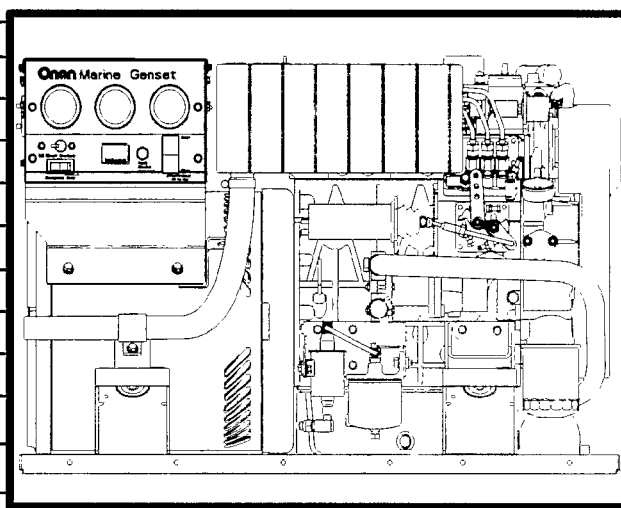


Ocean

MARINE

Operator's Manual

MDKAL



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. Electrocuting 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.

M8

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

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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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Introduction

ABOUT THIS MANUAL

This manual shows how to operate and maintain the Onan® MDKAL generator set. Study this manual carefully and observe all of its instructions and precautions. Using the genset properly and maintaining it regularly will promote longer set life, better performance, and safer operation.

The *Operating Recommendations* section covers the break-in procedure and the effects of high altitude and variations in climate. The *Wattage Requirements* section describes the wattage capacity of the set and lists the wattage use of common appliances and tools. Familiarize yourself and others who will operate this set with this information.

Onan is a registered trademark of Onan Corporation.

MODEL IDENTIFICATION

Have the following information ready when you call a distributor:

- Model number
- Serial number

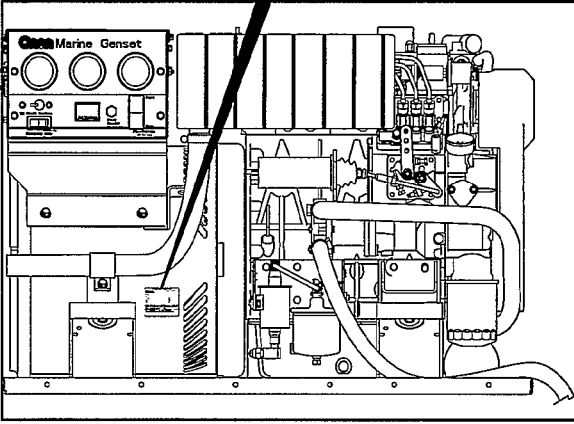
These are found on the nameplate (Figure 1), which is located on the generator. A service information label provides serial number and model number information on the control box.

Record these numbers from your generator set in the area provided in Figure 1. Make sure that all numbers are recorded correctly.

FEATURE AND COMPONENT LOCATIONS

Generator set components are shown in Figures 2 and 3.

IMPORTANT ENGINE INFORMATION			
Onan®		ONAN CORPORATION 1400 73rd Ave. NE Minneapolis, MN 55432 Made in U.S.A.	
Model No.: 80MDKAL11454B			
S/N: A953123456			
AC Volts:	Ph:	KW:	
Amps:	Pf:	RPM:	
Fuel:	Hz:	Bat:	12V
Insulation - NEMA Class		Ambient: 40°C	
		INI 3461 URC	
REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.			
THIS ENGINE MEETS 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES.			
SKB719U6D2RA		719 cc	



RECORD COMPLETE MODEL AND SERIAL NUMBER HERE

↓

MODEL NUMBER
SERIAL NUMBER

FIGURE 1. TYPICAL NAMEPLATE

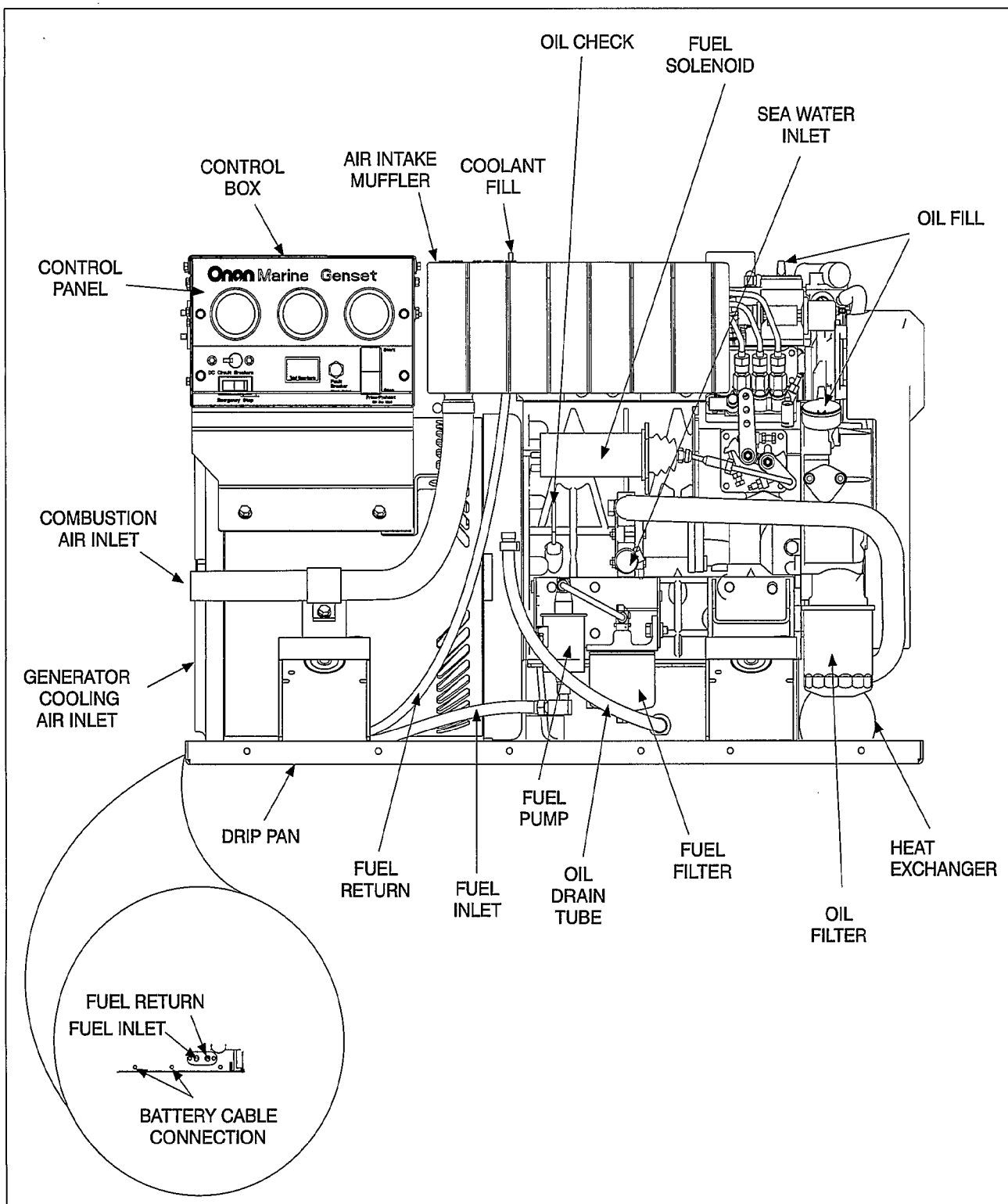


FIGURE 2. COMPONENT LOCATIONS, SERVICE SIDE OF SET

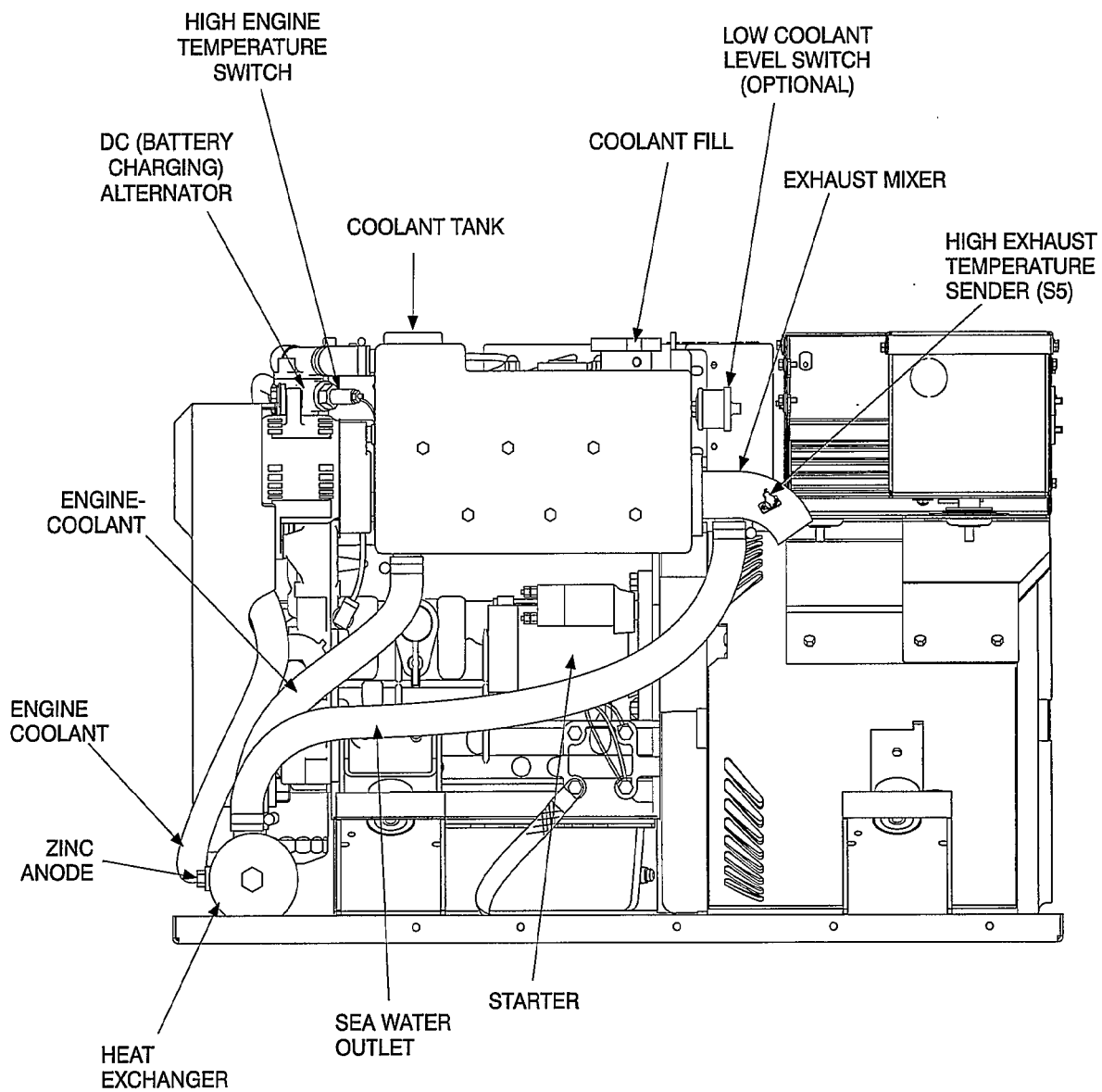


FIGURE 3. COMPONENT LOCATIONS, NON-SERVICE SIDE OF SET

Controls and Circuit Breakers

The set controls and circuit breakers are located on the control box at the upper left front of the generator set. See Figure 4.

Set-Mounted Controls and Breakers

Start/Stop/Prime/Preheat Switch S1: Starts and stops the generator set, operates the engine glow plugs and primes the fuel system.

DC/Emergency Stop Circuit Breaker CB4: Protects the genset and engine electrical components. When tripped, the genset stops.

Fault Circuit Breaker CB2: A breaker which trips, shutting down the set during fault conditions related

to AC over-voltage, overspeed, high exhaust temperature, high coolant temperature, low oil pressure, and low coolant level (optional).

Hour Meter M1: A meter that displays the number of hours the generator set runs.

DC Control Breaker CB1: A DC breaker that protects the engine glow plug (preheat) circuit, as well as all other 12 VDC components. If tripped, the generator set will stop.

Line Circuit Breaker: An AC output circuit breaker that protects the set from a short circuit or other overload. It is mounted on the side of the AC connection box.

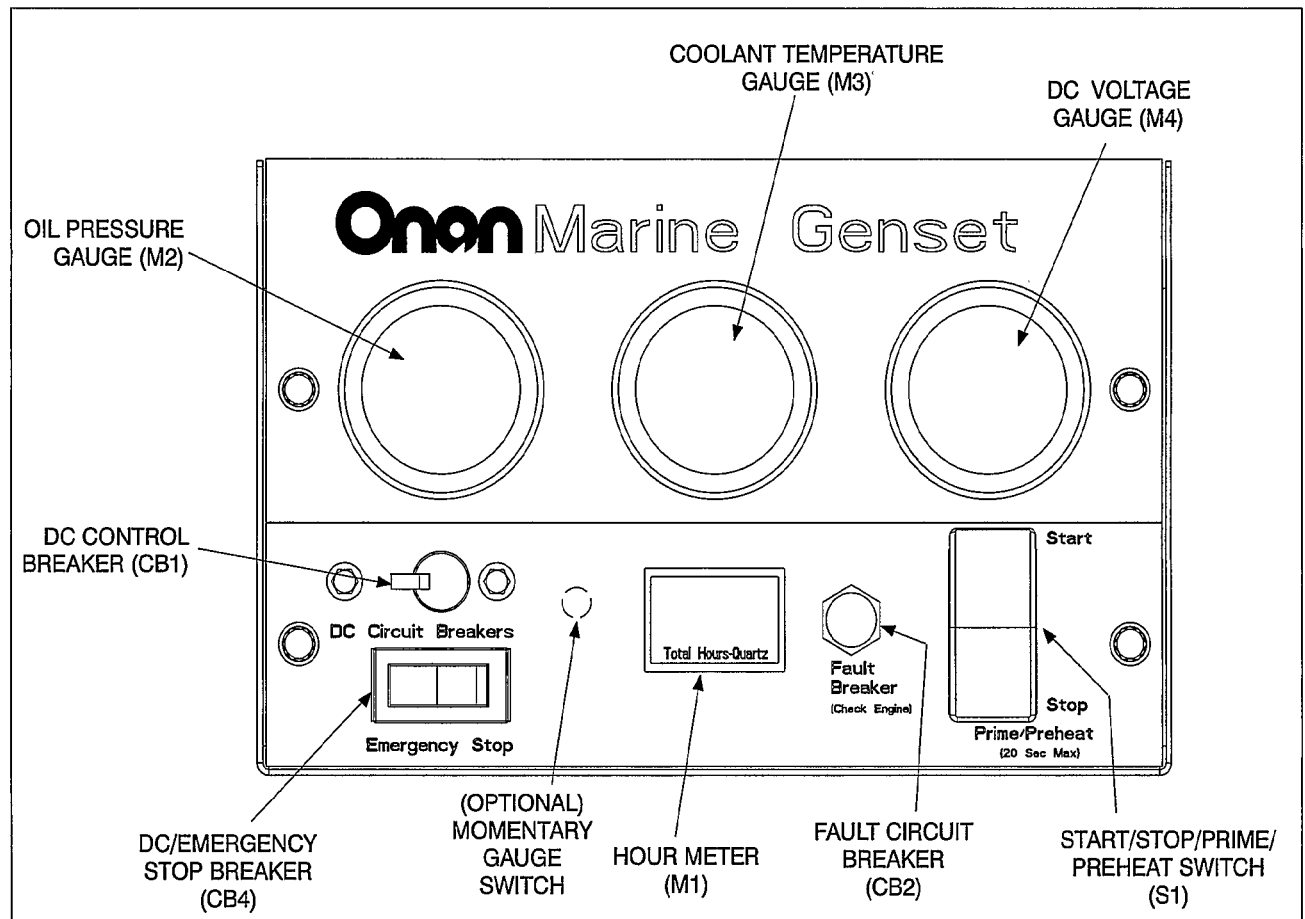


FIGURE 4. CONTROL PANEL

Optional Control/Meter Panel

An optional control panel includes a start/stop/prime/preheat switch, hourmeter, and gauges that monitor oil pressure, coolant temperature, and DC battery voltage. The Starting and Stopping section of this manual describes these meters and what they should show during set operation. See Figure 5.

If the GenSet has both set mounted gauges and remote gauges, an optional momentary gauge switch must be installed in the set mounted control panel. This switch connects the gauge signal to the remote gauges unless the switch is pressed. When the switch is pressed, the set mounted gauges register.

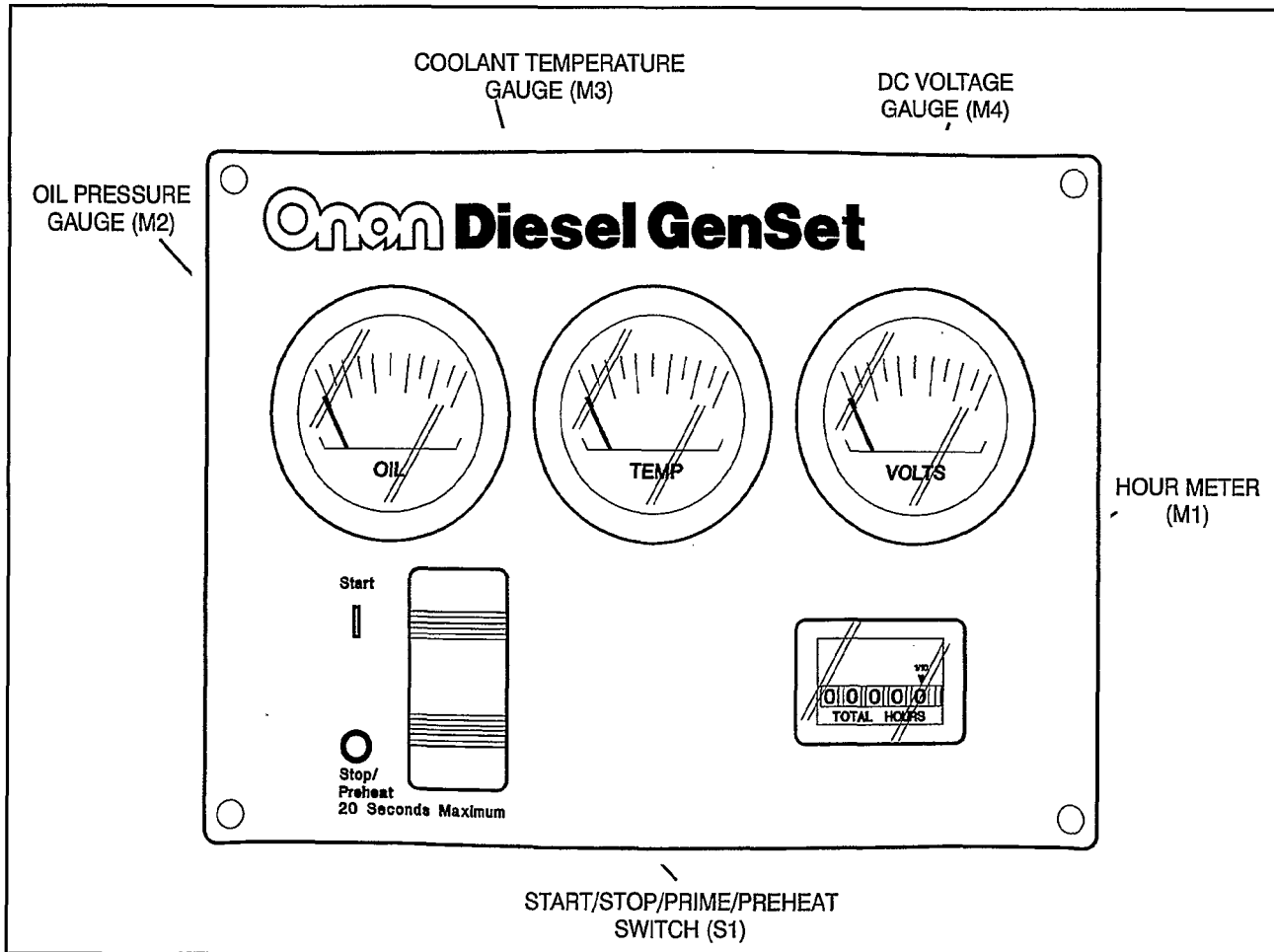


FIGURE 5. OPTIONAL CONTROL PANEL

Pre-Start Checks

GENERAL

Read through this entire section before attempting to start the genset. It is essential for safe operation that the operator be completely familiar with the set.

ENGINE OIL

Check the engine oil level before each start. When the generator set is new, the engine must be filled with oil before the initial start.

If adding oil between changes, use the same brand because different brands might not be compatible when mixed. Be careful not to overfill the crankcase because the oil may foam, resulting in engine shut-down.

Oil Recommendations

Use oils with the American Petroleum Institute (API) classification CG-4, CF-4, CD/SG or CE/SG in viscosities shown below in Table 1.

Select the oil viscosity that is right for the lowest temperature expected. Oil that is too thick may not lubricate when the engine is started. Use a lower viscosity oil as the ambient temperature gets colder.

Do not use synthetic oil or non-detergent oil.

Checking Engine Oil Level

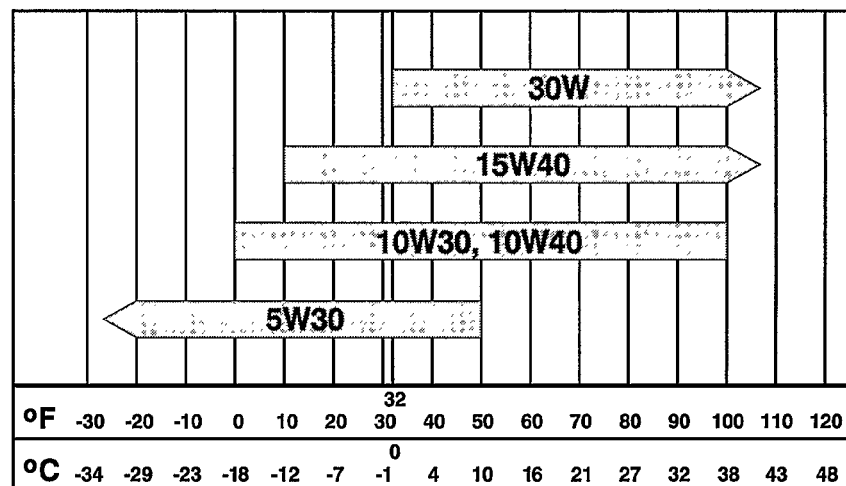
⚠ CAUTION *Do not operate the engine with the oil below the ADD mark or above the FULL mark. Overfilling can cause foaming or aeration of the oil, while operation below the ADD mark might cause loss of oil pressure.*

Check the engine oil level at the intervals shown in Table 4, later in this manual. The oil dipstick and fill are located on the side of the engine. The dipstick is stamped with two marks which indicate the oil level in the crankcase. For an accurate reading, shut off the engine and wait 10 minutes before checking the level. This lets oil in the upper part of the engine drain into the crankcase.

Keep the oil level as near as possible to the upper of the two marks on the dipstick. Remove the oil fill cap and add the same type of oil when necessary.

⚠ CAUTION *To avoid burns from hot engine or oil, allow engine to cool before checking oil.*

TABLE 1. OIL VISCOSITY VS. TEMPERATURE



Anticipated Ambient Temperature

COOLANT

NOTE: Throughout the manual, flotation water drawn into the vessel for engine cooling is called “sea water”.

With a cold engine, the coolant level should be at the COLD mark (the mark nearest the bottom of the coolant overflow tank). **Do not check while the coolant is hot.** Coolant level should always be between the COLD and HOT marks. Check for cooling system leaks and add coolant if the level goes below the COLD mark.

⚠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.*

EXHAUST

Thoroughly inspect the exhaust system for leaks or corrosion. Have any problems repaired before operating the generator set.

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Make certain that all exhaust components are operational and that there are no exhaust leaks.*

FUEL CHECK

Carefully inspect the fuel system for leaks and corrosion. Have any problems repaired immediately.

⚠WARNING *Diesel fuel presents the hazard of fire which can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, arcing switch or equipment, or other ignition source near the fuel system.*

Use the best fuel available. Fuel quality is important for dependable performance and satisfactory engine life. Regularly check the fuel filter according to the *Maintenance Schedule* in this manual. Replace if necessary.

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

Fuel Recommendation

Use ASTM 2-D (No. 2 Diesel) or ASTM 1-D (No. 1 Diesel) fuel with a minimum Cetane number of 45. No. 2 diesel fuel gives the best economy and performance under most conditions. Use No. 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 which has a cloud point 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.)

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 valve that admits sea water (sea cock) and remove the hose from the water filter outlet. Fill the hose and pump with clean water. Replace the hose and open the sea cock. Check pump operation on start-up by observing water discharge from the exhaust outlet.

⚠CAUTION *Never lubricate the impeller with engine oil or other petroleum-based lubricants. This will shorten impeller life.*

GENERAL INSPECTION

Check the generator set for damaged or loose parts. Make sure the air inlet and outlet areas are not blocked. Investigate any abnormal operating noises. Make sure that the generator set is securely mounted.

Starting and Stopping

⚠ 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.

STARTING

Starting at Set

1. Hold the starting switch to the STOP/PREHEAT position for 5 to 20 seconds, depending on the temperature (see Table 2).

⚠ CAUTION *Preheat time longer than 20 seconds may damage glow plugs.*

TABLE 2. PREHEAT TIME vs. TEMPERATURE

Ambient Temperature	Preheat Time
Above 32° F (10° C)	5 seconds
Below 32° F (0° C)	20 seconds

2. Release the switch, then move it to the START position. The starter will crank and after a few seconds the engine should start. The starter

will automatically disconnect when the generator AC voltage builds up.

3. If the engine does not start after cranking 20 seconds, release the switch. Wait two minutes, then repeat Step 1 (preheat).

⚠ CAUTION *Excessive cranking can overheat the starter, damaging it. Do not engage the starter longer than 20 seconds without allowing two minutes for cooling.*

4. If the engine does not start on the second attempt:

- Check the fuel supply.
- Make sure the fuel system has been primed.

With an empty tank, the fuel system may need priming before the set can start. See *Fuel System* in the *Maintenance Procedures* section.

Starting at Remote (Meter) Panel

If the optional remote panel with meters has been installed, monitor the oil pressure, water temperature, and set DC voltage after the set has warmed up. Note the following:

- **Oil Pressure Gauge:** The oil pressure should be in the range of 28 to 64 psi (194 to 442 kPa) when the engine is at operating temperature.
- **Coolant Temperature Gauge:** The coolant temperature should be in the range of 160° to 195° F (71° to 91° C) depending on the load and sea water temperature.
- **DC Voltmeter:** Normal battery voltage should be 12.5 to 15 volts. Actual voltage depends on the battery state-of-charge and condition.

STOPPING

Before Stopping

Run the genset at no load three to five minutes before stopping. This lets the lubricating oil and engine coolant carry heat away from the combustion chamber and bearings.

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

To Stop: Push the rocker switch to STOP.

Wattage Requirements

AC WATTAGE CAPACITY

The AC power output from the generator will power appliances and other equipment. (The wattage requirement of appliances and electrical equipment may be referred to as "electrical load".)

AC line circuit breakers mounted on the set protect the generator from an overloaded output, which occurs when too much load is applied at once, or if there is a short circuit in the system.

Connecting a Load

To determine the maximum amount of electrical load that can be applied, follow these steps:

1. Determine the maximum load (wattage) supplied by the generator set/vessel circuit, by multiplying the circuit breaker size by the AC output voltage:

$$85 \text{ (amps)} \times 120 \text{ (volts)} = 10,200 \text{ watts}$$

2. Check the wattage requirement of each appliance to be connected (see Table 3). The appliance nameplate should list the wattage of each item.
3. Add the wattages of all the items to be powered at the same time. Make sure that the total wattage does not exceed the limit of the circuit breaker.

Example:

Air Conditioner	1800 watts
Converter	500 watts
Coffee Percolator	600 watts
Television	300 watts
Total	3200 watts

4. Start the generator set and let it warm up a few minutes before applying electrical load.

Make sure that each appliance and tool is properly grounded and in good working condition before using it.

⚠ WARNING *Electrical shock can cause severe personal injury or death. Appliances should be in good working condition and be properly grounded to provide additional protection from electrical shock.*

TABLE 3. APPROXIMATE POWER DRAW OF COMMON APPLIANCES

Appliance or Tool	Approximate Running Wattage
Air Conditioner	1400-2000
Battery Charger	Up to 800
Coffee Percolator	550-750
Converter	300-500
Electric Blanket	50-200
Electric Broom	200-500
Electric Drill	250-750
Electric Frying Pan or Wok	1000-1500
Electric Iron	500-1200
Electric Stove (Per Element)	350-1000
Electric Water Heater	1000-1500
Hair Dryer	800-1500
Microwave Oven	1000-1500
Radio	50-200
Refrigerator	600-1000
Space Heater	1000-1500
Television	200-600

Motorized Appliances

Motorized appliances consume more power during startup than they do when running at normal speed. (Some motors draw as much as three times their operating power during startup.) If you plan to use a motorized appliance, turn it on **before** starting other appliances. When the motor is running at normal speed, more appliances may be added.

Circuit Breakers

Circuit breakers on the electrical distribution panel or on the generator set will open if their current ratings are exceeded. This may be caused either by running too many appliances at once, or by a short circuit.

The generator set will continue to run after a breaker trips. Turn off all appliances and other loads, then reset the breaker. If it trips again, a short circuit is indicated. Turn off the generator set and contact a qualified technician for assistance.

If the breaker does not trip, turn on only as many appliances as the breaker size allows (see *Connecting A Load* in this section). If the breaker trips again, a defective appliance or circuit breaker is indicated.

Connection to Utility Power

Connect the vessel to utility power (power from an outside source such as a plug-in outlet) **only** through an approved device, to protect against the possibility of generator power and utility power being connected. Consult the Installation Manual

(publication 981-0614) for information on isolating the genset from utility-supplied power.

⚠WARNING **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.*

DC POWER

A 35 amp, 12 volt belt-driven alternator on the engine supplies DC power to recharge the starting battery for the set on 12 VDC gensets.

Operating Recommendations

BREAK-IN PROCEDURE

Drain the crankcase and refill it with new oil after the first 35 hours of operation. See the *Maintenance Procedures* section of this manual for the procedure.

NO-LOAD OPERATION

Keep no-load operation to a minimum. With no load, combustion chamber temperatures drop so low that fuel does not burn completely. This creates carbon deposits which clog injectors, glaze cylinders and cause piston rings and valves to stick. If it is necessary to run the engine for long periods, **connect an electrical load to the generator output.**

EXERCISE PERIOD

Infrequent use can result in difficult starting and moisture condensation problems. This moisture is a result of the engine not being run long enough to reach normal operating temperature. In extreme cases, water may be deposited in the oil. If this happens, severe engine damage can result. To prevent this possibility, run the generator set under load at least one hour per week.

Exercising for one long period each week is better than several shorter periods of operation. Do NOT operate the set for long periods at no load.

Maintenance Schedule

Following the maintenance schedule and using the generator set properly will result in longer genset life, better performance, and safer operation. Perform each maintenance procedure at the time period indicated or after the number of operating hours indicated, whichever comes first. Refer to the *Maintenance Procedures* section for instructions.

Consult an Onan service center if the generator set will be subjected to extremely hot conditions; a more frequent maintenance schedule may be necessary.

Use the hourmeter to keep an accurate log of all service and maintenance for warranty support (see the *Maintenance Record* section).

⚠WARNING *Accidental starting of the generator set during maintenance can cause severe personal injury or death. Disconnect both generator set starting battery cables, before performing maintenance. Remove the negative (-) cable first to reduce the risk of arcing.*

TABLE 4. PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	SERVICE TIME				
	Daily or after 8 hours	Monthly or after 100 hours	6 Months or after 200 hours	Yearly or after 500 hours	P A G E
Inspect Set	x ¹				14
Check Oil Level	x				6
Check Coolant Level	x				7
Check Fuel Level	x				7
Check Battery Specific Gravity		x			23
Check Pump Belt Tension		x ³			19
Change Crankcase Oil and Filter			x ²		15
Drain Water/Sediment From Fuel Filter		x			22
Change Fuel Filter			x		22
Flush/Clean Cooling System				x	19
Clean Generator Assembly			x		14
Check Siphon Break Valve		x			20
Check Exhaust System		x			14
Change Zinc Anode on Heat Exchanger				x	20

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 genset.

3 - Visually check belts for evidence of slippage.

Maintenance Procedures

INTRODUCTION

The procedures described in this section are limited to those that can be performed by the knowledgeable genset operator. If there is any doubt as to the correct performance of a procedure, consult your Onan distributor. **Certain procedures on the Maintenance Schedule should only be performed by a qualified service technician.**

GENERATOR SET INSPECTION

Inspect the generator set daily or after every eight hours of operation, whichever comes first. Check the exhaust, fuel, and DC electrical systems as described below. Also check the mechanical condition of the set.

Engine Gauges (Remote Installation)

Check these gauges while the set is running.

Oil Pressure Gauge: Oil pressure should be 28 to 64 psi (194 to 442 kPa) when the engine is at operating temperature.

Coolant Temperature Gauge: Coolant temperature should be 160° to 195° F (71° to 91° C), depending on load and sea water temperature.

DC Voltmeter: Battery voltage during operation should be 12.5 to 15 volts on a 12-volt system.

Exhaust System

With the set running, 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 exhaust outlet. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. If any leaks are detected, **shut down the genset and do not operate until corrected.** Have corroded exhaust components replaced before leaks occur.

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

Fuel System

With the set running, inspect the fuel supply lines, return lines, filters, and fittings for leaks. Check flexible sections for cuts, cracks and abrasions. See that the fuel lines do not rub against anything that could break them. Replace worn fuel line components before leaks occur.

⚠ WARNING *Fuel leakage is 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 battery terminals for clean and tight connections. Loose or corroded connections create resistance which can impede starting. Clean and reconnect loose battery cables. 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, 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.

Cleaning The Set

Clean the generator set whenever dust and dirt begin to accumulate. Dust and dirt usually can be removed with a damp cloth. Steam cleaning may be needed to remove persistent dirt and grime. Do not clean the genset while the engine is running. Protect the generator, control panel, and electrical connections from cleaning solvents. Cleaning solvents can damage electrical connectors.

OIL AND FILTER CHANGE

NOTE: This generator set was shipped WITHOUT OIL in the crankcase. Before initial start, make certain that the lubrication system is filled with the recommended oil. See the Specifications section for oil capacity.

⚠ CAUTION *Operating the generator set without oil will damage or destroy the engine. Before starting the generator set, fill the engine crankcase with the proper amount and type of oil, as listed in the Specifications section of this manual.*

Change the oil and filter at the intervals listed in Table 4. Use oil that meets the API classification and SAE viscosity grade indicated in Table 1 (Page 6).

Engine Oil Change

NOTE: If an engine sump pump-out system is installed, follow the system instructions to drain and refill genset engine oil.

Run the engine until thoroughly warm. Stop the engine and unscrew the plug on the end of the drain hose. Drain the oil into a suitable container. See Figure 6. When the oil is completely drained, replace the plug. Return the hose to its storage position. Refill the crankcase with new oil. Dispose of used engine oil properly.

⚠ CAUTION *To avoid damage to the drain hose, use one wrench to hold the fitting at the end of the hose and another to loosen the plug.*

⚠ 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.*

⚠ WARNING *State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. When adding, changing or working with used oil, take care not to breathe, ingest or come into excessive contact with these substances. Wash hands after use. Wear protective clothing and equipment. Provide adequate ventilation.*

Oil Filter Change

Place a container under the oil filter (see Figure 6) to catch the oil that drips out of the engine while replacing the filter.

Spin off the oil filter and discard it properly. Thoroughly clean the filter mounting surface. Apply a thin film of oil to the filter gasket, and spin the filter on until the gasket just touches the mounting pad. Then turn an additional 3/4 turn. Do not over-tighten the filter.

Add the quantity of oil listed in the *Specifications* section of this manual to the crankcase, start the set and check for leakage around the filter gasket. Tighten the filter only enough to eliminate leaks. Shut off the set, recheck the oil level and add additional oil if necessary.

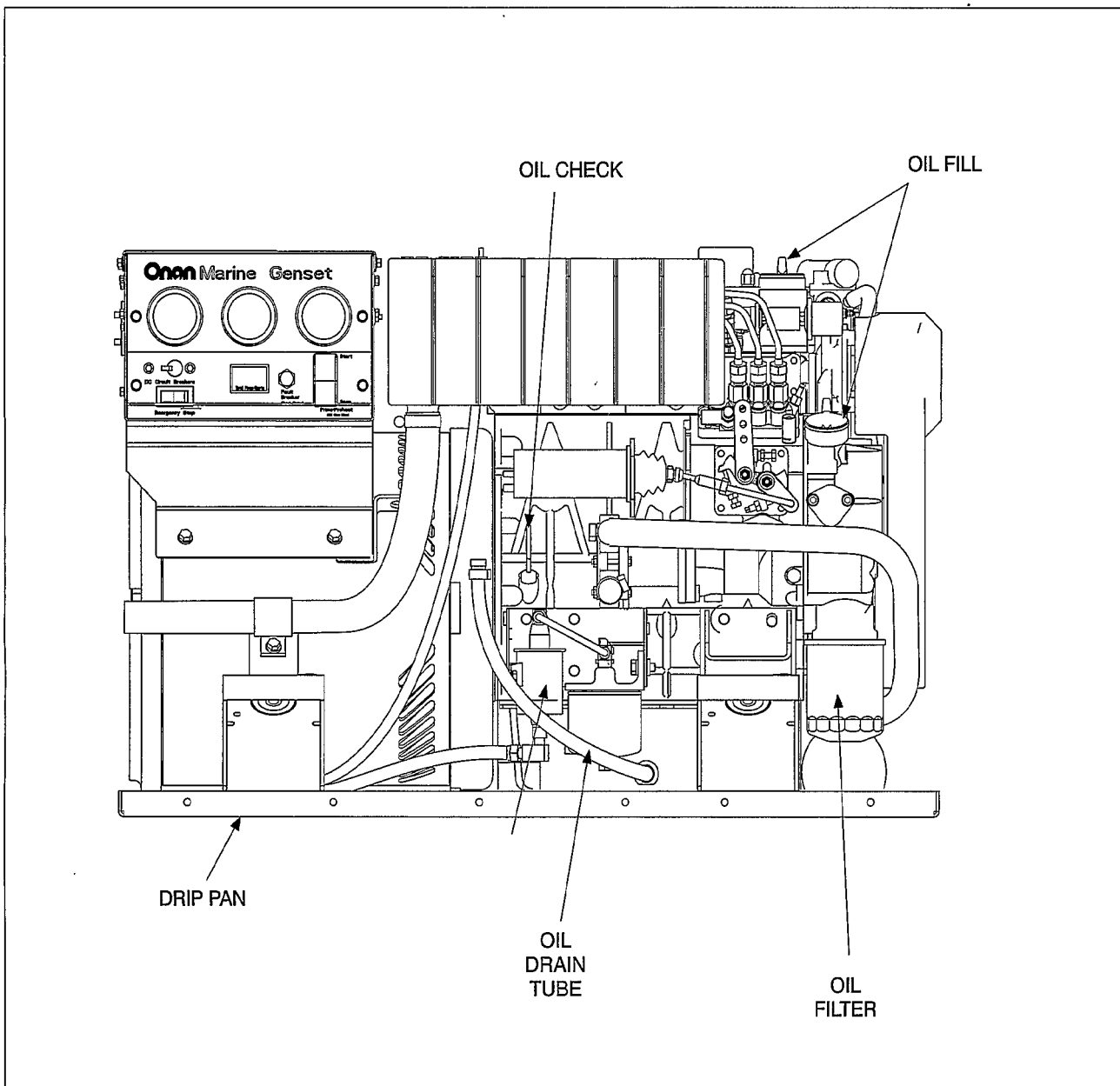


FIGURE 6. ENGINE OIL SYSTEM

COOLING SYSTEM

The cooling system is drained before the set is shipped. **It must be refilled before the genset is operated.** Cooling system capacity is listed in the *Specifications* section.

Coolant Requirements

Engine coolant must inhibit corrosion and protect against freezing. A 50/50 mixture of ethylene glycol anti-freeze and water is recommended for normal operation and storage. Use only a reliable brand of anti-freeze that contains a rust and corrosion inhibitor. **The anti-freeze should not contain a stop-leak additive.**

Do not deviate from a 50/50 mixture of ethylene glycol and water. A higher proportion of ethylene glycol will alter the heat transfer properties of the coolant. A 50/50 mixture will provide freeze protection to -34° F (-37° C).

Water used for engine coolant should be clean, low in minerals, and free of corrosive chemicals. Use distilled or soft water if available. Avoid the use of well water, which may contain minerals which can clog the heat exchanger core and reduce cooling efficiency.

Filling the Cooling System

Verify that all drain cocks are closed and all hose clamps are secure. Remove the cooling system

pressure cap and slowly fill the cooling system with the coolant mixture, until the coolant reaches the level of the bottom of the fill tube.

⚠ CAUTION *Attempting to fill the coolant system too quickly can cause incomplete filling of the engine block, leading to engine damage during warm-up. Always follow the recommended fill procedure.*

Fill the recovery tank with coolant mixture to the COLD mark. Operate the genset until normal operating temperature is attained (about 15 minutes of operation). Shut down the genset and let cool. Add coolant to the recovery tank until coolant level stabilizes at the COLD mark: this may require several operation cycles.

NOTE: Installation of the optional low coolant level shutdown switch will protect the engine in the event of a loss of coolant.

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

⚠ CAUTION *Coolant level must contact the shutdown switch. Low coolant will allow engine to overheat causing severe damage to the engine. Engine coolant levels must be maintained for overheat shutdown protection.*

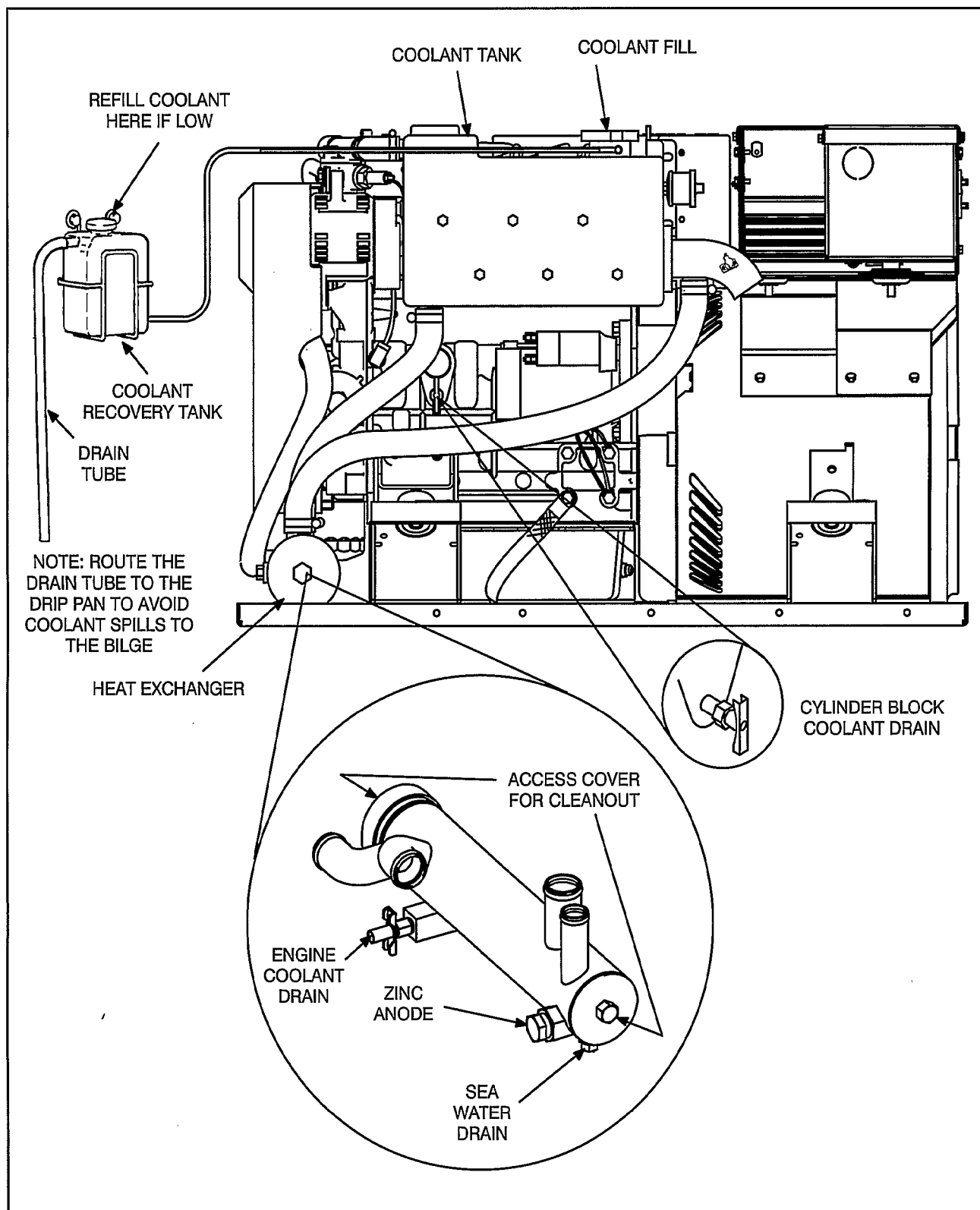


FIGURE 7. GENSET COOLING SYSTEM

Flushing and Cleaning

Once a year, drain, flush and refill the cooling system with new coolant. To drain the system, open the heat exchanger drain and the cylinder block drain on the left side of engine. See Figure 7. Take care to drain the system completely. Plan draining to avoid spillage into bilge. Some coolant can be toxic. Dispose in accordance with local regulations.

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

Chemical Cleaning: Rust and scale slow heat absorption and can block coolant flow. Clean the cooling system if rust and scale have collected on the engine water jacket or in the heat exchanger. Use a good cleaning compound and follow its instructions.

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

⚠ CAUTION *Never pour hot water into a cold engine or cold water into a hot engine. Doing so can crack the head or the cylinder block. Do not operate the unit without water for even a few minutes.*

Pressure Cap

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

Pump Belt

Access to the belt is made by opening the genset service door. On sets without sound shields, remove the belt guard. Before removing the belt guard, be sure the genset is disabled by removing the battery cables, 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.*

To adjust the belt, loosen the bottom pivot bolt on the alternator, then loosen the bolt that passes through the long slot in the alternator mounting bracket. Slide the alternator until the tension is right. See Figure 8.

Belt tension is correct when a finger pressure of 22 pounds (10 kg) at the middle of the belt deflects it about 0.4 inch (10 mm).

⚠ CAUTION *Operation of the generator set with too much tension on the pump belt may cause reduced belt life. For longest belt life, do not overtighten the pump belt.*

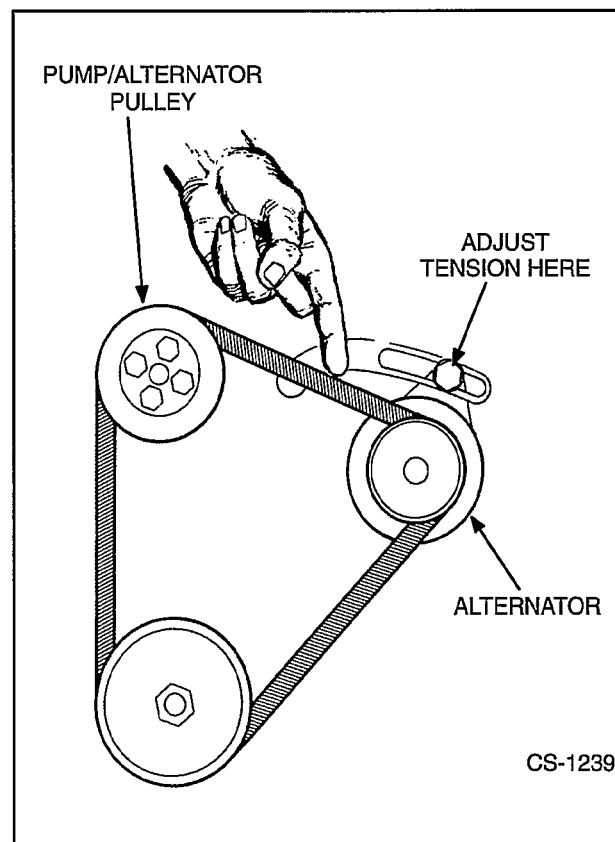


FIGURE 8. PUMP BELT ADJUSTMENT

Siphon Break Valve

A siphon break valve must be installed on gensets if the exhaust injection elbow is at or below load water line. A siphon break valve prevents sea water from siphoning into the engine and compartment when the generator set shuts down.

The siphon break valve is normally trouble-free. However, when used in contaminated waters or salt water, 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). The siphon valve is not part of the generator set; however, Onan provides a siphon valve kit.

Zinc Anode

The zinc anode is installed in the heat exchanger (see Figure 7). Refer to *Maintenance Schedule* for replacement interval. The sea water portion of the heat exchanger must be drained for this replacement to be performed.

FUEL SYSTEM

Use the best fuel available. Fuel quality is important for dependable performance and satisfactory engine life.

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

Fuel Recommendation

Use ASTM 2-D (No. 2 Diesel) or ASTM 1-D (No. 1 Diesel) fuel with a minimum Cetane number of 45. No. 2 diesel fuel gives the best economy and performance under most conditions. Use No. 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 which has a cloud point at least 10 degrees below the lowest expected fuel temperature.

Fuel Handling Precautions

Prevent dirt, water or other contaminants from entering the fuel system. Filter or strain the fuel as the tank is filled.

⚠ CAUTION *Due to the precise tolerances of diesel injection systems, dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles. It is extremely important the fuel be kept clean and water free.*

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

Low fuel in the tank promotes condensation. In warm weather, the fuel tank cools at night quicker than the fuel. If the fuel level is low, the upper portion of the tank will cool more rapidly, forming condensation. In cold weather, the warm fuel returning from the injectors heats the fuel in the supply tank. If the fuel is low, condensation may form on the upper part of the tank. **To avoid condensation, fill the fuel tank whenever the fuel level is below 1/2 full.**

Priming the Low-Pressure Fuel System

The fuel lines, fuel pump, and fuel filter must be filled with fuel for the engine to start. This procedure is normally done at the time of fuel filter replacement or generator set installation. Priming must also be done if the set is run out of fuel. The fuel system is vented and the fuel pump is operated to purge air from the generator set. The engine injection pump allows the air to be purged through the fuel return line. The bleed screw can be opened to quickly bleed the system.

⚠ WARNING *Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be qualified to perform diesel engine service.*

Priming the Fuel System

Normal fuel system venting does not require special steps. Press the Stop switch in the Stop/Prime position for up to 20 seconds at a time. The fuel transfer pump runs the pumps fuel to the injection pump, which vents internally to the return line. Completion of priming is confirmed when the engine starts and runs normally.

⚠ CAUTION *Depressing the start/stop switch in the stop/preheat mode for longer than 20 seconds can cause premature failure of the glow plugs. Either disconnect the glow plugs as described above, or allow the glow plugs to cool for 1 minute before repeating the prime procedure.*

If a significant amount of air is in the fuel system, use the following steps to prime the fuel system:

NOTE: A brief outline of the priming procedure is presented here. However, this procedure should only be performed by a trained diesel mechanic, or by a highly competent mechanical technician. Consult your Onan distributor for further information on priming the engine.

1. Disconnect the fuel return line and connect a hose from the fuel return to a container to catch vented fuel. This will provide an indication when priming is complete.
2. Open the vent screw on the injection pump inlet fitting if a significant amount of air is to be vented.

⚠ WARNING *Fuel will spray from this vent when the system is primed. Provide a way to catch the fuel. Wear safety glasses and keep hands and face well away.*

3. If the fuel supply line and/or fuel filter are completely dry, disconnect the lead to the set glow plugs and shield the terminal of this wire with tape or other insulator. If there is just a small amount of air to be purged or if the pump is to be run less than 20 seconds, this step is not necessary.

4. Push the start/stop switch to the stop position. Hold the switch for 20 seconds or until a steady stream of fuel can be observed coming from the fuel return connection.
5. Release the start/stop switch.
6. If the glow plug lead was disconnected, reconnect it now.
7. Reconnect the fuel return line in its original configuration.

⚠ CAUTION *Fuel is toxic. Properly dispose of fuel in accordance with local regulations.*

8. Start the generator set and check for normal operation. Check all lines, valves, and filters for leaks. If the engine does not start, the high pressure fuel lines may need to be bled.

Bleeding the High Pressure Fuel System

NOTE: If the engine does not start, the high pressure fuel lines may need to be bled. A brief outline of the bleeding procedure is presented here. However, this procedure should only be performed by a trained diesel mechanic, or by a highly competent mechanical technician. Consult an authorized Onan service center for further information on bleeding the high pressure fuel system.

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

1. Loosen the high pressure fittings at the nozzles.
2. Crank the generator set until fuel appears at the loosened fittings.
3. Wipe up the fuel leaked out from the system in step 2.
4. Retorque the fittings to the values shown in the Engine Service Manual (Onan publication 981-0517).

Fuel Filter

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 that the fuel be kept clean and free of water.*

Draining Water/Sediment From Filter: Refer to Table 4 for the recommended time interval. Drain about 1/4 cup (60 ml) of fuel as follows:

1. Open the drain plug on the fuel filter assembly (Figure 9). Collect water and fuel in a suitable container and dispose of it properly.
2. Tighten the drain plug.

Replacing Filter Element: Refer to Table 4 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 procedure to replace.

1. Loosen the filter drain plug. Collect fuel in a suitable container and dispose of properly. See Figure 9.
2. Spin the element off the base.
3. Clean the contact surface of the base.
4. Lubricate the new element and its gasket, and fill the element with clean diesel fuel.
5. Spin the new element onto the base and hand tighten. **DO NOT OVERTIGHTEN.**
6. Depress the Start switch and try to run the generator set. If the set does not start, perform the priming procedure described earlier in this section.

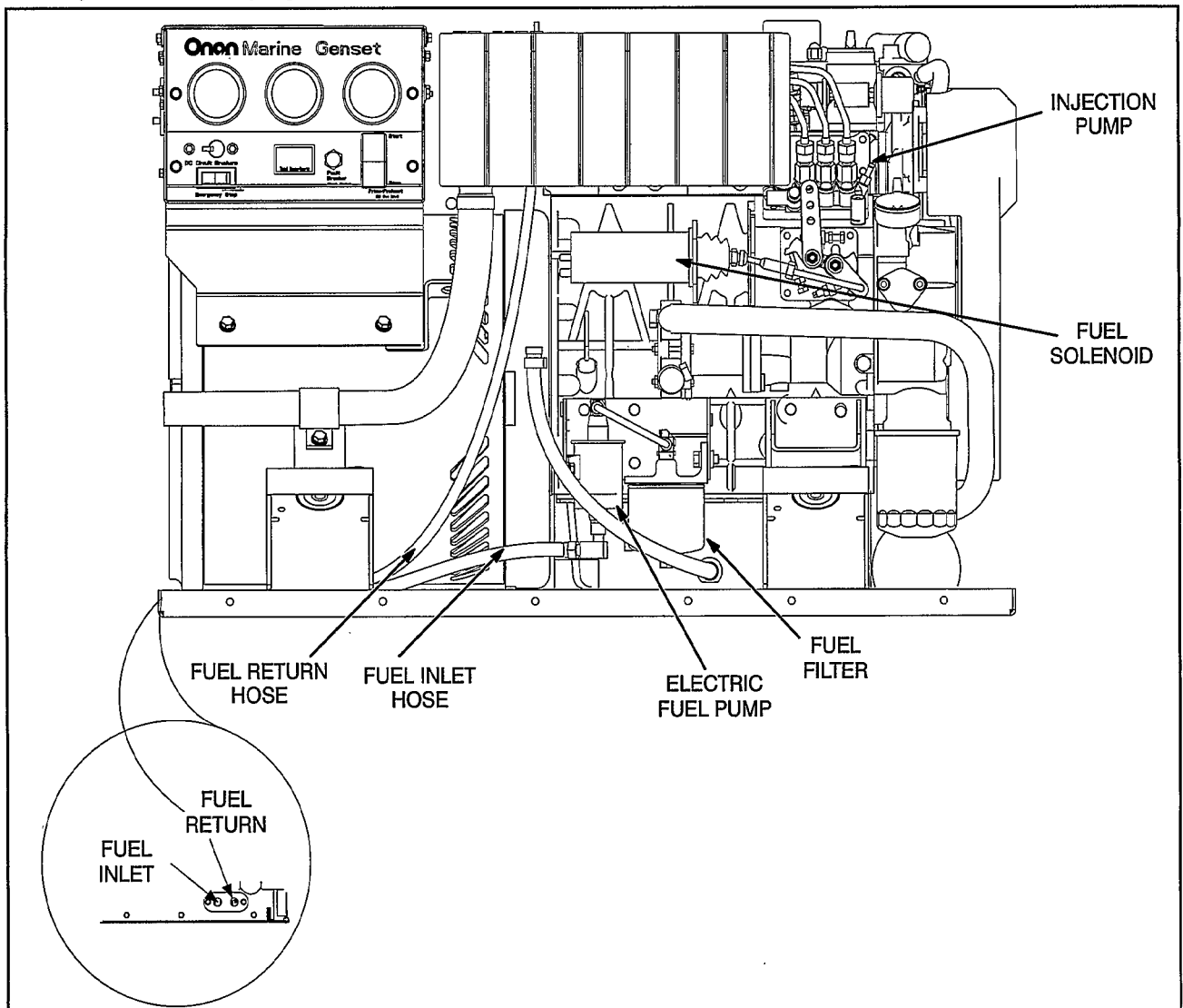


FIGURE 9. ENGINE FUEL SYSTEM COMPONENTS

BATTERY CARE

Sealed, maintenance-free batteries are preferred for marine application. They offer higher output ratings (CCA), and better durability. Consult your Onan distributor for recommendations. If the battery is not the maintenance-free type, service as follows:

Service the battery at the intervals shown in the maintenance schedule. Check the electrolyte level more frequently during hot weather.

⚠WARNING Batteries present the hazard of explosion that can result in severe personal injury. Do not smoke or allow any fire, flame, spark, pilot light, arc-producing equipment or other ignition sources around the battery area. Do not disconnect battery cables while the generator set is cranking or running because explosive battery gases could be ignited.

⚠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.

1. Keep the battery case clean and dry.
2. Make certain that the battery cable connections are clean and tight. Use a terminal puller tool to remove the battery cables.

Remove corrosion from the battery 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. 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.

3. Identify the cable as positive (+) or negative (-) before making the battery connections. Always connect the negative (-) cable last, to reduce the risk of arcing.
4. Maintain the electrolyte level by adding distilled water. Fill each cell to the split-level marker in the battery. The water component of the electrolyte evaporates, but the sulfuric acid compo-

nent remains. For this reason, add water, not electrolyte to the battery.

5. Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell (Figure 10). Charge the battery if the specific gravity measures less than 1.215. Do not over-charge the battery. Stop charging the battery when the electrolyte specific gravity reaches 1.260, at approximately 80° F (27° C).

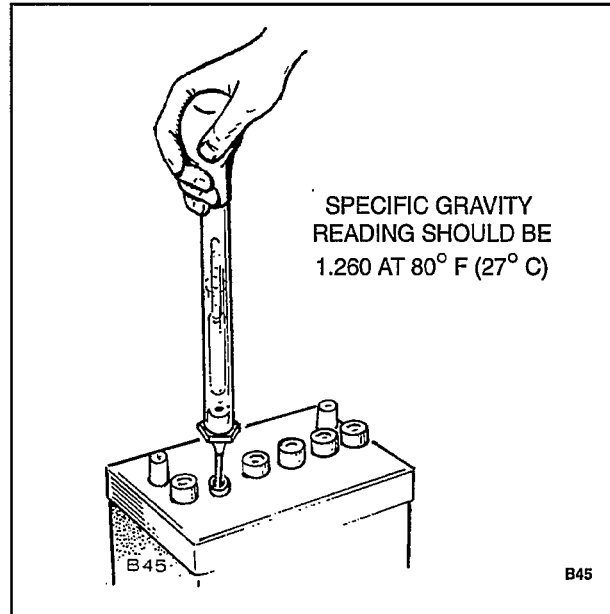


FIGURE 10. BATTERY CHECK

AC GENERATOR

Generator Bearing

⚠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) before inspecting the generator.

Inspect the bearing for evidence of outer case rotation every 1000 hours of use. The bearing should be replaced every five years, because the bearing grease gradually deteriorates due to oxidation. See the Service Manual (publication 981-0524) for the bearing replacement procedure. If the generator requires major repair or service, contact an authorized Onan dealer or distributor.

Generator Set Storage

OUT-OF-SERVICE PROTECTION

The lubricating qualities of No. 2 diesel fuel should protect the cylinders of a diesel engine at least 30 days when the set is not being run. For storage longer than 30 days, proceed as follows:

1. Exercise the genset (see *Operating Recommendations* 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 oil viscosity.
4. Check the coolant level. Add more coolant if low. If freezing temperatures are possible, test 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 the sea cock and remove the sea water inlet hose at filter.
- B. Place the end of the hose in a bucket of anti-freeze mixture and run engine until mixture is observed coming out of the exhaust outlet.

⚠WARNING *Anti-freeze is toxic and can pollute the environment. Do not allow anti-freeze to escape or drain to the ground or water. Dispose according to local regulations for hazardous substances.*

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. Lightly coat parts that may rust with grease or oil.

Returning the Genset to Service

Refer to the appropriate paragraphs in this *Maintenance Procedures* section for specific service procedures.

1. Remove plug from the exhaust outlet, and open the sea cock.
2. Check tag on oil base and verify that 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 at 80° F [27° C]) and verify the proper level. If the specific gravity is low, charge the battery until the value is correct. If the level is low, add distilled water and charge until the specific gravity reading is correct. **DO NOT OVERCHARGE.**

⚠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, negative (-) cable last.
6. Remove all loads before starting the genset.
7. After starting, run the generator set at no load for roughly 30 seconds. Then apply a load of at least 50 percent rated capacity.
8. Check all gauges for normal readings. Genset is ready for operation.

Troubleshooting

DC CONTROL

The DC control has sensors that continuously monitor the engine for low oil pressure, high coolant temperature and high exhaust temperature. If any of these conditions occur, the control stops the engine. Figures 11 illustrate these sensors and switches.

The AVR also monitors for overspeed, over voltage and low coolant level (optional).

If a major problem is indicated, contact an Onan dealer or distributor for help or service.

Low Oil Pressure

Remove dipstick and check oil level. If low, add oil to bring level up to 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).

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

High Coolant Temperature

If fault occurred during operation, check the set for indication of coolant temperature over 222° F (106° C). The coolant temperature switch closes at this temperature and actuates the fault circuit.

Check the coolant level in the coolant tank after allowing the engine to cool down. Ensure engine coolant pump belt is OK and has proper tension. The sea water flow at the exhaust outlet should be about 5 gal./min. (19 liter/min.) at 60 Hz. Also check cooling system cleanliness (freedom from contaminants, rust, sludge buildup, etc.).

Check the sea water pump for operation. If the impeller has failed or the pump has lost prime, the engine cooling system will overheat. Check for proper operation of the sea water pump by checking the pump body to see if it is warm.

⚠ CAUTION *Use extreme caution when checking the temperature of the sea water pump. If the pump is hot, it may cause burns.*

Check to see if sea water is being discharged in the exhaust at the through-hull discharge port.

⚠ CAUTION *The sea water pump impeller will fail if operated dry for 30 seconds. As the pump overheats, the impeller blades harden and flow is reduced. Operation for several minutes will cause pieces of the impeller to break off, impeding or eliminating cooling capability.*

⚠ WARNING *Contact with hot coolant can result in SEVERE burns. Allow cooling system to cool before releasing pressure and removing radiator cap or release of hot coolant can result.*

High Exhaust Temperature

The high exhaust temperature switch is mounted on the outlet of the exhaust manifold. It shuts down the set if sea water flow is lost.

⚠ WARNING *Inhalation of exhaust gas can cause serious personal injury or death. Do not disconnect or bypass the exhaust elbow switch. Excessive heat can 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.*

Over Voltage

The AVR monitors AC output voltage and shuts the set down if output voltage exceeds a preset limit of approximately 40% over the set voltage.

Over Speed

The AVR monitors genset output frequency and shuts down the set if it exceeds a preset limit. If the setting is 60 Hz, the shutdown setting is 74 Hz. If the setting is 50 Hz, the shutdown point is 64 Hz.

Low Coolant Level

The optional low coolant level switch is mounted on the exhaust manifold. If the coolant level goes below a safe level, the set is shut down.

AC CONTROL

The AC control consists of the line circuit breaker. The line circuit breaker is connected between the generator output and the load. The breaker is required to protect the generator from shorts or overload. The breaker is mounted in the AC connection box.

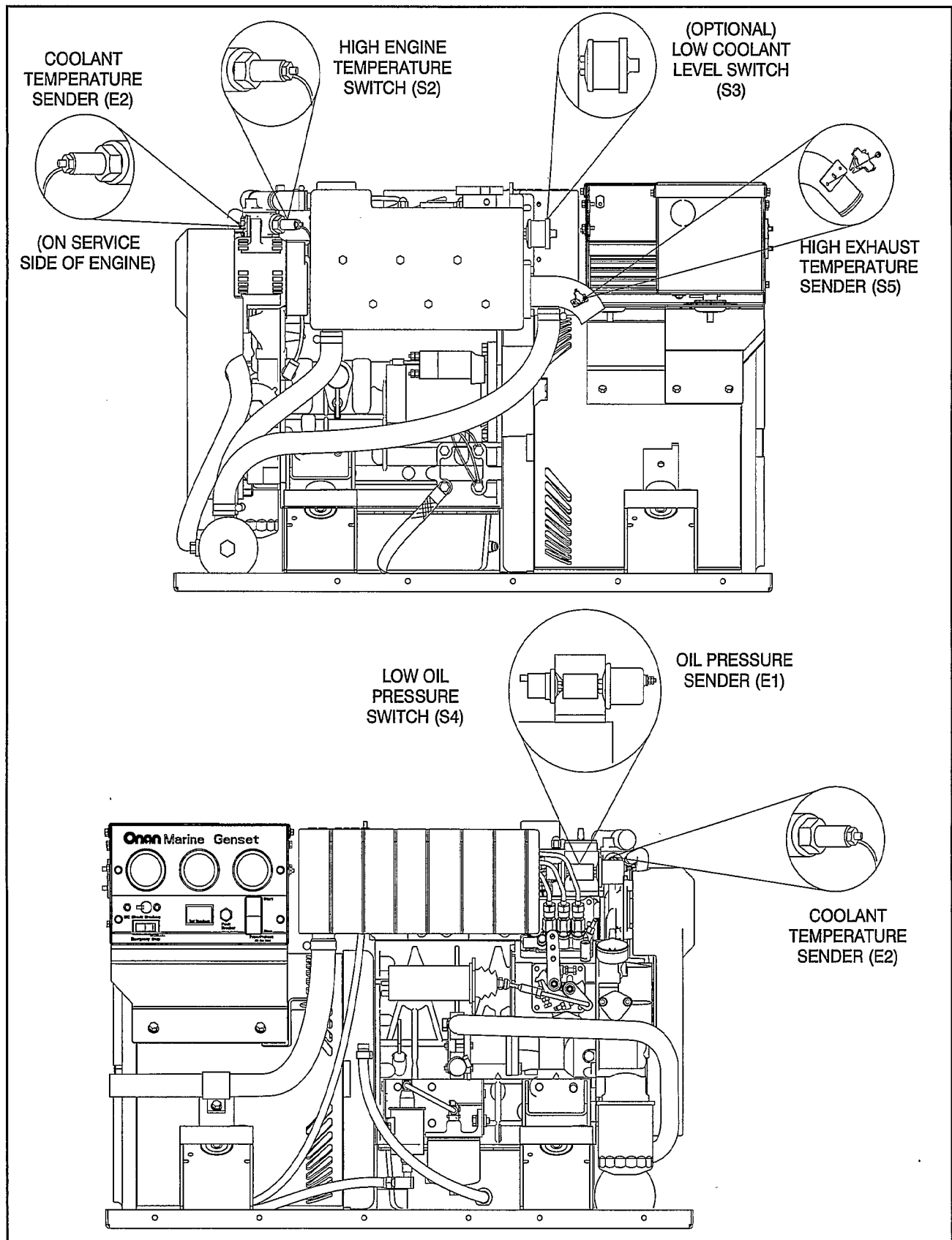


FIGURE 11. COOLANT AND OIL SENSOR LOCATIONS

How to Obtain Service

LOCATING SERVICE ASSISTANCE

When your generator set needs parts or service, contact the nearest authorized dealer or distributor. Onan Parts and Service representatives are factory-trained to handle all of your service needs. Locate the nearest authorized distributor as follows:

1. Check the North American Sales and Service Directory (F-118) and the International Sales and Service Directory (IN-1013) supplied with your Onan genset. These directories list authorized distributors who will assist you in locating the nearest authorized dealer.

-or-

2. Consult the Yellow Pages. Typically, our distributors are listed under:

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

-or-

3. For the name of your local Cummins®/Onan or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN (6620) (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.

If you need additional assistance, please call Onan Corporation, 1-612-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday.

SCHEDULING SERVICE

1. Before calling for service, have the following information available:

The complete Onan product model number and serial number (see Model Identification on page 1)

Date of purchase

Nature of the problem

2. Contact the authorized dealer or distributor nearest you to explain the problem and make an appointment.
3. If you have difficulty in arranging for service or resolving a problem, please contact the dealer coordinator or service manager at the nearest Cummins/Onan distributor for assistance.

⚠ WARNING

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

Specifications

MDKAL GENSET:

DIMENSIONS AND WEIGHT

Without sound shield:

Length	32.5 in. (826 mm)
Width	18.5 in. (470 mm)
Height	22.2 in. (564 mm)
Weight	525 lbs (238 kg)

With sound shield:

Length	36.0 in. (915 mm)
Width	22.0 in. (568 mm)
Height	23.5 in. (596 mm)
Weight	625 lbs (284 kg)

ENGINE

Engine type:	Kubota® D1005, diesel, 3 cylinder, vertical in-line
Bore:	2.99 in. (76 mm)
Stroke:	2.90 in. (73.6 mm)
Displacement:	61.08 in ³ (1001 cm ³)
Compression ratio:	23:1
Lube oil capacity:	4.5 qt. (4.25L) Including Filter
Power (maximum) at 1800 rpm:	13.1 bhp
Fuel consumption (No. 2 diesel fuel) average @ full load:	0.84 gph (3.2 l/h)
Fuel pump lift (self-priming)	4 ft. (1.2 m)
Fuel inlet	1/8-27, NPT, Female
Fuel return	1/8-27, NPT, Female
Total combustion air per minute required	1500 rpm: 25 ft ³ /min. (0.71 m ³ /min.) 1800 rpm: 30 ft ³ /min. (0.86 m ³ /min.)
Total cooling air per minute required (housed set)	1500 rpm: 75 ft ³ /min. (2.15 m ³ /min.) 1800 rpm: 90 ft ³ /min. (2.55 m ³ /min.)
Total cooling air per minute required (unhoused set)	1500 rpm: 125 ft ³ /min. (3.54 m ³ /min.) 1800 rpm: 150 ft ³ /min. (4.24 m ³ /min.)
Minimum compartment air opening (inlet)	35 in ² (225.8 cm ²)
Minimum compartment air opening (outlet)	35 in ² (225.8 cm ²)
Battery charge alternator maximum output (regulated)	35 amperes
Battery voltage (nominal)	12 volts
Battery recommendation minimum cranking performance @ 0° F (-18° C)	360 CCA
Coolant capacity	4 qt. (3.78 l)
Coolant flow rate (60 Hz)	5.0 gpm (19 l/min)
Coolant flow rate (50 Hz)	4.2 gpm (16 l/min)
Sea water flow (60 Hz)	6.0 gpm (23 l/min)
Sea water flow (50 Hz)	5.0 gpm (19 l/min)
Sea water lift capability	4 ft. (1.2 m) from water line to pump inlet

Kubota is a registered trademark of the Kubota Engine Company.

GENERATOR

Type 4-pole revolving field, 4-wire reconnectible (1-phase)
12-wire reconnectible (3-phase), 1500/1800 rpm

Single-phase ratings:

60 hertz general marine rating 8.0 kW, 10.0 kVA at 1.0 PF
50 hertz general marine rating 6.5 kW, 6.5 kVA at 1.0 PF

Three-phase ratings:

60 hertz general marine rating 8.0 kW, 8.0 kVA at 0.8 PF
50 hertz general marine rating 6.5 kW, 8.125 kVA at 0.8 PF

Frequency regulation, no load-rated load: 5 percent (± 1.5 Hz @ 5060 Hz)
Voltage regulation under varying load: ± 1 percent

Maintenance Record

Keep a record of all periodic and unscheduled maintenance. Record the service date and the

number of operating hours from the optional hour meter (if equipped).

[illegible]

Record the name, address, and phone number of your authorized Onan service center.

Information for California Genset Users

These gensets meet the requirements of California's Exhaust Emissions Standards for 1995 and later for Utility and Lawn and Garden Equipment Engines.

As a California user of these gensets, please be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the genset label is prohibited.

You should carefully review Operator (Owner), Installation and other manuals and information you receive with your genset. If you are unsure that the installation, use, maintenance or service of your genset is authorized, you should seek assistance from an authorized dealer.

California genset users may use Table 5 as an aid in locating information related to the California Air Resources Board requirements for emissions control.

TABLE 5. EMISSIONS CONTROL INFORMATION

Genset Warranty Information	The California emissions control warranty statement is located in the same packet of information as this manual when the engine is shipped from the factory.
Engine Fuel Requirements	The engine is certified to operate on diesel fuel. See FUEL RECOMMENDATIONS in <i>Pre-start Section</i> .
Engine Lubricating Oil Requirements	See ENGINE OIL RECOMMENDATIONS in <i>Pre-start Section</i> .
Engine Adjustments	High Idle Speed. This is a service procedure requiring trained personnel and proper tools. See the Service Manual.
Engine Emission Control System	The engine emission control system consists of engine design and precision manufacture. (IFI)



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