

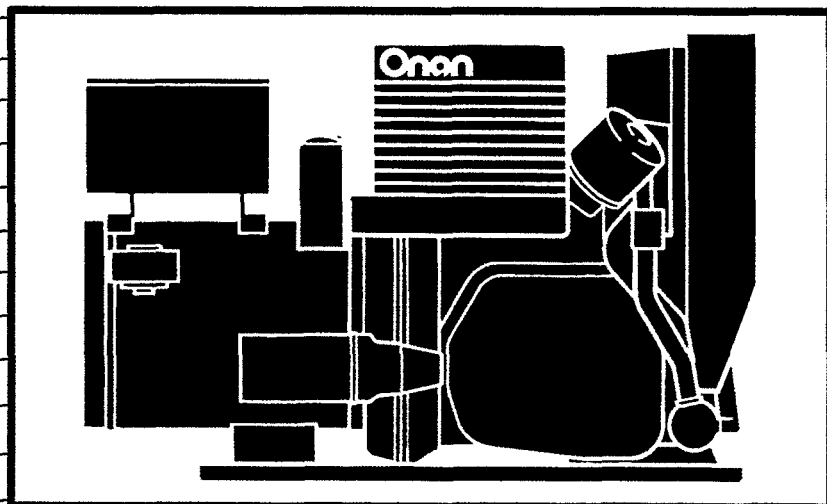
**Onan**

**MARINE**

**Operator's Manual**

**MCE**

**Ensign Series 4500/6500**



# Safety Precautions

---

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

Throughout this manual you will notice symbols which alert you to potentially dangerous conditions to the operator, service personnel, or the equipment itself.

**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, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC.** Fire, explosion, and personal injury can result from improper practices.

- 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.
- Do not fill fuel tanks with the engine running. Do not smoke around the generator set area. Wipe up any oil or gas spills. Do not leave oily rags in engine compartment or on the generator set. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip the engine fuel supply with a positive fuel shutoff.
- Always disconnect the battery ground (–) lead first and reconnect it last. Make sure you connect the battery correctly. A direct short across the battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is very explosive.
- Keep a fire extinguisher available in or near the engine compartment and in other areas throughout the vessel. Use the correct extinguisher for the area. For most types of fires, an extinguisher rated ABC by the NFPA is available and suitable for use on all types of fires except alcohol.

## EXHAUST GASES ARE DEADLY

- Provide adequate ventilation. Equip the bilge with a power

exhauster.

- Be sure propulsion and generator set engine exhaust systems are free of leaks. Perform thorough, periodic inspections of the exhaust system and repair leaks immediately. Exhaust gases are deadly.
- Never sleep in the vessel with the generator set running unless the vessel is equipped with an operating carbon monoxide detector.

## 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.

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any belt guards or covers with the generator set running.
- Keep hands and loose clothing away from moving parts. Do not wear jewelry while servicing any part of the generator set.
- Never step on the generator set (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.
- Before performing any maintenance on the generator set, disconnect its batteries to prevent accidental starting. do not disconnect or connect battery cables if fuel vapors are present. Ventilate the generator set compartment or bilge thoroughly with the power exhauster.

## ELECTRICAL SHOCK WILL CAUSE SEVERE PERSONAL INJURY OR DEATH



- Do not make adjustments in the control panel or on 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 standing on dry surfaces to reduce shock hazard.
- DO NOT CONNECT THE GENERATOR SET TO THE PUBLIC UTILITY OR TO ANY OTHER ELECTRICAL POWER SYSTEM. Electrocution or damage to property can occur at a site remote from the boat where line or equipment repairs are being made if the set is connected to the power system. An approved transfer switch must be used if more than one power source is to be made available to service the boat.
- 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. M8

Copy and post these suggestions in potential hazard areas of the vessel.

# Table of Contents

---

SECTION	TITLE	PAGE
	<b>SAFETY PRECAUTIONS</b> .....	Inside Front Cover
1	<b>INTRODUCTION</b> .....	1-1
	About this Manual .....	1-1
	How to Obtain Service .....	1-1
2	<b>SPECIFICATIONS</b> .....	2-1
	Generator Details .....	2-1
	Engine Details .....	2-1
3	<b>OPERATION</b> .....	3-1
	General .....	3-1
	Pre-Start Checks .....	3-1
	Control Panel .....	3-1
	Starting .....	3-2
	Stopping .....	3-2
	Operating Recommendations .....	3-3
	Troubleshooting .....	3-3
4	<b>MAINTENANCE</b> .....	4-1
	General .....	4-1
	Periodic Maintenance Schedule .....	4-1
	Set Inspection .....	4-2
	Lubrication System .....	4-2
	Cooling System .....	4-4
	Spark Plugs .....	4-5
	Battery .....	4-6
	AC Generator .....	4-7
	Out-of-Service Protection .....	4-7

 **WARNING:**   
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.



# Section 1. Introduction

## ABOUT THIS MANUAL

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

## HOW TO OBTAIN SERVICE

When the generator set requires service, contact an Onan Distributor or service center for assistance. Onan factory trained parts and service representatives are ready to handle your service needs.

When calling for service or parts, always supply the complete Model and Serial number as shown on the Onan nameplate, Figure 1-1. The nameplate is on the side of the DC control box.

<b>Onan</b>		
Model and Spec No.		
Serial No.		
<b>Important!</b> Always give above no.'s when ordering parts		
AC Volts	Ph	
KVA	kW	
PF	Amps	Hz
DCV	Amps	Watts
RPM	Bat.	
Time Rating		
Insulation-NEMA Class	F	For Electrical Equipment Only
Amb 40° C		
Onan Corporation 1400 73rd Avenue N.E. Minneapolis Minnesota 55432 U.S.A.		
Made in U.S.A.		99 0444

FIGURE 1-1. ONAN NAMEPLATE

### ⚠ 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.**

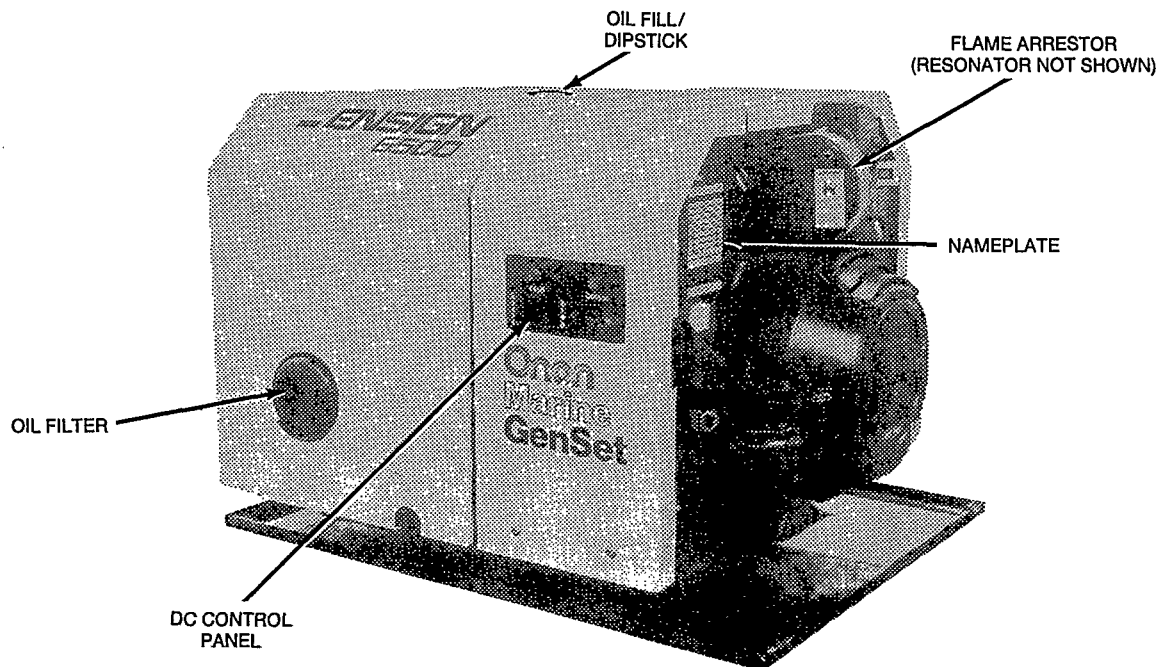


FIGURE 1-2. ONAN ENSIGN MARINE GENERATOR SET (HOUSED VERSION SHOWN)



# Section 2. Specifications

---

## GENERATOR

Type .....	Onan® YK, Revolving Field, 4-Pole
Standby Ratings	
60 Hertz, 6.5 MCE .....	6.5 kW, (6.5 kVA @ 1.0 PF)
60 Hertz, 4.5 MCE .....	4.5 kW, (4.5 kVA @ 1.0 PF)
50 Hertz, 5.0 MCE .....	5.0 kW, (5.0 kVA @ 1.0 PF)
Frequency Regulation .....	5% (3 hertz)
Voltage Regulation .....	±5%

## ENGINE

Engine Type .....	Onan® MCE, 2-cylinder opposed
Engine Speed (r/min) .....	1800/1500
Fuel .....	Gasoline, Unleaded 88 octane
Fuel Consumption, Average @ Full Load:	
60 Hertz, 6.5 MCE .....	1.3 gph (5.0 Lph)
60 Hertz, 4.5 MCE .....	1.0 gph (3.4 Lph)
50 Hertz, 5.0 MCE .....	1.1 gph (4.2 Lph)
Battery Requirements:	
Minimum Cold Cranking Amperes @ 0°F (-18°C) .....	360
Voltage .....	12
Battery Charge Circuit Maximum Output .....	10 amperes, regulated
Cooling System Capacity, Including Heat Exchanger .....	3 quarts (2.8 L)
Oil Capacity with Filter .....	3 quarts (2.8 L)
Spark Plug Gap .....	0.025 in. (0.64 mm)
Spark Plug Torque Spec .....	11 Ft/Lbs (15 N•m)





# Section 3. Operation

---

## **▲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.**

**Never sleep in the vessel with the generator set running unless the vessel interior is equipped with an operating carbon monoxide detector. Protection against carbon monoxide inhalation also includes proper exhaust system installation and visual and audible inspection of the complete exhaust system at the start of each generator set operation.**

1-M

## **GENERAL**

This section covers starting and operation of the generator set. The operator should read through this entire section before operating the set. It is essential that the operator be completely familiar with the set to provide safe operation.

### **PRE-START CHECKS**

Before starting the generator set, be sure the following checks have been made and the unit is ready for operation. Refer to the *Maintenance* section for the proper service procedures when needed.

#### **Lubrication**

Check the engine oil level. Keep oil level near as possible to the dipstick full mark. Do not overfill.

#### **Coolant**

The engine coolant system must be full, and the level on the coolant recovery tank should be between the Full and Add marks. Add proper coolant if low.

#### **Fuel**

Make sure the fuel tanks are full and the service shut-off valve is open.

#### **Exhaust**

Make sure exhaust system components are tightly connected and not corroded.

#### **Sea Water Pump Priming**

Before beginning operation (initial start-up) the sea water pump should be primed. The priming water prevents dry operation of the neoprene impeller until sea (flotation) water is pulled into the pump.

To prime the pump, close the sea cock and remove the hose from the water strainer outlet. Fill the hose and pump with clean water. Replace the hose and open sea cock. Check for pump operation on start-up by observing water discharge from the hull exhaust outlet.

## **CONTROL PANEL**

The following describes the function and operation of components found on the control panel shown in Figure 3-1.

#### **Start-Stop Switch**

This switch starts and stops the generator set locally.

#### **Running Time Meter**

Registers total number of hours that the unit has run. Useful for determining need for periodic maintenance procedures. Time is cumulative and cannot be reset.

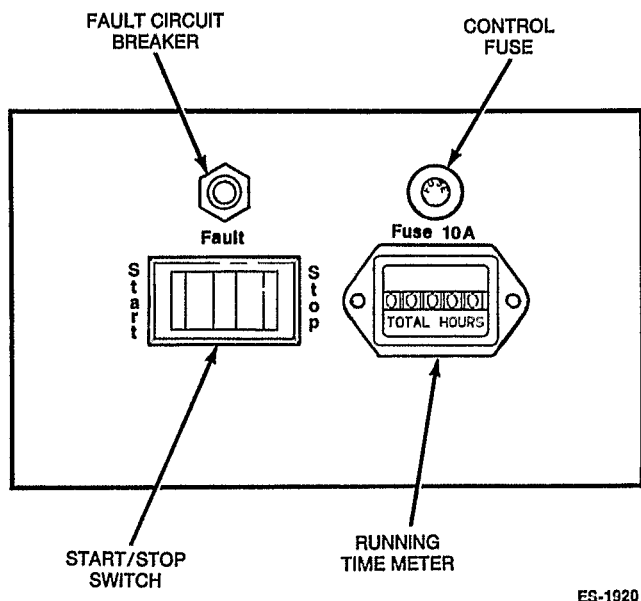


FIGURE 3-1. DC CONTROL PANEL

### Fault Breaker

This is a manual reset breaker that shuts down the engine for low oil pressure, high coolant temperature, and high exhaust temperature.

### Control Fuse

This is a 10 ampere fuse protecting the engine monitor board, remote control circuit (when used), and associated wiring.

## STARTING

This section covers starting of the generator set at the control panel and the remote panel (when used).

**⚠WARNING** Gasoline vapors can cause an explosion and fire resulting in severe personal injury or death. Before starting the generator set, operate the bilge blower for a minimum of 4 minutes. If fuel fumes are present, locate the source and correct prior to generator set operation.

### Starting at the Control Panel

Use the following steps for starting at the generator set control panel

1. Operate the bilge blowers for a minimum of four minutes prior to starting.
2. Holding the Start/Stop switch in the Start position activates the engine control and starting system. The starter will crank and after a few seconds the engine should start. The starter automatically disconnects when the generator AC voltage builds up.

3. If the engine does not start after cranking 30 seconds, release the start switch. Wait two minutes and then try starting again.
4. If the engine does not start on the second try, check the fuel supply and be sure the fuel valves are open.

**⚠CAUTION** Excessive cranking periods can overheat and damage the starter. Do not engage starter for periods longer than 30 seconds without allowing two minutes for the starter to cool.

**⚠CAUTION** When a marine hydrodynamic muffler is used, excessive engine cranking without starting can fill the muffler with water and back this water into the combustion system causing engine damage. If prolonged cranking is necessary in excess of two to three minutes, check the exhaust system for excessive water and drain prior to repeated starting attempts.

### Starting at a Remote Location

The same procedure and cautions for starting at the control panel apply for remote starting. If a deluxe panel with meters is used, observe the meters for proper generator set operation as follows.

- **Oil Pressure Gauge:** The oil pressure should be in the range of 20 to 50 psi (138 to 345 kPa) when the engine is at operating temperature.
- **Coolant Temperature Gauge:** The coolant temperature should be in the range of 175° to 230° F (79° to 110° C) depending on the load and ambient temperature.
- **DC Voltmeter:** Normal battery voltage during operation should be 12.5 to 15 volts. Actual voltage depends on the battery state-of-charge and condition.

## 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.

**⚠CAUTION** Failure to allow running time for engine to cool without load can result in engine damage. Make sure generator set runs unloaded for at least three minutes.

### Stopping

Press the Stop position of the Start/Stop switch at either the remote station or generator set control panel.

## OPERATING RECOMMENDATIONS

### Break-In

Drain and replace the crankcase oil after the first 35 hours of operation on new generator sets. Refer to the *Maintenance* section of this manual for the recommended procedures.

### No-Load Operation

Before shutdown, run the generator set 3 to 5 minutes without load. However, avoid longer periods of no-load operation if possible. No-load operation allows combustion chamber temperatures to drop so low that the fuel does not burn completely. This results in carbon deposits which can cause piston rings and valves to stick.

### Exercise Period

Infrequent generator set use can result in hard starting. Exercise the generator set at least once a month for a minimum of 30 minutes. Run the set with load applied to allow the engine to reach normal operating temperature. Exercising will keep the engine parts lubricated and maintain fuel prime. Top off the fuel tank after each exercise period. Use a gasoline stabilizer if fuel in the tank will not be used entirely within two months. Your Onan dealer or distributor has a product available for this purpose.

## TROUBLESHOOTING

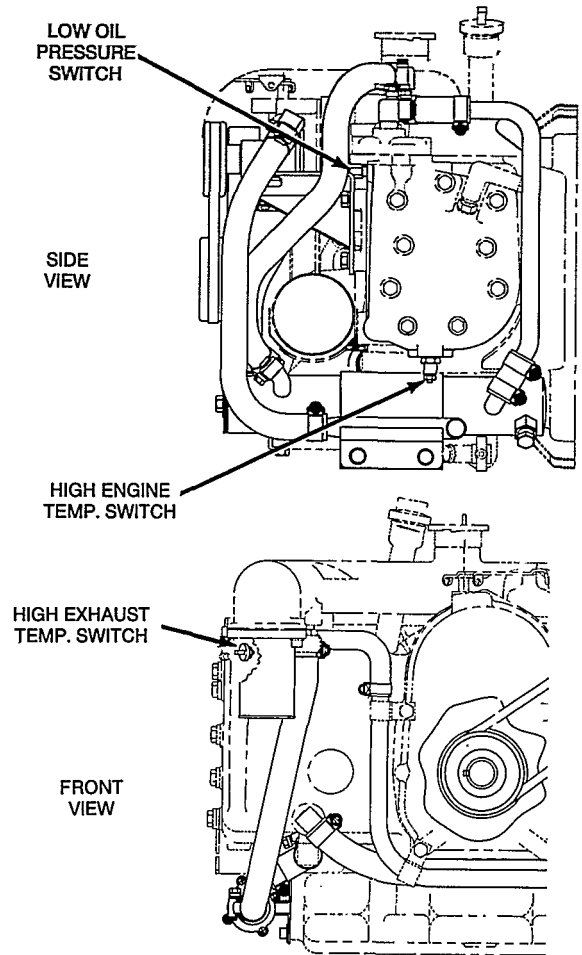
### DC Control

The engine has a number of sensors that continuously monitor it for abnormal conditions such as low oil pressure, high coolant temperature and high exhaust temperature. If any one of these conditions occur, the Fault reset breaker trips and stops the unit. See Figure 3-2.

The following sections describe operation of the fault systems and suggested items the operator can check. If a major problem is indicated, contact an Onan Dealer or Distributor for help or service.

The control panel Fault reset breaker will trip for any one of the fault conditions described separately below. The breaker button pops out about ¼ inch (6 mm) when a fault occurs. Locate the problem and make the necessary corrections before resetting breaker and starting the generator set. The high exhaust temperature and low oil pressure faults are delayed 5 seconds to avoid nuisance tripping.

**Low Oil Pressure:** Remove the dipstick and check the oil level. If low, add oil to bring level up to the Full mark. Do not overfill. Inspect engine exterior for leaks and repair as necessary. The oil pressure switch actuates the fault circuit if pressure drops below 9 psi (62 kPa).



M-1822

FIGURE 3-2. FAULT SENSOR LOCATION

**High Coolant Temperature:** Observe the coolant temperature gauge (deluxe remote panel option) for indication of temperature over 221° F (105° C). The coolant thermostat switch closes at this temperature ( $\pm 3\%$ ) and actuates the fault circuit.

Check coolant level in the recovery tank after allowing the engine to cool down. Ensure pump belt is okay and has proper tension; ensure the sea water flow at the exhaust outlet is about 3 gal/min (11 litre/min). Also check cooling system cleanliness (freedom from contaminants, rust, sludge build-up, etc.).

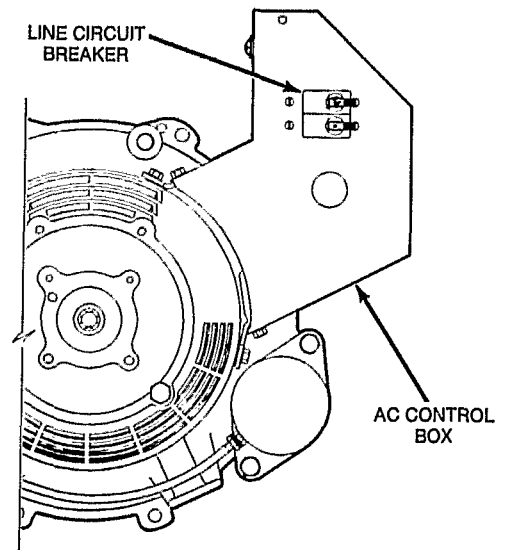
**High Exhaust Temperature:** The high exhaust temperature switch is mounted on the exhaust manifold and closes on temperature rise. It opens automatically when the generator set cools down.

High exhaust manifold temperature is caused by failure of the sea water cooling system. Sea water flow at the exhaust outlet should be about 3 gal/min (11 litre/min). Failure can be caused by a defective sea water pump, heat exchanger, drive belt, inlet strainer, or a closed sea water valve. Whenever a shutdown occurs, a thorough inspection of the complete exhaust system must be made by an experienced serviceperson.

**⚠WARNING** *Inhalation of exhaust gas can result in severe personal injury or death. Thoroughly inspect the exhaust system after a shutdown. Do not disconnect or bypass the exhaust manifold switch. Excessive heat can damage exhaust hoses and allow exhaust gas to escape.*

### AC Control

The AC line circuit breaker is mounted on the side of the AC control box as shown in Figure 3-3. Depending on the selected options, the breaker will be either single-pole or two-pole (shown). It is connected in series with the load and opens the load circuit if a short or overload occurs.



ES-1921

FIGURE 3-3. AC LINE CIRCUIT BREAKER

# Section 4. Maintenance

## GENERAL

Establish and adhere to a definite schedule for maintenance and service. If the generator set will be subjected to extreme operation conditions, the service intervals should be reduced accordingly. The authorized Onan Distributor or Service Facility will help determine a suitable schedule of maintenance if necessary.

Use the running time meter to keep a log of all service performed for warranty support. Perform service at the time period or after the number of operating hours shown, whichever comes first. Use the schedule to determine the maintenance required, then refer to the sections that follow for the correct service procedures.

**⚠WARNING** Leakage of fuel in or around the generator set compartment presents a hazard of fire or explosion that can cause severe personal injury or death. Do not disconnect battery cables if fuel vapors are present. Ventilate the compartment thoroughly with the bilge blowers or power exhausters.

**⚠WARNING** Accidental starting of the generator set can cause severe personal injury or death. Stop the generator set and disable by disconnecting the starting battery cables (negative [-] cable first) when maintenance or repairs are made to the engine, controls, or generator.

## PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	SERVICE TIME				
	DAILY OR AFTER 8 HOURS	MONTHLY OR AFTER 100 HOURS	6 MONTHS OR AFTER 250 HOURS	YEARLY OR AFTER 500 HOURS	PAGE
Inspect Set, Exhaust System	x <sup>1</sup>				4-2
Check Fuel System	x				4-2
Check Oil Level	x				4-3
Check Coolant Level	x				4-4
Check Battery		x			4-6
Change Crankcase Oil and Filter		x <sup>2,3</sup>			4-3
Check Drive Belt Tension			x <sup>4</sup>		4-5
Check Coolant/Anti-Freeze			x		4-4
Clean Generator Assembly			x		4-7
Inspect and Adjust Spark Plugs			x		4-5
Clean Carbon and Lead Deposits (cylinder head)			x <sup>5</sup>		4-3
Clean Cooling System				x	4-4
Replace Spark Plugs				x	4-5
Replace Fuel Filter				x	4-2

- <sup>1</sup> - Check for oil, fuel, cooling and exhaust system leaks. Check exhaust system audibly and visually with the set running and repair any leaks immediately.
- <sup>2</sup> - Perform after first 35 hours of operation.
- <sup>3</sup> - Perform more often if operation is in dusty conditions.
- <sup>4</sup> - Visually check belt for evidence of slippage.
- <sup>5</sup> - Have your Onan service center perform.

## 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 for continued safe operation.

### Engine Gauges (Remote Panel Option)

Check the following optional gauges while the generator set is operating.

**Oil Pressure Gauge:** The oil pressure should be in the range of 20 to 50 psi (138 to 345 kPa) when the engine is at operating temperature.

**Coolant Temperature Gauge:** The oil pressure should be in the range of 175° to 220° F (79° to 105° C) depending on the load and ambient temperature.

**DC Voltmeter:** Normal battery voltage during operation should be 12.5 to 15 volts. Voltage reading can change with battery condition and state-of-charge.

### Exhaust System

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, flexible hose, muffler and exhaust pipe. Check the sea water pump operation by observing sea water discharge from the exhaust outlet. It should be approximately 3 gal/min (11 litre/min). Visually and audibly check for leaks at all connections, welds, gaskets, and joints. If any leaks are detected, shut down the generator set and have them corrected immediately.

**▲WARNING** *Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Shut down the generator set and repair any leaks immediately.*

### Fuel System

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

**▲WARNING** *Fuel leakage will create a fire hazard which can result in severe personal injury or death if ignited. If any leaks are detected, have them corrected immediately.*

**▲WARNING** *Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, or other ignition source near the fuel system.*

**Fuel Filter:** Change the fuel filter at the interval recommended in the *Maintenance Schedule* or if performance problems occur and bad fuel is suspected. Shut off the fuel supply valve and allow the set to operate until it runs out of fuel. Allow the genset to cool down before replacing the fuel filter. Apply a thread sealant with teflon (Onan P. N. 518-0347) to connections, avoiding excess that can contaminate the fuel system. Tighten connections securely.

**▲WARNING** *Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, or other ignition source near the fuel system.*

**▲CAUTION** *Incorrect replacement of service parts can result in damage to equipment. Use genuine Onan replacement fuel filters only.*

**Fuel Requirements:** Use only good quality fuel obtained from a reputable supplier. The quality of the fuel used is important in obtaining dependable performance and satisfactory engine life. Use clean, fresh, unleaded gasoline. Using unleaded fuel results in reduced valve and carbon clean-out maintenance. Do not use leaded fuels or fuels containing alcohol additives.

**▲WARNING** *Fuel hose rupture can cause severe personal injury or death by fire or explosion. Alcohol additives in some fuel can permeate fuel hoses and cause swelling and deterioration. Check fuel hoses for deterioration and replace any defective hose immediately.*

### DC Electrical System

With the generator set off, check the battery terminals for clean and tight connections. Loose or corroded connections create resistance which can hinder starting. Clean and reconnect the battery cables if corroded or loose. Remove the negative (-) battery cable first and reconnect last. This prevents arcing if the tool accidentally touches the frame or other grounded metal parts while on the positive (+) battery terminal.

**▲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 a loose belt, fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately. Check the governor linkage for dust and dirt accumulation and clean if necessary. With the set running, listen for unusual noises that may indicate mechanical problems. Investigate anything that indicates a mechanical malfunction.

## Inspect and Clean Engine Combustion Chambers

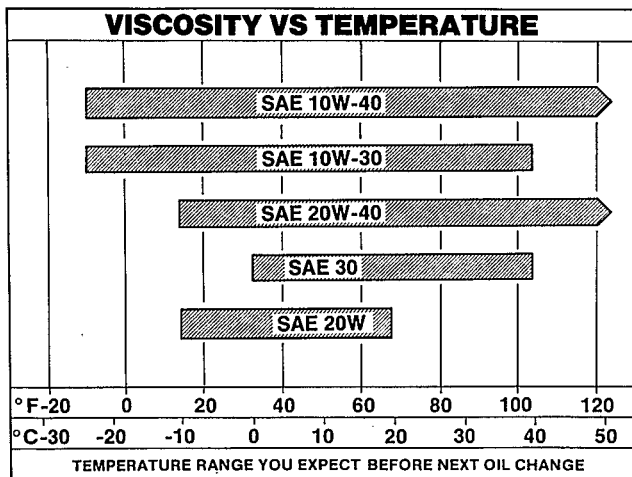
Have the engine combustion chamber inspected internally for carbon and lead deposits as recommended in the *Periodic Maintenance Schedule*. These deposits can cause preignition and knocking, impede engine performance, and shorten engine life. Because this procedure requires removing the cylinder heads, it must be performed by an Onan service representative, trained in genset maintenance and repair.

## 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. The engine lubricating oil capacity is 3 quarts (2.8 liters).

### Oil Recommendations

Use oils with the American Petroleum Institute (API) classification SG/CD in the viscosities per temperature as shown in the chart below.



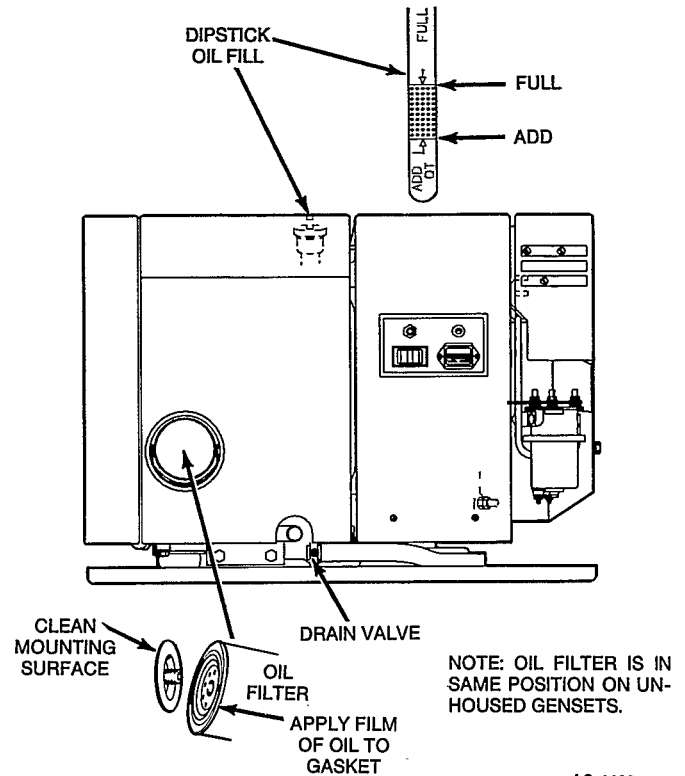
LS-1172-1

When selecting the oil viscosity, pick the viscosity 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 viscosity oil as the ambient temperature reaches the lower end of the scale.

Do not use synthetic oil or non-detergent oil; and do not mix different brands of oil.

### Engine Oil Level

Check the engine oil level during engine shut-down periods at the intervals specified in the *Periodic Maintenance Schedule*. The oil dipstick and oil fill are located on top of the engine (see Figure 4-1). The dipstick is marked with FULL and ADD 1 QT levels; the area between has a dot pattern. For accurate readings, shut off the engine and wait about 10 minutes before checking the level. This allows oil in the upper portion of the engine to drain back into the crankcase.



LS-1198

FIGURE 4-1. ENGINE OIL COMPONENTS

Keep the oil level within the dot pattern, preferably at the full mark. Add oil in the dipstick tube 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 can cause loss of oil pressure.

### Oil and Filter Change

Change the oil and filter at the intervals recommended in the *Periodic Maintenance Schedule*. Use oil that meets the API classification and viscosity requirements as shown in the Oil Recommendations section.

**Engine Oil Change:** Run the engine until thoroughly warm before draining the oil. Stop the engine, open the drain valve (Figure 4-1) and drain oil into a container. When completely drained, close the valve and refill crankcase with oil of the correct API classification and appropriate SAE viscosity.

**Oil Filter Change:** Spin off the oil filter and discard. Thoroughly clean filter mounting surface (Figure 4-1). Apply a thin film of clean oil to the filter gasket and spin filter on by hand until gasket just touches the mounting pad. Then turn an additional 1/2 turn. Do not overtighten.

With oil in the crankcase, start the engine and check for leaks around the filter gasket. Retighten only as much as necessary to eliminate leaks.

## COOLING SYSTEM

The cooling system is filled prior to shipping with a 50/50 solution of ethylene glycol and water. The generator set coolant level must be verified before operation. The cooling system capacity is 3 quarts (2.8 L).

### Coolant Requirements

A satisfactory engine coolant inhibits corrosion and protects against freezing. A 50/50 solution of ethylene glycol anti-freeze and water is recommended for normal operation and storage periods. Choose only a reliable brand of anti-freeze that contains a rust and corrosion inhibitor, but does not contain any stop-leak additives.

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

Do not exceed a 50/50 mixture of ethylene glycol and water. A higher content of ethylene glycol will alter the heat transfer properties of the coolant by lowering its efficiency.

### Filling the Cooling System

Verify that all drains are closed and all hose clamps secure. Remove the cooling system pressure cap and loosen the bleed valve on top of the right-side thermostat fitting (Figure 4-2). \*Slowly fill the cooling system with the recommended coolant until it starts running from the bleed valve. Tighten the bleed valve and continue to fill the system. Add coolant in the recovery tank to bring level to the full mark.

\*The cooling system must be filled slowly or air will be trapped and cause overheating. A suggested method: fill the coolant recovery tank, remove pressure cap, then hold coolant tank slightly above the genset to allow coolant to flow in slowly with the bleed valve open. This method takes a little longer, but the system will fill completely with minimum spillage.

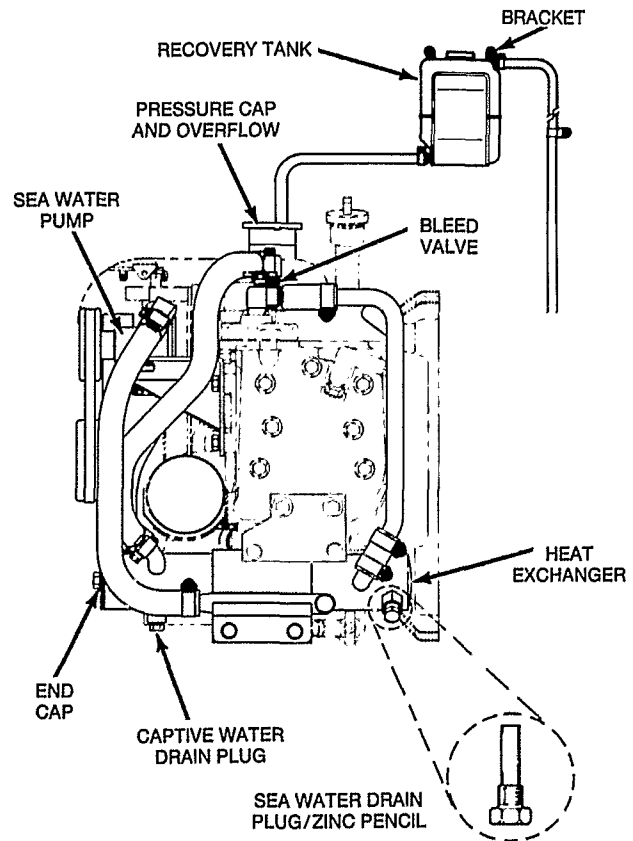
**CAUTION** *Trapped air in the cooling system can result in improper cooling. Be sure coolant is added slowly to allow air bleed.*

Start the engine and monitor the coolant level. As any trapped air is expelled from the system, the coolant level will drop and additional coolant should be added. Replace the pressure cap.

### Coolant Level

Check the coolant level in the recovery tank after allowing the engine to cool, and if necessary, add coolant until the level is at the full mark.

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



CS-1373

FIGURE 4-2. COOLING SYSTEM COMPONENTS

**CAUTION** *The engine coolant temperature switch will shut down the engine in an overheat condition only if the coolant level contacts the switch. Loss of coolant will allow the engine to overheat without protection of shutdown switch thereby causing severe damage to the engine. It is imperative that adequate engine coolant levels be maintained to provide operational integrity of the cooling system and engine coolant overheat protection.*

### Flushing and Cleaning

For efficient operation, the captive water cooling system should be drained, flushed, and refilled once a year.

**Draining:** Drain the system by removing the captive water drain plug on the heat exchanger. Remove the pressure cap and open the bleed valve to aid draining. Check the zinc pencil on the sea water drain plug at this time as described in this section.



**Flushing:** After cleaning or before filling the system with new coolant, drain the block and heat exchanger and fill with clean water. Operate the set for 10 minutes and then drain the system completely. Refill with the recommended coolant. Flush/clean the recovery tank and add coolant to the full mark.

**CAUTION** Adding cold coolant to a hot/warm engine can result in engine damage from sudden contraction of metals.

**Zinc Pencil:** The sea water side of the heat exchanger is protected from corrosion by a zinc pencil mounted on the sea water drain plug. See Figure 4-2. It should be inspected every two months and replaced if deteriorated to less than 1/2 inch (13 mm).

### Pressure Cap

Closed cooling systems make use of a pressure cap to increase the boiling point of the coolant and allow higher operating temperatures. See Figure 4-2. The pressure cap should be replaced every two years of operation. The cap is rated at 7 psi (48 kPa).

### Siphon Break

A siphon break is installed on generator sets if the exhaust injection elbow is at or below the load water line. When properly installed, it helps prevent sea water siphoning into the engine and compartment when the generator set is shut down.

The siphon break valve is normally trouble free. However, when used in contaminated waters or salt water for example, some corrosion may appear. The valve can be checked for free movement after unscrewing the top cover. If the valve sticks or the seat shows wear, the valve must be replaced.

### Pump Belt

Access to the belt is made by removing four screws from the belt guard. Before removing the belt guard, be sure the generator set is disabled by removing the battery cables. Do not operate the set without the belt guard in place.

**WARNING** Accidental starting of the generator set can cause severe personal injury or death. Stop the generator set and disable by disconnecting the starting battery cables (negative [-] cable first) when maintenance or repairs are made to the engine, controls, or generator.

Figure 4-5 shows the correct tension for the sea water pump belt. Remove the belt guard for belt inspection or replacement. A loose or defective belt can cause engine overheating and shutdown. Check the belt for excessive slickness, oil soak, wear, tear, cracks and overstretching. Replace if needed.

Tension is correct when the belt deflects 1/8 inch (3 mm) when a force of 7 pounds (3 kg) is exerted at midpoint between pulleys as shown. Tighten the pump adjustment capscrew when proper tension is obtained.

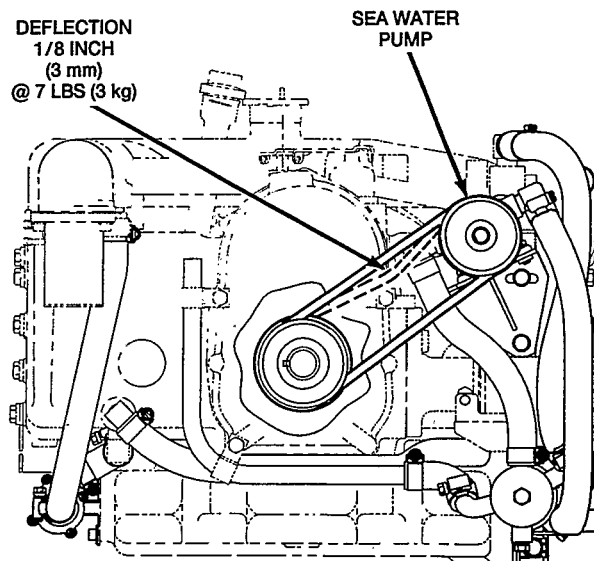


FIGURE 4-3. PUMP BELT ADJUSTMENT

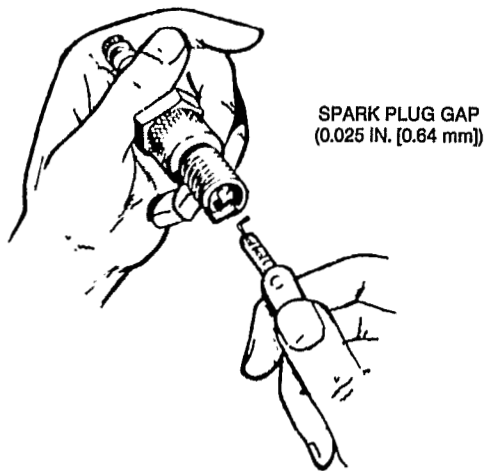
M-1823

### SPARK PLUGS

Remove and inspect/replace the spark plugs at the intervals recommended in the Periodic Maintenance Schedule. A careful examination of the plugs can often pin-point the source of an engine problem. The following covers some common spark plug conditions and the probable cause.

- **One Plug Carbon Fouled:** Check for an open ignition cable, or for low engine cylinder compression.
- **Black Soot Deposits:** Check for faulty choke operation, overly rich fuel mixture, or restricted air intake.
- **Oil Fouled:** Check for faulty crankcase breather hose, worn rings, or worn valve guides.
- **Burned or Overheated:** Check for a leaking intake manifold gasket, lean fuel mixture, or incorrect ignition timing. Be sure the plug has correct heat range.
- **Chipped Insulator:** Check for advanced timing. Bend the side electrode only when setting plug gap.
- **Splash Fouled:** Check for accumulated combustion chamber deposits.
- **Light Tan or Grey Deposits:** Normal plug color.

Spark plugs should be replaced at regular intervals. Replace plugs with the same type as listed in the Parts Manual. Check and adjust plug gap to 0.025 inch (0.64 mm). See Figure 4-4.



ES-1374

FIGURE 4-4. CHECKING PLUG GAP

**Installation:** A 13/16-inch hexagon spark plug socket is required to remove or install the plugs. Before removing the plugs, blow any dirt from the port area to prevent it getting into the combustion chambers.

Clean the plug contact surface on the head with a clean cloth before inserting the plug. Torque each spark plug to 11 foot pounds (15 N•m). Correct torque can be had only if the threads are clean.

## BATTERY

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

**▲WARNING** Leakage of fuel in or around the generator set compartment presents a hazard of fire or explosion that can cause severe personal injury or death. Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the compartment thoroughly with the bilge blowers or power exhausters.

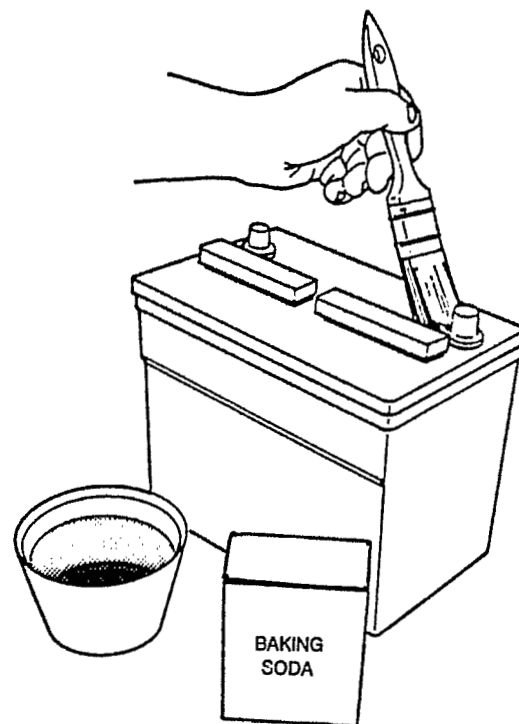
**▲WARNING** Ignition of explosive battery gases can cause severe personal injury. Do not smoke. Wear goggles and protective, rubber gloves and apron when servicing battery.

## Cleaning Battery

Keep the battery clean by wiping it with a damp cloth when dirt appears. 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 (about 100 grams) of baking soda added to 1 quart (about 1 litre) of water. See Figure 4-5.

Remove battery from the vessel for cleaning. Be sure the vent plugs are tight to prevent cleaning solution from entering battery cells. After cleaning, flush the outside of 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 silicon grease to retard corrosion.



ES-1675

FIGURE 4-5. CLEANING BATTERY

## Checking Specific Gravity

**▲WARNING** Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with battery.

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 below 80° F (27° C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if reading is below 1.215.

### Checking Electrolyte Level

Check the electrolyte level at least every 50 hours of operation. Fill the battery cells to the bottom of the filler neck. If one cell is low, check case for leaks or for a bad cell. Keep the battery case clean and dry. An accumulation of moisture will lead to 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 charge the battery and assure a thorough mixing of water and electrolyte.*

### AC GENERATOR

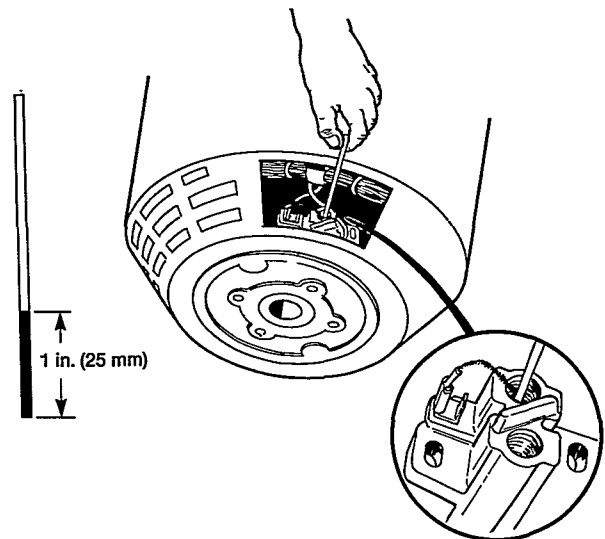
The generator should be inspected for brush wear and cleaning as required per the Periodic Maintenance Schedule. Be sure to disconnect the negative battery terminal to prevent starting of the generator set before proceeding.

**WARNING** *Accidental starting of the generator set can cause severe personal injury or death. Stop the generator set and disable by disconnecting the starting battery cables (negative [-] cable first) before inspecting the generator.*

Remove the brush block cover and inspect the brushes and brush holder for burn marks or other damage. If the brushes appear to be in good condition, use a piece of wire (modified with paint as shown in Figure 4-6) to check brush wear.

Insert the wire through the hole above each brush. Make sure the wire is resting of the brush and not on part of the spring. If the painted part of the wire is not visible, the brush is excessively worn and must be replaced. Refer service to the nearest Onan Authorized Service Center.

Inspect the slip rings for grooves, pits or other damage. They can be refinished as necessary by the service technician. If dust has accumulated on any generator components, they can be cleaned with filtered, low pressure air.



G-1174

FIGURE 4-6. CHECKING BRUSH WEAR

### OUT-OF-SERVICE PROTECTION

If the generator set will be out of service for more than 30 days, protect it by using the following procedures.

1. Start and run the generator set with load until it is thoroughly warm. Stop the set.
2. Drain the oil from the crankcase while the engine is still warm. Replace the oil filter and refill crankcase with new oil. Attach a tag to the generator set within clear view indicating crankcase oil viscosity.
3. Turn off the fuel supply valve. Start the engine and let the generator set run until it stops from lack of fuel.
4. Remove the spark plugs and pour about one ounce (30 ml) of rust inhibitor oil (or SAE 50 engine oil) into each cylinder plug opening. Crank engine over several revolutions, then install the spark plugs.
5. Check the ethylene glycol mixture in the captive cooling system to be sure it has sufficient freeze and corrosion protection.

6. Protect the sea water cooling system from freezing or corrosion as follows:
  - A. Shut off the sea water cock.
  - B. Remove inlet hose at the sea cock (or strainer if used) and insert hose end into a bucket containing at least two gallons (7.6 liters) of 50-50 anti-freeze/water mix.
  - C. Crank engine until coolant mixture discharges from the outboard exhaust fitting.
  - D. Re-install inlet hose removed in Step B.
7. Plug the exhaust outlet to prevent entrance of moisture, insects, dirt, etc.
8. Disconnect the starting battery and follow standard battery storage procedure.

**▲CAUTION** *Freezing temperatures can cause severe damage to the battery when in storage. Maintain electrolyte level and use a trickle charger to maintain specific gravity.*

9. Clean and wipe entire unit. Coat parts susceptible to rust with a light coat of rust inhibitor oil or grease.

### Returning Unit to Service

Refer to preceding paragraphs in this Maintenance section for specific service procedures.

1. Remove plug from the exhaust outlet and open the seacock.
2. Check the oil tag and verify that the oil viscosity is still correct for existing ambient temperature.
3. Clean and check the battery. For batteries not maintenance free, measure the specific gravity. Reading should be 1.260 at 80° F (27° C) for a fully charged battery. Add distilled water to bring level to the split ring on each cell. If the specific gravity reading was low, charge until correct value is obtained. **DO NOT OVERCHARGE.**

**▲WARNING** *Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.*

4. Connect the generator set leads to the battery, negative (-) lead last.
5. Remove all loads before starting the engine.
6. After starting the generator set, apply at least 50 percent of rated load capacity.
7. Check any optional gauges for normal readings. Set is ready for service.









**Onan**

**Onan Corporation**  
**1400 73rd Avenue N.E.**  
**Minneapolis, MN 55432**  
**1-800-888-ONAN**  
**612-574-5000 International Use**  
**Telex: 275477**  
**Fax: 612-574-8087**

Onan is a registered trademark of Onan Corporation