Onan®

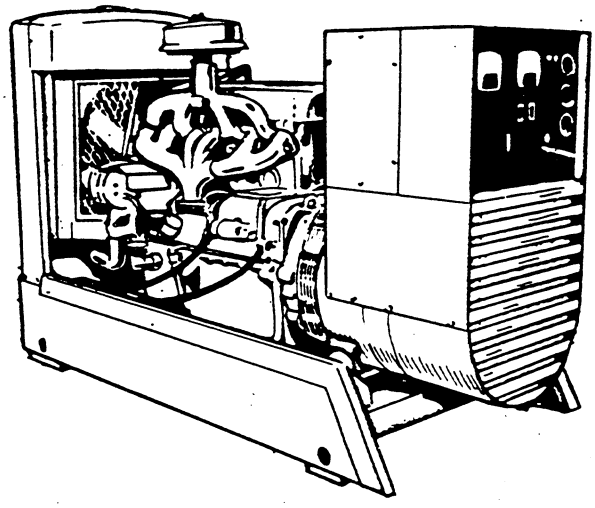
OPERATOR'S MANUAL

FOR

ELECTRIC GENERATING SETS

DEG

SERIES



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SAFETY PRECAUTIONS

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

ONAN recommends that you read your manual and become thoroughly acquainted with it and your equipment before you start your unit. These recommendations and the following safety precautions are for your protection.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

WARNING **Onan uses this symbol throughout this manual to warn of possible serious personal injury.**

CAUTION **This symbol refers to possible equipment damage.**

General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove any debris from set and keep the floor clean and dry.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the generating set are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- Do not wear loose clothing in the vicinity of moving parts, or jewelry while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts; cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.
- Do not work on this equipment when mentally or physically fatigued.
- 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. Bleed the system pressure first.

Protect Against Moving Parts

- Keep your hands away from moving parts.
- Before starting work on the generating set, disconnect batteries. This will prevent starting the set accidentally.

Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME in the vicinity of the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.

Guard Against Electric Shock

- 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 surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DON'T tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

Exhaust Gases Are Toxic

- Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

Keep the Unit and Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- 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.

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WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.

INTRODUCTION

FOREWORD

This manual is applicable to the DEG Series electric generating set consisting of an ONAN UR generator, driven by a Ford diesel engine. See *SPECIFICATIONS* for generator sizes. This manual provides information on installation, operation, and general maintenance. The manual should be used in conjunction with the Ford engine manual for specific engine information.

MODEL IDENTIFICATION

Identify your model by referring to the MODEL and SPECIFICATION NO. as shown on the Onan nameplate. Electrical characteristics are shown on the lower portion of the nameplate.

1. Indicates kilowatt rating (50 kW).
2. Factory code for SERIES identification.
3. 15 = 60 Hz. Reconnectible
   515 = 50 Hz. Reconnectible
   R—Indicates remote starting feature.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

When contacting a dealer or the factory regarding the set, always mention the complete Model, Spec No. and Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify your unit among the many manufactured. Refer to the engine nameplate when requesting information from its manufacturer. The Onan nameplate is located on the right side of the generator; the Ford nameplate is on the upper left hand side, on flywheel housing.

Left side and right side are considered when viewed from the engine or front end of the generating set.

WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- **Dizziness**
- **Intense Headache**
- **Weakness and Sleepiness**
- **Vomiting**
- **Muscular Twitching**
- **Throbbing in Temples**

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

SPECIFICATIONS

50.0 kW

ENGINE DETAILS

Engine Manufacturer	Ford
Engine Series	2715 E
Number of Cylinders	6
Displacement	380-inch^3 (6.2 litre)
BHP @ 1800 r/min	93 (69.4 kW)
Compression Ratio	16.0:1
Bore	4.22-inch (107.2 mm)
Stroke	4.52-inch (114.8 mm)
Fuel	ASTM No 2 Diesel
Battery Voltage	12
Battery Group (Two 6-Volt, 135 Ah [486 kC])	2H
Starting Method	Solenoid Shift
Governor Regulation	5% No Load—Full Load
Battery Charging Current	35-Amperes

GENERATOR DETAILS

Type	UR 15 60 Hz UR 515 50 Hz
Rating (Watts)	
60 Hertz Continuous Standby	50 000 (62.5 kVA)
50 Hertz Continuous Standby	40 000 (50.0 kVA)
AC Voltage Regulation	±2%
60 Hertz r/min	1800
50 Hertz r/min	1500
Output Rating	0.8 PF
AC Frequency Regulation	5% (3.0 Hz)

CAPACITIES AND REQUIREMENTS

Cooling System, Engine and Radiator	18-quarts (17 litres)
Engine Oil Capacity (Filter, Lines, Crankcase)	14-quarts (13.25 litres)
Exhaust Connection (inches pipe thread)	2-inch (male)

AIR REQUIREMENTS (1800 r/min)

Engine Combustion	160-cfm (5 m^3/min)
Radiator Cooled Engine	7300-cfm (210 m^3/min)
Total for Radiator Cooled Model	7460-cfm (215 m^3/min)
Alternator Cooling Air (60 Hertz)	1000-cfm (30 m^3/min)
(50 Hertz)	833-cfm (24 m^3/min)
Fuel Consumption at Rated Load, 60 Hertz	4.3-g/h (16.3 L/h)

GENERAL

Height	45.563-inches (1.16 m)
Width	33.0-inches (0.84 m)
Length	76.625-inches (1.95 m)
Approximate Weight (Mass)	2070-lb (939 kg)

DESCRIPTION

GENERAL

An Onan DEG series electric generating set is a complete unit consisting of an engine driven AC generator, with standard and optional controls and accessories as ordered.

ENGINE

The engine on the DEG is a Ford 2715 E as described in the engine manual. Basic measurements and requirements will be found under *SPECIFICATIONS.* For operation, maintenance and service information, consult the Ford manual.

AC GENERATOR

The generator is an ONAN Type UR, 12 lead, 4-pole revolving field, reconnectible, brushless unit. The main rotor is attached directly to the engine flywheel, therefore engine speed determines generator output frequency. The 60 Hz set operates at 1800 r/min; the 50 Hz at 1500 r/min. Excitation is achieved as follows—

Residual alternating current from the stator winding is applied to the voltage regulator, where it is compared with a reference voltage, rectified and returned to the field winding of the exciter. Current then induced in the exciter rotor is rectified and fed into the generator rotor. This induces a current in generator stator which is applied to the load.

CONTROL PANEL

The following is a brief description of each of the standard controls and instruments located on the face of the panel. See Figure 1.

DC Panel

Panel Light and Switch: Illuminates control panel.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine (wired to a sensor unit located on the engine).

Water Temperature Gauge: Indicates temperature of circulating coolant in engine. (Wired to a sensor unit located on the engine.)

Battery Charge Rate DC Ammeter: Indicates battery charging current.

Run-Stop/Reset-Remote Switch: Starts and stops the unit locally or from a remote location. Resets engine monitor relay in Stop/Reset position.

Warning Light: Indicates "Fault" in engine operation.

AC Panel

AC Voltmeter: Indicates AC generator output voltage. Dual range instrument: measurement range in use shown on indicator light.

Voltage Regulator: Rheostat, provides approximately plus or minus 5% adjustment of the rated output voltage.

Exciter Circuit Breaker: Provides generator exciter and regulator protection from overheating, in the event of certain failure modes of the generator, exciter and voltage regulator.

Running Time Meter: Registers the total number of hours, to 1/10th, that the unit has run. Use it to keep a record for periodic servicing. Time is accumulative; meter cannot be reset.

Voltmeter Phase Selector Switch: Selects phases of generator output to be measured by the AC voltmeter.

OPTIONAL EQUIPMENT

DC Panel

Warning Lights: Eliminates the one "Fault" light and substitutes five indicator (see Figure 2) lights to give warning of—

a. Overcrank
b. Overspeed
c. Low oil pressure
d. High engine temperature
e. Low engine temperature

Operation of these lights will be discussed in conjunction with engine monitor panel.

Reset Switch: Manual reset for engine monitor after malfunction shut-down.

Lamp Test: Press to test warning lamp bulbs (when engine is running only).

AC Panel

AC Ammeter: Indicates AC generator output current. Dual range in use shown on indicator lights.

Frequency Meter: Indicates the frequency of the generator output in hertz. It can be used to check engine speed. (Each hertz equals 30 r/min.)

Voltmeter-Ammeter Phase Selector Switch: Selects phase of generator output to be monitored by the AC voltmeter and optional AC ammeter.

CONTROL PANEL INTERIOR

The only equipments discussed in this section will be those which the operator may have reason to adjust or inspect for service.

Terminal Board (TB) 21

Connection of wire W12 to terminals H3, H4, H5 and H6 is made at this point, to change reference voltage when reconnecting generator for different voltages.

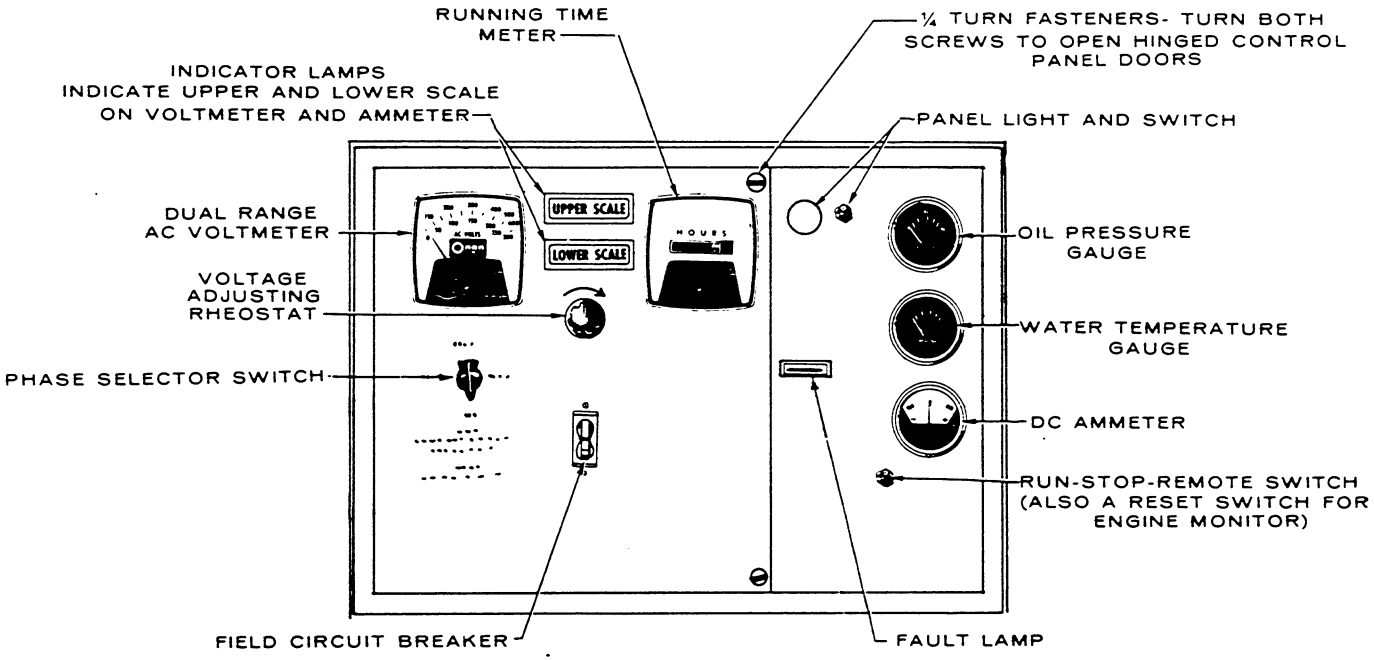


FIGURE 1. STANDARD CONTROL PANEL (ONE FAULT LAMP)

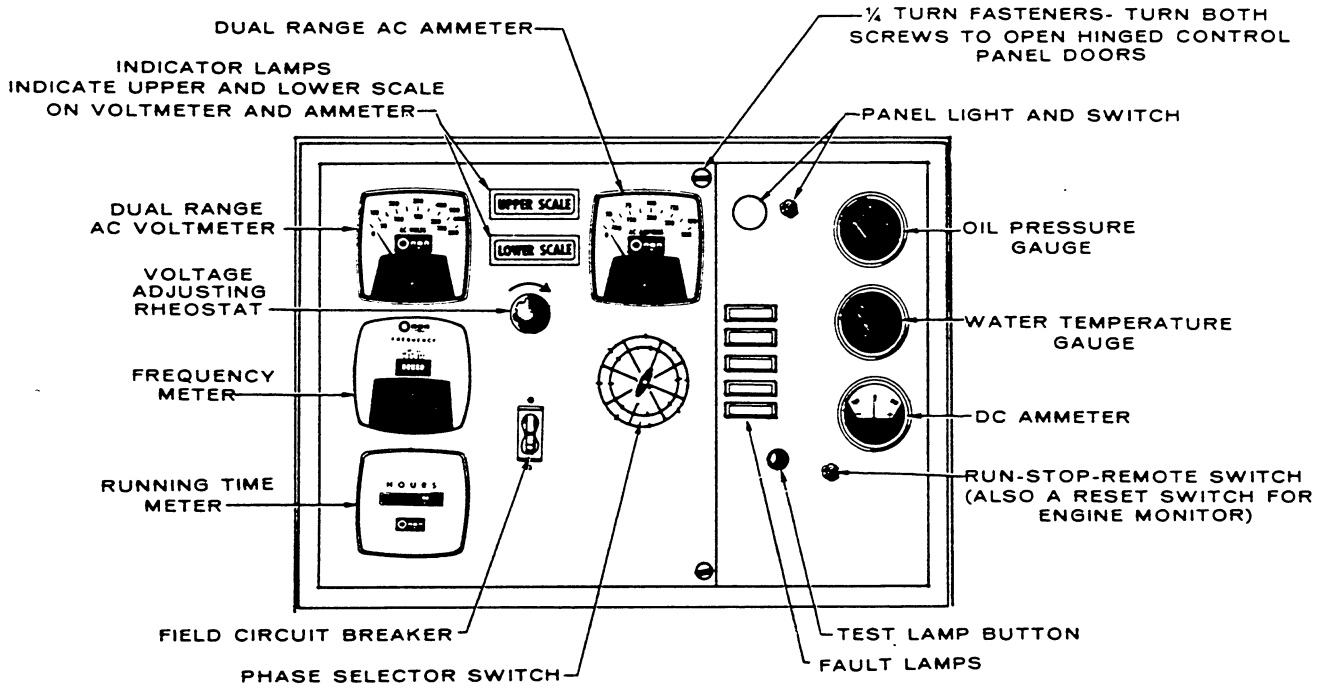


FIGURE 2. OPTIONAL CONTROL PANEL (FIVE FAULT LAMPS)

Voltage Regulator

Solid state unit, consisting of printed circuit board VR21; an SCR bridge CR21, with a commutating reactor L21 are located in the control panel as part of the voltage regulator system. AC output from generator is controlled at predetermined level regardless of load; regulation is plus or minus 2% from no load to full load, at 0.8 PF.

Engine Monitor

Printed circuit plug-in modules provide the following functions:

1. A 75-second cranking period.
2. Approximately a 12.5-second time delay for oil pressure buildup.
3. An external alarm contact to light a fault lamp and shut down the set for alarm conditions such as:
   a. Overcrank (failed to start after cranking 75 seconds).
   b. Overspeed (engine speed reaches 2100 rpm).
   c. Low oil pressure 14 psi (96.53 kN/m²).
   d. High engine temperature 215° F (102° C).

CAUTION **High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. It is therefore imperative that adequate engine coolant levels be maintained, to ensure operational integrity of cooling system and engine coolant overheat shutdown protection.**

On standard control panels, all four alarms are wired into one common fault lamp; on units with five fault lamps, four have shutdown alarms, the fifth (low engine temperature) lights a fault lamp only. Refer to Table 1.

Standard Cranking Module

Limits engine cranking time to 75 seconds. If engine fails to start after 75 seconds the engine monitor lights a fault lamp and opens the cranking circuit.

OPTIONAL MODULES

Cycle Cranker

Plug-in module replaces standard cranking circuit. Automatically provides a 15-second crank time and a 10-second rest time for three ON and two OFF cycles in 65 seconds. If engine fails to start, after 75-seconds the engine monitor lights a fault lamp and opens the cranking circuit.

Pre-Alarm

Gives advance warning for low oil pressure or high engine temperature. Requires two sensors each for engine temperature and oil pressure.

TABLE 1. FAULT LAMP OPTIONS

SYSTEM	FAULT	FAULT LAMP	STOP ENGINE	EXTERNAL ALARM	PRE-ALARM
PENN STATE SINGLE LIGHT	Overcrank	x	x	x	
	Overspeed	x	x	x	
	Low Oil Pressure	x		x	
	High Engine Temperature	x		x	
STANDARD SINGLE LIGHT	Overcrank	x	x	x	
	Overspeed	x	x	x	
	Low Oil Pressure	x	x	x	
	High Engine Temperature	x	x	x	
5 LIGHT	Overcrank	x	x	x	
	Overspeed	x	x	x	
	Low Oil Pressure	x	x	x	
	High Engine Temperature	x	x	x	
	Low Engine Temperature	x			
5 LIGHT PRE-ALARM	Overcrank	x	x	x	
	Overspeed	x	x	x	
	Low Oil Pressure	x	*	x	x
	High Engine Temperature	x	*	x	x
	Low Engine Temperature	x			

* - With additional optional sensors.

ENGINE SENSORS

Resistance units and switches in the engine temperature and oil pressure monitoring and shutdown systems are sealed units and are not repairable.

For location, refer to Figures 3 and 4. When changing a sensor, do not substitute, use recommended replacement parts. Resistance units are matched to the gauge they supply, and cut-off switches are close-tolerance actuation parts, made for a specific application.

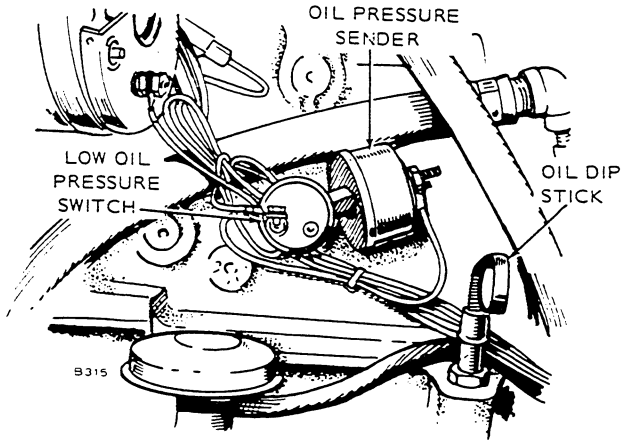
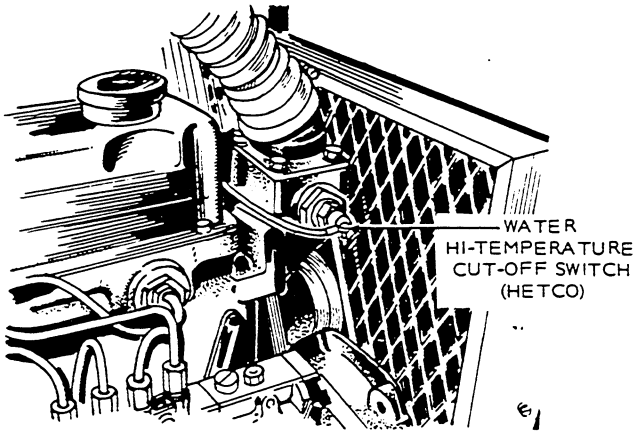


FIGURE 3. OIL PRESSURE MONITORS



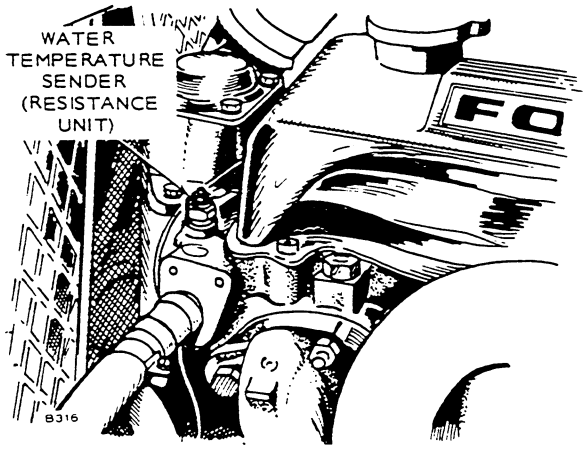


FIGURE 4. ENGINE TEMPERATURE MONITORS

INSTALLATION

GENERAL

Installations must be considered individually. Use these instructions as a general guide. All installations must meet regulations of state and local building codes, fire ordinances, etc., which may affect installation details. See Figure 5. Refer to *ONAN Technical Bulletin T-030* for further installation information.

Requirements to be considered prior to installation:

1. Level mounting surface.
2. Adequate cooling air.
3. Adequate fresh induction air.
4. Discharge of circulated air.
5. Discharge of exhaust gases.
6. Electrical connections.
7. Fuel installation.
8. Water supply (city water cooling).
9. Accessibility for operation and servicing.
10. Vibration isolation.
11. Noise levels.

LOCATION

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated. If practical, install inside a heated building for protection from extreme weather conditions.

MOUNTING

Generator sets are mounted on a rigid skid base which provides proper support. The engine-generator assembly is isolated from the skid base by rubber mounts which provide adequate vibration isolation for normal installations. For installations where vibration control is critical, install additional spring-type isolators between skid base and foundation.

For convenience in general servicing and changing crankcase oil, mount set on raised pedestal at least 6 inches (150 mm) high.

VENTILATION

Generator sets create considerable heat which must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for the required air flow. See *SPECIFICATIONS* for the air required to operate with rated load under normal conditions at 1800 r/min.

Radiator set cooling air travels from the rear of the set and is removed by a pusher fan which blows out through the radiator. Locate the air inlet to the rear of the set. The inlet opening should be at least 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 opening free area must be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to air flow. Use a duct of canvas or sheet metal between the radiator and the air outlet opening. The duct prevents recirculation of heated air.

For operation outside a building, a shelter housing with electrically operated louvres is available as an option. Transformers connected across the generator output supply current to the motors. When the generator is operating, current in the transformers actuate the motors and open the louvres. The louvres are held open for the duration of the set operation, then are closed by return springs when the set is shut down.

City Water cooled sets do not use the conventional radiator. A constantly changing water flow cools the engine. Sufficient air movement and fresh air must be available to properly cool the generator, disperse heat convected off the engine and support combustion in the engine. Installations require an auxiliary fan (connected to operate only when the unit is running) of sufficient size to assure proper air circulation and evacuation of fumes.

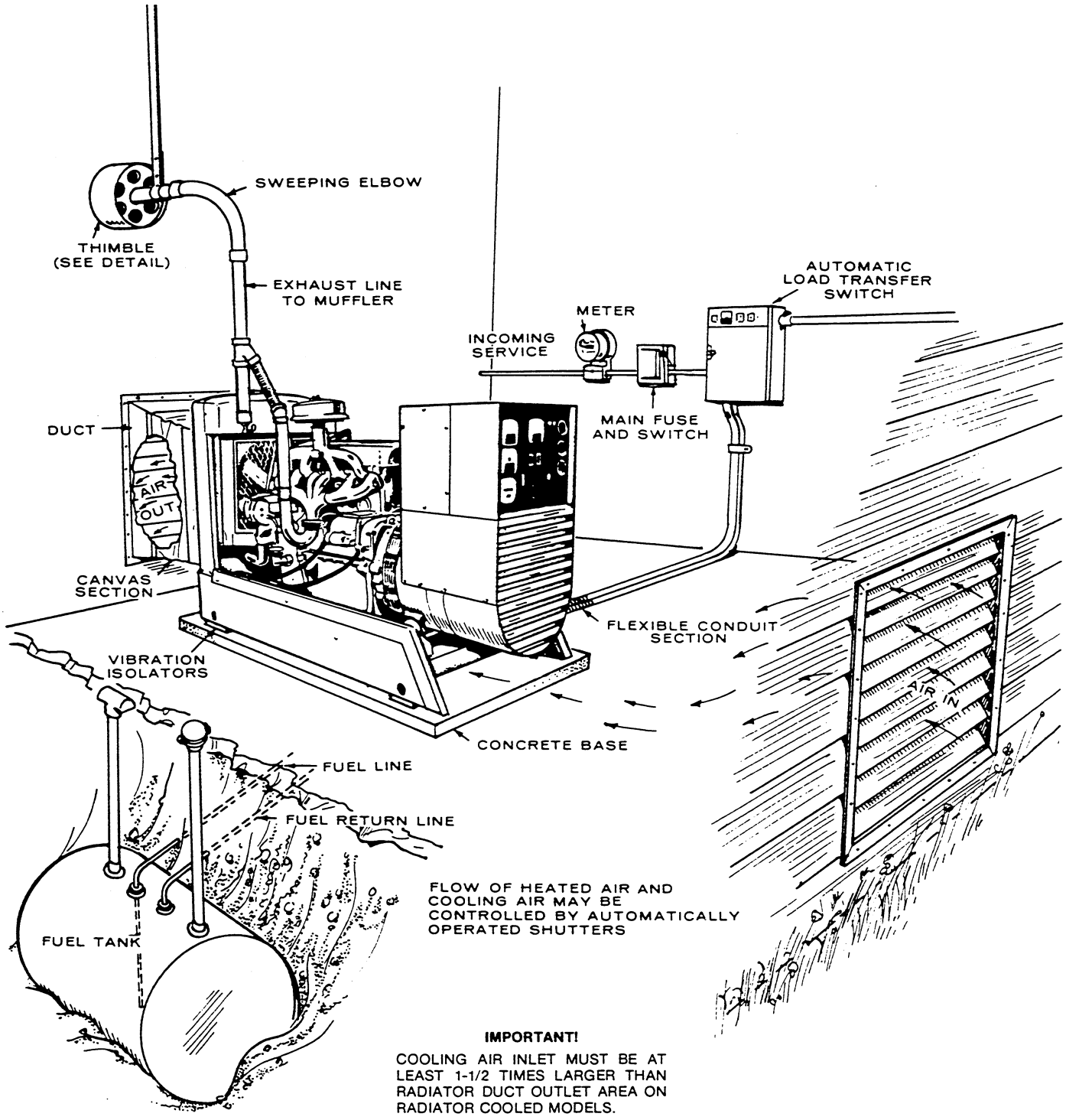
COOLING SYSTEM

Standard Radiator Cooling, uses a set mounted radiator and engine driven pusher type 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.

Heat Exchanger Cooling (optional), 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 raw 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 and other impurities.

This system reduces set enclosure airflow and noise levels. Proper operation depends upon a constant supply of raw water for heat removal. The engine coolant side of the system may be protected from freezing, the raw water side cannot. See Figure 6 for typical installation.

Standpipe Cooling (optional) substitutes a mixing (tempering) tank for the standard radiator and fan. Cooling water circulating through the engine jacket is mixed with raw water in the tank. Because raw water flows through the engine jacket, it must not contain scale forming impurities or fouling of the engine water will occur. Fouling results in engine overheating and costly repair bills.



IMPORTANT!

COOLING AIR INLET MUST BE AT LEAST 1-1/2 TIMES LARGER THAN RADIATOR DUCT OUTLET AREA ON RADIATOR COOLED MODELS.

FLOW OF COOLING AIR AND HEATED AIR MAY BE CONTROLLED BY AUTOMATICALLY OPERATED LOUVRES.

FIGURE 5. TYPICAL MODEL DEG INSTALLATION

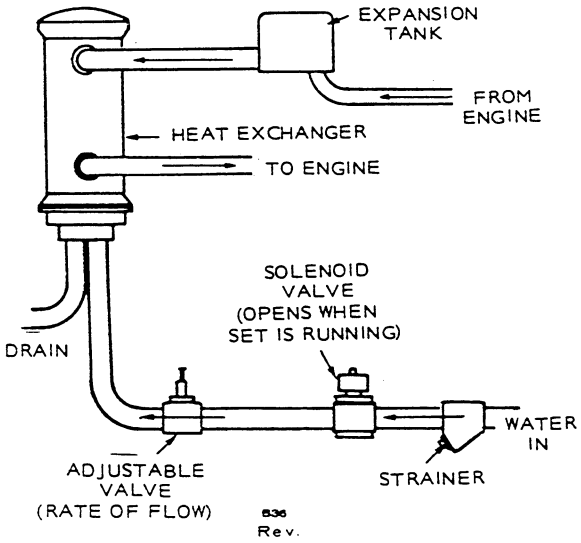


FIGURE 6. HEAT EXCHANGER (TYPICAL)

This system reduces set enclosure airflow requirements and noise levels. Proper operation is dependent on a constant supply of cooling water. The system cannot be protected from freezing. See Figure 7.

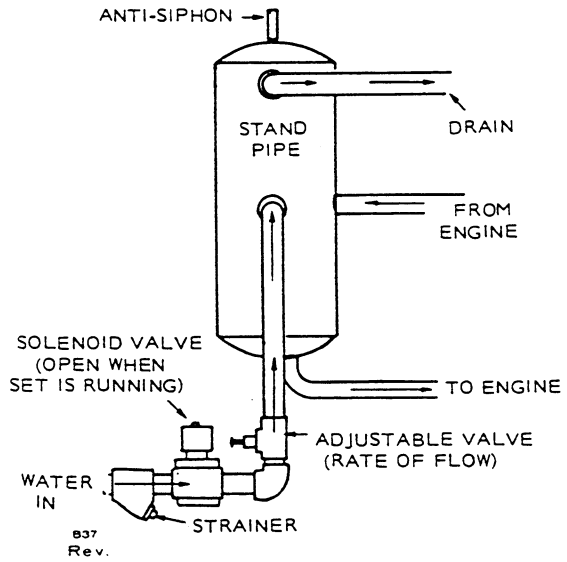


FIGURE 7. STANDPIPE (TYPICAL)

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

This system must be designed to meet specific requirements of the application.

COOLING CONNECTIONS

The radiator cooled (standard) set does not require any external connections except as discussed under *Ventilation.* Allow clearance around the set for access to service the radiator and fan belts. See Figure 5.

Heat Exchanger and Standpipe cooled sets must be connected to a pressurized supply of cold water. Make connections to the set with flexible pipe to absorb vibration. On the cool water line install a solenoid valve to shut off the flow when the set is shut down and a rate of flow valve to control engine temperature. This valve can be either manual or automatic. Actual rate of flow will depend on inlet water temperature.

Adjust the flow to maintain water temperature between 165°F and 195°F (73.9°C and 90.6°C) while viewing the water temperature gauge.

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 mounting radiator.

Remote radiator plumbing will vary with installation. All systems must comply with the following conditions—

1. Make all connections to the set and to the radiator, with flexible pipe.
2. Install an auxiliary circulating pump if the horizontal distance between the engine and radiator exceeds 15 feet (4.65 m).
3. Install a hot-well system to relieve excess engine water jacket pressure if the top of the radiator is more than 15 feet (4.65 m) above the center-line of the engine crankshaft.

GENERAL WATER FILTER

Some generator sets are equipped with a cooling system filter (corrosion resistor). This filter is a unit which directs coolant from the system through a filtering and treating device. It softens water, neutralizes acidity and protects against corrosion by the use of a replaceable chemically activated filtering element. In addition, the unit contains a sacrificial metal plate which arrests pitting of metals in the system by electro-chemical action.

Exact location of filter will vary because of other optional equipment which may also be installed. See Figure 8.

Two types of elements are available from your Onan dealer or distributor.

1. Regular formula (chromate)
2. PAF formula (borate) year round type

CAUTION **Do not use anti-freeze with an anti-leak formula. The stop-leak element can prevent or retard the flow through the filter, thereby eliminating the filtering process completely.**

The regular formula can be used with plain water and selected antifreezes. The best protection results will be gained by using the borate formula element with a permanent antifreeze.

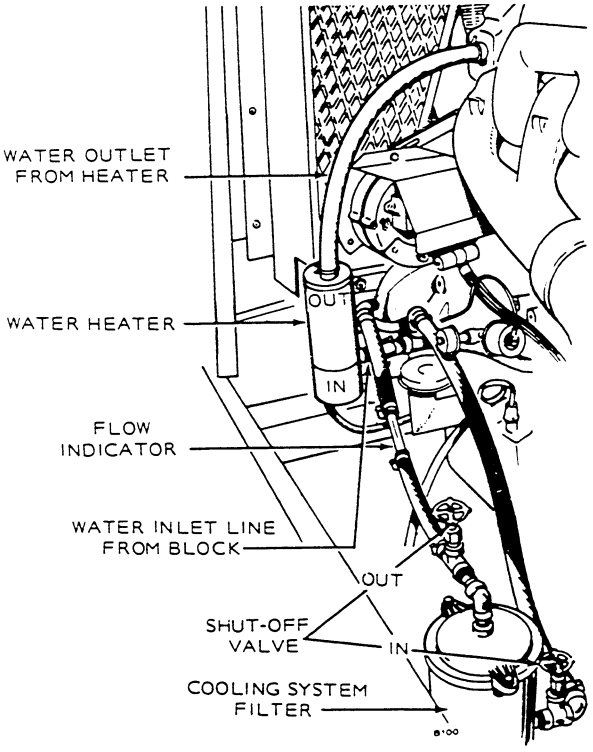


FIGURE 8. COOLING SYSTEM (RADIATOR)

ONAN recommends that shutoff valves be installed to the engine side of the inlet and outlet of the coolant filter, for ease in changing elements. Further, it is good practice to insert and clamp a thick-walled pyrex tube into the line at a convenient point to serve as a flow indicator. This flow indicator will act in the capacity of a sight gauge to observe general condition, possible air pockets and presence of contaminants in the coolant flow. See Figure 8 for installation recommendations.

WATER JACKET HEATER (Optional)

This heater is installed to maintain an elevated engine temperature in lower ambient temperature applications. It heats and circulates engine coolant, and is thermostatically controlled.

EXHAUST

WARNING **Inhalation of exhaust gases can result in death. Be certain that exhaust gases are properly vented and that an adequate supply of fresh air is always present.**

Engine exhaust gas must be piped outside building or enclosure. Do not terminate exhaust pipe near inlet vents or combustible materials. An approved thimble (Figure 9) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 10) at the point where a rise in the exhaust system begins. Avoid sharp bends; use sweeping long radius elbows. Provide adequate support for mufflers and exhaust pipes. Refer to Figure 5 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9 inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 4 inch (101.6 mm) pipe size outlet of the engine with a flexible portion between the engine and the muffler.

WARNING **Exhaust pipes are often hot and can cause injury if touched. Shielding should be used. Local codes may have additional requirements.**

Minimum diameters and maximum lengths of pipe are as follows:

Single Exhaust System:

3.0 inch pipe	60-feet (18 m)
3.5-inch pipe	176-feet (54 m)
4.0-inch pipe	272-feet (83 m)

Maximum permissible exhaust restriction (back pressure) is 20.4 inches (518 mm) H2O.

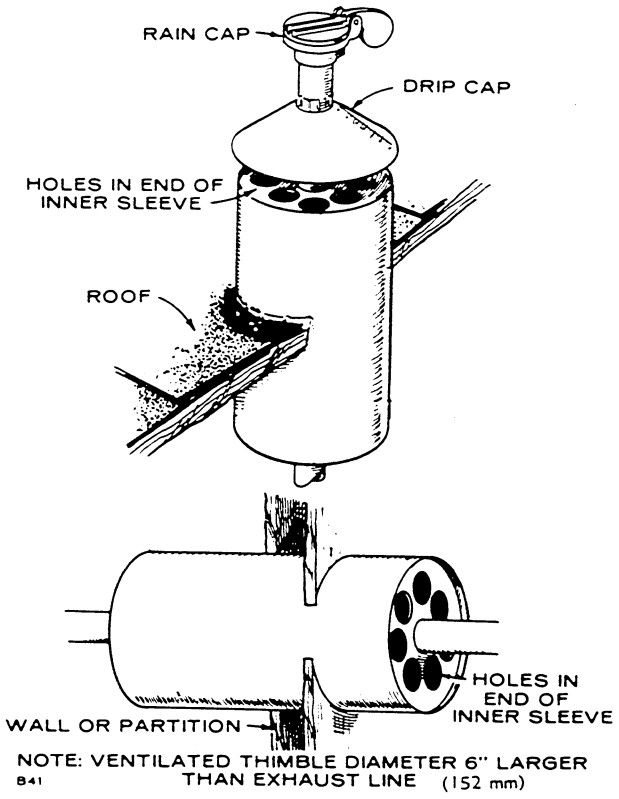


FIGURE 9. EXHAUST THIMBLE

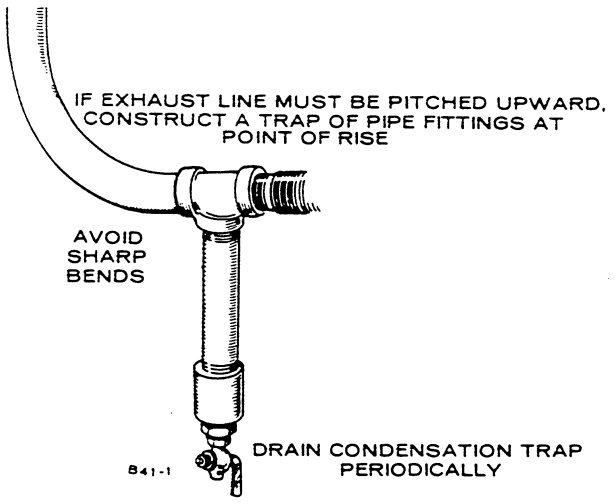


FIGURE 10. EXHAUST CONDENSATION TRAP

FUEL SYSTEM

Ford engines used on DEG sets are designed for use with ASTM No. 2 Diesel fuel.

FUEL CONNECTIONS

Check local regulations governing the installation of a fuel supply tank.

In any diesel engine installation, fuel system cleanliness is of utmost importance. Make every effort to prevent entrance of moisture or contaminants of any kind. Do not use lines or fittings of galvanized material.

A fuel lift in excess of 6 feet (1.8 m) is not recommended without a day tank installation, because of fuel drainage. Horizontal run, if the supply tank is level with the fuel pump, should not exceed 12.5 feet (3.9 m). However, a day tank is again recommended. A fuel sediment trap should be installed between fuel transfer pump and supply tank.

The fuel inlet is in the transfer pump and is threaded for 3/8 inch pipe. Injectors' return line requires a 1/8-inch low pressure hose connection. Refer to Figure 11.

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the fuel tank. The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and main fuel tank. Refer to the installations included with the tank. See Figure 12 for an example of a day tank installation. Tank and lines must be below level of injector pump return outlet.

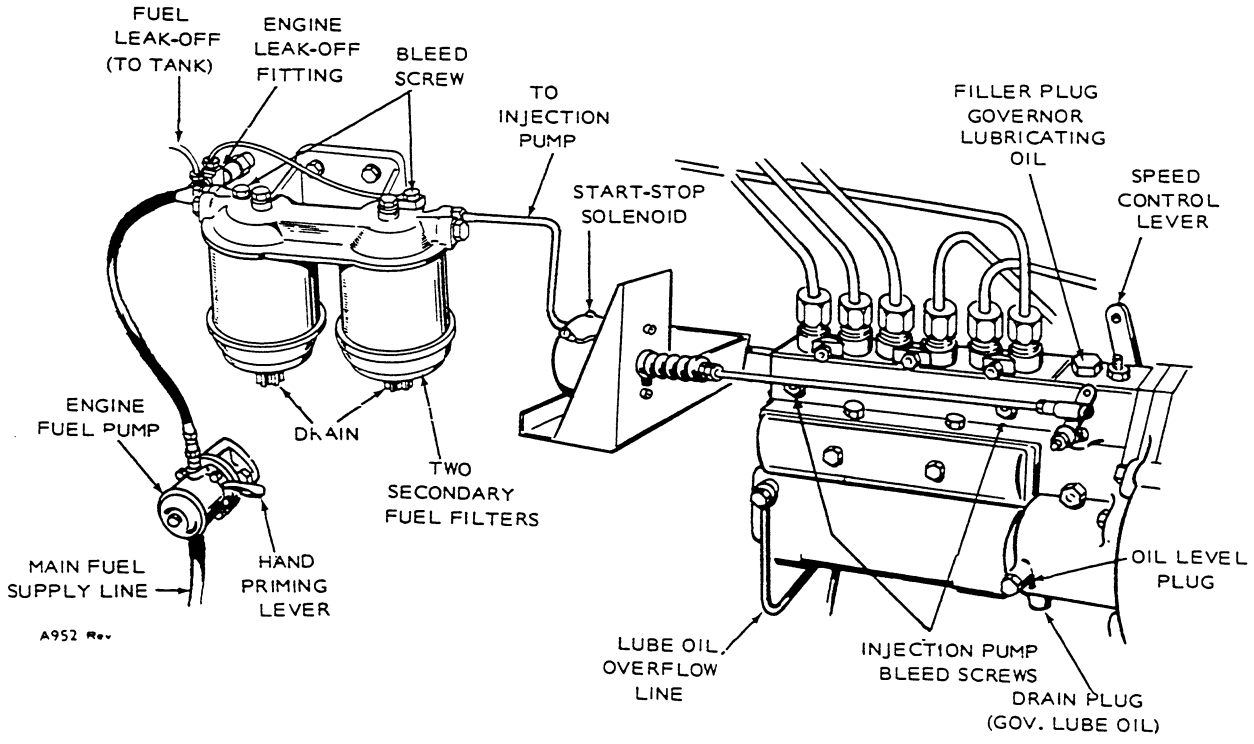


FIGURE 11. FUEL SYSTEM

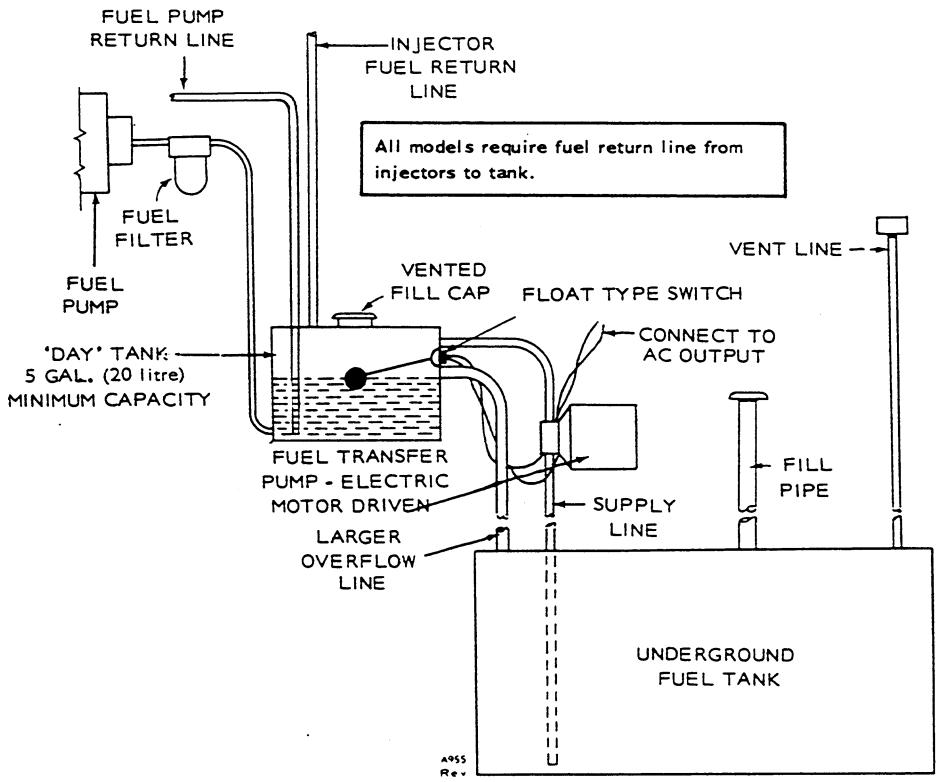


FIGURE 12. DAY TANK (TYPICAL)

BATTERY

Starting the unit requires 12-volt battery current. Use two 6-volt (see *SPECIFICATIONS*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 13. Necessary battery cables are on unit. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they 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 **Do not smoke while servicing batteries. Lead acid batteries give off explosive gases while being charged.**

BATTERY, HOT LOCATION

Batteries will self discharge very quickly when installed where the ambient temperature is consistently above 90° F (32.2° C) such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.260 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90° F (32.2° C), this should not be noticed. The lengthened battery life will be worth the effort.

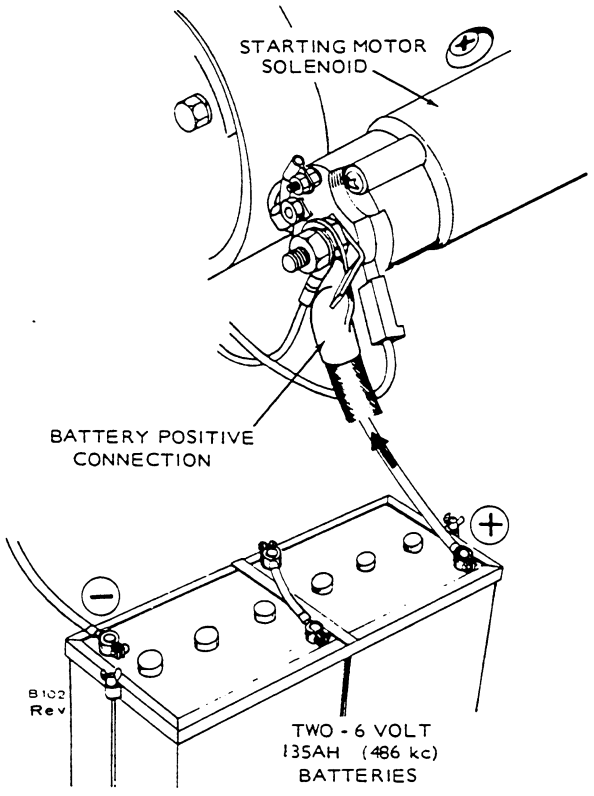
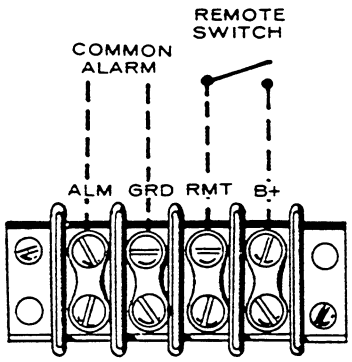


FIGURE 13. BATTERY CONNECTION

1. Fully charge the battery.
2. With the battery still on charge, draw off the electrolyte above the plates in each cell. DO NOT ATTEMPT TO POUR OFF; use a hydrometer or filler bulb and dispose of it in a safe manner. Avoid skin or clothing contact with the electrolyte.
3. Refill each cell with distilled water, to normal level.
4. Continue charging for 1 hour at 4 to 6 amperes.
5. Test each cell. If the specific gravity is still above 1.225, repeat steps 2, 3, and 4 until the reading is reduced to 1.225. Usually, repeating steps twice is sufficient.

REMOTE CONTROL CONNECTIONS

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated within the control box. Connect one or more remote switches across remote terminal and B+ terminal as shown in Figure 14. If the distance between the set and remote station is less than 1000-feet (305 m), use No. 18 AWG wire; between 1000- and 2000-feet (305 m and 610 m), use No. 16 AWG wire.



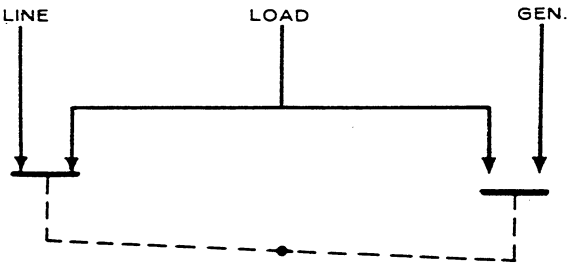
USE NO. 18 WIRE UP TO 900 FEET
16 WIRE UP TO 1500 FEET
14 WIRE UP TO 2400 FEET

FIGURE 14. REMOTE START CONNECTION (TB12)

WIRING CONNECTIONS

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

If the installation is for standby service, a double throw transfer switch must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator current to be connected to the load at the same time. See Figure 15. Instructions for connecting an automatic load transfer control are included with such equipment.



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.

FIGURE 15. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

Control Box Connections

The factory ships these 12 lead generators with load connection wires NOT connected together in the control box. These 12 wires are labeled T1 through T12 and must be brought together before making load connections. Proceed as follows:

1. Remove either right, left or top panel from control box. See Figure 16.
2. Connect wires together as shown on panel drawing and in Figure 21 according to voltage desired.
3. Open hinged control panel doors. Connect lead from terminal 63 to correct terminal for voltage desired. These terminals are labeled H3, H4, H5 and H6. See Figure 17.
4. Close front panel and secure with 1/4 turn fasteners.
5. Connect load wires to generator leads.

Preceding instructions do not apply to models designated Code 3 or 9X; this connection is made at the factory. The installer must only connect load wires.

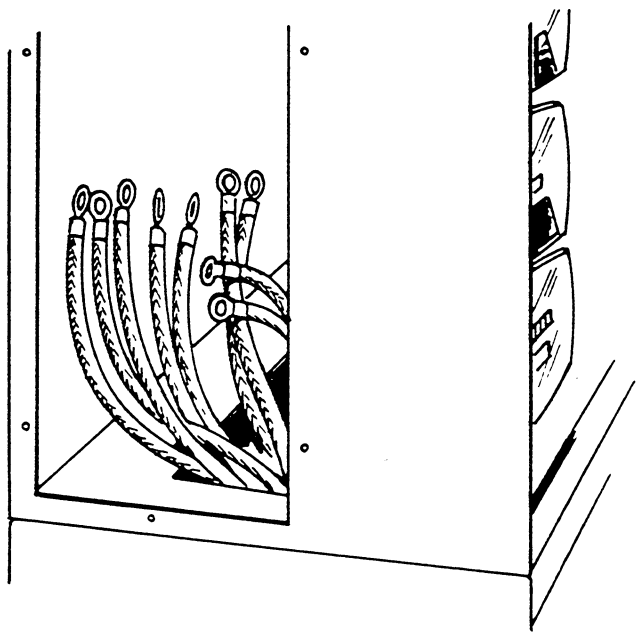


FIGURE 16. CONTROL BOX (SIDE PANEL REMOVED)

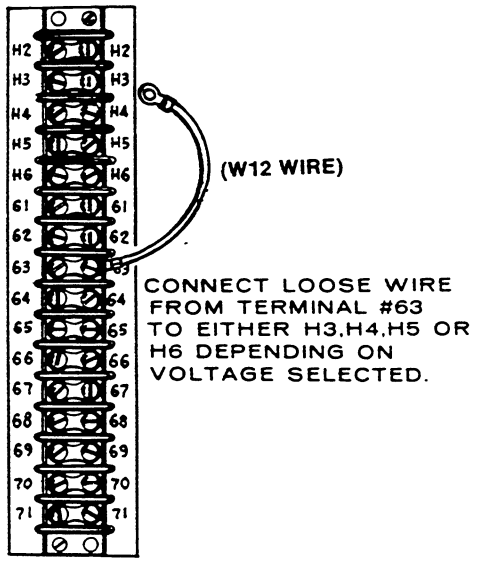


FIGURE 17. REFERENCE VOLTAGE CONNECTION (TB21)

120/240 Volt, Single Phase, Double Delta

Terminal connection L0 can be grounded (neutral). For 120 volts, connect the hot load wires to either the L1 or L2 connection, Figure 18. Connect the neutral load wire to the grounded L0 connection. Two 120-volt circuits are thus available, with not more than 1/3 the rated capacity of the set available on either circuit. If using both circuits, be sure to balance the load between them.

For 240 volts, connect one load wire to the L1 connection and the second load wire to the L2 connection. Terminal connection L0 is not used for 240 volt service.

Only 2/3 of rated current is available from this connection.

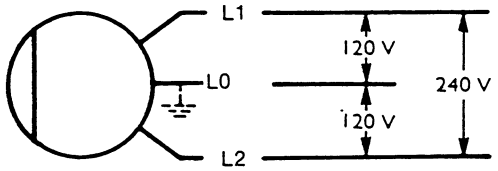


FIGURE 18. 120/240 V. 1-PHASE DOUBLE DELTA

120/240 Volt, 3 Phase, Series Delta

The 3 phase Series Delta connected set is designed to supply 120 and 240 volt, 1 phase current and 240 volt, 3 phase current, Figure 19. For 3 phase operation, connect the three load wires to generator terminals L1, L2 and L3—one wire to each terminal. For 3 phase operation the L0 terminal is not used.

For 120/240 volt, 1 phase, 3 wire operation, terminals L1 and L2 are the "hot" terminals. The L0 terminal is the neutral, which can be grounded if required. For 120 volt service, connect the black load wire to either the L1 or L2 terminal. Connect the neutral (white) wire to the L0 terminal. Two 120 volt circuits are available. Connect between any two 3-phase terminals for 240 volt 1-phase loads.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as total current does not exceed the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA. If no 3 phase output is used and the loads are mostly 120 volts, the double delta connection should be used instead of the series delta.

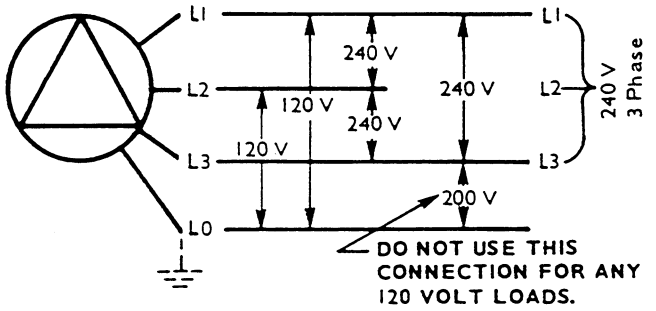


FIGURE 19. 120/240 V. 3-PHASE DELTA

3 Phase, Series Wye or Parallel Wye

The 3 phase, 4 wire set produces line to neutral voltage and line to line voltage. The line to neutral voltage is the lower voltage as noted on the unit nameplate, and the line to line voltage is the higher nameplate voltage.

For 3 phase loads, connect separate load wires to each of the set terminals L1, L2 and L3. Single phase output of the higher nameplate voltage is obtained between any two 3 phase terminals as shown in Figure 20.

The terminal marked L0 can be grounded. For 1 phase loads, connect the neutral (white) load wire to the L0 terminal. Connect the black load wire to any one of the other three terminals—L1, L2 or L3. Three separate 1 phase circuits are available, with not more than 1/3 the rated capacity of the set from any one circuit.

If using 1 phase and 3 phase current at the same time, use care to properly balance the 1 phase load, and not to exceed rated line current.

Figure 20 shows load connections for 120/208 voltage. Other voltages are available from either parallel wye or series wye illustration in Figure 21.

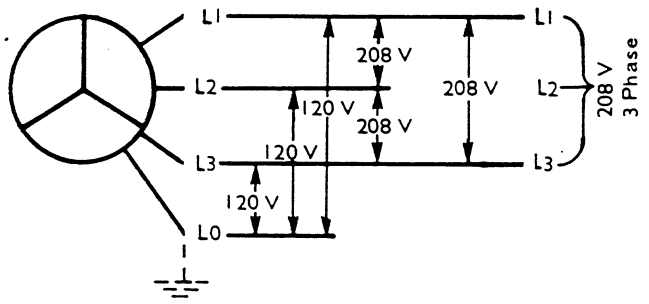


FIGURE 20. 120/208 V. 3-PHASE WYE

GROUNDING

Typical requirements for bonding and grounding are given in the National Electric Code, 1978, Article 250.

Periodic inspection is recommended, especially after service work has been performed on any equipment in the electrical system.

Generator Set Bonding and Equipment Grounding

Bonding is defined as: (reference National Electrical Code, 1978, Article 100). The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and capacity to conduct safely any current likely to be imposed.

WARNING **It is extremely important for life safety that bonding and grounding be properly done, and that all metallic parts likely to become energized under abnormal conditions be properly grounded.**

Circuit and System Grounding

This refers to the intentional grounding of a circuit conductor or conductors. The design and installation of a grounding system incompasses many considerations, such as multiple transformers, standby generators, ground fault protection, physical locations of equipment and conductors, just to mention a few.

TABLE 2. UR GENERATOR VOLTAGE CURRENT OPTIONS

VOLTS	FREQ	PHASE	AMPERES	DOUBLE DELTA	SERIES DELTA	PARALLEL WYE	SERIES WYE	REF VOLTAGE WIRE (W12) TAP
110/220	50 Hz	1	227*	x				H6
115/230	50 Hz	1	277*	x				H6
120/240	60 Hz	1	260*	x				H5
110/190	50 Hz	3	152			x		H3
115/200	50 Hz	3	144			x		H4
120/208	50 Hz	3	139			x		H4
120/208	60 Hz	3	173			x		H3
110/220	50 Hz	3	131		x			H6
127/220	50 Hz	3	131			x		H5
127/220	60 Hz	3	164			x		H4
115/230	50 Hz	3	126		x			H6
120/240	60 Hz	3	150		x			H5
139/240	60 Hz	3	150			x		H5
220/380	50 Hz	3	76				x	H3
230/400	50 Hz	3	72				x	H4
240/416	50 Hz	3	69				x	H4
240/416	60 Hz	3	87				x	H3
254/440	50 Hz	3	66				x	H5
254/440	60 Hz	3	82				x	H4
277/480	60 Hz	3	75				x	H5
9X 347/600	60 Hz	3	60					H5—Not Reconnectible

* This current value is available only from special long stack units (option B125). A standard 3-phase generator connected into a Double Delta configuration will deliver 2/3 current value shown (260 x .66 = 173 amperes).

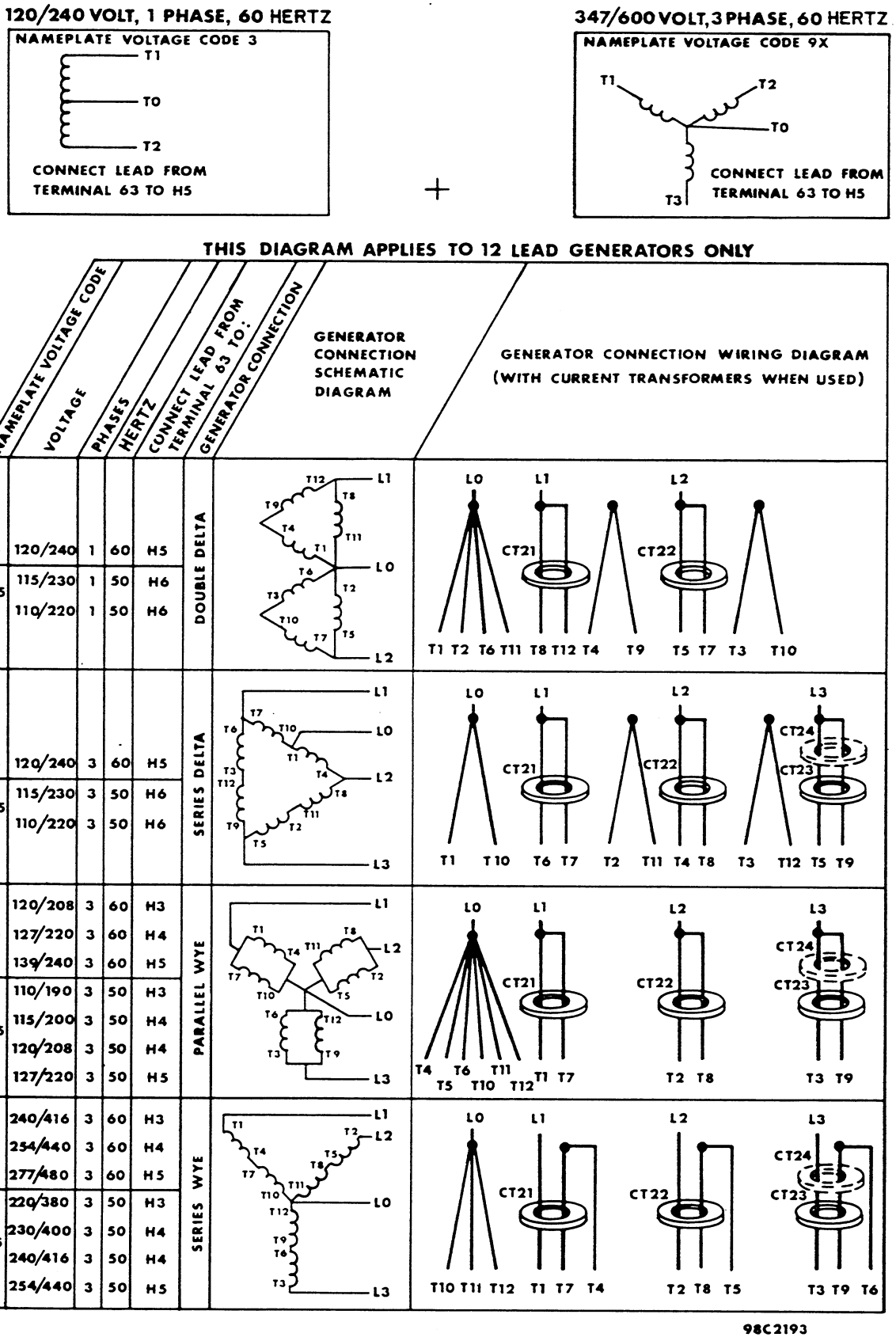


FIGURE 21. GENERATOR RECONNECTIONS

OPERATION

GENERAL

Onan DEG Series electric generating sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Inspect your unit closely for loose or missing parts and damage which may have occurred in transit. Tighten loose parts, replace missing parts and repair any damage before putting set into operation.

PRESTART SERVICING

Lubrication System

Engine oil was drained prior to shipment. Fill engine to capacities shown. After engine has been run, check dipstick, add oil to bring level to full mark. Record total capacity for future oil changes. For oil quality and viscosity recommendations, consult your Ford manual.

Oil Capacities (nominal)

Oil Pan and Filter — 14-quarts (13.25 litres)

Cooling System

Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 18 quarts (17 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean, soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures, use antifreeze with an ethylene glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to Ford engine manual for additional information.

CAUTION **1. Verify that the electric solenoid valve used with city water cooled sets is open before initial starting of unit to allow coolant chambers to fill. Overheating and damage to the engine could result from noncompliance.**

2. If engine is equipped with a cooling system filter, do not use antifreeze with an anti-leak formula. The stop leak element can prevent or retard the coolant flow through the filter, thereby eliminating the filtering process completely.

WARNING **Be careful when checking coolant under pressure. It is advisable to shut engine down and bleed off pressure before removing pressure cap. Severe burns could result from contact with hot coolant.**

Fuel System

Refer to the Ford engine manual for fuel oil specifications. Check with fuel supplier and ensure that fuel supplied meets the specifications. Filter or strain fuel when filling tank. Fuel supply tanks should be kept as nearly full as possible by topping up each time engine is used. Warm fuel returning from the injector pump heats the fuel in the supply tank. If the fuel level is low in cold weather, the upper portion of the tank not heated by returning fuel tends to increase condensation. In warm weather both the supply tank and fuel are warm. Cool night air lowers the temperature of the tank more rapidly than the temperature of the fuel. Again this tends to increase condensation.

Condensate mixing with the sulphur in the fuel forms a sulphurous acid which will corrode and damage the engine. KEEP FUEL CLEAN.

WARNING **DO NOT SMOKE while handling fuel. Diesel fuel is flammable.**

Priming Fuel System

Verify that all connections in the fuel system are secure and no leaks exist. Proceed with priming as follows:

1. Open bleed screw on the inlet side of fuel filter. See Figure 22.

1. SECURING BOLT
2. BLEED SCREWS
3. SEAL
4. FILTER ELEMENT
5. BOWL
6. DRAIN CAP
7. SEAL

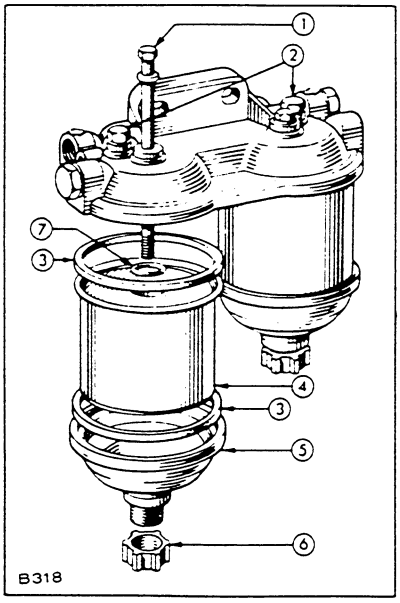


FIGURE 22. FUEL FILTER

2. Actuate priming lever on the side of the fuel transfer pump (Figure 11) until fuel flows from filter bleed screw without showing air bubbles.
3. Close filter inlet bleed screw.
4. Open bleed screw on the outlet side of filter. See Figure 22.
5. Again, actuate priming lever until a bubble-free flow of fuel comes out of the bleed screw.
6. Close filter outlet bleed screw.
7. Open one or two bleed screws on fuel injection pump.
8. Repeat priming lever actuation until bubble-free fuel is emitted from bleed screws on injection pump.
9. Close bleed screw(s).
10. Torque all the bleed screws.

    Filter — 5-7 lb-ft (6.88 to 9.5 N•m)
    Pump — 3-5 lb-ft (4.1 to 6.8 N•m)

BATTERIES

Ensure that the cable connections to the batteries are secure. Coat connections with petroleum based or non-conductive grease to retard formation of corrosive deposits.

Check level of electrolyte to be at split ring mark. Measure specific gravity of electrolyte: SG 1.260 at 80° F (26.7° C). If distilled water has been added or specific gravity is less than 1.260, place batteries on charge until desired reading is reached. Do not overcharge.

STARTING

When the preceding service functions have been performed, recheck to verify unit is ready to start.

1. Crankcase filled.
2. Cooling system filled—input solenoid valve open.
3. Batteries charged and connected.
4. Fuel solenoid valve open.

To start, move the "run-stop/reset-remote" switch to the "run" position. The engine should start after a few seconds of cranking. Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 30 psi and 55 psi (207 kPa and 380 kPa). Check the following gauges.

1. DC Ammeter—10 to 30 amperes.
2. AC Voltmeter—AC generator output voltage.
3. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 180° F to 195° F (82° C to 90.6° C). On city water cooled units an adjustable valve is connected in the water supply line. Adjust the hand wheel valve to provide a water flow that will keep the water temperature gauge reading within the range of 170° F to 200° F (76.7° C to 93.3° C).

Break-In Note

Run set at 50 percent rated load for the first half-hour of initial operation after reaching operating temperature.

Non-Start

If after a few seconds of cranking engine fails to start, or starts and runs then stops and fault lamp lights, refer to appropriate troubleshooting chart, Table 3 or Table 4.

STOPPING

To reduce and stabilize the engine temperatures, run the engine at no load for three to five minutes before shutting down.

Move the run-stop/reset-remote switch to stop position to shut down the set.

TABLE 3.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
(Engines with only one fault lamp)

SYMPTOM	CORRECTIVE ACTION
1. Engine stops cranking and fault lamp lights, after cranking approximately 75 seconds.	1. See engine service manual for troubleshooting fuel system. After correcting problem, reset engine monitor relay by placing Run-Stop/ Reset-Remote switch to Stop/Reset, then back to the required running position.
2. Fault lamp lights immediately after engine starts.	2. Check for: Overspeed condition as engine starts.
3. Fault lamp lights and engine shuts down after running for a period.	3. Check the following: a. Oil level. Engine will shut down if sensor is closed. b. Check engine manual for troubleshooting oil system. c. High engine temperature. Check coolant level; check water flow (city water cooled systems); check radiator for free air flow, and fan belts for tightness. See engine manual for troubleshooting cooling system. d. Check for faulty oil pressure sensor or faulty high engine temperature sensor.
4. Engine runs, shuts down and cranks for 75-seconds. Cranking cycle stops; fault lamp lights.	4. Check fuel supply.
5. Fault lamp lights, no fault exists.	5. To check a no-fault condition, disconnect leads from TB11 terminals 29, 30 and 31. If fault lamp lights with leads disconnected, replace engine monitor board. Reconnect leads.

TABLE 4.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
(Units with five fault lamps)

SYMPTOM	CORRECTIVE ACTION
1. Overcrank fault lamp lights and engine stops cranking after approximately 75-seconds.	1. See engine service manual for troubleshooting fuel system. After correcting fault, reset engine monitor relay by placing Run-Stop/ Reset-Remote switch to Stop/Reset position, depressing Reset button, then to the required running position.
2. Engine runs, shuts down, cranks for 75-seconds, cranking cycle stops, overcrank light ON.	2. Check fuel supply.
3. *Low oil pressure shutdown.	3. Check— a. Oil level. Replenish if necessary. b. Sensor. Faulty sensor will shut down engine. c. Refer to engine service manual for troubleshooting guide for oil system.
4. *High engine temperature shutdown.	4. Check— a. Coolant level. Replenish if necessary. b. City water cooled sets. Check water flow, valves, etc. c. Check sensor; check thermostat. d. Radiator model, check fan belts, radiator for obstructions, etc.
5. Overspeed shutdown.	5. Check governor and throttle linkages for freedom of movement. Check overspeed switch.
6. Overspeed light on, no shutdown.	6. Disconnect wire at TB11-29. Light on after reset; replace engine monitor board.
7. *Low oil pressure light ON. No shutdown.	7. Disconnect wire at TB11-30. Light ON after relay reset. Replace engine monitor board.
8. *High engine temperature light ON. No shutdown.	8. Disconnect wire at TB11-31. Light ON after relay reset. Replace engine monitor board.

***NOTE:** Not applicable on Pennsylvania State models.

EXERCISE PERIOD

Generator sets on continuous standby service are required to be operative at essential loads from a cold start in a short period of time in the event of a power outage.

This imposes severe conditions on the engine. Friction of dry piston rings upon dry cylinder walls causes scuffing and rapid wearing. These can be relieved by exercising the set at least once a week for a minimum time of 30 minutes per exercise period. Preferably, run the set under at least 50 percent load to allow the engine to reach normal operating temperature. This will keep engine parts lubricated, maintain fuel prime, prevent electrical relay contacts from oxidizing and ensure easy emergency starts. Onan automatic transfer switches contain an optional exercise switch which, by pre-selection, will start, determine run period and shut down a set on a weekly frequency. For example, the switch can be set for time of start, length of run, A.M. or P.M. and day of week.

After each exercise period, top off fuel tank, check engine for leaks and unit for general condition. Locate cause of leaks (if any) and correct.

NO LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of heater elements, etc.

OUT-OF-SERVICE PROTECTION

For storage of any duration refer to the Ford engine manual.

HIGH ALTITUDE

Ratings apply to altitudes up to 1000 feet (305 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

Engine horsepower loss is approximately 3 percent for each 1000 feet (305 m) of altitude above sea level. Use lower power requirement at high altitudes to prevent smoke, over-fueling and high temperatures.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to-and-from the set.
2. Keep cooling system clean.
3. Use correct SAE No. oil for temperature conditions.

LOW TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean and batteries in a well charged condition.
4. Partially restrict cool air flow but use care to avoid overheating.
5. Connect water jacket heater when set is not running.
6. Refer to Ford manual for further information.

Water Jacket Heater

The function of this optional heater is to keep the engine warm enough to assure starting under adverse weather conditions. 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.

GENERAL MAINTENANCE

GENERAL

Establish and adhere to a definite schedule of maintenance inspection and servicing, application and environment being the governing factors in determining such a schedule. If your set is a prime power application, base your schedule on operating hours. Use the running time meter to log hours run; maintain an accurate record of hours and service for warranty support.

A set on stand-by duty will need servicing at times other than those recommended by Onan and the engine manufacturer. Refer to Ford manual for engine services and maintenance procedures. Adjust your schedule to satisfy the following conditions—

- Continuous duty (prime power)
- Standby power
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water or sea water
- Exposure to dust, sand, etc.

Consult with your ONAN distributor or dealer for a schedule of maintenance and service more suitable to the unique environment and application of your set.

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	10	50	200	400
Inspect Complete Set	x			
Check Engine Oil Level	x			
Check Radiator Coolant Level	x			
Check Fuel	x1			
Check Governor Oil Level		x		
Check Air Cleaner (Clean if Required)		x2		
Check Electrolyte Level of Battery		x		
Stop-Solenoid Linkage		x2		
Adjust Fan Belt Tension			x3	
Change Governor Oil			x	
Change Engine Oil & Filter			x2	
Clean Fuel Lift Pump			x	
Clean Sediment Bowl & Filter			x	
Check Starter			x5	
Clean & Inspect Battery Charging (DC) Alternator			x	
Examine Exhaust System For Leaks	x*			
Replace Fuel Filter Element				x2
Replace Air Cleaner Element				x2
Remove & Service Injectors				x4
Adjust Valve Clearances				x
Examine Water Filter Element				x

x* - Visually and audibly examine installation for actual or potential leakage source.

x1 - After every run.

x2 - Perform more often in extremely dusty conditions.

x3 - Adjust to 1/2-inch (12.5 mm) depression between pulleys. Refer to Ford engine manual.

x4 - Check for proper spray pattern, etc. Refer to the Ford manual.

x5 - Oil front bearing sparingly; check brushes.

x6 - Check brushes (if installed), replace if worn to 5/8-inch (15.9 mm) or if damaged. DO NOT LUBRICATE.

NOTE: The above schedule is a minimum requirement for your engine. Refer to Ford engine manual for recommended service periods.

WARNING **Before commencing any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring, disconnect batteries. Failure to do so could result in damage to the unit or serious personal injury in the event of inadvertent starting.**

ENGINE SPEED

Generator frequency is in direct ratio to engine speed which is controlled by the governor. The governor controlling the DEG set is integral with the injector pump. High and low speed limit stops are set at the ONAN testing facility and normally do not require further adjustment, therefore, if your set is on continuous standby service, the governor may never need to be touched.

If however the unit is removed for repair or the set is used frequently, adjustment may be necessary due to wear of internal components.

To adjust governor, proceed as follows:

1. Loosen lock nuts on idle stop screw and maximum speed stop screw. Refer to Figure 23.
2. Start engine; apply full load.

   If governor setting is considerably out of adjustment, adjust low speed stop screw until frequency meter indicates approximately 63 Hz before applying load.

3. Back off maximum speed stop screw (screwdriver slot).
4. Turn idle speed stop screw clockwise until frequency meter indicates 60 Hz. (Counterclockwise reduces rpm.)
5. Turn maximum speed stop until it bottoms on governor control lever.
6. Secure lock nuts.

DUST AND DIRT

1. Keep set clean. Keep cooling system free of dirt, etc.
2. Service air cleaners frequently.
3. Store oil and fuel in dust-tight containers.
4. See engine operation and maintenance manual.

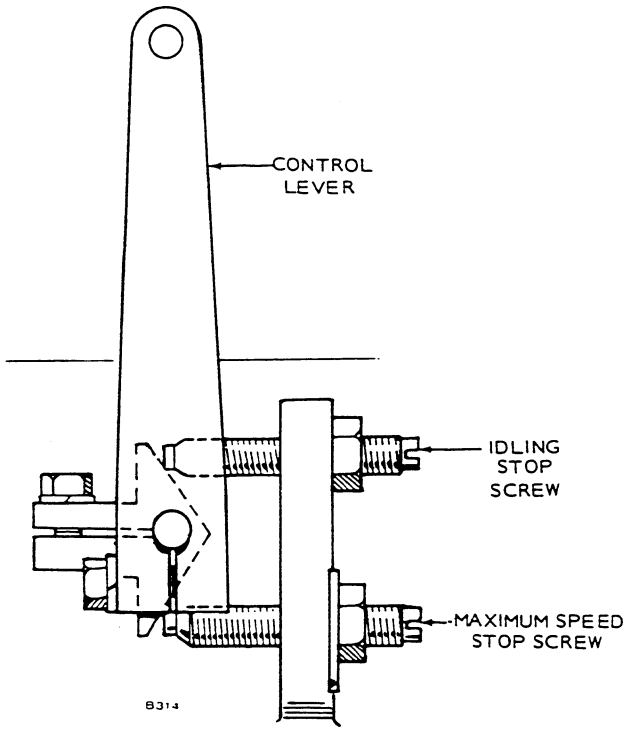


FIGURE 23. GOVERNOR SPEED ADJUSTMENT

COOLANT CORROSION RESISTOR (Water Filter)

The PAF formula elements can be used with most permanent antifreezes, but is not recommended for use with plain water. It is necessary to drain and flush the system thoroughly when changing from one element formula to the other if a non-compatible antifreeze is in use. See Figure 8 for view of the system.

At each 300 to 500 hour interval of operation, depending on conditions, service the coolant filter as follows:

1. Thoroughly clean filter body and surrounding area.
2. Close coolant inlet and outlet shutoff valves.
3. Remove drain plug from bottom of filter body and drain coolant.
4. Remove capscrews attaching filter cover to body and remove cover (Figure 24).
5. Lift upper plate and filter element out of filter body. Discard filter element.
6. Remove lower corrosion resistor plate and spring from filter body.
7. Inspect and clean lower corrosion resistor plate, buffing it to a bright finish. If plate is thin and pliable, or has developed holes, replace it.
8. Remove and clean sump plate. Clean sump area in filter body.
9. Install sump plate, spring, and lower corrosion resistor plate.
10. Install new filter element.
11. Position upper plate in filter body.
12. Make certain gasket is in good condition, then install cover and secure with attaching capscrews.
13. Replace drain plug and open inlet and outlet shutoff valves.

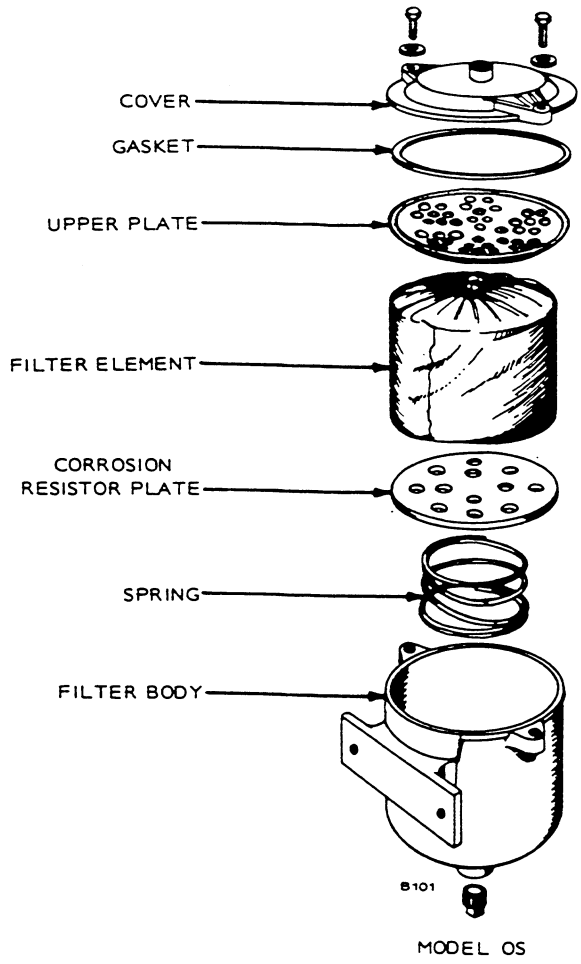


FIGURE 24. CHANGING CORROSION RESISTOR ELEMENT AND PLATE

Initially the element should be changed after 150 hours of operation for borate (PAF) formula filter elements.

Do not use soluble oil or other conditioners in the cooling system. However, filter efficiency is not affected by use of permanent type antifreeze in the system.

CAUTION **If a stop-leak is added to the coolant, do not allow it to circulate through the filter. Shutoff valves are provided in inlet and outlet lines for isolating the filter from remainder of cooling system.**

Whenever coolant supply is changed (spring and fall), the system must be drained and flushed.

On an extremely dirty system, the coolant should be drained and flushed before a new element is installed. In a few rare cases, additional flushing and change of filter may be necessary in order to completely purge the system. Generator sets subject to excessive idling or frequent start and stop cycles, or units located in areas with dust, air contaminants, or other noxious atmospheric conditions, will require more frequent servicing.

After maintenance has been completed, check flow indicator if one has been installed to see if air bubbles (which can cause pump cavitation) are in the system. If air is present, bleed the system by disconnecting the filter outlet line momentarily until the coolant flows in a solid stream.

GENERAL ENGINE MAINTENANCE

Refer to the engine manual furnished with the generating set for additional details on servicing procedures not covered by this manual. Refer to Table 4 for general information on clearing the electric generating set of any malfunctions which have developed during the period of operation.

START-STOP SOLENOID (Failure to Shut Down)

In case the set does not shut down when moving Run-Stop/Reset-Remote switch to *Stop* position, the stop solenoid linkage may be out of adjustment. See Figure 25. Adjust as follows:

1. Remove the joint that attaches the stop solenoid rod to injection pump arm.
2. With the engine running, move the lever arm on the injection pump back slowly towards radiator just until engine stops.
3. Hold lever in this same position and adjust linkage accordingly.
4. Snap rod joint back on injection pump arm.

CONNECTIONS (Fuel, Exhaust, etc.)

Operator should periodically make a complete visual inspection of the set while running at rated load. Some of the things to check for are as follows:

1. Check all fuel and oil lines for possible leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks.
3. Periodically or daily, drain moisture from condensation traps.
4. Inspect water lines and connections for leaks and security.
5. Inspect electrical wires and connections for security and fray damage.

AC GENERATOR

There are no brushes, brush springs or collector rings on these generators, therefore they require very little servicing. Periodic inspections, to coincide with engine oil changes, will ensure good performance.

If generator requires major repair or servicing, contact an authorized Onan dealer or distributor.

Generator Bearing

Inspect the bearing every 1000 hours with the unit running.

If using the unit for "prime power," replace the bearing every 10,000 hours or two years. If using the set for "standby," replace the bearing every five years.

Check generator voltage. It may be necessary to make a slight readjustment of the voltage rheostat to obtain the preferred voltage at average load.

INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly, make sure diodes are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure. Blow out the assembly periodically, with filtered, low pressure air. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 15 in. lb. (1.7 N•m) or finger tight plus a quarter turn. Blow dust out of control panel.

BATTERIES

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at terminals. Keep electrolyte at the proper level above the plates by adding distilled water. Check specific gravity; recharge if below 1.260.

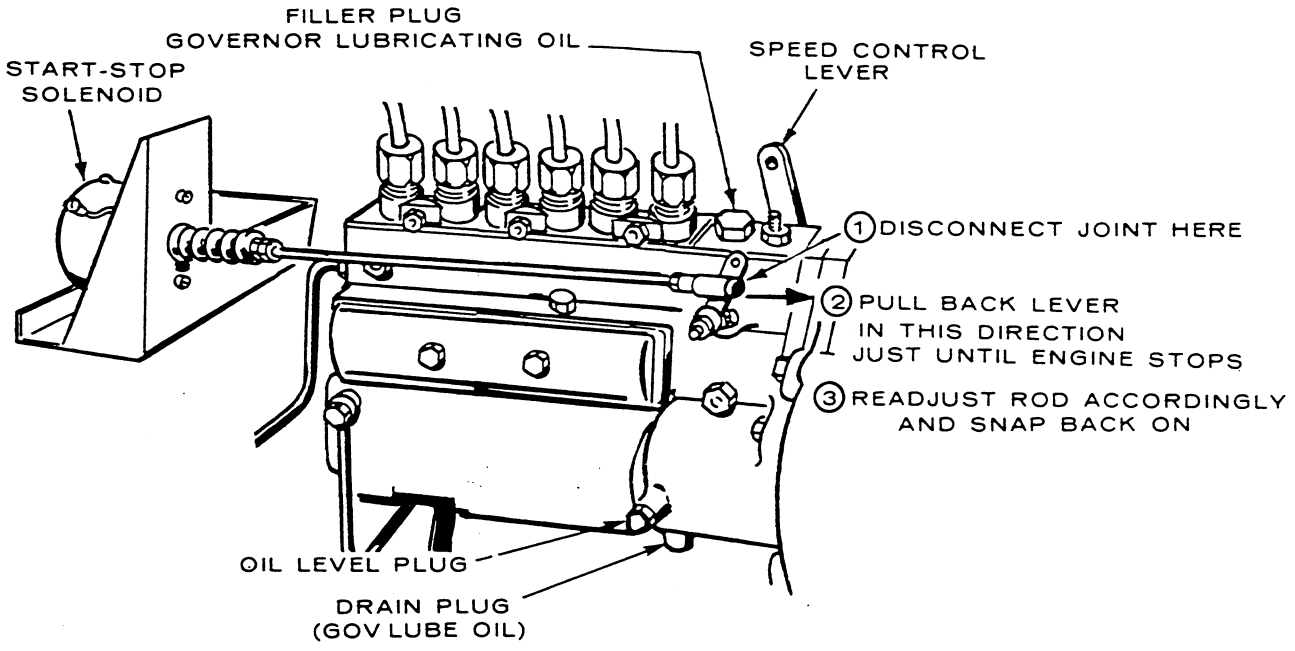


FIGURE 25. STOP-SOLENOID LINKAGE ADJUSTMENT

TANK HEATERS

A Kim Heater may be provided on the DEG generator set. For efficient operation and optimum product life, perform the following procedure at least once a year (see Figure 26).

1. Remove head and valve assembly.
2. Clean foreign matter out of the tank.
3. Remove element and scrape off scale accumulated on the sheathing.

CAUTION **When reassembling threaded aluminum parts, be sure to use anti-seize compound.**

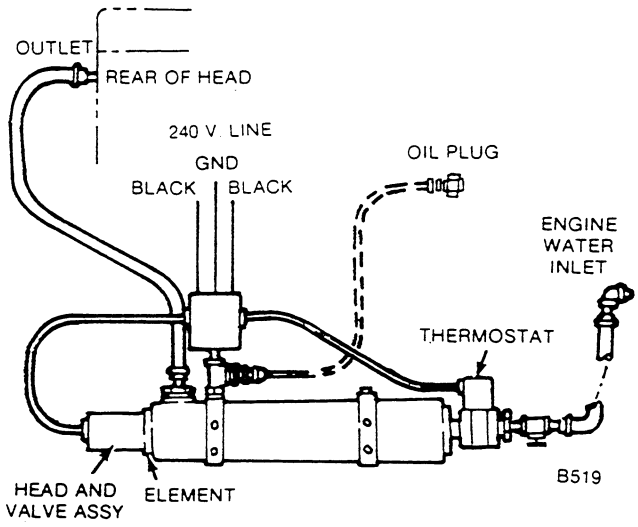
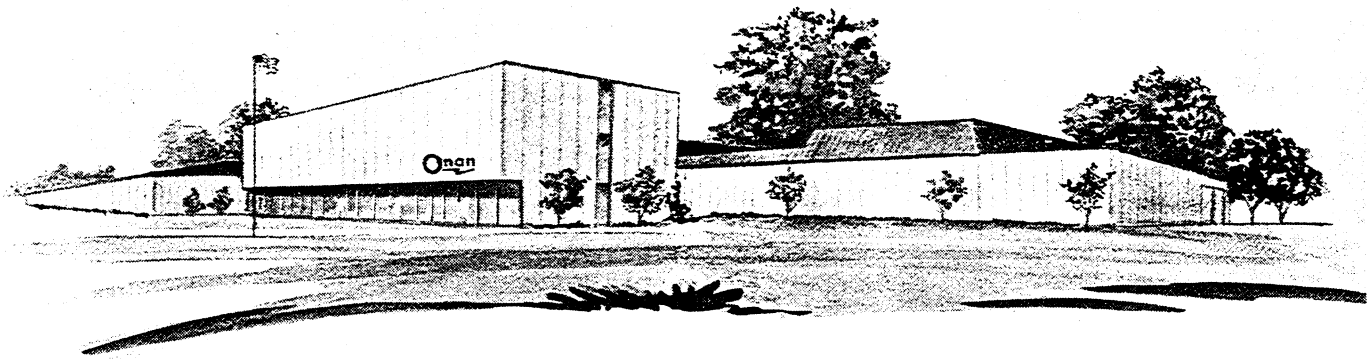


FIGURE 26. ENGINE HEATER



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