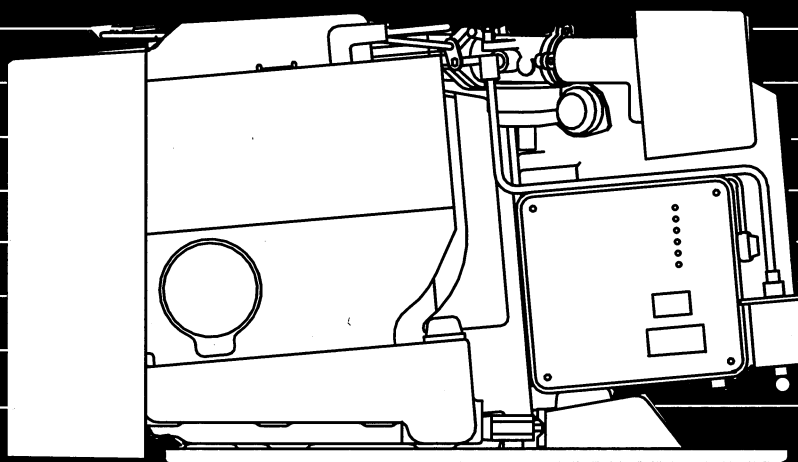


Onan

GenSet

Operator's Manual

BGD, NHD



Printed in U.S.A.

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6/94

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

- DO NOT fill fuel tanks while engine is running. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME 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, non-conductive line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.

GASOLINE AND LPG FUEL MAY BE ACCIDENTALLY IGNITED BY ELECTRICAL SPARKS, presenting the hazard of fire or explosion, which can result in severe personal injury or death. When installing the generator set:

- Do not tie electrical wiring to fuel lines.
- Do not run electrical lines and fuel lines through the same compartment openings.
- Keep electrical and fuel lines as far apart as possible.
- Place a physical barrier between fuel lines and electrical lines wherever possible.
- If electrical and fuel lines must pass through the same compartment opening, make certain that they are physically separated by running them through individual channels, or by passing each line through a separate piece of tubing.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Never sleep in the vehicle with the generator set running unless vehicle is equipped with an operating carbon monoxide detector.
- Provide an adequate exhaust system to properly expel discharged gases. Inspect exhaust system daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

Safety Precautions

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Before starting work on the generator set, disconnect batteries. This will prevent accidental arcing.
- Keep your hands away from moving parts.
- 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 while working on generator sets. 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

- Disconnect starting battery before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death.
- Follow all 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 device and after building main switch is open. Consult an electrician in regard to emergency power use.

GENERAL SAFETY PRECAUTIONS

- Have a fire extinguisher nearby. Maintain extinguisher properly and become familiar with its use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.
- 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.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage, which presents a potential fire hazard.
- **DO NOT** store anything in the generator compartment such as oil or gas cans, oily rags, chains, wooden blocks, portable propane cylinders, etc. A fire could result or the generator set operation (cooling, noise and vibration) may be adversely affected. Keep the compartment 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.

Section 1. Introduction

ABOUT THIS MANUAL

This manual covers the operation and maintenance of the BGD and NHD commercial mobile generator sets. For more information, see these publications:

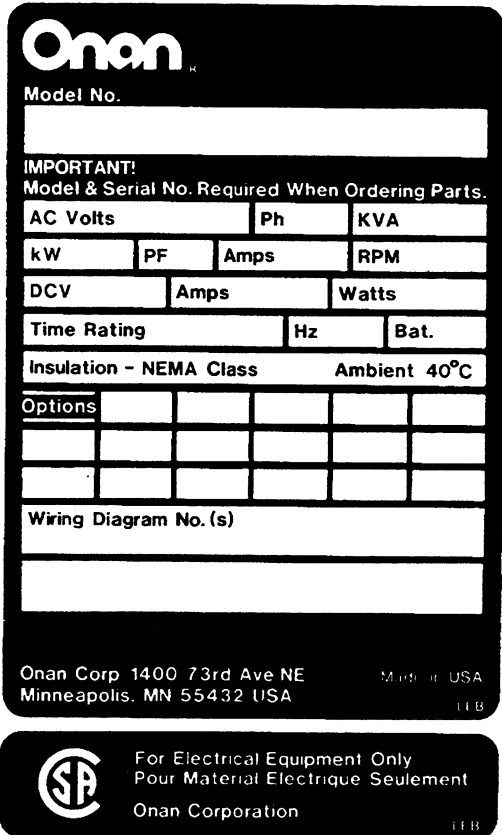
Electrical/Mechanical Fundamentals
(publication 932-0408)

Onan Generator Training Manual
(publication 932-0404)

BGD/NHD Installation Manual (Spec J)
(publication 965-0632)

BGD/NHD Service Manual (begin Spec H)
(publication 965-0500)

Read this manual carefully, and follow all warnings and cautions. Using the genset properly and following a regular maintenance schedule can bring about longer unit life, better performance, and safer operation. The generator set must be installed properly to operate safely.



The nameplate is a rectangular label with a black background and white text. It features the Onan logo at the top left. Below the logo is a field for 'Model No.' followed by a large white box. A section titled 'IMPORTANT!' states 'Model & Serial No. Required When Ordering Parts.' Below this is a table with fields for AC Volts, Ph, KVA, kW, PF, Amps, RPM, DCV, Watts, Time Rating, Hz, and Bat. Below the table is a field for 'Insulation - NEMA Class' and 'Ambient 40°C'. A section titled 'Options' follows with a grid of boxes. Below the grid is a field for 'Wiring Diagram No. (s)' followed by a large white box. At the bottom, it lists 'Onan Corp 1400 73rd Ave NE Minneapolis, MN 55432 USA' and 'Made in USA'. A small '118' is at the bottom right. Below the nameplate is a circular logo with 'SP' inside, followed by the text 'For Electrical Equipment Only', 'Pour Material Electrique Seulement', and 'Onan Corporation'. A small '118' is at the bottom right of this section.

AC Volts		Ph	KVA	
kW	PF	Amps	RPM	
DCV	Amps		Watts	
Time Rating		Hz	Bat.	
Insulation - NEMA Class		Ambient 40°C		
Options				
Wiring Diagram No. (s)				

Onan Corp 1400 73rd Ave NE
Minneapolis, MN 55432 USA

Made in USA

118

For Electrical Equipment Only
Pour Material Electrique Seulement
Onan Corporation

118

FIGURE 1-1. GENERATOR SET NAMEPLATE

HOW TO OBTAIN SERVICE

When the set needs service, call an authorized service center and give them the complete model number and serial number listed on the generator set nameplate.

Factory-trained parts and service centers can handle all service needs. The Parts and Service Center Directory (publication F-118, included with the set) lists the nearest center.

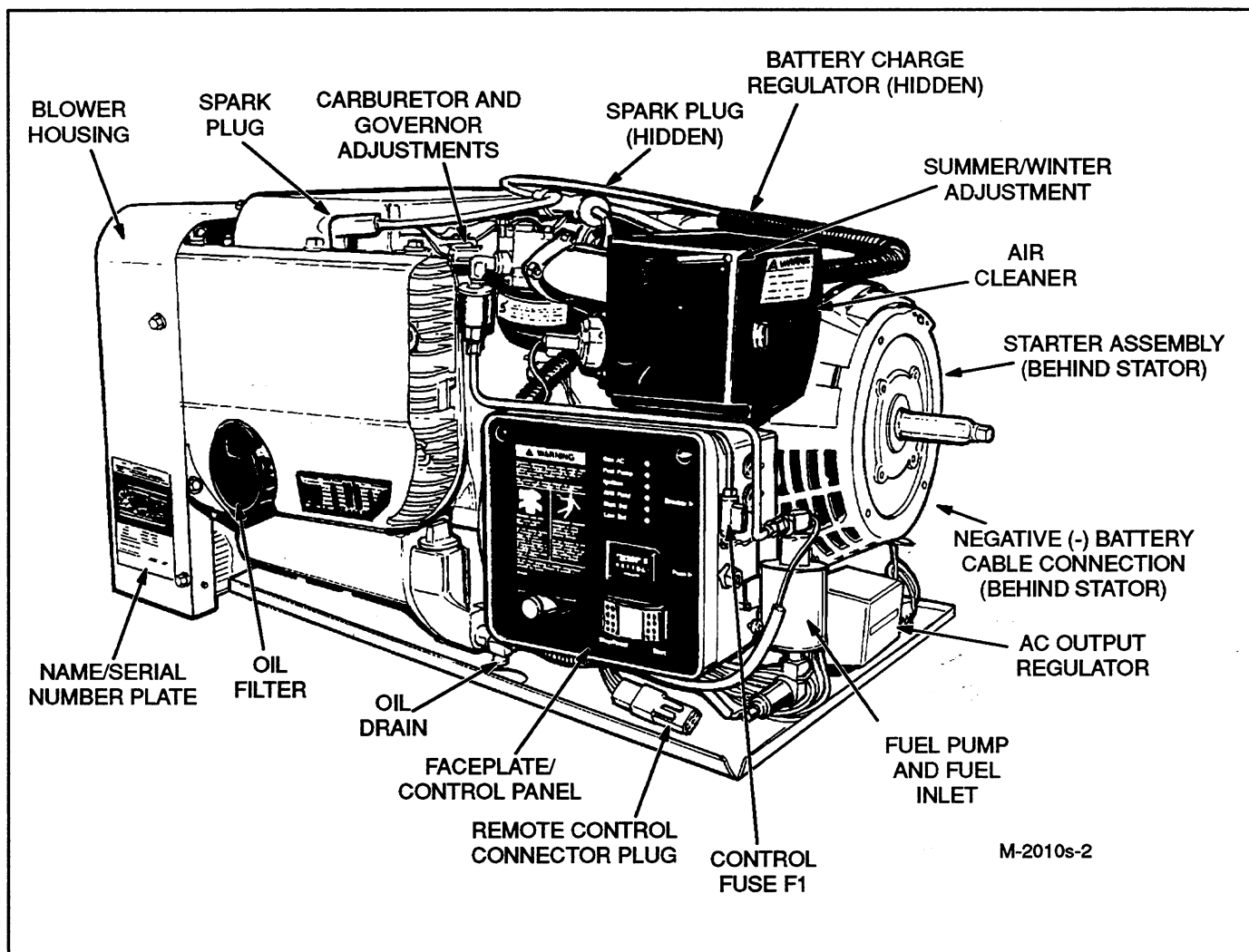


FIGURE 1-2. GASOLINE-FUELED BGD/NHD GENERATOR SET

Section 2. Specifications

	MODEL BGD	MODEL NHD
General		
Weight	204 pounds (92 kg)	230 pounds (104 kg)
Overall Dimensions (H x L x W)	14 x 25-1/4 x 19 in. (356 x 641 x 478 mm)	14-5/8 x 25-9/16 x 21-1/16 in. (371 x 649 x 535 mm)
Minimum Free Area for Ventilating Air	85 sq. in. (548 sq. cm)	85 sq. in. (548 sq. cm)
Minimum Vertical Clearance At Air Discharge Outlet	2 in. (51 mm)	2 in. (51 mm)
Exhaust Tailpipe Diameter and Material	1-3/8 in. ID, 18 Gauge Rigid Steel Tubing	1-3/8 in. ID, 18 Gauge Rigid Steel Tubing
Control Fuse (F1)	10 amp	10 amp
Engine		
Displacement	47.7 in ³ (782 cm ³)	60 in ³ (983 cm ³)
Compression Ratio	6.9:1	7.0:1
Bore	3.25 in. (82.6 mm)	3.56 in. (90.4 mm)
Stroke	2.87 in. (72.9 mm)	3.00 in. (76.2 mm)
Cylinder Compression (Hot)	75-115 psi (517-793 kPa)	100-120 psi (690-827 kPa)
Spark Plug Gap	0.025 in. (0.64 mm)	0.025 in. (0.64 mm)
Intake Valve Lash (cold)	0.005 in. (0.127 mm)	0.005 in. (0.127 mm)
Exhaust Valve Lash (cold)	0.013 in. (0.330 mm)	0.013 in. (0.330 mm)
Engine Oil Capacity (Dry Filter)	3.5 quarts (3.3 L)	3.5 quarts (3.3 L)
Ignition Timing (Non-adjustable)	14°-18° BTC	14°-18° BTC
Fuel Connections		
Maximum Gasoline Supply Pressure (at Carburetor)	6 psi (41 kPa)	6 psi (41 kPa)
Maximum Gasoline Fuel Pump Lift	3 Ft. (0.9 m)	3 Ft. (0.9 m)
Gasoline Supply Fitting	1/4 in. ID Hose Barb	1/4 in. ID Hose Barb
Min. – Max. Propane Supply Pressure (Vapor Withdrawal)	3.5 – 14 in. (89 – 356 mm) WC	3.5 – 14 in. (89 – 356 mm) WC
Propane Supply Connection (Vapor Withdrawal)	3/4 in. NPTF Tapping	3/4 in. NPTF Tapping
Propane Supply Connection (Liquid Withdrawal)	1/4 in. NPTF Tapping	1/4 in. NPTF Tapping

MODEL BGD**MODEL NHD****Battery**

Voltage	12	12
Cold Cranking Amps (SAE J537) for Ambients Above / Below Freezing	360 / 450	360 / 450
Minimum Required Voltage At Starter Motor Terminals During Cranking	10	10
Battery Charging Voltage (at No-Load AC)	14.4	14.4
Battery Charging Voltage (at Full-Load AC)	14.6	14.6
Maximum Continuous Battery Charging Amperage	10	10
Trickle Battery Charging Amperage	0.5	0.5

	50 Hertz	60 Hertz	50 Hertz	60 Hertz
Gasoline Fueled Sets				
Rated Power Output	4.0 kW	4.5 kW	5.0 kW	6.5 kW
Full-Load Current (1-Phase Generators)				
At 110/220 Volts	36.4/18.2 amps	—	45.5/22.7 amps	—
At 120/240 Volts	—	37.5/18.8 amps	—	54.2/27.1 amps
Full-Load Current (3-Phase Generators)				
At 220 Volts*	10.5 amps	—	13.2 amps	—
At 240 Volts*	—	10.8 amps	—	15.7 amps
Gasoline Consumption				
Under Full-Load	0.73 gph (2.8 L/h)	0.8 gph (3.0 L/h)	0.8 gph (3.0 L/h)	1.3 gph (4.9 L/h)
Under Half-Load	0.53 gph (2.0 L/h)	0.6 gph (2.3 L/h)	0.57 gph (2.2 L/h)	0.7 gph (2.5 L/h)
Under No-Load	0.35 gph (1.3 L/h)	0.4 gph (1.5 L/h)	0.35 gph (1.3 L/h)	0.4 gph (1.5 L/h)
Propane Fueled Sets				
Rated Power Output	3.5 kW	4.0 kW	5.0 kW	6.3 kW
Full-Load Current (1-Phase Generators)				
At 110/220 Volts	31.8/15.9 amps	—	45.5/22.7 amps	—
At 120/240 Volts	—	33.3/16.7 amps	—	52.5/26.3 amps
Propane Consumption				
Under Full-Load	0.98 gph (3.7 L/h)	1.3 gph (4.9 L/h)	1.18 gph (4.5 L/h)	1.7 gph (6.4 L/h)
Under Half-Load	0.65 gph (2.5 L/h)	0.8 gph (3.0 L/h)	0.78 gph (3.0 L/h)	1.05 gph (4.0 L/h)
Under No-Load	0.4 gph (1.5 L/h)	0.5 gph (1.9 L/h)	0.5 gph (1.9 L/h)	0.65 gph (2.5 L/h)

* – These values are for generators having a Series-Delta connection.

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 vehicle 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.

BEFORE STARTING

General Inspection

Inspect the set and the entire exhaust system before startup. Check for loose and damaged components and fasteners, and correct all problem areas.

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Make certain that all exhaust components work correctly and are secure.*

Do not start the set while it is connected to a load. First, make certain that any output switching device is in the "Utility" position, and that the vehicle AC distribution panel breakers are off (open). Do not start the set if exhaust gases will not be effectively expelled away from the vehicle. Make sure that the vehicle is not parked in high grass or brush. See Starting and Stopping in this section.

⚠WARNING *Fire can cause severe personal injury or death. Do not operate the generator set when the vehicle is parked in high grass or brush.*

⚠WARNING *Exhaust gases can cause severe personal injury or death. Never operate the generator set unless the exhaust outlet is clear of walls, snow banks, or any obstructions that can prevent exhaust gases from dissipating. Never operate any exhaust fan in the vehicle when the generator set is running: an exhaust fan can draw exhaust gas into the vehicle.*

Lubrication

Check the engine oil level often. Keep the level near the fill indicator FULL mark. Do not overfill. See Section 4, Maintenance, for instructions.

Fuel (Gasoline)

⚠WARNING *Gasoline presents the hazard of fire or explosion, which can result in severe personal injury or death. Do not smoke or allow any flame, spark, pilot light, arc-producing equipment or other ignition sources around fuel or fuel components. Keep a type ABC fire extinguisher nearby.*

Make certain that the fuel tanks are full before operating the set. Use clean, fresh unleaded gasoline.

(Leaded regular may be used if necessary.) Unleaded fuel promotes longer service intervals, longer spark plug life, and less carbon clean-out maintenance. Leaded fuel creates deposits on the cylinder heads, which cause power loss. These deposits must be removed periodically. Unleaded gas may be used after leaded gas only if these deposits are removed.

⚠ CAUTION *Engine damage may result from alternating unleaded and leaded gasoline, unless lead deposits are removed from the cylinder heads before switching to unleaded gasoline.*

Fuel (Propane)

Use clean, fresh commercial propane or HD-5 grade liquid propane gas in a mixture of at least 90 percent propane. Propane fuels other than HD-5 can contain more than 2.5 percent butane which can result in poor fuel vaporization and poor starting in low ambient temperatures (below 32° F or 0° C).

NOTE: A manual shutoff valve must be mounted on the propane fuel supply tank. This supply tank valve must be opened fully when operating the generator set to ensure the excess flow valve will close with a broken propane fuel line.

STARTING AND STOPPING

This section describes starting and stopping procedures. For the first startup of a new set, see Break-in Procedure in this section.

Starting

1. Note whether there is a remotely mounted set disable switch wired into the starting circuit. This may be a key switch or a toggle, mounted in a secured or locked area. If there is such a switch, move it to the ON or ENABLE position.
2. Move the STOP-RESET/START switch (set-mounted or remote) to START.

Cranking: The faceplate LEDs will light in the following pattern (see Figure 3-1):

- the **Gen AC** LED (green) will be **OFF**
- the **Fuel Pump** LED (green) will be **ON**
- the **Ignition** LED (green) will be **ON**
- the **AVR Field** LED (green) will be **ON**
- the **Start Sol** LED (green) will be **ON**

- the **Low Bat** LED (red) **MAY** flash **ON momentarily** (especially in cold conditions)

Set started and running: The faceplate LEDs will remain lighted in the following pattern (see Figure 3-1):

- the **Gen AC** LED (green) will be **ON**
 - the **Fuel Pump** LED (green) will be **ON**
 - the **Ignition** LED (green) will be **ON**
 - the **AVR Field** LED (green) will be **OFF**
 - the **Start Sol** LED (green) will be **OFF**
 - the **Low Bat** LED (red) will be **OFF**
3. Let the unit warm up before applying the load. During warmup, make sure that the set runs smoothly.
 4. Switch the load into the circuit by closing a breaker at the distribution panel. See Section 2 of this manual for set load ratings.

⚠ CAUTION *Continuous generator set overloading can cause high operating temperatures that could damage the generator windings. Keep the load within the nameplate rating.*

Stopping

1. Remove the load and let the unit run three to five minutes to cool down.
2. Move the STOP-RESET/START switch to STOP.

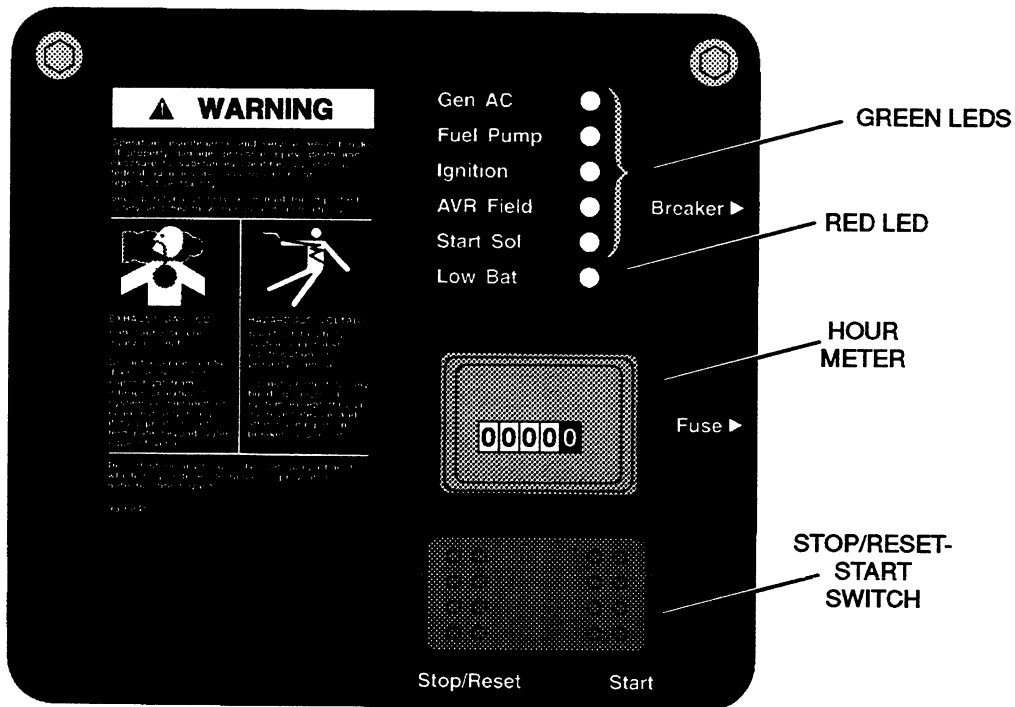
LED Fault Indicators

If the Gen AC LED does not light while the set is running, switch the genset OFF. Note that the Gen AC LED is independent of the set AC output breakers: resetting the breakers will make no difference.

During cranking, if the Fuel Pump, Ignition, AVR Field or Start Solenoid LEDs stay off, there is a fault in one of these circuits. Consult an authorized technician.

Note that the Low Bat LED **may** flash on momentarily during cranking, especially in cold environments. This is within the parameters of normal operation.

However, if the Low Bat LED turns on steadily while the set is running, this can mean that the battery is in poor condition, or that there are problems with the battery charging circuit or in the wiring harness.



Cranking:

- **Gen AC LED (green) will be OFF**
- **Fuel Pump LED (green) will be ON**
- **Ignition LED (green) will be ON**
- **AVR Field LED (green) will be ON**
- **Start Sol LED (green) will be ON**
- **Low Bat LED (red) MAY flash ON momentarily**
(especially in cold conditions)

Set started and running:

- **Gen AC LED (green) will be ON**
- **Fuel Pump LED (green) will be ON**
- **Ignition LED (green) will be ON**
- **AVR Field LED (green) will be OFF**
- **Start Sol LED (green) will be OFF**
- **Low Bat LED (red) will be OFF**

FIGURE 3-1. BGD/NHD FACEPLATE LEDS

BREAK-IN PROCEDURE

To prevent high oil consumption or glazing of the engine cylinders, break in the set as follows:

1. Start the set and apply a load equal to half its capacity.
2. Run the set for two hours with this load.
3. Run the set for another two hours at three-quarters capacity.
4. Change the engine oil after the first 50 hours of operation, and every 150 hours after that. See Section 4, Maintenance, for instructions.

NOTE: This procedure only begins the break-in process. For optimum set performance, make certain not to run the set for extended periods without load during the first 150 to 200 hours of use.

OPERATING CONDITIONS

Hot Weather

Keep the engine cooling fins clean at all times, especially when the outside temperature is higher than 90° F/ 33° C. Make sure that airflow to the set is not blocked.

Cold Weather

Use the correct oil weight for cold weather. See Section 4, Maintenance, for the type of oil to use. Change oil only after the engine is warm. If sudden temperature changes occur and the oil is not the correct weight, replace it with the proper oil.

Gasoline Models Only: Below 70° F (21° C), move the air preheater lever (see Figure 2-1) to WINTER. Above 70° F (21° C), move the air preheater lever to SUMMER.

⚠ CAUTION Operation of the preheater when temperatures are above 70° F (21° C) may cause erratic operation, and may result in reduced engine power and reduced engine life. For this reason, leave the preheater in the SUMMER position at high ambient temperatures.

High Altitudes

Engine power output decreases roughly four percent for each 1000 feet (310 m) above sea level, after the first 1000 feet. If the set runs poorly above 2000 feet (620 m.), turn the carburetor main fuel adjustment to a slightly leaner fuel mixture. This is a sensitive adjustment, so turn this screw no more than 1/8 turn at a time. See Figure 3-2.

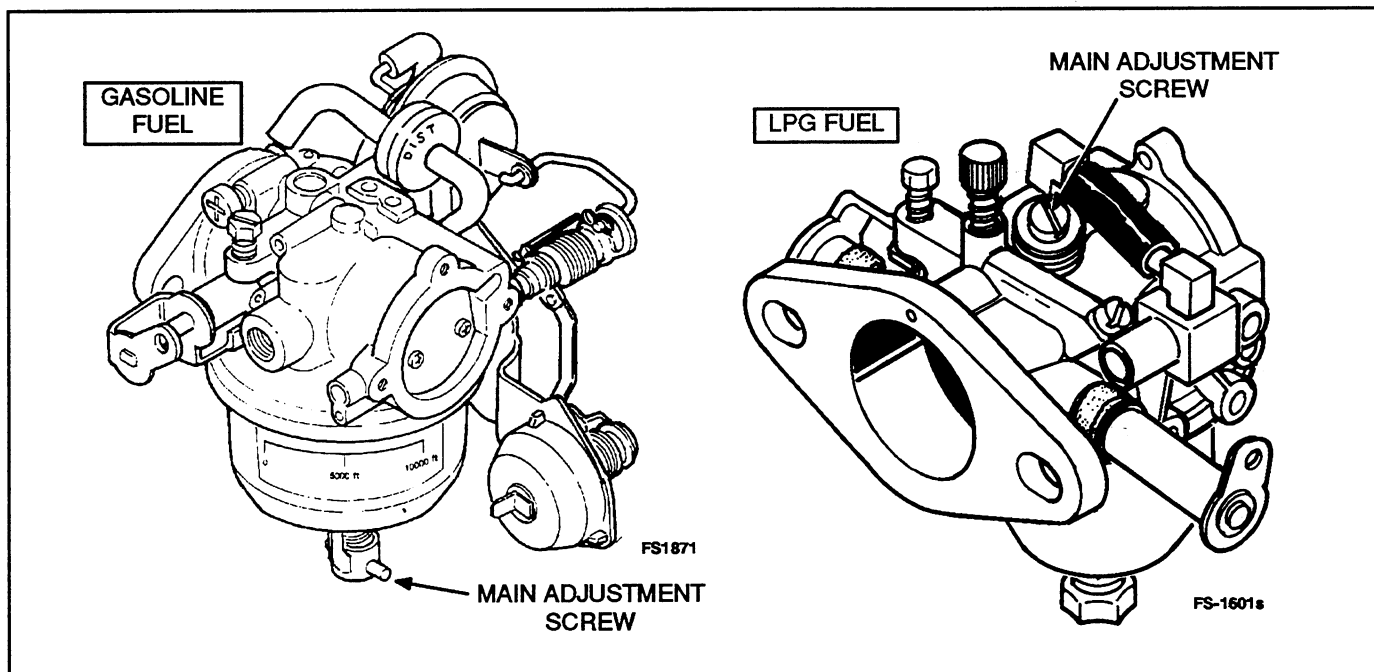


FIGURE 3-2. CARBURETOR MAIN ADJUSTMENT SCREW

⚠ CAUTION *Fuel mixture adjustment needles and seats can easily be damaged. When adjusting fuel mixture settings, never force the fuel mixture adjustment needles against their seats.*

Extremely Dusty or Dirty Conditions

1. Keep the generator set and its cooling surfaces as clean as possible.
2. Service the air cleaner frequently.
3. Change the engine oil every 50 operating hours.
4. Keep oil in a dust-tight container.
5. Clean the governor linkage regularly. See Section 4, Maintenance, for this procedure.

GENERATOR SET EXERCISE

Moisture can condense in the engine if it is not run often enough to reach normal operating temperature. This moisture can damage the engine.

To prevent moisture damage, run the generator set at one-half load two hours every four weeks. (See Section 2, Specifications, for the wattage rating.) Use a long exercise period rather than several short periods.

REMOTE CONTROL

The remote control allows starting the set from the cab of the vehicle. This control includes a start-stop switch and an indicator lamp that lights when the set is running. See Figure 3-3.

Using the Remote Control

Move the start-stop switch to START, and hold it until the light turns on to show that the set is running. Release the switch. See Figure 3-3.

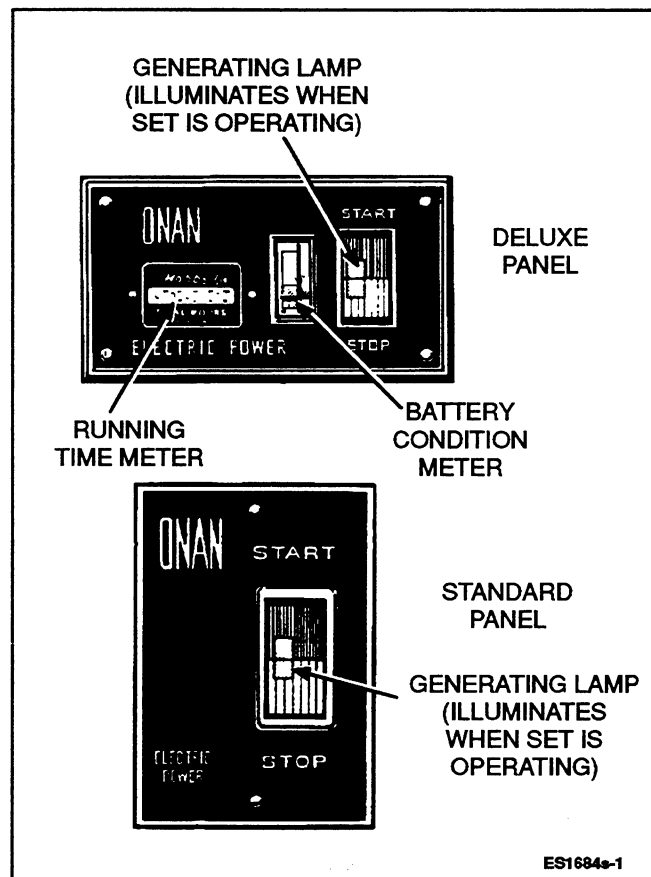


FIGURE 3-3. REMOTE CONTROL PANELS

If the switch is held at START for ten seconds and the light does not go on, release the switch, wait two minutes and try again. If the second try does not succeed, try the control on the set. If the light still does not go on, there may be an open circuit in the remote wiring. Contact an authorized service center for assistance.

The optional running time meter indicates total hours of generator set use. During scheduled maintenance, record the figure on the meter.

The battery condition meter shows the condition of the battery and charging circuit. This meter should remain in the normal range. If it reads high or low most of the time, contact a service center.

CONTROL FUSE (F1)

The BGD/NHD generator set includes a separate fuse for the ignition and electrically controlled automatic choke. Figure 3-4 illustrates the location of this 10-amp fuse, on the side of the control panel.

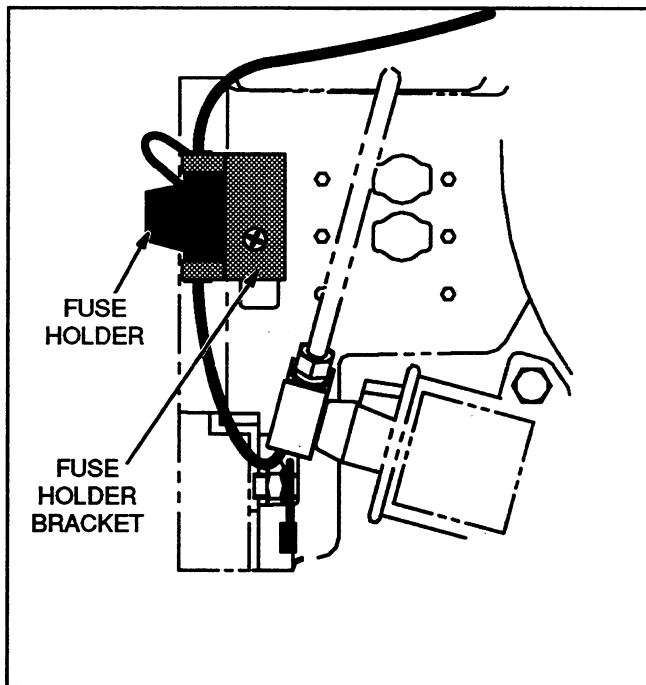


FIGURE 3-4. CONTROL FUSE F1 LOCATION

OUT-OF-SERVICE PROTECTION

If the set cannot be exercised, and it will not be used for 30 days or longer, perform the following storage procedure.

Generator Set Storage Procedure

1. Run the set at one-half load for one hour. See Section 2, Specifications, for the wattage rating.
2. Close the fuel supply and remove the air filter. As the set runs out of fuel, squirt fogger (a thick oil formulated for internal engine protection; Onagard brand is recommended) into the carburetor intake. Reassemble the air filter.
3. Stop the set. Remove the spark plugs. Pour one tablespoon (about 30 ml) of standard engine oil into each spark plug hole. Crank the engine for 10 seconds. Replace the spark plugs.
4. Change the oil after the exhaust system is cool.
5. Disconnect the cables from the starting battery.

Returning the Generator Set to Operation

1. Inspect the generator set.
2. Check the battery electrolyte level, and reconnect the cables.
3. Check the air filter. If the element is dirty, replace it.
4. Check the engine oil level.
5. Turn on the fuel supply.
6. Start the set at the set-mounted control. Start-up may be slow, due to oil in the cylinders. The set will run roughly, with a smoky exhaust, until the oil in the cylinders is burned. If the set does not start, replace the spark plugs.
7. Apply one-half load to the set until it runs smoothly. Run the set for an hour.
8. Remove the load and let the set run three to five minutes to cool down. Then move the start switch to the STOP position. The generator set is now ready for operation.

TROUBLESHOOTING GUIDE

⚠ WARNING Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.

Problem	Probable Cause	Solution
FAILS TO CRANK	<ol style="list-style-type: none"> 1. Low battery. 2. Bad battery connection. 3. Blown fuse. 	<ol style="list-style-type: none"> 1. Check battery electrolyte level. 2. Clean and tighten all battery and cable connections. 3. Replace fuse on control box. See specifications for proper fuse rating.
CRANKS SLOWLY	<ol style="list-style-type: none"> 1. Low battery. 2. Bad battery connection. 3. Oil is too heavy. 4. Load connected. 	<ol style="list-style-type: none"> 1. See "Fails to Crank", #1. 2. See "Fails to Crank", #2. 3. Replace with lighter oil. 4. Remove load.
CRANKS BUT WON'T START	<ol style="list-style-type: none"> 1. Fuel below genset pick-up level in tank. 2. Fuel supply shutoff valve closed. 3. Carbon deposits on spark plugs. 	<ol style="list-style-type: none"> 1. Add fuel. 2. Fully open fuel supply valve. 3. Remove spark plugs and clean.
EXHAUSTING BLACK SMOKE	<ol style="list-style-type: none"> 1. Rich fuel mixture. 2. Dirty air filter. 3. Choke stuck. 	<ol style="list-style-type: none"> 1. Turn main fuel adjustment in 1/8 turn (location of adjustment is shown in Figure 3-2). 2. Replace air filter. 3. See authorized representative.
UNIT RUNS THEN STOPS	<ol style="list-style-type: none"> 1. Out of fuel. 2. Low oil level. 3. Excess oil. 	<ol style="list-style-type: none"> 1. Refill fuel tank. 2. Add oil if necessary. 3. Reduce engine oil level.
UNIT RUNS BUT SURGES	<ol style="list-style-type: none"> 1. Loose or worn spark plug leads. 2. Ignition coil, wiring, or control components defective. 3. Corroded governor linkage. 4. Lean carburetor adjustment. 	<ol style="list-style-type: none"> 1. Check security of spark plug leads at spark plugs and ignition coil. Replace leads if worn. 2. Contact an authorized service center. 3. Contact an authorized service center. 4. Contact an authorized service center.

⚠ WARNING A hot generator set can cause severe burns. Always allow the generator set to cool before performing any maintenance or service.

Section 4. Maintenance

Establish a maintenance and service schedule for the generator set, and stick to it. Consult an authorized service center if the set will be used in extreme cold, heat, dust, humidity, or altitude, and shorten the maintenance intervals. Keep a log of all service and maintenance, for warranty support. Use the schedule to determine the maintenance required, then see this manual for the procedure.

⚠ WARNING *Accidentally starting the generator set during maintenance can cause severe personal injury or death. Disconnect both generator set starting battery cables, negative (-) cable first, before performing maintenance.*

GENERAL INSPECTION

Inspect the entire generator set at least once every eight operating hours. Start the set, and check for visible and audible faults.

EXHAUST

Examine the exhaust system for leaks. Inspect the generator compartment for holes which might let exhaust gas enter the vehicle. Do NOT operate the set if it runs louder than usual, if the compartment has holes to the interior, or if the exhaust system has leaks. Consult a service center as soon as possible, and do not run the set until the problem is corrected.

⚠ WARNING *Exhaust gas presents the hazard of severe personal injury or death. If there are any exhaust leaks, do not operate the generator set, and have the exhaust system repaired as soon as possible.*

PERIODIC MAINTENANCE SCHEDULE

Service These Items	After Each Cycle of Indicated Hours				
	8	50	150	200	300
General Inspection	X ¹				
Check Oil Level	X				
Check Battery Electrolyte Level		X			
Clean Out Spark Arrester	X				
Clean and Lubricate Governor Linkage		X			
Change Crankcase Oil and Oil Filter			X ^{2,6}		
Change Air Filter			X ²		
Clean Fuel Filter			X ³		
Replace Spark Plugs			X ^{4,5}		
Clean Cooling Fins				X ⁷	
Clean Carburetor & Combustion w/Onan "4C" Cleaner			X		
Clean Generator Set			X		
Inspect and Clean Internally Engine Combustion Chamber					X ⁵
Adjust Carburetor	As Required				
Check Generator Brushes	As Required				
Exercise Generator Set	As Required				
Adjust Output Voltage	As Required				

- 1 - With set running, visually and audibly check exhaust system for leaks.
- 2 - Every 150 operating hours or once a year, whichever is first. Perform more often in extremely dusty conditions (i.e., check monthly, and change if dirty).
- 3 - Equipped on LPG models. Customer option for gasoline models.
- 4 - Or replace annually, or prior to storage, whichever is first.
- 5 - Have your Onan service center perform this task, by removing cylinder heads.
- 6 - First oil change during first year or 50 hours of operation, whichever is first.
- 7 - During periods of nonuse, exercise for 2 hours every 4 weeks.
- 8 - Refer to Out-of-Service Protection if unit is to be stored.

SPARK ARRESTER

The exhaust spark arrester is needed to operate the set safely. It requires periodic cleaning to work correctly. Check the maintenance schedule for cleaning intervals.

Spark Arrester Cleaning Procedure

1. Remove the 1/8 inch pipe plug from the bottom of the muffler.
2. Run the generator set with load for five minutes.
3. Stop the generator set and let the muffler cool.
4. Replace the pipe plug in the muffler.

ENGINE OIL

Be sure the crankcase is filled with oil to the FULL mark on the oil level indicator (Figure 4-1). Use the same brand when adding oil between changes. See Recommended Engine Oil in this section.

Add oil until it reaches the FULL mark on the oil level indicator. Do not overfill: excess oil may foam in the crankcase and stop the engine. Replace the oil level indicator tightly to avoid leakage.

⚠ WARNING *Hot oil can cause severe personal injury. Do not check the oil level while the generator set is running: oil may blow out the filler.*

Oil Level Checking Procedure

NOTE: The generator set must be level when checking the oil indicator.

1. Remove the oil level indicator and wipe it with a clean rag.
2. Screw the indicator back into position (fully in).
3. Unscrew the indicator again, and check the oil level on the indicator stem.
4. Add oil to the FULL mark on the indicator.

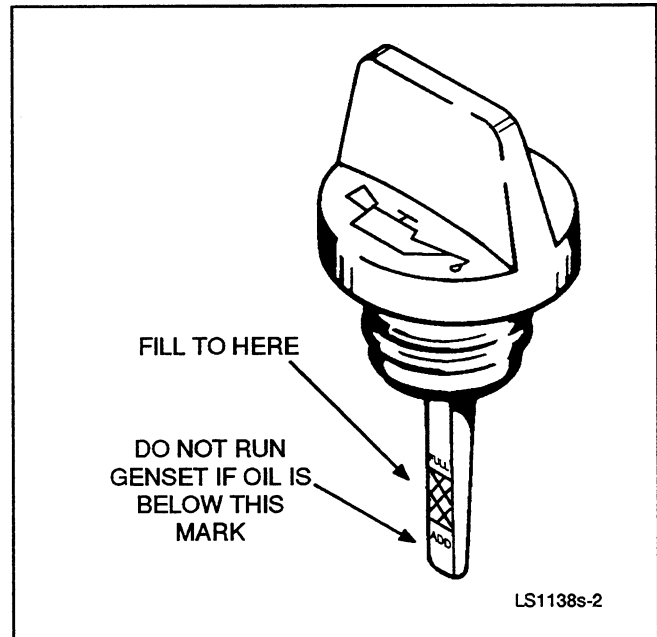


FIGURE 4-1. OIL LEVEL INDICATOR

Oil Draining/Changing Procedures

Figure 2-1 shows the oil drain, oil filter, and oil level indicator. In dusty or dirty conditions, change the oil more frequently than the maintenance schedule says.

NOTE: Run the engine until hot before draining/ changing the oil.

Oil Draining Procedure

1. Place a pan under the oil drain valve.
2. Open the valve and let the oil drain from the engine.
3. Close the valve. Dispose of the old oil properly.

Oil Filter Changing Procedure

1. Place an oil pan under the oil filter position on the engine.
2. Turn the filter counterclockwise to remove it.
3. Coat the new filter gasket with clean engine oil. Turn the new filter clockwise until its gasket just touches the filter mounting base, then tighten it another half turn.

Refer to Section 2, Specifications, for engine oil capacity. See Recommended Engine Oil in this section for the right type of oil.

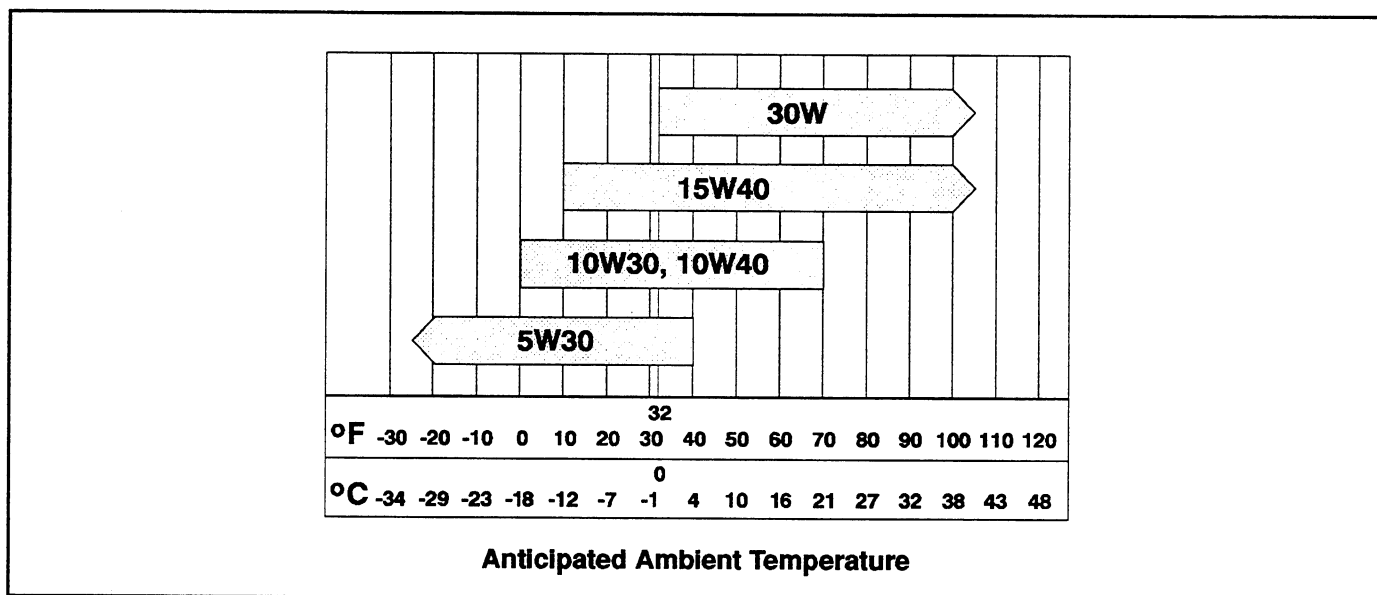


FIGURE 4-2. SAE VISCOSITY GRADES

Recommended Engine Oil

Use oil with the API (American Petroleum Institute) designation SG. Oil should be labeled as passing MS Sequence Tests (also known as ASTMG-1V Sequence Tests). Figure 4-2 shows recommended viscosity and temperatures.

Oil consumption may be higher with a multigrade oil than with a single-grade oil. For this reason, single-grade oils are recommended, unless wide temperature variations are possible.

BATTERY CARE

To increase battery life, perform the following steps.

⚠ WARNING *Accidental starting of the set can cause severe personal injury or death. Disconnect the battery cables when repairs are made to the engine, controls, or generator. Always disconnect the negative (-) cable first, to minimize the possibility of arcing.*

1. Keep the battery case clean and dry.

2. Make certain that the battery cable connections are clean and tight. To remove the cables, use a terminal puller tool.
3. Identify the cable as positive (+) or negative (-) before making the connection. Always connect the ground (negative) cable last, for less chance of arcing.
4. Add water (drinking quality or better) as needed to reach the split-level marker in the battery. The water in the electrolyte evaporates, but the sulphuric acid remains. For this reason, add water, not electrolyte to the battery.
5. Avoid overcharging the battery. Stop the charge when the electrolyte specific gravity is 1.260, at 80° F (27° C.)

⚠ WARNING *Batteries present the hazard of explosion, which can result in severe personal injury. Do not smoke or allow any fire, flame, spark, pilot light, arc-producing equipment or other ignition sources around the battery area. Do not disconnect battery cables while the generator set is cranking or running: batteries give off explosive gases.*

GOVERNOR LINKAGE

The nylon governor linkage must move freely through its range of travel. This joint is self-lubricating, and requires no lubricant. Wipe the joint with a dry cloth to clean it. See Figure 4-3.

CAUTION *Some solvents can damage the governor's nylon joint. Read the manufacturer's instructions before using any lubricants or solvents near the governor linkage.*

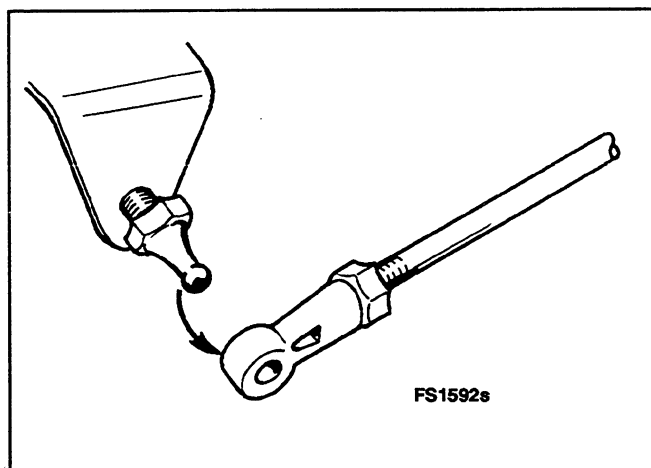


FIGURE 4-3. LINKAGE CLEANING AND LUBRICATION

AIR FILTER

In dusty conditions, change the air filter often. To release the filter, remove the through-bolt on the outside of the air cleaner housing (Figure 4-4).

CAUTION *(Gasoline units only) The carburetor air preheater hose can easily be damaged by rough handling. When removing the air cleaner housing, be careful not to damage the carburetor air preheater hose, which is attached to the housing.*

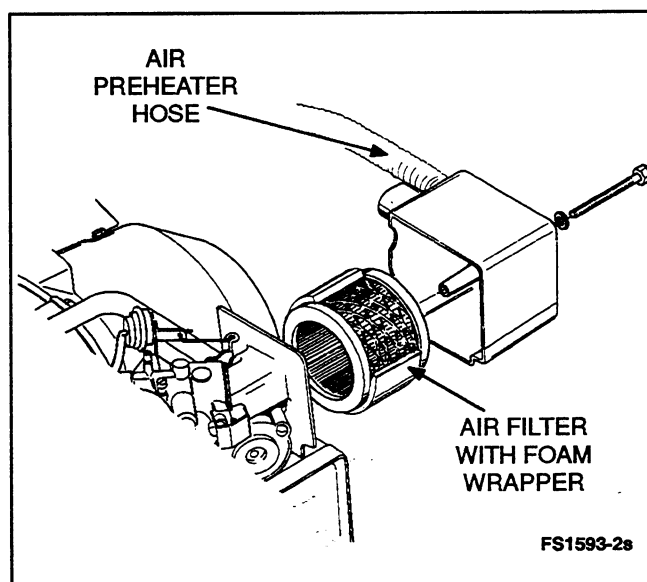


FIGURE 4-4. REPLACING THE AIR FILTER

FUEL FILTER (GASOLINE)

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 generator set to cool down before replacing the fuel filter. Refer to Figure 4-5.

⚠ WARNING *Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Do not permit any flame, spark, pilot light, lit cigarette, 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.*

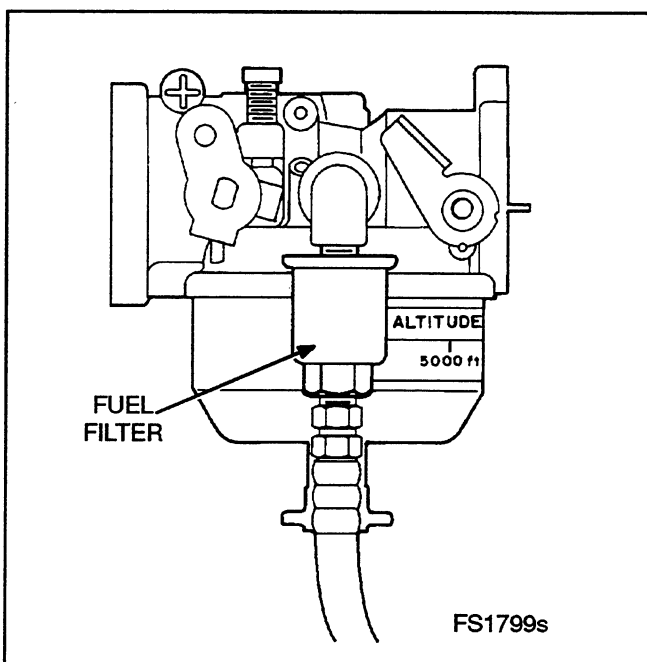


FIGURE 4-5. GASOLINE FUEL FILTER

FUEL FILTER (LPG FUEL)

The LPG fuel filter (Figure 4-6) removes solid impurities from the LP gas, before they reach the regulator and carburetor. A magnet in the filter housing attracts iron and rust particles, and a filter element traps other particles. The fuel filter operates at fuel tank pressure, so it must be reassembled carefully after cleaning, to avoid leakage.

To maintain the LPG fuel filter, purge the fuel system first, as described below.

Fuel System Purging Procedure

1. Close the shutoff valve at the fuel tank.
2. Start and run the generator set until it is out of fuel.
3. Crank the engine a few times after it stops, to make certain that it has no fuel.
4. Move the vehicle to a well-ventilated location that is far from fire, flame, pilot lights, arc-producing equipment, or other ignition source.
5. Remove the vehicle negative (-) battery ground cable and the generator set negative (-) ground cable from their batteries.
6. Close the generator set fuel system shutoff valves and all other fuel shutoff valves.

⚠ WARNING *LP gas presents the hazard of fire or explosion, which can result in severe personal injury or death. Eliminate all sources of ignition, such as pilot lights, sparing electrical equipment, flames, lit cigarettes, etc. before purging the fuel system. Provide adequate ventilation to dissipate LP gas as it is released.*

7. Open the section of flexible fuel line at the solenoid valve just enough to let the gas escape slowly.
8. Disconnect the fuel supply hose from the carburetor and hold it clear of the set.
9. Press and hold the primer button on the regulator to release LP gas from the fuel system. When gas can no longer be heard escaping from the open end of the fuel supply hose, reconnect the hose to the carburetor and move to the procedures described in LPG Fuel filter Cleaning Procedure in this section.

LPG Fuel Filter Cleaning Procedure

1. Remove the four capscrews and lock washers that hold the filter bowl to the filter body. See Figure 4-6.

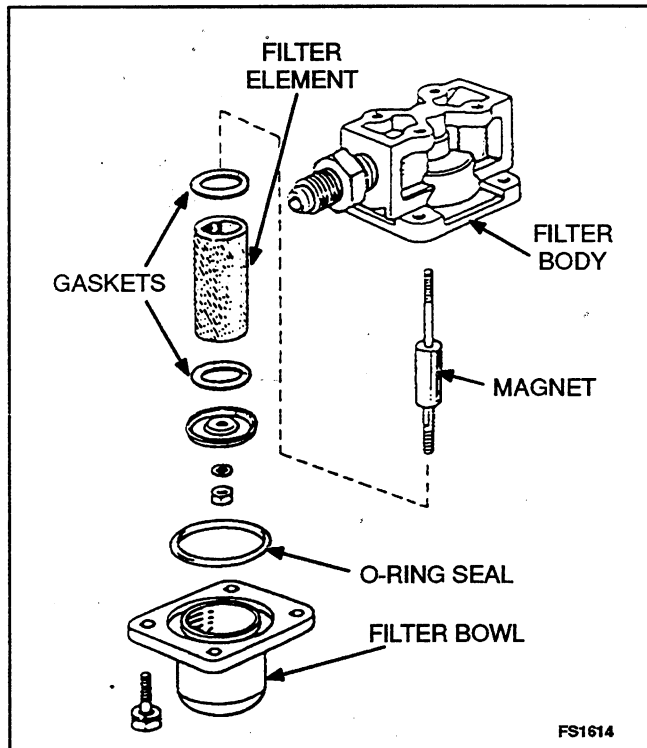


FIGURE 4-6. LIQUID LPG FUEL FILTER

2. Separate the filter bowl from the filter body and discard the O-ring seal.
3. Remove the nut and washer from the center stud and pull out the filter element.
4. If the filter element is clogged, wash the element in kerosene and blow it dry with low pressure (30 psi or 207 kPa) compressed air. Replace the filter element if damaged.

⚠ WARNING Kerosene presents the hazard of fire or explosion, which can cause severe personal injury or death. Do not smoke while using kerosene, or expose kerosene to any fire, flame, spark, pilot light, arc-producing equipment or other ignition sources. Use great care when cleaning with kerosene.

5. Wipe the center stud magnet clean of rust and scale deposits. Do not tap the magnet to loosen deposits: this may damage it.
6. Install a clean filter element using two new gaskets. Tighten the center and stud nuts.
7. Place a new O-ring in the filter bowl sealing groove.
8. Line up the reference mark on the filter bowl with the reference mark on the filter body, and install the capscrews. Tighten the capscrews 56 to 74 in-lb (6.5 to 8.3 N•m) torque. Pressurize the fuel system and check the filter for leaks.

⚠ WARNING LPG presents the hazard of fire or explosion, which can result in severe personal injury or death. After the filter assembly is assembled and the fuel shutoff valve is turned on, apply a soap or detergent solution to the joint, to check for leaks. If there is a leak, bubbles will show in the area; turn off the shutoff valve immediately. If the problem cannot be determined, call the nearest Onan service center.

SPARK PLUGS

A spark plug with heavy combustion deposits can make the generator set misfire, run rough, or stop when a load is applied. When the plugs are removed, inspect and regap them (Figure 4-7). If a plug is discolored or fouled, replace it:

- Black deposits indicate a rich mixture.
- Wet plugs indicate misfiring (gasoline fuel only).

- Badly or frequently fouled plugs indicate that a major tuneup is needed.

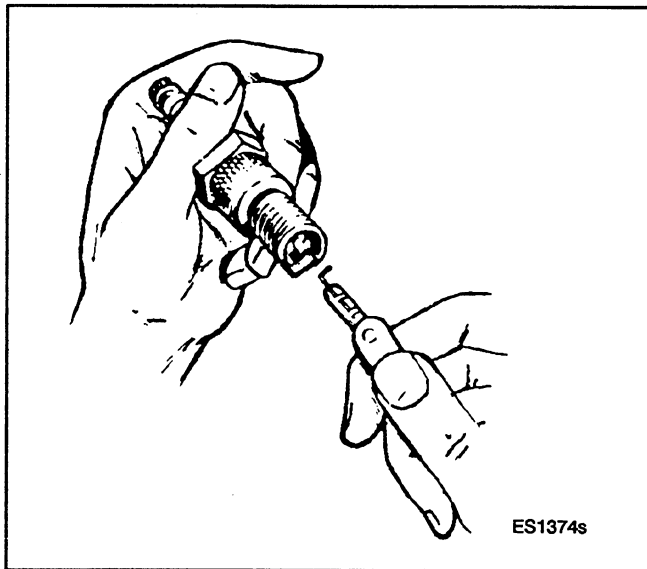


FIGURE 4-7. MEASURING PLUG GAP

CLEANING THE CARBURETOR/ COMBUSTION CHAMBER

⚠WARNING *Inhalation of chemical sprays can cause severe personal injury or death. Use safety goggles to protect eyes and a respirator or painter's mask to prevent inhaling any chemical that may spit back from the carburetor during this procedure. Also, work in a well-ventilated area so that other personnel will not inhale any fumes.*

⚠WARNING *Fumes from this cleaner present the hazard of fire or explosion, which can cause severe personal injury or death. Do not allow any spark, flame, pilot light, lit cigarette, or other ignition source near the generator set when performing this procedure. Keep a fire extinguisher rated ABC near the work area.*

Perform these steps to keep the carburetor and intake manifold clean, and to keep carbon deposits off the combustion chamber. If engine pinging or power loss occur, consult an authorized service center.

Before performing this procedure, move the vehicle to an outdoor location, far from any flame, spark, pilot light, arc-producing equipment or other ignition sources. Open all AC circuit breakers, and remove the plug from the spark arrester muffler.

1. Start the generator set and let it warm up to normal operating temperature.
2. Stop the generator set.
3. Remove the air cleaner housing and air filter.
4. Restart the generator set, and spray the 4C into the carburetor. Direct the spray to wash the choke plate and inside walls of the carburetor. Spray as much as possible into the carburetor without stalling the engine.

The spray enters the combustion chamber and softens the carbon, which flakes off and exits through the exhaust pipe. When about an ounce of 4C remains in the can, flood the engine until it stops.

5. Wait 15 minutes, while the 4C continues to soften the carbon.
6. Restart the engine, with no load connected. Increase the load gradually to full load. Let the set run a few minutes under full load to get rid of the carbon.

CLEANING THE GENERATOR SET

Clean the generator set every six months, or more often in severe conditions. Remove dust with a damp cloth. Use steam to remove tar or other residue (do not steam-clean the set while it is running). Protect the generator, air cleaner, control box, fuel solenoid, and electrical connectors from cleaning solutions. Do not clean with solvents; they may damage electrical connectors.

INSPECT AND CLEAN ENGINE (INTERNAL)

Widely varying operating conditions, light loads (less than 50 percent), and fuel with additives and impurities can degrade engine performance and shorten engine life.

Have the combustion chamber inspected internally for wear and carbon buildup after 300 hours. Because this means removing the cylinder head, it must only be done by an authorized service representative, who is trained in genset maintenance and repair.



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