

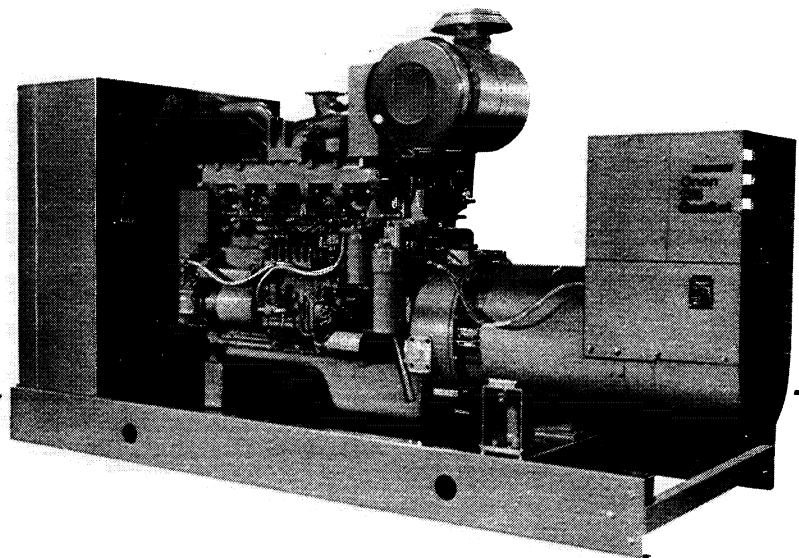


Operator's Manual

DVF

DVG

Diesel GenSets



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.

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Introduction

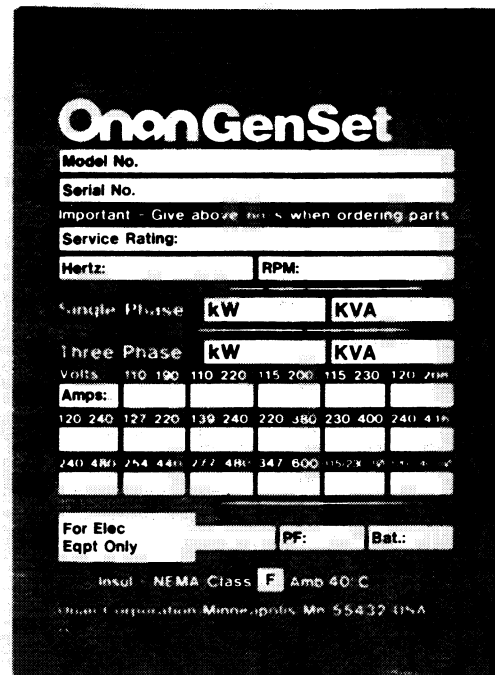
ABOUT THIS MANUAL

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.

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 info. when ordering parts

Service Rating: _____

Hertz: _____ RPM: _____

Single Phase kW _____ KVA _____

Three Phase kW _____ KVA _____

Volts	110 190	110 220	115 200	115 230	120 200
Amps:	_____	_____	_____	_____	_____
	120 240	127 220	139 240	220 380	230 400
	240 415	_____	_____	_____	_____
	240 480	254 440	277 480	347 600	352 600
	_____	_____	_____	_____	_____

For Elec _____ PF: _____ Bat.: _____

Insul - NEMA Class **F** Amp 40 C

Onan Corporation Minneapolis, Mn 55432 USA

Onan Nameplate

⚠ 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.

Specifications

DVF

GENERATOR DETAILS

Type	Onan, Revolving Field, 4-Pole, Brushless
Rating	
175 DVF 60 Hertz Continuous Standby	175 kW (219 kVA at 0.8 PF)
150 DVF 50 Hertz Continuous Standby	150 kW (188 kVA at 0.8 PF)
200 DVF 60 Hertz Continuous Standby	200 kW (250 kVA at 0.8 PF)
165 DVF 50 Hertz Continuous Standby	165 kW (206 kVA at 0.8 PF)
AC Voltage Regulation, 0 to 100% Load	±3%

ENGINE DETAILS

Engine	Onan 06110T
Engine Speed (r/min)	
50 Hertz Operation	1500
60 Hertz Operation	1800
Fuel	ASTM No. 2 Diesel
Fuel Inlet Size	For 3/8 in. (10 mm) I.D. Hose
Fuel Return Outlet	For 3/8 in. (10 mm) I.D. Hose
Fuel Pump Maximum Lift	3.5 ft. (1m)
Exhaust Outlet	3.74 in. (95 mm) Flange
Starting System Voltage	24
Battery Requirements	
BCI Group Size	4D
Cold Cranking Amps @ 0°F (-18°C)	700
Battery Voltage	12
Quantity Required	2
Cooling System (Engine and Radiator)	10.5 gallons (40 L)
Engine Oil Capacity (Filter, Lines, and Crankcase)	8.5 gallons (32 L)

DVG

GENERATOR DETAILS

Type Onan, Revolving Field, 4-Pole, Brushless
Rating
 60 Hertz Continuous Standby 250 kW (312 kVA at 0.8 PF)
 50 Hertz Continuous Standby 200 kW (250 kVA at 0.8 PF)
AC Voltage Regulation, 0 to 100% Load $\pm 3\%$

ENGINE DETAILS

Engine Onan 06110TA
Engine Speed (r/min)
 50 Hertz Operation 1500
 60 Hertz Operation 1800
Fuel ASTM No. 2 Diesel
Fuel Inlet Size For 3/8 in. (10 mm) I.D. Hose
Fuel Return Outlet For 3/8 in. (10 mm) I.D. Hose
Fuel Pump Maximum Lift 3.5 ft. (1m)
Exhaust Outlet 3.74 in. (95 mm) Flange
Starting System Voltage 24
Battery Requirements
 BCI Group Size 4D
 Cold Cranking Amps @ 0°F (-18°C) 700
 Battery Voltage 12
 Quantity Required 2
Cooling System (Engine and Radiator) 10.5 gallons (40 L)
Engine Oil Capacity (Filter, Lines, and Crankcase) 8.5 gallons (32 L)

Operation

GENERAL

This section covers starting and operating the generator set. It is recommended that the operator read through this entire section before attempting to start the set. It is essential that the operator be completely familiar with the set to insure 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 proper procedures.

Lubrication

Check the engine oil level. Keep the oil level near as possible to the dipstick high mark without overfilling.

Coolant

The coolant level should be about two inches (51 mm) below the radiator cap opening. Do not check while the coolant is hot.

⚠ WARNING

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

Fuel

Make sure the fuel tanks have sufficient fuel. See the *MAINTENANCE* section for recommended fuel

⚠ WARNING

Spilled fuel can ignite and cause severe personal injury or death. Never fill the fuel tank when the engine is running.

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.

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.

Fault Lamps: Indicate fault in engine operation. The Run and Fault lamps are standard, other lamps are control options. See description under "Indicator Lamps."

⚠ 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.

Running Time Meter: Registers the total number of hours that 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.

AC Panel

AC Voltmeter (Optional): Dual range instrument indicating generator AC voltage. Measurement range in use shown on indicator light.

AC Ammeter (Optional): Indicates AC generator line current.

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.

Field Breaker: Provides generator exciter and regulator protection from overheating in the event of certain failure modes of generator, exciter and voltage regulator.

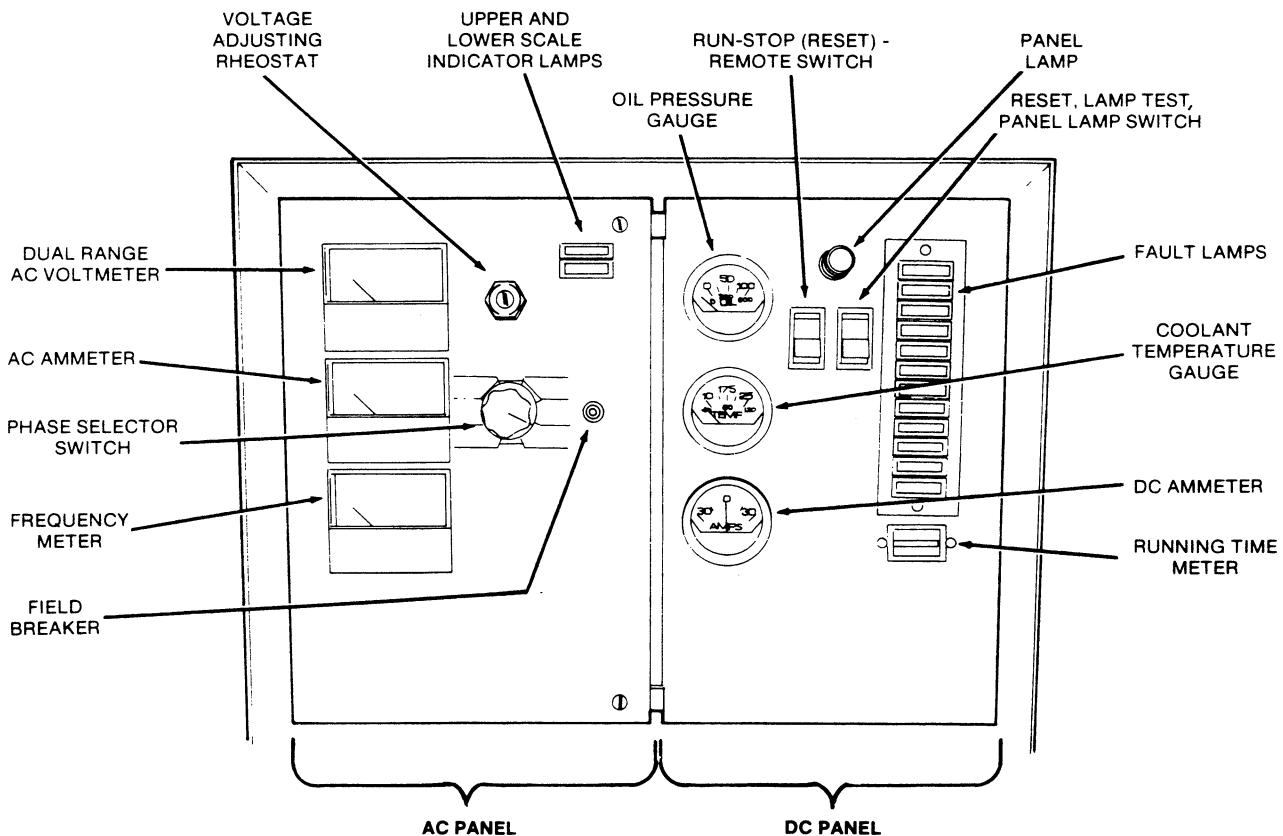
Phase Selector Switch (Optional): Selects phases of generator output to be measured by AC voltmeter and AC ammeter.

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 shutdown of the generator set.



M-1590

FIGURE 1. OPTIONAL CONTROL PANEL (12 FAULT LAMPS)

The optional control panel has a twelve-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.
- **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).
- **LOW ENG TEMP** (yellow) engine temperature is marginally low for starting. Indicates inoperative coolant heater.
- **LO FUEL** (yellow) indicates fuel supply is marginally low.
- **SWITCH OFF** (flashing red) indicates generator set is not in automatic start operation mode.

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 three 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 ± 100 r/min, 50 hertz units at 1900 ± 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 above 227°F (108°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 (216°F/102°C). The cause should be found and corrected as soon as possible.

⚠CAUTION

The high engine temperature shutdown 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. Therefore, maintain adequate engine coolant levels to ensure operational integrity of cooling system and engine coolant overheat shutdown protection.

- Low Coolant Level Shutdown (If Used): A coolant level actuated switch located in the radiator top tank providing engine shutdown if coolant level falls too low. It turns on the high engine temperature fault lamp on the control.

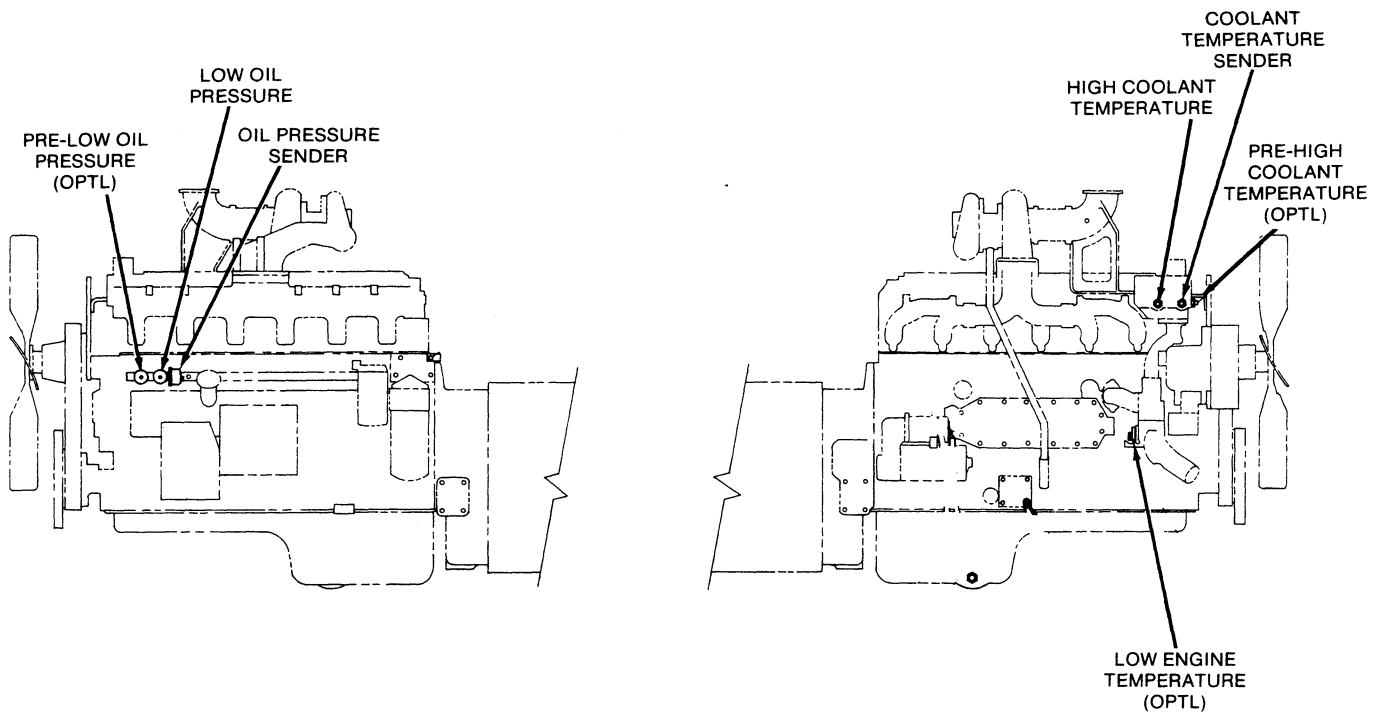


FIGURE 2. SENSOR LOCATIONS

STARTING PROCEDURE

The following sections cover the three systems used to start the generator set.

Start at Control Panel

Move the Run-Stop-Remote switch on the DC panel (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 specified 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 40 and 80 psi (275 and 550 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 175 and 212°F (80 to 100°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 on 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.

No-Load Operation

Hold periods on no-load operation to a minimum and avoid 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 injectors 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.

To avoid excessive 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.

High/Low Operating Temperature

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.

1. Use the correct viscosity oil for the most extreme expected ambient temperature conditions. If it is necessary to change oil, drain the oil only when the engine is warm.
2. Use only fresh diesel fuel and keep the fuel tank completely filled to prevent condensation of moisture. Use ASTM #1 fuel at temperatures below 14°F (-10°C).
3. Keep the batteries fully charged and keep all battery connections clean and free of corrosion.

4. For low temperatures, use a water jacket heater if a separate source of power is available. The optional heater is available from Onan and will assure reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating. Various voltage combinations are available.

See low temperature fuel recommendation in the Maintenance Section.

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 300 feet (91 m) with an ambient temperature of 77°F (25°C). For a rating relative to other applications, altitudes, cooling systems, ambient temperatures, or fuels, contact an authorized Onan Distributor.

OUT-OF-SERVICE PROTECTION

Onan recommends the exercise of generator sets at weekly intervals. Onan transfer switches can perform this function automatically and also keep the starting battery charged. If the generator set will be out-of-service longer than this, see the following recommendation.

The out-of-service time interval should not be extended beyond 30 days. Once-a-month operation restores oil films on internal engine surfaces. The inherent lubricating qualities of No. 2 diesel fuel should protect the cylinders of a diesel engine for 30 days when unit is not in service.

TROUBLESHOOTING

The generator set 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 might restart the set after making some adjustments or corrections.

The following troubleshooting charts list symptoms and corrective action for the three 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 Tables 2 through 3. If a major problem is indicated, contact your Onan Distributor for service.

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.

High voltages are present within the control box when the generator set is running. Do not open the control box unless the generator set is disabled.

⚠ 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 2.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
Controls with only one fault lamp

SYMPTOM	CORRECTIVE ACTION
1. Engine stops cranking and fault lamp lights, after cranking approximately 75 seconds.	1. Check for empty fuel tank, empty fuel filters, system leaks, or plugged fuel filters and fuel supply lines. Correct as required. Check for dirty or plugged air filters and replace if necessary (see <i>MAINTENANCE</i> section).
2. Fault lamp lights immediately after engine starts and unit shuts down.	2. Indicates possible overspeed condition. Contact an Onan Distributor.
3. Fault lamp lights and engine shuts down after running for a period.	3. Check oil level and replenish if necessary. Check coolant level on radiator and heat exchanger sets and replenish if necessary. Check for slipping drive belts or for obstructions to the airflow. Check for empty fuel tank, fuel system leaks, or plugged filters. Contact an Onan Distributor if none of the above.
4. Fault lamp lights, no fault exists.	4. Engine monitor or sensor malfunction. Contact an Onan Distributor.

TABLE 3.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
Controls with twelve fault lamps

SYMPTOM	CORRECTIVE ACTION
1. Overcrank fault lamp lights and engine stops cranking after about 75 seconds.	1. Check for empty fuel tank, empty fuel filters, system leaks, or plugged fuel filters and fuel supply lines. Correct as required.
2. Engine runs and then shuts down. The low oil pressure fault lamp is on.	2. Check fuel supply and for dirty fuel filters. Replace if necessary. Check oil level and replenish if needed. See <i>MAINTENANCE</i> section. Check for dirty or plugged air filters and replace if necessary (see <i>MAINTENANCE</i> section).
3. Low oil pressure shutdown; or pre low oil pressure shutdown if so programmed.	3. Check oil level and replenish if necessary. Contact an Onan Distributor if oil level is correct. Also see Symptom 2.
4. High engine temperature shutdown; or pre high engine temperature shutdown if so programmed.	4. Check coolant level on radiator and heat exchanger sets and replenish if necessary. Check for slipping drive belts or for obstructions to the airflow. Contact an Onan Distributor if none of the above.
5. Overspeed shutdown.	5. Contact an Onan Distributor.
6. Any one of the red fault lamps (or yellow pre-fault lamps if programmed for shutdown) light, but no shutdown occurs.	6. Engine monitor malfunction. Contact an Onan Distributor.
7. Run lamp is not on when generator set is operating.	7. Indicates that a starter disconnect function is not working. Contact an Onan Distributor.

continued -

TABLE 3 (continued)

SYMPTOM	CORRECTIVE ACTION
8. Low engine temperature fault circuit (yellow lamp) is energized.	8. Check power source supplying the coolant heater. Problem might be a power outage or power disconnect (blown fuses). If coolant heater, sensor or engine monitor is suspected, contact an Onan Distributor.
9. Low fuel fault circuit (yellow lamp) is energized.	9. Check fuel tank and replenish fuel as needed. If fuel in tank is adequate/full, contact an Onan Distributor.
10. An undedicated (red) fault lamp is energized and may or may not shut down the generator set.	10. Both fault functions are normally factory set for shutdown and Fault 1 is time delayed after start disconnect while Fault 2 is immediate. Both fault functions may be factory set optionally for non-shutdown and time delayed after start disconnect or immediate operation. Troubleshooting should be directed to the selected sensor application. If an engine monitor malfunction or sensor is suspected, contact an Onan Distributor.

Maintenance

Establish and adhere to a definite schedule for maintenance and service based on the application and severity of the environment. Table 4 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 of the factors that can affect the maintenance schedule are the following:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand
- Fuel sulphur content

Consult with an authorized Onan Distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated or after the number of operating hours indicated, whichever comes first. Use the table to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

⚠ 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.

TABLE 4. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	MAINTENANCE SCHEDULE					
	10 Hrs.	50 Hrs.	250 Hrs.	500 Hrs.	1000 Hrs.	2000 Hrs.
Inspect generator set	x ¹					
Check oil level	x					
Check coolant level	x					
Check air cleaner (clean if necessary)		x				
Check batteries			x			
Change engine crankcase oil			x ^{6,2}			
Change oil filter			x ^{6,2}			
Check alternator/fan belts			x ³			
Drain exhaust condensate trap			x			
Drain fuel tank water/sediment			x ⁴			
Change fuel filter element			x ⁵	x		
Check radiator, coolant hoses				x ³		
Clean cooling system & htr./replace coolant					x	
Check turbocharger					x	
Clean gen. assy./check generator bearing						x
Change air cleaner element					x ⁷	
Clean crankcase breather element						x
Check vibration damper						x
Check valve clearances			x ⁵			x
Check water pump						x

¹ - Check for oil, fuel, cooling, and exhaust leaks. Check exhaust system audibly and visually with generator set running. Repair any leaks immediately.

² - Or every 12 months, whichever occurs first.

³ - Or every 3 months, whichever occurs first.

⁴ - Or every 12 months. Drain at least one cup of fuel to remove water and sediment.

⁵ - Initial adjustment at 250 hours.

⁶ - Perform more often for high sulphur content fuel. See text.

⁷ - Or sooner if service indicator shows restriction.

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 insure continued safe operation.

Exhaust System

With the generator set operating, inspect the entire exhaust system visually and audibly 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, shut down generator set and have them corrected immediately.

▲WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Be sure deadly exhaust gas is piped outside and away from windows, doors or other inlets to building.*

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.

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

AC Electrical System

Check the following meters while the generator set is operating.

Frequency Meter (if equipped): The generator frequency should be stable and the reading should be the same as the nameplate rating (50 or 60 Hertz).

AC Voltmeter (if equipped): 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 (if equipped): 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 about the same.

Fault Lamps: With the generator set stopped (Run-Stop-Remote switch in Stop position), actuate the Lamp Test switch. Verify that all indicator lamps are on.

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 *Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.*

Mechanical

Follow warning below before proceeding. 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.

▲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.*

LUBRICATION SYSTEM

The lubrication system must have oil of the recommended classification and viscosity. Refer to the *SPECIFICATIONS* section for the lubricating oil capacity.

Oil API Classification

The lubricating oil recommended in Table 5 satisfies the engine needs for satisfactory operation under most conditions. A publication entitled "Lubricating Oil Data Book" is available from EMA (Engine Manufacturers Association) that list commercially available oils by brand name and the corresponding API Classifications. Once an oil is selected, do not mix it with oils of another classification or add any oil additives.

Oil Viscosity

The viscosity of an oil is a measure of its resistance to flow at certain specified temperatures. The viscosity grades shown in Table 5 are satisfactory for most conditions.

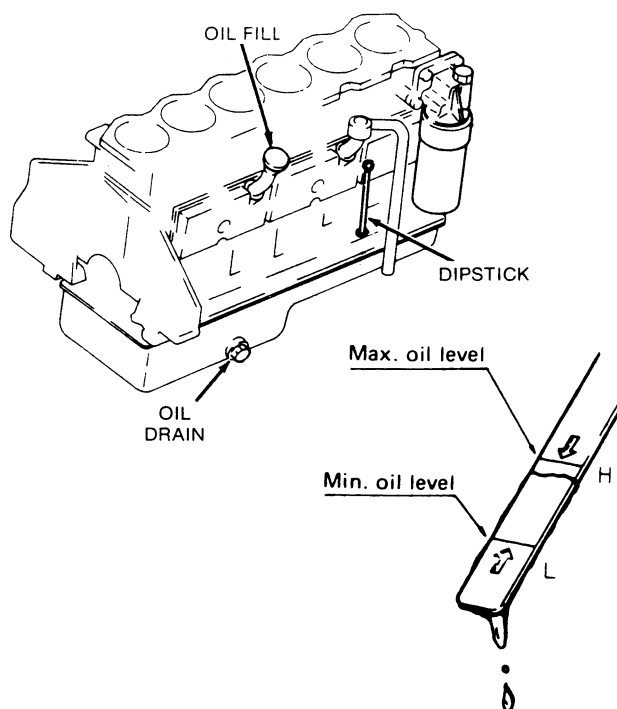
TABLE 5. PROPER SELECTION OF FUEL AND LUBRICANTS

KIND OF FLUID	AMBIENT TEMPERATURE						
	-4° F -20°	14° -10°	32° 0°	50° 10°	68° 20°	86° 30°	104° 40° C
Engine Oil Use API Class- ification CD			SAE 30				
	SAE 10W						
	SAE 10W-30						
	SAE 15W-40						
Diesel Fuel	*						
		ASTM D975 No. 2					

* ASTM D975 No. 1

Engine Oil Level

Check the engine oil level during engine shutdown periods at the intervals specified in the Operator Maintenance Schedule. Figure 3 shows the dipstick and oil fill locations. The dipstick is stamped with high and low marks to indicate the level of oil in the crankcase. For accurate readings, shut off the engine and wait five minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.



⚠ WARNING Crankcase pressure can blow out hot oil and cause severe burns while the engine is running. Do NOT check oil while the generator is operating.

Keep the oil level as near as possible to the high 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 low mark or above the high mark. Overfilling causes foaming or aeration of the oil while operation below the low mark causes loss of oil pressure.

Oil and Filter Change

Use oil that meets the API classification and viscosity requirements as indicated in the previous section. If the engine is started when ambient temperature is lower than 32° F (0° C), use SAE 10W oil even though the ambient temperature might go to 50° F (10° C) during the day.

If API oil classification CD is not available, classification CC can be used if the oil change interval is reduced to half.

FIGURE 3. LOCATION OF OIL FILL, DRAIN AND DIPSTICK

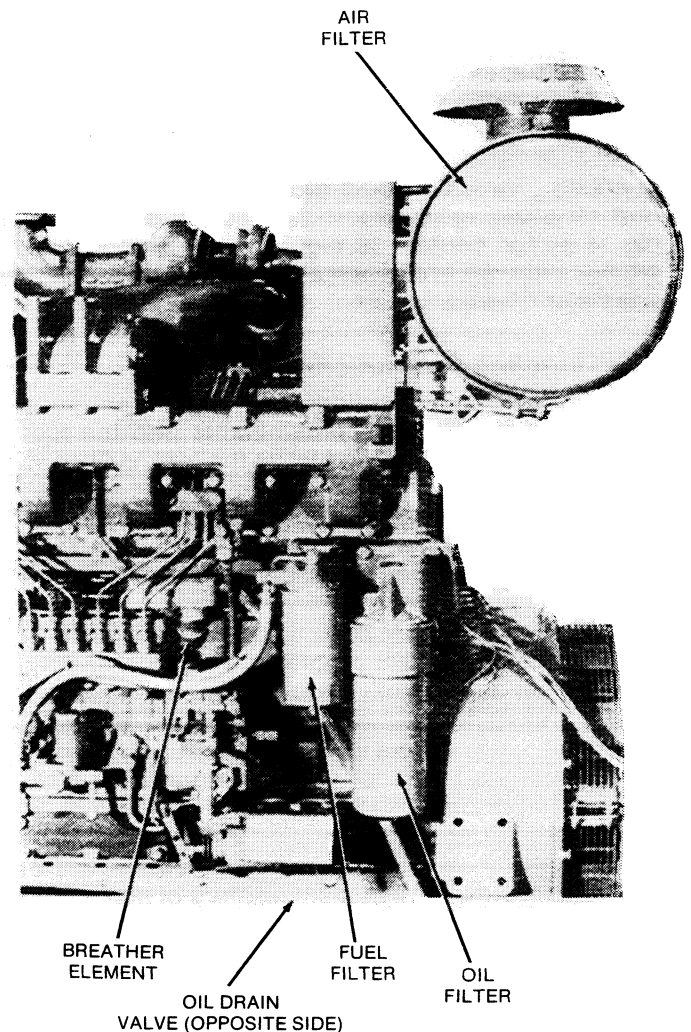
When the fuel sulphur content is less than 0.5%, change engine oil as recommended in the Operator Maintenance Schedule. If fuel sulphur content is above 0.5%, change oil as indicated in the following table:

Fuel Sulphur Cont.	Change Interval
0.5 to 1.0%	1/2 regular interval
Above 1.0%	1/4 regular interval

Oil and Filter Change Procedure:

1. Bring the engine up to operating temperature and then shut it off.
2. Open the drain valve and collect the engine oil in a pan. When the crankcase is drained, close the drain valve.
3. Unscrew the "spin-on" type oil filter and discard (see Figure 4).
4. Apply a light coat of oil to the gasket sealing surface of the new filter.
5. Install a new filter and tighten 2/3 turn by hand after the seal touches the sealing surface of the bracket. Do not overtighten.
6. Fill the crankcase with the amount of oil noted in the Specifications section.
7. Start the engine and check for oil leaks.
8. Shut off the engine, wait five minutes, and then check the oil level. Add oil if required.

⚠ WARNING *Crankcase pressure can blow out hot oil and cause severe burns while the engine is running. Do NOT check oil while the generator set is operating.*



FILTER 4. FILTER LOCATION

Crankcase Breather Element

Service the crankcase breather during engine shut-down periods at intervals specified in the Operator Maintenance Schedule. Perform more often for dusty conditions.

To clean the crankcase breather element, remove top cover from the breather assembly shown in Figure 4. Remove element, rinse in diesel fuel and reinstall.

⚠ WARNING *Fuel presents the hazard of fire and explosion that can cause severe personal injury or death. Do not permit any flame, cigarette, or other ignition source near the fuel.*

FUEL SYSTEM

Recommended Fuel

The engine has been primarily designed to operate on No. 2 diesel fuels since such fuels have a higher energy content and are generally lower in cost. Use No. 1 fuel for temperatures lower than 14°F (-10°C) or for all temperatures if altitudes are above 5000 feet (1500 m). The fuel should have a cetane rating of at least 40 and have less than 0.5 percent sulfur if possible. If sulfur content is higher, more frequent oil change intervals are necessary (described under "Oil and Filter Change").

Fuel Handling Precautions

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

⚠ WARNING

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

To avoid condensation problems, keep 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 sulphur in the fuel forms acid which can corrode and damage engine parts.

Fuel Filter/Air Bleed

To replace the fuel filter, use this procedure.

1. Move the operation selector switch to Stop position.
2. Remove fuel filter (Figure 5) by turning it counterclockwise with a filter tool.

3. Fill the new filter with clean fuel and install it after applying a light film of oil to the sealing surface.
4. Turn filter until sealing surface contacts filter base, then tighten it 2/3 turn by hand. Do not overtighten.
5. Loosen air bleed plug on top of filter base. Loosen knob of the manual transfer pump and move it up and down until air bubbles cease to come out of the bleed plug. Tighten bleed plug.

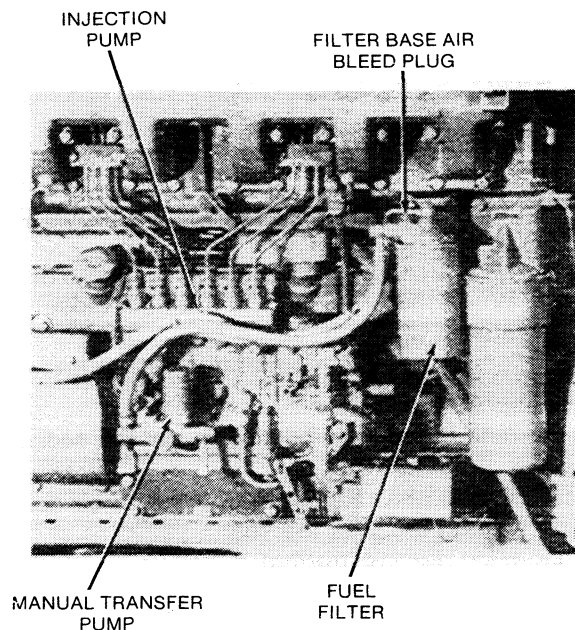


FIGURE 5. AIR BLEED COMPONENTS

6. Push in and tighten knob of the manual transfer pump.
7. Start the engine and check filter sealing surface for any leakage.

COOLING SYSTEM

The cooling system capacity of standard units with set mounted radiator is shown in the *SPECIFICATIONS* section.

Coolant Requirements

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

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 or reduce cooling efficiency.

Filling the Cooling System (Radiator and Heat Exchanger Sets)

Remove the cooling system pressure cap and fill the system with a water/anti-freeze mixture. 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.

⚠ WARNING

Contact with hot coolant can result in severe burns. Allow cooling system to cool before releasing pressure.

Coolant Level

Check the coolant level during shutdown periods at the intervals specified in the Operator Maintenance Schedule. Remove the radiator cap after allowing the engine to cool and if necessary, add coolant until the level is up to the overflow pipe.

Coolant Heater

Check the operation of the coolant heater by verifying that hot coolant is being discharged from the outlet hose (see Figure 6). For efficient operation and maximum life, clean the coolant heater whenever the cooling system is drained for flushing.

⚠ CAUTION

The heater must not be operated while the cooling system is empty or damage to the heater will occur.

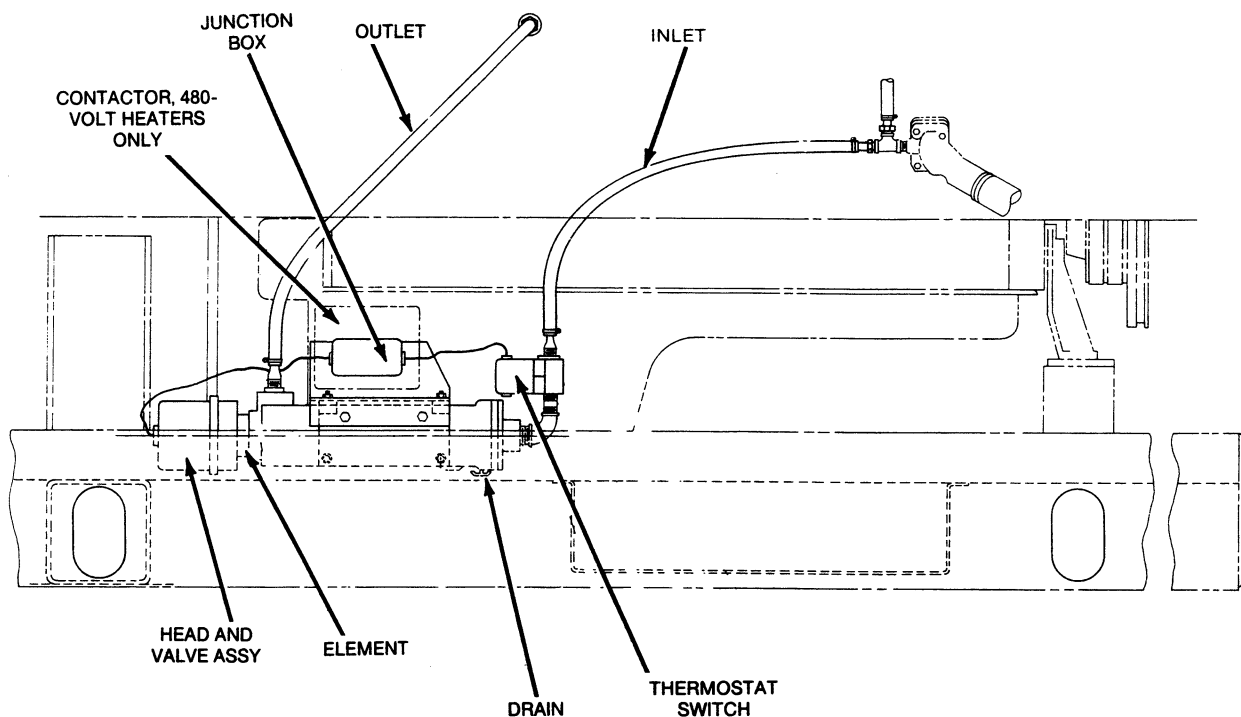


FIGURE 6. COOLANT HEATER

Flushing and Cleaning Cooling System

1. Add system cleaner or flush solution to the radiator as instructed on the container. Also follow instructions for running the unit. Proceed to step 2 when instructed to stop the engine.
2. Move the control selector switch to Stop.
3. Remove AC power to the coolant heater if equipped.

⚠CAUTION *Failure to disconnect AC power from the heater before draining coolant will result in heater damage.*

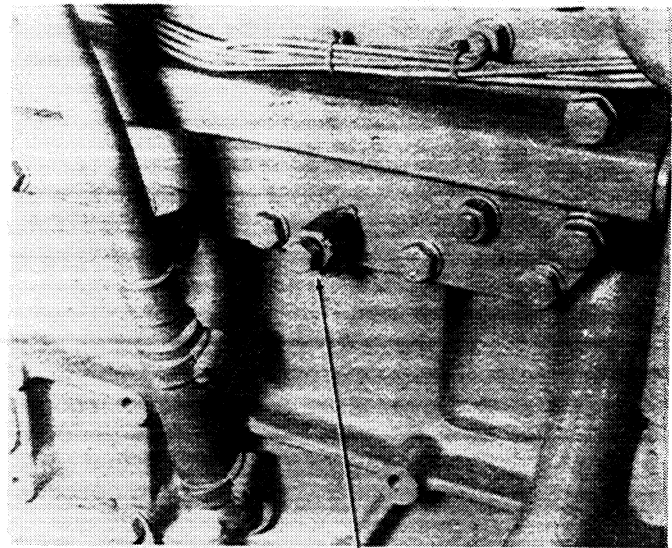
4. Wait for the engine to cool before draining the cooling system.

⚠WARNING *Contact with hot coolant can result in severe burns. Use care when draining cooling into a container.*

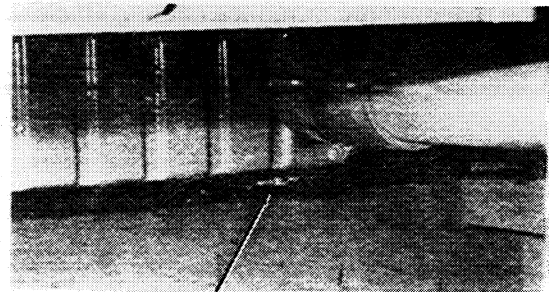
- A. Remove the radiator cap and open the radiator and cylinder block drain cocks. See Figure 7. Attach a hose to the cylinder block drain and collect coolant in a container. An air bleed petcock near the thermostat housing can be opened to facilitate draining and filling of the cooling system.
 - B. Open the cylinder block drain cock.
 - C. Open the coolant heater drain on the bottom of the heater. See Figure 6.
5. Flush cooling system if so instructed by cleaner or flush solution manufacturer. Do not add cold water or solution to a warm engine.

⚠CAUTION *Adding cold solution to a warm engine can result in engine damage.*

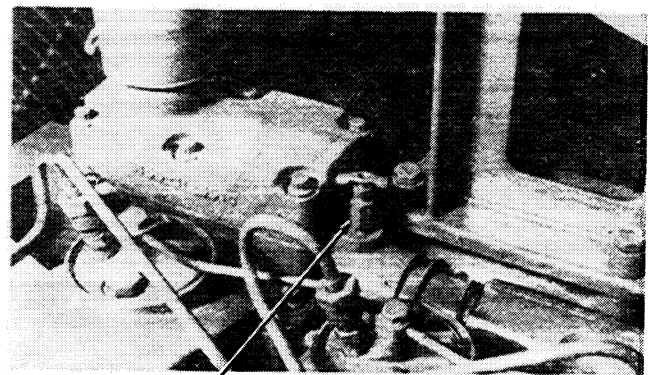
6. Close the radiator, coolant heater and cylinder block drain cocks.
7. Fill the cooling system with a 50/50 solution of ethylene glycol and water with approved rust inhibitor. This solution will protect the cooling system to -35° F (-37° C) temperature.
8. Reconnect AC power to the coolant heater if applicable.
9. Move the control selector switch to RUN position and operate engine for ten minutes to purge trapped air.
10. Allow engine to cool, then remove the radiator cap slowly and add coolant to bring level up to over the radiator core.



CYLINDER BLOCK
DRAIN COCK



RADIATOR
DRAIN COCK



AIR BLEED
PETCOCK

FIGURE 7. COOLING SYSTEM DRAIN LOCATIONS

Radiator Fins and Hoses

Every 500 hours or 3 months, clean the radiator fins of any restriction such as dust, leaves, mud, etc. with compressed air. Steam or water may be used instead of compressed air. At the same time, check coolant hoses for swelling, cracking or brittleness. Replace if necessary. Tighten hose clamps as needed.

Water Pump

Every 2000 hours inspect the water pump for bearing play and for grease or water leakage. If a fault is detected, have the Onan Distributor disassemble and repair or replace the pump.

BATTERIES

Check the condition of the starting batteries at the interval specified in the maintenance table. See that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water. Check specific gravity and recharge if below 1.260.

⚠ WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.*

ALTERNATOR AND FAN BELT

Inspect the belts regularly for wear, cracks or fraying. Replace if necessary. To check tension, first move the control selector switch to STOP. Then place a force of 13 pounds (6 kg) midway between the pulleys. If adjusted properly, the belt should deflect 3/8 inch (10 mm).

⚠ WARNING *Contact with rotating machinery can cause severe personal injury or death. Be sure to move the Operation Selector switch to STOP and disconnect the starting batteries before checking fan belt tension or before making any adjustments.*

Be sure to loosen both the adjusting strap and bracket capscrews when making adjustments. Pull on the front alternator frame only to tighten the belt. See Figure 8.

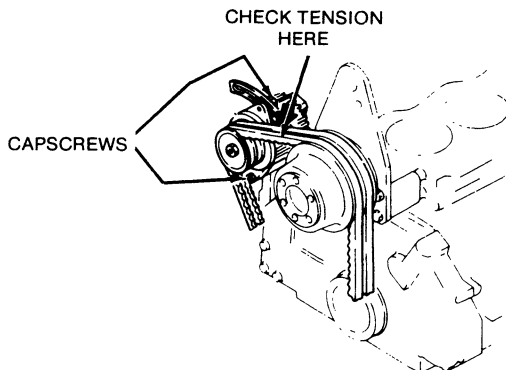


FIGURE 8. ADJUSTING BELT TENSION

AC GENERATOR

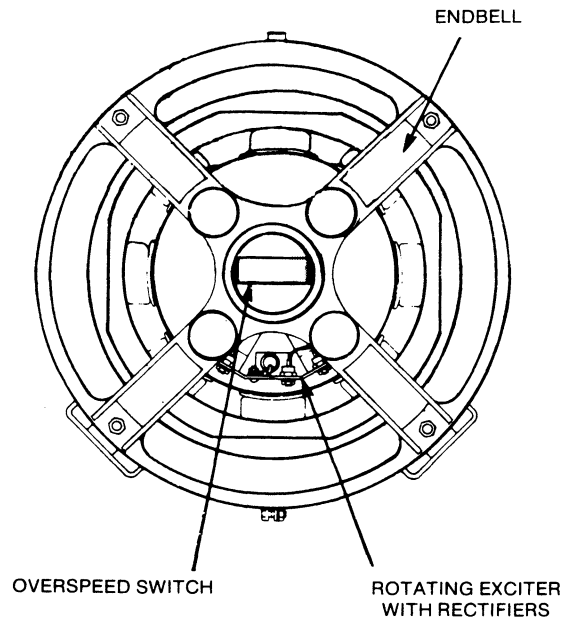
There are no brushes, brush springs or collector rings on these generators, therefore they require very little servicing. Periodic inspections, to coincide with engine oil changes, will ensure good performance.

Check generator voltage. It might be necessary to make a slight readjustment of the voltage rheostat to obtain the preferred voltage at average load.

Inspection of Rotating Rectifier Assembly

Move the control selector switch to STOP, disconnect the starting batteries, and then remove the generator grill section. Inspect the rotating rectifier assembly to make sure the diodes (see Figure 9) are free of dust, dirt, and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure. Blow out the assembly periodically with filtered low pressure air.

⚠ WARNING *Accidental starting of the set can cause severe personal injury or death. Move the Operation Selector switch to STOP and disconnect the starting batteries before inspecting rotating rectifier assembly.*



GENERATOR END VIEW (GRILLE REMOVED)

FIGURE 9. ROTATING RECTIFIER ASSEMBLY

Generator Bearing

Have the bearing inspected for wear every 2000 hours by an Onan service representative. If the unit is used for "prime power," have the bearing replaced every 10,000 hours or after two years. If the unit is used for "standby power," have the bearing replaced every five years.

AIR CLEANER

The air cleaner requires service any time the restriction indicator is tripped. When the red piston appears in the transparent part of this indicator, the element is clogged and should be serviced as soon as possible. See Figure 10. Use the following procedures for servicing the primary element and replacing the safety element option when necessary as found in some applications. Access to the elements are made by removing the clamp and cup assembly.

Primary Element

The primary element can be cleaned and reused providing it has not been damaged. Replace the element after six cleanings or yearly, whichever occurs first.

Clean the primary element by one of the following methods: compressed air or washing. Compressed air is recommended when element will be re-used immediately because a washed element must be dried before using. However, washing does a better job and must be used when exhaust soot has lodged in fine pores of the filter media.

CAUTION When cleaning the element either with compressed air or by washing, care must be taken to prevent the removed dirt from getting redeposited on the clean side of the element.

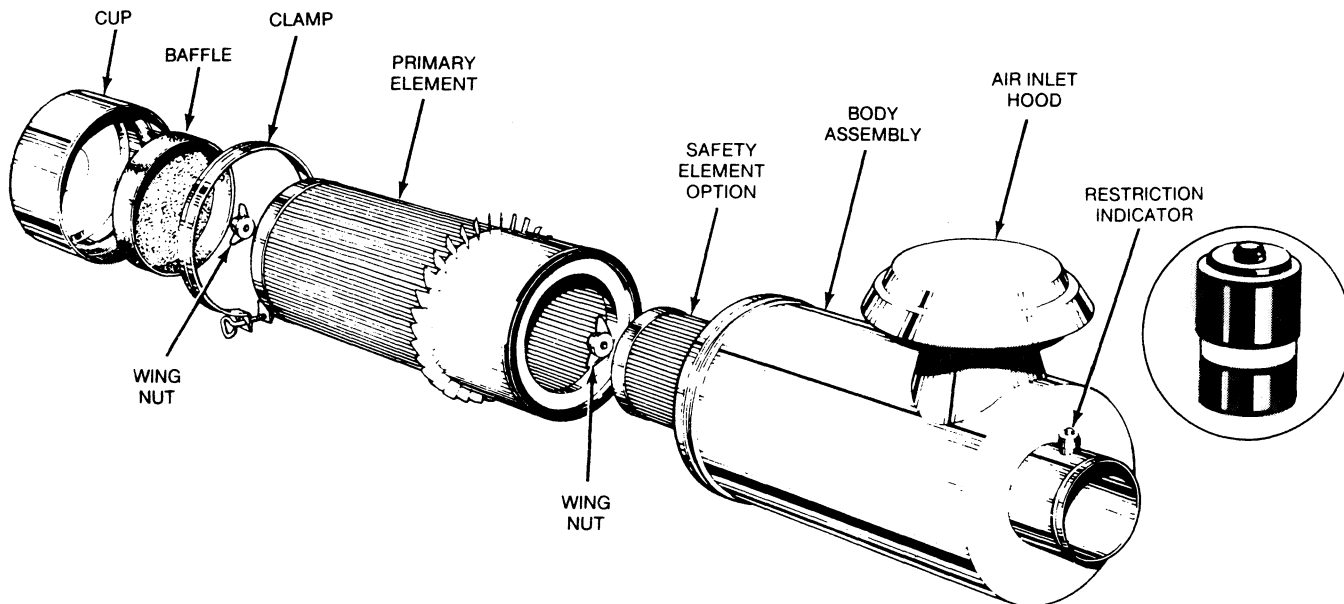
Compressed Air: Direct air through element in the direction opposite to normal airflow (direct air through the element from inside surface). Move the air nozzle up and down while rotating the element keeping the nozzle at least one inch (25 mm) from the pleated paper. Do not exceed 30 psi (207 kPa) air pressure.

Washing: Soak the primary element 15 minutes or more in a pail of clean water containing a detergent. Commercial cleaners designed for this purpose may be necessary if the element has soot accumulation. Rinse the element until water is clear. Do not exceed 40 psi (276 kPa) water pressure. Air-dry the element or use warm flowing air, maximum 160°F (71°C). DO NOT use compressed air or light bulbs.

Inspection: Place a bright light inside the primary element and rotate element slowly. If any rupture, holes or damaged gaskets are discovered, replace the element.

Safety Element (Option)

Do not remove the safety element from the filter housing except for replacement. The safety element is not intended to be cleaned. For maximum engine protection, replace the safety element with a new one every third primary element change or cleaning - or as indicated by the restriction indicator.



M-1156-1

FIGURE 10. AIR CLEANER

TURBOCHARGER

Routine maintenance of the turbocharger should be completed every 1000 hours of operation. Call the Onan Distributor for maintenance as he has the knowledge and necessary tools for this procedure.

Check the turbocharger daily for any exhaust leakage, air leakage, and for any oil leakage from the lubrication oil line. Oil leakage from the oil line (Figure 11) might cause bearings to seize. Leakage between the turbocharger and the intake manifold or exhaust manifold will cause performance reduction. Any exhaust leakage must be corrected immediately.

⚠WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Repair any leaks immediately.*

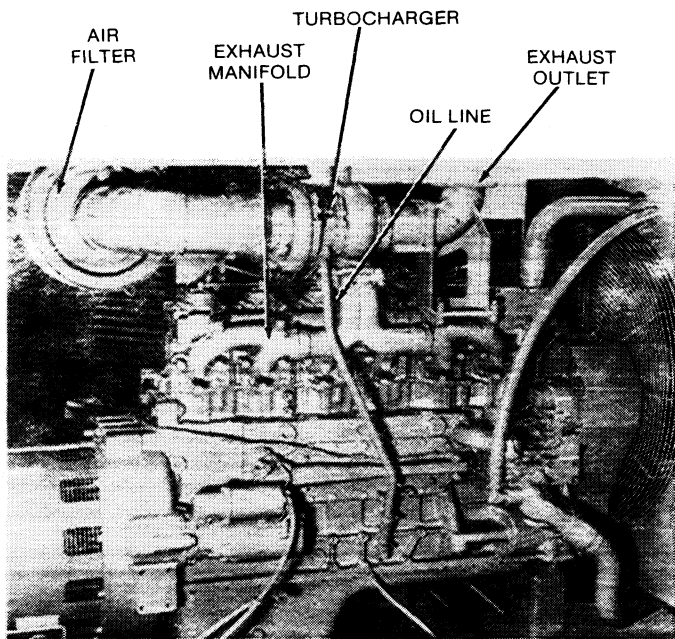


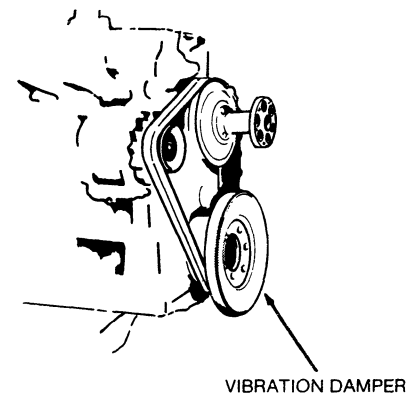
FIGURE 11. TURBOCHARGER

VALVE CLEARANCES

Special tools are required for removal and adjustment of related parts. Have engine valve clearances checked and adjusted by the Onan Distributor as specified in the Operator Maintenance Schedule.

VIBRATION DAMPER

Check the vibration damper after every 2000 hours of service. See Figure 12. Inspect the rubber damper for cracks, and the inertia member for deterioration that will impair its effectiveness. If a fault is detected, ask the Onan distributor for repair/replacement.



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FIGURE 12. VIBRATION DAMPER



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