Onan

Operator's Manual

DBEB DCEB DMEB
DBFA DCFA DMFA
DBFB DMFB

GenSets

Diesel-Driven Generator Sets 330-500kW

903-0125
1-89
Printed in U.S.A.

Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and your 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 SMOKE OR ALLOW AN OPEN FLAME near the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- 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 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. Inspect exhaust system daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Bleed the system pressure first.
- Keep your hands away from moving parts.
- Before starting work on the generator set, disconnect batteries. 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 surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable 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

- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that 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 your generator set and the surrounding area clean and free from obstructions. Remove any debris from 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.

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.

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Introduction

ABOUT THIS MANUAL

This manual provides general information for operating and maintaining your generator set. Study this manual carefully and observe all warnings and cautions. Using the generator set properly and following a regular maintenance schedule will result in longer unit life, better performance, and safer operation.

Included with the generator set literature package is a copy of the Cummins Manual for the engine. The engine manual may be used in conjunction with the Generator Set Operator's Manual. The operation and maintenance procedures for the complete generator set (including the engine) are covered in the Generator Set Operator's Manual. In case of conflicting information, the Generator Set Operator's Manual takes precedence over the engine manual.

HOW TO OBTAIN SERVICE

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

When contacting your distributor, always supply the complete Model and Serial number of your generator set as shown on the nameplate (Figure 1). The nameplate is located on the side of the generator control box.

FIGURE 1. NAMEPLATE

⚠WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL SERVICE.

Specifications

TABLE 1. SPECIFICATIONS

SYSTEM	GENSET MODEL		
	DBEB DCEB DMEB	DBFA DCFA DMFA	DBFB DMFB
Engine Cummins Model	KTA-19-G2	KTTA-19-G	KTTA-19-G2
Coolant Capacity With Standard Mounted Radiator	23.5 U.S. Gal. 89 Litres	23.5 U.S. Gal. 89 Litres	27.7 U.S. Gal. 105 Litres
Lubrication Oil Capacity (Includes standard bypass filters)	12.5 U.S. Gal. 47.3 Litres	12.5 U.S. Gal. 47.3 Litres	12.1 U.S. Gal. 46 Litres
Oil Type	Normal duty - 32° F (0° C) and above - SAE 20W-40 Refer to your Cummins Engine Manual for extreme conditions.		
Fuel	ASTM No. 2 Diesel Engine Fuel (Refer to your Cummins Engine Manual for analysis limits.)		
Connections	Refer to your GenSet Outline Drawing for sizes and location.		
Electrical DC System	Starting - 24 Volt DC Charging - Engine belt driven, 35 ampere, regulated, 24 VDC output. Batteries - Two 12-Volt DC, series connected.		
AC System	Refer to your generator set Product Data Sheet for available voltages and output ratings.		
General Application	Refer to your generator set Product Data Sheet for application data and limits.		

Operation

GENERAL

This section covers prestart checks, starting and stopping and operating the generator set. It is recommended that the operator read through this entire section before starting the generator set. It is essential that the operator be completely familiar with the set to insure safe operation

PRESTART CHECKS

Before starting, be sure the following checks have been made and the unit is ready for operation. Refer to the *MAINTENANCE* section for the recommended procedures.

Lubrication

Check the engine oil level. Keep the oil level near as possible to the dipstick high (H) mark without overfilling.

Coolant

Check the engine coolant level. The coolant level should be about two inches (51 mm) below the radiator cap opening. Do not check while the coolant is hot.

⚠WARNING ***Contact with hot coolant can result in severe burns. Do not bleed hot, pressurized coolant from a closed cooling system.***

Fuel

Make sure the fuel tanks have sufficient fuel and fuel system is primed. See the *MAINTENANCE* section for recommended fuel.

⚠WARNING ***Spilled fuel can ignite and cause severe personal injury or death. Never fill the fuel tank when the engine is running***

⚠WARNING

EXHAUST GAS IS DEADLY!

Engine 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.

CONTROL PANEL

The following describes the function and operation of the standard 2-lamp and optional 12-lamp generator set control. All instruments and control switches are located on the face of the control panel as illustrated in Figure 2. The control panel is separated into a DC panel for monitoring the engine and an AC panel for monitoring the generator. Depending on customer location, the control configuration and options available may differ. Review the following component descriptions and Figure 2 illustrations to identify your specific control model.

DC Panel

Panel Lamp: Illuminates control 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 the battery charging current.

Run-Stop-Remote Switch: Starts and stops the unit locally, or from a remote location that is wired to the control engine monitor board.

Running Time Meter: Registers the total number of hours the unit has run. Use it to keep a record of periodic servicing. Time is cumulative; meter cannot be reset.

Reset, Lamp Test, Panel Lamp Switch: Resets the fault circuit only when the Run-Stop-Remote switch is in the Stop (Reset) position. Tests fault lamps and turns on the control panel lamp.

Tachometer (Optional): Provides constant monitoring of engine r/min.

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

Frequency Adjust (Optional): Potentiometer providing engine speed adjustment to achieve proper AC frequency.

<u>Indicator Lamps</u>

Two-Indicator Lamp Control (Standard): The standard control panel has two monitor system indicator lamps.

- RUN (green)
- FAULT (red)

The green Run lamp comes on as soon as both primary and secondary starter circuits are opened after unit starts. The red Fault lamp indicates an emergency shutdown of the generator set.

Twelve-Indicator Lamp Control (Optional): The optional control panel has a 12-lamp monitoring system. The following describes each lamp function.

- RUN (green) lamp comes on when both starter circuits are opened after unit starts.
- PRE LO OIL PRES (yellow) indicates engine oil pressure is marginally low.
- PRE HI ENG TEMP (yellow) indicates engine temperature is marginally high.
- LO OIL PRES (red) indicates engine has shut down because of critically low oil pressure.
- HI ENG TEMP (red) indicates engine has shut down because of critically high temperature.
- OVERSPEED (red) indicates engine has shut down because of excessive speed.
- OVERCRANK (red) indicates the starter has been locked out because of excessive cranking time.
- FAULT 1 (red) an undedicated fault. May be programmed as a timed or non-timed shutdown or fault light only (normally factory set for timed shutdown).
- FAULT 2 (red) same features as Fault 1 (normally set for non-timed shutdown).
- LOW ENG TEMP (yellow) engine temperature is marginally low for starting. Indicates inoperative coolant heater. (Lamp lights when engine water jacket temperature is 70° F (21° C) or lower. The lamp may stay on during initial generator set operation, but should extinguish after the engine warms up.)
- LO FUEL (yellow) indicates fuel supply is marginally low.
- SWITCH OFF (flashing red) indicates generator set is not in automatic start operation mode.

Models: DBEB, DBFA, DBFB, and DMEB, DMFA, DMFB

Models: DCEB, DCFA

FIGURE 2. CONTROL PANEL (With Optional 12-Lamp DC Control and AC Meters)

AC Panel

AC Voltmeter (Optional): Dual range instrument indicating generator AC voltage. Measurement range in use shown on indicator light.

AC Ammeter (Optional): Dual range instrument indicates AC generator line current.

Wattmeter (Optional): Continuously gives reading of the generator output in kilowatts.

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

Voltage Adjust (Optional): Rheostat providing approximately plus or minus three percent adjustment of the rated output voltage.

Frequency Adjust (Optional): Potentiometer providing engine speed adjustment to achieve proper AC frequency.

Upper and Lower Scale Indicator Lamps (Optional): Indicates which scale to use on the AC voltmeter and AC ammeter.

Phase Selector Switch (Optional): Selects phases of generator output to be measured by AC voltmeter and AC ammeter.

Running Time Meter: Registers the total number of hours the unit has run. Use it to keep a record of periodic servicing. Time is cumulative; meter cannot be reset.

CONTROL PANEL INTERIOR

For information regarding option modules, transformers, fuse blocks, etc., that may be in your control box, refer to specifics of your generator set. Contact your distributor for further assistance. Review the following description of the Engine Control Module (ECM) to better understand the operation of the generator set should a fault condition occur.

Engine Control Module

This circuit board assembly contains the basic components for normal engine start-up and shutdown, terminals for remote control interconnect, plug-in connectors for option modules and engine sensor inputs. The control module provides the following functions of unit protection.

- Overcrank - Limits engine cranking to 75 seconds. If engine fails to start, the module lights a fault lamp and opens the cranking circuit. The cycle cranking circuit allows three 15-second cranking cycles with two 15-second rest periods (on the 12-lamp control only).
- Overspeed - Shuts down the engine immediately if overspeed occurs and lights a fault lamp. The sensor is a frequency detection module connected to the generator PMG output. The module is mounted in the generator output box. It is factory adjusted to shut down 60 Hz units at 2100 ±50 r/min, 50 Hz units at 1850 ±50 r/min.
- Low Oil Pressure - Shuts down the engine immediately if oil pressure drops below 14 psi (97 kPa) and lights a fault lamp. The fault is time delayed about 10 seconds following starter disconnect and inhibited during cranking. The delay allows oil pressure to rise to normal before the electronic control module monitors this system.

  A pre-low oil pressure sensor and lamp (used with optional 12-lamp system) provides an alarm that oil pressure is marginally low, 20 psi (138 kPa) or less. The cause should be found and corrected as soon as possible.
- High Engine Temperature - Shuts down the engine immediately if coolant temperature rises above 215° F (102° C) and lights a fault lamp. The fault is time delayed about 10 seconds following starter disconnect and inhibited during cranking. This delay allows coolant in a hot engine time to circulate and return the water jacket to normal before the electronic control module resumes monitoring this system.

  A pre-high engine temperature sensor and lamp, used with optional 12-lamp systems, provides an alarm that engine temperature is marginally high, 205° F (97° C) or higher. The cause should be found and corrected as soon as possible.

⚠CAUTION ***The high engine temperature shutdown system will not operate if the coolant level is too low. The high engine temperature sensor monitors coolant temperature. Loss of coolant will prevent sensor operation and allow the engine to overheat causing severe damage to the engine. Therefore, maintain adequate coolant level to ensure the operation of the high engine temperature shutdown system.***

- Low Coolant Level Shutdown (Optional) - A float actuated switch provides engine shutdown if coolant level falls too low. It also lights the high engine temperature fault lamp.

Models: DBEB, DBFA, DBFB, and DMEB, DMFA, DMFB

Models: DCEB, DCFA

FIGURE 3. CONTROL PANEL INTERIOR

STARTING

The following sections cover the three systems used to start the generator set; local, remote, and automatic.

Starting at Control Panel

Move the Run-Stop-Remote switch on the DC panel (Figure 2) to the RUN position. This will activate the engine control system and the starting system. The starter will begin cranking and after a few seconds the engine should start. The starter will disconnect when the engine reaches a speed of 450 to 570 r/min.

If the engine does not start, the starter will disengage after a specified period of time and the control will indicate an overcrank fault. Generator sets with the standard overcrank control will crank continuously for up to 75 seconds before disengaging the starter. Generator sets with the cycle cranking option will crank for 15 seconds and then stop for 15 seconds until 3 cycles have been completed. To clear an overcrank fault, place the Run-Stop-Remote switch in the STOP position and momentarily depress the Reset switch. Wait two minutes for the starter motor to cool and then repeat the starting procedure. If the engine does not run after a second attempt at starting, refer to the *TROUBLESHOOTING* section.

Starting From Remote Location

Move the Run-Stop-Remote switch on the DC panel to the REMOTE position. This allows the generator set to be started from a remote switch. Closing the remote switch initiates the starting sequence described in the previous section.

Automatic Starting

Place the Run-Stop-Remote switch on the DC panel to the REMOTE position if an automatic transfer switch is used. When properly interconnected, this allows the transfer switch to start the generator set if a power outage occurs and stop it when the power returns.

STOPPING

Before Stopping

Run the generator set at no-load for three to five minutes before stopping. This allows the lubricating oil and engine coolant to carry heat away from the combustion chamber and bearings.

To Stop

If the set was started at the set control panel or at a remote control panel, move the Run-Stop-Remote switch or remote starting switch to the STOP position. If the set was started by an automatic transfer switch, the set will automatically stop after the normal power source returns and any time delay stop function has timed out.

BREAK-IN

Drain and replace the crankcase oil after the first 50 hours of operation on new generator sets. Refer to the *MAINTENANCE* section of this manual for the recommended procedures.

NO-LOAD OPERATION

Periods of no-load operation should be held to a minimum. If it is necessary to run the engine for long periods when no electric output is required, best engine performance will be obtained by connecting a non-critical or load bank electrical load.

EXERCISE PERIOD

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps ensure reliable engine starting. Exercise the generator set at least once a week for a minimum of 30 minutes with load so the engine reaches normal operating temperatures.

Most automatic transfer switches have an optional exerciser clock that can be preset to provide regular exercise periods. Typically the exerciser can be set for time of start, length of run, and day of week.

HIGH/LOW OPERATING TEMPERATURES

If rapid generator set starts are required, engine coolant heaters should be used to ensure best combustion temperatures exist at start-up. Optional plumbing packages, and heaters to match utility voltages can be obtained from your distributor.

⚠CAUTION ***To avoid damage to heater, be sure the cooling system is full before applying power to the heater.***

POWER RATING FACTORS

The generator set power rating applies to sets used in standby applications. The set will operate at the stated rating for the duration of normal utility power interruptions. The rating was established for a standard radiator cooled generator set running on diesel fuel and operating at the referenced Product Data Sheet conditions. For a rating relative to other applications, altitudes, cooling systems, or ambient temperatures, contact your distributor.

Troubleshooting

The generator set has a number of sensor units (Figure 4) that continuously monitor the engine for abnormal conditions such as low oil pressure or high coolant temperature. If an abnormal condition does occur, the engine monitor will activate a fault lamp and may also stop the engine depending on the condition. If the generator set does shut down, the operator may be able to restart the set after making certain adjustments or corrections. This section describes the operation of the fault condition system and contains suggested troubleshooting (Table 2) procedures for the operator to follow.

Safety Considerations

High voltages are present within the control box and generator output box when the generator set is running. Do not open the control box or generator output box while set is running.

⚠WARNING ***Contacting high voltage components can cause serious personal injury or death. Keep control and output box covers in place during troubleshooting.***

Generator set installations are normally designed for automatic starting or remote starting. When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. Place the Run-Stop-Remote switch in the STOP position and remove the negative battery cable from the set starting battery.

⚠WARNING ***Accidental starting of the generator set during troubleshooting can cause severe personal injury or death. Disable the generator set before troubleshooting.***

When a fault occurs during operation, follow the procedures in Table 2 to locate and correct the problem. For any symptom not listed, contact your distributor for service.

Resetting the Control

The external alarm and fault lamp is deactivated by placing the Run-Stop-Remote switch in the Stop position and pressing the Reset/Lamp Test switch to the Reset position. Locate the problem and make the necessary corrections before restarting the generator set. While pressing the Reset/Lamp Test switch, observe that all lamps light.

Line Circuit Breaker (Optional)

The optional line circuit breaker mounts on the generator output box. If the load exceeds the circuit breaker current rating, the circuit breaker will open to prevent the generator from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as required. Manually reset the breaker to reconnect the load to the generator. Optional shunt-trip functions can cause the generator set to shut down and will require resetting the control.

FIGURE 4. ENGINE SENSORS

TABLE 2. TROUBLESHOOTING

⚠WARNING ***Untrained personnel should not attempt repair due to hazards which can result in personal injury or death. Troubleshooting information is provided for qualified repair personnel only.***

SYMPTOM	CORRECTIVE ACTION
*1. Green RUN lamp lights following engine start-up.	1. Indicates all engine systems are normal. No corrective action required.
2. PRE HI ENGINE TEMP lamp lights. Engine continues to operate.	2. Indicates engine has begun to overheat and engine temperature has risen to approximately 205° F (97° C). If generator is powering non-critical and critical loads, and cannot be shut down, use the following: a. Reduce load if possible by turning off non-critical loads. b. Check air inlets and outlets and remove any obstructions to airflow. c. Open doors or windows in generator area to increase ventilation. If engine can be stopped, follow procedure in step 3.
*3. HI ENG TEMP lamp lights. Engine shuts down.	3. Indicates engine has overheated (engine temperature has risen above 215° F/102° C) or coolant level is low (sets with coolant level sensor). Allow engine to cool down completely before proceeding with the following checks: a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b. Check for obstructions to cooling airflow and correct as necessary. c. Check for a slipping fan belt, tighten if loose. d. Reset control and restart after locating and correcting problem. Contact your distributor if none of the above applies.
4. PRE LO OIL PRES lamp lights. Engine continues to operate.	4. Indicates engine oil pressure has dropped to 20 psi (138 kPa). If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow step 5 procedure. If engine can be stopped, follow procedure in step 5.
*5. LO OIL PRES lamp lights. Engine shuts down. NOTE: See also step 6.	5. Indicates engine oil pressure has dropped to 14 psi (97 kPa). Check oil level, replenish as necessary. Check oil lines and filters for leaks, repair as required. Reset control and restart. Contact your distributor if oil pressure is not in the range of 50 to 70 psi (345 to 483 kPa).

*Use these steps when troubleshooting two-lamp control panels.
Run Lamp - See steps 1 and 17.
Fault Lamp - See steps 3,4,6,7, and 13.
Other Faults - See steps 14, 15, and 16.

TABLE 2. TROUBLESHOOTING (Continued)

⚠WARNING ***Untrained personnel should not attempt repair due to hazards which can result in personal injury or death. Troubleshooting information is provided for qualified repair personnel only.***

SYMPTOM	CORRECTIVE ACTION
*6. OVERCRANK lamp lights and engine stops cranking. **Or.** Engine runs, shuts down, and LO OIL PRES lamp lights.	6. Indicates possible fuel system problem. a. Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. b. Check for dirty fuel filter and replace if necessary (see MAINTENANCE section). c. Check for dirty or plugged air filter and replace if necessary (see MAINTENANCE section. d. Refer to step 5. e. Reset the control and restart after correcting the problem. Contact your distributor for service if none of the above applies.
*7. Engine runs and then shuts down, OVERSPEED lamp lights.	7. Indicates engine has exceeded normal operating speed. Contact your distributor for service.
8. SWITCH OFF lamp flashes.	8. Indicates Run-Stop-Remote switch is in the Stop position which will prevent automatic starting. Moving the Run-Stop-Remote switch to the Remote position will stop the lamp flashing and enable automatic starting.
9. LO FUEL lamp lights. Engine continues to run.	9. Indicates diesel fuel supply is running low. Check fuel supply and replenish as required.
10. LO FUEL lamp lights. Engine shuts down and LO OIL PRES lamp lights.	10. Indicates engine has run out of fuel. Check fuel level and replenish as required.
11. LO ENG TEMP lamp lights. Set is in standby mode but is not operating. (Lamp lights when engine coolant temperature is 70° F (21° C) or lower. Since the lamp goes out after the engine warms up, there should be no cause for alarm if it remains lighted during initial generator set operation.)	11. Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions: a. Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. b. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. c. Contact your distributor if none of the above applies.

*Use these steps when troubleshooting two-lamp control panels.

Run Lamp - See steps 1 and 17.
Fault Lamp - See steps 3,4,6,7, and 13.
Other Faults - See steps 14, 15, and 16.

TABLE 2. TROUBLESHOOTING (Continued)

⚠WARNING ***Untrained personnel should not attempt repair due to hazards which can result in personal injury or death. Troubleshooting information is provided for qualified repair personnel only.***

SYMPTOM	CORRECTIVE ACTION
12. The FAULT 1 or FAULT 2 fault lamp lights. Engine shuts down immediately, engine runs for several seconds and then shuts down, or engine continues to run.	12. The standard undesignated fault functions are programmed to shut down the set when a fault is sensed. Fault 1 is timed delayed while Fault 2 is immediate. The nature of the fault is an optional selection that is determined when the set installation is designed. The undesignated fault functions may also be programmed for non-shutdown or non-time delay.
*13. Fault lamp lights but no fault exists. Engine gauges show oil pressure, engine temperature, and frequency (speed) are within normal limits.	13. The monitor board or a sensor may be at fault. Contact your distributor for service.
*14. Engine starts from generator control panel but will not start automatically or from a remote panel. (Note: The Run-Stop-Remote switch must be in the Remote position for automatic or remote starting.)	14. Remote circuit breaker is tripped, reset breaker and restart. Contact your distributor if breaker trips after resetting.
*15. Engine will not crank.	15. Indicates possible fault with control or starting system. Check for the following conditions: a. Fault lamp on. Correct fault and reset control. b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c. Discharged or defective battery. Recharge or replace the battery. d. Contact your distributor for assistance if none of the above applies.
*16. No AC output voltage. **Note:** If unit is equipped with an excitation breaker (located on back side of output box, near regulator box), confirm it is at ON position.	16. Voltage regulator is inoperative. Refer to Initial Start and Checks, and Adjustments sections of your Installation Manual for voltage check and adjustment procedures. Contact your distributor if voltage build-up is still a problem.
*17. Green RUN lamp does not light following engine start-up.	17. Indicates possible Start/Disconnect relay failure. Contact your distributor for assistance.

*Use these steps when troubleshooting two-lamp control panels.
Run Lamp - See steps 1 and 17.
Fault Lamp - See steps 3,4,6,7, and 13.
Other Faults - See steps 14, 15, and 16.

Maintenance

Establish and adhere to a definite schedule for maintenance and service based on the application and severity of the environment. The table below covers the recommended service intervals for a generator set on standby service. If the set will be subjected to extreme operating conditions, the service intervals should be reduced accordingly. Some of the factors that can effect the maintenance schedule are the following:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand

Consult with your distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated or after the number of operating hours indicated, whichever occurs first. Use Table 3 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Disconnect the negative battery cable when repairs are made to the engine, controls, or generator.***

TABLE 3. MAINTENANCE SCHEDULE

MAINTENANCE CHECKS	SERVICE TIME				
	Daily or after 8 hours	Weekly or after 50 hours	Monthly or after 100 hours	6 Months or after 250 hours	Yearly or after 500 hours
Inspect Generator Set	x[1]				
Check Coolant Heater	x				
Check Oil Level		x			
Check Coolant Level		x			
Check Air Cleaner (clean if required)		x[2]			
Check Battery Charging System		x			
Drain Water/Sediment from Fuel Tanks		x[3]			
Check Antifreeze and DCA Concentration			x		
Check Drive Belt Tension			x[4]		
Check Fuel Level			x		
Drain Exhaust Condensation Trap			x		
Check Battery Level/Specific Gravity			x		
Check Generator Air Outlet			x		
Clean Generator Assembly				x	
Change Crankcase Oil and Filter				x[2]	
Check Heat Exchanger Plugs (if equipped)				x	
Change Coolant Filter				x	
Clean Crankcase Breather				x[2]	
Change Air Cleaner Element				x[2]	
Change Fuel Filters				x	
Clean Cooling System					x

1 - Check for oil, fuel, cooling, and exhaust leaks. Check exhaust system audibly and visually with the generator set running. Repair any leaks immediately.
2 - Perform more often in extremely dusty conditions.
3 - Drain 1 cup or more of fuel to remove water and sediment.
4 - Visually check belts for evidence of slippage.

GENERATOR SET INSPECTION

During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover several areas that should be frequently inspected to insure continued safe operation.

Exhaust System

With the generator set operating, inspect the entire exhaust system visually and audibly including the exhaust manifold, turbocharger, muffler, and exhaust pipe. Check for leaks at all connections, welds, gaskets, and joints and also make sure that exhaust pipes are not heating surrounding areas excessively. If any leaks are detected, shut down the generator set and have leaks corrected immediately.

⚠WARNING ***Inhalation of exhaust gases can result in serious personal injury or death. Be sure deadly exhaust gas is piped outside and away from windows, doors or other inlets to building.***

Fuel System

With the generator set operating, inspect the fuel supply lines, return lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and make sure they are not rubbing against anything that could cause breakage. If any leaks are detected, have them corrected immediately.

⚠WARNING ***Ignition of fuel can cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, or other igniter near the fuel system.***

AC Electrical System

Check the following while the generator set is operating; otherwise measure load lines L1, L2, and L3 using the appropriate AC meter.

Frequency Meter: The generator frequency should be stable and the reading should be the same as the nameplate rating (50 or 60 Hz).

AC Voltmeter: Turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2 on single phase sets; L1-L2, L2-L3, and L3-L1 on three phase sets). Read the AC voltmeter using the upper or lower scale as indicated by the scale indicator light. At full load, the line-to-line voltage(s) should be the same as the set nameplate rating.

AC Ammeter: Turn the phase selector switch to each phase selection shown on the amps scale (L1 and L2 on single phase sets; L1, L2, and L3 on three phase sets). Read the ammeter using the upper or lower scale as indicated by the scale indicator light. At no-load, the current readings should be zero. With a load applied, each line current should be about the same.

Fault Lamps (Two or Twelve Lamp Panels):
With the generator set stopped (Run-Stop-Remote switch in Stop position), actuate the Lamp Test switch. Verify that all indicator lamps are on and then release switch. Replace any bulbs that are burned out.

DC Electrical System

Check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance which can hinder starting. Clean and reconnect the battery cables if loose. Always disconnect both ends of the negative battery cable. Reconnect one end of the cable to the negative battery terminal and the other end to ground. This will ensure that any arcing will be away from the battery and least likely to ignite explosive battery gases.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.***

Mechanical

Follow warning below before proceeding. With the generator set stopped, check for loose belts and fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately. With the set running, listen for any unusual noises that may indicate mechanical problems and check the oil pressure frequently. Investigate anything that indicates possible mechanical problems.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Place the control switch in Stop position and disconnect the negative (-) battery cable before inspecting generator set.***

LUBRICATION SYSTEM

The lubrication system must be primed and filled with oil of the recommended classification and viscosity. Refer to the *SPECIFICATIONS* section for lubricating oil capacity.

Oil API Classification

The lubricating oil recommended for turbocharged diesel engines is API (American Petroleum Institute) Class CC/CD with a maximum sulphated ash content of 1.85 percent. Oils in this class satisfy the engine manufacturer's recommendations for satisfactory operation under most conditions. A book entitled "Lubricating Oils Data Book" is available from EMA (Engine Manufacturers Association) that lists the commercially available oils by brand name and the corresponding API classification. Once an oil is selected, do not mix it with oils of another classification or brand.

Oil Viscosity

The viscosity of an oil is a measure of its resistance to flow at certain specified temperatures. Oils that can meet both low (0° F or -18° C) and high (212° F or 100° C) temperature flow requirements are labeled as multigrade or multiviscosity oils. Multigrade oils that meet the API classification requirements are recommended for use in the engine by the engine manufacturer. The use of a multigrade oil will improve oil control, improve engine cranking in cold weather, maintain adequate lubrication, and can also contribute to improved fuel economy.

Table 4 shows the oil viscosity grades that are recommended for various ambient temperatures. Use only the viscosity grades shown in the table. The engine manufacturer does not recommend the use of a single grade oil.

TABLE 4

AMBIENT TEMPERATURE	SAE VISCOSITY GRADE
-13° F (-25° C) and below	See following section
-13° to 95° F (-25° to 25° C)1	10W-30
14° F (-10° C) and above	15W-40
32° F (0° C) and above	20W-40

When selecting the oil viscosity, pick the grade that is right for the lowest temperature expected. Oil that is too thick may result in a lack of lubrication when the engine is started. Use a lower grade of oil as the ambient temperature reaches the lower end of the scale.

Oil Viscosity for Extreme Cold

The engine manufacturer recommends using a synthetic lubricating oil when the ambient temperature is consistently below -13° F (-25° C) and there is no provision to keep the engine warm. Use an SAE5W grade synthetic oil provided it meets the following requirements:

- API class CC/CD
- Sulphated ash content does not exceed 1.85 percent.
- Pour point is 9° F (5° C) below the lowest expected temperature (minimum).
- Viscosity is 10,000 mPa•s (maximum) at -31° F (-35° C) and 4.1 mm^2/s (minimum) at 212° F (100° C).

Do not use a petroleum base 5W grade oil for extreme cold since it usually will not perform satisfactorily.

Engine Oil Level

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table. The oil dipstick, fill cap, and filters are located on the same side of the engine (see Figure 5). The dipstick is stamped with high and low marks to indicate the level of oil in the crankcase. For accurate readings, shut off the engine and wait approximately 15 minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.

FIGURE 5. OIL FILTER AND DIPSTICK LOCATION

⚠WARNING ***Crankcase pressure can blow out hot oil and cause serious burns. Do NOT check oil while the generator is operating.***

Keep the oil level as near as possible to the high mark on the dipstick. Remove the oil fill cap and add oil of the same API classification and brand when necessary.

⚠CAUTION ***Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling causes foaming or aeration of the oil, while operation below the low mark causes loss of oil pressure.***

Oil and Filter Change

Change the oil and filters at the intervals recommended in the Maintenance Table. Use oil that meets the engine manufacturer's API Classification and viscosity requirements.

1. Start the generator set and allow engine to warm up to operating temperature and then shut generator set off. Ensure that Run-Stop-Remote switch is at Stop position and the negative (-) battery cable is disconnected to avoid accidental start-up during this procedure.

2. Remove the oil drain plug or open the drain valve and collect the engine oil in a suitable size waste container. When the crankcase is drained, replace the oil drain plug or close the drain valve. Torque the oil drain plug to 60-70 ft-lb (81-95 N•m).

3. Unscrew the oil filters and discard. See Figure 5.

4. Apply a light coat of oil to the gasket sealing surface of the new filters and fill filters with clean, new oil.

5. Install filters and tighten 2/3 turn by hand after the seal touches the sealing surface of the bracket. Do not overtighten.

6. Fill the crankcase with the amount of oil to achieve reading at high mark of dipstick.

7. Reconnect the negative (-) starting battery cable, start the engine and check for oil leaks.

8. Shut off the engine, wait 15 minutes, and then check the oil level. Add oil if required.

⚠WARNING ***Crankcase pressure can blow out hot oil and cause serious burns. Do NOT check oil while the generator set is operating.***

CRANKCASE BREATHERS

Remove and clean the crankcase breathers at the interval specified in the Maintenance Table.

To Service:

1. Remove wing nut, flat washer and rubber washer holding cover, lift cover and swing away from filter assembly (see Figure 6).
2. Lift out breather element, vapor element and gasket.
3. Clean all parts with approved solvent. Dry with compressed air (30 psi /207 kPa recommended).
4. Inspect all parts, replace if necessary.
5. Reassemble filter assembly, replace cover and secure.

FIGURE 6. CRANKCASE BREATHER FILTER

COOLING SYSTEM

The cooling system must be refilled (radiator and heat exchanger) before being operated. The cooling system capacity of the standard unit with set mounted radiator is shown in the *SPECIFICATIONS* section.

⚠CAUTION ***The heater must not be operated while the cooling system is empty or when the engine is running or damage to the heater will occur.***

Coolant Level

Check the coolant level during shutdown periods at the intervals specified in the Maintenance Table. Remove the radiator cap after allowing the engine to cool and if necessary, add coolant until the level is near the top of the radiator. Use a coolant solution that meets the engine manufacturer's coolant requirements.

⚠WARNING ***Contact with hot coolant can result in serious burns. Allow cooling system to cool before releasing pressure and removing radiator cap.***

⚠CAUTION ***High Engine Temperature Cutoff will shut down the engine in an overheat condition only if coolant is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device and cause 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.***

Coolant Requirements

The water used for engine coolant should be clean, low in mineral content, and free of any corrosive chemicals such as chloride, sulphate, or acid. Generally, any water that is suitable for drinking can be treated for use as engine coolant.

Cooling systems that are subject to freezing conditions must also be protected with a permanent type antifreeze. Mix the water and antifreeze in the proportion recommended by the supplier for the lowest expected ambient temperature. Do not use an antifreeze that contains anti-leak additives. The water filter element will trap the additives and possibly become clogged.

⚠CAUTION ***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 ***Contact with hot coolant can result in serious burns. Do not bleed hot, pressurized coolant from a closed cooling system.***

Filling the Cooling System

(Standard Radiator and Heat Exchanger Sets)

Remove the cooling system pressure cap and fill the system with water or a water/antifreeze mixture. On the initial fill, the precharge water filter will automatically add the required anti-corrosion chemicals to the cooling system.

When the engine is first started, remove the pressure cap and monitor the coolant level. As trapped air is expelled from the system, the coolant level will drop and additional coolant should be added. Replace the pressure cap when the coolant level is stable.

⚠CAUTION ***Be sure the electric solenoid valve used with city water cooled sets is open before initially starting the set to allow coolant chambers to fill. Otherwise overheating and damage to the engine might result.***

Coolant Filter

When changing the coolant filter, replace the DCA precharge element filter with the DCA service element filter. After the third element change, check the DCA concentration to ensure that adequate corrosion protection is maintained. Each time the cooling system (set mounted radiator) is drained, install a new DCA precharge element water filter to bring the DCA concentration up to the recommended level.

To Service:

1. Close the shutoff valves (Figure 7).
2. Unscrew the coolant filter and discard.
3. Apply a light coat of lubricating oil to the gasket surface.
4. Install a new filter and tighten by hand until the seal just touches the filter head. Tighten an additional one-half to three-fourths turn.
5. Open the shutoff valves.

NOTE: OPEN COOLANT FILTER SHUTOFF VALVE BEFORE OPERATING GENERATOR SET.

FIGURE 7. COOLANT FILTER

Flushing and Cleaning

The cooling system must be clean and free of rust and scale if it is to perform properly. Use only coolant that meets the engine manufacturer's requirements.

Chemical Cleaning: Thoroughly clean the cooling system if rust and scale have collected on the engine water jacket or in the radiator. Rust and scale slow down heat absorption and can block the coolant flow. Use a good cooling system cleaner such as sodium bisulphate or oxalic acid and follow the instructions provided by the supplier. Follow up by neutralizing and flushing with clean water.

Flushing: Flush the radiator and block after cleaning or before refilling the system with new coolant. Open the upper and lower radiator hose connections and install the radiator cap. Attach a flushing gun nozzle to the lower radiator hose connection and let the water run until the radiator is full. When full, gradually apply air pressure to avoid damaging the core.

⚠CAUTION ***Excessive air pressure while starting the water flow could split the radiator core. Apply air pressure gradually to avoid damage.***

Shut off the air and allow the radiator to refill. Repeat flushing procedure until the water coming from the radiator is clean.

To flush the engine block, first remove the thermostat to allow the water to fill the block. Attach the flushing gun to the upper radiator hose and fill the block with water. Restrict the lower radiator hose opening until the block is filled. Apply air pressure and force water from the lower opening. Repeat until the water coming from lower radiator hose is clean.

Replace the thermostat and all hoses and refill cooling system.

Heat Exchanger Plugs

Check the zinc plugs in the heat exchanger and replace if they are eroded to less than half their original length. The frequency of replacement is dependent on the chemical reaction that occurs when the plugs are in contact with the raw water.

Coolant Heater

Check the operation of the optional coolant heater by verifying that hot coolant is being discharged from the outlet hose (see Figure 8). For efficient operation and maximum life, clean the coolant heater whenever the cooling system is drained for flushing.

FIGURE 8. COOLANT HEATER

To Service:

1. Remove AC power from coolant heater.

   ⚠WARNING ***Failure to remove AC power presents a shock hazard and can cause serious personal injury or death.***

2. Allow heater to cool before proceeding.

   ⚠WARNING ***Contact with hot coolant can result in serious burns. Do not bleed hot, pressurized coolant from a closed cooling system.***

3. Remove the head and valve assembly.
4. Clean any scale deposits out of the tank.
5. Remove heating element and scrape off any scale deposits that have accumulated on the sheathing.

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

6. Restore AC power to heater after system has been filled with coolant.

FUEL SYSTEM

The engine has been primarily designed to operate on No. 2 diesel fuels since such fuels have a higher energy content and are generally lower in cost. The engine will also operate satisfactorily on No. 1 fuel or other similar fuels if they meet certain specifications. Refer to the engine manual or consult your distributor for the specific requirements if using a non-standard fuel.

Fuel Handling Precautions

Take appropriate precautions to prevent the entrance of dirt, water, or other contaminants into the fuel system. Filter or strain the fuel as the tank is filled.

⚠WARNING ***Ignition of fuel can cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, or other igniter near the fuel system.***

To avoid condensation problems, keep fuel supply tanks as full as possible by filling up each time the engine is used. In cold weather, warm fuel returning from the injectors heats the fuel in the supply tank. If the fuel level is low, the upper portion of the tank tends to form condensation. In warm weather, both the fuel and the tank will be warm during the daytime. At night, cool air tends to lower the temperature of the tank more rapidly than the temperature of the fuel. If the fuel level is low, the upper portion of the tank will cool more rapidly and tend to form condensation.

Condensation (water) can cause clogging of fuel filters as well as freezing problems. In addition, water mixing with the sulphur in the fuel forms an acid which can corrode and damage engine parts.

Fuel Filters

At interval recommended in the Maintenance Table, remove the fuel filters and discard. Fill the new filters with diesel fuel and put a light coat of fuel on the sealing gasket. Install and tighten by hand until the gasket just touches the filter head. Tighten an additional one-half to three-fourths of a turn.

FIGURE 9. FUEL FILTERS

Fuel Water/Sediment Separator

A water/sediment separator is normally installed between the generator set and the day tank (if used) or the main tank. This separator should be drained or cleaned at regular intervals as specified in the Maintenance Table.

AIR CLEANER

The engine air intake components should be checked at the interval indicated in Maintenance Table. The frequency of cleaning or replacing air cleaner filter elements is primarily determined by the conditions that the generator set operates in. The standard air cleaner is a disposable type.The optional heavy duty air cleaner contains a paper cartridge filter element which can be cleaned and reused if not damaged, or discarded and replaced.

To Replace the Standard Air Cleaner:

1. Loosen the strap that fastens the air intake elbow to the air cleaner housing.
2. Disconnect air intake elbow from air cleaner housing by moving elbow straight away from air cleaner. Intake pipe-to-turbocharger connection will bend sufficiently to allow removal of air cleaner.
3. Remove air cleaner from mounting plate and discard.
4. Reassemble a new air cleaner to mounting plate. Secure fasteners.
5. Reassemble air intake elbow to air cleaner housing. Secure mounting strap.

To Service the Optional Heavy duty Air Cleaner:

1. Loosen fastener(s) and remove air cleaner housing end cap.
2. Remove the air filter element from the filter housing.
3. To clean, blow low pressure compressed air (30 psi/ 207 kPa) through the element from the clean side. Hold the nozzle at least 1 inch (25 mm) away to avoid damaging the element.
4. Soak the filter for at least 15 minutes in water and Donaldsons D1400 solvent (or equivalent other cleaning solvent) to remove soot and carbon as well as dirt.
5. Rinse with clean water (low pressure) and allow to air dry. Do not blow dry with compressed air. Reinstall when the filter element is dry. Replace the filter after two cleanings to avoid restricting the airflow.

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

AC GENERATOR

General

These generators require very little servicing. Periodic inspections, to coincide with engine oil changes, will ensure good performance.

Remove PMG (end bell) housing and visually inspect the generator for dust, dirt and grease. Excessive foreign matter will degrade generator performance and can lead to failure if not removed.

Check generator voltage. It may be necessary to make a slight readjustment to obtain the preferred voltage at average load. Refer to your Installation Manual for adjustment procedure.

Generator Bearing

Inspect the bearing for wear every 1000 hours. If the generator set is used for prime power, replace the bearing every 10,000 hours or after two years. If the generator set is used for standby power, replace the bearing every five years. Contact your distributor for service assistance.

BATTERIES

Check the condition of the starting batteries at the interval specified in the Maintenance Table. 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 and recharge if below 1.260.

Note: If the generator set is operated in an area where the ambient temperature is consistently above 95° F (35° C), a specific gravity of 1.225 is recommended to reduce electrolyte loss.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.***

FIGURE 10. CHECKING BATTERY

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1400 73rd Avenue N.E.
Minneapolis, MN 55432
Tel: (612) 574-5000
Tlx: 275477

ONAN INTERNATIONAL

Asia Region
8 Tanjong Penjuru
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Tlx: 25671

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54 Broadway
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England
Tel: 555211
Tlx: 329278

Onan Canada Ltee
800 Montee de Liesse
Saint-Laurent H4T 1N8
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Tel: (514) 738-7716