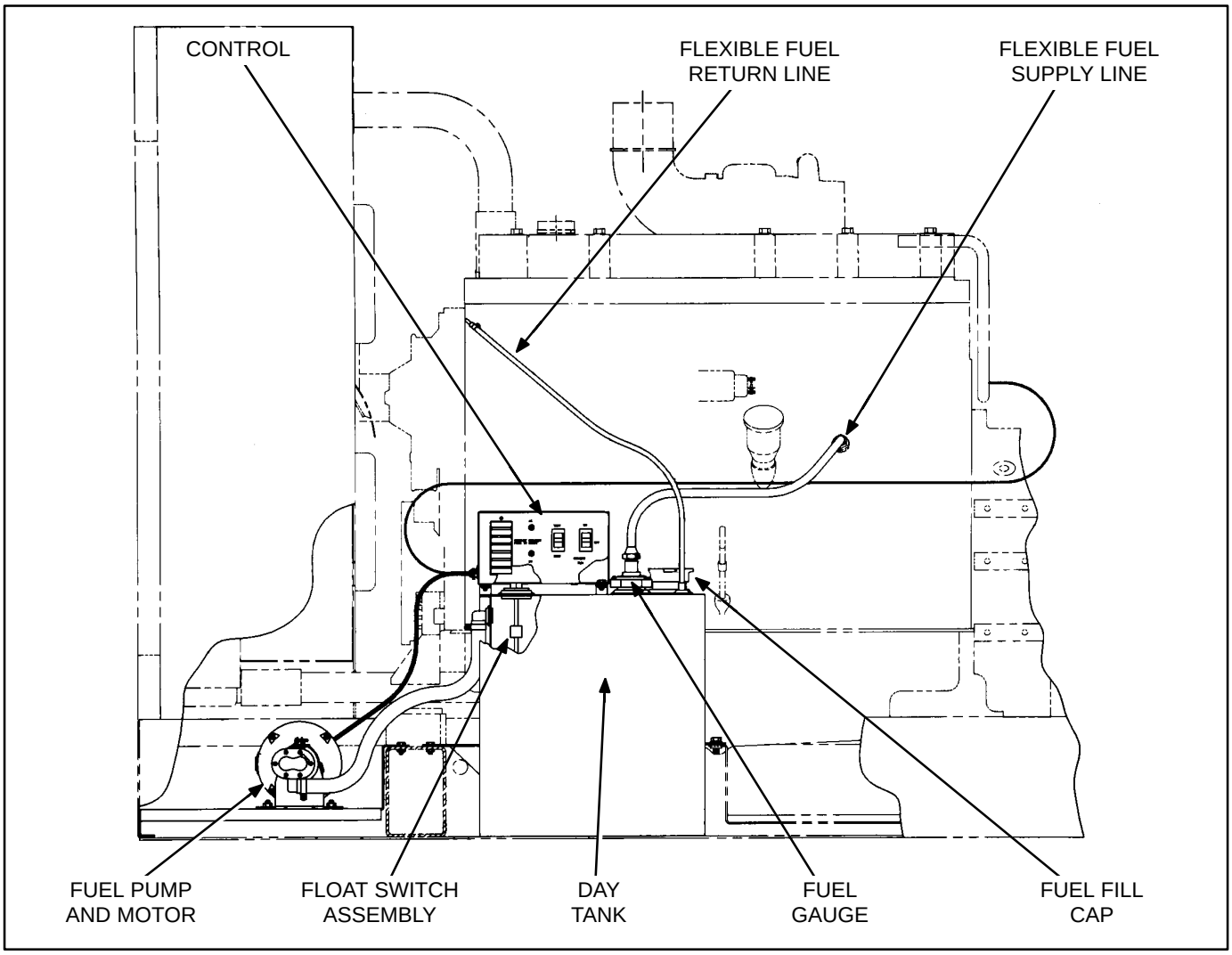



**FIGURE 7-6. TYPICAL IN-SKID DAY TANK INSTALLATION**

## Fuel Pump Control AC Connections

The control can be powered by 120 VAC or 240 VAC. The control is set up at the factory for connection to 240 VAC.

1. To convert the day tank controller from 240 VAC to 120 VAC, perform the following steps.

   A. Remove the two jumpers between terminals **TB1-6** and **TB1-7** in the control box and connect one between terminals **TB1-5** and **TB1-6** and the other between terminals **TB1-7** and **TB1-8**.

   B. Move selector switch **S103** on the control PCB to the up position for 120V.

   C. If the control is equipped with a transformer, remove the two jumpers between terminals **H2** and **H3** and connect one between **H1** and **H3** and the other between **H2** and **H4**.

2. To convert the day tank controller from 120 VAC to 240 VAC, perform the following steps.

   A. Remove the jumpers between terminals **TB1-5** and **TB1-6**, and **TB1-7** and **TB1-8** in the control box and connect the two jumpers between terminals **TB1-6** and **TB1-7.**

   B. Move selector switch S103 on the control PCB to the down position for 240 VAC.

   C. If the control is equipped with a transformer, remove the jumpers between terminals **H1** and **H3**, and **H2** and **H4** and connect the two jumpers between **H2** and **H3**.

3 Attach a tag to the control box indicating the supply voltage.

4 Terminals **TB1-8** and **TB1-5** are available for connection of a 120 or 240 VAC electric fuel shutoff valve rated not more than 0.5 amps. The voltage rating of the valve must correspond with the voltage utilized for the pump. See Item 2 above.

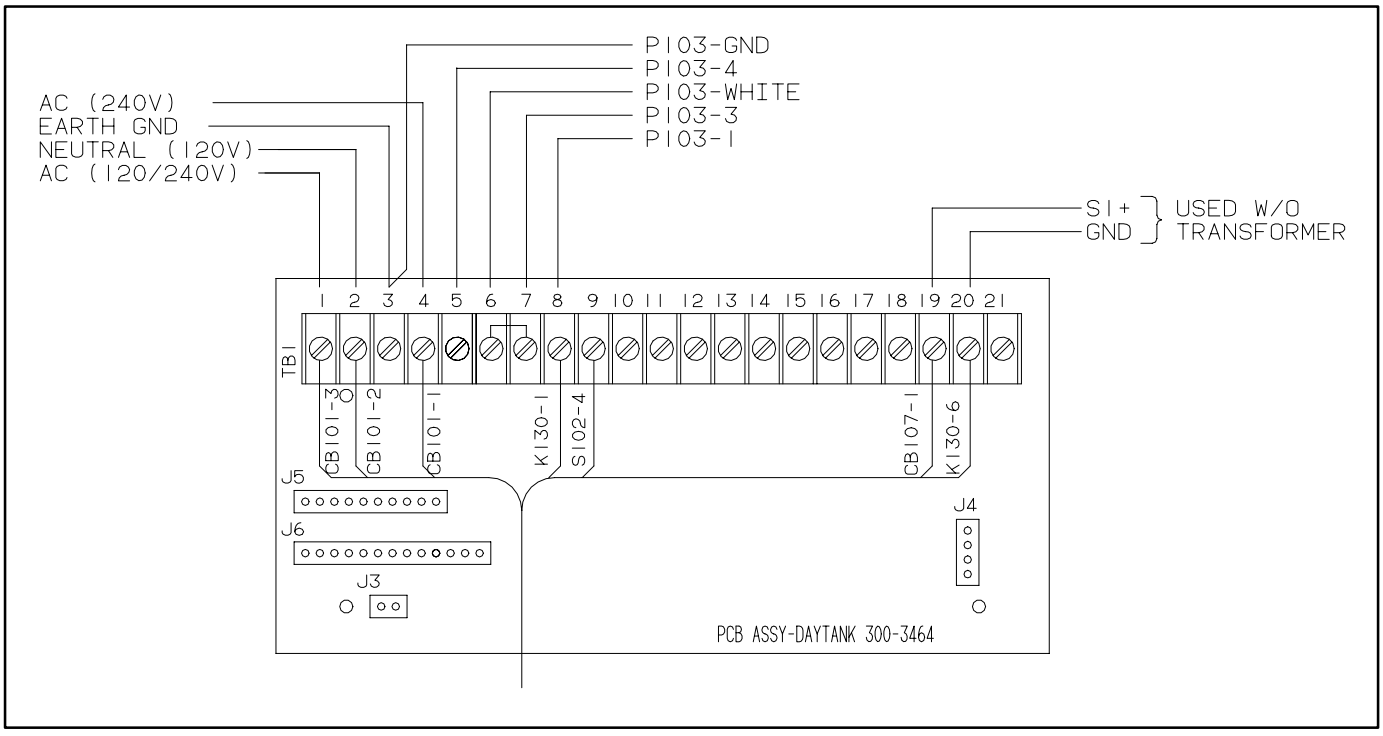



**FIGURE 7-7. FUEL PUMP CONTROL TERMINAL BOARD**

## GROUND FAULT ALARM RELAY (OPTIONAL)

The optional Ground Fault Relay (GFR) (Figure 7-8) is typically located behind the lower control housing grille. The ground fault relay continuously monitors the neutral to ground connection and activates a fault alarm when the connection is broken. During genset operation, the relay continuously monitors the line to neutral and activates a fault alarm when a ground fault is sensed.

The relay alarm contacts are typically connected to the genset control to provide a “Ground Fault Alarm” indication.

A control reset will clear the fault at the control panel and will also reset the ground fault relay.

The relay has a time delay setting of zero to one second and a current setting of 5 to 1200 amperes.

Adjust the Current and the Time Delay controls on the ground fault relay to the customers specifications.

After the installation of the genset is complete, perform the following procedure to test the operation of the ground fault relay.

A. Verify that the **N-G** Fault Indicator on the GFR is not lit. If lit, it indicates that the bonding jumper circuit (neutral to ground) is open. If genset does not require bonding jumper, a bonding jumper must be installed at the facility service entrance.

A. Move the control switch to the Run position.

B. Press the TEST switch on the ground fault relay.

C. Verify that the control panel warning message is displayed and the Fault Indicator (**>I**) on the GFR is lit.

D. Reset the control panel fault (this will also reset the ground fault relay).

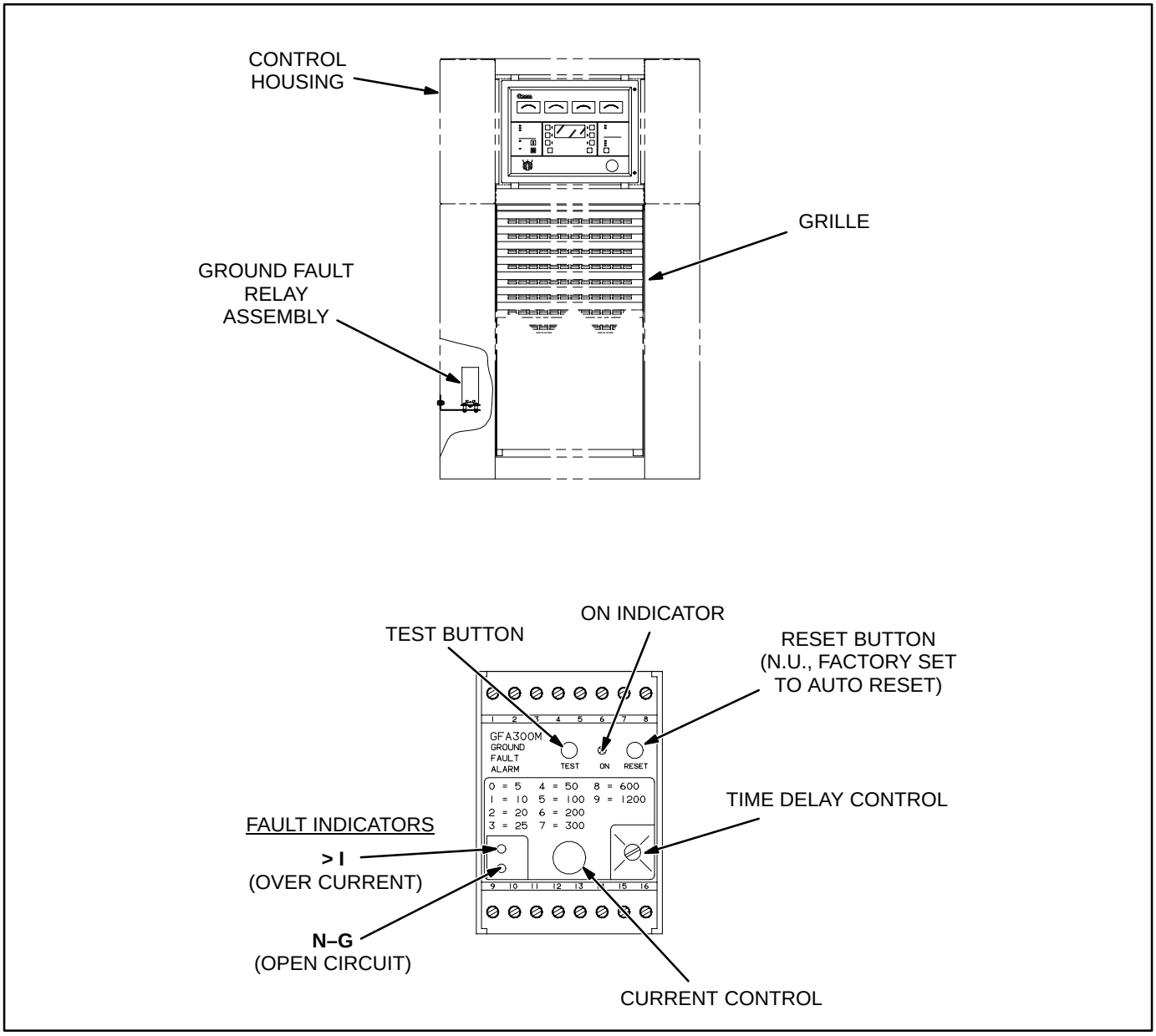



**FIGURE 7-8. GROUND FAULT ALARM RELAY**

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# 8. Prestart Preparation

## GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 10*.

## PCC POWER ON / STANDBY MODE

**⚠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.***

Before opening the PCC control cabinet to make the following Power On/Standby Mode selection, remove the negative (**–**) battery cable(s) from the generator set starting battery as follows:

1. Place the run switch on the control panel to the OFF or STOP position.
2. Turn off or remove AC power from the battery charger.
3. Remove the negative (**–**) battery cable from the generator set starting battery.

## Selecting Power On or Standby Mode

**⚠ CAUTION** ***Electrostatic discharge will damage circuit boards. To prevent this damage, always wear a grounding wrist strap when working inside control box.***

Set the Power On / Standby Mode switch (S5 in Figure 8-1) to the desired position.

**Power On Mode:** Slide the switch to the left to select the Power On (awake) mode. It is recommended that switch S5 be left in the Power On mode in all applications, except those where battery charging is not available.

The PCC will initialize the operating software and permit operation of the menu display panel. Power will stay on until the switch is reset to the Standby Mode.

**Standby Mode:** Slide the switch to the right to select the Standby (sleep) Mode. In this mode, the PCC operating software will be initiated by:

- moving the Run/Off/Auto switch to the Run position,
- pressing the Self Test button,
- a remote start input signal (genset in Auto mode), or
- any one of several “wake-up” signals from external switches.

With the switch set to Standby mode, pressing the Self Test button will allow you to activate and view the menu displays without starting the generator set. If no menu selections are made, a software timer will shut down the power after 30 seconds.

When left in the Standby Mode, and a “Warning” signal is sensed by the PCC (for example, low engine temp), the control will wake up and display the warning message. The control will remain active until the warning condition is corrected and the Reset button is pressed to clear the warning message.

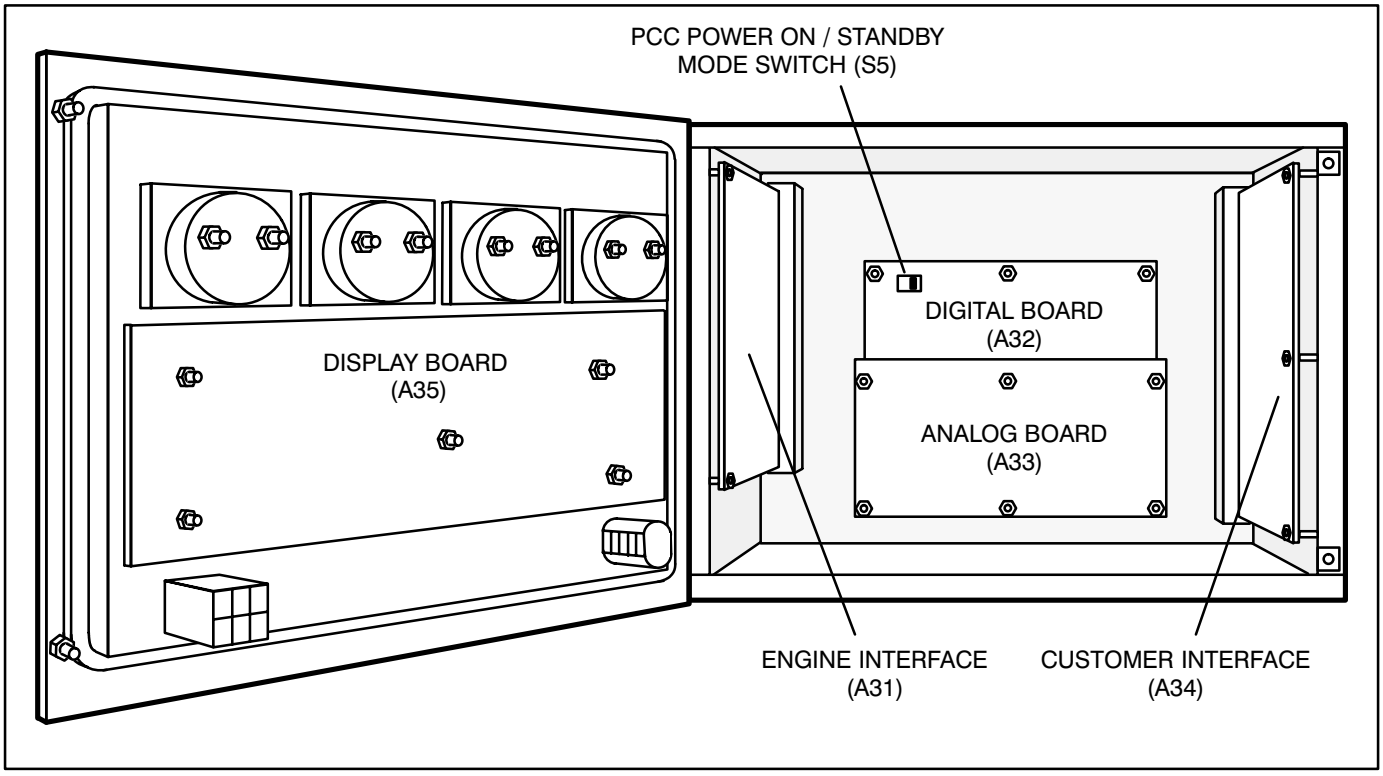


**FIGURE 8-1. CABINET INTERIOR (PCC 3100)**

## 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 24 volt battery current, using two or four, 12 volt batteries (see *Specification* section). Connect the batteries in series (negative post of first battery to the positive post of the second battery) as shown in Figure 8-2.

Service the batteries as necessary. If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger. A battery charger is required when the PowerCommand control is set to the Power On (awake) mode.

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

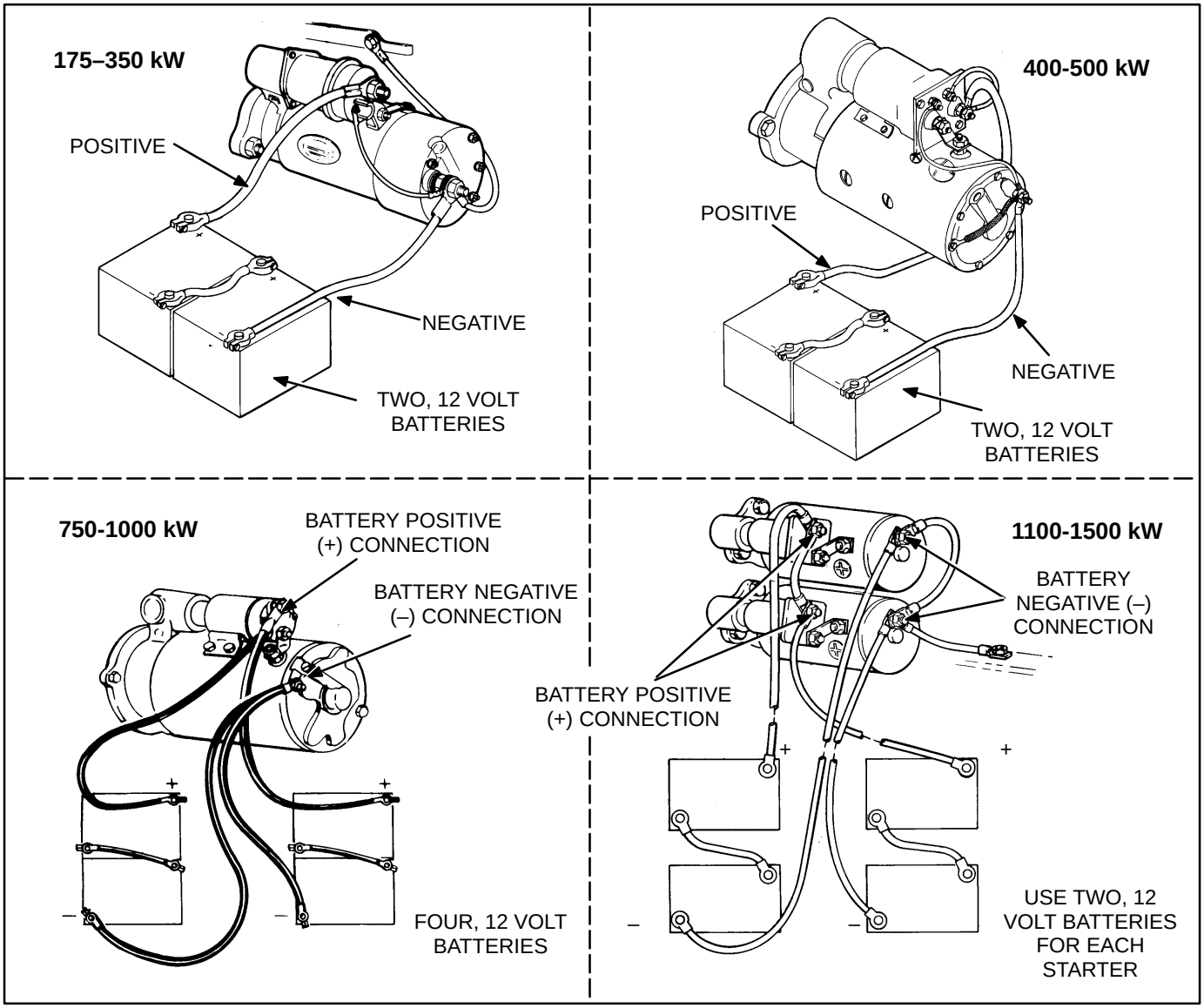


**FIGURE 8-2. 175 THROUGH 1500 kW GENSET BATTERY CONNECTIONS**

## PCC OPTIONS PRESTART CHECKS

All generator set configuration options are set at the factory except for site related options, (e.g., Start/ Stop Time Delays, Cycle Crank, Customer Fault 1 and 2, etc..

Adjustment of these options are divided into two categories within the menu driven system. These two categories are *Adjust* and *Setup/Calibrate*.

The *Setup/Calibrate* submenus are intended for qualified service personnel only and require a password to modify these submenus. The *Adjust* submenus are intended for service personnel and site personnel.

The *Adjust* submenus allow site personnel to calibrate the generator set voltage/frequency, idle speed and start/stop time delays. For the prestart checks, adjustment of only the start/stop delays is required.

### Adjust Menu

To adjust the start and stop delays, press the button next to the word “ADJUST” in the Main Menu. Figure 8-3 shows a block representation of the ADJUST menu. After you press the button next to the word “ADJUST” in the display, the VOLTAGE submenu will appear.

As shown in the diagram, the ADJUST menu has five submenus, including a save/exit procedure. To move through the VOLTAGE and FREQUENCY submenus, press the button next to the ’>>’ to display the STOP DELAY submenu.

***START DELAY submenu:*** This delay applies only to remote starting in the Auto mode. Use the buttons next to the “⇑” and “⇓” symbols to set the start delay. The start delay adjustment range is 0 to 300 seconds.

***STOP DELAY submenu:*** This delay applies only to remote stopping in the Auto mode. From the START DELAY submenu, press the button next to the “>>” in the display to move to the STOP DELAY submenu. Use the buttons next to the “⇑” and “⇓” symbols to set the stop delay. The stop delay adjustment range is 0 to 600 seconds.

***IDLE SPEED submenu:*** From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the IDLE SPEED submenu. Use the buttons next to the “⇑” and “⇓” symbols to set the idle speed. The idle speed adjustment range is 800 RPM ±100 RPM. (Default value is 800 RPM.)

**The idle speed can be adjusted only when the generator set is running in the idle mode. When not in idle mode, N/A is displayed in RPM field.**

***SAVE/EXIT submenu:*** From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the Main menu.

**If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down and return to the previous settings when the set is restarted.**

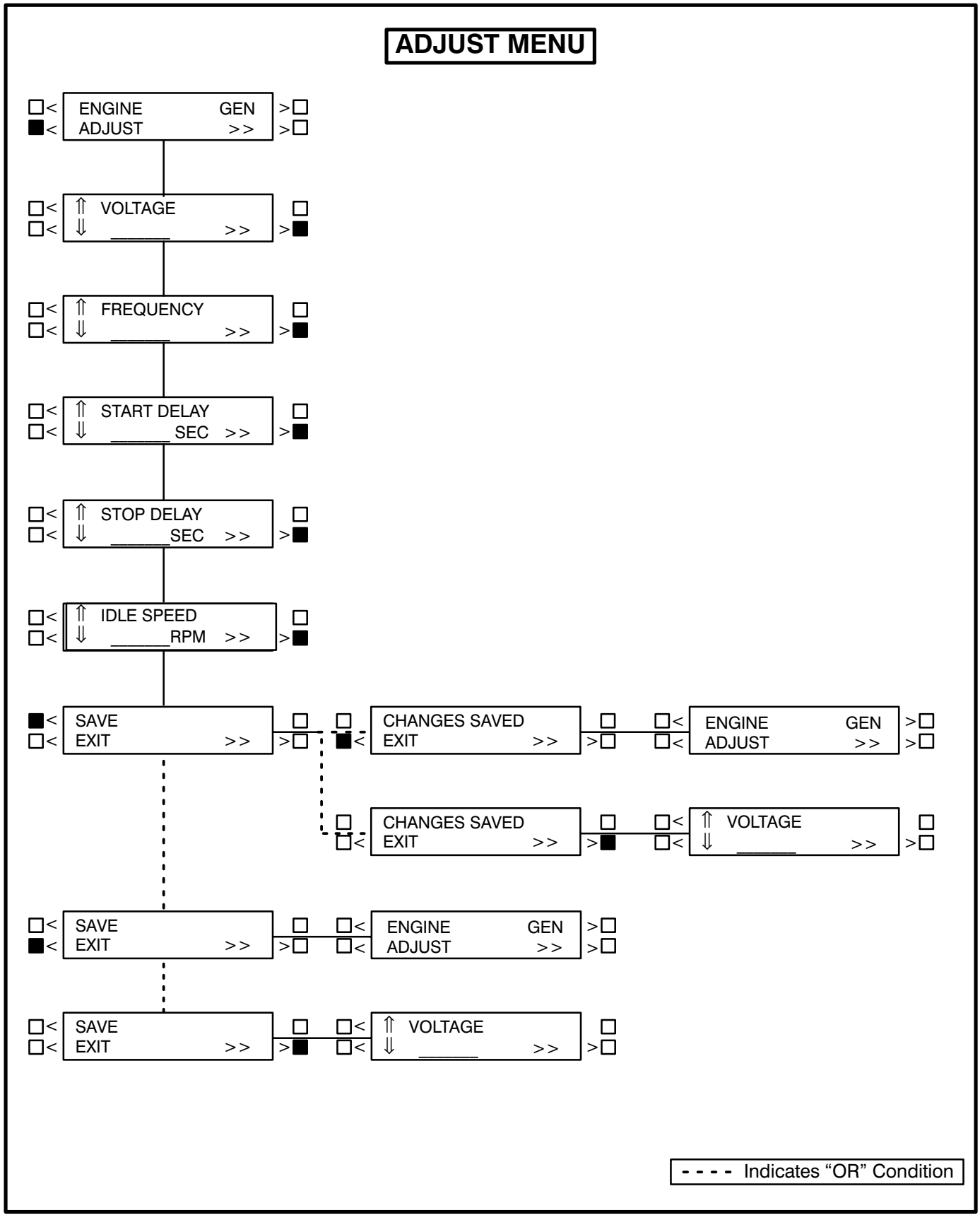


**FIGURE 8-3. ADJUST MENU**

## STARTING

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

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# 9. Prestart Preparation (Detector)

## GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 10*.

## 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 24 volt battery current, using two or four, 12 volt batteries (see *Specification* section). Connect the batteries in series (negative post of first battery to the positive post of the second battery) as shown in Figure 9-1.

Service the batteries 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 cable 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.

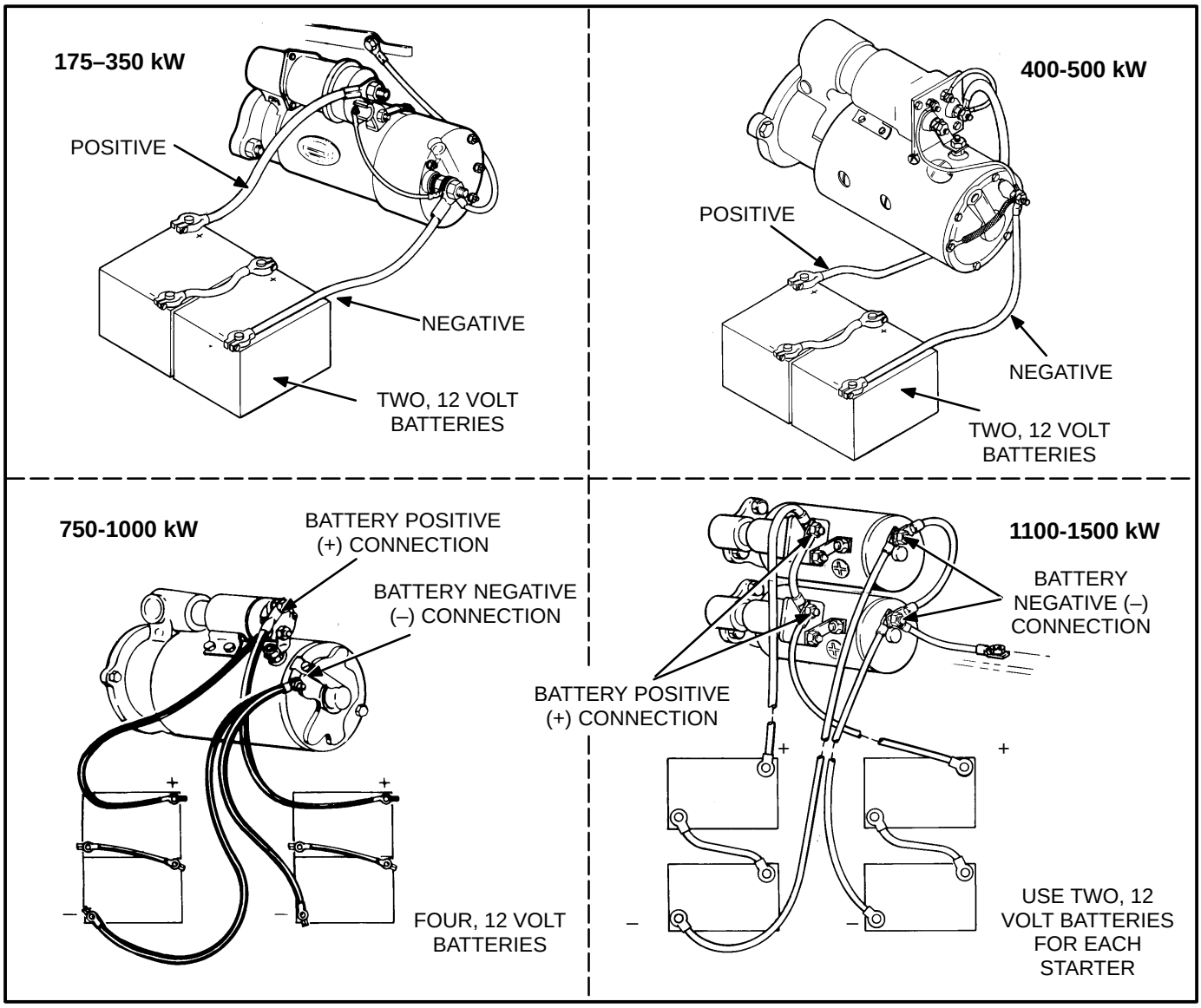



**FIGURE 9-1. 175 THROUGH 1500 kW GENSET BATTERY CONNECTIONS**

# 10. 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.

## 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.

# 11. Fan Belt Alignment (DFLE Only)

## GENERAL

The following procedure describes how to align the fan drive pulleys of the DFLE 50° C radiator cooling system.

## SPECIAL TOOLS

This installation requires the following tools:

- 8 mm hexagon wrench
- Straightedge at least 48 inches (1219 mm) long
- Large pry bar to align radiator to skid

**⚠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.***

### Align Cooling System Fan Drive

Align the fan drive after the genset is mounted, filled with coolant and leveled (see *Section 3*). The fan drive pulleys must be aligned for proper fan drive operation.

1. Place the run switch on the control panel to the OFF or STOP position.
2. Disable the starting system of the generator set:
   a. Disconnect the battery charger from its AC source.
   b. Disconnect negative (–) cables from the starting batteries and install a lockout device on the battery cable ends. (For engines equipped with an air-powered starting system, close air valve and install valve locking device.)
3. Remove the left and right side fan drive guards (Figure 11-1) to access fan drive system.

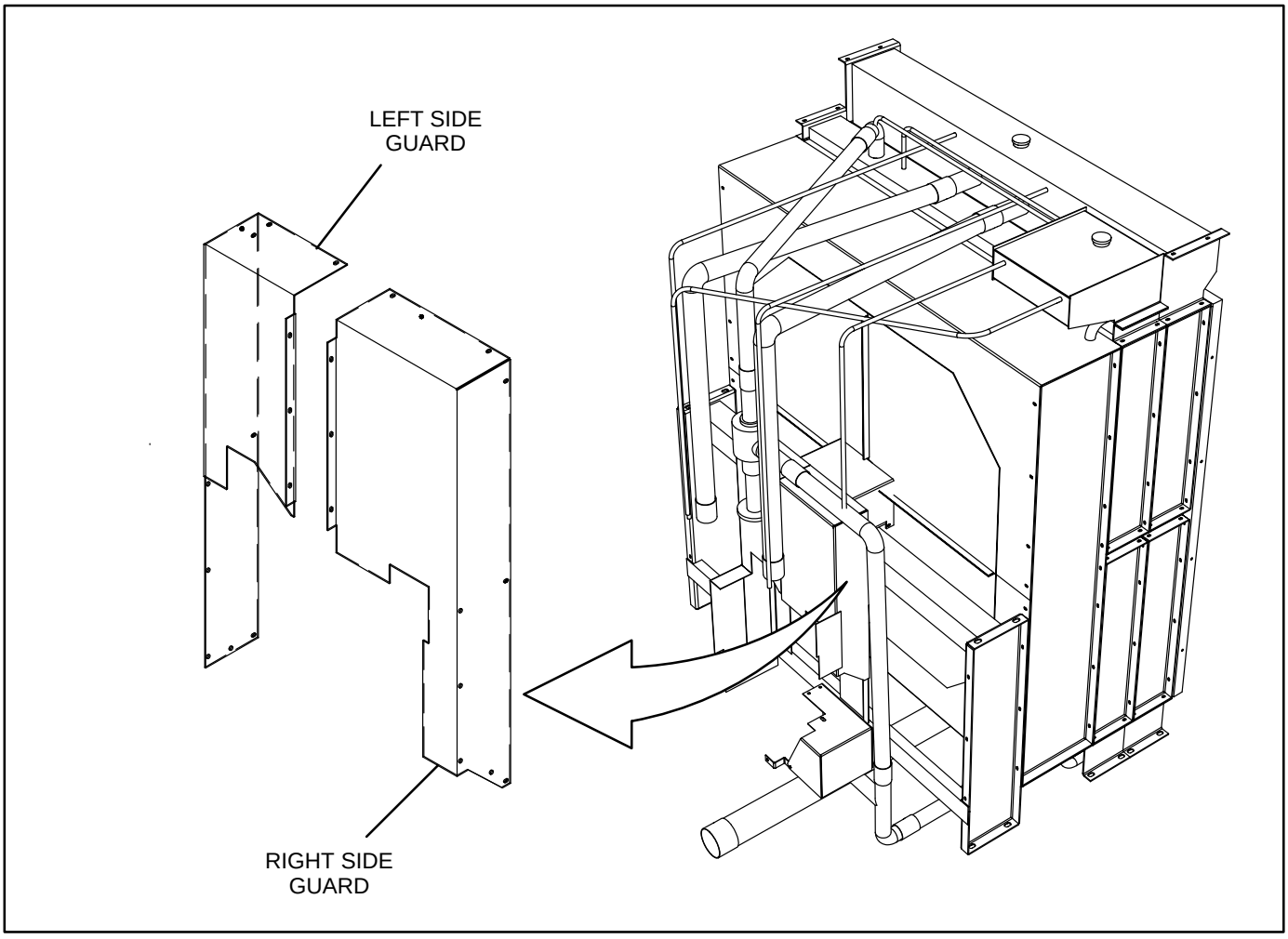



**FIGURE 11-1. FAN DRIVE GUARD (LEFT/RIGHT SIDE)**

4. Check the alignment using a long straightedge (not supplied). The straightedge should be flat against the vertical surface of the engine pulley near the center. See Figure 11-2. The fan drive pulley should be 0.25” nominal toward engine from straight edge.

   If alignment is required, continue with step 5. If OK, continue with step 8.

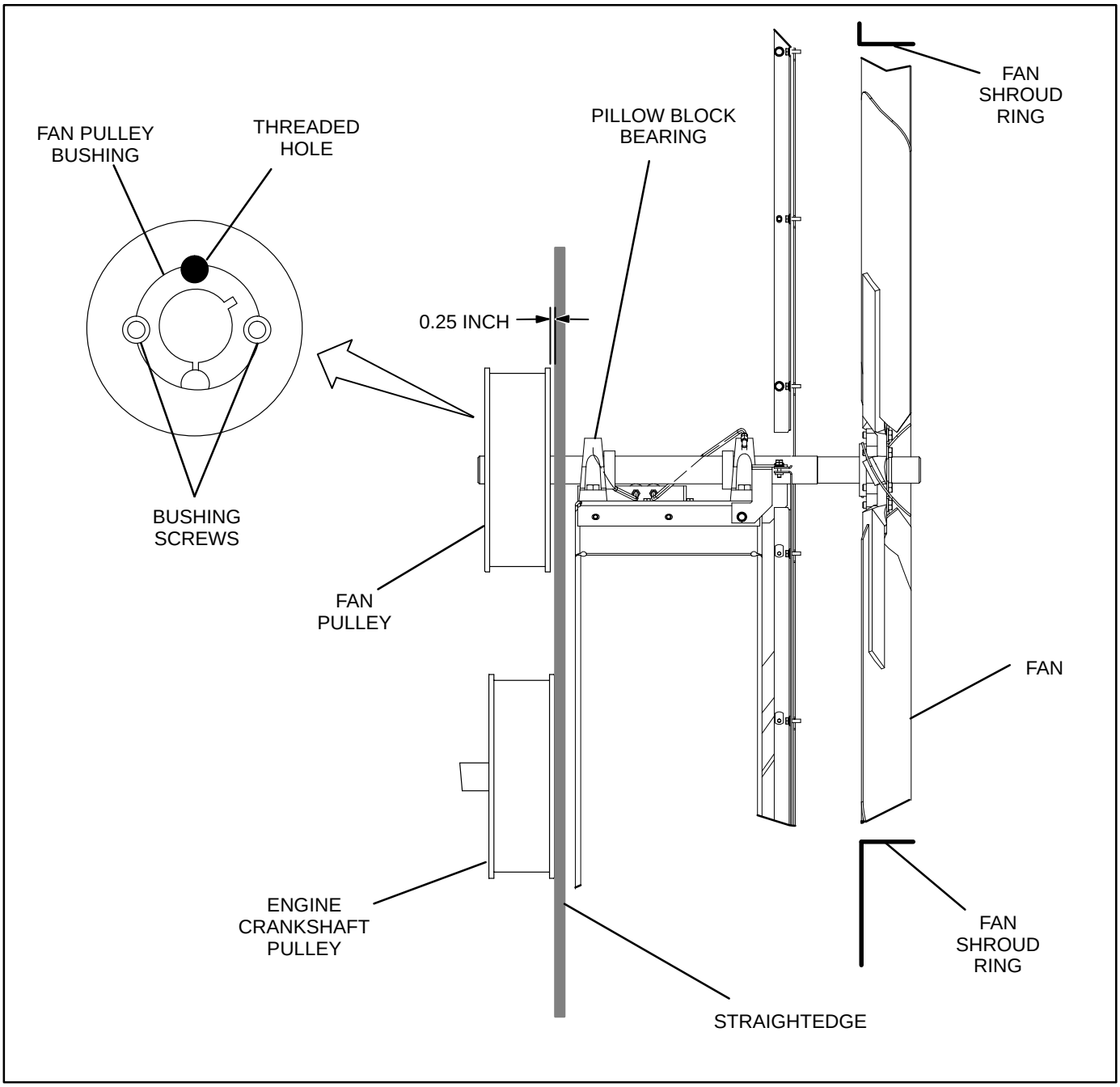



**FIGURE 11-2. FAN DRIVE PULLEY ALIGNMENT**

5. Remove the fan belt. This procedure requires two people.

   **⚠WARNING** ***The fan belt idler is under tension and can cause severe personal injury. Do not allow your hands to get between the idler and the belt or the fan hub.***

   Use an 8-point socket and breaker bar or a large wrench to hold the idler in position against the spring tension (Figure 11-3). Turn the wrench until the idler pulley position is sufficient to remove the belt. With the belt removed from the pulley, slowly release spring tension of idler arm.

6. To align the fan drive pulley so that it is 0.25" toward engine from the crankshaft pulley:

   A. Use pencil to mark current location of fan drive pulley on shaft.
   B. Mark estimated (new) location on shaft, determined by width of gap found in Step 1.
   C. Remove the two screws from the fan pulley bushing. Install one of these screws into the threaded hole located between the two screws that were removed. (Figure 11-2). Tighten the screw to separate bushing from pulley and remove the screw.
   D. Move bushing to the new location mark.
   E. Install the two screws into the bushing and tighten alternately to 67 ft-lbs (91 N•m) torque.
   F. Recheck alignment and repeat procedure until alignment is achieved.

   Perform a final check by rotating the fan slowly by hand and make sure the specified clearance is achieved. Make sure any loosened shroud or safety guard fasteners are retightened.

7. Install the drive belt. This procedure requires two people.

   **⚠WARNING** ***The fan belt idler is under tension. Do not allow your hands to get between the idler and the belt or the fan hub. Personal injury will result.***

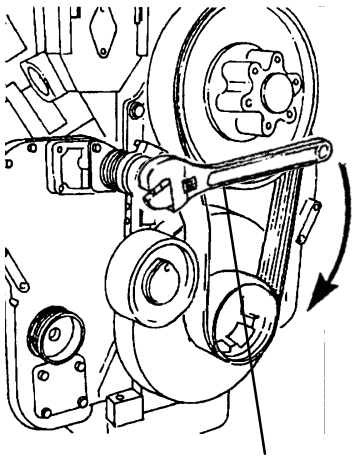
   Use an 8-point socket and breaker bar or a large wrench to hold the idler in position against the spring tension (Figure 11-3). Turn the wrench until the idler pulley position is sufficient to position the belt in front of the idler pulley. Align the grooves of the belt on the ribs of the pulley and shaft and then slowly release spring tension onto belt.

   **The spring-loaded idler used on this design automatically maintains the correct belt tension.**

8. Install the left and right side fan drive guards (Figure 11-1) that were removed in step 3.

9. Check to make sure that all fan guards are in place and secure. You should not be able to touch any moving part with guards properly installed.

   **⚠WARNING** ***Contact with fan, belt, or pulleys can result in severe personal injury. All shroud and guard pieces must be properly fastened in place to prevent unintended contact.***



TURN WRENCH IN DIRECTION OF ARROW
UNTIL SPRING TENSION IS RELIEVED

**FIGURE 11-3. FAN BELT INSTALLATION**

## Run The Generator Set

The final check is to observe the drive belt when the genset is running.

1. When starting the engine for the first time after completing the generator set site installation, confirm that the drive belt is properly seated in all grooves in both pulleys. This only requires visual inspection.

   **⚠WARNING** ***Wear safety glasses and stand far from the running fan drive without guards installed. A misaligned fan drive or improperly installed drive belt can cause the belt to break, causing severe injury to near by personnel. A properly aligned and installed belt can grab loose clothing or body parts causing severe personal injury.***

2. If the belt "wanders", "walks", or jumps between pulleys, either the fan drive needs to be re-aligned, or the belt was improperly installed.

3. If the belt or drive should be corrected, stop the engine, disconnect the negative lead (**–**) of the starting batteries (or close the pneumatic supply valve and bleed pressurized air if equipped with air starters). Disassemble the fan drive guard, realign the fan drive pulley, and check the alignment again.

4. After the belt is properly installed, start the genset and check belt walk again.

   **⚠WARNING** ***Contact with fan, belt, or pulleys can result in severe personal injury. All shroud and guard pieces must be properly fastened in place to prevent unintended contact.***

5. Attach and secure all fan guard pieces that were removed for belt adjustment.

   **⚠WARNING** ***Contact with hot coolant can result in serious burns. Allow the engine to cool before loosening the radiator cap or coolant drain.***

6. Recheck coolant levels after engine cools. Add coolant if required.

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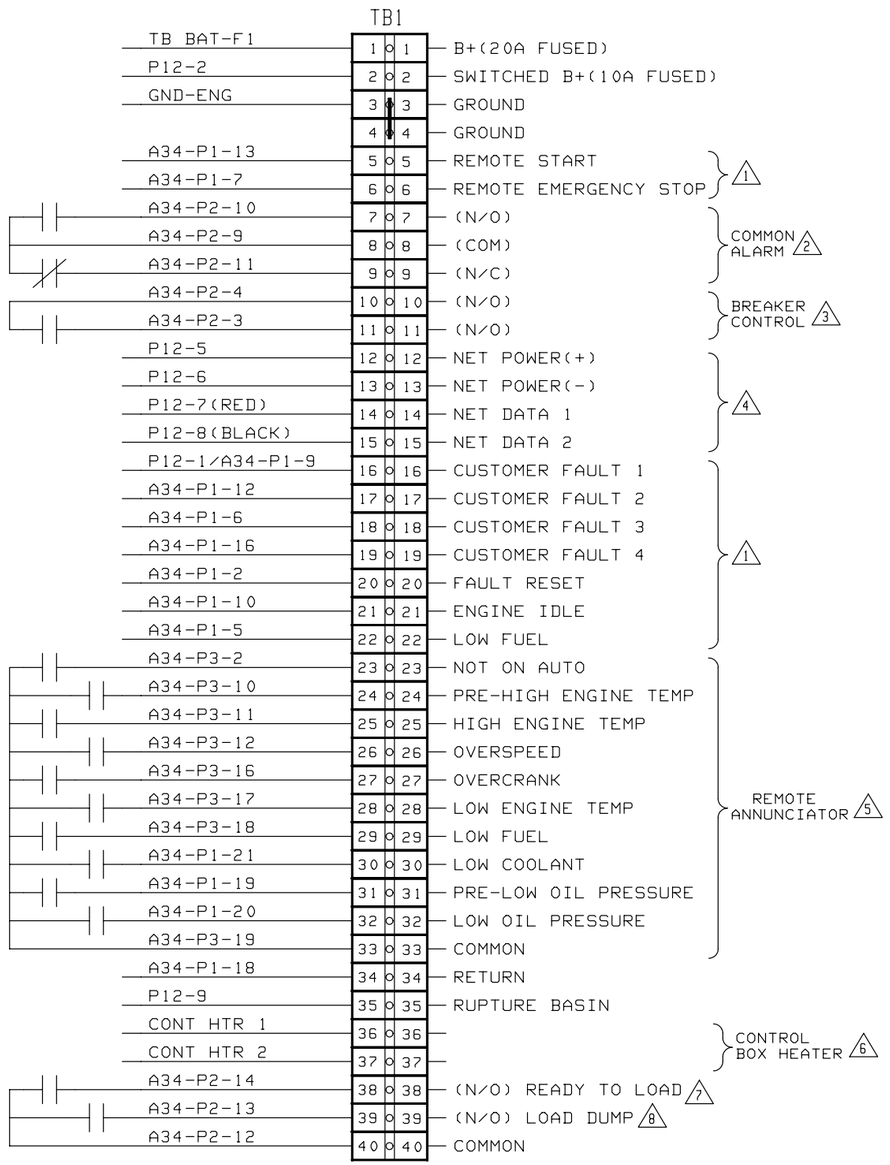
# 12. Wiring Diagrams

## GENERAL

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

**THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.**

## CUSTOMER TERMINAL BLOCK (SINGLE)



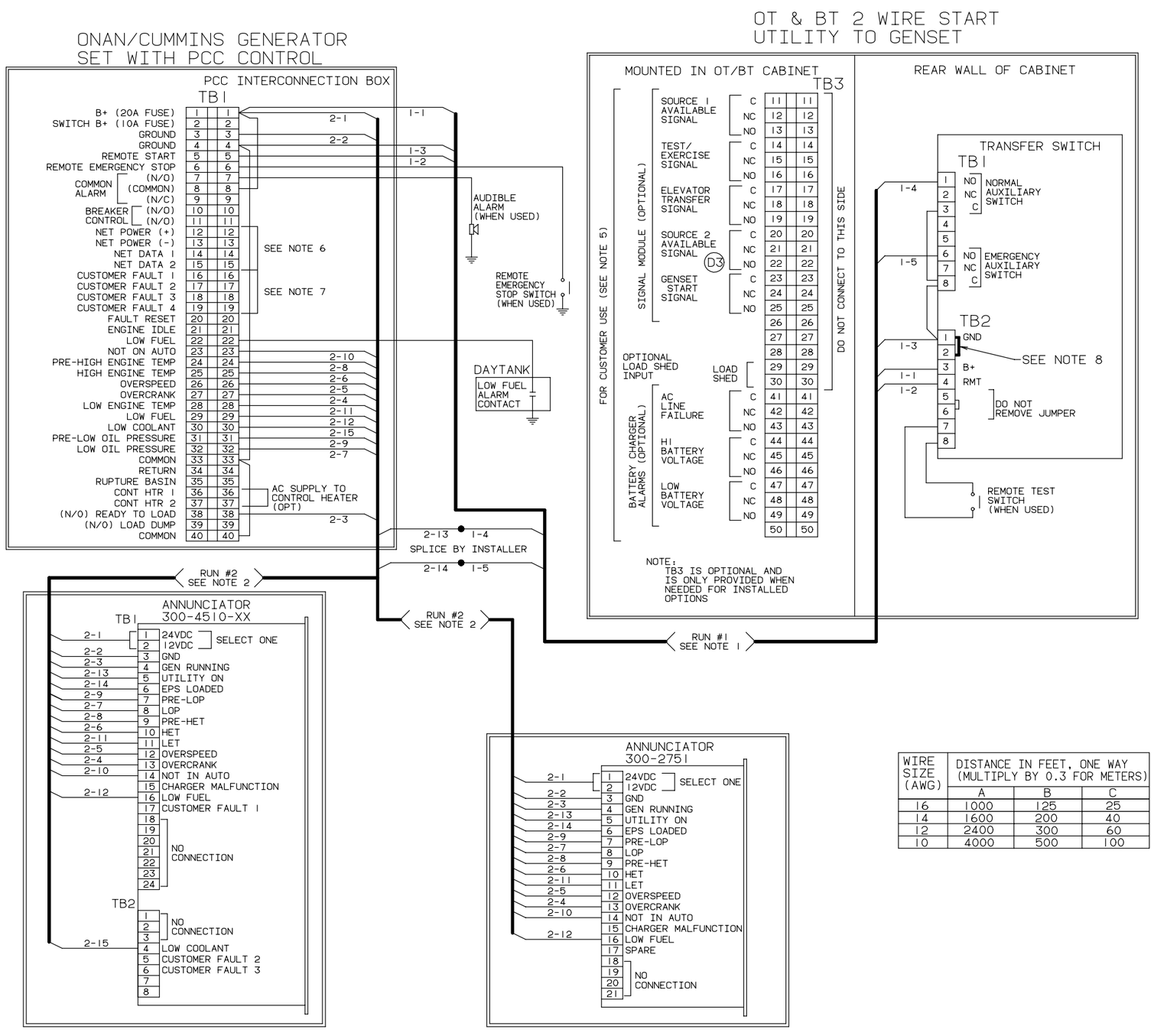

NOTES:

1. Apply a ground to activate input. Customer faults 2 & 3 "Wake-Up" the control. Use copper stranded wire, 20 ga for runs less than 1000 ft, 18 ga for runs 1000 to 2000 ft (less than 50mA).
2. 2A @ 30VDC relay contacts. This relay picks up with any warning or shutdown
3. 5A @ 30VDC relay contacts. This relay picks up on any shutdown fault in single mode.
4. Refer to Onan 900-0366 Power Command Network & Operation Manual for interconnection instrutions (optional PCC Network Interface Module).
5. 1A @ 30VDC isolated relay contacts. These relays pick up on the given fault.
6. 120VAC or 240VAC @ 50 Watts (optional).
7. 2A @ 30VDC isolated relay contacts. This relay picks up when generator AC voltage and frequency exceed 90% of nominal.
8. 2A @ 30VDC relay contacts. This relay picks up if a overload or underfrequency condition continues for more than 5 seconds.
9. Terminal Block Rating:
   20A, 600V
   22 to 12 ga wire
   Torque terminal screws to 7.0 in/lbs(0.8 N M)

| | |
|---|---|
| No | 12 5 s 3o 3 |
| Re | D S s HP |
| Modi ied | /13/ |



**CUSTOMER CONNECTIONS DIAGRAM (PCC)**




**THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.**

NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS 1-1, -2, -3, -4, -5 USE COL A.
   WITH 2 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. B
   WITH 10 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. C
2. RUN #2-GENSET TO ANNUNCIATOR-ALL LEADS, USE COL. A
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4. 
5. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
6. REFER TO ONAN 900-0366 POWER COMMAND NETWORK & OPERATION MANUAL. FOR WIRING INSTRUCTIONS.
7. INPUTS FOR CUSTOMER FAULTS. GROUNDED SIGNAL REQUIRED TO ACTIVATE INPUT (MAX 50 MA.)
8. INSTALL JUMPER BETWEEN TB2-1 & TB2-2. FOR SETS WITH PCC CONTROL.

| WIRE SIZE (AWG) | DISTANCE IN FEET, ONE WAY (MULTIPLY BY 0.3 FOR METERS) | | |
|---|---|---|---|
| | A | B | C |
| 16 | 1000 | 125 | 25 |
| 14 | 1600 | 200 | 40 |
| 12 | 2400 | 300 | 60 |
| 10 | 4000 | 500 | 100 |

| | | | | |
|---|---|---|---|---|
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**ACCESSORY INTERCONNECT DIAGRAM (PCC)**

**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*

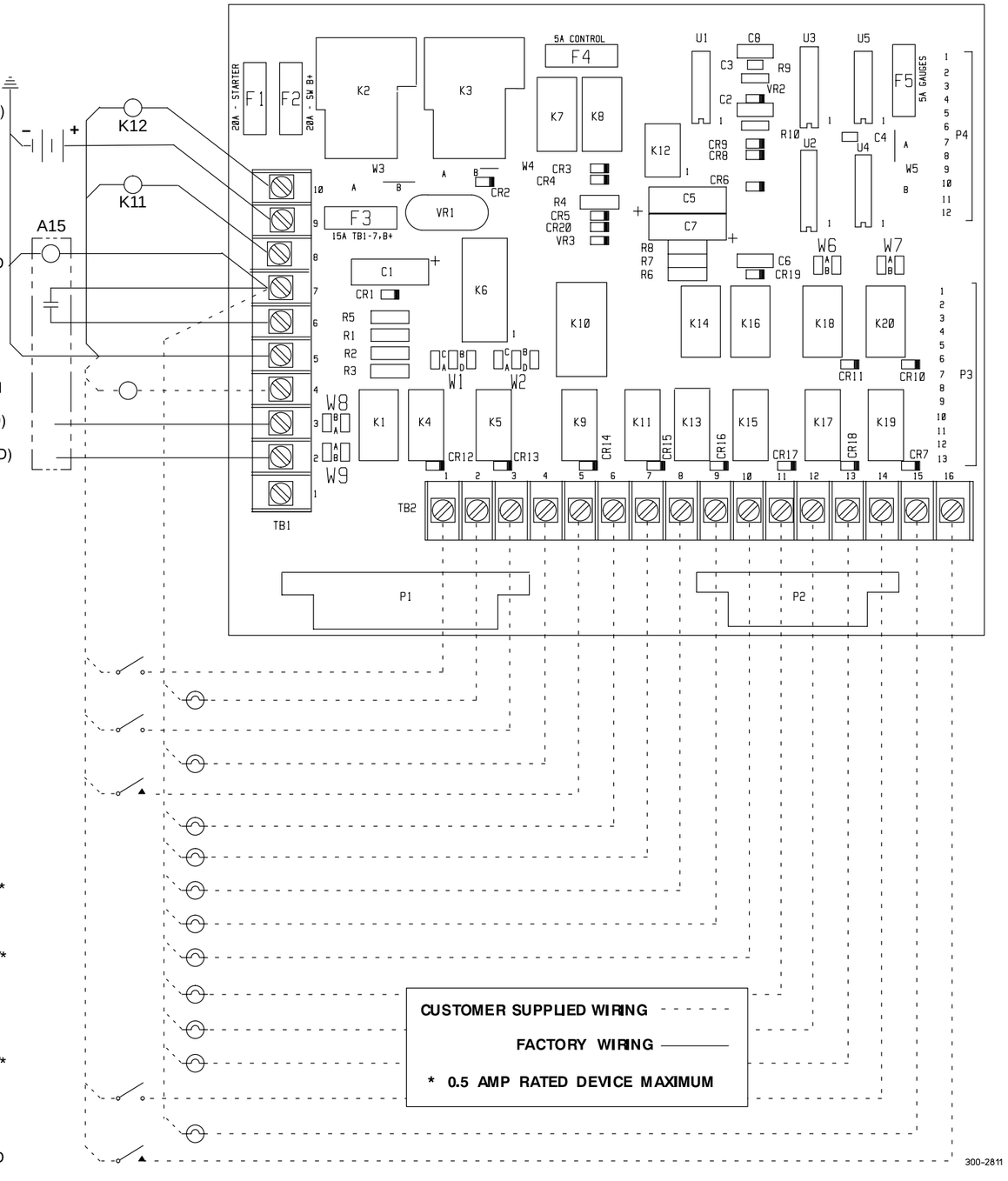
**TB2-12 (SWITCH OFF WARNING)** GROUND OUTPUT TO LIGHT/RELAY*

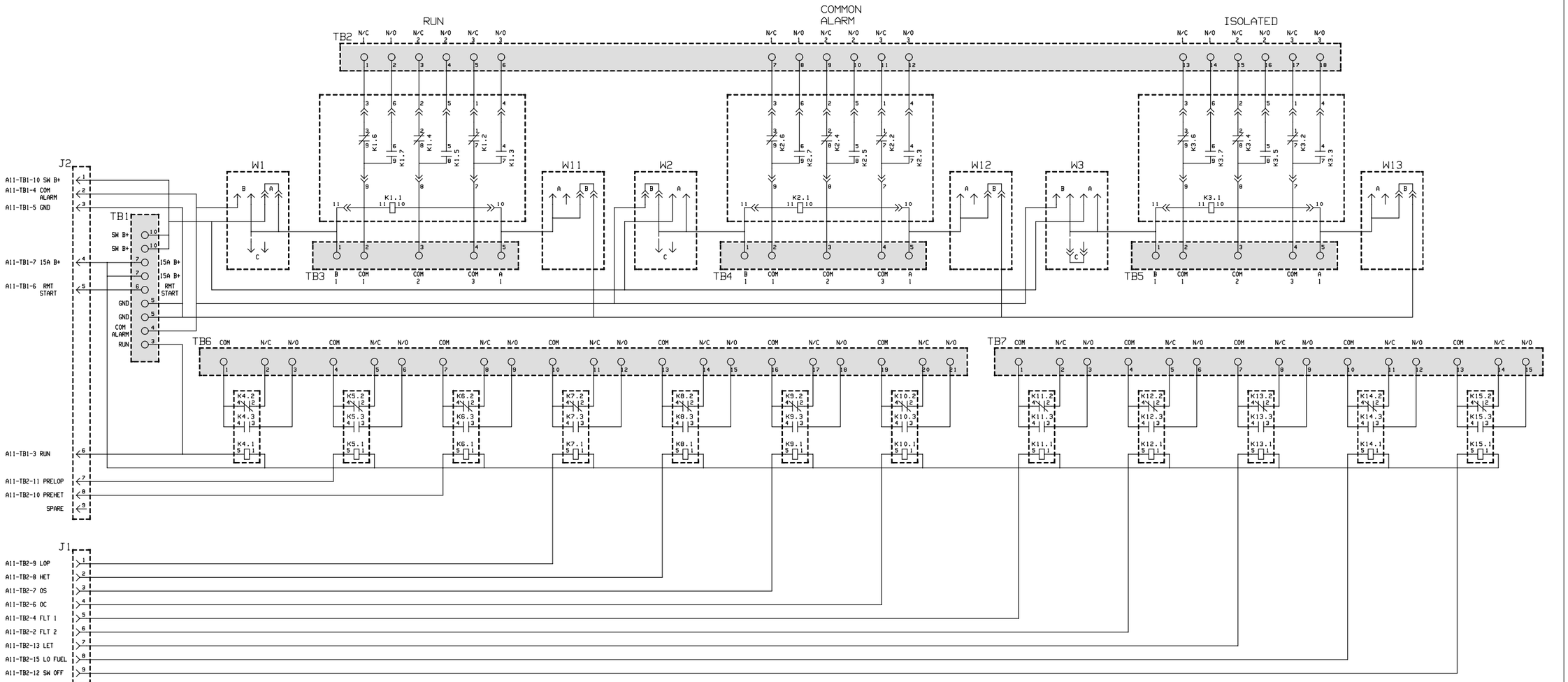
**TB2-13 (LOW ENGINE TEMPERATURE WARNING)** GROUND OUTPUT TO LIGHT/RELAY*

**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

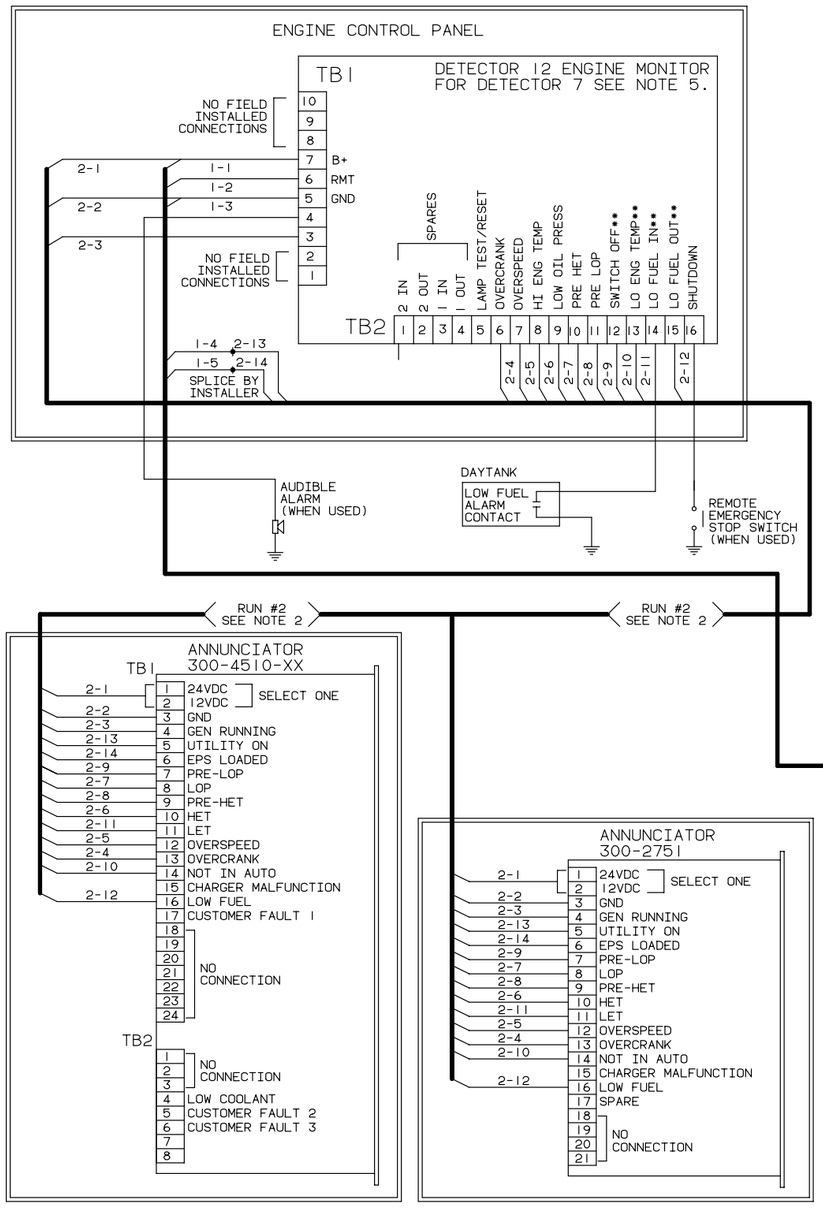




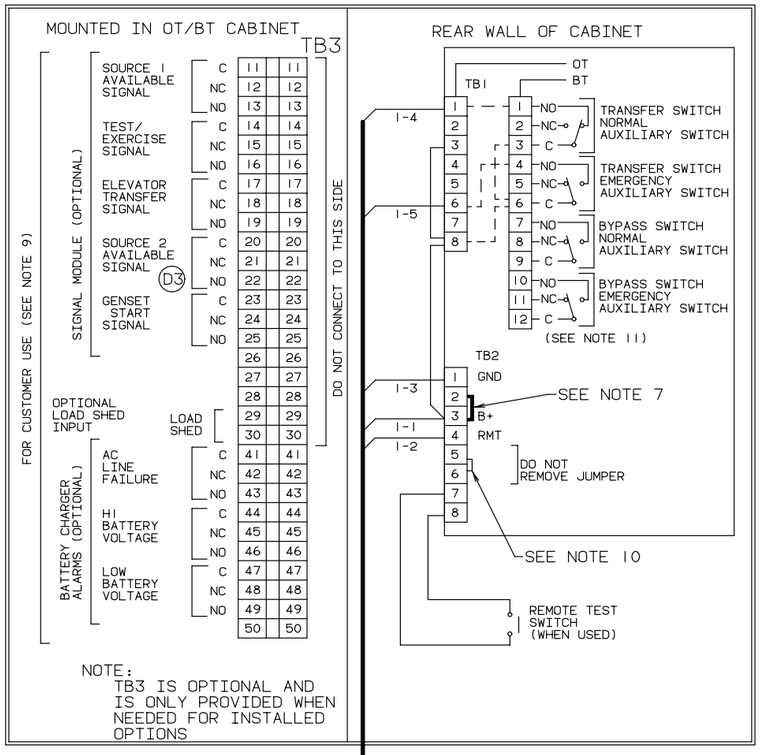

THE TERMINALS IN THE SHADED BOXES ARE FOR CUSTOMER CONNECTIONS

**CUSTOMER CONNECTINS AT THE AUXILIARY RELAY BOARD (DETECTOR CONTROL)**

## GENERATOR SET WITH DETECTOR 7 OR DETECTOR 12 CONTROL




## OT & BT 2 WIRE START UTILITY TO GENSET










| WIRE SIZE (AWG) | DISTANCE IN FEET, ONE WAY (MULTIPLY BY 0.3 FOR METERS) | | |
|---|---|---|---|
| | A | B | C |
| 16 | 1000 | 125 | 25 |
| 14 | 1600 | 200 | 40 |
| 12 | 2400 | 300 | 60 |
| 10 | 4000 | 500 | 100 |

NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS 1-1, -2, -3, -4, -5 USE COL. A
   WITH 2 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. B
   WITH 10 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. C
2. RUN #2-GENSET TO ANNUNCIATOR-ALL LEADS, USE COL. A
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4. INCLUDES EN AND ENTX. FOR ENT, SEE SHEET 4.
5. INCLUDES DL SERIES WITH 7 LIGHT OR 12 LIGHT MONITOR BOARD. FOR 9 LIGHT MONITOR BOARD, SEE SHEET 2. (D6)
6. FUNCTIONS INDICATED BY ** ARE NOT INCLUDED IN THE DETECTOR 7 CONTROL. JUMPER TB2-14 TO TB2-15 FOR LOW FUEL ALARM.
7. INSTALL JUMPER BETWEEN TB2-2 & TB2-3.
8. 300-4510-XX ANNUNCIATOR MAY BE USED ALSO. WIRE TB1 AS SHOWN.
9. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
10. WHEN CONNECTING A REMOTE SIGNAL TO THE TRANSFER INHIBIT CIRCUIT. THE INSTALLER MUST USE A TWISTED PAIR OF WIRES WITH A SHIELDED GROUND.
11. TRANSFER SWITCH SHOWN CLOSED TO NORMAL BYPASS SWITCH SHOWN IN NEUTRAL POSITION.

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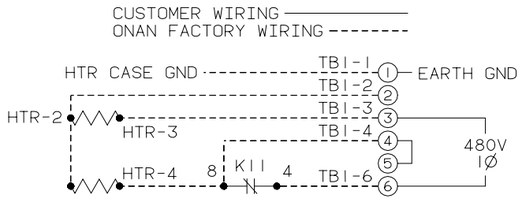
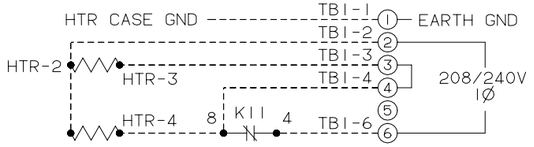



AC POWER SCHEMATIC

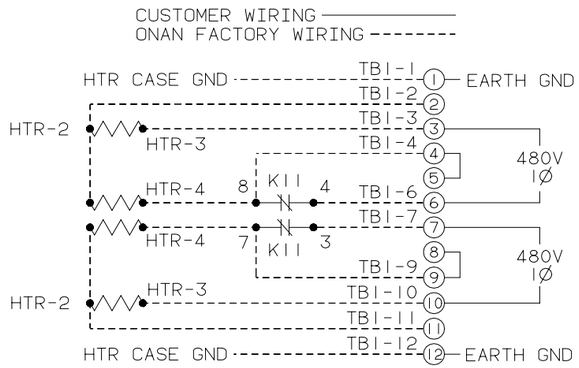
**STANDARD 480V CONNECTION FACTORY WIRED**




AC POWER SCHEMATIC
208/240V CONNECTION OPTIONAL

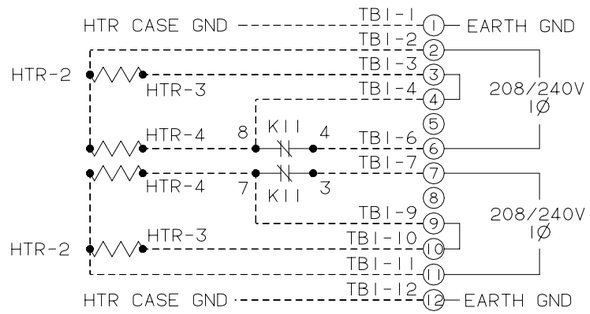
| HEATER AMPERAGE TABLE | | |
|---|---|---|
| SINGLE PHASE HEATER VOLTAGE | FEATURE CODE H556 4300W NOM HEATER | FEATURE CODE H557 5600W NOM HEATER |
| | AMPS | AMPS |
| 208 | 18.0 | 23.2 |
| 240 | 20.8 | 26.8 |
| 480 | 10.4 | 13.4 |

**SINGLE COOLANT HEATER DIAGRAM**




AC POWER SCHEMATIC

**STANDARD 480V CONNECTION FACTORY WIRED**




AC POWER SCHEMATIC
208/240V CONNECTION OPTIONAL

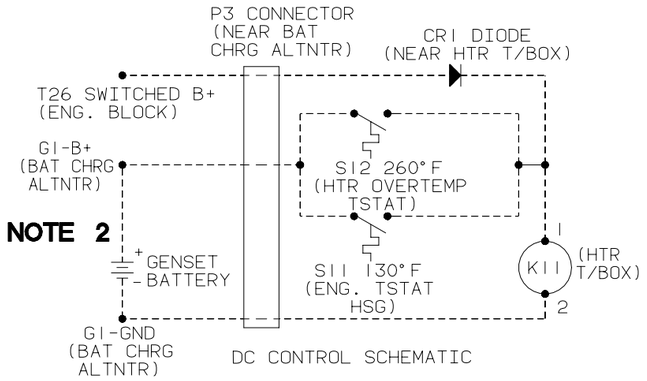
| HEATER AMPERAGE TABLE | | | | |
|---|---|---|---|---|
| SINGLE PHASE HEATER VOLTAGE | FEATURE CODE H556 TWO,4300W NOM HEATERS | | FEATURE CODE H557 TWO,5600W NOM HEATERS | |
| | PER HTR AMPS | TOTAL AMPS | PER HTR AMPS | TOTAL AMPS |
| 208 | 18.0 | 36.0 | 23.2 | 46.4 |
| 240 | 20.8 | 41.6 | 26.8 | 53.6 |
| 480 | 10.4 | 20.8 | 13.4 | 26.8 |

**DUAL COOLANT HEATER DIAGRAM**

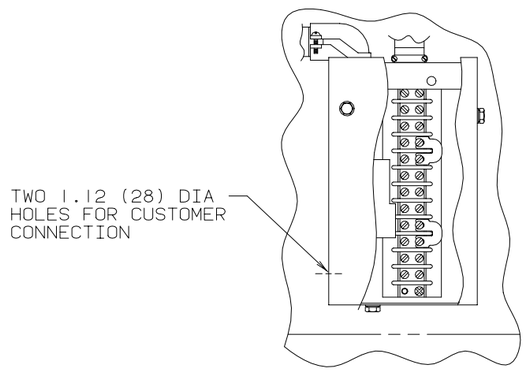
NOTES:

1. THE HEATER CONTROL RELAY DRAWS 83 mA OF CURRENT WHEN THE HEATERS ARE UNPOWERED. HEATERS ARE NOT POWERED WHEN:
   1) THE ENGINE HAS REACHED DESIGN TEMPERATURE OR
   2) THE ENGINE IS RUNNING.

⚠ **A BATTERY CHARGER IS REQUIRED TO PREVENT BATTERY DISCHARGE.**




DC CONTROL SCHEMATIC




DETAIL OF HEATER
TERMINAL BOX

**SINGLE/DUAL COOLANT HEATER DIAGRAMS**

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**SINGLE/DUAL HEATER WIRING DIAGRAM**

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



Power Generation