

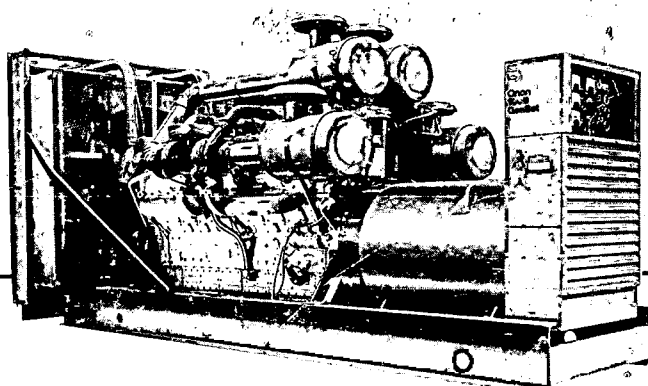


Operator Information

1000 kW

**DHH
GenSet**

- **Revolving Field**
- **Brushless Alternator**
- **Diesel Driven With
Electronic Governor**



**945-0120
(SPEC A)**

7-81

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.

ONAN recommends that you 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.

WARNING Onan uses this symbol throughout this manual to warn of possible serious personal injury.

CAUTION This symbol refers to possible equipment 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 generating 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 of steel piping, 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. DON'T 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. Check exhaust system regularly for leaks. 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.

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WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

General Information

ABOUT THIS MANUAL

This manual provides general information for operating the Onan DHH series generator set with Detroit Diesel 16V-149T engine and Marathon Magna One generator. Read this manual completely before attempting to operate the generator set and observe all cautions and warnings. Using the generator set properly and following a regular maintenance schedule will result in longer unit life, better performance, and safer operation.

More specific information concerning installation, maintenance, and service is contained in the following manuals which are available separately:

Onan Technical Bulletin T-030 - General installation recommendations for water cooled generator sets.

Series 149 Service Manual - Maintenance and service information for the Detroit Diesel 16V-149T engine.

Magna One Generator Installation, Operation and Maintenance Manual - Maintenance and service information for the Marathon Magna One generator.

Refer to these publications for more detailed information when recommended by this manual.

WHEN SERVICE IS NEEDED

When the generator set requires servicing, contact an authorized Onan Distributor for assistance. When your service requirements have been determined, Onan will advise you of the service unit that can satisfy your needs. Problems related to the generator control are handled directly by the Onan Distributor. Problems related to the generator or engine are handled by their respective manufacturer. Do not hesitate to call if you have any questions.

When contacting an Onan Distributor, always supply the complete Model and Spec. No. and the Serial No. as shown on the Onan nameplate (see Onan Model Designation section). This information is necessary to identify the generator set from among the many types of units manufactured by Onan. The Onan nameplate is located on the right side of the generator control box as shown in Figure 1. The right and left sides are determined by facing the generator set from the engine end of the unit.

The engine and generator manufacturer provide separate identification for their respective products. Marathon attaches a nameplate to the left side of the generator. Detroit Diesel stamps the engine Model and Serial numbers on the left side of the block

WARNING

ONAN RECOMMENDS THAT ALL SERVICE AND INSTALLATION OF REPLACEMENT PARTS BE DONE BY QUALIFIED ELECTRICAL AND/OR MECHANICAL SERVICE PERSONNEL. FROM THE STANDPOINT OF POSSIBLE INJURY AND/OR EQUIPMENT DAMAGE, IT IS IMPERATIVE THAT SERVICE PERSONNEL BE QUALIFIED.

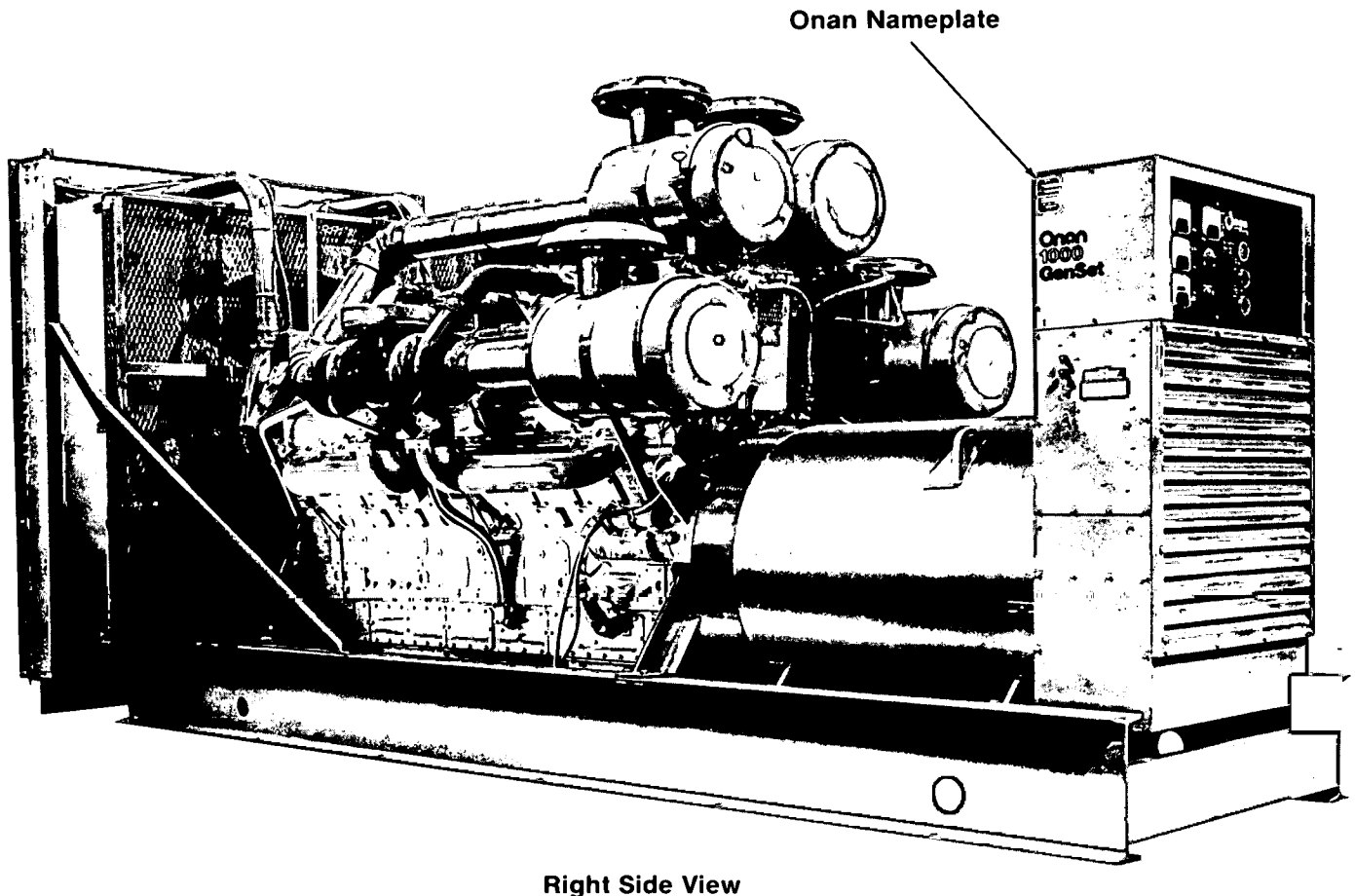
(near the front) and attaches an option plate to left valve cover. Always provide the appropriate Model Number or Serial Number when contacting the generator or engine manufacturer.

ONAN MODEL DESIGNATION

Identify your model by referring to the MODEL and SPECIFICATION NO. as shown on the Onan nameplate. Electrical characteristics are shown on the lower portion of the nameplate.

<u>1000.0</u>	<u>DHH</u>	<u>4X</u>	<u>R</u>	<u>/</u>	<u>1</u>	<u>A</u>
1	2	3	4	5	6	

1. Indicates Kilowatt rating (1000.0 kW).
2. Factory code for SERIES identification.
3. Voltage code: 4X - 277/480 volts
4. Starting system: R - remote.
5. Factory code for designating optional equipment if any.
6. Specification letter which advances when the factory makes production modification.



Right Side View

FIGURE 1. DHH GENERATOR SET

Specifications

GENERAL

Nominal dimensions of set	
Height	97.5 inches (2.48m)
Width	77 inches (1.96m)
Length	198 inches (5.03m)
Weight	20,000 pounds (9072 Kg)

ENGINE DETAILS

Engine	Detroit Diesel, 16V-149T	
Power at 1800 RPM	1515 BHP (1130 kW)	
Compression Ratio	17 to 1	
Number of cylinders (V-type)	16	
Displacement.....	2389 in ³ (39.18 litre)	
Cylinder bore.....	5.75 inch (146.05mm)	
Piston stroke.....	5.75 inch (146.05mm)	
Engine speed (60 Hz. operation).....	1800 r/min.	

CAPACITIES AND FUEL CONSUMPTION

Cooling System (Engine, Radiator and Aftercooler)....	91 gallons (345 litre)	
Engine Oil Capacity (Filter, Lines, Crankcase).....	40 gallons (151 litre)	
Diesel Fuel Consumption		
Full load,.....	78 g/h	(296 L/h)
3/4 load.....	62 g/h	(235 L/h)
1/2 load.....	43 g/h	(163 L/h)
1/4 load.....	23 g/h	(87 L/h)

INSTALLATION REQUIREMENTS

Fuel pump inlet thread size	1.0 inches NPTF	
Fuel pump maximum lift.....	10 feet (3.05m)	
Fuel return outlet thread size.....	0.75 inches NPTF	
Exhaust outlet I.D. (Two).....	9.88 inches (250.95mm)	
Maximum Exhaust back pressure (Full load).....	2.2 inches Hg. (7.45 kPa)	
Ventilation Required (1800 RPM)		
Cooling System (Radiator).....	59,000 feet ³ /min. (1671m ³ /min.)	
Combustion.....	4,800 feet ³ /min. (135.9m ³ /min.)	

BATTERY AND STARTING SYSTEM

Starting System Voltage.....	24	
Battery requirements		
Amp. Hr. Cap. (Per starter).....	205 (2)	
Battery Voltage.....	12	
Quantity Required.....	4	
Battery Charge Rate (Max.).....	35 Amps.	

GENERATOR DETAILS

Type.....	Revolving Field, 4-Pole, Brushless	
Rating (60 Hertz Continuous Standby).....	1000 kW (1250 KVA at .8PF)	
AC Voltage Regulation.....	+2%	
Phase.....	3	

Operation

GENERAL

This section covers starting, operating, and stopping the generator set. It is recommended that the operator read through this section and also any related sections in the engine and generator manuals before attempting to start the unit. It is essential that the operator be completely familiar with the unit to insure safe operation.

FIRST START PREPARATIONS

The generator set installer is generally responsible for completing all first start preparations including the following:

- Charging the lubricating system with a pressure prelubricator.
- Filling the crankcase
- Prelubricating the turbochargers
- Filling the cooling system
- Priming the fuel system
- Filling the fuel system
- Lubricating all fittings

Contact the installer to verify that all first start preparations have been completed and that the unit is fully operational before proceeding.

OPERATIONAL CHECKS

Normal operating procedure includes checking the engine oil, coolant, and fuel levels and generally verifying that the generator set is ready for safe operation. Refer to the Series 149 Service Manual, Section 13.1, as needed for the engine manufacturer's recommendations.

Lubricating Oil

Check the engine oil level during engine shut-down periods at the interval specified by the engine manufacturer. The oil dipstick and oil fill are located on the left side of the engine (see Figure 2). For accurate readings, shut off the engine and wait approximately 20 minutes before checking the oil level. This is to allow oil in the upper portion of the engine to drain back into the crankcase. Add the required amount of oil to reach the full mark on the dipstick. Use only oil that meets the engine manufacturers lubricating oil specifications.

CAUTION

Do not operate the engine with the oil level below the LOW mark or above the FULL mark. Overfilling may cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.

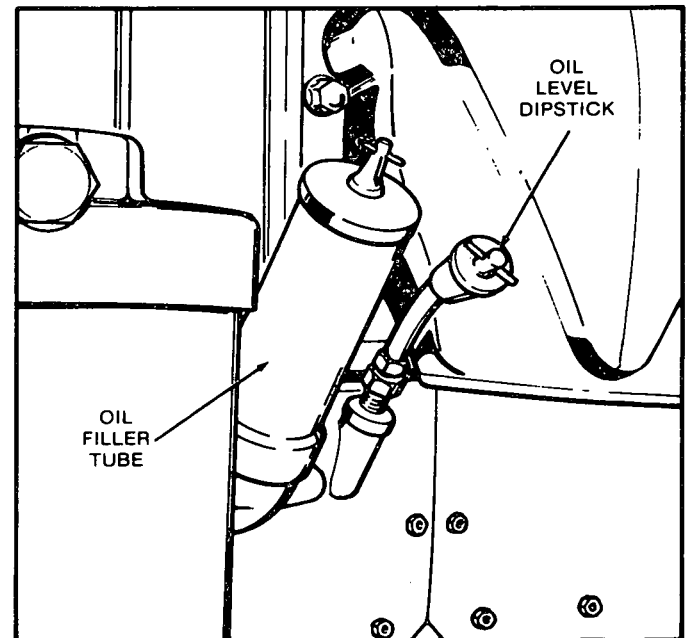


FIGURE 2. DIPSTICK AND OIL FILL

Coolant

Check the coolant level during shutdown periods at the intervals specified by the engine manufacturer. 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

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

Use a coolant solution that meets the engine manufacturer's coolant requirements.

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. It is therefore imperative that adequate engine coolant levels be maintained, to ensure operational integrity of cooling system and engine coolant overheat shutdown protection.

Fuel

Fill the fuel tank with clean, low sulfur (0.5%), No. 2-D diesel fuel that meets ASTM Designation D-975. Select a reputable fuel oil supplier to insure delivery of fuel that meets these specifications. In cold weather, the cloud point of the fuel should be 10°F (6°C) below the lowest expected temperature to prevent wax crystals from forming. Contact the engine manufacturer if operating in temperatures below -20°F (-29°C).

Take appropriate precautions to prevent the entrance of dirt, water, or other contaminant into the fuel system. Filter or strain the fuel as the tank is filled.

WARNING

*DO NOT SMOKE while handling fuel.
Diesel fuel is flammable.*

To avoid condensation problems, keep the fuel supply tanks as full as possible by filling up each time the engine is used. In cold weather, warm fuel returning from the injectors heats the fuel in the supply tank. If the fuel level is low, the upper portion of the tank tends to form condensation. In warm weather, both the fuel and the tank will be warm during the daytime. At night, cool air tends to lower the temperature of the tank more rapidly than the temperature of the fuel. If the fuel level is low, the upper portion of the tank will cool more rapidly and tend to form condensation.

Condensation (water) can cause clogging of fuel filters as well as freezing problems. In addition, water mixing with the sulfur in the fuel forms acid which will corrode and damage the engine parts.

CONTROL PANEL

The following describes the function and operation of the generator set controls. All instruments and control switches (except regulator circuit breaker) are located on the face of the control panel as illustrated in Figure 3. The control panel is separated into a DC panel for monitoring the engine and an AC panel for monitoring the generator.

DC Panel

Panel Light and Switch: Illuminates control panel.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine.

Water Temperature Gauge: Indicates temperature of circulating coolant in 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.

Reset Switch: Manual reset for engine monitor after malfunction shut-down.

Lamp Test: Press to test warning lamp bulbs (when engine is running only).

Six Warning Lights: The low engine temperature light indicates when engine temperature is below 75°F (24°C). The remaining five lights indicate the following malfunctions:

1. Overcrank (failed to start after cranking 75 seconds).
2. Overspeed (engine speed reaches 2100 rpm).
3. Low oil pressure (14 psi/97 kPa).
4. High engine temperature (205°F/96°C).
5. Generator overvoltage.

The operation of these lights will be covered in the TROUBLESHOOTING section.

AC Panel

AC Voltmeter: Indicates AC generator output voltage. Dual range instrument. Measurement range in use is shown on indicator light.

AC Ammeter: Indicates AC generator output current. Dual range instrument. Measurement range in use is shown on indicator lights.

Voltmeter-Ammeter Phase Selector Switch: Selects the phases of the generator output to be measured by the AC voltmeter and AC ammeter.

Voltage Regulator: Rheostat provides approximately plus or minus 5 percent adjustment of the rated output voltage.

Running Time Meter: Registers the total number of hours (to nearest 0.1 hour) that the unit has run. Use it to keep a record for periodic servicing. Time is accumulative; meter cannot be reset.

Frequency Meter: Indicates the frequency of the generator output in

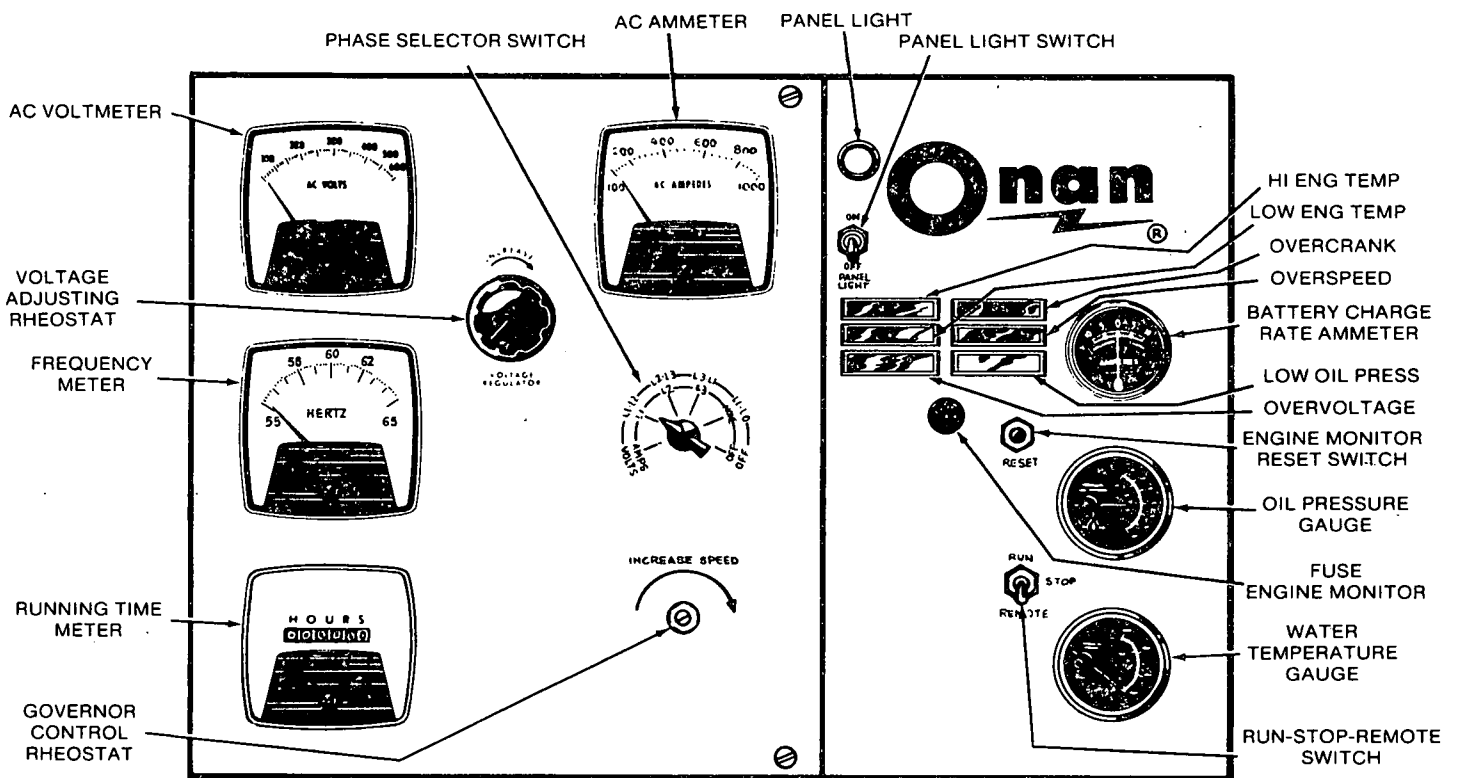


FIGURE 3. GENERATOR SET CONTROL

SC-1178

hertz. It can be used to check engine speed. (Each hertz equals 30 r/min.).

Regulator Circuit Breaker and Fuses: Located on right side of control panel. Circuit Breaker protects the exciter field against overcurrent. Fuses protect regulator against overcurrent.

STARTING

Before each start, check the following to verify that the generator set is ready to run:

1. Crankcase filled.
2. Fuel tank filled.
3. Cooling system filled.
4. Batteries charged and connected.

To Start: Move the Run-Stop-Remote switch on the DC panel 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 specified period of time. The standard start control will disconnect the starter after 75 seconds of cranking if the engine does not start. The optional start control will allow the starter to crank for up to 15 seconds and then disconnect for about 10 seconds. This crank/rest cycle will terminate if the engine fails to start after three cranking tries.

Remote Starting: Move the Run-Stop-Remote switch on the 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.

Start Up Checks: Observe the oil pressure gauge immediately after the

engine is started. A normal oil pressure reading is between 52 and 70 psi (359-483 kPa). The following gauges should also be checked for normal readings:

DC Ammeter - Normal charging rate is 10 to 30 amperes.

AC Voltmeter - Generator output voltage should be stable and not vary more than +2 percent 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 at 160° to 185° F (71° to 85° C).

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, turbo-charger, and bearings. The turbo-charger seals and bearings can be damaged by the sudden temperature rise that occurs when the engine is stopped under load.

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 information on how the switch operates.

New Engine Operation

No special break in procedures are required for new engines. When the engine has reached operating temperature,

the operator should check for coolant, fuel, or lubricating oil leaks and correct as required.

No Load Operation

Periods of no load operation should be held to a minimum and avoided if possible. No load operation allows combustion chamber temperatures to drop so low that the fuel does not burn completely. This results in carbon deposits which can clog injector holes and cause piston rings and valves to stick. If it is necessary to run the engine for long periods at no load, connect a "dummy" electrical load to the generator.

Exercise Period

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts since the protective oil film tends to drain off during periods of non-use. The friction of dry piston rings on dry cylinder walls can cause scuffing and rapid wear.

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 insure reliable starts. Top off the fuel tank after each exercise period.

Onan automatic transfer switches feature an optional exerciser that can be preset to provide regular exercise periods. Typically, the exerciser can be set for time of start (AM or PM), length of run, and day of week.

High/Low Operating Temperatures

The following recommendations apply when operating the generator set in

high (above 95°F/35°C) or low (below 50°F/10°C) ambient temperatures.

Low Temperatures:

1. Use the correct viscosity oil for the lowest expected ambient temperature conditions. If it is necessary to change oil, drain the oil only when engine is warm.
2. Use only fresh diesel fuel and keep the fuel tank completely filled to prevent condensation of moisture.
3. Keep the batteries fully charged and keep all battery connections clean and free of corrosion.
4. Use a water jacket heater if a separate source of power is available. The optional heater available from Onan will assure reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

High Temperatures:

1. Remove any objects that may obstruct the air flow to and from the generator set vent openings.
2. Remove any debris that may have collected on the radiator cooling fins.
3. Keep the cooling system clean and free of scale and rust deposits. The engine temperature should stay within the safe range of 160° to 180° F (71° to 85° C).
4. Use the correct viscosity oil for the ambient temperature conditions.

Power Rating Factors

The generator set power rating applies to sets used in continuous standby applications. The set will operate at the stated rating for the duration of normal utility power interruptions. The rating was established for a standard radiator cooled set running on #2

diesel fuel and operating at an altitude of 500 ft. (15 m) with an ambient temperature of 85°F (30°C). For a rating relative to other applications, altitudes, cooling systems, ambient temperatures, or fuels, contact an authorized Onan Distributor or the factory.

Safe Operation 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 insure continued safe operation.

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

WARNING

Check exhaust system frequently for leaks.

Be sure poisonous exhaust gases are piped to outside. Inhalation of exhaust gases can result in serious personal injury.

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. If any leaks are detected, have them corrected immediately.

DC Electrical System: Check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance which can hinder starting. Clean and reconnect the battery cables if loose. Always connect the negative battery cable last to reduce the possibility of arcing.

WARNING

Batteries emit hydrogen, a highly explosive gas. Do not smoke or create electrical sparks while servicing a battery to prevent a possible explosion.

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.

OUT-OF-SERVICE PROTECTION

If a generator set remains out of service for three or four weeks, special precautions must be taken to protect the engine from rust and corrosion. Refer to the Series 149 Service Manual for the engine manufacturer's recommended storage procedures

The generator and control do not require any special storage procedures other than covering to prevent the entrance of dirt and moisture. The battery should be disconnected and stored in a cool (preferably 72°F/22°C), dry place. Avoid storing the battery on a steel or cement surface as these surfaces absorb heat from the battery and cause it to lose its charge. On a monthly basis, measure the specific gravity of the battery and check the electrolyte level. Add distilled water if below the split ring and charge if the specific gravity is below 1.260 at 77°F (25°C).

Returning Unit to Service: Generator sets that have been in storage require complete servicing and a thorough inspection before they can be returned to normal use. Refer to the Series 149 Service Manual for the engine manufacturer's return to service recommendations. Remove all protective covering from the generator and control and wipe off any accumulations of dust or dirt. Do not reconnect the battery until engine service is complete.

TROUBLESHOOTING

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

The standard control has five fault lamps for indicating malfunctions and terminals for an external alarm for alerting the operator. The procedures to follow for locating a problem and making corrections are covered in Table 1. If a major problem is indicated, contact your Onan Distributor or the engine manufacturer for service. The fault lamp can be deactivated by placing the Run-Stop-Remote switch in the Stop position and pressing the Reset button.

MAINTENANCE

Establish and adhere to a definite schedule for maintenance and service based on the application and the severity of the environment. A set on continuous duty will need servicing at

times other than those recommended for standby duty sets. Some of the factors that can affect the maintenance schedule are the following:

- Continuous duty (prime power)
- Standby power
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water or sea water
- Exposure to dust, sand, etc.

Consult with an authorized Onan Distributor to determine a schedule of maintenance that is suitable for the operating environment of the set. Any maintenance schedule should also be consistent with the engine and generator manufacturers' recommendations. Use the running time meter to keep an accurate record of hours and service for warranty support.

WARNING

Before commencing any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring, disconnect batteries. Failure to do so could result in damage to the unit or serious personal injury in the event of inadvertent starting.

TABLE 1
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM

SYMPTOM	CORRECTIVE ACTION
1. Overcrank fault lights and engine stops cranking after approximately 75-seconds.	1. Check for empty fuel tank, fuel system leaks, or plugged fuel supply lines. Correct as required.
2. Engine runs, shuts down, cranks for 75-seconds, cranking cycle stops, overcrank light ON.	2. Check for dirty fuel filters and replace if necessary. (See Series 149 Service Manual). Check for dirty or plugged air filters and replace if necessary. (See Series 149 Service Manual).
3. *Low oil pressure shutdown.	3. Check oil level and replenish if necessary. Contact Onan Distributor if oil level is correct.
4. *High engine temperature shutdown.	4. Check coolant level on radiator and heat exchanger sets and replenish if necessary. Check for slipping drive belts or for obstructions to the air flow. Check water flow valve on city water cooled sets and adjust if necessary. Contact Onan Distributor or engine manufacturer if none of the above.
5. Overspeed shutdown.	5. Check the governor and throttle linkage for binding and freedom of movement. Reset air shutdown lever to the run position. Contact Onan Distributor or engine manufacturer if linkage is not at fault.
6. Overspeed light on, no shutdown. *Low oil pressure light ON. No shutdown. *High engine temperature light ON. No shutdown.	6. Engine monitor board or sensor malfunction. Contact Onan Distributor for test procedure and replacement.
7. Generator overvoltage.	7. Regulator system malfunction. Contact Onan Distributor.

*Not applicable on Pennsylvania State models.

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