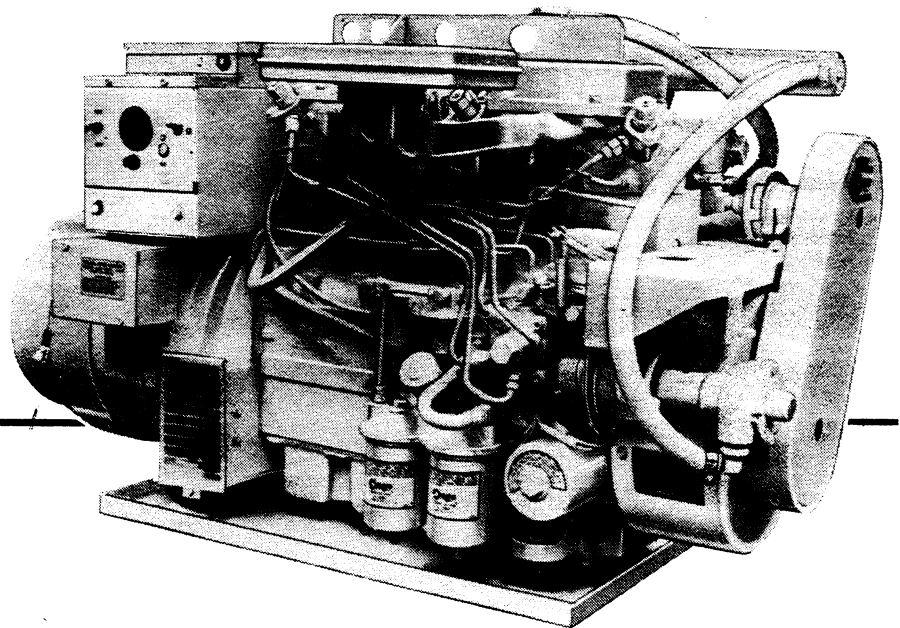


Onan

Operators Manual

MDJF
Marine GenSet



968-0121
(SPEC AB)
5-81

Printed in U.S.A.

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 AND FUMES ARE FLAMMABLE. Fire and explosion can result from improper practices.

- 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.
- Disconnect the battery ground lead (-) first; reconnect the ground lead (-) 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 with power exhausters or bilge vapors from the engine compartment.
- 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 under pressure has 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.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- 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 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 thoroughly with the bilge blowers or power exhausters.

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 GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM.** Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved device and after building main switch is open. Consult an electrician in regard to emergency power use.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- **Copy and post these suggestions in potential hazard areas of the vessel.**

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General Information

FOREWORD

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.

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.

MODEL IDENTIFICATION

Identify the model of your unit by referring to the model and specification number shown on the Onan nameplate. Electrical specifications are shown on the lower portion of the nameplate.

WARNING

ONAN RECOMMENDS THAT ALL SERVICE INCLUDING INSTALLATION OF REPLACEMENT PARTS ONLY BE DONE BY PERSONS QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE. FROM THE STANDPOINT OF POSSIBLE INJURY AND/OR EQUIPMENT DAMAGE IT IS IMPERATIVE THAT THE SERVICE PERSON BE QUALIFIED.

Specifications

GENERAL DETAILS

Engine

Number of cylinders (vertical in-line)	4
Displacement	140 cu in. (2294 cm ³)
Cylinder bore	3.5 in. (88.9 mm)
Piston stroke	3.625 in. (92.1 mm)
RPM (for 60 Hertz)	1800
RPM (for 50 Hertz)	1500
Injection Pump (American Bosch type)	PSU

Generator

Rating	
AC, 50 Hertz set	12.0 kW
AC, 60 Hertz sets	15.0 kW
	18.5 kW

CAPACITIES AND REQUIREMENTS

*Battery recommendation	Two 6-volt batteries in series
32° F (0° C) and warmer	Cranking Performance @ 0° F (-18° C) 560 Amps BCI Group Size 2
0° F (-18° C) and warmer	Cranking Performance @ 0° F (-18° C) 800 Amps BCI Group Size 5D
Battery charge rate amperes (normal)	2 to 5
Oil capacity	
With filter	6-1/2 U.S. qt (6.2 lit)
Without filter	6 U.S. qt (5.7 lit)
Total air per minute required (cooling and combustion)	208 CFM (5.9 m ³ /min)
Diesel fuel pump lift (maximum)	6 ft (1.8 m)
Cooling water flow	4 gpm (15.2 lit/min)

TUNE-UP SPECIFICATIONS

Cylinder head bolt torque	44 to 46 lb ft (60 to 62 N•m)†
Glow plug torque	10 to 15 lb ft (14 to 20 N•m)
Valve Clearance	
Intake	0.017 in. (0.43 mm)
Exhaust	0.017 in. (0.43 mm)
Centrifugal switch	0.020 in. (0.51 mm)
Injection firing order	1, 2, 4, 3

*Requirements of optional 32-volt systems as follows:

Battery Voltage	32-Volt Negative Ground
Battery Group (Four 8-Volt)	Type Determined by Installer

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

Installation

GENERAL

Proper installation is very important. Requirements to consider should include:

- Adequate cooling air
- Adequate combustion air
- Discharge of exhaust gases
- Discharge of circulated air
- Electrical connections and bonding
- Fuel connections
- Coolant connections
- Accessibility for operation and servicing
- Level mounting surface
- Noise levels

The installation should follow recommendations of the American Boat and Yacht Council (ABYC) and the National Fire Protection Association. (NFPA).

The instructions in this manual should be used only as a guide as each installation must be considered on an individual basis. Helpful guidance for the installer is available in the following publications:

ABYC "Safety Standards for Small Craft" from—
ABYC
15 East 26th St.
New York, NY 10010

NFPA302 "Fire Protection Standard for Motor Craft" from—
NFPA
470 Atlantic Ave.
Boston, MA 02210

USCG 33CFR183 from—
U.S. Government Printing Office
Washington, D.C 20404

Onan Technical Bulletin T-021 "Installation of Onan Marine Electric Generating Sets."

LOCATION

Set location is preferable in the same room or compartment as the propulsion engine, as this is usually a well ventilated area, insulated, close to the fuel supply and is the center of electrical load distribution. A generator set cannot be installed in the propulsion engine compartment unless specific conditions are met.

USCG regulation 33CFR183 pertains to gasoline fuel systems and requires a generator set operating in a

gasoline fuel environment to be "ignition protected." This means a set capable of operating in an explosive environment without igniting that environment.

This diesel generator set is not certified to operate in a gasoline fueled environment but is not required to meet the 33CFR183 regulation when used in a diesel fueled environment.

Keep the generator set away from living quarters, and away from bilge splash and vapors. Select a location that will allow adequate space on all sides for servicing the set, preferably on and parallel with the vessel center line.

MOUNTING

The floor should be flat and give support directly under the set (Figure 1) mounting points. A 2-1/2 inch (64 mm) clearance around the unit is required to permit rocking on its mounts without restraint. Use approved exhaust line, fuel line, battery cables and electrical wiring conduit.

Install two hold-down clamps in the accessory kit to the drip pan (front and rear or both sides). Secure the clamps to the mounting base.

An Onan "Sound Shield" is available only for the 15 kW gen sets. It is an insulated enclosure completely surrounding the generator set (Figure 2). 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 which are available.

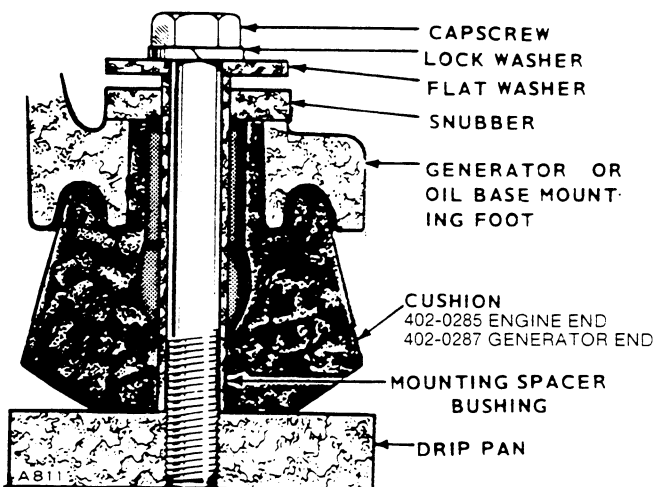


FIGURE 1. MOUNTING CUSHION

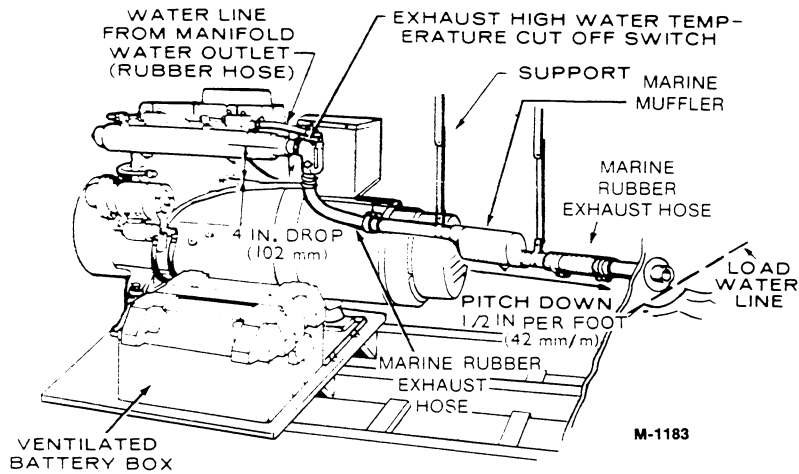
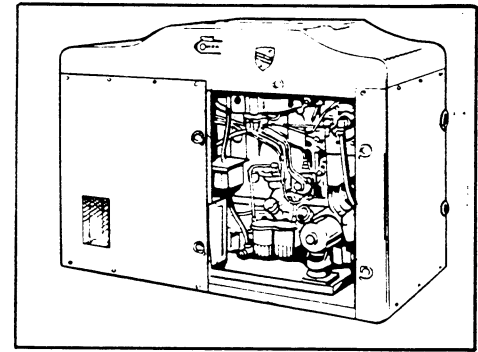


FIGURE 2. TYPICAL ABOVE WATER LINE INSTALLATION



SOUND SHIELD (15 kW Sets Only)

OIL DRAIN

The oil drain may be extended to suit the installation. The oil base has a 1/2 inch NPTF tapped hole.

VENTILATION

The marine electric set requires fresh air for cooling the generator and for engine combustion. Onan recommends the ventilation system be capable of delivering 1-1/2- to 2-times the air required by the set. See *SPECIFICATIONS*. When ventilation depends on wind or boat motion, use powered exhausters to provide ventilating air when the vessel is not underway.

EXHAUST SYSTEM

General

All exhaust systems for water-cooled marine installations must meet these requirements.

1. Except for vertical dry stack systems, exhaust systems must be water cooled, the water injected as near to the generator set as possible.
2. All exhaust system sections preceding the point of cooling water injection must be either water jacketed or effectively insulated.
3. The exhaust line must be installed so as to prevent back flow of water to the engine under any conditions, and the exhaust outlet must be above the load waterline. Water flowing back to the engine will damage it.
4. The generator set exhaust system must not be combined with the exhaust system of any other engine.
5. An approved, flexible exhaust line section should be used near the engine to allow for engine movement and vibration during operation.
6. Vertical dry stack exhaust systems must have spark arresters. The exhaust system between

engine manifold and spark arrester must be either water jacketed or well insulated.

7. The exhaust system must be of sufficient size to prevent excessive back pressure.
8. Install exhaust through hull fitting aft of sink, shower or other cabin drains.

WARNING

Use extreme care during exhaust system installation to ensure a tight exhaust system. Exhaust gases are deadly.

Material

Use material recommended by ABYC in "Safety Standard for Small Craft," Section P1. The exhaust line should be at least as large as the engine exhaust outlet.

To prevent vibration transmitting to the hull, use automotive type tail pipe hangers. Use flexible rubber hose for the water cooled section of the exhaust line for ease of installation and flexibility. Be sure the rubber hose is designed and approved for marine exhaust line use. Provide adequate support for rubber hose to prevent sagging, bending and formation of water pockets. Use two hose clamps having a minimum width of 1/2 inch (12.7 mm) at each end of hose. See Figure 3.

The flexible section of exhaust line should be installed between the engine and muffler (Figures 2 and 3). Do not connect the muffler directly to the exhaust manifold. Use rubber hose only in the water-cooled section of the exhaust system. When using metallic flexible exhaust line, install in straight lengths only.

WARNING

Do not install rubber hose with sharp bends as this will reduce efficiency. Do not use rubber hose on dry type exhaust applications. Doing so may cause hose failure and leakage of deadly exhaust gas.

Exhaust Back Pressure

Exhaust back pressure is an important criteria of an

adequate exhaust system. If the installation is excessively long or questionable (has elbows or sharp bends), back pressure should be checked before putting the unit into operation. Exhaust back pressure should not exceed 3 inches of mercury (10 kPa).

COOLING SYSTEM

Throughout this manual, flotation 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

The three systems of cooling are standard sea water, optional heat exchanger and keel cooling.

Exhaust Cooling Water Injection

The neoprene impeller pump moves the sea water through the cooling system and into the sea water injection elbow. The injected water cools the exhaust and prevents exhaust system damage from heat. A temperature operated switch on the exhaust elbow shuts the unit down if overheating occurs. See Figure 4. The switch is in series with the fuel solenoid and opens circuit if temperature reaches 185° to 195° F (85° to 91° C).

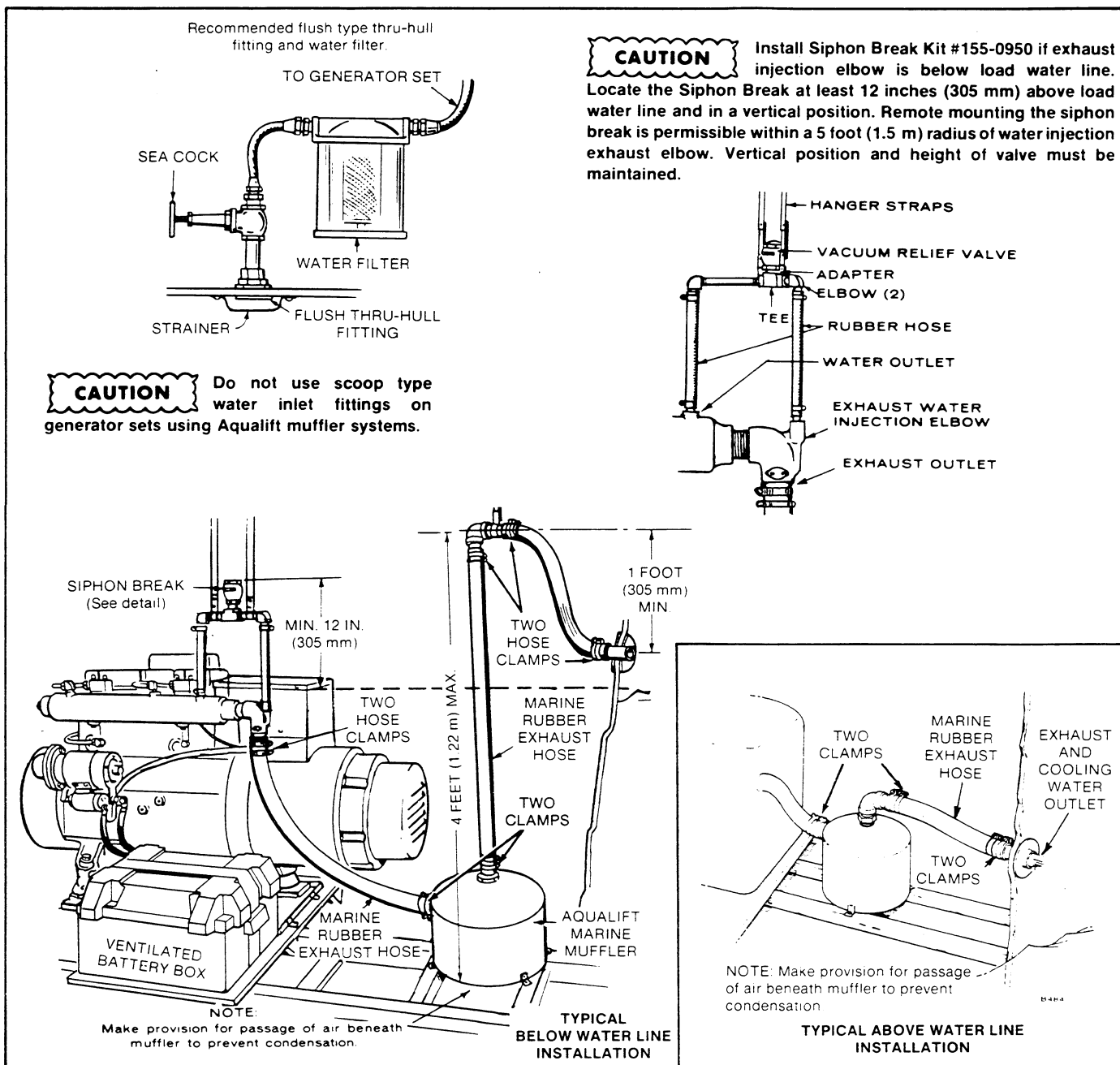


FIGURE 3. TYPICAL INSTALLATION WITH AQUALIFT MUFFLER

An important consideration of water injection is keeping water from flowing back through the exhaust system into the engine. When the boat pitches forward, water sloshing in the exhaust line can enter the engine. This is especially true where there is a considerable length of straight exhaust line or where pockets allow water to gather. The exhaust line must be installed to prevent back flow of water to the engine under all conditions.

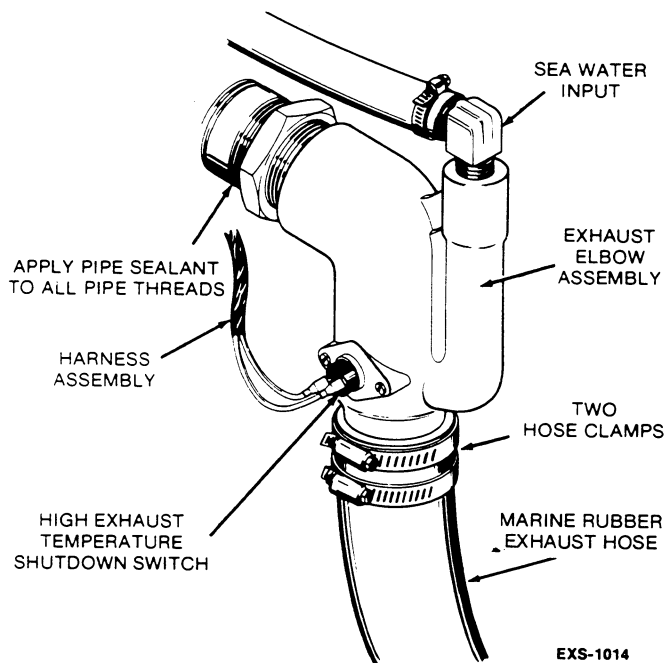


FIGURE 4. SEA WATER CONNECTIONS

WARNING Do not use the manifold as a muffler support because it puts excessive strain on the connecting exhaust line and can cause it to break or leak, resulting in the escape of deadly exhaust gases.

Siphon Break

The siphon break or anti-siphon is a vacuum-operated vent valve that opens the exhaust water discharge line to 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 water line (Figure 3). The siphon break is required in the sea water discharge line for direct flow, Aqualift Muffler, and heat exchanger installation.

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 3). 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 when the generator set is not running and boat is underway.

Sea Water Cooling

This system of cooling is not recommended for sea duty (salt water) because of the resulting corrosion, scale and alkali build-up in the engine block.

The water 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 to pump.

The pump lift should be limited to five feet (1.5 m). Normally, the pump should deliver four gallons (15 lit) of cooling water per minute. Measure the discharge water flow after thermostat opens. Reduce resistance on pipe runs longer than five feet (1.5 m) by using larger inside diameter plumbing. To ensure suction line is airtight, see that no bubbles appear in discharge water. An air leak reduces lubrication and shortens life of pump's impeller. Install a strainer in the water suction line inlet where it will be accessible for cleaning.

Heat Exchanger Cooling (Optional)

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 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 Do not 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 closed cooling systems with clean, alkali-free water to the proper level. Add an approved rust inhibitor to the coolant. If the coolant is an antifreeze and water mixture, test it periodically following antifreeze manufacturer's recommendations. Do not exceed a 50-50 mixture of ethylene glycol and water. A

stronger mixture will alter heat transfer properties of the coolant.

The heat exchanger and engine block have drain

plugs for changing coolant (Figures 5 and 6). Prime the sea water pump on initial start up as described in the Operation section.

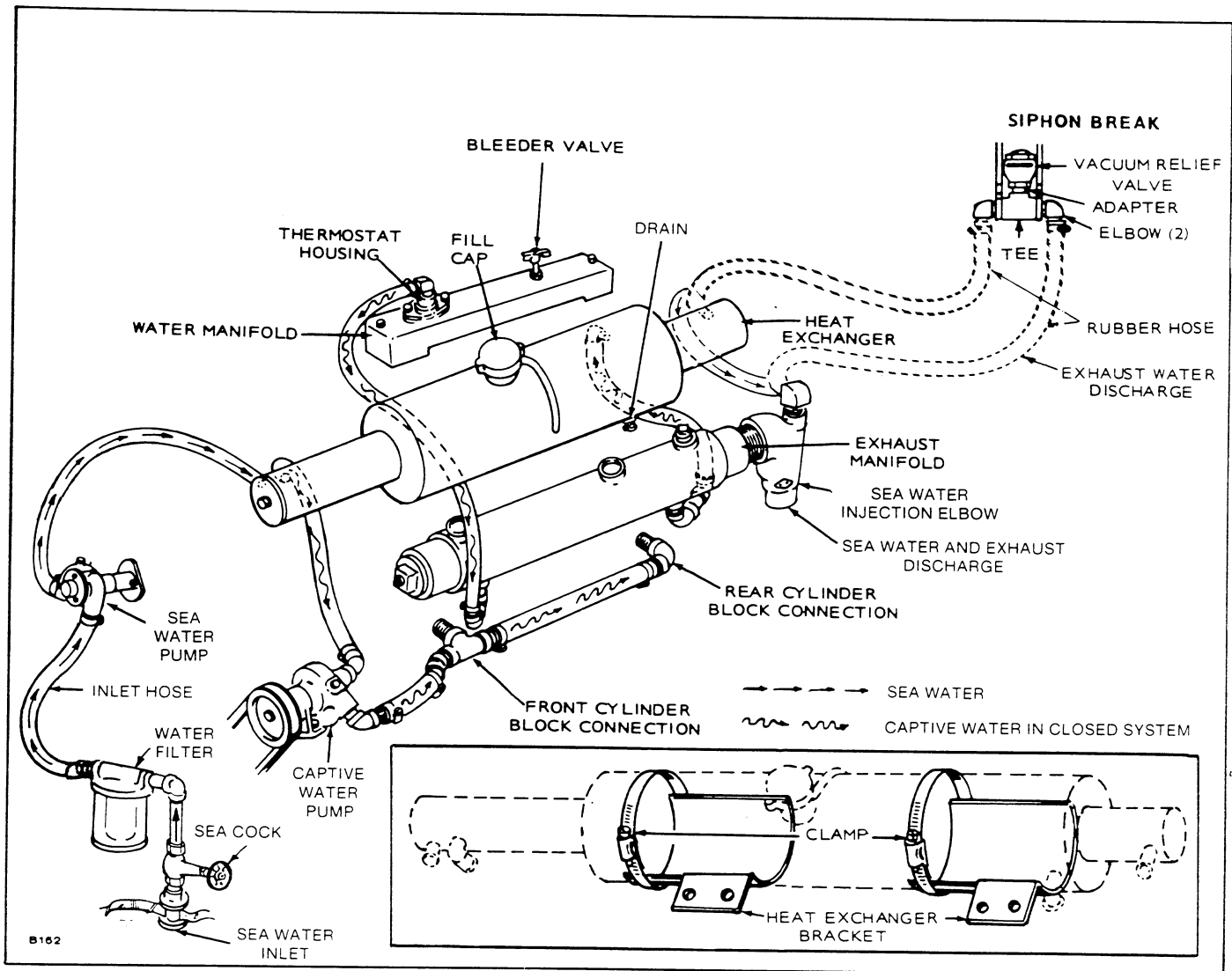


FIGURE 5. HEAT EXCHANGER PLUMBING

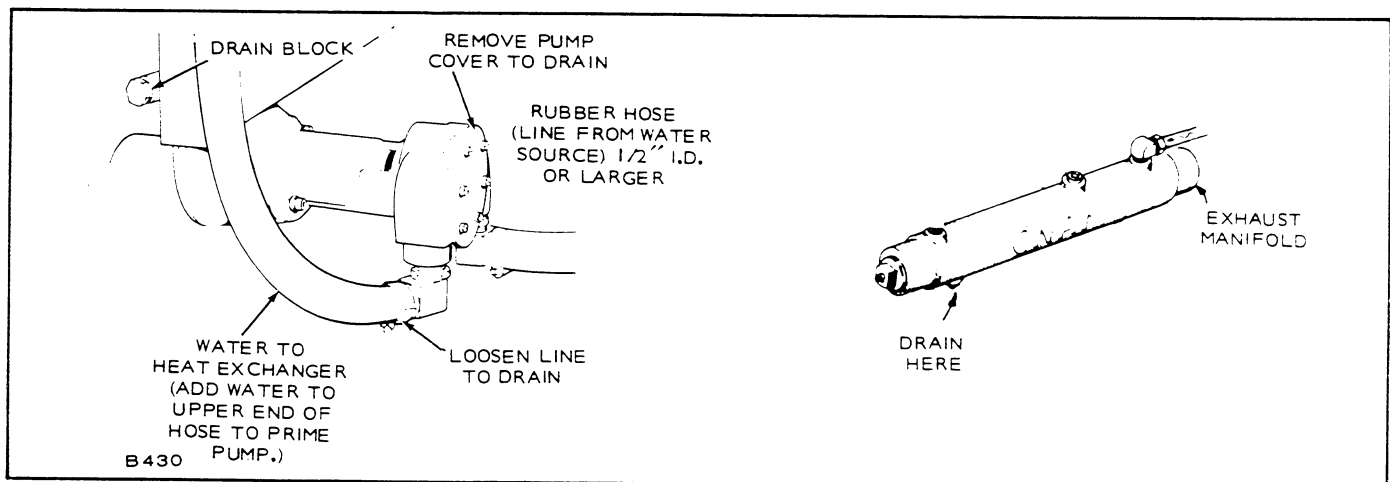


FIGURE 6. FILL AND DRAIN LOCATIONS

Keel Cooling (Optional)

This is a closed cooling system often referred to as skin cooling. Water circulated through the engine and keel cooler is called captive water in the closed system. Water pumped into the exhaust line is called sea water. See Figure 7 for line connections.

Onan does not offer an optional keel cooler. Ensure the keel cooler selected is large enough to cool the generator set (consult keel cooler manufacturer). Keel cooled generator sets have a larger captive water pump with necessary elbows and nipples for connection only. The larger pump uses a longer drive belt. User must provide the expansion tank and necessary plumbing as shown.

Always connect the neoprene impeller pump to only the sea water side of the cooling system. Use the metal impeller pump in the captive water side.

Fill the closed portion of the cooling system with clean, alkali-free water to the proper level. Add an approved rust inhibitor to the coolant. If antifreeze is required, test the coolant periodically to ensure

against freezing. Prime the sea water pump on initial start up as described in the Operation section.

Sea Water Pump

Before beginning operation, the sea water pump should be checked for water flow. With the unit running, observe the exhaust outlet to be sure the pump is delivering water to the system

CAUTION Do not use a scoop-type water inlet fitting. When the boat is underway and the generator set is not running, sufficient ram pressure can force water past the sea water pump, flooding the exhaust system, and possibly flood the engine cylinders.

If overheating occurs, check for a loose or defective pump belt. Also check for leaks or restrictions in the cooling system. Contact your local Onan dealer for further testing.

Do not use the sea water pump in the captive hot water side of cooling system. Heat, or soluble oil in many rust inhibitors and antifreezes, will damage the impeller.

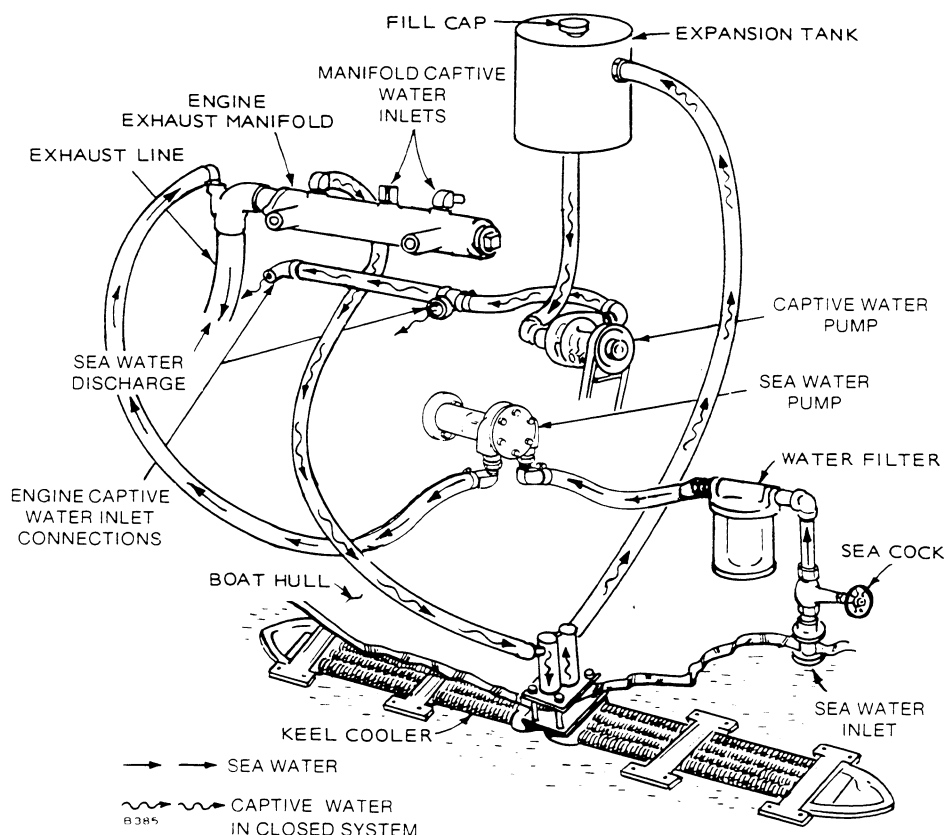


FIGURE 7. KEEL COOLING PLUMBING

FUEL SYSTEM

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. 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 8). If the fuel lift must exceed 6 feet (1.8 m), install an auxiliary electric fuel pump at the fuel supply.

Fuel Connection

Connect one of the fuel lines furnished to the fuel pump inlet. Pump is threaded 7/16-24 NPTF (American Standard Internal Tapered Pipe Thread).

Always use approved flexible hose between engine and the fuel supply.

The diesel engine requires a separate fuel return line. Install the fuel return line from the 7/16-24 size opening in the overflow fitting located on the injection pump to the top of the fuel supply tank (Figure 8). The return line maximum head is nine feet (2.7 m).

CAUTION Never use galvanized fuel lines, fittings, or fuel tanks with diesel fuel systems. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfurous acid. The zinc coating on galvanized lines or tanks reacts with the acid and flakes off to contaminate the fuel.

Carefully clean all fuel system components before putting the unit into operation.

ELECTRICAL SYSTEM

Battery Connection

The generator set batteries should be installed close to the unit, but not directly under the generator. If installed in a separate compartment, be sure the compartment is well ventilated to prevent any accumulation of hydrogen gas generated during battery charging.

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

Service the batteries as necessary. Infrequent unit use may allow the batteries to self-discharge to the point where they cannot start the unit.

Mount the batteries in an acid resistant tray on a platform above the floor, and secure them to prevent shifting. If batteries are in the engine compartment, always install a non-metallic cover over them to prevent sparks from objects dropped on the batteries. See Figure 9.

12-Volt Installation

Use two 6-volt batteries for a normal installation (see *Specifications*). Connect the batteries in series (negative post of first battery to positive post of second) as shown in Figure 10. Necessary battery cables are on the unit, and should be connected as shown. Coat the terminal connections with a non-conductive grease to retard corrosion.

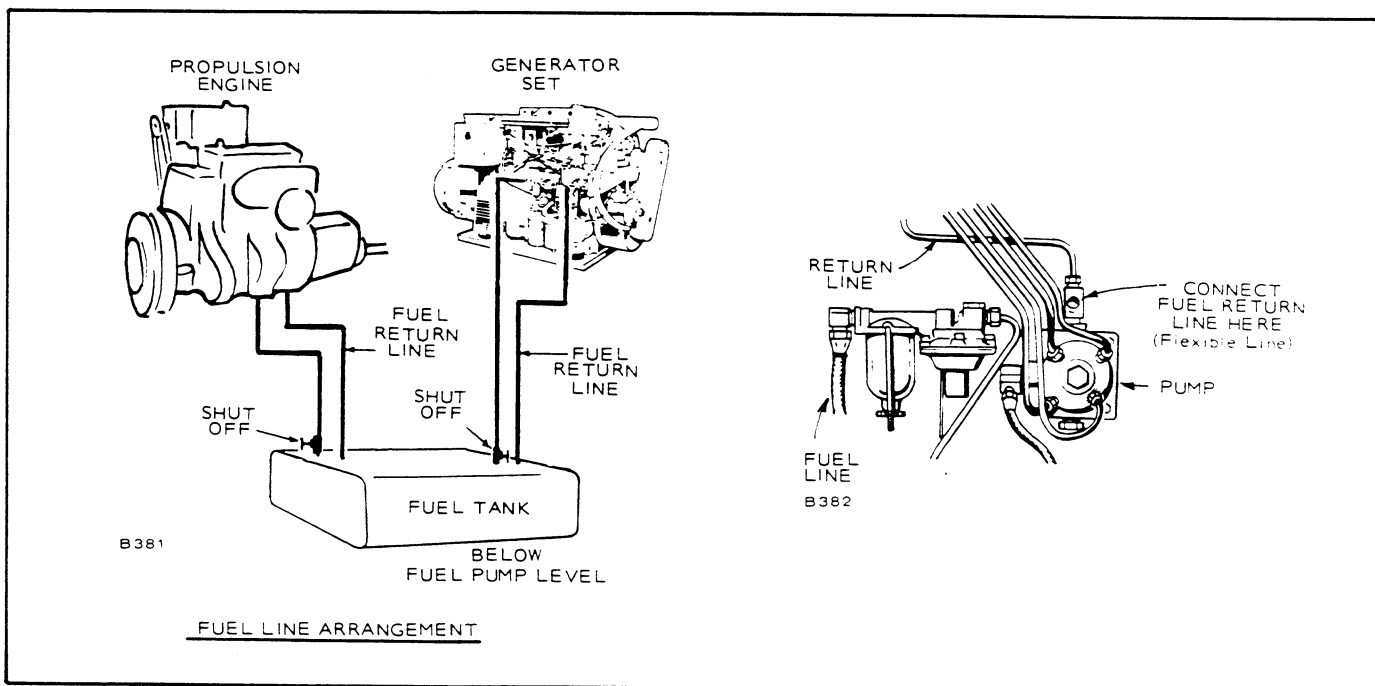


FIGURE 8. FUEL SYSTEM

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.

32-Volt Installation

These installations use four 8-volt batteries of a type and capacity determined by the installer. Due to the

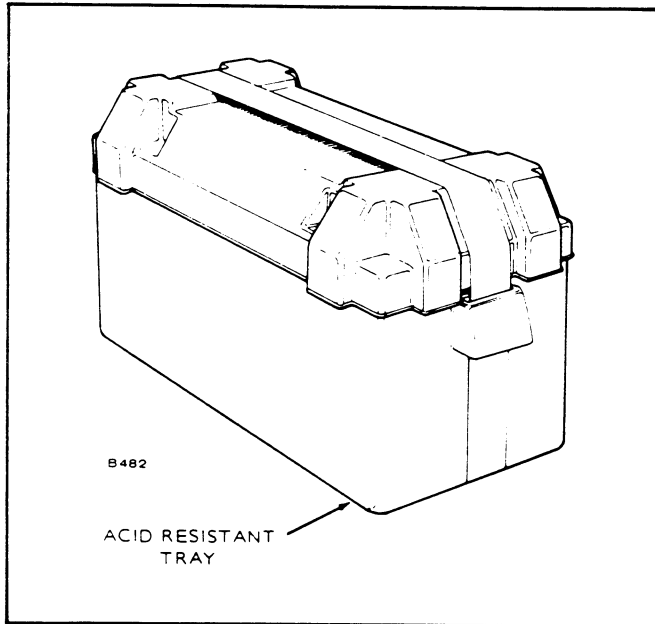


FIGURE 9. BATTERY TRAY AND COVER

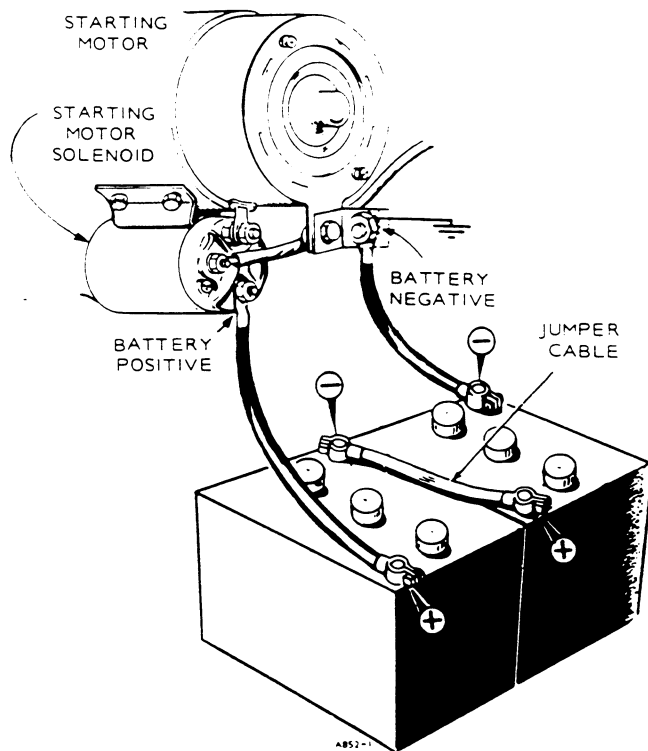


FIGURE 10. BATTERY CONNECTION, 12 VOLT SYSTEM

unique battery system, these batteries should be serviced by experienced personnel.

WARNING

Do not disconnect battery cables from battery while generator set is cranking or running; sparks may cause an explosion.

Battery, Hot Location

Batteries will self discharge very quickly when installed where the ambient temperature is consistently above 90° F (32° C). To lengthen battery life, dilute the electrolyte from its normal 1.265 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90° F (32° C), this should not be noticed. The lengthened battery life will be worth the effort.

1. Fully charge the battery.
2. With the battery still on charge, draw off the electrolyte above the plates in each cell. DO NOT ATTEMPT TO POUR OFF; use a hydrometer or filler bulb and dispose of it in a safe manner. Avoid skin or clothing contact with the electrolyte.
3. Refill each cell with distilled water, to normal level.
4. Continue charging for 1 hour at a 4 to 6 amp rate.
5. Test each cell. If the specific gravity is still above 1.255, repeat steps 2, 3, and 4 until the reading is reduced to 1.225. Usually, repeating steps twice is sufficient.

Load Wire Connections

The nameplate on the generator set shows the electrical output rating of the generator. The wiring diagram, shipped with the generator set, shows the electrical circuits and connections needed during installation. Have electrical connections made by a qualified serviceman or electrician to meet the electrical code requirements in your area.

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.

The junction box has a terminal strip to accept load wires. Use flexible conduit and stranded load wires near the set to absorb vibration. Connect load wire to the proper generator lead terminal. Install a fused main switch or circuit breaker between generator and load. If test run indicates wrong rotation of three-phase motors, switch the load connections at any two terminals.

Single-phase and broad range generators are connectible to provide output voltages shown in Figure 12.

Single Phase Reconnectible 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 11 and 12 at the installation site. Grounding procedure should comply with local codes.

Single/Three Phase Reconnectible 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 shown in Figure 12. Grounding procedure should comply with local codes.

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 connection diagram. A broad range generator is capable of generating numerous different output voltages as indicated by the diagram.

Balance All Loads

Divide any 120-volt loads approximately equally between the two 120-volt circuits. Line current for any one of the two output leads must not exceed nameplate rating. Overloading can damage the generator windings.

Single-Phase Loads on Three-Phase Generators

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 the single-phase load does not exceed 2/3 the three-phase rating.

Switchboard

A wall mounted 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 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.

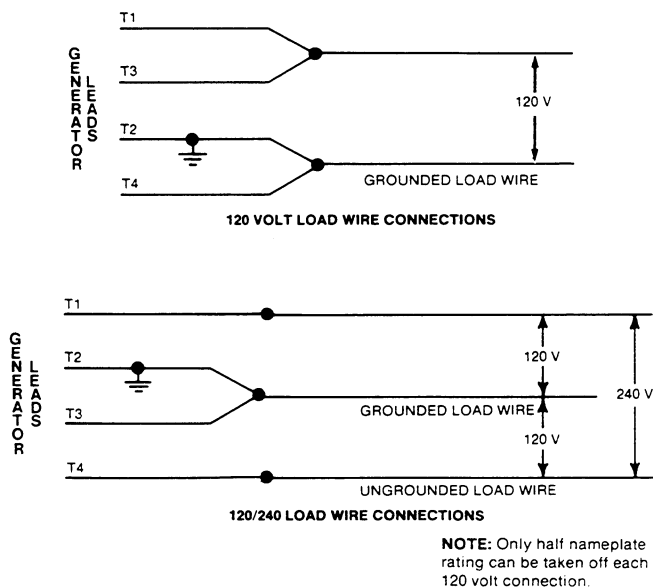


FIGURE 11. SINGLE-PHASE, "-3C" VOLTAGE CODE GENERATOR LOAD CONNECTIONS

NAMEPLATE VOLTAGE CODE					VOLTAGE			PHASE			FREQUENCY			CONNECT W/O JUMPER WIRE FROM V4 TO			GENERATOR CONNECTION			GENERATOR CONNECTION SCHEMATIC DIAGRAM			LOAD TO GENERATOR CONNECTION WIRING DIAGRAM		
																		CONNECT X1 TO TERMINAL 5 OF PRINTED CIRCUIT BOARD FOR 50 Hz, TO TERMINAL 6 FOR 60 Hz.							
3C	120/240	1	60	V1		240	120	120/240	240	120	120/240	240	120	120/240											
53C	120/240	1	50	V3																					
	115/230	1	50	V2																					
	110/220	1	50	V1																					
18	120/208	3	60	V1	PARALLEL WYE																				
518	110/190	3	50	V1																					
	115/200	3	50	V2																					
	120/208	3	50	V3																					
18	240/416	3	60	V1	SERIES WYE																				
518	220/380	3	50	V1																					
	230/400	3	50	V2																					
	240/416	3	50	V3																					
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 12. GENERATOR WIRING AND CONNECTION DIAGRAMS

Dockside Power Connection

Most boats incorporate a dockside connection so the boat can be plugged directly into a commercial source while at dock. If this is done, include a switch in the electric generating set output to switch the load between the unit and dock power. The generator and power line source *must never* be connected together at the same time. Either a manual switch or the Onan marine load transfer control can be used for this function. See Figure 13.

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 14. 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.

Automatic Load Demand Control (Optional)

The Onan HA automatic demand control starts the generator set when an electrical load is switched on. When the load is removed, it automatically stops the set.

The set continues to run as long as generator AC current flows through the load. In general, a 40-watt load keeps a 120-volt set running, 100 watts for a 240-volt set.

WARNING

The HA automatic control is not certified for use in a gasoline fueled environment. The control must be separated by a bulkhead or deck to prevent ignition of explosive fumes. An explosion could result in severe personal injury or death.

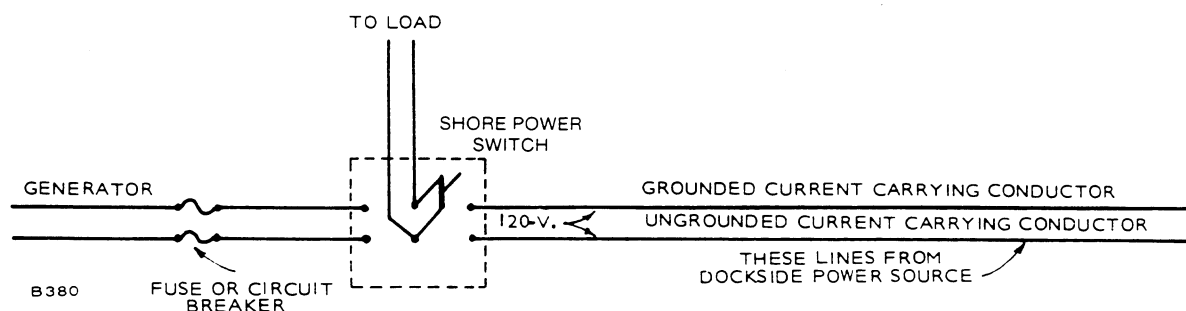


FIGURE 13. DOCKSIDE POWER SOURCE

WIRE SIZE	DISTANCE
#18	to 65 ft (20 m)
#16	to 100 ft (30 m)
#14	to 150 ft (46 m)
#12	to 280 ft (85 m)

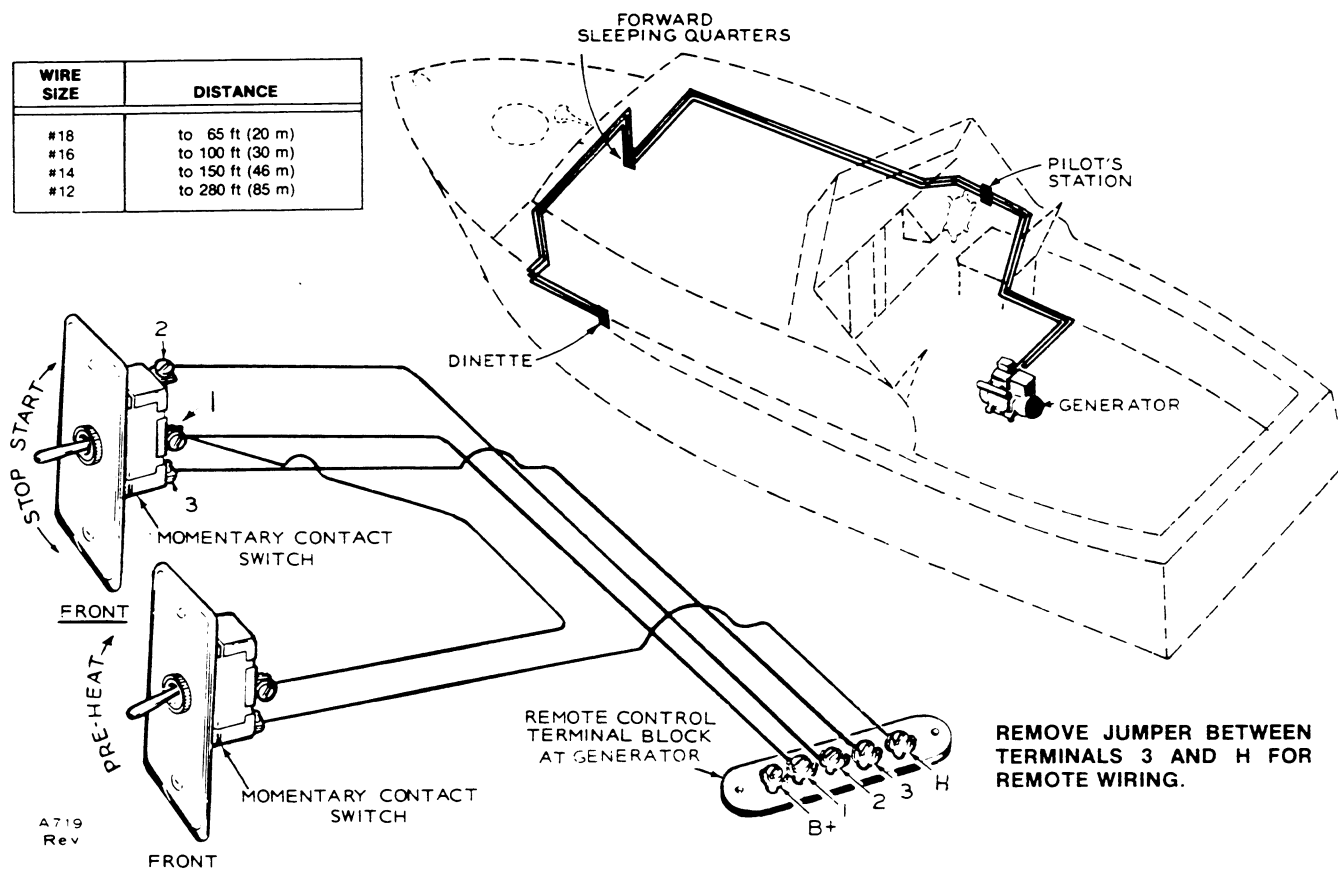


FIGURE 14. REMOTE CONTROL

Operation

⚠ WARNING

EXHAUST GAS IS DEADLY!

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

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

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

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

PRE-STARTING

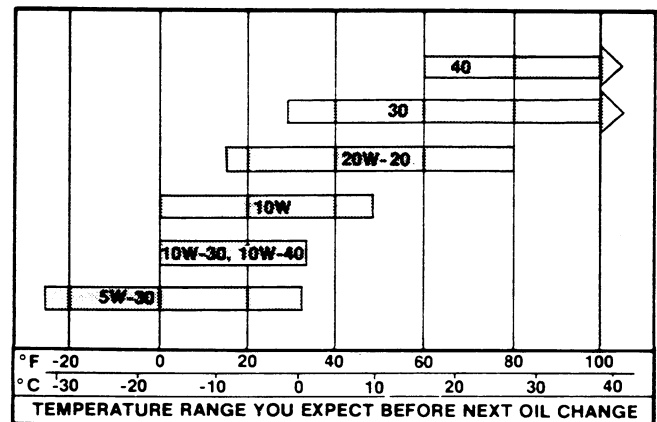
Preparations for operation should include checks of the oil, fuel, cooling, and electrical systems. Before the generator set is put in operation, check all components for mechanical security. If an abnormal condition, defective part, or operating difficulty is detected, repair or service as required. 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 viscosity grade oil by referring to Figure 15.

Multigrade oils (CC/SE or CD/SE) are recommended for temperatures of 32° F (0° C) and below, but they are not recommended for temperatures above 32° F (0° C). When adding oil between oil changes, use the same brand because different brands of oil may not be compatible.

USE THESE SAE VISCOSITY GRADES



AMBIENT TEMP. RANGE	RECOMMENDED VISCOSITIES	REQ'D QUALITY LEVELS (API CLASS)
60° F and warmer	SAE 40	CD/SE
32° F and warmer	SAE 30	
15° F to 80° F	SAE 20W-20	
0° F to 50° F	SAE 10W	
0° F to 32° F	SAE 10W-30, 10W-40	CD/SE or CC/SE
-25° F to 32° F	SAE 5W-30	CD/SE or CC/SE

Refer to Chart for Celsius Temperature Conversions.

FIGURE 15. RECOMMENDED OIL VISCOSITIES

⚠ WARNING

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

The *PERIODIC MAINTENANCE* section shows location of the oil fill, oil drain, and oil filter.

Recommended Fuel

Use ASTM 2-D or 1-D fuel with minimum Cetane number of 45. Although number 2 diesel fuel gives the best economy for most operating conditions, number 1 diesel fuel can be used:

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 (6° 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 or water 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 16). 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 the camshaft pump lobe is up, crank engine one revolution to permit hand priming. When finished, return priming lever inward (disengaged position) to permit normal pump operation.

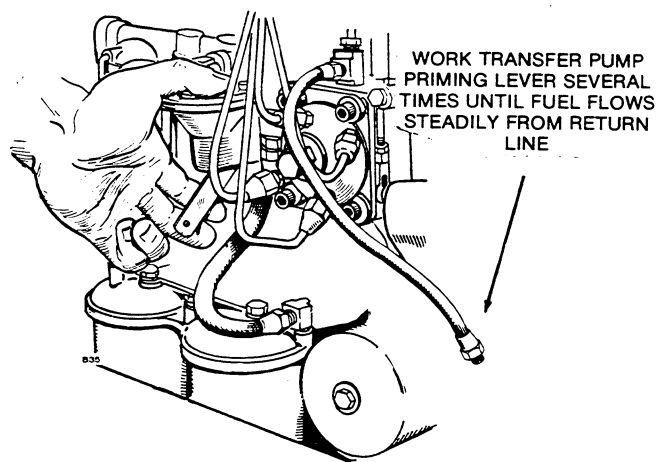


FIGURE 16. BLEEDING THE FUEL SYSTEM

Sea Water Pump Priming

Before beginning operation, 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 pump, remove the outlet hose from its connection on the end opposite the water pump. Fill the pump and hose with water and reconnect hose (Onan pump 131-0267, used for sea water cooling systems, has a removable plug for priming).

Controls

Before operation, become familiar with the various generator set controls and instruments. The standard control box has controls as shown on Figure 17. Optional controls that may be added on the standard panel include a fault lamp, an overspeed indicator, a voltage adjust knob and warning lights for operating conditions.

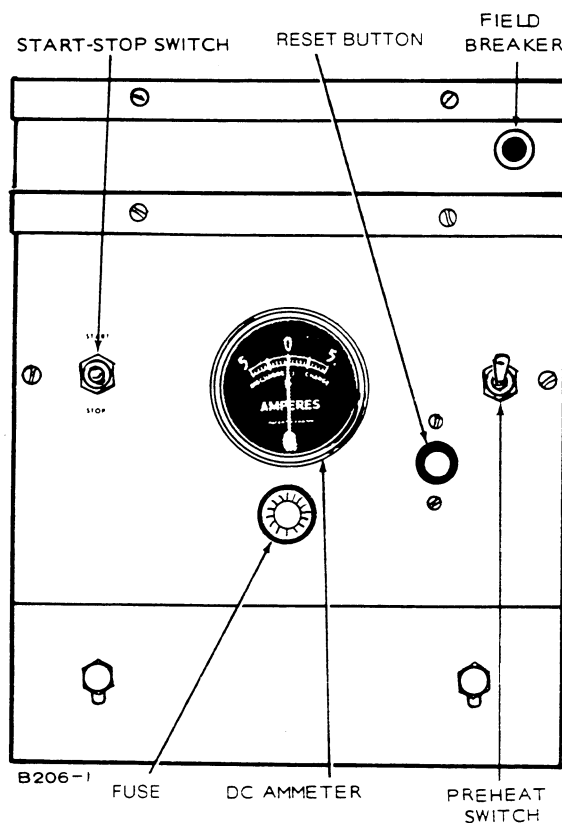


FIGURE 17. TYPICAL MARINE SET CONTROL PANEL

The following are brief descriptions of components on the 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.

Fuse: The fuse protects external wiring connected to the control B+ terminal. The set will not operate if fuse is blown.

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 (Optional): Provides approximately plus or minus 5 percent adjustment of the rated output voltage.

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

STARTING

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 battery source of same voltage connected in parallel with the starting batteries.

1. For cold engine starting, push preheat switch and hold for 30 seconds if ambient temperature is above 55° F (43° C); 60 seconds if below 55° F (see Onan Diesel Starting Guide on page 19).
2. Engage start switch and release preheat switch. Limit cranking 15 to 20 seconds to conserve battery.
3. Release start switch after engine starts and reaches speed. Oil pressure gauge should read at least 20 psi (138 kPa).

To prevent false starts, hold start switch until centrifugal switch automatically disengages the starter motor.

4. If engine fails to start in 20 to 30 seconds, rest starter one minute and repeat starting sequence. Always refer to the Onan Diesel Starting Guide when starting problems are encountered.

WARNING Do not disconnect cables from battery while generator set is cranking or running. Sparks could cause an explosion.

AUTOMATIC STARTING AND STOPPING

You can use separate controls for automatic starting and stopping, but they must provide engine preheating. An Onan automatic demand switch incorporates a time delay relay to preheat glow plugs and the manifold heater for 20 seconds before cranking occurs. The time delay relay prevents immediate engagement of the starter in case the load is reappplied before the engine stops.

STOPPING

1. Push start-stop switch to STOP position.
2. Release switch when set stops. If stop circuit fails, manually operate engine mounted fuel solenoid valve.

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 new or 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.

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.

POWER REQUIREMENTS FOR APPLIANCES

Approximate	Approximate Running Wattage
Air Conditioner	1400 to 2200 watts
Battery Chargers (Rectifier)	Up to 800 watts
Blankets (electric)	50 to 200 watts
Coffee makers	550 to 700 watts
Electric drill	as marked
Electric Range (Per Element)	550 to 1500 watts
Fans	25 to 75 watts
Fry pan	1000 to 1350 watts
Heater (space)	1000 to 1500 watts
Hot plate (per element)	350 to 1000 watts
Iron (electric)	500 to 1200 watts
Lights (AC)	as marked
Refrigerator	600 to 1000 watts
Television	200 to 300 watts
Toaster	800 to 1150 watts
Vacuum cleaner	500 to 1500 watts
Waffle iron	650 to 1200 watts
Water heater	1000 to 1500 watts
Microwave oven	650 to 1800 watts

ONAN DIESEL STARTING GUIDE

IMPORTANT!

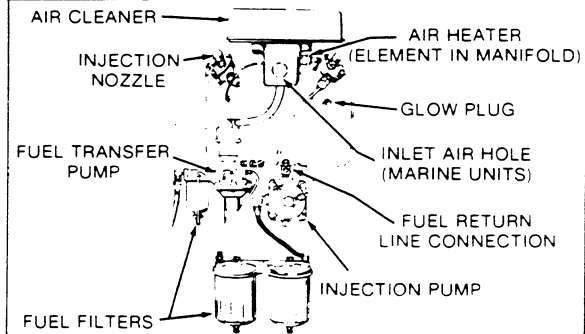
KEEP ENTIRE FUEL SYSTEM CLEAN AND FREE FROM WATER

- DIESEL INJECTION PUMPS WILL FAIL IF SYSTEM CLEANLINESS IS NEGLECTED

INJECTION PUMPS AND NOZZLES ARE NOT FIELD REPAIRABLE

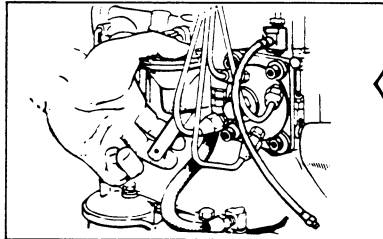
- WHEN TROUBLESHOOTING, CHECK ALL OTHER COMPONENTS FIRST

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



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:

PREHEAT



RELEASE PREHEAT

START



ENGAGE START SWITCH

STOP

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":

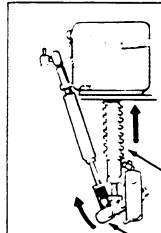
BLUE-WHITE EXHAUST SMOKE: ENGINE IS GETTING FUEL

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?

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

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

2-79 900-0217

EXERCISING UNIT

Infrequent use of units can result in the following: Water condensing in engine fuel and lubrication system causing contamination and corrosion, loss of protective oil film on moving engine parts, loss of engine fuel prime due to drain-back or evaporation, battery discharge due to internal and external current leakage, and breakdown of generator insulation due to water absorption.

Proper exercising does the following: Elevates engine oil temperature to at least 180°F (82.2°C) evaporating water from engine lubrication system, re-establishes a protective oil film on engine parts, recharges battery to full normal potential, and brings generator up to normal operating temperature through actual application of load. The unit should be exercised at least once each month.

Proper exercising can usually be accomplished by observing the following procedures:

1. Perform all specified maintenance checks. Start unit by connecting a load.* This exercises the control and switchgear.
2. Apply not less than 50 percent load to heat up engine and generator as described above.
3. Exercise unit long enough to provide at least 20 minutes running time at normal operating temperatures. This will require at least 60 minutes total running time.
4. Shutdown unit by removing load.*

***This applies to automatic demand controls only. Other units should be started and loaded by control and load application systems normally associated with operation of the unit.**

OUT-OF-SERVICE PROTECTION

For a generator set out of service (or in storage) for more than 30 days, 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 a 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 3). 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 (where water cooled) 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 the fuel line connections and check the fuel supply tank for moisture. Drain if necessary 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 be sure the suction line is air tight.
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, make sure the exhaust system is fit for operation and will not leak. Exhaust gases are deadly.

6. Check wiring system for worn wires, loose connections, etc. Remedy as required.
7. Install the fully-charged batteries and connect to the generator set. Observe correct polarity.
8. Start the generator set, connect a load, and observe general operation.
9. Check the entire generator set for water, fuel, or oil leaks. Correct as required.
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 6 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 vent valve or vent plugs.
3. To drain the water pump, loosen the cover and hose connections so the water runs out.
4. Drain the engine block by removing the 1/4-inch drain plug on the left, front side of the engine.
5. Drain the exhaust water manifold by removing the drain plug on the bottom.
6. Disconnect hose clamps and hoses to aid draining.
7. Heat Exchanger Cooling: Remove the heat exchanger end cap to clean internal portion of heat exchanger. Use a new gasket when replacing end cap.
8. When all water is drained out, reconnect hoses and re-install drain plugs, and close vent valve or plugs.

HEAT EXCHANGER FILLING

Improper filling of the heat exchanger can cause engine overheating. See Figure 18. To prevent this possibility, follow these instructions whenever adding coolant to the heat exchanger:

1. Remove fill cap.
2. Open fill vent valve (turn counterclockwise).
3. Fill with coolant.
4. Close fill vent valve (turn clockwise).
5. Replace fill cap.
6. Operate unit 10 minutes at full load; watch for leaks.
7. Shut down unit.

WARNING

After running unit 10 minutes, the closed cooling system is pressurized and hot. Open the pressure cap slowly to vent pressure. Otherwise, serious personal injury from scalding water or steam could result.

8. Slowly open pressure cap and check water level.
9. Fill system to top with coolant.
10. Repeat steps 5 through 9 as necessary.

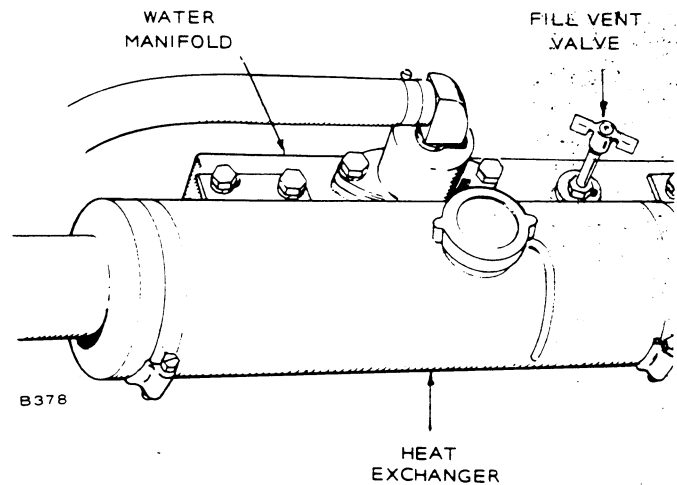


FIGURE 18. FILLING HEAT EXCHANGER

THERMOSTAT

Sea water or keel cooled models have a thermostat located on the right side of each cylinder head, connected by tubing to the water cooled manifold. A heat exchanger model has one thermostat in the water manifold. See Figure 19. Replace the thermostat if damaged by corrosion or other causes. If replaced, always install a new thermostat gasket.

HIGH TEMPERATURE CONDITIONS

1. See that nothing obstructs airflow to and from the generator set. The generator must have a constant source of cooling air to prevent overheating and damage.
2. Keep cooling system clean. Maintain the coolant level in a closed cooling system. If ethylene glycol antifreeze is used, do not exceed a 50-50 mixture with water.

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 well-charged condition.
4. Use additional preheating during cold starts. See *STARTING*, page 18.

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 in dust-tight containers.
4. Keep governor linkage clean.

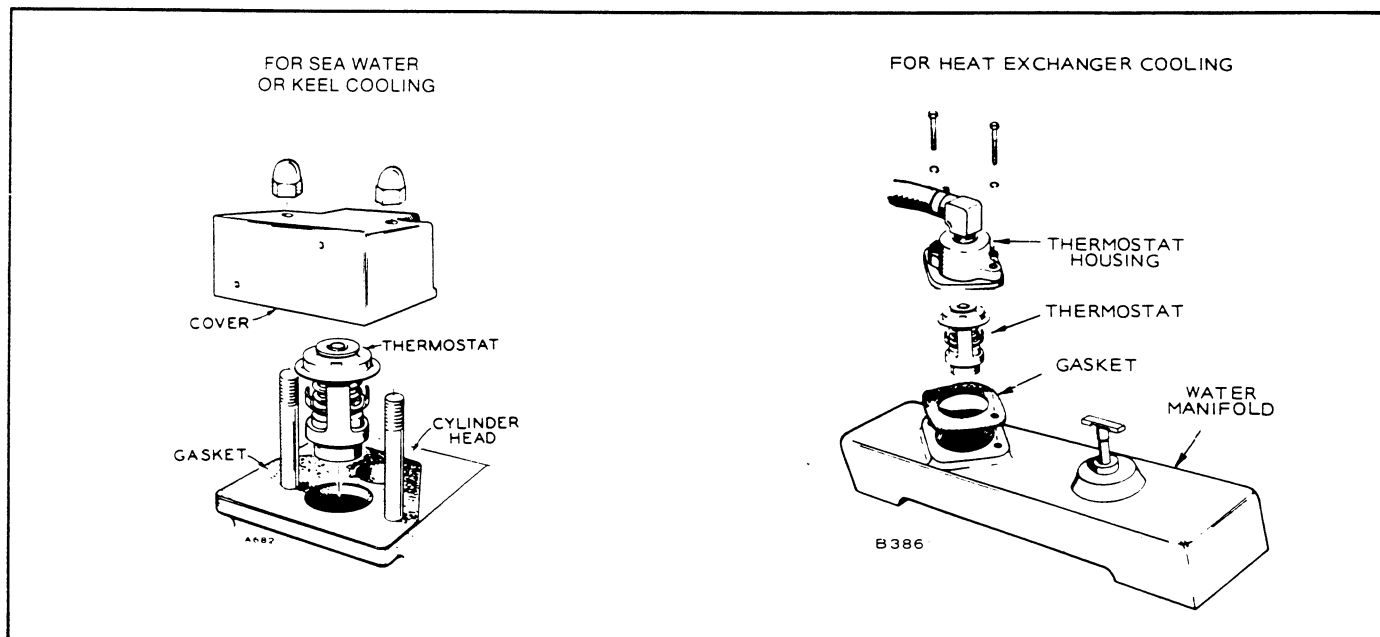


FIGURE 19. THERMOSTAT LOCATION

Service and Maintenance

GENERAL

Follow a definite schedule of inspection and servicing based on operating hours (Table 1). Keep an accurate logbook of maintenance, servicing, and operating time. Use the running time meter (optional equipment) to keep a record of operation and servicing. Regular service periods are recommended for normal service and operating conditions. For continuous duty, extreme temperature, etc., service more frequently.

**TABLE 1.
OPERATOR AND SERVICE MAINTENANCE SCHEDULE**

HOURS OF OPERATION	MAINTENANCE TASK
8	<ul style="list-style-type: none"> Inspect Generator Set, Set Note 1 Check Fuel Supply, see Note 2 Check Oil Level
50	<ul style="list-style-type: none"> Check Coolant Level on Closed Systems Clean Governor Linkage Drain Fuel Condensation Traps Empty Fuel Sediment Bowl
100	<ul style="list-style-type: none"> Change Crankcase Oil Drain Fuel Condensation Traps in Lines and Filters. See Note 2 Check Zinc Pencil on Heat Exch. Models, See Note 3
200	<ul style="list-style-type: none"> Replace Oil Filter Check Battery Electrolyte Level Check Water Pump Belt and Tension
500	<ul style="list-style-type: none"> Check Start-Disconnect Switch Points Check Valve Clearances See Note 4
600	<ul style="list-style-type: none"> Replace Primary Fuel Filter
1500 3000	<ul style="list-style-type: none"> Check torsional washers for corrosion, See Note 7. Replace Secondary Fuel Filter Clean Generator Inspect Valves, Grind if Necessary Clean Holes in Rocker Box Oil Line Check Nozzle Spray Pattern See Note 5
5000	<ul style="list-style-type: none"> General Overhaul (If Required) See Note 6

WARNING

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

Operator should periodically make a complete visual inspection with set running at rated load. Some of the things to check for are as follows:

1. Check all fuel and oil lines for leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks. The exhaust system does corrode (as in autos), especially in salt water atmospheres.
3. Inspect electrical wires and connections for security and fray damage.

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

OIL SYSTEM

Oil capacity is 6 U.S. quarts (5.68 lit) plus 1/2 quart (0.47 lit) with the oil filter. Fill the crankcase until the oil reaches the full mark on the oil level indicator (Figure 20). Check the oil after each operation and change oil every 100 operating hours or three months, whichever occurs first. If operating in dusty or dirty conditions, you might have to change it sooner.

Figure 20 shows the location of the oil drain, oil fill, and oil filter.

- NOTE**
1. Give unit general inspection. Then with generator set running, visually and audibly check the exhaust system for leaks.
 2. Water or foreign material in fuel can ruin the injection system. If daily inspection shows water or excessive dirt in sediment bowl fuel, handling and storing facilities should be checked and situation corrected. Primary and secondary fuel filters must be replaced following correction of fuel contamination problem.
 3. Or every 2 months (salt water use only).
 4. Clean breather tube if needed. See Figure 21.
 5. This service must be conducted by trained diesel injection equipment personnel with suitable test facilities. Omit this service until these conditions can be met.
 6. Tighten head bolts and adjust valve clearance after first 50 hours on an overhauled engine. Contact your local Onan dealer for servicing.
 7. Check yearly on non-commercial sets.

WARNING

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

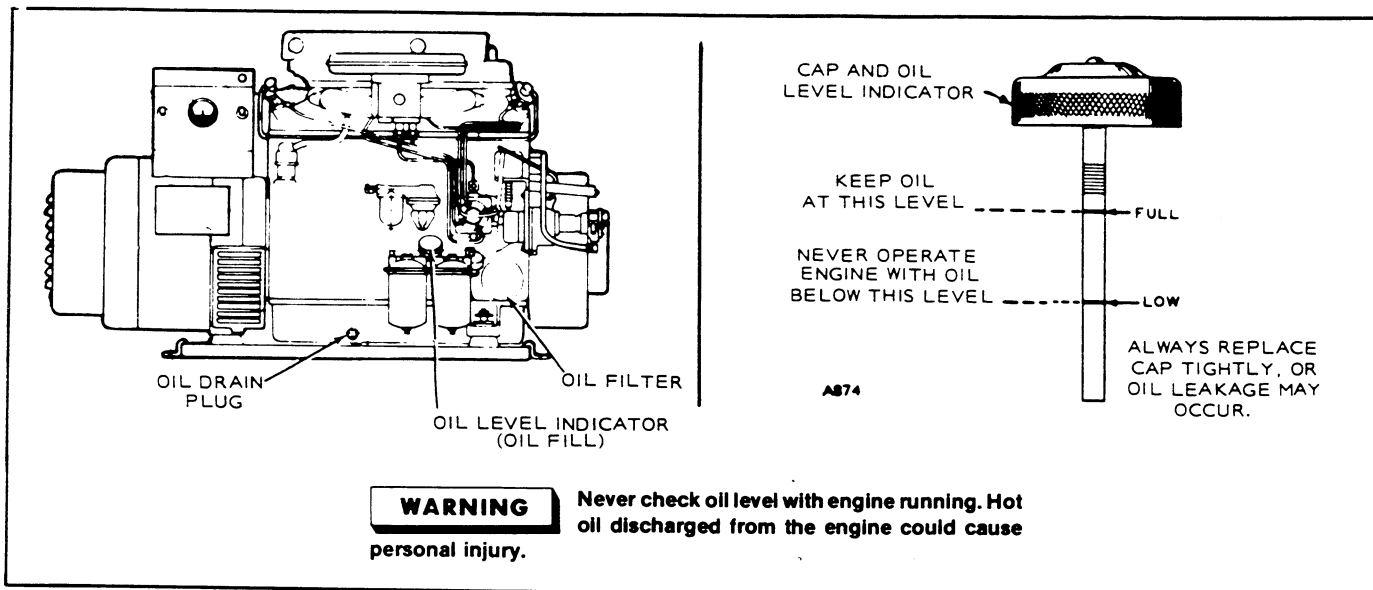


FIGURE 20. LOCATION OF OIL FILL, OIL DRAIN, AND OIL FILTER

Oil Filter

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

Crankcase Breather

The engine is equipped with a crankcase breather pipe that vents crankcase fumes directly from the rocker box cover to the cylinder head intake port. The crankcase breather pipe should be cleaned after every 500 hours of operation. This coincides with valve clearance adjustment and may be accomplished at the same time by your Onan dealer. Do not remove the tube for cleaning! Insert a small nail or wire from the top end, long enough to clean the entire pipe (Figure 21).

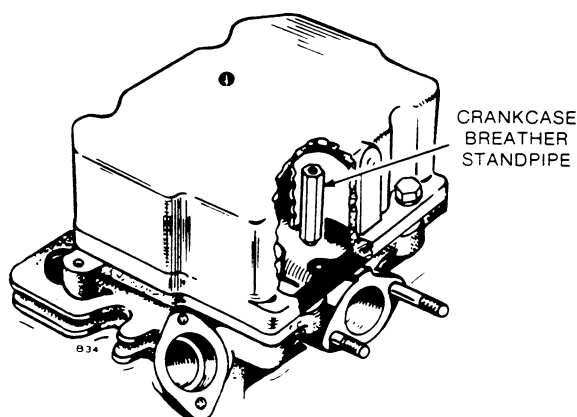


FIGURE 21. CRANKCASE BREATHER STANDPIPE

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 100 hours, remove the sediment bowl from the fuel transfer pump and filter body (Figure 22). 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.

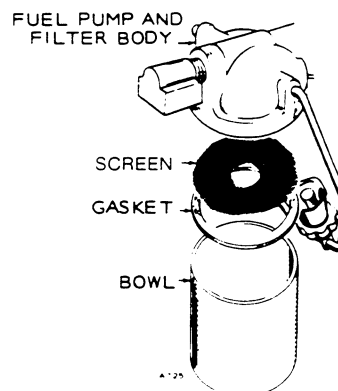


FIGURE 22. FUEL PUMP SEDIMENT BOWL

Fuel Filters

Every 100 hours, open the drains on the bottom of the fuel filter assembly (Figure 23) 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.

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 minimum 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 extensive damage.

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 24).
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.

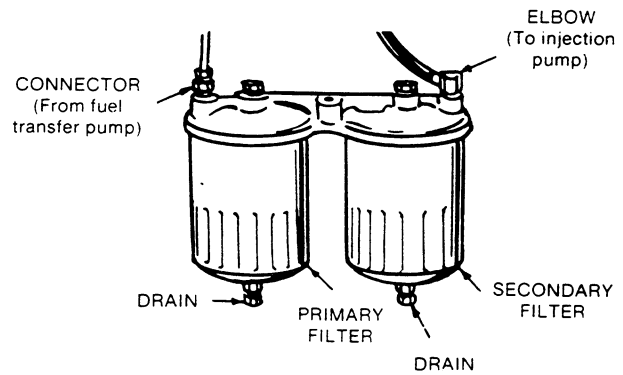


FIGURE 23. DUAL FUEL FILTERS

Zinc Pencil

The sea water side of the heat exchanger 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 24). The pencil should be inspected at least every two months and replaced if deteriorated to less than 1/2 inch (13 mm). This schedule applies only when craft is used on salt sea water.

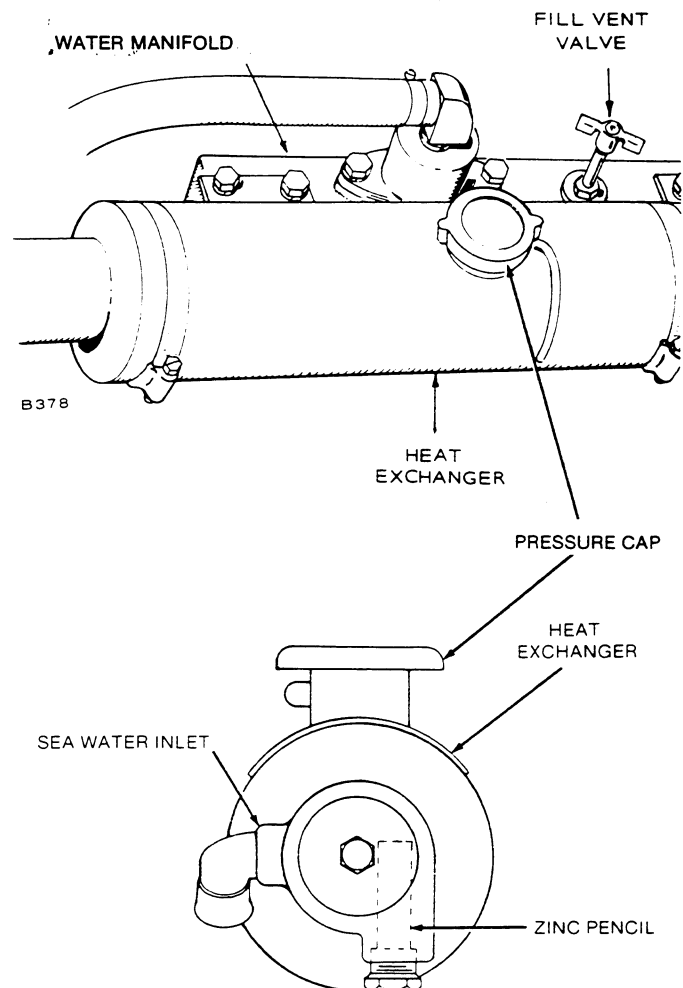


FIGURE 24. FILLING HEAT EXCHANGER/ZINC PENCIL LOCATION

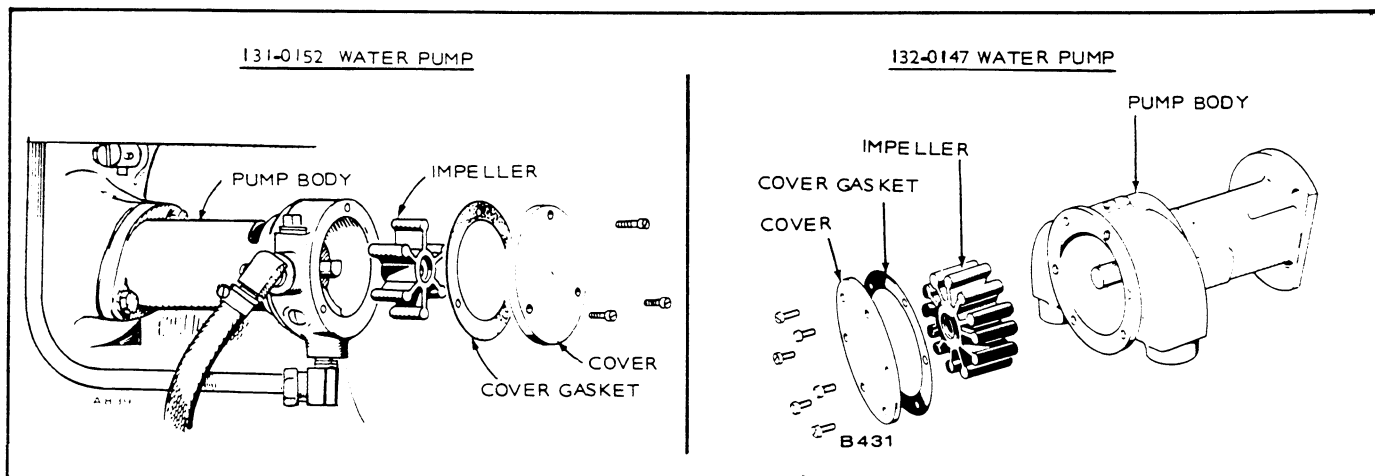


FIGURE 25. WATER PUMP

Sea Water Pump Impeller

Remove the cover of the water pump (Figure 25) and inspect the neoprene impeller. If worn or damaged, install a new one. When re-installing the water pump cover, make sure the cover is airtight to prevent early pump impeller failure. Tighten the cover screws 15 to 17 inch-pounds (1.70 to 1.92 N•m).

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.

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

High Temperature Cut-Off Switches

Two normally closed switches, opened by high operating temperatures, close the fuel solenoid and stop the engine. One on the rear of the cylinder head senses coolant temperature. Another on the exhaust elbow senses high exhaust temperatures. They are series connected, and permit restarting when safe operating temperatures are reached. If shutdown occurs, check the water pump belt, impeller and the thermostat.

BATTERIES

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water. Check specific gravity; 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.

AC GENERATOR

Periodic inspections that coincide with decommissioning/commissioning of the vessel will ensure good performance. Inspect the rotating rectifier assemblies (Figure 26) for freedom of foreign matter that may cause diodes to overheat and fail. If necessary, clean the assembly with filtered, low pressure air. Ensure all components and connections are secure.

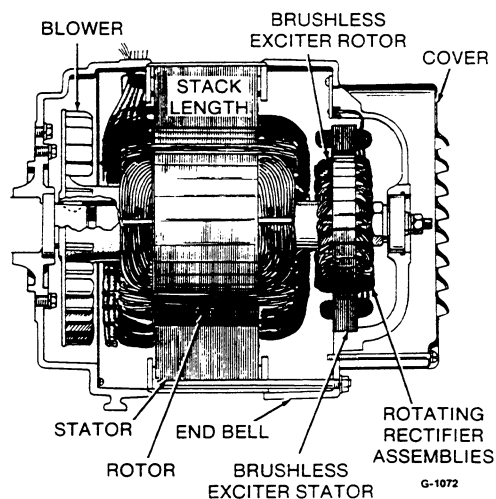


FIGURE 26. GENERATOR (CUTAWAY VIEW)

TORSIONAL WASHERS

Four torsional washer assemblies are bolted inside the flywheel pulley hub (Figure 27). When functioning properly, they react to relieve torsion stresses on the crankshaft. Inspect the assemblies periodically

for free movement of washers and freedom from corrosion (1500 hours on commercial craft, yearly non-commercial). Inspection requires removal of the belt guard cover. If condition is questionable, contact an Onan service center or distributor.

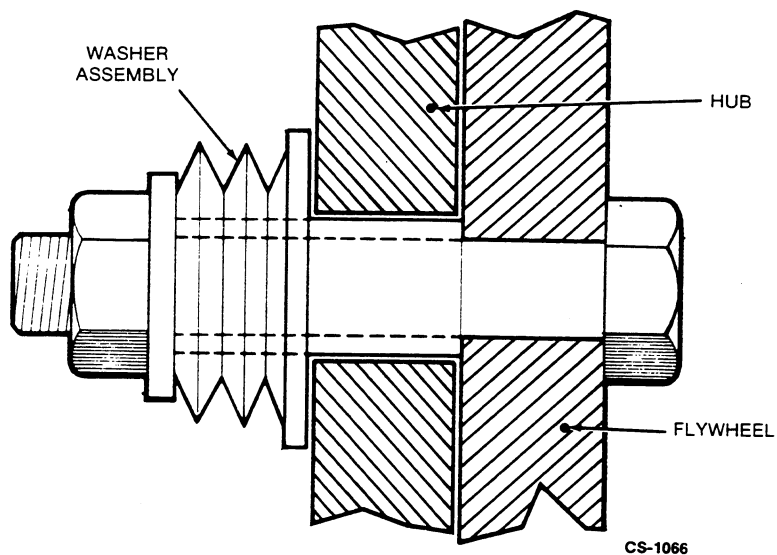


FIGURE 27. TORSION WASHER ASSEMBLY

Adjustments

CENTRIFUGAL SWITCH

The start-disconnect centrifugal switch (Figure 28) is located on the gear cover on the side of the engine above the oil filter. The switch opens when the engine stops and closes when engine speed reaches about 900 rpm. Remove battery B+ from switch (Faston connector) before checking or adjusting gap. Loosen the stationary contact and adjust the point gap at 0.020 inch (0.51 mm). Replace burned or faulty points.

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

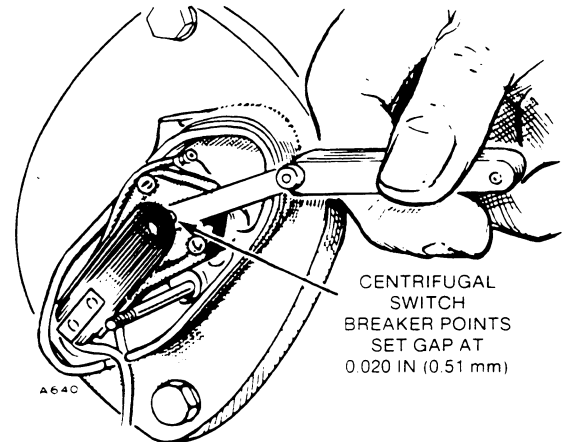


FIGURE 28. CENTRIFUGAL SWITCH

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

29). Turn the nut clockwise (more spring tension) to increase rpm and counterclockwise to reduce governed speed. Use a frequency meter to check rpm.

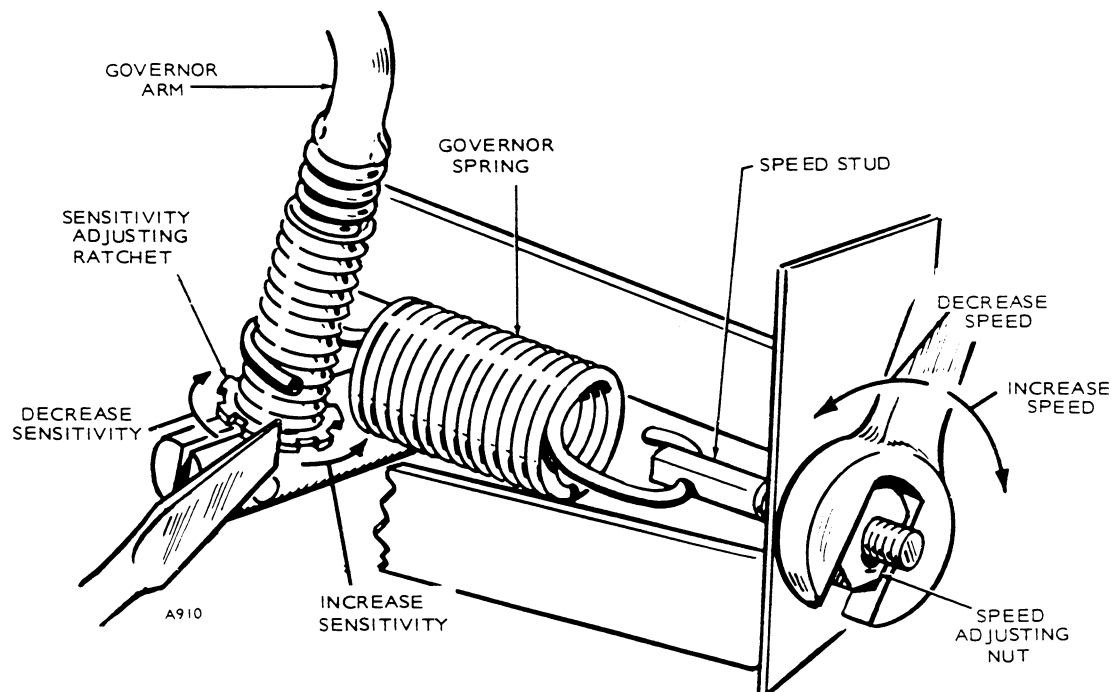


FIGURE 29. GOVERNOR ADJUSTMENT

Sensitivity Adjustment

To adjust governor sensitivity (no load to full load speed droop), turn the sensitivity adjusting ratchet accessible through a covered access hole on the side of the blower housing. Counterclockwise gives more sensitivity (less speed drop when full load is applied), clockwise gives 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. When finished, replace the knockout plug in the blower housing and secure speed stud lock nut.

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.



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