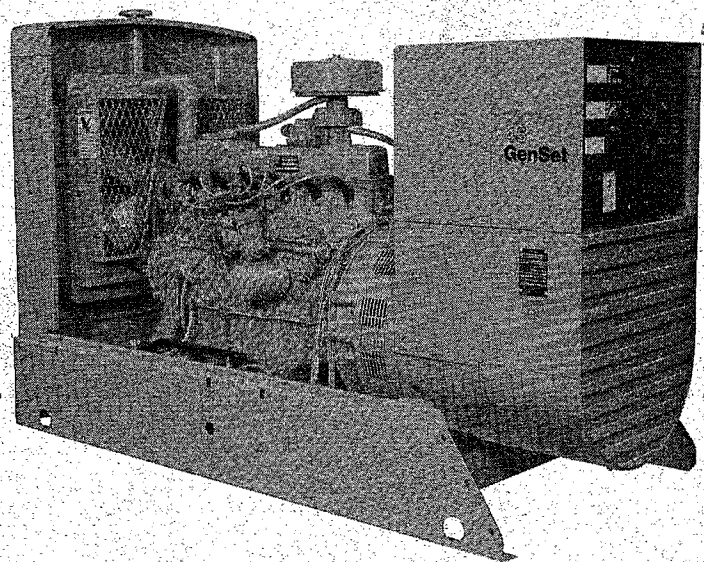


# Onan

## Operator's Manual EK-EM GenSets



**928-0120**  
SPEC R  
4/86  
Printed in U.S.A.

# Safety Precautions

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

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

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

**⚠ DANGER** *This symbol if used 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.*

## General

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

## Protect Against Moving Parts

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

## Fuel System

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

## Guard Against Electric Shock

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DO NOT tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

## Exhaust Gases Are Toxic

- Provide an adequate exhaust system to properly expel discharged gases. 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.

## Keep the Unit and Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.



## Product Support Bulletin

Date: 9/1/93 Page 1 of 1 Bulletin No. 585

Subject: OIL LEVEL

Ref. File #

Model(s) or Series: EN SERIES GENSETS WITH SERIAL NUMBERS PRIOR TO MARCH OF 1993 Effective: IMMEDIATELY

Generators powered by the Ford LSG875 engine may exhibit a low oil reading on the dipstick after changing oil.

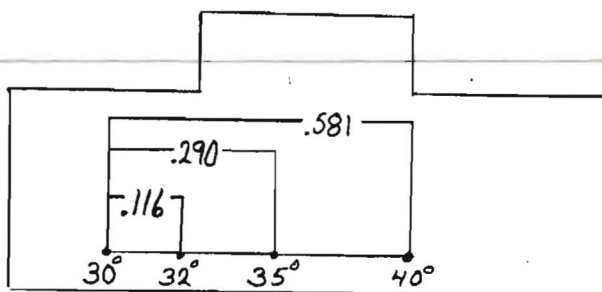
The cause is the dipstick not fully seating on the tube housing due to a restriction at the spot weld area of the tube and bracket. While this will not affect engine operation, it may be a customer concern. Replace the tube with Ford part number E4JL6754BA.

This is not a campaign; standard warranty applies.

### Tech Tip

When timing EN series generators, it is necessary to use an advance-style timing light due to certain fuels requiring degrees of advance past the Ford mark of 30.

If a standard light must be used, mark the dampner with the appropriate divisions for that advance requirement.



*Kirk Straight*

Kirk Straight  
Technical Service Representative  
Industrial Products

5. **Sensitivity**— If the engine tends to hunt under load conditions, increase the sensitivity screw where the spring link pivots. Any change in the setting of the sensitivity screw will require correcting the speed screw adjustment. Decreasing the sensitivity causes a slight speed increase that can be compensated for by turning the speed screw slightly counterclockwise to decrease spring tension.
6. **General** — Ensure all lock nuts are tightened as adjustments are completed. Governors cannot operate properly if there is binding, sticking, or excessive looseness in the connecting linkage or carburetor throttle assembly. A lean fuel mixture or a cold engine may cause hunting.
7. **Output** — Check the AC output voltage.
8. **Throttle stop** — With the engine stopped, see that the throttle stop lever (attaching the override lever, Figure 20) engages the carburetor throttle stop pin by  $1/4$  to  $1/2$  turn. This can be done by backing off the screw until it just clears the stop pin, then turning in  $1/4$  to  $1/2$  turn. This provides a "cracked open" throttle for good starting characteristics. Do not adjust the screw so far as to cause the engine to "diesel" and refuse to stop, thus defeating the purpose of the anti-dieseling control.
9. **Governor oil level** — Keep even with bottom of the oil level plug (refer to Figure 18). When adding oil to the governor, the oil should just start to flow out of the oil level plug hole. Do not overfill. Use a good grade engine oil of 10W-30 multiviscosity.
10. **Governor control linkage** — Keep the linkage lubricated every 100 hours (see Figure 21).

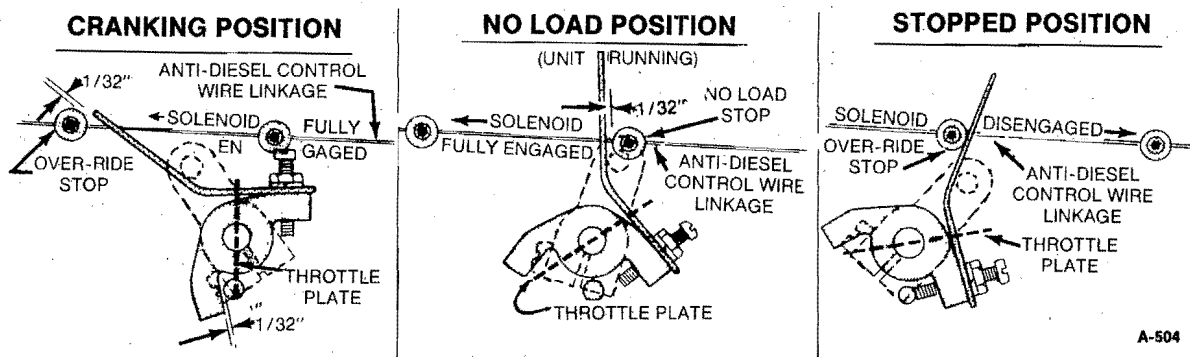


FIGURE 20. THROTTLE STOP

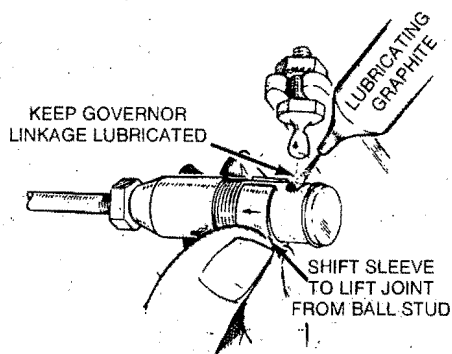


FIGURE 21. GOVERNOR CONTROL LINKAGE

## Anti-Dieseling Control

Normally factory adjustment should not be changed. Adjustment procedure is included with governor adjustment.

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

## MECHANICAL GOVERNOR

The governor controls the speed of the engine and, therefore, the generator output frequency (Figure 18). Engine speed also affects AC output voltage. Use either a tachometer or frequency meter to check engine speed for proper governor adjustment.

1. **Governor linkage** — With engine stopped, throttle held wide open, and tension on governor spring, adjust the governor linkage length by rotating the ball joint on the link so the throttle stop lever clears the stop pin by not less than 1/32 inch (0.8 mm).

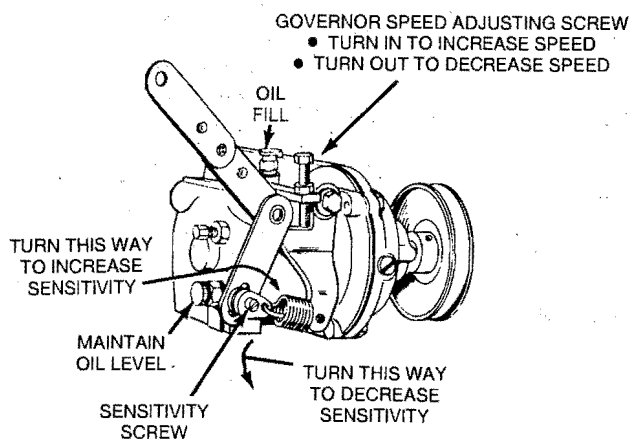


FIGURE 18. GOVERNOR ADJUSTMENT

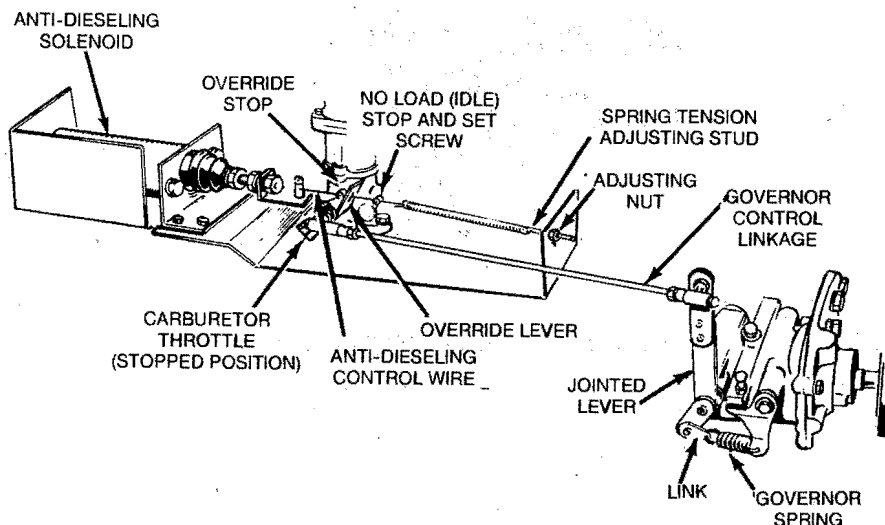


FIGURE 19. ANTI-DIESEL CONTROL

2. **Anti-diesel control** — Move override and no load stops (set screws on wire link, Figure 19) away from override lever so there is no effect on engine speed.

- a. Ensure the wire linkage is securely attached to the solenoid plunger. Do not shorten or lengthen this condition unless the spring tension at the opposite end cannot be fully adjusted by its stud, see Figure 19.
- b. Set the override stop (located nearer the solenoid) on the wire linkage to about 1/32 inch (0.8 mm) from the slotted override lever on the carburetor so it does not interfere with wide open throttle when the solenoid is fully engaged (plunger all-the-way in, as when engine is running).
- c. See that anti-dieseling control spring tension is just enough to positively bend governor's jointed lever and hold throttle closed during stopping. Spring tension adjusting stud serves also to rotate spring as necessary to hold linkage stops horizontally to engage flat against override lever.
- d. Set no load stop (set screw, located nearer the spring) on wire linkage 1/32 inch (0.8 mm) away from override lever while set is running at rated speed with electrical load removed (no load). Start and stop set to check adjustment.

Be sure all lock nuts are tightened as adjustments are completed.

3. **Warm-up** — Start the engine and allow it to reach operating temperature.
4. **Speed** — With no electrical load connected, adjust the speed adjusting screw to obtain 1890 r/min (63 hertz) for a 60 hertz set or 1590 r/min (53 hertz) for a 50 hertz set. Apply a full electrical load. The speed drop from the no load figure should be no more than 90 r/min (3 hertz) and no less than 45 r/min (1-1/2 hertz). An incorrect speed drop from no load to full load necessitates a sensitivity adjustment.

## Carburetor, Gas

Engines equipped for natural gas operation use a gas carburetor with combined regulator. Carburetor adjustments are the same as the combination gas/gasoline carburetor.

Conversion kits are available for LPG operation (Figures 15 and 16). Contact your local Onan representative for information. Give complete Model, Spec No. and Serial No. of set when requesting conversion information.

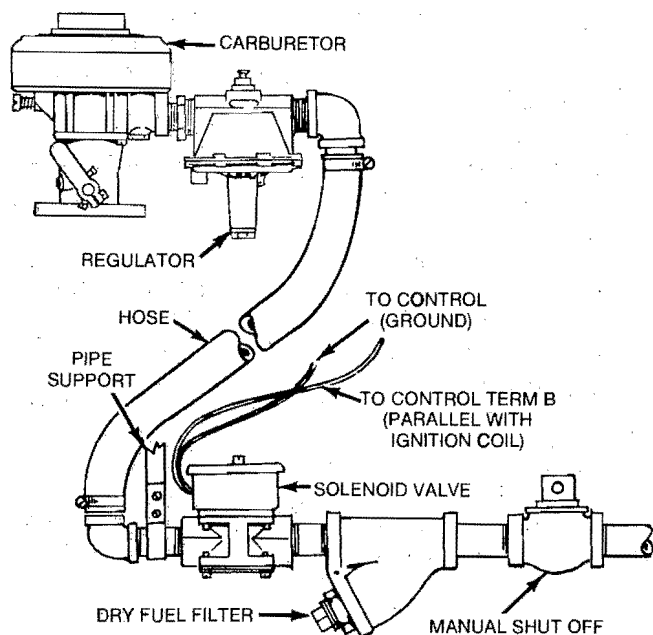


FIGURE 15. LPG VAPOR WITHDRAWAL

## ELECTRIC CHOKE

The 12-volt electric choke (Figure 17) is used on all gasoline fuel engines. The adjustable choke cover is held in place by three screws. The perimeter of the cover is divided into sections by small raised marks. One mark on the choke cover is labeled zero and the twelfth mark from zero is labeled with an asterisk (\*), which indicates the normal adjustment setting. A long raised line on top of the choke housing is used as the reference mark. Normal setting for the choke is made when the asterisk mark lines up with the reference line.

If overchoking occurs, loosen three locking screws and turn choke cover slightly counterclockwise (one or two notches will usually be sufficient). Tighten locking screws. To increase choking action, turn choke cover slightly to the right (clockwise). Retighten cover screws.

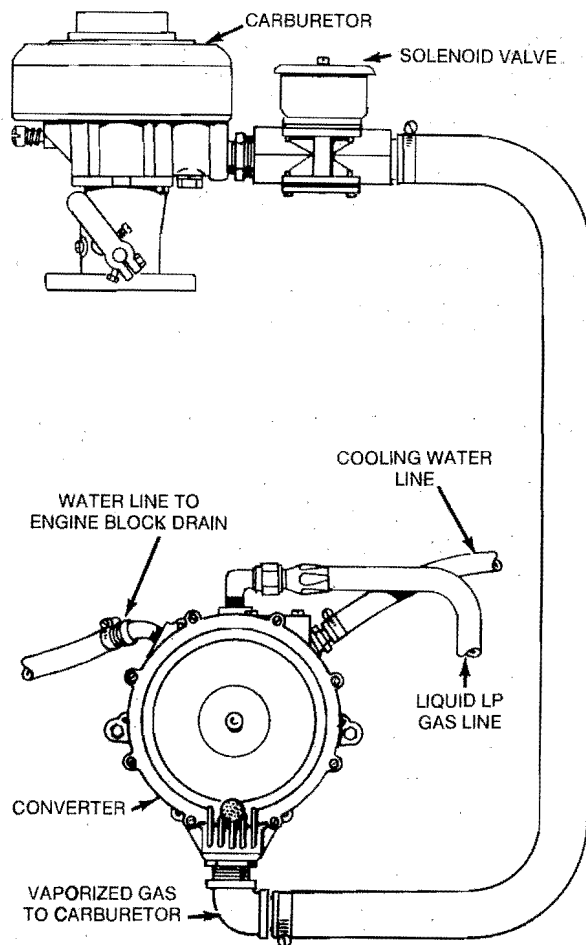
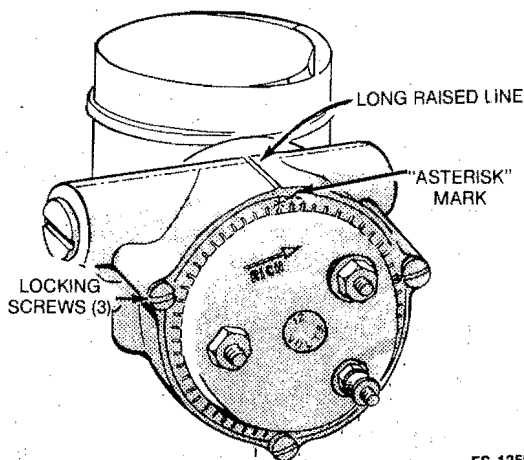


FIGURE 16. LPG LIQUID WITHDRAWAL



FS-1259

FIGURE 17. ELECTRIC CHOKE



# Adjustments

## CARBURETOR

The following carburetors were installed by Onan for a specific application and engine output. Use these instructions and adjustment procedures in preference to those given in the Ford Engine Manual

### Carburetor, Gasoline

Carburetors have main and idle adjusting needle valves. The main adjusting needle, at the bottom of the carburetor, affects operation at heavier load conditions. The idle adjusting needle, at the side of the carburetor, affects operation at light and no load conditions. For location of adjustments, see Figure 13.

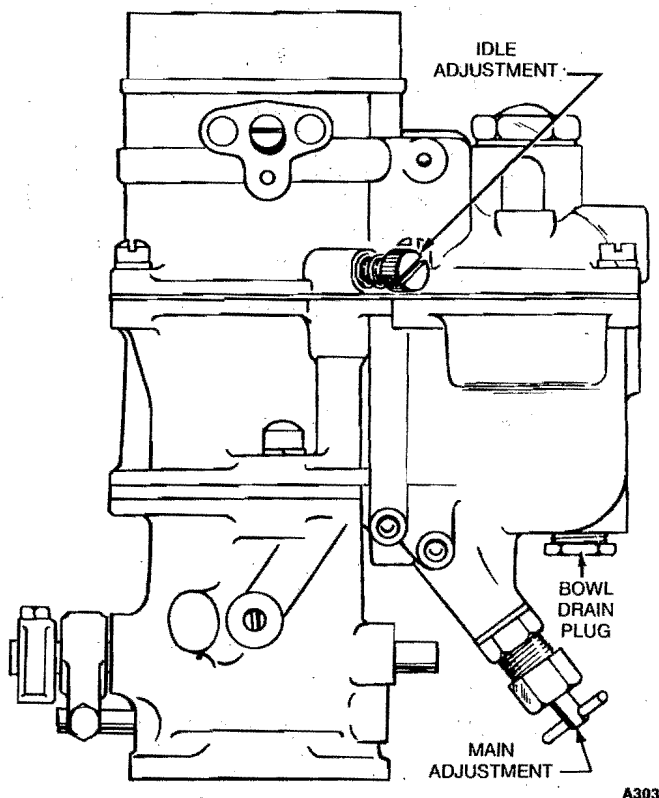


FIGURE 13. GASOLINE CARBURETOR

Under normal circumstances, factory carburetor adjustments should not be disturbed. If adjustments have been changed, an approximate setting of 1-1/2 turn open for idle needle and one turn open for main needle will permit starting. Adjust temporarily for smoothest running. Allow engine to thoroughly warm up before making final adjustment.

**CAUTION** Do not force idle screw against the seat. Damage to the screw and seat will otherwise result.

To adjust the idle screw, ensure no loads are connected to the generator. Slowly turn the idle adjusting screw out and disturb the governor linkage. When the unit starts to hunt, slowly turn the idle screw in until stability returns.

To adjust main needle, apply a full electrical load. Turn the main needle in until engine speed begins to drop. Slowly turn needle out until speed no longer rises. Try various electrical loads. If engine speed fluctuates at any load, turn main adjusting needle out slightly. Do not turn out more than 1/2 turn beyond original full load setting. If stable speed cannot be obtained by such carburetor adjustment, a change in governor sensitivity adjustment will probably be necessary.

### Combination Carburetor

If the engine is equipped with a combination carburetor (Figure 14), see that the gasoline shut-off valve is closed. The electric choke must be adjusted so the adjustable cover is turned 10 to 12 notches counter-clockwise from the asterisk (\*) mark. When properly adjusted, the electric choke will be completely open even at very low temperatures.

Gas fuel main adjustment should be made at full load only.

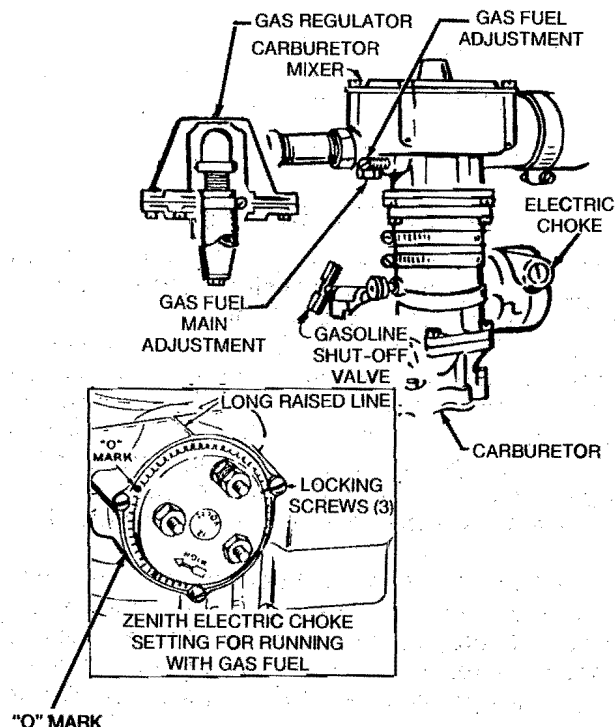


FIGURE 14. COMBINATION CARBURETOR

## Preparing Set for Storage - Indefinite Period

1. Drain the crankcase completely and refill with an engine preservative oil (SAE 10).
2. Run the engine until it is completely out of gasoline, then restart and run it on an unleaded, undyed gasoline for at least 10 minutes. Run the engine at 1800 r/min and treat the upper cylinders by spraying an engine preservative oil (SAE 10) into the carburetor air intake for about two minutes. Open the throttle for a short burst of speed, shut off the ignition and allow the engine to come to a stop while continuing to spray the oil into the carburetor air intake.
3. Disconnect and remove battery. Follow standard battery storage procedure. Apply film of non-conductive grease to terminal lugs.
4. Drain the oil and gasoline. Drain the water at the bottom of the radiator and side of the block.
5. Remove all grease and oil from the exterior surfaces of the engine.
6. Leave the spark plugs installed.
7. Seal all engine openings and accessories with water resistant adhesive tape. Mask off all areas to be used for electrical contact.
8. Make sure all surfaces are dry, then spray all taped openings, all engine accessories including ignition wiring, and all exterior surfaces of the engine with an ignition insulation compound.
9. Fill fuel tank to prevent condensation contaminates.
10. Provide suitable cover for entire unit.

## Returning Set to Service

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Refill crankcase with correct viscosity oil.
3. Clean and check battery. Measure specific gravity (1.260) at 77°F (25°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.***

4. Connect batteries.
5. Fill coolant system as described under the Lubrication System.
6. Verify that no load is connected to the generator.
7. Start engine.

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

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



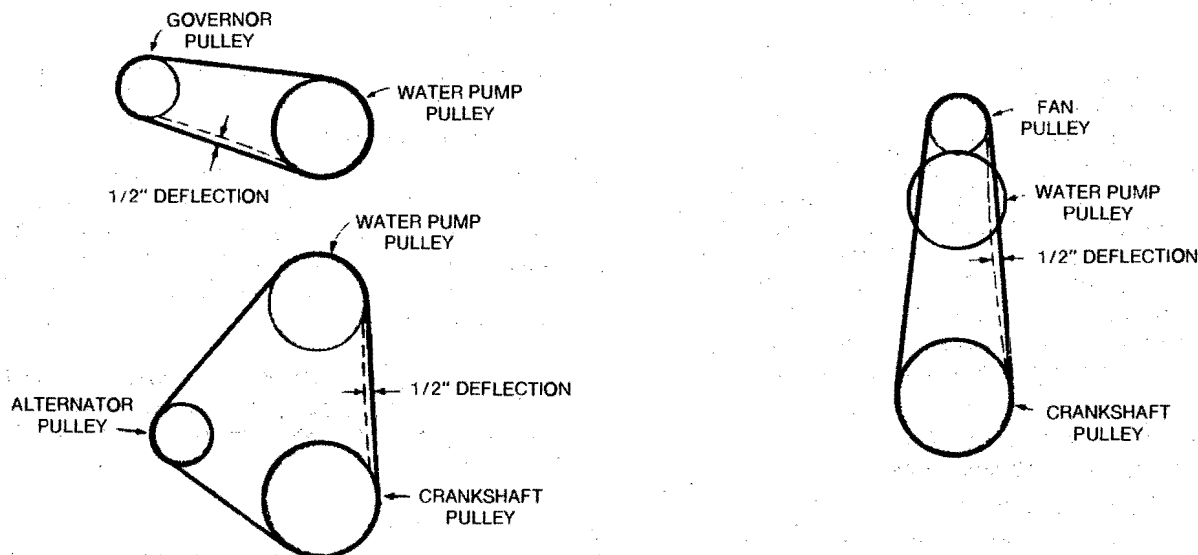


FIGURE 11. DRIVE BELT ADJUSTMENT

## 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 12) 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.*

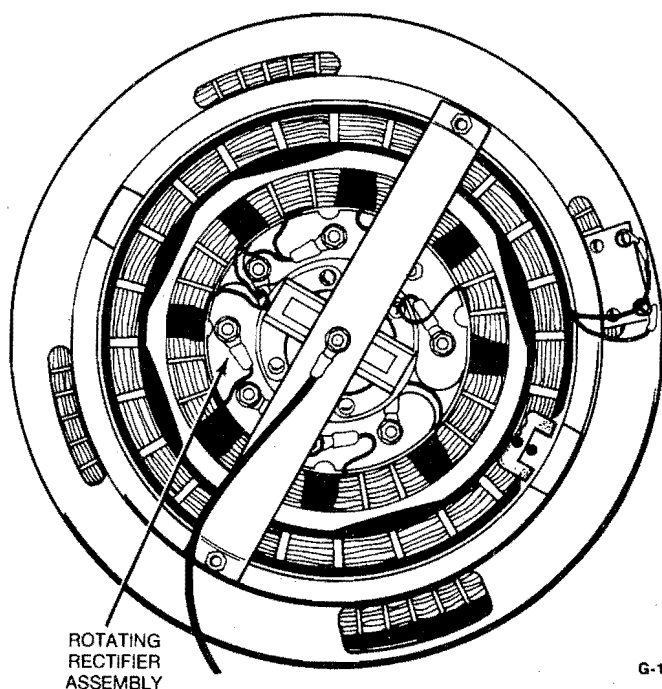


FIGURE 12. GENERATOR END VIEW

## Generator Bearing

Inspect the bearing for evidence of outer case rotation every 1000 hours while the unit is running.

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

Deterioration of the bearing grease due to oxidation makes this replacement necessary.

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

## 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 - One Month

1. Run the engine at 1800 r/min and treat the upper cylinders by spraying an engine preservative oil (SAE 10) into the carburetor air intake for about two minutes. Open the throttle for a short burst of speed, then shut off the ignition and allow the engine to come to a stop while continuing to spray the oil into the carburetor air intake.
2. Disconnect and remove battery.
3. Leave the spark plugs installed and cover all engine openings with dust-proof caps or shields.
4. Drain the oil, water and gasoline.

**▲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. If using a maintenance-free battery, disregard the sections on Checking Specific Gravity and Checking Electrolyte Level.

**▲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 (100 g/Litre) 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 ensure a thorough mixing of water and electrolyte. Incomplete mixing can allow the electrolyte to freeze and cause battery damage.*

**Battery, Hot Location**

Batteries will self-discharge very quickly when installed where the ambient temperature is consistently above 90°F (32.2°C), such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.260 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is diluted, but if the temperature is above 90°F (32°C), this should not be noticed. The lengthened battery life will be worth the effort.

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

**▲CAUTION**

*Discharged batteries are subject to severe damage if exposed to freezing temperatures. Store all batteries in a fully charged condition and maintain charge during storage.*

**DRIVE BELTS**

Three separate belts are used to drive the fan, water pump/alternator, and mechanical governor (Figure 11). Check the drive belts at the recommended interval. Remove the belt guard and inspect each belt for cracks, fraying, or glazing. Replace when necessary.

To adjust fan belt, loosen fan bracket screws, then move bracket up or down until a deflection of 0.50 in. (13 mm) is obtained between crankshaft pulley and fan pulley by applying a force of 10 pounds to the midpoint of the belt.

To adjust alternator or governor belt, loosen link clamp screw and the mounting bolts. Move alternator or governor toward or away from engine until a deflection of 0.50 in. (13 mm) is obtained between pulleys by applying a force of 10 pounds to the midpoint of the belt.

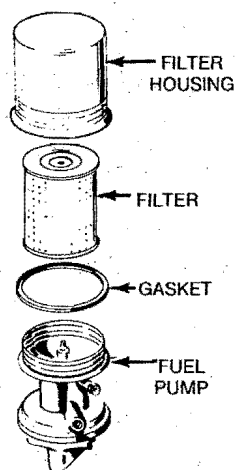
### **⚠ WARNING**

**Gasoline is extremely flammable and can cause severe personal injury or death if ignited. Keep fire or flame away while replacing the fuel filter.**

Place a new filter element over the spout in the fuel pump valve housing cover.

Be sure to use the proper type element for the installation.

Coat a new gasket with a light engine oil and position the gasket on the filter housing. Screw the filter housing onto the fuel pump. Hand tighten the filter housing until the gasket contacts the pump, and then advance it 1/8 turn. Start the engine and check for leaks.



B-370

**FIGURE 9. FUEL FILTER ASSEMBLY**

**Crankcase Ventilation (PCV) Valve:** Push fit in valve rocker cover. Remove and clean at every oil change. After cleaning, shake valve to ensure ball is free, then reinstall.

## **IGNITION SYSTEM**

The ignition system consists of the distributor, spark plugs, high tension wires, ignition coil, 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 a 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, or 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**

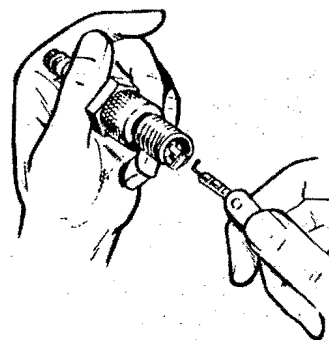
**The rotor can be damaged if dropped or handled roughly. Use care to avoid bending rotor blades while inspecting shaft.**

### **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 (Figure 10) to the amount specified in the Specifications section. Clean all dirt and grit away from the spark plug seats before installing plugs. Tighten to 15-20 ft-lbs (20-27 Nm).

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 10. 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.

### Water Jacket Heater (Optional)

A water jacket heater is optional equipment on the generator set. For efficient operation and optimum product life, perform the following procedure at least once a year (Figure 7).

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

#### **CAUTION**

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

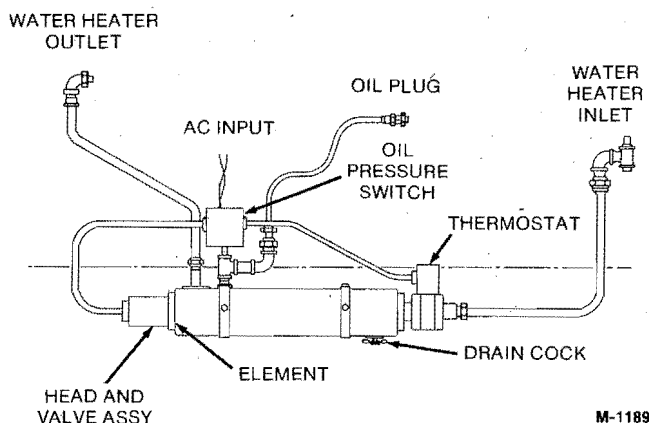


FIGURE 7. WATER JACKET HEATER MAINTENANCE

### FUEL SYSTEM

Use only a good quality fuel obtained from a reputable supplier. The quality of fuel used is important in obtaining dependable performance and satisfactory engine life. Fuels must be clean, completely distilled, well refined, and non-corrosive to fuel system parts.

#### **WARNING**

**Ignition fuel can cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, or other igniter near the fuel system.**

The following fuel systems are used with the generator set:

- Gasoline
- Natural Gas
- LP Gas (HD5 Vapor Withdrawal)
- LP Gas (HD5 Liquid Withdrawal)
- Combination Gasoline/Natural Gas

The maintenance procedures for air cleaners apply to all fuel systems. The maintenance procedures for fuel filters apply only to sets with the gasoline or combination gasoline/natural gas fuel systems.

### Air Cleaner

A set-mounted air cleaner with a single replaceable paper filter element is standard on all generator sets. Inspect the filter element at recommended intervals and clean or replace the filter as specified.

Remove the air cleaner wing nut and lift off the air cleaner cover and filter element (see Figure 8). 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.

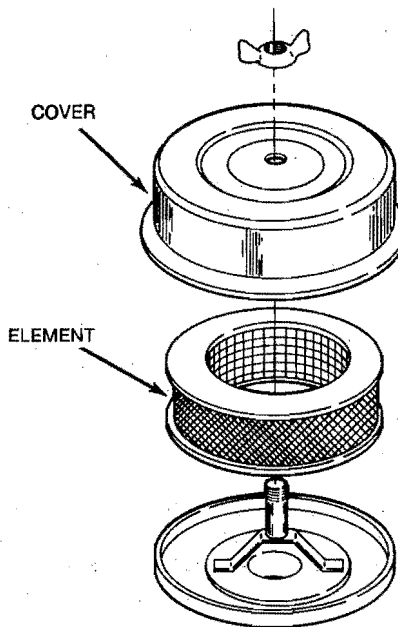


FIGURE 8. AIR CLEANER

#### **CAUTION**

**Do not clean the filter element by immersing it in a cleaning solution or the element can 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.

### Fuel Filter

Replace filter every 200 operational hours or as conditions require. Unscrew the filter housing from the fuel pump (Figure 9) and remove the filter element and gasket. Discard the element and gasket. Clean the filter housing in a petroleum cleaning solvent.

## 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. Refer to the FORD engine manual for additional information.

### 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 (Prestone II). If temperatures below  $-37^{\circ}\text{F}$  ( $-38^{\circ}\text{C}$ ) 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 Periodic Maintenance Schedule. 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.

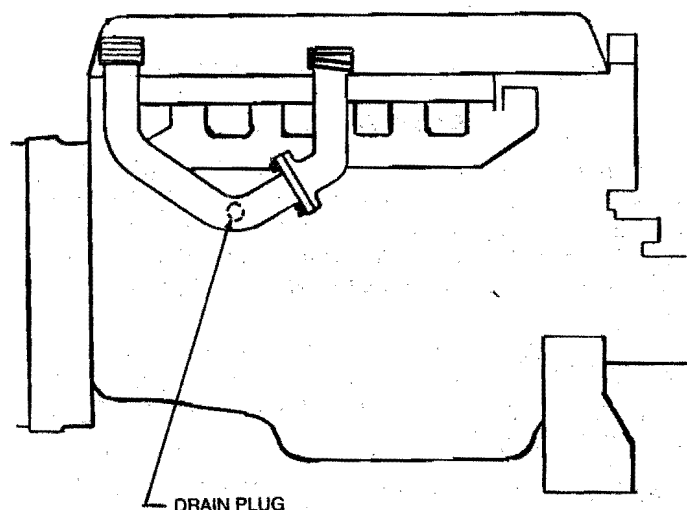
**WARNING** *The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury from the hot coolant. Remove the radiator pressure cap slowly after the engine has cooled.*

**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.*

### Drain 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 plug (see Figure 6). If genset is equipped with a water jacket heater, remove the hose that connects to engine block to drain water jacket. 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 or sediment.

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



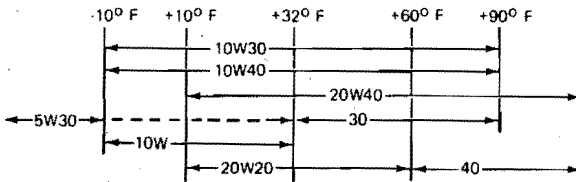
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FIGURE 6. WATER JACKET DRAIN

## Oil Recommendations

Refer to Figure 3 for the recommended oil viscosity grades at various ambient temperatures. Oils must conform to the American Petroleum Institute (API) classification SF. Lubricants that do not have both an SAE viscosity grade and an API service classification should not be used. Use only oils that are formulated to meet Ford Specification ESE-M2C153-A.

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.



Oil capacities (nominal)  
Oil Pan and Filter — 7-quarts (6.6 litres)

FIGURE 3. OIL RECOMMENDATIONS

## 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 the side of the engine. The dipstick is stamped **FULL** and **ADD** (Figure 4) 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.

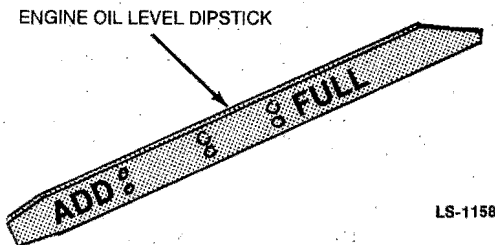


FIGURE 4. OIL LEVEL DIPSTICK

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. Operation below the **ADD** mark can cause loss of oil pressure while overfilling can cause foaming or aeration of the oil.

## 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 previously indicated.

**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 (Figure 5). Spin element on by hand until gasket just touches mounting pad and then turn an additional 3/4 to 1 turn. Do not overtighten.

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.

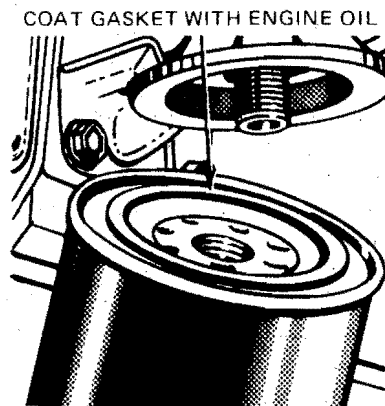


FIGURE 5. OIL FILTER ASSEMBLY



## 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 35 - 60 psi (241 to 414 kPa) when the engine is at operating temperature.

**Water Temperature Gauge:** The water temperature should be in the range of 180° to 195°F (83° 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 Onan distributor if any bulbs require replacement.

### Exhaust System

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, muffler, and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets, and joints and also make sure 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, return 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 that 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 that 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.

# Maintenance

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

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

Consult an authorized Onan distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable maintenance schedule. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period or after the number of operating hours indicated, whichever comes first. Use the schedule to determine the required maintenance and then refer to the following sections 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	400
Inspect Complete Set for Exhaust Leaks, etc.	x1			
Check Engine Oil Level	x1			
Check Radiator Coolant Level	x1			
Check Fuel	x1			
Check Governor Oil Level		x		
Check Air Cleaner (Clean or Replace as Necessary)		x2		
Check Electrolyte Level of Battery		x6		
Stop-Solenoid Linkage, Lubricate Governor Linkage		x2		
Change Engine Oil & Filter		x2		
Check All Hardware, Fittings, Clamps, Fasteners, etc.		x4		
Adjust Drive Belt Tension			x3	
Change Governor Oil			x	
Clean Fuel Lift Pump			x	
Clean Sediment Bowl & Filter			x	
Check Starter			x5	
Clean & Inspect Battery Charging (DC) Alternator			x	
Check AC Generator			x	
Inspect Spark Plugs, Replace if Necessary			x	
Replace Fuel Filter Assembly			x2	
Adjust Valve Clearances				x

x1 - After every run or exercise period.

x2 - Perform more often in extremely dusty conditions.

x3 - Adjust to 1/2-inch (12.5 mm) depression between pulley. Refer to Ford Engine Manual.

x4 - Or every three months.

x5 - Oil front bearing sparingly; check brushes.

x6 - Or every two weeks.

Note: The above schedule is a minimum requirement.

**TABLE 2. TROUBLESHOOTING (Continued)**

<b>SYMPTOM</b>	<b>CORRECTIVE ACTION</b>
<p>11. LO ENG TEMP lamp lights. Set is in standby mode but is not operating.</p> <p>(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>11. Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions.</p> <p>a. Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required.</p> <p>b. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required.</p> <p>c. Contact an Onan dealer or distributor if none of the above.</p>
<p>12. 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>12. The standard undesigned fault functions are programmed to shut down the set when a fault is sensed. Fault 1 is time-delayed 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 modes.</p>
<p>*13. Fault lamp lights but no fault exists. Engine gauges show oil pressure, engine temperature, and frequency (speed) are within normal limits.</p>	<p>13. 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>
<p>*14. Engine starts from generator control panel but will not start automatically or from a remote panel (Note: Run/Stop/Remote switch must be in the REMOTE position for automatic or remote starting).</p>	<p>14. Remote circuit breaker is tripped. Reset breaker and restart. Contact an Onan dealer or distributor if breaker trips after resetting.</p>
<p>*15. Engine will not crank.</p>	<p>15. Indicates possible fault with control or starting system. Check for the following conditions:</p> <p>a. Fault lamp on. Correct fault and reset control.</p> <p>b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections.</p> <p>c. Discharged or defective battery. Recharge or replace the battery.</p> <p>d. Contact an Onan dealer or distributor for assistance if none of the above.</p>
<p>*16. No AC output voltage.</p>	<p>16. Field breaker is tripped. Reset breaker. Contact an Onan dealer or distributor if voltage buildup causes breaker to trip.</p>
<p>*17. Green RUN lamp does not light following engine start-up.</p>	<p>17. Indicates possible Start/Disconnect relay failure. Contact an Onan dealer or distributor for assistance.</p>

**TABLE 2. TROUBLESHOOTING (Continued)**

SYMPTOM	CORRECTIVE ACTION
<p>*6. OVERCRANK lamp lights and engine stops cranking.</p> <p>or</p> <p>Engine runs, shuts down, and LO OIL PRES lamp lights.</p>	<p>6. Indicates possible fuel or ignition system problem.</p> <ul style="list-style-type: none"><li>a. Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required.</li><li>b. Check for dirty fuel filter and replace if necessary (see Maintenance section).</li><li>c. Check for dirty or plugged air filter and replace if necessary (see Maintenance section).</li><li>d. Check for loose connections in the ignition primary, ignition secondary, or solenoid valve circuits and correct as required.</li><li>e. Reset the control and restart after correcting the problem. Contact an Onan dealer or distributor for service if none of the above.</li><li>f. Check choke adjustment for dual-fuel system.</li></ul>
<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 Run/Stop/Remote switch is in the STOP position which will prevent automatic starting if an automatic transfer switch is used. Move the Run/Stop/Remote switch to the REMOTE position for automatic starting.</p>
<p>9. LO FUEL lamp lights. Engine continues to run.</p>	<p>9. Indicates gasoline fuel supply is running low. Check fuel supply and replenish if necessary. If set has a combination Gas/Gasoline fuel system, place fuel selector switch in the GAS position to change over to natural gas operation.</p>
<p>10. LO FUEL lamp lights. Engine shuts down and LO OIL PRES lamp lights.</p>	<p>10. Indicates engine has run out of fuel. Check fuel level and replenish as required.</p>

**TABLE 2. TROUBLESHOOTING**

<b>SYMPTOM</b>	<b>CORRECTIVE ACTION</b>
*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 the procedures in step 3. Use the following procedures if generator is powering critical loads and cannot be shut down. <ul style="list-style-type: none"> <li>a. Check air inlets and outlets and remove any obstructions to airflow.</li> <li>b. Open doors or windows in generator area to increase ventilation.</li> <li>c. Reduce load if possible by turning off non-critical loads.</li> </ul>
*3. HIGH ENG TEMP lamp lights. Engine shuts down.	3. Indicates engine has overheated and 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"> <li>a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary.</li> <li>b. Check for obstructions to cooling airflow and correct as necessary.</li> <li>c. Check for a slipping fan belt and tighten if loose.</li> <li>d. Reset control and restart after locating and correcting problem. Contact an Onan dealer or distributor if none of the above.</li> </ul>
4. PRE LO OIL PRES lamp lights. Engine continues to operate.	4. Indicates engine oil pressure has dropped to 20 psi (138 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 14 psi (97 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 35 to 60 psi (241 to 414 kPa).

\*Use these steps when troubleshooting two light control panels.

Run Lamp - See steps 1 and 17

Fault Lamp - See steps 3,4,6,7, and 13.

Other Fault - See steps 14, 15, and 16.

## Low Temperatures

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

## High Temperatures

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

## TROUBLESHOOTING

The generator has a number of sensors that continuously monitor the engine for abnormal conditions. The engine monitor will turn on a fault lamp, activate an external alarm and stop the engine depending on the condition. If the generator set shuts down, the operator can restart the set after making adjustments or corrections.

The following troubleshooting charts list symptoms and corrective action for the two fault systems. See Table 1 for the fault lamp options and included features.

If the external alarm is activated, check the control panel to determine which fault lamp is lit. The procedures for locating a problem and making corrections are covered in Table 2. If a major problem is indicated, contact your Onan distributor for service.

**⚠ WARNING** *Accidental starting of the generator set can cause severe personal injury or death. Place the control switch in Stop position and disconnect the battery cable before inspecting set.*

### Resetting the Control

The external alarm and fault lamp can be deactivated by placing the Run/Stop/Remote switch in the Stop position and pressing the adjacent Reset button. Locate the problem and correct before restarting the generator set.

**TABLE 1. FAULT LAMP OPTIONS**

SYSTEM	FAULT	FAULT LAMP	STOP ENGINE	EXTERNAL ALARM
Standard Fault Lamp and Run Lamp	Overcrank	x1	x	x
	Overspeed	x1	x	x
	Low Oil Pressure	x1	x	x
	High Engine Temperature	x1	x	x
12-Lamp (Includes RUN lamp)	Overcrank	x	x	x
	Overspeed	x	x	x
	Low Oil Pressure	x	x	x
	High Engine Temperature	x	x	x
	Pre Low Oil Pressure	x	*x	*x
	Pre High Engine Temperature	x	*x	*x
	Low Engine Temperature	x		
	Low Fuel	x		
	Switch Off (In Stop Mode)	x	x	
	Two Customer Selected Faults	x	x	x

\* - If factory programmed for shutdown

x1 - Single fault lamp for four faults



## 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 (refer to 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. The starter will also disconnect if the engine does not run after being cranked for a specific period of time.

### 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 Remote 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.

### Start-Up Checks

Observe the oil pressure gauge after the engine is started. A normal oil pressure reading (at operating temperature) is between 35 to 60 psi (241 to 414 kPa). The following gauges should also be checked for normal readings:

- DC Ammeter - Normal charging rate is 1 to 15 amperes depending on battery state of charge.
- AC Voltmeter - Generator output voltage should be stable and not vary more than  $\pm 1\%$  of the rated value while under load.
- Frequency Meter - Generator frequency should be stable.
- Water Temperature - Run the generator set for about 10 minutes and then check the water temperature gauge. The engine should stabilize between 180 to 195 °F (83 to 91 °C).

## 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

Move the Run/Stop/Remote switch or the remote starting switch to the STOP position.

## 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.

### Exercise Period

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

To avoid excessive engine wear, exercise the generator set at least once a week for a minimum of 30 minutes. Run the set with a load applied to allow the engine to reach normal operating temperature. Exercising will keep the engine parts lubricated, maintain fuel prime, and prevent electrical relay contacts from oxidizing to ensure reliable starts. Top off the fuel tank after each exercise period.

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.

### Combination Gas/Gaso Operation

Generator sets with a combination gas/gasoline carburetor can operate on either natural gas or gasoline.

Whenever gasoline is used as backup, it may be necessary to periodically burn up the old gasoline to prevent it from going flat. Replace the gasoline at least on a yearly basis.

Under normal conditions, the set should be started on gasoline. Place the fuel selector switch (located near base of carburetor) to the GASOLINE position and start the set. Operate the set long enough (approximately 3 minutes) for the choke to open and place the fuel selector switch in the GAS position. This will change the set to natural gas operation.

If it is necessary to start the set on natural gas, the choke must be adjusted to the fully open position before the set will start. Make a mark on the choke housing to indicate the position of the choke cover index pointer. Loosen the three choke cover screws and rotate the choke cover counterclockwise approximately 90°. Tighten the three choke cover screws and place the fuel selector switch in the GAS position. The set may now be started on natural gas.

To return the set to gasoline starting mode, stop set and allow choke cover to cool. Loosen choke cover screws and rotate cover clockwise to align choke cover index pointer with mark on choke housing. Tighten choke cover screws and place fuel selector switch to the GASOLINE position.

## 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 2) 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  $2200 \pm 100$  r/min, 50 hertz units at  $1900 \pm 100$  r/min.
- Low Oil Pressure - Shuts down the engine immediately if oil pressure drops below 14 psi (97 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.

A pre-low oil pressure sensor and lamp (used with optional 12-lamp system) provides an alarm that oil pressure is marginally low, 20 psi (138 kPa) or less. The cause should be found and corrected as soon as possible.

- High Engine Temperature - shuts down the engine immediately if coolant temperature rises about  $215^{\circ}\text{F}$  ( $102^{\circ}\text{C}$ ) 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-high engine temperature sensor and lamp used with optional 12-lamp systems, provides an alarm that engine temperature is marginally high,  $205^{\circ}\text{F}$  ( $97^{\circ}\text{C}$ ). The cause should be found and corrected as soon as possible.

**⚠ WARNING** *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.

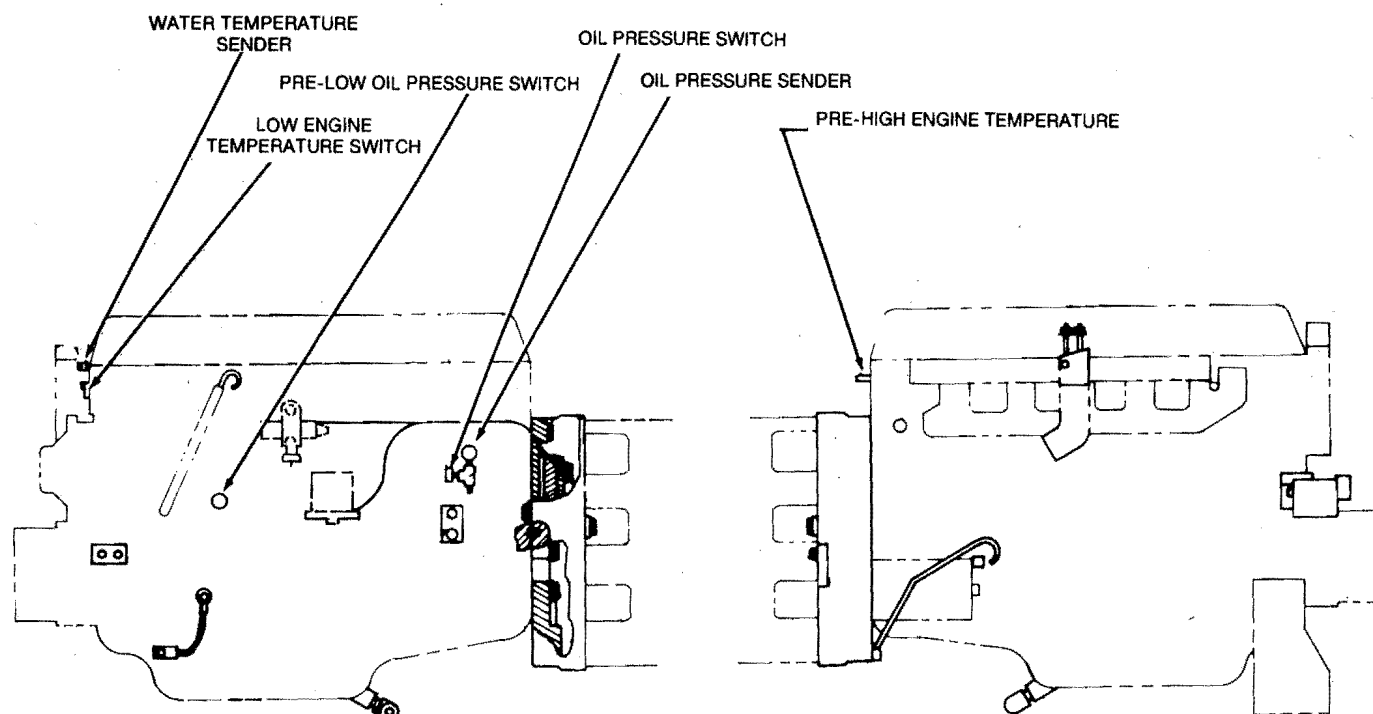


FIGURE 2. ENGINE SENSOR LOCATION

- **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 fault (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)** indicates fuel supply is marginally low.
- **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.

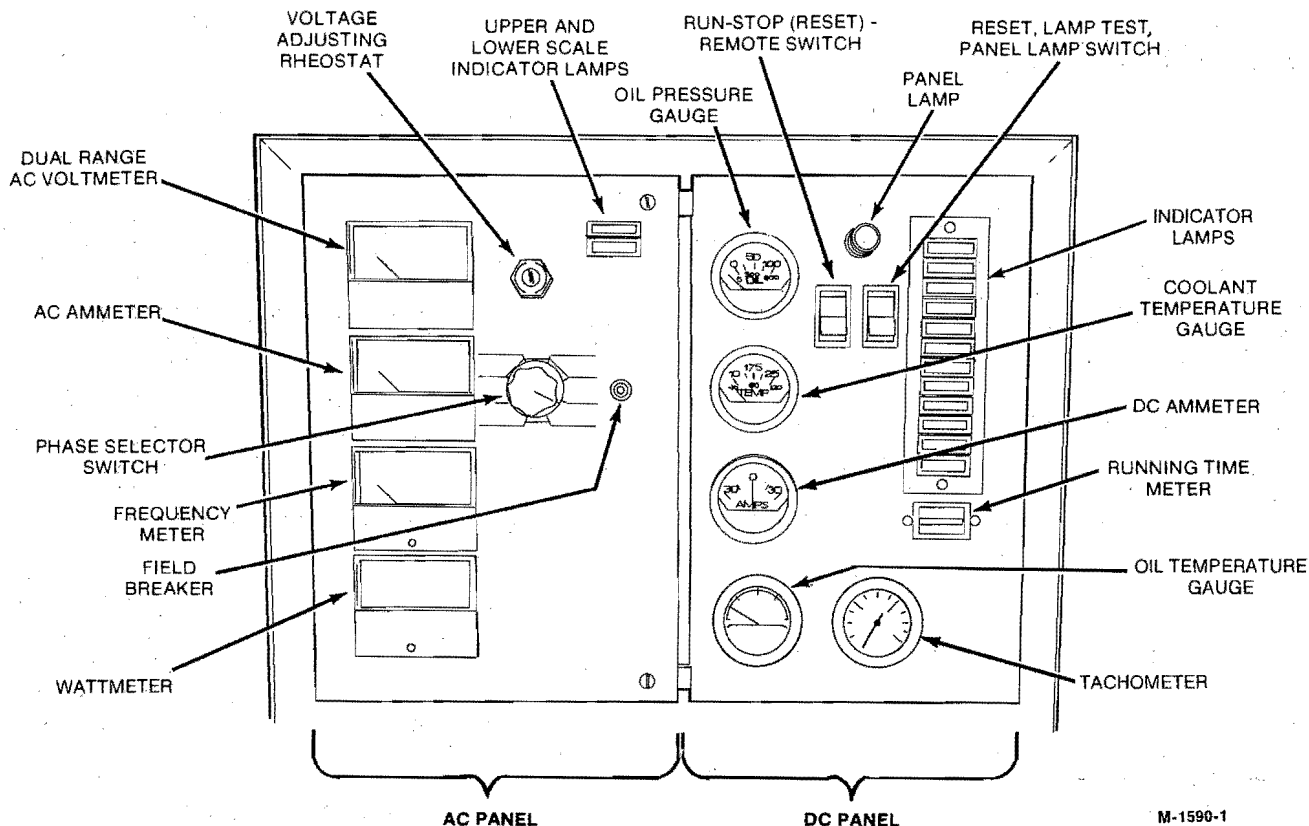


FIGURE 1. CONTROL PANEL

#### 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 for 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.

# Operation

## GENERAL

This section covers starting and operating the generator set. It is recommended the operator read through this entire section before attempting to start the set. It is essential 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 as 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 or running.

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

## Fuel

Determine the type of fuel system used with the set and then check the fuel supply as specified by the following:

- Gasoline - Verify that the fuel tanks have sufficient fuel for the expected period of operation.

### ▲WARNING

*Spilled fuel can ignite and cause serious personal injury or death.*

*Never fill the fuel tank when the engine is running.*

- Gaseous - Open all manual shutoff valves in the fuel supply system.
- Combination Gas/Gaso - Place fuel selector switch (located near base of carburetor) in the GASOLINE position for starting. If it is necessary to start the set on gaseous fuel, refer to Combination Gas/Gaso in this section for the recommended conversion procedures.

## 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 1. 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 formed during the combustion of hydrocarbon fuels. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning are the following:*

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

*If you or anyone else experience any of these symptoms, shut down the unit and get out into the fresh air immediately. If symptoms persist, seek medical attention. DO NOT OPERATE THE UNIT UNTIL IT HAS BEEN INSPECTED AND REPAIRED.*

*The best protection against carbon monoxide inhalation is proper installation and regular, frequent visual and audible inspections of the complete exhaust system.*

# Specifications

# 45 kW EM

### ENGINE DETAILS

Engine .....	Ford CSG-649I
Engine Speed	
60 Hertz .....	1800 r/m
50 Hertz .....	1500 r/m
Fuel .....	Gas/Gaso
Battery Requirements (Minimum)	
SAE Number .....	60
Voltage .....	12
Battery Charging Current .....	35 Amperes Max
Starting Method .....	Solenoid Shift

### GENERATOR DETAILS

Type .....	UR
Rating	
60 Hertz .....	45 kW (56.45 kVA)
50 Hertz .....	37 kW (46.87 kVA)
Phase .....	3

### CAPACITIES AND REQUIREMENTS

Cooling System (Engine and Radiator) .....	20 quarts (19 litres)
Engine Oil Capacity (With Filter) .....	7 quarts (6.6 litres)

### TUNE-UP SPECIFICATIONS

Spark Plug Gap .....	0.042 to 0.046 (1.05 to 1.15 mm)
----------------------	----------------------------------



# Specifications

# 30 kW EK

## ENGINE DETAILS

Engine .....	Ford CSG-649I
Engine Speed	
60 Hertz .....	1800 r/m
50 Hertz .....	1500 r/m
Fuel .....	Gas/Gaso
Battery Requirements (Minimum)	
SAE Number .....	60
Voltage .....	12
Battery Charging Current .....	35 Amperes Max
Starting Method .....	Solenoid Shift

## GENERATOR DETAILS

Type .....	UR
Rating	
60 Hertz .....	30 kW (37.5 kVA)
50 Hertz .....	25 kW (31.25 kVA)
Phase .....	3

## CAPACITIES AND REQUIREMENTS

Cooling System (Engine and Radiator) .....	20 quarts (19 litres)
Engine Oil Capacity (With Filter) .....	7 quarts (6.6 litres)

## TUNE-UP SPECIFICATIONS

Spark Plug Gap .....	0.042 to 0.046 (1.05 to 1.15 mm)
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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 Maintenance and Operator's Manual for the CSG-6491 engine. The engine manual may be used in conjunction with the EK-EM generator set Operator's Manual. The operation and maintenance procedures for the complete generator set (including the engine) are covered in the EK-EM Operator's Manual. In case of conflicting information, the EK-EM 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. The Onan nameplate is located on the side of the generator control box.

**Onan GenSet**

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	15/230	10	15/230	10

For Elec \_\_\_\_\_ PF: \_\_\_\_\_ Bat: \_\_\_\_\_

Eqpt Only \_\_\_\_\_

Insul - NEMA Class **F** Amb 40°C

Onan Corporation Minneapolis, Mn 55432 USA

M-1592

## ⚠ WARNING

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

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