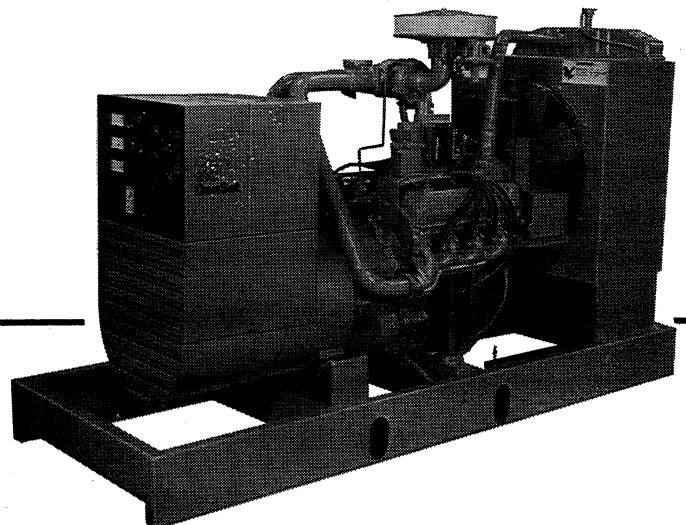




Operator's Manual

ENTX
GenSets

Natural Gas Fuel



Safety Precautions

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

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

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

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

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

FUEL AND FUMES ARE FLAMMABLE. Fire and explosion can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.

- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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Introduction

ABOUT THIS MANUAL

This manual provides general information for operating and maintaining your Onan generator set. Study this manual carefully and observe all warnings and cautions. Using the generator set properly and following a regular maintenance schedule will result in longer unit life, better performance, and safer operation.

Included with the generator set literature package is a copy of the Ford Operator's Manual for the engine. The engine manual may be used in conjunction with the generator set Operator's Manual. The operation and maintenance procedures for the complete generator set (including the engine) are covered in the ENTX Operator's Manual. In case of conflicting information, the ENTX Operator's Manual takes precedence over the engine manual.

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact an Onan Distributor for assistance. Onan factory trained Parts and Service representatives are ready to handle all your service needs.

When contacting an Onan Distributor, always supply the complete Model number and Serial number as shown on the Onan nameplate (Figure 1). The Onan nameplate is located on the side of the generator control box.

▲WARNING

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

Onan

Model No. _____

Serial No. _____

Important - Give above no.'s when ordering parts

Service Rating: _____

Hertz: _____ RPM: _____

Single Phase kW _____ KVA _____

Three Phase kW _____ KVA _____

Volts: 110/190 110/220 115/200 115/230 120/208

Amps: _____

120/240 127/220 139/240 220/380 230/400 240/416

240/480 254/440 277/480 347/600 115/230 1Ø 120/240 1Ø

For Elec Eqpt Only _____ PF: _____ Bat.: _____

Insul - NEMA Class **F** Amb 40°C

Onan Corp
Minneapolis Mn
55432 USA
Made in USA

M-1641

FIGURE 1. ONAN NAMEPLATE

Specifications

ENGINE DETAILS

Engine	Modified Ford LSG-875-6005A
Engine Speed	
60 Hertz	1800 r/min
50 Hertz	1500 r/min
Fuel	Natural Gas
Battery Requirements (Minimum)	
SAE Number	3EE
Voltage	12V
Battery Charging Current	35 Amperes
Starting Method	Solenoid Shift

GENERATOR DETAILS

Type	Onan UR, Revolving Field, Brushless
Rating (60 Hertz)	100 kW (125 kVA @ 0.8 PF)
Phase	3

CAPACITIES AND REQUIREMENTS

Cooling System (Engine and Radiator)	7.75 Gal. (29L)
Engine Oil Capacity (With Filter)	2.5 Gal. (9.5L)

TUNE-UP SPECIFICATIONS

Ignition Timing (1800 r/min)	32°BDTC
Spark Plug Gap	0.035 inch (0.89 mm)
*CO Setting @ 1800 r/min and Rated Load	1.5% + .5%

⚠ CAUTION

****Carburetor is factory adjusted and sealed at this setting. If carburetor requires readjustment, a CO analyzer must be used to obtain this setting. Failure to do so can damage the engine and void the warranty.***

Operation

GENERAL

This section covers starting and operating the generator set. It is recommended that the operator read through this entire section before attempting to start the set. It is essential that the operator be completely familiar with the set to ensure safe operation.

PRESTART CHECKS

Before starting, be sure the following checks have been made and the unit is ready for operation. Refer to the Maintenance section for the recommended procedures.

Lubrication

Check the engine oil level. Keep the oil level near as possible to the dipstick high mark without overfilling.

Coolant

Check the engine coolant level. The coolant should be about two inches below the radiator cap opening. Do not check while the engine is hot.

⚠ CAUTION

Contact with hot coolant can result in serious burns. Do not bleed hot, pressurized coolant from a closed cooling system.

Fuel

Open all manual shutoff valves in the fuel supply system.

CONTROL PANEL

The following describes the function and operation of the standard generator set control. All instruments and control switches are located on the face of the control panel as illustrated in Figure 2. The control panel is separated into a DC panel for monitoring the engine and an AC panel for monitoring the generator.

⚠ WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and Sleepiness***
- ***Throbbing in Temples***
- ***Muscular Twitching***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Protection against carbon monoxide inhalation includes proper installation and regular, frequent visual and audible inspections of the complete exhaust system.

1-P/EM

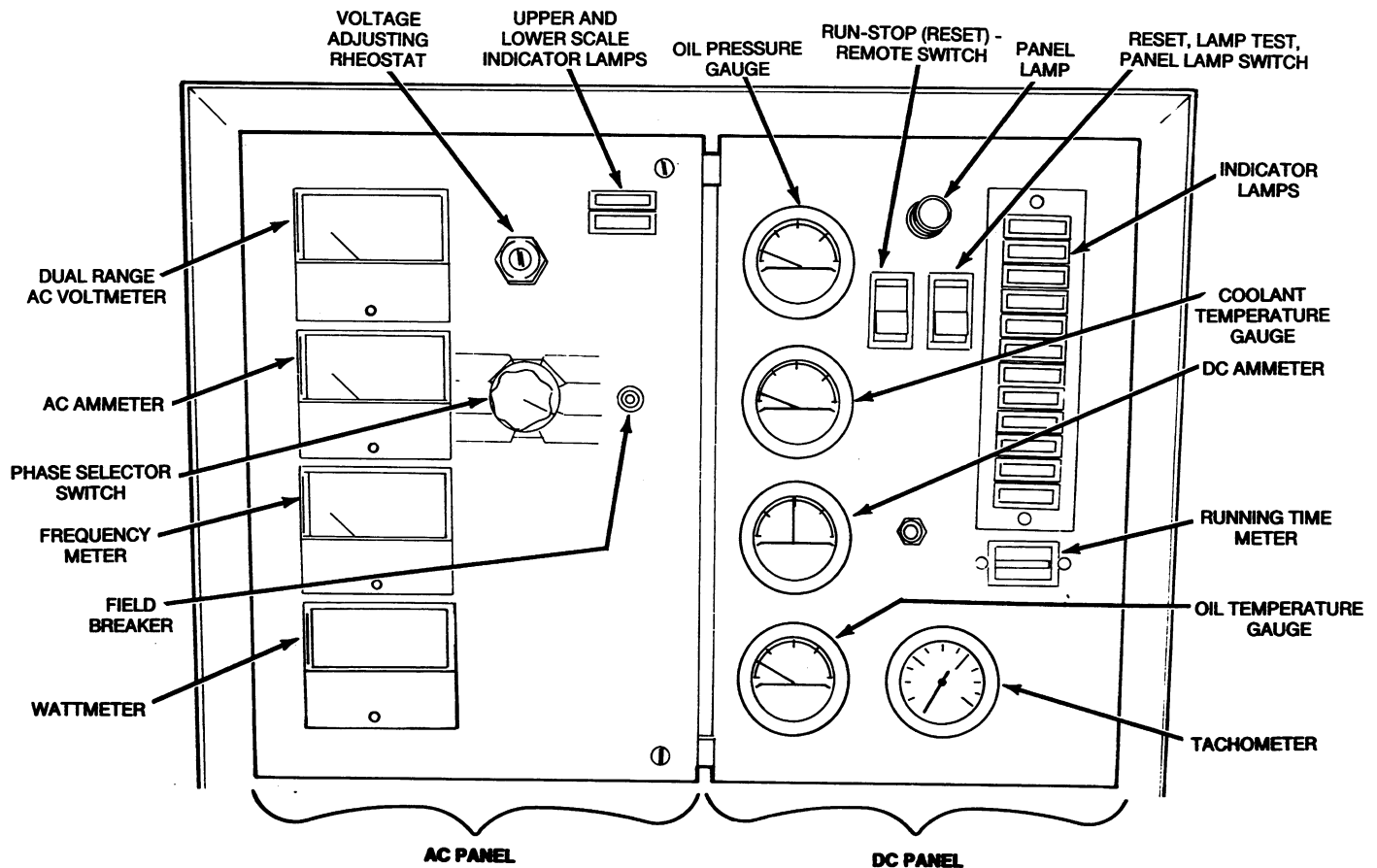


FIGURE 2. CONTROL PANEL

M-1590-1

DC Panel:

Panel Lamp: 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 the battery charging current.

Run/Stop/Remote Switch: Starts and stops the unit locally, or from a remote location wired to the control engine monitor board.

Running Time Meter: Registers the total number of hours the unit has run. Use it to keep a record of periodic servicing. Time is cumulative; meter cannot be reset.

Reset, Lamp Test, Panel Lamp Switch: Resets the fault circuit only when the Run/Stop/Remote switch is in the Stop (Reset) position. Tests fault lamps and turns on the control panel lamp.

Tachometer (Optional): Provides constant monitoring of engine r/min.

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

Indicator Lamps: The standard control panel has two monitor system indicator lamps.

- RUN (green)
- FAULT (red)

The green Run lamp comes on as soon as both primary and secondary starter circuits are opened after unit starting. The red lamp indicates an emergency shut-down of the generator set.

The optional control panel has a 12-lamp monitoring system. The following describes each lamp function.

- RUN (green) lamp comes on when both starter circuits are opened after unit starting.
- PRE LO OIL PRES (yellow) indicates engine oil pressure is marginally low.
- PRE HI ENG TEMP (yellow) indicates engine temperature is marginally high.
- LO OIL PRES (red) indicates engine has shut down because of critically low oil pressure.

- **HI ENG TEMP (red)** indicates engine has shut down because of critically high temperature.
- **OVERSPEED (red)** indicates engine has shut down because of excessive speed.
- **OVERCRANK (red)** indicates the starter has been locked out because of excessive cranking time.
- **FAULT 1 (red)** an undedicated fault. May be factory programmed as a shutdown or non-shutdown, and as a timed or non-timed (normally set for timed shutdown).
- **FAULT 2 (red)** same features as Fault 1 (normally set for timed shutdown).
- **LO ENG TEMP (yellow)** engine temperature is marginally low for starting. Indicates inoperative coolant heater. (Lamp lights when engine water jacket temperature is 70°F (21°C) or lower. Since the lamp goes out after the engine warms up there should be no cause for alarm even during initial generator set operation.)
- **LO FUEL (yellow).** Not applicable on ENTX.
- **SWITCH OFF (flashing red)** indicates generator set is not in automatic start operation mode.

AC Panel

AC Voltmeter (Optional): Dual range instrument indicating AC voltage. Measurement range in use shown on indicator light.

AC Ammeter (Optional): Indicates AC generator line current.

Wattmeter (Optional): Continuously gives reading of the generator output in kilowatts.

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

Voltage Adjust (Optional): Rheostat providing approximately plus or minus five percent adjustment of the rated output voltage.

Upper and Lower Scale Indicator Lamps (Optional): Indicates which scale to use on the AC voltmeter and ammeter.

Phase Selector Switch (Optional): Selects phases of generator output to be measured by AC voltmeter and AC ammeter.

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

CONTROL PANEL INTERIOR

Generator AC Voltage Regulator

The solid-state regulator (VRAS-2) controls AC output voltage from the generator at a predetermined level regardless of load. Voltage regulation is plus or minus two percent from no load to full load. Random voltage variation is plus or minus one percent for constant loads.

Engine Control Module

Electronic and relay components of the engine monitoring circuit are on a circuit board assembly. Sensor inputs (Figure 3) are connected by the wiring harness to plug connectors on the board. The control module provides the following functions of unit protection.

- **Overcrank** - Limits engine cranking to 75 seconds. If engine fails to start, the module lights a fault lamp and opens the cranking circuit. The cycle cranking option allows three 15-second cranking cycles with two 15-second rest periods on the 12-lamp control.
- **Overspeed** - Shuts down the engine immediately if overspeed occurs and lights a fault lamp. The sensor switch is mounted in the end bell on the generator shaft. It is factory adjusted to shut down 60 hertz units at 2100 ± 90 r/min, 50 hertz units at 1850 ± 50 r/min.
- **Low Oil Pressure** - Shuts down the engine immediately if oil pressure drops below 25 psi (172 kPa) and lights a fault lamp. The fault is time-delayed about 10 seconds following starter disconnect and inhibited during cranking. The delay allows oil pressure to rise to normal before the electronic control module monitors this system.
- **High Engine Temperature** - shuts down the engine immediately if coolant temperature rises above 215°F (102°C) and lights a fault lamp. The fault is time-delayed about 10 seconds following starter disconnect and inhibited during cranking. This delay allows coolant in a hot engine time to circulate and return the water jacket to normal before the electronic control module monitors this system.

A pre-low oil pressure sensor and lamp (used with optional 12-lamp system) provides an alarm that oil pressure is marginally low, 30 psi (207 kPa) or less. The cause should be found and corrected as soon as possible.

A pre-high engine temperature sensor and lamp used with optional 12-lamp systems, provides an alarm that engine temperature is marginally high, 205°F (97°C). The cause should be found and corrected as soon as possible.

⚠ CAUTION

The high engine temperature shutdown system will shut down the engine in an overheat condition only if the coolant level is sufficiently high to physically contact the shutdown switch. Loss of coolant will allow the engine to overheat without protection of the shutdown system, thereby causing severe damage to the engine. Therefore, maintain adequate engine coolant levels to ensure the operational integrity of the cooling and overheat shutdown protection systems.

- Low Coolant Level Shutdown (If Used) - A float actuated switch provides engine shutdown if coolant level falls too low. It also turns on the high engine temperature fault lamp.

STARTING PROCEDURE

The following sections cover the three systems used to start the generator set.

Starting at Control Panel

Move the Run-Stop-Remote switch on the DC panel (Figure 1) to the RUN position. This will activate the engine control system and the starting system. The starter will begin cranking and after a few seconds the engine should start. The starter will disconnect when the engine reaches a speed of 450 to 570 r/min.

If the engine does not start, the starter will engage after a specified period of time and the control will indicate an overcrank fault. Generator sets with the standard overcrank control will crank continuously for up to 75 seconds before disengaging the starter. Generator sets with the cycle cranking option will crank for 15 seconds and then disengage for 15 seconds until 3 cycles have been completed. To clear an overcrank fault, place the Run-Stop-Remote switch in the STOP position and momentarily depress the Reset switch. Wait two minutes for the starter motor to cool and then repeat the starting procedure. If the engine does not run after a second attempt at starting, refer to the Troubleshooting section.

Starting from Remote Location

Move the Run-Stop-Remote switch on the generator set DC panel to the REMOTE position. This allows the generator set to be started from a remote switch. Closing the remote switch initiates the starting sequence described in the previous section.

Automatic Starting

Place the Run-Stop-Remote switch on the generator set DC panel in the REMOTE position if an automatic transfer switch is used. This allows the transfer switch to start the generator set if a power outage occurs and stop it when the power returns.

STOPPING

Before Stopping

Run the generator set at no load for three to five minutes before stopping. This allows the lubricating oil and engine coolant to carry heat away from the combustion chamber and bearings.

To Stop

If the set was started at the set control panel or at a remote control panel, move the Run/Stop/Remote switch or remote starting switch to the STOP position. If the set was started by an automatic transfer switch, the set will automatically stop about 15 minutes after the normal power source returns.

OPERATING RECOMMENDATIONS

Some of the following sections require that a load be connected to the generator set. This is usually done using a load transfer switch. Refer to the transfer switch operator's manual for operation information.

Break-In

Drain and replace the crankcase oil after the first 50 hours of operation on new generator sets. Refer to the MAINTENANCE section of this manual for the recommended procedures.

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.

Exercise Period

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts.

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps ensure reliable engine starting. Exercise the generator set at least once a week for a minimum of 30 minutes with load so the engine reaches normal operating temperatures.

Onan automatic transfer switches have as an option an exerciser that can be preset to provide regular exercise periods. Typically, the exerciser can be set for time of start, length of run, and day of week.

Low Operating Temperatures

Use a water jacket heater if a separate source of power is available. The optional heater available from Onan will ensure reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

⚠CAUTION

To avoid damage to heater, be sure the cooling system is full before applying power to the heater.

Power Rating Factors

The generator set power rating applies to sets used in standby applications. The set will operate at the stated rating for the duration of normal utility power interruptions. The rating was established for a standard radiator cooled set running on natural gas fuel and operating at an altitude of 300 feet (92 m) with an ambient temperature of 77°F (25°C). For a rating relative to other applications, altitudes, cooling systems, or ambient temperatures, contact an authorized Onan Distributor.

TROUBLESHOOTING

The generator set has a number of sensor units (Figure 3) that continuously monitor the engine for abnormal conditions such as low oil pressure or high coolant temperature. If an abnormal condition does occur, the engine monitor will activate a fault lamp and may also stop the engine depending on the condition. If the generator set does shut down, the operator may be able to restart the set after making certain adjustments or corrections. The following sections describe the operation of the fault condition system and suggested troubleshooting procedures for the operator.

The standard two light control has a single green light to indicate Run and a single fault light to indicate malfunctions. The optional 12 light control has a single green Run light, 4 amber pre-fault lights, and 7 red fault lights. Both controls also have a terminal connection for an external alarm which will sound when a fault occurs.

Safety Considerations

High voltages are present within the control box and generator output box when the generator is running. Do not open the control box or generator output box while set is running.

⚠WARNING

Contacting high voltage components can cause serious personal injury or death. Keep control and output box covers in place during troubleshooting.

Generator set installations are normally designed for automatic starting or remote starting. When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. Place the Run/Stop/Remote switch in the STOP position and remove the negative battery cable from the set starting battery.

⚠ WARNING *Accidental starting of the generator set during troubleshooting can cause severe personal injury or death. Disable the generator set before troubleshooting.*

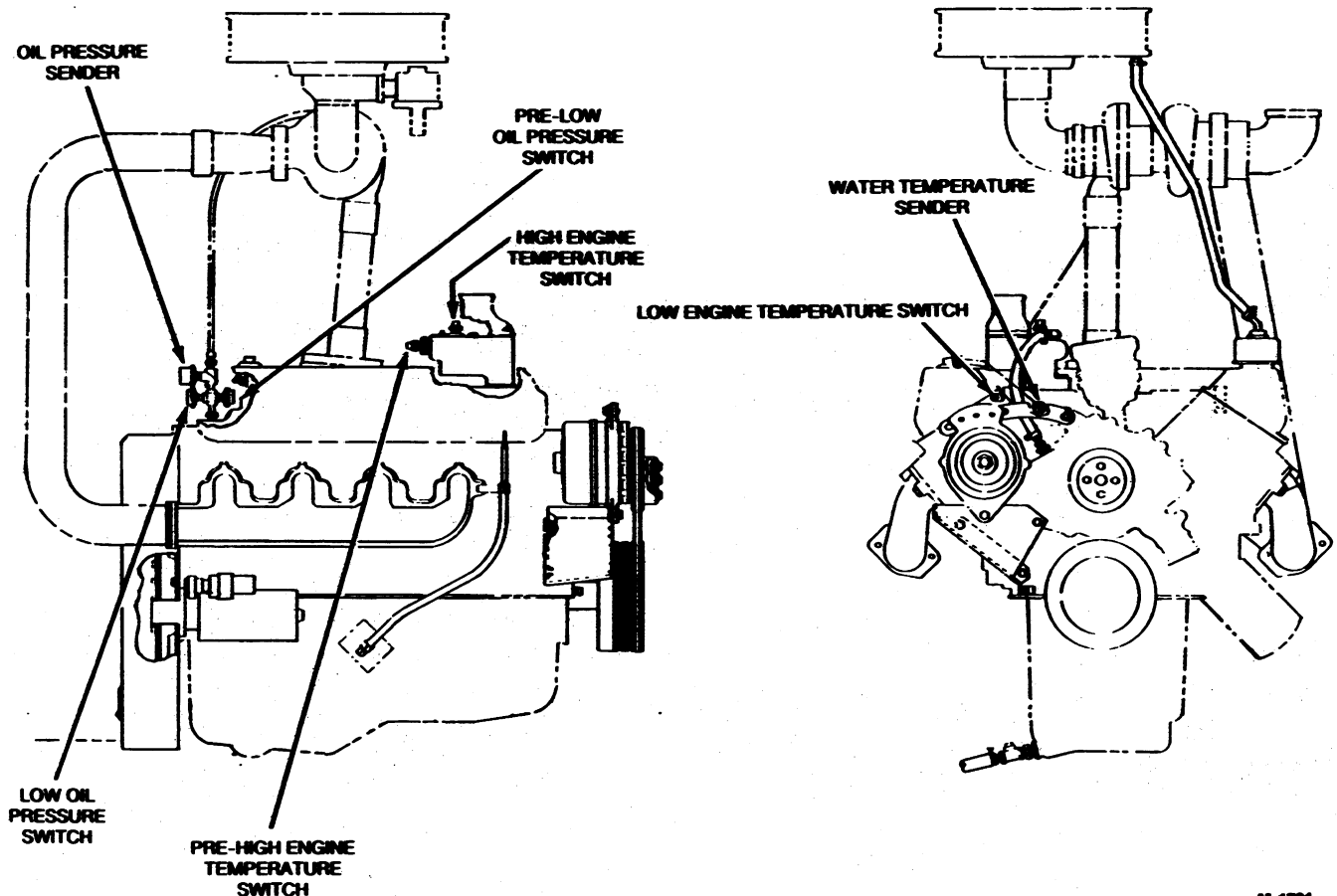
When a fault light comes on during operation, follow the procedures in Table 1 to locate and correct the problem. If a major problem is indicated, contact an Onan Distributor for service.

Resetting the Control

The external alarm and fault lamp can be deactivated by placing the Start/Stop/Remote switch in the Stop position and pressing the Reset/Lamp Test switch. Locate the problem and make the necessary corrections before restarting the generator set.

Line Circuit Breaker (Optional)

The optional line circuit breaker mounts on the generator output box. If the load exceeds the generator current rating, the line circuit breaker will open to prevent the generator from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as required. Manually reset the breaker to reconnect the load to the generator.



M-1701

FIGURE 3. ENGINE SENSOR LOCATION

TABLE 1. TROUBLESHOOTING

SYMPTOM	CORRECTIVE ACTION
*1. Green RUN lamp lights following engine start-up.	1. Indicates all engine systems are normal. No corrective action required.
2. PRE HI ENGINE TEMP lamp lights. Engine continues to operate.	2. Indicates engine has begun to overheat and engine temperature has risen to approximately 205°F (97°C). If engine can be stopped, follow procedures in step 3. Use the following procedures if generator is powering critical loads and cannot be shutdown. <ul style="list-style-type: none"> a. Check air inlets and outlets and remove any obstructions to airflow. b. Open doors or windows in generator area to increase ventilation. c. Reduce load if possible by turning off non-critical loads.
*3. HI ENG TEMP lamp lights. Engine shuts down.	3. Indicates engine has overheated (engine temperature has risen above 215°F/102°C or coolant level is low (sets with coolant level sensor). Allow engine to cool down completely before proceeding with the following checks: <ul style="list-style-type: none"> a. Check coolant level and replenish if low. Low for possible coolant leakage points and repair if necessary. b. Check for obstructions to cooling airflow and correct as necessary. c. Check for a slipping fan belt and tighten if loose. d. Reset control and restart after locating and correcting problem. Contact an Onan Dealer or Distributor if none of the above.
4. PRE-LO OIL PRES lamp lights. Engine continues to operate.	4. Indicates engine oil pressure has dropped to 30 psi (207 kPa). If engine can be stopped, follow procedures in step 5. If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow step 5 procedure.
*5. LO OIL PRES lamp lights. Engine shuts down NOTE: See also step 6.	5. Indicates engine oil pressure has dropped to 25 psi (172 kPa). Check oil level and replenish if low. Reset control and restart. Contact an Onan Dealer or Distributor if oil pressure is not in the range of 40-65 psi (275 to 448 kPa).

*Use these steps when troubleshooting two light control panels.

Run Lamp - See steps 1 and 15

Fault Lamp - See steps 3,5,6,7 and 11.

Other Faults - See steps 12, 13 and 14.

TABLE 1. TROUBLESHOOTING (Continued)

SYMPTOM	CORRECTIVE ACTION
<p>*6. OVERCRANK lamp lights and engine stops cranking. or</p> <p>Engine runs, shuts down, and LO OIL PRES lamp lights.</p>	<p>6. Indicates possible fuel or ignition system problem.</p> <ol style="list-style-type: none"> Check fuel leaks, or plugged fuel lines and correct as required. Check for dirty fuel filter and replace if necessary (see MAINTENANCE section). Check for dirty or plugged air filter and replace if necessary (see MAINTENANCE section). Check for loose connections in the ignition primary, ignition secondary, or solenoid valve circuits and correct as required. Reset the control and restart after correcting the problem. Contact an Onan Dealer or Distributor for service if none of the above.
<p>*7. Engine runs and then shuts down, OVERSPEED lamp lights.</p>	<p>7. Indicates engine has exceeded normal operating speed. Contact an Onan Dealer or Distributor for service.</p>
<p>8. SWITCH OFF lamp flashes.</p>	<p>8. Indicates Start/Stop/Remote switch is in the Stop position which will prevent automatic starting if an automatic transfer switch is used. Move the Start/Stop/Remote switch to the Remote position for automatic starting.</p>
<p>9. LO ENG TEMP lamp lights. Set is in standby mode but is not operating. (Lamp lights when engine water jacket temperature is 70°F (21°C) or lower. Since the lamp goes out after the engine warms up, there should be no cause for alarm even during initial generator set operation.</p>	<p>9. Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions:</p> <ol style="list-style-type: none"> Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. Contact an Onan Dealer or Distributor if none of the above.
<p>10. The FAULT 1 or FAULT 2 fault lamp lights. Engine shuts down immediately, engine runs for several seconds and then shuts down, or engine continues to run.</p>	<p>10. The standard undesigned fault functions are programmed to shutdown the set when a fault is sensed. Fault 1 is timed delay while Fault 2 is immediate. The nature of the fault is an optional selection that is determined when the set installation is designed. The undesigned fault functions may also be programmed for non-shutdown or non time delay.</p>
<p>*11. Fault lamp lights but no fault exists, Engine gauges show oil pressure, engine temperature, and frequency (speed) are within normal limits.</p>	<p>11. Reset control. If control will not reset, the monitor board or a sensor may be at fault. Contact an Onan Dealer or Distributor for service.</p>

*Use these steps when troubleshooting two light control panels.

Run Lamp - See steps 1 and 15.

Fault Lamp - See steps 3,5,6,7 and 11.

Other Faults - See steps 12, 13 and 14.

TABLE 1. TROUBLESHOOTING (Continued)

SYMPTOM	CORRECTIVE ACTION
*12. Engine Starts from generator control panel but will not automatically or from a remote panel (Note: The Start/Stop/Remote switch must be in the Remote position for automatic or remote starting).	12. Remote circuit breaker is tripped. Reset breaker and restart. Contact an Onan Dealer or Distributor if breaker trips after resetting.
*13. Engine will not crank.	13. Indicates possible fault with control or starting system. Check for the following conditions: a. Fault lamp on. Correct fault and reset control. b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c. Discharged or defective battery. Recharge or replace the battery. d. Contact an Onan Dealer or Distributor for assistance if none of the above.
*14. No AC output voltage.	14. Field breaker is tripped. Reset breaker. Contact an Onan Dealer or Distributor if voltage build up causes breaker to trip.
*15. Green RUN lamp does not light following engine start-up.	15. Indicates possible Start/Disconnect relay failure. Contact an Onan Dealer or Distributor for assistance.

*Use these steps when troubleshooting two light control panels.

Run Lamp - See steps 1 and 15.

Fault Lamp - See steps 3,5,6,7 and 11.

Other Faults - See steps 12,13, and 14.

NOTE: LO FUEL LAMP not applicable on natural gas units.

Maintenance

Establish and follow a definite schedule for maintenance and service based on the application and severity of the environment. The table below covers the recommended service intervals for a generator set on STANDBY service. If the set will be subjected to extreme operating conditions, the service intervals should be reduced accordingly. Some of the factors that can affect the maintenance schedule are the following:

- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand

Consult with an authorized Onan Distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated or after the number of operating hours indicated, whichever comes first. Use the table to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

⚠ WARNING *Accidental starting of the set while performing maintenance procedures can cause serious personal injury or death. Place the Run-Stop-Remote switch in the STOP position and disconnect the negative (-) battery cable from the battery terminal before beginning maintenance procedures.*

PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS				
	10	100	200	300	400
Inspect Complete Set for Leaks, etc.	x1				
Check Engine Oil Level	x1				
Check Radiator Coolant Level	x1				
Check Air Cleaner (Clean or Replace as Necessary)		x2			
Check Electrolyte Level of Battery		x6			
Lubricate Governor Linkage		x2			
Change Engine Oil & Filter		x2			
Check all Hardware, Fittings, Clamps, Fasteners, etc.		x4			
Adjust Drive Belt Tension			x3		
Check Starter			x5		
Clean & Inspect Battery Charging (DC) Alternator			x		
Check AC Generator			x		
Check Governor Frequency Setting				x	
Adjust Valve Clearances					x

- x1 - As noted or after every run.
 x2 - Perform more often in extremely dusty conditions.
 x3 - Adjust to 1/2-inch (12.5 mm) depression between pulleys.
 x4 - Or every 3 months.
 x5 - Oil front bearing sparingly; check brushes.
 x6 - Or every two weeks.

NOTE: The above schedule is a minimum requirement.

GENERATOR SET INSPECTION

During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover several areas that should be frequently inspected to ensure continued safe operation.

Engine Gauges

Check the following while the generator set is operating.

Oil Pressure Gauge: The oil pressure should be in the range of 40-65 psi (265-448 kPa) when the engine is at operating temperature.

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

DC Ammeter: The maximum charge rate for the set mounted battery charging alternator is 35 amperes. Charge rate should taper to zero following start-up as battery becomes charged.

AC Meters (If Equipped)

Check the following while the generator set is operating.

Frequency Meter: The generator frequency should be stable and the reading should be the same as the nameplate rating (50 or 60 Hertz).

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

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

Engine Monitor Indicator Lights

Hold the Reset/Lamp Test switch in the Test position. All indicator lamps (except Run) should light. Verify that all of the bulbs are on and then release the switch. Contact an Onan Distributor if any bulbs require replacement.

Exhaust System

With the generator set operating, inspect the entire exhaust system including the exhaust manifold turbo-charger, muffler, and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets, and joints and also make sure that exhaust pipes are not heating surrounding areas excessively. If any leaks are detected, have them corrected immediately.

⚠ WARNING

Inhalation of exhaust gases can result in serious personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Repair any leaks immediately.

Fuel System

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

⚠ WARNING

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

DC Electrical System

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

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.

Mechanical

With the generator set stopped, check for loose belts and fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately. With the set running, listen for any unusual noises that may indicate mechanical problems and check the oil pressure frequently. Investigate anything that indicates possible mechanical problems.

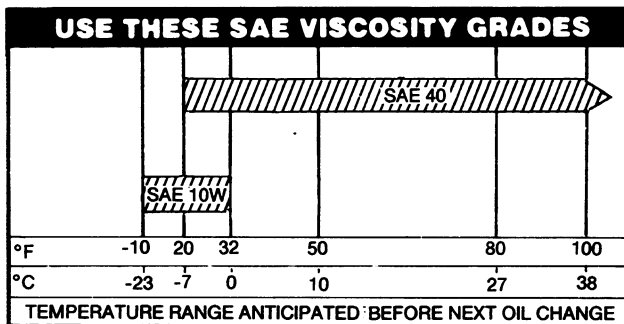
LUBRICATION SYSTEM

The engine oil was drained from the crankcase prior to shipment. Before the initial start, the lubrication system must be filled with oil of the recommended classification and viscosity. Refer to the Specifications section for the lubricating oil capacity.

Oil Recommendations

Refer to Figure 4 for the recommended oil viscosity grades at various ambient temperatures. Oils must conform to the American Petroleum Institute (API) classification SF or SF/CC. Lubricants that do not have both an SAE viscosity grade and an API service classification should not be used.

When selecting the oil viscosity, pick the grade that is right for the **LOWEST** temperature expected. Oil that is too thick may result in a lack of lubrication when the engine is started. Use a lower grade of oil as the ambient temperature reaches the lower end of the scale.



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FIGURE 4. OIL VISCOSITY GRADES

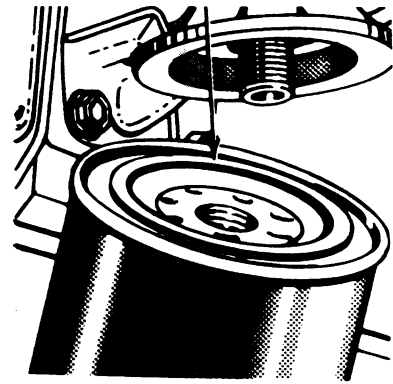
Engine Oil Level

Check the engine oil level during engine shut-down periods at the intervals specified in the Maintenance Table. The dipstick is stamped with FULL and ADD to indicate the level of oil in the crankcase. For accurate readings, shut off the engine and wait approximately 10 minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.

Keep the oil level as near as possible to the FULL mark on the dipstick. Remove the oil fill cap and add oil of the same quality and brand when necessary.

CAUTION Do not operate the engine with the oil level below the ADD mark or above the FULL mark. Overfilling can cause foaming or aeration of the oil while operation below the ADD mark might cause loss of oil pressure.

COAT GASKET WITH ENGINE OIL



LS-1169

FIGURE 5. ENGINE OIL FILTER

Oil and Filter Change

Change the oil and filter at the intervals recommended in the maintenance table. Use oil that meets the API classification and viscosity requirements as indicated in the previous section.

Engine Oil Change: Run engine until thoroughly warm before draining oil. Stop the engine, place a pan under the drain outlet and remove the oil drain plug or open the drain valve. After the oil is completely drained, replace the drain plug or close the drain valve. Refill with oil of the correct API classification and appropriate SAE viscosity grade for the temperature conditions.

WARNING Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.

Oil Filter Change: Spin off oil filter and discard it. Thoroughly clean filter mounting surface. Apply a thin film of oil to filter gasket and install new element. Spin element on by hand until gasket just touches mounting pad and then turn an additional 3/4 to 1 turn. Do not overtighten (Figure 4).

With oil in crankcase, start engine and check for leaks around filter element. Retighten only as much as necessary to eliminate leaks, but do not overtighten.

COOLING SYSTEM

The cooling system on each set is drained prior to shipping and must be refilled before being operated. The cooling system capacity of the standard unit with set mounted radiator is shown in the Specifications section.

Coolant Requirements

A satisfactory engine coolant inhibits corrosion and if necessary protects against freezing. In warm weather climates where there is no danger of freezing, use a mixture of rust inhibitor and water as the coolant. In cold weather, use a 50/50 mixture of water and antifreeze. If temperatures below -37°F (-38°C) are possible, use a mixture of 65% antifreeze and 35% water.

The water used for engine coolant should be clean, low in mineral content, and free of any corrosive chemicals such as chloride, sulphate, or acid. Use soft water whenever available. Well water often contains lime and other minerals which eventually may clog the radiator core and reduce the cooling efficiency.

Filling the Cooling System

Verify that all drain cocks are closed and all hose clamps secure. Remove the cooling system pressure cap and slowly fill the cooling system with the recommended coolant.

▲CAUTION *Never pour hot water into a cold engine or cold water into a hot engine. Doing so can crack the head or the cylinder block. Do not operate the unit without water for even a few minutes.*

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

Coolant Level

Check the coolant level during the shutdown periods at the intervals specified in the Maintenance Table. Remove the radiator cap after allowing the engine to cool and if necessary, add coolant until the level is near the top of the radiator.

▲WARNING *The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury from the hot coolant. Remove the radiator pressure cap slowly after the engine has cooled.*

▲CAUTION

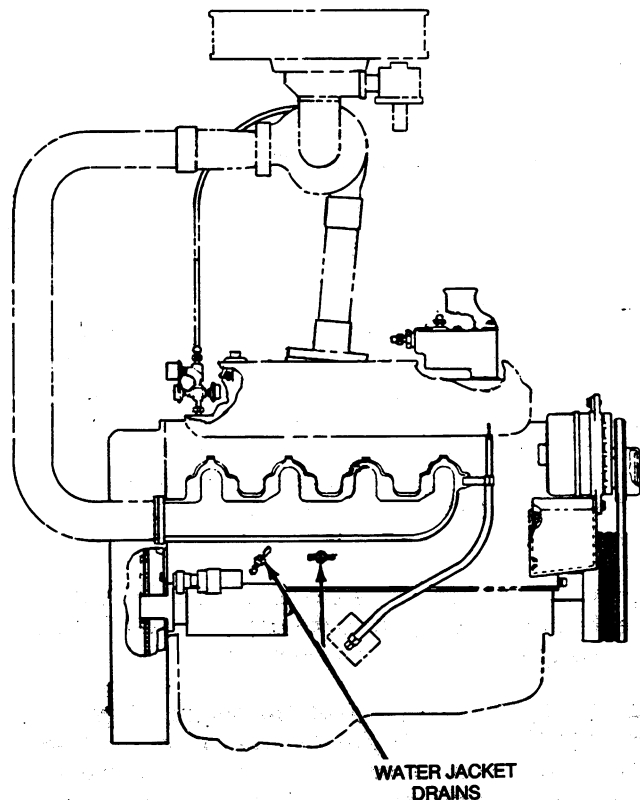
High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. Maintain adequate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

Draining and Flushing

To maintain adequate corrosion protection and remove rust and scale deposits, drain and flush the cooling system at the recommended interval. Allow the engine to cool and then remove the radiator filler cap. Open the radiator drain cock and remove the water jacket plugs (one on each side of engine). When the coolant is drained, place the end of a water hose into the filler opening and turn on water supply. Regulate the flow of water into the radiator until it is equal to the outflow. Continue flushing until outflow from drain openings is clear of rust sediment.

If engine is equipped with water jacket heater, drain coolant by opening valve on bottom of heater.

Replace the water jacket plugs and close the radiator drain cock when flushing is complete. Refill the cooling system with the recommended coolant.



CS-1321

FIGURE 6. WATER JACKET DRAIN

FUEL SYSTEM

Air Cleaner

The air cleaner requires service or replacement any time the restriction indicator is tripped. When the red piston appears in the transparent part of this indicator, the element is clogged and should be serviced as soon as possible. See Figure 7.

Remove the air cleaner wing nut and lift off the air cleaner cover and filter element (see Figure 7). Use low pressure air (30 PSI/207 kPa) to remove embedded dirt from the filter element. Hold the hose nozzle at least 2 inches away from the element and direct the air to blow through the filter from the inside.

CAUTION *Do not clean the filter element by immersing it in a cleaning solution or the element might be damaged.*

After the filter element has been cleaned, shine a light through the inside of the element and inspect for holes or tears. Replace element if damaged.

Wipe away any dirt that may have accumulated on the inside of the air cleaner cover or on the base. Install the air cleaner filter element and cover and tighten wing nut.

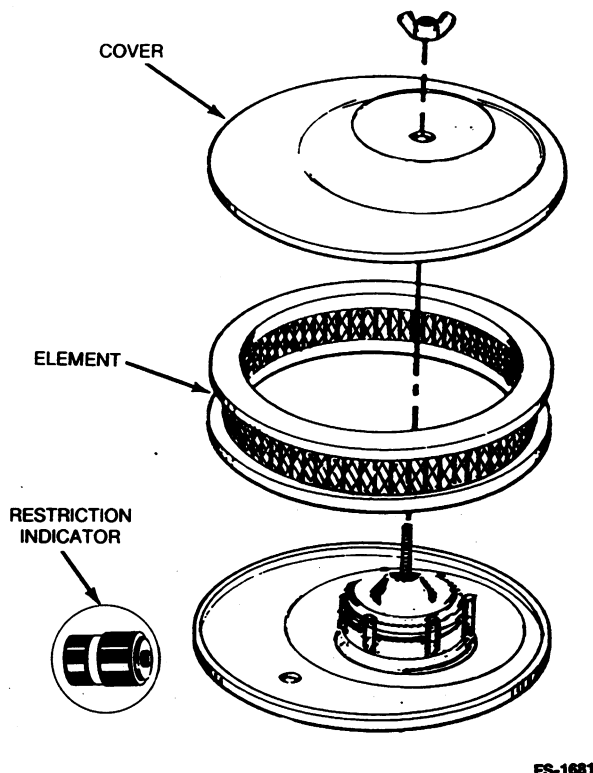


FIGURE 7. AIR CLEANER AND RESTRICTION INDICATOR

IGNITION SYSTEM

The ignition system consists of the distributor, ignition coil, high tension wires, spark plugs, and electronic control module. Maintenance consists of periodic inspections to detect possible problems and replacement of worn or deteriorated parts. The ignition system must be completely functional or the set may run poorly or be unable to carry full load. Perform the following inspections at the recommended intervals.

Distributor Cap

Remove the distributor cap and inspect the inside for cracks, burn marks, deterioration of the carbon center button, or eroded terminals. Replace the cap if any of these conditions are noted. Light scaling on the terminals may be cleaned with a knife blade.

If the cap is greasy, dirty, or coated with a powder-like substance, wash the cap using warm water and mild detergent. Scrub with a soft brush, rinse clean, and then dry thoroughly with a soft cloth.

Rotor

While the distributor cap is removed, inspect the rotor for cracks, excessive burning of the tip, deterioration of the center spring terminal. Replace the rotor if any of these conditions are noted. Light scaling on the rotor tip can be removed with a knife blade.

CAUTION *The rotor can be damaged if dropped or handled roughly. Use care to avoid bending rotor blades while inspecting rotor*

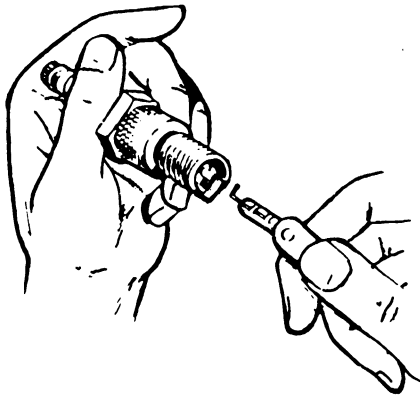
Remove the rotor and scrape the inside surface of the rotor ground strap. This will ensure the shutter blades are well grounded to the distributor shaft.

Spark Plugs

Remove the spark plugs and inspect for cracked or damaged insulators, worn electrodes, damaged gaskets, or excessive carbon deposits. Replace the spark plug if any of these conditions are noted. Clean those plugs that can be reused and regap (See Figure 8) to the amount specified in the Specifications section. Clean all dirt and grit away from the spark plug seats before installing plugs. Tighten to 20 ft-lbs (27 N•m) torque.

If the spark plugs show any of the following conditions, the engine may require additional service. Contact an authorized Onan Distributor for assistance.

- Black Carbon Fouled - Overly rich fuel mixture
- Oil Fouled - High oil consumption
- Burned or Overheated - Excessive combustion chamber temperature



ES-1374

FIGURE 8. GAPPING SPARK PLUGS

High Tension Wires

Check the spark plug wires and coil wire for good contact at the coil, distributor cap, and spark plugs. Terminal connections should be tight and fully seated. All spark plug covers and cable end boots should be in good condition and fit tightly. There should be no breaks or cracks in the insulation. Replace the wire if any of these conditions are noted.

⚠CAUTION

High tension wires can be damaged if removed incorrectly from terminals.

Grasp wire by spark plug cover or boot to prevent damage to conductor.

Ignition Coil

Clean the top of the ignition coil and check for cracks, carbon tracks, or corrosion in the high tension terminal hole. Replace the coil if any of these conditions are noted.

BATTERY

Check the condition of the starting battery at the interval specified in the Periodic Maintenance Schedule. Always disconnect the negative ground strap from the battery before working on any part of the electrical system or the engine. Disregard the sections on Checking Specific Gravity and Checking Electrolyte Level if using a maintenance-free type battery.

⚠WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.

Cleaning Batteries

Keep the batteries clean by wiping them with a damp cloth whenever dirt appears excessive.

If corrosion is present around the terminal connections remove battery cables and wash the terminals with an ammonia solution or a solution consisting of 1/4 pound of baking soda added to 1 quart (.95 L) of water.

Be sure the vent plugs are tight to prevent cleaning solution from entering the cells. After cleaning, flush the outside of the battery and surrounding areas with clean water.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or non-conductive grease to retard corrosion.

Checking Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. Hold the hydrometer vertical and take the reading. Correct the reading by adding four gravity points (0.004) for every five degrees the electrolyte temperature is above 80°F (27°C) or subtracting four gravity points for every five degrees below 80°F (27°C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if the reading is below 1.215.

Checking Electrolyte Level

Check the level of the electrolyte (acid and water solution) in the batteries at least every 100 hours of operation.

Fill the battery cells to the bottom of the filler neck. If cells are low on water, add distilled water and recharge. If one cell is low, check case for leaks. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

⚠CAUTION

Do not add water in freezing weather unless the engine will run long enough (two to three hours) to assure a thorough mixing of water and electrolyte. Incomplete mixing may allow the electrolyte to freeze and cause battery 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.

Remove the generator output box cover and inspect the rotating rectifier assembly to make sure the diodes (see Figure 9) are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and result in failure. Blow out the assembly periodically with filtered low pressure air.

⚠CAUTION

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

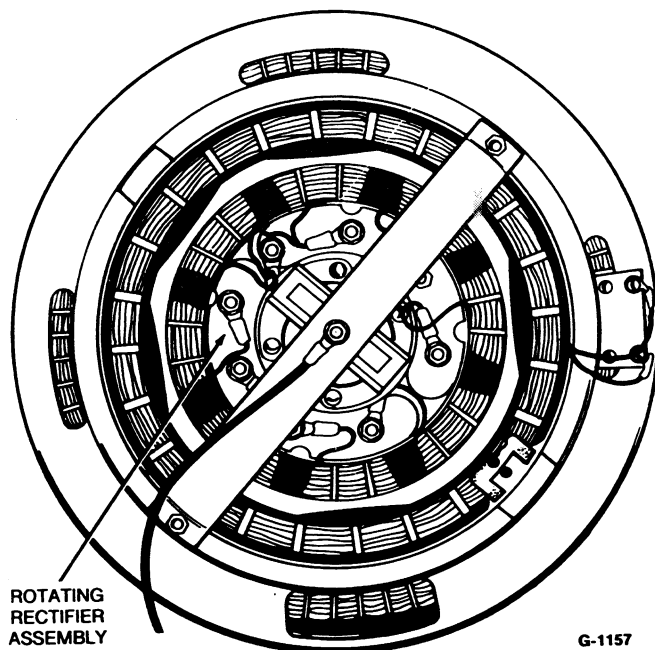


FIGURE 9. GENERATOR END VIEW

Generator Bearing

Inspect the generator bearing for signs of outer case rotation every 500 hours. Have the bearing replaced every five years. Deterioration of the bearing grease due to oxidation makes replacement necessary. If the generator requires major repair or servicing, contact an Onan Distributor for service.

OUT-OF-SERVICE PROTECTION

When the set is to be stored or removed from operation for an extended period of time, take the following precautions to prevent rust accumulation, corrosion of bearing and mating surfaces within the engine, and gum formation in the fuel system.

Preparing Set for Storage

1. Exercise the generator set as described in the OPERATION section until the engine is up to operating temperature.
2. Shut down engine.
3. Drain the engine oil while still warm and refill with rust preventative oil. Attach a warning tag indicating type of oil used.
4. Remove the spark plugs and pour two ounces of rust preventative oil into each spark plug opening. Crank the set for five seconds to distribute the oil on the cylinder walls and then replace the spark plugs.
5. Drain the cooling system including the engine block.

6. Remove the air cleaner and seal off the carburetor air inlet opening and PCV hose.
7. Plug the exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
8. Disconnect battery and store in a cool dry place. Connect battery to charger every 30 days to maintain it at full charge.
9. Clean and wipe entire unit. Coat parts susceptible to rust with a light coat of grease or oil.
10. Provide a suitable cover for the entire set after set has cooled down.
11. If set is stored for several months, repeat step 4 every three months using one ounce of rust preventive oil for each cylinder.

Returning Set to Service

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Remove seal from carburetor and PCV hose and replace air cleaner.
3. Drain the rust preventive oil from the crankcase and fill with oil of the recommended API classification and viscosity.
4. Refill the cooling system with the recommended coolant.
5. Clean and check battery. Measure specific gravity (1.260 at 80°F/27°C) 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

Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.

6. Connect starting battery (ground terminal last).
7. Remove all loads before starting the engine.
8. After start, apply load to at least 50 percent of rated capacity.
9. Check all gauges for normal readings. Set is ready for service.

Adjustments

GOVERNOR ADJUSTMENT

The governor used on the ENTX is electronically controlled and factory set. If replacing any parts it will be necessary to readjust as follows:

1. Set speed by adjusting speed pot clockwise to increase speed.
2. Adjust the GAIN pot by turning it up (clockwise) until the engine starts to hunt. (It may be necessary to push linkage off speed to get it to hunt). Then back off (counterclockwise) until the engine speed is once again stable.
3. Adjust the "D" pot the same as (2) above.
4. Adjust the "I" pot by pushing the actuator arm to its minimum position and holding it there until the engine slows. Release arm and watch the frequency meter for overshoot above rated speed. Turn the "I" pot down (counterclockwise) a small amount to decrease overshoot. A small amount of overshoot is acceptable.
5. Apply 1/4 load and adjust GAIN pot as in step 2 again. From no load, apply full load and make sure the set will carry it. If set will not accept full load, stop the set and lengthen link, by half turns, until it will. Check at different loads for stability.
6. Stop set and wait for 30 seconds to allow turbo-charger to coast down. Start set and check for overshoot of engine speed. If set shuts down on over-speed, check for binding linkage, repair and repeat step. Tighten all jam nuts and set screws. Replace any seals removed.

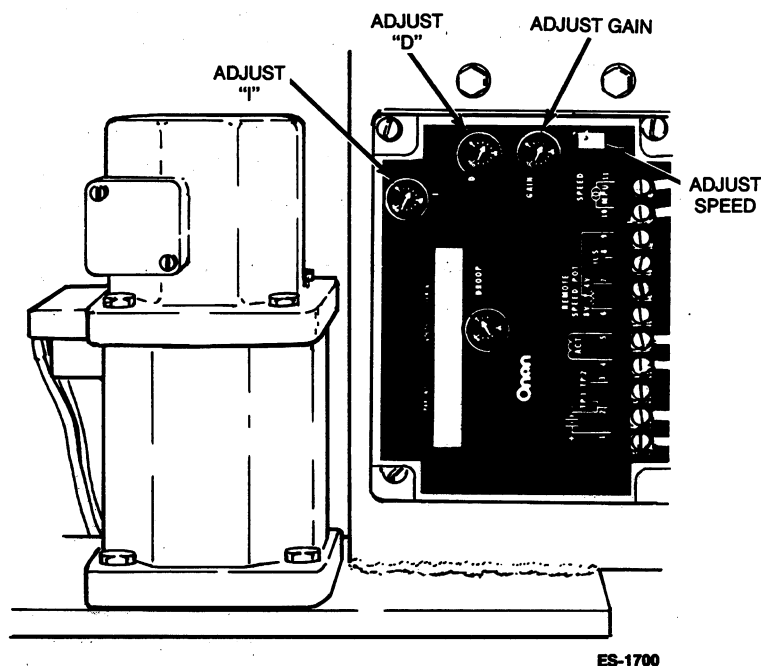


FIGURE 10. GOVERNOR CONTROL ADJUSTMENTS

NATURAL GAS CARBURETOR

The carburetor is factory set and sealed. No adjustments are required or recommended.

DRIVE BELT ADJUSTMENT

Separate belts are used to drive the fan and alternator (Figure 11). Maintain correct adjustment of these belts to provide proper engine cooling and alternator output. Check belts for cracks and wear occasionally, and replace when necessary.

To adjust fan belt, loosen fan bracket screws, then move bracket up or down until a deflection of 1/2 inch (13 mm) is obtained between crankshaft pulley and fan pulley, with light thumb pressure on the belt.

To adjust alternator belt, loosen link clamp screw and the mounting bolts, move alternator toward or away from engine until a deflection of 1/2 inch (13 mm) is obtained between pulleys, with light thumb pressure on belt.

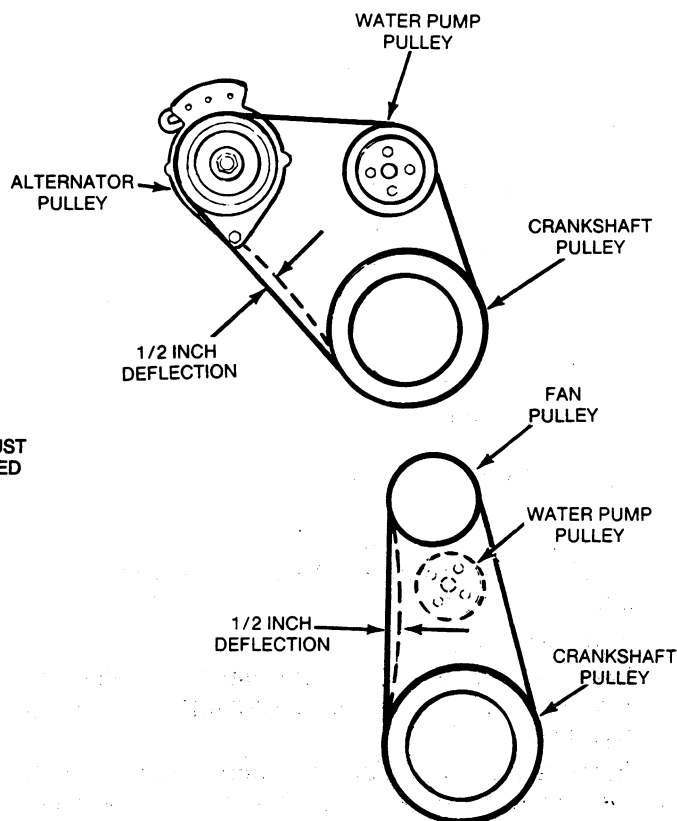


FIGURE 11. DRIVE BELT ADJUSTMENT



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