

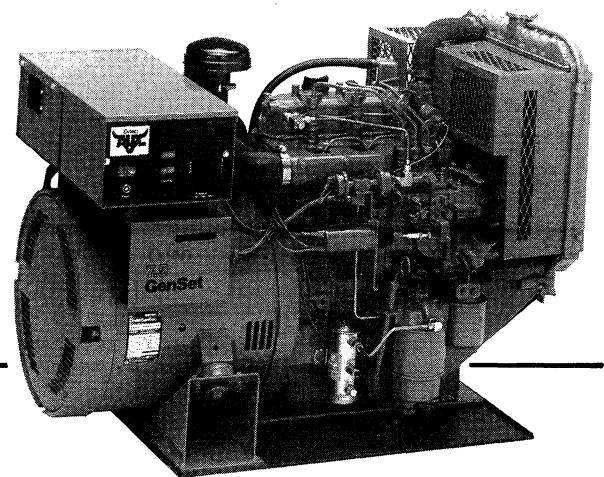


Installation Manual

DKC/DKD Series

AUX GenSet

- **Auxiliary Power Generators
For Trucks**
-



Safety Precautions

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully before operating your unit. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

⚠ DANGER *This symbol is used to warn 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.*

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards which can result in severe personal injury or death. Take care and follow these recommended procedures.

Do not work on this equipment when mentally or physically fatigued.

- **Use Extreme Caution Near Gasoline, Gaseous Fuel and Diesel Fuel. A constant potential explosive or fire hazard exists.**

Do not fill fuel tank with engine running. Do not smoke or use open flame near the unit or the fuel tank.

Be sure all fuel supplies have a positive shutoff valve between the fuel tank and generator set.

Solid fuel lines must be of steel piping, adequately secured and free of leaks. Use a flexible section of fuel line between generator set fuel pump and incoming stationary fuel supply line. This flexible section must be 100% NON-METALLIC to prevent electrical current from using it as a conductor. Do NOT use copper tubing for flexible fuel lines as copper will work harden and become brittle enough to break. The fuel line must be routed separately and never tied together with any electrical wiring.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.

- **Guard Against Electric Shock**

Disconnect the starting battery to prevent accidental starting of the generator set 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 surfaces to be damp when handling electrical equipment.

Jewelry is a good electrical conductor and should be removed before working on any electrical equipment.

Use extreme caution when working on electrical components. High voltages can cause severe personal injury or death.

Installation of wiring must conform to all applicable codes and follow National Electrical Code standards and recommended practices. A qualified electrician should inspect all wiring.

Do not plug or connect any portable, mobile or standby set directly into a house receptacle or distribution box to provide emergency power. It is possible for current to flow from generator into the utility line. This creates extreme hazards to anyone working on lines to restore power.

- **Do Not Smoke While Servicing Batteries**

Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by flame, electrical arcing or by smoking.

- **Exhaust Gases Are Toxic**

Provide an adequate exhaust system to properly expel discharged gases. Inspect exhaust system visually and audibly for leaks daily. Ensure that exhaust manifold is secure and not warped. Be sure the unit is well ventilated. Don't use discharged cooling air for compartment heating since it could contain poisonous exhaust gases.

Engine exhaust contains CARBON MONOXIDE, a dangerous gas that is potentially lethal. Avoid carbon monoxide inhalation by NOT operating the generator set in any type of enclosure that could allow exhaust gases to accumulate. On portable models, locate the generator set so that exhaust is directed away from any building windows or entrances.

- **Keep the Unit and Surrounding Area Clean**

Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Do NOT store anything in the generator compartment or on the unit itself such as oil or gas cans, oily rags, chains, wooden blocks, etc. A fire could result or the generator set operation may be adversely affected. Keep the set and/or compartment and floor clean and dry.

Do not steam clean the generator set while the engine is running. When cleaning, provide cover or protection so spray is not directed into the generator, air cleaner, control box, fuel solenoid, or electrical connectors. Do not clean with solvents. They may damage electrical connectors.

- **Protect Against Moving Parts**

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be worn because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep shields and guards in position.

If adjustments must be made while the unit is running, use extreme caution around electrical wiring, hot manifolds, moving parts, etc.

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Introduction

ABOUT THIS MANUAL

This manual provides procedures and recommended practices for installing the Onan DKC and DKD Aux generator sets. This includes the following information:

- **Location and Mounting**—Recommendations for side-mount and over-the-rail installations such as compartment size and mounting, ventilation, and generator set installation.
- **Mechanical Connections**—Requirements and connection points for the exhaust and fuel system.
- **Electrical Connections**—Requirements and location of electrical connection points for the load, remote panel, and battery.
- **Prestart Preparations**—Procedures needed to prepare the generator set for operation.
- **Initial Start and Checks**—Test of the complete system to ensure proper installation, satisfactory performance, and safe operation.

The manual is arranged in a logical sequence of steps that should be followed during the actual installation. Read the manual and code references completely before starting the installation to become familiar with procedures, safety warnings, and code requirements.

This manual **does not** provide application information for selecting the size generator set or designing the complete installation. Engineering data specific to the DKC or DKD generator set are in the model.

Specification Sheet and Product Data Sheet are available from an authorized Onan Distributor.

The following list of installation codes and safety recommendations pertains to the installation of truck mounted generator sets. The address of each agency is listed so that copies may be obtained for reference.

INSTALLATION CODES AND SAFETY RECOMMENDATIONS

- | | |
|---|---|
| 1. NFPA 70 (N.E.C.) | National Fire Protection Assoc. 470 Atlantic Ave. Boston MA 02210 |
| 2. Federal Motor Carrier Safety Regulations Title 49-Transportation | Superintendent of Documents U.S. Government Printing Office Washington D.C. 20402 |

INSTALLATION OVERVIEW

The manual recommendations apply to typical generator set installations. 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.

WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

Specifications

INSTALLATION INFORMATION

Diesel Fuel System

| | |
|--|------------------------------|
| Fuel | No. 1, No. 2 Diesel or Blend |
| Fuel Pump Inlet Size..... | 1/8 NPTF |
| Fuel Return Outlet Size..... | 1/8 NPTF |
| Fuel Pump Maximum Lift..... | 44 In. (1.1 m) |
| Fuel Consumption, No. 2 Diesel Fuel, gph (L/h) | |
| 4.0 DKC, Half Load | 0.25 (0.95) |
| Full Load..... | 0.50 (1.89) |
| 7.5 DKD, Half Load | 0.50 (1.89) |
| Full Load..... | 0.90 (3.40) |

Exhaust System

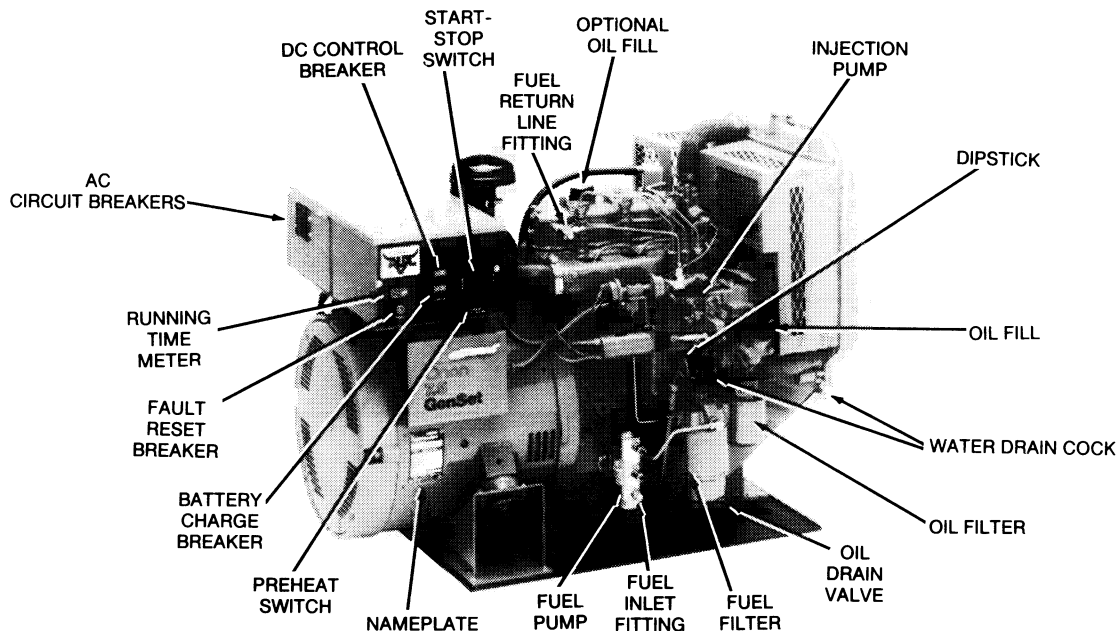
| | |
|------------------------------------|---------------------------|
| Exhaust Outlet Size..... | 1¼ In. NPT External |
| Maximum Exhaust Back Pressure..... | 1.2 In. (30mm) Hg (4 kPa) |

Electrical System

| | |
|------------------------------------|--|
| Starting Battery Requirement | 12-Volt, 425 Cold Crank Amps @ 0°F (-17.8°C) |
| DC Alternator Output | 12-Volt, 12- to 15-Amp |
| AC Alternator Output | |
| 4.0 DKC | 1-Phase, 120 Volt, 33.3 Amperes |
| 7.5 DKD | 1-Phase, 120/240 Volt, 62.5/31.3 Amperes |

Approximate Dry Weight

| | |
|--------------|-------------------|
| 4.0 DKC..... | 475 Lbs. (215 kg) |
| 7.5 DKD..... | 505 Lbs. (229 kg) |



Location and Mounting

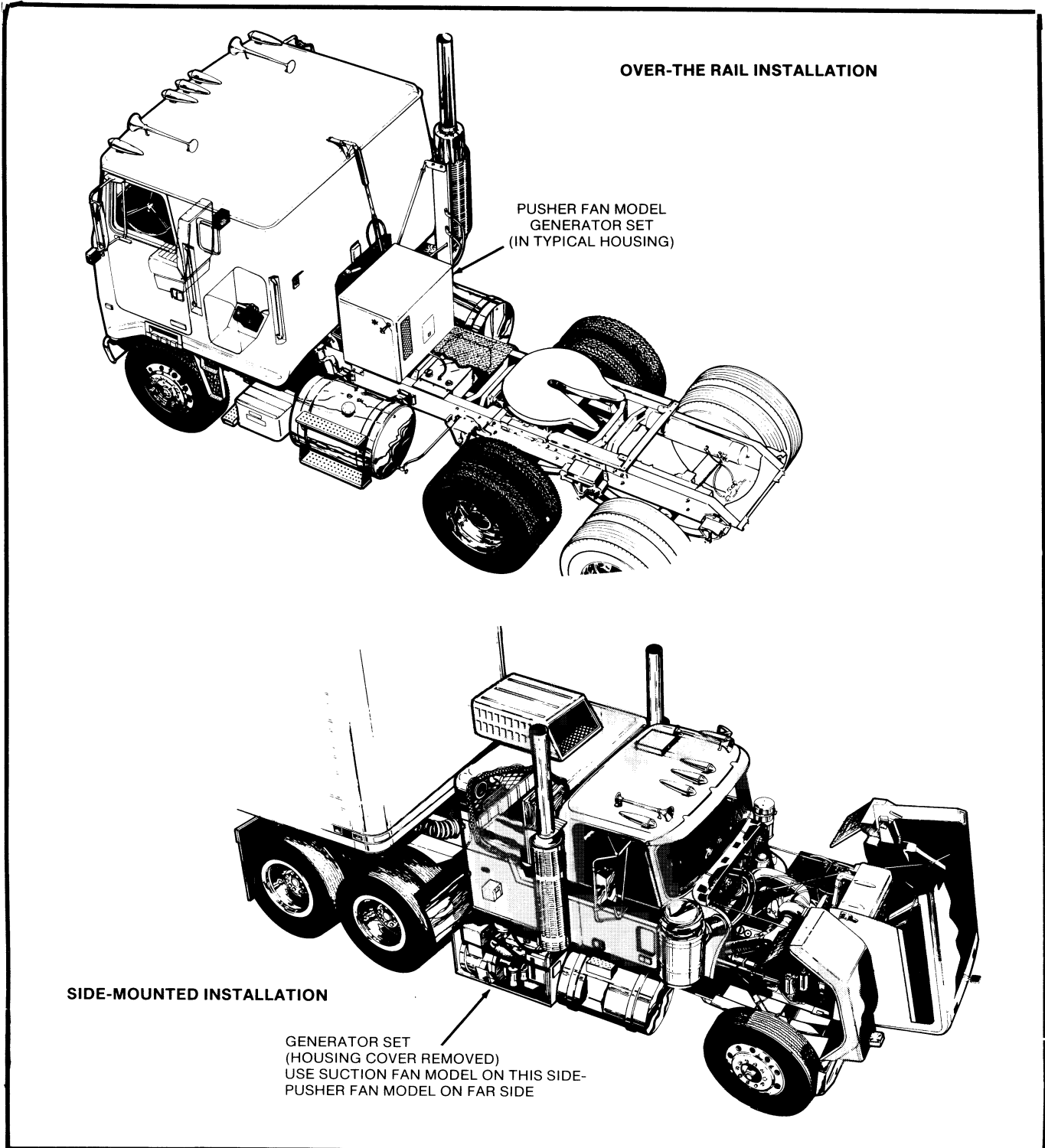


FIGURE 2. TYPICAL INSTALLATIONS

GENERAL

Most installations must be engineered to ensure the generator set will function properly under the expected load conditions. Use these instructions as a guide only. Follow the instructions of a consulting engineer or an experienced truck dealer when locating, mounting, and installing any components. The completed installation must comply with all state and federal codes, and other applicable regulations.

Requirements to be considered prior to starting the installation are:

- Level mounting surface
- Adequate cooling and induction air
- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Accessibility for servicing
- Vibration and/or noise isolation
- Optional Fuel Tank Mounting
- Minimizing Road Contaminants

The generator set should be located to keep exposure to road contaminants (dust, water, salt spray, etc.) minimal. Constructing a compartment for the generator set and the use of tire flaps and special baffles are strongly recommended.

Each truck chassis must be evaluated and certain measurements must be made by the installer prior to starting any installation. These measurements determine whether there is sufficient, unobstructed space to permit installation of the generator set compartment and a fuel tank (if required) in their recommended locations.

The generator sets are designed primarily for installation in Class 7 or 8 long haul trucks. Exact compartment location along the truck frame rail will vary between different truck makes and models.

An optional tank for #1 diesel fuel may be desired (or a consideration) to ease starting in extremely cold weather after extended shutdown. Refer to the Fuel System section for installation data.

Mounting Recommendations

Most truck chassis manufacturers assume NO WARRANTY for frame failures resulting from improperly mounted accessories. Always consult the truck manufacturer's chassis manual for specific recommendations and procedures prior to any lifting, jacking, drilling or any other frame modifications.

Truck manufacturers do NOT recommend welding to the frame rails as they might be heat treated for greater strength. Clamping around the frame rail must allow for flexing, twisting and stress placed on frame members due to load and vibration. Any new holes drilled to frame rails cannot be located closer to frame flanges than the existing bolt pattern regardless of frame material. NO drilling is allowed in the top or bottom frame rail flanges. Consult the truck manufacturer's manual.

▲CAUTION *Cracks will start around the edge of drilled holes marked with a sharp tool. Do not use a sharp tool for making hole locations. Use the approved method as outlined below.*

Marks for any new mounting holes must be made with a lead pencil. Do NOT use a sharp tool for making scribe marks to prevent cracks from starting or extending beyond the circumference of the drilled hole. See Figure 3 for approved method for making marks on truck frame rails. Hole should not be larger than necessary to allow bolts to fit freely. Do not force bolts into place.

▲CAUTION *Drilling through the rail can damage wiring, fuel, air or hydraulic lines. Check the area inside the truck frame rail so that drilling of frame mounting holes will not interfere with any of these components.*

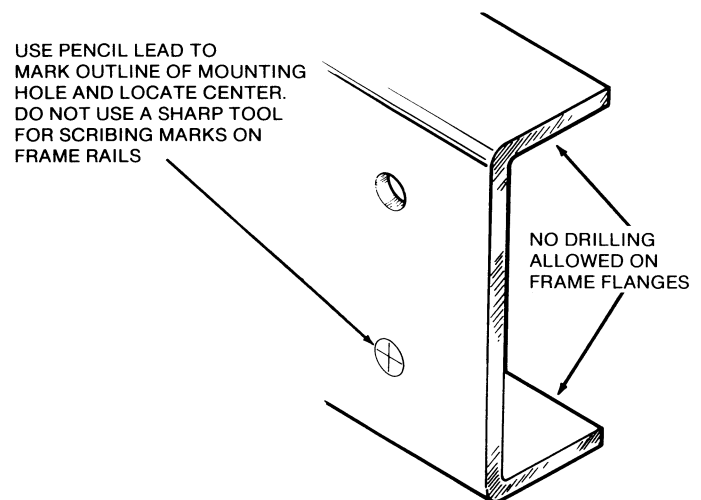


FIGURE 3. MARKING MOUNTING HOLE LOCATION ON TRUCK FRAME RAIL-SIDE MOUNT ONLY

Design variables in truck wheelbase and cab styles might require relocation of batteries, tool boxes, etc., to make room for the generator set. Some degree of modification and possible relocation of these chassis components may be necessary to provide the physical space required for the compartment installation.

⚠WARNING *The completed installation must conform to all codes and safety regulations to ensure installation safety. Relocation or modification of any major truck chassis components must be performed by an experienced truck dealer or service person only. These conditions must be identified prior to performing any part of the generator set installation.*

Compartment Construction

The generator set compartment must be constructed in accordance with safety codes and recommendations (see page 2). Design of the compartment must be large enough for the generator set, with specified minimum clearances between the set and compartment walls and ceiling (and acoustical materials, if used).

The compartment dimensions must include one inch (25 mm) minimum clearance between set and insulation. Minimum spacing between any engine exhaust component and a combustible material such as insulation is 3 inches (76 mm). See Figures 4 and 5 for generator set dimensions and mounting holes for the DKC and DKD models respectfully.

Allow clearance for access to the oil fill, drain, filter and dipstick, as well as the air cleaner and circuit breaker. Also allow room for any accessory items such as an engine coolant recovery tank. Engine oil drainage is through a 1½ inch (38 mm) diameter hole in line with the oil drain hole as shown on the drip pan outline, Figures 4 and 5. Make holes/provisions for diesel fuel input and return lines to the compartment, and for the exit of the breather hose and the exhaust plumbing. See the Fuel, Exhaust and Cooling System sections of this manual for guidance and code references.

Plan the compartment to permit easy access to the set. Openings for engine and generator cooling air must be provided. Refer to the Ventilation section of this manual for more details.

⚠WARNING *Inhalation of exhaust gas can result in severe personal injury or death. Be sure all openings are sealed tightly to prevent entrance of deadly exhaust gas into the vehicle coach.*

[illegible]

ENGINE TO SIDEWALL = 1 IN. (25 mm)
EXHAUST CLEARANCE = 3 IN. (76 mm)

7

[illegible]

ENGINE TO SIDEWALL = 1 IN. (25 mm)
EXHAUST CLEARANCE = 3 IN. (76 mm)

8

OVER-THE-RAIL INSTALLATION

The generator set is designed primarily for installation in class 7 or class 8 long haul trucks. Exact compartment mounting location over the truck frame rail will vary between truck makes and models. A location as far forward to the back wall of the truck cab is most suitable for axle weight distribution.

Figure 6 references a critical distance "X" that must be maintained between the generator set compartment and the kingpin. Refer to this illustration and chart when measuring this distance.

| Trailer Width in. (mm) | "Y" Kingpin Distance in. (mm) | "X" Min. Distance* From Compartment to Kingpin in. (mm) |
|------------------------|-------------------------------|---|
| 96 (2440) | 36 (910) | 64 (1630) |
| 102 (2590) | 36 (910) | 66.5 (1690) |
| 96 (2440) | 48 (1220) | 72 (1830) |
| 102 (2590) | 48 (1220) | 74 (1880) |

* - Distance "X" based on square-cornered trailer including 4 inches (102 mm) for trailer movement.

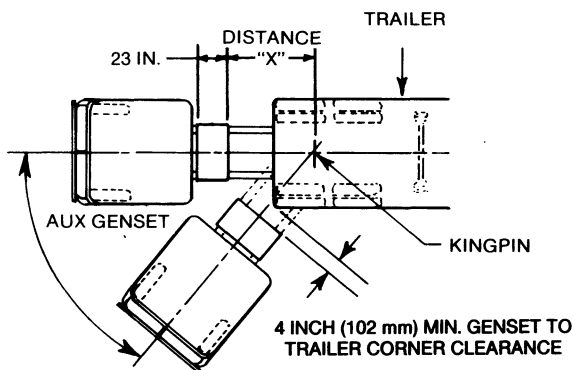


FIGURE 6. CRITICAL DIMENSIONS, TOP VIEW

Position the compartment baseplate over the truck frame rails in the desired mounting location. Check for adequate clearance as shown in Figure 6. Allow sufficient clearance between the sleeper cab and the compartment for wiring connections.

WARNING Falling heavy objects can cause severe personal injury or death. Be sure the base plate is adequately secured to the frame rails when setting the generator set/compartment on top of it.

A minimum vertical clearance of ½ inch (13 mm) must be maintained between the baseplate and any permanent truck chassis component underneath as shown in Figure 7. Spacers should not be used to obtain this clearance. The baseplate must rest on the truck frame rails when installed. The base plate can be moved horizontally to obtain this clearance if critical dimensions shown in Figure 6 are not exceeded. Before securing the baseplate, review the requirements of a separate fuel tank if one is to be installed. Refer to the Fuel System section of this manual.

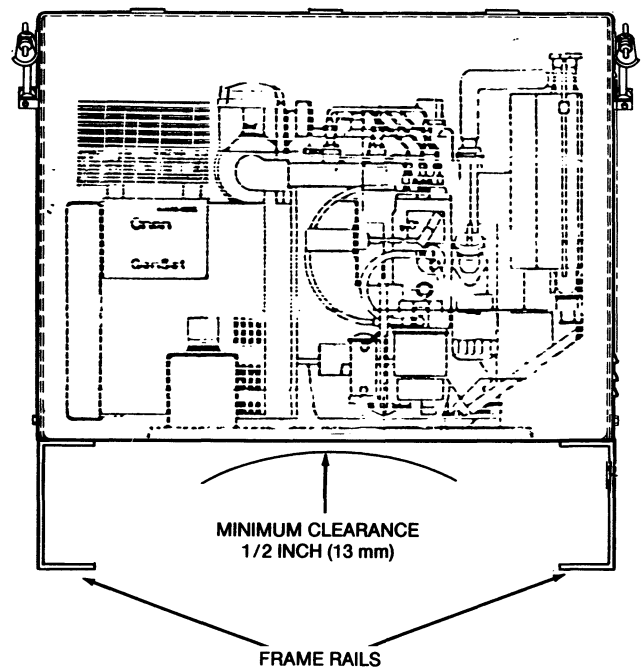


FIGURE 7. CRITICAL DIMENSION, HORIZONTAL VIEW

After the baseplate is secured to the truck rails, holes will be required in the baseplate for mounting the generator set and for the oil drain and exhaust pipe. Refer to Figure 4 or 5 for holes sizes and location for the model being installed. It is advisable to place the generator set upon the baseplate and mark the hole locations. Use a forklift or appropriate size hoist and lifting strap.

⚠WARNING *Manual lifting and mounting of heavy equipment can cause severe personal injury. Use appropriate mechanical lift equipment and strap attached to the generator set.*

Install the generator set drip pan under the baseplate. Refer to other sections in this manual for making fuel, exhaust, and electrical connections.

SIDE-MOUNTED INSTALLATION

Position the generator set compartment against the truck frame rail. The compartment top must be level with the rail or be no higher than the fuel tanks to have adequate trailer clearance. Use temporary blocking to support the compartment in place while making the mounting hole locations. Make necessary relief holes in the compartment rear wall to avoid interference with any existing frame rail bolts. Refer to text titled Mounting Recommendations covered previously with regard to cautions when drilling holes in the truck frame rail.

Ventilation

The most important factors of ventilation for radiator-cooled mobile electric generator sets are sufficient incoming cooling air and adequate exhausting of heated air. The engine fan circulates air through the radiator fins. A centrifugal blower on the generator drive disc draws air from the generator end of the compartment through the generator (Figure 8). Be sure nothing obstructs or restricts discharged airflow.

Cooling air requirements for Onan generator sets vary with type and size. Special equipment is needed to measure it. Since the discharge area cannot be changed, the air inlet and outlet openings are critical.

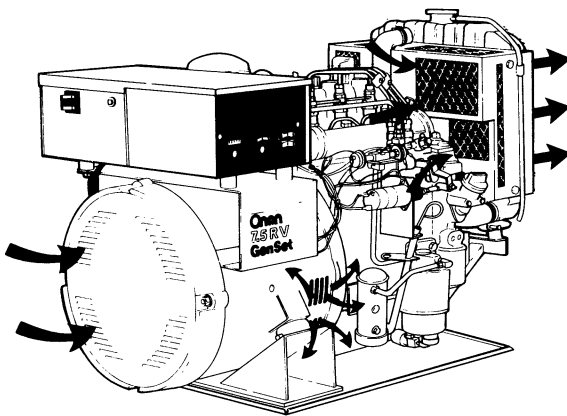
When constructing a compartment for the unit, allow for airflow restrictions caused by any duct work and grilles. To purge the compartment of heated air, position of the air openings must permit flow while the unit is running. On shutdown, the openings must allow for convection cooling of the compartment so heated air can escape.

⚠ WARNING *Inhalation of exhaust gases might result in severe personal injury or death. Never use discharged cooling air for heating since it may contain poisonous gases.*

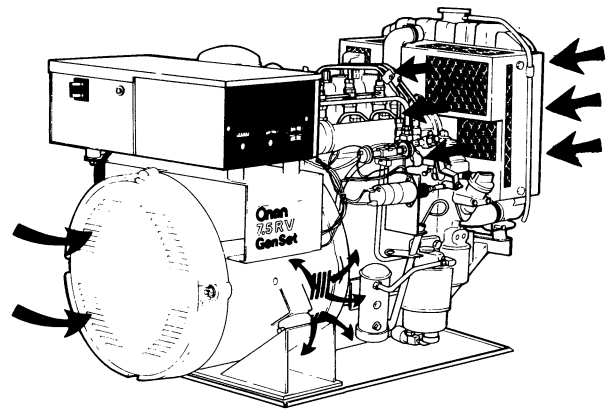
Two radiator fan options are offered on the DKC/DKD generator sets. The pusher fan is recommended for all over-the-rail installations, and on units mounted on the left side of the truck. These locations using a pusher fan tend to enhance the natural flow of cooling air (Figure 8). Compartment mounted units require a minimum outlet at the radiator of 12.5 x 15.5 inches (318 x 394 mm) and an air inlet area of 180 in.² (1161 cm²).

Generator sets with a suction fan are recommended for mounting on the right side of the truck (Figure 8). When compartment mounted, these units require a minimum free air inlet at the radiator of 12.5 x 15.5 inches (318 x 394 mm) with no restrictions, and a minimum air discharge opening area of 270 in.² (1742 cm²).

A metal grill can be used over the air inlet and outlet of the compartment. However, the most efficient grille only provides about 90 percent free inlet area per square foot. Contact the Onan distributor for help on special installation considerations.



PUSHER FAN GENSET (OVER-THE-RAIL AND LEFT SIDE INSTALLATIONS)



SUCTION FAN GENSET (RIGHT SIDE INSTALLATIONS)

FIGURE 8. GENERATOR AND ENGINE COOLING AIRFLOW

CS-1272

Fuel System

GENERAL

A separate fuel tank containing number 1 diesel fuel is recommended for installations where below 0° F (-18° C) cold start temperatures are expected. Number 1 fuel provides the best economy and performance when ambient temperatures fall below 32° F (0° C) and during long periods of light engine load. A separate tank also allows selection of fuel having a low sulfur content and low cloud point.

Blended fuel may be used for most cold weather operation and for extreme cold (below 0° F (-18° C) if fuel heating is used. Fuel heating can be had by use of heat exchangers, or use of the electric heater built into the fuel filter if sufficient battery power/charging is available. (See Electrical Connections section).

If the generator set fuel supply is taken from the existing truck fuel tank, similar regulations and codes will apply. Be sure to check all regulations and codes governing fuel system installations before proceeding.

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 external of the engine before installing. If water in the fuel is a problem despite all precautions to prevent entrance of moisture, a water separator is recommended.

⚠CAUTION

Never use galvanized fuel lines, fittings or fuel tanks with diesel fuel systems.

Condensation in the tank and lines combines with the sulfur in diesel fuel to produce a sulfuric acid. The zinc coating on galvanized lines or tanks reacts with the acid and flakes off to contaminate the fuel.

OPTIONAL FUEL TANK LOCATION

The remote fuel tank is designed for mounting between the truck frame rails in all applications. It is intended to be mounted as far forward as possible between truck frame cross-support members (usually behind the transmission and above the drive shaft) if space permits.

Mounting the fuel tank requires an unobstructed opening measuring 16½ inches (419 mm) lengthwise (parallel to the truck frame rail) by 25 inches (635 mm) wide (between the frame rails) by 10½ inches (267 mm) deep. The depth requirement includes up to 3 inches (76 mm) clearance above the truck drive shaft to allow for suspension rebound under the weight of the loaded trailer and road shock vibration.

The optional Onan fuel tank has a capacity of 12 gallons. The 4.0 DKC unit will operate about 25 to 30 hours on this tank, the 7.5 DKD will operate about 12 to 15 hours.

⚠WARNING

Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. The fuel tank fill spout must not be positioned on the same side of truck as the generator set exhaust outlet.

INSTALLATION OF OPTIONAL ONAN TANK

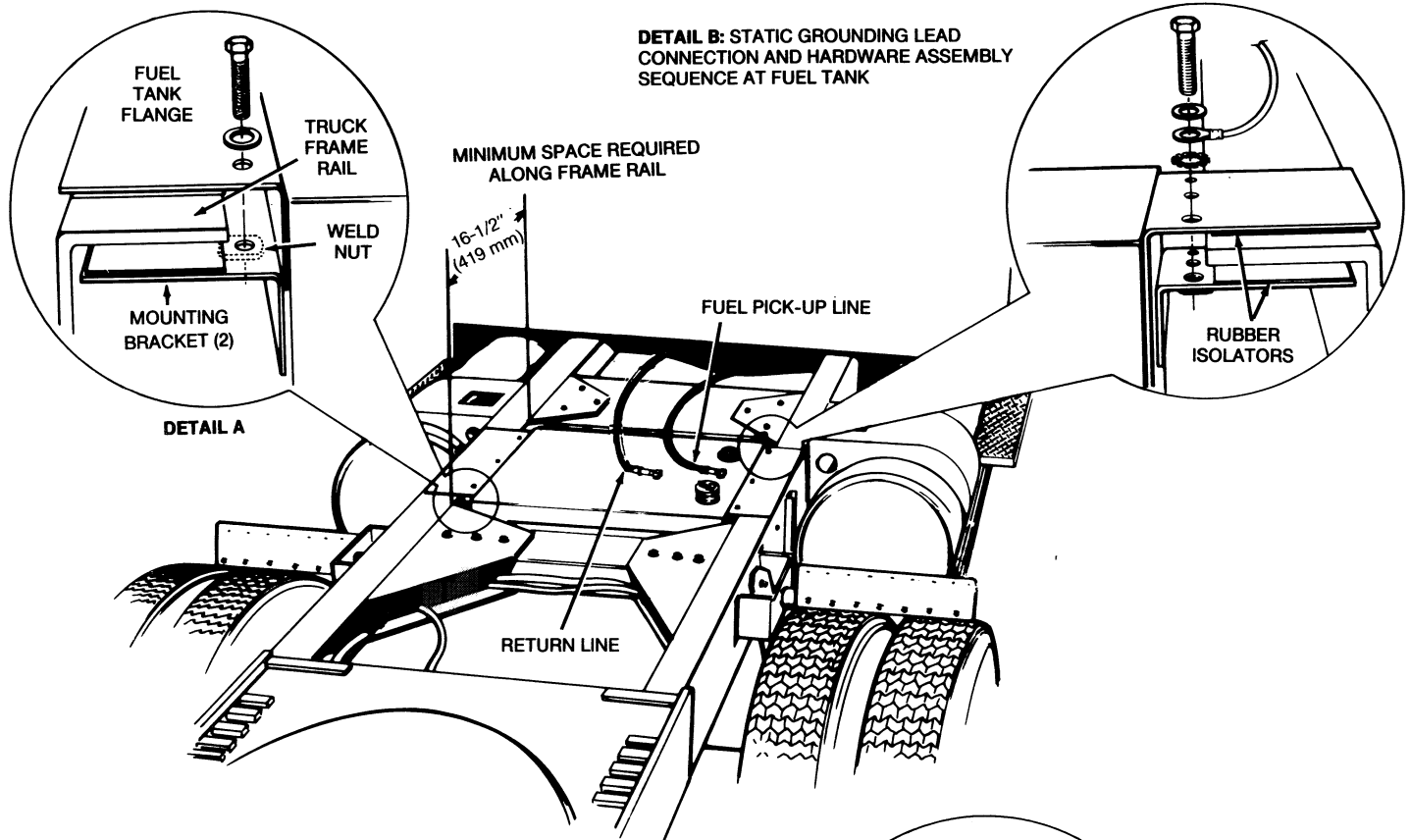
Install remote fuel tank using the assembly sequence illustrated in Figure 9. Perform the steps in order listed to minimize installation problems. All component parts necessary to install the fuel tank are supplied in fuel tank kit.

1. Position fuel tank in the selected unobstructed opening between truck frame rails. Tank may be installed with fuel fill, fuel supply and return, and fuel level gauge on either driver or curb side as desired by the owner.
2. Position the two L-shaped mounting brackets on the inside (underneath) of the top truck frame rail flange (one on each side), so that weld nuts in brackets line up with pre-drilled mounting holes in fuel tank flanges as shown in Figure 9. The rubber vibration isolator pads on both the fuel tank flanges and fuel tank mounting brackets must contact the truck frame rail flange.

Pre-drilled mounting hole location in fuel tank flange is usually adequate to securely fasten fuel tank in most installations. Some trucks may have variations in width of frame rail flange area or width between truck frame rails that could require spacing and drilling new mounting holes in fuel tank flanges. When installed, the vertical surface of the mounting bracket should rest against the side of the fuel tank and the wider surface area of the mounting bracket (surface with rubber isolation pad) should be relatively close to radius of truck frame rail. See detail A in Figure 9. If not, new 3/8 inch (9.5 mm) mounting holes will have to be spaced and drilled in fuel tank flange as required so that fuel tank is held securely in position.

NOTE: NO WELDING OR DRILLING REQUIRED
TO INSTALL FUEL TANK. TORQUE ALL SIX
5/16 MOUNTING BOLTS AT 24 INCH POUNDS (2.7 N•m)
ON ALUMINUM TANKS

SIX 5/16-18 x 1-1/2" (38 mm)
MOUNTING BOLTS

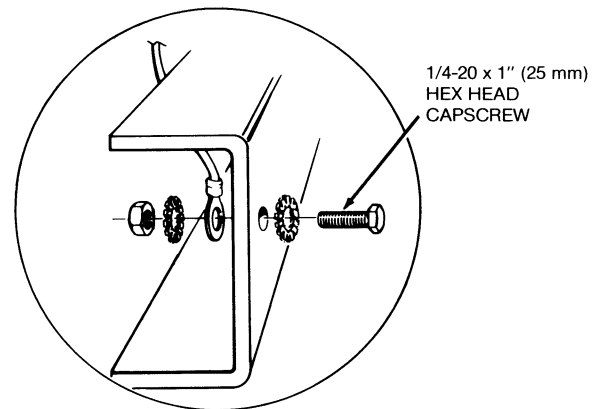


DETAIL B: STATIC GROUNDING LEAD
CONNECTION AND HARDWARE ASSEMBLY
SEQUENCE AT FUEL TANK

DETAIL A

CAUTION

*Incorrect drilling can damage truck frame rails. Do not drill any new holes in the truck frame rails closer than two inches (51 mm) to top or bottom flange area of frame rail. Bolt holes in frame rails **MUST NOT** be located any closer to frame rail flanges than present bolt hole pattern. If in doubt, consult truck manufacturer's chassis manual. Refer to Figure 3 for recommendations regarding marking of new frame holes. No drilling whatsoever is allowed in the top or bottom frame rail flanges.*



DETAIL C: HARDWARE ASSEMBLY SEQUENCE
FOR STATIC GROUND LEAD CONNECTION TO TRUCK
FRAME

FIGURE 9. FUEL TANK INSTALLATION

3. Install 5/16-18 x 1-1/2 inch (38 mm) hex head capscrews and lockwashers in center mounting holes only (one on each side). Mounting hardware assembly sequence is shown in Figure 9, detail A.
4. The 18 inch (457 mm) 12-gauge static ground lead must be installed under the most convenient fuel tank mounting screw as dictated by physical location and layout of truck chassis components in each installation. Fuel tank terminal end of ground lead is a 5/16 inch eyelet terminal. Install this terminal under most convenient 5/16 inch capscrew and lockwasher on top of fuel tank mounting flange. See Figure 9, detail B. The remaining chassis end of static grounding lead has 1/4 inch eyelet terminal. Locate a nearby hole in truck frame rail within reach of the lead and attach terminal with 1/4-20 x 1 inch (25 mm) screw, lockwashers, and nut. Hardware assembly sequence is shown in Figure 9, detail C.

If no existing hole is available, a 5/16 inch (8 mm) hole must be drilled (within reach of grounding lead) in the side (vertical surface) of truck frame rail. Hole must be located as close to vertical center of the frame rail as possible. Be careful not to locate hole where drilling might puncture fuel tank.

5. Install three remaining 5/16-18 x 1-1/2 inch (38 mm) hex head capscrews and lockwashers in fuel tank mounting brackets. Hardware assembly sequence is shown in Figure 9, detail B. Torque all six mounting screws to 24 inch pounds (2.7 N•m).
6. Verify that the ground strap and all mounting bolts are securely tightened following torque specifications where listed. With installation completed, check for adequate clearance above truck drive shaft and bottom of gasoline fuel tank. Allow 3 inch (76 mm) clearance for suspension rebound and road shock vibration with loaded trailer coupled to truck.

FUEL LINE RECOMMENDATIONS

The fuel lines from the fuel tank to generator set compartment fittings are not supplied due to variation in length requirement of trucks. The following recommendations pertain to material and size of fuel supply and return line.

- Route fuel lines as far away as possible from hot engine or exhaust areas. This reduces chance of high fuel temperature and fire danger.

- Do NOT route or bundle fuel lines together with any AC or DC electrical wiring.
- Install fuel lines so they are accessible for service but protected from physical damage.
- Do NOT drill any additional holes in frame rails or frame cross support members for routing of fuel lines.

FUEL LINE INSTALLATION

1. Use fuel hose fittings with 7/16 - 20 thread size and SAE 37° flare for compartment connectors and fuel tank pick-up and return line connectors.
2. Use protective sleeving such as heater hose over sections of fuel line that pass over frame rails. Any existing holes in frame cross support members used for routing of fuel line should be protected with rubber grommets to prevent chaffing.
3. Use clamps or ties without sharp edges to secure fuel line approximately every 18 inches (457 mm) along the run.

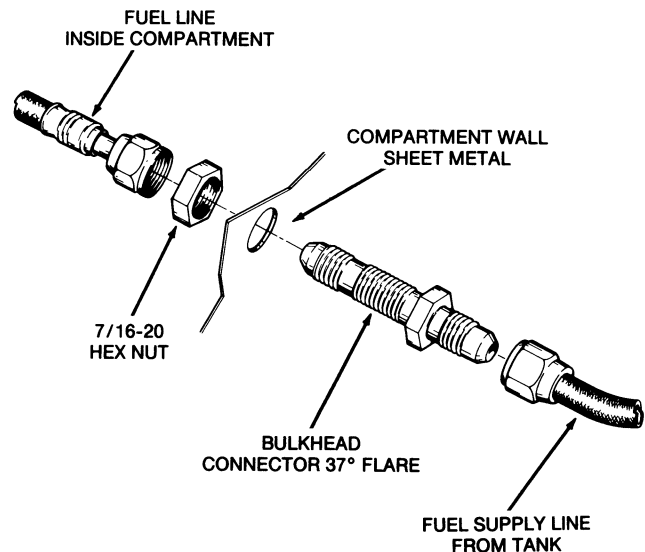


FIGURE 10. TYPICAL FUEL LINE HOSE FITTINGS, SUPPLY AND RETURN

4. Connect the fuel lines to bulkhead connectors at the compartment, or protect them where they leave the compartment. Connect opposite ends of the fuel lines to 37° flare fittings on the fuel tank. Direction of fuel tank fittings must be adjusted during connection of fuel lines to prevent kinks or sharp bends.

Exhaust System

GENERAL

Plan the exhaust system carefully. A proper installation must be free of all exhaust leaks and comply with all applicable codes and regulations.

⚠ WARNING *Exhaust gas presents the hazard of severe personal injury or death. Plan and install the exhaust system carefully.*

The exhaust system must be no closer than 3 inches (76 mm) from combustible material, or be so located, insulated or shielded that it does not raise the temperature of any combustible material by more than 117° F (65° C) above the ambient air inlet temperature.

The maximum allowable back pressure measured at the exhaust manifold is 1.2 inches (30 mm) mercury (4 kPa). Back pressure readings higher than this might adversely affect engine performance.

EXHAUST INSTALLATION

The information furnished in this section can only be a guide because of the many variables in truck construction. The lengths of pipe used in the exhaust plumbing must be tailored to each specific truck model. A typical automotive type installation is shown in Figure 11.

Use a 1.75 inch (44.5 mm) I.D. 18 gauge rigid steel tubing for the tailpipe. This size is sufficient for 20 foot (6.1 m) lengths without adversely affecting back pressure readings.

Flexible exhaust pipe can be used for the downpipe and tailpipe. Allow sufficient pipe length to permit movement of the generator set without undo strain on the exhaust piping.

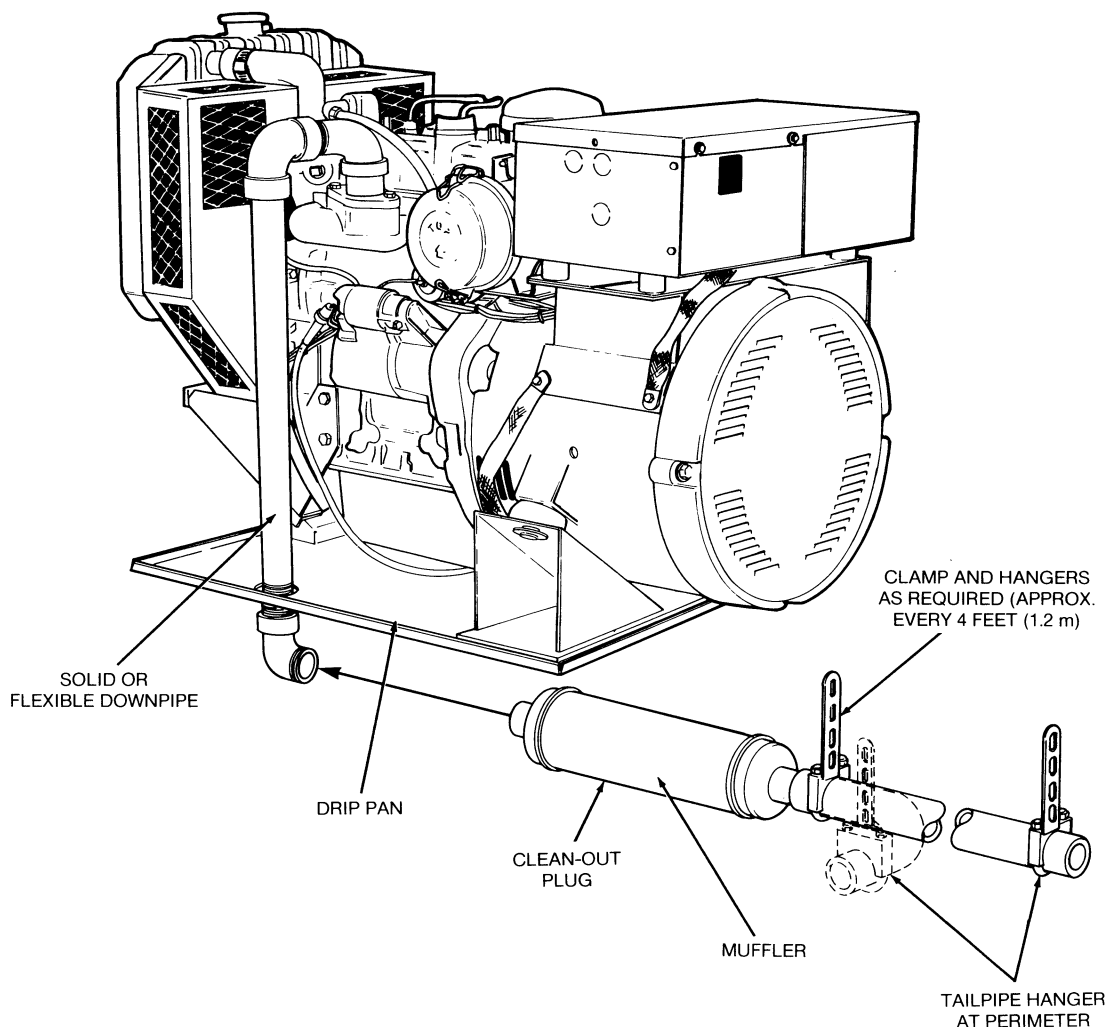


FIGURE 11. TYPICAL EXHAUST INSTALLATION

XEXS-1123

The following procedure is referenced to the typical exhaust installation drawing in Figure 11.

1. The downpipe plumbing from the engine exhaust manifold should be completed through the drip pan before the unit is set in place and secured.
2. Install the elbow on the downpipe, then turn muffler onto the elbow. The muffler should be level and the spark arrestor cleanout plug must face downward within 45° of vertical.
3. Attach tailpipe to the muffler with a U-bolt type exhaust system clamp and hanger. Use an automotive type tailpipe hanger for additional support at the perimeter of the vehicle.

▲CAUTION *Excessive vibration transfer and exhaust pipe damage can be caused by angular mounting. Muffler and tailpipe hanger brackets must be mounted directly above the component being supported and NOT at an angle.*

After muffler is installed and prior to installing the exhaust tailpipe, refer to the following safety considerations.

▲WARNING *Exhaust gas presents the hazard of severe personal injury or death. Do NOT terminate the exhaust system under the truck cab. Direct exhaust gases away from any window, door, or compartment openings. Do NOT operate the generator set without an exhaust tailpipe.*

▲CAUTION *If a tailpipe deflector is used, be sure it is large enough to prevent excessive back pressure which might cause engine damage.*

▲CAUTION *Do not connect the generator set exhaust to the vehicle exhaust system. Water vapor from one engine might damage the other engine.*

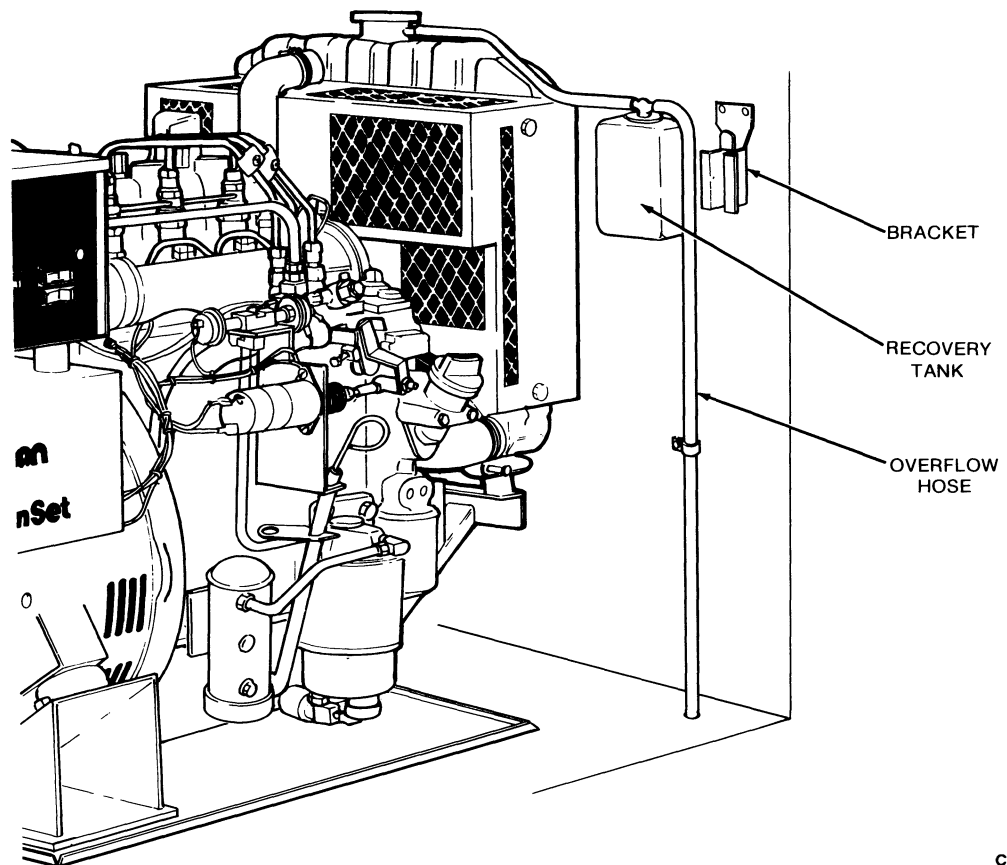
Cooling System

A coolant recovery tank is in the accessory kit furnished with each generator set. Figure 12 shows a typical installation with the tank accessible on the service side of the engine. It should be located so the hose between the radiator and tank is pitched slightly downward.

Use the bracket as a template to locate mounting holes. Allow a minimum of 2 inches (51 mm) from the top of the tank to any upper structure so tank can be lifted off the bracket for servicing. Mount with two 5/16 inch (8 mm) bolts.

Use a length of hose from the kit between the radiator overflow and the dip-tube connector on the recovery tank. This hose is heavier and resists collapse from vacuum. The original hose may be used on the overflow side to the drain. Allow sufficient hose lengths so the tank can be easily removed from the bracket to add coolant.

Engine coolant is at proper level when the recovery tank level is between Full and Low (engine cold).



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FIGURE 12. TYPICAL COOLANT RECOVERY TANK INSTALLATION

Electrical Connections

GENERAL

Wiring harnesses for interconnection of the auxiliary generator set, load distribution panel, individual AC load circuits and remote start panel must be fabricated and hand wired during the installation of the generator set.

▲WARNING *Accidental starting of the generator set during installation creates a hazard of serious personal injury or death. Do not connect the starting batteries until instructed to later in this section.*

▲CAUTION *Installation of all wiring must conform to all applicable codes and follow National Electrical Code standards and recommended practices. A qualified electrician should inspect all wiring.*

The following general wiring recommendations should be reviewed before starting any electrical connections.

- Use multistrand type SO cable throughout the truck for the installation. Specific sizes for main feeder conductors and individual AC load circuit wiring are specified in this section of the Installation Manual. All wiring must be of adequate size, properly insulated, and supported in an approved manner.

▲CAUTION *Solid metal conductors can develop metal fatigue from vibration and eventually break. Do not use solid metal conductors anywhere in this installation.*

- Mount all switches and controls in a manner to prevent damage from vibration and road shock. Switches must be vibration-proof to prevent accidental opening or closing while the truck is in motion.
- Route AC and DC wiring along the inside of the truck frame rails whenever possible. Keep wiring away from rotating or moving shafts and linkages of the truck. Use insulated hold-down clamps spaced approximately every 18 inches (457 mm); closer together in bends or near heat sources. Plastic tie wraps can be used between heavier insulated clamps.

▲WARNING

Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Do not tie electrical wiring to the fuel or hydraulic lines of the truck because of fire hazard. Keep wiring away from the exhaust system.

- Use wire ties inside the control box to secure added AC and DC wires to existing harnesses. This will help prevent short circuits from insulation wear or loose wires lying next to sharp edges of screws, control components, etc. Remember that vibration exists when the generator set is turned off and the truck is on the road.
- Use additional protective sleeving (such as heater hose) over wiring wherever it crosses over frame rails or in sharp bends. Existing holes in the truck cross support frame members used for routing of wires should have grommets to protect wiring.

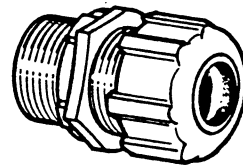
▲CAUTION

Do NOT drill any additional new holes in the truck frame rails or cross-support frame members for routing wiring through. Any existing holes used for routing of wiring should be protected with grommets.

- Use water-tight strain relief connectors (1/2 inch or 3/4 inch) whenever wiring passes through any housing compartment, shelf, panel, cab wall or partition. See Figure 13.

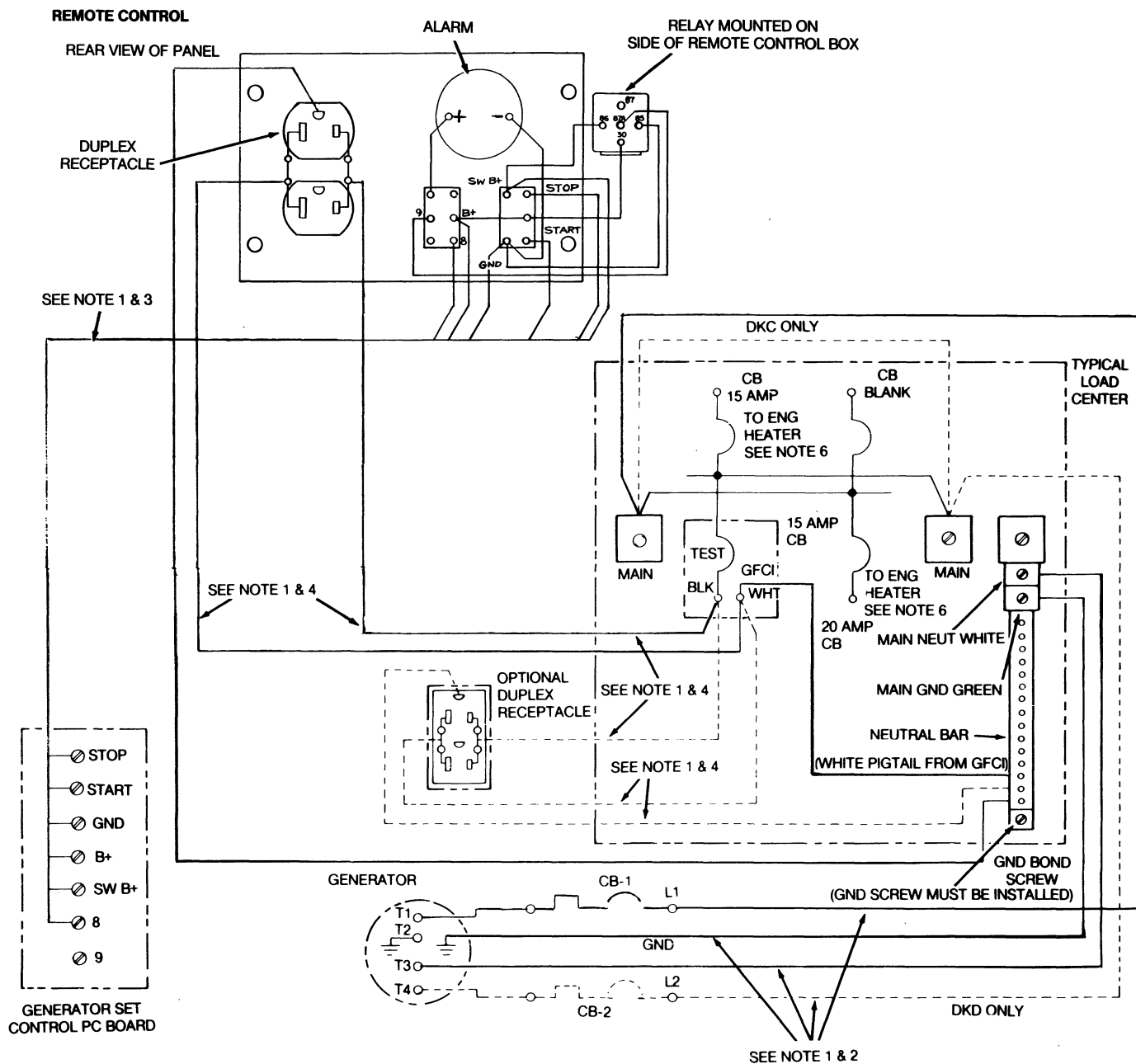
▲WARNING

Exhaust gas presents the hazard of severe personal injury or death. Seal all openings into the vehicle interior to prevent the entrance of exhaust gases.



C-1105

FIGURE 13. WATER-TIGHT STRAIN RELIEF CONNECTOR



NOTES:

1. WIRE TYPE: SO, 90°C, NEOPRENE JACKET PREFERRED BLACK (ALT YELLOW), RUBBER INSULATED COLOR CODED CONDUCTORS
2. WIRE SIZE/NO. OF CONDUCTORS:
7.5 DKD TO BE 10/4
4.0 DKC TO BE 10/3
3. WIRE SIZE/NO. OF CONDUCTORS:
7.5 DKD & 4.0 DKC TO BE 16/6
4. WIRE SIZE/NO. OF CONDUCTORS:
7.5 DKD & 4.0 DKC TO BE 14/3
5. BALANCE LOADS AT THE LOAD CENTER ON THE 7.5 DKD
6. VEHICLE ENGINE HEATER WIRING TERMINATING AT A DUPLIX RECEPTACLE MUST BE GFCI PROTECTED

| BREAKER | GENERATOR SET SIZE | |
|---------|--------------------|-----------|
| | 4.0 Kw | 7.5 Kw |
| CB-1 | 40 Ampere | 35 Ampere |
| CB-2 | | 35 Ampere |

FIGURE 14. ELECTRICAL SYSTEM WIRING DIAGRAM

MAIN FEEDER CONDUCTORS

The main feeder conductors supply the AC current from the generator set to the main bus terminal for the circuit breakers in the load distribution panel. The number of individual conductors (wires) and wire size (gauge) is determined by the kilowatt rating and amperage output of the generator set.

The main feeder conductors of the auxiliary generator set must have an ampacity of not less than 110 percent of the nameplate current rating of the generator set. Neutral conductors must be of the same size as the conductors of the outside legs. Do NOT splice any wiring in the main AC feeder conductors.

The generator AC output wires (3 or 4 depending on model) terminate within the control box on top of the generator set. The wires must be connected as shown in Figure 14 to the conductors of the main feeder cable. All wiring must follow electrical codes.

⚠ CAUTION *Loose connections can cause arcing or short circuits. If wire nuts are used, wrap them with electrical tape after installation as further protection against loosening due to vibration.*

DKD Models

The main feeder conductor cable for the AC output leads of the DKD generator set should be 10-gauge, 4 conductor (type SO) neoprene-jacketed multistrand wire rated for 600 VAC, 140° F (60° C) operation.

DKC Models

The main feeder conductor cable for the AC output leads of the DKC generator set should be 10-gauge, 3 conductor (type SO) neoprene-jacketed multistrand wire rated for 600 VAC, 140° F (60° C) operation.

⚠ WARNING *Poisonous gas presents the hazard of severe personal injury or death. Do not use poly-vinyl-chloride type wire on any AC or DC load or control circuit wiring in this application. Overloading this type of wire causes a chlorine gas emission.*

Current for any one output conductor must not exceed the nameplate rating. When more than one load circuit is available, divide the load equally between them. Refer to the wiring diagram in Figure 14.

DISTRIBUTION PANEL

Mount the distribution panel in a weather protected area (inside the cab if possible or in a storage compartment) as close as possible to the generator set to minimize wiring length requirements.

⚠ WARNING *Exhaust gas presents the hazard of severe personal injury or death. Seal all holes leading to the inside of the truck cab for electrical wiring to prevent poisonous exhaust gases from entering the cab interior.*

Selected mounting location should be convenient for driver to operate. Distribution panel should be through-bolted using 1/4-20 screws of suitable length with flat washers, lockwashers and nuts. Circuit breakers should be switched off prior to starting generator set or whenever air conditioning, heaters, engine block or lube oil heaters are not required.

⚠ CAUTION *Do NOT use any wood or sheet metal screws to mount load distribution panel. The panel must be through-bolted because vibration will cause wood or sheet metal screws to loosen.*

Insert plastic cover into the extra blank circuit breaker position in the cover of the distribution panel (as shown in Figure 15) prior to installing circuit breaker cover on distribution panel.

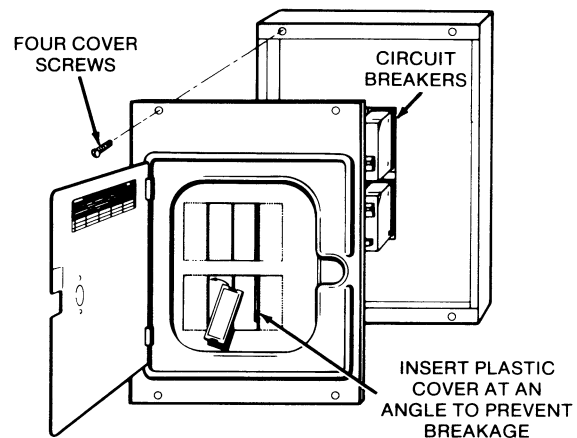
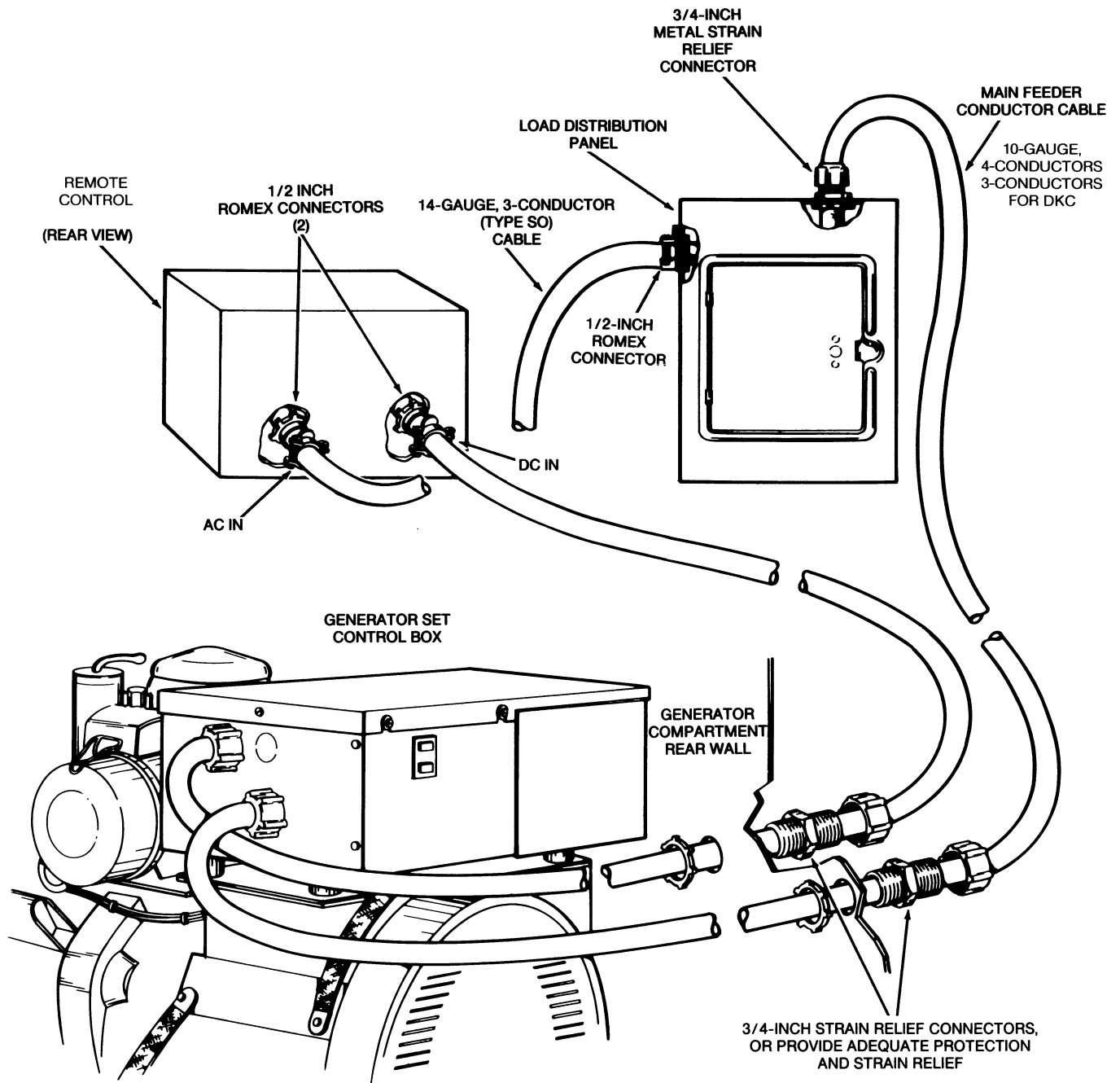


FIGURE 15. TYPICAL LOAD DISTRIBUTION PANEL

With the distribution panel mounted in the desired location, the AC feeder conductors from the generator set must be routed and properly secured (see general wiring recommendations in the beginning of this section). The individual conductors (already connected at the generator set) can now be connected to the main bus terminals of the circuit breakers and the grounding bar inside the distribution panel. See Figures 14 and 16.

AC Engine Heaters

Truckers may prefer to connect the vehicle engine heaters into a separate AC source if the truck is not in service for extended periods. This feature can be provided by installing separate outlets for the heaters to plug into so they can be unplugged and plugged into utility power. These outlets must be protected by ground fault circuit interrupter (GFCI) breakers as shown in Figure 14.



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FIGURE 16. SYSTEM WIRING DIAGRAM PICTORIAL

Fuel Filter Heater

The Aux generator set has a fuel heater built into the filter housing. Fuel heating may be necessary for operation at ambient temperatures below 20°F (-7° C) if No. 1 fuel is not used. At these temperatures the paraffin wax in diesel fuel starts solidifying and can stop fuel flow through the filter.

Heater operation is made by a switch in the truck cab. An indicator light should be included to alert the driver that the heater is on. A rocker-type switch or circuit breaker with built-in indicator may be used for this application.

A typical wiring schematic is shown in Figure 17. Be sure to fuse the circuit and follow all applicable wiring codes. Truck battery connection can be made at a fused accessory terminal. The heater element is thermostatically controlled and requires 8 to 12 amperes depending on fuel temperature. A separate 10- to 15-ampere charger may be required to maintain battery charge during long cold weather usage when vehicle engine is not running.

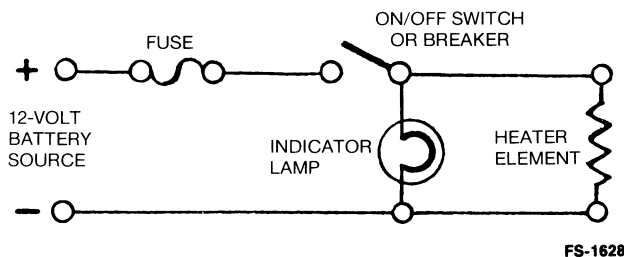


FIGURE 17. TYPICAL FUEL HEATER SCHEMATIC

REMOTE CONTROL CONNECTIONS

An optional remote control panel allows the driver to start the generator set from within the truck cab. The panel contains a preheat/on-off alarm switch, a start-stop switch, an audible unit shut down alarm and one AC duplex receptacle.

The remote panel box has three 5/16 inch (8 mm) mounting holes on the bottom panel for shelf mounting and two 7/8 inch (22 mm) holes on the back panel for the DC control harness and AC receptacle. Use 1/4-20 screws of suitable length to securely fasten the panel in the desired location.

Exact location of the remote panel varies according to owner preference and set location as well as type of truck chassis. The remote panel is usually located near driver's seat in the cab or in a convenient location within the sleeper cab. The generator set can be started at the compartment location if desired.

Remote Panel Wiring

A 7-conductor, 16-gauge (type SO) neoprene-jacketed multistrand wire cable is required for connecting into the remote terminals on the generator set control board. The cable must be fabricated during the installation, cut to required length and hand wired to terminals inside the control box. Suitable sleeving should be used on the assembled cable. Secure the cable with insulated hold-down clamps or plastic tie wraps at least every 18 inches (457 mm) along the wiring run.

The remote cable is not supplied due to variation of length requirements between truck makes and models.

⚠ WARNING *Electrical shock can cause severe personal injury or death. Do not install the remote starting panel without the remote control box housing. A potential shock hazard exists because of the exposed terminals of the AC receptacle.*

⚠ CAUTION *Do not use solid wire or wire smaller than 16 gauge. Solid wire will fatigue from vibration and break. Wire smaller than 16 gauge will result in poor starting from the remote panel and shorten service life.*

Refer to the wiring diagram in Figure 14 for remote panel wiring connections. Use Heyco strain reliefs or Romex connectors on cable when routing through entry holes in remote panel. Be sure to seal all entry holes into the truck cab.

⚠ WARNING *Exhaust gas presents the hazard of severe personal injury or death. Seal all holes leading to the inside of the truck cab for electrical wiring to prevent poisonous exhaust gases from entering the cab interior.*

CONNECTING STARTING BATTERY

General

The battery cables must be properly sized in order for the generator set to crank properly under all operating conditions. Most trucks have 12-volt batteries wired in parallel with negative ground

Cable Recommendations

Double 00 (2/0) cable conforming to SAEJ1127 - type SGR is recommended for both positive (+) and negative (-) battery cables up to 10 feet (3 m) per cable. For longer length cable runs, cable size increases and voltage drop must meet the requirements of SAEJ-541a. The maximum allowable voltage drop between the generator set and truck battery while cranking is 0.48 volts. Battery cables are not supplied because length requirements vary between installations.

Routing Battery Cables

Route battery cables through 1-1/8 inch (29 mm) O.D. holes in the compartment wall. Water-tight 3/4 inch metal strain relief connectors must be used on each cable going through the compartment access holes. Use suitable sleeving or grommets at entry point to the truck battery compartment. Battery terminal connectors of suitable size and type must be obtained through a local truck dealer or service outlet.

Battery Connections

CAUTION A negative battery cable must be installed. Do NOT rely on truck chassis to carry generator set cranking current.

The battery positive (+) terminal connects to the start solenoid as shown in Figure 18. Connect the negative battery cable last to a hole in the engine block as shown. Use the metric M10 bolt and EIT lockwasher in the accessory kit. Use the same size cable for battery negative and battery positive. Be sure terminal connections are clean and tight.

The truck frame ground and the battery and generator set ground must all be electrically connected and be at zero ground potential. All Onan units are designed for negative ground application.

To determine which battery is always grounded, use a voltmeter with a 0-30 VDC minimum scale. Connect the meter negative (-) lead to the truck chassis. Connect the meter positive (+) lead to one 12-volt battery positive (+) terminal. It should read 12-volts with the truck engine not running. Now crank the truck engine. If the voltage remains at 12-volts or less while cranking, connect the auxiliary generator set battery cables to that battery. If the voltage increases to approximately 24-volts while cranking, do not connect to that battery.

CAUTION Connecting the generator set to the truck battery that is switched during cranking can damage the grounded battery and the truck charging system.

WARNING Sparks can ignite battery gases and result in an explosion and severe personal injury. Do not disconnect battery cables from the battery while the generator set is cranking or running. Do not smoke while servicing the batteries.

The belt driven battery charge alternator has a maximum output rating of 150 watts. The actual output amperage depends on the battery state-of-charge and any load that may be connected.

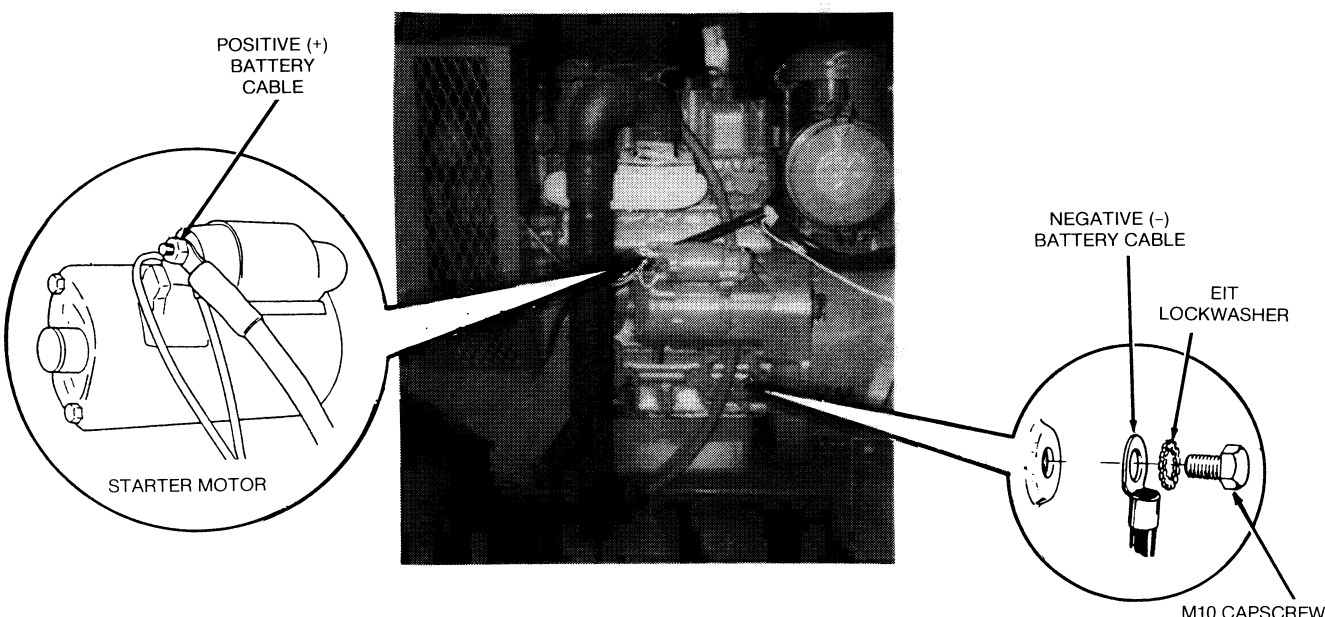


FIGURE 18. BATTERY CONNECTIONS

Final Installation Checks

INSTALLATION CHECKS

Before trying to start the generator set, determine that the installation is complete by answering affirmatively the following questions:

- Is the exhaust system secure and all connections tight?
- Is exhaust pipe terminated away from windows, vents or other openings that might allow exhaust gases to enter, or be pulled into the truck cab when in motion?
- Does the fuel system have a flexible section at the generator set to allow for movement of set and to withstand vibration?
- Are AC leads securely connected to the load circuit and insulated?
- Is wiring secured in the generator set control box to prevent insulation wear due to vibration?
- Are battery leads connected correctly and securely at the generator set and battery?
- Is the generator set adequately protected from road contaminants?
- Has crankcase oil and coolant been added to the engine, and are they at correct levels? Refer to the Maintenance section of the Operator's Manual.

▲CAUTION *Operation without oil or coolant will damage the engine. Oil, fuel and coolant have been drained from the engine prior to shipping from the factory. Be sure to add oil and coolant.*

INITIAL STARTING AND CHECKS

▲WARNING *Exhaust gases presents the hazard of severe personal injury or death. For this reason, do not operate the generator set within any room or building.*

Before trying to start the set, prime the fuel system (refer to the Operator's Manual).

1. Start the generator set by first holding the preheat switch on the engine control panel in the Preheat position for 15 to 30 seconds. Then hold the Start/Stop switch in the Start position. the engine should start within a few seconds.

▲CAUTION *Do not energize the preheat for more than 30 seconds or damage to the heaters will result.*

2. Check the exhaust system for leaks, visually and audibly. Note the security of the exhaust system supports. If any leaks are found, shut down the generator set immediately and repair.

▲WARNING *Exhaust gas presents the hazard of severe personal injury or death. For this reason, shut down the generator set immediately if you discover an exhaust leak or exhaust component needing replacement. Do not use the generator set until you have the exhaust system repaired.*

3. Check the generator set for fuel, oil or coolant leaks. If any are found, shut down the generator set and repair leak before making any more checks.
4. Connect an accurate AC voltmeter and frequency meter across two line terminals. Apply load to the generator and check generator output voltage and frequency. The voltage can be adjusted if not within specs as shown in Figure 19 for the generator connection used. Adjust per the following procedure.

▲WARNING *Generator output presents a shock hazard which can result in severe personal injury or death. Proceed with care!*

Voltage Adjustment Procedure

If voltage adjustment is needed, use the following procedure:

- A. With unit running, note if voltage needs to be increased or decreased.
- B. Stop generator set. Disconnect starting battery ground cable.

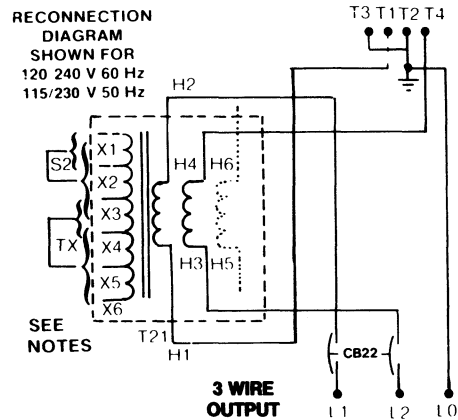
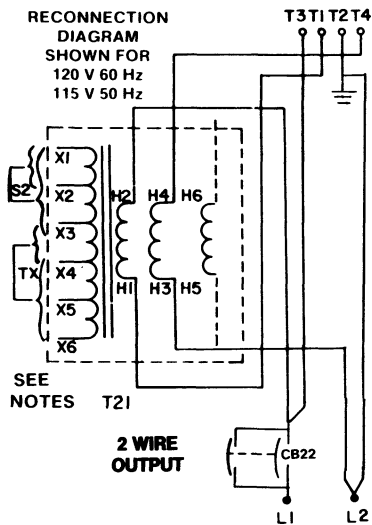
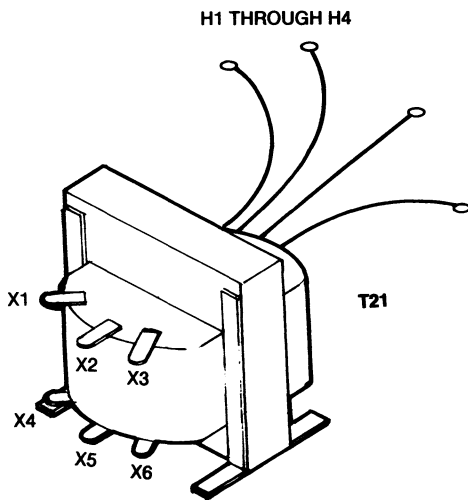
▲WARNING *Accidental starting of the set might cause severe personal injury or death. Disconnect the battery cable when repairs are made to the engine, controls, or generator.*

- C. Move taps on T21 inside the control box as shown on the charts in Figure 19.
- D. Reconnect starting battery ground cable. Operate unit and recheck voltage. If necessary, repeat steps A through D.

Output frequency is determined by engine speed and normally does not require adjustment. Call an authorized Onan distributor for assistance if needed.

| DKC MDKC | OUTPUT VOLTAGE ADJUSTMENT | 60 Hz (-Q1) | | 50 Hz (-Q2) | | | | | |
|-------------|---------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | | 120, 120/240V | | 110, 110/220V | | 115, 115/230V | | 120, 120/240V | |
| | | TAP POSITION S2 | TAP POSITION TX | TAP POSITION S2 | TAP POSITION TX | TAP POSITION S2 | TAP POSITION TX | TAP POSITION S2 | TAP POSITION TX |
| ↑ | INCREASE | X2 | X3 | X3 | X6 | X3 | X5 | X3 | X4 |
| | STD | X1 | X3 | X2 | X6 | X2 | X5 | X2 | X4 |
| | DECREASE ↓ | X2 X1 | X4 X4 | X1 | X6 | X1 | X5 | X1 | X4 |

| DKD MDKD | OUTPUT VOLTAGE ADJUSTMENT | 60Hz (-Q3) | | 50Hz (-Q4) | | | | | |
|-------------|---------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | | 120, 120/240V | | 110, 110/220V | | 115, 115/230V | | 120, 120/240V | |
| | | TAP POSITION S2 | TAP POSITION TX | TAP POSITION S2 | TAP POSITION TX | TAP POSITION S2 | TAP POSITION TX | TAP POSITION S2 | TAP POSITION TX |
| ↑ | INCREASE | X2 X1 | X3 X3 | X3 | X6 | X3 | X5 | X3 | X4 |
| | STD | X2 | X4 | X2 | X6 | X2 | X5 | X2 | X4 |
| | DECREASE ↓ | X1 | X4 | X1 | X6 | X1 | X5 | X1 | X4 |



NOTES

- TO ADJUST OUTPUT VOLTAGE, MOVE TAPS ON T21 ACCORDING TO TABLES
1. IN ALL VOLTAGE CONNECTIONS (50 AND 60 Hz) LEAVE T1 AND T4 CONNECTED TO H1 AND H4 RESPECTIVELY.
2. FOR 60 Hz: USE S2 LEAD (FROM GEN) ON TAPS X1-2 (4 TAPS) USE TX LEAD ON TAPS X3-4
3. FOR 50 Hz: USE S2 LEAD (FROM GEN) ON TAPS X1-3 (6 TAPS) USE TX LEAD ON TAPS X4-6
 - a. FOR 110/220V AND 110V CONNECT H2 TO H6.
 - FOR 110V CONNECT H5 TO T3 (L1) AND H3 TO T2 (L2).
 - FOR 110/220V USE H5 FOR L1 AND H3 FOR L2 (T2 AND T3 ARE GND)

- b. FOR 115/230V AND 115V INSULATE H5 AND H6 (NOT USED)
- c. FOR 120/240V AND 120V CONNECT H2 TO H5
- FOR 120V CONNECT H6 TO T3 (L1) AND H3 TO T2 (L2).
- FOR 120/240V USE H6 FOR L1 AND H3 FOR L2 (T2 AND T3 ARE GND).
4. DASHED LINES INDICATE WHEN USED
5. H5 AND H6 LEADS ARE USED ONLY ON 50 Hz 110V, 110/220V AND 50 Hz 120V, 120/240V CONNECTIONS

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FIGURE 19. TRANSFORMER REGULATOR ADJUSTMENT

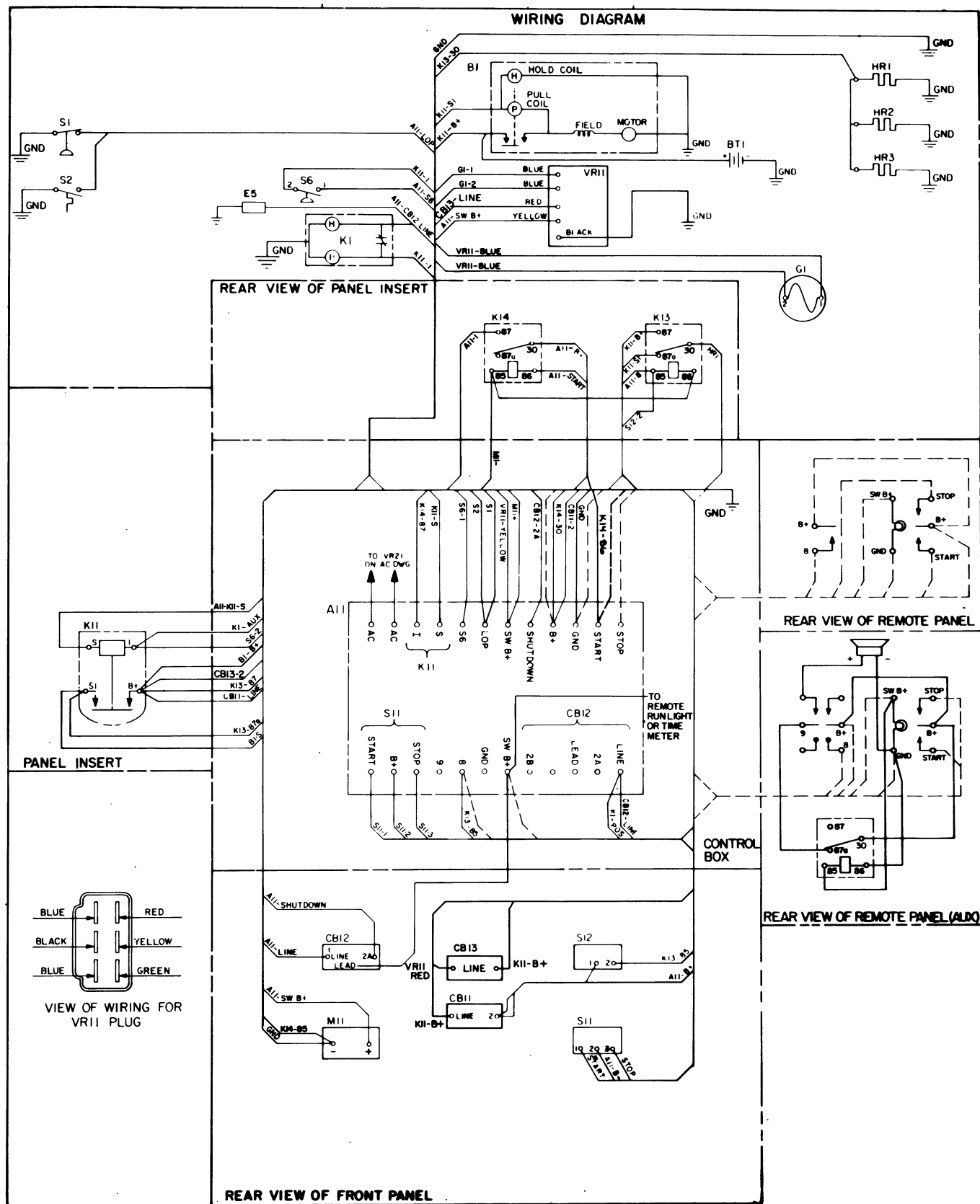
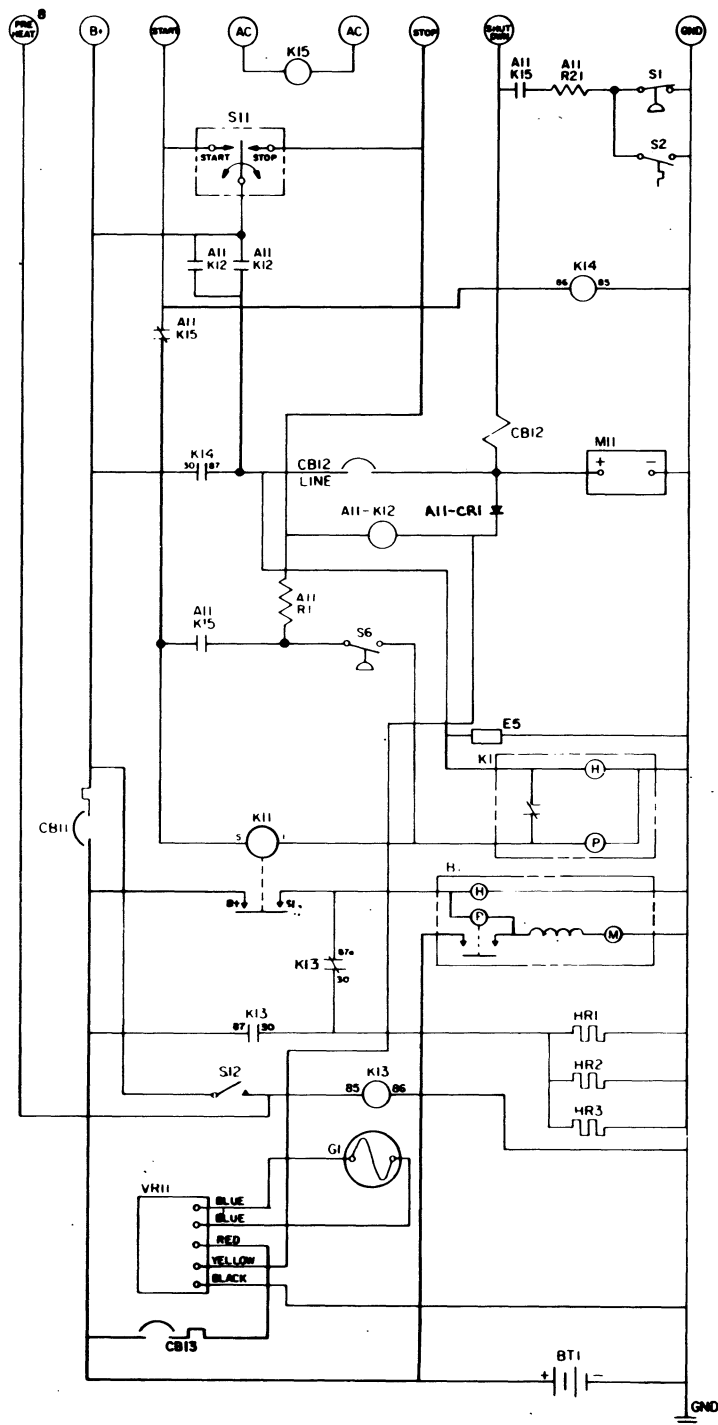


FIGURE 20. CONTROL WIRING DIAGRAM



| PARTS LIST (REF) | |
|------------------|-------------------------------------|
| REF DES. | DESCRIPTION |
| B1 | Starter & Solenoid |
| BT1 | Battery (12 V) |
| HR 1-3 | Heater - Glow Plug |
| E5 | Fuel Pump - Electric |
| K1 | Fuel Solenoid |
| S1 | Switch-Low Oil Pressure |
| S2 | Switch-High Coolant Temp |
| S6 | Switch-Control Power Latch |
| G1 | Alternator |
| VR11 | Voltage Regulator |
| A11 | PCB Assy - Engine Monitor |
| CB11,13 | Circuit Breaker (Control) |
| CB12 | Circuit Breaker (Fault) |
| CR11 | Bridge-Rectifier |
| K11 | Relay-Start Solenoid (Starter) 12 V |
| A11-K12 | Relay-Power |
| K13 | Relay Heater (12 V) |
| A11-K15 | Relay-Starter Protection |
| K16 | Relay-Start Disconnect |
| A11-R1 | Resistor (K12) |
| A11-R2 | Resistor (LOP Timing) |
| M11 | Meter-Time Totalizing 4-40 VDC |
| S11 | Switch-Start/Stop |
| S12 | Switch-Preheat |

FIGURE 21. CONTROL SCHEMATIC



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