Onan

Operator's Manual

6.3 kW

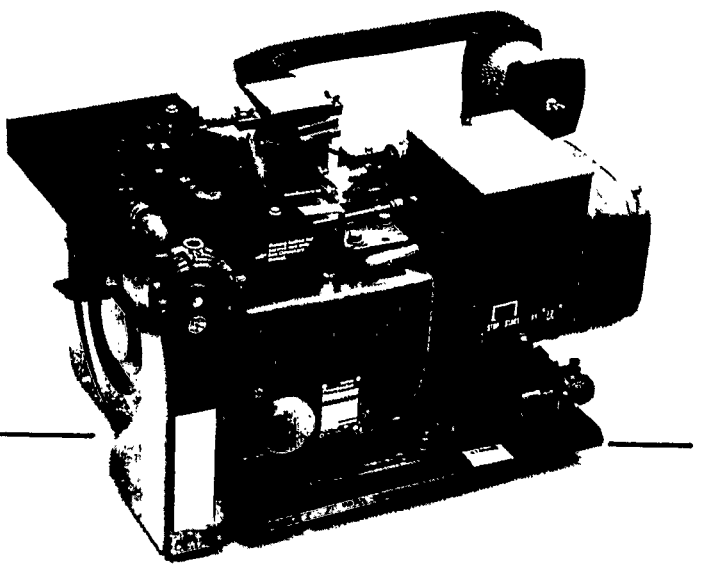
NHL

GenSet

Liquid LPG Fuel
RV Electric Generating Set

UL LISTED

CSA



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(SPEC P)
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Safety Precautions

⚠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.***

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.

Do not work on this equipment when mentally or physically fatigued.

- **Use Extreme Caution Near Fuel. A constant potential explosive or fire hazard exists.**

Do not fill fuel tank near unit with engine running. Do not smoke or use open flame near the unit or the fuel tank.

Be sure all fuel supplies have a positive shutoff valve.

Use a non-metallic, non-conductive, flexible section of fuel line between the generator set and stationary fuel line in vehicle.

LPG: The propane fuel supply lines MUST comply with all requirements of NFPA 501C Section 3-5, paragraphs 1.1 and 1.2 as well as Canadian Gas Association Bulletin B149.2-78. The installer must review and comply with all applicable codes regarding fuel tanks, supply lines, and pressure testing complete system for leaks after installation is complete and PRIOR to initial operation of the generator set.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper 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.

- **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.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

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.

Use extreme caution when working on electrical components. High voltages cause injury or death.

Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician.

- **Do Not Smoke While Servicing Batteries**

Batteries emit a highly-explosive gas that can be ignited by electrical arcing or by smoking.

- **Exhaust Gases Are Toxic**

Never sleep in the vehicle with the generator set running unless the vehicle is equipped with an operating carbon monoxide detector.

Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped.

Be sure the unit is well ventilated.

- **Keep the Unit and Surrounding Area Clean**

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.

When cleaning generator set, provide cover or other protection so that cleaning and rinse water, and other contaminants are not allowed into the generator, air cleaner, control box, fuel solenoid, or electrical connectors. Generator set operation and internal components can be adversely affected.

Do NOT clean the generator set while unit is operating. This can result in personal injury or product or property damage.

Do NOT use high pressure air, water, or steam for cleaning generator set and compartment. Dirt and other foreign matter can be forced into generator, engine and control housings. Generator set operation and internal components can be adversely affected.

Do NOT use high strength solvents. They can damage electrical connectors.

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.

- **Protect Against Moving Parts**

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be permitted because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep power shields and guards in position.

If adjustments *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

- **General**

Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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TO THE OWNER

Welcome to the growing family of *Onan Power users*. . . We are proud to have you as a customer.

Read this manual carefully and observe all safety rules within. Operating instructions, adjustments and periodic maintenance procedures are given so that you . . . the owner, can keep your unit running like new and expect many years of dependable service from it. Remember . . . any machine, regardless of design or type, will perform only in relation to the services it received.

If your generator set needs special attention, ask your Onan dealer for assistance; the Onan Parts and Service Organization has been factory-trained to provide up-to-date know-how for keeping your RV electric generating set "on the road".

A reader comment form is located next to the rear cover. Your comments and questions about this manual will help us produce a better publication in the future. Please detach and fill out this card and send back to Onan Corporation. Postage is prepaid.

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WARNING

TO PREVENT FIRE OR ACCIDENT HAZARD . . . THIS UNIT MUST BE INSTALLED ACCORDING TO THE MANUFACTURER'S DETAILED INSTALLATION PROCEDURES OBSERVING ALL MINIMUM CLEARANCES.

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, ANY INSTALLATION AND ALL SERVICE MUST BE PERFORMED BY QUALIFIED PERSONNEL.

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General Information

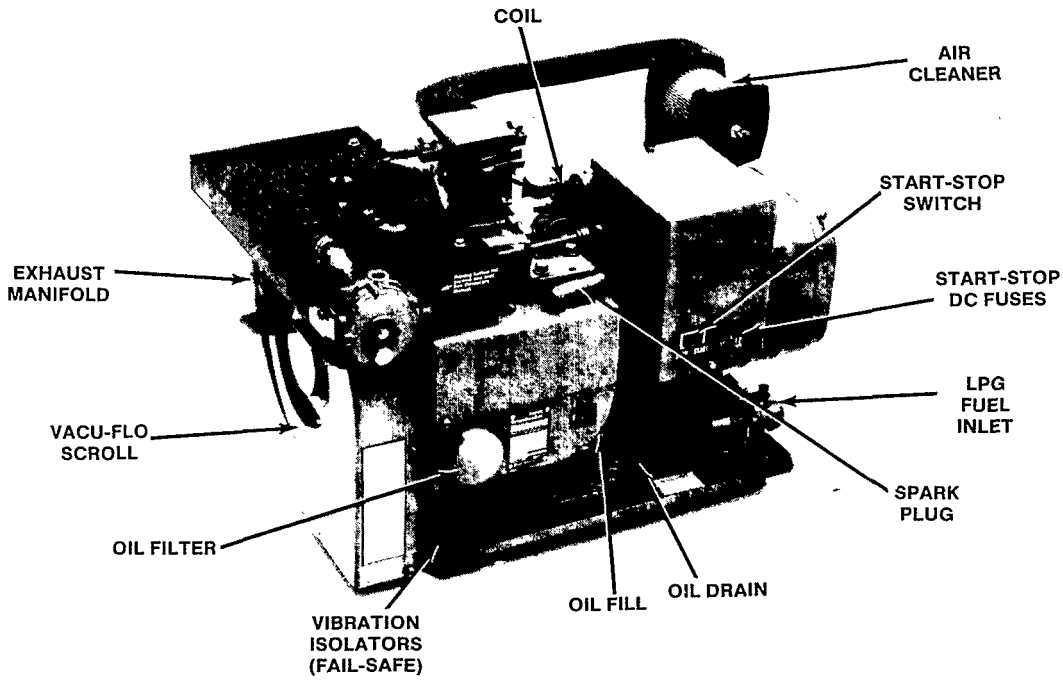
YOUR MANUAL

This manual contains operation and other information to properly maintain, service, and make adjustments on your NHL generator set. Study and follow the instructions carefully. A well-planned service and maintenance program will result in longer unit life and better performance. Because the most important part of repair is diagnosis, a troubleshooting chart is included.

Throughout the manual, engine end of the generator set is the front. Left and right sides are determined when facing the engine (front) end.

When contacting your Onan dealer, distributor, or the factory about the generator set, always supply the complete model number and serial number as shown on the nameplate (se *Model Designation* following). This information is necessary to identify your generator set among the many types manufactured by Onan.

Onan electric sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Upon receiving your unit, check it thoroughly for any damage that may have occurred during shipping. Tighten loose parts, replace missing parts and repair any damage before operating the unit.



TYPICAL NHL FOR RECREATIONAL VEHICLES

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Specifications

This manual contains SI metric equivalents that follow immediately in parentheses after the U.S. customary units of measure.

GENERAL

Nominal Dimensions of Set	
Height	19.50 in. (495 mm)
Width	20.00 in. (508 mm)
Length	33.37 in. (848 mm)
Weight	305 lbs. (138 kg)

ENGINE DETAILS

Manufacturer	Onan
Number of Cylinders	Two
Displacement (cubic inches)	60 in^3 (983 cm^3)
Cylinder Bore	3-9/16 in. (90.49 mm)
Piston Stroke	3 in. (76.20 mm)
Compression Ratio	7.0 to 1
Engine Speed	1800 rpm
Engine Design	Four Cycle, Air Cooled, L-Head Horizontally Opposed
Starting System	Exciter Cranking (Generator)
Ignition	Battery
Recommended Fuel	Propane (Commercial or HD-5 Grade)
Average Fuel Consumption (at rated load & speed)	1.70 Gallons per Hour (6.44 L)

GENERATOR DETAILS

Manufacturer	Onan
Design	Revolving Armature, Four Pole, 1800 rpm
Rating (in watts 60 Hertz)	6,300 (6.3 kW)
Voltage	120 or 120/240
Current Rating (amperes)	
120 Volt	52.5 Amperes
240 Volt	26.25 Amperes each leg
Phase	Single
Wire	4 Wire Reconnectible
Output Rating	Unity Power Factor
Cranking Current	100 Amperes (Nominal)

CAPACITIES AND REQUIREMENTS

Oil Capacity	3 U.S. Quarts (2.8 lit) Plus 1/2 Quart for oil filter change
Recommended Battery	12 Volt 74 Amp/Hr (266.40 kC)
Battery Charge Rate (Fixed)	1-1/2 Amperes
Ventilation Requirements (Total-No Restrictions)	120 sq. in. (774 cm^2)

TUNE-UP SPECIFICATIONS

Spark Plug Gap	.020 in (0.51 mm)
Breaker Point Gap (Cold Setting)	.016 in. (0.41 mm)
Ignition Timing Reference (Cold Setting)	20° BTC
Valve Tappet Clearance	
Intake	.005 in. (.127 mm)
Exhaust	.013 in. (0.330 mm)

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Installation Checks

INSTALLATION

Nearly all Onan electric generating sets are installed by the motor home manufacturer. Although the manufacturer must follow safety codes when installing, certain installation problems could arise after the unit is installed and subjected to vibration. There are a few areas that you as the operator should be concerned with. If in doubt about any aspect of your generator set's operation or safety, contact your nearest authorized Onan Service Center. A daily inspection of your installation should include the following:

EXHAUST

Check for leaks around manifolds, gaskets, and welds. Make sure exhaust lines are not heating surrounding areas excessively. If so, have corrected immediately. Remember EXHAUST GASES CONTAIN DEADLY CARBON MONOXIDE. Be sure all holes to the inside of RV from set compartment are sealed to prevent poisonous exhaust gases from entering vehicles.

WARNING **All exhaust shielding supplied with generator set MUST be properly installed to prevent overheating of compartment walls or the possibliity of fire.**

WARNING **Do not terminate exhaust under vehicle, as carbon monoxide gas is poisonous. Direct exhaust gases away from window and door openings.**

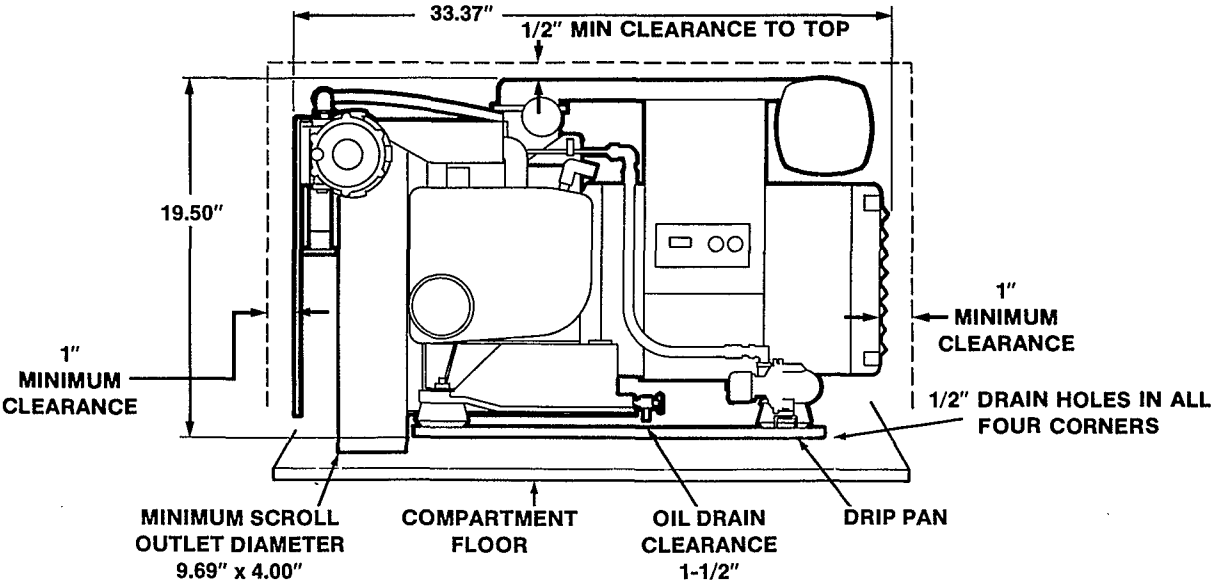
LIQUID PROPANE FUEL SYSTEM

WARNING ***Leaking propane will cause fumes which could EXPLODE. Check around all fuel system components and fuel line connections for loose or leaking joints. Make sure fuel lines are not rubbing against anything which could cause them to break. If at all connections are OK in a "static condition", recheck all joints and connections using a soap and water mixture with set running.***

ELECTRICAL

AC Output: All AC leads (M1, M2, M3 and M4) terminate in generator sets junction box. These wires should be connected to distribution box with multistrand wire enclosed in a flexible conduit. Check all wires (to and from the generator set) for fraying and loose connections. For information on load connections refer to operation section following.

Battery Connections: Battery positive (+) connection connects to start solenoid. Battery negative connects to location on rear of generator. Check terminals on set and battery for clean and tight connections.



1. DIMENSIONS IN ( ) ARE MILLIMETERS
2. APPROX WEIGHT: 305 LBS MASS: 138 kg
3. A 1.00" (25) MIN CLEARANCE REQUIRED AROUND SET AND .50 (13) MIN ABOVE CARB TO COMPARTMENT WALLS OR SOUND INSULATION (OIL FILTER MAY PROTRUDE INTO 1.00" (25) CLEARANCE).
4. VACU-FLO SCROLL EXTENDS BELOW MOUNTING PLATE
5. FOR CUSTOMERS COMPARTMENT HOLE SIZE FOR SCROLL:
   5:1 WIDTH: 4.00 (102)
   5.2 LENGTH: 9.69 (246)

FIGURE 1. INSTALLATION OUTLINE

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Onan recommends using a separate battery for operation of the generator set in addition to the regular vehicle starting battery. Refer to individual installation guide for additional information on battery sharing.

Grounding: Generator must be effectively bonded to recreational vehicle chassis.

For additional information on installation contact your Onan Service Representative or request Installation Guide #940-0625.

Vehicle chassis (frame) ground and the battery and generator set ground should all be electrically connected to be at 0 ground potential. All Onan units are designed for negative ground application.

WARNING Mount the battery in a separate compartment from the set or any spark-producing device to prevent fire or explosion.

VENTILATION

The biggest enemy of electric generating sets installed in motor homes is excessive heat. Make sure the set's air inlet and outlet are not plugged with dust, dirt, bugs, leaves or anything that could restrict cooling air.

WARNING Don't use discharged cooling air for compartment heating since it could contain poisonous exhaust gases.

WARNING Do not terminate exhaust under vehicle, as carbon monoxide gas is poisonous. Direct exhaust gases away from window and door openings.

WARNING On all listed models with exhaust shielding supplied with unit, shielding MUST be properly installed to prevent overheating of compartment walls or the possibility of fire. Refer to appropriate installation guide for each model for details.

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

WARNING DO NOT DISCONNECT BATTERY CABLES FROM BATTERY WHILE GENERATOR SET IS CRANKING OR RUNNING; SPARKS MAY CAUSE AN EXPLOSION.

IMPORTANT: Certain states (particularly California) have state ordinances pertaining to the type and usage of exhaust muffler/spark arresters on internal combustion engines or engine driven equipment when used in a recreational vehicle such as electric generating sets. Be sure your installation meets all Federal, State and local codes pertaining to your unit. Failure to provide and maintain a spark arrester may be in violation of the law.

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 vehicle with the generator set running unless the vehicle 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.

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Operation

BEFORE STARTING

Inspection: Inspect the engine visually before starting. Check for loose or missing parts or any shipping damage.

CRANKCASE OIL

The set oil capacity is 3 U.S. quarts (2.8 lit) plus 1/2 quart for oil filter change. Fill the crankcase until the oil reaches the "FULL" mark on the oil level indicator (Figure 2). Do NOT OVERFILL. (Overfilling may cause foaming and engine shutdown.) Always change the oil filter when changing oil. Refer to *Periodic Maintenance Schedule* in *MAINTENANCE* section for service interval.

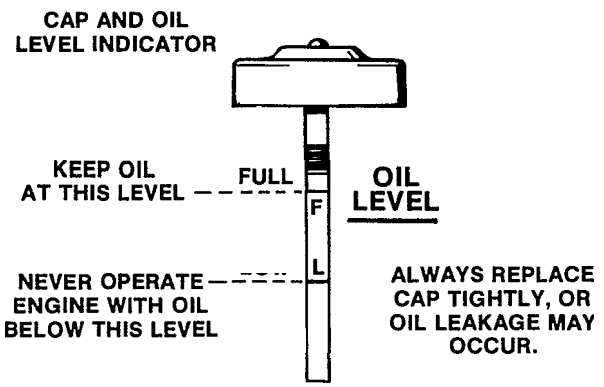


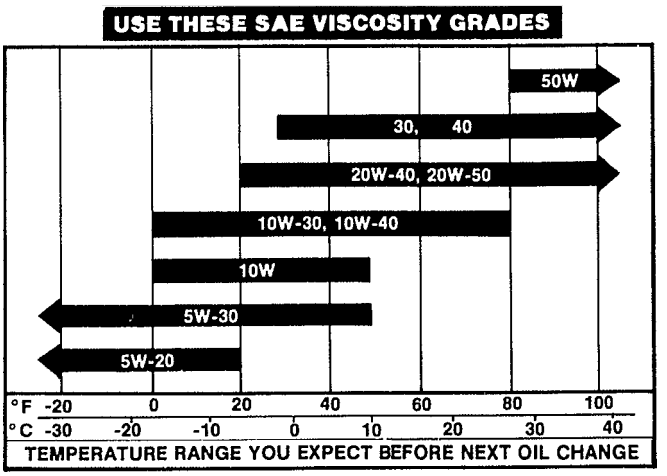
FIGURE 2. CHECKING OIL LEVEL

Be sure to fill the crankcase with oil to the "FULL" mark on the oil level indicator. Use oil with the API (American Petroleum Institute) designation SE or SE/CC. Oil should be labeled as having passed MS Sequence Tests (also known as having passed ASTMG-1V Sequence Tests). Refer to oil chart for recommended viscosity and temperature.

Oil consumption may be higher with a multigrade oil than with a single grade oil if both oils have comparable viscosities at 210° F (99 °C). Therefore, single grade oils are generally more desirable, unless anticipating a wide range of temperatures.

Use of the same grade and quality of oil as that used in your recreational vehicle engine is acceptable as long as unit is serviced regularly and oil meets requirements shown in chart.

WARNING **Do NOT check oil while the generator set is operating. Hot oil could cause burns by blowing out of oil fill tube due to crankcase pressure.**



Check oil level daily and change oil every 100 normal operating hours. See Figure 3 for location of oil drain. If operating in extremely dusty or dirty conditions, the oil might have to be changed sooner. When adding oil between changes, use the same brand as in the crankcase. Various brands of oil might not be compatible when mixed.

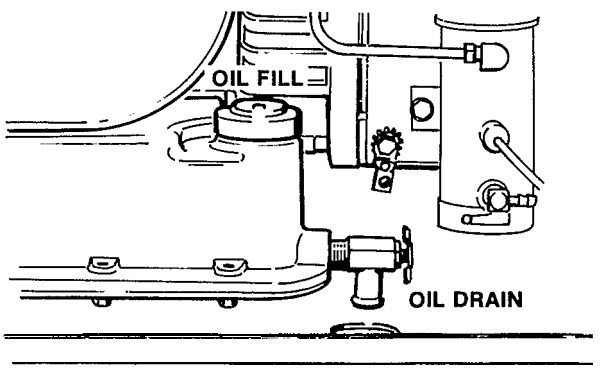


FIGURE 3. OIL DRAIN AND FILL

LIQUID PROPANE GAS FUEL RECOMMENDATIONS

Use clean, fresh commercial propane or HD-5 grade liquid propane gas in a mixture of at least 90% propane or greater. Propane fuels other than HD-5 grade may contain more than 2.5% butane. Use of propane fuel mixtures containing more than 2.5% butane will result in poor fuel vaporization and engine starting in low ambient temperatures. Liquid propane gas that has not been properly stored and transported may contain a large portion of contaminates. Always purchase propane from a reputable dealer.

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WARNING **LP gas, propane and butane are extremely flammable substances which MUST be handled with extreme care. Do NOT operate the generator set in an enclosed area. Do NOT smoke. All bulk tank(s) are pressurized but require vaporization to operate appliances or use as a vehicle engine fuel source. Keep a type ABC fire extinguisher handy.**

WARNING **Leakage of propane in or around the compartment is a definite hazard. The system should provide a constant flow of air to expel any accumulation of fuel vapor while the vehicle is in transit. Compartments must be vapor tight to the interior to keep fumes from within the vehicle.**

STARTING

Push the start-stop switch to the start position. Release the switch when engine starts. If engine fails to start, inhibitor oil used at the factory may have fouled the spark plugs. Remove the plugs, clean in a suitable solvent, dry thoroughly and re-install. Heavy exhaust smoke when the engine is first started is normal and caused by the inhibitor oil.

STOPPING

Push the start-stop switch to the stop position and hold until unit stops completely.

BREAK-IN PROCEDURE

Controlled break-in with the proper oil and a conscientiously applied maintenance program will help to assure satisfactory service from your Onan electric generating set. Break-in as follows:

1. One half hour at 1/2 load (with one air conditioner) and approximately 500 watts additional load.
2. One half hour at 3/4 load (with one air conditioner) and approximately 1500-2000 watts additional load.
3. Change crankcase oil after the first 50 hours of operation.

APPLYING LOAD

If practical, allow set to warm up before connecting a heavy load. Continuous generator overloading may cause high operating temperatures that can damage the windings. Keep the load within nameplate rating.

LOAD CONNECTIONS

1. Generator set load wires (M1, M2, M3 and M4) terminate in generator sets's junction box. Connect and join wires within junction box in an approved manner for desired voltage code. See Figure 4.
2. Wires must be adequate size, properly insulated and supported.
3. Mount switches and controls securely to prevent damage from vibration and road shocks. All switches must be vibration proof to prevent accidental opening or closing while the vehicle is in motion.
4. All wiring must meet applicable local electrical codes. Have a qualified electrician install and inspect the wiring.

EXERCISE

Infrequent use results in hard starting. Operate the generator set one 30-minute period each week. Run longer if battery needs charging. Exercising for one long period each week is better than several short periods.

BATTERY CHARGING

The battery charge rate is controlled by a fixed value resistor that allows a trickle charge rate of 1 - 1-1/2 amps under all conditions.

HIGH OPERATING TEMPERATURES

1. See that nothing obstructs air flow to and from the set.
2. Keep cooling fins clean. Air housing should be properly installed and undamaged.
3. Keep ignition timing properly adjusted.

LOW OPERATING TEMPERATURES

1. Use correct SAE oil for temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move vehicle to a warm location.
2. Use of commercial propane or HD-5 grade liquid propane gas in a mixture of at least 90% propane or greater will permit reliable generator set operation down to -10° F (-24° C). Propane fuels other than commercial or HD-5 grade may contain more than 2.5% butane resulting in poor fuel vaporization and engine starting in colder ambient temperatures.
3. Keep ignition system clean, properly adjusted and batteries in a well charged condition.
4. Partially restrict cool airflow, but use care to avoid overheating.

A carburetor air preheater kit is available for cold weather operation -below 45° F (7° C), which helps prevent carburetor icing. Order Kit No. 140-1673.

EXTREMELY DUSTY OR DIRTY

1. Keep unit clean. Keep cooling surfaces clean.
2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 50 operating hours.
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.
6. Clean generator brushes, slip rings, and commutator, do *not* remove normal dark brown film. Do *not* polish.

HIGH ALTITUDE OPERATION

For operation at altitudes of 2500 feet (775 m) above sea level, close carburetor main jet adjustment slightly to maintain proper air-to-fuel ratio (refer to the *ADJUSTMENTS* section). Maximum power will be reduced approximately four percent for each 1000 feet (310 m) above sea level after the first 1000 feet.

POWER REQUIREMENTS FOR APPLIANCES

Appliance or Tool	Approximate Running Wattage
Refrigerator	600-1000
Electric broom	200-500
Coffee percolator	550-700
Electric frying pan	1000-1350
Hair dryer	350-500
Electric stove (per element)	350-1000
Electric iron	500-1200
Radio	50-200
Electric water heater	1000-1500
Space heater	1000-1500
Electric blanket	50-200
Television	200-600
Electric drill	250-750
Battery charger	Up to 800
Electric water pump	500-600
Air Conditioner	1400-2200
Converter	300-350
Microwave oven	700-1500

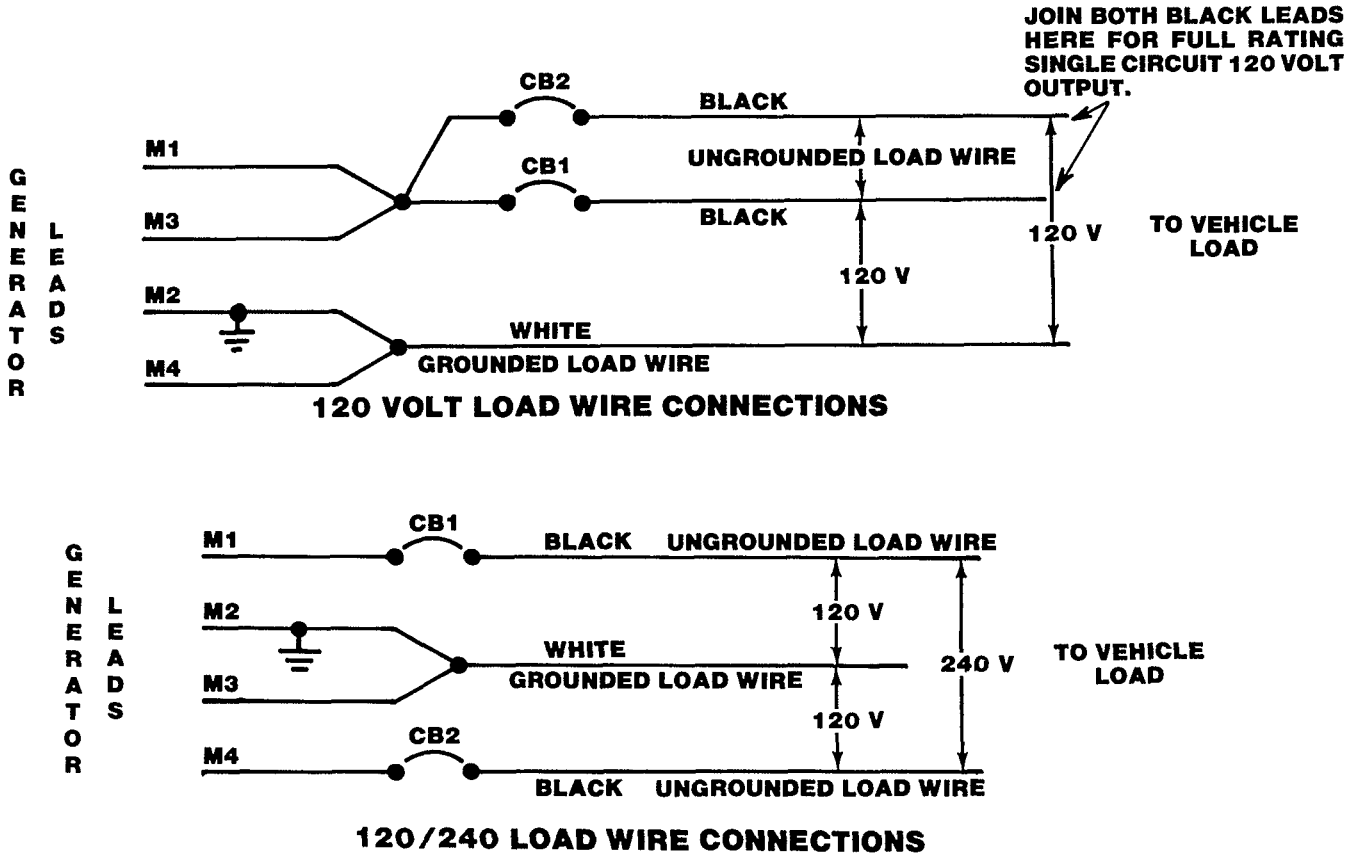

FIGURE 4. SINGLE-PHASE, "-3C" VOLTAGE CODE GENERATOR CONNECTIONS

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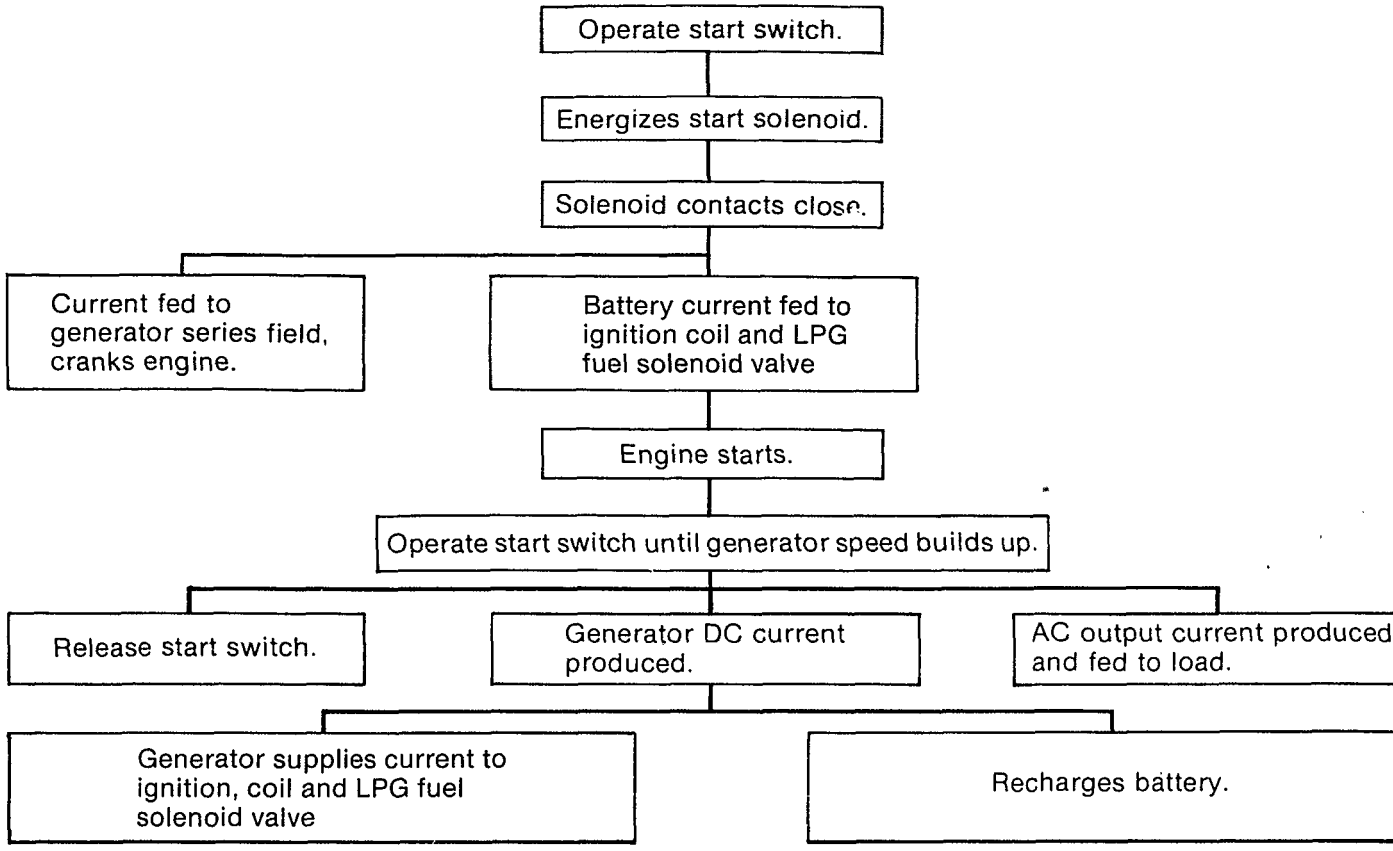

FIGURE 5. SEQUENCE OF OPERATION

SEQUENCE OF OPERATION

Figure 5 shows the operation sequence of the NHL electric generating set. Figure 6 shows the flow diagram for the LPG liquid fuel system components used on this RV generating set.

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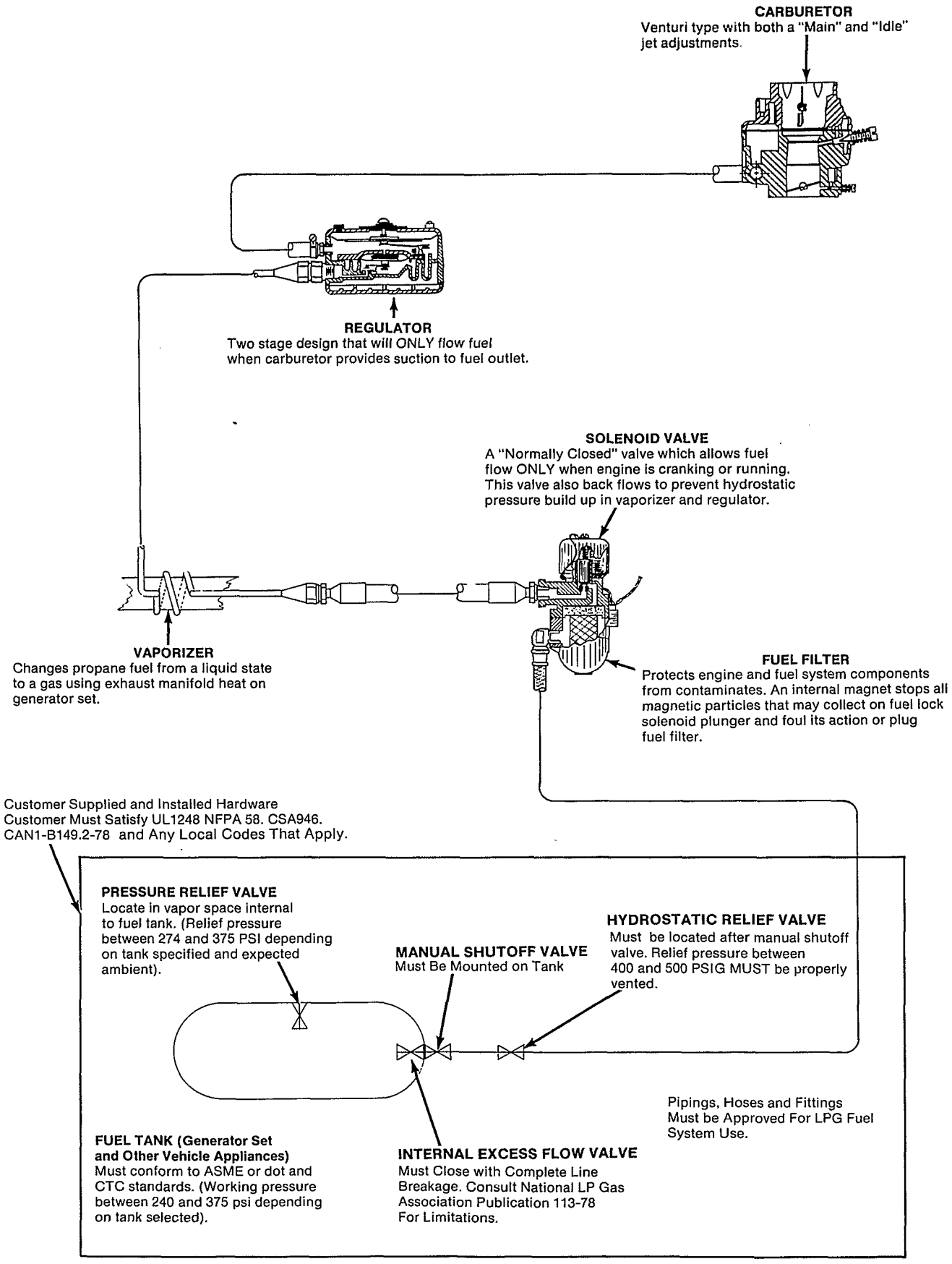

FIGURE 6. FLOW DIAGRAM OF LPG "LIQUID" FUEL SYSTEM COMPONENTS

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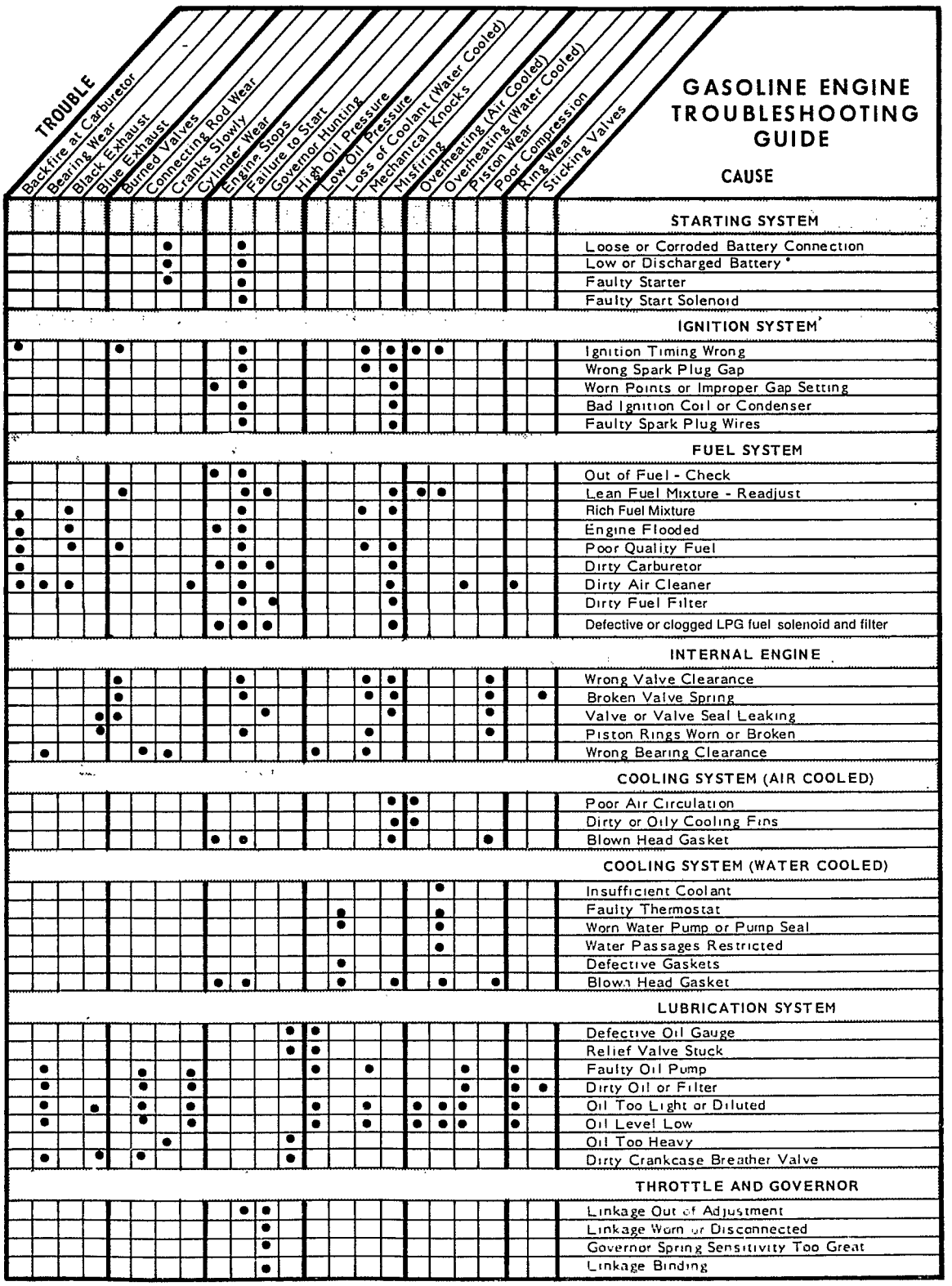
Engine Troubleshooting



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Maintenance

BATTERY CARE

To increase battery life, the operator can perform a number of routine checks and some preventive maintenance.

1. Keep the battery case clean and dry.
2. Make sure the battery cable connections are clean and tight. Use a terminal puller when removing cables for any reason.
3. Coat the battery terminals with a mineral grease or petroleum jelly to reduce corrosion and oxidation.
4. Identify each battery cable to be positive or negative before making any connection. Always connect the ground (negative) cable last.
5. Maintain the electrolyte level of adding water (drinking quality or better) as needed for filling to split level marker. (The water ingredient of the electrolyte evaporates, but the sulphuric acid ingredient remains. Therefore, add water, not electrolyte.
6. Avoid overcharging when recharging. Stop the boost charge when the specific gravity is 1.260 and the electrolyte is 80° F (26.7° C).

LPG FUEL FILTER AND SOLENOID VALVE

Onan liquid LPG generator sets contain a filter cartridge and magnet within the fuel solenoid valve to protect the solenoid valve and regulator valves from dirt and metallic particles. LPG fuel that has not been properly stored and transported may contain a large portion of contaminates. Always purchase propane from a reputable dealer. If the fuel filter becomes plugged, the generator set will operate erractically at heavier loads and/or in colder weather due to high fuel demand and lower tank pressure to push liquid propane through the filter in the fuel solenoid valve. Fuel solenoid valve and filter is shown in Figure 7.

COOLING SYSTEM

The generator set is cooled by a flywheel blower fan which pulls air over the cylinders and cooling fins. The air path is directed by sheet metal shrouds and plates. These shrouds and plates must always be installed properly so unit does not overheat.

Check and clean (if necessary) the cooling fins at least every 200 hours of operation. Remove any dust, dirt or oil which may have accumulated. Check compartment air inlet and generator set air outlet for build-up of dirt, chaff, etc.

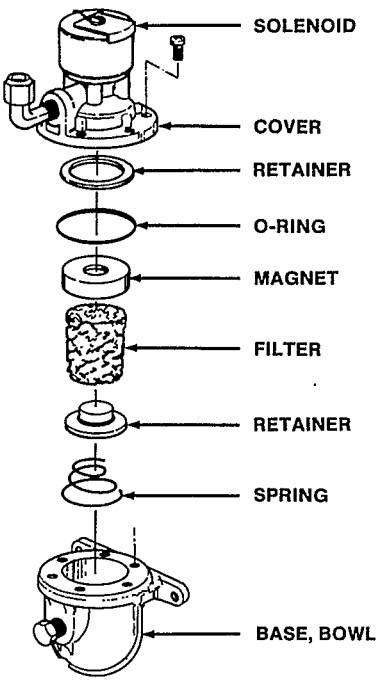

FIGURE 7. FUEL SOLENOID VALVE AND FILTER

AIR CLEANER ELEMENT

Check and clean element at least every 100 hours. Loosen wing nut to remove. Clean by tapping base lightly on a flat surface. Replace element at least every 200 operating hours; clean or replace more often in dusty conditions. See Figure 8.

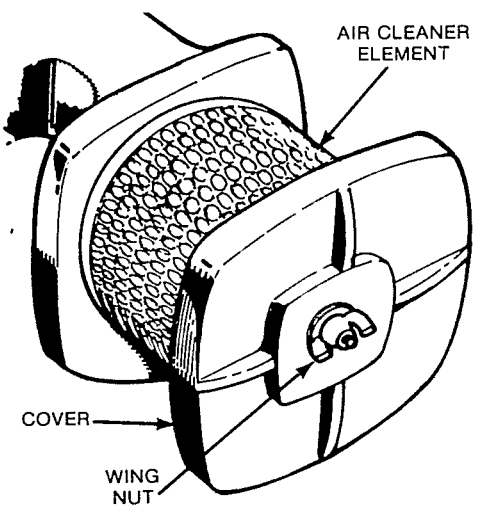

FIGURE 8. AIR CLEANER ELEMENT

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SPARK PLUGS

Replace spark plugs every 100 hours or at least once a year. A badly leaded plug will cause misfiring, poor operation or stopping when a load is applied.

- Badly or frequently fouled plug indicates the need for a major tune-up.

Each time the spark plugs are removed, inspect, clean and regap (Figure 9). If the plug looks discolored or has fouled, replace it.

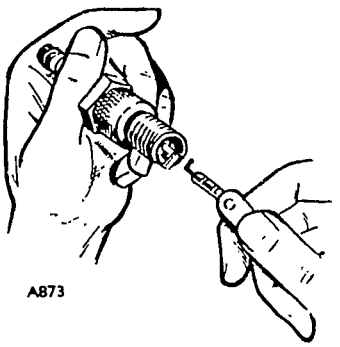

FIGURE 9. CHECKING SPARK PLUG GAP

GOVERNOR LINKAGE

The linkage must be able to move freely through its entire travel. Every 50 hours of operation, clean the joints and lubricate as shown in Figure 10. Also inspect the linkage for binding, excessive slack and wear.

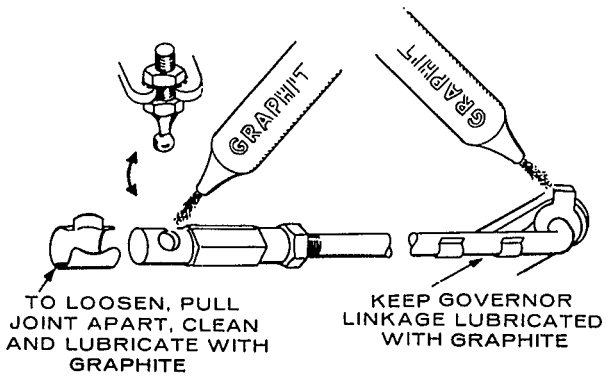

FIGURE 10. GOVERNOR LINKAGE

OUT-OF-SERVICE PROTECTION

Protect a generator set that will be out of service for more than 30 days from damage caused by rust or corrosion. Use the following procedure to properly protect the set.

1. Run the generator set with at least a 50% load until thoroughly warm (usually about 1 hour).
2. Close the manual shut-off valve on the vehicle propane supply tank and allow the generator set to run out of fuel and stop.
3. Drain the oil from oil base while engine is still warm. Replace the oil filter if so equipped. Replace drain plug and refill. Attach a warning tag stating type and viscosity of oil used.
4. Remove spark plugs. Pour 1 ounce of rust inhibitor oil (or SAE #10) into each cylinder. (Spray cans work well for this application). Turn engine over by hand at least 2 complete revolutions. Replace the spark plugs.
5. Replace the air cleaner at least on an annual basis.
6. Plug the exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
7. Clean and oil all exposed engine parts including carburetor and governor linkage.
8. Wipe generator brushes, slip rings, housing, etc. Do not apply any lubricant or preservative.
9. Remove the battery and store in a cool dry place. Coat the battery terminals and cable connections with vasoline or grease to prevent any corrosion. Recharge the battery at least monthly or maintain with a trickle type battery charger.
10. Provide a suitable cover if the unit is exposed to the elements.

RETURNING THE UNIT TO SERVICE

1. Remove the cover and all protective wrapping. Wipe the oil film off all exposed engine parts. Remove the plug from the exhaust outlet.
2. Visually inspect the unit for any damage. Check to be sure the carburetor and governor linkage are free. Remove the generator end bell band and check to be sure the brushes work freely in their holders.
3. Check the tag to ensure oil of the proper brand and grade has been installed. Check the oil level.
4. Install the battery (be sure battery is fully charged), observing proper polarity. Ground is negative.
5. Remove spark plugs, clean and gap. Turn the engine over by hand several times. Reinstall spark plugs.
6. Open the manual shut-off valve on the vehicle propane supply tank.
7. Remove all load and start the generator set at the unit. Initial start may be slow due to oil or rust inhibitor in the cylinders. Excessive smoke and rough operation will occur until the oil or rust inhibitor is burned off.
8. Apply a 50% load after the set runs smooth. Allow the generator set to warm up (1 hour) with the load connected. Check speed and voltage.
9. Unit is now ready for service.

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GENERATOR MAINTENANCE

The generator normally needs little care other than a periodic check of the brushes, commutator and collector rings. If a major repair job on the generator should become necessary, have the equipment checked by a competent electrician who is thoroughly familiar with the operation of electric generator equipment.

Brush Replacement

Install new brushes when the old ones are worn to the dimensions shown in Figure 11. Remove the end bell band to expose the brush holders. Remove the three screws holding each brush holder in place (Figure 11). Remove the old brushes and clean the holders so the new brushes can move easily in their holders. Install the new brushes in the same manner as the old ones. Always use the correct brush as listed in the PARTS CATALOG. Never substitute a brush which may appear to be the same for it may have different characteristics. New brushes are shaped to fit and seldom need sanding to seat properly. If some brush sparking occurs after replacing brushes, run the set under a light load until the brushes wear to a good seat.

Collector rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright newly machined appearing surface. Ordinary cleaning with a dry, lint free cloth is usually sufficient. Very fine sandpaper (#200) may be used to remove slight roughness.

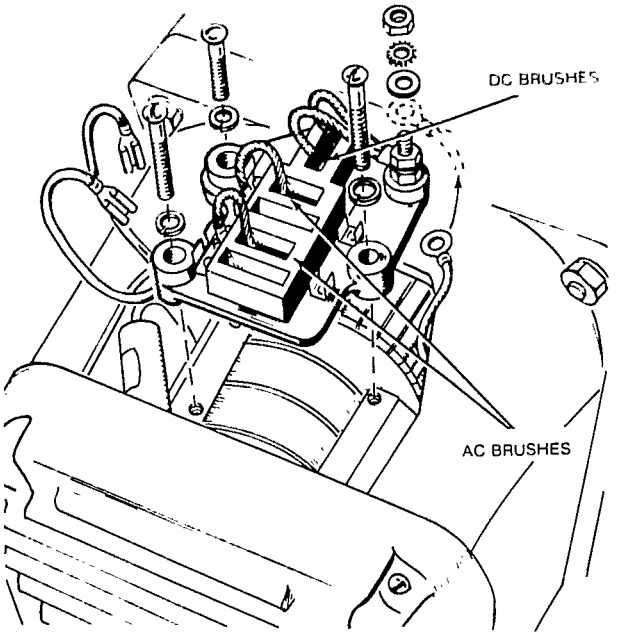
ASSEMBLY TORQUES

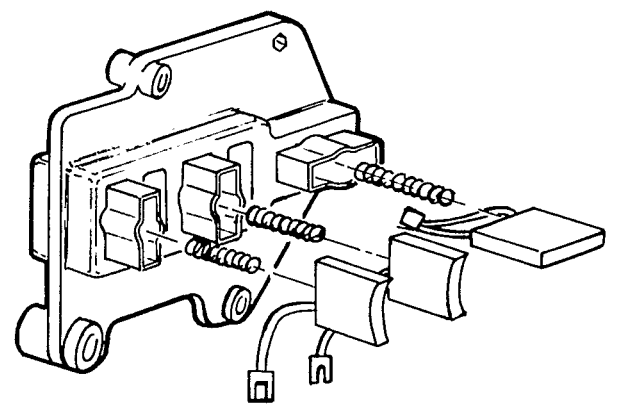
BOLT TORQUE	FT.-LB.
Gearcase Cover	8-10
Rear Bearing Plate Screws	25-28
Connecting Rod Bolt	14-16
Flywheel Cap Screw	35-40
Other 5/16" Cylinder Block Stud and Nuts	8-10
Oil Base Mounting Screws	18-23
Manifold Mounting Screws	18-23
Oil Pump	7-9
Exhaust Manifold	18-23

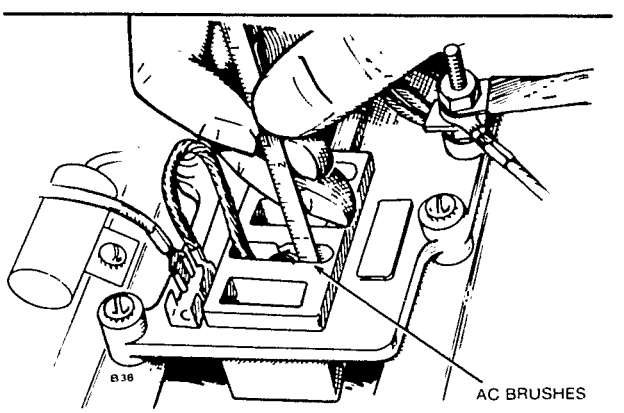
CYLINDER HEAD STUD NUT TORQUE PROCEDURE

This generator set engine uses a special "graph-oil" head gasket and two compression washers and a hardened flat washer on each of the top 6 longer cylinder head studs as shown in Figure 12. The bottom 4 shorter cylinder head studs use ONLY a hardened flat washer and NO compression washers as shown in Figure 12. The final torque value varies depending on whether compression washers are used or not.

Follow the cylinder head torque tightening sequence shown in Figure 12. Start out tightening all nuts to 5 lb. ft. (7 N•m), then 10 lb. ft. (14 N•m), etc., until the correct torque is reached. The top six nuts should be tightened to 12 lb. ft. (N•m) and the bottom four nuts should be tightened to 15 lb. ft. (20 N•m).







MEASURE FROM TOP FACE OF BRUSH BLOCK TO TOP OF BRUSH

	DC	AC
NEW	5/8"	11/16"
½ WEAR	13/16"	7/8"
REPLACE	1"	1 1/16"

FIGURE 11. BRUSH LENGTH

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After the cylinder head stud nuts have been tightened once, it will be necessary to tighten each cylinder head nut to the specified torque a second time. Follow the same sequence shown in Figure 12. Failure to retorque could result in a blown head gasket.

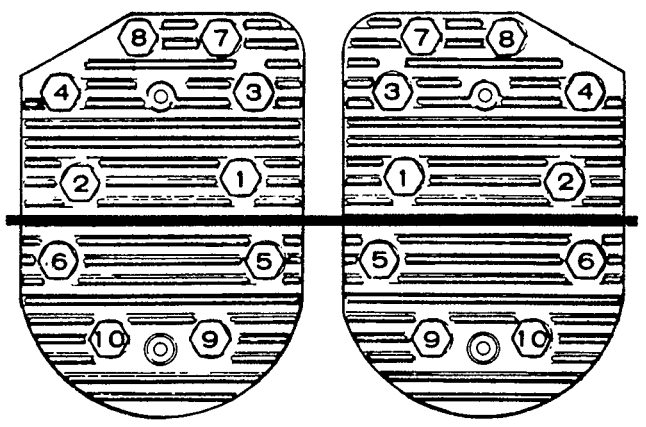
CAUTION ***If graph-oil gasket is removed at a later date, the gasket surface must be below 100° F before removal. At temperatures above 100° F, the gasket will become gummy and difficult to remove from the surface of the block and cylinder head.***

EXHAUST SPARK ARRESTER/MUFFLER

Exhaust spark arresters are necessary for SAFE OPERATION. All require periodic clean-out (every 50 to 100 operating hours) to maintain maximum efficiency. Some state and federal parks require them.

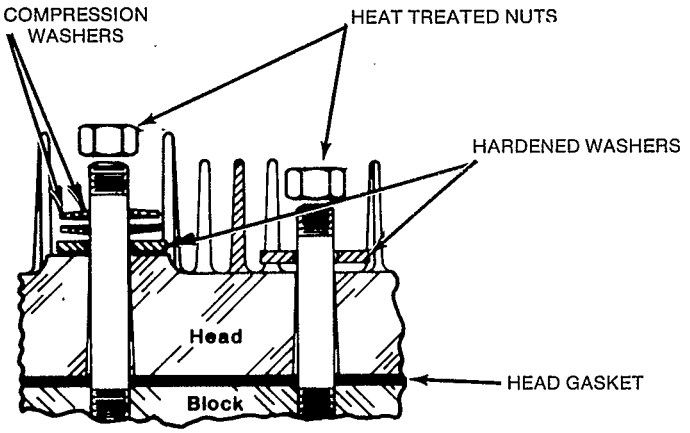
To clean spark arrester remove 1/8" pipe plug in bottom of muffler. Run set under load for 5 minutes. Replace plug. Inspect exhaust system (visually and audibly) for leaks daily (at least every 8 hours of running time).

WARNING ***Do NOT operate generator set if exhaust system is damaged or excessively noisy. Have it inspected and repaired immediately by an authorized Onan service center.***



NUMBERS INDICATE CORRECT TIGHTENING SEQUENCE FOR CYLINDER HEAD NUTS

TORQUE NUTS IN PROPER SEQUENCE TO SPECIFIED TORQUE VALUES LISTED, TWICE BEFORE RUNNING THE GENERATOR SET.



6 LONG STUDS (TOP)

TORQUE TOP SIX NUTS TO 12 LB. FT. (COLD)

4 SHORT STUDS (BOTTOM)

TORQUE BOTTOM FOUR NUTS TO 15 LB. FT.

FIGURE 12. CYLINDER HEAD STUD NUT TORQUE SEQUENCE

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Periodic Maintenance Schedule

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The following schedule can be used as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check the condition of the crankcase oil, the filters, etc. frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc., contact your nearest authorized Onan dealer.

WARNING ***Always allow generator set to cool off before performing any maintenance or installation work on the set. Working on a hot set could cause severe burns.***

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS				
	8	50	100	200	400
General Inspection	X1				
Check Oil Level	X				
Check Battery Electrolyte Level		X			
Change Crankcase Oil			X2		
Check Air Cleaner			X2		
Check Spark Plugs			X4		
Check Breaker Points			X3		
Change Oil Filter			X2		
Clean Cooling Fins				X2	
Replace Breaker Points				X4	
Clean Crankcase Breather				X2	
Replace Air Cleaner				X2	
Remove Carbon Deposits from Heads				X	
Adjust Tappets					X
Check Generator Brushes (Replace if Necessary)	As Required				

X1 - With set running, visually and audibly check exhaust sytem for leaks.
X2 - Perform more often in extremely dusty conditions.
X3 - Replace if necessary.
X4 - Replace annually or prior to storage.

WARNING **All exhaust system connections MUST be checked regularly for any leaks and tightened as necessary. Do NOT terminate exhaust pipe under vehicle or near any window or door openings. Inspect the vapor tight seals around all openings made in the set's compartment for wiring, conduit, etc., to prevent entrance of any noxious fumes to motor home interior.**

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Adjustments

Satisfactory generator set performance depends on correct adjustments. If trouble develops, follow an orderly procedure to determine the cause before making changes in adjustments. Refer to *ENGINE TROUBLESHOOTING AND PERIODIC MAINTENANCE SCHEDULE* for additional help.

IMPORTANT

The following LP gas carburetor adjustment procedures are unique to this model and are NOT the same as gasoline powered RV models.

CARBURETOR

The "LPG" generator set carburetor has two mixture adjustments, an idle mixture which affects operation mainly at no load and a main (power) adjustment which affects operation at maximum load (Figure 13). If your generator set has a "hunting" (sudden surges and drops in speed) condition at no load or full load and cannot be corrected by carburetor adjustments, check governor linkage and adjustment. A hunting condition at no load can usually be corrected by a carburetor idle mixture and/or throttle stop screw adjustments.

CAUTION ***When determining fuel mixture settings, never force the fuel mixture adjustment needles against their seats (damages the seats and needles).***

CARBURETOR AND GOVERNOR ADJUSTMENT PROCEDURES

Connect a plug-in type AC voltmeter and/or AC frequency meter into one of the AC duplex receptacles in the motorhome. When the following procedure calls for full load, turn on AC powered appliances in the motorhome or use an Onan load test panel. The first three adjustments are made with the generator set turned off (NOT Running).

Engine speed determines the output voltage and frequency of the generator. By increasing the engine speed, generator voltage and frequency are increased, and by decreasing the engine speed, generator voltage and frequency are decreased. An accurate voltmeter or frequency meter (preferably both) should be connected to the generator output in order to correctly adjust the governor. A small speed drop not noticeable without instruments will result in an objectionable voltage drop.

Initial Setting(s):

1. Turn idle mixture screw out (counterclockwise) 1/2 of a turn from seated position. See Figure 13.
2. Turn main mixture screw out (counterclockwise) 1-5/8 turns from seated position. See Figure 13.
3. Adjust the length of the governor linkage and check linkage and throttle shaft for binding or excessive looseness.

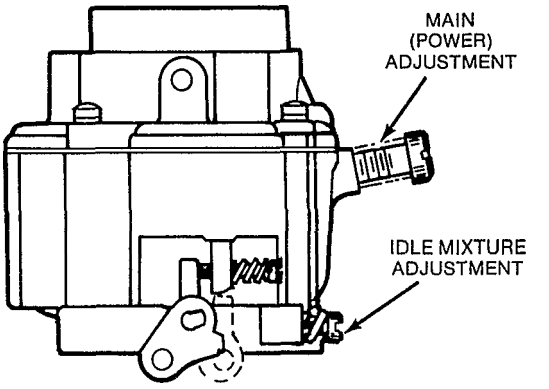

FIGURE 13. CARBURETOR FUEL MIXTURE ADJUSTMENTS

Linkage: The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle shaft assembly is adjusted by rotating the ball joint. Adjust this length so that with the engine stopped and tension on the governor spring, the stop on the throttle shaft assembly almost touches the throttle stop screw housing (approximately .050 gap) on side of carburetor (one more turn of governor ball joint would allow throttle shaft linkage to rest against stop screw housing). See Figure 14, "Open Position".

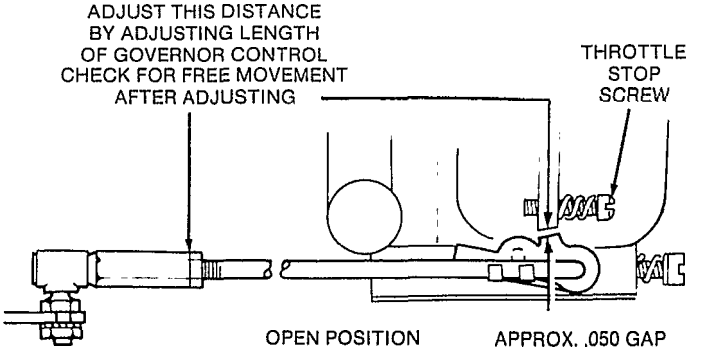

FIGURE 14. GOVERNOR LINKAGE ADJUSTMENT

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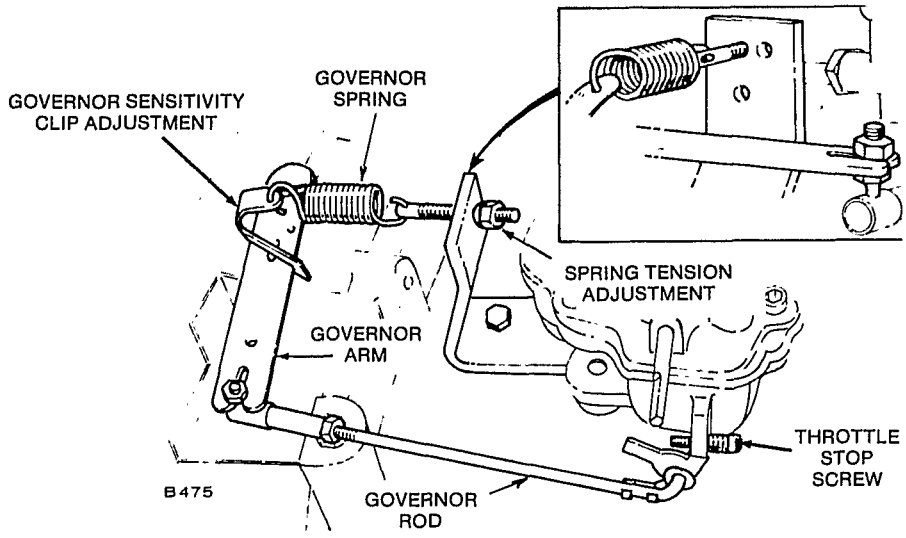

VOLTAGE CHART FOR CHECKING GOVERNOR REGULATION	120 VOLT 1 PHASE 2 WIRE
MAXIMUM NO-LOAD VOLTAGE	132
MINIMUM FULL-LOAD VOLTAGE	108

SPEED CHART FOR CHECKING GOVERNOR REGULATION	
MAXIMUM NO-LOAD SPEED (RPM)	1890
HERTZ (CURRENT FREQUENCY)	63
MINIMUM FULL-LOAD SPEED (RPM)	1770
HERTZ	59

FIGURE 15. GOVERNOR ADJUSTMENT LIMITATIONS

4. Start the unit and run under light load (approx. 1000 watts) for about 15 minutes to allow unit to reach normal operating temperature. Make a preliminary governor spring tension adjustment as follows:

   Spring Adjustment: With the warmed-up unit operating at no load, adjust the tension of the governor spring. Refer to the Voltage Chart and the Speed Chart. Turn the speed adjusting nut to obtain a voltage and speed reading within the limits shown in Figure 15.

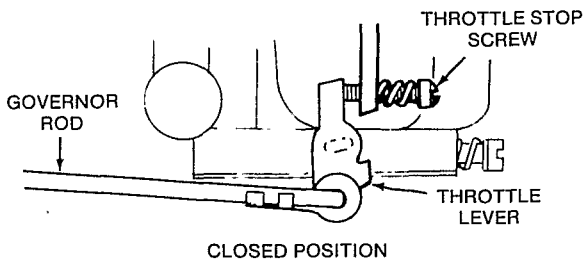

FIGURE 16. THROTTLE STOP SCREW SETTING

5. Hold back governor so that throttle lever rests on throttle stop screw. The throttle stop screw is located on the base of the carburetor. Adjust throttle stop screw to 1680 RPM (56 hertz or 112 volts). See Figures 13 and 16. Release governor arm.
6. Adjust governor spring setting so that engine speed is 1860 RPM at no load (62 hertz or 124 volts). See Figure 15.
7. Apply full AC load to generator set and adjust main mixture screw with set running at 1800 rpm (60 Hz). Starting with nominal carburetor settings, turn main screw clockwise (lean) until speed increases to max rpm (about 1-1/2-2 hertz more), then richen mixture 1/8 turn (counterclockwise) from max rpm point. See Figure 13.
8. Adjust governor sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition. To increase sensitivity (closer regulation), shift the spring toward the governor shaft. Refer to the voltage and Speed Charts in Figure 15.
9. Readjust governor spring setting so engine speed is 1860 RPM at no load (62 hertz or 124 volts). See Figure 15.

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10. Remove all load to generator and adjust idle mixture screw as follows: Adjust throttle stop screw to hold governor at 1800 rpm (60 Hz). Turn idle screw lean, from nominal setting, (clockwise) until speed falls 50 rpm (about 1-1/2 Hz), then richen mixture 1/2 turn from that point. Re-adjust throttle stop screw to 56 HZ. See Figure 13 and 16.

11. Remove and add load several times to check for a governor hunting condition. Readjust governor spring setting if required.

A binding in the bearings of the governor shaft, in the ball joint, or in the carburetor throttle assembly will cause erratic governor action or alternate increase and decrease in speed (hunting). A lean carburetor adjustment may also cause hunting. Springs of all kinds have a tendency to lose their calibrated tension through fatigue after long usage. If all governor and carburetor adjustments are properly made, and the governor action is still erractic, replacing the spring with a new one and resetting the adjustments will usually correct the trouble.

BREAKER POINTS AND IGNITION TIMING

The correct point gap setting is .016 cold (0.41 mm) and should be adjusted as follows:

1. Remove cover by loosening screws and lift off.
2. To set the point gap turn the engine crankshaft with rotation until the maximum breaker point gap is obtained.

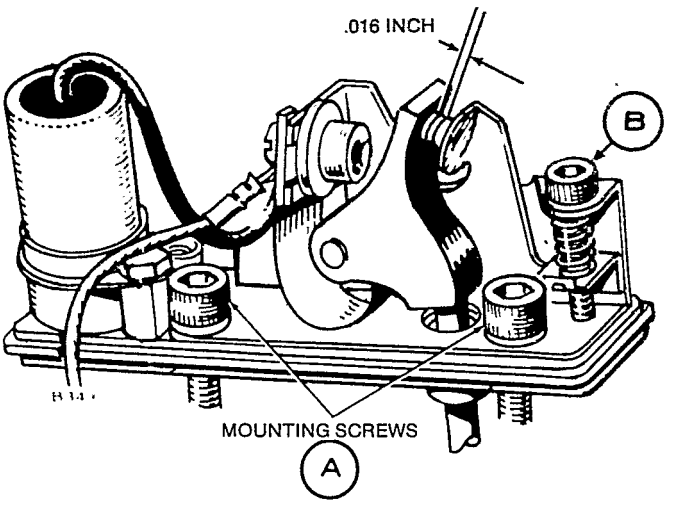

FIGURE 17. TOP ADJUST POINTS

3. Using an allen head wrench, adjust set screw (B) for a .016 (0.41 mm). Measure point gap with a flat thickness gauge.

   Make sure feeler gauge is clean and free of any grease, oil or dirt. See Figure 17.

   The timing is adjusted during initial engine assembly and is fixed by the point gap adjustment. No other adjustment or alignment is necessary. A .016 point gap is equivalent to approximately 20° BTC.

4. Replace point box cover.

   The ignition adjustments should be made with the engine in a static condition and cold.

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Control Troubleshooting

PROBLEM	PROBABLE CAUSE	REMEDY
FAILS TO CRANK	1. Bad Battery Connection	1. Clean and tighten all battery and cable connections.
	2. Low Battery	2A. Check specific gravity. Recharge or replace battery if necessary.
		2B. Reverse current diode (CR1) may be shorted or open causing a drain on the battery. R2 may be open.
	3. Faulty Start Solenoid (K1)	3A. Check for Battery Voltage at K1 "I" terminal. 3B. Push start switch. Check start solenoid "S1" terminal voltage to ground. When battery voltage at start solenoid "B+" terminal is present, battery voltage should also appear at "S1" terminal; if not, replace start solenoid.
	4. Faulty Start Switch	4. Jumper switch (#3 terminal) to ground. If solenoid energizes, replace switch.
CRANKS SLOWLY	1. Bad Battery Connection	1. See 1 above (FAILS TO CRANK)
	2. Low Battery	2. See 2 above (FAILS TO CRANK)
CRANKS BUT WON'T START	1. Blown Fuse (F2)	1. Replace fuse (F2) on control.
	2. Faulty Fuel Solenoid or Plugged Fuel Filter	2. Fuel solenoid must open during cranking and running. Check by cranking set with spark plugs disconnected. Push priming button on regulator and listen for fuel flow and propane odor. If no flow or odor, check and replace fuel filter or fuel solenoid valve. **WARNING** ***Use extreme care for this test. Make sure area is well ventilated to prevent accumulation of LPG fumes.***
	3. Faulty Ignition	3. Check to see if points open and close during cranking. If they do not open and close, adjust and set points. Plug and plug wires must be in good condition. Voltage at ignition coil negative terminal (-) must alternate from +12 volts to zero as points open and close during engine cranking.
	4. Faulty Crank Ignition Relay (K2)	4. Check voltage from relay terminal "4" to ground while cranking unit. Battery voltage should appear at this terminal. If not check for voltage at relay terminals "1" and "2". If battery voltage is present at terminals 1 and 2, but not at 4, replace relay. If not voltage appears at terminals 1 and 2 on relay while cranking, check wiring between start solenoid (K1) and crank ignition relay (K2).
UNIT STARTS, BUT STOPS IMMEDIATELY AFTER RELEASING START SWITCH S1	1. Resistor R1 may be open. 2. Run Ignition Relay K3. 3. Low Oil Level 4. S3 Low oil pressure switch may be defective.	1. Check voltage on both sides of R1. With set running voltage should be 24-32 volts DC. 2. Check voltage on both sides of K3. Should be 12 volts. 3. Check oil level. If low or empty, refill to proper level. 4. Check S3. Switch should close with set running at 10 lbs. minimum oil pressure.
UNITS RUNS THEN STOPS	1. Low Oil Level	1. Check oil level. If low or empty, refill to proper level.
UNITS RUNS BUT SURGES		
	1. Governor Not Adjusted Properly	2. Readjust Governor
UNITS STOPS	1. Faulty Ignition	1. See 3 above (CRANKS BUT WON'T START)
	2. Out of Fuel	2. Refill fuel tank.
	3. Low Oil Level	3. Check oil level. If low or empty, refill to proper level.
REMOTE RUNNING TIME METER OR GENERATOR LAMP INOPERATIVE	1. Blown Fuse (F1)	1. Replace F1 fuse on control.

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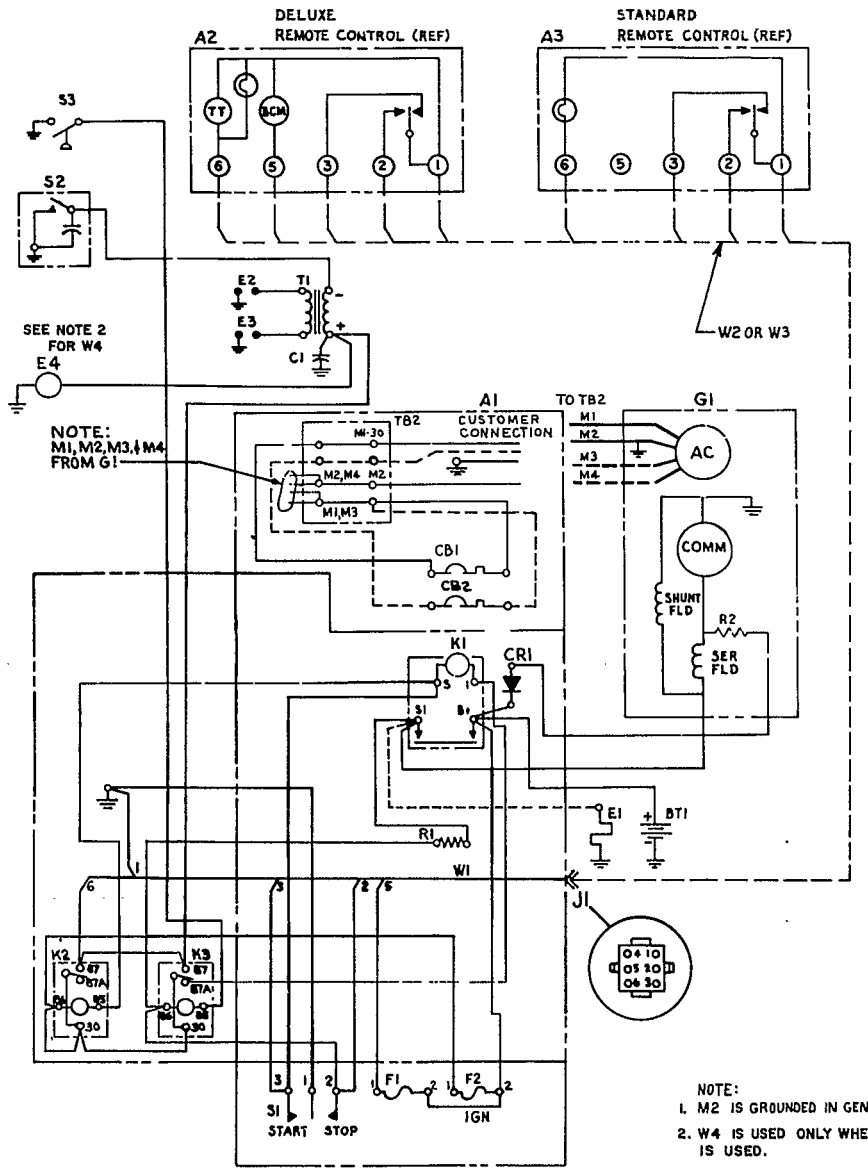
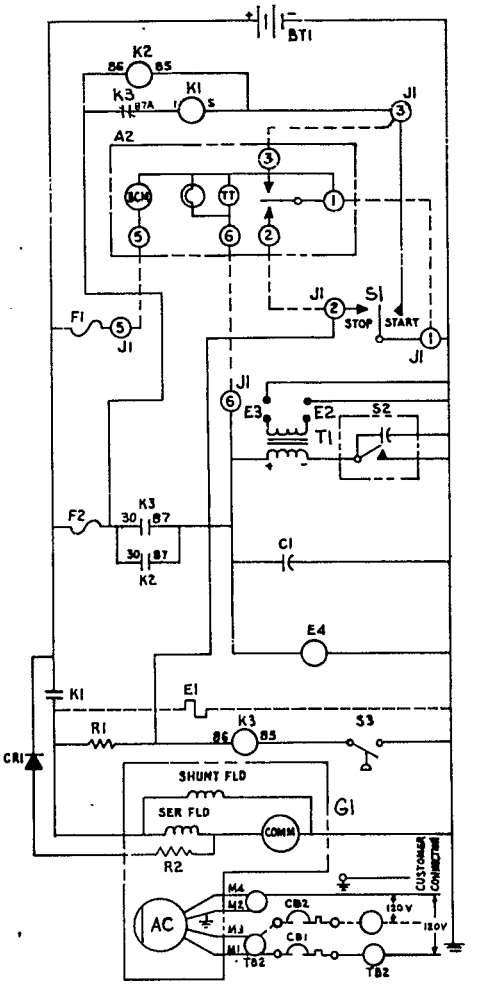
WIRING DIAGRAM

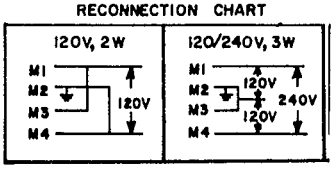


SCHEMATIC



NOTE:
1. M2 IS GROUNDED IN GENERATOR
2. W4 IS USED ONLY WHEN SHUTOFF/FILTER IS USED.

6.5 NH
RECONNECTION CHART



A1 ..... Control Assembly
A2 ..... Deluxe Remote Control
A3 ..... Standard Remote Control
BT1 ..... 12 Volt Battery
CB1 ..... Circuit Breaker
CB2 ..... Circuit Breaker (when used)
CR1 ..... Reverse Current Diode (prevents battery discharge when unit is shut down)
E1 ... Onan Choke (Gasoline Sets ONLY)
E2, E3 ..... Spark Plugs
E4 ..... LPG Fuel Solenoid Valve
F1, F2 ..... Fuse (5-amp, 32 volt)
G1 ..... Generator
K1 ..... Start Solenoid
K2 ..... Crank Ignition Relay
K3 ..... Ignition Run Relay
R1 ..... Battery Charging Resistor (fixed value)
S1 ..... Start-Stop Switch
S2 ..... Breaker Points Assembly
S3 ..... Low Oil Pressure Switch
T1 ..... Ignition Coil

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Remote Accessories

INSTALLING STANDARD OR DELUXE REMOTE START CONTROLS

The standard control includes a start-stop switch and indicator lamp. The deluxe control contains these items plus a running time meter and a battery condition meter. Install as follows:

1. Select control location. Using Figure 18 or 19 as a guide, drill screw holes and cut hole to accommodate remote switch in dash panel.
2. Following national local electrical codes and using #18 or larger insulated wires of predetermined length, connect remote control to generator set. Ensure that leads from remote control connect to corresponding terminals on generator set. Refer to Figure 20 for wiring connections.

CAUTION **Do not route DC wires for remote control through conduit containing AC load wiring. Induced voltages may cause erratic operation.**

3. Insert remote control in hole cutout and secure with woodscrews supplied with switch.

WARNING **Seal all holes that might allow noxious gases to enter motor home.**

CAUTION **Ensure that leads from remote switch connect with corresponding terminals on generator set.**

For sets without remote connector plug, connect terminals 1, 2, and 3 to corresponding terminals on generator set terminal block. Connect terminal #5 (if used) to B+ (on terminal block) or to battery connection on start solenoid. This connection should be protected with a 5 amp fuse. Connect terminal #6 to positive terminal on ignition coil and protect with a 5 amp fuse.

4. When wiring is complete, check for proper operation by starting and stopping set at the set control and by the remote start switch.

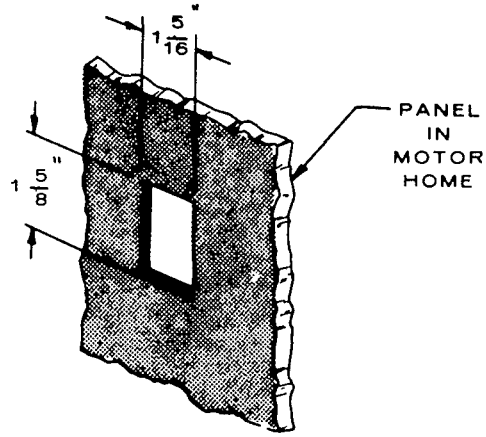

FIGURE 18. MOTOR HOME CUTOUT FOR STANDARD CONTROL PANEL

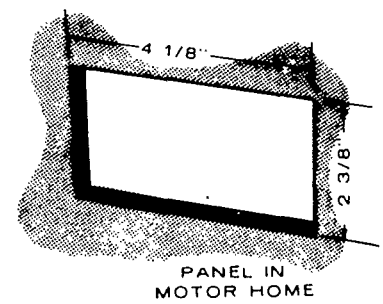

FIGURE 19. MOTOR HOME CUTOUT FOR DELUXE CONTROL PANEL

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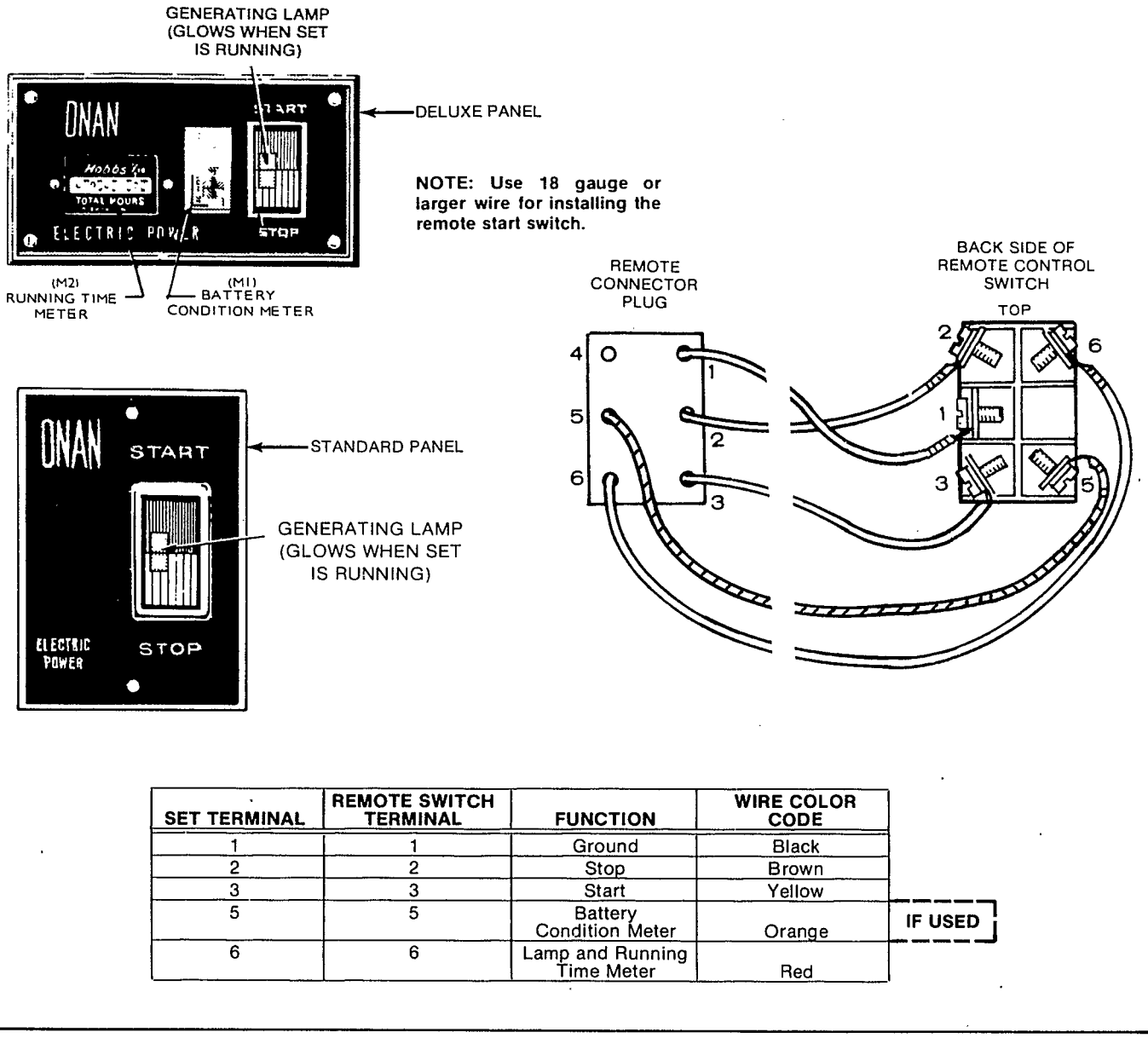

SET TERMINAL	REMOTE SWITCH TERMINAL	FUNCTION	WIRE COLOR CODE	
1	1	Ground	Black	
2	2	Stop	Brown	
3	3	Start	Yellow	
5	5	Battery Condition Meter	Orange	IF USED
6	6	Lamp and Running Time Meter	Red	

FIGURE 20. WIRING CONNECTIONS FOR REMOTE CONTROLS

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