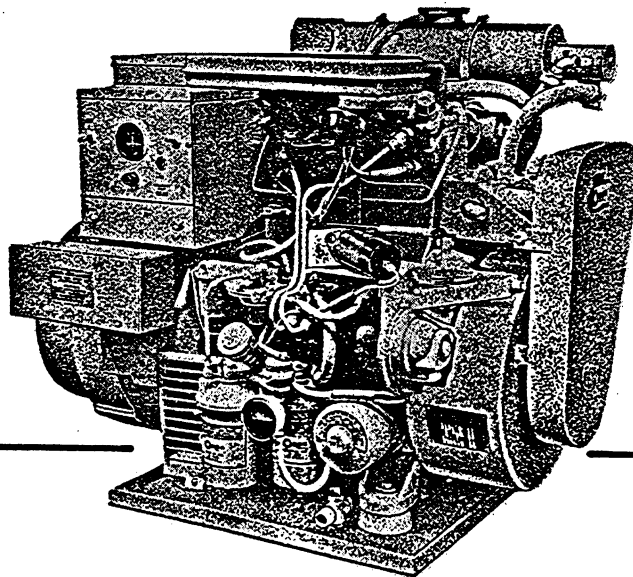


McGRAW-EDISON

Onan

Operators Manual

**MDJE
Marine GenSet**



Safety Precautions

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

WARNING

This symbol is used throughout the text to warn of possible injury or death.

CAUTION

This symbol is used to warn of possible equipment damage.

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 simple and fundamental rules or precautions.

- Do not fill fuel tanks with the engine running. Do not smoke around 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.
- Equip the engine fuel supply with a positive fuel shutoff.
- Provide adequate ventilation (preferably power exhausters) to expel toxic gas fumes and fuel vapors from the engine compartment. Be sure propulsion and generator engine exhaust systems are free of leaks.
- Perform thorough, periodic inspections of the exhaust system and repair leaks immediately. Exhaust gases are deadly.
- Coolants under pressure have boiling points over 212°F (100°C). Do not open a coolant pressure cap while the engine is running. Always bleed off the system pressure first.
- Do not remove any belt guards or covers with the unit 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 set, disconnect its batteries to prevent accidental starting. Disconnect the ground lead first. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive. Make sure you connect the battery correctly. A direct short across the battery terminals can cause an explosion. Connect the ground lead last.
- Do not make adjustments in the control panel or on engine with unit running. High voltages are present. If you must work around unit while it is running, stand on dry surfaces to reduce shock hazard.
- Keep a fire extinguisher available in or near the engine compartment and in other areas through 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.
- Onan suggests copying and posting these suggestions in potential hazard areas of the vessel. Most important, exercise caution and use common sense.

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC-rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work-harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.

- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [-] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (-) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

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.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or 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.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocutation can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [-] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [-] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (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.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

GENERAL INFORMATION

YOUR MANUAL

This manual gives you operation and maintenance instructions to help you keep your unit running like new. Read it carefully. Remember . . . any machine, regardless of design or type, performs only in relation to the services it gets.

Throughout the manual, engine end is considered front of the generator set. Left and right are determined while facing the engine end.

Where applicable, metric equivalents appear in parentheses following the U.S. customary units.

In this manual, water for engine cooling will be referred to by only two types. Water drawn into and expelled from the boat will be called *Sea Water*. Water recirculated through the closed cooling system will be called *Captive Water*. This will avoid confusion that exists with use and mixing of other water terms such as raw, fresh, flotation, direct, cold, hot, discharged, etc.

YOUR GENERATOR SET

Upon receipt of your unit, check it thoroughly for any damage which may have occurred during shipping. Tighten any loose parts, replace missing parts, and repair any damage before putting the unit in operation.

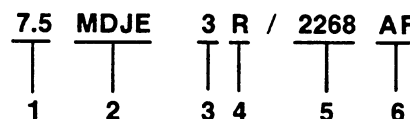
When contacting a dealer or distributor regarding the set, always mention the complete Model, Spec No. and Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify your unit among the many manufactured.

If the nameplate is lost or illegible, unit identification can be re-established by furnishing the engine serial number. It is stamped on the engine close to the fuel transfer pump.

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How to interpret MODEL and SPEC NO.



1. Indicates nominal kW rating.
2. Factory code for general identification.
3. Voltage code.
4. Starting method (R = Remote Starting).
5. Factory code for optional equipment.
6. Specification (Spec) letter (advances when factory makes production modifications).

WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.

SPECIFICATIONS

GENERAL DETAILS

Engine

Number of cylinders (vertical in-line)	2
Displacement	70 cu in. (1150 cm ³)
Cylinder bore	3.50 in. (88.9 mm)
Piston stroke	3.62 in. (92.1 mm)
R/min (for 60 hertz)	1800
R/min (for 50 hertz)	1500

Generator

Rating (output in watts)*	
AC, 60 hertz set	7500 (7.5 kW)
AC, 50 hertz set	6000 (6.0 kW)

CAPACITIES AND REQUIREMENTS

Battery recommendation	Two 6-volt batteries in series
32° F (0° C) and warmer	Cranking Performance @ 0° F (-18° C) 450 Amps BCI Group Size 1
0° F (-18° C) and warmer	Cranking Performance @ 0° F (-18° C) 560 Amps BCI Group Size 2
Battery charge rate amperes (normal)	2 to 5
Oil capacity	
With filter	3-1/2 U.S. qt (3.31 lit)
Without filter	3 U.S. qt (2.84 lit)
Total air per minute required (cooling and combustion)	167 CFM (5 m ³ /min)
Diesel fuel pump lift (maximum)	6 ft (1.8 m)
Cooling Water Flow	
@ 1800 r/min (60 hertz)	
Sea Water Cooling	3.3 GPM (12.4 lit/min)
Heat Exchanger or Keel Cooling	4 GPM (15.0 lit/min)
@ 1500 r/min (50 hertz)	
Sea Water Cooling	3.2 GPM (11.9 lit/min)
Heat Exchanger or Keel Cooling	3.6 GPM (13.7 lit/min)

TUNE-UP SPECIFICATIONS

Cylinder head bolt torque	44 to 46 ft lb (60-62 N•m)†
Glow plug torque	10 to 15 ft lb (14-20 N•m)
Valve Clearance	
Intake	0.017 in. (0.43 mm)
Exhaust	0.017 in. (0.43 mm)
Centrifugal switch (gap)	0.020 in. (0.51 mm)

*Subtract 4 percent high altitude deration for each 1000 feet (300 m) above sea level and subtract 2 percent for each 10° F (5.6° C) above an average operating temperature of 85° F (29° C).

† Apply Never Seize or equivalent to capscrew threads and under capscrew head.

INSTALLATION

GENERAL

Each installation must be considered individually and made in compliance with existing regulations. Figure 1 shows a typical installation. The advice and guidance contained in the booklet entitled *Fire Protection Standard for Motor Craft*: (NFPA No. 302) offered by the National Fire Protection Association International, Boston, Massachusetts, will be helpful to the installer of equipment in vessels. Onan recom-

mends that this unit be installed as recommended in the American Boat and Yacht Council publication "Safety Standards for Small Craft."

LOCATION

Select a location for the unit, preferably near the keel, which is dry, properly ventilated and above low lying vapors or splash from the bilge. Provide accessibility for minor servicing operations, draining of the crankcase lubricating oil and the cooling system.

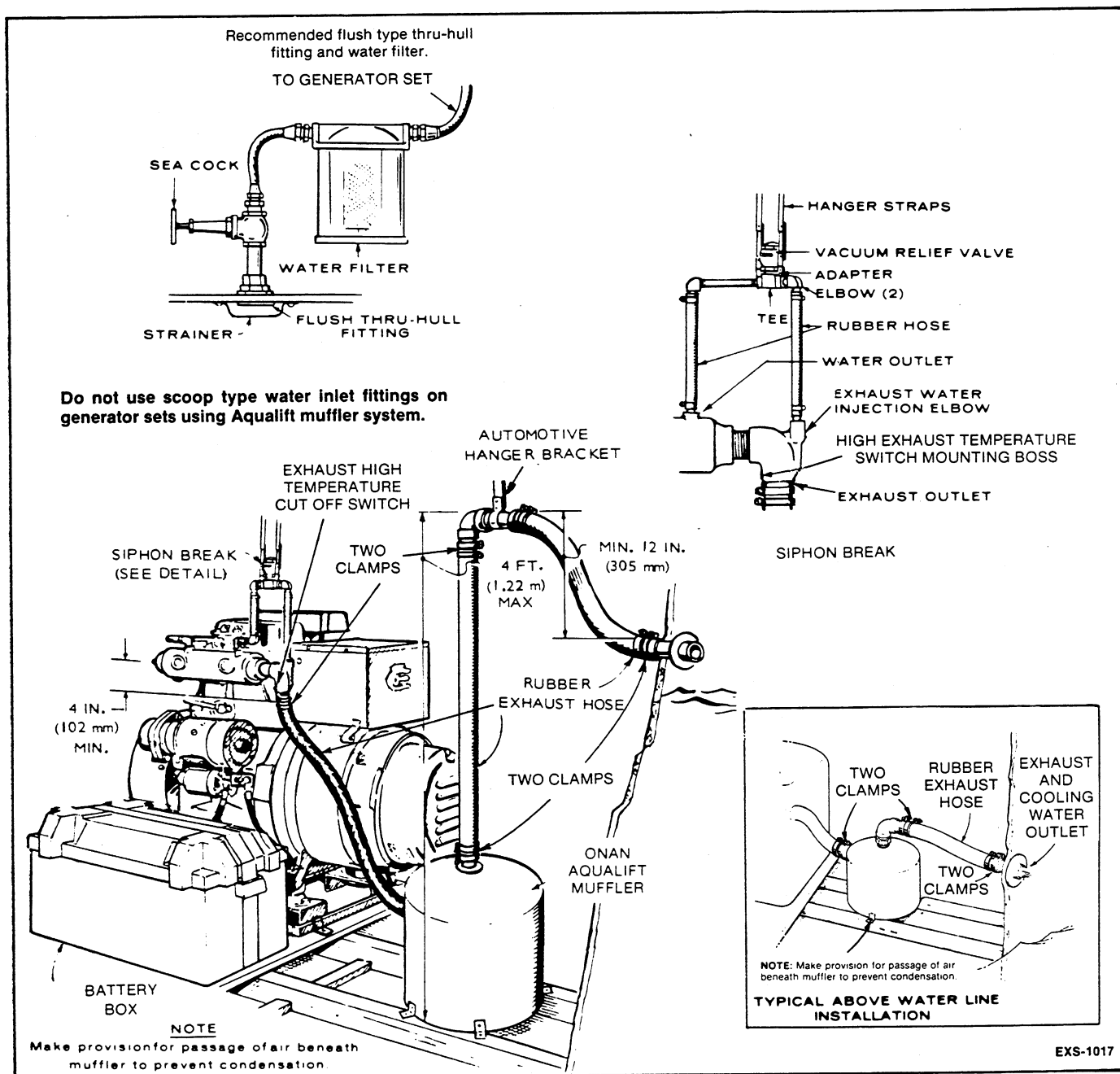


FIGURE 1. TYPICAL INSTALLATION WITH AQUALIFT MUFFLER

MOUNTING

The floor should be flat, and give support directly under the set mounting points. A 2-1/2 inch clearance around the unit is required to permit it to rock on its mounts without restraint. Use flexible exhaust line, fuel line, battery cables, and electrical wires.

To install cone-type mounting cushions (Figure 2), position the set on the drip pan and place the cushions under the oil base and generator support. Secure the set to the drip pan with the associated hardware (Figure 2). Add thin flat washers to maintain approximately 1/16-inch clearance between snubber washer and flat washer. Cushion deflection under load should be approximately 3/16-inch.

Install two hold-down clamps to the drip pan (front and rear or both sides). Secure the clamps to the mounting base. For maximum noise reduction, install the Onan "Sound Shield" which is an insulated steel enclosure completely surrounding the generator set. Openings are provided for connection to all external lines and wires. Internal air ducts reduce airborne noise to a minimum. Contact your local Onan dealer for noise reduction methods and the special kits available.

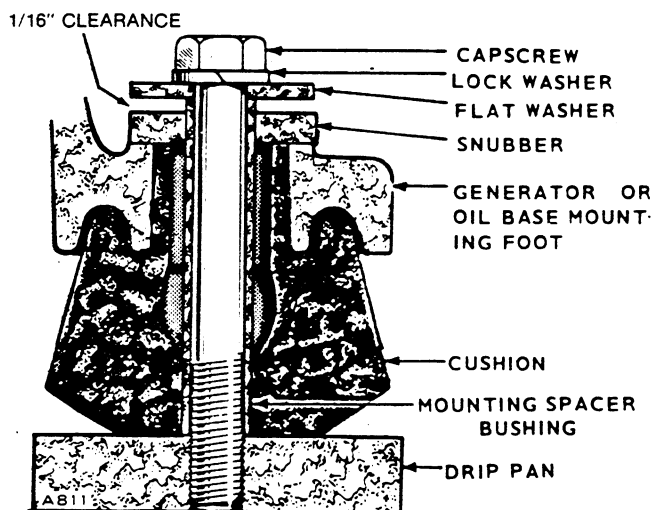


FIGURE 2. CONE-TYPE MOUNTING CUSHION

EXHAUST

WARNING

Pipe exhaust gases outside of the hull — exhaust gases are poisonous!

The engine exhaust connection is tapped 1-1/4 inch U.S. national pipe thread. Using Figure 1 as a guide, install a separate exhaust line, keeping the following in mind:

1. Keep the line above vessel load water line.
2. Pitch it downward to prevent water backflow.

3. Shield line near combustible material.
4. Use flexible hose or tubing certified for marine use.
5. For turns, use sweeping (long radius) elbows.
6. Increase one pipe size for every 10 feet (3 m) in length.
7. Install exhaust through hull fitting aft of sink, shower or other cabin drains.
8. Use two clamps at every hose connection.

SIPHON BREAK

The siphon break is a vacuum-operated vent valve that opens the exhaust water discharge line to the atmosphere when the engine shuts down. The open vent valve prevents sea water from being siphoned into the exhaust manifold and cylinders on engines installed below the load waterline (Figure 1). The siphon break is required in the sea water discharge line for direct flow, Aqualift muffler, and heat exchanger installations.

Install Siphon Break Kit #155-0950 if exhaust injection elbow is below load water line. Locate the Siphon Break at least 12 inches (305 mm) above load water line and in a vertical position. Remote mounting the siphon break is permissible within a 5 foot (1.5 m) radius of water injection exhaust elbow. Vertical position and height of valve must be maintained.

CAUTION

Be sure the slotted opening in the vacuum relief valve is open to atmospheric pressure. The siphon break will not function if the relief valve slot is closed and may result in damage to engine.

AQUALIFT MUFFLER (Optional)

The Aqualift is a highly-efficient marine muffler designed for above or below water line installations when water cooled exhaust systems are used (Figure 1). Because of installation variables, customers must provide the brackets, hoses and clamps, required for installation. Follow installation instructions provided with the Aqualift muffler.

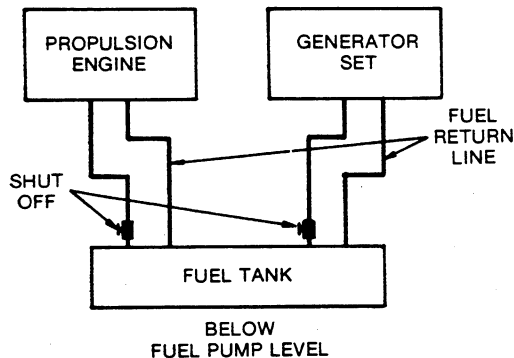
CAUTION

Do not use scoop type water inlet fittings when installing an Aqualift muffler. Forward facing scoops develop sufficient ram pressure to force water past the set's water pump, flooding the exhaust system where it can flow back and flood the engine cylinders. This can happen only if the generator set is not running and boat is underway.

FUEL TANK

If a separate fuel tank is used, install the tank so the bottom is less than 6 feet (1.8 m) below the fuel pump.

The tank top must be below fuel pump level to prevent siphoning. Install a shutoff valve at the tank. When the fuel tank is shared with another engine, use a separate fuel line and return line for each to avoid starving the set (Figure 3). If the fuel lift must exceed 6 feet (1.8 m), install an auxiliary electric fuel pump at the fuel supply.



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FIGURE 3. FUEL TANK ARRANGEMENT

FUEL CONNECTION

The diesel engine requires one fuel line for delivering fuel to the engine and another line for returning excess fuel back to the fuel tank. The delivery line is connected at the fuel pump inlet and the return line connects to the return line fitting near the injection pump (Figure 4). The connections for both lines are 1/4 inch inverted female fittings with 7/16 NPTF thread.

Always use a flexible fuel line between the engine and fuel supply. Use a line without internal wire reinforcement to prevent DC or AC current flow through the wire in the event of a failure in the engine grounding system (Onan recommends that the line conforms to the requirements of USCG regulation (183.558).

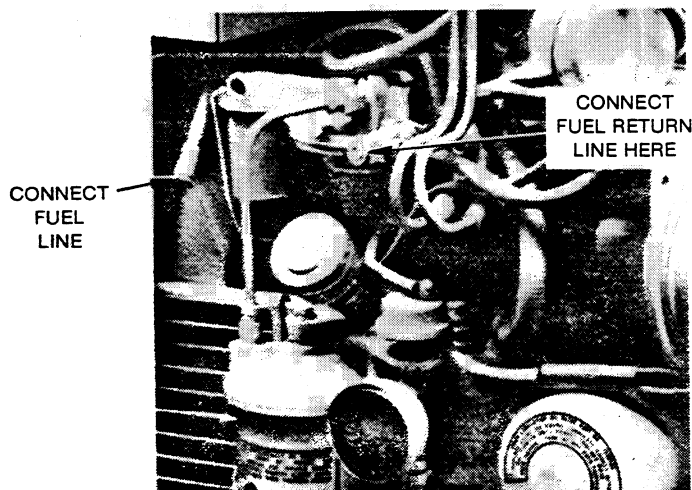


FIGURE 4. FUEL CONNECTIONS

Do not use galvanized lines, fittings, or fuel tanks in the fuel system. Carefully clean all fuel system components before putting the unit into operation. Any dirt or contamination may cause major damage to the fuel injection system.

VENTILATION

The generator set requires fresh air for combustion and generator cooling. Onan recommends that the ventilation system be able to deliver 1-1/2 to 2 times the air required by the set. When the ventilation system depends on wind or boat motion, use powered exhausters to provide ventilation when the boat is not in motion. For more information, refer to Onan Technical Bulletin T-021.

COOLING SYSTEM

Throughout this manual, water drawn into the boat for engine cooling will be called sea water. Water recirculated through a closed system will be called *captive* water. Use of the term "sea water" does not necessarily imply that the water is salty. In fact, use of salt water in the engine block for cooling may result in severe corrosion problems. Units operating in a salt water environment should use either a keel type or heat exchanger type closed cooling system.

Sea Water Cooling

This system pumps a continuous supply of sea water through the engine and exhaust system to provide cooling.

The pump inlet is 1/4-inch pipe thread to 1/2-inch hose coupling. Use a section of flexible hose near the set to absorb vibrations. The inside diameter of the plumbing must be 1/2 inch or larger. Use Permatex or other pipe sealer on all pipe fittings in supply line.

Reduce resistance on pipe runs longer than five feet (1.5 m) by using larger inside diameter plumbing. Install a strainer in the water suction line inlet where it will be accessible for cleaning.

Sea Water Pump Check

Check the exhaust outlet to be sure the sea water pump is delivering water to the system. If the exhaust is dry, the pump may require priming. Remove the pump outlet hose from its connection opposite the pump. Fill the hose and pump with water and reconnect the hose. Once again, check the exhaust for water discharge.

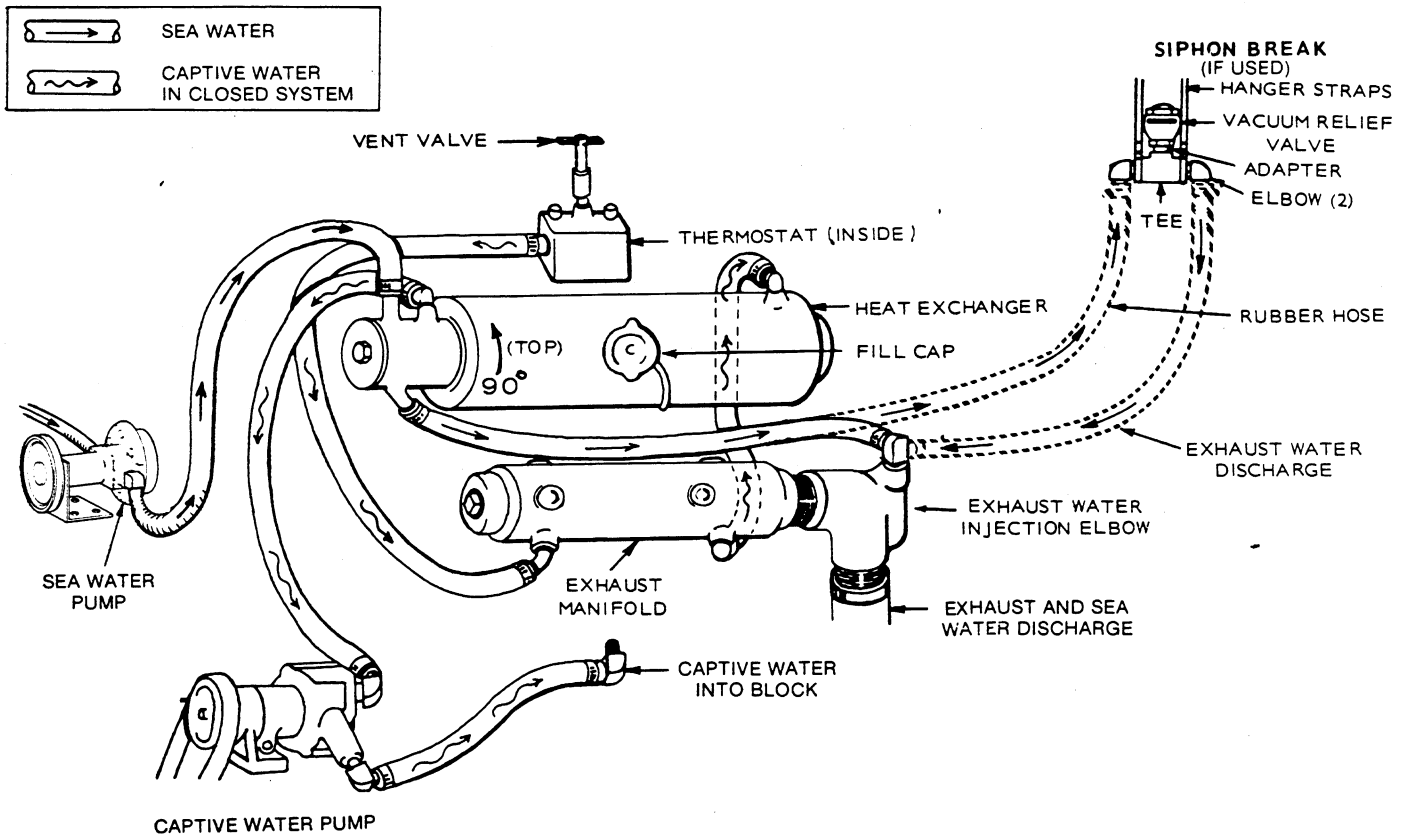


FIGURE 5. HEAT EXCHANGER PLUMBING

Heat Exchanger Cooling (Optional)

To provide engine cooling, this closed cooling system pumps captive water through the engine and exhaust manifold water jackets and into a heat exchanger. In the heat exchanger, this hot captive water is piped through a bath of sea water to cool it. The cooled captive water then returns to the captive water pump and is pumped back through the system. A second, sea water pump is used to constantly renew the sea bath in the heat exchanger and discharge the heated sea water into the exhaust line (Figure 5).

WARNING Never remove pressure cap on heat exchanger until all pressure has been carefully vented. Otherwise, serious personal injury from scalding water or steam could result.

Fill the closed cooling system with clean, alkali-free water and rust inhibitor or antifreeze. Onan recommends the use of clean ethylene glycol antifreeze solutions in closed cooling systems during normal operation and storage periods. If freezing hazards exist, an antifreeze solution strong enough to prevent freezing must be used. Test antifreeze solutions periodically following antifreeze manufac-

turer's recommendations. The heat exchanger and engine block have drain plugs for changing coolant (Figure 5 and 6). Prime and test the sea water pump before operation.

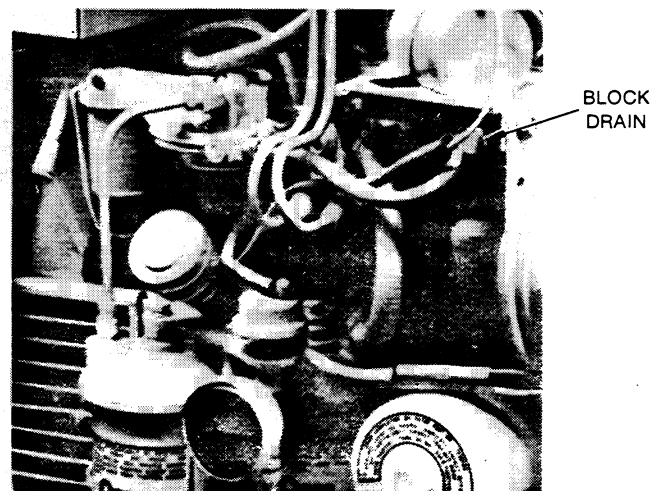


FIGURE 6. BLOCK DRAIN LOCATION

Keel Cooling (Optional)

This closed cooling system uses the same type of captive water cooling found in the heat exchanger system described above. However, rather than cooling the captive water in a heat exchanger, the water is pumped under the boat hull to a keel cooler, providing direct sea water cooling (Figure 7). A second, sea water pump supplies sea water to the exhaust for cooling.

Do not use existing neoprene impeller sea water pump for captive water side of cooling system. Heat, or soluble oil in many rust inhibitors and antifreezes, will damage the impeller. Always connect the neoprene impeller pump to the sea water side. Use a centrifugal metal impeller water pump (Onan No. 132-0074 or equal) in the captive water side. Drive it with a belt from the set power take-off.

Onan has available the necessary water pumps and other hardware for a keel cooling system. However, the keel cooler, expansion tank and plumbing must be obtained from another source. Onan recommends that a keel cooler manufacturer be consulted for help in selecting the proper keel cooler for the generator set. Onan Technical Bulletin T-021 provides further information on keel cooling requirements.

Recommendations for protecting this system are the same as those given for the heat exchanger system explained previously.

ELECTRICAL CONNECTIONS

The generator set nameplate indicates the electrical output rating and voltage code of the unit. The wiring diagram shipped with the unit provides the necessary hookup information. Have all electrical connections made by a qualified electrician or serviceman and inspected as necessary to meet electrical code requirements.

WARNING

It is extremely important for life safety that bonding and equipment grounding be properly done. All metallic parts which could become energized under abnormal conditions must be properly grounded.

Load Wires

The AC output box, located under the set control box, has knockout sections to accommodate load wires. The bolt through the bottom of the box should be used for ground connections. Use flexible multi-strand wire near the set to absorb vibration. Insulate ungrounded connections. Install circuit breakers or a fused main switch between the load and the set to prevent overload damage to the generator.

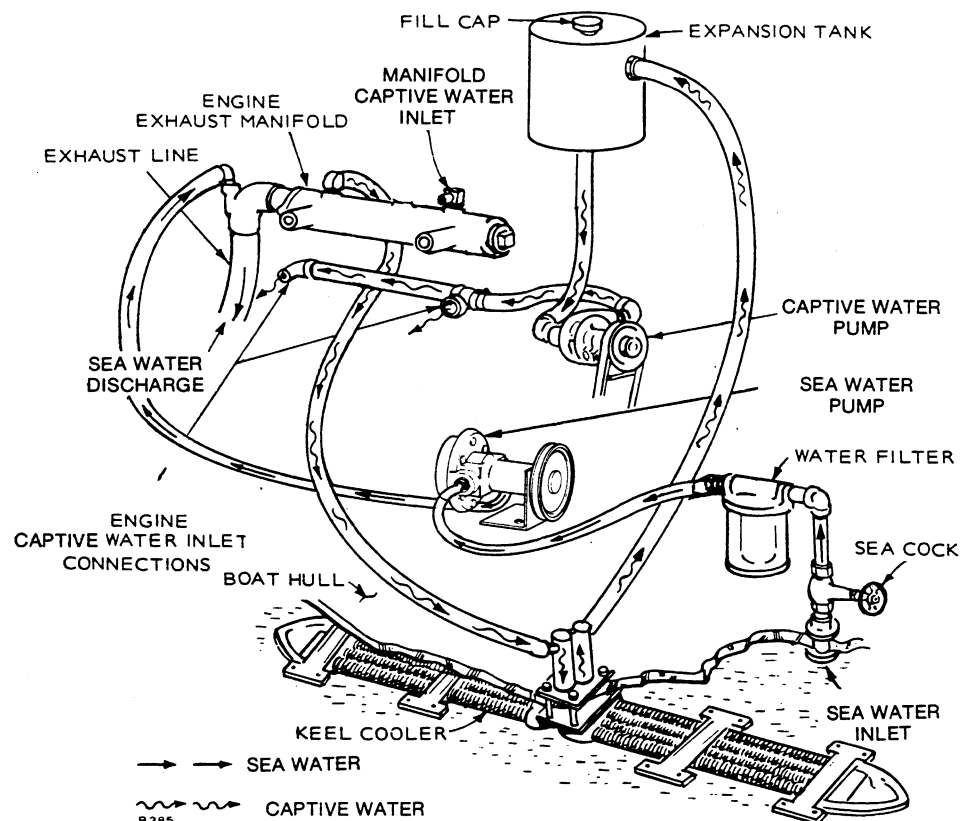


FIGURE 7. KEEL COOLING PLUMBING

The factory ships all special order sets with instruments on the control panels completely wired for the voltage code or voltage specified on the customer's purchase order. Standard sets without instruments are shipped with the T¹-T⁴ or T¹-T¹² output leads separated in the output box. These single phase and broad range generators are connectible to provide the output voltages shown in Figure 9.

Single Phase Reconnectable Generators (Code 3C, 53C): The single-phase, 60 and 50 hertz generators have output leads T¹, T², T³, and T⁴ available for making the single-phase voltage and load connections shown in Figures 8 and 9 at the installation site. Grounding procedure should comply with local codes.

When connecting for 120/240 volt, 3 wire service, be sure the load is balanced and does not exceed generator capacity. If no 240 volt load is connected, the total load capacity of the generator shall be divided evenly between each of the two 120 volt connections. If a 240 volt load is connected, deduct the 240 volt power to be used from the total power capacity of the generator. Divide the remaining power available evenly between the two 120 volt load connections.

Single/Three Phase Reconnectable Generators (Code 18, 518): The three phase, broad range, 60 and 50 hertz, 12 lead generators have output leads T¹ through T¹² available for making several single- and three-phase voltage load connections as shown in Figure 9.

Any combination of single phase and three phase loading can be used at the same time as long as total current does not exceed the generator nameplate rating and single-phase load does not exceed 2/3 three-phase rating. Divide loads equally between output leads.

CAUTION Overloading can damage generator windings.

When connecting the output leads, be sure to connect jumper W10 on the voltage regulator printed circuit board between terminal V⁴ (common) and V¹, V², or V³ as listed on the reconnection diagram. Remove the cover on the voltage regulator box, located on top of the unit control box, to gain access to the circuit board.

Switchboard

A bulkhead-mounting switchboard containing ammeters, a voltmeter, and circuit breakers is optional. When used, the following connections apply:

1. Connect one ungrounded (hot) generator lead to the unused terminal on each ammeter.
2. Connect the generator lead and load wires which are to be grounded to the ground stud on the switchboard.

3. Connect one ungrounded (hot) load wire to the unused terminal on each circuit breaker.
4. On sets that generate more than one voltage (example: 120/240), the voltmeter should be wired to indicate the higher of the two voltages.

POWER REQUIREMENTS FOR APPLIANCES

Appliance	Approximate Running Wattage
Air Conditioner.....	1400-2200
Coffee Percolator.....	550-700
Electric Blanket	50-200
Electric Frying Pan	1000-1350
Electric Iron.....	500-1200
Electric Water Heater	1000-1500
Electric Water Pump	500-600
Hair Dryer.....	350-500
Microwave Oven.....	650-1800
Radio	50-200
Refrigerator	600-1000
Space Heater.....	1000-1500
Television	200-600
Vacuum Cleaner.....	500-1500

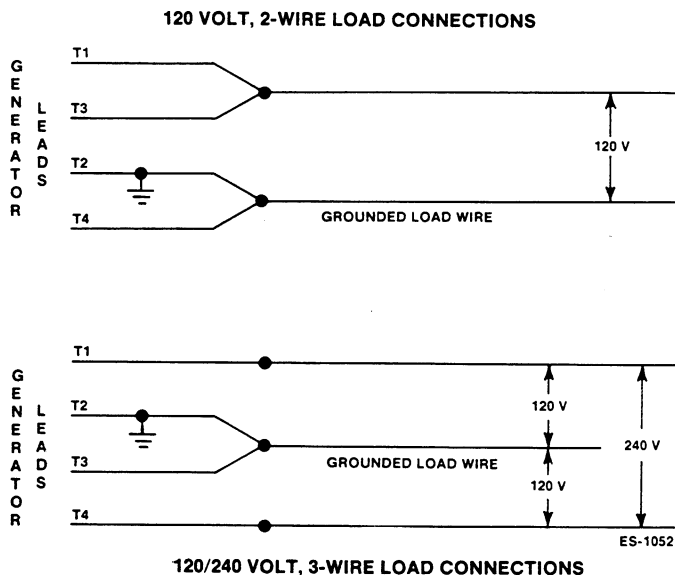


FIGURE 8. SINGLE-PHASE, "-3C" VOLTAGE CODE GENERATOR LOAD CONNECTIONS

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASE	FREQUENCY	CONNECT W10 JUMPER WIRE FROM V4 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	LOAD TO GENERATOR CONNECTION WIRING DIAGRAM
3C	120/240	1	60	V1			
53C	120/240	1	50	V3			
	115/230	1	50	V2			
	110/220	1	50	V1			
18	120/208	3	60	V1	PARALLEL WYE		
	127/220	3	60	V2			
	139/240	3	60	V4			
518	110/190	3	50	V1			
	115/200	3	50	V2	SERIES WYE		
	120/208	3	50	V3			
	127/220	3	50	V4			
18	240/416	3	60	V1			
	254/440	3	60	V2	SERIES WYE		
	277/480	3	60	V4			
518	220/380	3	50	V1			
	230/400	3	50	V2			
	240/416	3	50	V3	SERIES WYE		
	254/440	3	50	V4			
18	120/240	3	60	V1	SERIES DELTA		
518	110/220	3	50	V1			
	115/230	3	50	V2			
	120/240	3	50	V3			
18	120/240	1	60	V1	DOUBLE DELTA		
518	110/220	1	50	V1			
	115/230	1	50	V2			
	120/240	1	50	V3			
18	120	1	60	V1	PARALLEL DELTA		
518	110	1	50	V1			
	115	1	50	V2			
	120	1	50	V3			

FIGURE 9. GENERATOR WIRING AND CONNECTION DIAGRAMS

Dockside Power Connection

If the installation connects to shore power, install a double-throw transfer switch (either manual or automatic type), such as Onan No.'s 308-0269, 2-pole; 308-0270, 3-pole; to prevent commercial power and generator output from being connected to the load at the same time. Instructions for connecting an automatic load transfer switch are included with such equipment. See Figure 10.

REMOTE START-STOP SWITCH (Optional)

For remote control starting and stopping, use three wires to connect the remote switch (single-pole, double-throw, momentary contact, center-off type) to the terminal block marked B+, 1, 2, and 3 in the set control box using wire sizes as listed in Figure 11. A preheat circuit requires an extra wire to terminal H and momentary contact switch (SPST) connection. Remove jumper between terminals 3 and H before installing remote wiring.

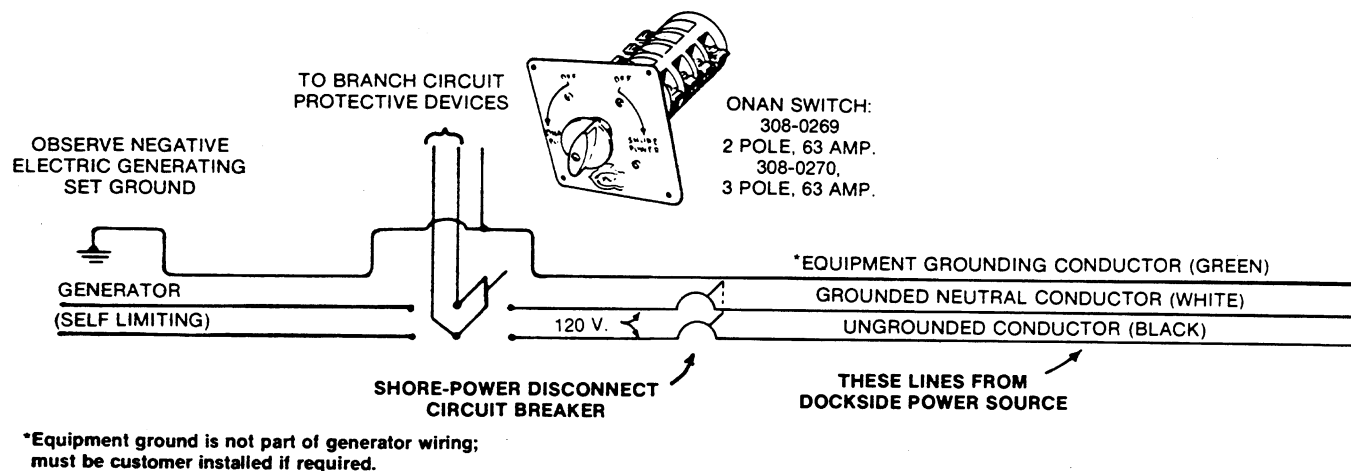


FIGURE 10. SHORE POWER WIRING CONNECTIONS

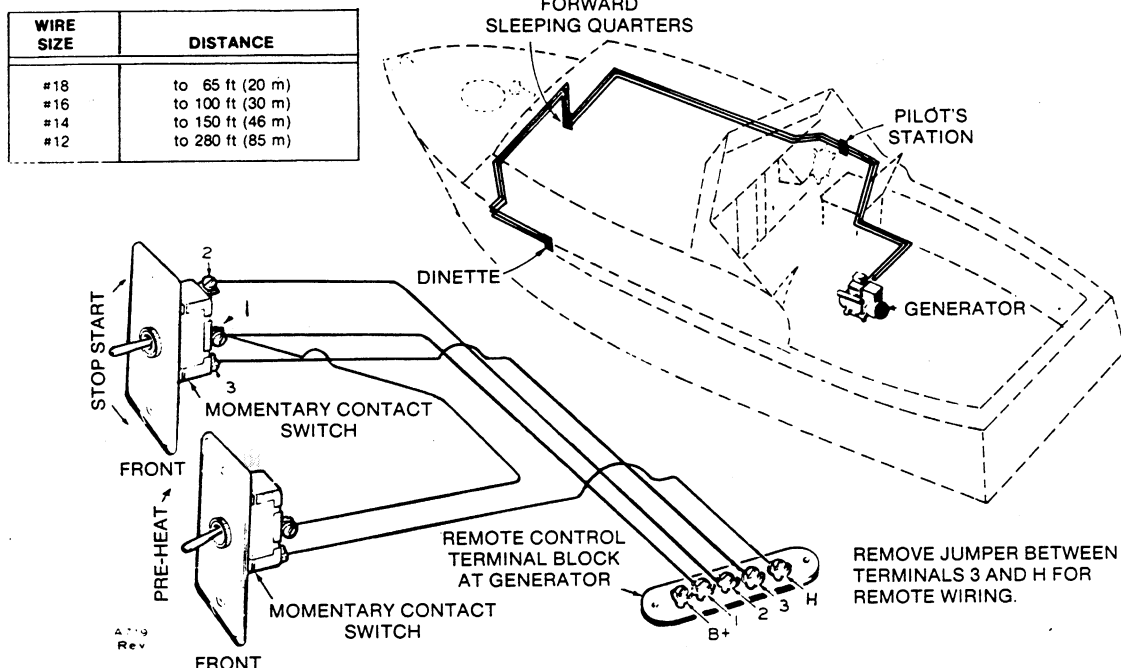
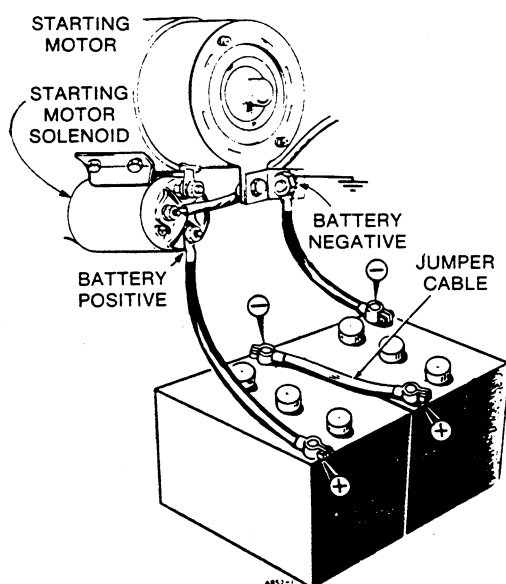


FIGURE 11. REMOTE CONTROL

BATTERY CONNECTIONS

Connect the two, six-volt batteries in series for negative (-) ground only. See Figure 12. Be sure all battery connections are secure. Coat the terminal connections with petroleum grease to retard corrosion.

CAUTION If battery polarity is wrong, damage will occur within 3 minutes while stopped or 5 seconds while running. Generator windings will be damaged almost instantly if battery charging circuit is shorted between resistor R21 and the B1 end of the charging winding.



The generator set and propulsion engine must be grounded in accordance with the ABYC standard. The standard requires a common conductor connected between the generator set and propulsion engine grounded cranking motor circuits. See Figure 12. The conductor prevents accidental passage of cranking current through fuel systems and smaller electrical conductors common to the engines. The conductor must be the same size as the largest battery cable.

WARNING Without the common conductor, the cranking current could melt fuel lines or burn up conductors if a cranking motor ground circuit opens from corrosion, vibration, etc. Both hazards could lead to fire and explosion accidents.

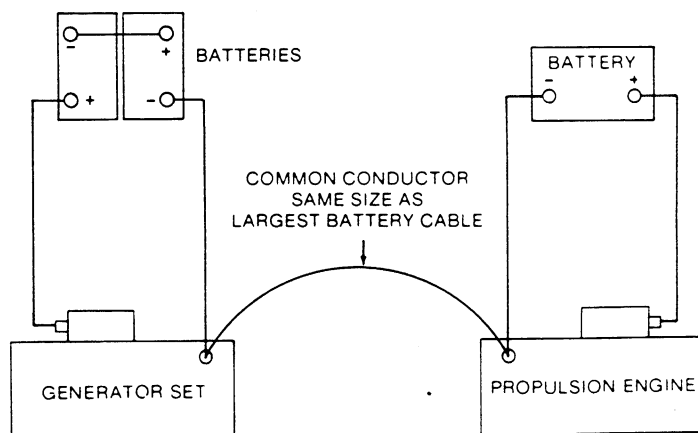


FIGURE 12. BATTERY CONNECTIONS

OPERATION

WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

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

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

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

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

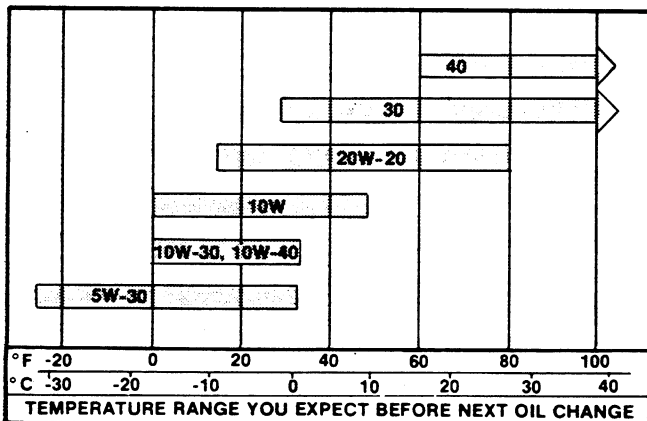
PRE-STARTING

Preparations for operation should include checks of the oil, fuel, cooling, and electrical systems. Before the generator set is put in operation, check all components for mechanical security. If an abnormal condition, defective part, or operating difficulty is detected, repair or service as required. The generator set should be kept free of dust, dirt, and spilled oil or fuel.

Crankcase Oil

Use an oil with the API designation CD/SE. However, to reduce oil consumption to a normal level in the shortest time possible on a new or rebuilt engine, use CC/SE oil for the first fill only (50 hours). Then use the recommended oil only. Select the correct SAE grade oil by referring to the following:

USE THESE SAE VISCOSITY GRADES



Multigrade oils are recommended for temperatures 32°F (0°C) and below, but they are not recommended for temperatures above 32°F (0°C). When adding oil between oil changes, it is preferable to use the same brand as various brands of oil may not be compatible when mixed together.

The *PERIODIC MAINTENANCE* section shows location of the oil fill, oil drain, and oil filter. Do not overfill crankcase!

WARNING

Never check oil with the engine running. Hot oil discharged from the engine could cause personal injury.

Recommended Fuel

Use ASTM 2-D or 1-D fuel with a minimum Cetane number of 45. Number 2 diesel fuel gives the best economy for most operating conditions; however, use ASTM 1-D fuel during the following conditions:

1. When ambient temperatures are below 32°F (0°C);
2. During long periods of light engine load; or no load.

Use low sulfur content fuel having a pour point (ability to filter) of at least 10°F (-12°C) below the lowest expected temperature. Keep the fuel clean and protected from adverse weather. Leave some room for expansion when filling the fuel tank.

CAUTION

Due to the precise tolerances of diesel injection systems, it is extremely important the fuel be kept clean. Dirt in the system can cause severe damage to both the injection pump and the injection nozzles.

Fuel System

Check for an adequate fuel supply and bleed any air from the lines as follows. Disconnect the fuel return line (Figure 13). Operate the hand priming lever on fuel transfer pump until there are no air bubbles in fuel flowing from the fuel return line fitting. Then connect the fuel return line.

If fuel tank is disconnected, use a separate container of fuel and connect a short hose line between the transfer pump inlet and the fuel container. The pump has enough lift (6 feet [1.8 m]) to pull the fuel out of the container.

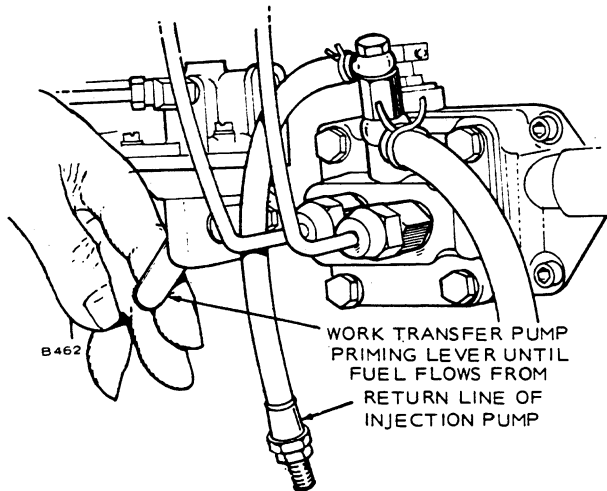


FIGURE 13. BLEEDING THE FUEL SYSTEM

Cooling System

Before operation, the optional captive water system must be filled. At the time of initial operation, check the exhaust outlet to be sure the sea water pump is functioning properly. See the Cooling System portion of Installation and Periodic Maintenance sections of this manual.

Controls

Before operation, become familiar with the various generator set controls and instruments. The standard control box has a battery charge rate ammeter, pre-heat switch, a start-stop switch, a fuse and field circuit breaker on the control panel, Figure 14. Optional controls that may be added on the standard panel include a fault lamp and a voltage adjust control.

The control panel fuse protects external wiring of remote instruments connected to the B+ terminal, and some DC circuits inside the control box. If the fuse blows, the set will stop. The cranking circuit will still work, but the engine cannot reach operating rpm. Determine cause of fuse failure and replace with same size and type.

Some of the following components on the control may vary according to the customer purchase order.

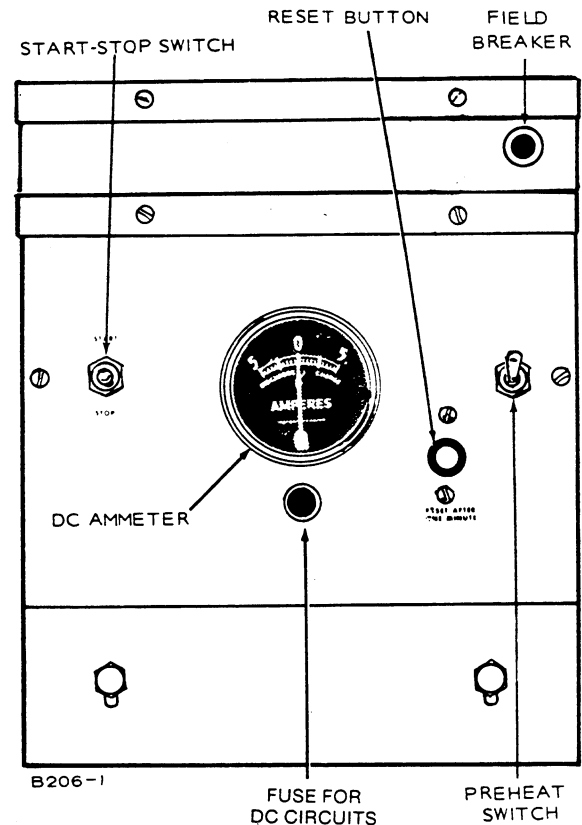


FIGURE 14. TYPICAL MARINE SET CONTROL PANEL

Start-Stop Switch: Starts and stops the unit locally.

Battery Charge Rate DC Ammeter: Indicates the battery charging current.

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

Pre-Heater Switch: Provides pre-heat control for manifold heater and glow plugs for cold diesel engine starting.

Reset Buttons: If the control has a reset button, push it to reset after a shutdown resulting from low oil pressure or engine overspeed. Find the cause before restarting the engine. If continuous false starting occurs, make sure the start-disconnect centrifugal switch closes during speed build-up.

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

ONAN DIESEL STARTING GUIDE

IMPORTANT!

KEEP ENTIRE FUEL SYSTEM CLEAN AND FREE FROM WATER

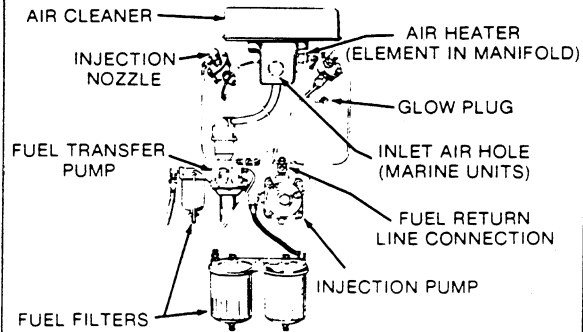
- DIESEL INJECTION PUMPS WILL FAIL IF SYSTEM CLEANLINESS IS NEGLECTED

INJECTION PUMPS AND NOZZLES ARE NOT FIELD REPAIRABLE

- WHEN TROUBLESHOOTING, CHECK ALL OTHER COMPONENTS FIRST

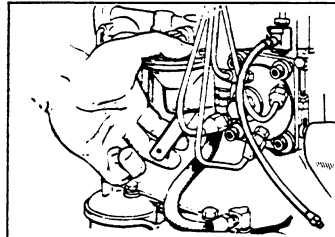
WARNING

DO NOT USE ETHER STARTING AIDS! ETHER IS EXTREMELY EXPLOSIVE AND MAY CAUSE SERIOUS PERSONAL INJURY. ENGINE DAMAGE IS ALSO LIKELY.



BEFORE STARTING:

CHECK FUEL SUPPLY. BE SURE SHUTOFF VALVES ARE OPEN.



PRIME FUEL SYSTEM IF: FUEL FILTERS WERE DRAINED OR CHANGED, SYSTEM WAS JUST INSTALLED, FUEL TANK RAN DRY.



TO PRIME PUMP, MOVE PRIMING LEVER UP AND DOWN UNTIL FUEL FLOWS STEADILY FROM RETURN LINE (DISCONNECTED).



PREHEAT COLD ENGINE: PUSH PREHEAT SWITCH AND HOLD —

- 30 SECONDS IF ABOVE 55° F (13° C);
- 60 SECONDS IF BELOW 55° F (13° C).

TO START:



RELEASE PREHEAT



ENGAGE START SWITCH

LIMIT CRANKING TO 15 TO 20 SECONDS TO CONSERVE BATTERY. ALLOW 1 MINUTE BEFORE RE-CRANKING.

IF ENGINE DOES NOT START:

IF ENGINE FIRED, REPEAT ABOVE PROCEDURES, INCLUDING PRE-HEAT. IF IT STILL DOES NOT START, PROCEED AS FOLLOWS:

TEMPERATURES BELOW 32° F (0° C):

USE NUMBER 1 DIESEL FUEL. USE CORRECT VISCOSITY OIL. KEEP BATTERIES FULLY CHARGED. DO NOT USE ETHER STARTING AID.



OBSERVE ENGINE EXHAUST "SIGNALS":

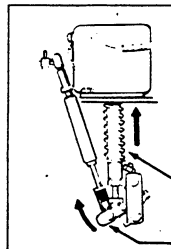
BLUE-WHITE EXHAUST SMOKE:
ENGINE IS GETTING FUEL

LITTLE OR NO EXHAUST SMOKE: ENGINE IS NOT GETTING FUEL.
PRIME FUEL SYSTEM AS SHOWN ABOVE:
OBSERVE FUEL FLOW FROM RETURN LINE

CHECK PREHEAT SYSTEM:

1. OBSERVE AIR HEATER THRU AIR INLET HOLE OR BY REMOVING AIR CLEANER.
2. ENGAGE PREHEAT.
3. IF HEATER ELEMENT DOES NOT GLOW RED WITHIN 30 SECONDS, CHECK AIR HEATER AND GLOW PLUG WIRING:
 - CONNECTIONS TIGHT?
 - FREE FROM CORROSION?

FUEL FLOWS STEADILY



SOLENOID ROD
THROTTLE ARM

CHECK FUEL SOLENOID:
SOLENOID ROD SHOULD PULL IN AND THROTTLE ARM FOLLOW (AS SHOWN) WHEN START SWITCH IS TURNED ON. IF NOT, CHECK FOR

- BINDING LINKAGE
- LOOSE OR BROKEN WIRES

LITTLE OR NO FUEL FLOW

CHECK FUEL SUPPLY SYSTEM:

- FUEL TANK EMPTY?
- SHUTOFF VALVES CLOSED?
- FUEL LINES KINKED?
- LOOSE CONNECTIONS?
- CLOGGED FUEL FILTERS?

IF ENGINE IS STILL NOT GETTING FUEL, CHECK TRANSFER PUMP:
1. CRANK ENGINE AND OBSERVE FUEL FLOW FROM RETURN LINE.
2. IF FUEL DOES NOT SPURT OUT, PUMP MAY BE DEFECTIVE.

IF ENGINE STILL DOES NOT START, CONTACT AUTHORIZED ONAN SERVICE REPRESENTATIVE

STARTING

Starting instructions are provided in the Diesel Starting Guide on page 14. The following information should also be noted:

1. In extremely cold weather, it may be necessary to re-engage the PREHEAT switch after the engine starts to obtain smooth firing of both engine cylinders.
2. Oil pressure should read at least 20 PSI when the engine is running. (The engine pressure relief valve is not adjustable.)

WARNING

Always operate bilge blower for 5 minutes after refueling or anytime prior to starting engines or generator set. The blower removes vapors which have explosive potential.

CAUTION

Do not exceed the 1 minute preheat time when the engine is not running or being cranked. Overheating due to a lack of air flow can cause failure of the manifold heater or glow plugs.

CAUTION

Do not apply overvoltage to the starting circuit at any time. Overvoltage will destroy the glow plugs and air heater in two to three seconds. If it becomes necessary to use an additional source of power to start the unit—use a 12-volt battery connected in parallel with the starting batteries.

STOPPING

1. Push start-stop switch to STOP position.
2. Release switch when set stops. If stop circuit fails, close fuel valve.

AUTOMATIC STARTING AND STOPPING

You can use separate controls for automatic starting and stopping, but they must provide engine preheating. An Onan automatic demand control can incorporate time delay relays to preheat glow plugs and the manifold heater for about 20 seconds before cranking occurs. The relays prevent immediate engagement of the starter in case the load is reapplied before the engine stops.

SAFETY DEVICES

In case of dangerously high coolant (water) temperature or low oil pressure, a cut-off switch stops the unit. After an emergency stop, investigate and correct the cause. Press reset button before restarting.

BREAK-IN PROCEDURE

For a reconditioned unit, use the following break-in procedure at the indicated approximate loads.

1. One half hour at 1/2 load.
2. One half hour at 3/4 load.
3. Full load for several hours, if possible. New units have already been run under load at the factory.

Continuous running with less than one-half load during the first few hundred hours usually results in poor piston ring seating, causing higher than normal oil consumption and blowby.

Drain and replace the crankcase oil and oil filter after initial 50 hours of operation; drain while the engine is still hot.

APPLYING LOAD

If practical, allow the generator set to warm up before connecting a heavy load. Continuous generator overloading can cause high operating temperatures which can damage the windings. The generator can handle an overload temporarily, but for normal operation, keep the load within nameplate rating. The exhaust system might form carbon deposits during operation at light loads; apply full load occasionally before shutdown to prevent excessive accumulations.

PERIODIC EXERCISE

Infrequent use results in hard starting. Operate the generator set at least 30 minutes each week, with load if possible (longer if battery needs charging).

HIGH TEMPERATURE CONDITIONS

1. See that nothing obstructs airflow to and from the generator set.
2. Keep cooling system clean. Check water level frequently on closed cooling system applications.

LOW TEMPERATURE CONDITIONS

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh fuel and protect against moisture condensation.
3. Keep fuel system clean, and batteries in a full-charged condition.
4. Protect closed cooling systems with antifreeze to prevent freezing.

DUSTY AND DIRTY CONDITIONS

1. Keep the generator set clean. Keep cooling system clean.
2. Change crankcase oil every 50 operating hours.
3. Keep oil and fuel in dust-tight containers.
4. Keep governor linkage clean.

OUT-OF-SERVICE PROTECTION

For a generator set out of service (or in storage), protect it by using the following procedure:

1. Start and run the generator set until it is thoroughly warm.
2. Shut down the engine.
3. Disconnect the starting batteries and follow standard battery storage procedures.



CAUTION When batteries are in storage, maintain liquid level and use a trickle charger to maintain specific gravity. Otherwise, severe damage can occur to the batteries if exposed to freezing temperatures.

4. Drain the oil from the oil base while the engine is still warm. Refill the oil base with clean oil and attach tag stating the oil used.
5. Freezing temperatures require cooling system protection. A heat exchanger or keel cooling system should be protected with a 50-50 ethylene glycol and water mixture.
The sea water system can easily be protected by filling with the same 50-50 mixture. Close sea cock and remove the sea water inlet hose at filter (Figure 1). Place end of hose in bucket of anti-freeze mixture and run engine until mixture is observed coming out of exhaust outlet. Replace inlet hose. Ensure sea cock is opened before operation is resumed.
6. Remove the flexible section of the exhaust line and plug the engine exhaust outlet to prevent entrance of moisture and dirt. Attach a warning tag to exhaust line noting exhaust line is plugged.
7. Check the fuel sediment bowl for water and dirt. Clean if necessary.
8. Check the fuel filters for presence of water as shown in the *PERIODIC MAINTENANCE* section.
9. Clean the throttle and governor linkage. Protect by wrapping with a clean cloth.
10. Clean and wipe the entire unit. Coat parts susceptible to rust with a light coat of oil or grease.

Returning Unit to Operation

1. Remove any dust and dirt from the generator set.
2. Check condition of the fuel line connections and fuel supply tank and fill with fresh fuel.
3. Check the tag stating oil type and weight. If not correct, drain and refill with correct oil. Be sure oil is up to "FULL" mark on dipstick.
4. Check coolant level and antifreeze protection on captive water systems. Prime the sea water pump and, when engine is running, be sure the suction line is air tight by checking for air bubbles in the discharge water.

5. Remove the material used to plug the exhaust outlet and reconnect the exhaust line. Check the complete exhaust system for tight connections and condition of muffler, exhaust line, etc.

WARNING

Be sure to connect the exhaust line and make sure the exhaust system is fit for operation and will not leak. Exhaust gases are deadly.

6. Check the entire generator set for water, fuel, or oil leaks. Correct as required.
7. Check wiring system for worn wires, loose connections, etc. Remedy as required.
8. Install the fully-charged batteries and connect to the generator set. Observe correct polarity.
9. Start the generator set, connect a load, and observe general operation.
10. Remove load and stop the generator set.

Draining the Cooling System

To drain the cooling system, follow the procedures outlined below. Refer to Figures 5 and 7 for identification of components.

Generator sets equipped with closed-type cooling systems (heat exchanger or keel cooling) should be filled with ethylene glycol antifreeze and water mixture even if freezing temperatures are not expected. The antifreeze helps exchange heat, lubes the pump and helps prevent corrosion. Drain only those components in the sea water system not protected from freezing, or protect with antifreeze as suggested in Step 5 of Out-Of-Service Protection.

In normal operation, there is relatively little water in the Aqualift muffler. It does not have to be drained because freezing temperatures will not damage it.

1. Flush out cooling system until water runs clear.
2. Open the vent valve or vent plugs on the thermostat housing.
3. Drain the engine block by removing the 1/4-inch drain plug on the left front side of the engine (Figure 6).
4. Drain the exhaust manifold by removing the drain plug located on the bottom of the unit.
5. Drain the water pump by loosening the cover and hose connections.
6. Disconnect hoses and hose clamps to aid in draining.
7. When all water drains out, reconnect hoses, reinstall drain plugs, and close vent valve or plugs.

PERIODIC MAINTENANCE

GENERAL

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The schedule shown in Table 1 can be used as a guide. However, actual operating conditions under which the unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check the condition of the crankcase oil, the filters, etc., frequently until the proper service time periods can be established.

Adjust valve clearance after the first 50 hours of operation on a new or overhauled engine.

WARNING

Before performing any maintenance work on the engine, generator, control panel, automatic demand control or associated wiring, disconnect batteries. Failure to do so could result in damage to the unit or serious personal injury from electric shock or inadvertent starting.

A periodic visual inspection should be made by the operator with the set running at rated load. This inspection should include:

1. Checking all fuel, oil and cooling system components for leakage.
2. Visually and audibly inspecting exhaust lines and mufflers for possible leakage and cracks.
3. Inspecting electrical wires and connections for possible arcing, fray damage or interference with moving parts.

TABLE 1. OPERATOR AND SERVICE MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS						
	8	50	100	200	500	600	3000
Inspect Marine Set	x4						
Check Fuel Level	x						
Check Oil Level	x						
Check Coolant Level on Closed Systems		x1					
Clean Governor Linkage		x					
Drain Fuel Condensation Traps		x					
Empty Fuel Sediment Bowl		x					
Check Zinc Pencil on Heat Exch. Models			x2				
Change Crankcase Oil			x				
Replace Oil Filter				x			
Check Battery Electrolyte Level				x			
Check Water Pump Belt and Tension				x			
Check Start-Disconnect Switch Points					x		
Replace Primary Fuel Filter						x	
Check Valve Clearances					x3		
Replace Secondary Fuel Filter							x
Clean Generator							x
Inspect Valves, Grind if Necessary							x

x1 - Replace antifreeze once a year.

x2 - Or every 2 months, whichever occurs first.

x3 - Contact your local Onan dealer for servicing.

x4 - Give unit general inspection. Then with generator set running, visually and audibly check the exhaust system for leaks.

WARNING

All exhaust system connections MUST be checked regularly for any leaks and tightened as necessary. Do NOT terminate exhaust pipe near any window or bulkhead (door) openings. Do NOT use the air cleaner/flame arrester as a supporting step. Always operate bilge blower for 5 minutes after refueling or any time prior to starting engines or generator set.

If generator requires major repair or servicing, contact an authorized Onan dealer or distributor.

FUEL SYSTEM

Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean. Dirt or water in the system can cause severe damage to both the injection pump and nozzles.

If daily inspection shows water or excessive dirt in the sediment bowl on the fuel pump, fuel handling and storing facilities should be checked and the situation corrected. If a serious fuel contamination problem exists, the primary and secondary fuel filters must be replaced following correction of the problem.

Fuel Pump Sediment Bowl

Every 50 hours, remove the sediment bowl from the fuel transfer pump and filter body (Figure 15). Clean out any water or particulate from the bowl and screen. When re-installing the sediment bowl, make sure the screen and gasket are in place.

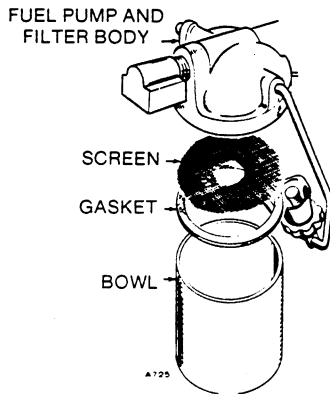


FIGURE 15. FUEL PUMP SEDIMENT BOWL

Fuel Filters

Every 50 hours, open the drains on the bottom of the fuel filter assembly (Figure 16) and allow any water to escape. The drain plug on the fuel filter can tolerate only a limited amount of torque. Use two wrenches in combination for breaking the plug loose and for final tightening.

Every 600 hours, change the primary fuel filter by removing the washer and capscrew on top of the fuel filter body. Every 3000 hours, change the secondary fuel filter in the same manner as the primary fuel filter.

OIL SYSTEM

The oil capacity of the engine is 3 U.S. quarts (2.8 lit) plus an additional 1/2 quart (0.47 lit) residing in the oil filter. After filling the crankcase, be sure the oil reaches, or is just below, the full mark on the oil level indicator (Figure 17). Check the oil level after each operation and change oil every 100 operating hours or three months, whichever occurs first. If the unit is

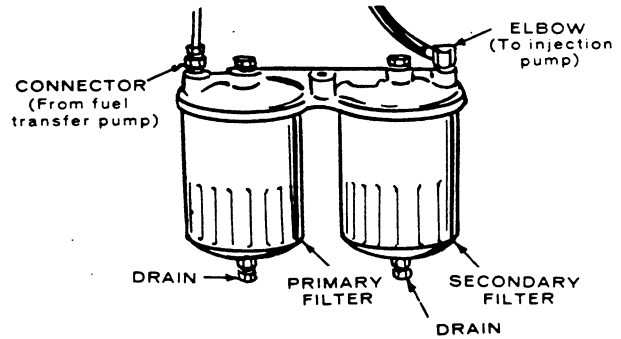
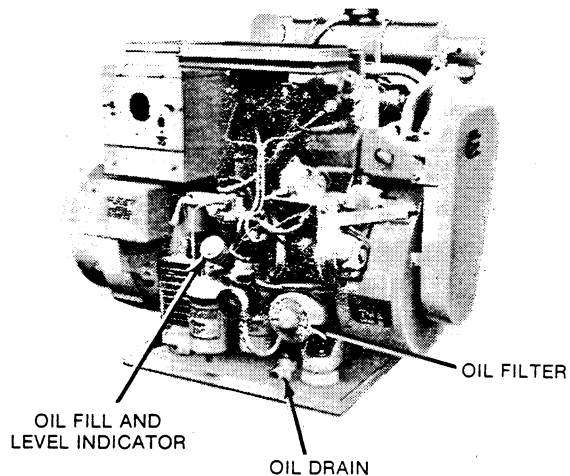


FIGURE 16. DUAL FUEL FILTERS

being operated in an abnormally dirty or dusty environment, change the oil every 50 hours of engine operation.

Oil Filter

Change the oil filter every 200 operating hours. Remove the filter by turning counterclockwise with an oil filter wrench. Spread a drop of clean oil around the gasket of the new filter. Install the filter finger-tight plus 1/4 turn.



WARNING Never remove oil level indicator cap with the engine running, because oil can blow out of the tube causing possible injury.

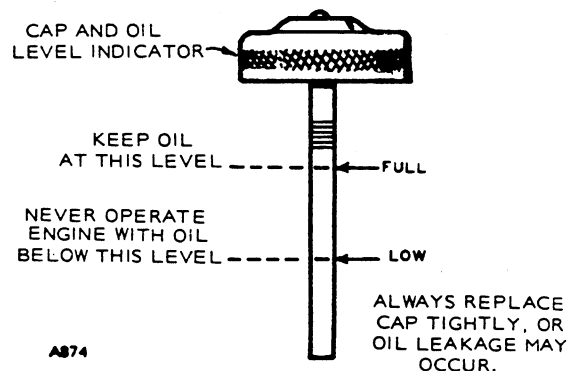


FIGURE 17. LOCATION OF OIL FILL, OIL DRAIN, AND OIL FILTER

Crankcase Breather

This unit is equipped with a ball check valve for maintaining crankcase vacuum. The only maintenance required is to clean the components periodically. Remove the hose clamp, breather hose and breather cap clamp to release the breather cap and valve assembly. Wash the cap, valve assembly and filter in a suitable solvent and reinstall, Figure 18.

Do not disassemble the cap and four-ball valve assembly; the ball travel clearance is critical and must not be changed.

WARNING

Use extreme care when cleaning with a petroleum-base solvent due to fire hazard.

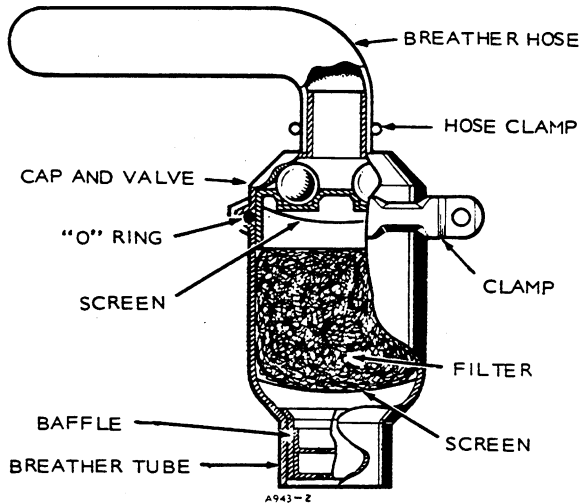


FIGURE 18. CRANKCASE BREATHER

COOLING SYSTEM

The cooling system works efficiently only when it is clean. Scale and rust in the cooling system slows heat absorption and restricts water flow. Clean and flush the system at least once a year and more often if operation indicates clogged passages or overheating. Clean the cooling system with a dependable cleaning compound and follow the procedure recommended by the supplier.

Antifreeze

Onan recommends the use of clean ethylene glycol antifreeze solutions in closed cooling systems during normal operation and storage periods. Be sure antifreeze solution will protect the cooling system during the coldest winter weather.

Most antifreeze manufacturers recommend a 50-50 mix of ethylene glycol antifreeze and water for winter and summer in closed water systems with a complete change every year to avoid corrosion and more expensive 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. Pressure caps should be replaced every two years or whenever they malfunction.

Heat Exchanger Filling

Units equipped with a heat exchanger have a fill vent valve installed on top of the thermostat housing to bleed off air that may be trapped in the system. To eliminate air from the system, the following procedure should be followed whenever adding coolant to the heat exchanger:

1. Remove pressure cap from heat exchanger.
2. Open the fill vent valve (Figure 19).
3. Add coolant through pressure cap opening until coolant starts to flow out top of fill vent valve.
4. Close fill vent valve.
5. Fill heat exchanger to top and replace pressure cap.
6. Operate unit for 10 minutes at full load, watching for leaks.
7. Shut down unit and allow to cool.
8. After the unit has cooled down, SLOWLY turn fill cap until pressure escapes.
9. Remove fill cap and add coolant as necessary until system is full to top.

WARNING

Never remove pressure cap on heat exchanger until all pressure has been carefully vented. Otherwise, serious personal injury from scalding water or steam could result.

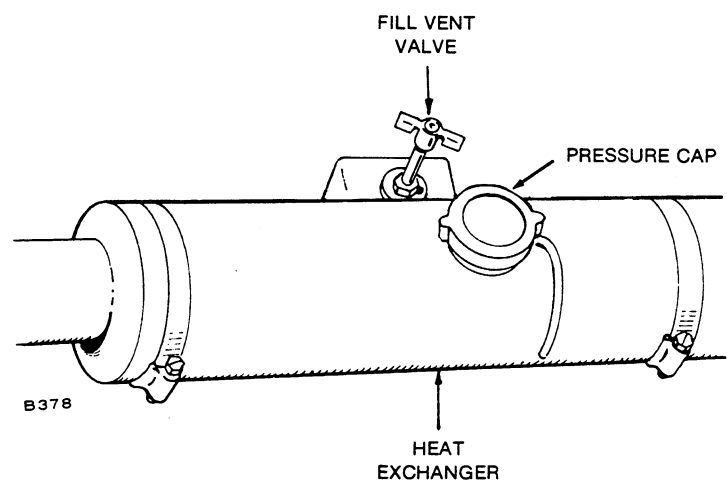


FIGURE 19. FILLING HEAT EXCHANGER

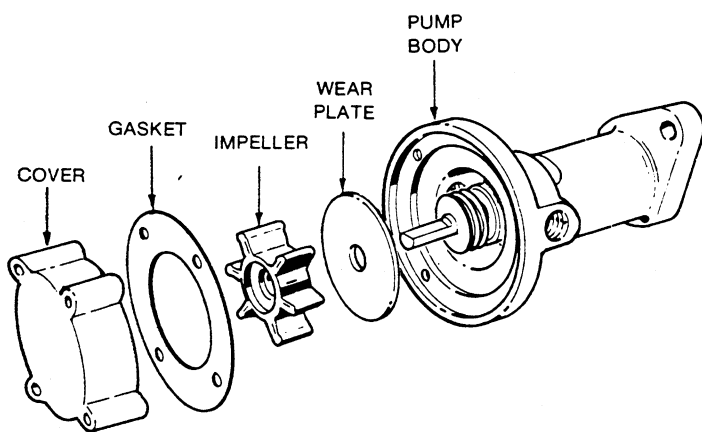


FIGURE 20. SEA WATER PUMP

Sea Water Pump Impeller

Improper functioning of the sea water pump is usually caused by failure of the neoprene impeller. Because of continuous flexing, the impeller deteriorates with time and must be replaced. If, however, the impeller fails after short service, check for possible defects in the pump or the system (Figure 20).

Remove the cover of the water pump and check for pock marks on the end surfaces of the impeller. Pock marks are a sign of air in the cooling system, which reduces pump lubrication and causes overheating. Replace the impeller if such conditions exist and seal off all air leaks. When re-installing the pump cover, coat the inside with grease to insure proper pump lubrication during initial operation. Make sure the cover is installed airtight and torque the screws to 15 to 17 inch-pounds (1.70 to 1.92 N•m).

Water Pump Belt

Improper belt tension will result in a slipping or broken belt. This in turn will result in overheating of the engine caused by reduced coolant flow.

To adjust the tension, loosen the pump mounting bolts (on systems with two pumps, loosen pump nearest heat exchanger) and slide pump along bolt slots. A force of 15 pounds (67 N) applied between the pump pulley and the engine pulley should deflect the belt about 1/2 inch (13 mm). Be sure to tighten mounting bolts when tension is correct.

If the belt is frayed, cracked or glazed, it should be replaced.

Thermostat

The temperature of the cooling system is thermostatically controlled. The thermostat mounts on the cylinder head and is housed in a thermostat cover (Figure 21). Replace the thermostat if corroded, damaged or opening improperly. Check the opening of the thermostat by immersing it in a bath of water and heating the water. The thermostat should just start to open around 145°F (63°C) on sea water cooled systems and around 180°F (82°C) on heat exchanger and keel cooling systems.

High Temperature Cut-Off Switch

This normally closed switch, mounted on the rear of the cylinder head, senses coolant temperature in the engine cooling jacket. When engine temperature rises beyond a specific point, the switch opens, closing the fuel solenoid and cutting off fuel to the engine. When coolant temperature lowers to a safe operating range, the switch closes, permitting engine restarting. If high temperature shutdown occurs, check the water pump impeller and the thermostat.

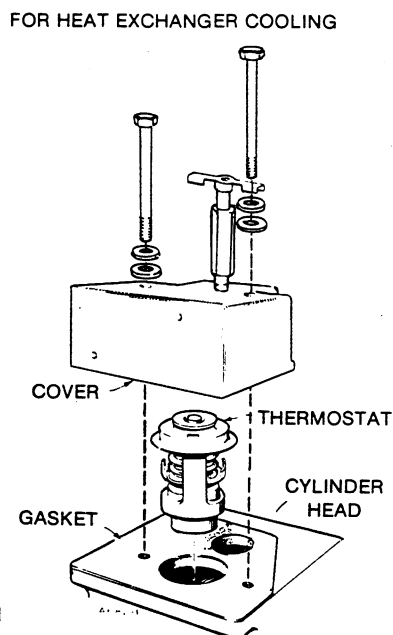
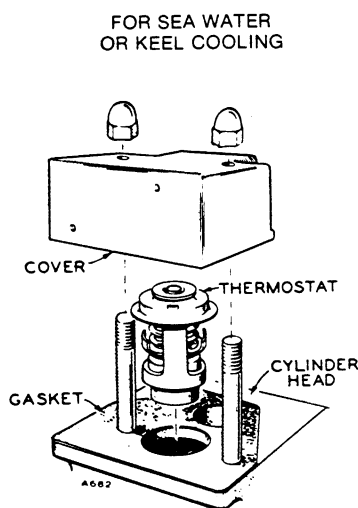


FIGURE 21. THERMOSTAT LOCATION

Zinc Pencil

The sea water side of the heat exchanger, where used, is protected from corrosion by a zinc pencil mounted on a pipe plug. It is located close to the sea water inlet connection on the end of the heat exchanger (Figure 22). The pencil should be inspected at least every two months and replaced if deteriorated to less than 1/2 inch (13 mm). The zinc pencil replacement part number is 130-1340.

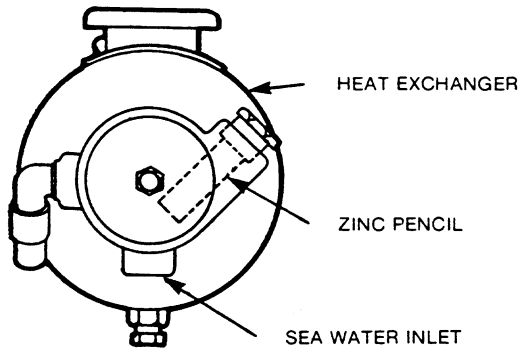


FIGURE 22. ZINC PENCIL LOCATION

AC GENERATOR

Periodic inspections that coincide with engine oil changes will ensure good performance. When inspecting the rotating rectifier assembly (Figure 23), make sure diodes are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure.

BATTERIES

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of nonconductive grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water. Check specific gravity; recharge if below 1.260 at 77° F (25° C).

WARNING

Do not smoke while servicing batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.

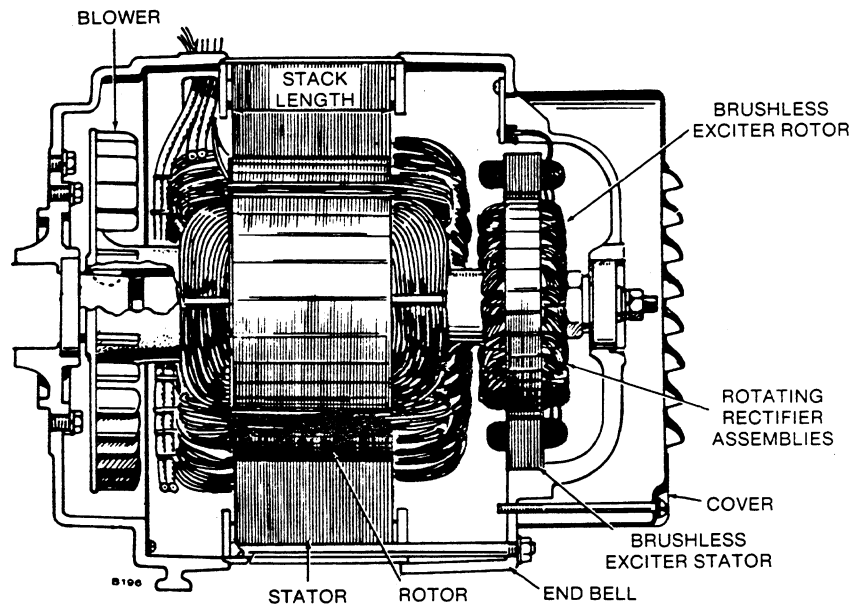


FIGURE 23. GENERATOR (CUTAWAY VIEW)

ADJUSTMENTS

CENTRIFUGAL SWITCH

The start-disconnect centrifugal switch, located on the gear cover near the oil filter, automatically de-energizes the starter as engine speed reaches 900 rpm. With the engine stopped and the battery disconnected, adjust the point gap to .020 inch (0.51 mm). See Figure 24. Replace burned or faulty points.

Using a socket wrench on flywheel retaining screw, rotate engine crankshaft a few degrees clockwise before adjusting points.

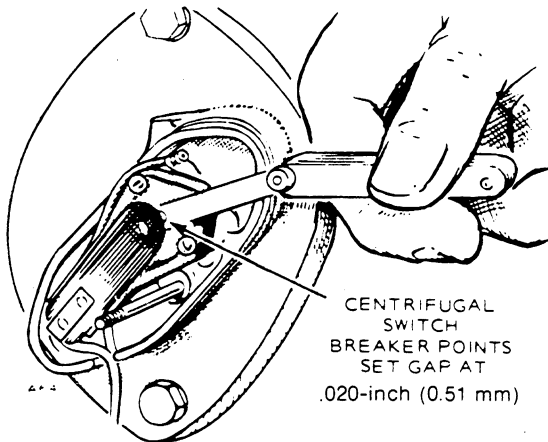


FIGURE 24. CENTRIFUGAL SWITCH

GOVERNOR

The governor controls engine speed. Rated speed and voltage appear on the nameplate. Preferred speed does not vary more than 3 hertz from no-load to full-load operation. Be sure throttle, linkage, and governor mechanism operate smoothly.

Speed Adjustment

To change the governor speed, change the spring tension by turning the governor spring nut (Figure 25). Turn the nut clockwise (more spring tension) to increase rpm and counterclockwise to reduce governed speed. Hold a tachometer against flywheel cap screw.

Sensitivity Adjustment

To adjust governor sensitivity (no load to full load speed drop), turn the sensitivity adjusting ratchet counterclockwise for more sensitivity (less speed drop when load is applied) or clockwise for less sensitivity (more speed drop). If the governor is too sensitive, a rapid hunting condition occurs (alternate increasing and decreasing speed). Adjust for maximum sensitivity without hunting. After sensitivity adjustment, the speed will require readjustment. Be sure to secure the speed stud lock nut when finished.

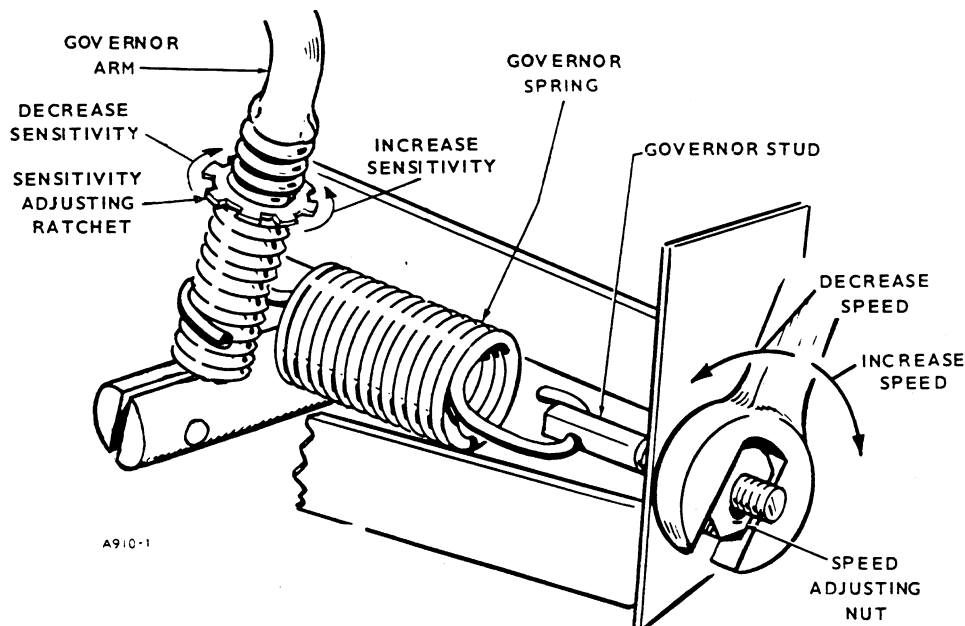


FIGURE 25. GOVERNOR ADJUSTMENT

CHARGE RATE ADJUSTMENT

The adjustable resistor slide tap (in the charging circuit) is set to give approximately a two-ampere charging rate. For applications requiring frequent starts, check battery specific gravity periodically and, if necessary, increase the charging rate slightly (move slide tap nearer ungrounded lead) until it keeps the battery charged. The resistor is located in the generator air outlet. Adjust only when unit is stopped.

If you use a separate automatic demand control for starting and stopping, adjust the charge rate for maximum 4.5 amperes. This normally keeps battery charged even if starts occur as often as 15 minutes apart.

SIPHON-BREAK

A siphon break is installed on units if the exhaust injection elbow is below load water line. When properly installed, it helps prevent sea water siphoning into the engine and compartment when generator set is not running.

The siphon break valve is very reliable. 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, it should be replaced (see Parts Catalog).



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