Onan®

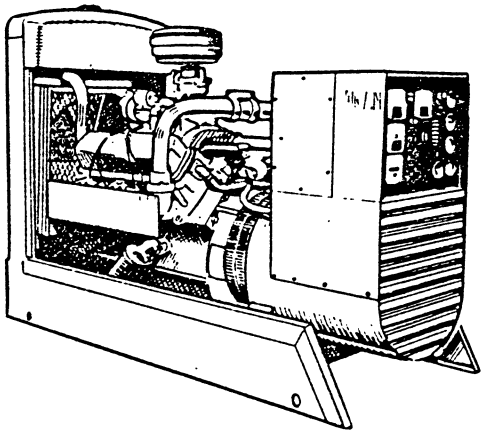
OPERATOR'S MANUAL

FOR

KR

SERIES

ELECTRIC GENERATING SETS



FORM NUMBER
957-0120

ISSUE DATE
6-79
(SPEC V)

SAFETY PRECAUTIONS

Throughout this manual you will find eye-catching flags containing Warnings and Cautions. These will alert you to conditions that could result in danger to you or the equipment, if the notice is ignored.

ONAN recommends that you read your manual and become thoroughly acquainted with it and your equipment before you start your unit. The accumulated experience of ONAN engineers is available to you, enabling you to operate your set in the most efficient and safest manner possible. These recommendations and the following safety precautions are for your protection. Study and know them!

REMEMBER. Most accidents are caused by failure to follow simple and fundamental safety rules or precautions.

Most accidents can be prevented!

KNOW YOUR MANUAL—KNOW YOUR EQUIPMENT

WARNING **Set forth below are a number of potential hazards which could result in some degree of personal injury. The suggested procedures should be adhered to.**

General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove all oil deposits; 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 necessary to make adjustments while the unit is running, use extreme caution when close to hot exhausts, moving parts, etc.
- Do not stand on a wet floor while working on electrical equipment. Use rubber insulative mats placed on dry wood platforms.

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.

  REMEMBER—IF YOU CAN SMELL FUMES—A POSSIBLE EXPLOSION AND FIRE CONDITION EXISTS!
- Make sure that oily rags are not left on or near the engine. Oil soaked rags are combustible and present hazardous walking conditions.
- 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.
- Your engine installation should be equipped with a means of positive fuel shutoff in applications when fuel is conducted from a remote source. Fuels under pressure (e.g. natural gas or liquefied petroleum gas) should be controlled by a positive shutoff valve, preferably automatic, in addition to any valve integral with the carburetor or gas regulator equipment.

Exhaust System

- Exhaust products of any internal combustion engine are toxic and can cause serious personal injury, if inhaled. All engine installations, especially those within a confine, should be equipped with an exhaust system to discharge gases to the atmosphere. Do not use exhaust gases to heat a compartment.
- Inspect exhaust system regularly to assure that system is free of leaks.

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

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

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC–rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work–harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.
- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [–] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [–] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

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

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

TABLE OF CONTENTS

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 following series of electric generator sets—

70.0 KR
85.0 KR

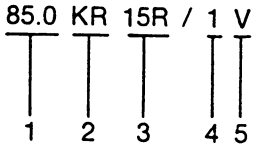
These sets consist of ONAN UR series generators in the ratings noted, driven by International Harvester gas/gasoline engines. Information is provided on installation, operation, troubleshooting and parts ordering for the set. The manual should be used in conjunction with the International Harvester Engine Manual and Parts Catalog, as your specific engine may have variations due to optional equipment installed.

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

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

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.
2. Factory code for SERIES identification.
3. Indicates voltage code.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

If it is necessary to contact 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 types 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 International Harvester nameplate is on the right side of flywheel housing.

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

SPECIFICATIONS

	70.0KW	85.0KW
ENGINE DETAILS		
Engine Manufacturer	INTERNATIONAL HARVESTER	
Engine Series	C 549	
Number of Cylinders	V8	
Displacement	549 inch³ (8.99 liters)	
BHP @ 1800 RPM	150 (111.9 kW)	172 (128.31 kW)
Compression Ratio	7.5:1	
Bore	4.50 inches (114.3mm)	
Stroke	4.313 inches (109.55 mm)	
Fuel	Gas/Gaso	
Battery Voltage	12	
Battery Group (One 12-Volt, 72 A.H.)	3 EE	
Starting Method	Solenoid Shift	
Governor Regulation	5% Maximum	
Battery Charging Current	35-Amperes	
GENERATOR DETAILS		
Type	UR15 60 Hz UR515 50 Hz UR9X 60 Hz	
Rating (Watts)		
60 Hertz Continuous Standby	70,000	85,000
50 Hertz Continuous Standby		70,000
AC Voltage Regulation	±2%	
60 Hertz RPM	1800	1800
50 Hertz RPM		1500
Output Rating	0.8 PF	
AC Frequency Regulation	3 Hz Max. No Load—Full Load	
CAPACITIES AND REQUIREMENTS		
Cooling System (Includes Radiator)	10 Gallons (37.85 liters)	
Engine Oil Capacity (Filter, Lines, Crankcase)	13 Quarts (12.3 liters)	
Exhaust Connection (inches pipe thread)	3	
AIR REQUIREMENTS (1800 RPM)		
Engine Combustion	230 CFM (6.51m³/min)	
Radiator Cooled Engine	11263 CFM (319 m³/min)	
Total for Radiator Cooled Model	11493 CFM (325.5m³/min)	
ALTERNATOR COOLING AIR		
(1800 RPM)	1000 CFM (28.32m³/min)	
(1500 RPM)	833 CFM (23.6m³/min)	
FUEL CONSUMPTION AT RATED LOAD		
Gasoline		13 gph 49.2 liters/hr
Propane 2500 BTU/ft³		400 ft³/hr
93.13 MJ/m³		11.33m³/hr
Natural Gas 1000 BTU/ft³	1000 ft³/hr	1400 ft³/hr
37.25 MJ/m³	28.32m³/hr	39.65m³/hr
GENERAL		
Height	52.5 inches (1.33m)	
Width	40.75 inches (1.04m)	
Length	85.0 inches (2.16m)	
Weight (Approx.)	2480 lb. (1124.93kg)	(2550 lb. (1156.68kg)

TABLE 1A.
UR GENERATOR VOLTAGE OPTIONS

70.0KW 87.5KVA 60 Hz

VOLTS	FREQ.	PHASE	AMPERES	DOUBLE DELTA	SERIES DELTA	PARALLEL WYE	SERIES WYE	REF. VOLTAGE WIRE (W12) TAP
120/240	60 Hz	1	140	x				H5
120/240	60 Hz	3	210		x			H5
120/208	60 Hz	3	243			x		H3
127/220	60 Hz	3	230			x		H4
139/240	60 Hz	3	210			x		H5
240/416	60 Hz	3	121				x	H3
254/440	60 Hz	3	115				x	H4
277/480	60 Hz	3	105				x	H5
9XR 347/600	60 Hz	3	84					H3 Not Reconnectible

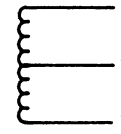
TABLE 1B.
UR GENERATOR VOLTAGE OPTIONS

85.0KW 106.25KVA 60 Hz
70.0KW 87.5KVA 50 Hz

VOLTS	FREQ.	PHASE	AMPERES	DOUBLE DELTA	SERIES DELTA	PARALLEL WYE	SERIES WYE	REF. VOLTAGE WIRE (W12) TAP
120/240	60 Hz	1	295	x				H5
115/230	50 Hz	1	253	x				H6
120/240	60 Hz	3	256		x			H5
115/230	50 Hz	3	220		x			H6
120/208	60 Hz	3	295			x		H3
127/220	60 Hz	3	279			x		H4
139/240	60 Hz	3	256			x		H5
110/190	50 Hz	3	266			x		H3
115/200	50 Hz	3	253			x		H4
240/416	60 Hz	3	148				x	H3
254/440	60 Hz	3	140				x	H4
277/480	60 Hz	3	128				x	H5
220/380	50 Hz	3	133				x	H3
230/400	50 Hz	3	126				x	H4
9XR 347/600	60 Hz	3	102					H3 Not Reconnectible

120/240 VOLT, 1 PHASE, 60 HERTZ

NAMEPLATE VOLTAGE CODE 3

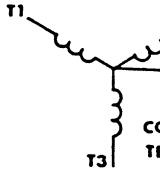


CONNECT LEAD FROM TERMINAL 63 TO H5

+

347/600 VOLT, 3 PHASE, 60 HERTZ

NAMEPLATE VOLTAGE CODE 9X



CONNECT LEAD FROM TERMINAL 63 TO H5

THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

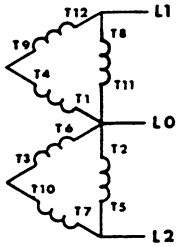
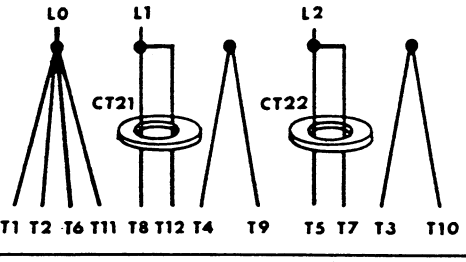
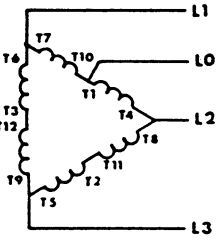
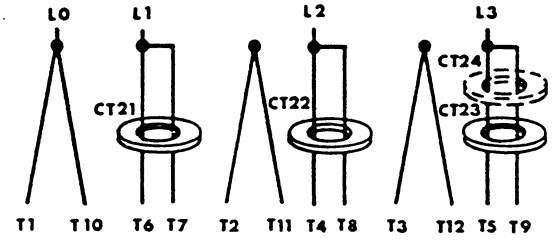
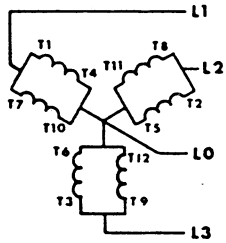
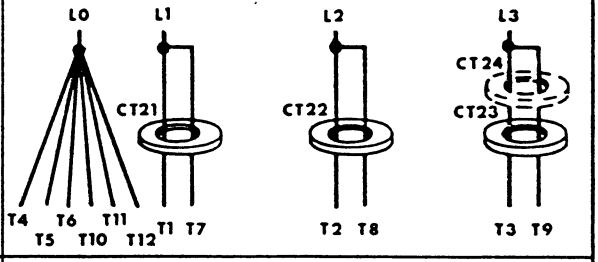
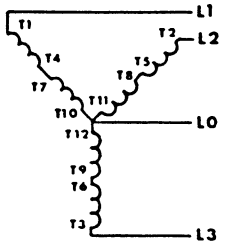
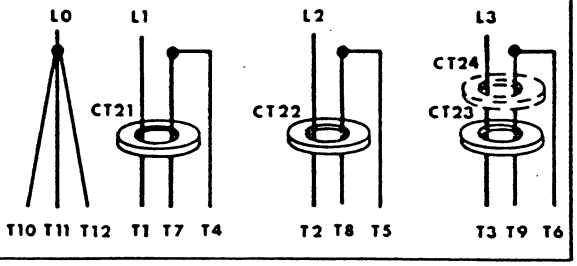
NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASES	FREQUENCY	CONNECT LEAD FROM TERMINAL 63 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM (WITH CURRENT TRANSFORMERS WHEN USED)
15	120/240	1	60	H5	DOUBLE DELTA		
515	115/230	1	50	H6			
	110/220	1	50	H6			
15	120/240	3	60	H5	SERIES DELTA		
515	115/230	3	50	H6			
	110/220	3	50	H6			
15	120/208	3	60	H3	PARALLEL WYE		
	127/220	3	60	H4			
	139/240	3	60	H5			
515	110/190	3	50	H3			
	115/200	3	50	H4			
	120/208	3	50	H4			
	127/220	3	50	H5			
15	240/416	3	60	H3	SERIES WYE		
	254/440	3	60	H4			
	277/480	3	60	H5			
515	220/380	3	50	H3			
	230/400	3	50	H4			
	240/416	3	50	H4			
	254/440	3	50	H5			

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FIGURE 1. VOLTAGE CONNECTIONS

DESCRIPTION

GENERAL

ONAN KR series electric generating sets are complete units each consisting of an engine driven AC generator, with controls and accessories as ordered.

ENGINE

The engines on the KR are International Harvester as described in engine manual. Basic measurements and requirements will be found under *Specifications.* However, the engine used for your unit may have variations due to optional equipment available, therefore, the International Harvester manual should be consulted.

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. Excitation is achieved as follows—

Residual alternating voltage 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 2.

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 transfers control to 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 percent 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 3) 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 shutdown.

Lamp Test: Press to test warning lamp bulbs (when engine is running only), on five light panels.

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.)

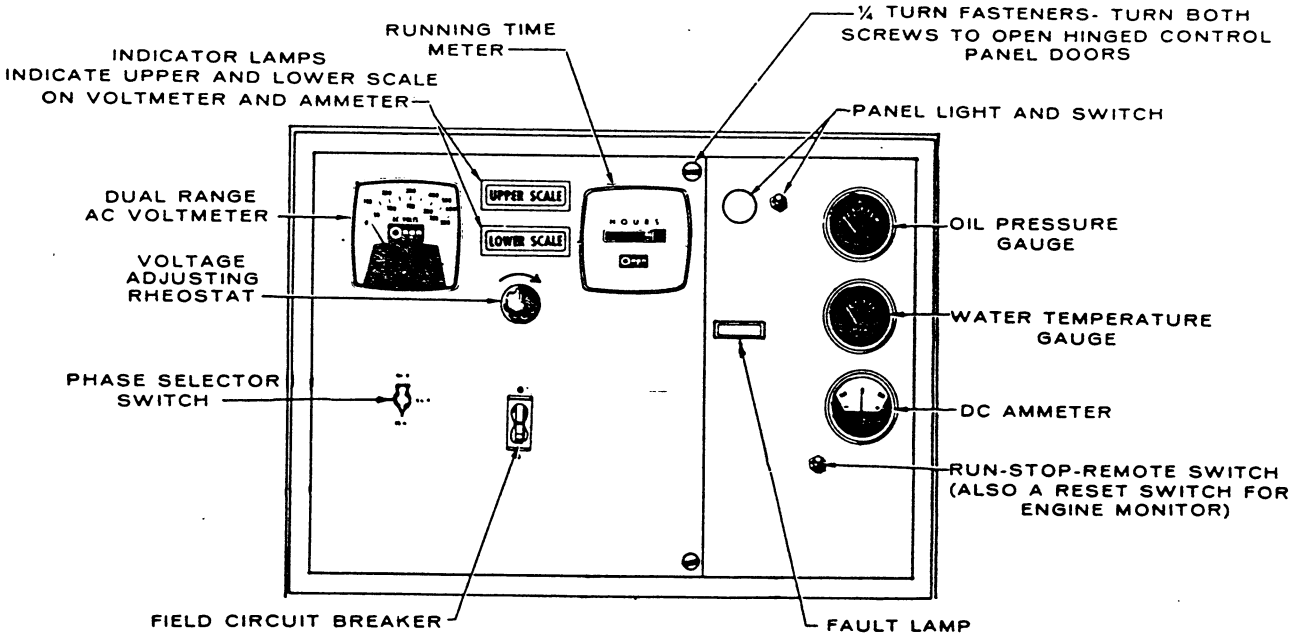


FIGURE 2. STANDARD CONTROL PANEL (ONE FAULT LAMP)

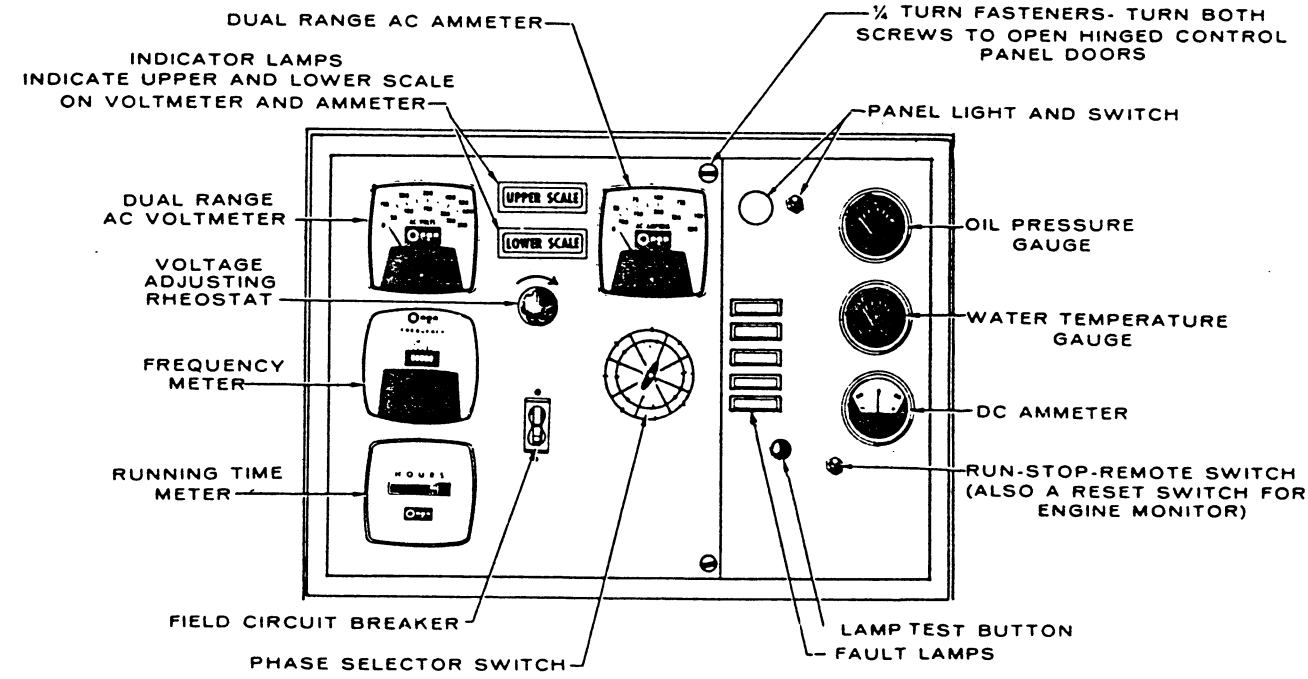


FIGURE 3. OPTIONAL CONTROL PANEL (FIVE FAULT LAMPS)

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. Refer to Figure 1.

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 percent 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 r/min).
   c. Low oil pressure 14 psi (96.5 kPa).
   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 2.

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. The ON and OFF cycle times are nominal and can be adjusted at potentiometers on the cranker module board.

Pre-Alarm

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

ENGINE SENSORS

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

For location, refer to Figures 4 and 5. When replacing a sensor, do not substitute, use recommended items. Resistance units are matched to the gauge they supply, and cut-off switches are close-tolerance actuation parts, made for a specific application.

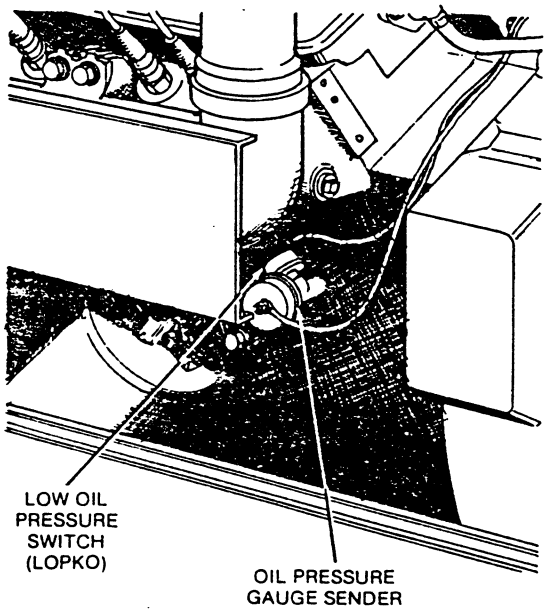


FIGURE 4. OIL PRESSURE MONITORS

TABLE 2. 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.

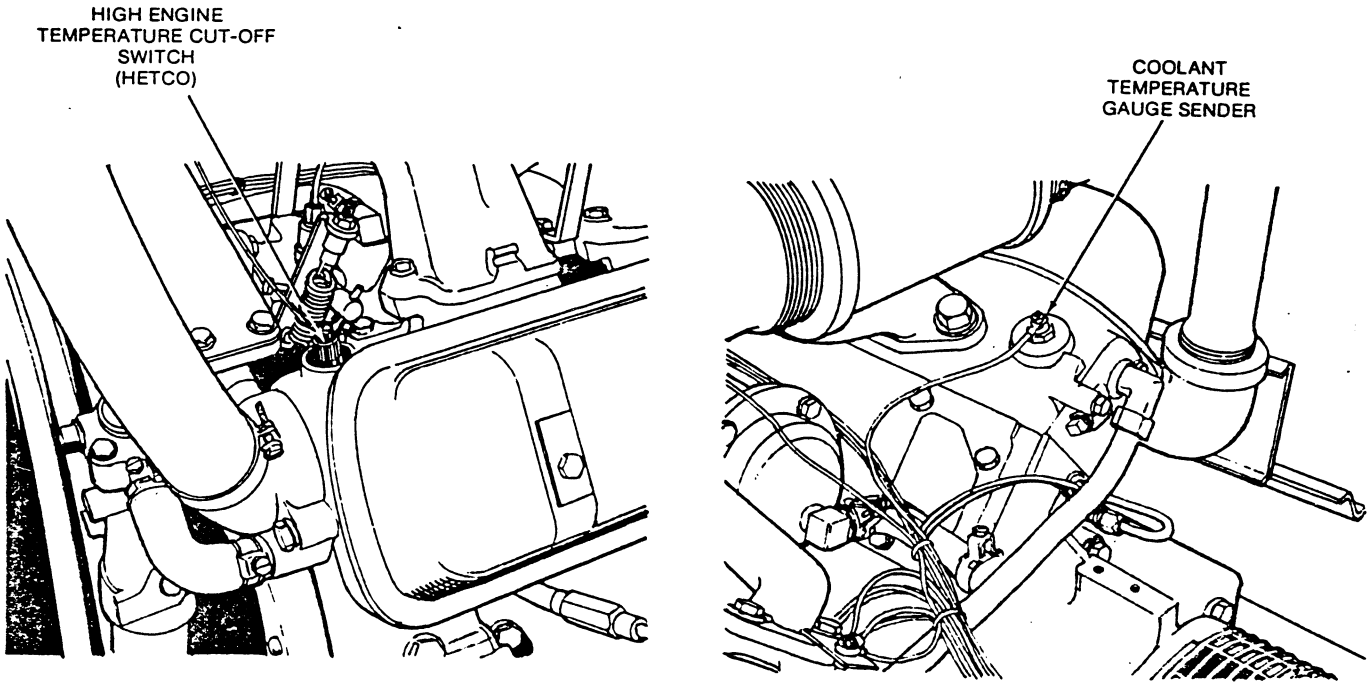


FIGURE 5. ENGINE TEMPERATURE MONITORS

INSTALLATION

GENERAL

Installations must be considered individually. Use these instructions as a general guide. Meet regulations of federal, state and local building codes, fire ordinances, etc., which may affect installation details. See Figure 6.

Installation requirements include:

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 connections.
8. Water connections.
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 extremes in weather conditions.

MOUNTING

Generating sets are mounted on a rigid skid base which provides proper support. Install vibration isolators between skid base and foundation. For general servicing and convenience in draining crankcase oil, mount set on raised pedestals (at least 6 inches high). If mounting in a trailer, or for other mobile applications, bolt securely in place. Extra support for the vehicle flooring may be necessary. Bolting down is recommended for stationary installations.

VENTILATION

Generating sets create considerable heat which must be removed by proper ventilation. Outdoor installations rely on natural air circulation but mobile and 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 rpm.

Radiator set cooling air travels from the rear of the set to the front end. Locate the room or compartment air inlet where most convenient, preferably to the rear of the set. Make the inlet opening at least as large as the radiator area (preferably 1-1/2 times larger).

Engine heat is removed by a pusher fan which blows cooling air out through the front of the radiator. Locate the cooling air outlet directly in front of the radiator and as close as practical. The opening size should 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.

Provide a means of restricting the air flow in cold weather to keep the room or compartment temperature at a normal point.

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. Ventilation is seldom a problem, but 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.

For small compartments, a duct of equal or larger area than generator outlet is recommended to remove the heated air from the generator air outlet to the outside atmosphere. Limit bends and use radius type elbows where needed. A larger, well ventilated compartment or room does not require a hot air duct.

Installations made in a small room may require installation of an auxiliary fan (connected to operate only when the unit is running) of sufficient size to assure proper air circulation.

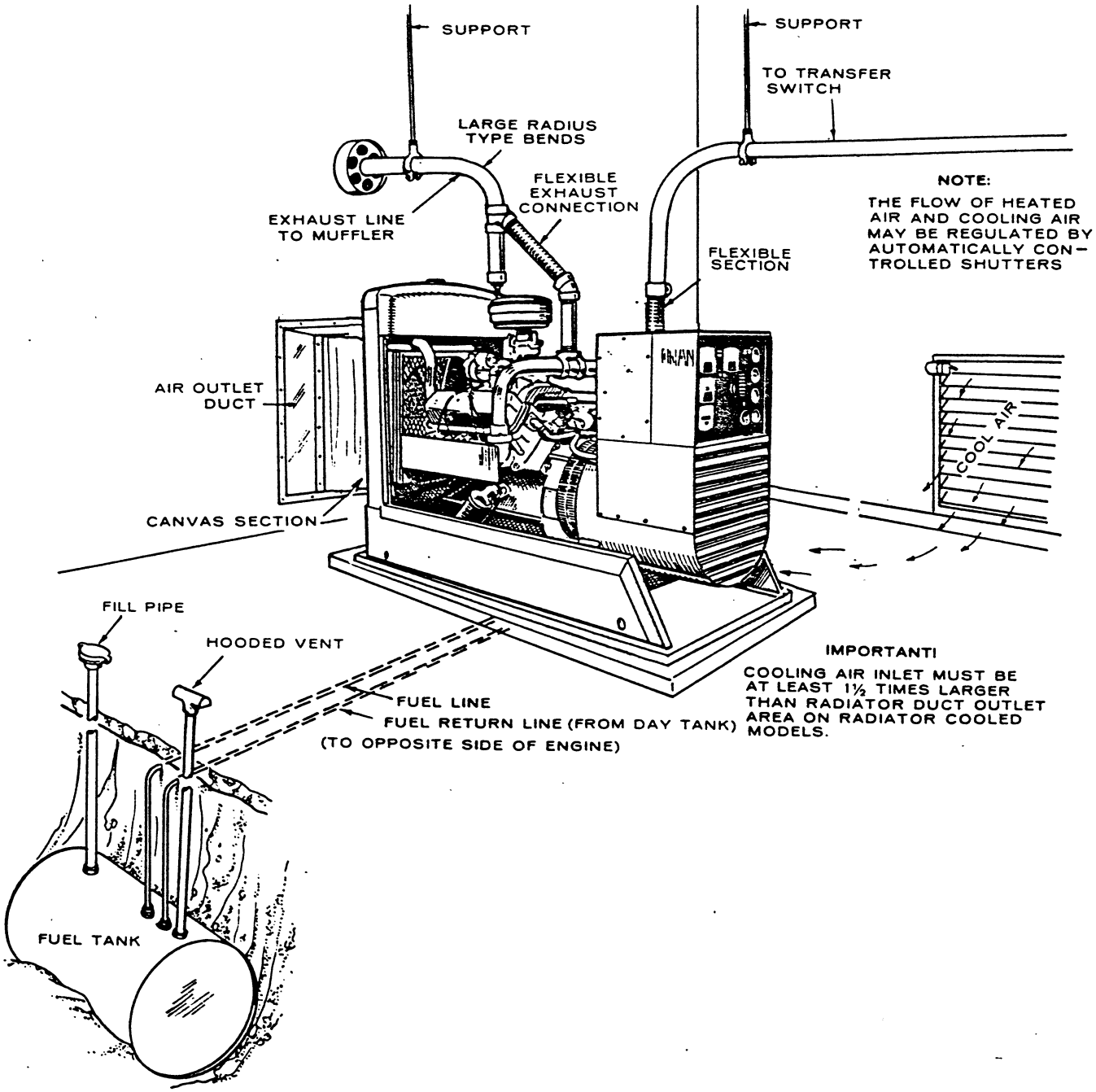


FIGURE 6. TYPICAL INSTALLATION

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, or other impurities.

This system reduces set enclosure airflow requirements 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 7 for typical installation.

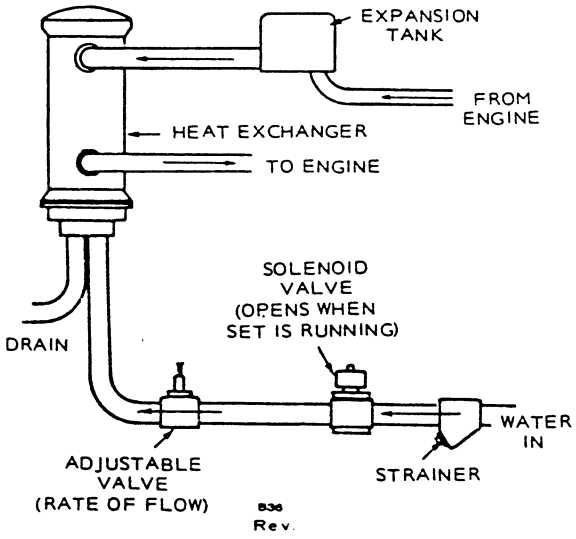


FIGURE 7. TYPICAL HEAT EXCHANGER SYSTEM

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 passages will occur. Fouling results in engine overheating and costly repair bills.

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 8.

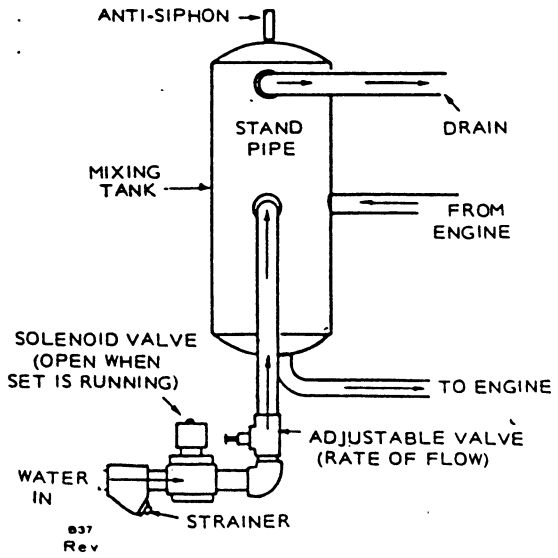


FIGURE 8. TYPICAL STANDPIPE SYSTEM

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.

Water Jacket Heater (optional) may be installed to keep engine coolant warm while engine is shut down. It heats and circulates the coolant within the engine, which reduces start-up time and engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

Direct Flow Installation

With this system, a city or raw water cooling supply under pressure forces water directly into the engine, through the engine and to the outlet. An adjustable valve controls the incoming water flow rate to obtain correct engine water temperature, as measured at engine coolant water outlet while the generator set is operating under full load. A solenoid valve is coordinated with the generator set system to open during set operation.

CAUTION **Restrict inlet water pressure to a maximum of 7 psi or 48.3 kPa, otherwise engine gaskets and seals will leak.**

Raw water cooling is often undesirable because:

1. The water supply must be very clean or engine deposits will result.
2. A high temperature differential between the cold incoming water into the engine and warm discharged water can put damaging stresses on engine components (no overall uniform engine temperature).

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 6.

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 and applied load.

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 pump exceeds 15 feet (4.57 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 (4.57 m) above the center-line of the engine crankshaft.

EXHAUST

WARNING **Inhalation of exhaust gases can result in serious personal injury or death.**

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.

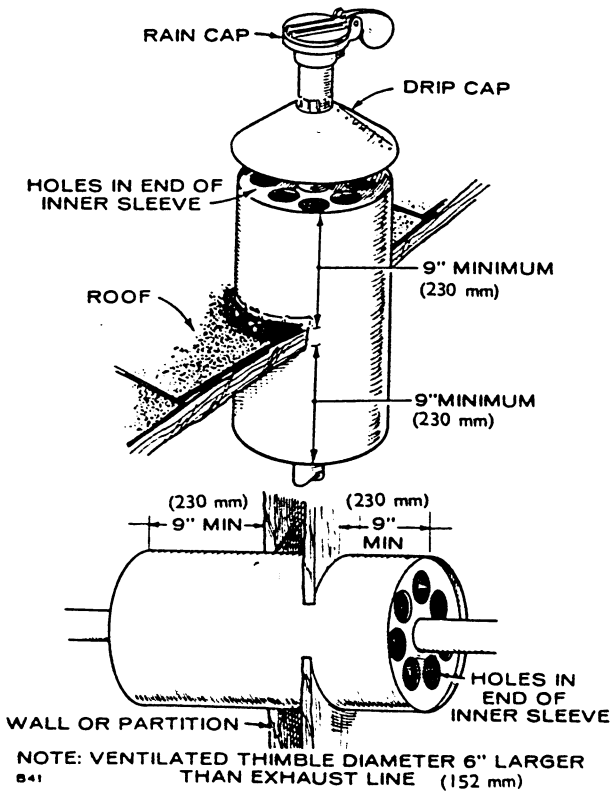


FIGURE 9. EXHAUST THIMBLE

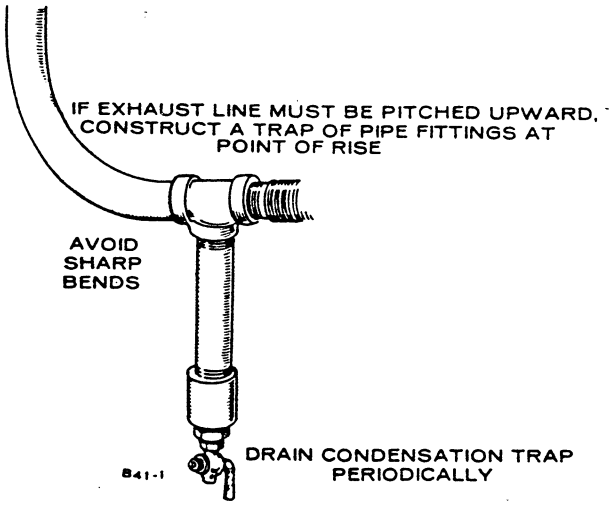


FIGURE 10. EXHAUST CONDENSATION TRAP

Avoid sharp bends; use sweeping long radius elbows. Provide adequate support for mufflers and exhaust pipes. Refer to Figure 6 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 3 inch pipe size outlet of the engine with a flexible portion between the engine and the muffler. Do not connect a flexible line to the exhaust manifold. Minimum diameters and maximum lengths of pipe are as follows:

MODEL	PIPE DIA		LENGTH	
	(mm)	INCHES	METERS	FEET
70.0KR	88.9	3.5	24.4	80.0
	101.6	4.0	54.9	180.0
	127.0	5.0	152.4	500.0
85.0KR	88.9	3.5	18.3	60.0
	101.6	4.0	46.9	154.0
	127.0	5.0	139.3	457.0

Maximum permissible exhaust restriction (back pressure) is 25 inches H^2O (1.84 inches Hg.); (635 mm H^2O [46.8 mm Hg]).

FUEL SYSTEM

International Harvester engines used on KR sets are designed to operate on gasoline (average regular grade of 93 octane), natural gas with thermal rating of 1000 BTU/ft³ (37.25 MJ/m³) or liquefied petroleum gas (LPG) Propane at 2500 BTU/ft³ (93.13 MJ/m³).

FUEL CONNECTIONS

Before starting any type of fuel installation; ONAN recommends that the regulations described in Pamphlet 58 of the National Fire Prevention Association (NFPA) be studied. All pertinent state and local

codes, most of which are governed by NFPA 58, must be complied with, and the installation must be inspected before the unit is put in service.

Fuels under pressure (e.g. natural gas or LPG) should be controlled by a positive shut off valve, preferably automatic, in addition to any valve, integral with the carburetor or gas regulator equipment.

Optional Day Tank: The engine may be equipped with a one quart reservoir tank to replenish fuel lost from the carburetor by evaporation during shutdown. See Figure 11. Connect a 1/4-inch or larger return line between the reservoir upper side fitting (this fitting has a restricted orifice and must be used) and the main supply tank. Be sure the return line has a continuous drop to the main supply tank with no dip-and-rise where fuel could collect and form a vent seal. See that the top center opening of the tank is tightly plugged.

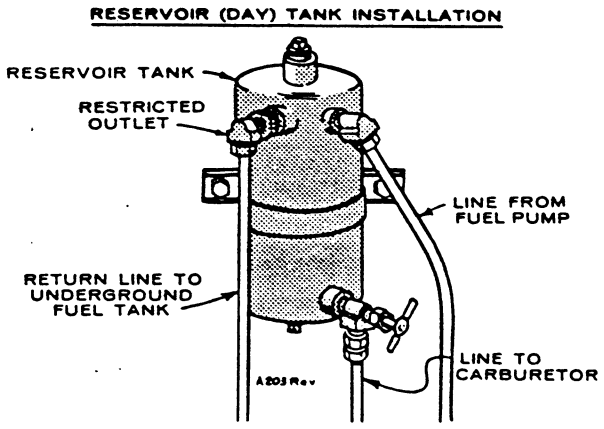


FIGURE 11. DAY TANK INSTALLATION

Natural or Manufactured Gas: On sets equipped with the Impco carburetor, the gas pressure at the carburetor must be set at 3 ounces (5 inch water column) 13 grams/cm² (127 mm H^2O) with the engine running at 1800 rpm at no load. If the pressure is excessive, install a suitable pressure reducing regulator. Be sure to comply with all local regulations such as:

- Recommended electric shutoff valve.
- Hand shutoff valve at the fuel source.
- Supply line filter.

Use a short length of approved flexible connection between the supply pipe and the set regulator inlet. For emergency operation on gasoline fuel, follow the appropriate fuel connection instructions.

Combination Gas-Gasoline: Combination gas-gasoline sets are designed for normal operation on gas fuel, with provision for emergency operation on gasoline. Follow the procedure as given for gas fuel connections. A reservoir tank is sometimes provided, so a fuel return line may be necessary as described for gasoline fuel.

BATTERY

Starting the unit requires 12 volt battery current. Use one 12 volt (see specification) battery for a normal installation. Connect the battery as in Figure 12.

Connect battery positive before connecting battery negative, to prevent the possibility of arcing.

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

WARNING **Do not smoke while servicing batteries. Lead acid batteries give off explosive gases while being charged.**

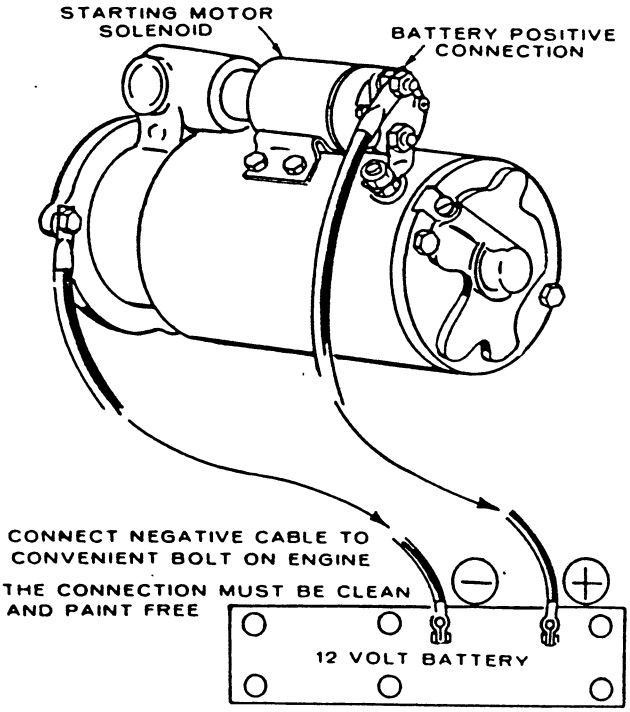


FIGURE 12. BATTERY CONNECTION

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 13. If the distance between the set and remote station is less than 1000 feet (305 meters), use No. 18 AWG wire; between 1000 and 2000 feet (305 and 610 meters), use No. 16 AWG wire.

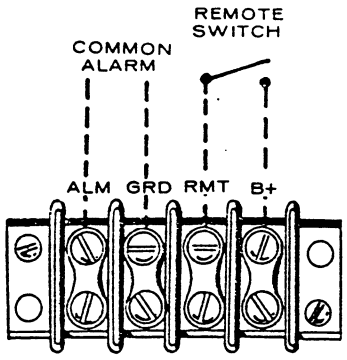
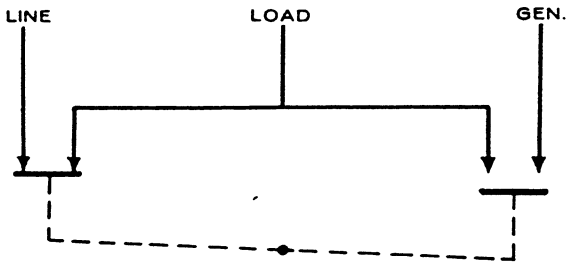


FIGURE 13. REMOTE STARTING

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. See Figure 14. 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. Instructions for connecting an automatic load transfer control are included with such equipment.



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.

FIGURE 14. 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 15.

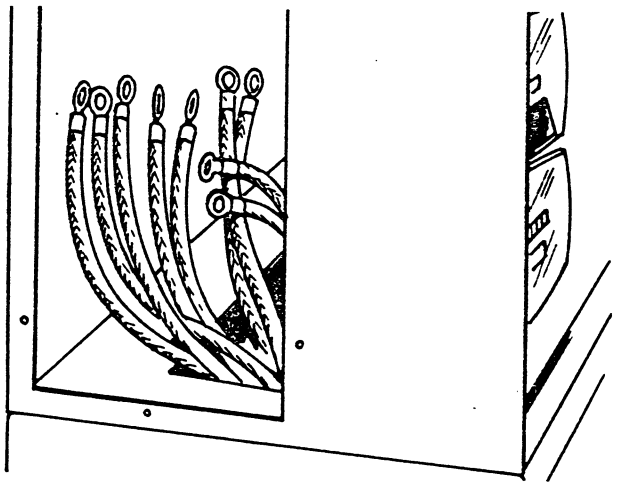


FIGURE 15. CONTROL BOX (SIDE PANEL REMOVED)

2. Connect wires together as shown on panel and in Table 2 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 H2, H3, H4, H5 and H6. See Figure 16.
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 with a 347/600 voltage (designated 9X) or a 120/240 voltage (designated 3R); these connections are made at the factory. The installer must only connect load wires.

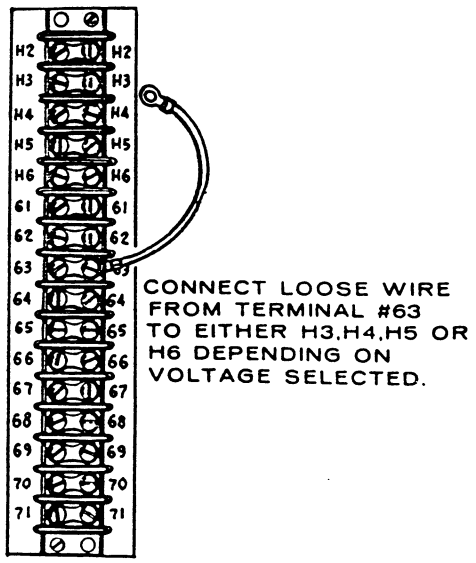


FIGURE 16. CONNECTING LEAD FROM TERMINAL 63

OPERATION

GENERAL

ONAN KR 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.
tion.

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. Do not mix brands nor grades of lubricating oils.

Gasoline engines, use API (American Petroleum Institute) SE/CC or MIL-L-46152.

Natural Gas and LPG, use low ash or ashless API CC/SC or CB/SC.

AMBIENT TEMPERATURE	USE SAE VISCOSITY	
	SINGLE	MULTI-
Below -10° F (-23.3° C)	—	5W-20
-10° F (-23.3° C) to +10° F (-12.2° C)	10W	10W-30
+10° F (-12.2° C) to 32° F (0° C)	20W	10W-30
Above 32° F (0° C)	30W	20W-40

Oil capacities (nominal)

Oil Pan and Filter — 13 quarts (12.3 liters)

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 10 gallons (22 liters). 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 anti-freeze 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 International Harvester engine manual for additional information.

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

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.**

Air Cleaner: Gasoline fueled sets are equipped with an oil bath air cleaner. Service the air cleaner with oil, filling to the level marks on the cleaner. Use the same SAE number as used in the crankcase. However, if air cleaner renewal is likely to be frequent, it is not necessary to use expensive heavy duty oil in the air cleaner. A straight non-detergent mineral oil is satisfactory.

Gaseous fueled units are equipped with a dry element air cleaner. Follow the instructions in the engine manual to service this air cleaner.

Fuel: If the set uses gasoline fuel, see that the fuel supply tank is properly filled with automotive "regular" gasoline. Do not use highly leaded premium grade gasoline. Check with the fuel supplier for assurance that the fuel supplied meets the specifications. Make every effort to keep the fuel supply clean.

If the set is equipped for gas fuel, see that the fuel supply is turned on. Observe all safety precautions regarding the use of gas fuel. Refer to the engine manual.

Combination Gas-Gasoline: A set designed for normal operation on gas fuel with provision for emergency operation on gasoline fuel, is equipped with a gas-gasoline toggle switch. Throw the switch to the appropriate position according to the type of fuel in use.

Check all connections in fuel system for security, to ensure that pressure will not bleed off when engine is not in use. Pressure should be maintained for immediate starting if unit is on standby service.

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 over charge.

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.

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 an 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 a 4 to 6 amp-hour rate.
5. Test each cell. If the specific gravity is still above 1.255, repeat steps 2, 3, and 4 until the reading is reduced to 1.225. Usually, repeating steps twice is sufficient.

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 and 55 psi (207 and 380 N•m). 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° to 195° F (82° to 90° 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 165° F to 195° F (74° to 90° 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 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.

EXERCISE PERIOD

Generating sets on continuous standby service are required to be operative at full load from a cold start in less than 10 seconds 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 insure 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 up fuel tank, check engine for leaks and unit for general condition. Locate cause of leaks (if any) and correct.

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, ignition system, etc. 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. Check ignition system.
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
(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, ignition system, etc. 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, check ignition.
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.

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

Generator sets removed from service for extended

periods of time (over 30 days) should be protected from rust and corrosion. Onan recommends the following protective procedure—

1. Check coolant. Top up if necessary, using recommended anti-freeze.
2. Run set until thoroughly warm; generator under at least 50% load. Stop engine by shutting off fuel supply to allow engine to drain fuel lines and carburetor.
3. Drain oil base while still warm. Refill and attach a tag indicating viscosity of oil used.
4. Remove spark plugs. Pour 1-ounce of rust inhibiting oil (or SAE #10 oil) into each cylinder. Crank engine over several times. Install spark plugs.
5. Service air cleaner.
6. Clean throttle and governor linkage, protect by wrapping with a clean cloth.
7. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
8. Clean off dirt and dry entire unit. Coat parts likely to rust with a light film of oil or grease.
9. Disconnect battery and follow standard battery storage procedure. Apply a film of non-conductive grease (e.g. vaseline) to battery cable terminal lugs.
10. Fill fuel tank to prevent condensate contamination.
11. Provide a suitable protective cover for the entire unit.

RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperature.
3. Clean and check battery. Measure specific gravity 1.260 at 25° C (77° F) and verify level to be at split ring. If specific gravity is low, charge until correct value is obtained. If level is low, add distilled water and charge until specific gravity is correct. DO NOT OVERCHARGE.

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

4. Connect batteries.
5. Liquid cooled sets. Check coolant level. Adjust if necessary.
6. Verify that no loads are connected to the generator.
7. Start engine.

After engine has started, excessive blue smoke will be exhausted and the engine will run rough until the rust inhibitor or oil has burned away.

8. After start, apply load to at least 50% of rated capacity.
9. Check all gauges to be reading correctly. Unit is ready for service.

HIGH ALTITUDE

Ratings apply to altitudes up to 1000 feet (305 m) standard cooling and with normal ambients. 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 for a naturally aspirated engine. 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 International Harvester 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 (Figure 17).

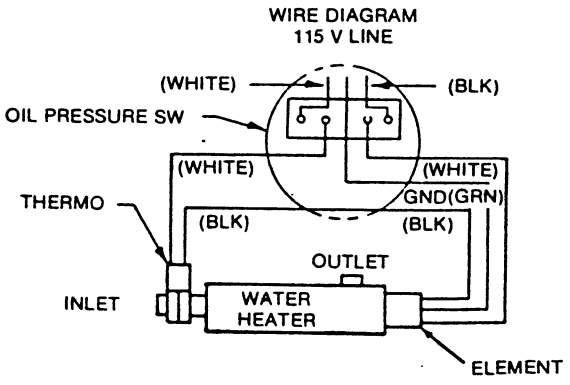


FIGURE 17. ENGINE HEATER

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 International Harvester manual for engine service 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 air
- 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.

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.**

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS					
	10	40	100	125	150	300
Inspect complete set for exhaust leaks, etc.	x1					
Check Engine Oil Level	x1					
Check Radiator Coolant Level	x1					
Check Fuel	x1					
Change Engine Break-in Oil and Filter		x				
Check Battery Electrolyte Level		x2				
Check Air Cleaner (clean or replace as necessary)		x3				
Change Engine Oil and Filter*			x4			
Check Starting Motor				x5		
Check Ignition Timing; Adjust if Necessary					x4	
Check, Clean, and Gap Spark Plugs					x4	
Replace Spark Plugs						x6
Check Distributor Points						x6
Check and Test High Tension Ignition Cables						x6
Check Crankcase Ventilating System						x6

x1 - After every run or exercise period.
x2 - Or every two weeks.
x3 - Perform more often in extremely dusty conditions.
x4 - Or every four months.
x5 - 75 to 125 hours.
x6 - Or every twelve months.
* - The Engine Oil and Filter, for Liquid Propane Gas (LPG) and Natural Gas (NG), must be changed after every 500 hours of operation.

ENGINE

General: Basic maintenance procedures are contained within the International Harvester manual, which should be used in conjunction with the set manual, except in such cases where instructions state otherwise. Then, the new information unique to the KR set shall take precedence.

Air Filter: Remove wing nut in center of filter cover. Remove cover and filter. Tap filter on a flat surface to remove adherent dirt. Place a light source inside the filter and inspect for free air passage. If necessary, apply a low pressure air source (30-psi [207 kPa] OSHA) to the inside of the filter to remove as much dirt as possible. Inspect interior housing. Vacuum clean if dirty, or remove housing and wipe clean.

CAUTION **Do not clean filter housing while still installed. Loose dirt entering intake could damage carburetor or engine.**

Replace air filter every 40 hours of operational time; more often in extremely dusty conditions.

Oil Filter: Replace filter element with every oil change, at every 100 hours of operational time.

1. Remove canister retaining bolt and washer; then remove canister and filter element. See Figure 18.

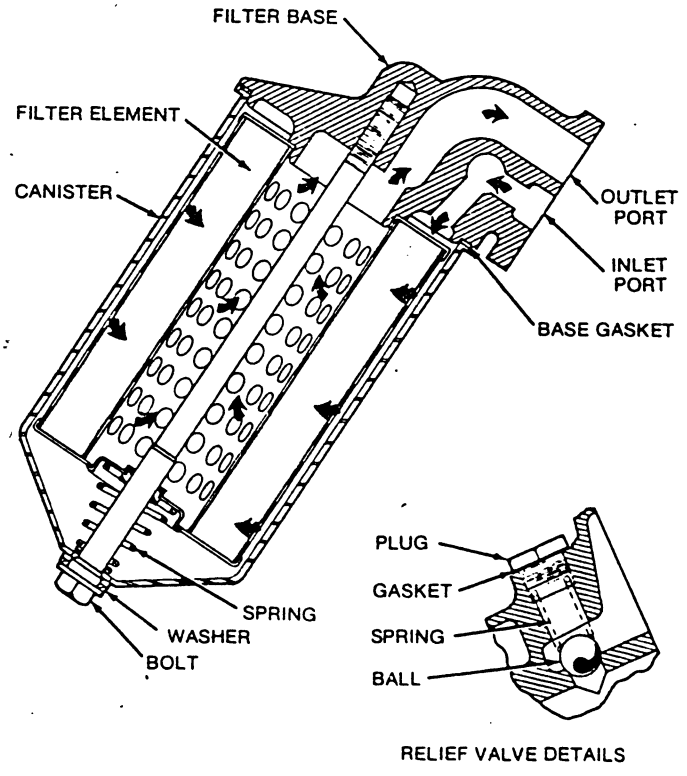


FIGURE 18. OIL FILTER ASSEMBLY

2. Wash canister in cleaning solvent, making sure all sediment is removed from inside of canister.

WARNING **Use extreme care when cleaning with a petroleum-base cleaner, due to fire hazards.**

3. Install new filter element in canister over canister bolt and spring. Seal end of filter element must be installed toward spring in bottom of canister.

Check condition of oil base gasket. Replace gasket if necessary.

4. Install canister making sure canister seats on gasket in filter base. Tighten canister retaining bolt to 30-35 ft. lbs. (40.6-47.4 N•m).
5. Add two quarts of oil to engine to compensate for filter element change.
6. Start engine and run for at least five minutes to warm oil and check for leaks. Check oil level.

Positive Crankcase Ventilation (PCV): Check PCV valve after every 300 hours. Remove and clean. After cleaning, shake valve to ensure ball is free, then reinstall.

BATTERIES

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water.

CONNECTIONS (Fuel, Exhaust, etc.)

Operator should periodically make a complete visual inspection of the unit while running at rated load.

Some of the things to check for are as follows:

1. Check 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 for security.

GASOLINE CARBURETOR

This carburetor has a fixed main jet. It has two idle adjustment screws. See Figure 19. Under normal circumstances, the factory adjustment should not be disturbed. If the adjustment has been changed, an approximate adjustment setting of 1-1/2 turns open will permit starting. Adjust temporarily for smoothest running. Allow engine to warm up before making final adjustment.

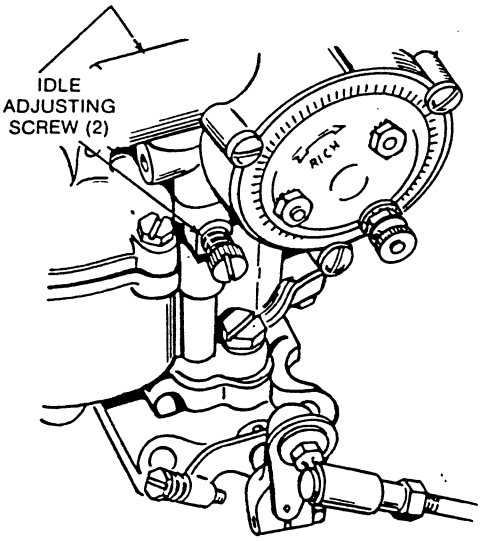


FIGURE 19. GASOLINE CARBURETOR

GASOLINE CARBURETOR CHOKE

The carburetor designed for gasoline (only) fuel is equipped with an electrically heated choke. A heating element inside the choke cover acts upon a bimetal thermal coil to turn the choke shaft and valve. The outer edge of the choke cover is divided into small sections by raised marks, one of which is emphasized by an asterisk (*). See Figure 20. A long raised mark on top of the choke housing is used as reference mark. The normal setting is made with the * mark aligned with the reference line. If adjustment is necessary, loosen the cover locking screws and turn the cover clockwise for more choking action, counterclockwise for less choking. Turning one or two marks is usually sufficient. Retighten the cover screws.

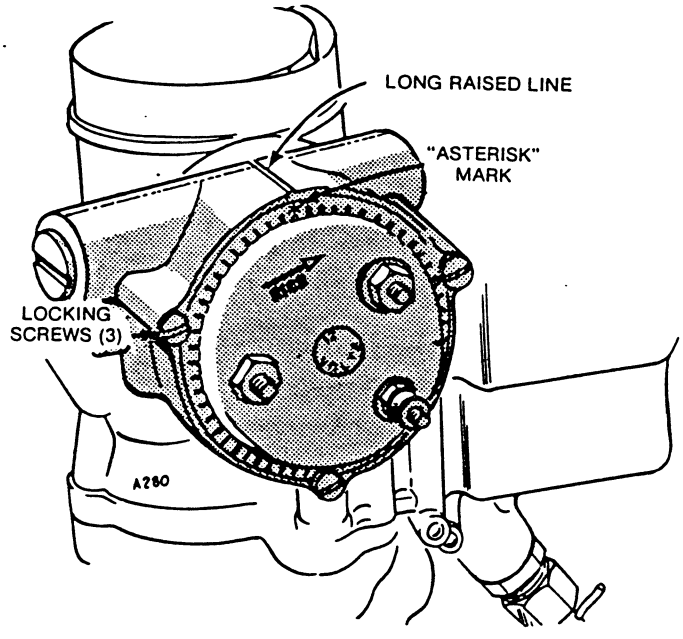


FIGURE 20. ELECTRIC CHOKE

COMBINATION GAS-GASOLINE CARBURETOR

If the unit is equipped with a combination carburetor (Figure 21), adjust the electric choke so that the cover is turned 10 to 12 notches counterclockwise from the (*) mark. When properly adjusted, the choke will be completely open, even at very low temperatures.

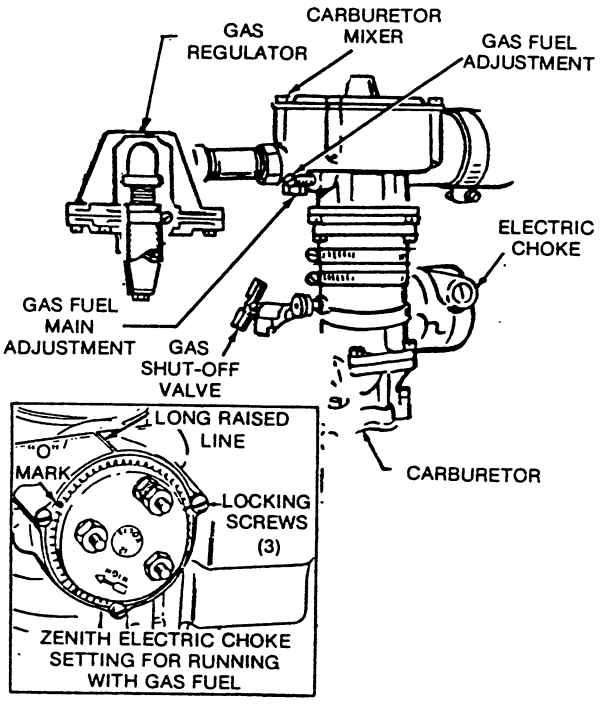


FIGURE 21. COMBINATION GAS-GASOLINE

CARBURETOR, GAS

With the unit operating at full load, turn the main adjusting valve toward the "L" (lean) setting (clockwise) until the engine speed begins to drop. Then turn the valve toward "R" (rich) setting (counterclockwise) until the voltage returns to normal.

LPG FUELED OPERATION

LPG fueled units are equipped with a regulator and a solenoid actuated fuel valve in the fuel line. The fuel valve replaces the anti-dieseling solenoid. The regulator and fuel valve are shown in Figure 22.

ANTI-DIESELING SOLENOID

The anti-dieseling solenoid is a device to hold the throttle closed during engine shutdown. This ensures prompt stopping and prevents backfiring. A spring and linkage hold the throttle closed during shutdown. A solenoid is energized to overcome spring tension permitting the throttle to open for engine operation.

Normally factory adjustments should not be changed. If adjustment should become necessary, adjust carburetor arm so that anti-dieseling solenoid plunger and face of solenoid are flush. See Figure 23.

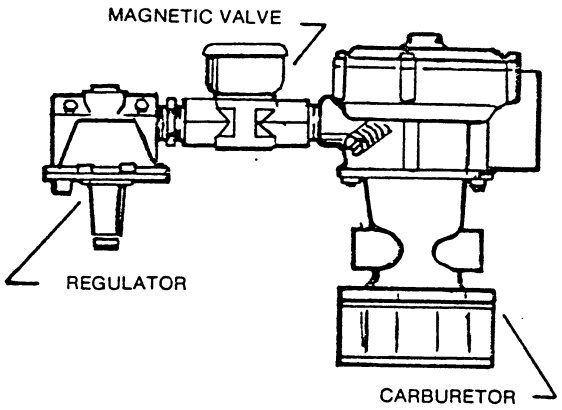


FIGURE 22. LPG COMPONENTS

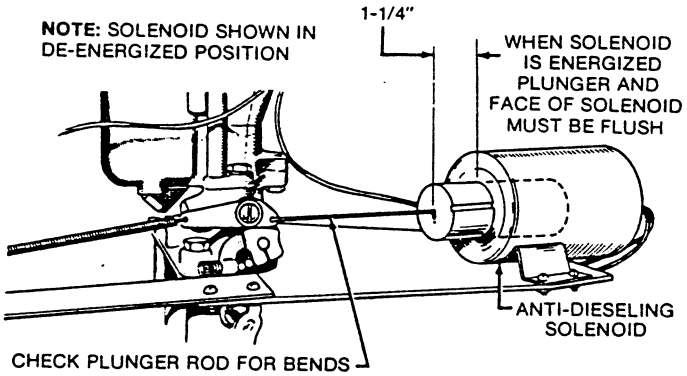


FIGURE 23. ANTI-DIESELING SOLENOID

GOVERNOR ADJUSTMENT

The governor controls the engine speed and, therefore, the frequency of the generator output current under various load conditions. Use either a tachometer or a frequency meter to check engine speed for proper governor adjustment. Each 30 rpm engine speed is equivalent to 1 hertz of current frequency.

Before making a governor adjustment, the unit should be run long enough for the engine to warm up thoroughly. The carburetor must be adjusted for proper fuel ratio—either a too-rich or a too-lean mixture can cause loss of power and erratic governor action.

1. With the unit stopped, see that the linkage between the governor arm and the carburetor throttle is adjusted to the proper length for fully open carburetor position. See Figure 24.
2. See that the governor "bumper" screw is backed off far enough to make it temporarily inoperative.
3. With no electrical load connected, adjust the speed adjusting screw to obtain a speed of no more than 1890 rpm (63 hertz) for a 60 hertz set or 1590 rpm (53 hertz) for a 50 hertz set.
4. Apply a full electrical load. The speed drop from the no load figure should be no more than 90 rpm (3 hertz) and no less than 45 rpm (1-1/2 hertz). If speed drop is excessive, increase the sensitivity as illustrated. If the set tends to alternately increase and decrease speed (hunt), decrease the sensitivity. Any change in the sensitivity adjustment will require a slight compensating adjustment of the speed screw.
5. Check the output voltage (which should be adjustable with 5% of the rated voltage) by means of the control panel rheostat. If necessary, adjust the screw but keep the speed within the no load limit of 1890 rpm (63 hertz) for a 60 hertz set and full load speed of 1770 rpm (59 hertz) with the preferred difference of about 60 rpm (2 hertz).
6. After satisfactory operating adjustment is made, remove the electrical load and turn in the bumper screw just to the point of causing a slight speed increase. Back the bumper screw off 1/2 turn.
7. Be sure that the lock nuts on the speed adjusting and bumper screws are tightened to prevent any change in the settings from vibration.

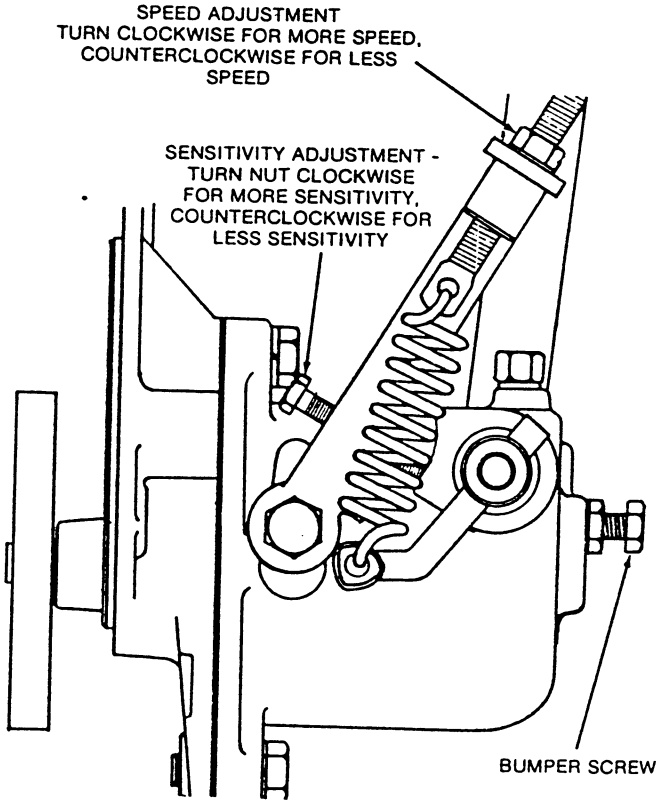


FIGURE 24. GOVERNOR

AC GENERATOR (Begin Spec P)

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.

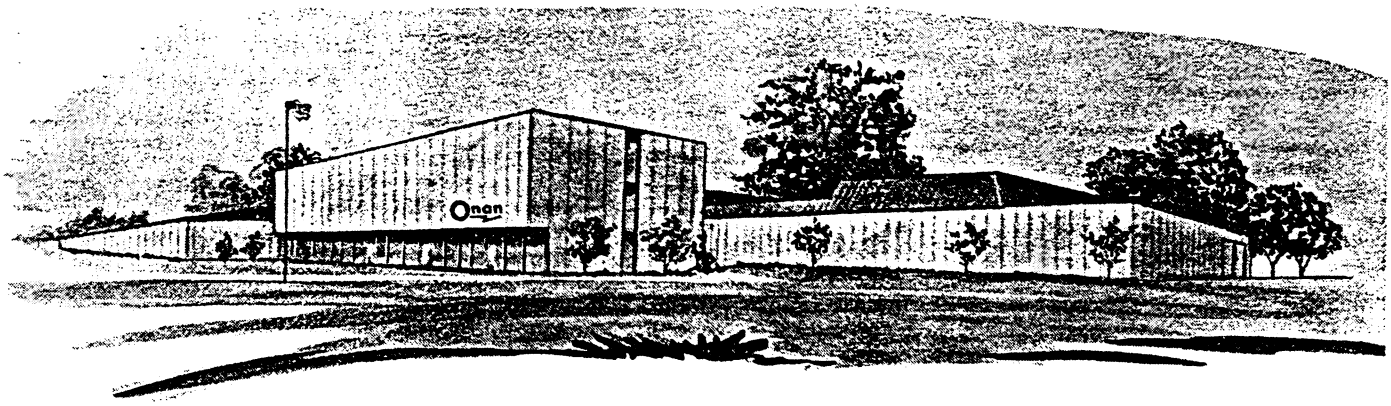
Generator Bearing: Inspect the bearing every 1000 hours with the unit running.

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.

Inspection and Cleaning: When inspecting the voltage regulator and exciter assemblies, be sure the diodes and heat sinks are kept free of dust, dirt and grease. Blow the assemblies out periodically with filtered, low pressure, compressed air. Also check these diodes for security.

CAUTION **Excessive foreign matter on diodes and heat sinks will cause overheating and possible failure.**

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



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