

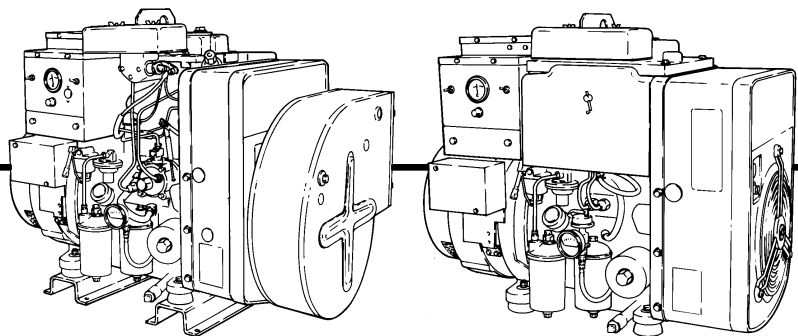


Operator's Manual

DJB, DJE

GenSets

Electric Generating Sets



967-0121

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Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

⚠ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

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

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.

- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- 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 surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. 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.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

GENERAL SAFETY PRECAUTIONS

- 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. Allow the generator set to cool and bleed the system pressure first.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

Section 1. General Information

This manual contains information on operating, maintaining, and adjusting the Onan® DJB and DJE generator sets. Study and follow these instructions carefully. A well-planned service and maintenance program will help provide longer unit life and better performance.

In this manual, the engine end of the generator set is defined as the front. The “left” and “right” sides are defined when facing the engine (front) end.

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact your nearest dealer or distributor. Factory-trained Parts and Service representatives are ready to handle all your service needs.

If unable to locate a dealer or distributor, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC, or
ENGINES-GASOLINE OR DIESEL

For the name of your local Cummins®/Onan or Onan-only distributor in the United States or Canada, call

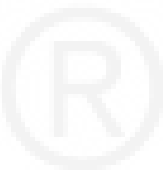
1-800-888-ONAN (this automated service uses touch-tone phones only). By entering your area code and the first three digits of your local telephone number, you will receive the name and telephone number of the distributor nearest you.

When contacting your distributor, always supply the complete Model Number and Serial Number as shown on the generator set nameplate.

Onan gensets are given a complete running test under a variety of load conditions, and are thoroughly checked before leaving the factory. Examine this unit closely when it arrives, for possible shipping damage. Tighten loose parts, replace missing parts and repair all visible damage before starting the unit.

MODEL IDENTIFICATION

When this manual refers to a specific generator set, identify it by referring to the MODEL and SPEC NO. shown on the unit nameplate. Electrical specs are listed on the lower portion of the nameplate.



Section 3. Control Description

CONTROL PANEL COMPONENTS

NOTE: Controls and instruments on the genset vary according to customer requirement.

Standard Features

- **Start-Stop Switch:** Starts and stops the genset locally.
- **Battery Charge Rate DC Ammeter:** Monitors the battery charging current.

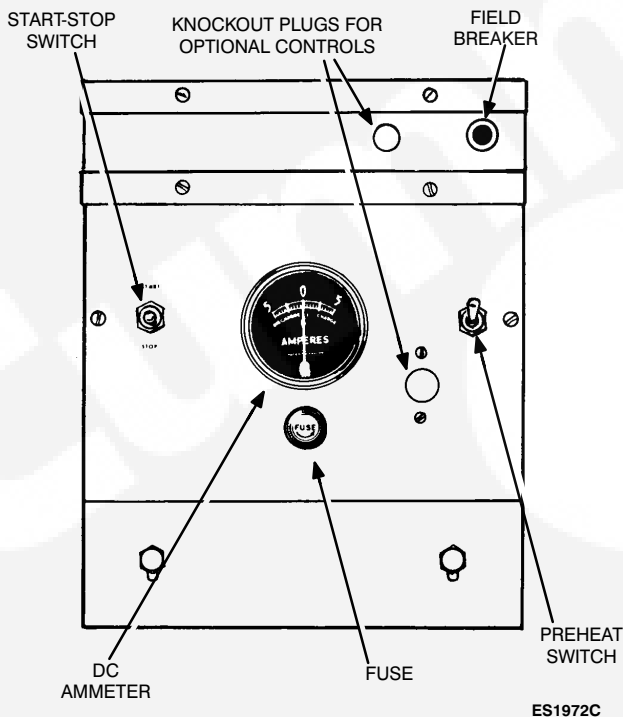


FIGURE 3-1. STANDARD CONTROL PANEL

Optional Features (found on Housed Units)

- **AC Voltmeter:** Monitors output voltage.
- **Voltmeter Phase Selector Switch:** Selects the output voltage phase to be measured.
- **Voltage Adjust Rheostat:** Adjusts output voltage $\pm 5\%$.
- **Running Time Meter:** Registers the total genset running time: used to time service intervals.
- **Exciter Field Circuit Breaker:** Protects the exciter and the alternator if the voltage regulator malfunctions.
- **Preheat Switch:** Activates the manifold heater and glow plugs for cold engine starting.
- **Oil Pressure Gauge:** Monitors engine lubricating oil pressure.
- **Fuse:** Protects DC circuit against reversed battery terminals.
- **Frequency Meter:** Indicates the frequency (hz) of the output voltage. This meter can be used to determine engine speed (one hz equals 30 rpm).
- **Warning Lights:** Red warning lights indicate the following conditions:
 1. Overspeed
 2. Low oil pressure
 3. High engine temperature
- **Reset Pushbutton:** Permits restarting after a fault condition is corrected.
- **Line Circuit Breakers:** Protects the generator from line overloads.

- **Cranking Limiter:** Thermally activated device limits cranking time to 45 - 90 seconds, depending on ambient temperature. At the end of the cranking period, a red pushbutton pops out, which cannot be re-set until one minute has elapsed.

Other Optional Control Features

- **Low Oil Pressure Shutdown:** The engine is equipped with a low oil pressure cutoff switch (LOPCO) to shut down the engine if oil pressure drops below 14 psi (97 kPa) \pm 2 psi.
- **High Air Temperature Shutdown:** The engine is equipped with a high air temperature cutoff switch

(HATCO) to shut down the engine if engine temperature rises above 375° F \pm 15° F (190.5° C).

- **AC Control With Meters:** The AC control panel has a voltmeter, ammeter, frequency meter, phase selector switch, output voltage adjusting rheostat and resettable exciter field circuit breaker.
- **AC Control - Housed Sets:** The AC control panel has a voltmeter, an ammeter for each line, a circuit breaker for each line, a frequency meter and a running time meter.

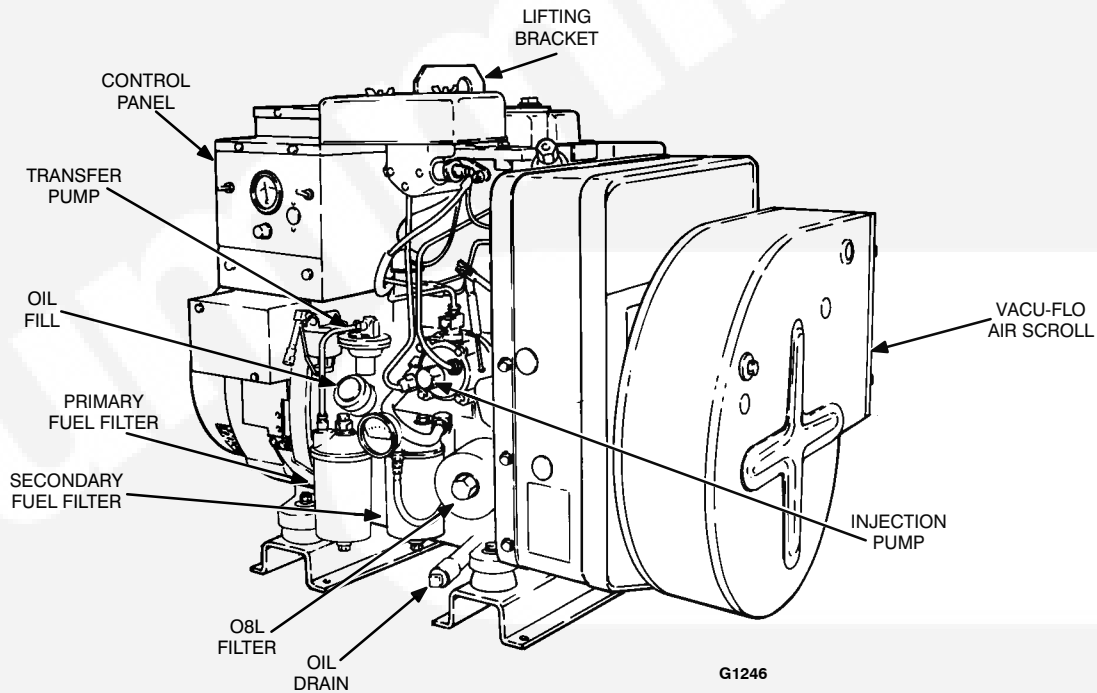


FIGURE 3-2. DJB GENERATOR SET

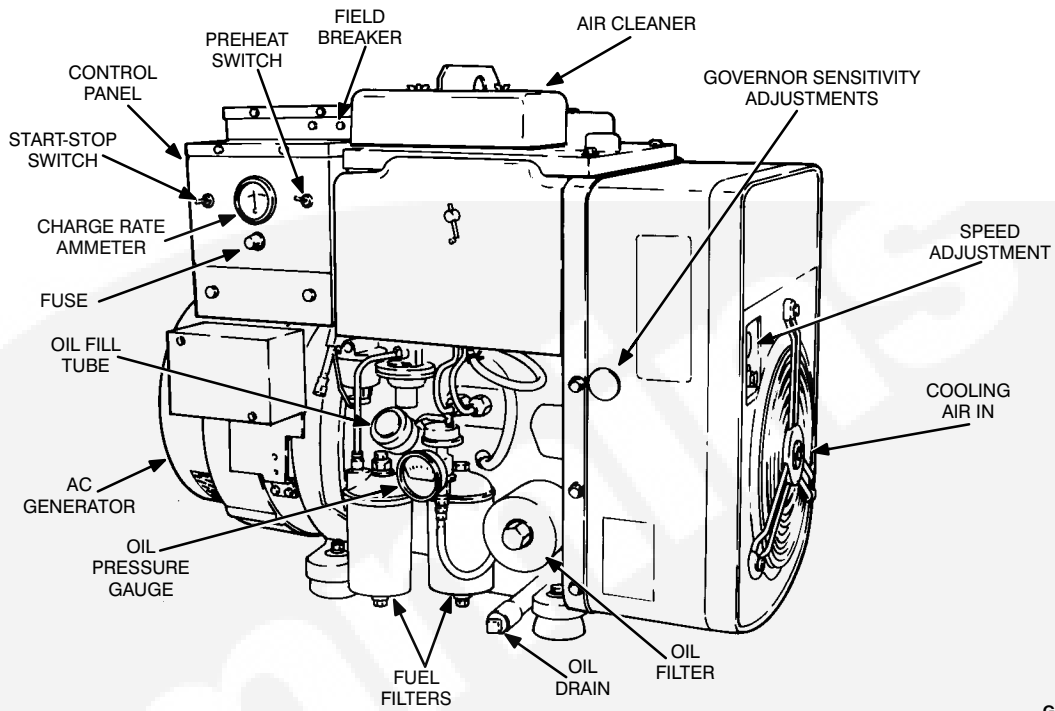


FIGURE 3-3. DJE GENERATOR SET

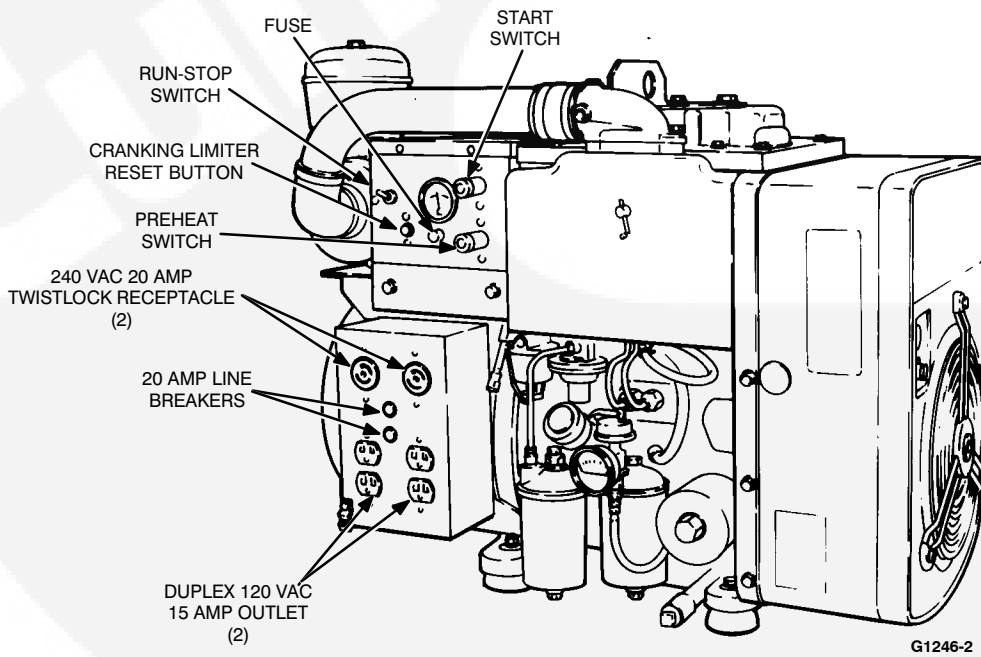


FIGURE 3-4. DJE GENERATOR SET (CONTRACTOR VERSION)

Section 4. Installation

INSTALLATION REQUIREMENTS

Generator set installations must conform to local building codes, fire ordinances, and other local, state and federal regulations.

Installation requirements include:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Fuel connections
- Accessibility for operation and servicing
- Isolation from vibration
- Minimal noise levels

For more detailed installation instructions, consult Onan Application Manual T-030, or contact an authorized Onan service representative.

⚠WARNING *Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be qualified to perform electrical and mechanical component installations and service. Installation must comply with all state and local codes.*

GENERATOR SET LOCATION

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

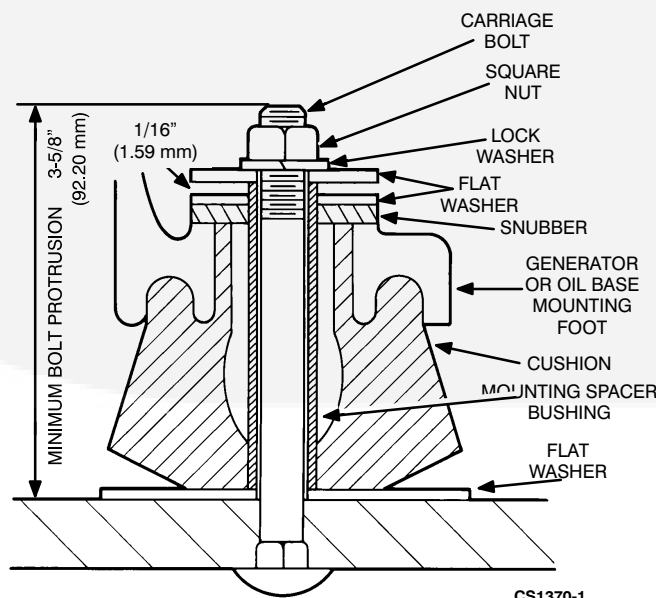
The left side of the set, where generator air is discharged, requires 3 inches (76 mm) clearance from the wall, so the set can rock on its mounts. There should be at least 24 inches (610 mm) clearance around all other sides for service access.

MOUNTING

A permanent genset installation must have a sturdy, level mounting base of concrete, heavy wood or structural steel. This base should be raised if possible, for easier oil changing and set operation. The set may be bolted into position.

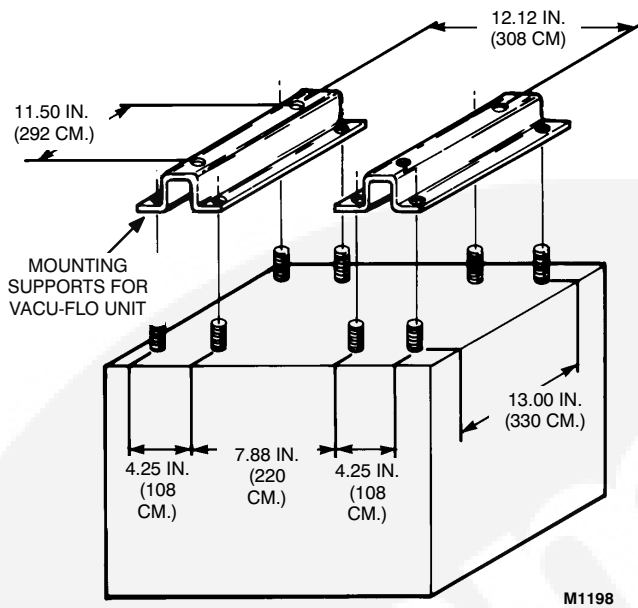
On all installations, assemble the mounting cushions, washers and spacer bushing carefully. The spacer bushing prevents compression of the snubber (upper rubber cushion). Place the cushions (Figure 4-1) under the engine and generator mounting feet. Use cushions with a higher number (part number is shown on cushion) on the heavier generator end. Space the mounting bolts in the floor or the base with distances between hole centers as shown in Figure 4-2 for either the DJB or the DJE.

⚠CAUTION *The oil filter can be punctured easily by the end of the mounting bolt. For this reason, provide at least 1/2-inch (12.7 mm) clearance between the oil filter and the end of the mounting bolt, to avoid puncturing the filter.*

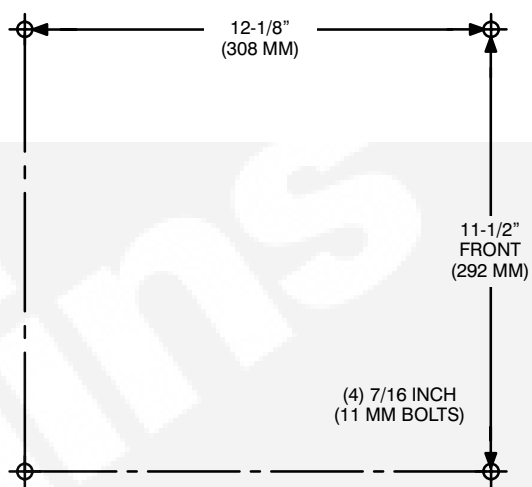


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FIGURE 4-1. MOUNTING CUSHION INSTALLATION



DJB MOUNTING BASE



DJE MOUNTING BASE

FIGURE 4-2. MOUNTING BASE

VENTILATION

Air circulation is needed to dissipate heat produced by the engine and generator in normal operation. Outdoor installations can rely on natural circulation, but mobile, indoor or housed installations need proper size and positioned vents for required air flow. See SPECIFICATIONS for air requirements.

Vent sizes depend on variable conditions:

- Size of enclosure
- Ambient temperature
- Electrical load
- Running time
- Restrictions imposed by screens, louvers, or filters
- Prevailing wind direction

The required volume of air must reach the unit, absorb the heat, and be discharged away from the installation.

Air Intake Requirements

DJB - Vacu-Flo® Cooling: On the DJB, the Vacu-Flo cooling inlet vent must be at least 1-1/3 sq. ft (1236 cm²) in area; the duct for discharged air should be at least as large as the scroll outlet. Section 2 of this manual, SPECIFICATIONS, lists the air flow requirement for this set. See Figure 4-3.

DJE - Pressure Cooling: The pressure-cooled DJE needs an inlet vent with an unrestricted opening of at least 3-1/2 square feet (3252 cm²) for variables. Section 2 of this manual, SPECIFICATIONS, lists the air flow requirement for this set. See Figure 4-4.

Air Discharge Requirements

DJE and DJB Gensets: Install separate ducts for air discharge from the engine and generator (see exception) as follows:

1. The engine discharge duct must be the same size as the engine outlet: 8 x 10 inches (203 x 254 mm). If a screen is used in the duct, increase the duct size in proportion to the restriction. Consider installing the screen diagonally to limit the restriction, and increase duct size for runs over 9 feet (2.74 m). If bends are necessary, use large radius elbows. Use a canvas section at the set to absorb vibration and noise.
2. Generator outlet ducts must be used when units are installed in compartments too small for operator to walk. Ducts are recommended for all other indoor installations. The air outlet is 5-5/8 x 3 inches (140 x 76 mm). Follow the same principles of duct design and installation as used for the engine duct. Engine and generator require separate ducts.

Auxiliary fans can be used to increase airflow to units installed in small, poorly ventilated rooms. The fan size and location should be such that the air inlet to the engine

doesn't exceed 120° F (49° C) when running at full rated load.

Onan thermostatically controlled shutters can be used to aid warm-up after starting and keep cold air out during shutdown. When the discharged air reaches 120° F (49° C), shutters begin to open; at 140° F (62° C), the shutters completely open.

⚠ CAUTION *Generator set overheating can result in engine damage. To avoid this, never operate the generator set with any of the cooling system components removed.*

EXHAUST

Pipe exhaust gases outside the enclosure. The exhaust outlet fits a 1-1/2 inch pipe. Locate the exhaust outlet as far as possible from the air inlet, to keep gases from reentering the enclosure. Use seamless flexible tubing to connect the engine exhaust to a rigid pipe extension, if used, to prevent transmission of vibration.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Modifying the exhaust system can allow poisonous exhaust gases to escape. Use only original equipment replacement parts when servicing the exhaust system. Unauthorized modifications will also void the warranty and cancel the UL Listing/CSA Certification. Liability for injury or damages due to unauthorized modifications becomes the responsibility of the person making the change.*

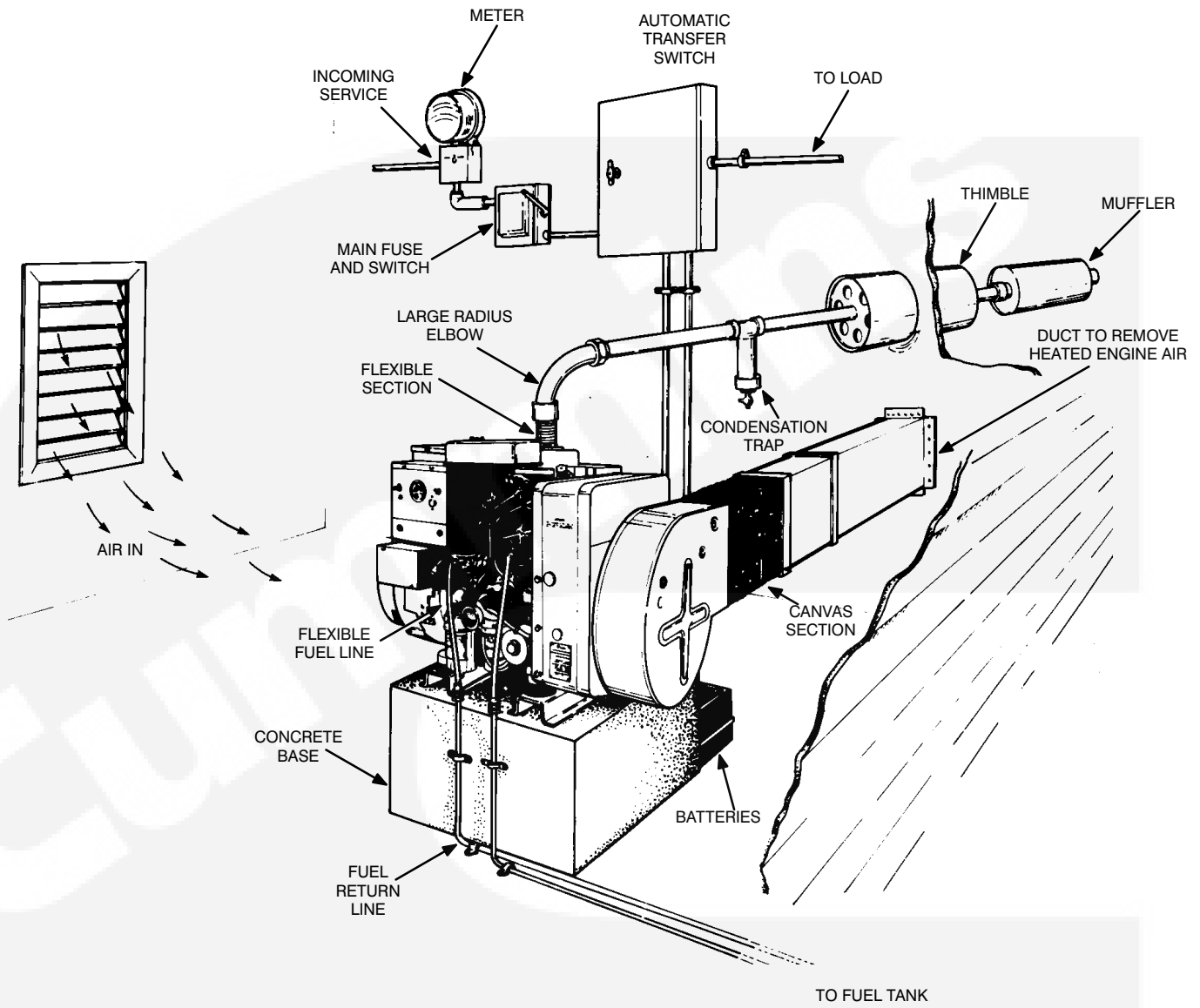
Because an exhaust system is subjected to detrimental conditions such as extreme heat, infrequent operation, and light operating loads, inspect the exhaust system frequently to be sure that it remains fume-tight.

⚠ WARNING *Inhalation of exhaust gas presents the hazard of severe personal injury or death. Exhaust gas can easily leak from a faulty manifold. Do not use exhaust manifold heat to warm a room or compartment.*

An approved thimble must be used (Figure 4-5) to pass exhaust pipes through walls or partitions. Build this thimble according to code (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, a larger pipe is required, to reduce excessive exhaust restriction and back pressure.



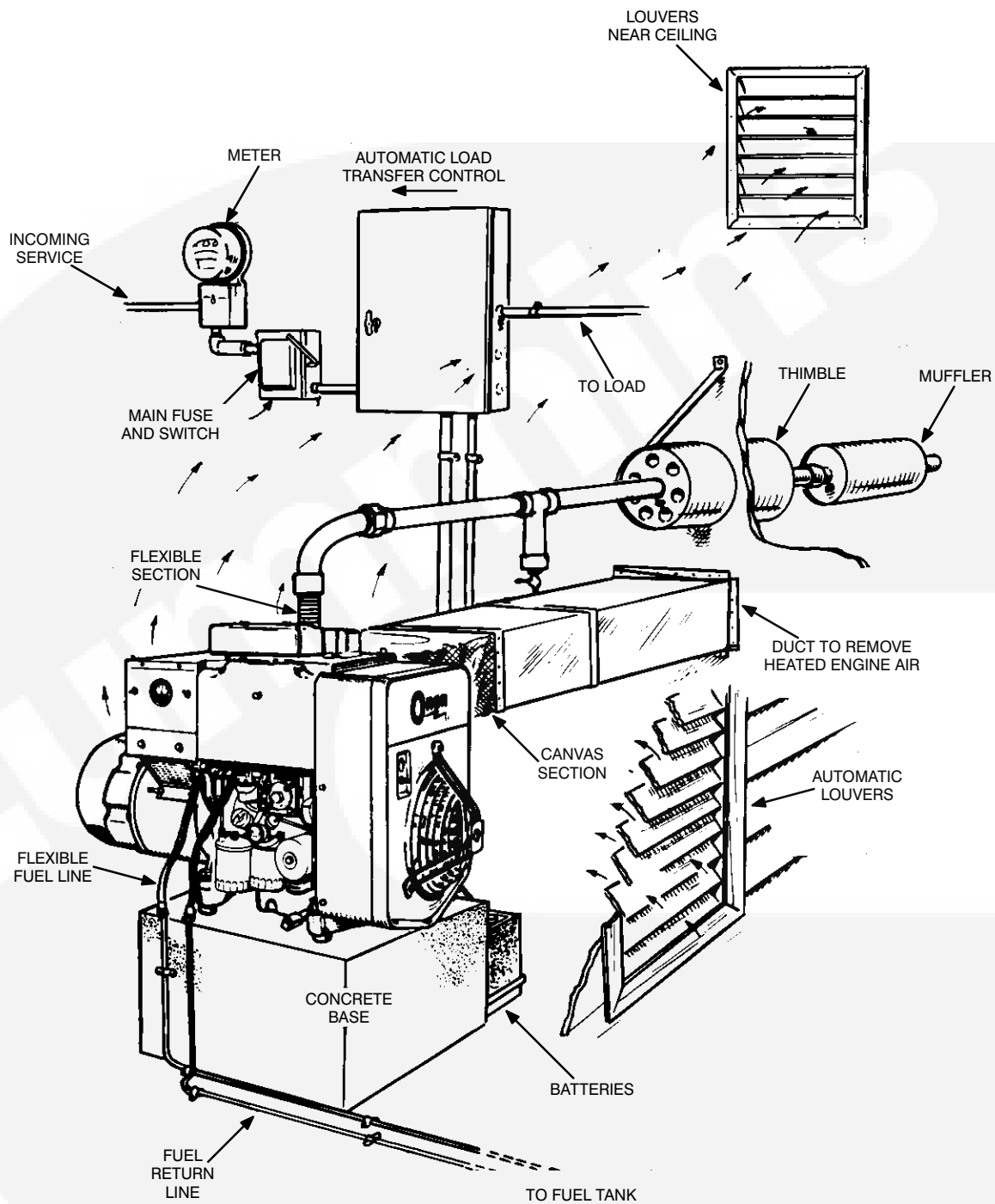


NOTE: If revolving-field type unit is installed in smaller than approximately 384 cu. ft. (11 m³) compartment, duct generator heated air to outside.

Do not join with duct for engine heated air.

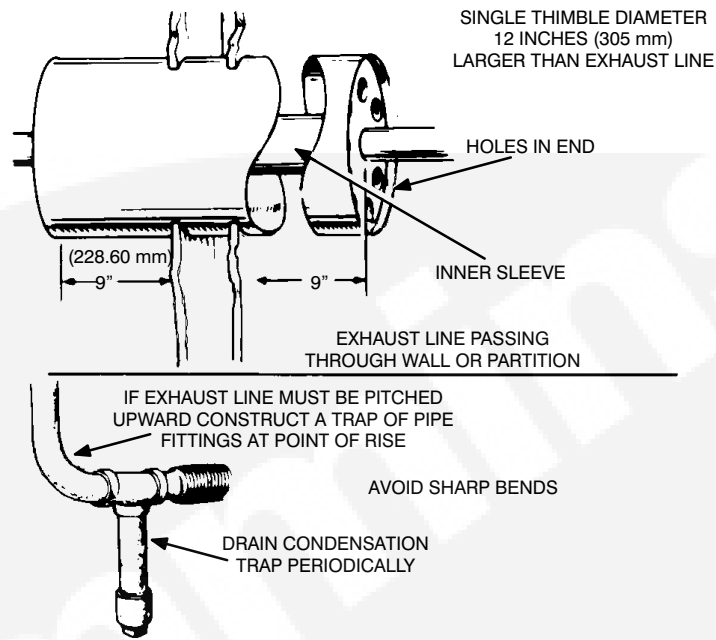
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FIGURE 4-3. DJB, TYPICAL INSTALLATION



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FIGURE 4-4. DJE, TYPICAL INSTALLATION



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FIGURE 4-5. EXHAUST PIPING

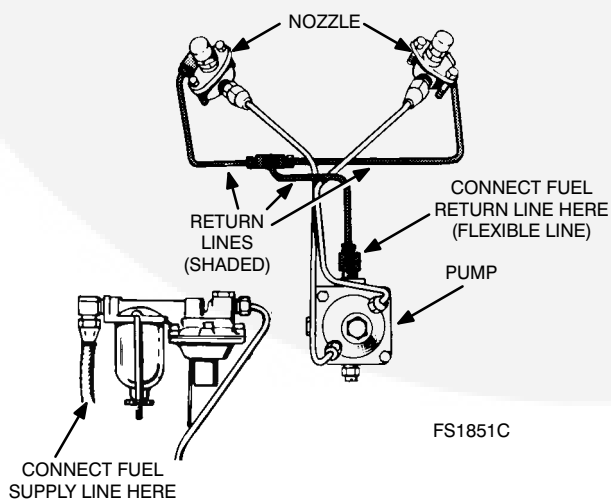
FUEL TANK AND LINES

⚠WARNING Fuel tanks risk explosion and fire, which can cause severe personal injury or death. Because fuel leaks create fire hazards, always use flexible tubing between the engine and the fuel supply, to avoid leaks due to vibration and/or fuel line failure. Do not allow the fuel line to contact rough, sharp or hot surfaces.

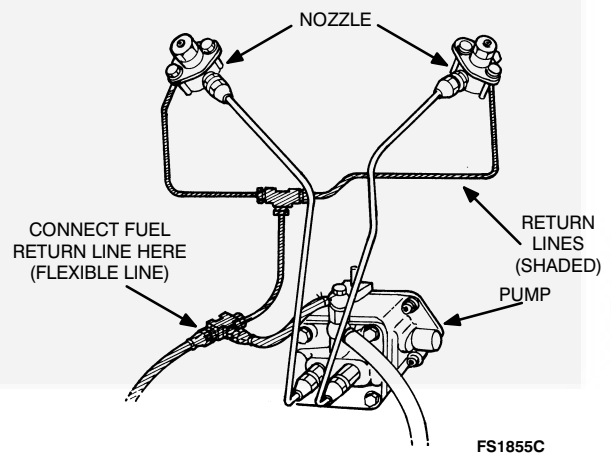
Connect the fuel line to the fuel pump inlet as shown in Figure 4-6 for either the DJB or DJE generator set.

Use an 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. The pump is threaded 7/16-24 NPTF (American Standard Internal Tapered Pipe Thread).

Install fuel return line from the 7/16-24 size 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. Shield the line with fire-retardant material if it passes through a combustible wall or partition.



DJB FUEL LINE CONNECTIONS



DJE FUEL LINE CONNECTIONS

FIGURE 4-6. FUEL LINE CONNECTIONS

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

⚠WARNING Never use galvanized or copper 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 sulfuric acid. The molecular structure of the copper or galvanized lines or tanks reacts with the acid and contaminates the fuel.

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.

⚠CAUTION Dirt in the system can severely damage both the injection pump and the injection nozzles. Dirty fuel is one of the major causes of engine failure. Even a tiny particle of dirt in the injection system may stop the engine. Because diesel injection systems have extremely precise tolerances, make certain that fuel is kept clean.

Separate Fuel Tanks

The fuel tank top must be lower than the fuel pump level to prevent putting a static head on the fuel pump inlet. If the fuel tank is shared with another engine, use separate fuel lines for both engines to avoid starving either one.

The following restrictions apply to separate fuel tank installation:

1. The bottom of the 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 the Wiring Diagram for the connection.

2. If the tank is installed above the fuel pump inlet level without a supply line shutoff valve, a ruptured pump diaphragm could cause oil dilution, fuel loss, and fuel leakage to the crankcase.

3. If the maximum fuel lift must be exceeded on any installation, consult Onan Application Manual T-030 for information on installing a day tank and an electric solenoid shutoff valve.

4. Use an electric or manual shutoff valve if the minimum fuel level in the tank is higher than the pump inlet, to provide positive fuel shutoff when the engine is stopped. This valve also prevents loss of fuel from possible leaks between the tank and the fuel pump.

⚠WARNING Fuel leaks create the hazard of explosion and fire, which can cause severe personal injury or death. For these reasons, always use flexible tubing between the engine and the fuel supply, to avoid leaks due to vibration and/or fuel line failure. Make certain that the fuel system and the fuel tank location meet applicable local codes.

INJECTION PUMP ADAPTER ASSEMBLY (DJE only)

A spring and plunger assembly on the side of the pump adapter (Figure 4-7) on the DJE generator set limits the maximum power output of the engine for safe operation and permits maximum fueling during starting.

⚠CAUTION Do not change the adjustment of this device unless absolutely required. The warranty may be voided if the fuel stop is intentionally altered to increase engine power.

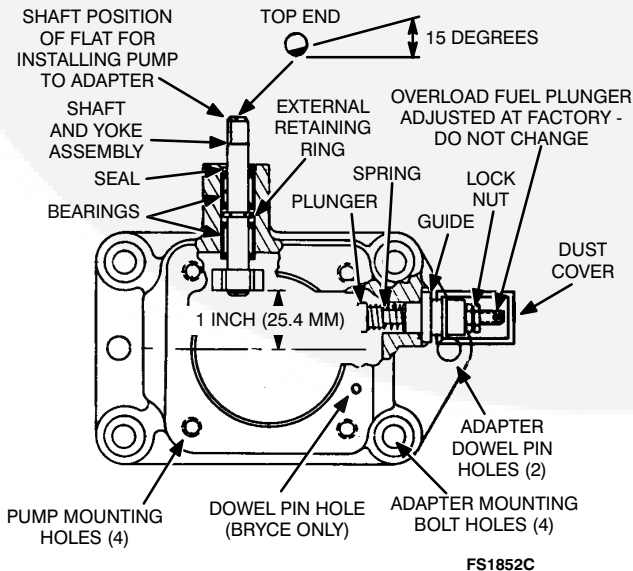


FIGURE 4-7. INJECTION PUMP ADAPTER ASSEMBLY

OIL DRAIN

Extend the drain to suit the installation. The oil base has a 1/2-inch pipe size tapped hole.

⚠WARNING *Do not position the oil drain so that oil might drip onto the muffler, any exhaust components, or any other hot parts, causing a fire hazard. Fire presents the hazard of severe personal injury or death.*

ELECTRICAL CONNECTIONS

The nameplate on the genset lists its electrical output rating in watts, volts, and hertz. The wiring diagram, shipped with the set, depicts the electrical circuits and connections for installation.

All electrical connections should be made by an electrician or a qualified Onan technician, to meet the local electrical code requirements.

⚠WARNING *Electrical shock can cause severe personal injury or death. Do not touch electrical wiring or components during testing. Disconnect electrical power by removing starting battery negative (-) cable before handling electrical wiring or components.*

Load Wires

The control box (junction box) has knockout sections to accommodate load wires. Use flexible conduit and

stranded load wires near the set, to isolate vibration. Use the correct size insulated wires for the load rating applied.

Connect each load wire to the proper generator output lead inside the control box. Insulate the bare ends of the ungrounded wires. Use the 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 the load. If a test run indicates the wrong rotation of 3-phase motors in the load circuit, switch the connections at any two of the generator terminals.

⚠WARNING *Electrical shock can cause severe personal injury or death. Check voltage at the nearest junction box to be sure power has been disconnected before disconnecting load wires.*

⚠CAUTION *An excessive electrical load can damage the generator windings. Divide loads equally between the output leads to prevent generator damage.*

Standby

If the genset is being installed for standby service, add a manual or automatic double-throw transfer switch to avoid feeding generator output into the normal power source lines, and to prevent commercial power and generator output from being connected to the load at the same time. See the transfer switch installation manual for connection instructions. Also see Figure 4-8.

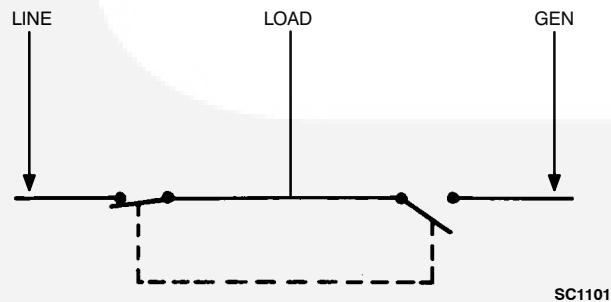
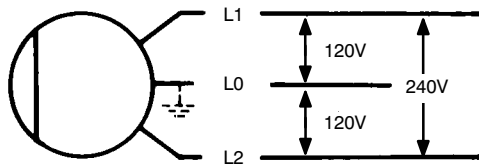


FIGURE 4-8. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

BALANCING LOADS

⚠WARNING *Electrical shock can cause severe personal injury or death. Do not touch electrical wiring or components during testing. Disconnect electrical power by removing starting battery negative (-) cable before handling electrical wiring or components.*

120/240 Volt, Single Phase: Terminal connection L0 (neutral) may be grounded, if required. For 120 volts, connect the hot load wires to either the L1 or L2 connection, Figure 4-9. Connect the neutral load wire to the L0 connection. Two 120 volt circuits are thus made 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.



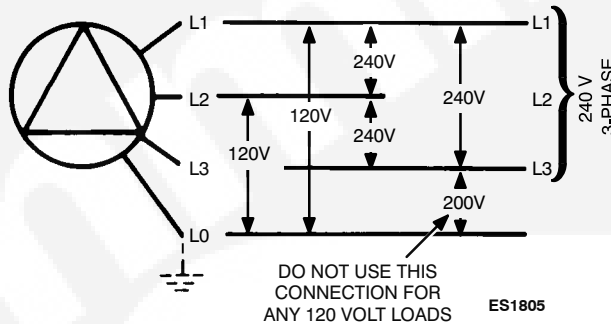
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FIGURE 4-9. 120/240 VOLT, SINGLE PHASE

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.

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 4-10). In 3-phase operation, connect the three load wires to generator terminals L1, L2 and L3 - one wire to each terminal. In 3-phase operation, the L0 terminal is not used.



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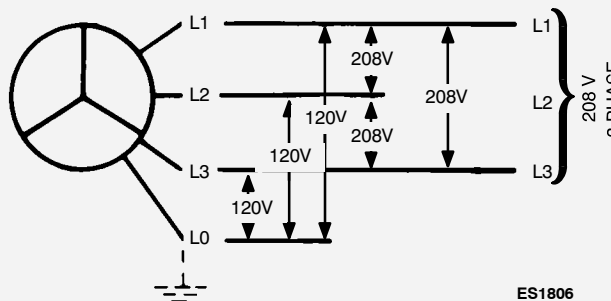
FIGURE 4-10. 3 PHASE, DELTA CONNECTION

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.

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.

Any combination of 1-phase and 3-phase loading may be used at the same time, if 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.

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 4-11.



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FIGURE 4-11. 3 PHASE, WYE CONNECTION

The terminal marked L0 may be grounded if necessary. 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 available at 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 4-11 shows load connections for 120/208 voltage. Other voltages are available from either parallel wye or series wye, illustrated in Figure 4-12.

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASE	FREQUENCY	CONNECT W1 TO 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	
J	120/240	1	60	V1	PARALLEL WYE	240 V 	120 V 	120/240 V
P	120/240	1	50	V1		240 V 	120 V 	120/240 V
	115/230	1	50	V2		240 V 	120 V 	120/240 V
	110/220	1	50	V3	240 V 	120 V 	120/240 V 	
L	120/208 127/220 139/240	3	60 60 60	V1 V2 V4	PARALLEL WYE			
Z	110/190 115/200 120/208 127/220	3	50 50 50 50	V1 V2 V3 V4				
L	240/416 254/440 277/480	3	60 60 60	V1 V2 V4	SERIES WYE			
Z	220/380 230/400 240/416 254/440	3	50 50 50 50	V1 V2 V3 V4				
L	120/240	3	60	V1	SERIES DELTA			
Z	110/220 115/230 120/240	3	50 50 50	V1 V2 V3				
L	120/240	1	60	V1				
Z	110/220 115/230 120/240	1	50 50 50	V1 V2 V3	DOUBLE DELTA			
L	120/240	1	60	V1				
Z	110/220 115/230 120/240	1	50 50 50	V1 V2 V3				
L	120	1	60	V1	PARALLEL DELTA			
Z	110 115 120	1	50 50 50	V1 V2 V3				
H	347/600	3	60	V1				WYE

FIGURE 4-12. GENERATOR WIRING AND CONNECTION DIAGRAMS

GROUNDING

Typical requirements for bonding and grounding are given in the National Electrical Code, 1990, 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 in the National Electrical Code, 1990, Article 100, as: 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 *Bonding and equipment grounding must be done correctly for proper system operation and operator safety. Abnormal system conditions may allow ungrounded metallic parts to be energized, which could result in severe personal injury or death.*

Circuit and System Grounding

The design and installation of grounding systems involves many factors, including multiple transformers, standby generators, ground fault protection, physical locations of equipment, and conductor type and size. Although the consulting engineer and installer are responsible for the design and wiring of each particular grounding application, system grounding 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

⚠WARNING *Electrical shock can cause severe personal injury or death. Use extreme caution when working on electrical circuitry. Attach and remove switchboard leads only when generator set is not operating. Make certain that the generator set is inoperative by disconnecting the negative (-) battery cable. Do not touch leads during operation of generator set.*

A optional wall-mounted switchboard contains ammeters, a voltmeter, and circuit breakers. If it is 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 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), wire the voltmeter to indicate the higher voltage.

RECONNECTIBLE GENERATORS

The factory ships special-order sets with control panels especially wired for the voltage specified by the customer. 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 may be connected to provide any of the output voltages shown in Figure 4-12. Grounding or earthing procedures should comply with local electrical codes.

⚠WARNING *Electrical shock can cause severe personal injury or death. Never remove the grounding pin from electrical equipment. Incorrect ground or no ground can cause the installation to become electrically "hot". Equip the installation with adequate Ground-Fault Circuit Protection devices to meet the National Electrical Code (NFPA 70, 551- 7[C]) and to provide personal safety.*

Code 3C or 53C Reconnectible Generators: The single-phase, 60- and 50-hertz generators have output leads T1, T2, T3 and T4 available to make the single phase voltage and load connections shown in Figure 4-12 at the installation site.

Code 18 or 518 Reconnectible Generators: The three-phase, broad-range, 60 and 50 hertz 12-lead generators have output leads T1 through T12 available to make the single and three phase voltage load connections shown in Figure 4-12.

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.

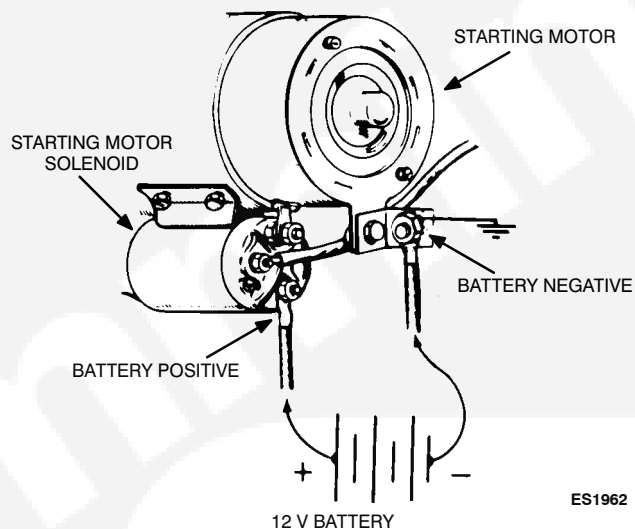
Code 9x Generators: These special-order three-phase, 60 hz, 4-wire generators are rewired at the factory to provide 347/600 VAC. Output leads T1, T2, T3 and T0 are available for connection to the load wires. See connection diagram, Figure 4-12.

BATTERY CONNECTIONS

The battery is connected for negative (-) ground, Figure 4-13. Be sure all battery connections are tight.

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

⚠WARNING Batteries present the hazard of explosion, which can result in severe personal injury. Disconnecting battery cables from the battery while the generator set is cranking or running causes arcing. For this reason, do not disconnect battery cables from the battery while the generator set is cranking or running. To minimize arcing, always disconnect the negative (-) cable first, and connect it last.



ES1962

CABLE SIZE

mm	6.5	7.3	8.3	9.3	10.5	11.6
INCH WIRE SIZE	.258	.289	.325	.365	.410	.460
	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

FIGURE 4-13. BATTERY CONNECTIONS AND CABLE DIMENSIONS

⚠CAUTION Reversed battery polarity can damage or destroy the generator within 3 minutes if stopped, or within 5 seconds if running. With reversed polarity, alternator windings will be damaged almost instantly if the battery charging circuit is shorted between resistor R21 and the B1 end of the charging winding. Make certain that battery polarity is correct, to avoid damaging or destroying the system.

See the Specifications section of this manual for the 12 volt battery minimum requirements. Connect battery positive (+) to starter engaging solenoid terminal post, Figure 4-13. Connect battery negative (-) to a solid ground connection on the engine.

OPTIONAL ALARM

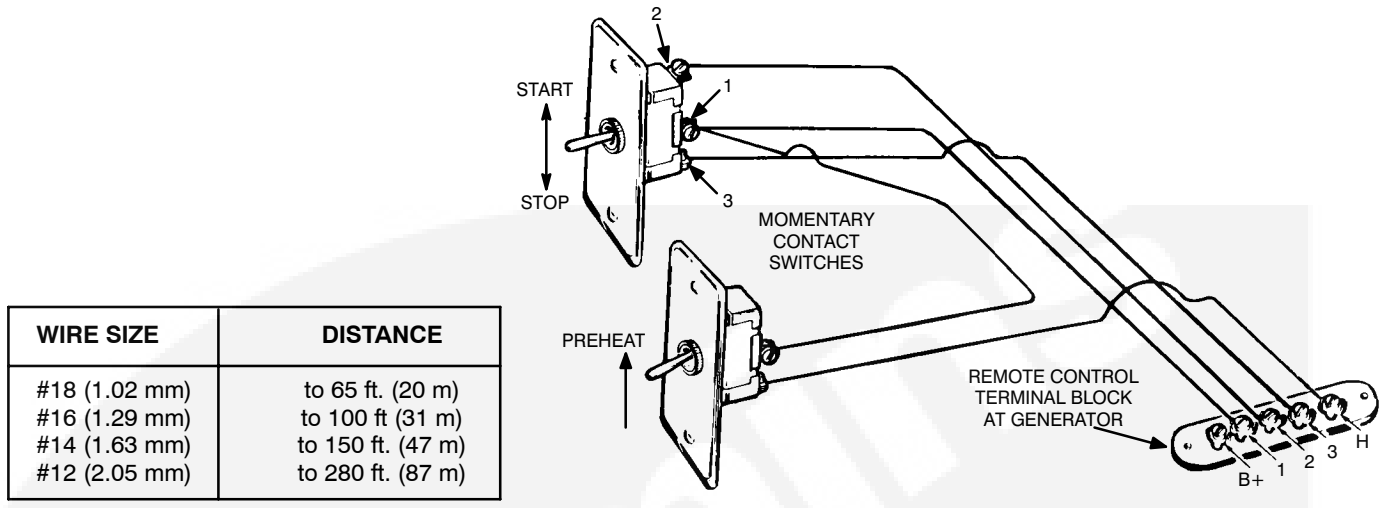
The GND terminal on the remote control terminal block is

intended for a customer-supplied alarm at a remote location, to warn of emergency shutdown. Refer to the Wiring Diagram for proper alarm connections.

REMOTE START-STOP SWITCH (Optional)

Use 2 wires to connect the SPST remote start-stop switch to the terminal block marked B+ and to the remote in the control box, using the wire sizes listed in Figure 4-14.

⚠CAUTION Incorrect connections can damage the control, the remote switch, and the interconnecting wiring. Ensure that the leads from the remote switch connect with the corresponding terminals on the generator set.



WIRE SIZE	DISTANCE
#18 (1.02 mm)	to 65 ft. (20 m)
#16 (1.29 mm)	to 100 ft (31 m)
#14 (1.63 mm)	to 150 ft. (47 m)
#12 (2.05 mm)	to 280 ft. (87 m)

FIGURE 4-14. REMOTE CONTROL

ES1970C

Section 5. Operation

⚠WARNING

EXHAUST GAS IS DEADLY!

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

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

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

Protection against carbon monoxide inhalation includes proper installation and regular, frequent visual and audible inspections of the complete exhaust system.

PRE-STARTING

Preparation for initial and subsequent starts includes careful checks of the oil, fuel, cooling, and electrical systems. Close the cylinder air housing door with all air shrouds in place.

Before the generator set is activated, check all components for mechanical integrity. If an abnormal condition, defective part, or operating difficulty is detected, repair or service the genset as required. Keep the generator set free of dust, dirt, and spilled oil or fuel.

⚠WARNING **Accidental starting of the generator set can cause severe personal injury or death. Make certain the generator set is stopped and disconnect the starting battery cables (negative [-] cable first) before inspecting the generator set.**

Oil Recommendations

The use of quality engine lubricating oils combined with appropriate oil drain and filter change intervals are critical factors in maintaining engine performance and durability.

Use SAE 30 oil that meets the American Petroleum Institute (API) Classification of CE/SF. CD/SF oil may be used in areas where CE/SF oil is not available. CE and

CD oils are designed for high temperature, severe duty service.

A maximum sulfated ash content of 1.85 mass % is recommended to prevent guttering and valve burning.

The use of a multi-viscosity lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures. While 15W-40 oil is recommended for most climates, refer to the accompanying table for oil viscosity recommendations for extreme climates.

⚠CAUTION **Limited use of low viscosity oils, such as 10W-30 may be used for easier starting and providing sufficient oil flow at ambient temperatures below -5° C (23° F). However, continuous use of low viscosity oils can decrease engine life due to wear. Refer to the accompanying chart.**

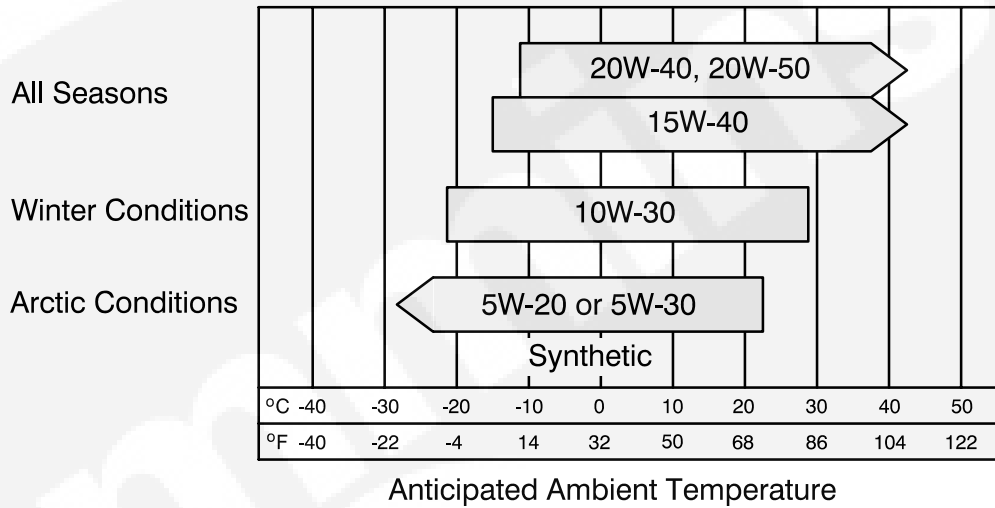
If an engine is operated in ambient temperatures consistently below -23° C (-10° F) and there are no provisions to keep the engine warm when it is not in operation, use a synthetic CE/SF or CD/SF engine oil with adequate low temperature properties such as 5W-20 or 5W-30.

⚠WARNING **The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as corrosion, deposits and wear.**

In extremely dusty or dirty conditions, oil should be changed more frequently. When adding oil between changes, use the same brand as already in the engine. Various brands of oil may not be compatible when mixed.

Refer to the Maintenance section of this manual for oil change interval and procedures. Always change the oil filter when changing the oil.

TABLE 5-1. SAE OIL VISCOSITY RECOMMENDATIONS



EXS-1147-1

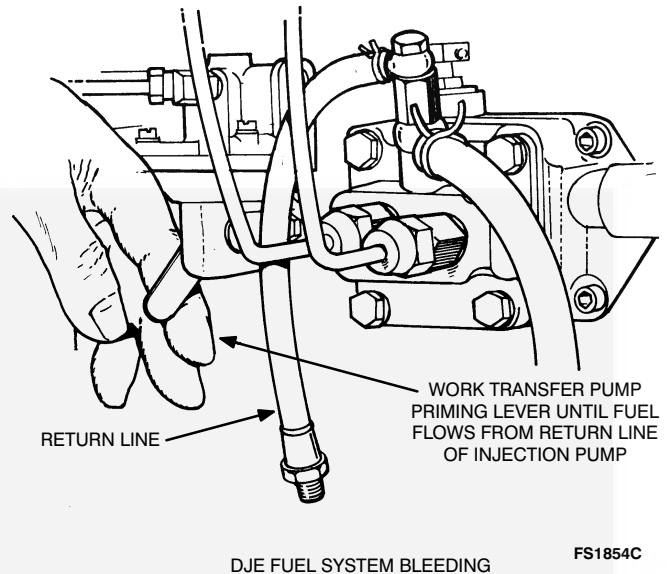
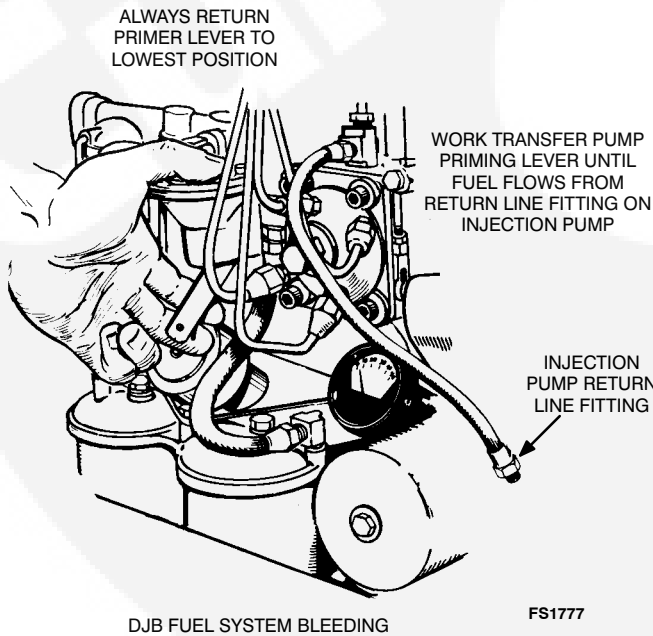


FIGURE 5-2. FUEL SYSTEM

Recommended Fuel

Use ASTM 2-D or 1-D fuel, with a minimum Cetane number of 45*. Number 2 diesel fuel is usually most economical; 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 necessary in higher altitudes or in extremely low ambient temperatures, to prevent misfires.

Use fuel with a low sulfur content and a pour point (ability to filter) of at least 10°F (6°C) below the lowest expected ambient temperature. Keep fuel clean and protected

from adverse weather. Leave room for fuel expansion when filling the fuel tank.

⚠ CAUTION *Dirt in the system can severely damage both the injection pump and the injection nozzles. Because diesel injection systems have extremely precise tolerances, make certain that fuel is kept clean.*

Bleeding Fuel System

Bleed air from fuel system as follows: Disconnect the fuel return line (Figure 5-2). Operate the hand priming lever on the fuel transfer pump until the fuel flowing from the 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.

If the camshaft's pump lobe is up, crank the engine one revolution to permit hand priming. When finished, return priming lever inward (disengaged position) to permit normal pump operation.

PRE-HEATING AND STARTING

Preheat the engine for 60 seconds when the ambient temperature is 55°F (13°C) or lower. Preheat the engine for 30 seconds in temperatures above 55°F (13°C).

⚠ WARNING *Do not use ether as a cold weather starting aid. The heat from the glow plugs or manifold heater may cause a sudden ignition of the ether vapor. This can result in personal injury and damage to the engine.*

To preheat the engine:

1. Engage the preheat switch for one minute. On contractor models, turn OFF-RUN switch to RUN.
2. Release the preheat switch and engage the start switch. On contractor models, continue to hold PREHEAT switch until engine comes up to speed. On all other models, hold START switch to START until engine comes up to speed. (This will maintain heater operation until START switch is disengaged.)
3. Release the start switch after the engine reaches speed.
4. Check the oil pressure gauge: it should read at least 20 psi (138 kPa).

NOTE: the pressure-relief valve is not adjustable.

5. If the engine fails to begin firing after 20 seconds of cranking, return to the preheat procedure of step 1, then repeat step 2. Absence of blue exhaust smoke

during cranking indicates that no fuel is reaching the engine.

6. In extreme cold (below 32°F or 0°C) it may be necessary to maintain preheating for two minutes after the engine starts, to obtain firing or smooth out cylinders, especially at no load or light loads.

NOTE: When remotely starting the set, the switch on the set control must be in its remote position.

⚠ CAUTION *Preheating the engine longer than one minute in moderate ambient temperatures before cranking the engine can destroy the manifold heater and glow plugs, because there is no incoming air flow to cool them. For this reason, do not exceed the one minute preheat periods (unless ambient temperature is below 0°F), to prevent heater burnout and conserve the battery.*

NOTE: Continuous operation of the preheaters during cranking in cold weather helps preheat the incoming combustion air, to prevent misfires as the engine starts running.

When the engine reaches operating speed, the centrifugal switch and the start-disconnect relay automatically stop cranking. If the engine fails to start in 45 to 120 seconds, the cranking limiter trips and stops cranking. If this occurs, wait one minute before resetting the cranking limiter and trying to restart the engine.

NOTE: Depress the preheat switch for one minute, then release it and push the start switch.

If the control has an emergency relay reset button, perform reset only after a shutdown occurs due to low oil pressure or high water temperature. Make certain to find the cause of the failure before restarting the engine.

⚠ CAUTION *Overvoltage will destroy the glow plugs and air heater in 2 to 3 seconds. If extra power is needed to start the set, connect an additional 12 volt battery in parallel to the starting battery. Do not apply overvoltage to the starting circuit at any time.*

STOPPING

1. Push the start-stop switch to the stop position.
2. If the stop circuit fails, push governor arm down to shut off fuel injection pump.

AUTOMATIC STARTING AND STOPPING

An optional automatic demand control may be used for starting and stopping, but it 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 a load is reapplied before the engine comes to a complete stop.

APPLYING LOAD

Allow the set to warm up before connecting a heavy load. Continuous generator overloading may cause high operating temperatures that can damage the windings. Keep the load within the nameplate value for normal operation. Carbon deposits may form on the exhaust system during operation at light loads; apply full load occasionally before shutdown to prevent excessive carbon accumulations. When possible, connect the load in small increments, instead of fully loading the genset at once.

EXHAUST SYSTEM INSPECTION

Make regular inspections of the exhaust system. If you notice a change in the sound or appearance of the exhaust system, shut the unit down immediately and have it inspected by your Onan dealer or distributor.

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Inspect the exhaust system audibly and visually each day. With the generator set running, momentarily open the access cover to inspect the muffler. Have any leaks repaired immediately.*

BREAK-IN PROCEDURE

⚠CAUTION *Continuous generator set overloading can cause high operating temperatures that could damage the generator windings. Keep the load within the nameplate rating.*

Observe the following schedule for genset break-in:

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

Do not run the generator set continuously under one half load during the first few hundred hours of operation. This usually results in poor piston ring seating, causing higher-than-normal oil consumption and blowby.

Drain and replace the crankcase oil after the first 50 hours of operation. Do this while the engine is still hot.

SAFETY DEVICES

In case of dangerously low oil pressure (below 14 psi [97 kPa]), the cutoff switch (LOPCO) stops the unit. After an emergency stop, investigate and correct its cause. Press the reset button on the control panel before restarting.

⚠WARNING *Hot oil can cause severe personal injury. Do not check the oil level while the generator set is running; wait until the generator set is cool before investigating.*

EXERCISING UNIT

Infrequent use of the generator set can cause it to deteriorate. The following can occur:

- Condensation in the 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
- 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)
- Evaporates water from engine lubrication system
- Reestablishes a protective oil film on engine parts
- Recharges battery to full normal potential
- Brings generator to normal operating temperature through load application

The generator set should be exercised at least once each week: the engine oil temperature should be held at 180°F (82.2°C) for at least 30 minutes during this exercise.

To exercise the generator set, do the following:

1. Perform all required maintenance checks, start the unit, and apply a load by creating a simulated power failure*. This exercises the control and switchgear systems.
2. Apply at least 50 percent load, using the thermostatic shutters if needed, to heat the engine and generator, as described above.
3. Exercise the unit long enough to provide at least 30 minutes running time at normal operating temperatures. This requires at least 60 minutes total running time.
4. Shut the unit down by simulating the return of normal power*. Run the set for approximately 10 minutes with no load to allow the engine to cool down.

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

⚠ CAUTION *Improper exercising may cause more damage than no exercising at all. Significant amounts of water and raw fuel will remain in the lubrication oil if the unit is run at a low operating temperature. Also, operating the engine at no load or at low temperatures causes carbon buildup and exhaust system fouling. Continued operation in this manner may cause starting failure and/or engine damage. Exercising a generator set without exercising its associated controls and switchgear does not test the operation of the controls and switchgear. If the control systems are not fully functional, the system may fail to provide power when required.*

After each exercise period, refill the fuel tank and check the engine for leaks and overall condition. Locate the cause of any leaks and correct.

ENGINE RATINGS

Ratings apply to altitudes up to 1000 feet (305 m), gensets using standard cooling, normal ambient temperatures and with No. 2 Diesel fuel. Consult the nearest authorized Onan service center for operating characteristics under other conditions.

HIGH/LOW OPERATING TEMPERATURES

The generator set has been designed to operate satisfactorily in both high (above 100° F) and low (below 0° F) temperatures. Use the oil recommended in the PRE-START section for the expected temperature conditions.

High Operating Temperatures

1. See that nothing obstructs air flow to and from the set.
2. Keep cooling fins clean. Cylinder air housings should be properly installed and undamaged.

Low Operating 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 heated air (never use open flame) externally until oil flows freely.
2. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean, and batteries in a well charged condition.
4. Partially restrict cool air flow but use care to avoid overheating.
5. Use additional preheating during cold starts.

DUST AND DIRT

1. Keep the generator set and the cooling system clean.
2. Service the air cleaner as frequently as necessary.
3. Change the crankcase oil every 100 operating hours.
4. Keep oil and fuel in dust-tight containers.
5. Keep governor linkage clean.

HIGH ALTITUDE

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

OUT-OF-SERVICE PROTECTION

The lubricating qualities of diesel fuel should protect a diesel engine for at least 30 days when the 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 the set under at least 50 percent load, until it is thoroughly warmed up.
2. Shut down the engine.
3. Disconnect the starting batteries and follow standard battery storage procedures.

⚠ CAUTION *Freezing temperatures may severely damage the starting batteries. When the batteries are in storage, be certain to maintain their liquid level. Use a trickle charger to maintain the correct specific gravity.*

4. Drain the oil from the crankcase while the engine is warm. Refill it with clean oil, and attach a tag listing the type of oil used.
5. Remove the flexible section of the exhaust line. (The exhaust should have a rain cap to prevent the entrance of moisture and dirt. If not, the exhaust can be plugged.)
6. Service the air cleaner.
7. Remove the glow plugs from the cylinders. Pour 1 ounce (30 ml) of rust inhibitor (or SAE #10 oil) into each cylinder. Crank the engine over several times. Reinstall the glow plugs.

⚠ CAUTION *Do not exceed one ounce oil per cylinder. excess oil may fill the combustion chamber and prevent the engine from cranking, due to hydraulic lock.*

8. Check the fuel filters for the presence of water, as shown in the Periodic Maintenance section.
9. Clean the throttle and governor linkage. Protect them 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.
11. Provide a suitable cover for the entire unit after it cools down.

RETURNING THE SET TO OPERATION

1. Remove the protective cover from the unit. Wipe off dust and dirt.
2. Check that fuel lines and injectors are secure and properly torqued without air or fuel leaks.
3. Check the tag stating the oil type and weight. If it is not correct, drain oil from the engine, and refill with the correct oil. Be sure that it is up to "FULL" mark on dipstick.
4. Remove the material used to plug the exhaust outlet and reconnect the exhaust line. Check the complete exhaust system for tight connections. Note the condition of the muffler, exhaust line, etc., and repair as necessary.

▲WARNING *Exhaust gases contain carbon monoxide, which may cause severe personal injury or death. Before operating the generator set, make certain the exhaust line is connected correctly, is fit for operation, and does not leak.*

5. Check the entire generator set for fuel or oil leaks. Correct as required.
6. Check the wiring system for worn wires, loose connections, etc. Repair as required.
7. Install the fully-charged batteries, and connect them to the generator set. Observe correct polarity. Connect the ground cable last.

▲WARNING *Explosive gases are emitted from batteries when they are being charged. Ignition of these gases can cause severe personal injury. Do not smoke or allow flame, sparks or arcing equipment in the vicinity while servicing batteries.*

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

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

Section 6. Adjustments

⚠WARNING *Inadvertently starting the engine may result in damage to the generator set or serious personal injury. For this reason, disconnect the batteries, negative (-) cable first, before beginning any adjustment or maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring.*

CENTRIFUGAL SWITCH

The start-disconnect centrifugal switch (Figure 6-1) is lo-

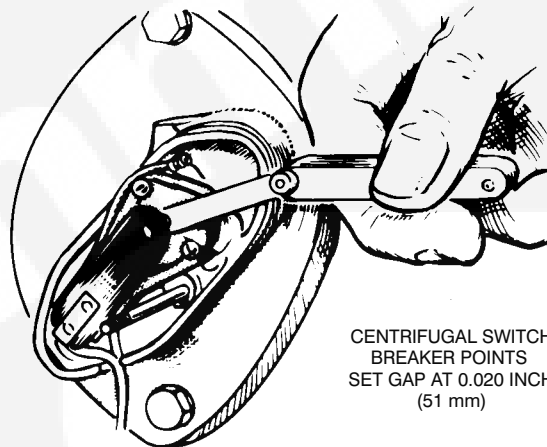


FIGURE 6-1. CENTRIFUGAL SWITCH ADJUSTMENT

GOVERNOR

The governor controls engine speed. On a 4 pole generator, engine speed equals frequency multiplied by 30. Thus 1800 rpm generates 60 hertz. Preferred engine speed does not vary more than 3 hertz from no-load to full-load operation. Be sure that the 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 6-1. Turn the nut clockwise (more spring tension) to increase rpm, or counterclockwise to reduce governed speed. Use a

stroboscope or a frequency meter to make this adjustment.

stroboscope or a frequency meter to make this adjustment. The switch opens when the engine stops, and closes when engine speed reaches 900 rpm. If necessary, loosen the stationary contact and adjust the point gap to 0.020 inch (51 mm). Replace burned or faulty points.

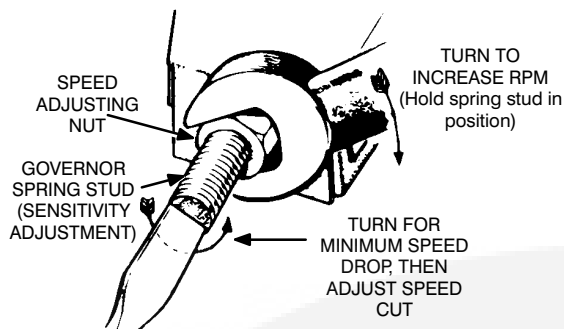
⚠WARNING *High voltage, which can cause severe personal injury or death, is present at the breaker point gap. For this reason, disconnect the battery cable, negative [-] terminal first, before setting the breaker point gap.*

stroboscope or a frequency meter to make this adjustment.

Sensitivity Adjustment

To adjust governor sensitivity (no-load to full-load speed droop), turn the sensitivity adjusting ratchet. On city water-cooled units, turning the ratchet counterclockwise provides more sensitivity (less speed drop when full load is applied), and turning it clockwise provides less sensitivity (more speed drop).

If the governor is too sensitive, a rapid hunting condition occurs (alternate increasing and decreasing speed). Adjust the governor for maximum sensitivity without hunting. After making the sensitivity adjustment, readjust the speed.



CHARGE RATE ADJUSTMENT

The adjustable resistor slide tap (Figure 6-3) in the charging circuit is set to produce a 2 ampere charging rate. This resistor is found in the generator air outlet. For applications requiring frequent starts, check the battery specific gravity periodically. If necessary, increase the charging rate slightly (move the slide tap up). Adjust this slide tap only when the engine is stopped.

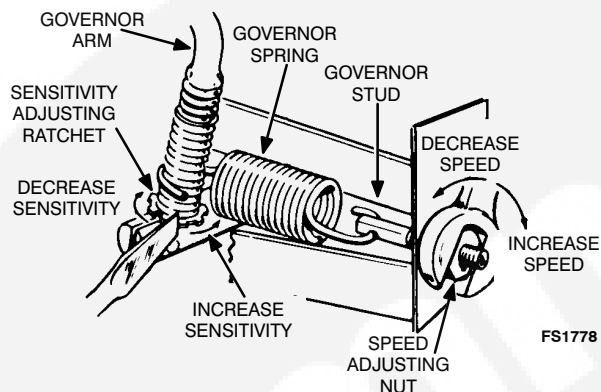


FIGURE 6-2. ADJUSTING GOVERNOR

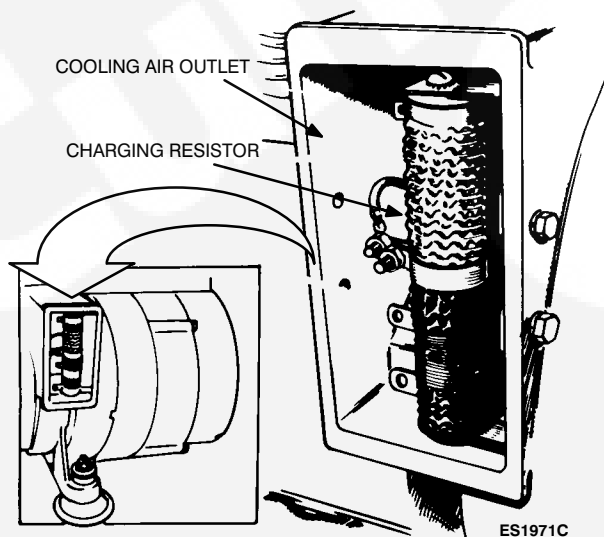


FIGURE 6-3. CHARGING RESISTOR

⚠ WARNING Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any flame, sparks, or arc-producing devices in the battery area.

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

VALVE CLEARANCE ADJUSTMENTS

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

⚠ CAUTION Incorrect valve clearance adjustment can lead to irrevocable damage to the generator set. Make certain that only qualified personnel perform this adjustment.

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 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 should be stationary.

2. Turn the flywheel an additional 10 to 45 degrees clockwise (estimated). When the piston is in this position, it is in its power stroke, with both valves com-

pletely closed.

3. Check cylinder head-bolt torque prior to valve clearance adjustment. Torque values are listed in Section 2, Specifications. Adjust valve clearance with the locknut which secures the rocker arm to the cylinder head (see Figure 6-4). Loosen this locknut to increase clearance: tighten it to reduce clearance.

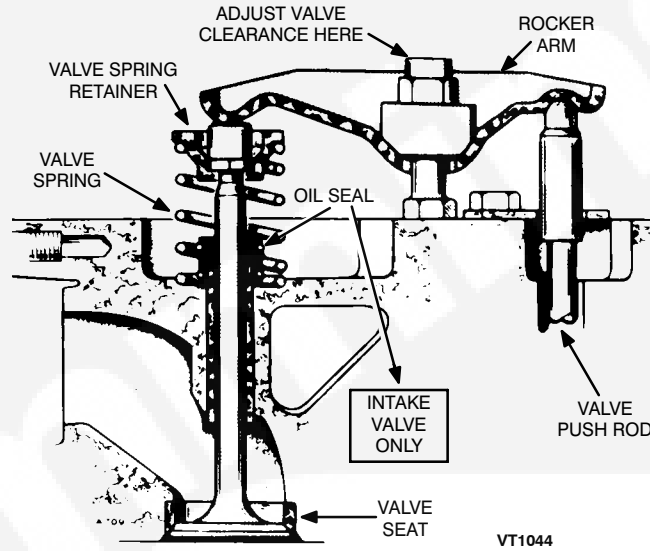


FIGURE 6-4. VALVE CLEARANCE ADJUSTMENTS

4. Using a feeler gauge, check the clearance between the rocker arm and the valve (see Figure 6-5). Increase or decrease the clearance until the proper

gap is established. Valve clearances are listed in the Specifications section.

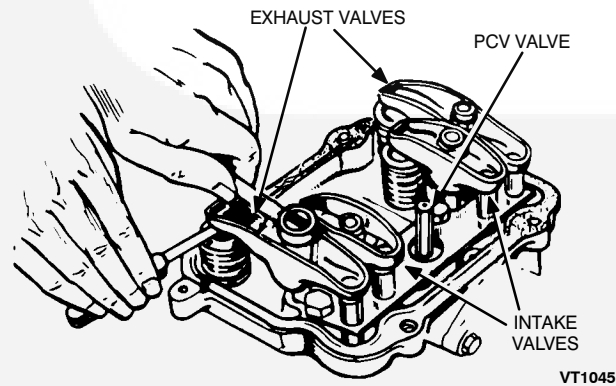


FIGURE 6-5. CHECK VALVE CLEARANCE

Section 7. General Maintenance

Follow a regular schedule of inspection and servicing, based on operating hours. Keep an accurate record of maintenance, service, and operating time. Use the running time meter (optional) to monitor operating hours. Follow the service schedule listed in the Periodic Maintenance Schedule on page 8-1.

⚠WARNING *Many maintenance procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the safety precautions on the inside cover page of this manual.*

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 the cooling system. Be sure the cooling fins are clean.
5. Inspect electrical wires and connections to see they are secure and have no fray damage.

If the generator requires major repair or servicing, contact an authorized Onan service center.

⚠WARNING *Inadvertently starting the engine may result in damage to the generator set or serious personal injury. For this reason, disconnect the batteries, negative (-) cable first, before beginning any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring.*

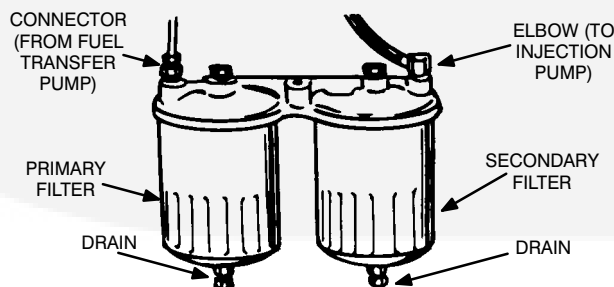


FIGURE 7-1. DUAL FUEL FILTERS

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BATTERIES

Check the condition of the starting batteries at least every two weeks. Make certain that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at terminals. Add distilled water to keep the electrolyte at the proper level above the plates. Check the specific gravity; recharge if below 1.260 at 77°F (25°C).

⚠WARNING *Batteries present the hazard of explosion, which can result in severe personal injury. Disconnecting battery cables from the battery while the generator set is cranking or running causes arcing. For this reason, do not disconnect battery cables from the battery while the generator set is cranking or running. To avoid excessive arcing, always disconnect the negative (-) cable first, and connect it last.*

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

FUEL FILTERS

Every 100 hours, open the drains on the bottom of the fuel filter assembly (Figure 7-1) 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.

⚠WARNING *Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, arc-producing equipment or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.*

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.

⚠WARNING *Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Do not work on the fuel system when the generator set is hot. Clean fuel spills and allow vapor to evacuate prior to starting the generator set.*

GOVERNOR LINKAGE

Every 100 hours, carefully pull the neoprene governor ball joints apart and clean them. Do not lubricate these joints. See Figure 7-2.

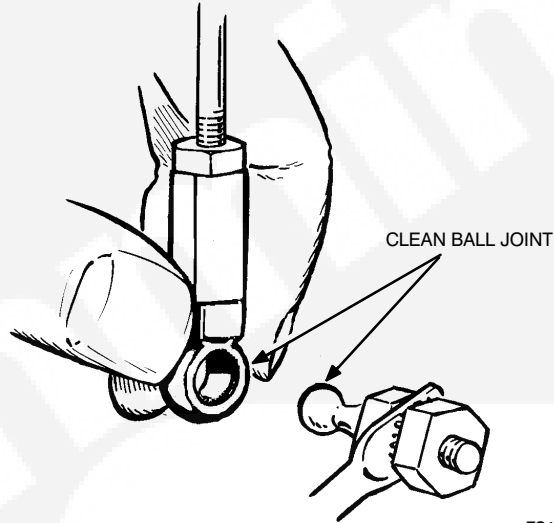


FIGURE 7-2. GOVERNOR BALL JOINT

⚠CAUTION *Some solvents can damage the neoprene governor ball joints. Read the manufacturer's recommendations before using any lubricants or solvents near the ball joints.*

⚠WARNING *Fumes from this cleaner may present the hazard of fire or explosion, which can cause severe personal injury or death. Do not allow any spark, flame, pilot light, lit cigarette, arc-producing equipment or other ignition source near the generator set when performing this procedure. Keep a fire extinguisher rated ABC near the work area.*

CRANKCASE BREATHER TUBE

To clean the crankcase breather tube, remove both rocker covers, as shown in Figure 7-3. The breather tube itself is installed with a sealant on the threads to prevent oil leakage into the intake manifold: it should NOT be removed. A small wire, nail or drill bit inserted through from the top can be used to clean out the breather hole. The breather hole seldom needs cleaning: a 500 hour interval coincides with the valve lash adjustments, because the rocker box covers must be removed at that time.

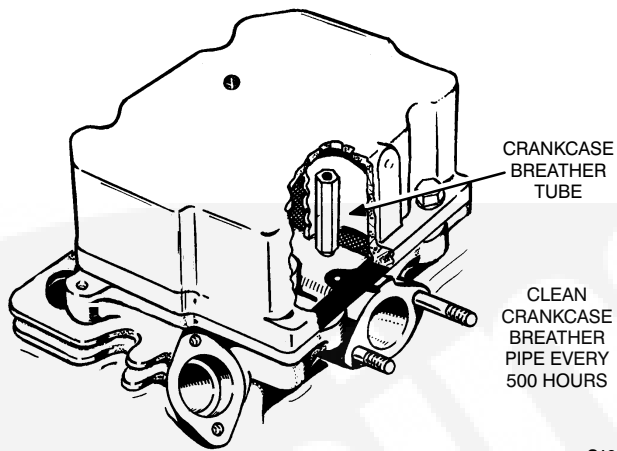


FIGURE 7-3. CLEANING BREATHER

CRANKCASE BREATHER

After every 200 hours of operation, remove hose clamp, breather hose, breather cap clamp and insulator halves

to release breather cap and valve assembly, Figure 7-4. Wash cap, valve assembly and baffle in suitable solvent. Dry and reinstall.

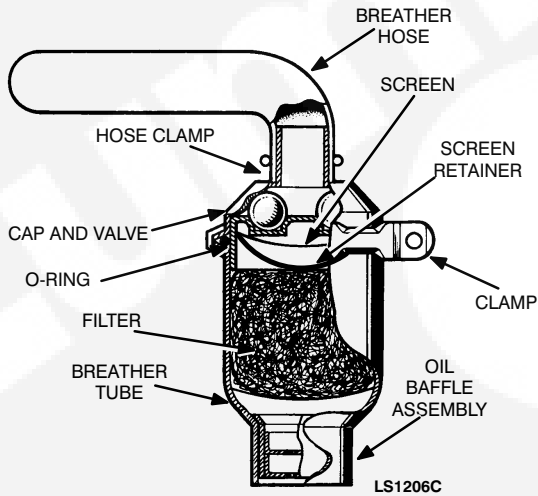
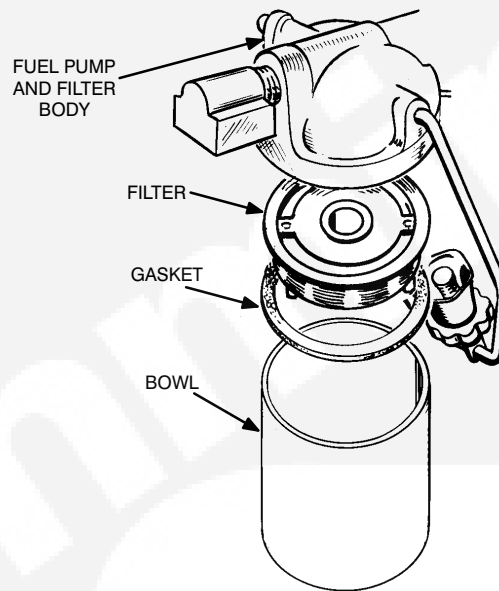


FIGURE 7-4. CRANKCASE BREATHER

FUEL PUMP SEDIMENT BOWL

⚠WARNING Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, arc-producing equipment or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.

Every 100 hours, remove the sediment bowl from the fuel transfer pump and filter body (Figure 7-5). Clean out any water or particulate present in the bowl and filter. When re-installing the sediment bowl, make sure the filter and gasket are in place.



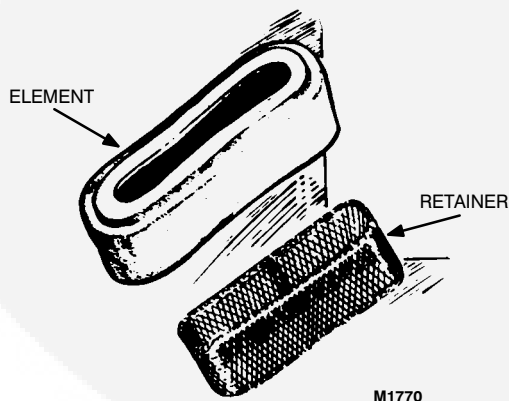
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FIGURE 7-5. FUEL PUMP SEDIMENT BOWL

AIR CLEANERS

After every 50 hours of operation, remove and clean the filter element (Figure 7-6). After washing the element in

solvent, dip the element in engine oil and squeeze it as dry as possible.



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FIGURE 7-6. POLYURETHANE FOAM AIR CLEANER

CONTRACTOR MODEL AIR CLEANER

1. Remove pre-cleaner and wash out dirt. Dry and re-install.
2. Loosen clamp and remove end cover.

3. Remove thumbscrew and take out element. Wash element in detergent and water (use new element after 6 washings). Dry and reinstall.
4. Remove air cleaner baffle from cover, wash out dirt, and reinstall in cover.
5. Install cover with "TOP" up and tighten clamp.

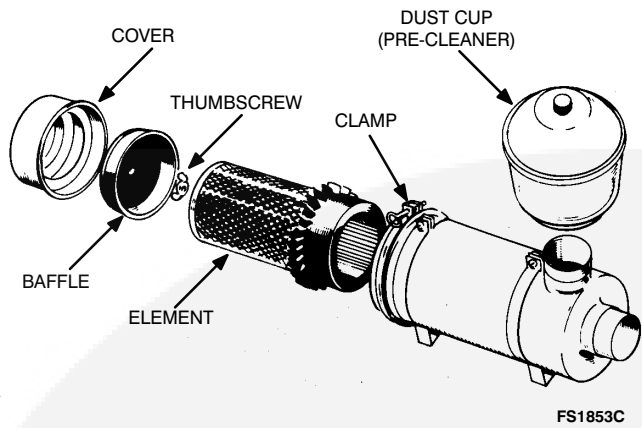


FIGURE 7-7. DJE CONTRACTOR MODEL AIR CLEANER



OPTIONAL OIL BATH AIR CLEANER

1. Loosen the bottom clamp, remove the cleaner base and clean the part (Figure 7-8).

2. Refill the base to the oil level mark with fresh oil of the same weight as used in the engine.

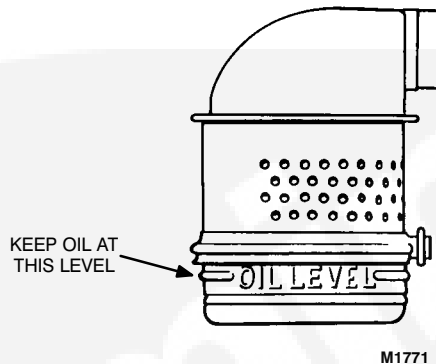


FIGURE 7-8. OIL BATH AIR CLEANER

OIL FILTER CHANGE

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

⚠WARNING *Hot oil and a hot oil filter may cause severe burns to the skin. Wear goggles, apron and gloves when replacing the oil filter.*

OIL CHANGE

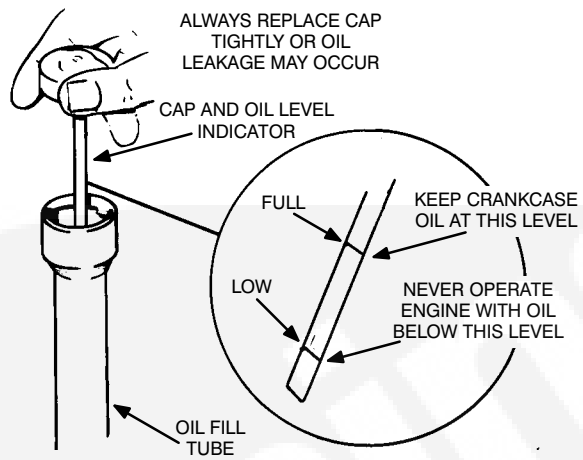
⚠WARNING *Inadvertently starting the engine may result in damage to the generator set or serious personal injury. For this reason, disconnect the batteries, negative (-) cable first, before beginning any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring.*

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 SAE viscosity grade for the temperature conditions (refer to Operation section).

⚠WARNING *Hot oil may cause severe burns. Wear goggles, apron and rubber gloves, and use extreme care when changing the oil.*

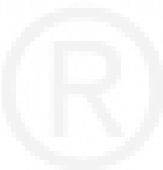
Check the oil level indicator after every 8 hours of operation, and maintain the oil level at the full mark (Figure 7-9). The oil should be changed after every 100 hours of operation. Refer to the Specifications section for crankcase and filter capacity.

⚠WARNING *Hot oil may cause severe burns by blowing out from the oil fill tube of a running generator set. Do not check the oil level while the generator set is operating.*



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FIGURE 7-9. OIL LEVEL INDICATOR



Section 8. Periodic Maintenance Schedule

Regularly scheduled maintenance means lower operating costs and longer service life for the generator set. The following schedule may be used as a guide. However, actual operating conditions should determine the maintenance schedule. In exceptionally dusty or dirty conditions, certain service periods may have to be reduced. Check the condition of the crankcase oil, filters, etc., frequently, until the proper service time periods are established.

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

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Inspect the exhaust system audibly and visually each day, or each time the generator is started (whichever is sooner). With the generator set running, momentarily open the access cover to inspect the muffler. Shut down the generator set and have any leaks repaired immediately.*

⚠WARNING *Failure to disconnect the generator set battery could result in damage to equipment or serious personal injury in the event of inadvertent starting. Before beginning any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring, disconnect the battery, negative (-) cable first.*

⚠WARNING *Many troubleshooting and maintenance procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page before attempting these maintenance procedures.*



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 (or annually) • Clean sediment bowl and filter on fuel transfer pump. See Note 1. • 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.

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. Tighten head bolts and adjust valve clearance after first 50 hours on new and overhauled engines, and then adjust valve clearance each 500 hours thereafter.