Installation Manual

Our energy working for you.™

Power Generation

Generator Set
with PowerCommand® 3201 Controller

DQGAA (Spec A–C)
DQGAB (Spec A–C)

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SAFETY PRECAUTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions that should be followed during installation and maintenance of the generator set 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 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. To prevent severe scalding, let engine cool down before removing coolant pressure cap. Turn cap slowly, and do not open it fully until the pressure has been relieved.
- 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 or combustible material are not left on or near the generator set.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under or near 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 near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator system, turbo charger system and exhaust system.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

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 DOES NOT provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), additional information is required. Review standard installation practices. For engineering data specific to the generator set, refer to the *Specification* and *Data Sheets*. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets".

INSTALLATION OVERVIEW

These installation recommendations apply to typical installations with standard model generator sets. Whenever possible, these recommendations also cover factory designed options or modifications. However, because of the many variables in any installation, it is not possible to provide specific recommendations for every situation. If there are any questions not answered by this manual, contact your nearest Cummins Power Generation distributor for assistance.

Application and Installation

A 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 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 or other trained specialists are responsible for the design of the complete power system and for selecting the materials and products required.

Installation refers to the actual set-up and assembly of the 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 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.

Standby Heating Devices

In accordance with NFPA 110, Cummins Power Generation recommends installing diesel standby generator sets (life safety systems) equipped with engine jacket water coolant heaters in locations where the minimum ambient temperature is above 40°F (4°C). NFPA also requires that the engine be heated as necessary to maintain the water jacket temperature determined by the manufacturer for cold start and load acceptance for the type of system. Although most Cummins Power Generation generator sets will start in temperatures down to –25°F (–32°C) when equipped with engine jacket water coolant heaters, it might take more than 10 seconds to warm the engine before a load can be applied when ambient temperatures are below 40°F (4°C).

The **Engine Cold (Code 1435)** message, in conjunction with illumination of the Warning LED, is provided to meet the requirements of NFPA 110. The engine cold sensing logic initiates a warning when the engine jacket water coolant temperature falls below 70°F (21°C). In applications where the ambient temperature falls below 40°F (4°C), a cold engine may be indicated even though the coolant heaters are connected and operating correctly. Under these conditions, although the generator set may start, it may not be able to accept load within 10 seconds. When this condition occurs, check the coolant heaters for proper operation. If the coolant heaters are operating properly, other precautions may be necessary to warm the engine before applying a load.

Product Modifications

Agency certified products purchased from Cummins Power Generation comply only with those specific requirements and as noted on company product specification sheets. Subsequent modifications must meet commonly accepted engineering practices and/or local and national codes and standards. Product modifications must be submitted to the local authority having jurisdiction for approval.

2. Specifications

MODEL	DQGAA, DQGAB
Cummins Diesel Series	QSK50 (50/60 Hz)
Generator Kw Rating	See Genset Nameplate for rating information.
Cooling System (Capacity Std. Raidiator) – Gal (L)	143 (541)
Lubricating System Oil Cap. w/Filters Oil Type*	61.0 Gallons (231 L)
Engine Fuel Connection Inlet/Outlet Thread Size	Refer to Generator Outline Drawing
Fuel Flow Max. Fuel Inlet Restriction Max. Fuel Return Restriction	8 in. Hg. (203.2 mm Hg) 8 in. Hg. (203.2 mm Hg)
Exhaust Outlet Size Maximum Allowable Back Pres. Exhaust Flow at Rated Load Exhaust Temperature	Refer to Generator Outline Drawing 27 in. H_2O (6.71 kPa) 12065 cfm (342 m^3/min) 915.0° F (491.0° C)
Electrical System Starting Voltage Battery Group Number CCA (minimum) Cold Soak @ 0°F (-18° C)	24 Volts DC Four, 12 Volt 8D 1400
* Refer to Cummins engine *Owners Manual* for lubricating oil recommendations/specifications.	

FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)

MODEL	DQGAA	DQGAB
US gph (L/hr)	92.7 (350.9)	109.4 (414.1)

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3. Mounting the Generator Set

GENERAL

Generator set installations must be engineered so the generator set will function properly under the expected load conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire ordinances, and other applicable regulations. A typical generator set installation is shown in Figure 3-1.

Requirements to be considered prior to installation:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of generator set air
- Discharge of exhaust gases
- Non-combustible mounting surface.
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation

⚠ CAUTION ***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 9 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 breaker box. 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.

⚠ 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.

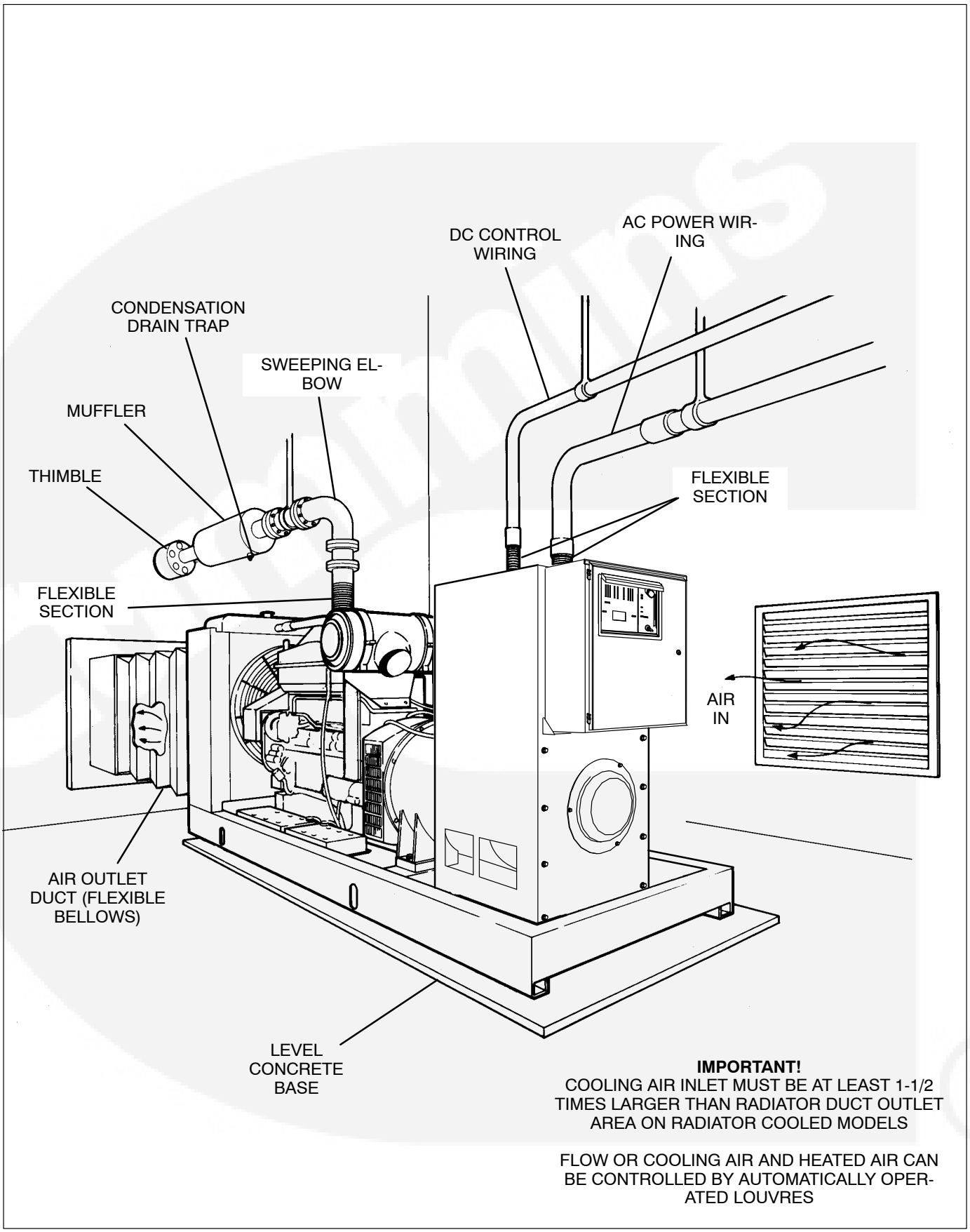

FIGURE 3-1. TYPICAL INSTALLATION

MOUNTING

Generator sets are mounted on a steel skid that provides proper support. The engine-generator assembly is mounted directly to this steel skid. Vibration isolation between the steel skid-base and the supporting structure is always required, whether that supporting structure is a foundation, building, or sub-base fuel tank.

Note: The use of unapproved isolators may result in harmful resonances and may void the generator set warranty.

For fuel tank mounted generator sets, it is required that the tank be mounted such that an air space is provided between the bottom of the tank and the floor underneath to reduce corrosion and permit visual inspections for leaks.

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 using a flat washer and hexagonal nut for each bolt (see Figure 3-2). 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*.

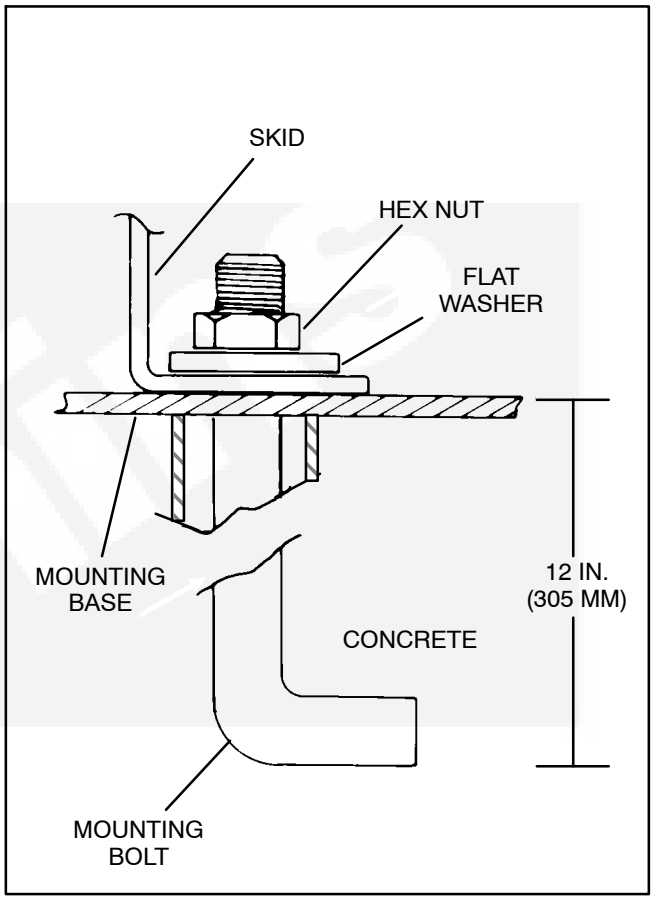

FIGURE 3-2. BOLT DIAGRAM

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. 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.

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.

   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 (see Section 9).

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 must remain loose and therefore provide better isolation between the genset and support structure.

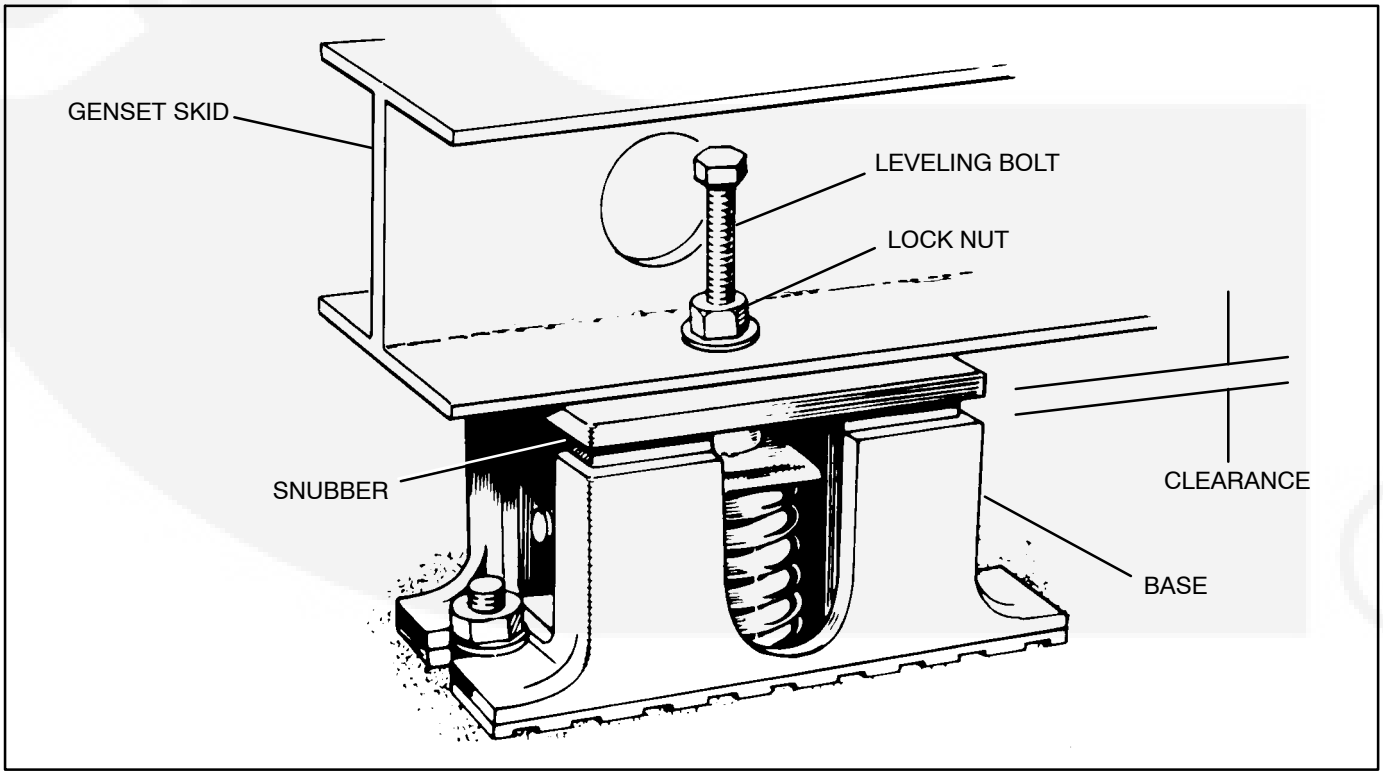

FIGURE 3-3. VIBRATION ISOLATORS

ALIGNING GENERATOR WITH ENGINE

Proper alignment of the generator and engine assemblies is necessary to avoid premature wear and improper operation of the genset. It is suggested that the *angular alignment* of the generator set be checked before initial start-up.

Review the following alignment conditions and procedures for aligning the generator assembly to engine flywheel housing.

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: 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 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 disks is measured.

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

Note: Axial misalignment should be checked only when an objectionable vibration is present.

Either type of 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.

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.

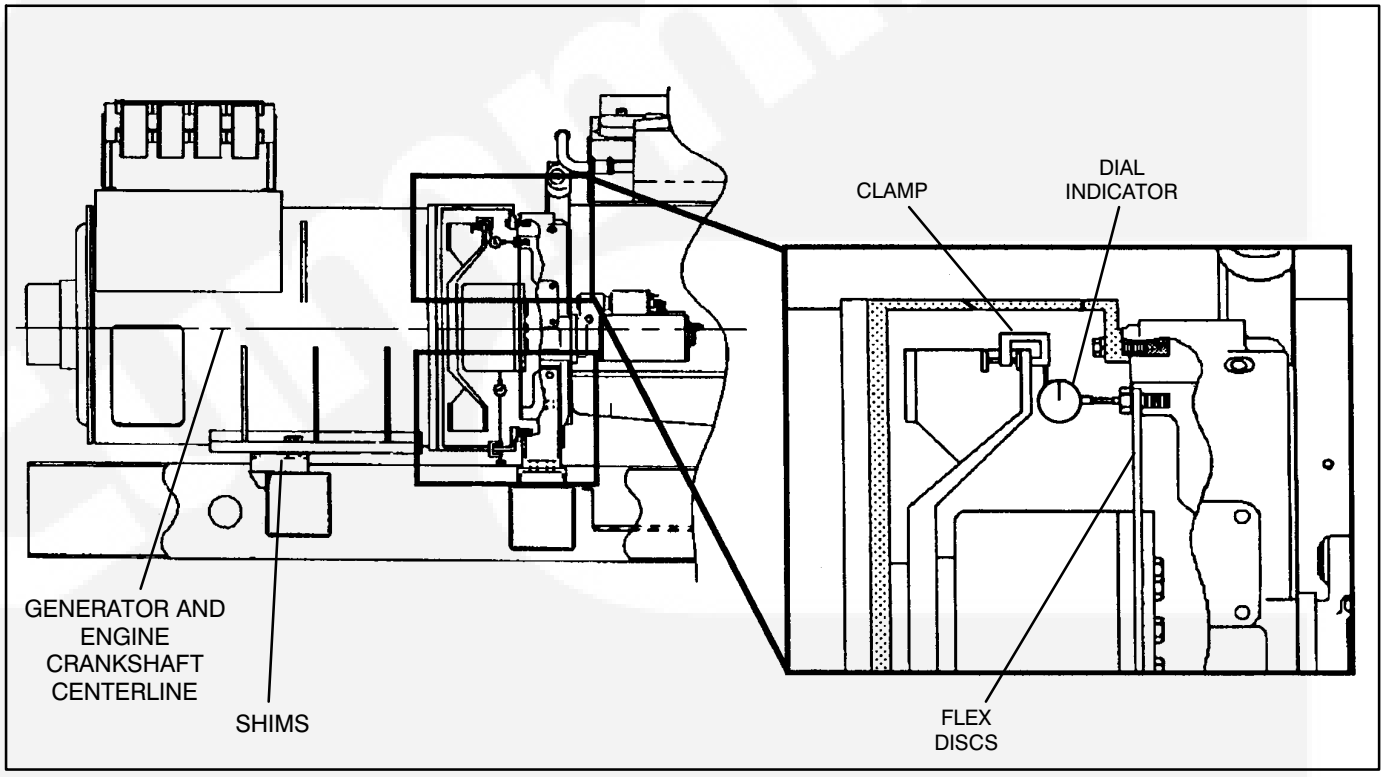

FIGURE 3-4. ANGULAR ALIGNMENT MEASUREMENT

Sample Generator Runout Readings

When taking the deflection readings described, make a diagram similar to the example shown in Figure 3-5, where the total indicator reading is .025". (The highest positive value of +.010 and the largest negative value of -.015".) The indicator is closer at 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 the four 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 the four mounting feet of the generator.)

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", 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.)

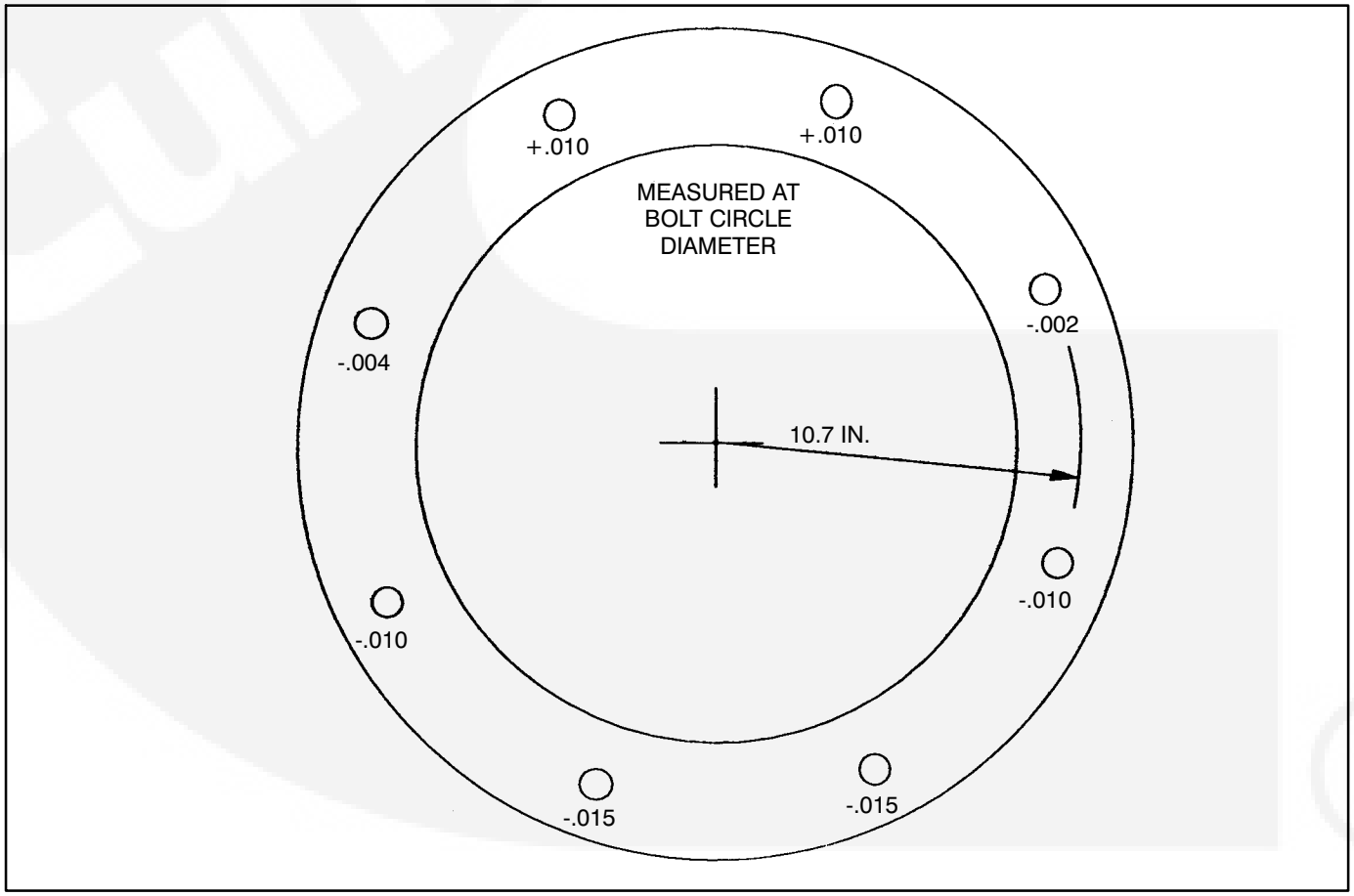

FIGURE 3-5. ANGULAR ALIGNMENT MEASUREMENT READINGS (Example)

HC4–7 Axial Alignment Procedure

Note: 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 axes.

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 6-18. 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", 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 mountain hub.

The goal of the Axial realignment 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 the 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.

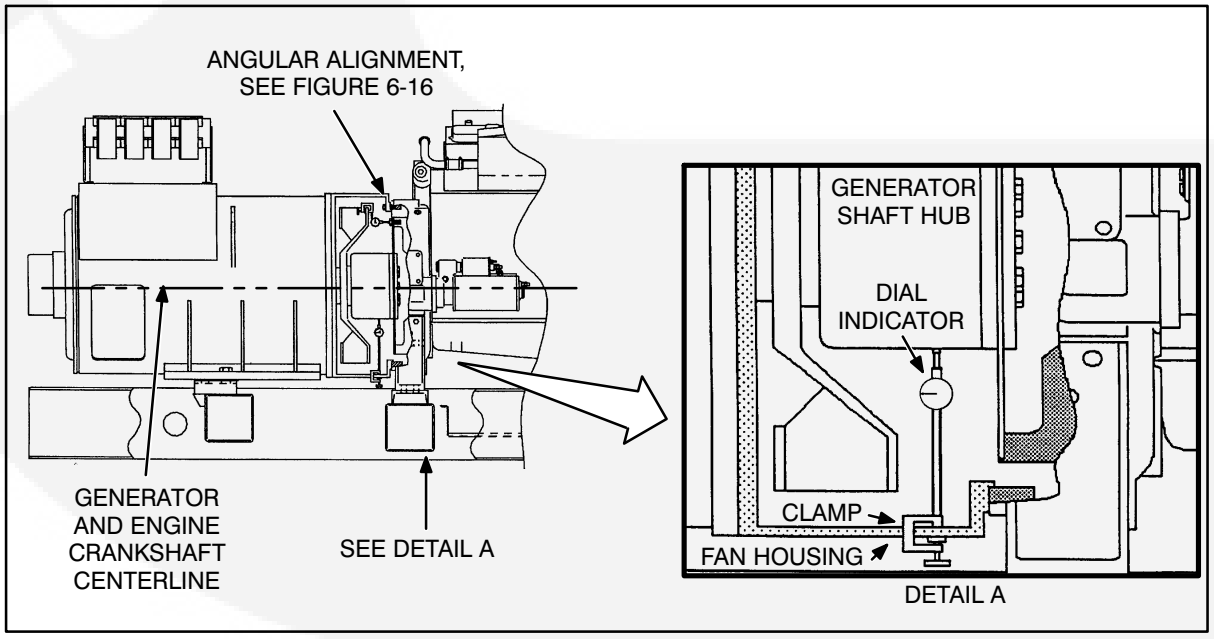

FIGURE 6-18. HC4–7 AXIAL ALIGNMENT MEASUREMENT

P7 Axial Alignment Procedure

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

If excessive vibration remains after the angular alignment, concentric alignment of the generator shaft/engine crankshaft axes may be at fault.

The goal of the axial realignment is to reduce the vibration level of the genset while it is operating. A small improvement in the axial alignment may have dramatic effects in the measured or physically observed vibration levels.

To correct for possible axial misalignment, 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 two bolt holes from their original location. Put the drive discs capscrews back in and retorque. Recheck/record vibration levels as before. Repeat this test until the drive discs holes are repositioned 180 degrees from their original location.

Review vibration data and position drive disc in lowest recorded level location.

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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 *Owners 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.

Note: 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 all 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.

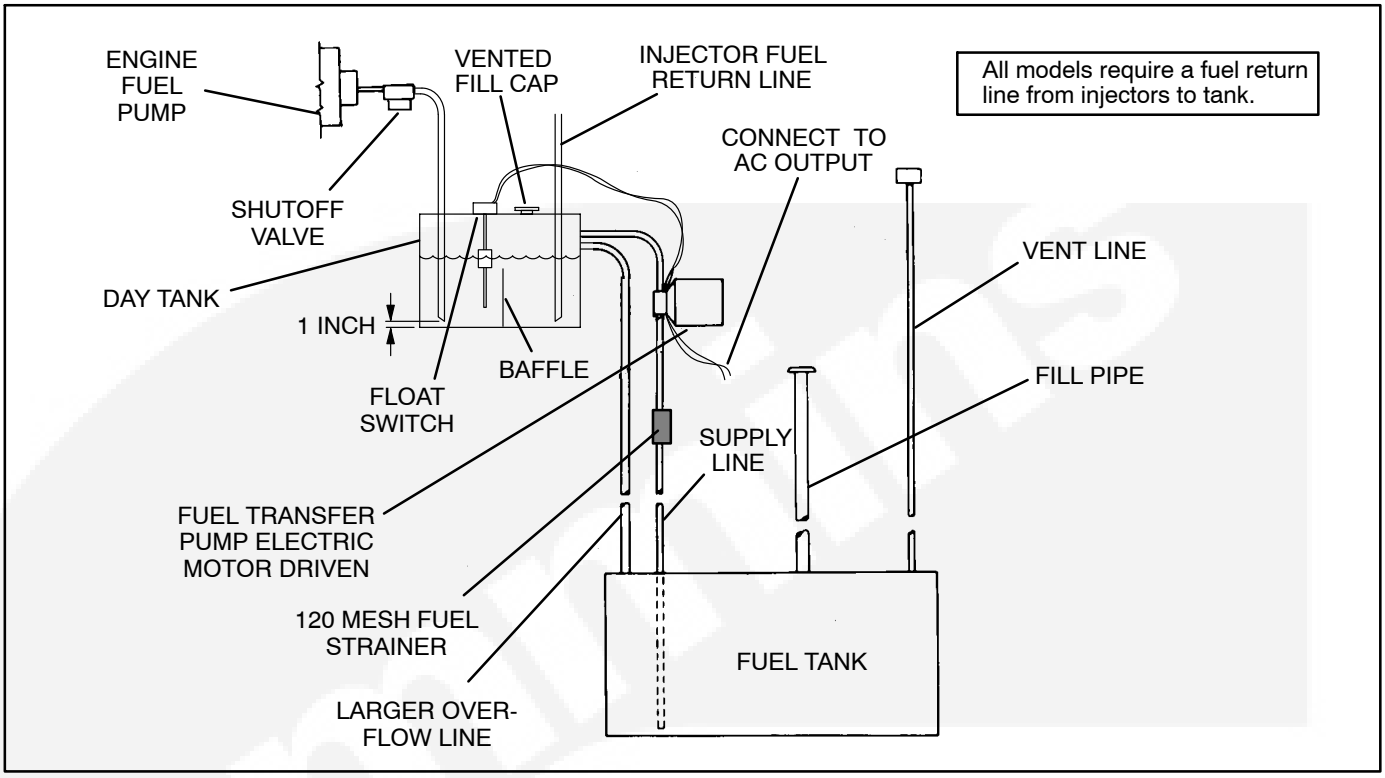

FIGURE 4-1. TYPICAL FUEL SUPPLY INSTALLATION

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 (sometimes 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.

Note: 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 not running, 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 a fuel transfer pump, to pump fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the fuel transfer pump.

Note: When using a fuel transfer 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: With this installation, the day tank is installed near the generator set, below the fuel injection system and within the fuel inlet restriction limit. Include a automatic fuel 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.

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.

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

Fuel Filter Installation

This section describes the installation procedures for the fuel filter. Read these instructions thoroughly and become familiar with safety warnings, cautions and procedures before starting the installation.

⚠CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. Service personnel may be required to correct fault.***

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

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

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

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

⚠WARNING ***Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke or allow any flame, spark, pilot light, arc-producing equipment, electrical switch or other ignition source around fuel or fuel components, or in areas sharing ventilation. Keep a type ABC fire extinguisher handy.***

1. Press the Emergency Stop button and wait at least 30 seconds.

   ⚠CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. Service personnel may be required to correct fault.***

2. Place O/Manual/Auto switch in O (Off) position.
3. Turn off and disconnect battery charger (if equipped).
4. Disconnect the negative (–) cable from the battery to prevent accidental starting.

Note: See Figure 4-2 for installation site of fuel filter on the generator set.

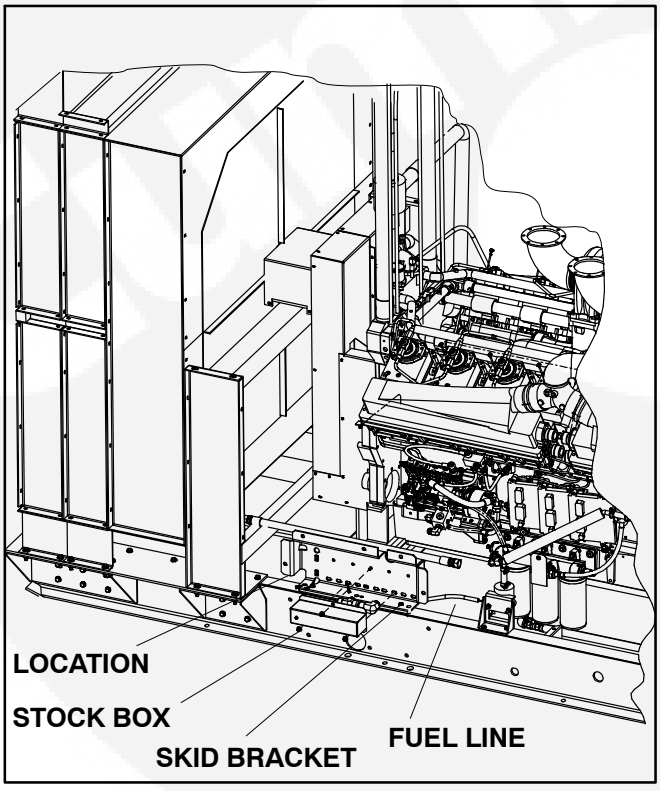

FIGURE 4-2. FUEL FILTER ASSEMBLY LOCATION ON GENERATOR SET

5. **For new installations** – Remove the cap from the fuel inlet port of engine.

   For existing installations – Make sure fuel shutoff valve is closed (if equipped) and remove fuel hose from fuel inlet port. Use container to collect any fuel in system.

6. **Wall Mount -** Continue with Step 8.
7. **Skid Mount -** Refer to Figure 4-4 for installation diagram. In the following procedure, numbers in parentheses refer to the item numbers in Figure 4-4.

   a. Remove skid bracket and fasteners currently mounted to skid. Keep the bracket, but discard the fasteners and stockbox.

   Note: See Figure 4-5 for Fuel Filter Bracket drawing and its measurements.

   b. Disassemble the fuel filter assembly from the black bracket and discard the black bracket.

   c. Install the skid bracket removed in step 7a to the fuel filter assembly using screw (6) and flat washer (7). Check connections to ensure tightness.

   d. Install the priming pump with bolts as illustrated in Figure 4-3 (Item A).

   e. Place fuel filter (3) spacer on skid where bracket will sit using hardware 7 and 8. See Section A-A of Figure 4-4 for details.

   f. Secure fuel filter assembly to skid bracket (2) using hardware (9, 10, 11 and 12 as illustrated in Figure 4-4). Flat washer (9) and 3/8 -16 nut (10) should be installed at the back-side of skid to secure mounting bracket and fuel filter assembly to the skid.

   g. Bolt bracketed assembly to skid using hardwares 9, 10, 11, and 12 as illustrated in Fig. 4-4.

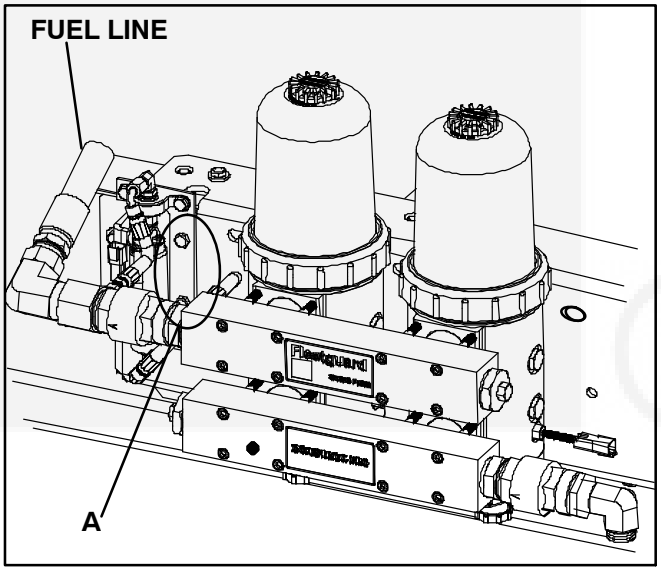

FIGURE 4-3. DUAL HEAD FUEL FILTER

8. Thread tube elbow (4) into fuel filter assembly. Position elbow as shown.
9. Install the reducer (13) at the checkvalve using thread sealant (6).
10. Install the tube elbow into fuel filter as shown in Customer Installation drawing in Figure 4-4. Position elbow as shown.
11. Connect the fuel line (5) and fuel inlet hose.
12. Connect the wire harness.
13. Connect the negative (–) cable to the battery.
14. Connect the battery charger (if applicable).
15. Open fuel shutoff valve (if applicable).
16. Prime the fuel system. Operate the set to check for fuel leaks. Do not place the set in service until all fuel leaks have been fixed.

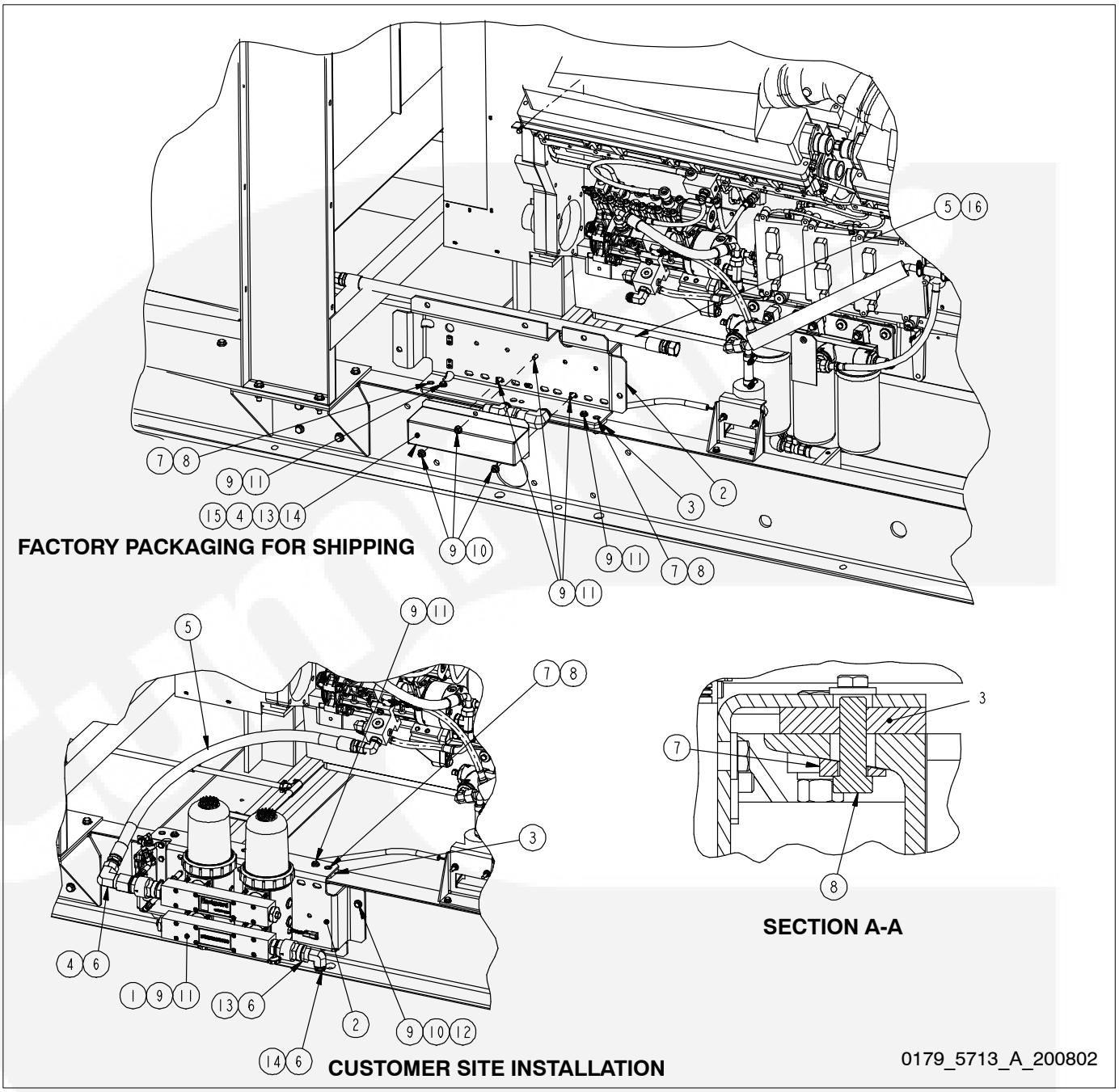

FIGURE 4-4. FUEL FILTER ASSEMBLY LOCATION

ITEM	QTY.*	DESCRIPTION	ITEM	QTY.*	DESCRIPTION
1	––	FUEL FILTER (INCLUDED)	3	1	FUEL FILTER SPACER
2	1	FUEL FILTER BRACKET (1/4 IN. THICK)	4	1	TUBE ELBOW

(Item identification table cont'd on next page...)

(Cont'd. from previous page...)

ITEM	QTY.*	DESCRIPTION	ITEM	QTY.*	DESCRIPTION
5	1	FUEL LINE	12	5	SCREW (3/8 - 16NC x 1.5)
6	AR	THREAD SEALANT	13	1	REDUCER
7	5	BEVEL WASHER	14	1	TUBE ELBOW (1" NPT–1 3/16 ORFS)
8	5	HEX HEAD CAP SCREW (1/2 - 13NC x1.5)	15	1	STOCK BOX (DISCARDED)
9	27	FLAT WASHER (3/8)	16	4	CABLE TIE
10	5	NUT (3/8 - 16UNC)	17	––	FUEL FITER HARNESS ACCESSORY (INCLUDED WITH ENGINE)
11	16	SCREW (3/8 - 16NC x 1)	–––	–––	–––––––

* Number reflects quantity for all items used for both factory packaging to be shipped and what is required for customer site installation.

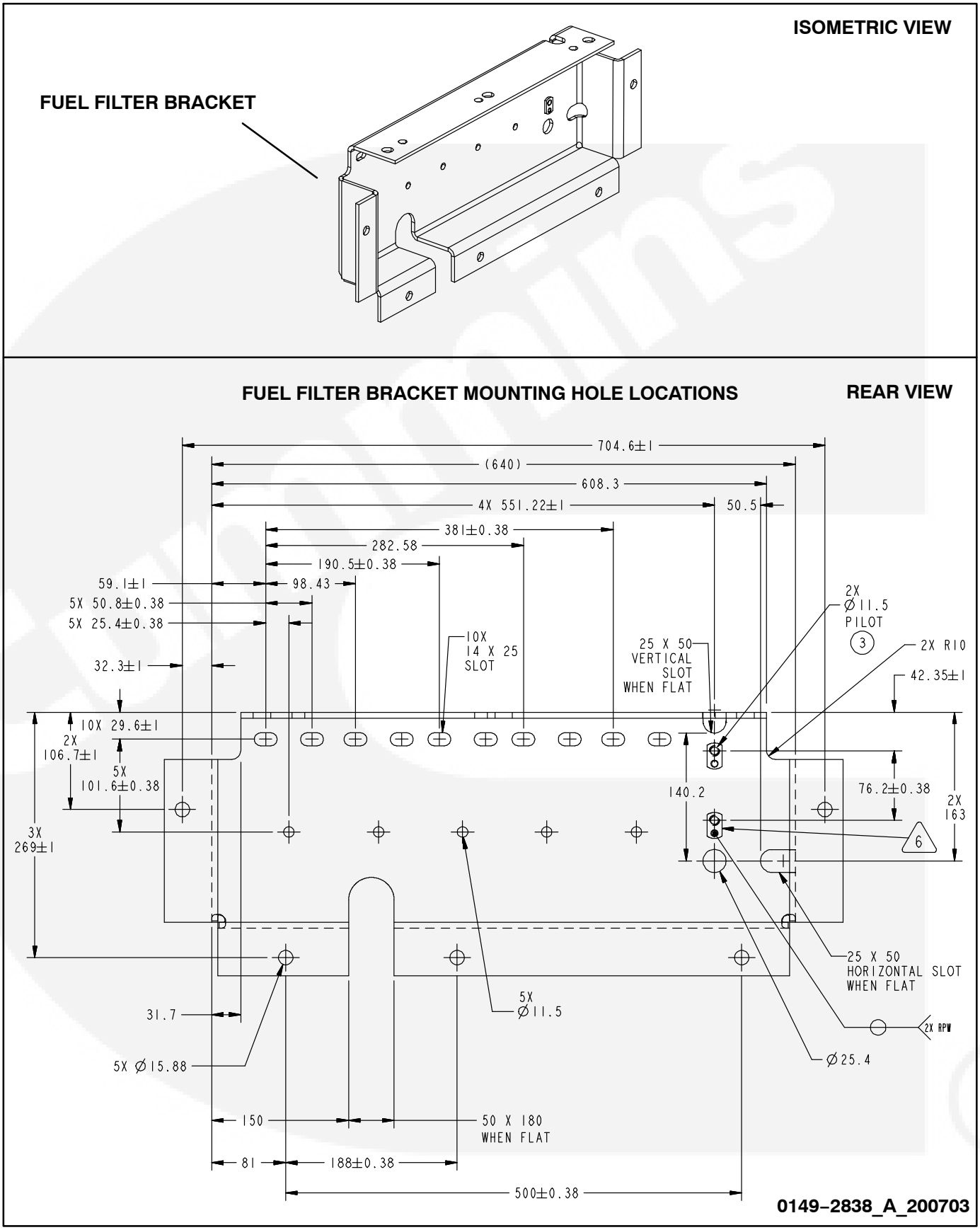

FIGURE 4-5. FUEL FILTER BRACKET

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 tight 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 4-6) 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.

Note: 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 4-7).

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.***

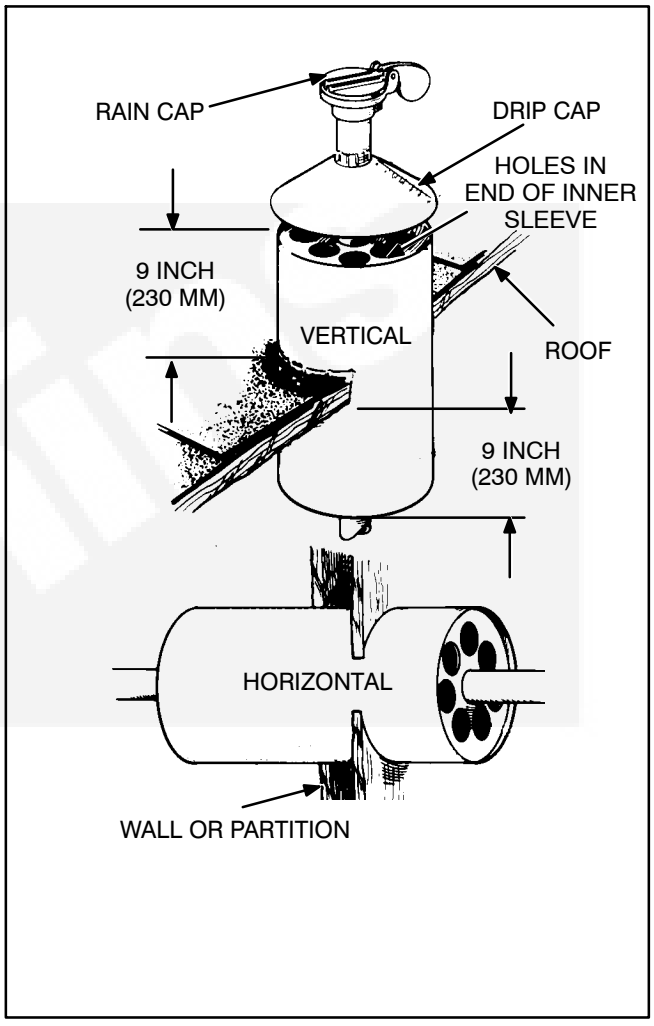

FIGURE 4-6. MOUNTING EXHAUST THIMBLE

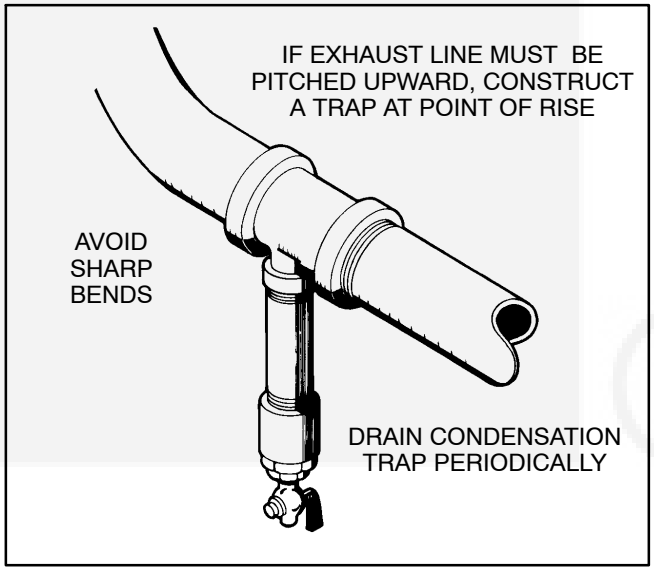

FIGURE 4-7. CONDENSATION TRAP

VENTILATION AND COOLING

Generator sets create considerable heat that must be removed by proper ventilation. Outdoor installations normally rely on natural air circulation but indoor installations need properly sized and positioned vents for required airflow.

Vents and Ducts

For indoor installations, locate vents so incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement.

Size the vents and ducts so they are large enough to allow the required flow rate of air. The ”free area” of ducts must be as large as the exposed area of the radiator. Refer to the 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, or if outlet vent cannot be located as mentioned, install wind barrier. See Figure 4-8.

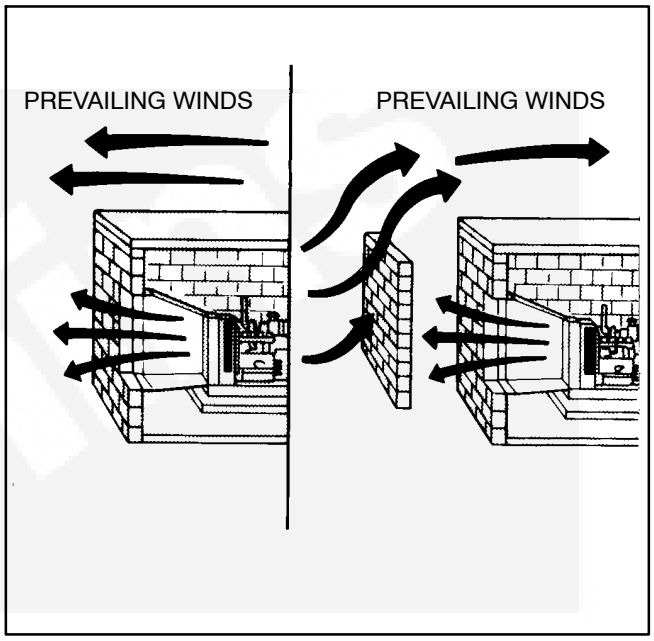

FIGURE 4-8. WIND BARRIER

Dampers

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

In cold climates, the radiator exhaust air can be recirculated to modulate the ambient air temperature in the generator set room. This will help the generator set warm up faster, and help to keep fuel temperatures higher than the cloud point of the fuel. If recirculation dampers are used, they should be designed to “fail closed”, with the main exhaust dampers open, so that the generator set can continue to operate when required. Designers should be aware that the generator set room operating temperature will be very close to the outdoor temperature, and either not route water piping through the generator set room, or protect it from freezing.

Radiator Set Requirements

Note: 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.

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

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

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

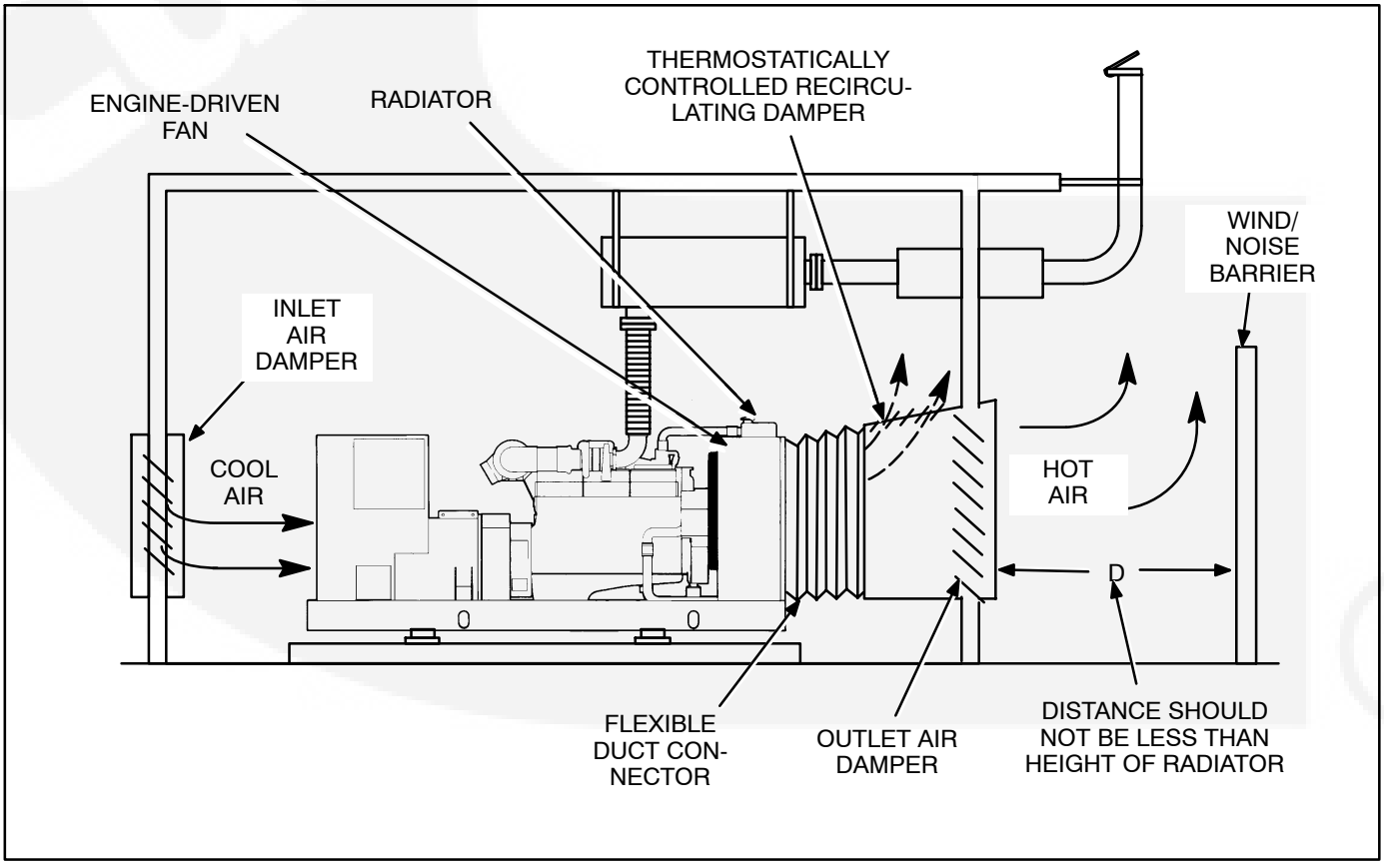

FIGURE 4-9. TYPICAL RADIATOR SET INSTALLATION

Remote Radiator Cooling (Optional) substitutes a remote mounted radiator and an electrically driven fan in place of genset mounted components. Removal of the radiator and the fan from the genset 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.

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

Engine Coolant Heater (Optional)

An optional 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.

Heat Exchanger (Optional)

The optional heat exchanger (Figure 4-10) 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.

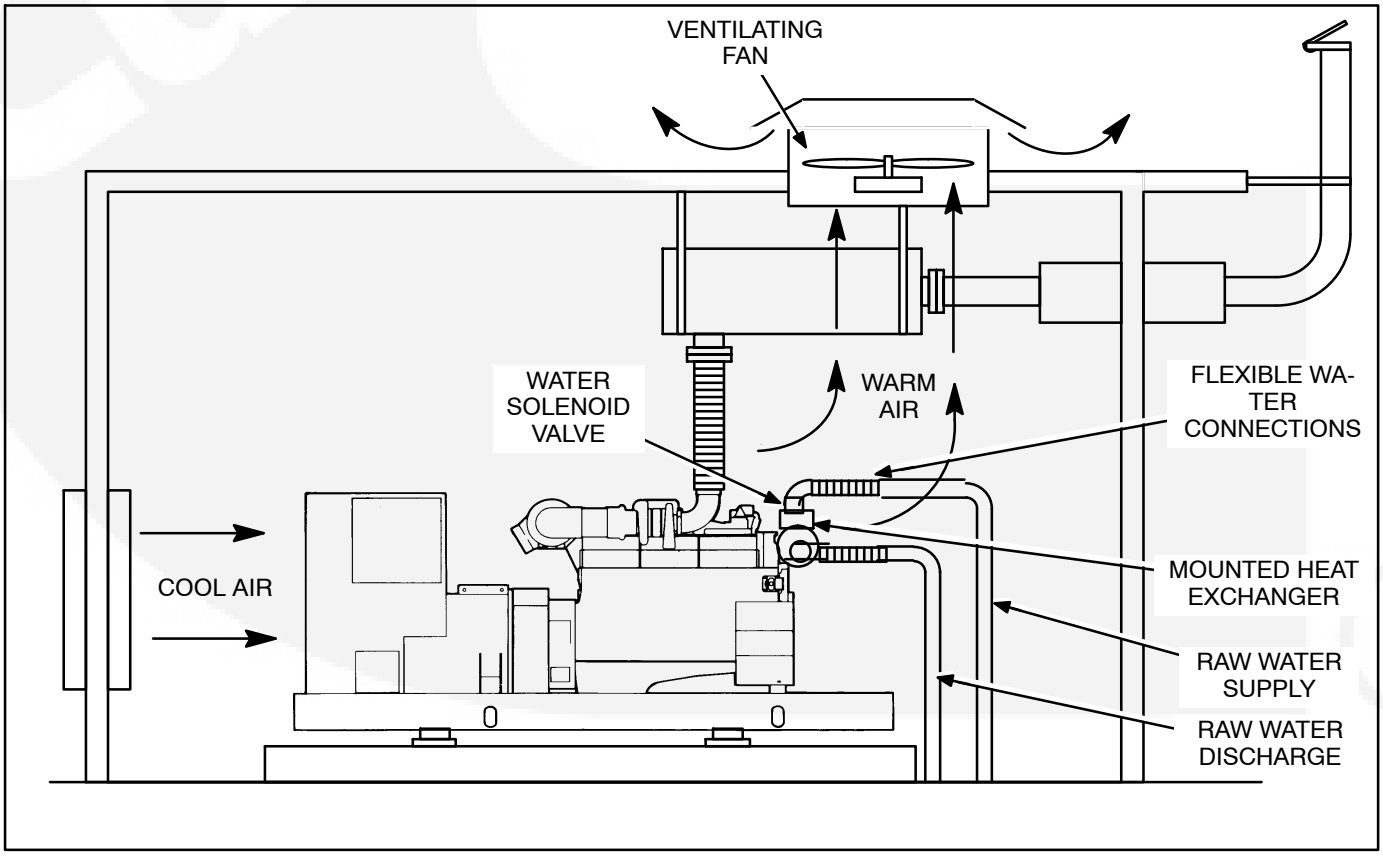

FIGURE 4-10. TYPICAL HEAT EXCHANGER INSTALLATION

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5. DC Control Wiring

CONTROL WIRING

The generator set control box assembly (Figure 5-1), contains connection points for remote control and monitor options.

⚠ CAUTION ***Do not attach conduit to the control box assembly for any reason. All conduit must be attached to the control housing. Attaching conduit to the control box assembly will compress the control box vibration isolators, causing the box to vibrate and damage the electronic circuitry.***

Use flexible conduit for all wiring connections to the generator set. All conduit used for control wiring must be attached to the control housing, not to the control box assembly. Route the control wiring through the control housing and into the access hole on the back panel of the control box assembly (Figure 5-2). Use cable ties to keep control wiring away from sharp edges and AC power cables within control housing.

After completing all customer connections (wires routed and secured), heat shrink the boot that is located on backside of access hole, until sealed.

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

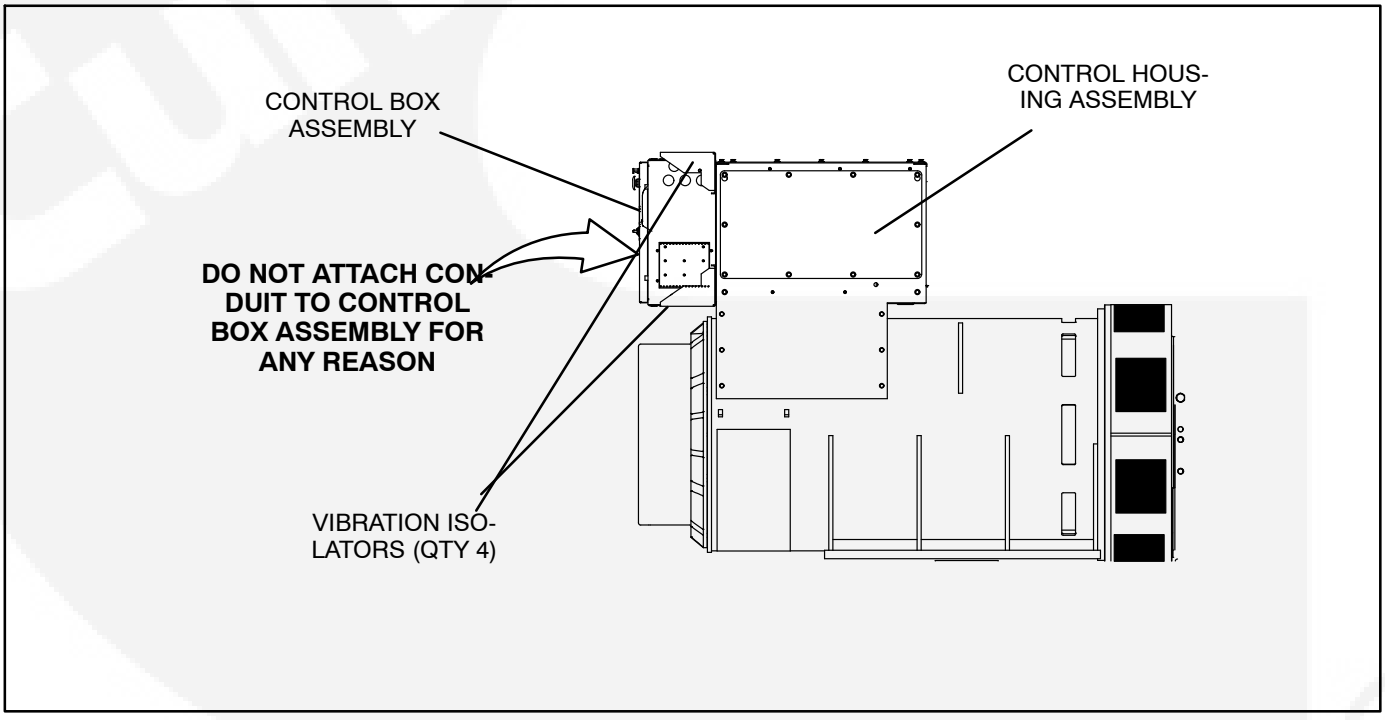


FIGURE 5-1. CONTROL BOX – REAR MOUNT

REMOTE MONITOR/CONTROL CONNECTIONS

Customer monitor/control connections are attached to terminal blocks TB3 and TB8 (see Figure 5-2). Optional equipment such as a remote annunciator panel, sensing devices used to monitor genset operation, remote start/stop switches, control box heater, and etc. are also attached to these terminal blocks. Driver signals for customer supplied relays are also provided for several alarm and shut down conditions. Refer to Customer Connections diagram in Section 10.

⚠ CAUTION ***When removing terminal block connector TB8 from Base card, note orientation of connector. This terminal block connector is not keyed and can be installed incorrectly, which will cause control failures.***

Terminal Block 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 the terminal blocks. 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 terminal blocks, the electrical contractor must determine the gauge of the **stranded copper** wire that is used at this installation site. Refer to Customer Connections diagram in Section 10 for the relay specifications.

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

Delayed Switched B+: (Fused at 10 amps. with a 10 second dropout) Use for external fuel shut-off solenoid. Same as Relay Connection description.

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

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

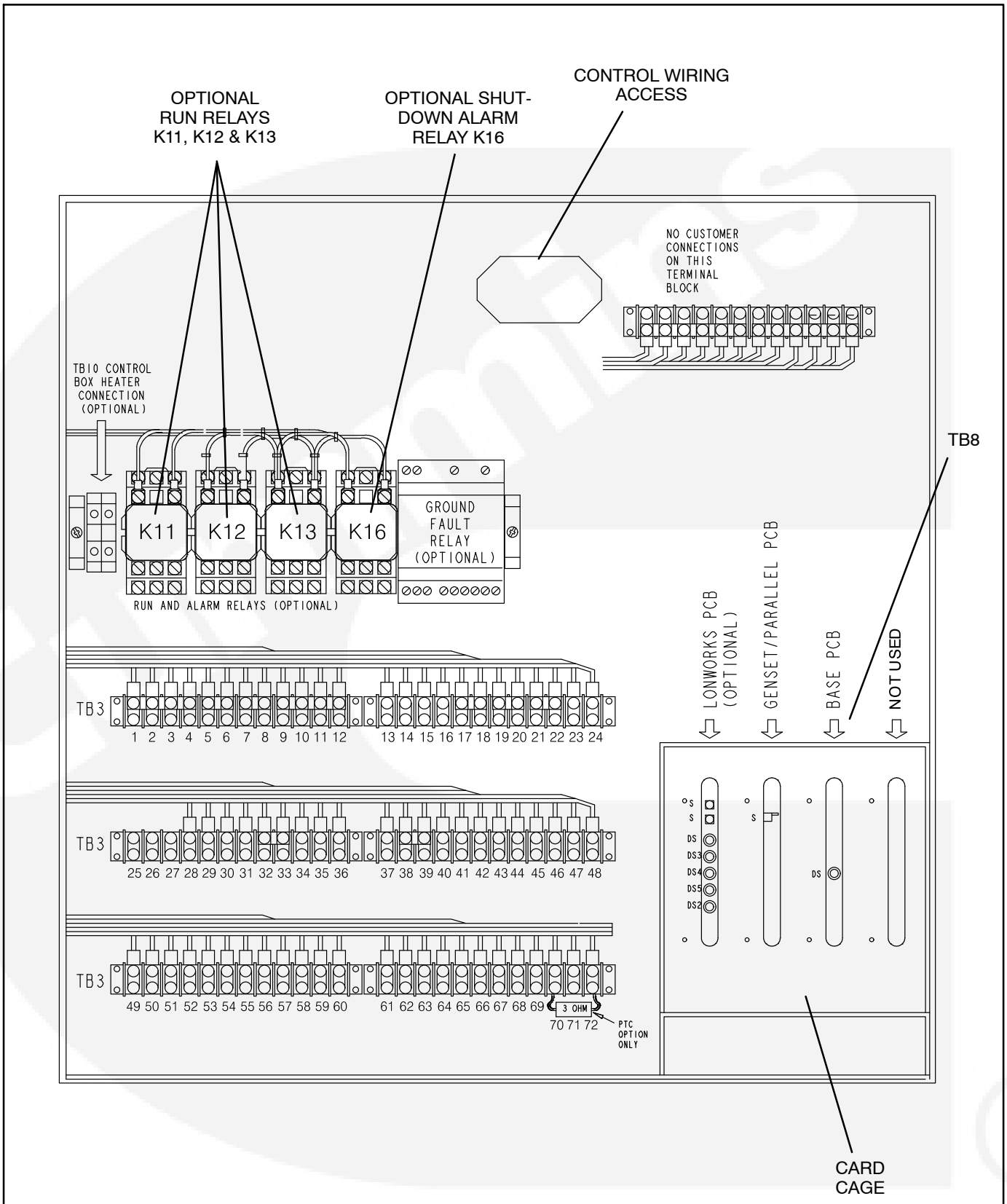


FIGURE 5-2. CONTROL BOX ASSEMBLY INTERIOR

RUN RELAYS (K11, K12, K13)

The optional run relays are rail mounted inside the control box (Figure 5-2). 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 5-3) are used to control auxiliary equipment such as fans, pumps and motorized air dampers. The run relays are energized when the generator set reaches operating speed.

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

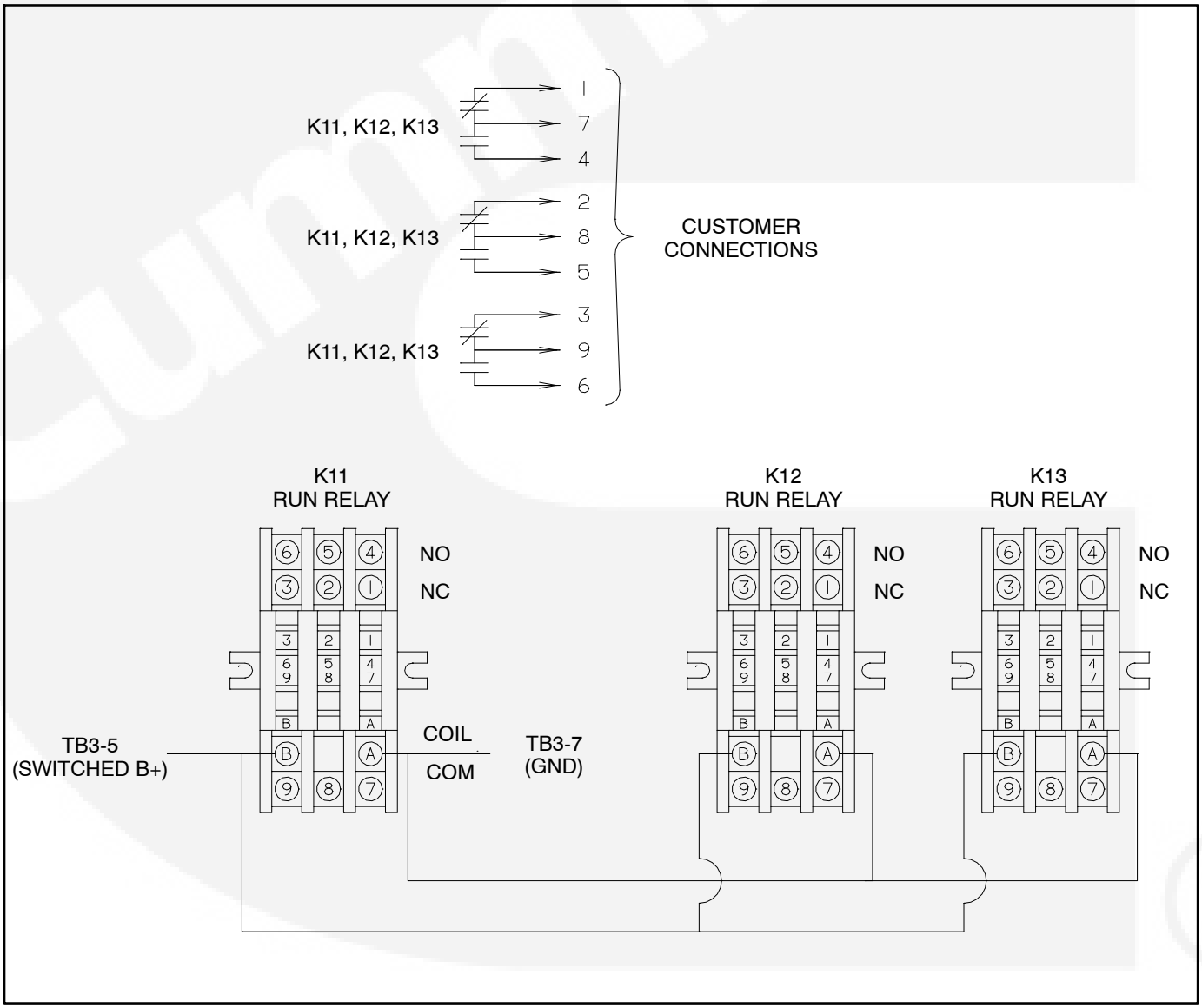


FIGURE 5-3. OPTIONAL RUN RELAYS (K11, K12, K13)

ALARM RELAY (K16)

The optional alarm relay is rail mounted inside the control box (Figure 5-2). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 5-4) is often used to energize warning devices such as audible alarms. Any generator set 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

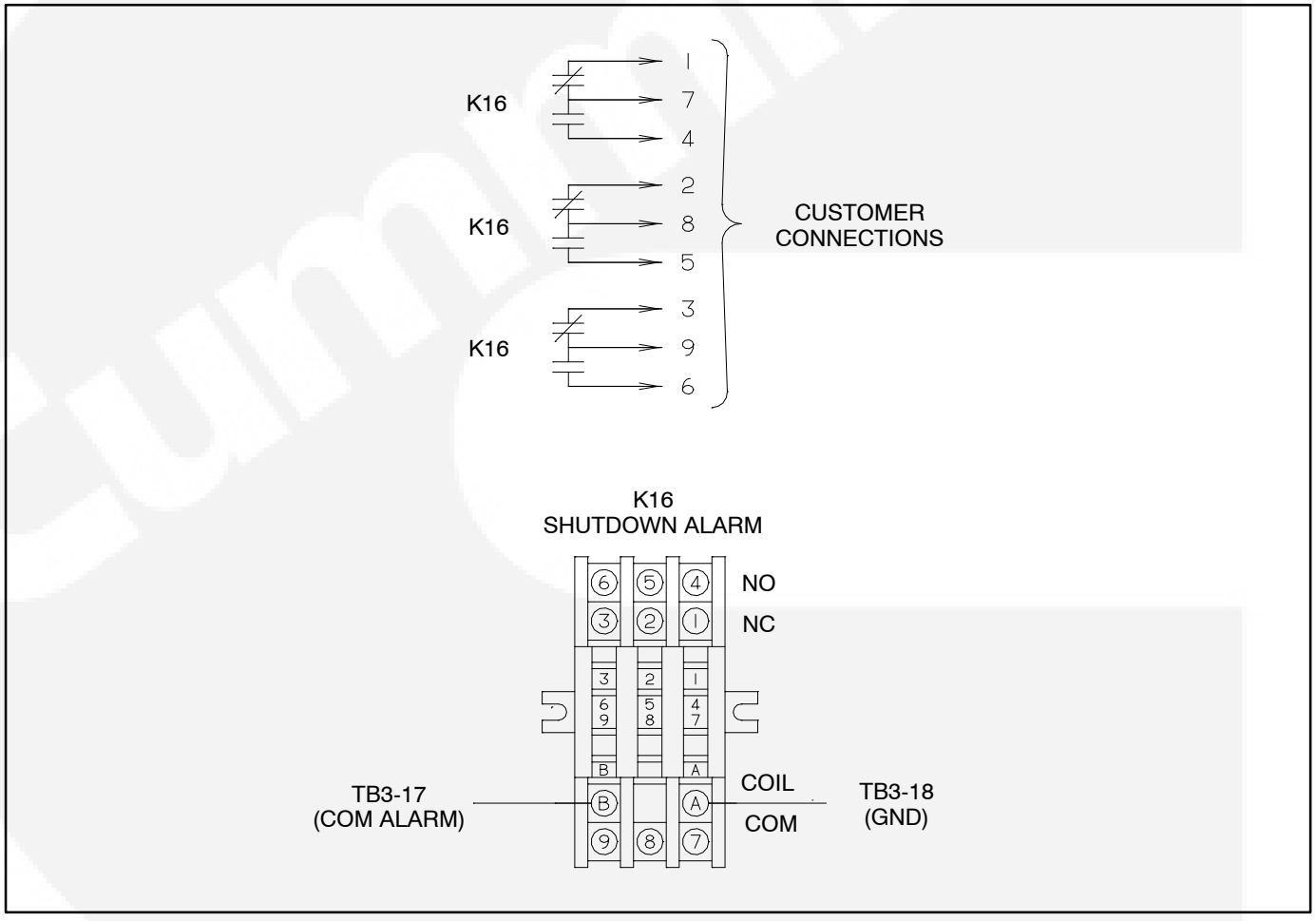


FIGURE 5-4. OPTIONAL ALARM RELAY (K16)

POWER TRANSFER CONTROL (OPTIONAL)

The optional Power Transfer Control (PTC) feature requires connecting the control relays of the PTC circuit to the generator set and utility circuit breakers. These relays are used to control the opening and closing of these circuit breakers via the PCC, for transfer and retransfer of the load to the generator set or the utility. A typical PTC installation is shown in Figure 5-5.

Relay Connections: Due to a wide verity of circuit breakers that can be attached to the relay outputs of PCC terminal block TB3, the system designer must determine if the electrical requirements of the installation does not exceed the limits of the PTC control relays. Relays that can handle larger switching current/voltage will need to be connected to the PTC control relays if the electrical limits of the PTC relays are exceeded.

The four PTC control relays are each rated at 16 amps at 250 VAC or 24 VDC.

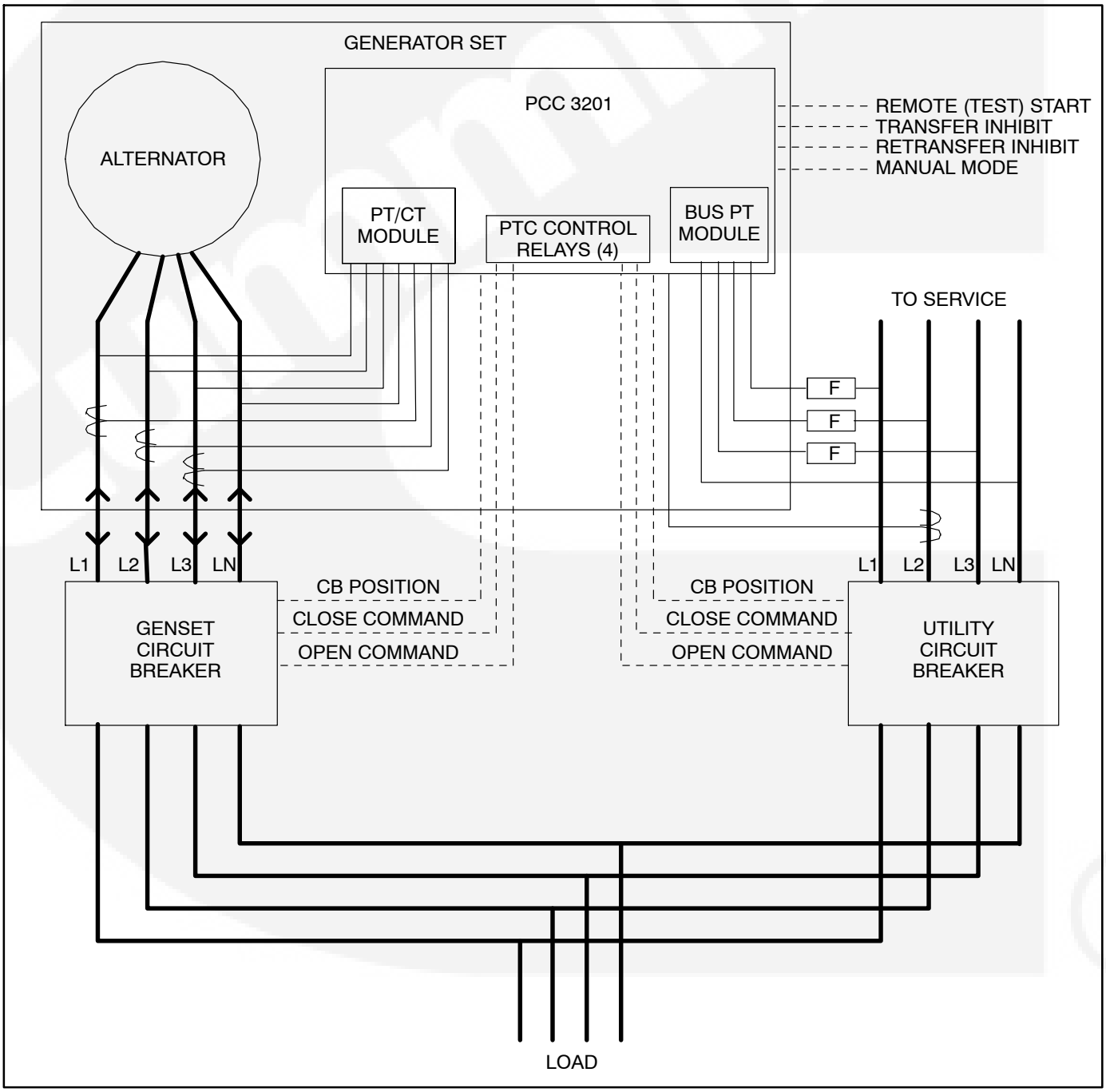


FIGURE 5-5. TYPICAL POWER TRANSFER CONTROL INSTALLATION

6. AC Electical Connections

GENERAL

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

⚠CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. Service personnel may be required to correct fault.***

⚠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 making any AC electrical connections, make certain the generator set cannot be accidentally started as follows:

1. 2. Move the O/ Manual/Auto switch on the control panel to the O (OFF) position.
3. 4. Turn off or remove AC power from the battery charger.
5. 6. Press the Emergency Stop button and wait at least 30 seconds before completing Step 4.
7. 8. Remove the negative (–) battery cable from the generator set starting battery.

Connecting the genset AC electrical system involves:

- Installation of transfer switch
- Generator output voltage selection and calibration
- 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 electrical hazard, 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

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

The initial condition of the windings should be assessed both visually and by measurement of insulation resistance to earth using a 500v megger.

Megger and PI testing **must** be performed on all medium voltage (601 through 15,000 volts) generator sets before initial start-up. Failure to do so, may void generator set warranty. PI testing for low voltage (less than 600 volts) generator sets is also recommended by Cummins Power Generation.

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

Care should be taken when dealing with windings which are suspected of being excessively damp or dirty. The initial measurement of insulation resistance should be established using a low voltage (500V) megger type instrument and if manually powered the handle should initially be turned slowly.

Full voltage megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

⚠CAUTION ***The AVR plus any voltage transformers should be disconnected, and any temperature detector leads (RTDs/thermistors) should be grounded during the test. Refer to the generator wiring diagram for details.***

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.

⚠DANGER ***Do not perform these procedures unless fully trained in medium voltage grounding procedures and have necessary safety equipment. Severe injury or death due to high voltage electrical shock may result.***

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. Move the O/Manual/Auto switch on the control panel to the O (OFF) position.
   b. Turn off or remove AC power from the battery charger.
   c. Press the Emergency Stop button and wait at least 30 seconds before completing Step d.
   d. Remove the negative battery cable (–) from the battery.
   e. 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 static and/or induced charges that may have been present in the generator stator.

   Leave grounds connected for at least one minute so static charge can dissipate. 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

⚠ DANGER ***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 still exist, caused by induced voltage within the generator or cables. Service personnel must be well-trained/ qualified to work with distribution voltages. (See Generator Set Grounding Procedure in this section.)***

IMPORTANT ! The windings have been H.V. tested during manufacture and further H.V. testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V. testing, for customer acceptance, the tests must be carried out at reduced voltage levels (i.e. Test Voltage = 0.8 [2 X Rated voltage + 1000]).

Megger Test: The megger test consists of applying voltage for up to one minute. The highest resistance values shown in Table 6-1 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.

The insulation resistance values quoted are for windings at an ambient temperature of 20°C. It should be noted that as winding temperature increases, values of insulation resistance will significantly reduce. Therefore, the reference values for insulation resistance can only be properly established with windings at a temperature of approximately 20°C.

An approximate guide to allow comparison with values taken at other temperatures is to assume that the IR reduces by 50% for every 10°C increase in temperature. Thus the reduction factors are:

20°C x 1.0
30°C x 0.5
40°C x 0.25
" "
80°C x 0.015 etc.

Should the values be less than the quoted limits, drying out the generator windings is essential.

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.

The polarization index should be in the order of 2 or greater at 20°C. ($PI = IR_{10\ min} / IR_{1\ min}$)

If low readings are obtained, the cause should be investigated and corrected before the generator set is returned to service. If moisture is determined to be the cause of low test readings, a winding drying process will be required (refer to genset *Service* manual for drying procedure).

1. Perform the *Generator Set Grounding Procedure* in this section.
2. Open the control box door and remove connector **10** from the AVR module.
3. Remove connector **9** from the PT/CT module (AC voltage sense leads and CT leads).
4. If the RTD (resistance temperature detector) option is installed, ground all six RTD temperature leads. Each RTD has three leads, one red and two white leads. Total of 18 leads must be grounded.

Main Stator:

5. Remove and separate the neutral leads of the generator from the generator load terminal marked "N".

   ⚠ CAUTION ***Make sure megger voltage is set to voltage shown in Table 6-1. Failure to use correct test voltage may result in equipment damage.***

6. Connect the megger between one phase of the stator and ground while grounding the other two phases and conduct the test. Refer to Table 6-1 for megger voltage selection and required resistance values.

   Repeat this step in turn for the other two phases.

Main Rotor:

7. Disconnect the main rotor and voltage suppressor leads from terminals **F1+** and **F2–** on the rotating rectifier assemblies and isolate them from ground. Tag and mark each lead with its terminal number (**F1+** or **F2–**).

   ⚠ CAUTION ***Make sure megger voltage is set to voltage shown in Table 6-1. Failure to use correct test voltage may result in equipment damage.***

8. Connect the megger between one of the rotor leads and ground and conduct the test. Refer to

Table 6-1 for megger voltage selection and required resistance values.

TABLE 6-1. GENERATOR INSULATION RESISTANCE

FRAME SIZE	GENERATOR VOLTAGE	MEGGER VDC SETTING	MINIMUM RESISTANCE (MEG OHMS)	
			MAIN STATOR	MAIN ROTOR
P7	600 VAC or less	500	10 – 1	10 – 1
MV7	601 thru 5000 VAC	2500	100 – 50	
		500		10 – 1

TRANSFER SWITCH

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

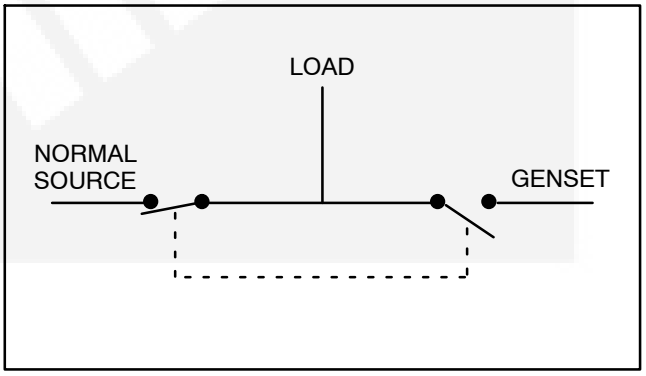


FIGURE 6-1. TYPICAL LOAD TRANSFER FUNCTION

AC WIRING

Generator Voltage Connections

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

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

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

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

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

Load Connections

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

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

Load Balancing

When connecting loads to the generator set, balance the loads so the current flow from each line terminal (L1, L2 and L3) is about the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading can be used as long as each line current is about the same, within 10 percent of median value and no line current exceeds the nameplate rating of the generator. Check the current flow from each line after connections by observing the control panel ammeter.

Current Transformers

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 CT1, CT2 and CT3 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. CT1 – U load leads (A phase),
   CT2 – V load leads (B phase)
   CT3 – W load leads (C phase)
C. Route the appropriate load wires through each CT.
D. The CT's have dual secondaries (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 2 for high voltage gensets or to pin 3 for low voltage gensets. (Refer to Reconnection Diagram.)

Grounding

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

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

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

⚠WARNING ***Electric current can cause severe personal injury or death. Bonding and grounding must be done properly. All metallic parts that could become energized under abnormal conditions must be properly grounded.***

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

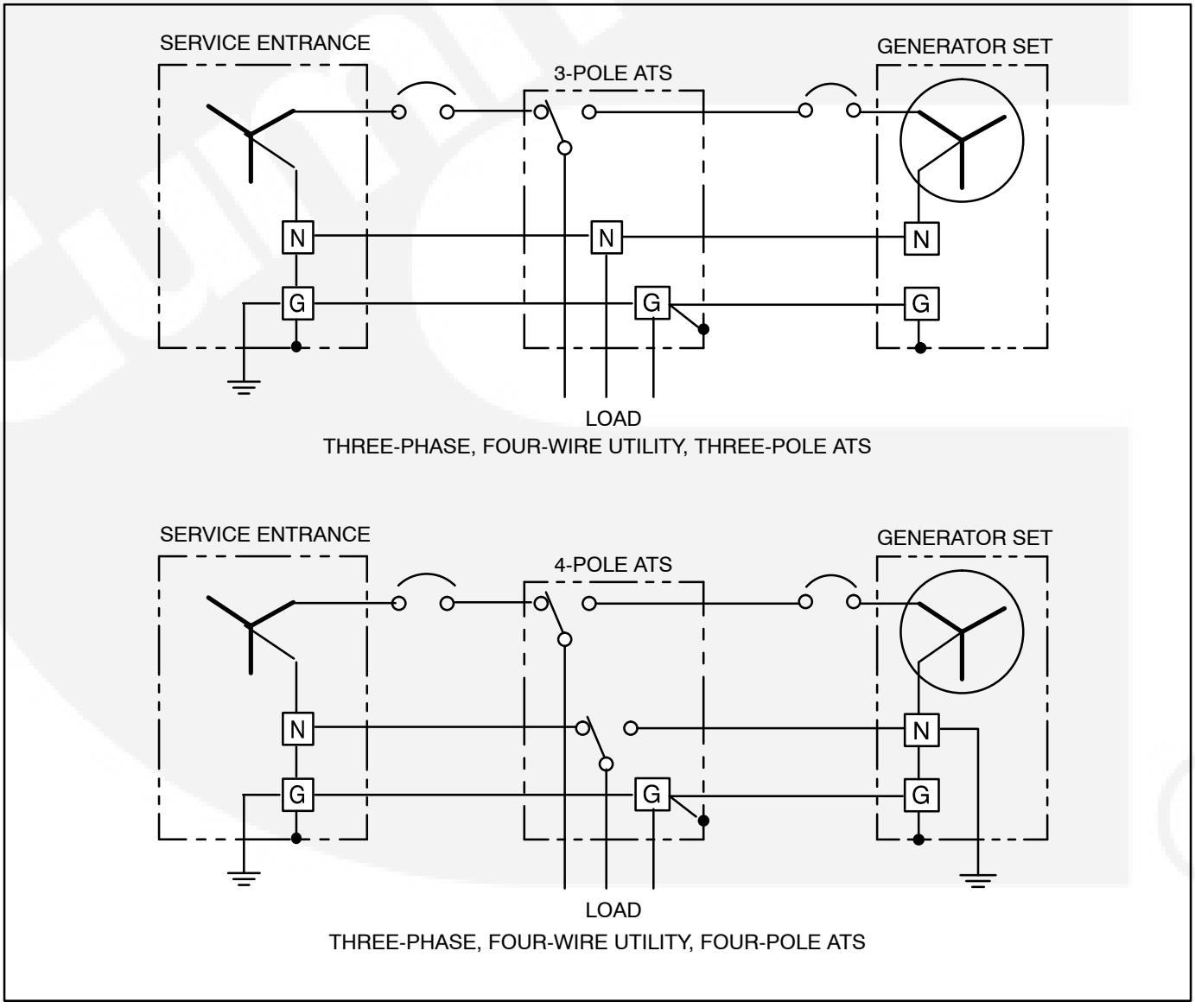


FIGURE 6-2. TYPICAL SYSTEM GROUNDING ONE-LINE DIAGRAMS

CONTROL HEATER (OPTIONAL)

A control heater (Figure 6-3) provides a means of humidity /temperature control 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. Thermostat control de−energizes the heater when the control box interior reaches 75° F (24° C).

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 rating.

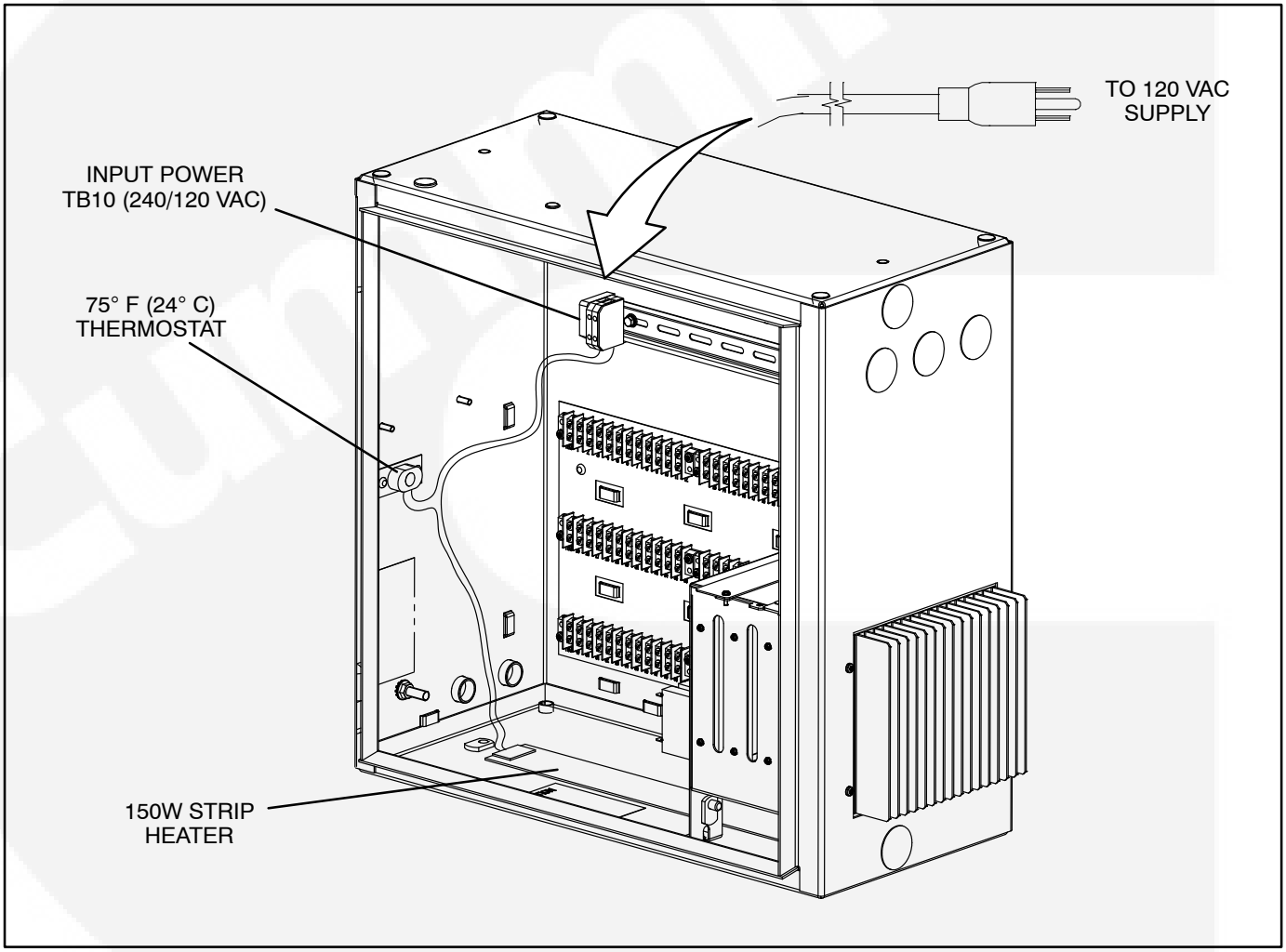


FIGURE 6-3. OPTIONAL CONTROL HEATER

COOLANT HEATER (OPTIONAL)

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

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

Figure 6-4 shows a typical coolant heater. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the supply voltage and circuit amperage is correct for the heater element rating.

Make sure that all three ball valves are opened before connecting power to the heaters. With ball valves closed, heated coolant will not circulate through the engine. Extended operation with ball valves closed can damage coolant heaters.

Note: 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.

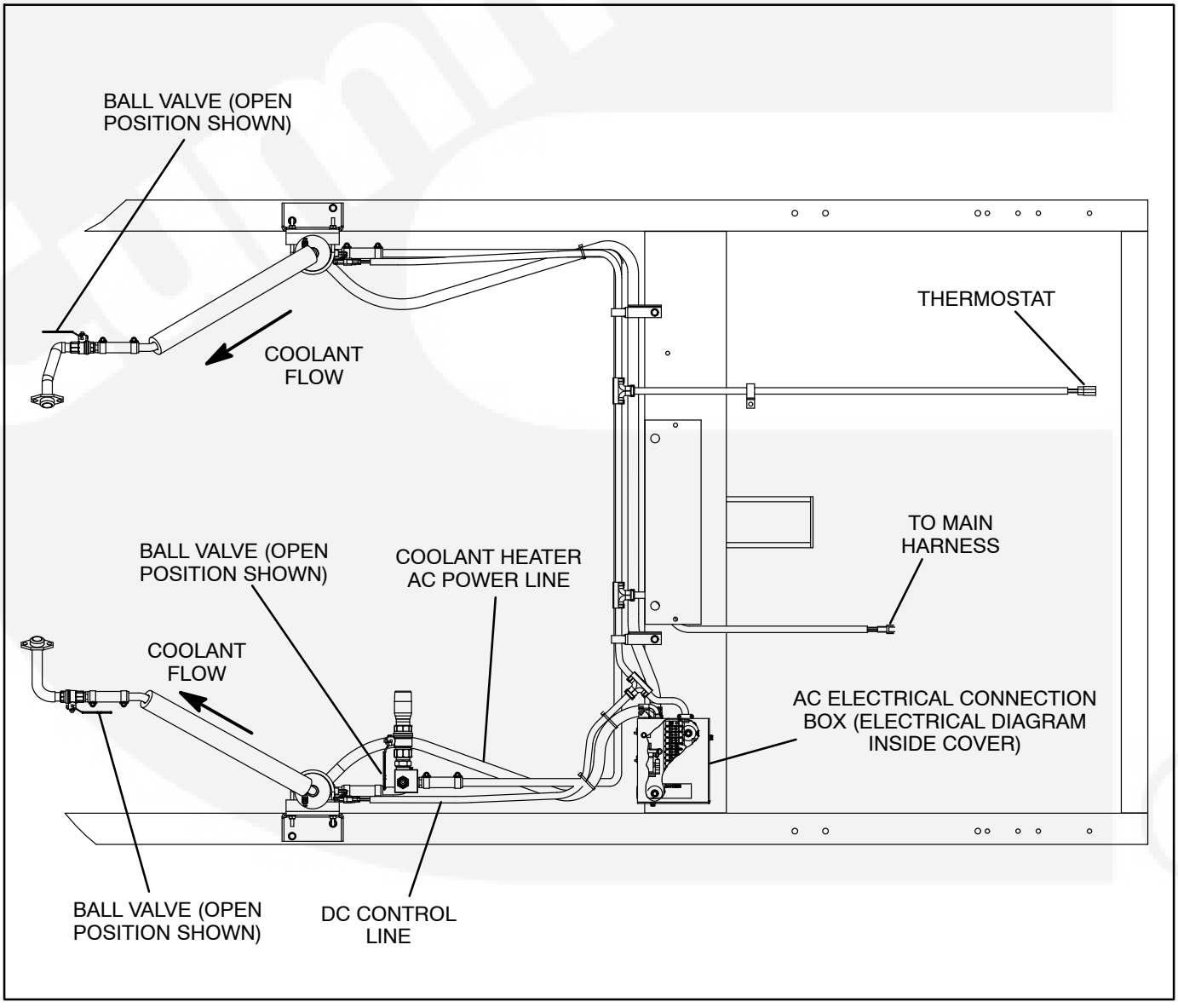


FIGURE 6-4. TYPICAL COOLANT HEATER

GENERATOR HEATER (OPTIONAL)

A generator heater(s) is used to help keep the generator free of condensation when the generator set is not running. During cool and humid conditions, condensation 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 6-5 illustrates the installation of two heater elements. Connect the heater(s) to a source of power that will be on during the time the engine is not running. Be sure the supply voltage and circuit amperage is correct for the heater element rating.

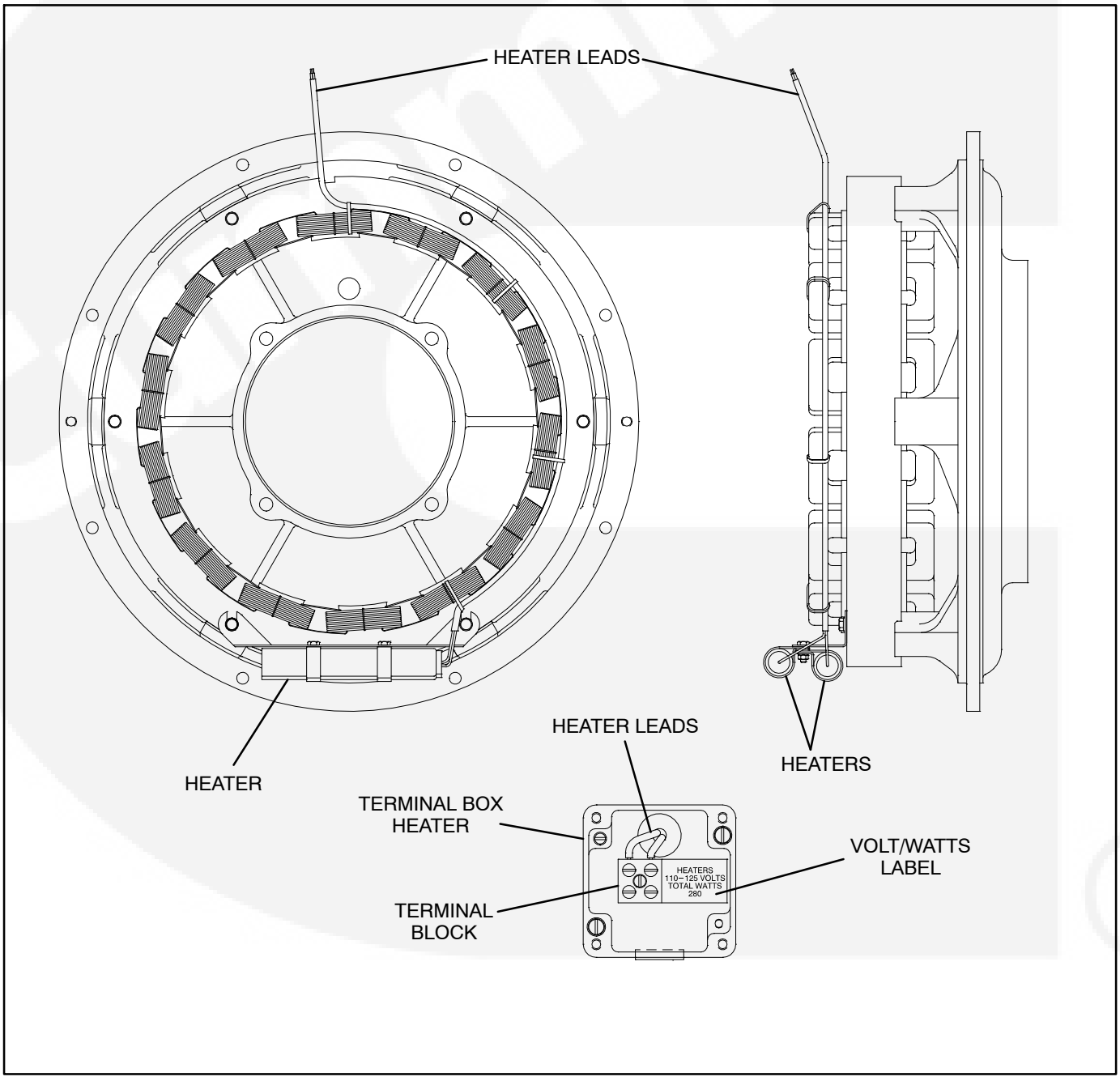


FIGURE 6-5. TYPICAL GENERATOR HEATER INSTALLATION

7. Prestart Preparation

GENERAL

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

INPOWER SERVICE TOOL GENERAL INFORMATION

InPower is a PC based service tool for the PowerCommand® 3201 Control (PCC). Use InPower to:

- Make adjustments to the controls trims and settings.
- Perform diagnostics and monitoring.
- Review event history.
- Create a capture file of the controls trims and settings.
- Update control calibrations (InPower PRO version).

Refer to INPOWER User's Guide for specifics.

InPower Adjust Mode

The adjustment feature allows you to make adjustments to genset parameters, calibrations and settings. There are several groups of adjustment parameters; note that not all gensets will have the same adjustments available.

InPower Capture File Description

InPower provides a method of extracting (capturing) a device's parameter values. Capturing saves device information in a file that is identified with a .CAP extension.

Capture files are used to store a copy of the genset's parameter values. During genset installation, it is suggested that a capture file be made before and after changes are made to the genset operating parameters. This information can be a very useful when troubleshooting the genset (determine if parameters/settings have been modified after installation) and when replacement of the Base board is necessary. The capture file can be used as a template to write the previous settings to the new Base board software.

ELECTRICAL SYSTEM

Make sure 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 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 7-1.

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

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.***

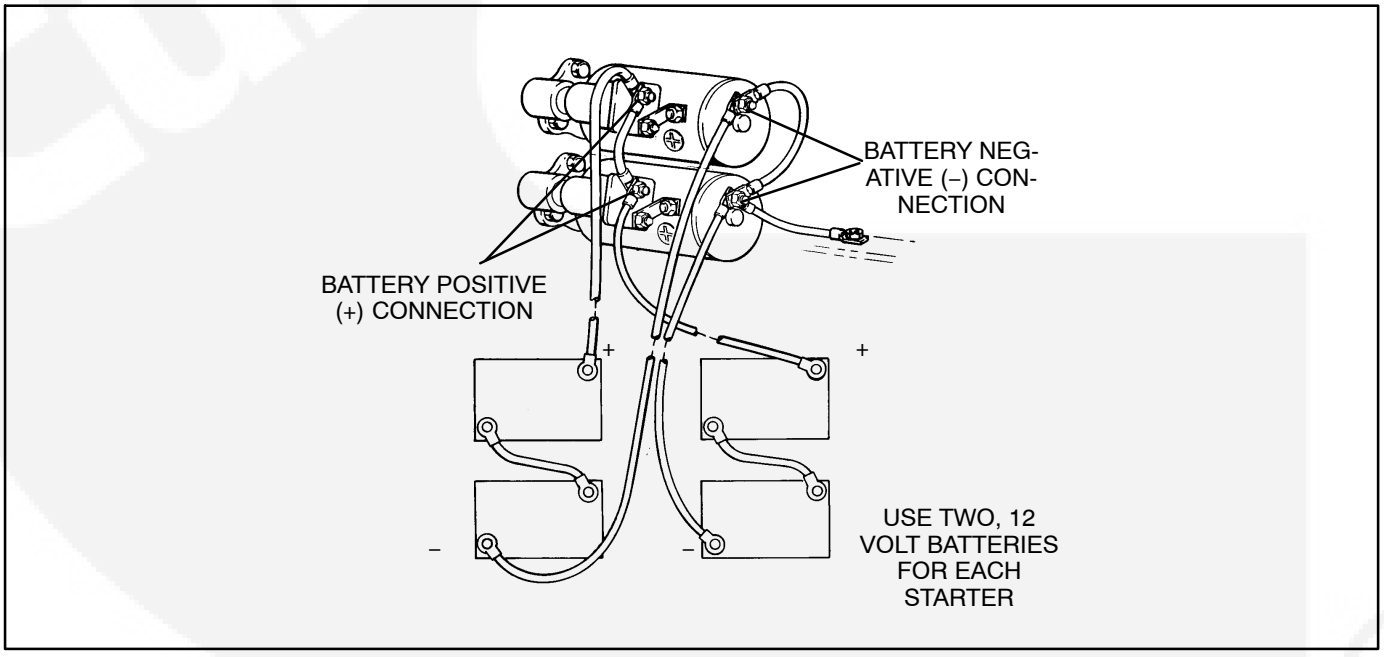


FIGURE 7-1. GENSET BATTERY CONNECTIONS

CONTROL PRESTART CHECKS

All generator set configuration options are set at the factory except for site related options, (e.g., Start/Stop Delays, Cycle Crank, Customer Fault names, etc.) and the optional Power Transfer Control (PTC) feature.

Adjustments of these options are divided into two categories within the menu driven system. These two categories are Setup and Adjust.

The Setup submenus are intended for qualified service personnel only. The Adjust submenu is intended for qualified service and site personnel only. For this reason, a separate password is required to modify the Setup submenus. The Adjust submenu may or may not require a password (site dependent).

⚠ CAUTION ***Improper calibration or adjustment of the control can cause equipment malfunction or damage. Calibration and adjustment must be performed by technically qualified personnel only.***

The following procedures describe how to modify the Adjust submenu options and if installed, the PTC Setup submenus, which are required to complete the genset installation.

The Adjust submenu allows you to calibrate the generator set voltage/frequency and start/stop time delays. For the prestart checks, adjustment of only the start/stop delays is required.

The PTC Setup submenus contain parameters with adjustable default values that should be checked and modified if necessary for this site. The descriptions in this section include ranges for the parameters and default values for this feature.

Saving Menu Changes

Changes are automatically saved when the menu is exited.

Language/Units Selection Menu

During any control panel operation, you can select one of three languages and change how units are displayed by pressing the two lower menu buttons (one on each side of display). When pressing these two buttons simultaneously, the language/units menu will appear (Figure 7-2). After making desired selections, press the **ENTER** button in this menu to change and save the selections.

Note: Use the + button to select the desired option for each field. Use the arrow (→) button to move to the next field. Selected field is highlighted.

Language: Used to select desired language (default = English).

Local/Remote Field: This selection must be set to **Local** when the graphical display is mounted on the generator set front control panel or **Remote** when mounted remotely of the generator set.

Temp: Used to select °F or °C for temperature readings.

Pressure Fluid: Used to select PSI, KPA, BAR or IN for pressure readings.

Pressure Gas: Used to select INHG or MMHG for pressure readings.

Flow Air: Used to select CFM or CMM for air flow readings.

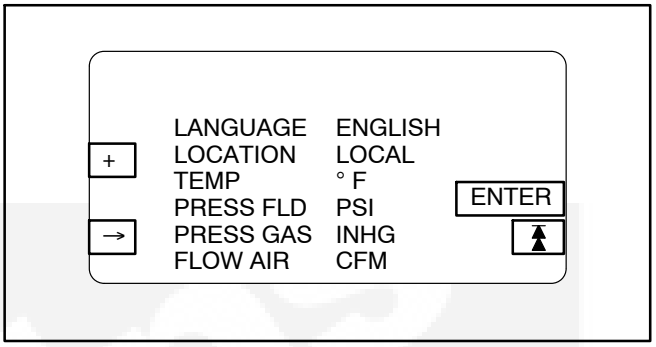


FIGURE 7-2. LANGUAGE/UNITS MENU

Password Menu

To allow the site personnel to modify only the Adjust submenu and not the Setup submenus, two passwords are assigned within the system software. An **Application** password is used for the Setup submenus and a **User** password is used for the Adjust submenu.

The two passwords are assigned during the initial installation of the generator set (via InPower) and will vary between sites. The installer must make sure that the passwords are available to the appropriate personnel.

Note: When the generator set is first installed, the *Application* and *User* password are both set to GENSET to allow initial modification of the Setup and Adjust submenus. Assign new passwords when site installation is complete.

When viewing the Adjust menu, pressing the + or – button will display the User Password menu.

When viewing a Setup menu, pressing the + or – button will always display the Application Password menu.

After entering the correct password, the system will allow you to modify the submenus. To help prevent unauthorized adjustment, the entered password is valid for 10 minutes after the last button is pressed (i.e., the password will need to be reentered after the ten minute time–out.

Entering Password

To enter the password:

1. Display submenu to modify.
2. Press either the + or – button within the displayed submenu. The Password menu appears.
3. Press the + and – button to select the first character of the password (A–Z or 0–9). (Enter **Application** password for Setup submenus; Enter **User** password for Adjust submenu.)
4. Press the → button to select the next character field. Selected character field is highlighted.
5. Repeat steps 3 and 4 to enter remaining password characters.
6. Press the **Enter** button after entering the password. The submenu selected in step 1 will reappear.
7. After making desired changes to submenu, exit submenu to save changes.

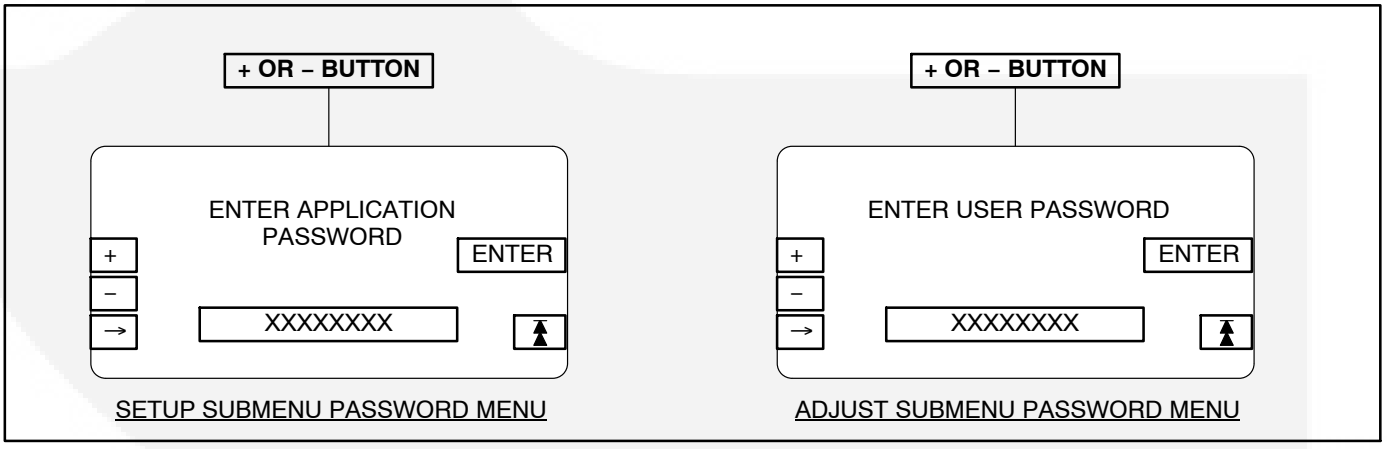


FIGURE 7-3. PASSWORD MENUS

ADJUST SUBMENU

Figure 7-4 shows the main menus (Menu A and Menu B) of the system control and the Adjust submenu.

To display the Adjust submenu, press the **MORE>>** button in Menu A and then the **ADJUST** button in Menu B.

The Adjust procedure is intended for qualified service personnel and site personnel only and may require a **USER** password. If a password is required, the **USER** password menu will appear when you try to modify the Adjust submenu. (Refer to *PASSWORD Menu* in this section to enter password.

Changes are automatically saved when you exit this menu.

Note: Use the + and – buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field.

START DELAY: This delay applies only to remote starting in the Auto mode. The Start Delay adjustment range is 0 to 300 seconds.

STOP DELAY: This delay applies only to remote stopping in the Auto mode. The Stop Delay adjustment range is 0 to 600 seconds.

VOLTAGE: Used to adjust the output voltage ±5%.

FREQUENCY: Used to adjust the frequency ±3 Hz.

VOLTAGE/SPEED DROOP: These two submenus apply to a genset that has the paralleling option and is configured to operate in droop mode. These adjustments must be performed by technically qualified personnel only.

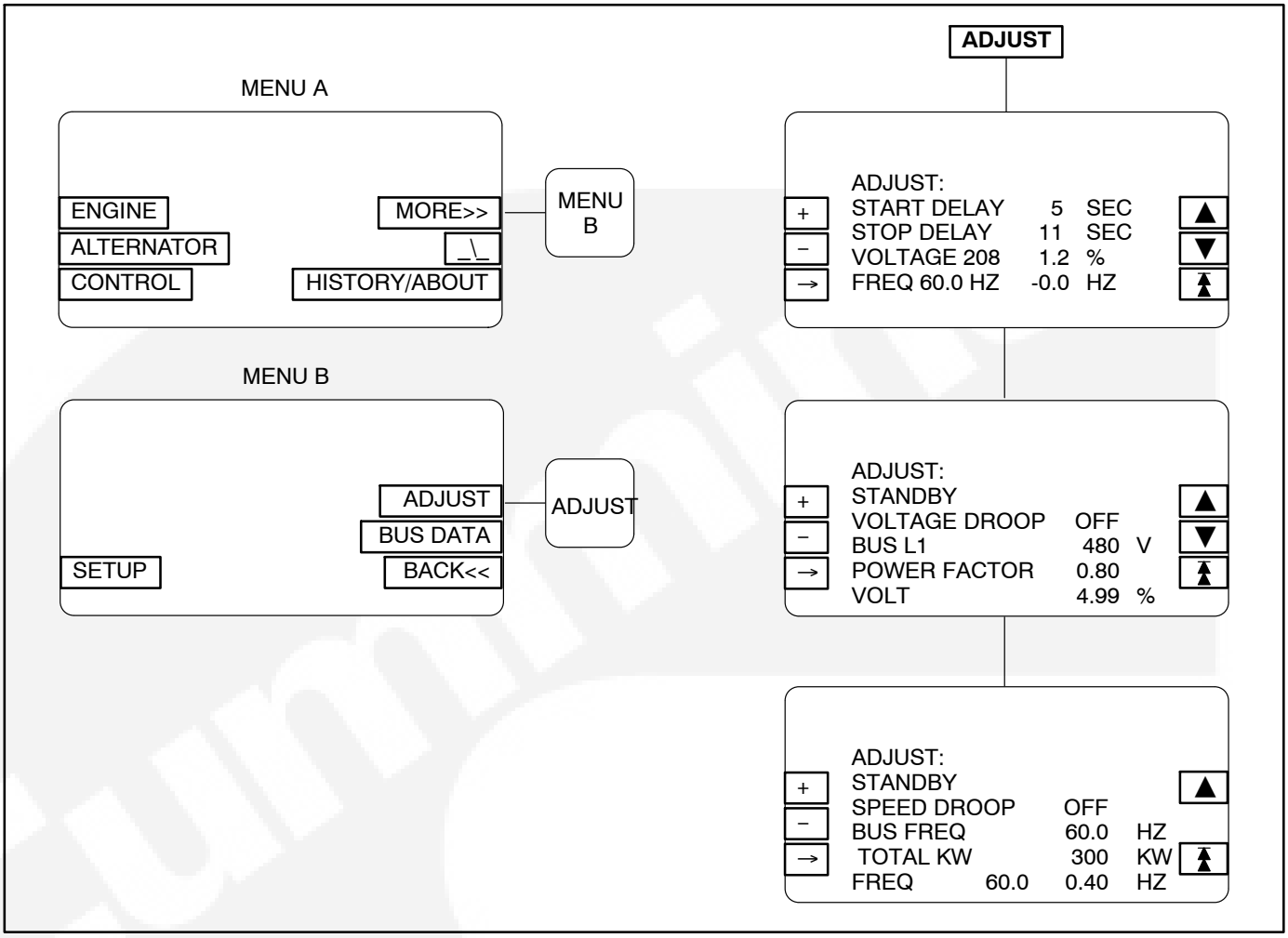


FIGURE 7-4. ADJUST SUBMENU

POWER TRANSFER CONTROL MAIN MENUS

Figure 7-5 shows the main menus (Menu A and Menu B) of the system control, the two setup menus and the two main menus of the optional Power Transfer Control (PTC) feature.

To adjust PTC system parameters, press the appropriate PTC main menu button and refer to the page number shown in Figure 7-5 for detailed information related to the submenu selected.

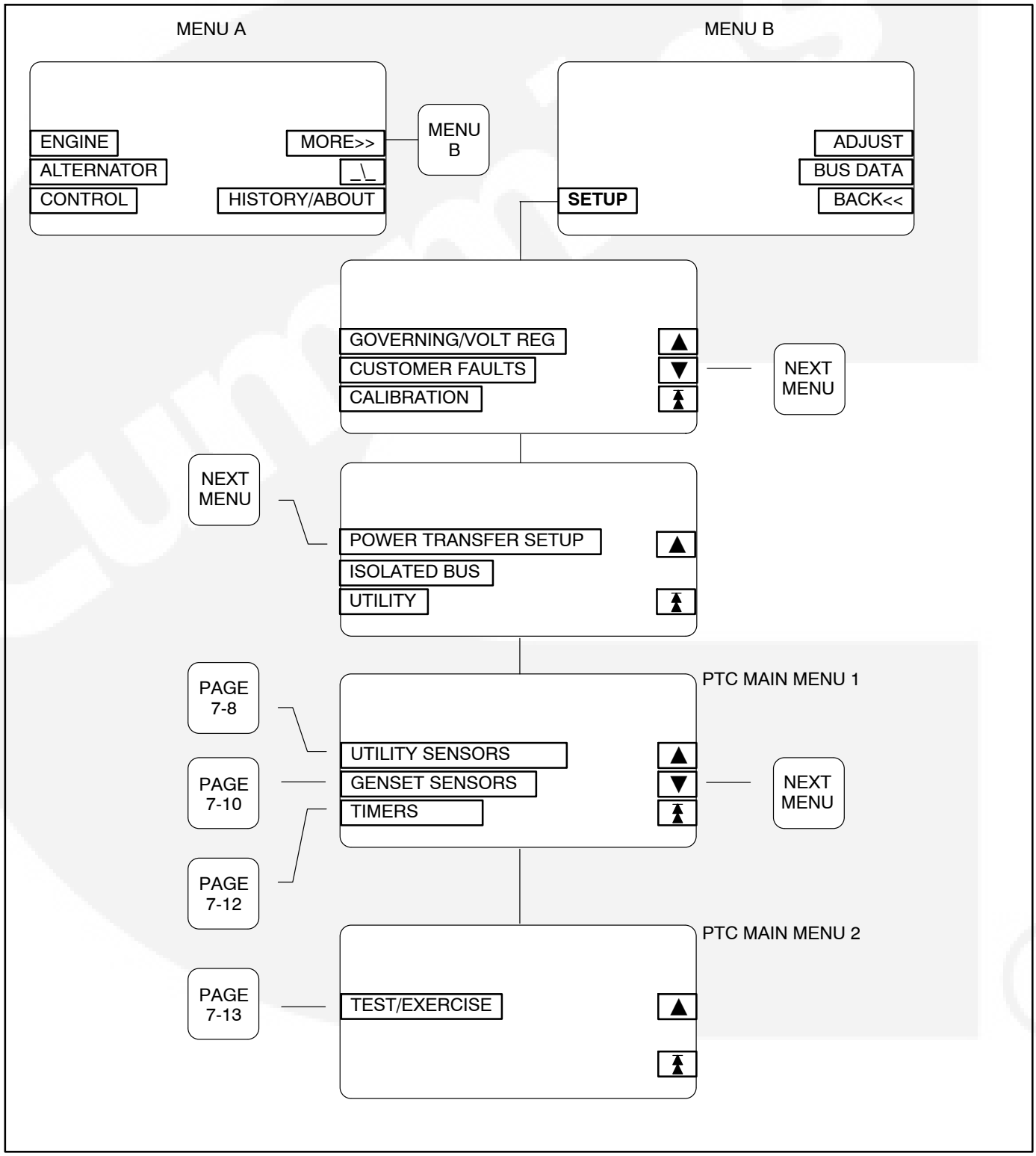


FIGURE 7-5. PTC SETUP MAIN MENUS

UTILITY SENSORS SUBMENUS

If you press the "UTILITY SENSORS" button in the PTC Main Menu 1, the Utility Sensors submenus will appear (Figure 7-6).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field. For a complete explanation of these fields, refer to heading "*PTC Detailed Field Descriptions*" in this section.

Note: Use the + and – buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

U PT VOLT LL: Enter the value of the utility line-to-line voltage which yields 100% voltage at the terminals of the utility (bus) PT module.

Range: 1–15000V, adjustable by standard nominal voltage values, 100V, 10V and 1V increments (1V).

The 100% voltages for each of the four possible utility (bus) PT modules are as follows, based on module dash number:
–01 = 208 volts LL
–02 = 416 volts LL
–03 = 600 volts LL
–04 = 120 volts LL

Example 1: Nominal Utility voltage is 480V. This means that utility (bus) PT module number –02 should be used. The voltage which will yield 100% volts at this PT module is 416 per the above table. Thus enter 416V.

Example 2: Nominal Utility voltage is 4160V. A primary stage transformer with a ratio of 4200/240 is used. This means that utility (bus) PT module number –01 should be used. The voltage which will yield the 100% volts (208V from above table) is calculated as follows:
208 x (4200/240) = 3640. Thus enter 3640V.

U NOM VOLT LL: Enter the nominal utility line-to-line voltage. For example, 480, 4160, etc.. Range: 1–15000 V, adjustable by standard nominal voltage values, 100V, 10V and 1V increments (1V).

U CT RATIO: Enter the CT Ratio of the Utility L2 CT. This is the Ratio to 1 Amp. Range: 1–18000 (1A).

⚠ CAUTION ***This CT must be rated for 1 Amp output (e.g. NOT 5 Amp). Be sure CT secondary circuit has burden resistor or a shorting jumper in place before putting power through the CT. Example: CT Ratio = 2650:1. Thus enter 2650.***

U SENSOR TYPE: Enter the line-to-line (L-N) for 3 phase line-neutral voltage sensing or line-to-line (L-L) for 3 phase line-line voltage sensing. This applies to both the utility undervoltage and overvoltage sensors. Range: L–L, L–N (L–N).

U <wye> <delta>: Enter utility connection type. Range: Delta, Wye (Wye).

U UNLOADED KW: Enter the kW on utility Line 2 at which the utility is considered as unloaded. This is the L2 kW level at which a closed transition soft transfer will disconnect from the utility.

UTILITY UNDERVOLTAGE: Non-adjustable field, always enabled.

UTILITY OVERVOLTAGE, FREQUENCY: Used to enable or disable menu function. Choose Enabled or Disabled (Enabled).

UV PICKUP: Enter a number between 85 and 100% of the nominal voltage (90%).

UV DROP OUT: Enter a number between 75 and 98% of the under-voltage pick-up percentage (90%).

UV DELAY: Enter a time between 0.1 and 5.0 seconds (0.5 seconds).

UV MIN PHASE: Displays the lowest line voltage of the three utility phases.

OV PICKUP: This adjusts the over-voltage pickup as a percentage of the over-voltage drop-out. Enter a number between 95 and 99% (95%).

OV DROP OUT: Enter a percentage between 105 and 135% of the nominal voltage (110%).

OV DELAY: Enter a range between 0 and 120 seconds (3 seconds).

OV MAX PHASE: Displays the highest line voltage of the three utility phases.

CENTER (FREQ): Enter a frequency between 45 and 65 Hz (60 Hz).

PICK UP (FREQ): Enter a percentage between 5 and 20% of the nominal frequency (10%).

DROP OUT (FREQ): Enter a percentage between 1 and 5% of the nominal frequency (1%).

DELAY (FREQ): Enter a time between 0.1 and 15.0 seconds (5.0 seconds).

FREQUENCY: This field displays the sensed utility line frequency.

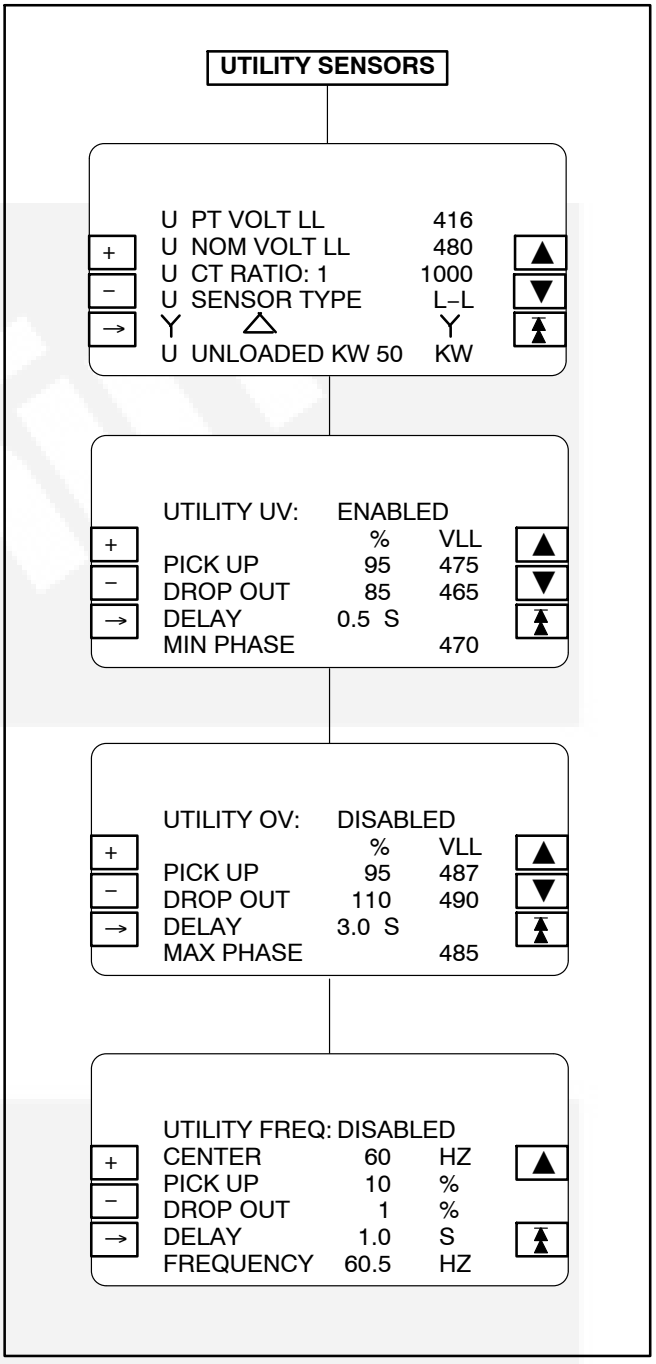


FIGURE 7-6. UTILITY SENSORS SUBMENUS

GENSET SENSORS SUBMENUS

If you press the “GENSET SENSORS” button in the PTC Main Menu 1, the Genset Sensors submenus will appear (Figure 7-7).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field. For additional information regarding these fields, refer to heading “*PTC Detailed Field Descriptions*“ in this section.

Note: Use the + and – buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

G NOM VOLT LL: Non-adjustable field, displays current setting of genset nominal voltage. (See Adjust submenu to adjust the output voltage ±5%.)

G SENSOR TYPE: Enter the line-to-line (L-N) for 3 phase line-neutral voltage sensing or line-to-line (L-L) for 3 phase line-line voltage sensing. This applies to both the genset undervoltage and overvoltage sensors. Range: L–L, L–N (L–N).

G BASE LOAD: Enter the maximum load the genset will carry during a closed transition. Range: 0–100% (80%).

G RAMP LOAD: Enter the ramp time for the genset ramp load rate during a closed transition soft load transfer. Ramp rate is +100%kW divided by this time setting. Range: 0–900 seconds (20 sec).

G RAMP UNLOAD: Enter the ramp time for the genset ramp unload rate during a closed transtion soft load retransfer. Ramp rate is –100%kW divided by this time setting. Range: 0–900 seconds (20 sec).

G UNLOADED KW: Enter the %kW (based on standby rating) that the genset is considered unloaded. This is the %kW level at which a closed transition soft retransfer will disconnect from the genset. Range: 0–100% (5%).

GEN UNDERVOLTAGE: Non-adjustable field, always enabled.

GEN OVERVOLTAGE, FREQUENCY: Used to enable or disable menu function. Choose Enabled or Disabled (Enabled).

UV PICKUP: Enter a number between 85 and 100% of the nominal voltage (90%).

UV DROP OUT: Enter a number between 75 and 98% of the under-voltage pick-up percentage (90%).

UV DELAY: Enter a time between 0.1 and 5.0 seconds (4 seconds).

UV MIN PHASE: Displays the lowest line voltage of the three genset phases.

OV PICKUP: This adjusts the over-voltage pickup as a percentage of the over-voltage drop-out. Enter a number between 95 and 99% (95%).

OV DROP OUT: Enter a percentage between 105 and 135% of the nominal voltage (110%).

OV DELAY: Enter a range between 0 and 120 seconds (3 seconds).

OV MAX PHASE: Displays the highest line voltage of the three genset phases.

CENTER (FREQ): Enter a frequency between 45 and 65 Hz (60 Hz).

PICK UP (FREQ): Enter a percentage between 5 and 20% of the nominal frequency (10%).

DROP OUT (FREQ): Enter a percentage between 1 and 5% of the nominal frequency (1%).

DELAY (FREQ): Enter a time between 0.1 and 15.0 seconds (5.0 seconds).

FREQUENCY: Displays the sensed genset line frequency.

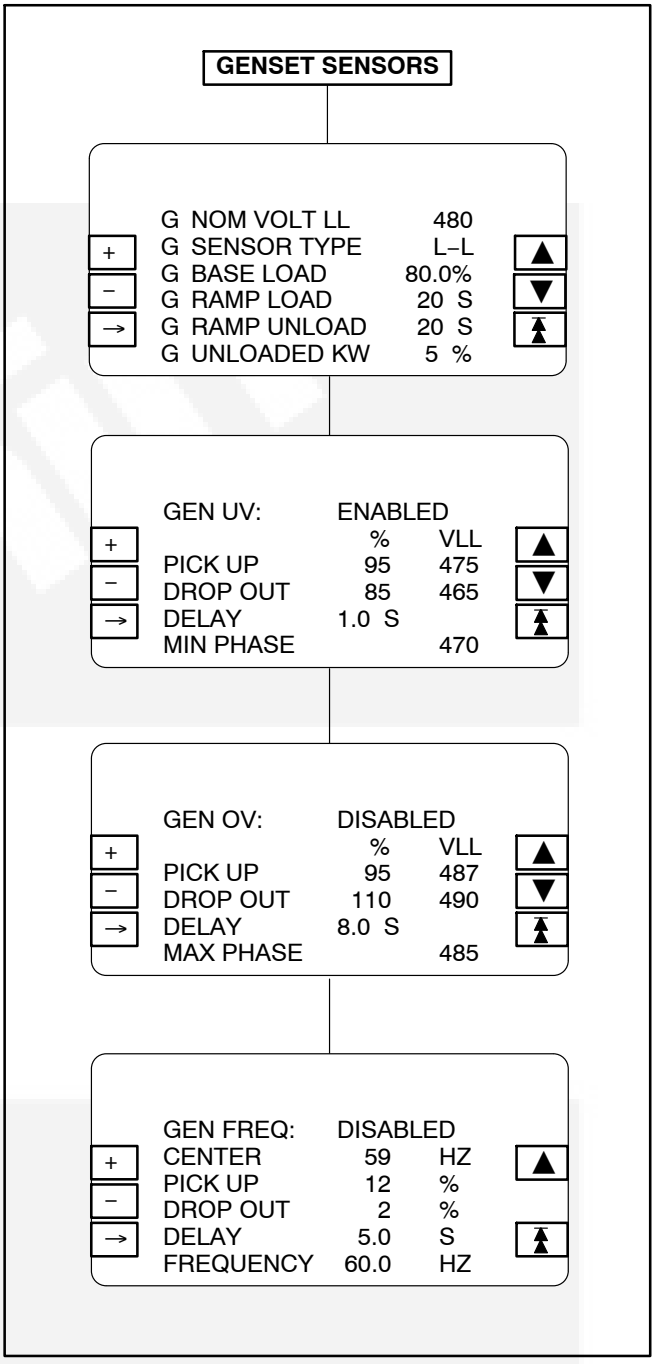


FIGURE 7-7. GENSET SENSORS SUBMENUS

TIMERS SUBMENU

If you press the “TIMERS” button in the PTC Main Menu 1, the Timers submenu will appear (Figure 7-8).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field. For a complete explanation of these fields, refer to heading “*PTC Detailed Field Descriptions*“ in this section.

Note: Use the + and – buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

START DELAY: Sets time delay for genset engine start. Prevents nuisance genset starting during brief power interruptions.

Enter a range from 0 to 300 seconds (0 seconds).

STOP DELAY: Sets the time delay for engine cooldown following a re-transfer. This stop delay works in conjunction with and is activated at the same time as the normal cooldown timer. (Will extend normal cooldown timer if entered time is greater.)

Enter a time from 0 to 600 seconds (0 seconds).

TRANSFER: In a Normal to Emergency transfer this function allows the genset to stabilize before the load is applied. Enter a time from 0 to 120 seconds (10 seconds).

RETRANSFER: In a Emergency to Normal transfer this function allows the utility to stabilize before the load is applied.

Enter a time from 0 to 1800 seconds (600 seconds).

PGM TRANSIT: Sets the time delay for Programmed Transition. A setting of 0.0 disables the program.

Enter a time from 0 to 60 seconds (0 seconds).

MAX PARALLEL: Sets the maximum time during closed transition that utility and genset can be paralleled.

Enter a time from 0 to 1800 seconds (20 seconds).

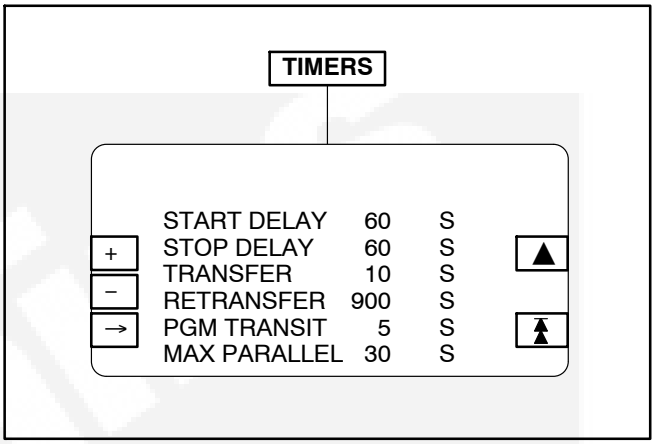


FIGURE 7-8. TIMERS SUBMENU

TEST/EXERCISE SUBMENU

If you press the “TEST/EXERCISE” button in the PTC Main Menu 2, the Test/Exercise submenu will appear (Figure 7-9).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field.

Note: Use the + and – buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

MODE: Indicates the generator set application type for PTC option.

OT-PGM TRAN – Open transition load transfer.

CT-MOMENT – Closed transition load transfer with momentary (<100ms) overlap.

CT-SOFT – Closed transition load transfer with load ramping.

TEST WITH LOAD: Feature allows genset Test sequence, which is initiated through the Remote Start (TEST) switch, to operate with or without load. Default: **OFF**

EXER WITH LOAD: Feature allows genset Exercise sequence, which is initiated through control panel Exercise button to operate with or without load. Default: **OFF**

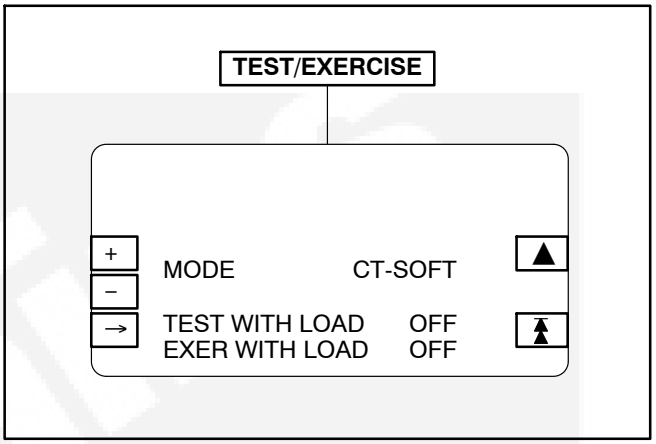


FIGURE 7-9. TIMERS SUBMENU

PTC DETAILED FIELD DESCRIPTIONS

⚠WARNING ***Improper calibration or adjustment of electronic control modules can cause death, severe personal injury, and equipment or property damage. Calibration and adjustment of these components must be performed by technically qualified personnel only.***

Start Delay: This start time delay is adjustable from 0 to 300 seconds. This brief time delay prevents the generator set from starting during short power interruptions. Timing starts at the utility power interruption. If the duration of interruption exceeds the delay time, the control system starts the generator.

Stop Delay: This stop time delay is adjustable from 0 to 600 seconds. The Stop Delay begins timing when the load is retransferred to the utility. At the end of the delay, the stop signal is sent to the generator set. This stop delay works in conjunction with and is activated at the same time as the normal cooldown timer. (Will extend normal cooldown timer if entered time for Stop Delay is greater.)

Transfer: This transfer time delay begins when genset voltage and frequency reach the settings of the control. After the delay, the PTC transfers the load to the utility. This brief time delay allows the generator set to stabilize before the load is applied. It has an adjustable range of 0 to 120 seconds. The default value is 10 seconds.

Retransfer: This retransfer time delay begins the moment utility line voltage and frequency return to specified values. After the delay, the PTC can retransfer the load to the utility. The delay allows the utility to stabilize before retransfer. It has an adjustable range of 0 to 1800 seconds. The default value is 600 seconds.

Under-Voltage Sensing

The PTC feature includes under-voltage sensors for the utility and the genset. When a sensor detects a low voltage condition over a specified time period, it initiates a transfer. When the source voltage returns to an acceptable value again, the sensor initiates a retransfer.

These parameters are adjustable. The under-voltage sensing range for a falling voltage (drop-out) is 75 to 98% of the pick-up voltage setting. The default value is 90%. The pick-up range for a rising voltage is 85 to 100% of the nominal voltage setpoint. The default value is 90%. The adjustable range for the time delay period is 0.1 to 5.0 seconds. The default delay time is 4 seconds. See Figure 7-10 for an example using the default values.

FIGURE 7-1.

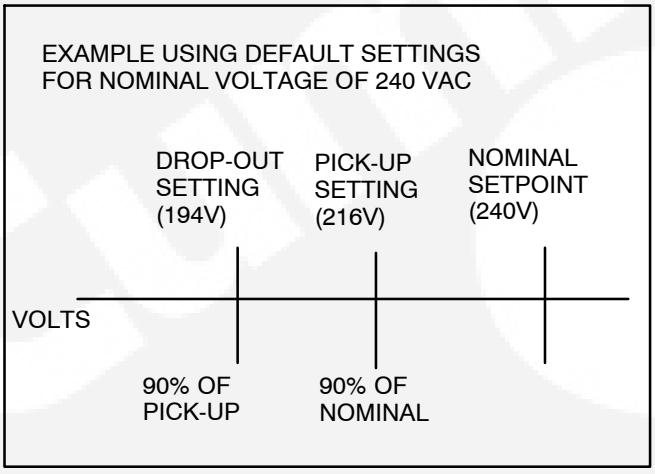


FIGURE 7-10. UNDER-VOLTAGE SENSING

Over-Voltage Sensing

The PTC feature includes over-voltage sensors for the utility and the genset that can be disabled and not used. When a sensor detects a high voltage condition over a specified time period (delay), it initiates a transfer. When the source voltage falls to an acceptable value again, the sensor initiates a retransfer.

These parameters are adjustable. The over-voltage sensing range (drop-out) for a rising voltage is 105 to 135% of the nominal voltage setpoint. The default value is 110%. The pick-up range for a falling voltage is 95 to 99% of the drop-out setting. The default value is 95%. The adjustable range for the delay time period is 0.0 to 120.0 seconds. The default delay time is 3.0 seconds. See Figure 7-11 for an example using the default values.

FIGURE 7-2.

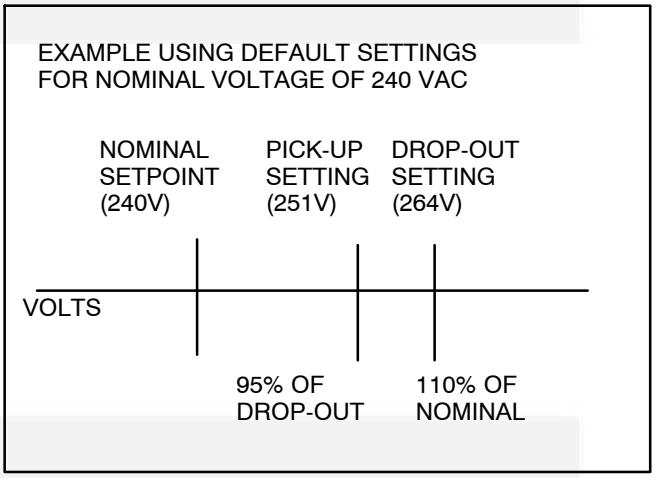


FIGURE 7-11. OVER-VOLTAGE SENSING

Frequency Sensing

The PTC feature includes frequency sensors for the utility and the genset that can be disabled and not used. When a sensor detects a high or low frequency condition over a specified delay time period, it initiates a transfer. When the frequency returns to an acceptable value again, the sensor initiates a retransfer.

FIGURE 7-3.

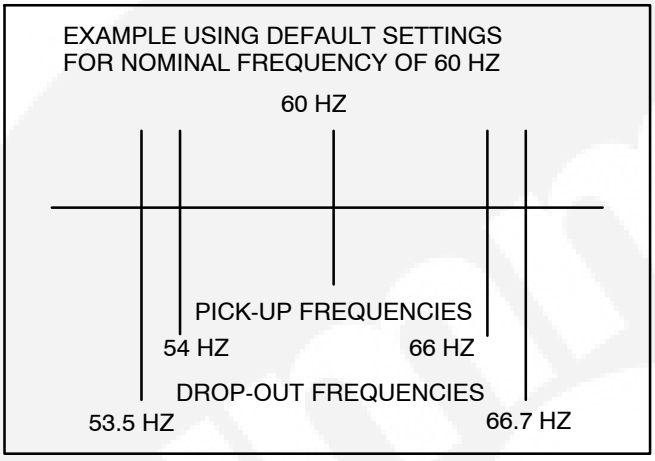


FIGURE 7-12. FREQUENCY SETTING

These parameters are adjustable. The nominal frequency can be set between 45.0 and 65.0 Hz. The default frequency is 60 Hz. The acceptable frequency bandwidth (pick-up) is ±5 to ±20% of the nominal frequency setpoint. The default value is 10%. The drop-out frequency is 1 to 5% beyond the pick-up. The default value is 1%. The range for the delay time period is 0.1 to 15 seconds. The default delay time is 5 seconds. The frequency sensing feature is enabled by default. This feature can also be disabled.

Programmed Transition

Programmed Transition introduces a delay (TDPT) during an “open transition” transfer or retransfer. Programmed transition causes a pause in the neutral position for an adjustable interval of time. In this position, the load is not connected to either the utility or the genset. This delay allows residual current from inductive loads to decay to an acceptable level before transfer is completed.

The length of time that the utility or genset breaker/contactors are both in the neutral (open) position can be adjusted from 0 to 60 seconds. The default value is 0 seconds. The proper adjustment is a function of the load. This feature is enabled by default.

This feature is not used in closed transition paralleling applications.

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.

8. Installation Checklist

GENERAL

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

GENERATOR SET SUPPORT

- ☐ Floor, roof or earth on which the generator set rests is strong enough and will not allow shifting or movement. Observe local codes on soil bearing capacity due to freezing and thawing.
- ☐ Generator set is properly supported and retained to approved base.
- ☐ Supporting base is large enough and is of noncombustible 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.
- ☐ Automatic 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.
- ☐ Created control capture file of the genset's parameter values before and after modifications.

9. Fan Belt Alignment

GENERAL

The following procedure describes how to align the fan drive pulleys of the 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

⚠CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. Service personnel may be required to correct fault.***

⚠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 O/Manua/Auto switch on the control panel to the O (Off) position.
2. Disable the starting system of the generator set:
   a. Disconnect the battery charger from its AC source.
   b. Press the Emergency Stop button and wait at least 30 seconds before completing Step c.
   c. 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 9-1) to access fan drive system.

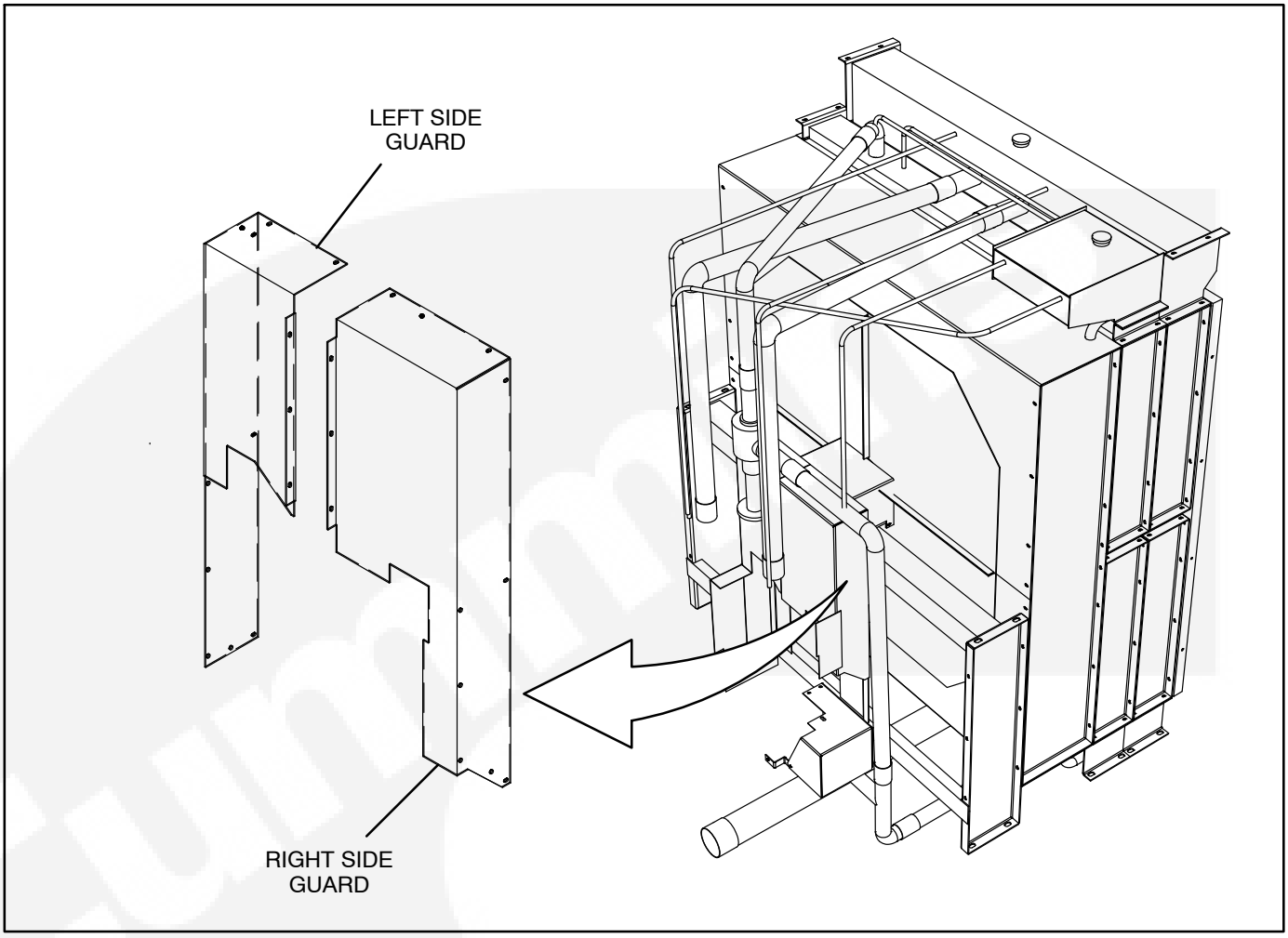


FIGURE 9-1. FAN DRIVE GUARD (LEFT/RIGHT SIDE)

4. 5. 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 9-2. The fan drive pulley should be 0.25” nominal toward engine from straight edge.

6. If alignment is required, continue with step 8. If OK, continue with step 14.

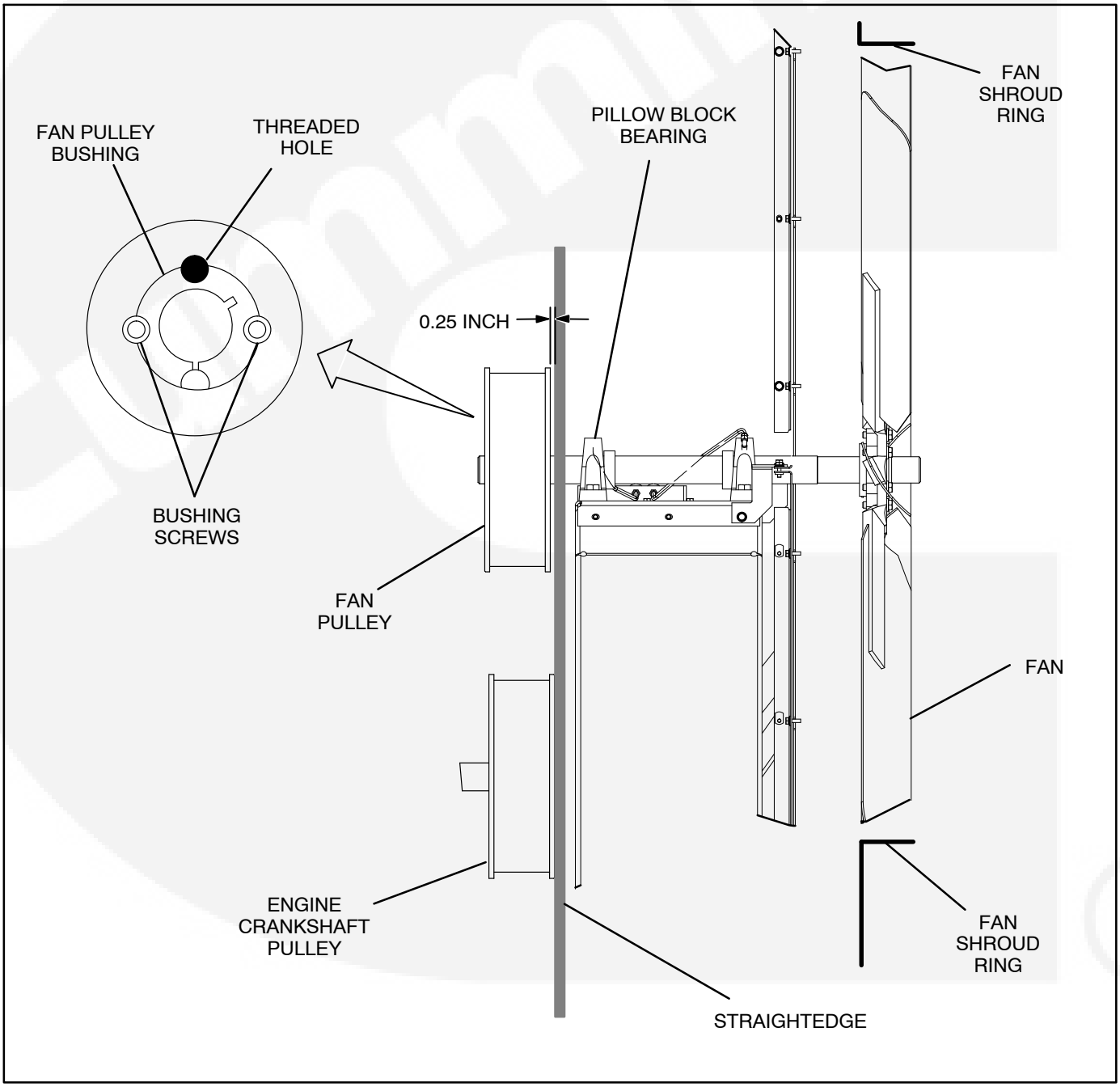


FIGURE 9-2. FAN DRIVE PULLEY ALIGNMENT

7. 8. 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 9-3). 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.

9. 10. 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 9-2). 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.

11. 12. 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.***

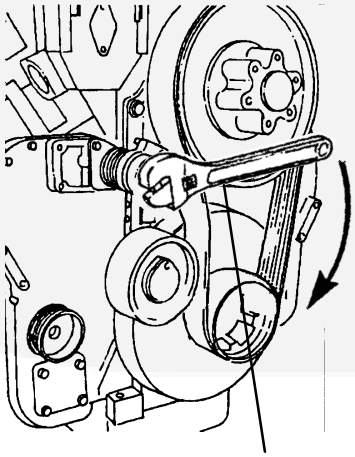
Use an 8-point socket and breaker bar or a large wrench to hold the idler in position against the spring tension (Figure 9-3). Turn the wrench until the idler pulley position is sufficient to position the belt in front of the idler pulley. Align the grooves of the belt on the ribs of the pulley and shaft and then slowly release spring tension onto belt.

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

13. 14. Install the left and right side fan drive guards (Figure 9-1) that were removed in step NO TAG.

15. 16. 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 9-3. 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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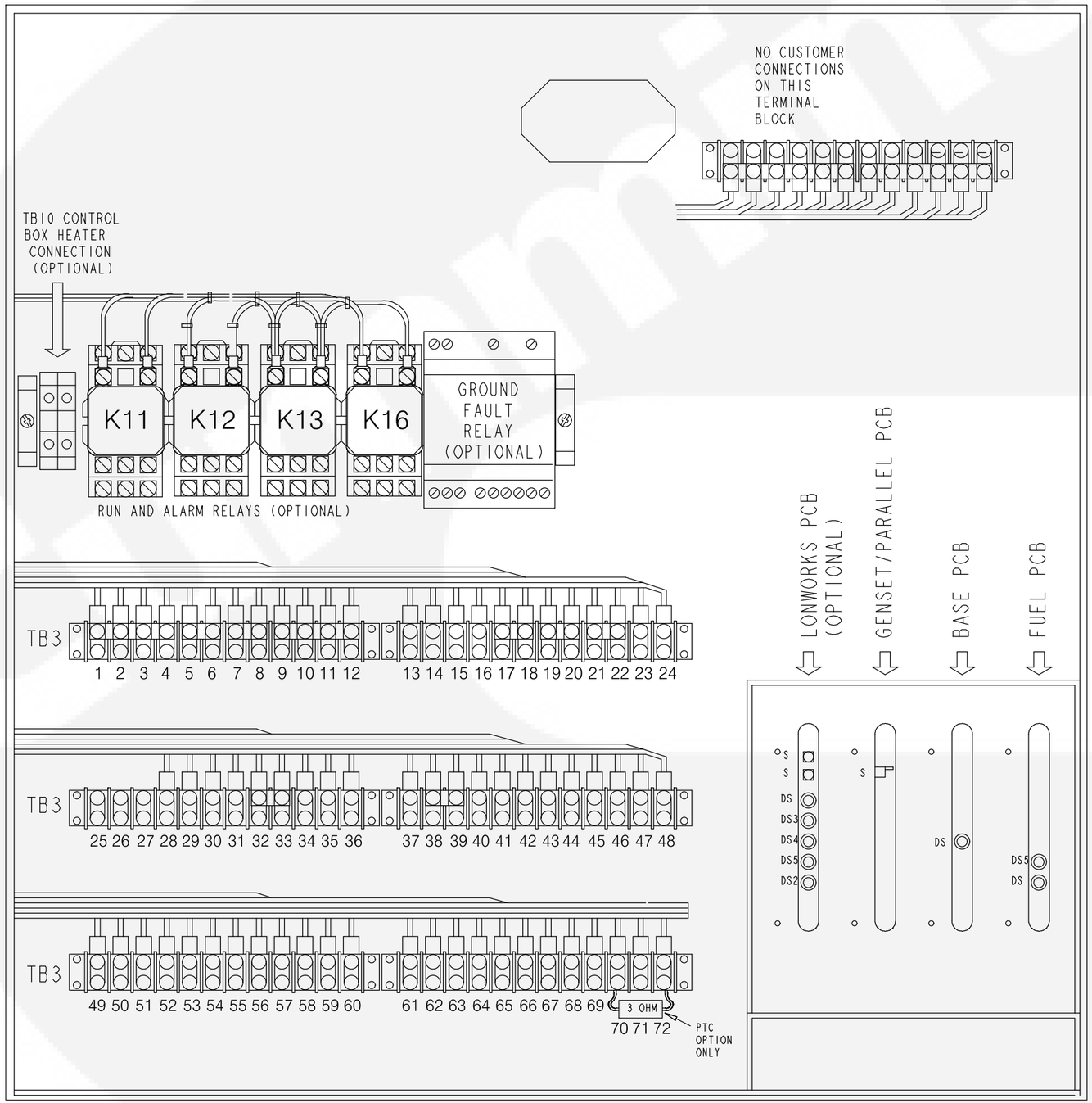
10. Wiring Diagrams

GENERAL

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

- Page 10-2 thru 10-6 – Customer Connections



(SEE PAGE 10-3 FOR TERMINAL DESCRIPTIONS)

NO. 900-8298
OF 4
REV. B
MODIFIED 01-05

CUSTOMER CONNECTIONS (PAGE 1 OF 4)

TERMINAL BLOCK TB3

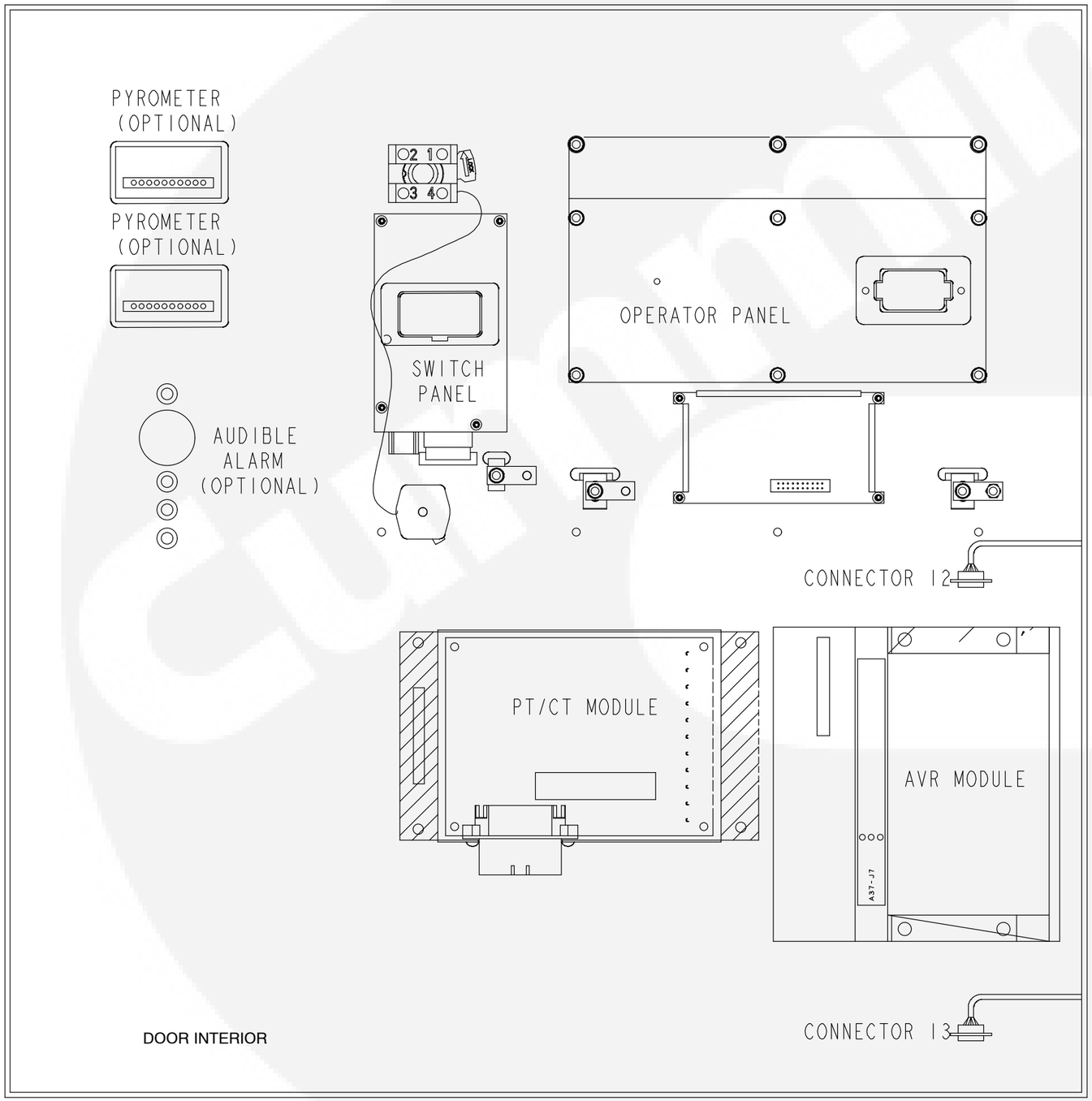
(SEE PAGE 10-1 FOR TB3 LOCATION)

TB3-	NAME	DESCRIPTION
1	B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY
2		
3		
4		
5	SWITCHED B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING
6		
7	DELAYED OFF SWITCHED B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPL.Y, AVAILABLE WHEN GENSET IS RUNNING. CONFIGURABLE DELAYED OFF IS TYPICALLY USED FOR FUEL SHUTOFF.
8		
9	GND	BATTERY NEGATIVE
10		
11		
12		
13	CONFIGURABLE INPUT #1	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
14	CONFIGURABLE INPUT #2	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
15	CONFIGURABLE INPUT #3	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
16	CONFIGURABLE INPUT #4	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
17	CONFIGURABLE INPUT RETURN	RETURN PATH FOR CONFIGURABLE INPUTS. (TB3-13, 14, 15, 16)
18		
19	RELAY COIL SOURCE	SWITCHED 24VDC POWER SUPPLY. USE ON THE HIGH SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY DRIVER. PROVIDES A MINIMUM 800ma OF CURRENT
20		
21	READY TO LOAD RELAY DRIVER	ACTIVATES WHEN GENSET HAS REACHED 90% OF FREQUENCY & VOLTAGE. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20).
22		
23	LOAD DUMP RELAY DRIVER	ACTIVATES AT A CONFIGURABLE LOAD LEVEL OR UNDER FREQUENCY CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20)
24	COMMON SHUTDOWN RELAY DRIVER	ACTIVATES ON ANY GENSET SHUTDOWN CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20) USE NC CONTACT TO POWER MODEM.
25	SPARE	
26	SPARE	
27	SPARE	
28	MODEM RELAY DRIVER	PROVIDES A CONFIGURABLE METHOD OF CONTROLLING AND CYCLING POWER TO AN EXTERNAL MODEM. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20)
29	COMMON WARNING RELAY DRIVER	ACTIVATES ON ANY WARNING CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20)
30	LOCAL LOW FUEL INPUT	PROVIDES A LOW FUEL INDICATION FOR GENSETS APPLIED WITH A DAY TANK OR AN INTEGRATED FUEL TANK. SWITCH RETURN WITH TB3-31
31	LOCAL LOW FUEL RETURN	SWITCH RETURN FOR LOCAL LOW FUEL INPUT (TB3-30)
32	FIRST START INPUT	FOR PARALLELING APPLICATIONS, CONNECTS TO REMOTE MASTER START SENSOR OR BUS PT MODULE WITH FIRST START SENSOR.
33		

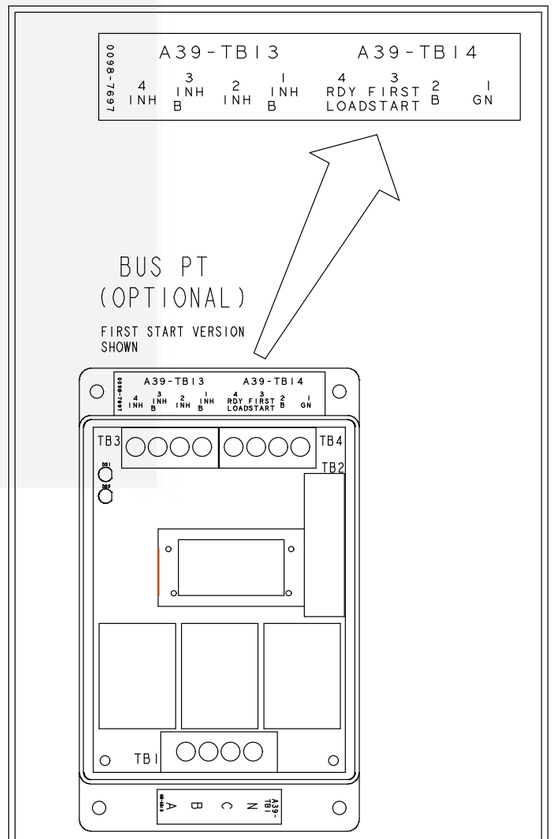
TB3-	NAME	DESCRIPTION
34	LOAD DEMAND INPUT	FOR ISOLATED BUS PARALLEL APPLICATIONS, INPUT ALLOWS GENSET TO RAMP TO NO LOAD, OPEN BREAKER AND SHUT DOWN. REMOVING INPUT CAUSES GENSET TO START, SYNCHRONIZE, CLOSE BREAKER, AND RAMP TO LOAD. FOR POWER TRANSFER CONTROL APPLICATIONS, INPUT WILL PUT CONTROL INTO MANUAL MODE. APPLY WITH SWITCH RETURN (TB3-38/39)
35	SINGLE MODE ENABLE INPUT	FOR SINGLE GENSET PARALLEL POWER TRANSFER (PLT) APPLICATIONS ONLY. APPLY WITH SWITCH RETURN (TB3-38/39) TO ENABLE MODE.
36	RAMP LOAD/UNLOAD SWITCH	USED WITH MULTIPLE GENSETS IN PARALLEL IN CONJUNCTION WITH A MASTER CONTROL OR OTHER PLC DEVICE. APPLY SWITCH RETURN (TB3-38/39) TO LOAD/UNLOAD GENSET AS LOAD PROFILE DICTATES
37	REMOTE LOW FUEL INPUT	PROVIDES A LOW FUEL INDICATION FOR GENSETS THAT ARE NOT FITTED WITH AN INTEGRATED FUEL TANK. APPLY SWITCH RETURN (TB-38/39) TO ACTIVATE
38	SWITCH RETURN	SWITCH RETURN FOR TB3-34, 35, 36, AND 37
39		
40	SYNC ENABLE INPUT	FOR USE IN SINGLE MODE PLT APPLICATIONS ONLY. +24VDC INPUT SIGNALS GENSET TO SYNCHRONIZE WITH UTILITY. (TB3-5 OR 6 CAN BE USED FOR 24VDC SUPPLY)
41	LOAD GOVERN KW + INPUT	ALLOWS A REMOTE DEVICE TO CONTROL KW LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC
42	LOAD GOVERN KW -	RETURN LINE LOAD GOVERN KW
43	LOAD GOVERN KVAR + INPUT	ALLOWS A REMOTE DEVICE TO CONTROL KVAR LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC THIS INPUT IS DEFAULTED TO "DISABLED" AND IS ENABLED WITH INPOWER.
44	LOAD GOVERN KVAR -	RETURN LINE FOR LOAD GOVERN KVAR.
45	EXTERNAL KW/KVAR SHIELD	SHIELD TERMINATION POINT FOR LOAD GOVERN INPUTS.
46	AUTO MODE OUTPUT	SWITCHED BATTERY 24VDC, FUSED AT 5A. AVAILABLE WHEN GENSET IS RUNNING IN AUTO MODE
47	GROUND FAULT INPUT	ACTIVATES A GROUND FAULT WARNING WHEN SWITCHED TO THE GROUND FAULT RETURN (TB3-48). USE IN CONJUNCTION WITH AN EXTERNAL GROUND FAULT RELAY.
48	GROUND FAULT RETURN	RETURN LINE FOR GROUND FAULT INPUT
49	GROUND FAULT ANALOG INPUT	FUTURE FEATURE.
50	GROUND FAULT METER RETURN	RETURN LINE FOR GROUND FAULT ANALOG INPUT.
51	LOAD SHARE KW +	FOR ISOLATED BUS PARALLELING ONLY. KW LOAD SHARING LINES FOR POWERCOMMAND GENSETS.
52	LOAD SHARE KW -	RETURN FOR LOAD SHARE KW.
53	LOAD SHARE KVAR +	FOR ISOLATED BUS PARALLELING ONLY. KVAR LOAD SHARING LINES FOR POWERCOMMAND GENSETS.
54	LOAD SHARE KVAR -	RETURN FOR LOAD SHARE KVAR .
55	LOAD SHARE SHIELD	SHIELD TERMINATION POINT FOR LOAD SHARE KW AND LOAD SHARE KVAR LINES.
56	GENSET BREAKER POSTION SWITCH INPUT	FOR PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT GENSET BREAKER IS CLOSED. USE WITH GENSET BREAKER SWITCH RETURN (TB3-58).
57	GENSET BREAKER INHIBIT SWITCH INPUT	FOR PARALLELING APPLICATIONS, WHEN CLOSED TO GENSET BREAKER SWITCH RETURN (TB3-50), GENSET BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING. FOR POWER TRANSFER CONTROL APPLICATIONS, WHEN CLOSED TO GENSET BREAKER SWITCH RETURN (TB3-50), RESULTS IN TRANSFER INHIBIT.

58	GENSET BREAKER SWITCH RETURN	RETURN LINE FOR TB3-56/57.
59	GENSET BREAKER OPEN COMMAND	FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN GENSET BREAKER. USE WITH TB3-60.
60	GENSET BREAKER OPEN COMMAND RETURN.	USE WITH TB3-59.
61	GENSET BREAKER CLOSE COMMAND.	FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSES TO CLOSE GENSET BREAKER. USE WITH TB3-62.
62	GENSET BREAKER CLOSE COMMAND RETURN	USE WITH TB3-61.
63	UTILITY BREAKER POSTION INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT UTILITY BREAKER IS CLOSED. USE WITH UTILITY BREAKER RETURN (TB3-65).
64	UTILITY BREAKER INHIBIT INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED TO UTILITY BREAKER RETURN (TB3-65), RESULTS IN RETRANSFER INHIBIT.
65	UTILITY BREAKER RETURN	USE WITH TB3-63/64
66	UTILITY BREAKER OPEN COMMAND	FOR USE IN POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN UTILITY BREAKER.. USE WITH TB3-67.
67	UTILITY BREAKER OPEN COMMAND RETURN	USE WITH TB3-66.
68	UTILITY BREAKER CLOSE COMMAND	FOR USE IN POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSES TO CLOSE UTILITY BREAKER.. USE WITH TB3-69.
69	UTILITY BREAKER CLOSE COMMAND RETURN	USE WITH TB3-68.
70	SYSTEM LOAD INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. ACCEPTS CT INPUT FOR MONITORING B PHASE CURRENT ON THE UTILITY BUS. USE UTILITY CT RETURN (TB3-72). A 3 OHM BURDEN RESISTOR IS CONNECTED ACROSS TB3-70 AND TB3-72.
71	SPARE	
72	SYSTEM LOAD RETURN	USE WITH TB3-70.

NOTES
USE 18AWG SHIELDED CABLE FOR TERMINALS TB3-41, 42, 43, AND 44. TERMINATE DRAIN WIRE ON TB3-45
USE 18AWG SHIELDED CABLE FOR TERMINALS TB3-51, 52, 53, AND 54. TERMINATE DRAIN WIRE ON TB3-55



DOOR INTERIOR



LEFT SIDE INTERIOR

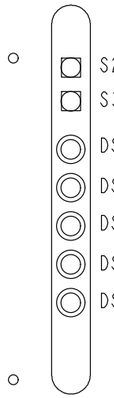
LONWORKS PCB (OPTIONAL)

STANDARD PCB
CUSTOMER CONNECTION INFORMATION

MISCELLANEOUS

LONWORKS PCB

FRONT OF CARD



TB6 CONNECTIONS

TB6-1	GENSET BATTERY +
TB6-2	GENSET BATTERY -
TB6-3	NOT USED
TB6-4	LONWORKS DATA CONNECTION 1
TB6-5	LONWORKS DATA CONNECTION 2
TB6-6	NETWORK POWER +
TB6-7	NETWORK POWER +
TB6-8	NETWORK POWER -
TB6-9	NETWORK POWER -

RJ45 CONNECTION

PROVIDES A TEMPORARY SERVICE CONNECTION TO THE NETWORK

S1-TERMINATION SWITCH

LOCATED ON TOP MIDDLE OF CIRCUIT CARD. CARD MUST BE REMOVED TO ACCESS. SWITCH TO ON IF SINGLE DEVICE NETWORK OR TERMINATED DEVICE IN A MULTIDROP TOPOLOGY.

S4-NODE CONFIGURATION SWITCH

LOCATED ON TOP FRONT OF CIRCUIT CARD. CARD MUST BE REMOVED TO ACCESS. USE TO SET NODE ADDRESS AND SWITCH BETWEEN 24VDC AND 12VDC SUPPLY.

S2-RESET SWITCH

MOMEMTARY PUSH BUTTON SWITCH USED TO RESET THE NETWORK COMMUNICATIONS MODULE (NCM).

S3-SERVICE SWITCH

MOMEMTARY PUSH BUTTON SWITCH USED TO PLACE THE NCM IN SERVICE MODE DURING LOGICAL INSTALLATION.

DS1-SERVICE LED (AMBER)

ILLUMINATED WHEN NCM IS IN SERVICE MODE.

DS3-STATUS LED (GREEN)

FLASHES AT A 1HZ RATE WHEN NCM IS PROPERLY EXECUTING ITS APPLICATION. WHEN THE LED IS NOT FLASHING THE NETWORK IS EITHER UNCONFIGURED, OFF-LINE, OR AN ERROR HAS OCCURRED.

DS4-NETWORK ERROR LED (RED)

ILLUMINATED WHEN NCM HAS DETECTED A NETWORK ERROR.

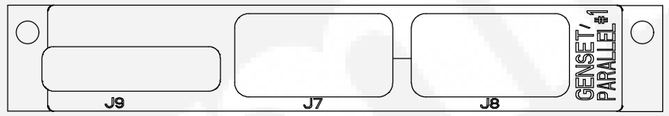
DS5-NETWORK ACTIVITY LED (GREEN)

ILLUMINATED FOR 1/16TH OF A SECOND WHEN NCM SENDS OR RECEIVES AN EXPLICIT NETWORK MESSAGE.

DS2-SLAVE B ACTIVITY LED (GREEN)

ILLUMINATED WHEN NCM EXCHANGES DATA WITH THE BASE CARD.

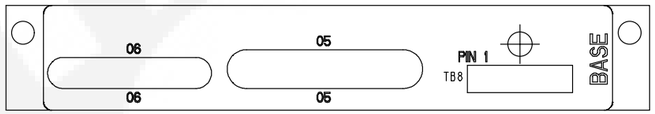
GENSET/PARALLEL PCB



S1-SLEEP IN AUTO SWITCH

SWITCH TO ON (UP POSITION) TO KEEP CONTROL AWAKE IN AUTO MODE.

BASE PCB



TB8-	NAME	DESCRIPTION
1	REMOTE EMERGENCY STOP	OPEN THE CONNECTION BETWEEN THESE TERMINAL POSITIONS TO INITIATE AN EMERGENCY STOP. TERMINAL POSITIONS MUST BE SHORTED TOGETHER IF REMOTE EMERGENCY STOP IS NOT USED.
2		
3	REMOTE START TYPE	DETERMINES START TYPE: OPEN = EMERGENCY START SEQUENCE. CLOSED = NORMAL START SEQUENCE. APPLY REMOTE START RETURN (TB8-5) TO CLOSE.
4	REMOTE START	APPLY REMOTE START RETURN (TB8-5) TO REMOTE START THE GENSET.
5	REMOTE START RETURN	RETURN LINE FOR REMOTE START TYPE AND REMOTE START.

DS1-READY STATUS LED (GREEN)

WHEN CONTINUOUSLY ILLUMINATED INDICATES THE CONTROL IS FUNCTIONING NORMALLY AND ALL CIRCUIT CARDS ARE IN THE CORRECT SLOT. LED WILL BLINK AT 1 SECOND INTERVALS WHEN THERE IS A CONFIGURATION PROBLEM. LED WILL BLINK AT 1/2 SECOND INTERVALS WHEN FAULT FLASHOUT IS ACTIVATED, WHEN FIRST BOOTING UP, OR WHEN A VALID OPERATING PROGRAM IS NOT LOADED.

12 TO 22 AWG (2.5-.75MM^2) USE MINIMUM 60C RATED STRANDED COPPER WIRE ONLY. TORQUE 4.4 IN.-LB. (.5 NM)

FUEL PCB

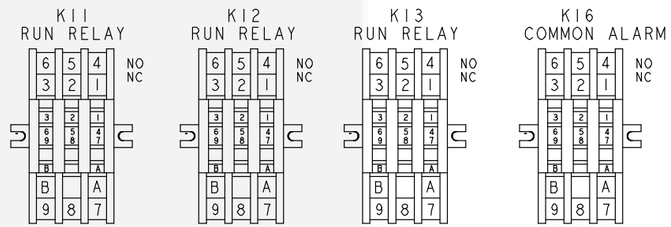
DS5-WARNING LED (AMBER)

ILLUMINATED WHEN A WARNING CONDITION IS PRESENT.

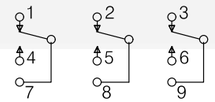
DS1-SHUTDOWN LED (RED)

ILLUMINATED WHEN A SHUTDOWN HAS OCCURRED.

CUSTOMER RELAYS



RELAY CONTACT LAYOUT

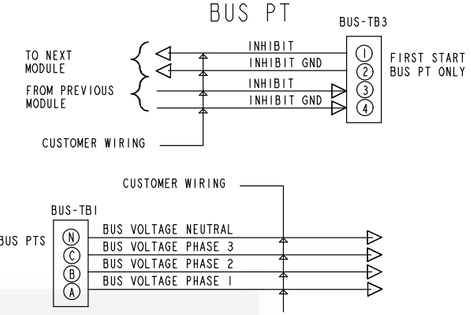


RUN RELAYS (K11, K12, & K13)
ACTIVATES WHEN GENERATOR SET IS RUNNING.

ALARM RELAY (K16)
ACTIVATES ON AN ALARM CONDITION.

CONTACT RATINGS: 10 AMP = 28VDC / 120 VAC, 6 AMP = 240 VAC .8 PF, 3 AMP = 480 / 680 VAC .8 PF
12 - 16 AWG (25 - 1.0 MM^2) USE MINIMUM 60C RATED STRANDED COPPER WIRE ONLY. TORQUE 11 IN.-LB. (1.2 NM)

BUS PT



12 TO 22 AWG (2.5-.75MM^2) USE MINIMUM 60C RATED STRANDED COPPER WIRE ONLY. TORQUE 9 IN.-LB. (1.0 NM)

BUS-TB3 (FIRST START VERSION ONLY)

PROVIDES A MEANS TO DAISY CHAIN CIRCUIT BREAKER INHIBIT SIGNALS AND SYSTEM GROUNDS WITH MULTIPLE GENSETS IN PARALLEL. BUS-TB3-4 AND BUS-TB3-2 ARE COMMON TO EACH OTHER. BUS-TB3-1 AND BUS-TB3-3 ARE COMMON TO EACH OTHER.

BUS-TB1

TERMINAL BLOCK FOR BUS VOLTAGE SENSING.

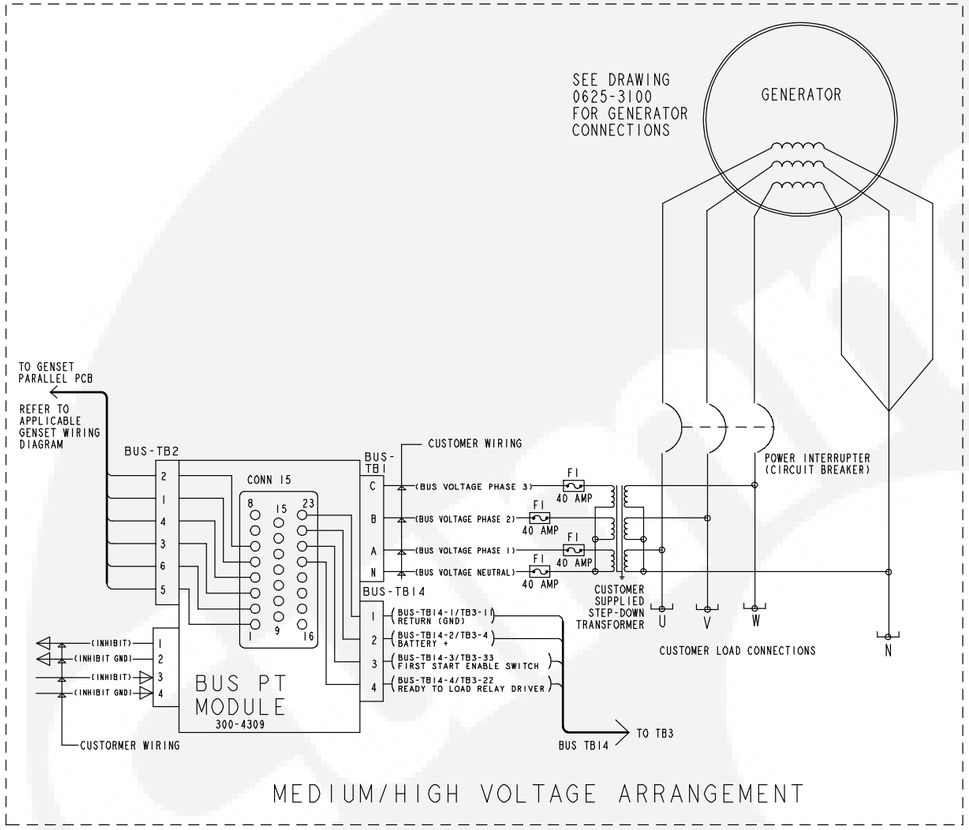
FRONT DOOR

CONNECTOR J2

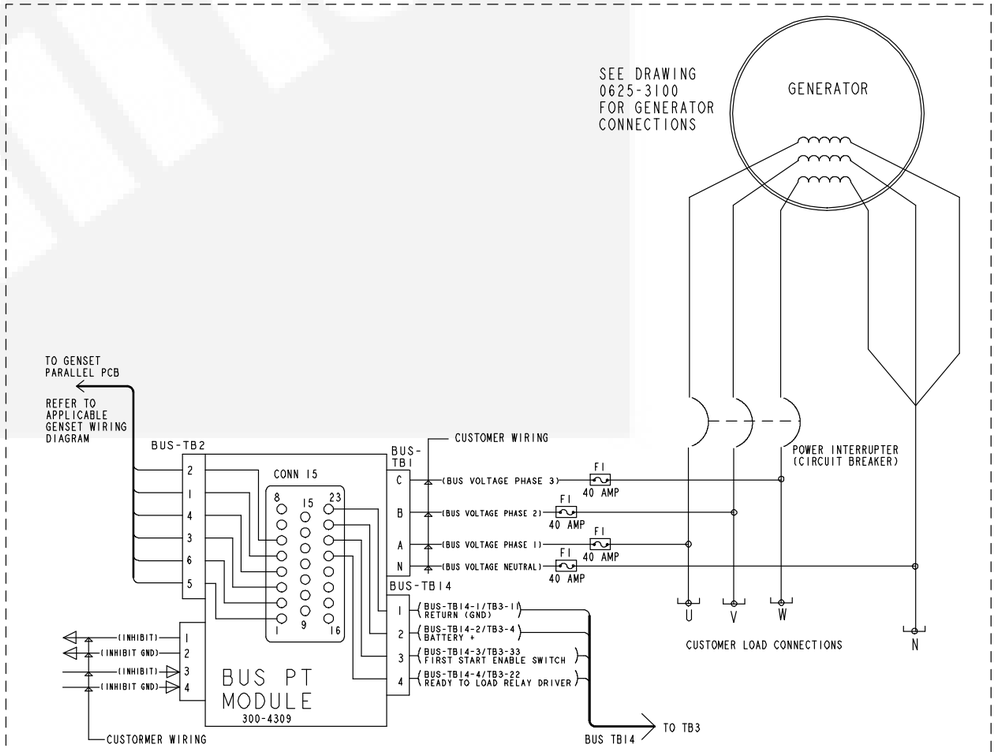
9 PIN RS232 CONNECTOR FOR DISPLAY PANEL PROGRAMMING.

CONNECTOR J3

9 PIN RS232 CONNECTOR FOR PCC 3200 PROGRAMMING.

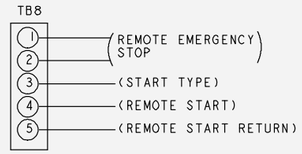


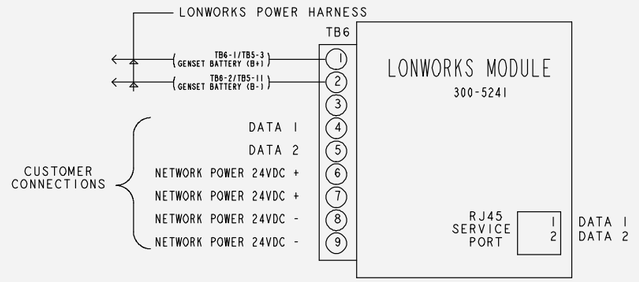
MEDIUM/HIGH VOLTAGE ARRANGEMENT



LOW VOLTAGE ARRANGEMENT

CUSTOMER CONNECTIONS ON BASE PCB





LONWORKS OPTION

NO. 630-3226
OF 1
REV. A
MODIFIED 11-10-05

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