Onan®

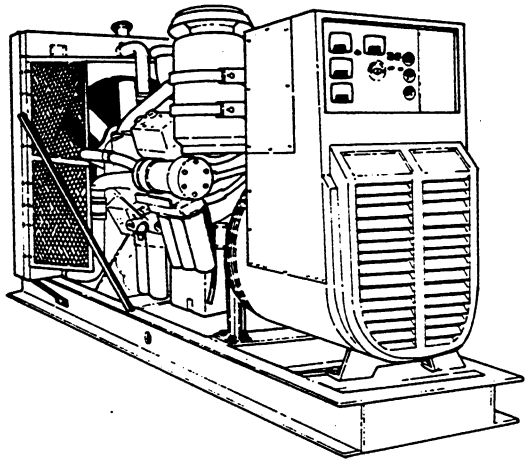
OPERATOR'S MANUAL

FOR

ELECTRIC GENERATING SETS

SERIES

DFV



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Important Safety Precautions

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

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

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

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

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

EXHAUST GAS IS DEADLY

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

Make sure exhaust is properly ventilated.

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

BATTERY GAS IS EXPLOSIVE

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

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

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

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

If the cabinet must be opened for any reason:

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

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

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

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

*SUPPLEMENT 960-1018A

12-80

The following information pertains to changes made to the oil specifications for Onan generator sets utilizing Cummins Engines. Reference Product Support Bulletin 332 and Cummins Engine Manual for additional information. Listed below are the new specifications and Operator's Manuals affected by the change.

AMBIENT TEMPERATURE**	SAE VISCOSITY GRADE
-13°F (-25°C) and below	See engine manual
-13°F to 95°F (-25°C to 35°C)	10W-30
14°F (-10°C) and above	15W-40
32°F (0°) and above	20W-40

** SAE - 5W mineral oils should not be used.

Operator's Manual	Publication No.
DFE	956-0120
DFM	960-0120
DFN	960-0121
DFP	960-0122
DFS	960-0123
DFV	960-0126
DFW	960-0127
DFX	960-0317
DFY	960-0129

***NOTE:** Supplement 960-1018 dated 10-80 referenced wrong Product Support Bulletin. Discard Supplements dated 10-80.

SUPPLEMENT 960-1018

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DFX	960-0317
DFY	960-0127

960-1016 (12-1-78)
SUPPLEMENTARY INSTRUCTIONS

This supplemental information applies to the following Generator sets. Manual Number, Model Series, and applicable Specification Letter are listed below. A Barber-Colman DYNA 1 governor will be standard equipment, beginning with Specification Letters listed below. The Woodward PSG governor, previously standard, will be offered as an option.

Manual No.	Series	Spec Letter
960-0126	DFV	K
960-0127	DFW	G
960-0129	DFY	D

INSTRUCTIONS

These instructions detail adjustment procedures for the Barber-Colman DYNA 1 governor. The adjustment procedures for the Woodward PSG governor, in the subject manuals, are valid when that option is chosen.

Substitute the following on pages 24-25.

GOVERNOR ADJUSTMENTS—ENGINE SPEED

A Barber-Colman electric governor is standard equipment. (The Woodward PSG governor is optional.) Governors are set at the Onan testing facility and should not require further adjustment for normal standby service. Since improper speed control may have several causes, an authorized Onan service representative should be called for repair. If it has been determined that the Barber-Colman governor requires adjustment, proceed as follows.

CAUTION **Potentiometers are delicate and may be damaged from turning too hard. Turn slowly and lightly; stop if resistance is met.**

1. Remove four screws and cover from governor controller.
2. Disconnect wire from TB11-22. This disconnects the starter solenoid.
3. Place Run-Stop-Remote switch to RUN position. Governor should stay at the minimum fuel position. If this position is not obtained, consult with Onan service representative.
4. Return Run-Stop-Remote switch to STOP. Reconnect wire at TB11-22.
5. Position speed control rheostat on generator control panel to mid-range of travel (out 5 turns from low r/min).
6. Adjust speed reference potentiometer in governor controller counterclockwise four turns, if available.

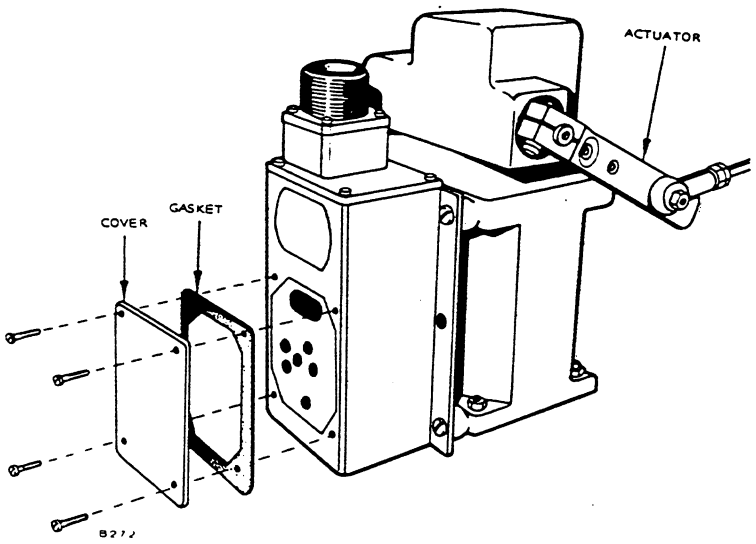
7. Start engine. Be prepared at this point, to assume manual control of engine in the event that adjustments are incorrect. If engine does not attain correct r/min it may be necessary to adjust the speed reference potentiometer; clockwise to increase speed, counterclockwise to decrease.
8. Adjust Gain potentiometer slightly clockwise then counterclockwise as necessary until engine is stable and responsive to governor control.
9. Load and unload engine several times to ensure correct gain adjustment.
10. Shut down engine. Restart engine to make sure that unit does not overspeed.
11. Shut down engine. Replace governor control box cover. Engine is now ready for service.

Any subsequent speed adjustment can be made at the control panel potentiometer.

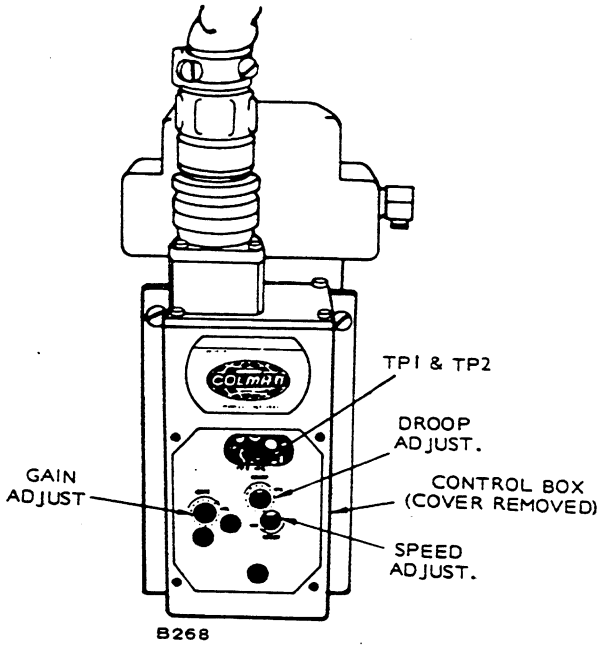
When using generator frequency meter to determine engine speed, multiply frequency by 30 to calculate engine speed.

Example: 30 x 61 Hz = 1830 rpm.

Adjust engine speed to 1800 rpm for 60 Hertz and 1500 rpm for 50 Hertz sets.



BARBER COLMAN GOVERNOR



GOVERNOR CONTROL BOX

TABLE OF CONTENTS

WARNING

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

INTRODUCTION

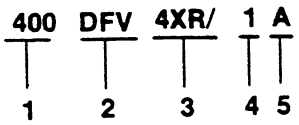
FOREWORD

This manual is applicable to the DFV Series electric generating set, consisting of an ONAN UV 400 kW generator, driven by a Cummins VT-1710-G Diesel Engine.

The manual should be used in conjunction with the Cummins engine manual, for specific engine information.

MODEL IDENTIFICATION

Identify your model by referring to the MODEL and SPECIFICATION NO. as shown on the Onan nameplate. Electrical characteristics are shown on the lower portion of the nameplate.



1. Indicates Kilowatt rating (400 kW).
2. Factory code for SERIES identification.
3. Refer to Table 1.
   R—Indicates remote starting feature.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

When contacting a dealer or the factory regarding the set, always mention the complete Model, Spec No. and Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify your unit among the many manufactured. Refer to the engine nameplate when requesting information from its manufacturer. The Onan nameplate is located on the right side of the generator; the Cummins nameplate is on the right hand side of the block.

Left side and right side are considered when viewed from the engine or front end of the generating set.

WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

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

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

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

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

SPECIFICATIONS

400.0 kW

ENGINE DETAILS

Engine Manufacturer	Cummins
Engine Series	VT-1710-G
Number of Cylinders	1710-in³ (28.03 litres)
Displacement	685 (514 kW)
BHP @ 1800 r/min (standby power)	14.7:1
Bore	5.5 inch (140 mm)
Stroke	6.0 inch (153 mm)
Fuel	ASTM No. 2 Diesel
Battery Voltage	24
Battery Group (Two 12 Volt, 225 A/hr [810 kC])	8D
Starting Method	Solenoid Shift
Governor Regulation	Adjustable Isoch. to 5%
Battery Charging Current	35-Amperes

GENERATOR DETAILS

Type	60 Hz 50 Hz
Rating (Watts)	
60 Hertz Continuous Standby	400,000 (500 kVA)
AC Voltage Regulation	± 2%
60 Hertz r/min	1800
Output Rating	0.8 PF
AC Frequency Regulation	0-3 Hz Max.

CAPACITIES AND REQUIREMENTS

Cooling System (Engine and Radiator)	42.5 gallons (161 litres)
Engine Oil Capacity (Filter, Lines, Crankcase)	27 gallons (102.2 litres)
Exhaust Connections (inches pipe thread)	Two 5-inch (male)
Fuel System Connections	
Inlet	7/8 inch 14 UNF
Injection Return	3/4 inch 16 UNF

AIR REQUIREMENTS (1800 r/min)

Engine Combustion	1520 cfm (43 m³/min)
Radiator Cooled	29000 cfm (821 m³/min)
Total for Radiator Cooled Model	33520 cfm (949 m³/min)
(1800 r/min)	3000 cfm (85 m³/min)
Fuel Consumption at Rated Load	
60 Hertz	31 gallon/hr (117.3 litre/hr)

GENERAL

Height	88.81 inches (2.26 m)
Width	68.56 inches (1.74 m)
Length	135.62 inches (3.45 m)
Approximate Weight (Mass)	10,910-lb (4948 kg)

The customary unit of Brake Horsepower (BHP) becomes kilowatts (kW) when converted to S1 metric units. This kW rating should not be confused with the kW rating of the generator which will always be lower due to losses inherent with any electrical induction device.

TABLE 1. GENERATOR VOLTAGE OPTIONS

400.0 kW @ 60 Hz (500 kVA)
330.0 kW @ 50 Hz (412.5 kVA)

VOLTAGE	CODE	HZ	AMPERES	DELTA	SERIES WYE	PARALLEL WYE
120/208	4	60	1390			X
120/240	5D	60	1204	X		
240/416	7X	60	695		X	
240/480	6D	60	602	X		
277/480	4X	60	602		X	
347/600	9X	60	482			X
110/190 or 115/200	519	50	1253, 1191		X	
220/380 or 230/400	520	50	626, 595			X
120/208 or 127/220	521	50	1145, 1082		X	
240/416 or 254/440	522	50	572, 541			X

NOTE: Single phase 0.8 pf. current available is 2/3 that of value given.

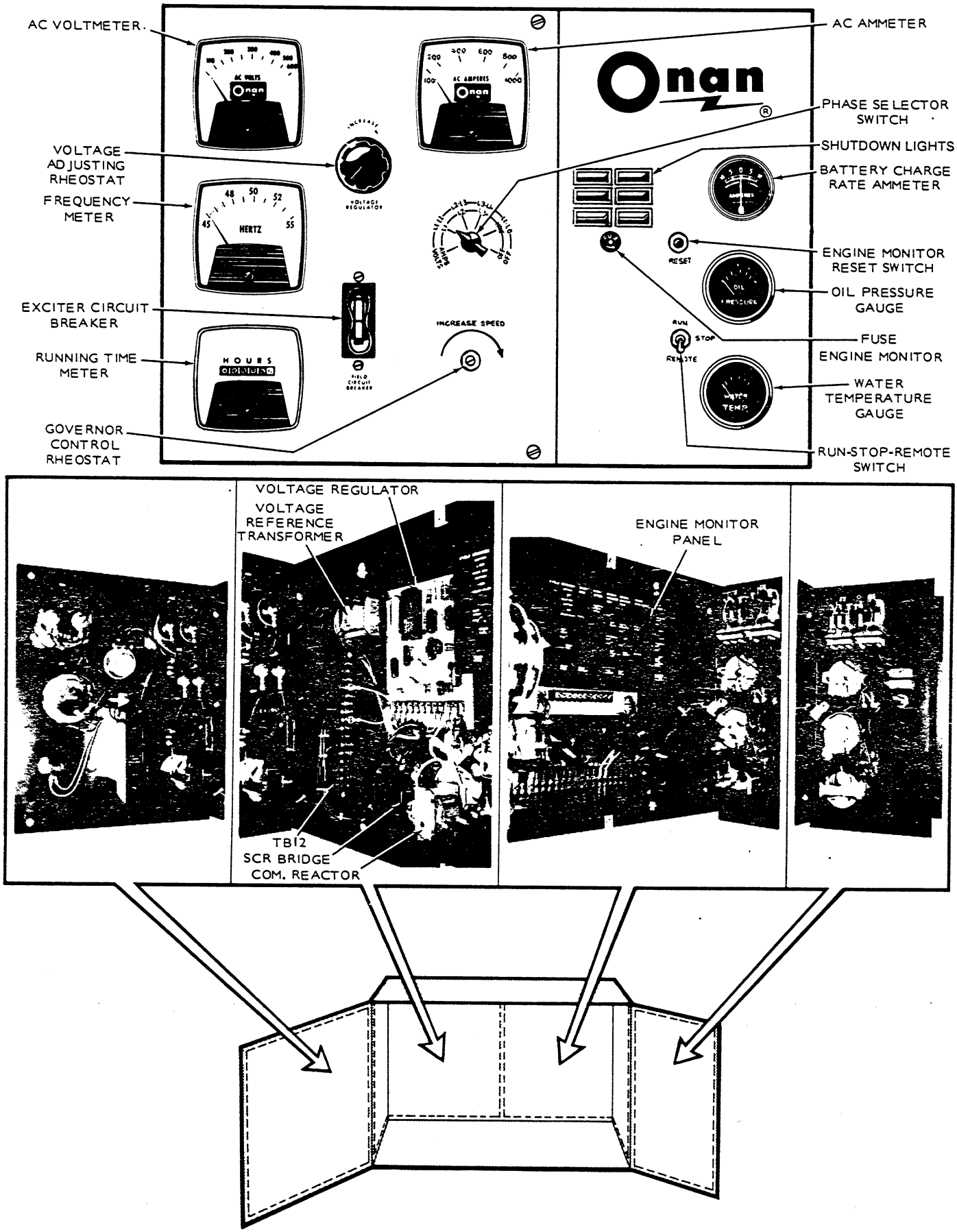


FIGURE 1. CONTROL PANEL

DESCRIPTION

ENGINE

The engine on the DFV is a Cummins VT1710G, as described in the engine manual. Basic measurements and requirements will be found under *SPECIFICATIONS.* For operation, maintenance and service information, consult the Cummins manual.

GENERAL

An Onan DFV series electric generating set is a complete unit consisting of an engine driven AC generator, with standard and optional controls and accessories as ordered.

AC GENERATOR

The generator is an ONAN Type UV, 4 lead, 4-pole revolving field, brushless unit. The main rotor is attached directly to the engine flywheel, therefore engine speed determines generator output frequency. The 60 Hz set operates at 1800 r/min, the 50 Hz at 1500 r/min. Excitation is achieved as follows—

Residual alternating current from the stator winding is applied to the voltage regulator, where it is compared with a reference voltage, rectified and returned to the field winding of the exciter. Current then induced in the exciter rotor is rectified and fed into the generator rotor. This induces a current in generator stator which is applied to the load.

CONTROL PANEL

The following is a brief description of each of the standard controls and instruments located on the face of the panel. See Figure 1.

DC Panel

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine (wired to a sensor unit located on the engine).

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

Battery Charge Rate DC Ammeter: Indicates battery charging current.

Run-Stop/Reset-Remote Switch: Starts and stops the unit locally or from a remote location. Resets engine monitor relay in Stop/Reset position.

Warning Lights: (6) Low Engine Temperature. Wired into a switch on engine block which operates at a nominal temperature of 75°F (24°C). The remaining five give indication of engine malfunction shutdown due to:

a. Overcrank
b. Overspeed
c. Low Oil Pressure
d. High Engine Temperature
e. Generator Overvoltage

Reset Switch: Manual reset for engine monitor after shutdown.

AC Panel

AC Voltmeter: Indicates AC generator output voltage.

Voltage Regulator: Rheostat, provides approximately plus or minus 5% adjustment of the rated output voltage.

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

Running Time Meter: Registers the total number of hours, to 1/10th, that the unit has run. Use it to keep a record for periodic servicing. Time is accumulative, meter cannot be reset.

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

AC Ammeter: Indicates AC generator output current.

Frequency Meter: Indicates the frequency of the generator output in hertz. It can be used to check engine speed. (Each hertz equals 30 r/min.)

Voltmeter-Ammeter Phase Selector Switch: Selects phases of generator output to be measured by the AC voltmeter and ammeter.

CONTROL PANEL INTERIOR

Voltage Regulator: Solid state unit controls AC output from generator at predetermined level regardless of load. Regulation plus or minus 2% from no load to full load, 0.8 P.F.

Engine Monitor: Printed circuit plug-in modules provide the following functions:

1. A 75-second cranking period.
2. Approximately a 12.5-second time delay for oil pressure buildup.
3. An external alarm contact to light a fault lamp and shut down the set for alarm conditions such as:
   a. Overcrank (failed to start after cranking 75 seconds).
   b. Overspeed (engine speed reaches 2100 rpm). See Figure 2.
   c. Low oil pressure 14 psi (96.53 kPa).
   d. High engine temperature 205° F (96° C).
   e. Generator overvoltage.
   f. Battery condition indicator.

Upper light green	Alternator 22-28 VDC
Lower light green	Battery 22-28 VDC
Upper light red	Alternator over 28 VDC
Lower light green	Battery 22-28 VDC
Upper light green	Alternator 22-28 VDC
Lower light red	Battery below 22 VDC
Upper light red	Alternator above 28 VDC
Lower light red	Battery below 22 VDC

CAUTION **High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. It is therefore imperative that adequate engine coolant levels be maintained, to ensure operational integrity of cooling system and engine coolant overheat shutdown protection.**

Cranking Module: Limits engine cranking time to 75 seconds. The cranking time (set at factory) can be continuous or set to allow a 15-second crank time and a 10-second rest time for three ON and two OFF cycles in 65 seconds. If engine fails to start, after 75-seconds the engine monitor lights the overcrank lamp and opens the cranking circuit.

Pre-Alarm: Gives advance warning for low oil pressure or high engine temperature. Requires two sensors, each for engine temperature and oil pressure.

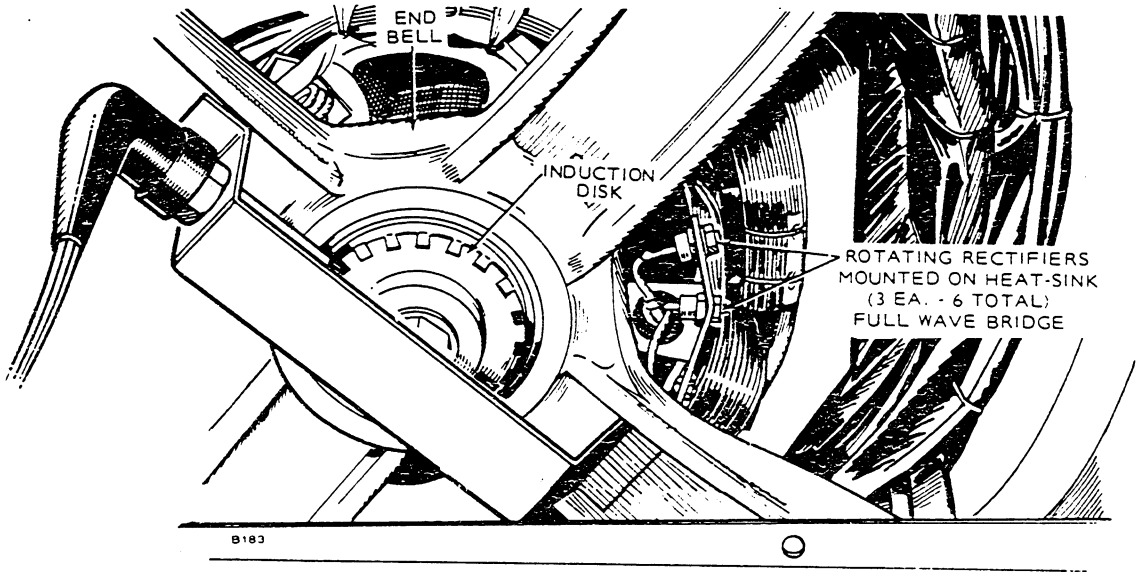


FIGURE 2. OVERSPEED SWITCH

ENGINE SENSORS

Resistance units and switches in the engine temperature and oil pressure monitoring and shut-down systems are sealed units and are not repairable.

The oil pressure sensor and shutdown switch are located on the right hand side of the block above the starter. The engine temperature sensor and switch are on the top of the engine at the rear where the cooling water exits the engine.

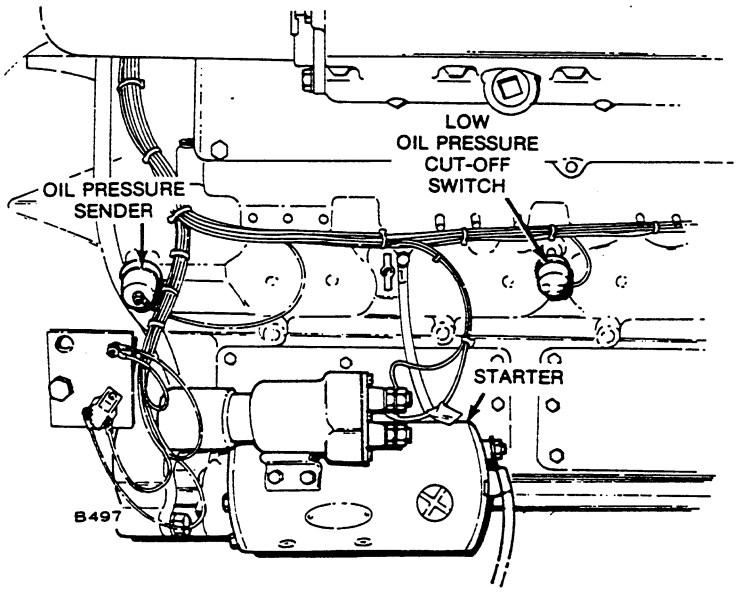


FIGURE 3. OIL PRESSURE MONITORS

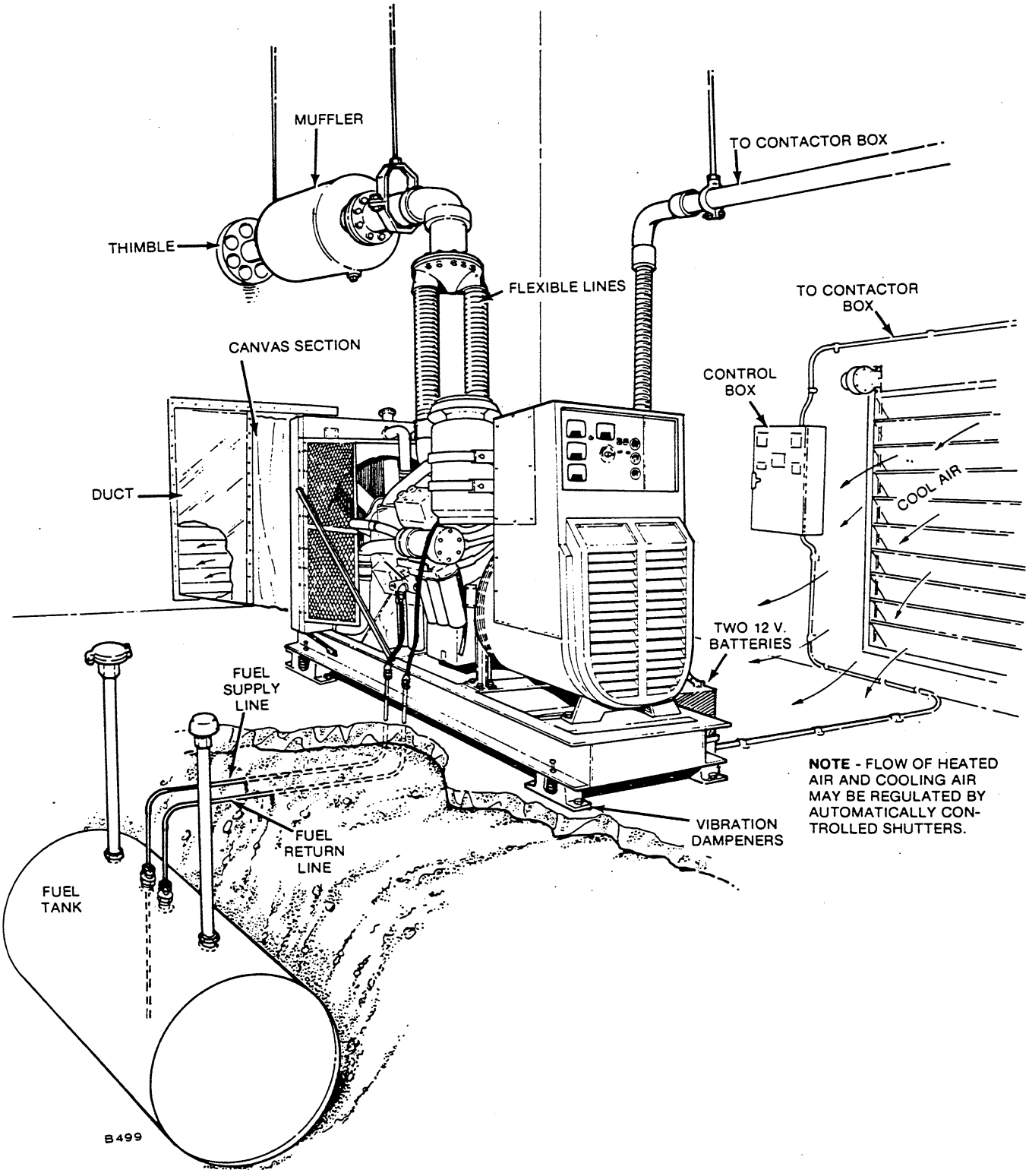


FIGURE 4. TYPICAL INSTALLATION

INSTALLATION

GENERAL

Installations must be considered individually. Use these instructions as a general guide. Meet regulations of local building codes, fire ordinances, etc., which may affect installation details.

Installation points to consider include:

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

LOCATION

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated. If practical, install inside a heated building for protection from extremes in weather conditions.

MOUNTING

Generating sets are mounted on a rigid skid base which provides proper support. Install vibration isolators between skid base and foundation. For convenience in draining crankcase oil and general servicing, mount set on raised pedestals (at least 6 inches high [155 mm]).

CAUTION **The generator support must be aligned to the skid base to prevent premature generator bearing failure, vibration and possible drive disc failure. Failure to do so could void the warranty. Align generator support to skid base according to the following instructions.**

1. Set unit on its mounting foundation, using vibration isolators between skid base and foundation (Figure 6). Secure skid base to the isolators and the isolators to mounting foundation. Remove the two mounting bolts; use them as jack screws by moving them to adjacent threaded holes, then raise the generator and remove shims from between generator and support and skid base.

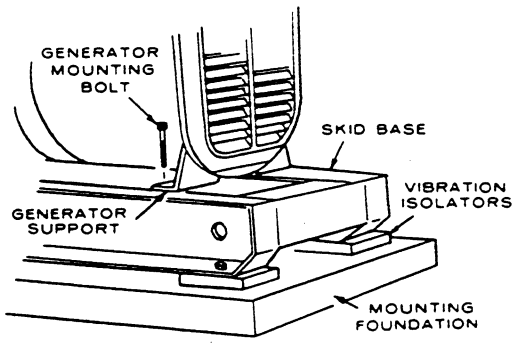
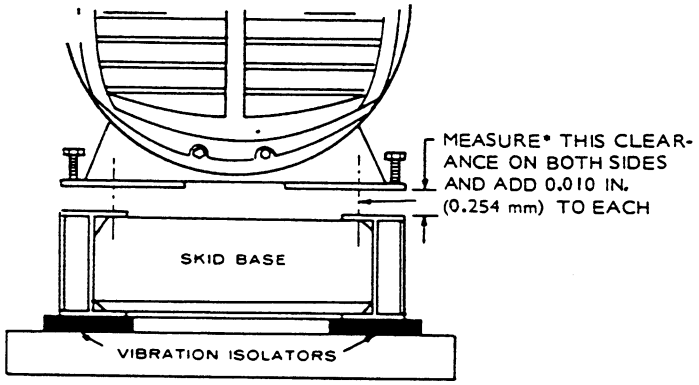


FIGURE 5

2. Adjust tension from the jackscrews and allow generator to hang free. Using a feeler gauge, measure clearance from the top surface of the skid base to each generator support mounting surface (Figure 6). To this measured clearance, add 0.010 inches (0.254 mm) to each side of the skid base—this total clearance will determine the amount of shims required.

The clearance may be different for each side of skid base. If there is a great difference, loosen generator support and realign.



*The measurement should be taken in line with bolt hole.

FIGURE 6

3. After determining the proper clearance for each side of the skid base, turn jackscrews in the threaded holes to allow a clearance for placing the shims between skid base and generator support (Figure 7). Lower generator (using jackscrews) and allow to rest on shims. Recheck the total generator clearance, base to support; it must equal the base to support clearance plug the 0.010-inches (0.254 mm).

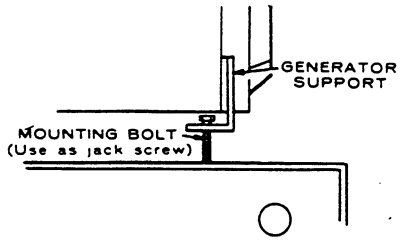


FIGURE 7

4. Remove the jackscrews and reinstall as mounting bolts through generator support, shims and skid base. Secure and lock the mounting bolts in place (Figure 8).

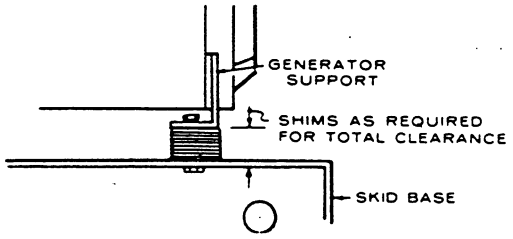


FIGURE 8

VENTILATION

Generator sets create considerable heat which must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for the required air flow. See *SPECIFICATIONS* for the air required to operate with rated load under normal conditions at 1800 r/min.

Radiator set cooling air travels from the rear of the set and is removed by a pusher fan which blows out through the radiator. Locate the air inlet to the rear of the set. Make the inlet opening at least 1½-times larger than the radiator.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The opening size should be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to air flow. Use a duct of canvas or sheet metal between the radiator and the air outlet opening. The duct prevents recirculation of heated air.

Provide a means of restricting the air flow in cold weather to keep the room or compartment temperature at a normal point.

For operation outside a building, a shelter housing with electrically operated louvres is available as an option. Transformers connected across the generator output supply current to the motors.

When the generator is operating, current in the transformers actuate the motors and open the louvres. The louvres are held open for the duration of the set operation, then are closed by return springs when the set is shut down.

City water cooled sets do not use the conventional radiator. A constantly changing 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, disperse heat convected off the engine and support combustion in the engine.

For small compartments, a duct of equal or larger area than generator outlet is recommended to remove the heated air from the generator air outlet to the outside atmosphere. Limit bends and use radius type elbows where needed. A larger, well ventilated compartment or room does not require a hot air duct.

Installations made in a small room may require installation of an auxiliary fan (connected to operate only when the unit is running) of sufficient size to assure proper air circulation and evacuation of fumes.

COOLING SYSTEM

Standard Radiator Cooling, uses a set mounted radiator and engine driven pusher type fan to cool engine water jacket. Air travels from the generator end of the set, across the engine and out through the radiator. An integral discharge duct adapter flange surrounds the radiator grille.

Heat Exchanger Cooling (optional), uses a shell and tube type heat exchanger instead of the standard radiator and fan. Engine jacket coolant circulates through the shell side of the heat exchanger, while raw cooling water is pumped through the tubes. Engine coolant and raw water do not mix. This type of cooling separation is necessary when the raw water contains scale forming lime and other impurities.

This system reduces set enclosure airflow and noise levels. Proper operation depends upon a constant supply of raw water for heat removal. The engine coolant side of the system may be protected from freezing the raw water side cannot.

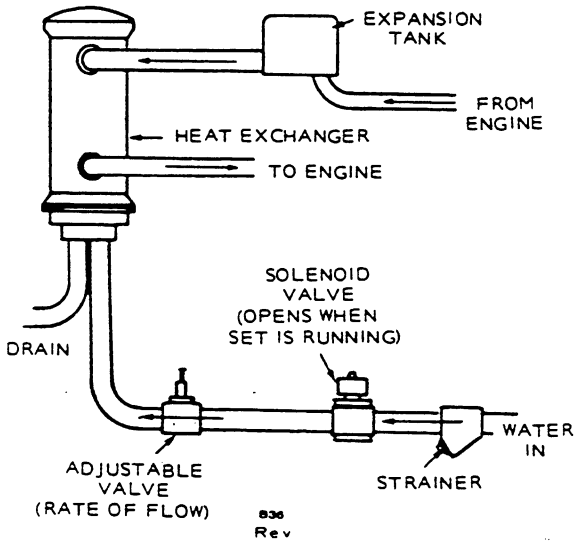


FIGURE 9 TYPICAL HEAT EXCHANGER SYSTEM

Standpipe Cooling (optional) substitutes a mixing (tempering) tank for the standard radiator and fan. Cooling water circulating through the engine jacket is mixed with raw water in the tank. Because raw water flows through the engine jacket, it must not contain scale forming impurities or fouling of the engine water will occur. Fouling results in engine overheating and costly repair bills.

This system reduces set enclosure airflow requirements and noise levels. Proper operation is dependent on a constant supply of cooling water. The system cannot be protected from freezing.

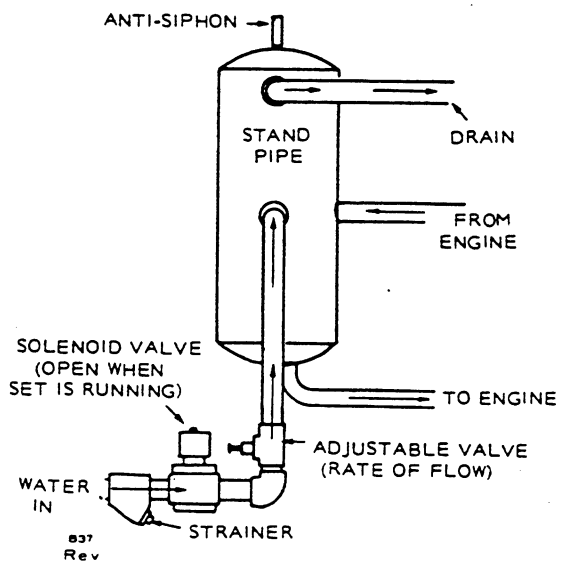


FIGURE 10. TYPICAL STANDPIPE SYSTEM

Remote Radiator Cooling (optional), substitutes a remote mounted radiator and an electrically driven fan, for the set mounted components. Removal of the radiator and fan from the set reduces set enclosure airflow requirements and noise levels without forcing dependence on a continuous cooling water supply. The remote radiator system can be completely protected against freezing.

This system must be designed to meet specific requirements of the application.

Water Jacket Heater (optional): Installed to keep engine coolant warm while engine is shut down. It heats and circulates the coolant within the engine, which reduces start-up time and engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

COOLING CONNECTIONS

The radiator cooled (standard) set does not require any external connections except as discussed under *Ventilation*. Allow clearance around the set for access to service the radiator and fan belts.

Heat Exchanger and Standpipe cooled sets must be connected to a pressurized supply of cold water. Make connections to the set with flexible pipe to absorb vibration. On the cool water line install a solenoid valve to shut off the flow when the set is shut down and a rate of flow valve to control engine temperature. This valve can be either manual or automatic. Actual rate of flow will depend on inlet water temperature.

Adjust the flow to maintain water temperature between 165° F and 195° F (73.9° C and 90.6° C) while viewing the water temperature gauge.

Before filling cooling system check all hardware for security. This includes hose clamps, capscrews, fittings and connections. Use flexible coolant lines with heat exchanger, standpipe or remote mounting radiator.

Remote radiator plumbing will vary with installation. All systems must comply with the following conditions—

1. Make all connections to the set and to the radiator, with flexible pipe.
2. Install an auxiliary circulating pump if the horizontal distance between the engine and pump exceeds 23-feet (7 m).
3. Install a hot-well system to relieve excess engine water jacket pressure if the top of the radiator is more than 23-feet (7 m) above the center-line of the engine crankshaft.

COOLANT FILTER

Two spin-on type corrosion filters are standard equipment on a DFV set. These precharge filters are compatible with plain water or all permanent ethelyne glycol base permanent antifreeze coolants. Refer to engine manufacturer's manual for instructions if a methoxy propanal base antifreeze is desired.

Do not use any type of antifreeze with a stop-leak additive. The filter will remove the additive (usually a particulate) and become clogged and ineffective. Replace filter periodically as recommended in *GENERAL MAINTENANCE* section.

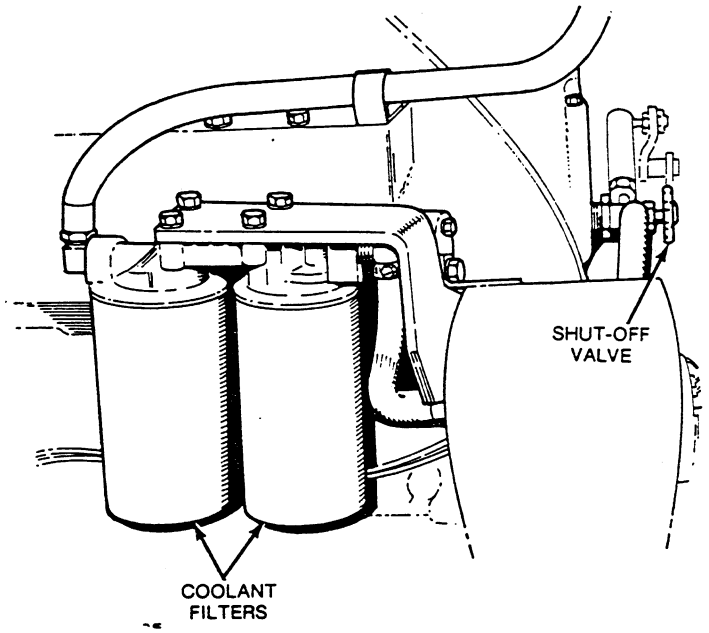


FIGURE 11. COOLANT FILTER INSTALLATION

EXHAUST

WARNING Inhalation of exhaust gases can result in death.

Engine exhaust gas must be piped outside building or enclosure. Do not terminate exhaust pipe near inlet vents or combustible materials. An approved thimble (Figure 12) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 13) at the point where a rise in the exhaust system begins. Avoid sharp bends; use sweeping long radius elbows. Provide adequate support for mufflers and exhaust pipes. Refer to Figure 4 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9 inches (230 mm) of clearance if the pipes run close to a combustible wall or partition.

Maximum permissible exhaust restriction (back pressure) is 3 inches (76 mm) Hg.

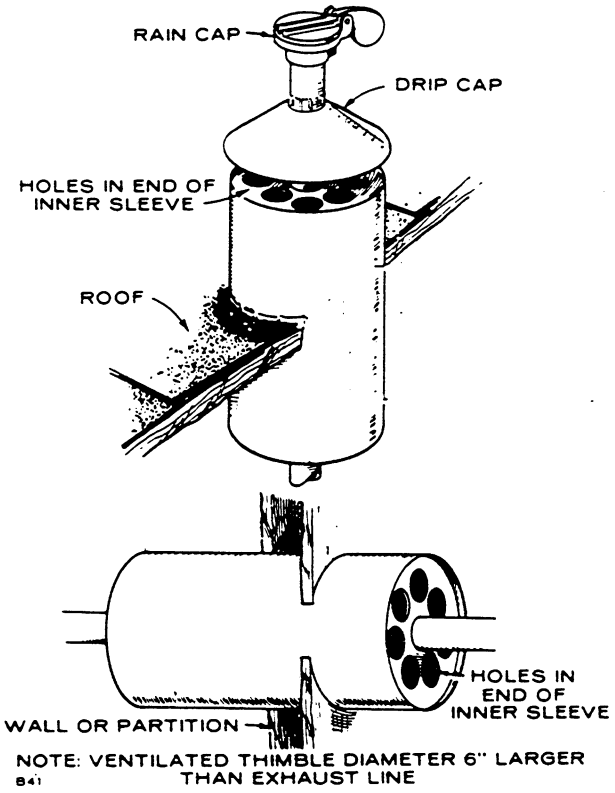


FIGURE 12. TYPICAL EXHAUST THIMBLE

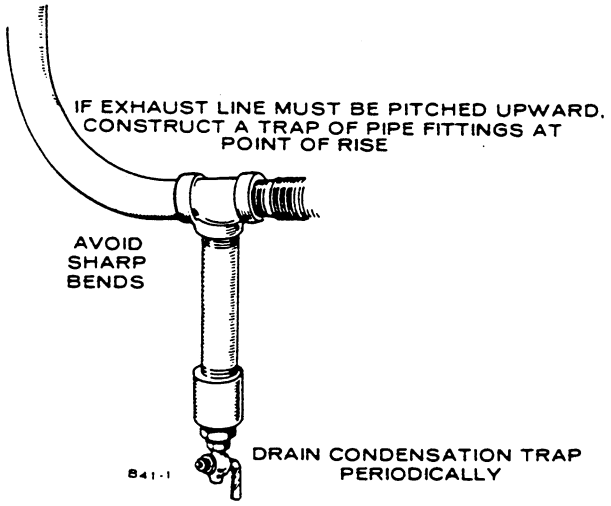


FIGURE 13. EXHAUST CONDENSATION TRAP

Use two, five-inch (127 mm) pipes with a flexible portion between the engine and mufflers. Do not connect flexible line to the exhaust manifold.

A critical muffler recommended for this unit is sized for an 8-inch exhaust pipe. Maximum allowable length of exhaust pipe for this diameter is 580-feet (177 m).

FUEL SYSTEM

Cummins engines used on the DFV sets are designed for use with ASTM No. 2 Diesel fuel. They will, however, operate on diesel fuels within the specifications delinated in the Cummins engine manual.

FUEL CONNECTIONS

Check local regulations governing the installation of a fuel supply tank.

In any diesel engine installation, fuel system cleanliness is of utmost importance. Make every effort to prevent entrance of moisture or contaminants of any kind. Do not use lines or fittings of galvanized material.

A fuel lift in excess of 5 feet (1.5 m) is not recommended without a day tank installation, because of fuel drainage.

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the day tank from an electric pump (pump not included). The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and main fuel tank. Refer to the installations included with the tank. See Figure 14 for an example of a day tank installation. Tank and lines must be below level of injector pump return outlet.

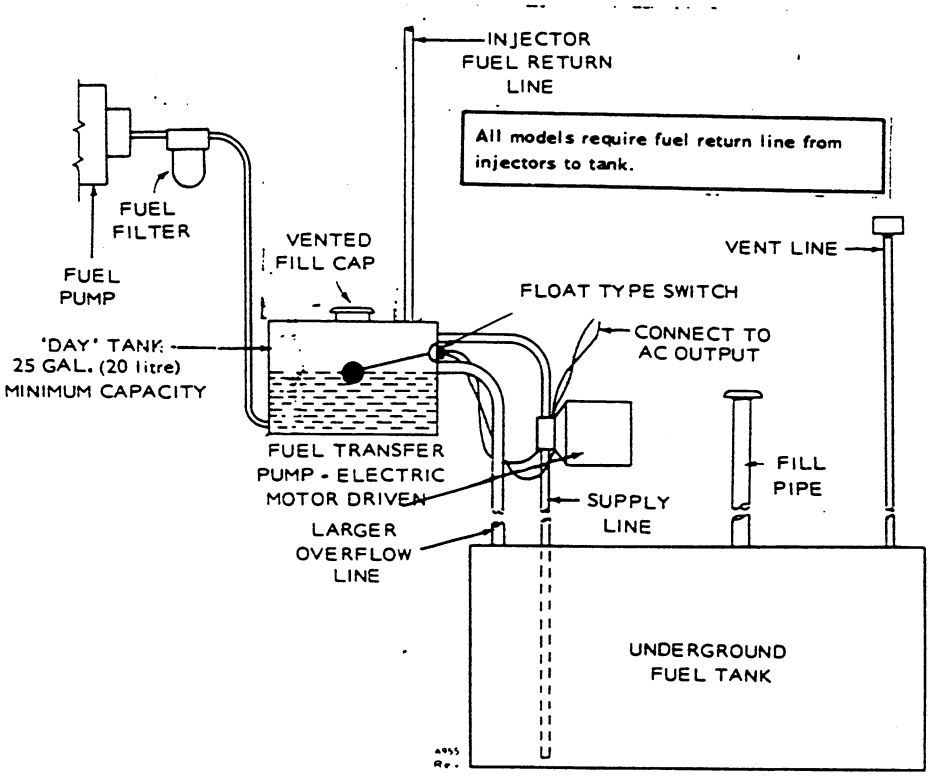


FIGURE 14. DAY TANK (TYPICAL)

BATTERY

Starting the unit requires 24-volt battery current. Use two 12-volt (see *SPECIFICATIONS)* batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 15. Necessary battery cables are on unit. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Onan automatic transfer switches include such a battery charging circuit.

WARNING **Do not smoke while servicing batteries. Lead acid batteries give off explosive gases while being charged.**

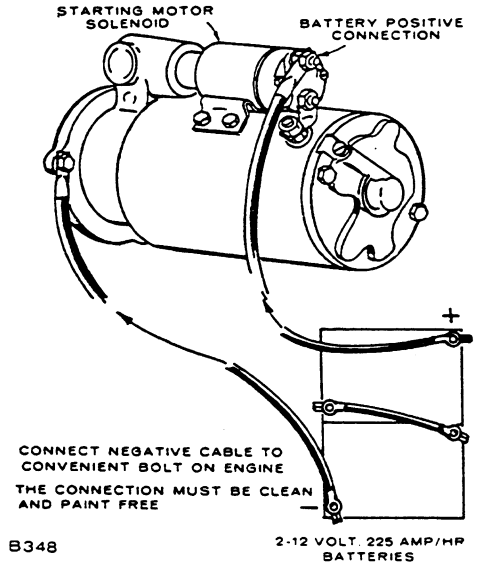


FIGURE 15. BATTERY CONNECTION

BATTERY, HOT LOCATION

Batteries will self discharge very quickly when installed where the ambient temperature is consistently above 90° F (32.3° C) such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.265 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90° F (32.2° C), this should not be noticed. The lengthened battery life will be worth the effort.

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

REMOTE CONTROL CONNECTIONS

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated within the control box. Connect one or more remote switches across remote terminal and B± terminal as shown in Figure 16. If the distance between the set and remote station is less than 1000-feet (305 m), use No. 18 AWG wire; between 100- and 2000-feet (305 and 610 m), use No. 16 AWG wire.

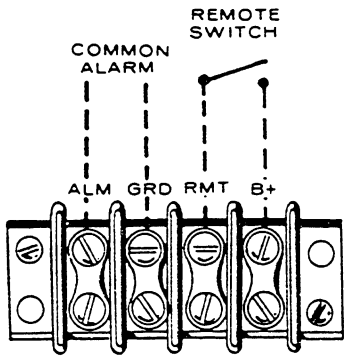
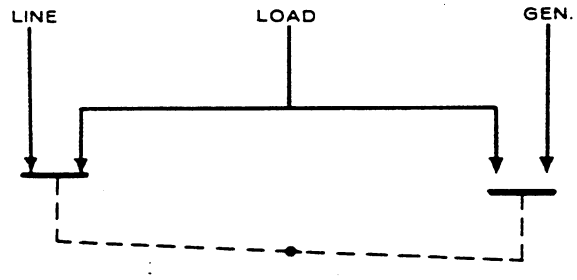


FIGURE 16. REMOTE START CONNECTION (TB12)

WIRING CONNECTIONS

Most local regulations require that wiring connections be made by a licensed electrician and that the installation be inspected and approved before operation. All connections, wire sizes, etc. must conform to requirements of electrical codes in effect at the installation site.

If the installation is for standby service, a double throw transfer switch (Figure 17) must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator power to be connected to the load at the same time. Instructions for connecting an automatic transfer switch are included with such equipment.



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.

FIGURE 17. LOAD TRANSFER SWITCH (TYPICAL)

GENERATOR CONNECTIONS

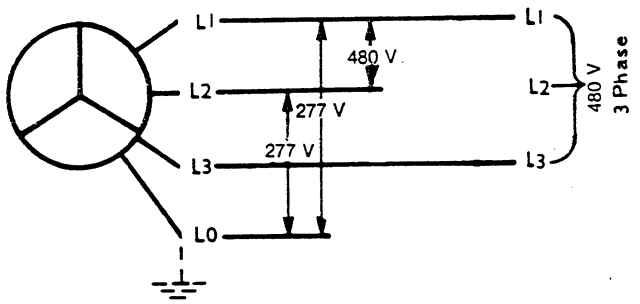
Voltage output of the model UV generator is predetermined at the factory by the internal connections to the bus-bars. It is not recommended that these be changed. The generator is rated in two voltages, the lower being line to neutral and the higher is the line-to-line voltage. Refer to the rating plate on the generator. For maximum current available at these voltages, see Table 1.

For 3-phase loads connect separate load wires to each of the set terminals L1, L2 and L3 (Figure 18). For a single phase load of higher nameplate voltage only, connect between terminals L1 and L2. Available capacity is 2/3 maximum output.

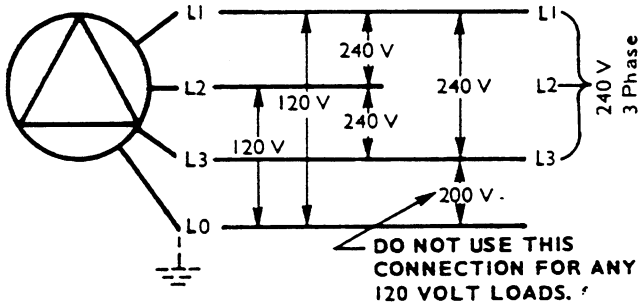
The terminal L0 can be grounded. For 1-phase loads of lower nameplate voltage, connect the neutral load wire to the L0 terminal. Connect the "hot" (black) load wire to either terminal — L1, L2. Two separate single phase circuits are available with a total capacity of up to 2/3 of the generator rated 3-phase output.

If using 1-phase and 3-phase current at the same time, ensure the 1-phase load is properly balanced. Do not exceed rated line current.

ONAN recommends that all connections from the generator to the bus-bars and from the bus-bars to the load be made by a qualified electrician. All applicable local and state laws should be complied with.



3-PHASE WYE CONNECTION



3-PHASE DELTA CONNECTION

FIGURE 18.

GROUNDING

Typical requirements for bonding and grounding are given in the National Electrical Code, 1975, 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, 1975, Article 100) The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and capacity 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, and that all metallic parts likely to become energized under abnormal conditions 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 incompasses 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.

OPERATION

GENERAL

Onan DFV Series electric generating sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Inspect your unit closely for loose or missing parts and damage which may have occurred in transit. Tighten loose parts, replace missing parts and repair any damage before putting set into operation.

PRESTART SERVICING

Lubrication System: Engine oil was drained prior to shipment. Fill crankcase to capacities shown below. After engine has been run, check dipstick, add oil to bring level to full mark. Record capacity for future oil changes.

Lubricating oil recommended for turbo-charged diesel engines is API Class CC/CD with a maximum sulphated ash content of 1.85%. Oils in this class should be satisfactory for most operating conditions. Do not mix brands nor grades of oil.

Oil viscosity should be as follows:

AMBIENT TEMPERATURES	VISCOSITY
-10° F (-23° C) and below	See engine manual.
-10 to 30° F (-23 to -1° C)	10W
20 to 60° F (-7 to 16° C)	20-20W
40° F (4° C) and above	30

Nominal lubricating oil capacity (including oil pan and filter) is 27 gallons (102.2 litres).

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 42.5-gallons (161 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures, use antifreeze with an ethylene glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to Cummins engine manual for additional information.

CAUTION **1. Verify that the electric solenoid valve used with city water cooled sets is open before initial starting of unit to allow coolant chambers to fill. Overheating and damage to the engine could result from noncompliance.**

CAUTION **If engine is equipped with a cooling system filter, do not use antifreeze with an anti-leak formula. The stop leak element can prevent or retard the coolant flow through the filter, thereby eliminating the filtering process completely.**

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

Fuel System: Refer to the Cummins engine manual for fuel oil specifications. Check with fuel supplier and ensure that fuel supplied meets the specifications. Filter or strain fuel when filling tank. Fuel supply tanks should be kept as nearly full as possible by topping up each time engine is used. Warm fuel returning from the injector pump heats the fuel in the supply tank. If the fuel level is low in cold weather, the upper portion of the tank not heated by returning fuel tends to increase condensation. In warm weather both the supply tank and fuel are warm. Cool night air lowers the temperature of the tank more rapidly than the temperature of the fuel. Again this tends to increase condensation.

Condensate mixing with the sulphur in the fuel forms a sulphurous acid which will corrode and damage the engine. KEEP FUEL CLEAN.

WARNING **DO NOT SMOKE while handling fuel. Diesel fuel is flammable.**

Priming Oil System: If it is necessary to prime oil system refer to the Cummins engine manual.

Priming Fuel System: If it is necessary to prime fuel system refer to the Cummins engine manual.

BATTERIES

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

Check level of electrolyte to be at split ring mark. Measure specific gravity of electrolyte: SG 1.265 at 80° F (26.7° C). If distilled water has been added or specific gravity is less than 1.265, place batteries on charge until desired reading is reached. Do not over charge.

STARTING

When the preceding service functions have been performed, recheck to verify unit is ready to start.

1. Crankcase filled.
2. Governor sump filled.
3. Cooling system filled—input solenoid valve open.
4. Batteries charged and connected.
5. Fuel solenoid valve open.

To start, move the "run-stop/reset-remote" switch to the "run" position. The engine should start after a few seconds of cranking. Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 50- and 70 psi (345.0—483 kPa). Check the following gauges:

1. DC Ammeter—10 to 30 amperes.
2. AC Voltmeter—AC generator output voltage.
3. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 165° F to 195° F (74° C to 90.6° C). On city water cooled units an adjustable valve is connected in the water supply line. Adjust the hand wheel valve to provide a water flow that will keep the water temperature gauge reading within the range of 165° F to 195° F (74° C to 90.6° C).

STOPPING

To reduce and stabilize the engine temperatures and prevent turbocharger housing damage, run the engine at no load for three to five minutes before shutting down.

Move the run-stop/reset-remote switch to stop position to shut down the set.

Break-in Note: Run set at 50 percent rated load for the first half-hour of initial operation after reaching operating temperature.

Non-Start: If after a few seconds of cranking, engine fails to start, or starts and runs then stops and fault lamp lights, refer to troubleshooting chart.

NO LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of heater elements, etc.

EXERCISE PERIOD

Generator sets on continuous standby service are required to be operative at essential loads from a cold start in a short period of time in the event of a power outage.

This imposes severe conditions on the engine. Friction of dry piston rings upon dry cylinder walls causes scuffing and rapid wearing. These can be relieved by exercising the set at least once a week for a minimum time of 30 minutes per exercise period. Preferably, run the set under at least 50 percent load to allow the engine to reach normal operating temperature. This will keep engine parts lubricated, maintain fuel prime, prevent electrical relay contacts from oxidizing and insure easy emergency starts. Onan automatic transfer switches contain an optional exercise switch which, by pre-selection, will start, determine run period and shut down a set on a weekly frequency. For example, the switch can be set for time of start, length of run, A.M. or P.M. and day of week.

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

TABLE 2.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM

An engine malfunction shutdown will be indicated by a 'FAULT' light on the DC control panel. A red light will indicate in one of the following areas.

1. Overcrank
2. Low Oil Pressure
3. High Engine Temperature
4. Overspeed
5. Generator Overvoltage.

Proceed with troubleshooting as follows:

SYMPTOM	CORRECTIVE ACTION
1. Fault lamp lights and engine stops cranking after approximately 75-seconds.	1. See engine service manual for troubleshooting fuel system. After correcting fault, reset engine monitor relay by placing Run-Stop/ Reset-Remote switch to Stop/Reset position, depressing Reset button, then to the required running position.
2. Engine runs, shuts down, cranks for 75-seconds, cranking cycle stops, light ON.	2. Check fuel supply.
3. *Low oil pressure shutdown.	3. Check— a. Oil level. Replenish if necessary. b. Sensor. Faulty sensor will shut down engine. c. Refer to engine service manual for troubleshooting guide for oil system.
4. *High engine temperature shutdown.	4. Check— a. Coolant level. Replenish is necessary. b. City water cooled sets. Check water flow, valves, etc. c. Check sensor; check thermostat. d. Radiator model, check fan belts, radiator for obstructions, etc.
5. Overspeed shutdown.	5. Check governor and throttle linkages for freedom of movement.
6. Overspeed light on, no shutdown.	6. Disconnect wire at TB11-29. Light ON after reset; replace engine monitor board.
7. *Low oil pressure light ON. No shutdown.	7. Disconnect wire at TB11-30. Light ON after relay reset. Replace engine monitor board.
8. *High engine temperature light ON. No shutdown.	8. Disconnect wire at TB11-31. Light ON after relay reset. Replace engine monitor board.
9. Generator overvoltage.	9. Indication of malfunction in generator regulator system. a. Replace SCR block. b. Replace voltage regulator.

* - Not applicable on Pennsylvania State models.

NOTE: The above troubleshooting procedure is designed to locate the more obvious causes of malfunction shutdown. If after performing the appropriate remedy the fault persists, contact the nearest ONAN distributor or Service Department.

HIGH ALTITUDE

Engine ratings apply to altitudes up to 5000-feet (1500 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

OUT OF SERVICE PROTECTION

For storage of all durations, refer to the Cummins engine manual.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to-and-from the set.
2. Keep cooling system clean.
3. Use correct SAE No. oil for temperature conditions.

LOW TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
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. Connect water jacket heater when set is not running.
6. Refer to Cummins manual for further information.

Water Jacket Heater (optional): The function of this heater is to keep the engine warm enough to assure starting under adverse weather conditions. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

GENERAL MAINTENANCE

GENERAL

Establish and adhere to a definite schedule of maintenance inspection and servicing, application and environment being the governing factors in determining such a schedule. If your set is a prime power application, base your schedule on operating hours. Use the running time meter to log hours run; maintain an accurate record of hours and service for warranty support.

A set on stand-by duty will need servicing at times other than those recommended by Onan and the engine manufacturer. Refer to Cummins manual for engine services and maintenance procedures. Adjust your schedule to satisfy the following conditions—

- Continuous duty (prime power)
- Standby power
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water or sea water
- Exposure to dust, sand, etc.

Consult with your ONAN distributor or dealer for a schedule of maintenance and service more suitable to the unique environment and application of your set.

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

TABLE 3 OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	8	50	100	200-250
Inspect Set	x			
Check Radiator Coolant	x			
Check Oil Level	x4			
Check Air Cleaner (Clean if Required)		x1		
Clean and Inspect Crankcase Breather			x	
Inspect Fan Belt			x2	
Check Cooling System			x3	
Clean and Inspect Battery Charging Alternator				x
Change Crankcase Oil			x1	
Replace Oil Filter Element			x1	
Check Batteries		x5		
Replace Fuel Filter				x
Check all hardware, fittings, clamps, fasteners, exhaust system for security.	x*		x6	

x1 - Or every 3 months, perform more often in extremely dusty conditions.

x2 - Or every 3 months, adjust to 1/2 inch depression between pulleys.

x3 - Or every 3 months, check for rust or scale formation. Flush if necessary.

x4 - For accurate readings, check oil level approximately 15 minutes after shutdown. Keep oil level as near "FULL" mark on dipstick as possible. See engine manual.

x5 - Or every two weeks.

x6 - Or every 3 months.

x* - With set running, visually and audibly check exhaust system for leaks.

NOTE: The above schedule is a minimum requirement. For the recommended service periods for your engine, refer to engine manual.

GOVERNOR ADJUSTMENTS—ENGINE SPEED

The PSG governor manufactured by Woodward Governor Company, is standard equipment on DFV generator sets. (Barber-Colman governors are optional.)

Normally, the governor adjustments for speed, droop, and compensation needle valve, are set at the factory. Minor adjustments are required after installation due to engine or turbine variances. Normal factory settings of the various governor adjustments are given in Table 4.

TABLE 4. FACTORY ADJUSTMENTS

ADJUSTMENT	FACTORY (TEST) SETTING
Speed Setting:	Preset at the factory to specified full-load rated speed.
Droop setting (internally adjusted):	Set at designated droop percentage as specified for the particular application.
Compensation needle valve:	Factory preset 1/2 turn open (nominal). Normally requires adjustment to suit the particular installation.

Prior to starting the engine or turbine for the first time after installation of a new or overhauled governor, make certain the speed is set to minimum (idle). Start the engine or turbine under manual control according to the engine manufacturer's recommendations, and allow it to warm up. Transfer the engine or turbine to governor control, but be prepared to resume manual control until satisfied that the governing system is fully operative.

Adjust the governor for no-load rated speed. Open the compensation needle valve (2 to 3 turns) until the engine or turbine begins to hunt or surge. Allow the engine or turbine to hunt for approximately 1/2 minute to purge trapped air from the internal passages in the governor. Gradually close the needle valve until hunting just stops. Closing the needle valve further than necessary results in a slow return to speed following a change in load. Test the governing action by manually disturbing engine or turbine speed. The engine should return promptly to original steady state speed with only a small overshoot.

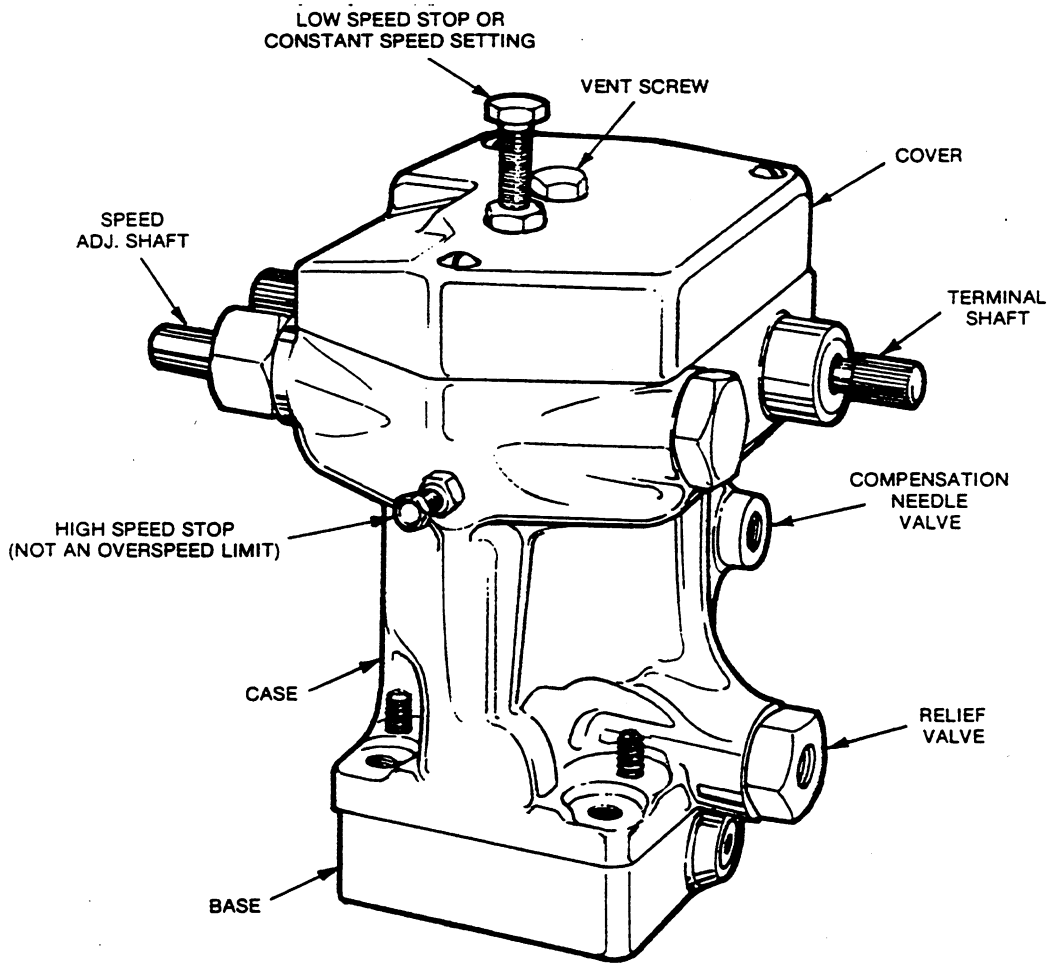


FIGURE 19. GOVERNOR

Speed Droop

Speed droop is provided and is internally adjustable between zero and seven percent, depending on speed setting, speeder spring, flyweights, and terminal shaft travel. Speed droop permits load division between two or more engines driving generators in parallel or connected to a single shaft. If the engine is operated alone or on a DC system with proper generator compounding, the governor may be set for zero droop (isochronous operation).

For AC generating units tied in with other units. set the droop sufficiently high to prevent interchange of load between units. If one unit in the plant or system has enough capacity, set its governor on zero droop and it will regulate the frequency of the entire system. This unit then takes all load changes within the limits of its capacity and controls the frequency if its capacity is not exceeded.

Adjust the system frequency by changing the speed setting of the governor having zero droop. Load distribution between units is accomplished by changing the speed setting of the governor having speed droop.

Speed Droop Adjustment

Figure 20 shows the governor with the top cover removed to expose the speed droop mechanism and adjustments. The speed droop bracket is clamped to the terminal lever by the slotted hexagonal head screw.

The speed droop bracket, when loosened, is adjustable radially to the terminal shaft. When the bracket is moved, a pin on the bracket is moved radially from the terminal shaft's centerline to a radius of 1/2 inch. This pin controls the position of the speed droop lever. When the pin is set at the centerline of the terminal shaft, the governor is set at zero droop. As the pin is moved away from the shaft's centerline, terminal shaft rotation moves the pin and, therefore, the end of the speed droop lever which pivots on the speed droop pin. The resultant speed setting is a function of terminal shaft position with speed setting decreasing as fuel flow increases.

Since there is no calibration for the droop adjustment, the zero droop position may be set only by trial and error on the engine, or by use of a dial indicator on the speed droop lever during manual rotation of the terminal shaft. If speed droop is required, it must be set by operation on the engine, readjusting the slide to obtain the desired speed droop between full load and no load.

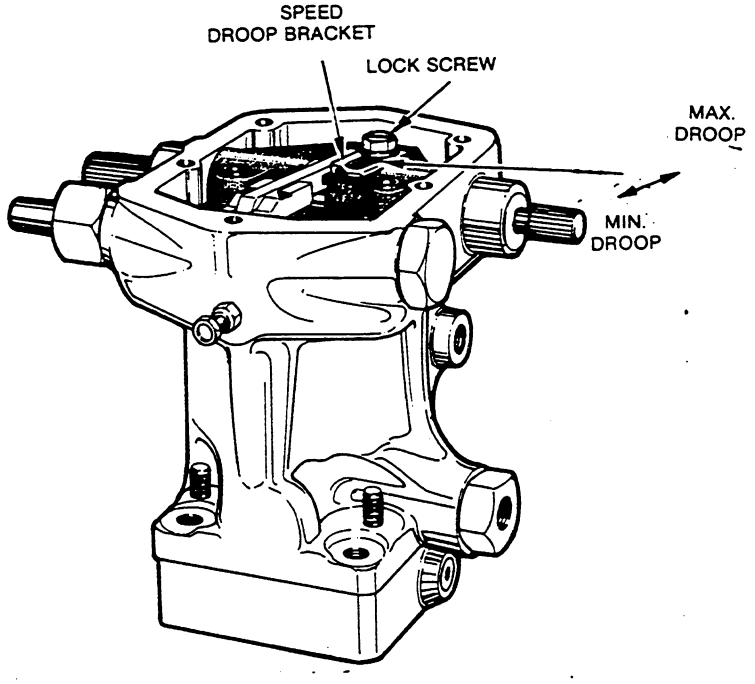


FIGURE 20.

AC GENERATOR

There are no brushes, brush springs or collector rings on these generators, therefore they require very little servicing. Periodic inspections, to coincide with engine oil changes, will ensure good performance.

Generator Bearing: Inspect the bearing every 1000 hours with the unit running.

If using the unit for "prime power", replace the bearing every 10,000 hours or two years. If using the set for "standby", replace the bearing every five years.

Check generator voltage. It may be necessary to make a slight readjustment of the voltage rheostat to obtain the preferred voltage at average load.

INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly, 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. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 30 in. lb. or finger tight plus a quarter turn.

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 1.265.

CONNECTIONS (Fuel, Exhaust, etc.)

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

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

FILTERS

A planned program of filter cleaning or replacement will pay dividents in engine life, operation and reliability.

Air Filter: Replace or clean when plugged, or in accordance with service maintenance instructions. To remove filter element, loosen eight nuts holding head, lift off head and remove filter element.

Recommended clean method for element:

1. Blow dry compressed air (30 psi [207 kPa] maximum) through element from clean side. Hold air nozzle at least 1 inch (25 mm) away.
2. Soak for at least 15 minutes in water and Donaldsons D1400 solvent to remove soot and carbon as well as dirt. Rinse until water is clear (use low pressure water) and air dry. Do not use compressed air.

CAUTION **Filters should be handled with care to prevent damage. If the filter does become damaged, install recommended replacement part.**

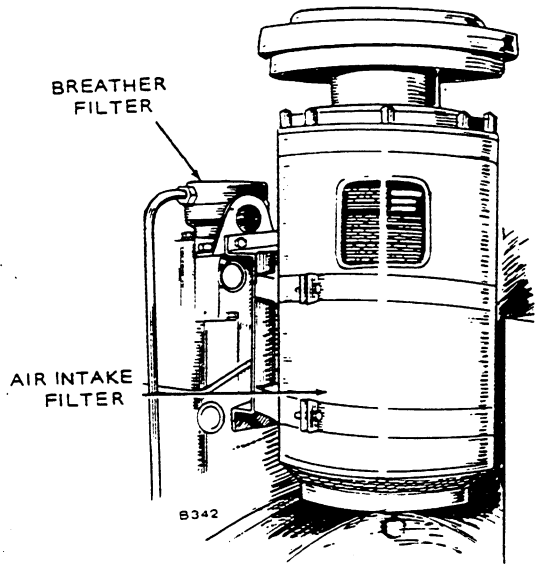


FIGURE 21. AIR FILTER

Lubrication Oil Filter: Spin-off throw away elements, replace at every oil change.

To change filter, proceed as follows—

1. Unscrew and discard filters.
2. Fill new filters with lubricating oil.
3. Position filter on adapter and hand tighten until seal contacts filter head. Advance one-half to three quarters turn. Do not overtighten.
4. Fill crankcase to "H" mark on dipstick, run engine to verify no oil leaks, shut down engine and add oil as necessary.

Always allow 15 minutes after engine shutdown before checking oil level. This will give oil time to drain back into the crankcase.

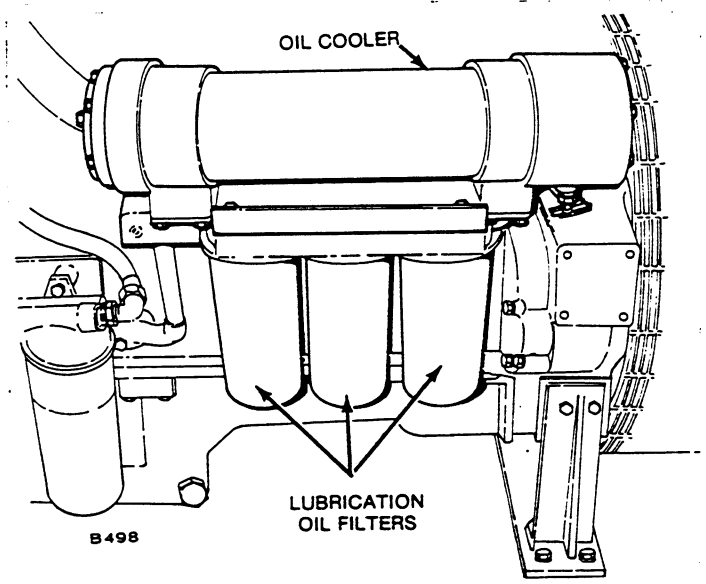


FIGURE 22. LUBRICATION OIL FILTERS

Coolant Filter: A shut off valve (see Figure 11) is installed in the inlet and outlet line to the coolant filter to be closed, for minimum coolant loss when the filter is removed. Refer to engine manufacturer's manual for coolant filter replacement information.

Fuel Filter: Spin-off, throw-away unit. When replacing filter, fill with clean fuel before installation.

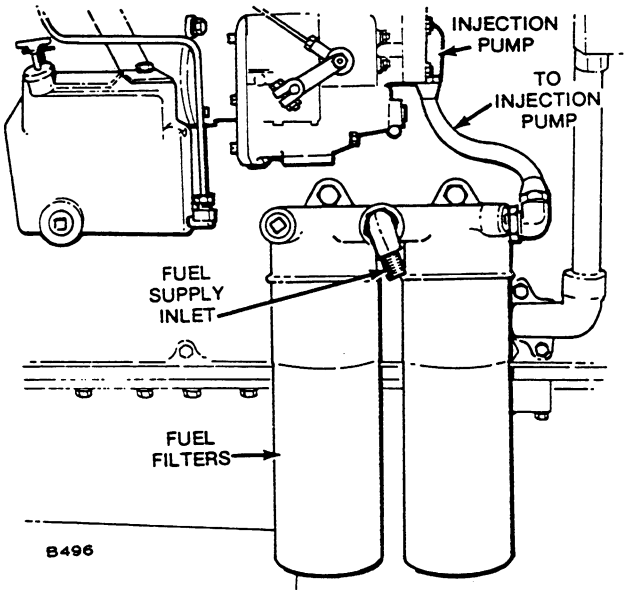


FIGURE 23. FUEL FILTERS

TANK HEATERS

A Kim Tank Heater is optional equipment on the DFV generator set. For efficient operation and optimum product life, perform the following procedure at least once a year (see Figure 24):

1. Remove head and valve assembly.
2. Clean foreign matter out of the tank.
3. Remove element and scrape off scale accumulated on the sheathing.

When reassembling threaded aluminum parts, be sure to use anti-seize compound.

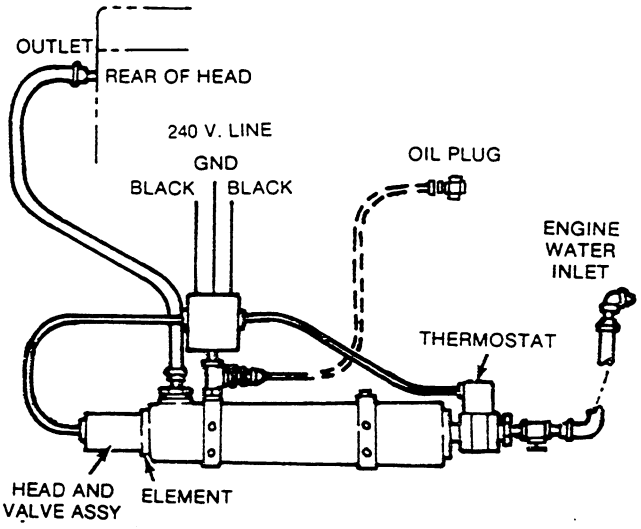
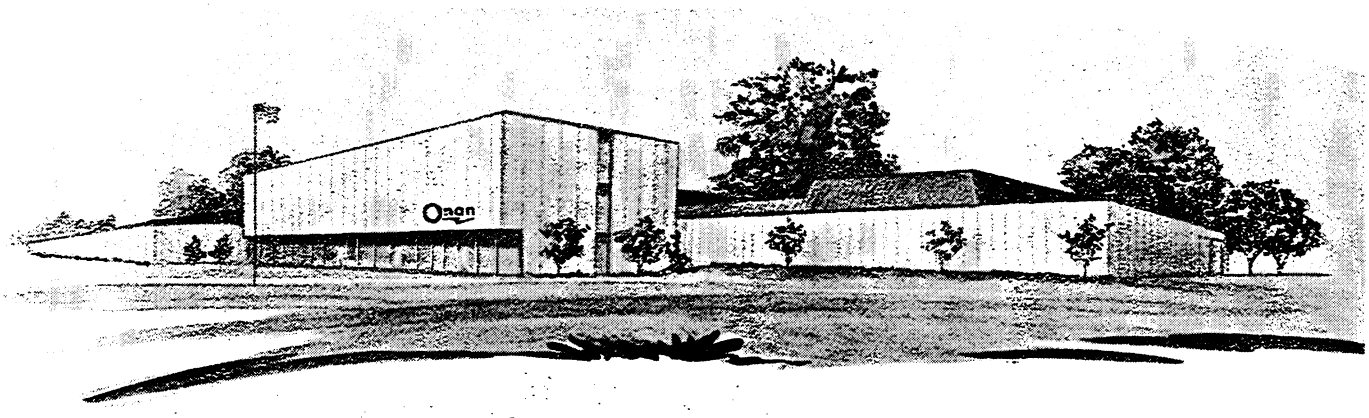


FIGURE 24. ENGINE HEATER



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