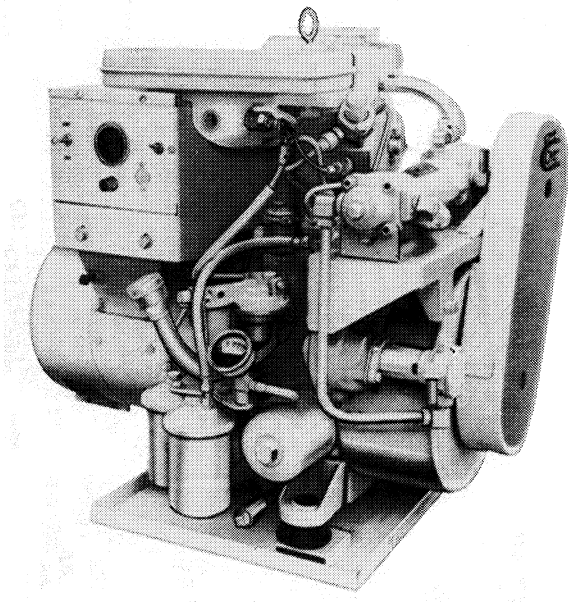
Onan Operators Manual

SERIES
MDJA
GenSet

Marine Electric Generating Set



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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 **Onan uses this symbol 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 for a remote fuel supply source.
- 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 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.
- Onan suggests 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. Electrocution 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.

Table of Contents

Introduction

YOUR MDJA GENERATOR SET

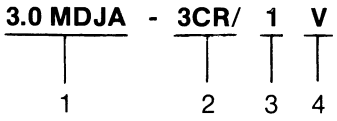
The MDJA generator set has a one cylinder diesel engine and a 3.0 kW (2.5 kW for 50 Hertz) alternating current generator. The standard control box has a battery charge rate ammeter, preheat switch, a start-stop switch and field circuit breaker on the control panel.

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.

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.

EXPLANATION OF MODEL NUMBER

Following is a typical model number with an explanation of the various parts.



1. Factory code for general identification.
2. Specific Type:
   C — Indicates reconnectible.
   R — Remote, electric starting. For permanent installation, can be connected to optional accessory equipment for remote or automatic control of starting and stopping.
3. Factory code for optional equipment.
4. Specification (Spec) letter (advances when factory makes production modifications).

YOUR MANUAL

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

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.

WARNING

ONAN RECOMMENDS THAT ALL SERVICE AND INSTALLATION OF REPLACEMENT PARTS BE DONE BY QUALIFIED ELECTRICAL AND/OR MECHANICAL SERVICE PERSONNEL. FROM THE STANDPOINT OF POSSIBLE INJURY AND/OR EQUIPMENT DAMAGE, IT IS IMPERATIVE THAT SERVICE PERSONNEL BE QUALIFIED.

Specifications

GENERAL

Nominal Dimensions of Generator Set (inches)	
Height	26.81 (681 mm)
Width	20.62 (524 mm)
Length	28.62 (727 mm)
Weight (approx. lb.)	365 (166 kg)

ENGINE DETAILS

Number of Cylinders	1
Displacement (cubic inch)	30 (491.7 cm^3)
Cylinder Bore (inches)	3.25 (82.55 mm)
Piston Stroke (inches)	3.625 (92.07 mm)
BHP at 1800 rpm	7 (5.2 kW)
RPM (for 60 hertz)	1800
RPM (for 50 hertz)	1500
Compression Ratio	19:1

CAPACITIES AND REQUIREMENTS

Battery Voltage	12 volt
Battery Size	
SAE Group. 1H 6 Volt	Two in Series
Cold Cranking Amps @ 0° F (-18° C)	450
Amp. Hr., SAE 20 Hr. (nominal)	105 (378 kC)
Battery Charge Rate Ampere (normal)	2-5
Oil Capacity in U.S. Quarts - Refill	2.5 (2.4 litre)★
Cooling Water Flow (gallons per minute)	4 (15 litre)
Generator Cooling Air (CFM at 1800 rpm)	75 (2.12 m^3/min)
Combustion Air (CFM at 1800 rpm)	16 (0.453 m^3/min)
Total Cubic Feet Per Minute of Air Required	91 (2.573 m^3/min)
Diesel Fuel Lift (maximum)	6 feet (1.83 m)

GENERATOR DETAILS

Output is rated at Unity Power Factor Load	1 phase
Ratings (Output in Watts)	
60 hertz AC Service	3000
50 hertz AC Service	2500
AC Voltage Regulation in %	5
AC Frequency Regulation in %	5
Generator Design	Revolving Armature

TUNE-UP SPECIFICATIONS

Cylinder Head Bolt Torque (lbs. ft.)	44-46 (60-62 N•m)†
Valve Clearance	
Intake	.020 inch (.508 mm)
Exhaust	.020 inch (.508 mm)

* - 30-9/16" (776 mm) on 4 wire models.
★ - Plus 1/2 quart (.47 L) for new filter.
† - Apply Never Seeze or equivalent to capscrew threads and under capscrew head.

Installation

GENERAL

Proper installation is very important. Requirements to consider must 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), the National Fire Protection Association (NFPA) and the United States Coast Guard (USCG).

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."*

The instructions in this manual are only a guide as each installation must be considered on an individual basis.

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. This generator set cannot be installed in the propulsion engine compartment unless specific conditions are met.

USCG regulation 33CFR183 requires a generator set operating in a gasoline fuel environment be "ignition protected." This means a set capable of operating in an explosive environment without igniting that environment.

The MDJA must not be installed on a gasoline powered boat unless it is isolated from gasoline engines and gasoline fuel system components, except for uninterrupted runs of fuel lines. See USCG publication *"Electrical System Compliance Guideline"* for details.

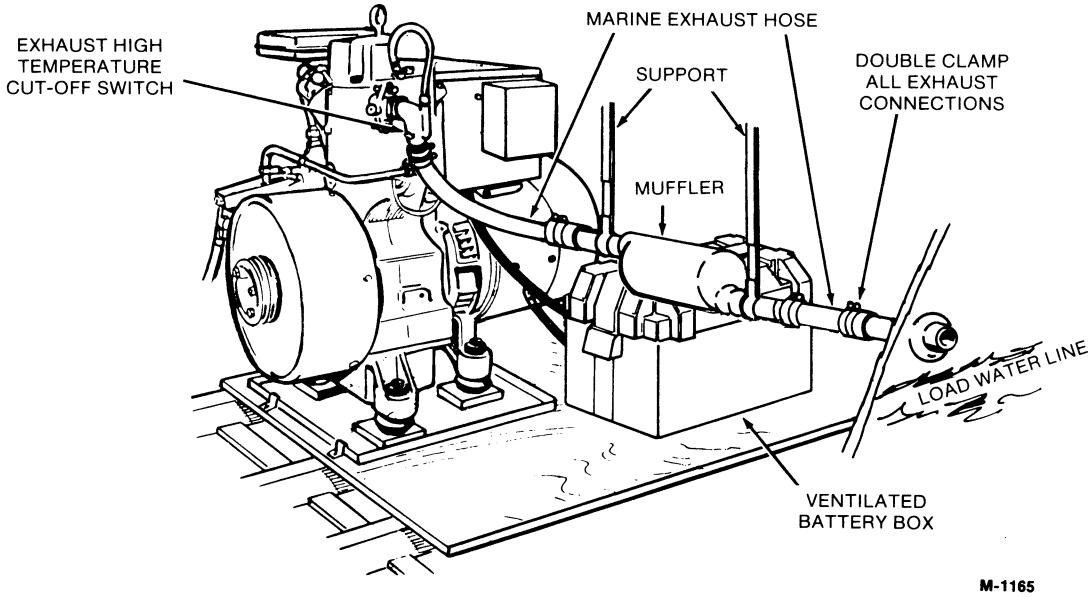


FIGURE 1. TYPICAL INSTALLATION

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.

MOUNTING

The floor should be flat and give support directly under the set mounting points. See Figures 1 and 3. A 2-1/2 inch (64 mm) clearance around the unit is required to permit rocking on its mounts without restraint. Use approved 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. Install the two hold-down clamps to drip pan (front and rear or both sides). Secure clamps to the mounting base.

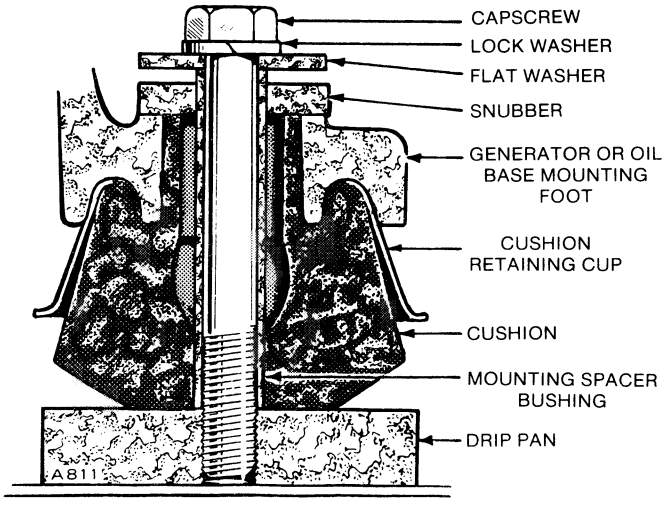


FIGURE 2. MOUNTING CUSHION

OIL DRAIN

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

VENTILATION

The generator 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's 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. 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.

WARNING ***Exhaust line fittings must be gas tight to prevent leakage of poisonous exhaust fumes into the engine compartment. Inhalation of exhaust gases can result in death. The exhaust system must be inspected visually and audibly for leaks during each eight hour period of operation.***

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 (13 mm) at each end of hose. See Figure 3.

A flexible section of exhaust line should be installed between the engine and muffler (Figure 3). Do not connect the muffler directly to the exhaust manifold. Use rubber hose only in the water-cooled sections 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.***

Raise the dry portion of the exhaust line high enough to prevent water backflowing into the engine under all conditions. The water jacketed exhaust manifold is pipe tapped at both ends for convenience in exhaust line connection. The engine exhaust connection is 1-1/4 inch pipe tapped.

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. Because of installation variables, customers must provide the brackets, hoses and clamps, required for installation. Installation instructions are included with the 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 may flow back, flooding the engine cylinders. This can happen only if the generator set is not running and boat is underway.***

CAUTION ***Do not weld on the muffler. Welding will damage the interior protective coating decreasing the life expectancy.***

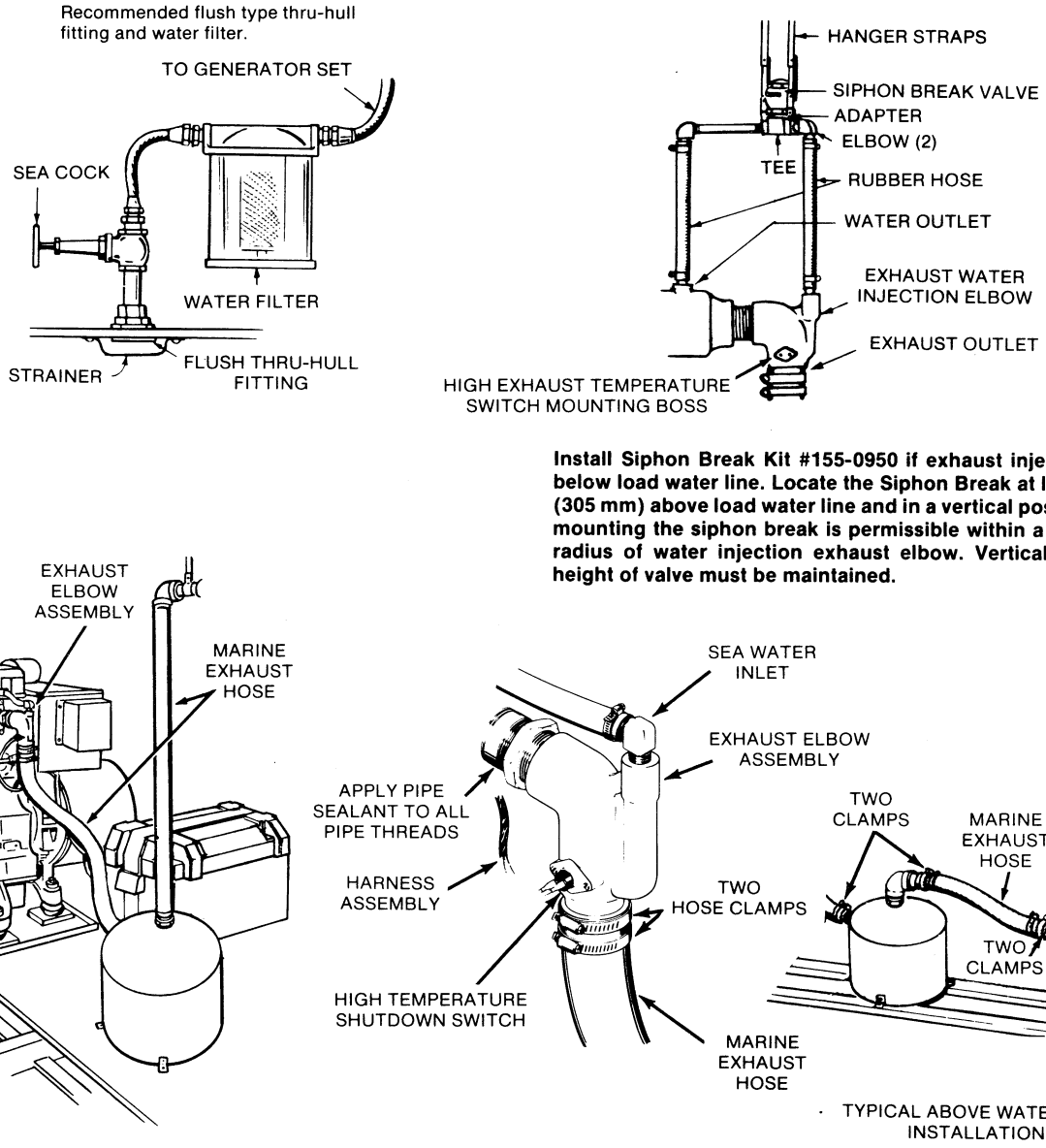


FIGURE 3. TYPICAL INSTALLATION WITH AQUALIFT MUFFLER

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. Maximum allowable exhaust back pressure is 3 inches of mercury (10 kPa).

Exhaust Cooling Water Injection

Cool the exhaust with all of the electric generating set cooling system water output. If a keel cooler is used, install a separate hull water inlet and use the engine-mounted neoprene impeller pump to provide exhaust cooling water. The switch on the exhaust elbow shuts the unit down if the exhaust overheats (about 190° F (88° C).

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.

High Exhaust Temperature Shutdown Switch

A high exhaust temperature shutdown switch is included on all units. The switch mounts on a raised boss on the exhaust elbow (Figure 3), and stops the generator set if the exhaust system overheats. The switch is wired in series with the high water temperature shutdown switch on the engine block.

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 in a salt water environment should use either a keel type or heat exchanger type closed cooling system.

Three types of marine cooling systems in general use today are sea water, heat exchanger and keel or skin cooling. The standard MDJA model uses sea water cooling. Heat exchanger and keel cooling are optional equipment.

The engine block has a drain plug for draining coolant. See Figure 4.

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.

WARNING ***Exhaust line fittings must be gas tight to prevent leakage of poisonous exhaust fumes into the engine compartment. Inhalation of exhaust gases can result in death. The exhaust system must be inspected visually and audibly for leaks during each eight hour period of operation.***

WARNING ***Be careful when checking coolant under pressure. Shut engine down and bleed off pressure before removing pressure cap. Severe burns could result from contact with hot coolant.***

Sea Water Pump

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 (Figure 4). 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.***

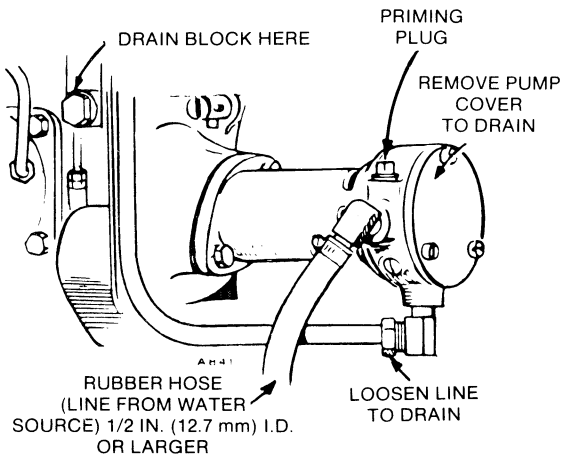


FIGURE 4. SEA WATER PUMP

Sea Water Cooling

This system uses a continuous supply of sea water through the engine for cooling. 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.

Normally, the pump should deliver four gallons (15 L)

of cooling water per minute. Measure the discharged water flow after thermostat opens, to assure the supply line is large enough. Reduce resistance on pipe runs longer than five feet (1.5 m) by using larger inside diameter plumbing.

An air leak in the water inlet line reduces lubrication and shortens life of pump's impeller. Install a strainer in the water inlet and where accessible for cleaning.

Heat Exchanger Cooling (Optional)

This is a closed cooling system referred to as captive water cooling. Water circulated through the engine and heat exchanger is termed captive water in the closed system. Water circulated through the heat exchanger only is called sea water. The discharged sea water from the heat exchanger goes into the exhaust line. Supply line connections are the same as standard system.

A heat exchanger with antifreeze coolant is recommended where freezing hazards exist or where the owner wants to prevent salt water corrosion problems. See Figure 5. *Cooling system capacity is 2-1/4 quarts.*

Install a new zinc "pencil" (Figure 5) which screws into sea water inlet end of heat exchanger, every two months or as inspection dictates.

Onan recommends filling of the captive cooling system with a 50-50 mixture of ethylene glycol and water. Do not exceed a 50-50 mixture. A stronger antifreeze mixture will alter heat transfer properties of the coolant.

The heat exchanger and engine block have drain plugs for changing coolant (Figures 4 and 5). Prime the sea water pump on initial start up as described in the *OPERATION* section.

Do not use existing neoprene impeller 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 cold water side. Use a centrifugal metal impeller water pump (Onan No. 132-0110 or equal) in the captive water side. Drive it with a belt from the set's power take-off.

The heated sea water discharge line connects the heat exchanger to the exhaust outlet as shown in Figure 5. The exhaust package shipped with the marine generator set must be installed before initial start-up of the generator set. Installation instructions are included in the exhaust package.

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 6 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). User must provide the expansion tank and necessary plumbing.

Do not use the existing neoprene impeller pump for the captive water side of the cooling system. Always connect the neoprene impeller pump to the sea water side. Use a centrifugal metal impeller pump in the captive water side.

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

Prime the sea water pump on initial start up as described in the *OPERATION* section.

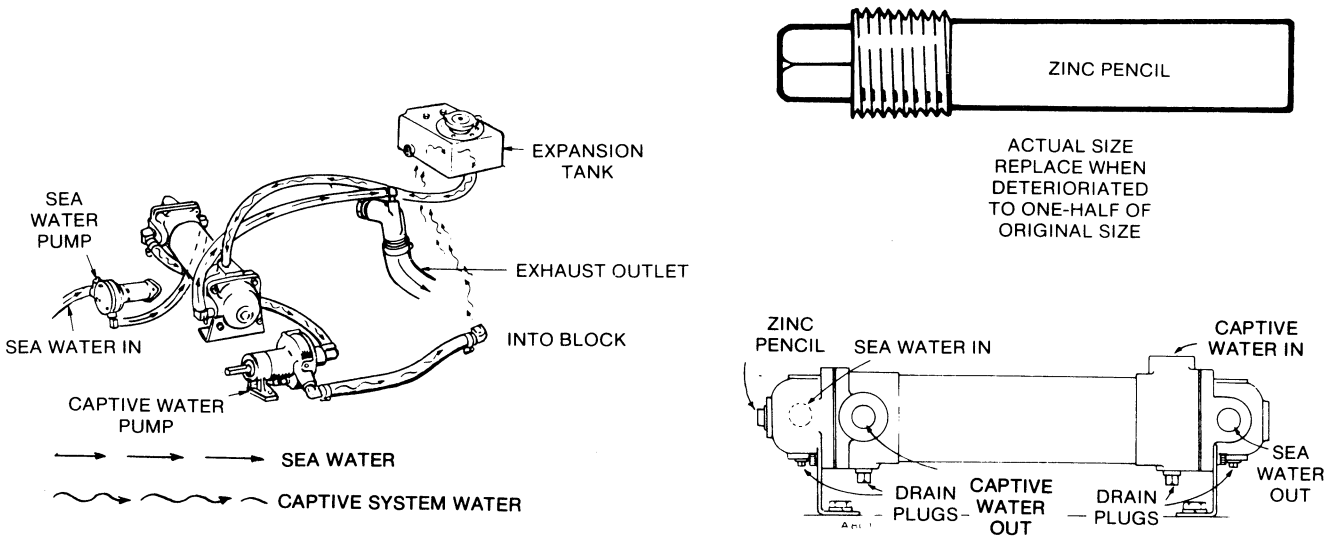


FIGURE 5. HEAT EXCHANGER PLUMBING

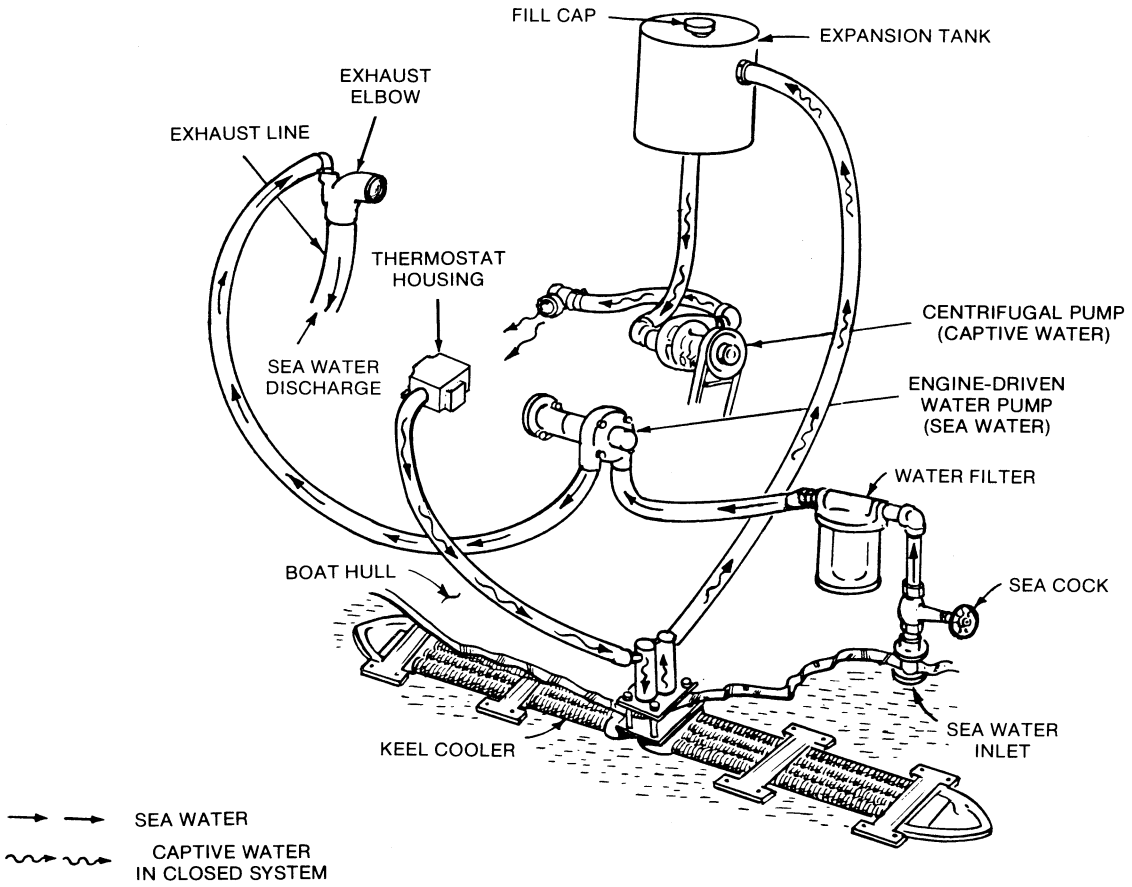


FIGURE 6. KEEL COOLING PLUMBING

FUEL SYSTEM

Fuel Tank

If a separate fuel tank is used, install the tank so the bottom is less than 6-feet (1.83 mm) below the fuel pump. If the fuel lift must exceed 6-feet (1.83 mm), install an auxiliary electric fuel pump at the fuel supply. 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 7). The return line must not be above the injector nozzle.

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).

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 7).

Always use approved flexible hose between the engine and fuel supply line. Use a hose 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 hose conforms to the requirements of USCG regulation 183.558.)

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.

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 and damage injectors and injection pumps.***

ELECTRICAL CONNECTIONS

The nameplate on the generator set shows the electrical output rating of the generator in watts, volts, and hertz. The wiring diagram, shipped with the generator set, shows the electrical circuits and connections needed during installation. All electrical con-

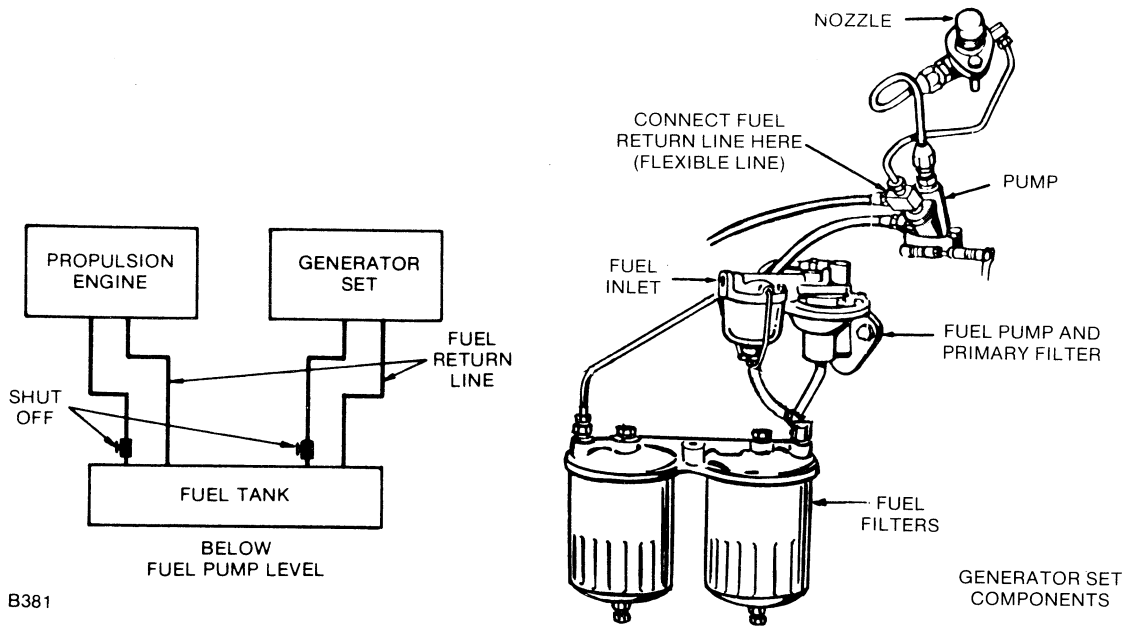


FIGURE 7. FUEL SYSTEM

nections must be done by a qualified serviceman or electrician to meet the electrical code requirements in your area.

Load Wires

The control box (junction box) has knock out sections to accommodate load wires. Use flexible conduit and stranded load wires near the set to absorb vibration. Use sufficiently large insulated wires. Strip insulation from wire ends as necessary for clean connections. Connect each load wire to the proper generator output lead inside the set box. Insulate bare ends of ungrounded wires. Use a bolt (through the control box) to connect the generator ground lead and load wire. Install a fused main switch (or circuit breaker) between the generator and load.

WARNING ***It is extremely important for life safety that bonding and equipment grounding be properly done, and that all metallic parts likely to become energized under abnormal conditions be properly grounded.***

Code 3C or 53C Reconnectible Generators: The single phase, 60 and 50 Hertz generators have output leads M^1, M^2, M^3, and M^4 available for making the single phase voltage and load connections shown in Figure 8 at the installation site. Grounding procedure should comply with local codes.

Balance All Loads

Divide any 120-volt loads approximately equally between the two 120-volt circuits. Overloading can damage the generator windings.

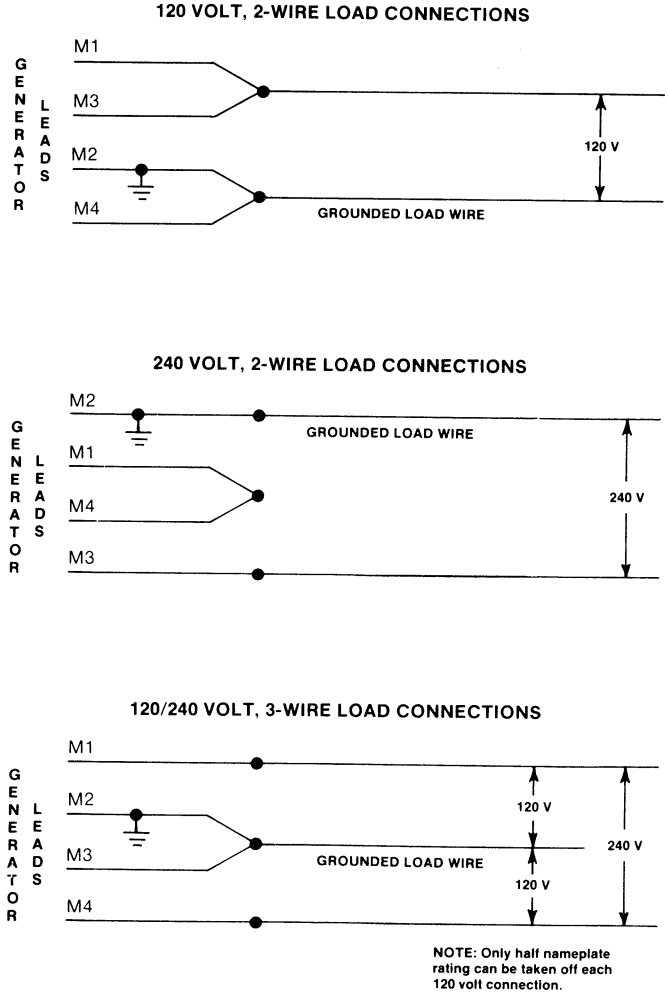


FIGURE 8. LOAD WIRING CONNECTIONS

Switchboard

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

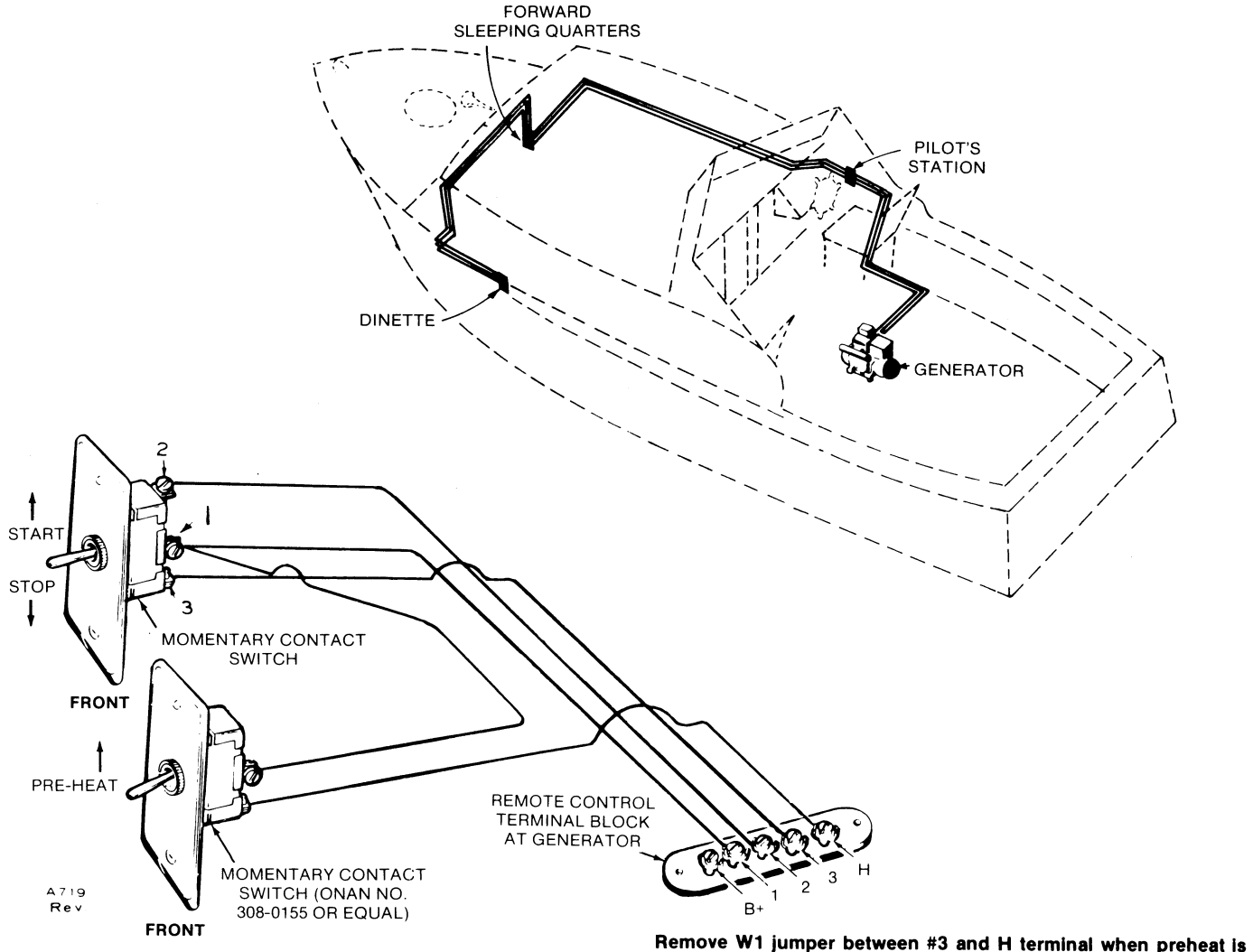
1. Connect one ungrounded (hot) generator lead to the unused terminal on each ammeter.
2. Connect the generator lead and load wires which are to be grounded to the ground stud on the switchboard.
3. Connect one ungrounded (hot) load wire to the unused terminal on each circuit breaker.
4. On sets that generate more than one voltage (example: 120/240), the voltmeter should be wired to indicate the higher of the two voltages.

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 to the load at the same time. Either a manual switch or the Onan marine load transfer control can be used for this function.

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 9. 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.



Remove W1 jumper between #3 and H terminal when preheat is used with automatic demand or transfer switch.

FIGURE 9. REMOTE CONTROL

BATTERY CONNECTIONS

The battery is connected for negative (-) ground, Figure 10. Be sure all battery connections are secure. Coat the terminal connections with mineral grease or petrolatum to retard corrosion.

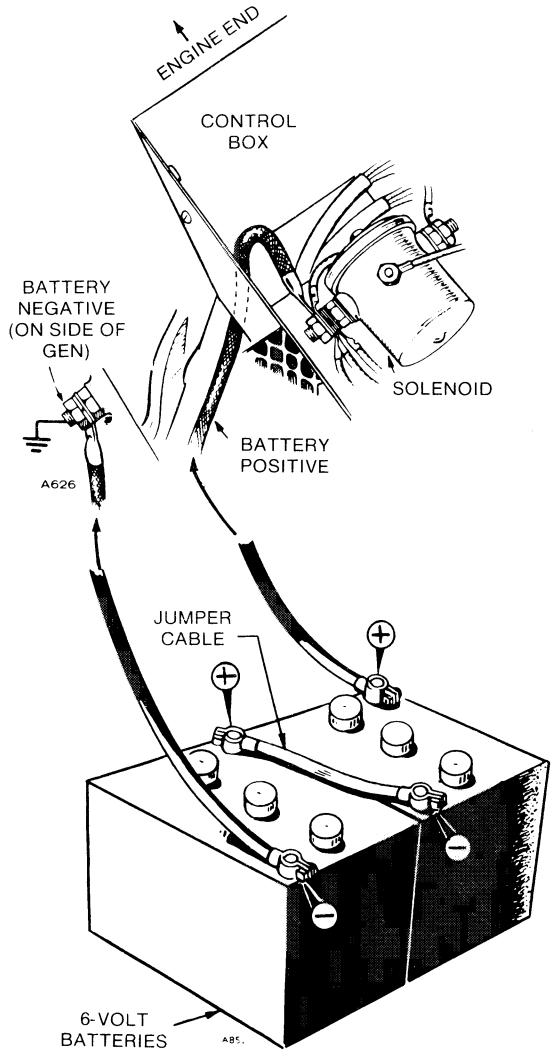


FIGURE 10. 12 VOLT BATTERY CONNECTION

Battery polarity must agree with the rectifier located in the control box. If battery ground must be changed, reverse the rectifier connection in the control box.

CAUTION ***If battery polarity is reversed without reversing the rectifier, damage will occur within 3 minutes while stopped or 5 seconds while running.***

Provide two 6 volt batteries connected in series (one battery's negative to other battery's positive) for a 12 volt source. See *SPECIFICATIONS* for minimum battery requirements. Connect the remaining battery positive (+) to the start solenoid (located in the control box). Connect the battery negative (-) to a good ground on the generator frame.

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

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 11. 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.***

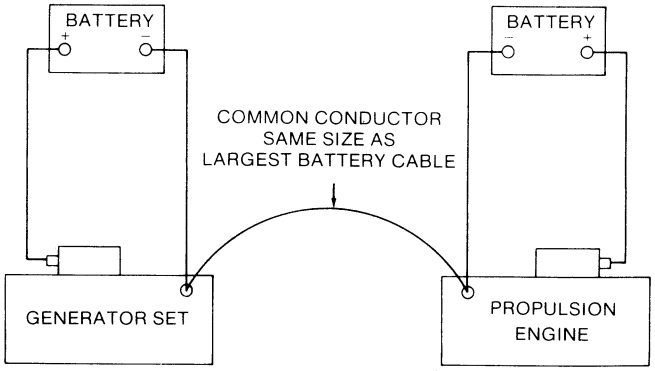


FIGURE 11. COMMON CONDUCTOR CIRCUIT

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.

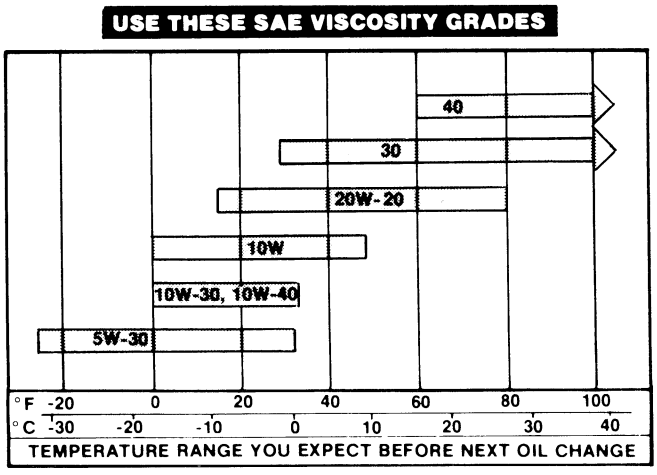
The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

PRESTART SERVICING

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 preceding chart.

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.***

Cooling System

The cooling system was drained prior to shipment. Fill system before starting as described under *Cooling System* in the *INSTALLATION* section. Also see special instructions on page 19 for filling the heat exchanger.

Fuel System

Check the fuel system to be sure fuel supply is adequate and that the lines are free of air. Bleed air from fuel system as follows: Disconnect the fuel return line. See Figure 12. Operate the hand priming lever on diaphragm type 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.

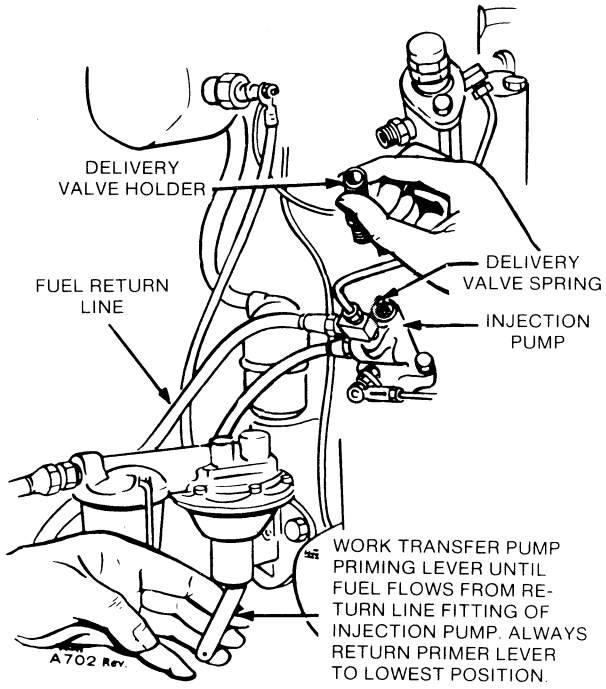


FIGURE 12. BLEEDING THE FUEL SYSTEM

If engine will not start after performing the above procedure, use this alternate method of bleeding the fuel system. Completely loosen the lower nut on the injection pump to nozzle fuel line. Loosen the delivery valve holder, located below the fuel line nut, until it can be turned with the fingers. Crank engine until clear fuel emerges around the loosened delivery valve holder. Retighten the fuel line and torque the delivery valve holder to 30 lbs. ft. (41 N•m) torque. Fuel injection should occur almost immediately when engine is cranked.

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 ensure proper operation, remove the plug from the sea water pump inlet fitting (Figure 4). Fill the pump with water to lubricate and prime it. Replace plug before operation.

Controls

Before operation, become familiar with the various controls and instruments of the MDJA generator set.

The control box has a battery charge rate ammeter, pre-heat switch, start-stop switch and fuse on the control panel, Figure 13.

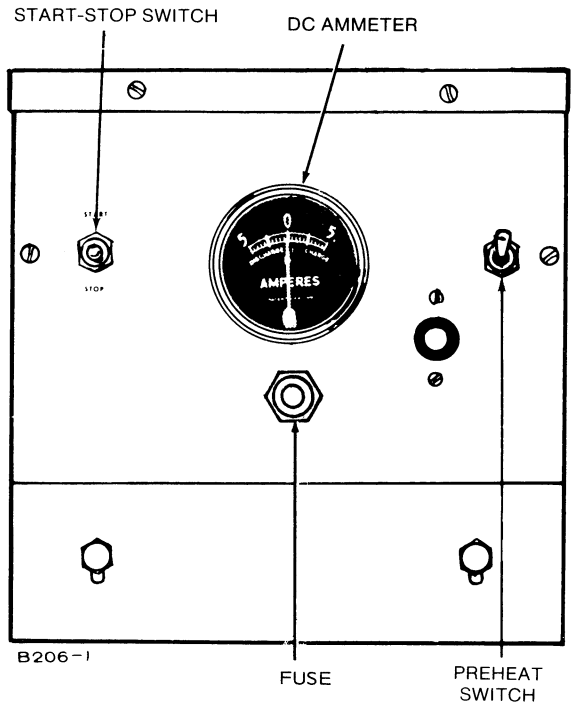


FIGURE 13. TYPICAL MARINE SET CONTROL PANEL

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

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

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

Fuse: This 10-ampere fuse protects the wiring harness, fuel solenoid, ignition and general control components.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine (located on the engine service side).

Batteries

Ensure that cable connections to the batteries are clean and tight. Coat connections with petroleum based or non-conductive grease to retard formation of corrosive deposits.

STARTING

1. For cold engine starting, depress the Preheat switch 30 seconds for temperatures above 55°F (13°C), 60 seconds below 55°F.
2. Push start-stop switch to its START position (Figure 14).
3. Release switch after engine starts and reaches speed.

   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* (page 17) when starting problems are encountered.

CAUTION ***Do not exceed the one minute preheat periods; longer preheating time prior to cranking the engine can ruin the manifold heater and glow plugs because there is no incoming air flow to cool them. Additional operation of the preheaters for a few seconds during cranking in cold weather may help to preheat the incoming combustion air and prevent misfires as the engine starts running.***

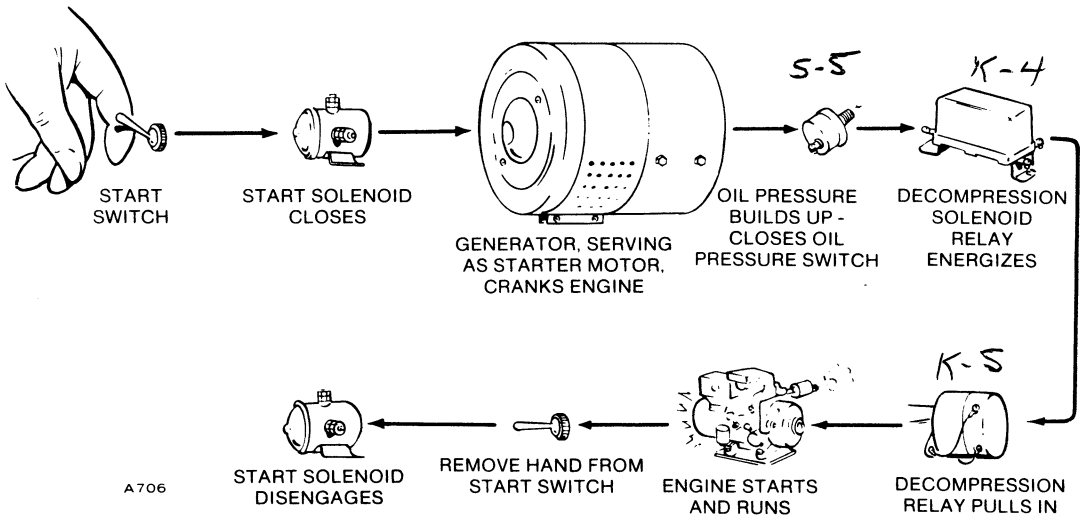


FIGURE 14. STARTING CYCLE

ONAN DIESEL STARTING GUIDE (DJA, MDJA)

IMPORTANT!

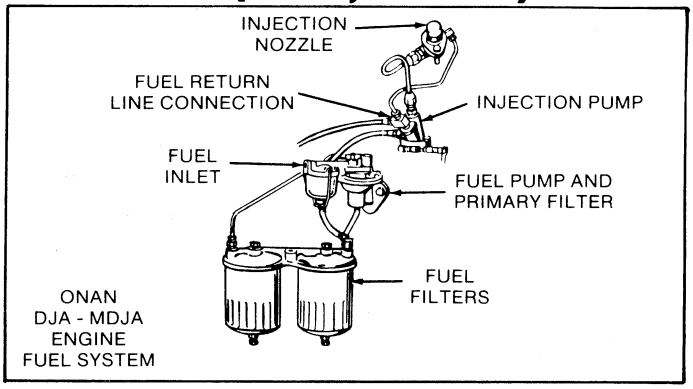
KEEP ENTIRE FUEL SYSTEM CLEAN AND FREE FROM WATER

- DIESEL INJECTION PUMPS WILL FAIL IF SYSTEM CLEANLINESS IS NEGLECTED

INJECTION PUMPS AND NOZZLES ARE NOT FIELD REPAIRABLE

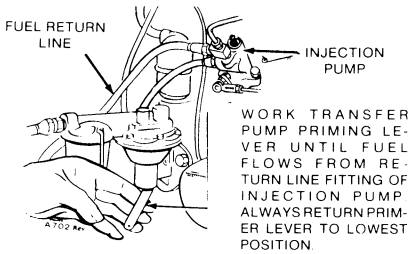
- WHEN TROUBLESHOOTING, CHECK ALL OTHER COMPONENTS FIRST

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). IF NECESSARY, USE SURER ALTERNATE METHOD AS DESCRIBED IN MANUAL.

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 PREHEAT. 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.**

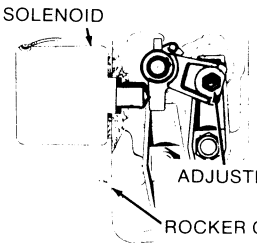
OBSERVE ENGINE EXHAUST "SIGNALS":

BLUE-WHITE EXHAUST SMOKE: ENGINE IS GETTING FUEL (FUEL FLOWS STEADILY FROM FUEL RETURN LINE).

CHECK PREHEAT SYSTEM:

- **ENGAGE PREHEAT AND OBSERVE HEATER THRU AIR INLET HOLE OR BY REMOVING AIR CLEANER. ELEMENT SHOULD GLOW RED WITHIN 30 SECONDS—IF NOT, CHECK FOR CLEAN, TIGHT CONNECTIONS.**

CHECK DECOMPRESSION MECHANISM:



- **AS CRANKING SPEED INCREASES, OIL PRESSURE SWITCH ACTIVATES SOLENOID, EXHAUST VALVE CLOSES AND CAUSES COMPRESSION.**
- **CHECK ADJUSTMENT AS OUTLINED IN MANUAL.**

LITTLE OR NO SMOKE. PRIME FUEL SYSTEM AS SHOWN ABOVE.

LITTLE OR NO FUEL FLOW FROM RETURN LINE.

CHECK FUEL SUPPLY SYSTEM:

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

FUEL FLOW FROM RETURN LINE, STILL NO SMOKE?

USE ALTERNATE BLEEDING METHOD AS STATED IN MANUAL.

CHECK TRANSFER PUMP:

- **CRANK ENGINE AND OBSERVE FUEL FLOW FROM RETURN LINE. IF FUEL DOES NOT SPURT OUT, PUMP MAY BE DEFECTIVE.**

8-79
98-4019
900-0223

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

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.***

4. Oil pressure gauge should read at least 20 psi (138 kPa) with unit running.

AUTOMATIC STARTING AND STOPPING

Separate controls may be used for automatic start and stop, but they must provide engine preheating. The automatic control has a time delay relay to preheat glow plugs and the manifold heater for about 20 seconds before cranking occurs. The time delay relay prevents immediate engagement of the starter in case the load is reapplied before the engine stops.

STOPPING

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

SAFETY DEVICES

In case of dangerously high coolant (water) temperature or low oil pressure, the decompression solenoid stops the unit. After an emergency stop, investigate and correct the cause.

BREAK-IN PROCEDURE

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

1. One half at 1/2 load.
2. One half at 3/4 load.
3. Full load.

Continuous running under 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 after 50 hours of operation; drain while the engine is still warm. Retorque head bolts and adjust valve clearance on cold engine (see *SPECIFICATIONS*).

APPLYING LOAD

Allow the generator set to warm up before connecting a heavy load. Continuous overloading may cause high operating temperatures that can damage the engine or generator. The generator can safely handle an overload temporarily, but for normal operation, keep the load within nameplate rating. The exhaust system may form carbon deposits during extended operation at light loads; apply full load occasionally before shutdown to prevent excessive carbon 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
Electronic oven	750 to 1800 watts

PERIODIC EXERCISE

Infrequent use results in hard starting. Operate the generator set at least 30 minutes each week with not less than 1/2 load. Run longer if battery needs charging.

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 caution 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 antifreeze 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 fuel line connections for tightness and check the fuel supply tank for moisture. Drain if necessary and fill with fresh fuel.
3. Check the engine oil for moisture. If there is no moisture and the oil type and weight is correct, the oil is okay to use. Otherwise, drain and refill with new oil.
4. Check coolant level and adjust if necessary.
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 the entire generator set for water, fuel, or oil leaks. Correct leakage as required.
7. Check the 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 for general operation.
10. Remove load and stop the generator set.

DRAINING COOLING SYSTEM

Drain the entire cooling system including the water-cooled exhaust manifold and exhaust line. Drain the heat exchanger or keel cooler components, engine cylinder block, and water pumps on a yearly schedule.

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 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. Replace 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 overheating of the engine. See Figure 15. Therefore,

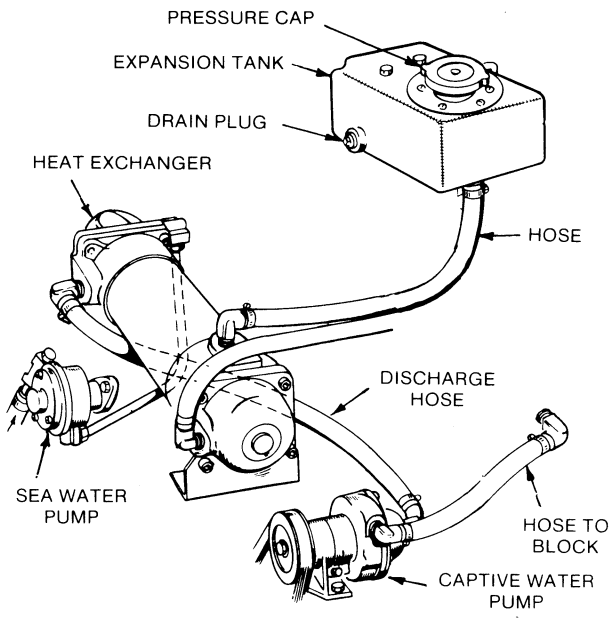


FIGURE 15. FILLING HEAT EXCHANGER

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 (50-50 water-antifreeze).
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.***

8. Slowly open pressure cap and check coolant level.
9. Fill system to top with coolant.

THERMOSTAT

A thermostat located on the cylinder head, is connected by tubing to the water cooled manifold. See Figure 16. Replace the thermostat if damaged by corrosion or other causes. If the thermostat is replaced, always install a new thermostat gasket.

HIGH TEMPERATURE CONDITIONS

1. See that nothing obstructs airflow to and from the generator set.
2. Keep cooling system clean. Maintain the coolant level in a closed cooling system.

LOW TEMPERATURE CONDITIONS

1. Use correct SAE grade oil for temperature conditions. Change oil only when engine is warm.
2. Use good quality fuel free of moisture and with proper cetane number.
3. Keep fuel system clean, and batteries in a well-charged condition.
4. Use additional preheating during cold starts (see *Onan Diesel Starting Guide*).

DUSTY AND DIRTY CONDITIONS

1. Keep the generator set clean. Keep cooling system clean.
2. Change crankcase oil every 50 operating hours.
3. Keep governor linkage clean.

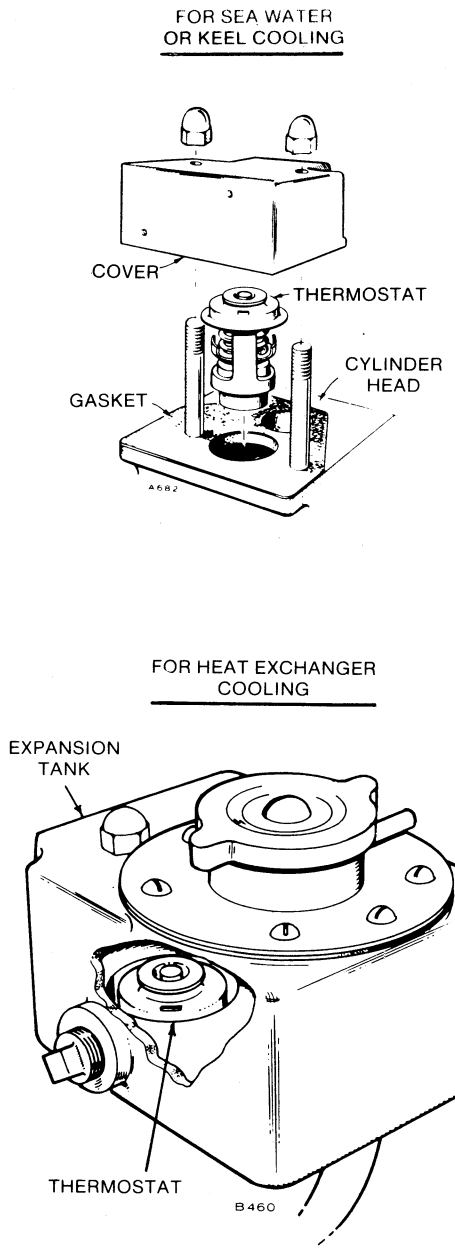


FIGURE 16. THERMOSTAT LOCATION

EMERGENCY OPERATION IF BATTERY FAILS

If the battery fails and set must be operated during an emergency, a battery can be shared with other equipment. Refer to *Battery Connections* section on page 13.

Periodic Maintenance

GENERAL

Follow a regular schedule of inspection and servicing, based on operating hours (Table 1). Keep an accurate logbook of maintenance, servicing, and operating time. Regular service periods are recommended for normal service and operating conditions. For continuous duty, extreme temperature, etc., service more frequently.

WARNING ***Before commencing 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.***

TABLE 1.
OPERATOR AND SERVICE MAINTENANCE SCHEDULE

HOURS OF OPERATION	MAINTENANCE TASK
8	• Inspect generator set, see Note 1 • Check fuel supply, see Note 2 • Check oil level
100	• Change crankcase oil • Drain fuel condensation traps in lines and filters, see Note 2
200	• Clean crankcase breather • Replace oil filter • Check battery condition
500	• Check valve clearances
600	• Change primary fuel filter
2000	• Grind valves (if required) • Clean holes in rocker box oil line • Check nozzle spray pattern, see Note 3 • Clean generator
3000	• Change secondary fuel filter
5000	• General overhaul (if required) see Note 4

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. This service must be conducted by trained diesel injection equipment personnel with suitable test facilities. Omit this service until these conditions can be met.

4. Retorque head bolts and adjust valve clearance after first 50 hours on an overhauled engine (see *SPECIFICATIONS*).

***** If set develops loss of power (cannot take load), change fuel filters. Water in fuel will be evidenced by black slime on filters caused by bacteria.

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

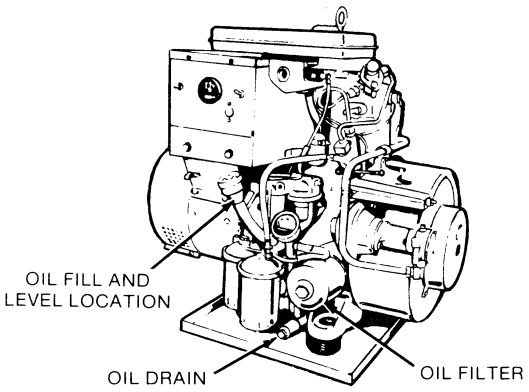
1. Check all fuel and oil lines for possible leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks.
3. Periodically or daily, drain moisture from condensation traps.
4. Inspect electrical wires and connections for security and fray damage.

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

CRANKCASE OIL

Oil capacity of the MDJA is 2.5 U.S. quarts (2.37 L) plus 1.0-pint (.47 litre) for the oil filter. Fill the crankcase until the oil reaches the full mark on the oil level indicator (Figure 17). 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, the oil should be changed sooner.

Figure 17 shows the location of the oil drain, oil fill, and oil filter.



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

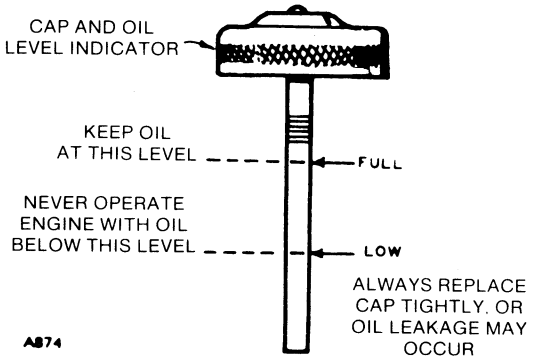


FIGURE 17. LOCATION OF OIL FILL, DRAIN AND OIL FILTER

OIL FILTER

Change the oil filter every 200 operating hours. Remove the filter by turning counterclockwise (can use a filter wrench). With your finger, place a drop of clean oil on the filter gasket of the new filter. Install the filter fingertight plus 1/4 turn. If oil becomes so dirty that the markings on the oil level indicator cannot be seen, shorten both the filter and oil change service periods.

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

CRANKCASE BREATHER

To clean the crankcase breather assembly shown in Figure 18, remove the hose clamp, hose, breather cap clamp and insulator halves. Wash the cap and valve assembly and baffle in a petroleum-base solvent. Dry and reassemble.

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

SEA WATER PUMP IMPELLER

Remove the cover of the water pump as shown in Figure 19 and inspect the neoprene impeller. If worn or damaged, install a new one. Lubricate impeller with grease when replacing. 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).

FUEL PUMP SEDIMENT BOWL

Every 100 hours, remove the sediment bowl from the fuel transfer pump and filter body (Figure 20). Clean out any water or particulate from the bowl and filter. When re-installing the sediment bowl, make sure the filter and gasket are in place.

FUEL FILTERS

Every 100 hours, open the drains on the bottom of the fuel filter assembly (Figure 21) 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.

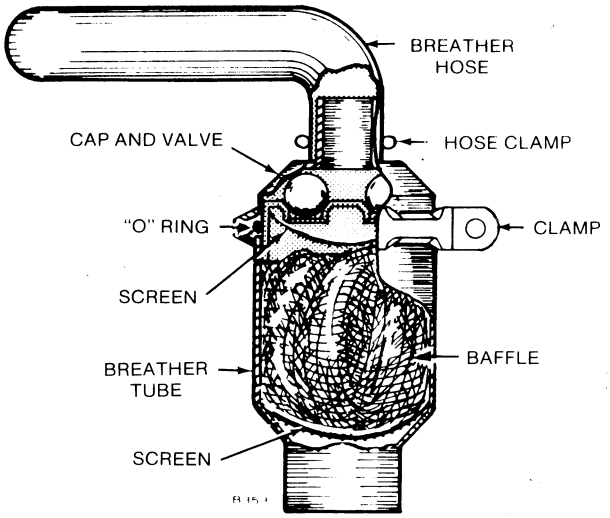


FIGURE 18. CRANKCASE BREATHER

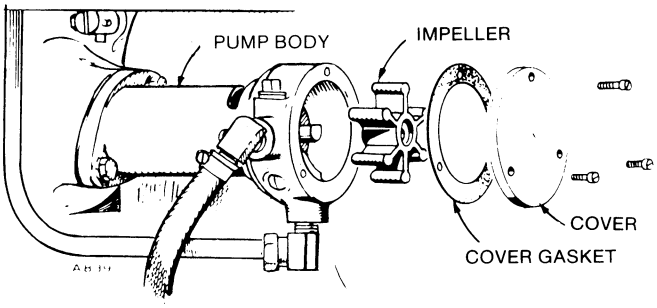


FIGURE 19. SEA WATER PUMP

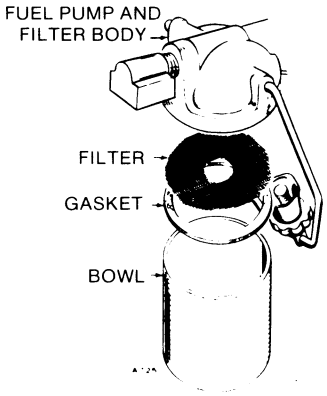


FIGURE 20. FUEL PUMP SEDIMENT BOWL

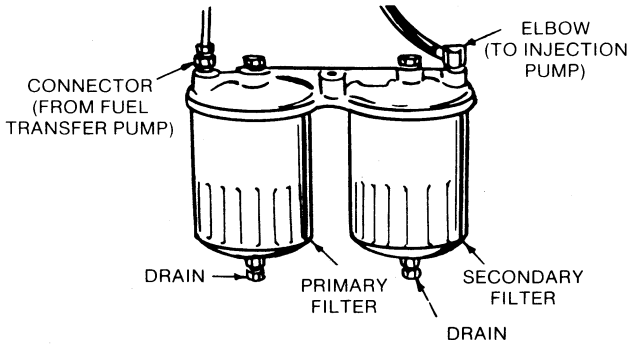


FIGURE 21. DUAL FUEL FILTERS

CAUTION ***Drain plug on fuel filters can tolerate only a limited amount of torque. Use two wrenches in combination for breaking plug loose and for final tightening.***

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 1.265.

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 engine oil changes will ensure good performance.

Brushes

To examine the brushes, remove the end bell band and cover. Replace the brushes when they wear to the Onan name and part number. At this point there is about 5/8 inch (16 mm) of brush remaining. If the brush is not replaced, the slip rings or commutator will be damaged. All brushes must have at least a 50-percent seat. If they don't, sand as illustrated in Figure 22.

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).

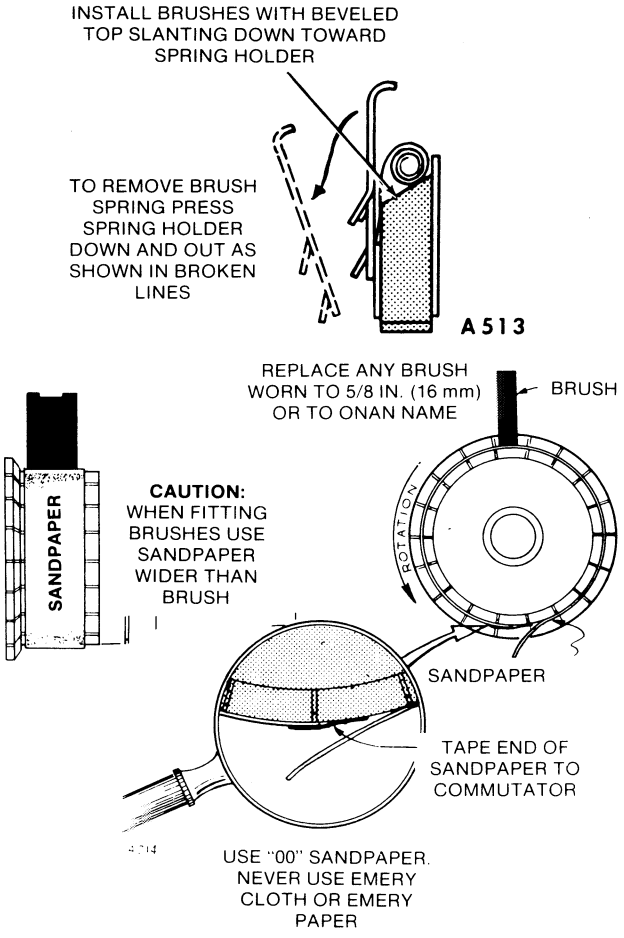


FIGURE 22. SEATING BRUSHES

Adjustments

GOVERNOR

The governor controls engine speed. Rated speed and voltage appear on the set nameplate (also see *SPECIFICATIONS*). On a 4-pole generator, engine speed equals frequency multiplied by 30. Thus 1800 rpm gives 60-hertz output. 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 23). Turn the nut clockwise (more spring tension) to increase rpm and counterclockwise to reduce governed speed. Hold a tachometer against flywheel cap screw. Set speed at 1845-1890 rpm (61.5 to 63.0 Hz), no load.

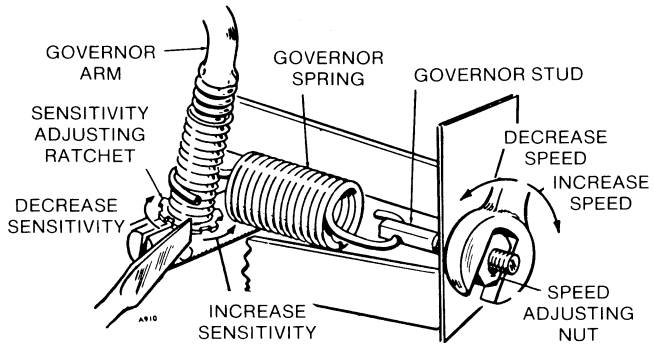


FIGURE 23. GOVERNOR ADJUSTMENT

Sensitivity Adjustment

To adjust governor sensitivity (no load to full load speed droop) turn the sensitivity adjusting ratchet. 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 54 to 90 rpm speed droop when full load is applied. Check for hunting at 0, 1/4, 1/2, 3/4 and full load. After sensitivity adjustment, the speed will require readjustment. After adjusting the governor, secure speed stud lock nut.

CHECK ANTI-FLICKER POINTS

The anti-flicker circuit eliminates flare or flickering of lights due to engine rpm change on the power stroke. Replace burned or faulty points. If only slightly burned, dress smooth with file or fine stone. Measure gap with thickness gauge, Figure 24. Loosen and adjust stationary contact to correct gap.

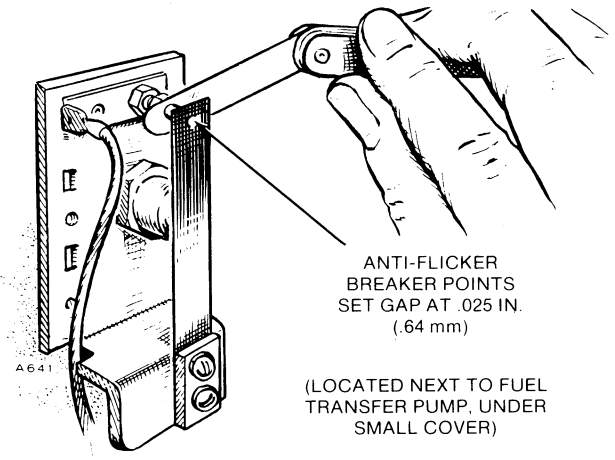


FIGURE 24. ANTI-FLICKER POINTS

CHARGE RATE ADJUSTMENT

The adjustable resistor slide tap (in the charging circuit) is set to give approximately 2 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. Adjust only when engine is stopped. Avoid overcharging. The resistor is located in the connection box.

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

DECOMPRESSION SOLENOID

The decompression release mechanism (Figure 25) holds the exhaust valve open long enough for cranking speed (rpm's) to build up without opposition from compression. The release solenoid energizes when starting speed is attained to release the exhaust valve for operation as long as the engine runs. The solenoid de-energizes when the engine is shut down allowing the release mechanism to open the exhaust valve and stop the engine by decompression.

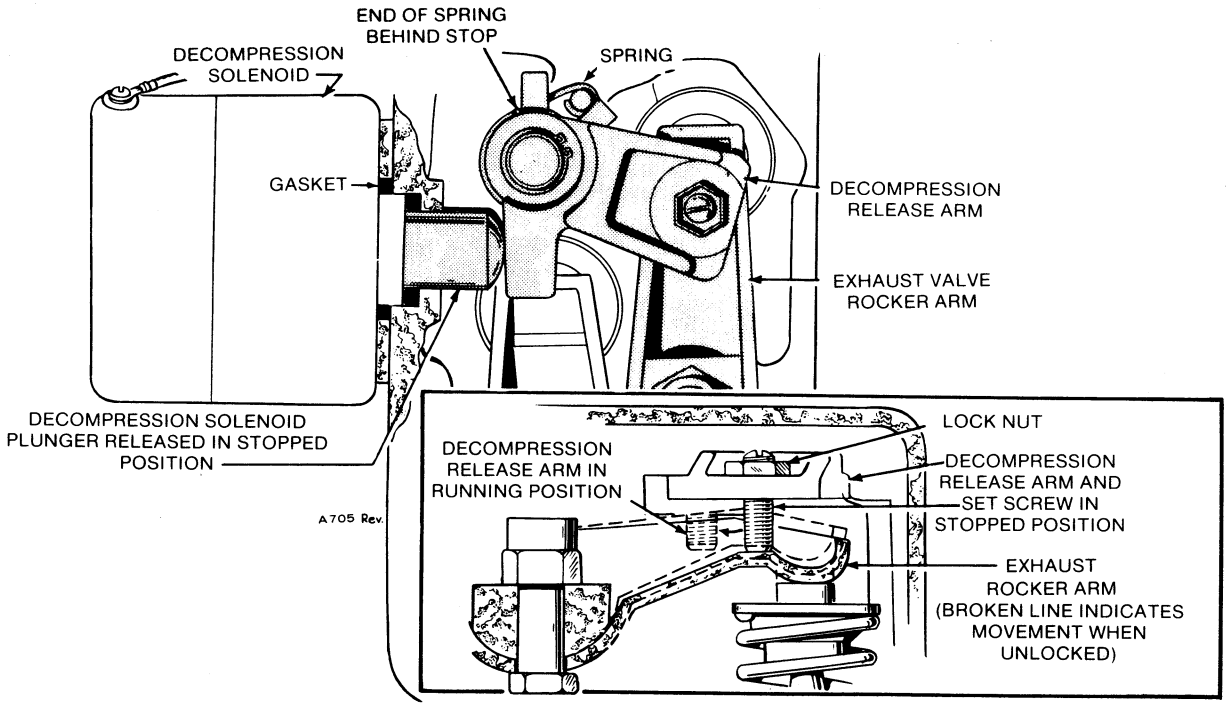


FIGURE 25. DECOMPRESSION MECHANISM

Before adjusting the decompression mechanism, the valves must be set for the correct clearance.

1. With piston 10 degrees to 45 degrees past TDC on power stroke, hold arm in decompression position (tension against spring). Turn set screw so it just touches exhaust rocker arm. The release arm must be tight against snap ring during adjustment. Then turn screw exactly one revolution clockwise. Original factory setting is marked with white or yellow paint.

   CAUTION ***If screw is tightened more than one turn, piston could hit exhaust valve and cause major damage.***

   Hold the set screw and lock it into position with the attached nut. Turn the nut hand tight plus 1/4 to 1/2 turn to lock the mechanism.

2. Release mechanism to allow compression and check the clearance between screw and rocker arm. Insert a feeler gauge between valve and rocker arm to take up valve clearance for this check. If there is no clearance, back off set screw until it just clears rocker arm.

   When reassembling the rocker cover, remove the solenoid, dip the plunger "O" ring in oil and reinstall when cover is on the engine. Align solenoid so terminal "SW" is above terminal "IGN."

DIESEL ENGINE TROUBLESHOOTING GUIDE LIQUID OR AIR COOLED

TROUBLE / CAUSE	COMPRESSION POOR	CONNECTING ROD, BUSHINGS, BEARINGS WORN	COOLANT TEMPERATURE TOO HIGH (FRESH WATER SYSTEM)	COOLANT TEMPERATURE TOO LOW (FRESH WATER SYSTEM)	COOLANT LOSS (FRESH WATER SYSTEM)	ENGINE MISFIRE	ENGINE POWER LOW	ENGINE OVERHEAT	ENGINE SPEED TOO LOW	ENGINE SPEED TOO HIGH	FUEL CONSUMPTION EXCESSIVE - BLACK SMOKEY EXHAUST	FUEL CONSUMPTION EXCESSIVE	FUEL KNOCKS	GOVERNOR CONTROL LOSS	HUNTING	INJECTION PUMP TIMING INCORRECT	MECHANICAL KNOCKS	OIL CONSUMPTION EXCESSIVE - LIGHT BLUE SMOKEY EXHAUST	OIL CONSUMPTION EXCESSIVE - NO SMOKE INCREASE	OIL DILUTED	OIL PRESSURE HIGH	OIL PRESSURE LOW	PISTON, CYLINDER AND RING WEAR	STARTER SPEED SLOW	STARTER MOTOR DOES NOT TURN	STARTING HARD, OR FAILURE TO START	SENSITIVITY POOR	VALVE BREAKAGE	VALVE BURNING	VALVE STICKING
STARTING SYSTEM																														
Discharged or Defective Battery																								•	•					
Defective Glow Plug or Lead						•					•		•												•					
Load Connected When Starting																									•					
Defective Solenoid																							•	•	•					
Defective Starter																							•	•	•					
Defective Control Circuit																								•	•					
FUEL SYSTEM																														
Defective Fuel System						•	•				•	•			•										•					
Air in Fuel System						•	•					•		•	•										•					
Incorrect Timing						•	•				•	•	•			•									•					
Restricted Air Intake - Dirty Air Filter						•	•				•	•											•		•					•
Poor Quality Fuel						•	•				•	•	•												•					
Dirty Fuel Filters						•	•					•													•					
Out of Fuel or Shut Off Closed												•													•					
Worn or Damaged Transfer Pump, Leaking Diaphragm												•						•							•					
Faulty Injection Pump, Nozzles or Gaskets						•	•				•	•	•			•									•					
Fuel Line Leaks						•	•					•			•	•									•					
Wrong Timing Button in Injection Pump							•									•														
Wrong Thickness Pump Mounting Gaskets							•									•														
Run For Long Periods of Time at NO LOAD	•						•										•													
LUBRICATION SYSTEM																														
Low Oil Supply		•	•													•						•	•							
Defective Oil Gauge																						•								
Excess Oil in Crankcase																	•						•							
Oil Leaks From Engine Base or Connections																		•												
Light or Diluted Crankcase Oil		•															•	•					•	•						
Leaky Oil Seals																		•												
Improper Lubrication		•	•														•						•	•						•
Faulty Oil By-Pass																		•				•	•							
Worn Oil Pump		•																					•							
Heavy Oil or Clogged Passages		•																				•								
Dirty Oil Filter		•																												•
GOVERNOR SYSTEM																														
Loose or Disconnected Linkage							•		•	•				•	•											•				
Binding Linkage							•		•	•				•	•											•				
Excessive Wear in Linkage									•	•					•											•				
Incorrect Governor Adjustment									•	•				•	•											•				
High Spring Sensitivity														•	•															
Incorrectly Installed Governor Yoke or Cup									•					•																
Overloaded Generator		•							•	•																				
COOLING SYSTEM																														
Insufficient Coolant			•				•																							
Faulty Thermostat			•	•		•	•																							
Worn Water Pump or Defective Seals			•		•		•																							
Water Passages Restricted			•				•																							
Blown Head Gasket	•		•		•	•												•												
Overheating																•	•					•	•				•	•		
Restricted or Too Long Water Lines							•																							
Defective Expansion Tank Pressure Cap			•		•																									
Dirt on Cooling Fins (Air Cooled)							•																							
Inadequate Air Circulation (Air Cooled)							•																							
INTERNAL ENGINE																														
Poor Compression						•				•	•						•									•				
Loose Piston																•						•								
Loose Connecting Rod or Crankshaft Bearing																•						•								
Incorrect Valve Clearance	•					•	•				•					•									•		•	•	•	
Broken or Weak Valve Spring	•					•	•									•											•	•	•	
High Exhaust Back Pressure							•																				•	•		
Valves Not Seating Properly	•					•	•		•	•	•														•					
Worn Bearings																•						•		•						
Worn Cylinder Walls, Pistons, Rings	•					•	•				•						•					•								
Sticking Valves	•					•	•				•						•													
Worn or Dirty Valve Guides																	•										•			•

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