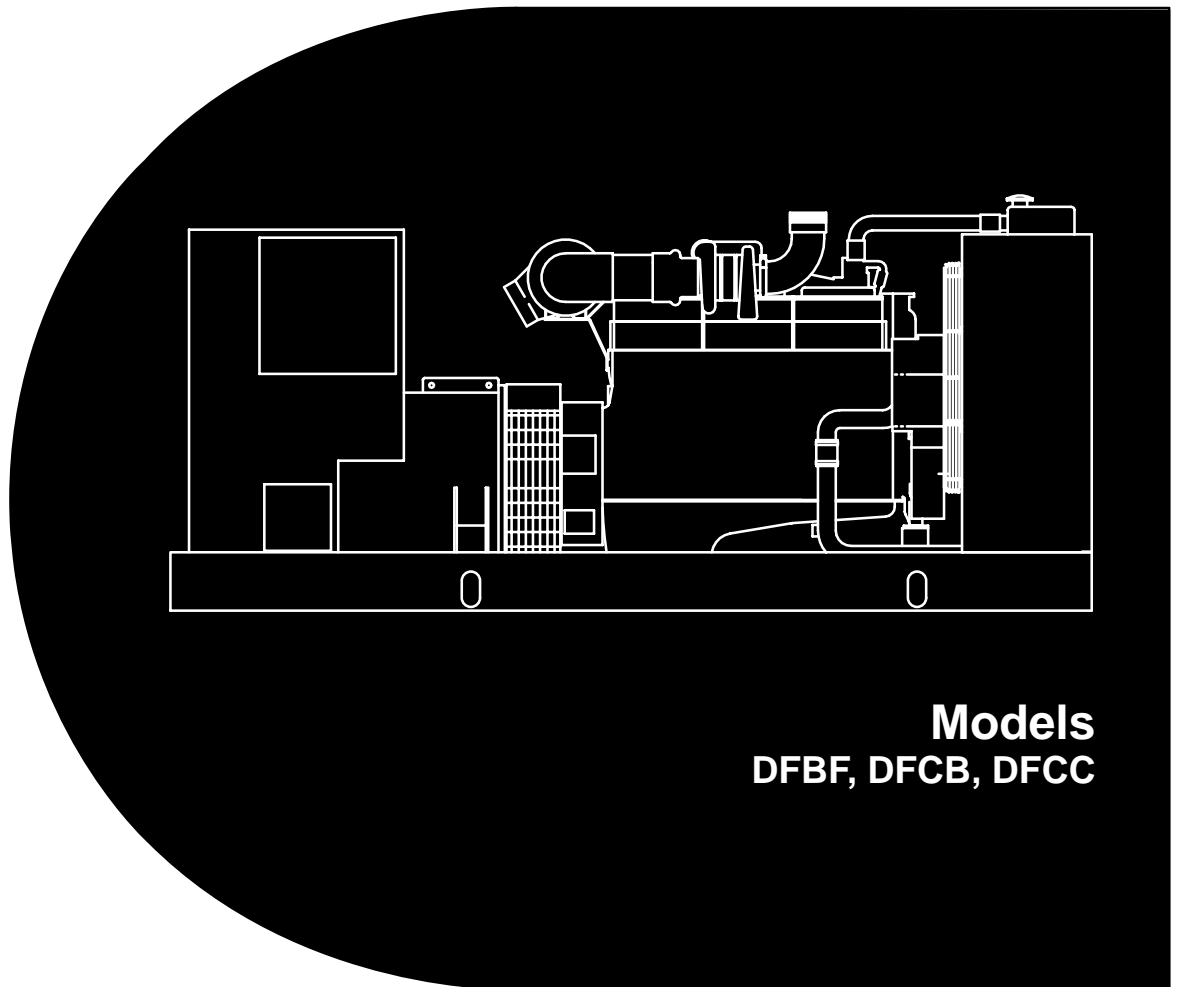


Installation Manual

Detector™ Control Generator Sets



Models
DFBF, DFCB, DFCC

Table of Contents

SECTION	TITLE	PAGE
1	INTRODUCTION	1-1
	About this Manual	1-1
	Installation Overview	1-1
2	SPECIFICATIONS	2-1
3	MOUNTING THE GENERATOR SET	3-1
	General	3-1
	Location	3-1
	Mounting	3-2
	Access to Set	3-2
	Vibration Isolators	3-4
4	MECHANICAL CONNECTIONS	4-1
	General	4-1
	Fuel System	4-1
	Exhaust System	4-3
	Ventilation and Cooling	4-4
5	ELECTRICAL CONNECTIONS	5-1
	General	5-1
	Transfer Switch	5-1
	AC Wiring	5-2
	DC Wiring	5-3
6	PRESTART PREPARATION	6-1
	General	6-1
	Ventilation	6-1
	Exhaust System	6-1
	Mechanical Checks	6-1
	Electrical System	6-1
	Coolant	6-2
	Lubrication	6-2
	Fuel	6-3
7	INITIAL START AND CHECKS	7-1
	Starting	7-1
	Engine Gauges	7-1
	AC Meters	7-1
	Engine Monitor Indicator Lamps	7-1
	Exhaust System	7-1
	Fuel System	7-2
	DC Electrical System	7-2
	Cooling System	7-2
	Mechanical Adjustments	7-2
8	WIRING DIAGRAMS	8-1

IMPORTANT SAFETY INSTRUCTIONS

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

Before operating the generator set (genset), read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

⚠ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use zinc coated or copper fuel lines with diesel fuel.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

EXHAUST GASES ARE DEADLY

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect battery charger from its AC source, then disconnect starting batteries, negative (–) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

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

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment. Do not wear jewelry. Jewelry can short out electrical contacts and cause shock or burning.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag and lock open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

MEDIUM VOLTAGE GENERATOR SETS

(601V to 15kV)

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

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10).
- Make sure that rags are not left on or near the engine.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breathe or ingest or come into contact with exhaust gases.
- Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.
- Wear hearing protection when going near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator, turbo charger and exhaust system.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides installation instructions for the DF Series generator sets. This includes the following information:

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

Mechanical Connections - Location of connection points for fuel, exhaust, ventilation, and cooling.

Electrical Connections – Location of electrical connection points for the control, generator, and starting system.

Prestart – Checklist of items or procedures needed to prepare generator set for operation.

Initial Startup – Test complete system to ensure proper installation, satisfactory performance, and safe operation. Refer to Operators Manual for troubleshooting information.

This manual DOES NOT provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), review standard installation practices, or specify system materials, additional information is required. For engineering data specific to the generator set, refer to the specification and product data sheets. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets", available from Onan.

INSTALLATION OVERVIEW

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

Application and Installation

A standby power system must be carefully planned and correctly installed for proper operation. This involves two essential elements: application and installation.

Application (as it applies to generator set installations) refers to the design of the complete standby power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, and cooling, exhaust, and fuel systems. Each component must be correctly designed so the complete system will function as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers are responsible for the design of the complete standby system and for selecting the materials and products required.

Installation refers to the actual set-up and assembly of the standby power system. The installers set up and connect the various components of the system as specified in the system design plan. The complexity of the standby system normally requires the special skills of qualified electricians, plumbers, sheet metal workers, etc. to complete the various segments of the installation. This is necessary so all components are assembled using standard methods and practices.

Safety Considerations

The generator set has been carefully designed to provide safe and efficient service when properly installed and operated. However, the overall safety and reliability of the complete system is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

2. Specifications

Systems	275 DFBF	300 DFCB	350 DFCC
Cummins Model Engine	NT855-G6	NTA855-G2	NTA855-G3
Coolant Capacity Engine and Radiator	66 Qt. (62.5L)	68 Qt. (64.4L)	68 QT. (64.4L)
Oil Capacity	42 QT. (40L)	42 Qt. (40L)	42 Qt. (40L)
Fuel Pump Inlet Thread Size Outlet Thread Size Maximum Lift	7/8-14 UNF 3/4-16 UNF 5 ft (1.5m)	7/8-14 UNF 3/4-16 UNF 5 ft (1.5m)	7/8-UNF 3/4-16 UNF 5 ft (1.5m)
Exhaust Outlet Size Maximum Allowable Exhaust Back Pressure	5 in NPT 40.8 in H ₂ O (10.2 kPa)	6 in NPT 40.8 in H ₂ O (10.2 kPa)	6 in NPT 40.8 in H ₂ O (10.2 kPa)
Starting System Voltage DC	24	24	24
Battery Requirements Battery Cold Cranking Amps	Two, 12V Group 8D 975	Two, 12V Group 8D 975	Two, 12V Group 8D 975

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.

3. Mounting the Generator Set

GENERAL

Most generator set installations must be designed so the generator set will function properly under all anticipated operating conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire ordinances, and other applicable regulations.

Requirements to be considered prior to installation (refer to Figure 3-2):

- Level mounting surface
- Adequate cooling air supply
- Adequate fresh induction air
- Discharge of cooling air
- Discharge of exhaust gases

- Fuel system installation
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation

LOCATION

Optimum generator set location is determined by related systems such as ventilation, wiring, fuel, and exhaust. The set should be located as near as possible to the main power fuse box.

Wood floors should be covered with sheet metal extending 12 inches (305 mm) beyond the extremities of the set.

Provide a location away from extreme ambient temperatures. Protect the generator set from adverse weather conditions, and unauthorized personnel.

MOUNTING

Generator sets are mounted on a steel subbase that provides proper support. For critical installations, install vibration isolators between the subbase and the foundation.

Mount the generator set on a substantial and level base such as a concrete pad. For typical installations, use 3/4 inch anchored mounting bolts to secure the generator set subbase to the floor to prevent movement. Secure the subbase/vibration isolators using flat or bevel washer and hexagonal nut for each bolt (see Figure 3-1). For proper spacing of mounting bolts and set mounting dimensions, see your generator set outline drawing.

ACCESS TO SET

Plan for access to the generator set for servicing and provide adequate lighting around the set. For convenience in general servicing such as the radiator, fan belt, and changing the crankcase oil, the surface of the mounting base should be at least 6 inches (152 mm) above the floor.

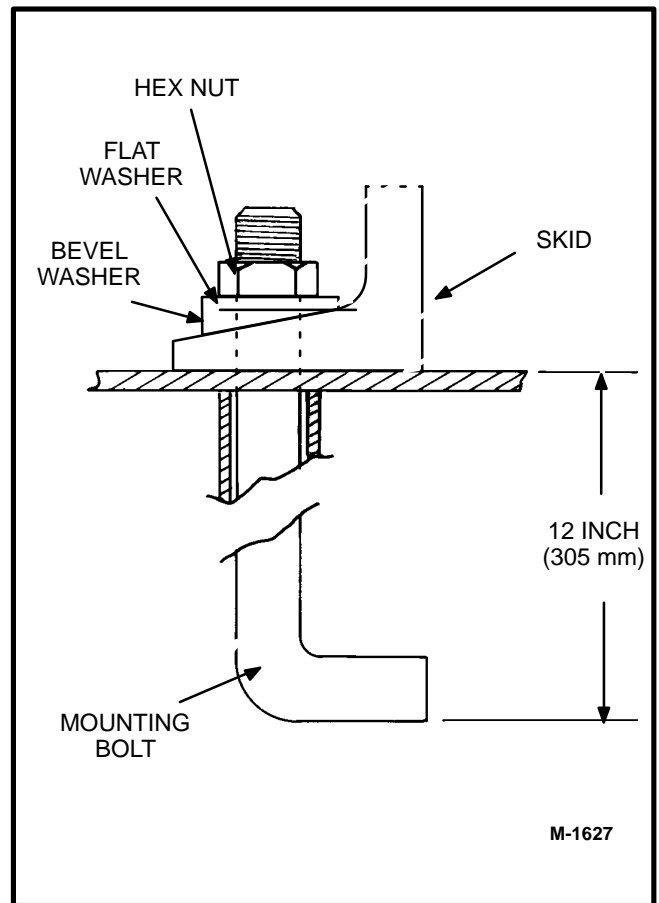


FIGURE 3-1. TYPICAL ANCHOR BOLT DIAGRAM

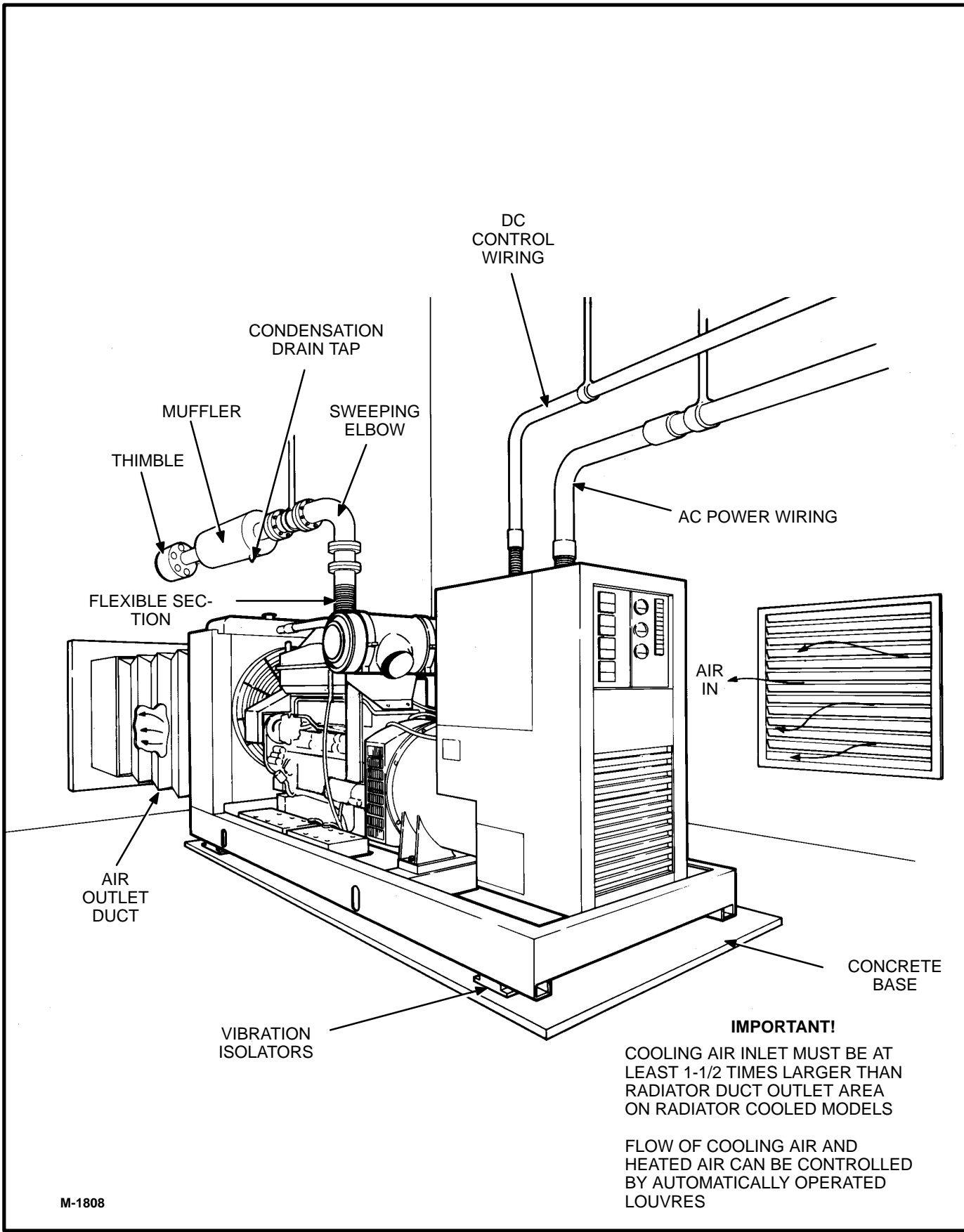


FIGURE 3-2. TYPICAL INSTALLATION

VIBRATION ISOLATORS

Installation and Adjustment Procedure

1. Place the 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 on which the isolator bases rest on must also be flat.
2. Loosen the side snubber lock nuts so that the top plate of the isolator is free to move vertically and horizontally. Be sure that the top plate is correctly aligned with the base and springs.
3. Place the genset onto the isolators while aligning the skid's mounting with the threaded isolator hole. The top plates will move down and 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.

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

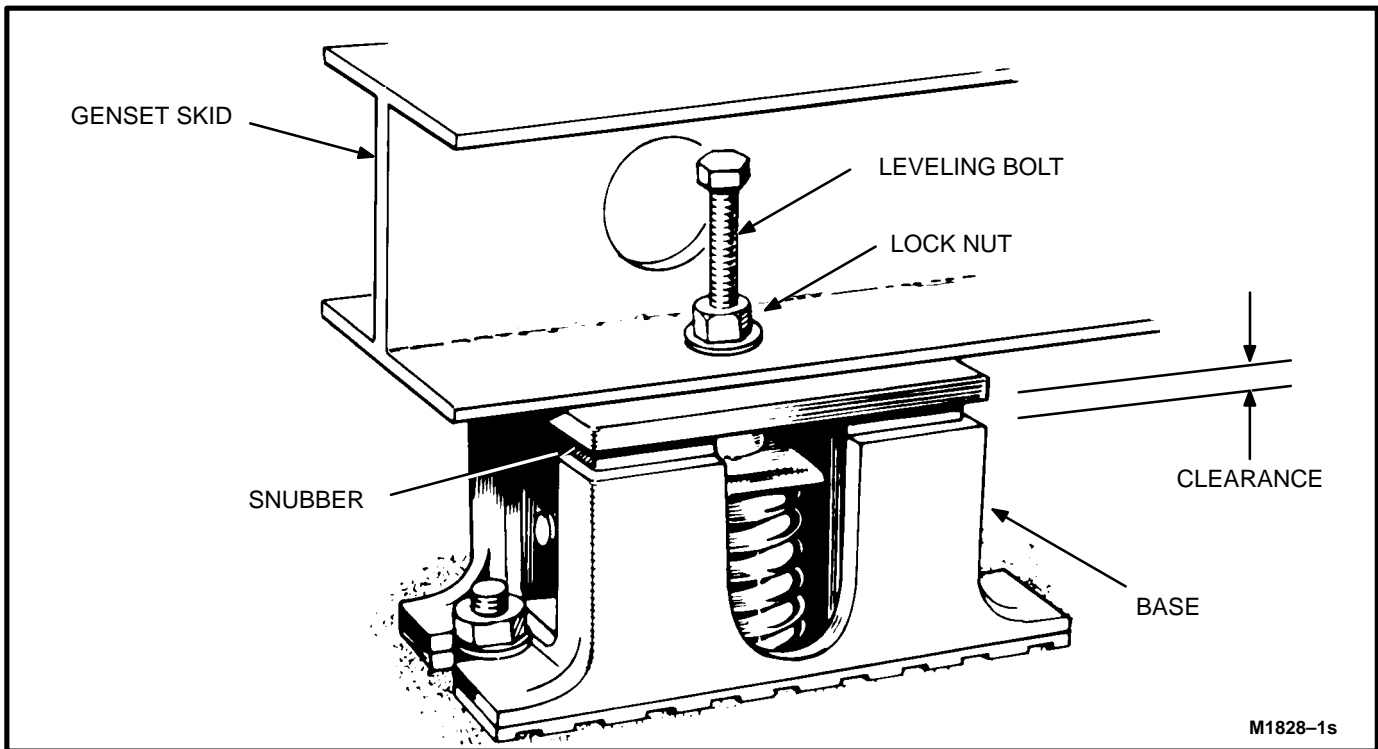


FIGURE 3-3. VIBRATION ISOLATORS

4. Mechanical Connections

GENERAL

The generator set mechanical system installation includes connecting the fuel, exhaust, ventilation and cooling systems (Figure 3-2). Before starting any type of fuel installation, all pertinent state and local codes must be complied with and the installation must be inspected before the unit is put in service.

FUEL SYSTEM

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

In all fuel system installations, cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture, dirt or contaminants of any kind. Clean all fuel system components before installing.

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Use a flexible section of tubing between the engine and fuel

supply line to provide vibration isolation. Refer to your generator set outline drawing for sizes and locations.

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

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

Supply Tank

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

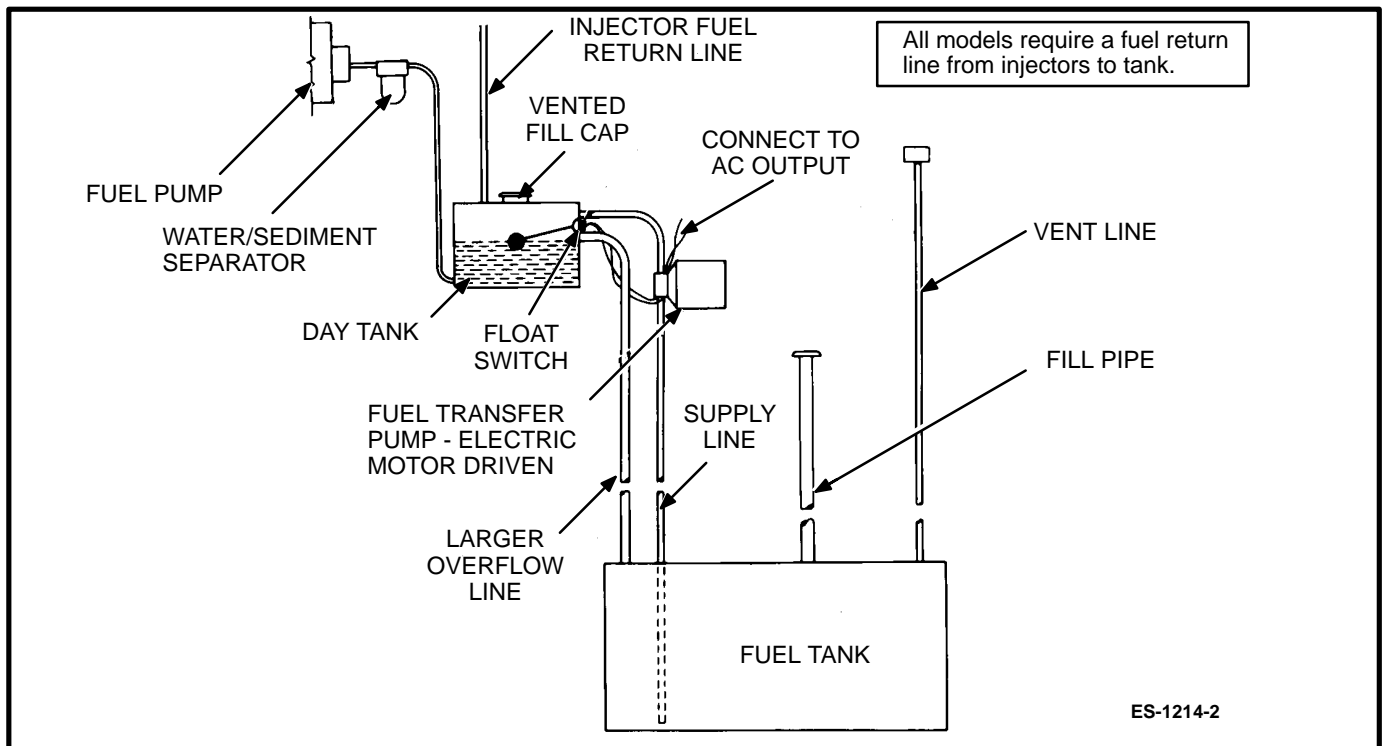


FIGURE 4-1. TYPICAL FUEL SUPPLY INSTALLATION

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

If the main fuel tank is installed below the lift capabilities of the standard fuel transfer pump, a transfer tank (referred to as a day tank) and auxiliary pump will also be required. If an overhead main fuel tank is installed, a transfer tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components. See Day Tank and Figure 4-1.

Day Tank (If Used)

Fuel day tanks are used when the standard engine fuel pump does not have the capacity to draw the fuel from the supply tank; or the supply tank is overhead and presents problems of high fuel head pressure for the fuel return.

Supply Tank Lower Than Engine: With this installation, the day tank is installed near the generator set and within the engine fuel pump lift capability, but below the fuel injection system. Install an auxiliary fuel pump as close as possible to the supply tank to pump fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the auxiliary fuel pump.

The supply tank top must be below the day tank top to prevent siphoning from the fuel supply to the day tank.

Provide a return line from the engine injection system return connection to the day tank (near the top). Provide a day tank overflow line to the supply tank in case the float switch fails to shut off the fuel transfer pump.

⚠WARNING *Spilled fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Provide an overflow line to the supply tank from the day tank.*

Supply Tank Higher Than Engine: Install the day tank near the generator set, but below the fuel injection system. Use fuel line at least as large as the fuel pump inlet. The engine fuel return line must enter the day tank.

Include a shutoff valve in the fuel line between the fuel supply tank and the day tank to stop fuel flow when the generator set is off.

Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections by the factory. Flexible lines for connecting between the engine and the stationary fuel line are supplied as standard equipment.

EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlets away from any air inlets to avoid gases re-entering the enclosure. Exhaust installations are subject to various detrimental conditions such as extreme heat, infrequent operation and light loads. Regularly inspect the exhaust system both visually and audibly to see that the entire system remains fume tight and safe for operation.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to provide a tight exhaust system. Terminate exhaust pipe away from enclosed areas, windows, doors and vents.*

Use an approved thimble (Figure 4-2) where exhaust pipes pass through wall or partitions. Refer to NFPA 37, Section 6-3. "Stationary Combustion Engines and Gas Turbines" for accepted design practices. Build according to the code requirements in effect at the installation site.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Do not use exhaust heat to warm a room, compartment or storage area.*

Rain caps are available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

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

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

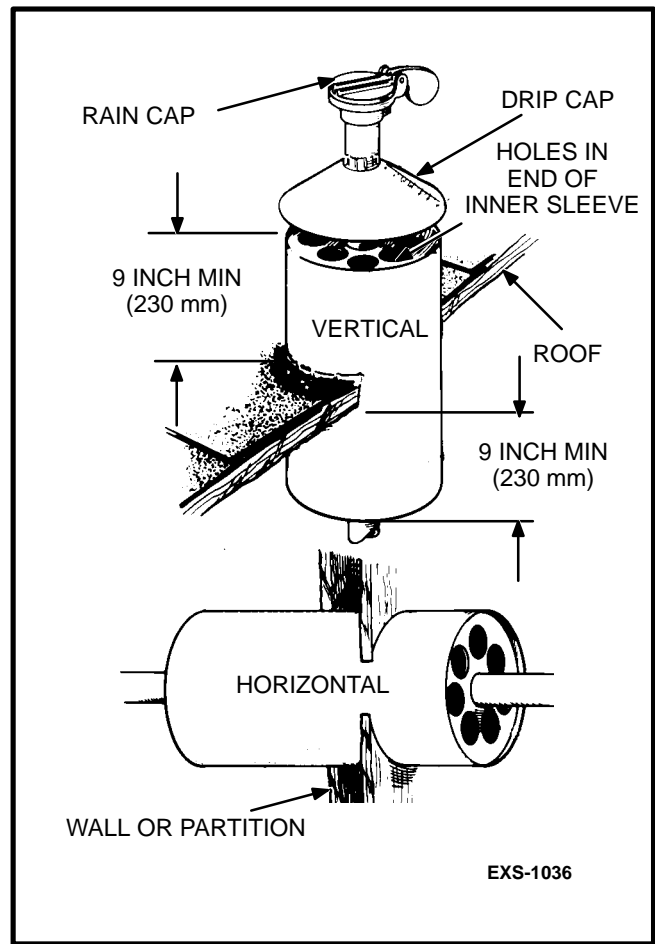


FIGURE 4-2. MOUNTING EXHAUST THIMBLE

Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for muffler and tailpipe. Pitch a horizontal run of exhaust pipe DOWNWARD to allow any moisture condensation to drain away from the engine. If an exhaust pipe must be turned upward, install a condensation trap at the point where the rise begins (Figure 4-3).

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

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

VENTILATION AND COOLING

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

Vents and Ducts

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

Size the vents and ducts so they are large enough to allow the required flow rate of air. The “free area” of ducts must be as large as the exposed area of the radiator. Refer to the DF series Product Data Sheets for the airflow requirements.

Wind will restrict free airflow if it blows directly into the air outlet vent. Locate the outlet vent so the effects of wind are eliminated. See Figure 4-4.

For operation outside a building, a shelter housing with electrically operated louvers is available as an option. Transformers connected across the generator output supply current to the motors.

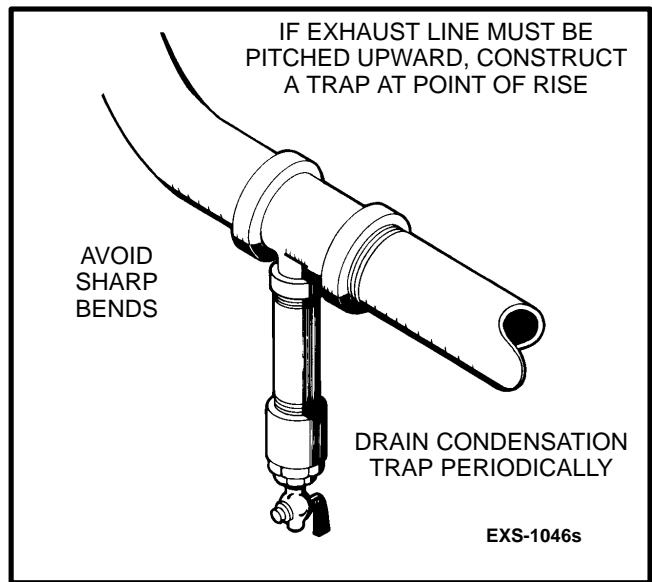


FIGURE 4-3. CONDENSATION TRAP

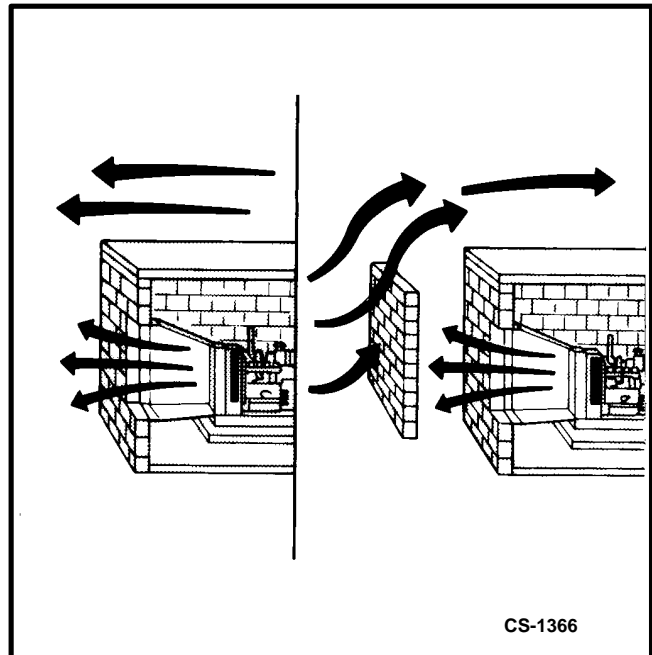


FIGURE 4-4. WIND BARRIER

Dampers

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

In cooler climates movable or discharge dampers are used. These dampers allow the air to be recirculated back to the equipment room. This enables the equipment room to be heated while the genset engine is still cold, increasing the engine efficiency.

Radiator Set Requirements

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

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

The radiator has an air discharge duct adapter flange. Attach a canvas or sheet metal duct to the flange and the air outlet opening using screws and

nuts so duct can be removed for maintenance purposes. The duct prevents circulation of heated air. Before installing the duct, remove the radiator core guard.

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

Remote Radiator Cooling (Optional) substitutes a remote mounted radiator and an electrically driven fan for the set mounted components. Removal of the radiator and the fan from the set reduces noise levels without forcing dependence on a continuous cooling water supply. The remote radiator installation must be completely protected against freezing.

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

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

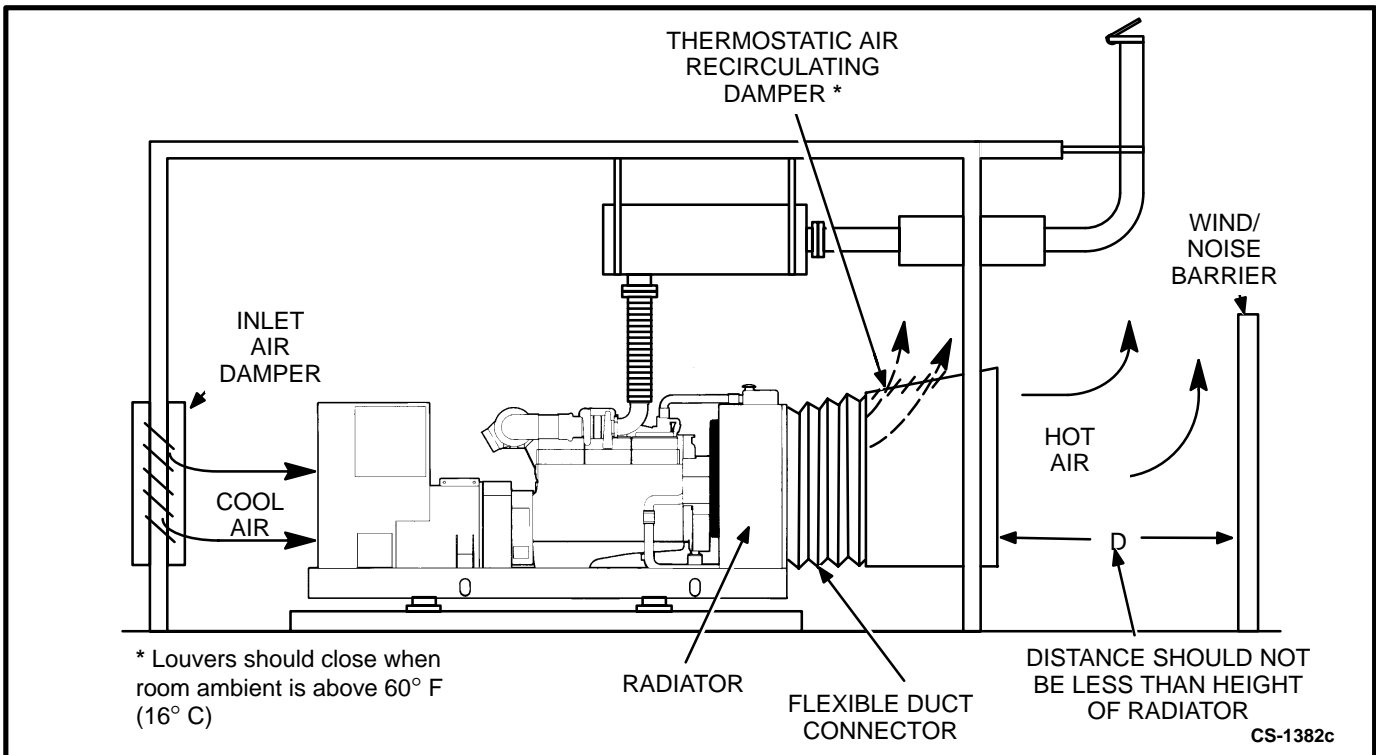


FIGURE 4-5. TYPICAL RADIATOR SET INSTALLATION

Water Jacket Heater (Optional)

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

Heat Exchanger (Optional)

The optional heat exchanger (Figure 4-6) uses a shell and tube type heat exchanger instead of the standard radiator and fan. Engine jacket coolant circulates through the shell side of the heat exchanger while the cooling water is pumped through the

tubes. Engine coolant and raw water do not mix. This type of cooling separation is necessary when the raw water contains scale forming lime or other impurities.

This system can reduce set enclosure airflow requirements and noise levels. Proper operation depends on a constant supply of raw water for heat removal. Adjust the flow to maintain engine coolant temperature between 165° F and 195° F (74° C and 91° C) while viewing the water temperature gauge. The engine coolant side of the system can be protected from freezing; the raw water side cannot be protected.

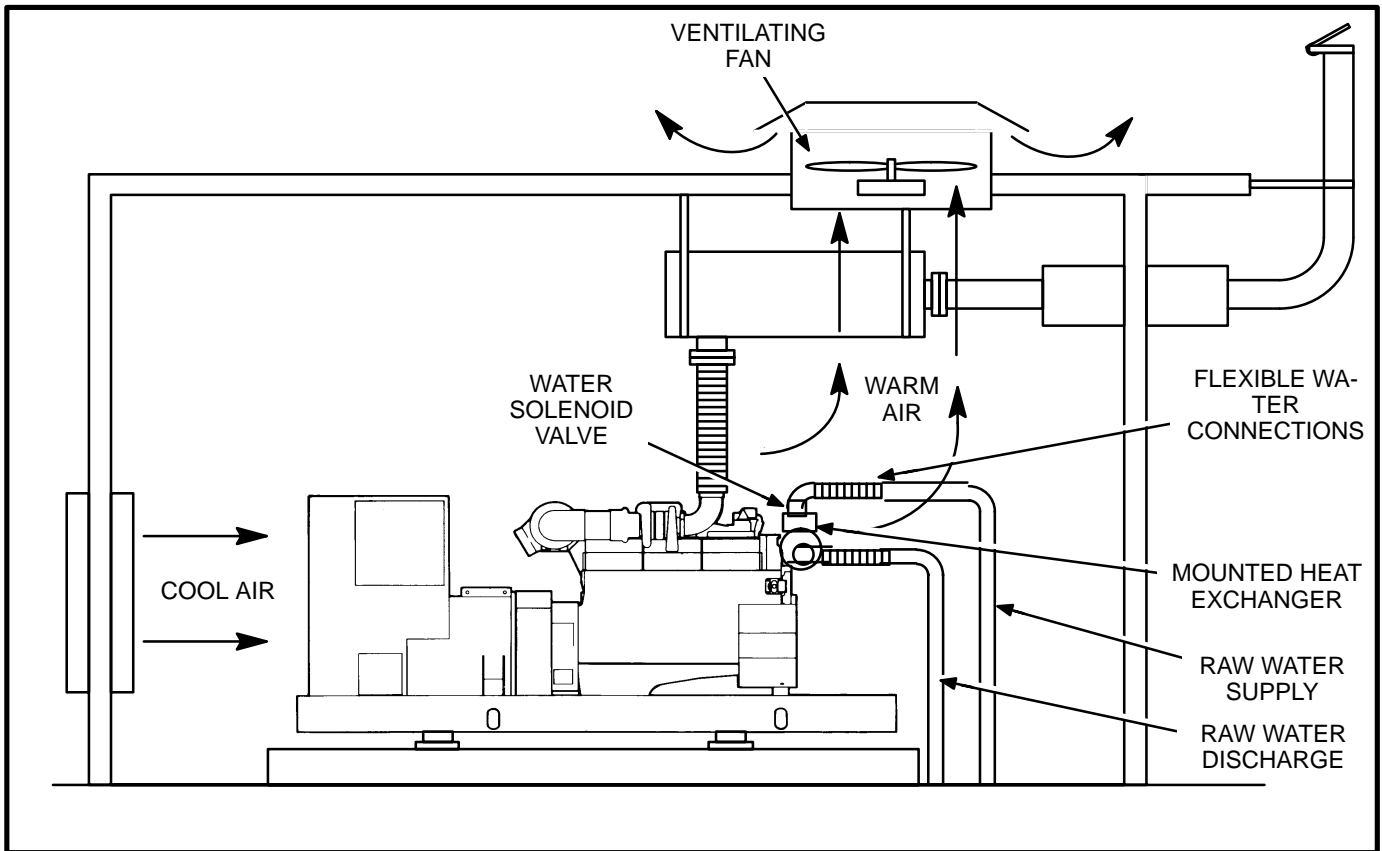


FIGURE 4-6. TYPICAL HEAT EXCHANGER INSTALLATION

Coolant Filter

One spin-on type corrosion filter (Figure 4-7) is standard equipment. This precharge filter is compatible with plain water and all ethylene glycol base permanent antifreeze coolants. Refer to engine manufacturer's manual for instructions if a methoxy propanal base antifreeze is desired. Replace filter periodically as recommended in the *Maintenance* section of the Operator's manual.

Coolant Heater

A coolant heater is used to 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.

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

Figure 4-8 shows the heater line connections. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

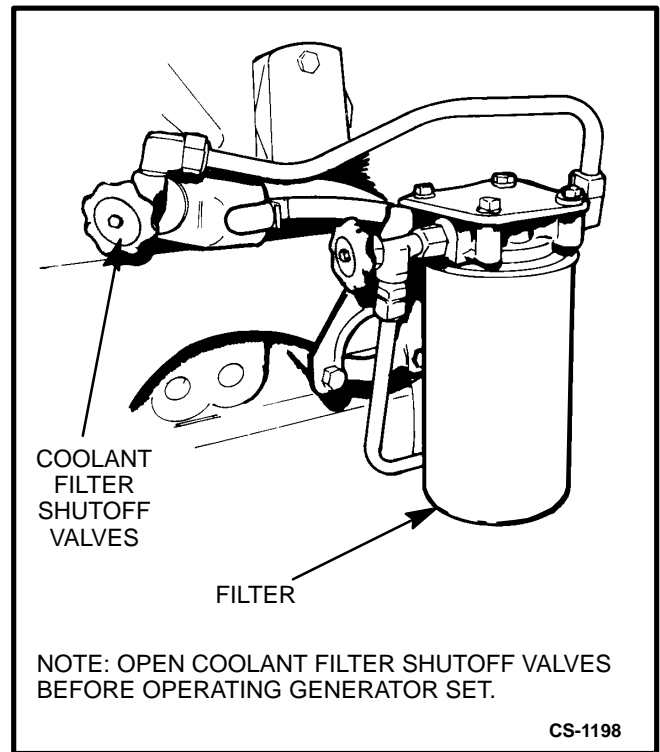


FIGURE 4-7. TYPICAL COOLANT FILTER

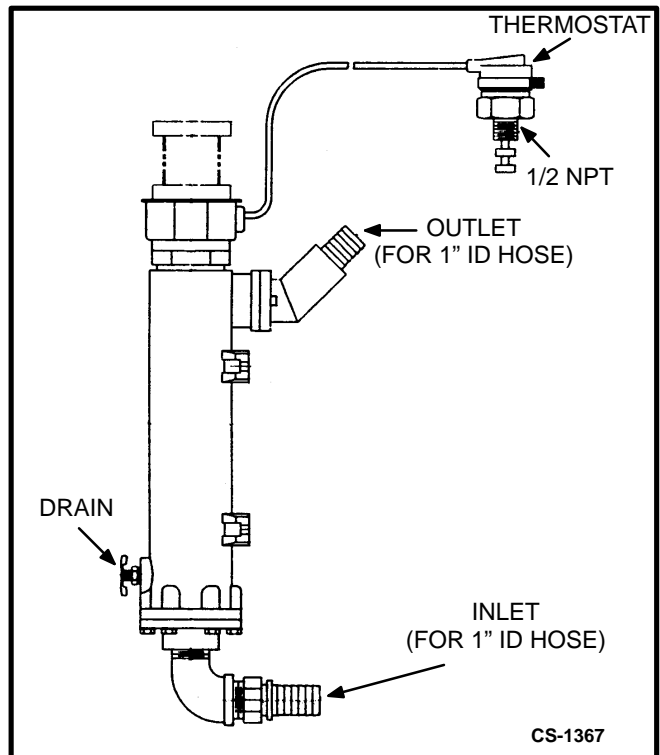


FIGURE 4-8. TYPICAL COOLANT HEATER

5. Electrical Connections

GENERAL

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

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

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

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

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

⚠️WARNING *Improper wiring can cause a fire or electrocution, resulting in severe personal injury or death and/or property and equipment damage.*

TRANSFER SWITCH

If the installation is for standby service, a transfer switch is required for switching the load from the normal power source to the generator set (Figure 5-1). Either a manual or automatic switch can be used. Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

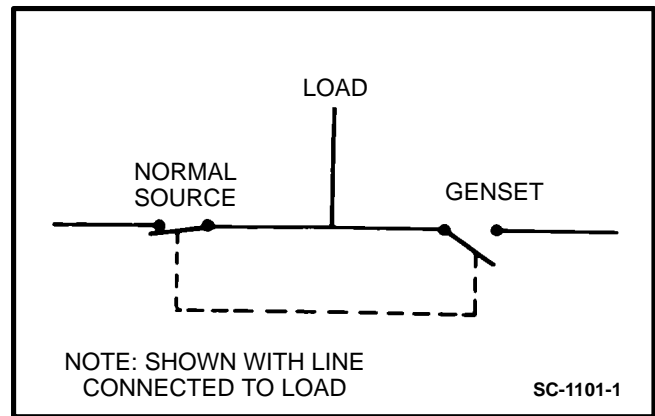


FIGURE 5-1. TYPICAL LOAD TRANSFER SWITCH

AC WIRING

Generator Voltage Connections

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

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

Refer to *Wiring Diagram* section when reviewing the voltage connection information; and use the electrical schematic supplied with your generator set when actually performing load connections.

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

Load Connections

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

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

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

Load Balancing

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

Grounding

Grounding involves making a conducting connection between the metal parts of the generator set or one of its electrical circuits and the earth. The design and installation of a grounding system is affected by many factors such as the use of multiple transformers, ground fault protection requirements and physical location of the generator. Follow the recommendations of the consulting engineer when installing the grounding system.

⚠ WARNING *Contact with electrical equipment can result in severe personal injury or death. It is extremely important that bonding and equipment grounding be properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.*

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

DC WIRING

Remote Control Connections

Provisions are made inside the control box for adding optional remote starting stations and alarms. Connections are made on the terminal block (TB1) located on the engine monitor circuit board (A11). Connect one or more remote switches across remote terminal and B+ terminal. Refer to Figure 5-2.

If the distance between the generator set and remote stations is less than 1000 feet (305 m), use 18 gauge stranded copper wire. If the distance is 1000 to 2000 feet (305 to 610 m), use 16 gauge stranded copper wire. Always run control circuit wiring in a separate conduit from the AC power cables to avoid

inducing currents that could cause problems within the control.

Remote Monitor Connections

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

⚠ CAUTION *Do not install DC control wiring in the same conduit as the AC power. AC voltage induced currents can create operational problems with electronic solid-state devices.*

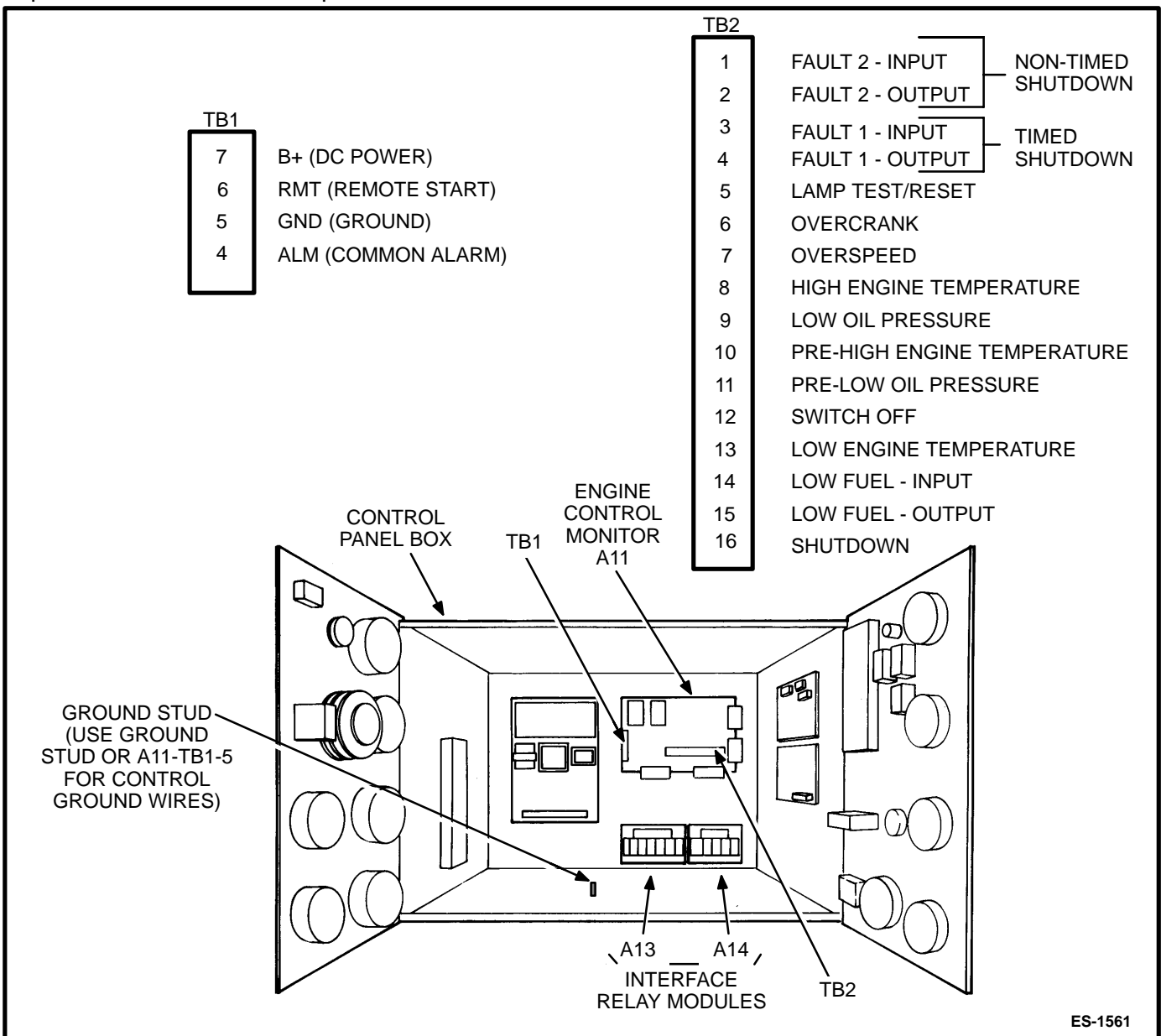


FIGURE 5-2. REMOTE CONTROL AND REMOTE MONITOR CONNECTION POINTS

Battery Connections

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

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

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

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

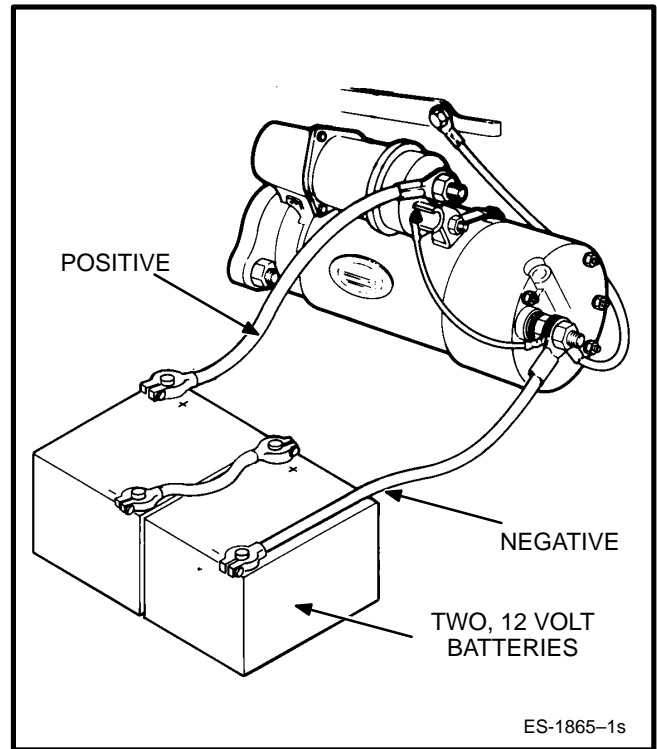


FIGURE 5-3. BATTERY CONNECTIONS

Control Heater (Optional)

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

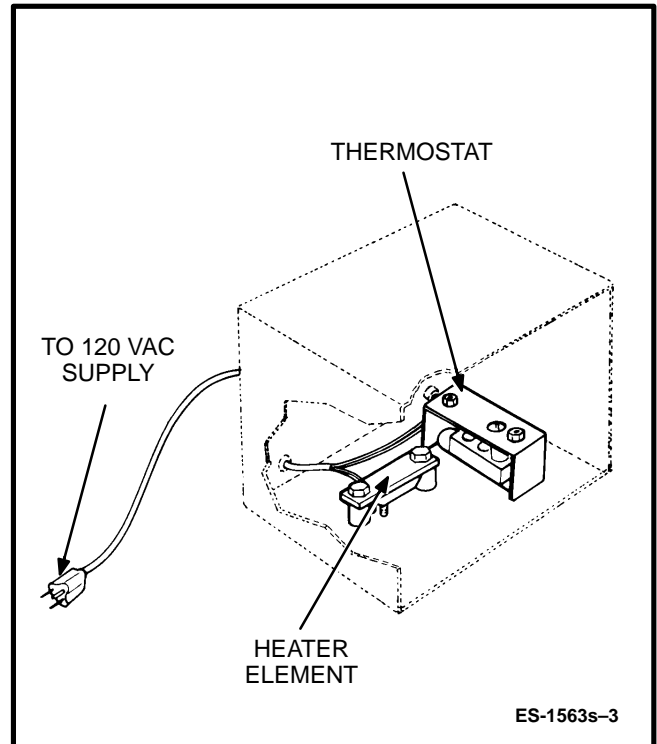


FIGURE 5-4. OPTIONAL CONTROL HEATER

6. Prestart Preparation

GENERAL

Before attempting the initial starting of the generator set, be sure it is serviced and ready for operation (Figure 6-1). Perform the following:

- Check ventilation and exhaust systems
- Check all mechanical connections
- Fill the coolant, lubrication and fuel systems
- Prime the lubrication and fuel systems
- Check the fuel system for leaks
- Check the lubrication system for leaks

VENTILATION

Verify all air vents and ducts are open and free from any obstructions. Verify dampers, if used, operate properly.

EXHAUST SYSTEM

Check the exhaust system for proper installation. Verify there is at least 12 inches (305 mm) clearance between exhaust pipes and combustible materials, and all connections are tight.

MECHANICAL CHECKS

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

ELECTRICAL SYSTEM

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

Load Connections

Check that load cables from generator set are properly connected to either a transfer switch or circuit breaker panel.

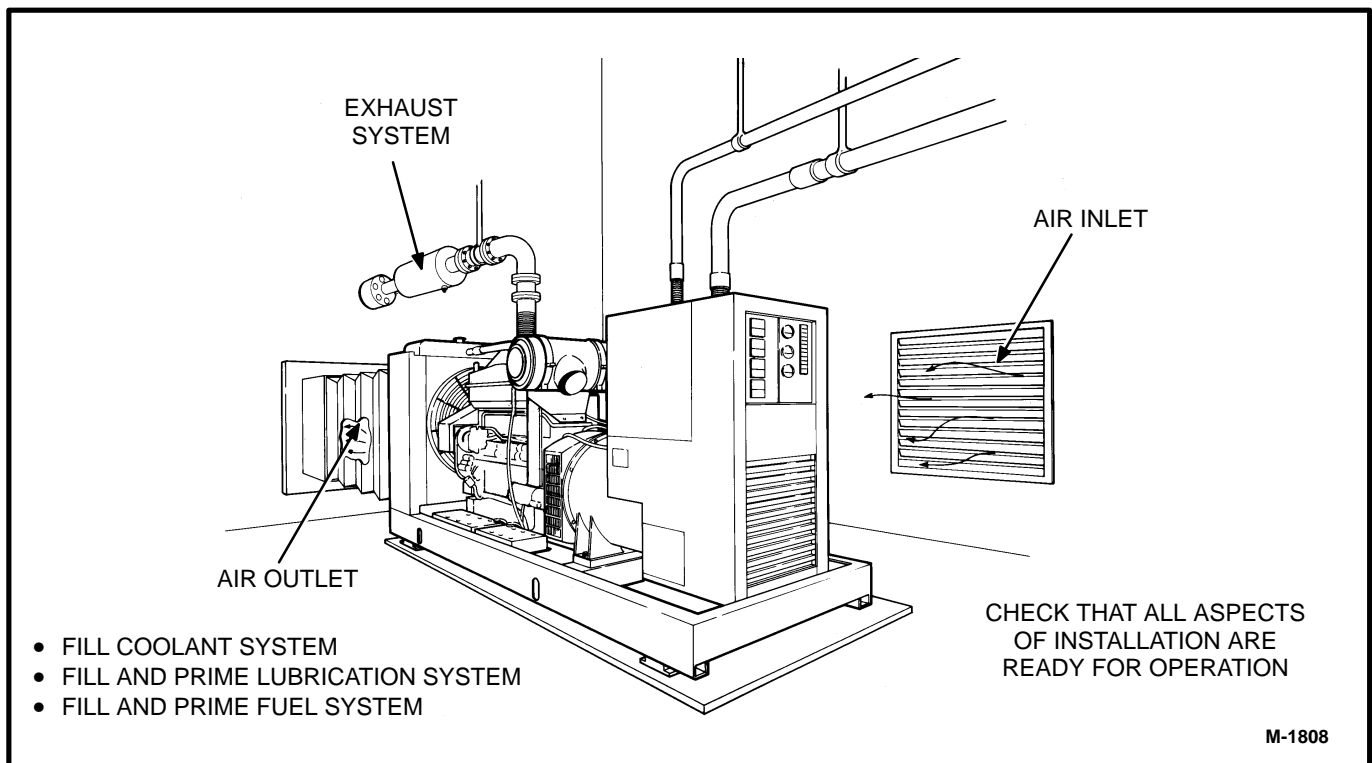


FIGURE 6-1. TYPICAL INSTALLATION

Battery Connections

Use two 12 volt batteries for a normal installation. Connect the negative (-) battery cable last to reduce the risk of arcing.

Service the batteries as necessary. If an automatic transfer switch is not used or installed without a built-in charge circuit, connect a separate float charger to the battery.

COOLANT

Engine coolant is drained prior to shipment. Before starting, fill the cooling system with the recommended coolant. See Operator's manual *Maintenance* section for more information.

LUBRICATION

Engine oil is drained prior to shipment. Before starting, fill and prime the lubrication system as follows:

1. Remove oil inlet line from turbocharger housing (Figure 6-2), fill bearing housing with clean engine lubricating oil; replace line and secure.
2. Fill crankcase to "L" (low) mark on dipstick (Figure 6-3) and refer to *Maintenance* section in Operator's manual for oil recommendations.
3. Remove plug from head of oil filter housing. Connect a hand or motor driven priming pump, equipped with pressure gauge, from a source of clean lubricating oil to the plug boss in the filter housing.
4. Prime until a 30 psi (207 kPa) pressure is obtained.
5. Disconnect wire from fuel solenoid valve (Figure 6-4).
6. On the engine control panel, depress the RUN switch to crank the engine, while maintaining an oil priming pressure of 15 psi (103 kPa) for 15 seconds, at filter head priming port.
7. Stop engine cranking, remove external priming equipment, reinstall plug in filter housing and torque to 15 to 20 ft lb (20 to 27 N•m).
8. Reconnect wire to fuel solenoid valve.
9. Complete oil fill to "H" (high) mark on dipstick.

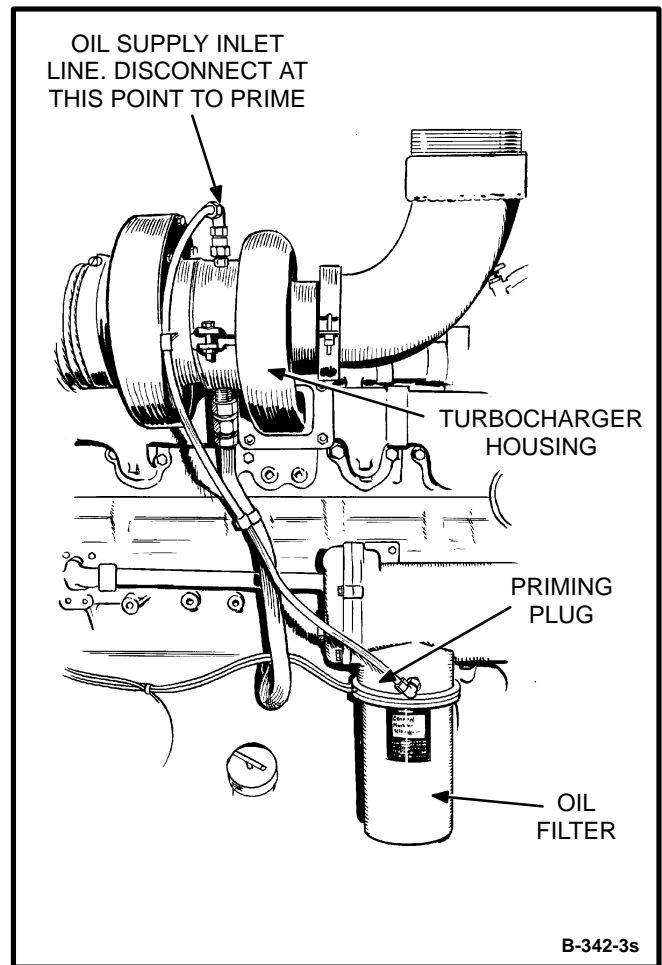


FIGURE 6-2. PRIMING TURBOCHARGER

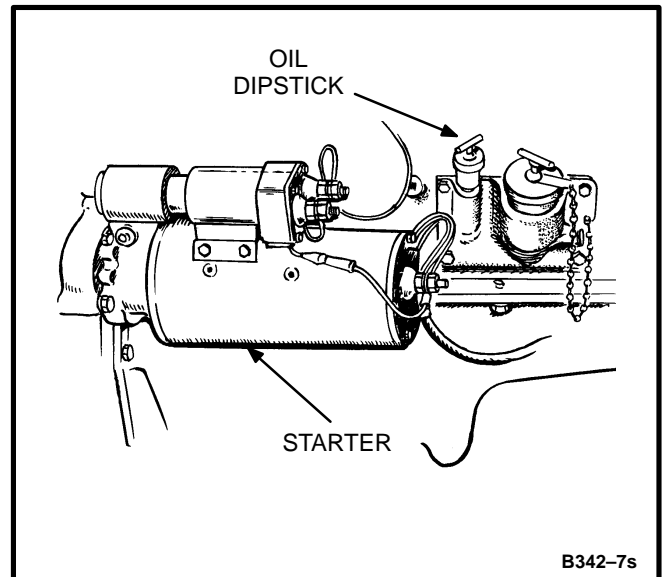


FIGURE 6-3. OIL DIPSTICK LOCATION

FUEL

Fill the fuel tanks with the recommended fuel. Engine fuel may not be primed at the fuel filters after shipment. To verify and reprime the fuel system perform the following procedure:

1. Remove each fuel filter and fill with clean fuel (Figure 6-5).

⚠ CAUTION *Due to the precise tolerances of diesel injection systems, it is extremely important the fuel be kept clean and free of water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.*

2. Put a light coat of fuel on the sealing gasket.
3. Install and tighten by hand until the gasket just touches the filter head.
4. Tighten the filter an additional one-half to three-fourths turn.

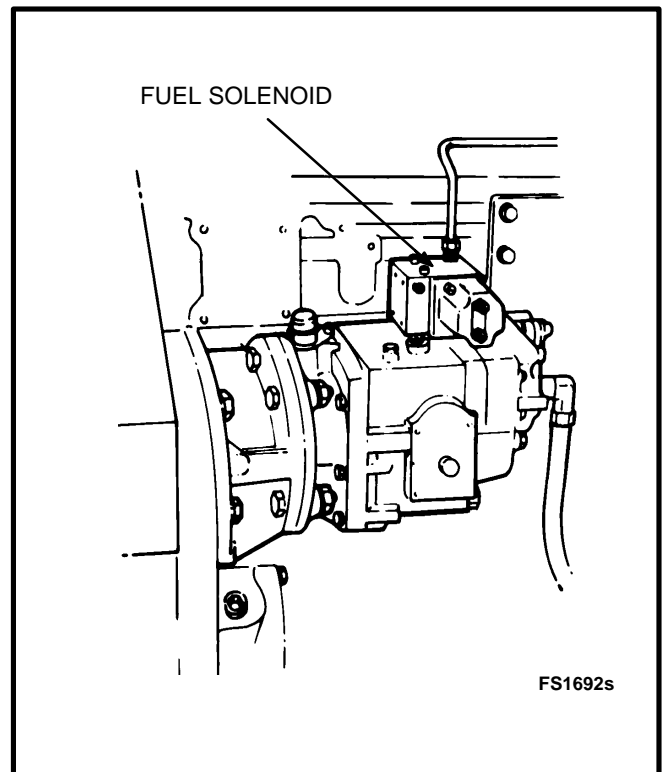


FIGURE 6-4. FUEL SOLENOID VALVE LOCATION

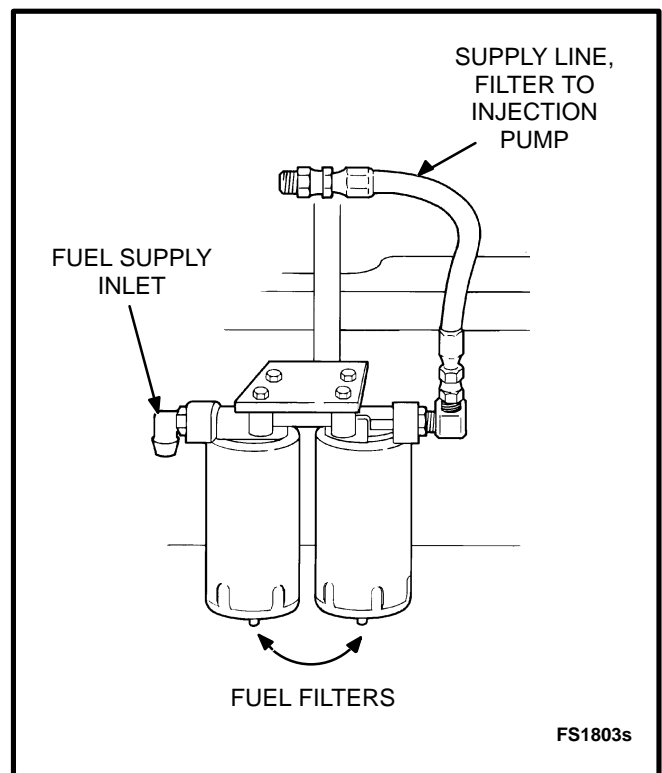


FIGURE 6-5. FUEL FILTERS

7. Initial Start and Checks

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

STARTING

Move the Run/Stop/Remote switch on the engine control panel to the Run position. The starter should crank the engine and the engine should start within a few seconds. If after a few seconds of cranking the engine fails to start or starts, runs and then stops, refer to Troubleshooting charts in the Operator's Manual.

ENGINE GAUGES

Check the following while the genset is operating:

Oil Pressure Gauge

The oil pressure should be in the range of 40 to 60 psi (275 to 414 kPa) when the engine is at operating temperature.

Water Temperature Gauge

The water temperature should be in the range of 165° to 195°F (74° to 91°C) depending on the load and ambient temperature.

DC Voltmeter

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

AC METERS (IF EQUIPPED)

Note the AC instruments on the control panel. The frequency meter and voltmeter should indicate rated nameplate frequency and voltage. Turn the control panel Voltage Adjust control (if equipped) for nameplate voltage. Use the Phase Selector Switch to read each of the line-to-line voltages.

Frequency Meter

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

AC Voltmeter

Turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2 on single phase sets; L1-L2, L2-L3 and L3-L1 on three phase sets). Read the AC voltmeter using the upper or lower scale as indicated by the scale indicator light. At no load, the line-to-line voltage should be the same as the set nameplate rating.

AC Ammeter

Turn the phase selector switch to each phase selection shown on the amperes scale (L1 and L2 on single phase sets; L1, L2 and L3 on three phase sets). Read the ammeter using the upper or lower scale as indicated by the scale indicator light. At no load, the current readings should be zero. With a load applied, each line current should be approximately the same and no line current should exceed the set nameplate reading.

ENGINE MONITOR INDICATOR LAMPS

Move the Run/Stop/Remote switch on the engine panel to the Stop position. Hold the Reset/Lamp Test switch in the Test position. All indicator lamps should light. Verify all the lamps are on and then release the switch. Contact your authorized service center if any lamps require replacement.

EXHAUST SYSTEM

With the genset operating, inspect the entire exhaust system including the exhaust manifold, muffler, turbocharger and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets and joints. Make sure exhaust pipes are not heating surrounding areas excessively. If any leaks are detected, have them corrected immediately.

⚠️WARNING *Inhalation of exhaust gases can result in severe injury or death. Inspect exhaust system visually and audibly for leaks daily. Repair any leaks immediately.*

FUEL SYSTEM

With the genset operating, inspect the fuel supply lines, filters and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and make sure they are not rubbing against anything that could cause breakage.

⚠WARNING *Leaking fuel will create a fire hazard that can result in severe personal injury or death if ignited by a spark. If any leaks are detected, have them corrected immediately.*

DC ELECTRICAL SYSTEM

With the generator set off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance that can hinder starting. Clean and reconnect the battery cables if loose. Always connect the negative battery cable last.

⚠WARNING *Ignition of explosive gases can cause explosion and fire, resulting in severe personal injury or death. Do not smoke while servicing the batteries.*

COOLING SYSTEM

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

MECHANICAL ADJUSTMENTS

With the generator stopped, check for loose belts and fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately.

With the set running, listen for any unusual noises that can indicate mechanical problems. Check the oil pressure frequently. Refer to Operator's or Service Manual for required adjustments.

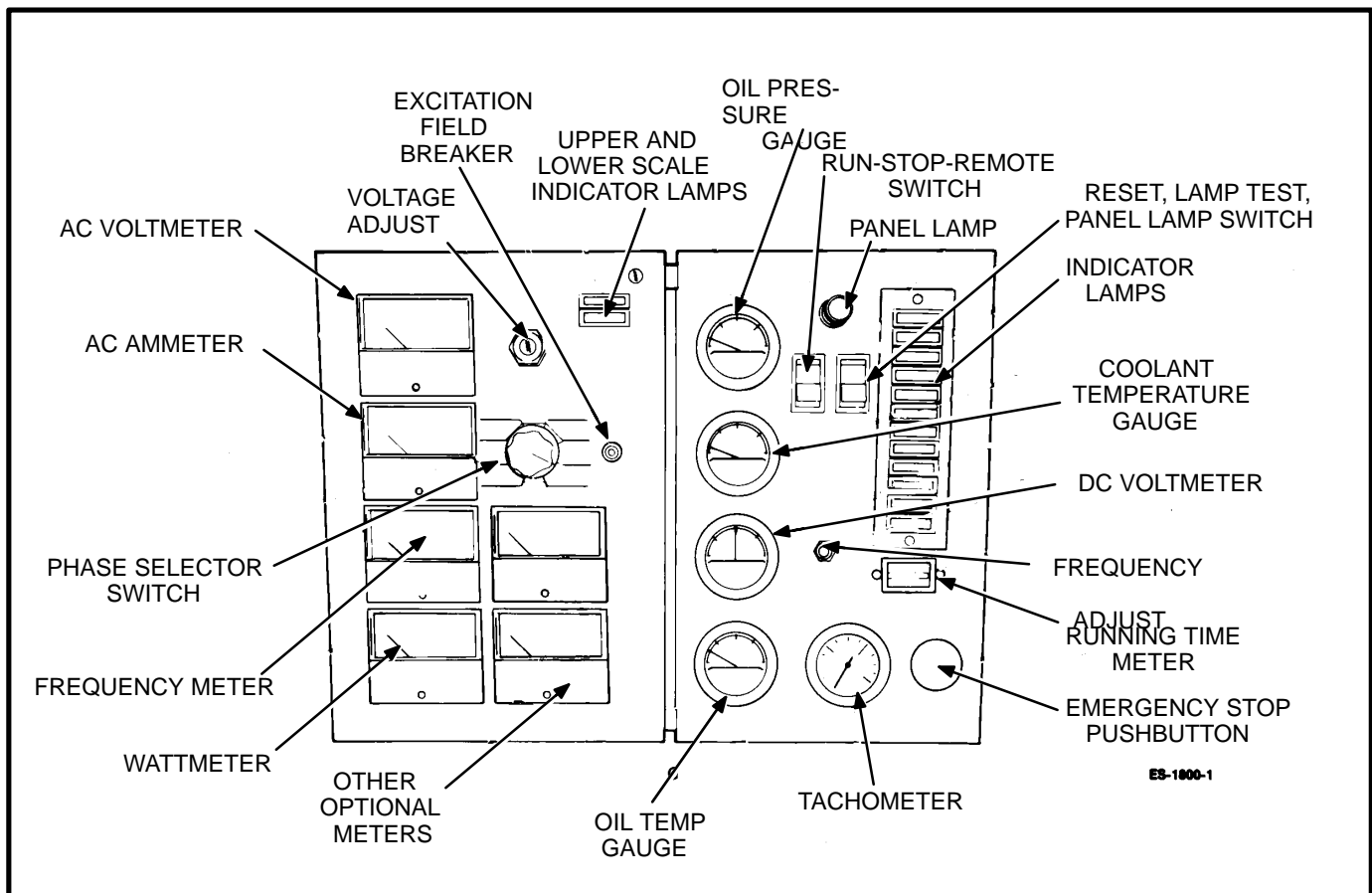


FIGURE 7-1. CONTROL PANEL WITH OPTIONS

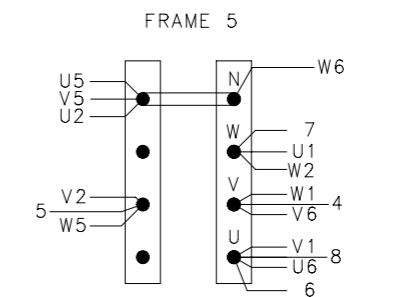
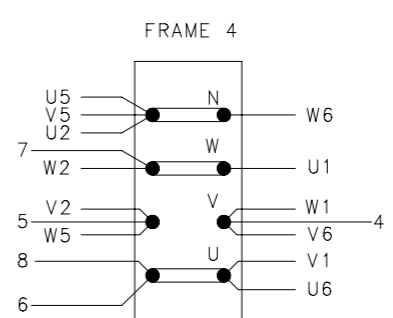
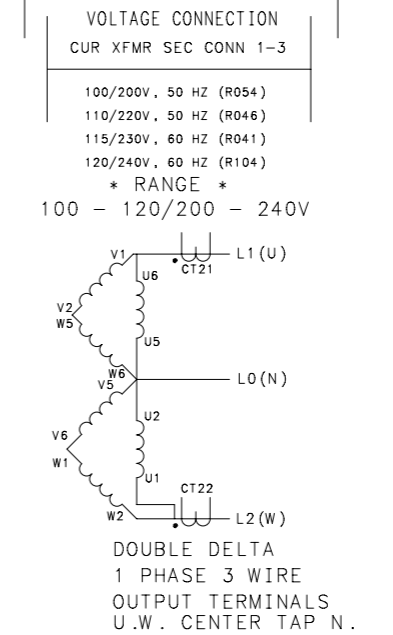
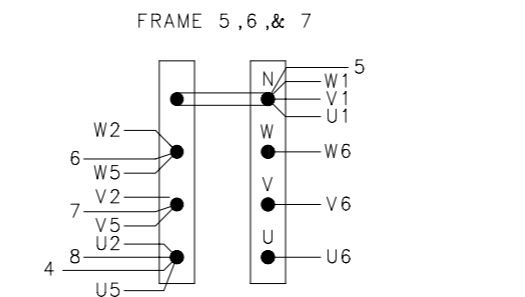
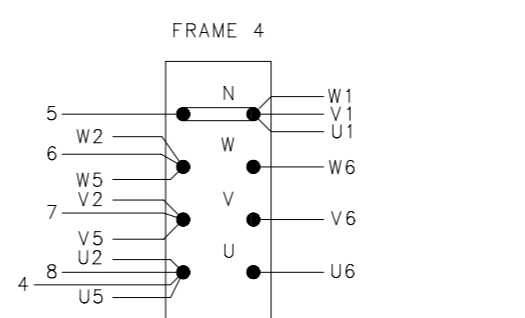
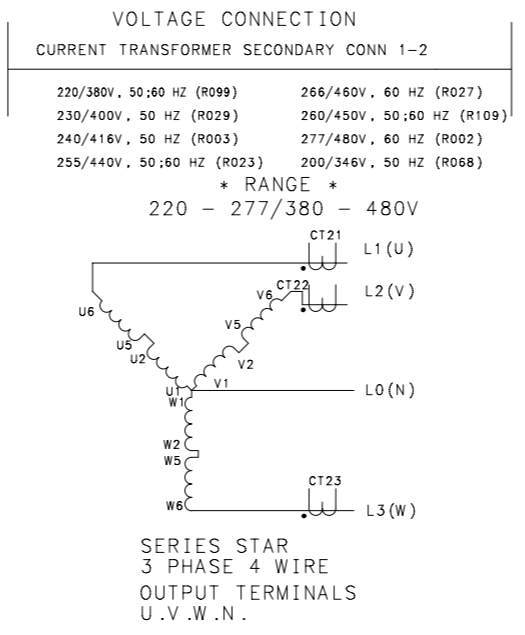
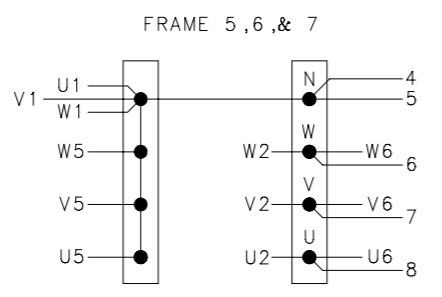
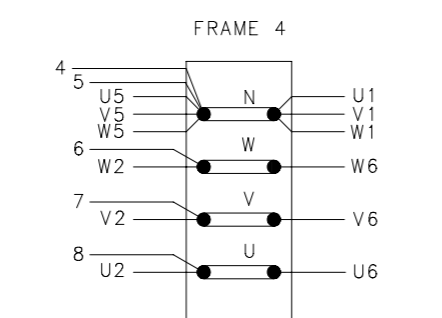
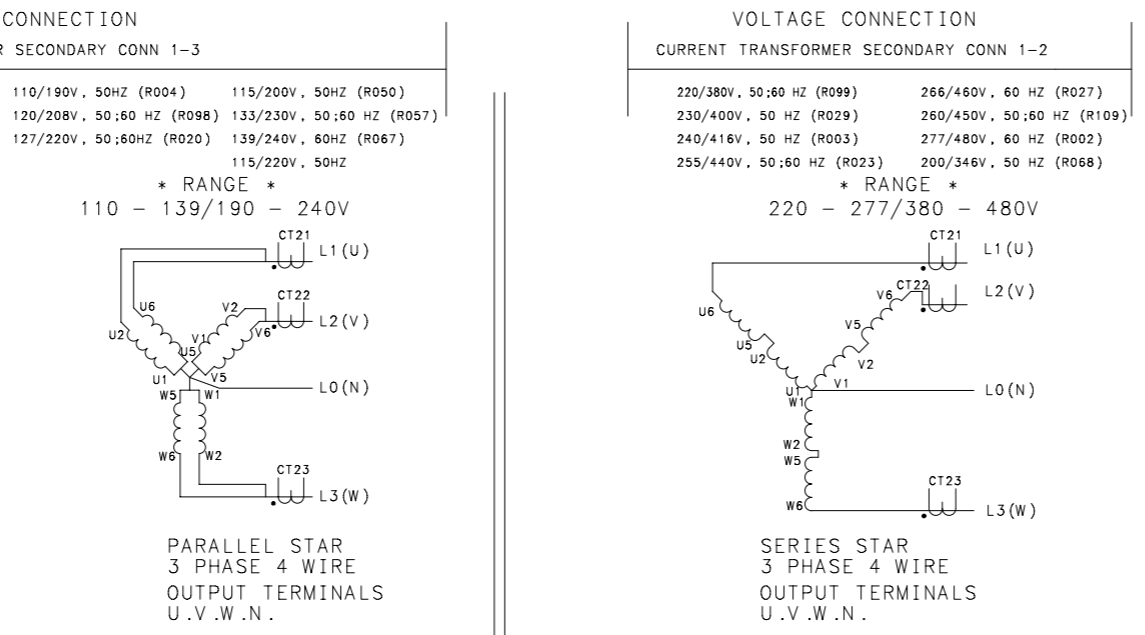
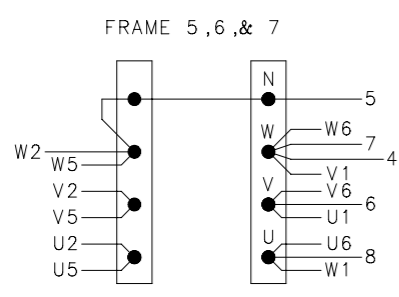
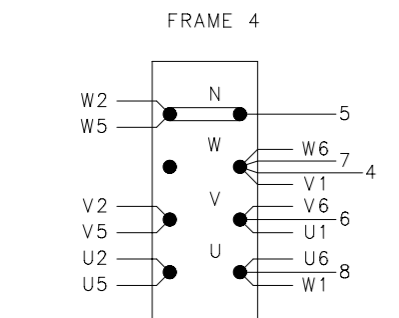
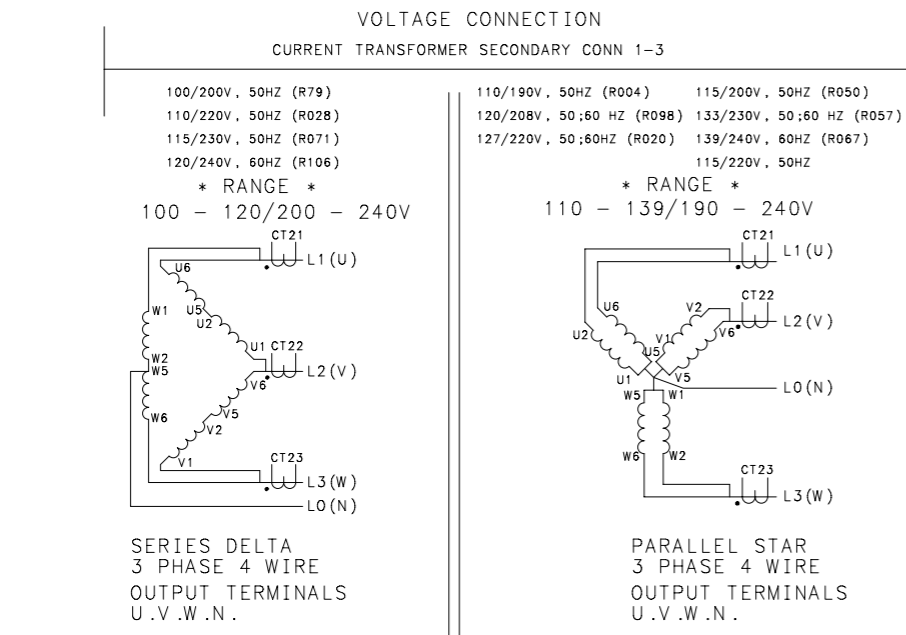
8. Wiring Diagrams

Reconnectible Voltages 8-3
Non-reconnectible Voltages 8-4

SC, CC, HC GENERATORS

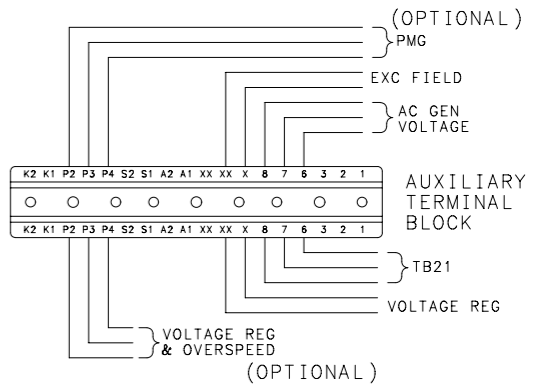
3 PHASE RECONNECTABLE

1 PHASE RECONNECTABLE



NOTES:
1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.

CONTROL INPUT 12 LEAD					
CONTROL INPUT TB21	AUX TERM CON	SERIES DELTA	PARALLEL STAR	SERIES STAR	DOUBLE DELTA
22	8	8	8	8	8
23	7	7	7	7	7
24	-	4	4	4	4
25	6	6	6	6	6
26	-	5	5	5	5
JUMPER	-	-	-	-	-



No. 625-2165 Sh 1 of 2
Rev. J Sys: Revision
Modified 2/1994

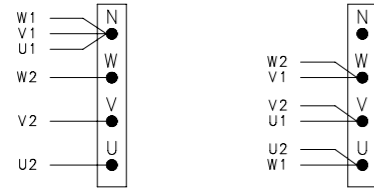
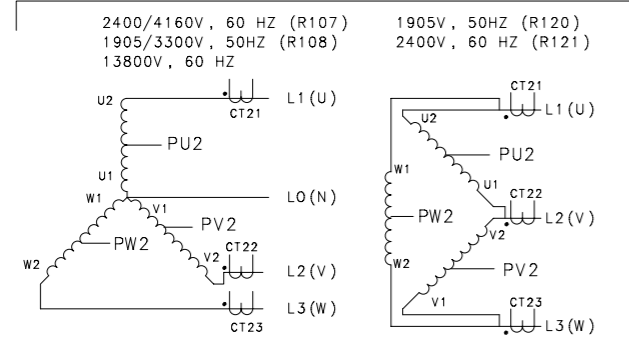
RECONNECTIBLE VOLTAGES

SC, CC, HC GENERATORS

3 PHASE NON-RECONNECTABLE

MEDIUM VOLTAGE

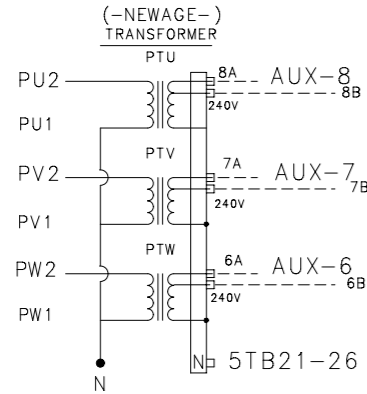
CURRENT TRANSFORMER SECONDARY CONN 1 - 2



PRIMARY JUMPERS

WYE CONNECTIONS:
PV1 - PW1 - PU1

A - 4160 VOLT WYE
B - 3300 VOLT WYE



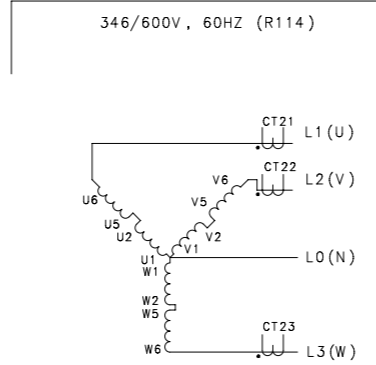
PRIMARY JUMPERS

DELTA CONNECTIONS:
PV1 - PU2
PW1 - PV2
PU1 - PW2

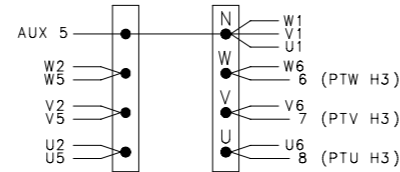
A - 2400 VOLT DELTA

CONTROL INPUT				
6 OR 12 LEAD				
CONTROL INPUT TB21	AUX TERM CON	SERIES STAR	SERIES DELTA	MEDIUM VOLTAGE
22	8	8	8	8
23	7	7	7	7
24	-	-	-	-
25	6	6	6	6
26	-	5	5	5
JUMPER	-	21 - 24	21 - 24	21 - 24

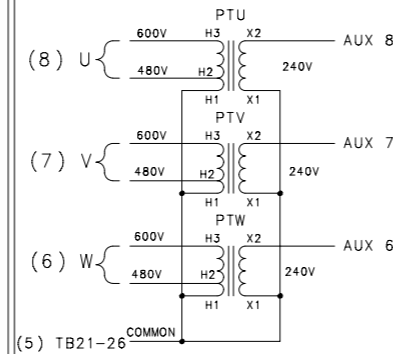
CURRENT TRANSFORMER SECONDARY CONN 1 - 2



FRAME 4, 5, & 6



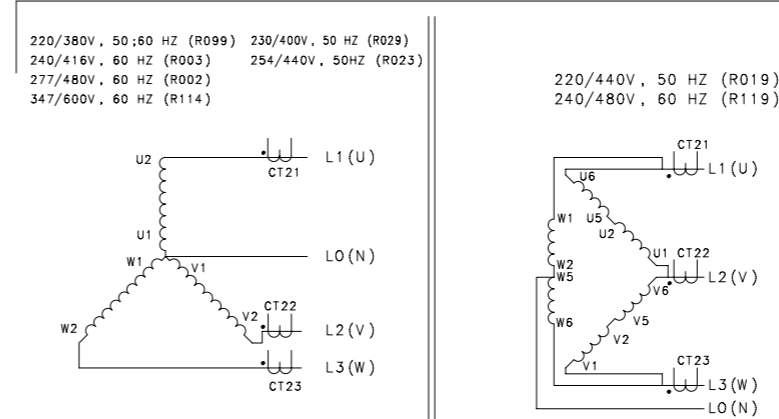
TRANSFORMER



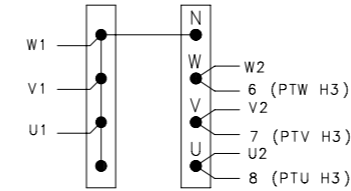
REFERENCE ONLY
P/N 319-1246

NOTE: JUMPER TB21-21 TO TB21-24
IN THE CONTROL

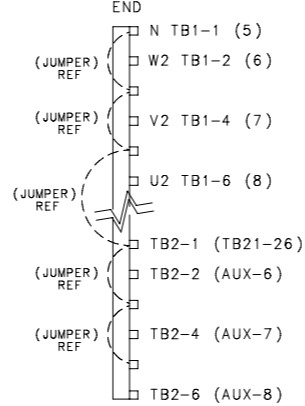
CURRENT TRANSFORMER SECONDARY CONN 1 - 2



FRAME 5, 6, & 7



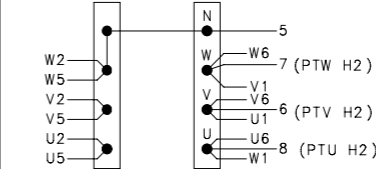
TB1



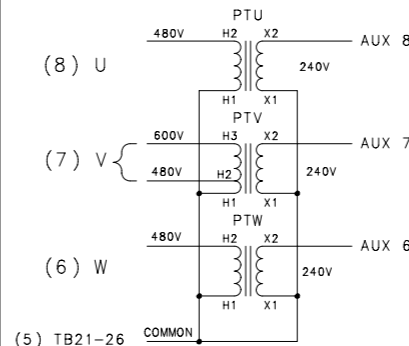
TB2

TRANSFORMER CONNECTIONS
ASSEMBLY

FRAME 5, 6, & 7



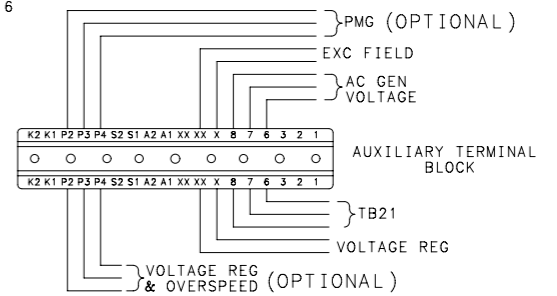
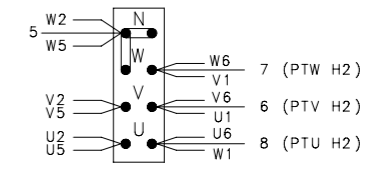
TRANSFORMER



REFERENCE ONLY
P/N 319-1246

NOTE: JUMPER TB21-21 TO TB21-24
IN THE CONTROL

FRAME 4



NON-RECONNECTIBLE VOLTAGES

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

Cummins is a registered trademark of Cummins Inc.

