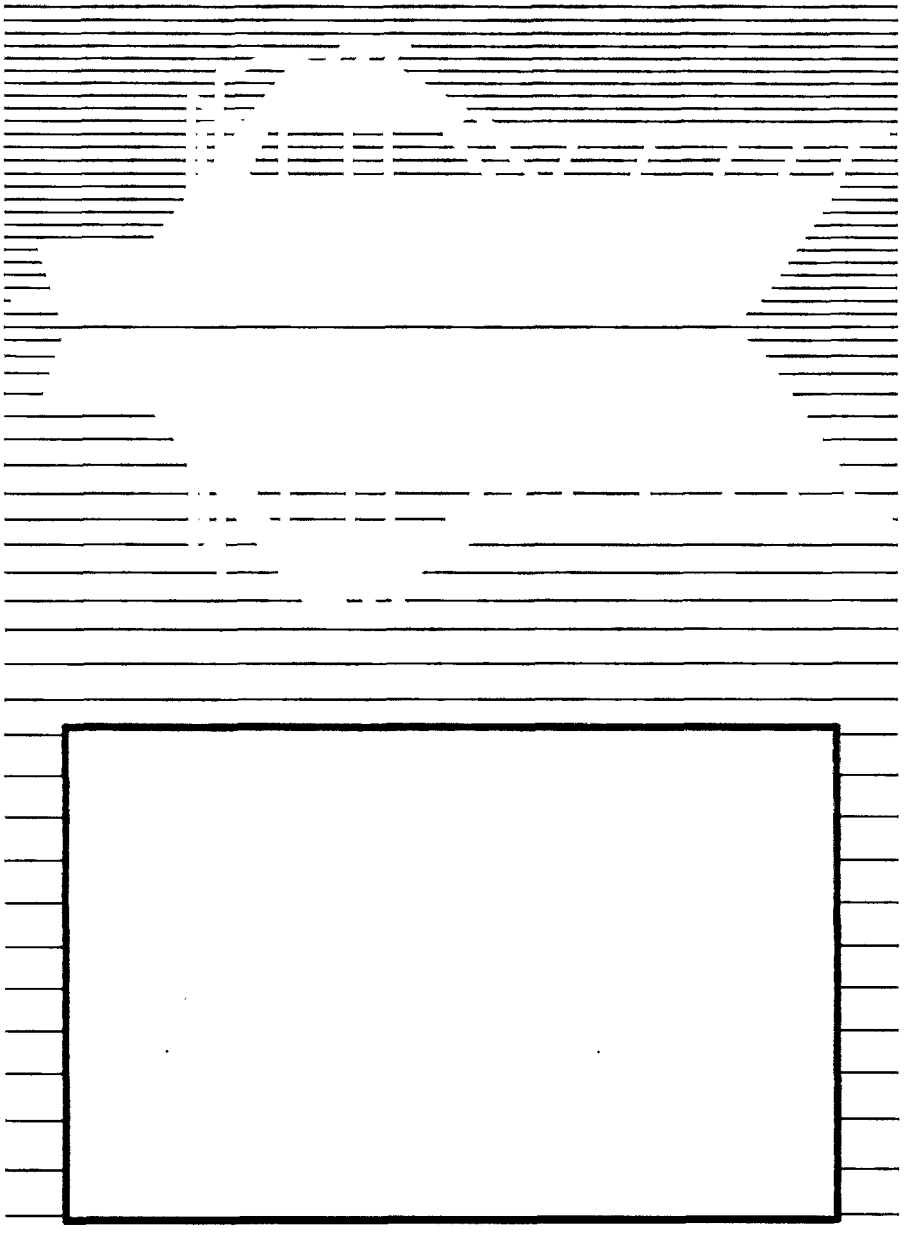
MARINE

Operator's Manual

MDL3
MDL4
MDL6



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Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and your unit. **Safe and efficient operation can be achieved only if the unit is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

Throughout this manual you will notice symbols which alert you to potentially dangerous conditions to the operator, service personnel, or the equipment itself.

⚠ DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC. Fire, explosion, and personal injury can result from improper practices.

- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Do not fill fuel tanks with the engine running. Do not smoke around the generator set area. Wipe up any oil or gas spills. Do not leave oily rags in engine compartment or on the generator set. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip the engine fuel supply with a positive fuel shutoff.
- Always disconnect the battery ground (–) lead first and reconnect it last. Make sure you connect the battery correctly. A direct short across the battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is very explosive.
- Keep a fire extinguisher available in or near the engine compartment and in other areas throughout the vessel. Use the correct extinguisher for the area. For most types of fires, an extinguisher rated ABC by the NFPA is available and suitable for use on all types of fires except alcohol.

EXHAUST GASES ARE DEADLY

- Provide adequate ventilation. Equip the bilge with a power exhauster.
- Be sure propulsion and generator set engine exhaust systems are free of leaks. Perform thorough, periodic inspections of the exhaust system and repair leaks immediately. Exhaust gases are deadly.
- Never sleep in the vessel with the generator set running unless the vessel is equipped with an operating carbon monoxide detector.

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any belt guards or covers with the generator set running.
- Keep hands and loose clothing away from moving parts. Do not wear jewelry while servicing any part of the generator set.
- Never step on the generator set (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions...from leaking fuel, leaking exhaust fumes, etc.
- Before performing any maintenance on the generator set, disconnect its batteries to prevent accidental starting. Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the generator set compartment or bilge thoroughly with the power exhauster.

ELECTRICAL SHOCK WILL CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not make adjustments in the control panel or on engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel standing on dry surfaces to reduce shock hazard.
- DO NOT CONNECT THE GENERATOR SET TO THE PUBLIC UTILITY OR TO ANY OTHER ELECTRICAL POWER SYSTEM. Electrocution or damage to property can occur at a site remote from the boat where line or equipment repairs are being made if the set is connected to the power system. An approved transfer switch must be used if more than one power source is to be made available to service the boat.
- 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.

Copy and post these suggestions in potential hazard areas of the vessel.

Table of Contents

Section 1. Introduction

ABOUT THIS MANUAL

This manual provides information for operating and maintaining the genset. Study this manual carefully and observe all warnings and cautions. Using the genset properly and following a regular maintenance schedule will contribute to longer unit life, better performance, and safer operation.

HOW TO OBTAIN SERVICE

When the genset requires servicing, contact your nearest dealer or distributor. Factory-trained Parts and Service representatives are ready to handle all your service needs.

If unable to locate a dealer or distributor, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC,
ENGINES-GASOLINE OR DIESEL, OR
RECREATIONAL VEHICLES-EQUIPMENT, PARTS AND SERVICE.

For the name of your local Cummins/Onan or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN (This automated service utilizes touch-tone phones only). By entering your area code and the first three digits of your local telephone number, you will receive the name and telephone number of the distributor nearest you.

For the name of your local Cummins-only distributor, or if you need more assistance, please call Onan Corporation, 1-612-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday.

When contacting your distributor, always supply the complete Model Number and Serial Number as shown on the genset nameplate.

⚠WARNING

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

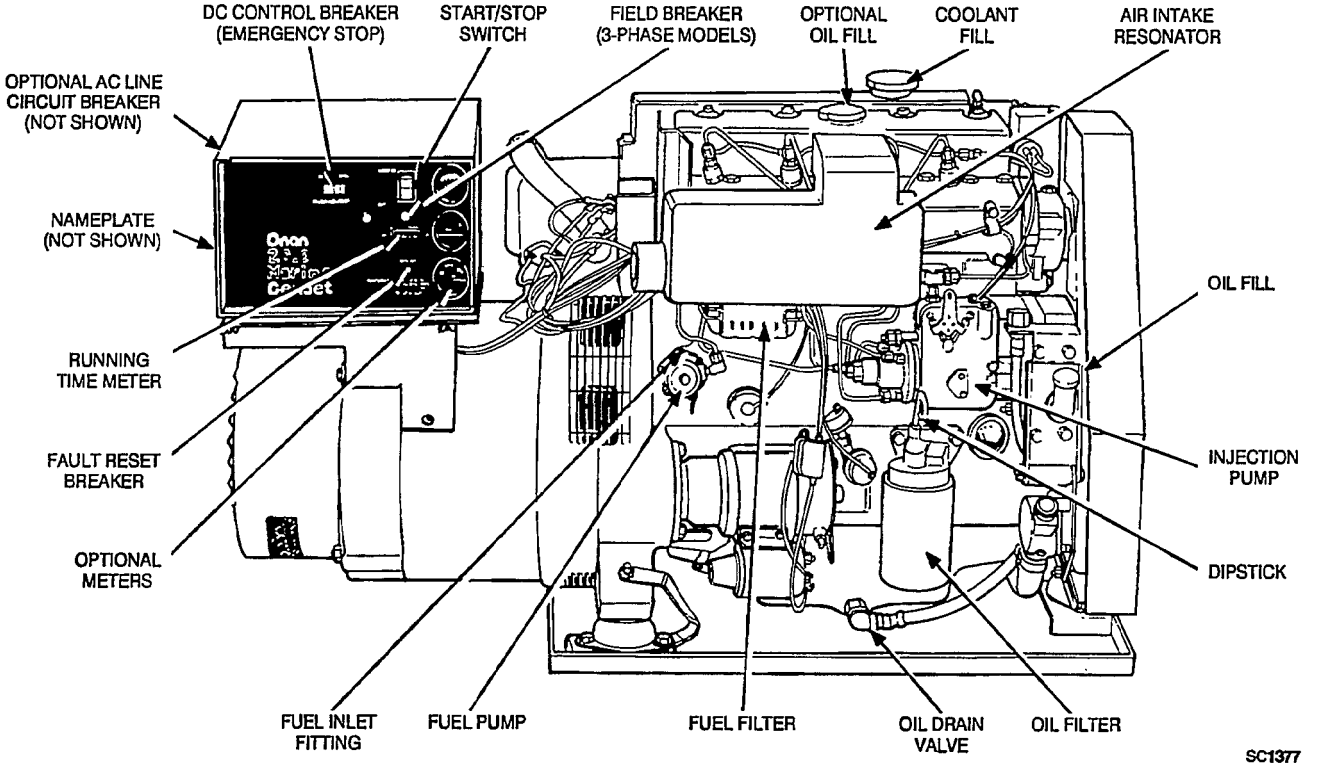


FIGURE 1-1. TYPICAL MDL-SERIES GENSET (MDL4 SHOWN)

Section 2. Specifications

MDL3

GENERATOR DETAILS

Type	Onan®, Revolving Field, 4-Pole, Brushless
Ratings, General Marine:	
60 Hertz, 3-phase	15 kW, 18.75 kVA at 0.8 PF
1-phase	15 kW, 15 kVA at 1.0 PF
50 Hertz, 3-phase	12 kW, 15 kVA at 0.8 PF
1-phase	12 kW, 12 kVA at 1.0 PF
60 Hertz, 3-phase	12.5 kW, 15.625 kVA at 0.8 PF
1-phase	12.5 kW, 12.5 kVA at 1.0 PF
50 Hertz, 3-phase	10 kW, 12.5 kVA at 0.8 PF
1-phase	10 kW, 10 kVA at 1.0 PF
AC Voltage Regulation:	
Electronic Regulation	±2%
Magnetic Regulation	±5%

ENGINE DETAILS

Engine Model	Cummins® 3A1.7
Engine Speed (r/min)	1800/1500
Fuel	No.2 Diesel
Average Fuel Consumption:	
50 Hertz,12.0 kW, Full Load	1.3 gph (4.9 L/h)
Half Load	0.50 gph (1.89 L/h)
10.0 kW, Full Load	1.1 gph (4.2 L/h)
Half Load	0.6 gph (2.3 L/h)
60 Hertz, 15.0 kW, Full Load	1.6 gph (6.1 L/h)
Half Load	0.8 gph (3.0 L/h)
12.5 kW, Full Load	1.34 gph (5.1 L/h)
Half Load	0.74 gph (2.8 L/h)
Fuel Inlet Size	1/4–18 NPTF
Fuel Return Outlet Size	1/8–27 NPT
Exhaust Outlet Hose Fitting	2.5 in. (64 mm) OD
Battery Requirements:	
Cold Cranking Amps @ 0° F (–18° C)	500
Battery Voltage, Standard System	12
*Quantity Required	1
Cooling System Capacity	10 quarts (9.4 L)
Engine Oil Capacity (Filter, Lines, Crankcase)	6 quarts (5.7 L)
Total Air Per Minute Required (Generator Cooling and Combustion):	
60 Hertz	344 cu. ft./min (9.8 m^3/min)
50 Hertz	287 cu. ft./min (8.2 m^3/min)
Sea Water Flow Rate:	
60 Hertz	15 gpm (57 L/min)
50 Hertz	12.5 gpm (47 L/min)

***24-Volt Optional System** ..... **Two 12-Volt Batteries In Series**

MDL4

GENERATOR DETAILS

Type	Onan®, Revolving Field, 4-Pole, Brushless
Ratings, General Marine:	
60 Hertz, 3-phase	20 kW, 25 kVA at 0.8 PF
1-phase	20 kW, 20 kVA at 1.0 PF
50 Hertz, 3-phase	16 kW, 20 kVA at 0.8 PF
1-phase	16 kW, 16 kVA at 1.0 PF
AC Voltage Regulation:	
Electronic Regulation	±2%
Magnetic Regulation	±5%

ENGINE DETAILS

Engine Model	Cummins® 4A2.3
Engine Speed (r/min)	1800/1500
Fuel	No.2 Diesel
Average Fuel Consumption:	
50 Hertz, Full Load	1.7 gph (6.4 L/h)
Half Load	1.0 gph (3.8 L/h)
60 Hertz Full Load	2.1 gph (7.9 L/h)
Half Load	1.2 gph (4.5 L/h)
Fuel Inlet Size	1/4–18 NPTF
Fuel Return Outlet Size	1/8–27 NPT
Exhaust Outlet Hose Fitting	2.5 in. (64 mm) OD
Battery Requirements:	
Cold Cranking Amps @ 0° F (–18° C)	500
Battery Voltage, Standard System	12
*Quantity Required	1
Cooling System Capacity	10 quarts (9.4 L)
Engine Oil Capacity (Filter, Lines, Crankcase)	6 quarts (5.7 L)
Total Air Per Minute Required (Generator Cooling and Combustion):	
60 Hertz	359 cu. ft./min (10.2 m^3/min)
50 Hertz	298 cu. ft./min (8.5 m^3/min)
Sea Water Flow Rate:	
60 Hertz	15 gpm (57 L/min)
50 Hertz	12.5 gpm (47 L/min)

***24-Volt Optional System** ..... **Two 12-Volt Batteries In Series**

MDL6

GENERATOR DETAILS

Type ..... Onan®, Revolving Field, 4-Pole, Brushless
Ratings, General Marine:
60 Hertz General Marine Rating, 3-phase ..... 30 kW, 37.5 kVA at 0.8 PF
1-phase ..... 30 kW, 30 kVA at 1.0 PF
50 Hertz General Marine Rating, 3-phase ..... 25 kW, 31.25 kVA at 0.8 PF
1-phase ..... 25 kW, 25 kVA at 1.0 PF
AC Voltage Regulation:
Electronic Regulation ..... ±2%
Magnetic Regulation ..... ±5%

ENGINE DETAILS

Engine Model ..... Cummins® 6A3.4
Engine Speed (r/min) . 1800/1500
Fuel ..... No.2 Diesel
Average Fuel Consumption:
50 Hertz, Full Load ..... 2.6 gph (9.6 L/h)
Half Load ..... 1.5 gph (5.7 L/h)
60 Hertz Full Load ..... 2.92 gph (10.8 L/h)
Half Load ..... 1.68 gph (6.2 L/h)
Fuel Inlet Size ..... 1/4–18 NPTF
Fuel Return Outlet Size ..... 1/8–27 NPT
Exhaust Outlet Hose Fitting ..... 2.5 in. (64 mm) OD
Battery Requirements:
Cold Cranking Amps @ 0° F (–18° C) 500
Battery Voltage, Standard System 12
*Quantity Required 1
Cooling System Capacity ..... 3.3 gal. (12.5 L)
Engine Oil Capacity (Filter, Lines, Crankcase) ..... 9 quarts (8.5 L)
Total Air Per Minute Required (Generator Cooling and Combustion):
60 Hertz ..... 390 cu. ft./min (11.1 m³/min)
50 Hertz ..... 325 cu. ft./min (7.1 m³/min)
Sea Water Flow Rate:
60 Hertz ..... 24 gpm (91 L/min)
50 Hertz ..... 20 gpm (76 L/min)

***24-Volt Optional System ..... Two 12-Volt Batteries In Series**

Section 3. Operation

⚠WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

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

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Never sleep in the vessel with the generator set running unless the vessel interior is equipped with an operating carbon monoxide detector. Protection against carbon monoxide inhalation also includes proper exhaust system installation and visual and audible inspection of the complete exhaust system at the start of each generator set operation.

GENERAL

This section covers starting and operating the genset. Read through this entire section before attempting to start the genset. It is essential that the operator be completely familiar with the genset.

PRE-START 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 full mark. Do not overfill.

Coolant

The coolant level should be near the top of heat exchanger fill cap. Do not check while the coolant is hot.

⚠WARNING ***The sudden release of hot pressurized coolant can result in serious personal injury. Remove the expansion tank pressure cap slowly after the engine has cooled.***

Fuel

Make sure the fuel tanks are full and the fuel system is primed for operation (see Maintenance section).

Exhaust

Make sure the exhaust system components are tightly connected and not corroded.

Sea Water Pump Priming

Before beginning operation (initial start-up) the sea water pump should be primed. The priming water provides an impeller surface lubricant until flotation water is pulled into the pump.

To prime the pump, close the sea cock and remove hose from the water filter outlet. Fill hose and pump with clean water. Replace hose and open sea cock. Check for pump operation on start-up by observing water discharge from exhaust outlet.

CONTROL PANEL

The following describes the function and operation of the genset controls. All instruments and control switches are located on the face of the control panel as illustrated in Figure 3-1.

Gauges/Meters and Switches

Start-Stop Switch: Starts and stops the genset locally. When switch is released, the genset can be operated from a remote switch connected to the control panel.

Running Time Meter: Registers the total number of hours that the unit has run. Useful for determining need for periodic maintenance procedures. Time is cumulative and cannot be reset.

DC Voltmeter (Option, 12- and 24-volt Only): Monitors B+ voltage useful to determine battery condition and charge system operation. See Battery portion of the Maintenance section.

Coolant Temperature Gauge (Option, 12- and 24-volt Only): Shows engine coolant temperature. The gauge is wired to a sensor on the engine and has a range of 100° to 250° F (40° to 121° C).

Oil Pressure Gauge (Option): Shows engine lubricating oil pressure. The gauge has a range of 0 to 100 psi (0 to 700 kPa) and is connected to an engine sensor.

Low Coolant Level Shutdown (Option): A sensor located in the engine cooling system closes a switch to shut down the engine if coolant level is too low.

Oil Pressure Gauge (Mechanical, Option): Connects directly to the engine oil line on side of engine. It has a range of 0 to 100 psi (0 to 700 kPa).

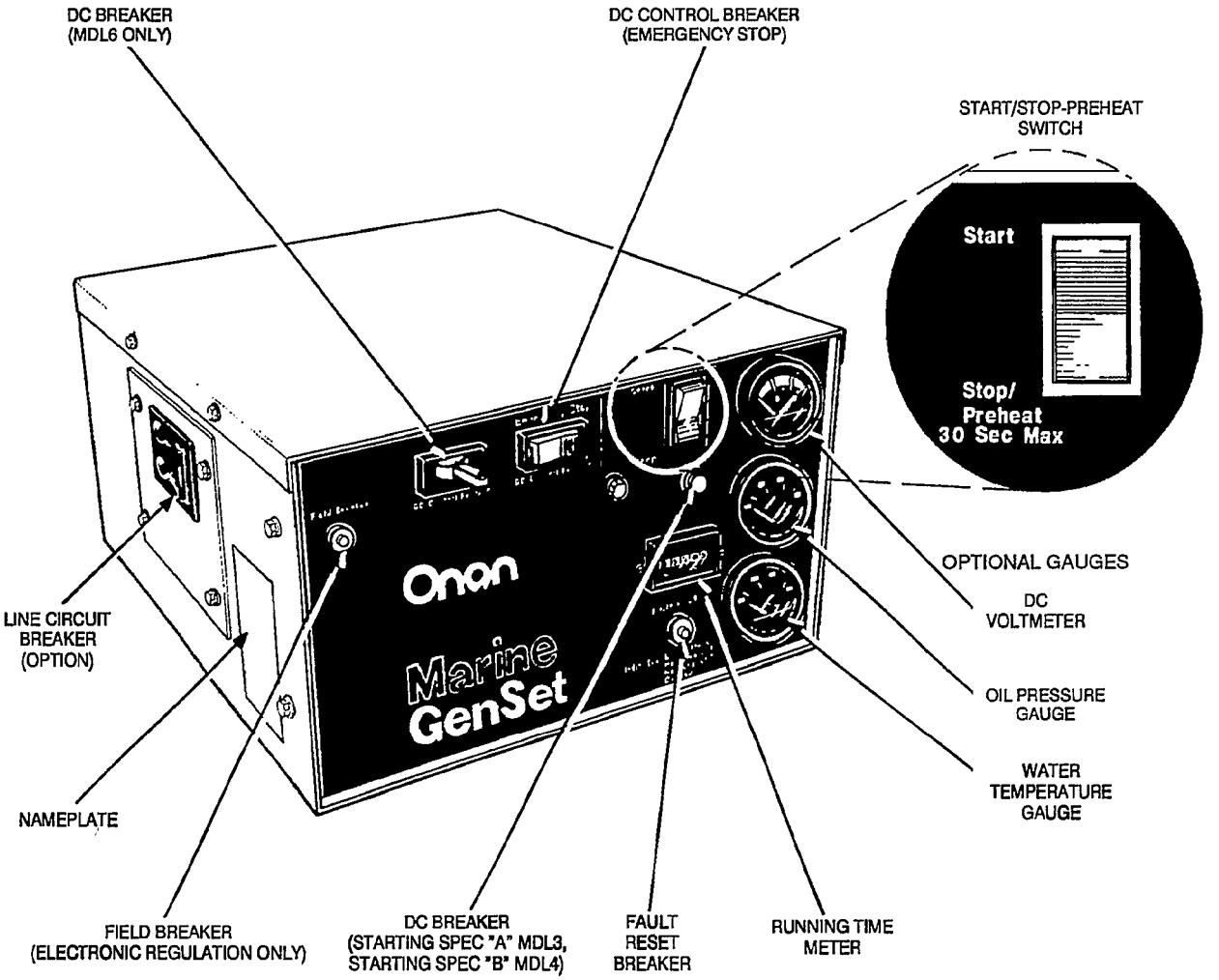


FIGURE 3-1. CONTROL BOX FRONT PANEL

Circuit Breakers

Fault Reset: A manual reset breaker that shuts down the engine for low oil pressure, high coolant temperature, high exhaust temperature, overspeed (optional for MDL3), and optional low-coolant level.

Emergency Stop DC Control Breaker: A 15-ampere breaker providing protection to the control box wiring and remote wiring from short circuits or overload. Also serves as an emergency stop switch and control disable for service.

Line Circuit Breakers (Option): Protects generator from a short circuit or other overload. When furnished by Onan, they mount on the control box. Replacements must meet ABYC specs for proper protection.

Field Breaker (Electronic Regulators Only): A 3 ampere breaker providing generator field protection if the voltage regulator fails.

DC Breaker: Connects B+ to the control and trips if a short or overload occurs. Model MDL6 gensets have the breaker located on the left side of the control panel because of its physical size and larger ampere rating. On Model MDL4 Spec "A" gensets, the DC breaker was replaced by a fuse holder located between the starter terminal and the control box.

STARTING

This section covers starting of the genset at the control panel and the remote panel (when used).

Starting at Control Panel

The following steps outline the correct procedures for starting the genset at the genset control panel, or from a remote control location. The DC Breaker must be in ON position.

1. Hold the Start-Stop switch in the Stop/Preheat position for 10 to 30 seconds depending upon temperature as shown below in Table 3-1. Do not exceed 30 seconds.

   ⚠CAUTION ***Preheat time longer than 30 seconds may damage glow plugs.***

TABLE 3-1. PREHEAT TIME vs TEMPERATURE

Ambient Temperature	Preheat Time
Above 86° F (30° C)	About 10 seconds
Between 50° to 86° F (10° to 30° C)	About 15 seconds
Between 32° to 50° F (0° to 10° C)	About 20 seconds
Below 32° F (0° C)	About 30 seconds

2. Release switch and press the Start position. This activates the engine control, glow plugs and starting system. The starter will crank and after a few seconds the engine should start. The starter will disconnect if switch is released, or when the generator AC voltage reaches about 90 volts AC.

3. If the engine does not start after cranking 30 seconds, release the Start switch. Wait two minutes and then repeat Steps 1 and 2.

   ⚠CAUTION ***Excessive cranking periods can overheat and damage the starter. Do not engage starter for periods longer than 30 seconds without allowing two minutes for cooling.***

4. If the engine does not start on second try, check the fuel supply and be sure the fuel system has been primed. If the genset runs out of fuel, the fuel system may need priming before it will start. See Fuel System in the Maintenance Section.

Start-up Checks

Check optional gauges on the control after the engine has started. Observe the oil pressure gauge immediately.

Oil Pressure Gauge: The oil pressure should be in the range of 30 to 55 psi (207 to 380 kPa) when the engine is at operating temperature.

DC Voltmeter: Battery voltage during operation is dependent upon battery state-of-charge, but should be 13.5 to 15 volts on a 12-volt system; 27 to 30 volts on a 24-volt system .

Water Temperature Gauge: The water temperature should be in the range of 165° to195° F (74° to 91° C) depending on the load and ambient temperature.

STOPPING

Before Stopping

Run the genset 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 chambers and bearings.

⚠CAUTION ***Failure to allow running time for engine cooling without load can result in engine damage. Make sure the generator set runs unloaded for at least three minutes.***

To Stop: Hold the Start-Stop/Preheat switch, or the remote control switch in the Stop position.

OPERATING RECOMMENDATIONS

Break-In

Drain and replace the crankcase oil and reset the valve lash after the first 50 hours of operation on new gensets. Refer to the Maintenance Section of this manual.

No-Load Operation

Hold periods of genset no-load operation to a minimum and avoid if possible. No-load operation (other than before stopping after delivering load) allows combustion chamber temperatures to drop so low that the fuel does not burn completely. This results in carbon deposits which can clog injectors, cause piston rings and valves to stick, and can cause cylinder glazing. If it is necessary to run the engine for long periods, connect an electrical load to the generator.

Exercise Period

To avoid some engine wear, exercise the genset a minimum of 30 minutes at least once a week. Run the genset 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 relay contacts from oxidizing. Top off the fuel tank after each exercise period.

TROUBLESHOOTING

DC Control

The DC control has a number of sensors that continuously monitor the engine for abnormal conditions such as low oil pressure, high coolant temperature, high exhaust temperature, overspeed (option on MDL3), and low-coolant level (option). If any one of these conditions occur, the fault breaker trips and stops the genset. See Figure 3-2.

The following sections describe operation of the fault systems and suggested items the operator can check. If a major problem is indicated, contact an Onan Dealer or Distributor for help or service.

The control panel Fault reset breaker will trip for any one of the fault conditions described separately in the following text. The white breaker reset button pops out about 1/4 inch (6 mm) when a fault occurs. Locate the problem and make necessary corrections before resetting the breaker and starting the genset. All fault shutdowns except high exhaust temperature and overspeed are delayed 5 seconds to avoid nuisance tripping.

Low Oil Pressure: Remove dipstick and check oil level. If low, add oil to bring level up to the full mark. Inspect engine exterior for leaks and repair as necessary. The oil pressure switch actuates the fault circuit if pressure drops below 14 psi (97 kPa).

High Coolant Temperature: If fault occurred during operation, observe Coolant Temperature Gauge (option) for indication of temperature over 222° F (106° C). The coolant thermostat switch closes at this temperature and actuates the fault circuit.

Check coolant level in the expansion tank alter allowing the engine to cool.

Check condition of the pump belt and that it has proper tension. The sea water flow at the exhaust outlet should be as shown in the Specifications Section. Also check the cooling system cleanliness (freedom from contaminants, rust, sludge build-up, etc).

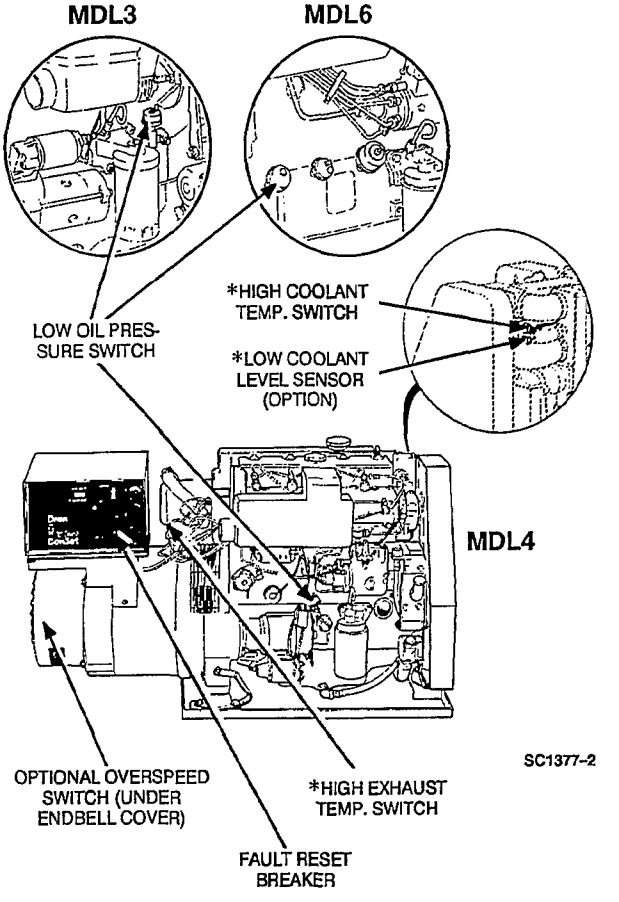


FIGURE 3-2. FAULT SENSOR LOCATION

High Exhaust Temperature: The high exhaust temperature switch is mounted on the exhaust elbow and closes on temperature rise above 190° F (88° C). It will open again when temperature reaches about 165° F (74° C) and functions to protect exhaust system hoses.

⚠WARNING ***Inhalation of exhaust gas can cause serious personal injury or death. Do not disconnect or bypass the exhaust elbow switch. Excessive heat caused by a sea water flow malfunction will damage the exhaust hoses and cause exhaust gas leakage. If exhaust hose is damaged, shut off the generator set immediately and do not operate until hose is repaired.***

High exhaust elbow temperature is caused by insufficient or lack of sea water flow. Refer to the Specifications Section for the proper sea water flow rate.

Overspeed (Option For MDL3): This switch is mounted on the front of the engine crankshaft. It is factory adjusted to shut down 60 hertz gensets at 2150 to 2200 r/min, 50 hertz gensets at 1800 to 1850 r/min. After correcting the problem, press the Fault Reset breaker.

Low Coolant Level (Option): This electronic sensor completes the fault circuit if coolant level falls below the sensor's location in the cooling system. It provides an added level of engine protection.

AC Control

The AC control may use two circuit breakers on the control box depending upon purchased options. See figure 3-3. If either one trips, it results in loss of generator AC power output. They function as follows:

Field Breaker (Electronic Regulator Only): This 3-ampere breaker is located on the control side panel. It is in the regulator AC input circuit and protects the generator field if the voltage regulator fails and places abnormal demands on it. If resetting the breaker returns power only momentarily, then trips again, consult an Onan dealer or distributor for service.

Line Circuit Breakers (Option): When supplied by Onan, these breakers are mounted on the control side panel. They are connected in series with the load.

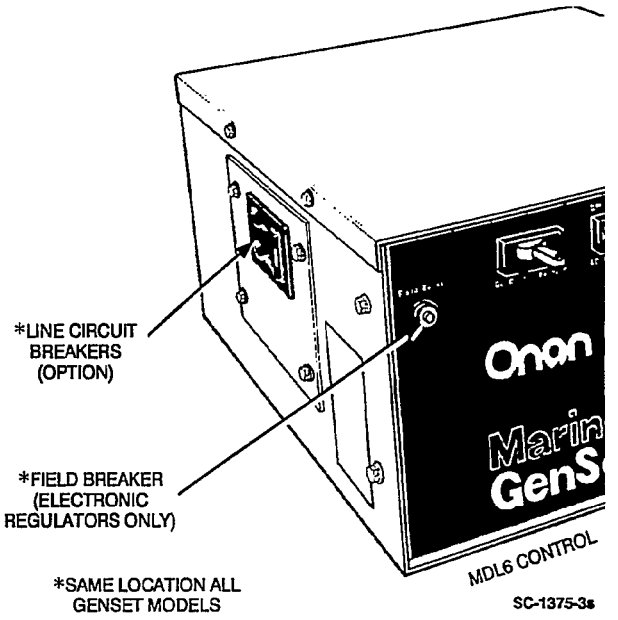


FIGURE 3-3. AC CONTROL BREAKERS

Section 4. Maintenance

GENERAL

Establish and adhere to a regular schedule for maintenance and service. If the genset will be subjected to extreme operation conditions, the service intervals should be reduced accordingly as indicated in Table 4-1.

Consult with an authorized Onan® Dealer or Distributor if the genset will be subjected to any extreme operating conditions (high surrounding temperature, dusty air conditions, etc.), 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 schedule 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 due to electrocution or contact with rotating parts. Disconnect the starting battery cables (negative [–] cable first) when repairs are made to the engine, controls, or generator.***

The negative (–) cable is disconnected first to prevent arcing if the tool accidentally touches the frame or other grounded metal parts of the set while disconnecting the positive (+) cable from the battery. Severe injury can result if arcing ignites the explosive hydrogen gas given off by the battery.

TABLE 4-1. PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	SERVICE TIME				
	Daily or after 8 hours	Monthly or after 50 hours	6 Months or after 200 hours	Yearly or after 400 hours	PAGE
Inspect Generator Set	x[1]				4-2
Check Oil Level	x				4-3
Check Coolant Level	x				4-4
Check Fuel Level	x				4-5
Change Crankcase Oil and Filter		See Note 2	x[2,3]		4-3
Check Battery Condition			x		4-7
Flush and Clean Cooling System				x	4-4
Check Pump Belt			x		4-4
Clean Generator Assembly			x		4-8
Change Fuel Filter				x[4]	4-6
Check Valve Clearance		See Notes 2, 4		x[2,4]	4-7

1 – Check for oil, fuel, cooling and exhaust system leaks. Check exhaust system audibly and visually with genset running and repair any leaks immediately.
2 – Perform after first 35 hours of operation on new sets.
3 – Perform more often if in extremely dusty conditions.
4 – Contact Onan authorized service dealer or distributor.

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 for continued safe operation.

Engine Gauges

Check the following while the genset is operating.

Oil Pressure Gauge (Option): The oil pressure should be in the range of 30 to 55 psi (207 to 380 kPa) when the engine is at operating temperature.

Coolant Temperature Gauge (Option): The water temperature should be in the range of 165° to 195° F (74° to 91° C) depending on the load and ambient temperature.

DC Voltmeter (Option): Normal battery voltage during operation should be 13.5 to 15 volts on a 12-volt system; and 27 to 30 volts on a 24-volt system.

Exhaust System

With the genset operating, inspect the entire exhaust system including the exhaust manifold, exhaust elbow, muffler and exhaust pipe. Check sea water pump operation by observing sea water discharge from the exhaust outlet (see Specifications section for flow rate). Visually and audibly check for leaks at all connections, welds, gaskets, and joints. If any leaks are detected, have them 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.***

Fuel System

With the genset operating, inspect the fuel supply lines, return lines, filters, and fittings for leaks. Check flexible sections for cuts, cracks and abrasions so they are not rubbing against anything that could cause breakage.

⚠WARNING ***Fuel leakage will create a fire hazard which can result in severe personal injury or death if ignited. While checking for leaks, do not smoke or allow any spark, flame, pilot light or other ignition source in the area. If any leaks are detected, have them corrected immediately.***

DC Electrical System

With the genset off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance which can hinder or prevent starting. Clean and reconnect the terminals if loose. Always disconnect the negative (–) battery cable first, and connect it last to reduce the possibility of arcing.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke. Wear goggles and protective, rubber gloves and apron when servicing batteries.***

Mechanical

With the genset stopped, check for loose belt and fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately. With the genset running, listen for any unusual noises that may indicate mechanical problems and check the oil pressure frequently. Investigate anything that indicates possible mechanical problems.

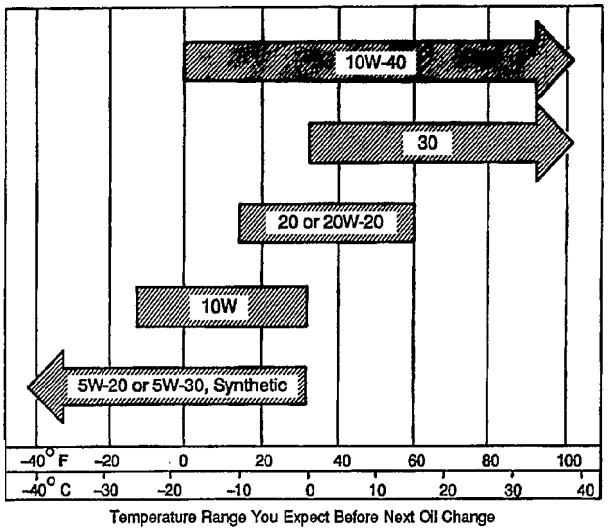
LUBRICATION SYSTEM

The engine oil was drained from the crankcase prior to shipment. Before the initial start, the lubrication system must be filled with oil of the recommended classification and viscosity. Refer to the Specifications section for the lubricating oil capacity.

Oil Recommendations

Recommended engine oil viscosities are 15W-40, 30, 20W-20, and 10W meeting the American Petroleum Institute (API) classification CD/SG, CD/SF, or Military Specification MIL-L-2104C. When a 5W-20 or 5W-30 oil is required, it must be a synthetic oil meeting Military Specification MIL-L-46167, MIL-L-2104C, or MIL-L-46152B. Viscosity 5W-20 and 5W-30 mineral base oils are not recommended for use in the engine under any condition.

TABLE 4 -2. OIL VISCOSITY VS TEMPERATURE



Temperature Range You Expect Before Next Oil Change

LS1028-1

Engine Oil Level

Check the engine oil level during engine shut-down periods at intervals specified in Table 4–1. The oil dipstick

and oil fill are located on the side of the engine (see Figure 4-1). The dipstick is stamped with FULL and ADD marks to indicate crankcase oil level. For accurate readings, stop the engine and wait about 10 minutes. This allows oil drainage into the crankcase before checking.

Keep the oil level near as possible to the FULL mark on dipstick. Remove the oil fill cap and add oil of the same quality and brand when necessary.

⚠CAUTION ***Do not operate the engine with the oil level below the ADD mark or above the FULL mark. Overfilling can cause foaming or aeration of the oil while operation below the ADD mark can cause loss of oil pressure.***

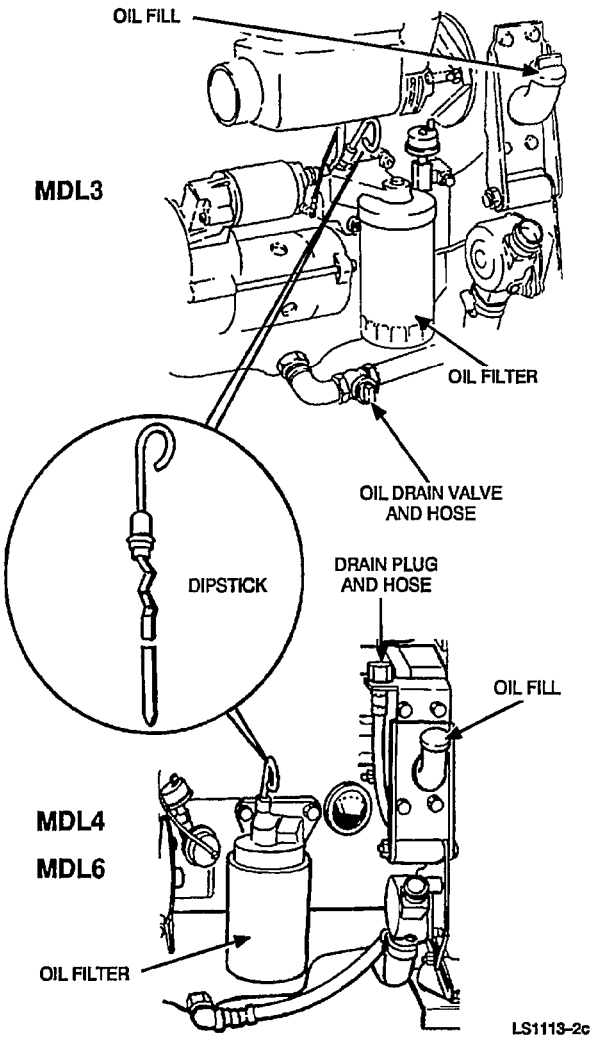


FIGURE 4-1. ENGINE OIL

Oil and Filter Change

Change the oil and filter at the intervals recommended in Table 4–1. Use oil that meets the API classification and appropriate SAE viscosity grade as indicated in the Oil Recommendations section.

Engine Oil Change: Run the engine until thoroughly warm before draining the oil. Stop engine, open the drain valve (Figure 4-1) and drain oil into a container. When completely drained, close valve and refill the crankcase with new oil of proper classification and grade.

⚠WARNING ***Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.***

Oil Filter Change: Spin off the oil filter and discard it. Thoroughly clean filter mounting surface. Apply a thin film of oil to filter gasket, and spin filter on by hand until gasket just touches the mounting pad. Then turn an additional 1/2 turn. Do not over-tighten.

With oil in the crankcase, start the genset and check for leakage around the filter gasket. Tighten only as necessary to eliminate leaks.

COOLING SYSTEM

The cooling system was drained prior to shipping and must be refilled before genset is operated. See the Specifications section for the appropriate model capacity.

Coolant Requirements

A satisfactory engine coolant inhibits corrosion and protects against freezing. A 50/50 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.

Do not exceed a 50/50 mixture of ethylene glycol and water. A stronger mixture of ethylene glycol will alter heat transfer properties of the coolant. A 50/50 mixture will provide freeze protection to –34° F (–37° C) as measured with an accurate hydrometer.

The water used for engine coolant should be clean, low in mineral content, and free of any corrosive chemicals such as chloride, sulfate, or acid. Use distilled or soft water whenever available. Well water often contains lime and other minerals that eventually can clog the heat exchanger core or reduce cooling efficiency.

Filling the Cooling System

Verify that the block drain valve is closed and all hose clamps secure. Remove the cooling system pressure cap on the exhaust manifold and slowly fill the system with recommended coolant.

Leave the pressure cap off the exhaust manifold and start the genset. As trapped air is expelled from the sys-

tem, the coolant level may drop and additional coolant can be added. Replace the pressure cap when coolant level is stable. Any excess coolant will be expelled through the overflow hose and into the recovery tank.

Coolant Recovery Tank: Fill the recovery tank with coolant mixture to the COLD mark. Operate the genset until normal operating temperature is maintained as observed on the temperature gauge (option), or about 15 minutes of operation. Stop the genset and let cool. Add coolant into the recovery tank (if needed) to the COLD mark. The level should stabilize after several operation cycles.

Coolant Level

Check the coolant level daily as specified in Maintenance Table 4-1. Add the required coolant if needed as specified above.

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

⚠CAUTION ***The high engine temperature switch will shut down the engine in an overheat condition only if the coolant level is high enough to contact the switch. Loss of coolant will allow engine to overheat without shutdown protection, thereby causing severe damage to the engine. It is imperative that adequate engine coolant levels be maintained for operation integrity of the cooling system and coolant shutdown protection.***

Flushing and Cleaning

The cooling system should be drained, flushed, and refilled yearly with new coolant for efficient operation and protection. The heat exchanger drains and cylinder block plug/valve must be opened to drain the system completely. See Figure 4-2. Remove the pressure cap to facilitate draining.

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

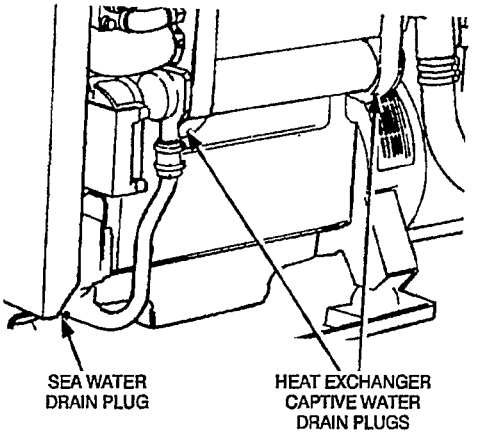
Chemical Cleaning: Use a chemical cleaner if the cooling system shows rust and scale collecting on the engine water jacket, or in the heat exchanger. Rust and scale slow down heat absorption and can block the coolant flow. Use a good cleaning compound and follow the supplier's instructions.

Flushing: After cleaning, or before filling the system with new coolant, drain the system and fill with clean water. Operate the genset for 10 minutes, then drain the system completely. Refill with the recommended coolant.

⚠CAUTION ***Adding cold coolant to a warm or hot engine can result in engine damage.***

Pressure Cap

Closed cooling systems make use of a pressurized cap to increase the boiling point of the coolant and allow higher operating temperatures. The pressure cap should be replaced every two years, or sooner if it malfunctions. The cap is rated at 7 psi (48 kPa).



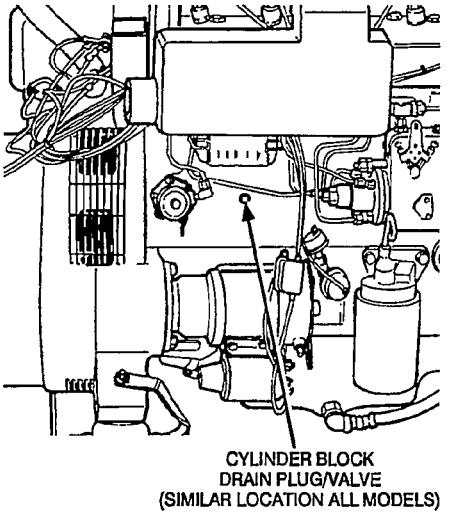


FIGURE 4-2. LOCATION OF BLOCK DRAIN PLUG/VALVE

Pump Belt

Access to the belt is made by removing the belt guard from the front of the genset. Before removing the belt guard, be sure to disable the genset by removing the battery cables—the negative (–) cable first. Do not operate the genset without the belt guard in place.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Stop the generator set and disable by disconnecting the starting battery cables (negative [-] cable first) when maintenance or repairs are made to the engine, controls, or generator.***

Check belt for ply separation, fraying and glazing which gives a belt a shiny appearance. Inspect both sides of the belt, and replace it if any of these conditions exist.

Belt tension measured by a belt tension tool should be 60 pounds (267 N). To adjust tension, loosen bolt that passes through elongated slot in the sea water pump bracket and slide pump until proper tension is secured. See Figure 4-3.

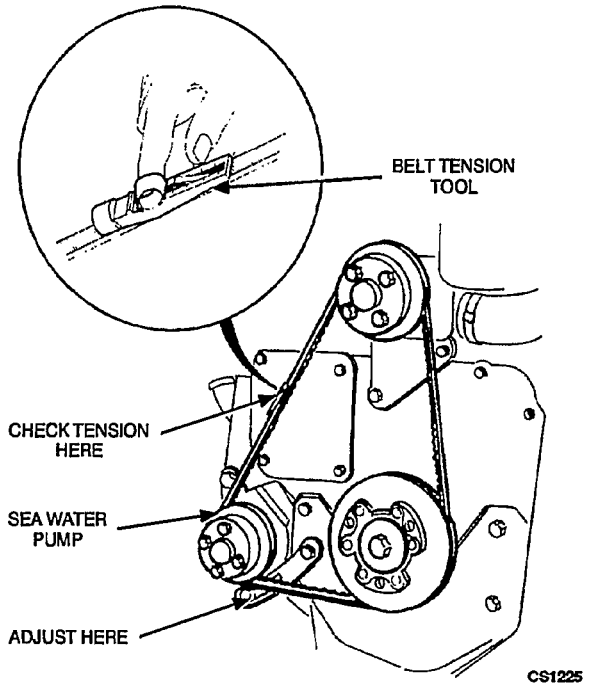


FIGURE 4 -3. PUMP BELT ADJUSTMENT

Siphon Break Valve

A siphon break valve is installed on gensets if the exhaust injection elbow is at or below load water line. When properly installed, it helps prevent sea water siphoning into the engine and compartment when the genset shuts down.

The siphon break valve is normally trouble free. However, when used in contaminated waters or salt water for example, some corrosion may appear. The valve can be checked for free movement after unscrewing the top cover. If the valve sticks or the seat shows wear, the valve must be replaced (see Parts Manual).

FUEL SYSTEM

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

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

Fuel Recommendations

Use ASTM 2-D (no. 2 Diesel) or ASTM 1-D (No. 1 Diesel) fuel with a minimum cetane number of 45. Number 2 diesel fuel gives the best economy and performance under most operating conditions. Use number 1 diesel fuel when ambient temperatures are below 32° F (0° C) and during long periods of light engine load.

Use low sulfur content fuel having a cloud point of at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which wax crystals begin to form in diesel fuel.

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.

⚠CAUTION ***Dirt or water in the system will cause severe damage to both the injection pump and the injection nozzles. It is extremely important the fuel be kept clean and water free.***

To avoid condensation problems, keep fuel supply tanks as full as possible by filling up each time the genset 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 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 can corrode and damage engine parts.

Priming the Fuel System

The fuel system must be primed prior to initial start-up or after engine has run out of fuel.

Low Pressure Fuel System: The low pressure fuel system consists of the fuel transfer pump, fuel filter and injection pump inlet. To prime these components, use the following procedure. Be sure there is fuel in the tank, and the shut-off valve is open.

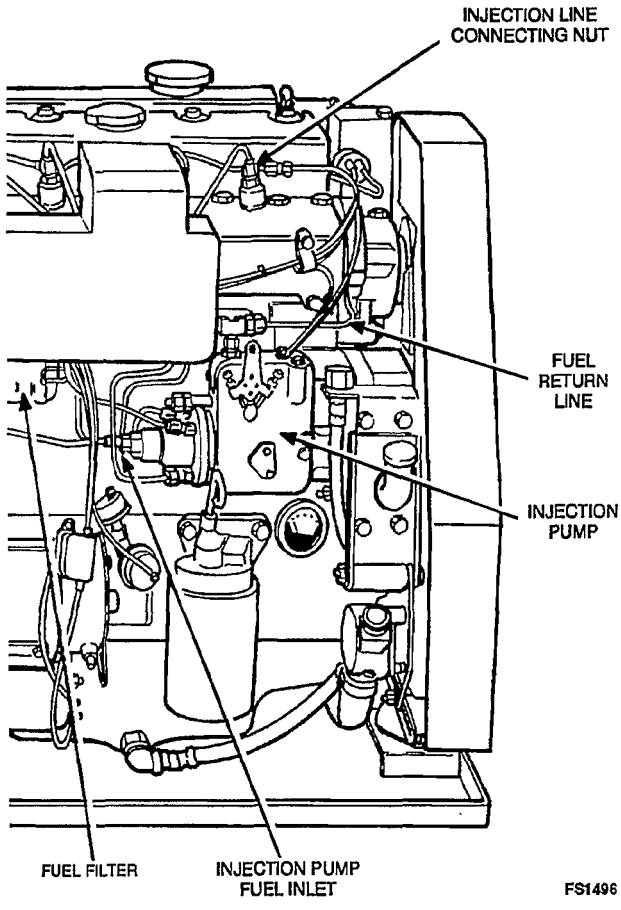


FIGURE 4-4. DIESEL FUEL SYSTEM (MDL4 SHOWN)

1. Loosen the filter-to-injection-pump fuel line at the injection pump inlet fitting. See Figure 4-4.

2. Actuate the transfer pump priming lever until fuel flows from the fitting. See Figure 4-5. Note: If the pump pushrod is on the high part of the camshaft lobe, crank the engine over one revolution to permit hand operation.

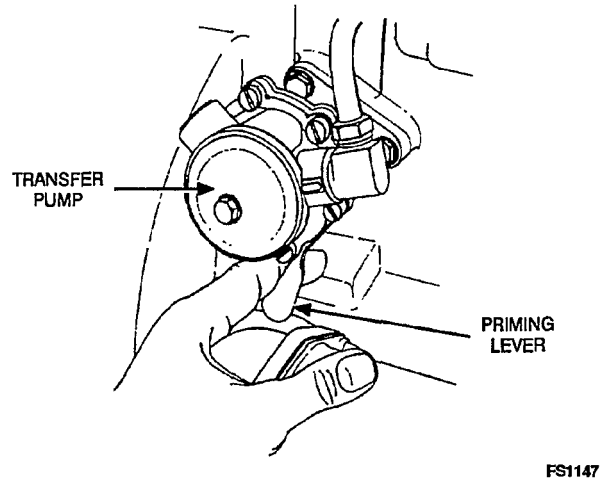


FIGURE 4-5. FUEL TRANSFER PUMP

3. Tighten the fuel line at the injection pump inlet.

High Pressure Fuel System: The high pressure fuel system consists of the injection pump,fuel injection lines and fuel injectors. See Figure 4-4. This part of the system is self-priming since any trapped air is usually forced out through the injection nozzles. However, if the engine has run out of fuel, been shut down for an extended period, or has had the injection lines removed, it may be necessary to prime. Use the following procedure.

1. Loosen the fuel injection line connecting nut attaching each line to corresponding nozzle holder. See Figure 4-4.

2. Energize the starting motor by holding the Start-Stop/Preheat switch in the Start position.

3. After 30 seconds, release the switch and pause for two minutes to permit the starter motor to cool.

⚠CAUTION ***Excessive cranking periods can overheat and damage the starter. Do not engage starter for periods longer than 30 seconds without allowing two minutes for starter to cool.***

Fuel Filter

The combination primary and secondary fuel filter is a disposable type. Any dirt that passes through the primary section is trapped by the secondary section. This prevents dirt from entering the fuel injection pump.

The filter replacement interval will vary according to the fuel quality and cleanliness. Using the wrong fuel, or dirty fuel, will shorten service life of the filter.

⚠CAUTION ***Dirt or water in the system will cause severe damage to both the injection pump and the injection nozzles. It is extremely important the fuel be kept clean and free of water.***

Refer to the Periodic Maintenance Schedule for the recommended filter change interval. However, if the engine shows signs of fuel starvation (reduced power or surging), change the fuel filter. Use the following procedures to replace.

1. Close the fuel tank shutoff valve.

2. Clean all dirt from around the filter, filter base and surrounding area.

3. Remove the filter retaining clips. See Figure 4-6.

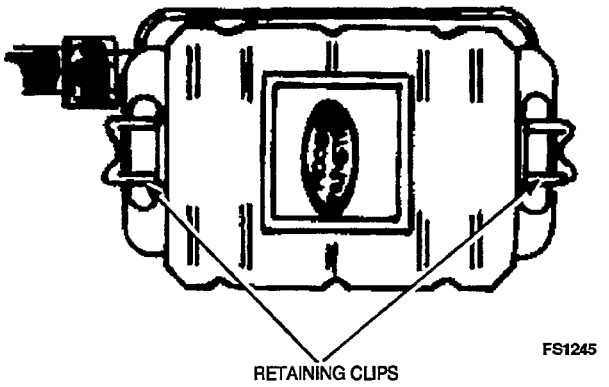


FIGURE 4-6. FUEL FILTER ASSEMBLY

4. Remove the old filter and dispose of properly.
5. Install new filter element and prime the fuel system.

VALVE CLEARANCE

Correct valve clearance is very important in diesel engine performance because of the high compression developed in the cylinders. Incorrect valve clearance will cause loss of compression, misfiring, noise and may eventually lead to damaged engine components. Always perform valve clearance adjustments on a cold engine, with the piston near top dead center on its compression stroke and intake and exhaust valves closed. For detailed valve clearance adjustment procedures, refer to the Engine Service Manual (934-0750) or call the authorized Onan Engine Service Center.

BATTERY

Check the condition of the starting battery at the interval specified in Table 4-1. Always disconnect the negative (–) cable from the battery before working on any part of the genset electrical system. Disregard the sections on Checking Specific Gravity and Checking Electrolyte Level when using a maintenance-free type battery.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke, wear goggles and protective-rubber gloves and apron when servicing batteries.***

Cleaning the Battery

Keep the battery clean by wiping it with a damp cloth whenever it appears dirty. Remove the battery cables (negative (–) cable first) if corrosion is present around the terminal connections. Wash the terminals with an ammonia solution, or a solution consisting of 1/4 pound (about 100 grams) of baking soda in 1 quart (about 1 liter) of water. See Figure 4-7.

Remove the battery from vessel for cleaning. Be sure the vent plugs are tight to prevent cleaning solution from entering the cells. After cleaning, flush the outside of the battery and the surrounding areas with clean water.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of non-conductive grease or petroleum jelly to retard corrosion.

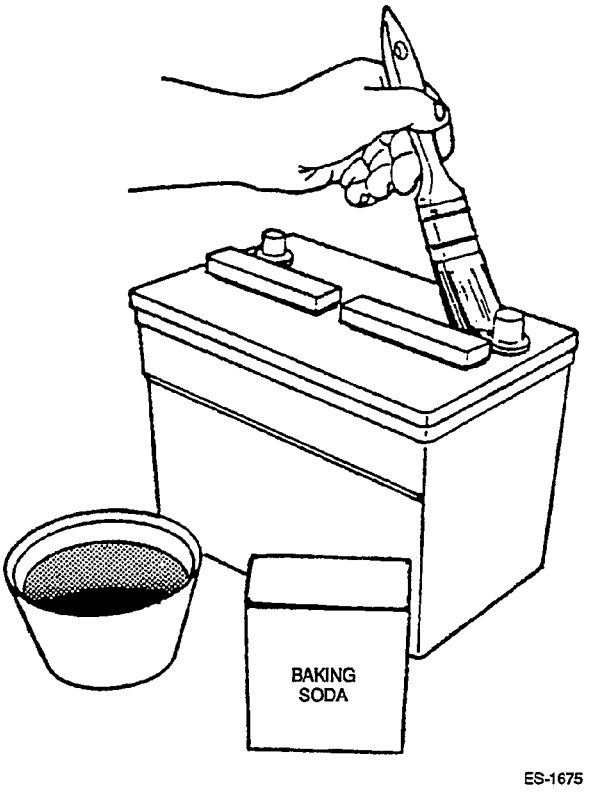


FIGURE 4-7. CLEANING BATTERY

Checking Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell.

⚠WARNING ***Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.***

Hold the hydrometer vertical and take the reading. Correct the reading by adding four gravity points (0.004) for every five degrees the electrolyte temperature is above 80° F (27° C), or subtracting four gravity points for every five degrees below 80° F (27° C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if the reading is below 1.215.

Checking Electrolyte Level

Check the level of the electrolyte (acid and water solution) in the battery at least every 50 hours of operation. Fill the battery cells to the bottom of the filler neck. If cells are low on water, add distilled water and recharge. If one cell is low, check case for leads or for a bad cell.

⚠CAUTION ***Do not add water in freezing weather unless the engine will run long enough (two to three hours) to provide thorough mixing of water and electrolyte.***

Keep the battery case clean and dry. An accumulation of moisture will lead to battery discharge and failure.

AC GENERATOR

There are no brushes, brush springs or collector rings on the generator, therefore it requires very little maintenance. Periodic inspections, to coincide with engine oil changes, will help provide good performance.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Move the Operation Selector switch to STOP and disconnect the starting battery (negative [–] lead first) before inspecting the rotating rectifier assembly.***

Remove the generator end bell cover and inspect the rotating rectifier assembly to make sure the diodes are free of dust, dirt and grease (see Figure 4-8). Excessive foreign matter on these diodes and heat sinks will cause diode overheating and failure. Blow out the assembly periodically with filtered, low-pressure air.

⚠CAUTION ***Excessive foreign matter on diodes and heat sinks will cause overheating and possible failure.***

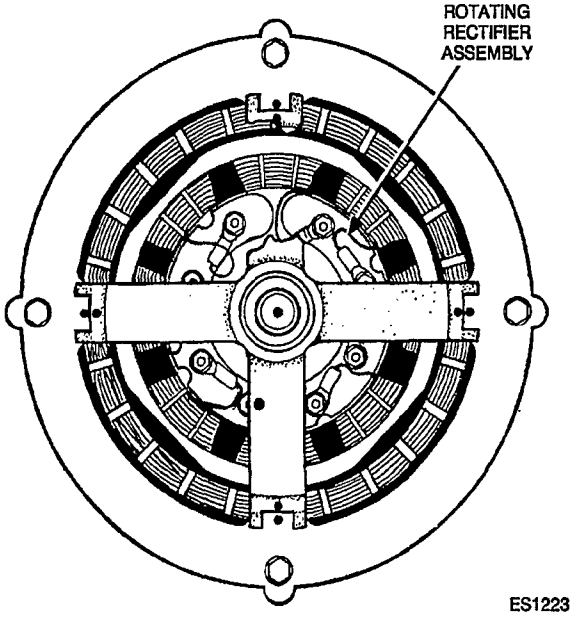


FIGURE 4-8. GENERATOR END VIEW

Generator Bearing

Inspect the bearing for evidence of outer case rotation every 1000 hours of use. The bearing should be replaced every five years. Deterioration of the bearing grease due to oxidation makes this replacement necessary. If the generator requires major repair or service, contact an authorized Onan dealer or distributor.

OUT-OF-SERVICE PROTECTION

The inherent lubricating qualities of No. 2 diesel fuel should protect the cylinders of a diesel engine for at least 30 days when not in service. To protect an engine that will be out of service for more than 30 days, proceed as follows:

1. Exercise the genset, as described in the Operation section, until the engine is at operating temperature.
2. Shut down the genset and disconnect the battery cables (negative [–] cable first). Store the battery in a cool, dry place and connect to a trickle charger once every 30 days to maintain full charge.

   ⚠WARNING ***Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.***
3. Drain the crankcase oil while still warm. Replace oil filter. Refill crankcase and attach a tag indicating viscosity of the oil used.
4. Check the coolant level and add more coolant if low. If freezing temperatures are possible, test strength of the coolant mixture.

   The sea water cooling system must be drained of water, or protected with a 50-50 anti-freeze mixture as follows:

   A. Close sea cock and remove the sea water inlet hose at filter.

   B. Place hose end in a bucket of anti-freeze mixture and run engine until mixture is observed coming out of the exhaust outlet.

   C. Replace inlet hose and tighten clamp.
5. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
6. Clean and wipe the entire genset. Coat parts susceptible to rust with a light coating of grease or oil.

Returning the Genset to Service

Refer to the preceding paragraphs in this Maintenance section for specific service procedures.

1. Remove plug from the exhaust outlet, and open the seacock.

2. Shut down the genset and disconnect the battery (negative [–] lead first). Store the battery in a cool, dry place and connect to a trickle charger once every 30 days to maintain full charge.

   Check the tag on the oil base and verify that the oil viscosity is still correct for existing ambient temperature.

3. Clean and check the battery. Measure the electrolyte specific gravity with a hydrometer (1.260 @ 80° F [27° C]) and verify proper level. If the specific gravity is low, charge the battery until correct value is obtained. If level is low, add distilled water and charge until the specific gravity reading is correct.

   ⚠WARNING ***Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.***

4. Prime the fuel system.

5. Connect the starting battery, the negative (–) cable last.

6. Remove all loads before starting the genset.

7. After starting, apply load of at least 50 percent rated capacity.

8. Check all gauges for normal readings. Genset is ready for operation.

Notes

California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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