

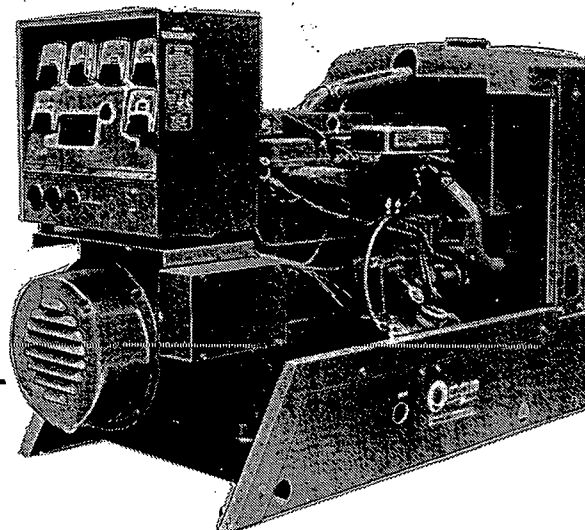
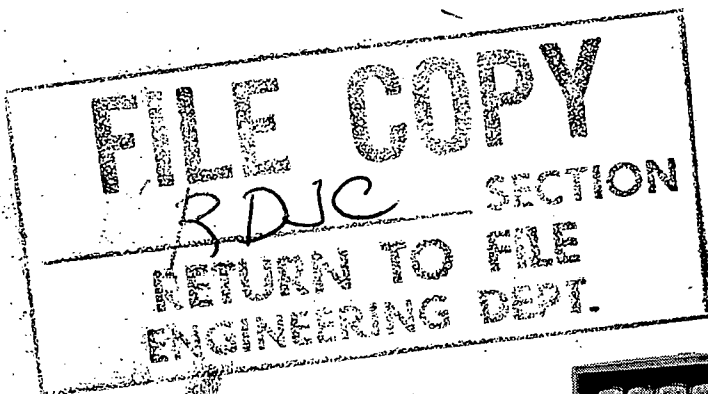


McGRAW-EDISON

Onan

Operators Manual

RDJC
GenSet



974-0121
(Spec AC)

9-84
Printed in U.S.A.

Safety Precautions

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

Read your manual and become thoroughly acquainted with it and your equipment before you start your unit. These recommendations and the following safety precautions are for your protection.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

WARNING

This symbol is used throughout this manual to warn of possible serious personal injury or death.

CAUTION

This symbol refers to possible equipment damage.

General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove any debris from set and keep the floor clean and dry.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the generating set are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- Do not wear loose clothing in the vicinity of moving parts, or jewelry while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts; cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.
- Do not work on this equipment when mentally or physically fatigued.
- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Bleed the system pressure first.

Protect Against Moving Parts

- Keep your hands away from moving parts.

- Before starting work on the generating set, disconnect batteries. This will prevent starting the set accidentally.

Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME in the vicinity of the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be adequately secured and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.

Guard Against Electric Shock

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DON'T tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

Exhaust Gases Are Toxic

- Provide an adequate exhaust system to properly expel discharged gases. Inspect exhaust system daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

Keep the Unit and Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Introduction

TO THE OWNER

Welcome to the growing family of *Onan Power users*.
... We are proud to have you as a customer.

Read this manual carefully and observe all safety rules within. Operating instructions, adjustments and periodic maintenance procedures are given to help you ... keep your unit running like new so that you can expect many years of dependable service from it.

Remember ... any machine, regardless of design or type, will perform only in relation to the services it received.

If your generator set needs special attention, ask your Onan dealer for assistance; the Onan Parts and Service Organization has been factory-trained to provide up-to-date know-how for keeping your electric generating set ready to supply power at all times.

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WARNING

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

KEEP FUEL CLEAN!

•

DIRTY FUEL IS ONE OF THE MAJOR CAUSES
OF ENGINE FAILURE

•

REMEMBER—EVEN A TINY PARTICLE OF DIRT IN THE INJECTION SYSTEM MAY STOP YOUR ENGINE!

•

General Information

YOUR MANUAL

This manual contains operation and other information to properly maintain, service, and make adjustments on your RDJC generator set. Study and follow instructions carefully. A well-planned service and maintenance program will result in longer unit life and better performance. Because the most important part of repair is diagnosis, a troubleshooting chart is included.

Throughout the manual, engine end of the generator set is the front. Left and right sides are determined when facing the engine (front) end.

When contacting your Onan dealer, distributor, or the factory about the generator set, always supply the complete model number and serial number as shown on the nameplate (see *Model Designation* following). This information is necessary to identify your generator set among the many types manufactured by Onan.

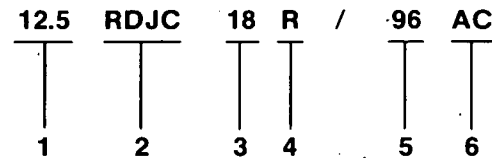
Where applicable, metric equivalents appear in parentheses following the U.S. customary units.

Onan electric sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Upon receiving your unit, check it thoroughly for any damage that may have occurred during shipping. Tighten loose parts, replace missing parts and repair any damage before operating the unit.

MODEL IDENTIFICATION

When instructions in this manual refer to a specific model of generating set, identify the model by referring to the MODEL and SPECIFICATIONS NO. as shown on the unit nameplate. Electrical characteristics are shown on the lower portion of the unit nameplate.

How to interpret MODEL and SPEC. NO.



1. Kilowatt rating of unit.
2. Factory code for series identification.
3. 18 - Reconnectable for various voltages
3C - Reconnectable for 120/240 volts.
4. Specific Type:
E - *ELECTRIC*. Electric starting at the set only.
R - *REMOTE*. Electric Starting. For permanent installation, can be connected to optional accessory equipment for remote or automatic control of starting and stopping.
5. Factory code for optional equipment.
6. Specification (Spec) letter advances when factory makes production modifications.

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.

Specifications

This manual contains SI metric equivalents that follow immediately in parentheses after the U.S. customary units of measure.

MODEL SERIES

12.5 RDJC

15.0 RDJC

GENERAL

Nominal Dimensions of Set in inches

Height	40.12 (1019 mm)
Width	27.00 (686 mm)
Length	56.62 (1438 mm)
Weight	
(Approximate) Unhoused	940 lbs (426 kg)
(Approximate) Housed	1040 lbs (471 kg)

ENGINE DETAILS

Manufacturer	Onan
Number of Cylinders (Vertical-in-line)	4
Displacement	120 in. ³ (1966 cm ³)
Cylinder Bore	3-1/4 in. (82.6 mm)
Piston Stroke	3-5/8 in. (92.1 mm)
RPM	
50 Hertz Operation	1500 RPM
60 Hertz Operation	1800 RPM
Compression Ratio	19.0:1
Injection pump (American Bosch)	PSU
Recommended Fuel	#1 or #2 Diesel
Starting System (Automotive type)	Solenoid Shift Starter
Exhaust Connection (Pipe tapped)	1-1/2 in. (38.1 mm)
Diesel Fuel Lift (Maximum)	6 feet (1.8 mm)
Oil Filter	Full Flow Type
Lubrication System (Oil pump)	Full Pressure

GENERATOR DETAILS

Manufacturer	Onan
Design	Revolving Field, 4-pole, Brushless Exciter and Solid State Voltage Regulator
Wire	4
Output Rating	0.8 Power Factor
Cranking Current at 10°F (-12°C) minimum	475 Amps

Rating (AC output in watts)

12.5 RDJC, 60 Hertz	12.5 kW
15.0 RDJC, 60 Hertz	15.0 kW
12.5 RDJC, 50 Hertz	12.5 kW

CAPACITIES AND REQUIREMENTS

Battery Voltage	12 Volt Negative Ground
Battery Size	
Two 6 Volt (In Series)	
Above 32°F (0°C)	BCI Group 2, 560 Cold Crank Amps
Above 0°F (-18°C)	BCI Group 5D, 800 Cold Crank Amps
Battery Charge Rate (Adjustable)	2 to 5 Amps
Oil Capacity With Filter	6-1/2 U.S. Qts (6.15 L)
Without Filter	6 U.S. Qts (5.7 L)
Water Capacity (Radiator)	3 U.S. Gallons (11.36 L)

CAPACITIES AND REQUIREMENTS (Continued)

Cooling Water Flow	24 gpm (90.84 L/min)
Engine Fan Size and RPM.....	14 in. (2900 rpm) belt-driven, pusher, Type, C.C.W. Rotation
Fuel Pump Inlet and Fuel Return Line Thread Size	7/16-24 NPTF
Fuel Pump Maximum Lift	6 ft (1.83 m)
Ventilation Required (1800 RPM)	
Engine (radiator cooled)	3000 cfm (84.93 m ³ /min)
Generator	160 cfm (4.53 m ³ /min)
Combustion	62 cfm (1.76 m ³ /min)
Fuel Consumption (At Rated Load) 60 Hz	1.3 gph (4.92 lit/hr)

TUNE-UP SPECIFICATIONS

Start-Disconnect Centrifugal Switch	0.020 in (0.51 mm)
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 Clearances	
Intake	0.011 in. (0.28 mm)
Exhaust	0.016 in. (0.41 mm)
Injector Firing Order.....	1,2,4,3

Description

CONTROL PANEL COMPONENTS

Controls and instruments on the RDJC series control panels vary according to the customers purchase order. The following is a brief description of typical components located on the panels, Figure 2.

Standard

Run-Stop-Remote Switch: Starts and stops the unit.

Preheat Switch: Controls manifold heater and glow plugs.

Battery Charge Rate DC Ammeter: Indicates charging current.

Field Circuit Breaker: Provides protection for exciter and alternator if voltage regulator develops a malfunction.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine.

Water Temperature Gauge: Indicates temperature of circulating coolant in engine. (Wired to a sensor unit located on the engine.)

Cranking Limiter: Thermally actuated device limits cranking time to between 45 and 90 seconds depending on the ambient temperature. Red pushbutton pops out and cannot be reset until one minute has elapsed.

Optional

AC Voltmeter: Indicates output voltage.

Voltmeter Phase Selector Switch: Selects the phases of the generator output to be measured.

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

Running Time Meter: Registers the total number of running hours. Use it as an indicator for periodic servicing.

Frequency Meter: Indicates the frequency of the output voltage in hertz. It can be used to check engine speed (30 rpm produces one hertz).

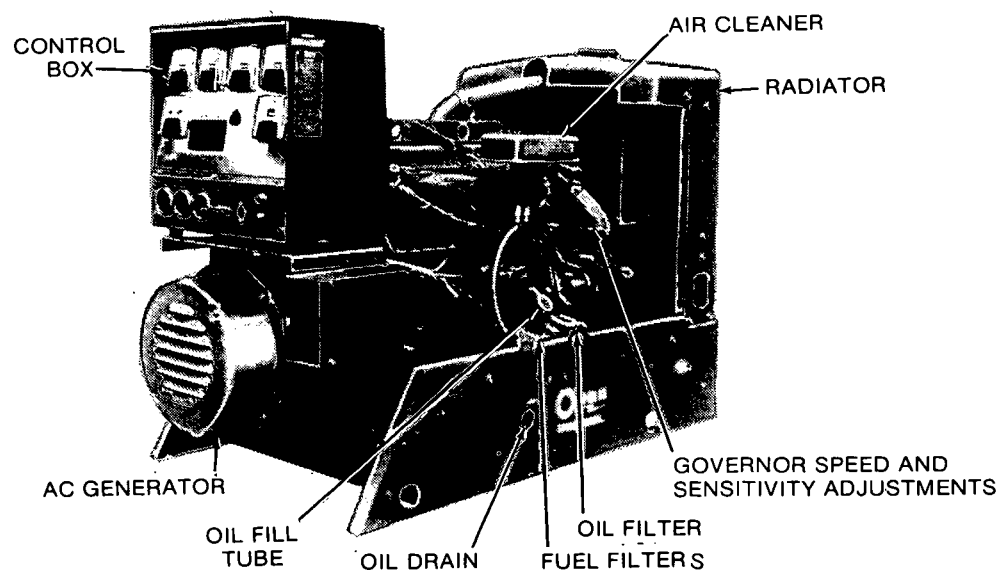


FIGURE 1. TYPICAL RDJC GENERATOR SET

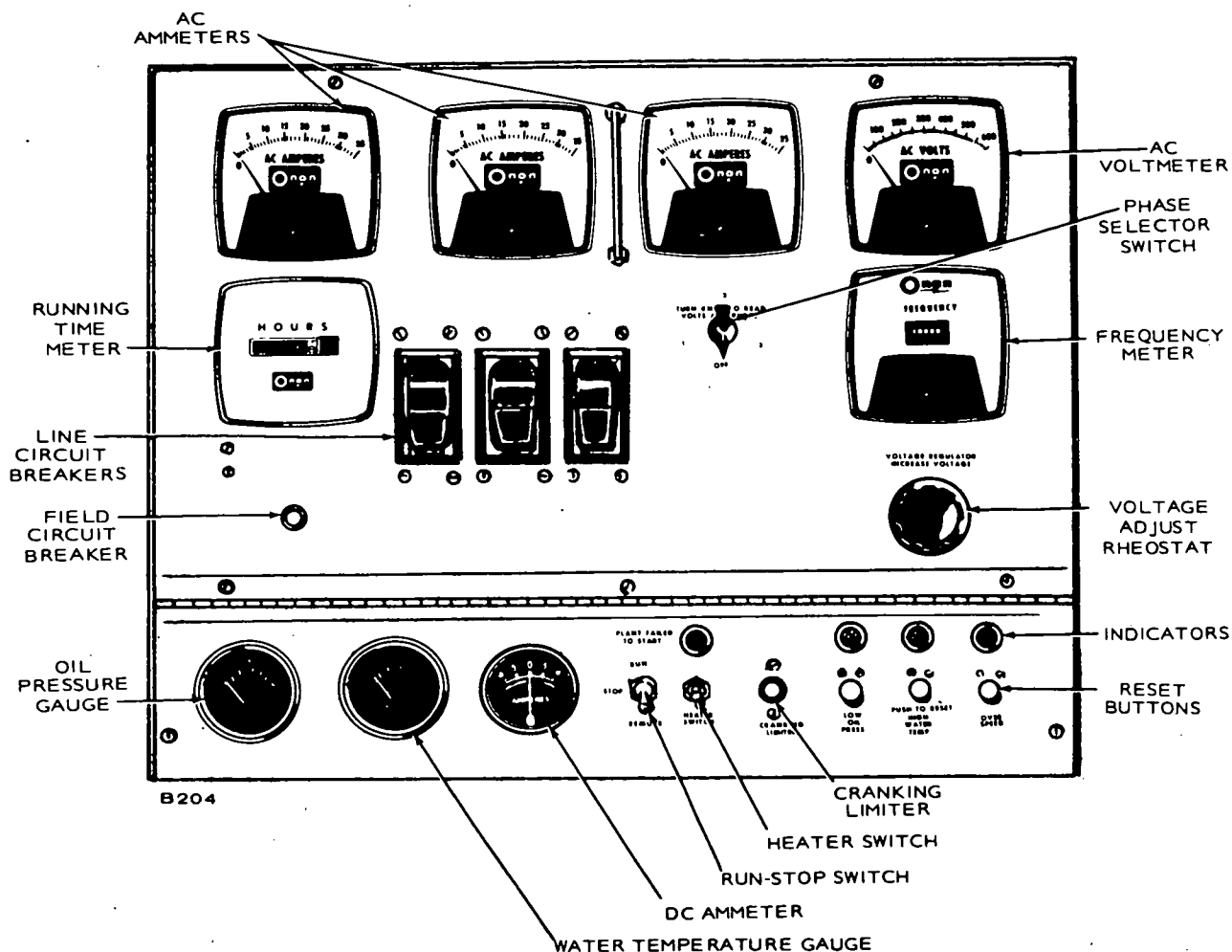


FIGURE 2. TYPICAL RADIATOR-COOLED SET CONTROL PANEL

Warning Lights: Red indicator lights give warning of:

1. Engine failed to start.
2. Overspeed.
3. Low oil pressure.
4. High engine temperature.

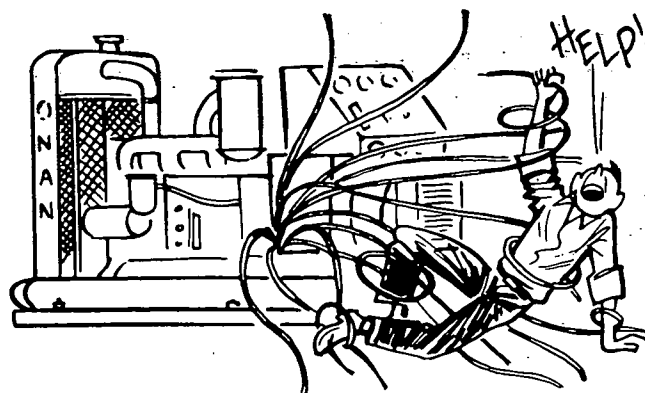
CAUTION To prevent equipment damage, contact your Onan Service Center for generator reconnection.

Reset pushbuttons permit restarting after trouble is corrected.

Line Circuit Breakers: Protect generator from line overloads.

VOLTAGE RECONNECTION WITH OPTIONAL INSTRUMENTS

The optional AC instruments on the control panel (such as voltmeters and running time meters) are installed for use with specific nameplate voltages. Control components may have to be changed to match new current ratings when field reconnections for other voltages are made.



Installation

GENERAL

Installations must conform to local building codes, fire ordinances, and other local, state and federal regulations. See Figure 3. For detailed installation instructions request Onan Technical Bulletin T-030 or contact your Onan Service Representative.

Installation requirements include:

1. Level mounting surface.
2. Adequate cooling air.
3. Adequate fresh induction air.
4. Discharge of circulated air.
5. Discharge of exhaust gases.
6. Electrical connections.
7. Fuel connections.
8. Accessibility for operation and servicing.
9. Vibration isolation.
10. Noise levels.

LOCATION

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated.

The air discharge side of set requires 3 inches (76 mm) clearance from wall to permit set to rock on its mounts; at least 24 inches (610 mm) clearance is required around all other sides for service accessibility.

MOUNTING

A permanent installation needs a sturdy, level mounting base of concrete, heavy wood or structural steel, preferably raised to aid oil changing and operation. Set may be bolted in position if desired.

Mobile applications (as in trucks or trailers) must be securely bolted down to prevent shifting in transit. Extra support for the vehicle flooring may be necessary.

VENTILATION

Generator sets create a considerable amount of heat which must be removed by proper ventilation. Outdoor installation can rely on natural air circulation, but mobile and indoor installations need properly sized and positioned vents for the required air flow.

Ventilation systems are designed and based on the presence or absence of a fan and radiator. With a radiator, the engine-pusher fan is sized to provide

adequate airflow to remove all heat rejected by the engine, generator, and a few feet (metre or so) of uninsulated exhaust pipe. Restrictive ducting or heat sources other than the generator set requires the use of auxiliary fans to increase airflow.

With other cooling options, ventilation fans are required to provide adequate ventilation. Size the fans to remove all heat rejected in the room by the generator set, uninsulated exhaust pipes and other heat producing equipment. Maintaining a temperature differential of 20° to 30° F (11° to 17° C) is usually satisfactory.

RADIATOR COOLING

Cooling air travels from the rear of the set to the front end. Locate the room or compartment air inlet where most convenient, preferably to the rear of the set. The inlet opening should be at least as large as the radiator area. Increase the opening area if it will be restricted with louvers or filters. See Figure 3.

Engine heat is removed by a pusher fan which blows cooling air out through the front of the radiator. The cooling air outlet should be directly in front of the radiator and as close as is practical. The opening size should be at least as large as the radiator area. A duct of canvas or sheet metal must be used between the radiator and the air outlet opening. Ducts prevent recirculation of heated air.

Generator cooling air is discharged from the engine-generator-adaptor on the left side of the engine.

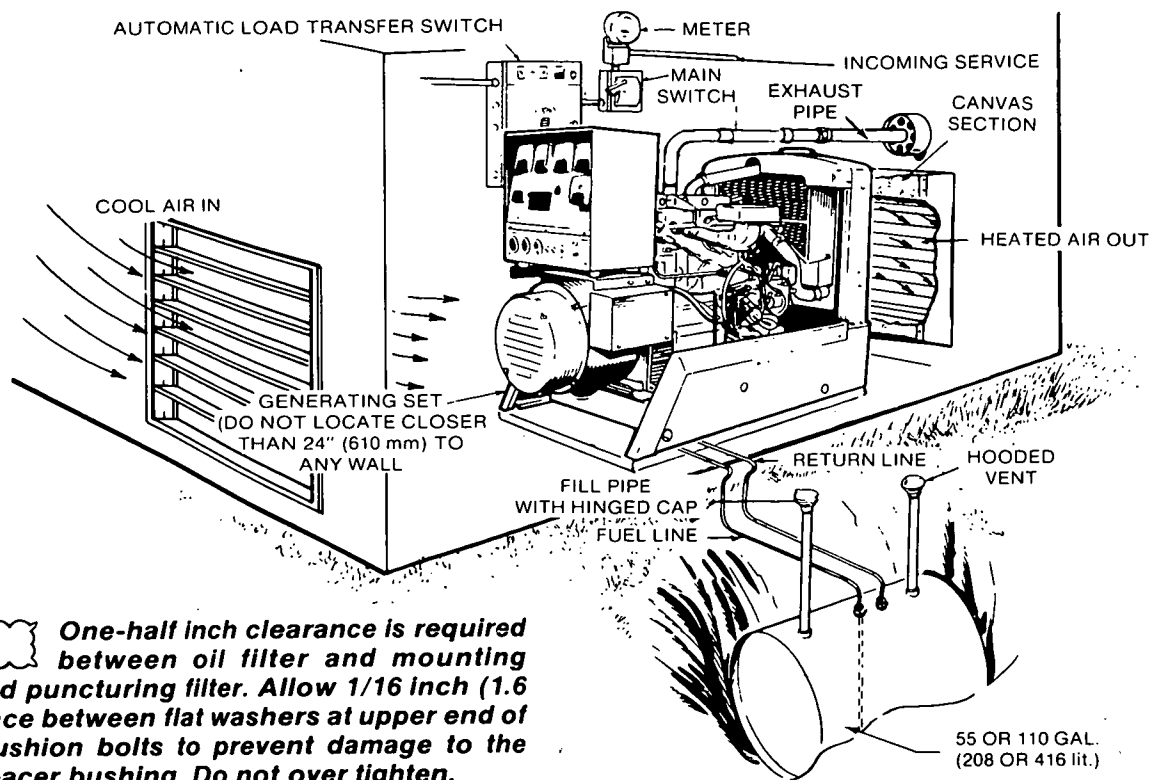
EXHAUST

Pipe exhaust gases outside any enclosure. The exhaust outlet is 1-1/2 inch pipe size. Locate the exhaust outlet far from the air inlet to avoid gases re-entering the enclosure. Use flexible tubing to connect between the engine exhaust and any rigid pipe extension to prevent transmission of vibration.

WARNING

Pipe POISONOUS exhaust gas outside enclosure. Inhalation of exhaust gases can result in serious injury or death.

Exhaust installations are subjected to various detrimental conditions, such as extreme heat, infrequent operation, light operating loads, etc. Therefore, regular and frequent inspections are necessary to ensure that the exhaust system remains fume-tight and safe for operation.



CAUTION One-half inch clearance is required between oil filter and mounting bolts to avoid puncturing filter. Allow 1/16 inch (1.6 mm) clearance between flat washers at upper end of mounting cushion bolts to prevent damage to the mounting spacer bushing. Do not over tighten.

FIGURE 3. TYPICAL INSTALLATION

WARNING Do not use exhaust manifold heat to warm a room or compartment occupied by people. Possible leaking of harmful exhaust gases can result in personal injury or death.

An approved thimble must be used (Figure 3a.) where exhaust pipes pass through walls or partitions. Build the thimble according to codes (see National Fire Protection Association bulletin, Volume 4, section 211 on "Standards for Chimneys, Fireplaces, and Vents").

As the exhaust pipe length and number of bends increases, larger pipe is required to eliminate excessive exhaust restriction and back pressure.

Table 1 shows the maximum equivalent exhaust pipe length for exhaust systems using 1-1/2 inch through 3 inch pipes. Also shown are the equivalent lengths of various pipe fittings. The TOTAL exhaust system equivalent length (including all fittings and muffler) must NOT exceed the length shown in Table 1 for the size of pipe used. Exceeding the maximum length will

cause excessive back pressure in the system. The maximum allowable back pressure (measured at exhaust manifold) is 27.2 inches (691 mm) H₂O.

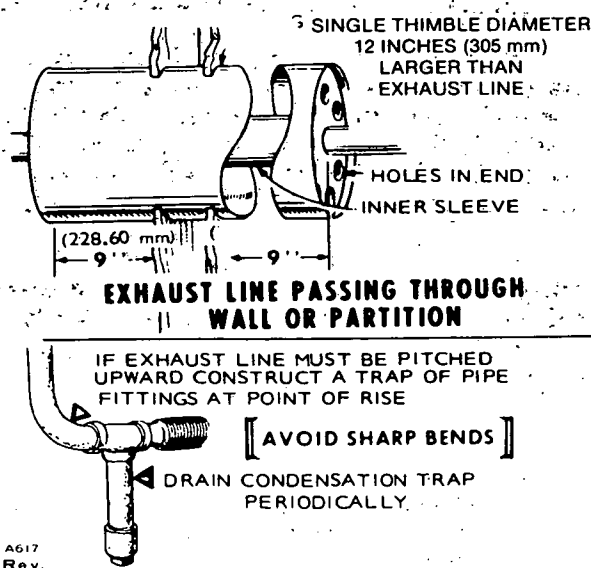


FIGURE 3A. EXHAUST PIPING

TABLE 1. EXHAUST LENGTH

**MAXIMUM EQUIVALENT EXHAUST PIPE
LENGTH - ONE CRITICAL MUFFLER INCLUDED**

PIPE SIZE (INCHES)	1.5	1.75	2.0	2.5	3
MAXIMUM PIPE LENGTH IN FEET	14 (4.3)	28 (9)	56 (17)	148 (45)	466 (142)

(Metres in Parentheses)

Max. Allowable Back Pressure is 27.2 inches (691 mm) H₂O.

EQUIVALENT LENGTHS OF PIPE FITTINGS

TYPE OF FITTING Inches	1.5	2	2.5	3
STANDARD ELBOW Feet (Metres)	4.4 (1.34)	5.3 (1.62)	6.4 (1.95)	8.1 (2.47)
LONG RAD. ELBOW Feet (Metres)	2.8 (0.85)	3.5 (1.07)	4.2 (1.28)	5.2 (1.58)
MED. RAD. ELBOW Feet (Metres)	3.6 (1.10)	4.6 (1.40)	5.4 (1.64)	6.8 (2.07)
STANDARD TEE Feet (Metres)	9.3 (2.83)	13 (3.96)	14 (4.27)	17 (5.18)

HEAT EXCHANGER COOLING (OPTIONAL)

This is a closed cooling system commonly referred to as fresh water cooling, Figure 4. Water circulated through the engine is termed fresh water, hot water, jacket water, etc. Water circulated through the heat exchanger only is called raw water, cold water, city water, etc. This system (with anti-freeze coolant) is recommended where freezing hazards exist.

Two conditions prevail: (1) Factory installed heat exchanger, and (2) Customer installed Onan heat exchanger kit. Get details from Onan.

Fill closed cooling systems with clean, alkali-free water, to the proper level in the expansion tank. Add an approved rust inhibitor to the coolant. If the coolant is anti-freeze, test it periodically.

Install a new zinc "pencil" (part #130-0626) which screws into raw water inlet end of heat exchanger, every two months or as inspection dictates.

CAUTION Use an expansion tank in the closed water system to maintain proper water level by preventing overflow and loss of coolant when the engine heats up.

Use a centrifugal metal impeller water pump (Oberdorfer 1-GP, or equal) in the hot water side. Drive it with a belt from the engine power takeoff.

CITY WATER COOLING (OPTIONAL)

On city water cooled sets, the conventional radiator is not used and a constant water flow cools the engine. Ventilation is seldom a problem, but sufficient air movement and fresh air must be available to properly cool the generator and support combustion in the engine. For small compartments, a duct larger than the generator outlet opening is recommended to remove heated air from the generator to the outside. Limit bends and use radius type elbows where needed. A large, well ventilated compartment or room does not require a hot air duct. Water cooled exhaust manifolds are recommended.

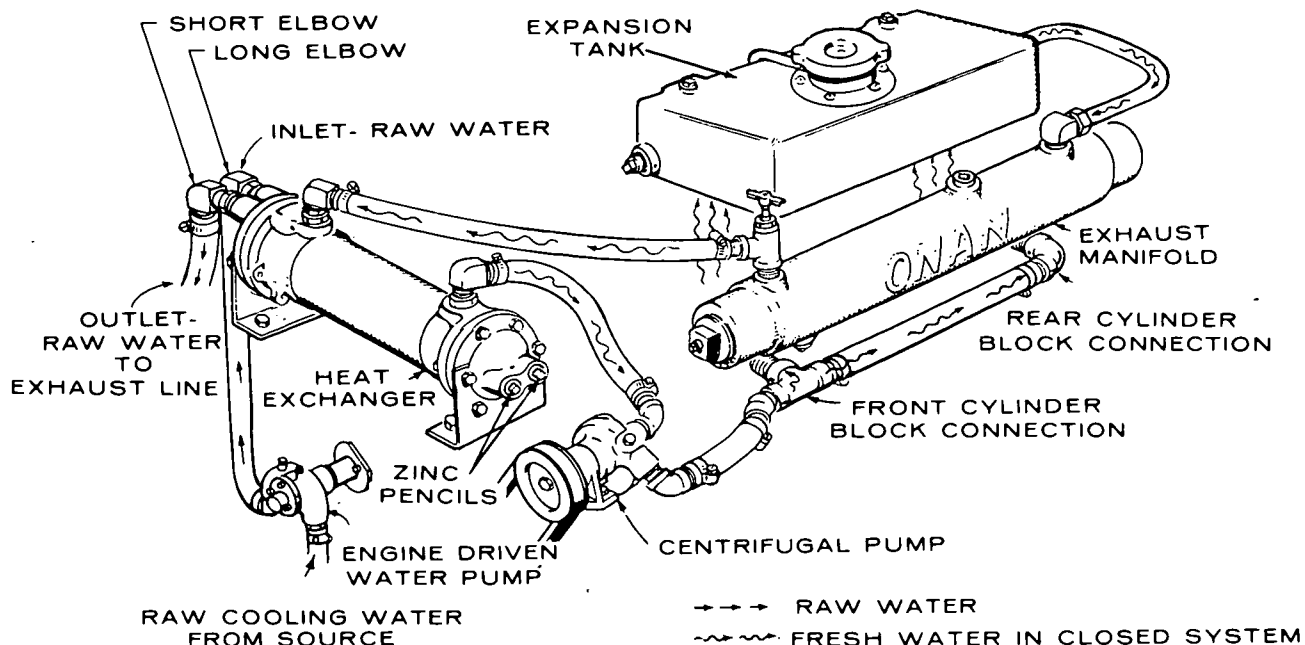


FIGURE 4. HEAT EXCHANGER PLUMBING

Connections on the engine are 3/8 inch pipe. A solenoid shut-off valve and a manual supply valve are furnished but not installed. The solenoid valve is coordinated with the engine control to shut off the water supply when set is not in use.

The manual supply valve is adjusted to control water rate-of-flow for proper cooling with a minimum flow of water. Final adjustment should be made under the maximum load the set will carry with the engine thoroughly warmed up and water temperature stabilized.

FUEL TANK AND LINES

The top of the fuel supply tank must be below the fuel pump to prevent siphoning if a system leak occurs. For servicing, put a shut-off valve at the fuel tank. Where the fuel tank is shared, to avoid starving either engine, do not connect to an existing line at a point above the fuel supply level.

WARNING *The fuel system should meet applicable codes. Always use flexible tubing between engine and the fuel supply to avoid line failure and leaks due to vibration. Fuel leaks create fire hazards.*

Use approved flexible fuel line next to the engine. Diesel engines require a fuel supply line and a separate fuel return line. Install the fuel supply line from the supply tank to the inverted flare male elbow mounted in the inlet of the fuel pump. Install the fuel return line from the injection pump bleeder valve to the supply tank, Figure 5.

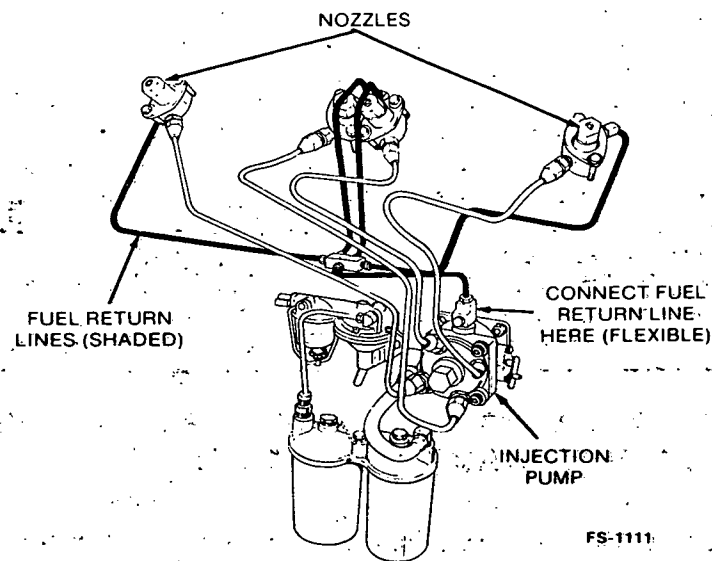


FIGURE 5. FUEL SYSTEM

Shield the line with fire retardant material if it passes through a combustible wall or partition. If turns are

necessary, use long sweeping type elbows. Use one pipe size larger for each ten feet (3.1 mm) in length. Position the exhaust outlet away from the engine air intake.

OIL DRAIN

Extend to suit installation. Oil base has 1/2 inch pipe size tapped hole.

SEPARATE FUEL TANKS

The tank top must be below fuel pump level to prevent putting a static head on the fuel pump inlet. When sharing the fuel tank with another engine, use a separate fuel line for each engine to avoid starving either one of the engines.

The following restrictions apply to separate fuel tank installation:

1. The bottom of an underground fuel tank must not be more than 6 feet (1.8 m) below the fuel transfer pump inlet, unless an auxiliary electric fuel pump is added. The maximum lift capacity of the transfer pump is six feet. See Wiring Diagram for installation connection.
2. If the tank is installed above the fuel pump inlet level without a supply line shutoff valve, a ruptured diaphragm in the pump could cause fuel leakage to the crankcase, oil dilution and loss of fuel.
3. If the maximum fuel lift must be exceeded on any installation, request Onan Technical Bulletin T-030 for day tank and electric solenoid shutoff valve installation information.
4. An electric or manual shutoff valve must be used whenever the minimum fuel level in the tank is above the pump inlet to ensure positive shutoff when the engine is shut down. It will also prevent loss of fuel from possible fuel leaks between the tank and the fuel pump.

WARNING *The fuel system should meet applicable codes. Always use flexible tubing between engine and the fuel supply to avoid line failure and leaks due to vibration. Fuel leaks create fire hazards. Fuel tank location must conform to local codes.*

**KEEP FUEL
CLEAN!**

**DIRTY FUEL IS ONE OF THE MAJOR CAUSES
OF ENGINE FAILURE**

FUEL CONNECTION

Connect fuel line to fuel pump inlet. Pump is threaded 7/16-24 NPTF (American Standard Internal Tapered Pipe Thread).

NAMEPLATE VOLTAGE CODE					VOLTAGE		PHASE	FREQUENCY	CONNECT W10 JUMPER WIRE FROM V4 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	LOAD-TO-GENERATOR CONNECTIONS
												CONNECT X1 TO TERMINAL 5 OF PRINTED CIRCUIT BOARD FOR 50 Hz, TO TERMINAL 6 FOR 60 Hz.
3C	120/240	1	60	V1								
53C	120/240	1	50	V3								
	115/230	1	50	V2								
	110/220	1	50	V1								
18	120/208	3	60	V1	PARALLEL WYE							
	127/220	3	60	V2								
	139/240	3	60	V4								
518	110/190	3	50	V1								
	115/200	3	50	V2	PARALLEL WYE							
	120/208	3	50	V3								
	127/220	3	50	V4								
18	240/416	3	60	V1	SERIES WYE							
	254/440	3	60	V2								
	277/480	3	60	V4								
518	220/380	3	50	V1								
	230/400	3	50	V2	SERIES WYE							
	240/416	3	50	V3								
	254/440	3	50	V4								
18	120/240	3	60	V1	SERIES DELTA							
518	110/220	3	50	V1								
	115/230	3	50	V2								
	120/240	3	50	V3								
18	120/240	1	60	V1	DOUBLE DELTA							
518	110/220	1	50	V1								
	115/230	1	50	V2								
	120/240	1	50	V3								
18	120	1	60	V1	PARALLEL DELTA							
518	110	1	50	V1								
	115	1	50	V2								
	120	1	50	V3								
9X	347/600	3	60	V4	WYE							

FIGURE 6. GENERATOR WIRING AND CONNECTION DIAGRAMS

WARNING

Always use flexible tubing between engine and the fuel supply to avoid line failure due to vibration.

The engine requires a fuel supply line and a separate fuel return line. Install fuel return line from the 7/16-24 opening in the overflow fitting located on injection pump (where nozzle fuel return line is also connected) to the top of the fuel supply tank. See Figures 3 and 5.

WARNING

Do not use galvanized lines, fittings, or fuel tanks in underground portions of the fuel system. Hazardous fuel leaks may be caused by electrolytic corrosion from moisture and chemicals in the soil (galvanism). Some safety ordinances prohibit the use of galvanized materials in fuel systems and the use of threaded cast iron fittings as well.

Carefully clean all fuel system components before putting the set into operation. Any dirt or contamination may cause major damage to the fuel injection system.

ELECTRICAL CONNECTIONS

The nameplate on the generator set shows the electrical output rating on 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 connections should 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 isolate vibration. Use suitable size insulated wires for the load rating applied.

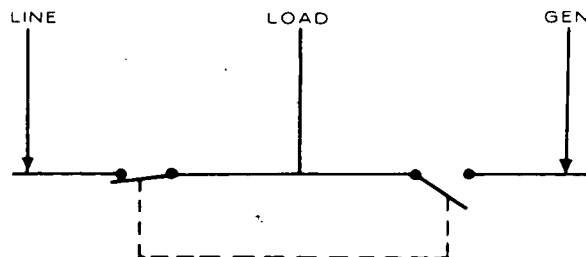
Connect each load wire to the proper generator output lead inside the control box. Insulate bare ends of ungrounded wires. Use bolt provided on the control box to connect the generator ground lead or earth wire. Install a fused main switch (or circuit breaker) between the generator and load. If a test-run indicates wrong rotation of 3 phase motors in the load circuit, switch the connections at any two of the generator terminals.

CAUTION

Overloading can damage the generator windings. Divide the loads equally between output leads to prevent unbalanced loading and burned windings.

Standby

If the installation is for standby service, install a double-throw transfer switch (either manual or automatic type) to prevent feeding generator output into the normal power source lines and to also prevent commercial power and generator output from being connected to the load at the same time. Instructions for connecting an automatic load transfer switch is included with such equipment. See Figure 7.



NOTE SHOWN WITH LINE CONNECTED TO LOAD

SC-1101

FIGURE 7. LOAD TRANSFER SWITCH

BALANCING LOADS

120/240 Volt, Single Phase: Terminal connection L0 (neutral) can be grounded, if required. For 120 volts, connect the hot load wires to either the L1 or L2 connection, Figure 8. Connect the neutral load wire to the L0 connection. Two 120 volt circuits are thus available, with not more than 1/2 the rated capacity of the set available on either circuit. If using both circuits, be sure to balance the load between them.

For 240 volts, connect one load wire to the L1 connection and the second load wire to the L2 connection. Terminal connection L0 is not used for 240 volt service.

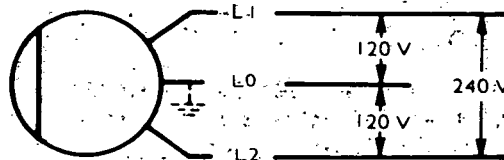


FIGURE 8. 120/240 VOLT, SINGLE PHASE

120/240 Volt, 3 Phase, 4 Wire Delta Connected Set:

The 3 phase Delta connection is designed to supply 120 and 240 volt, 1 phase current and 240 volt, 3 phase current, Figure 9. For 3 phase operation, connect the three load wires to generator terminals L1, L2 and L3—one wire to each terminal. For 3 phase operation the L0 terminal is not used.

For 120/240 volt, 1 phase, 3 wire operation, terminals L1 and L2 are the "hot" terminals. The L0 terminal is the neutral, which can be grounded if required. For 120 volt service, connect the black load wire to either the L1 or L2 terminal. Connect the neutral (white) wire to the L0 terminal. Two 120 volt circuits are available.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as no terminal current exceeds the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA.

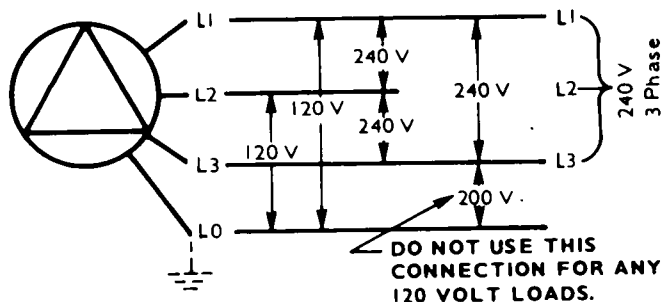


FIGURE 9. 3 PHASE, DELTA CONNECTION

3 Phase, 4 Wire, Wye Connected Set: The 3 phase, 4 wire connection produces line to neutral voltage and line to line voltage. The line to neutral voltage is the lower voltage as noted on the unit nameplate, and the line to line voltage is the higher nameplate voltage.

For 3 phase loads, connect separate load wires to each of the set terminals L1, L2 and L3. Single phase output of the higher nameplate voltage is obtained between any two 3 phase terminals as shown in Figure 10.

The terminal marked L0 can be grounded if required. For 1 phase loads, connect the neutral (white) load wire to the L0 terminal. Connect the black load wire to any one of the other three terminals — L1, L2 or L3. Three separate 1 phase circuits are available, with not more than 1/3 the rated capacity of the set from any one circuit.

If using 1 phase and 3 phase current at the same time, use care to properly balance the 1 phase load, and not to exceed rated line current.

Figure 10 shows load connections for 120/208 voltage. Other voltages are available from either parallel wye or series wye illustration in Figure 6.

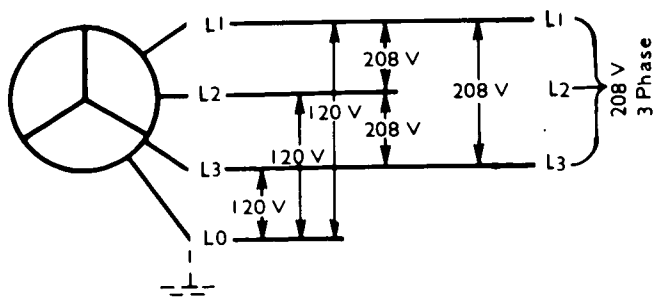


FIGURE 10. 3 PHASE, WYE CONNECTION

GROUNDING

Typical requirements for bonding and grounding are given in the National Electrical Code, 1981, Article 250.*

Periodic inspection is recommended, especially after service work has been performed on equipment anywhere in the electrical system

Generator Set Bonding and Equipment Grounding

Bonding is defined as: (Reference National Electrical Code, 1981, Article 100). The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity to conduct safely any current likely to be imposed.

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.

Circuit and System Grounding

This refers to the intentional grounding of a circuit conductor or conductors. The design and installation of grounding system encompasses many considerations, such as multiple transformers, standby generators, ground fault protection, physical locations of equipment and conductors, just to mention a few.

Although the consulting engineer and installer are responsible for the design and wiring of each particular grounding application, the basic grounding requirements must conform to national and local codes.

Output Lead Markings

Leads on revolving field generators are marked T¹, T², etc. These identifying marks also appear on the wiring diagram.

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 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.

RECONNECTIBLE GENERATORS

The factory ships all special order sets with instruments on the control panels completely wired for voltage code or voltage specified on the customers purchase order. Standard sets without instruments are shipped with the T¹-T⁴ or T¹-T¹² output leads separated in the output box. These single phase and broad range generators are connectible or later reconnectable to provide any of the output voltages shown in Figure 6. Grounding or earthing procedure should comply with local electrical codes.

Code 3C or 53C Reconnectable Generators: 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 Figure 6 at the installation site.

Code 18 or 518 Reconnectable Generators: 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 6.

When connecting the output leads, be sure to connect jumper W10 on the voltage regulator printed circuit board between terminal V⁴ (common) and V¹, V², or V³ as listed on the reconnection diagram.

Code 9X Generators: These special order three phase, 60 Hertz, 4 wire, generators are rewired at the factory to provide 347/600 VAC. Output leads T¹, T², T³, and T⁰ are available for connection to the load wires. See connection diagram Figure 6.

BATTERY CONNECTIONS

The battery is connected for negative (-) ground, Figure 11. Be sure all battery connections are tight.

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

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

See Specifications for minimum 12 volt battery requirements. Connect battery positive (+) to starter engaging solenoid terminal post, Figure 11. Connect battery negative (-) to a good ground on the engine.

OPTIONAL ALARM

The GND terminal on the remote control terminal block is for a customer supplied alarm at a remote location to warn of emergency shutdown. Refer to Wiring Diagram for proper voltages.

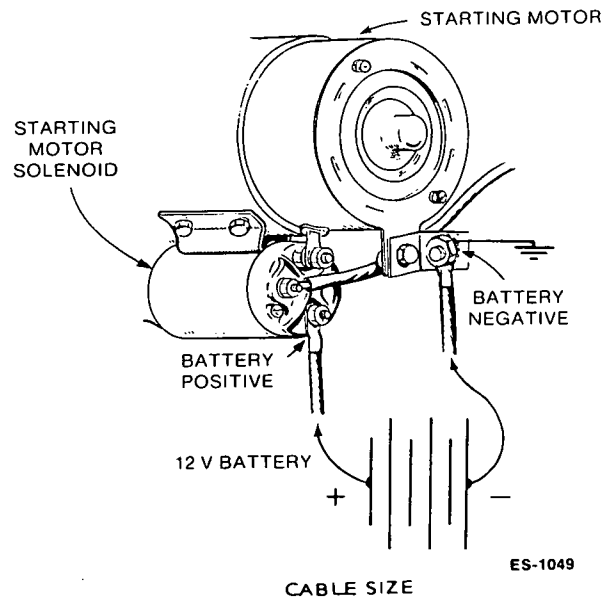
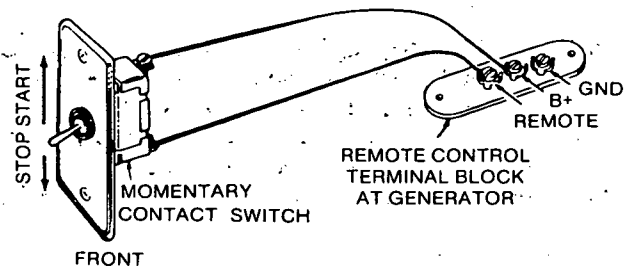


FIGURE 11. BATTERY CONNECTIONS AND CABLE DIMENSIONS

mm	6.5	7.3	8.3	9.3	10.5	11.6
INCH	.258	.289	.325	.365	.410	.460
WIRE SIZE	2	1	0	00	000	0000
LOOP	4 ft. 1.24 m	5 ft. 1.55 m	7 ft. 2.17 m	9 ft. 2.79 m	11 ft. 3.41 m	14 ft. 4.34 m

REMOTE START-STOP SWITCH (Optional)

For remote control starting and stopping, use 2 wires to connect the remote switch single-pole single-throw, to the terminal block marked B+ and remote in control box using wire sizes as listed in Figure 12.



WIRE SIZE	DISTANCE
#18	to 900 ft (279 m)
#16	to 1500 ft (465 m)
#14	to 2400 ft (744 m)
#12	to 3700 ft (1147 m)

FIGURE 12. REMOTE CONTROL SWITCH CONNECTIONS

Operation

PRE-STARTING

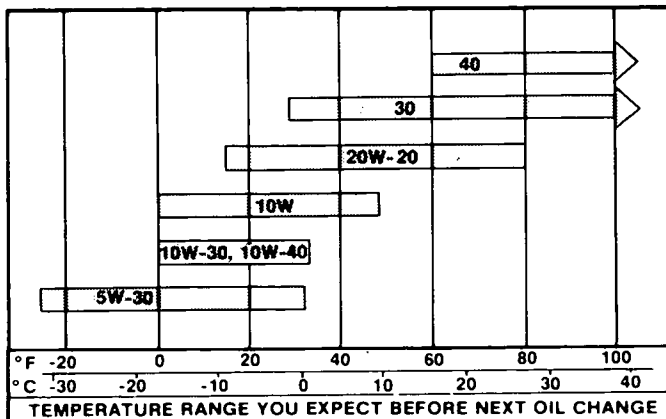
Preparations for the initial and each additional starting operation include careful checks of the oil, fuel, cooling, and electrical systems.

Before generator set is put into 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 classification CD/SE (all grades) or CC/SE (10W-30, 10W-40, or 5W-30). However, to reduce oil consumption to a normal level in the shortest time possible on a new or rebuilt engine, use CC oil for the first fill only (50 hours). CD is the API classification for severe duty diesel lube oil.

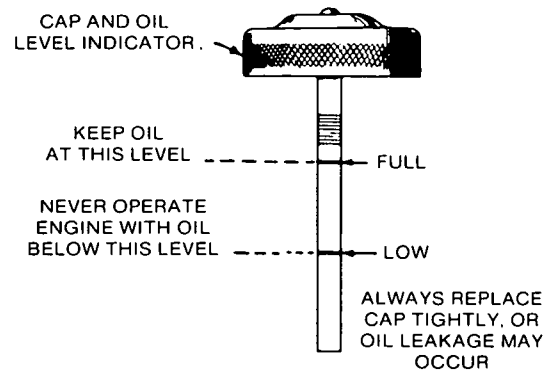
USE THESE SAE VISCOSITY GRADES



Multi-grade oils should not be used when ambient temperatures are warmer than approximately 32°F (0°C). Use only specified single-grade oils (SAE 20W-20 is an exception and should be used.)

The set oil capacity is 6 U.S. quarts plus 1/2 quart for oil filter change. Fill the crankcase until the oil reaches the "FULL" mark on the oil level indicator. See Figure 13.

If operating in extremely dusty or dirty conditions, the oil might have to be changed more frequently. When adding oil between changes, use the same brand as in the crankcase. Various brands of oil might not be compatible when mixed. Refer to *MAINTENANCE* section for oil change interval and procedures. Always change the oil filter when the oil is changed.



LS-1016

FIGURE 13. LOCATION OF OIL FILL

WARNING

Do NOT check oil while the generator set is operating. Hot oil could cause burns by blowing out of oil fill tube.

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.

*NOTE: Fuels with Cetane numbers higher than 45 may be needed in higher altitudes or when extremely low ambient temperatures are encountered to prevent misfires.

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 injections systems, it is extremely important that the fuel be kept clean. Dirt in the system can cause severe damage to both the injection pump and the injection nozzles.

Bleeding Fuel System

Bleed air from fuel system as follows: Disconnect fuel return line, Figure 14. Operate hand priming lever on fuel transfer pump until fuel flowing from fuel return line is free of air bubbles. Then reconnect the fuel return line. Cranking the engine should expel trapped air from the injection pump.

ALWAYS RETURN
PRIMER LEVER TO
LOWEST POSITION

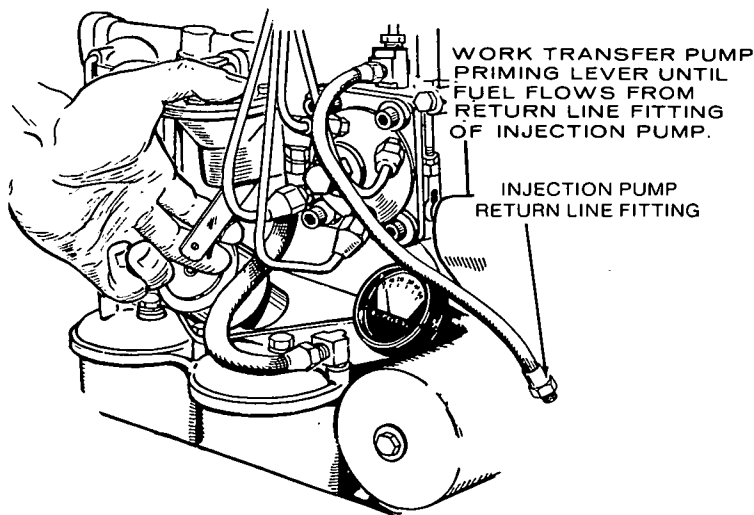


FIGURE 14. BLEEDING THE FUEL SYSTEM

If the camshaft's 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.

PRE-HEATING AND STARTING

Preheating for 60 seconds is recommended when ambient temperature is 55° F (13° C) or lower, and 30 seconds for temperatures above 55° F (13° C).

1. Engage Preheat switch for one minute.
2. Engage Start switch and hold in Start position until engine comes up to speed. (This will maintain heater operation until Start switch is released.
3. Release switch after engine starts and reaches speed.
4. Oil pressure should read at least 20 psi (138 kPa) (pressure-relief valve is not adjustable).
5. If engine fails to start after 20 seconds of cranking, wait one minute to conserve battery and repeat steps 1 and 2. Absence of blue exhaust smoke during cranking indicates no fuel is being delivered.
6. In extreme cold (below 32° F or 0° C) it may be necessary to maintain preheating for 2 minutes after engine starts to obtain firing or smooth out cylinders, especially at no load or light loads.

When starting set from a remote station, the switch on the set control must be in its REMOTE position.

CAUTION Do not exceed the one minute preheat periods to prevent heater burn out and conserve the battery. 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.

When engine comes up to speed, cranking will automatically stop by action of the centrifugal switch and start-disconnect relay. If the engine fails to start in 45 to 120 seconds, the cranking limiter will trip and cranking will stop. If this occurs, wait one minute before resetting the cranking limiter and trying to start the engine.

Refer to Onan Diesel Starting Guide on page 17.

CAUTION Depress preheat switch for one minute and then push start switch. Both switches must be engaged for starting.

If the control has an emergency relay reset button, push it to reset only after a shutdown resulting from low oil pressure or high water temperature condition occurs. Find the cause before restarting the engine.

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

CAUTION Do not apply overvoltage to the starting circuit at any time. Overvoltage will destroy the glow plugs and air heater in 2 to 3 seconds. If it becomes necessary to use an additional source of power to start the set—use a 12 volt battery connected in parallel.

Radiator: See Specifications for water capacity. Check to see that the radiator drain valve is closed and cylinder block drain plug is tight. Fill the radiator with clean, soft (alkali free) water such as rain water. The use of a good rust and scale inhibitor is recommended.

If the set will be exposed to freezing temperatures, use a standard anti-freeze solution. Use the correct proportion of anti-freeze as recommended by the anti-freeze manufacturer, to protect to at least 10° F (6° C) below the lowest expected temperature.

STOPPING

1. Push start-stop switch to stop position.
2. Release switch when set stops. If stop circuit fails, push governor arm down to shut off fuel in injection pump.

APPLYING LOAD

Allow set to warm up before connecting a heavy load. Continuous generator overloading may cause high operating temperatures that can damage the windings. The generator can safely handle a temporary overload, but for normal operation, keep the load within nameplate value. The exhaust system may form carbon deposits during operation at light loads; apply full load occasionally before shutdown to prevent excessive carbon accumulations. When possible, connect the load in steps instead of full load at one time.

ONAN DIESEL STARTING GUIDE

IMPORTANT!

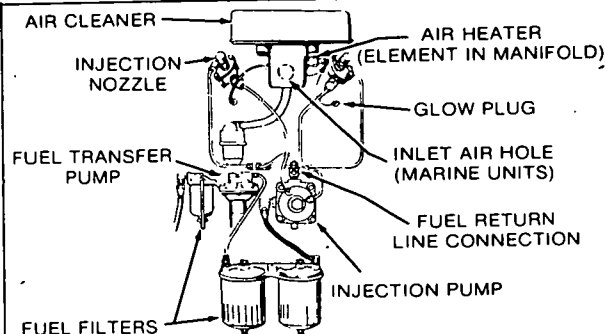
KEEP ENTIRE FUEL SYSTEM CLEAN AND FREE FROM WATER

- DIESEL INJECTION PUMPS WILL FAIL IF SYSTEM CLEANLINESS IS NEGLECTED

INJECTION PUMPS AND NOZZLES ARE NOT FIELD REPAIRABLE

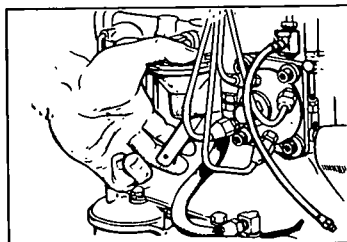
- WHEN TROUBLESHOOTING, CHECK ALL OTHER COMPONENTS FIRST

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":

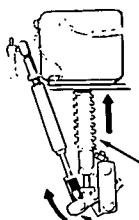
BLUE-WHITE EXHAUST SMOKE: ENGINE IS GETTING FUEL

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

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

FUEL FLOWS STEADILY

LITTLE OR NO FUEL FLOW



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

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

BREAK-IN PROCEDURE

For a new unit, run the unit with as much load as available (without exceeding nameplate rating) for approximately 2 hours. This procedure promotes better ring seating and lowers oil consumption which leads to longer over-all service life.

Continuous running under one half load during 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 first 50 hours of operation; drain while the engine is still hot.

SAFETY DEVICES

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

EXERCISING UNIT

Infrequent use of units can result in the following: Water condensing in engine fuel and lubrication system causing contamination and/or corrosion, loss of protective oil film on moving engine parts, loss of engine fuel prime due to drain-back and/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 engine oil temperature should be held at 180°F (82.2°C) for at least 20 minutes and 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 and apply load by creating a simulated power failure*. This exercises the control and switchgear systems.
2. Apply not less than 50 percent load and use thermostatic shutters if needed, 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. Shut unit down by simulating return of normal power.* Provide approximately 10 minutes of operation at no load to allow the engine to cool down.

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

Improper exercising may cause more damage than no exercising at all because of the following: Significant amounts of water and raw fuel will remain in the lubrication oil if the unit is not at the specified operating temperature; operating engine at no load or at temperatures, below those specified causes carbon build-up and exhaust system fouling, and inadequate charging of battery. Continued operation in this manner may cause starting failure and/or engine damage. Exercising a generator set without exercising associated controls and switchgear does not ensure operation integrity of the controls and switchgear. If the associated equipment is not fully functional, the system may fail to provide power when required.

After each exercise period, refill fuel tank and check engine for leaks and general condition. Locate cause of leaks (if any) and correct.

ENGINE RATINGS

Ratings apply to altitudes up to 1000 feet (305 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult nearest Onan service center or factory for operating characteristics under other conditions.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to and from set.
2. Be sure set location is properly ventilated.
3. Check level of battery electrolyte frequently and add approved water when necessary to maintain proper level.
4. Keep cooling system clean, radiator filled and see that fan belt tension is properly adjusted.

LOW TEMPERATURES

1. Use correct viscosity oil for temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move the set to a warm location or apply externally heated air until oil flows freely (never use open flame).
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.

DUST AND DIRT

1. Keep the generator set clean. Keep cooling system clean.

2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 100 operating hours. Keep governor linkage clean.

HIGH ALTITUDE

Maximum power will be reduced approximately 4 percent for each 1000 feet (305 m) above sea level, after the first 1000 feet (305 m).

OUT-OF-SERVICE PROTECTION

The natural lubricating qualities of diesel fuel should protect a diesel engine for at least 30 days when unit is not in service. To protect a set that will be out of service for more than 30 days, proceed as follows:

1. Run set until thoroughly warm; generator under at least 50 percent load.
 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. If the unit will be exposed to freezing temperatures, drain coolant from the engine, water pump, and cooling system components which are not protected by antifreeze. See *Draining Cooling System*.
 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. Service air cleaner.
 8. Remove glow plugs. Pour 1 ounce (30 ml) of rust inhibitor (or SAE #10 oil) into each cylinder. Crank engine over several times. Reinstall glow plugs.
 9. Check the fuel filters for presence of water as shown in the *PERIODIC MAINTENANCE* section.
 10. Clean the throttle and governor linkage. Protect by wrapping with a clean cloth.
 11. Clean and wipe the entire unit. Coat parts susceptible to rust with a light coat of oil or grease.
 12. Provide a suitable cover for the entire unit after unit has cooled down.

DRAINING COOLING SYSTEM

Drain the entire cooling system including the water-cooled exhaust manifold and exhaust line.

CAUTION

Drain only those components not protected from freezing (exhaust lines, water pump, intake and outlet lines, etc.)

1. Open vent valve or vent plugs.
2. To drain the water pump, loosen the cover and hose connections so the water runs out.
3. Drain the engine block by removing the 1/4 inch drain plug on the left, front side of the engine.
4. Drain the water manifold by removing the drain plug on the bottom.
5. Disconnect hose clamps and hoses to aid draining.
6. Open petcock on bottom of radiator and remove fill cap. Replace cap after radiator has drained completely.
7. Flush out cooling system until water runs clearly.
8. When all water drains out, reconnect hoses, reinstall drain plugs, and close all vent valves or plugs.

RETURNING THE SET TO OPERATION

1. Remove protective cover from unit (if used). Wipe off dust and dirt.
 2. Check that fuel lines and injectors are secure and properly torqued without any air or fuel leaks.
 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 adjust if necessary. Service the cooling system (without antifreeze) with clean and fresh water. Prime the water pump and bleed air from the system.
 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, making sure the exhaust system is fit for operation and does not leak. Exhaust gases contain carbon monoxide which present a potential asphyxiation hazard.*
6. Check the entire generator set for water, fuel, or oil leaks. Correct as required.
 7. Check wiring system for worn wires, loose connections, etc. Remedy as required.
 8. Install the fully-charged batteries and connect to the generator set. Observe correct polarity.

WARNING

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

9. Verify that no loads are connected to generator.
10. Start engine and observe oil pressure gauge and charge rate ammeter. After start, apply load to at least 50 percent of rated capacity.

After engine has started, excessive blue smoke will be exhausted until the rust inhibitor or oil has burned away.

11. Unit is ready for service and load may be applied.

HEAT EXCHANGER FILLING

Improper filling of the heat exchanger (Figure 15) can cause overheating of the engine. To prevent this possibility, follow these instructions whenever adding coolant to the heat exchanger.

WARNING *Avoid removing the pressure cap on the heat exchanger until unit has cooled. If this is impractical, the system may be opened while hot if certain precautions are taken. While wearing rubber insulated gloves for protection, slowly open the cap allowing the pressure to vent. This is necessary to avoid personal injury from contact with hot coolant or steam.*

1. Remove fill cap.
2. Open fill vent valve (turn counterclockwise).
3. Remove vent plug.
4. Fill with coolant until vents begin to overflow.
5. Close fill vent valve (turn clockwise).
6. Replace vent plug.
7. Replace fill cap.
8. Operate unit 10 minutes at full load; watch for leaks.

9. Shut down unit.
10. Slowly open pressure cap and check water level.
11. Fill system to top with coolant.

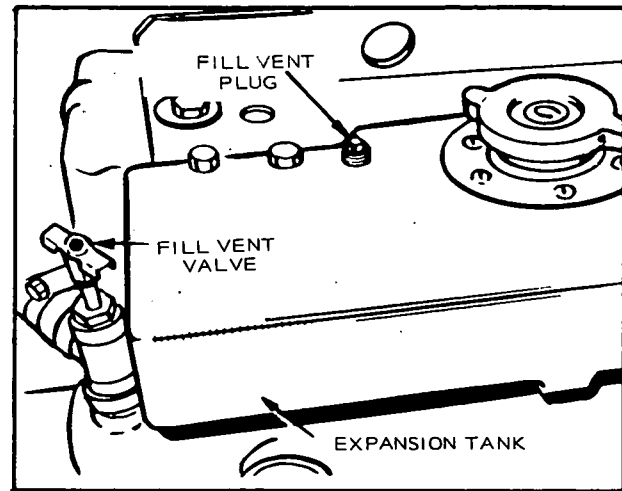


FIGURE 15. FILLING HEAT EXCHANGER

Adjustments

CENTRIFUGAL SWITCH

The start-disconnect centrifugal switch Figure 16 is located 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. If necessary, loosen the stationary contact and adjust point gap at 0.020 inch (51 mm). Replace burned or faulty points.

WARNING Disconnect battery cable prior to setting breaker point gap. Failure to do so could result in personal injury.

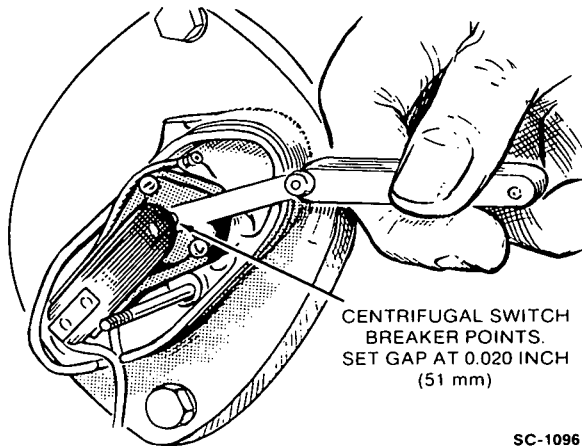


FIGURE 16. CENTRIFUGAL SWITCH ADJUSTMENT

GOVERNOR

The governor controls engine speed. Engine speed equals frequency multiplied by 30 on a 4 pole generator, thus 1800 rpm generates 60 hertz; 1500 rpm generates 50 hertz. 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.

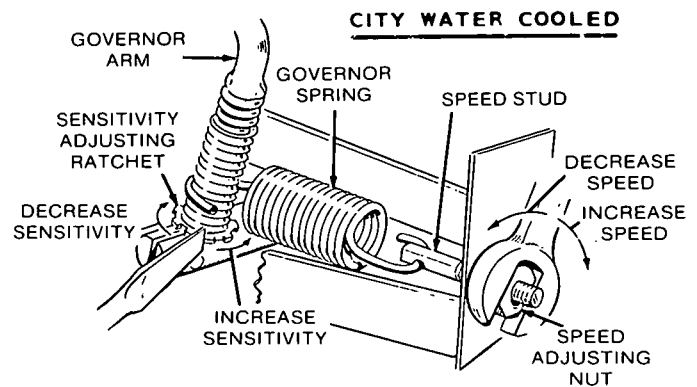
Speed Adjustment

To change the governor speed, change the spring tension by turning the governor spring nut, Figure 17. Turn the nut clockwise (more spring tension) to increase rpm and counterclockwise to reduce governed speed. Use a stroboscope or observe a frequency meter.

Sensitivity Adjustment

To adjust governor sensitivity (no load to full load speed droop) turn the sensitivity adjusting ratchet.

On city water cooled units, counterclockwise gives more sensitivity (less speed drop when full load is applied), clockwise gives less sensitivity (more speed drop). On radiator cooled units, clockwise gives more sensitivity when full load is applied; counterclockwise gives less sensitivity. If the governor is too sensitive, a rapid hunting condition occurs (alternate



Excessive droop may be caused by engine misfiring. Correct this condition before adjusting governor.

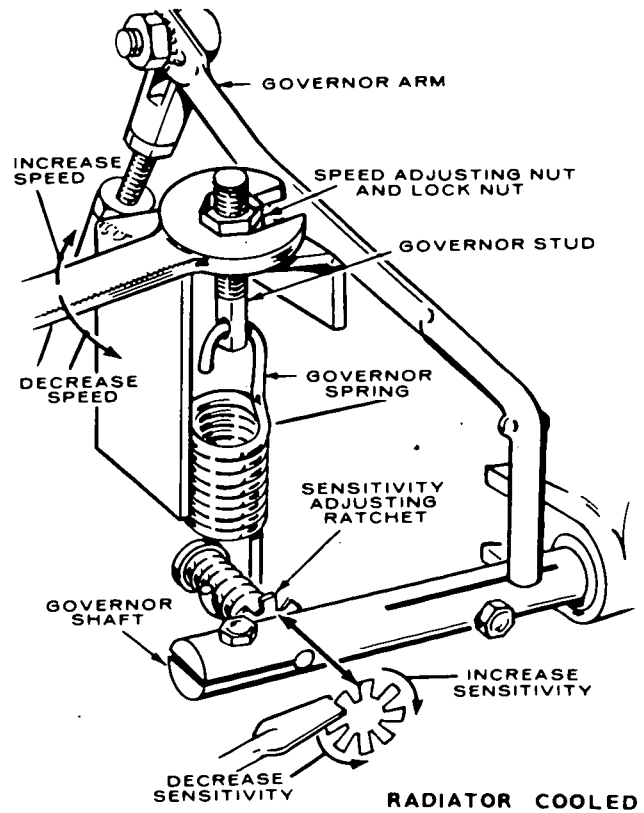


FIGURE 17. ADJUSTING GOVERNOR

increasing and decreasing speed). Adjust for maximum sensitivity without hunting. After sensitivity adjustment is made, the speed will require readjustment. When governor adjustments are completed, 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 2 ampere charging rate. The resistor is located in the generator air outlet. For applications requiring frequent starts, check battery specific gravity periodically and, if necessary, increase the charging rate slightly (move slide tap up). Adjust only when engine is stopped. Avoid overcharging.

Make small increments of change until proper rate has been determined to keep battery charged.

VALVE CLEARANCE ADJUSTMENTS

Check valve clearance when the engine is at room temperature, about 70°F (21°C).

1. Turn the flywheel until the cylinder which is to have its valve adjusted is on its compression stroke. On engines without a hand crank, use a socket wrench on the flywheel hex head screw.

To determine if the cylinder is in its compression stroke, observe the action of the push rods as the engine is rotated in a clockwise direction. The exhaust valve push rod will be in its lowest position and the intake valve push rod will be moving downward. As the piston reaches top dead center, the flywheel timing mark should be aligned with the timing pointer and the valve push rods stationary.

2. Turn the flywheel clockwise for an additional 10 to 45 degrees. There is no timing mark for this position so it must be estimated. With the piston located in this position, it will be in its power stroke with both valves completely closed.
3. Valve clearance is adjusted with the locknut which secures rocker arm to the cylinder head (see Figure 18). Loosen the locknut to increase clearance and tighten to reduce clearance.
4. Using a feeler gauge, check the clearance between the rocker arm and the valve (see Figure 19). Increase or decrease the clearance until the proper gap is established. Valve clearances are given in the *Specifications* section.
5. Always adjust the valve clearances in the firing order (1-2-4-3) sequence. After positioning #1 cylinder, adjust the valve clearance according to steps 3 and 4.

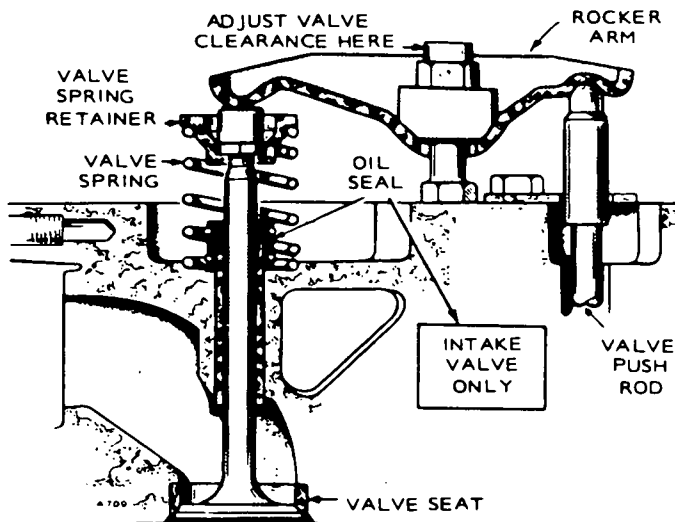


FIGURE 18. VALVE CLEARANCE ADJUSTMENTS

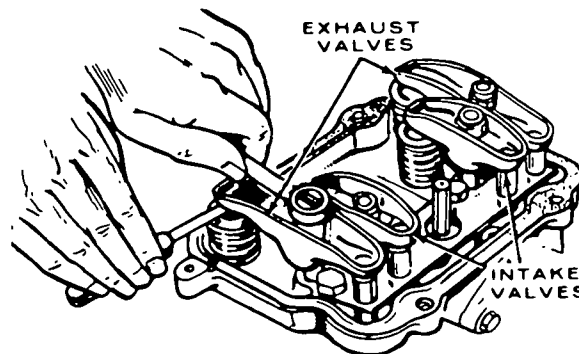


FIGURE 19. CHECK VALVE CLEARANCE

6. To adjust the valve clearance of #2 cylinder, turn the flywheel in a clockwise direction 180 degrees (one half revolution) from the position used when timing #1 cylinder. The flywheel position should be between 10 and 45 degrees past the BC (bottom center) flywheel mark.
7. After positioning #2 cylinder, adjust the valve clearance according to steps 3 and 4.
8. To adjust the valve clearance for #4 cylinder, turn the flywheel in a clockwise direction 180 degrees (one half revolution). The flywheel should be between 10 and 45 degrees past the TC (top center) flywheel mark.
9. After positioning #4 cylinder, adjust the valve clearance according to steps 3 and 4.
10. To adjust the valve clearance for #3 cylinder, turn the flywheel in a clockwise direction 180 degrees (one half revolution). The flywheel should be between 10 and 45 degrees past the BC (bottom center) flywheel mark.
11. After positioning #3 cylinder, adjust the valve clearance according to steps 3 and 4.

General Maintenance

Follow a regular schedule of inspection and servicing, based on operating hours. Keep an accurate log-book of maintenance, servicing, and operating time. Use running time meter (optional equipment) to keep a record of operating hours. Follow service schedule in *Periodic Maintenance schedule* on page 26.

PERIODIC CHECKS

1. Check all fuel and oil lines for possible leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks.
3. Periodically drain moisture from condensation traps.
4. Inspect radiator for leaks and security. Be sure cooling fins are clean.
5. Inspect electrical wires and connections for security and fray damage.

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

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.

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.

CAUTION

Discharged batteries are subject to severe damage if exposed to freezing temperatures. Store all batteries in a fully charged condition and maintain charge during storage.

FUEL FILTERS

Every 100 hours, open the drains on the bottom of the fuel filter assembly (Figure 20) 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.

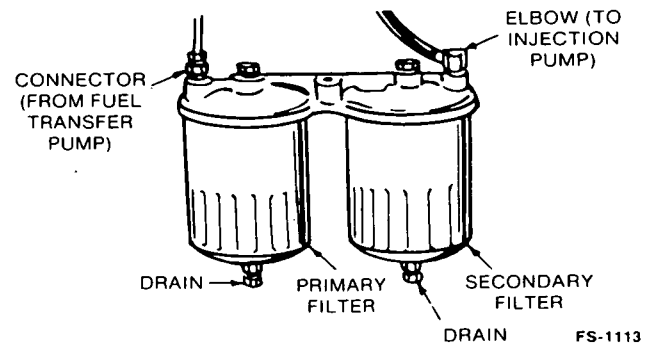


FIGURE 20. DUAL FUEL FILTERS

GOVERNOR LINKAGE

Every 100 hours, carefully pull the neoprene governor ball joints apart and clean. Do not lubricate. See Figure 21.

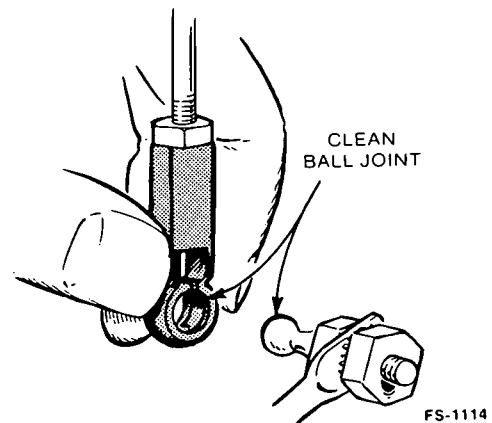


FIGURE 21. GOVERNOR BALL JOINT

WARNING

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

CRANKCASE BREATHER

To clean crankcase breather tube it is necessary to remove both rocker covers as shown in Figure 22. The breather tube itself is installed with a sealant on the threads to prevent oil leakage into the intake manifold and should NOT be removed. A small wire,

nail or a drill bit inserted through from top end should be adequate to clean out the breather hole. The breather hole seldom needs cleaning; the 500 hour interval is suggested to coincide with valve lash adjustments, because the rocker box covers must be removed at that time.

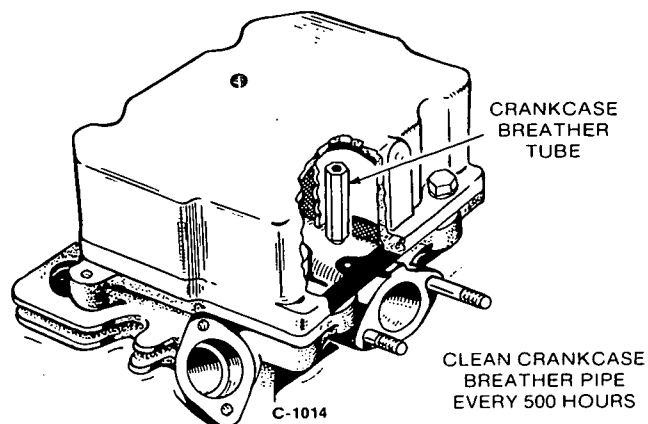


FIGURE 22. CLEANING BREATHER

COOLING SYSTEM MAINTENANCE

The cooling system including the block and radiator should be cleaned and flushed at least once a year. This is especially true in cold weather conditions or when preparing unit for extended storage (over 30 days or more)!

The thermostat is calibrated to open at $150^{\circ}\text{F} \pm 2^{\circ}\text{F}$ (66°C). It should be checked for proper operation.

An appropriate anti-freeze mixture should be used in colder climates.

For identification purposes, left and right sides of the set are viewed from the engine (radiator) end, engine being the front and generator the rear of the set.

The following drain plugs must be removed to allow complete flushing of the cooling system.

Radiator: Hose must be disconnected at the water pump to drain radiator.

Engine Block: One drain plug left front near water pump.

Water Pump: By loosening cover.

Further information concerning the location and part numbers for the various drain plugs throughout the unit is contained in the parts catalog which may be ordered under part #974-0221.

TESTING THERMOSTAT

If a sticking or faulty thermostat is suspected, test as follows:

1. Remove thermostat from cylinder head.

2. Heat a pan of water to approximately 150°F (66°C). Check the temperature using a thermometer immersed in water.
3. With the thermostat suspended in water at a temperature of 150°F (66°C), the thermostat should start to open.
4. After the thermostat has opened completely, remove it from the hot water and allow it to cool in surrounding air. The thermostat should close within a short time.
5. If the thermostat sticks or does not operate properly, replace it with a new one.
6. Always install a new gasket when replacing the thermostat.

FAN BELT

To adjust the fan belt, loosen the nut on the belt tightener pulley shaft. Move the shaft left or right in the elongated slot in pulley mounting bracket until a deflection of $1/2$ inch (13 mm) is obtained when about 15 pounds (20 N•m) of force is applied at a point midway between the water pump pulley and belt tightener pulley. Be sure to tighten nut securely.

AC GENERATOR

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

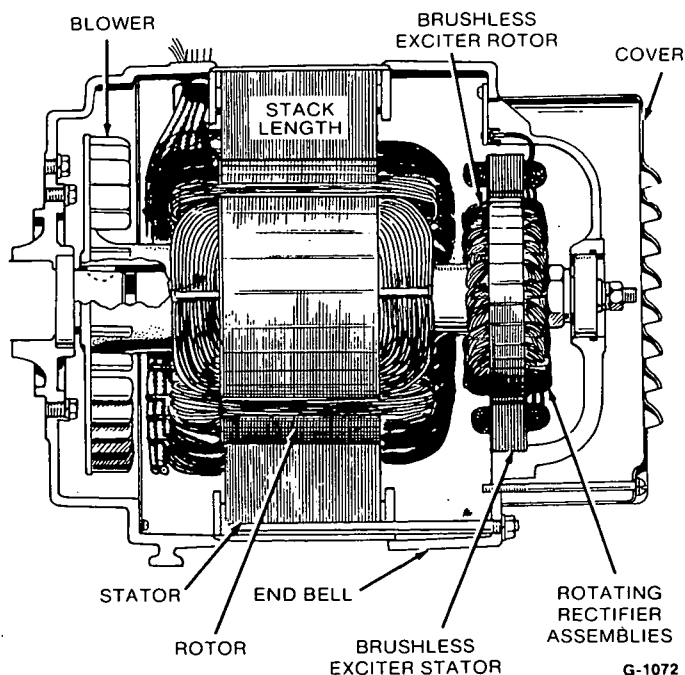


FIGURE 23. GENERATOR (CUTAWAY VIEW)

FUEL PUMP SEDIMENT BOWL

Every 100 hours, remove the sediment bowl from the fuel transfer pump and filter body (Figure 24). 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.

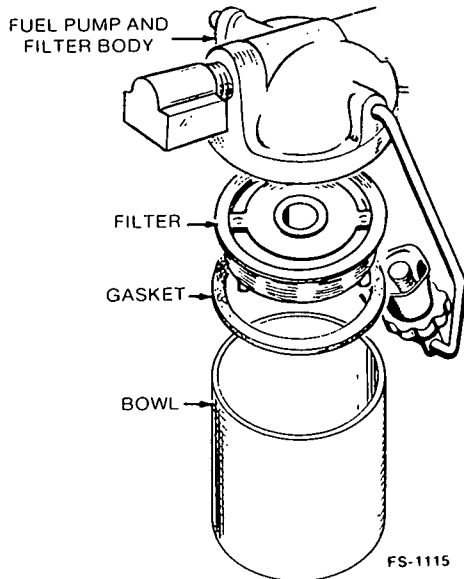


FIGURE 24. FUEL PUMP SEDIMENT BOWL

AIR CLEANERS

After every 50 hours of operation remove and clean filter element, Figure 25.

MOISTENED FOAM TYPE AIR CLEANER

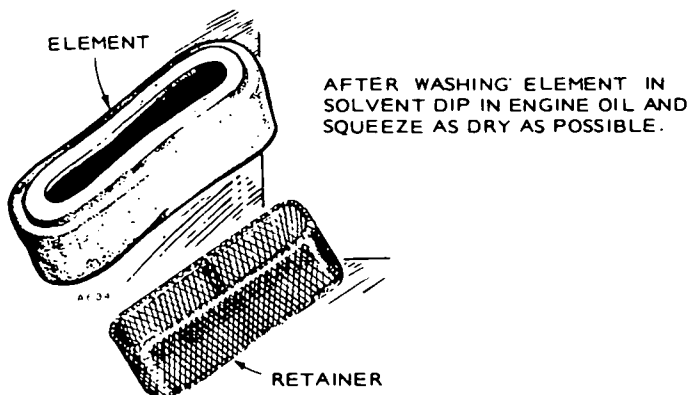


FIGURE 25. POLYURETHANE FOAM AIR CLEANER

OIL FILTER CHANGE

Place pan under oil filter and remove filter by turning counterclockwise. Clean filter mounting area. Oil filter gasket and install new filter. Turn filter on clockwise until gasket touches mounting base, then tighten 1/2 turn.

OPTIONAL OIL BATH AIR CLEANER

1. Loosen bottom clamp, remove cleaner base and clean, Figure 26.
2. Refill base to oil level mark with fresh oil, same weight as used in engine.

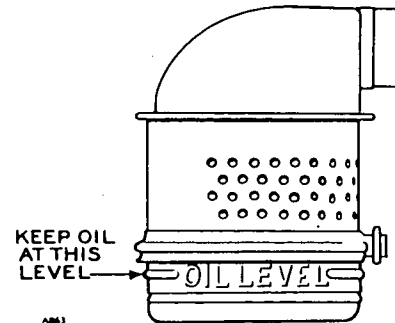


FIGURE 26. OIL BATH AIR CLEANER

OIL CHANGE

Stop the engine and drain the crankcase oil while the engine is still hot. Place a pan under the drain outlet and remove the oil drain plug or open the oil drain valve. After the oil is completely drained, replace the drain plug or close the drain valve. Refill with oil of the correct API designation and the appropriate SAE viscosity grade for the temperature conditions (refer to *OPERATION* section).

Check the oil level indicator after every 8 hours of operation and maintain the oil level at the full mark (Figure 27). The oil should be changed after every 100 hours of operation. Refer to the *SPECIFICATIONS* section for crankcase and filter capacity.

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

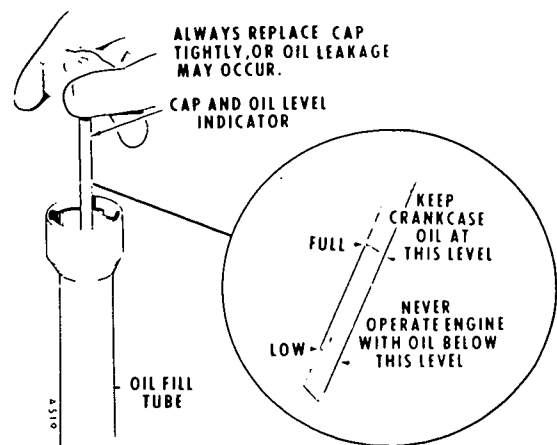


FIGURE 27. OIL LEVEL INDICATOR

PERIODIC MAINTENANCE SCHEDULE

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

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc., contact your nearest authorized Onan dealer.

WARNING Always allow generator set to cool off before performing any maintenance or installation work on the set. Working on a hot set could cause severe burns.

HOURS OF OPERATION	MAINTENANCE TASK
8	<ul style="list-style-type: none"> • Inspect exhaust system • Inspect generator set • Check fuel supply; see Note 1. • Check oil level
50 (more often in dusty conditions)	<ul style="list-style-type: none"> • See Note 3. • Check air cleaner.
100	<ul style="list-style-type: none"> • Clean governor linkage • Change crankcase oil • Clean sediment bowl and filter on fuel transfer pump. See Note 1.
200	<ul style="list-style-type: none"> • Replace air cleaner element • Replace oil filter • Check battery condition
500	<ul style="list-style-type: none"> • Check start-disconnect circuit • Check valve clearances
600	<ul style="list-style-type: none"> • Change primary fuel filter
2000	<ul style="list-style-type: none"> • Grind valves (if required) • Clean holes in rocker box oil line • Check nozzle spray pattern; see Note 2. • Clean generator
3000	<ul style="list-style-type: none"> • Change secondary fuel filter
5000	<ul style="list-style-type: none"> • General overhaul (if required) See Note 3.

NOTE 1. 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 can be replaced following correction of fuel contamination problem.

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

3. Adjust valve clearance after first 50 hours on new and overhauled engines, and then adjust valve clearance each 500 hours thereafter.

WARNING All exhaust system connections **MUST** be checked regularly for any leaks and tightened as necessary. Do **NOT** terminate exhaust pipe under vehicle or near any window or door openings. Inspect the vapor tight seals around all openings made in the set's compartment for wiring, conduit, etc., to prevent entrance of any noxious fumes to motor home interior.

TROUBLE																					DIESEL ENGINE TROUBLESHOOTING GUIDE										CAUSE									
COMPRESSION POOR	CONNECTING ROD, BUSHINGS, BEARINGS WORN	COOLANT TEMPERATURE TOO HIGH (FRESH WATER SYSTEM)	COOLANT TEMPERATURE TOO LOW (FRESH WATER SYSTEM)	ENGINE MISFIRE	ENGINE POWER LOW	ENGINE OVERHEAT	ENGINE SPEED TOO LOW	FUEL CONSUMPTION TOO LOW	FUEL CONSUMPTION TOO HIGH	FUEL CONSUMPTION EXCESSIVE	GOVERNOR CONTROL EXCESSIVE	HUNTING	INJECTION PUMP	MECHANICAL KNOCKS	OIL CONSUMPTION EXCESSIVE	OIL CONSUMPTION EXCESSIVE - LIGHT BLUE SMOKEY EXHAUST	OIL DILUTED	OIL PRESSURE HIGH	PISTON, CYLINDER AND RING WEAR	STARTER SPEED SLOW	STARTING MOTOR DOES NOT TURN	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														
																										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														
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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