



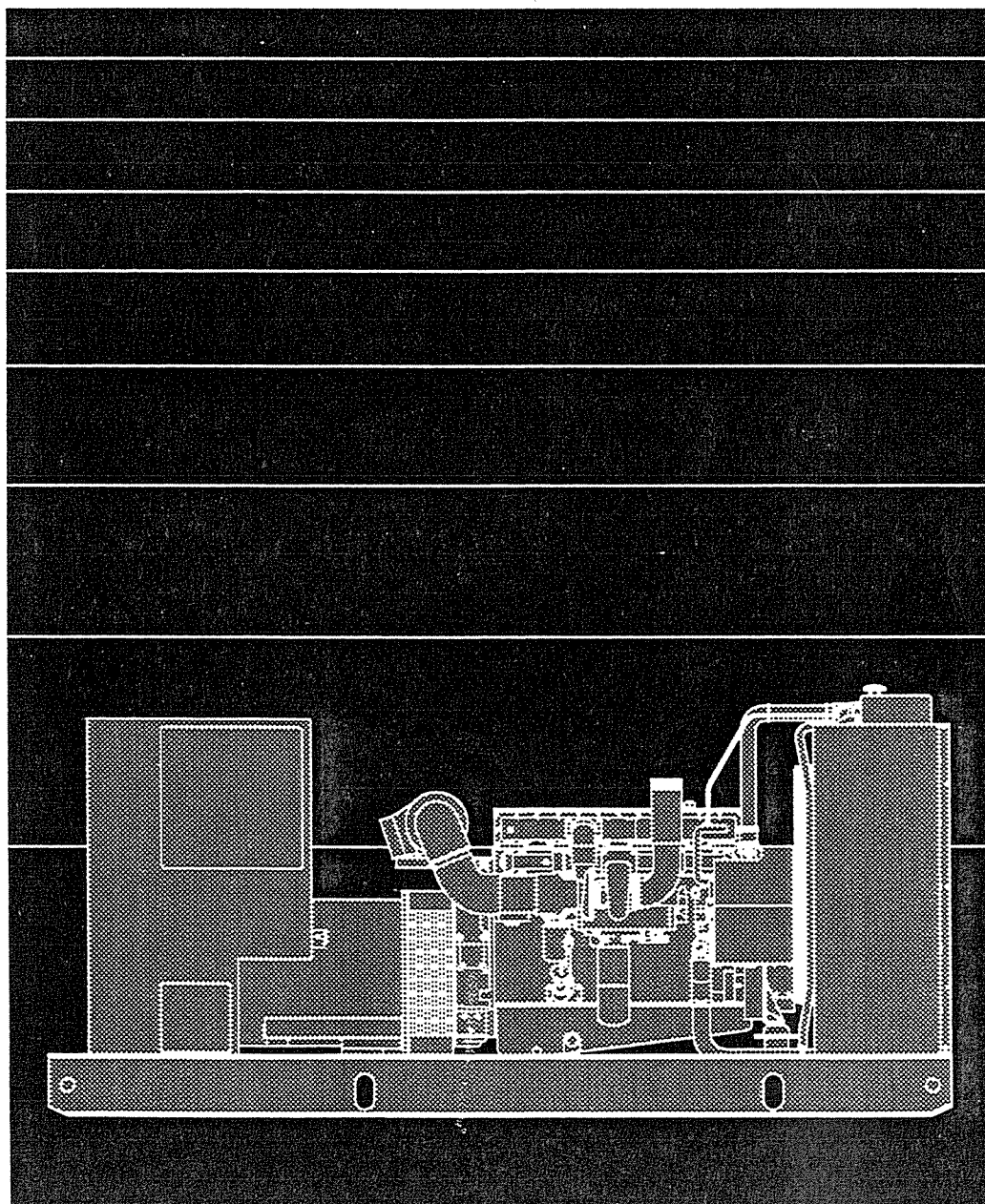
Operator's Manual

DFAA

DFAB

DFAC

GENERATOR SETS



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. Electrocutation 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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Safety Precautions

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

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

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

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

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

FUEL AND FUMES ARE FLAMMABLE

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

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.

- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

GENERAL SAFETY PRECAUTIONS

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

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. 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 contribute to longer unit life, better performance and safer operation.

HOW TO OBTAIN SERVICE

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

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

GENERATORS-ELECTRIC or
ELECTRICAL PRODUCTS

For the name of your local Cummins®/Onan® or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN (this automated service utilizes touch-tone phones only). By entering your area code and the first three digits of your local telephone number, you will receive the name and telephone number of the distributor nearest you.

For outside North America, call Onan Corporation, 1-612-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday. Or, send a fax to Onan using the fax number 1-612-574-8087.

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

⚠ WARNING

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

Onan is a registered trademark of Onan Corporation.
Cummins is a registered trademark of Cummins Engine Company Inc.

2. Specifications

MODEL	DFAA	DFAB	DFAC
Engine Cummins Diesel Series 60 Hz 50 Hz	LTA10-G1 LTA10-G3	LTA10-G1 LTA10-G3	LTA10-G1 LTA10-G3
Generator (Standby Rating) 3 Phase, 60 Hz (kVA @ 0.8 PF) 3 Phase, 50 Hz (kVA @ 0.8 PF)	200kW (250) 175kW (219)	230kW (288) 200kW (250)	250kW (313) 220kW (275)
Electrical System Starting Voltage Battery	24 Volts DC Two, 12 Volt	24 Volts DC Two, 12 Volt	24 Volts DC Two, 12 Volt
Cooling System Capacity with Standard Radiator	13 Gal (49 L)	13 Gal (49 L)	13 Gal (49 L)
Lubricating System Oil Capacity with Filters Oil Type -13° F to 95° F (-25° C to 35° C) 14° F (-10° C) and above 32° F (0° C) and above	9.5 Gal (36 L) SAE 10W30 SAE 15W40 SAE 20W40	9.5 Gal (36 L) SAE 10W30 SAE 15W40 SAE 20W40	9.5 Gal (36 L) SAE 10W30 SAE 15W40 SAE 20W40

3. Operation

GENERAL

This section covers prestart checks, starting and stopping and operating the generator set. Each operator should read through this entire section before attempting to start the set. It is essential that the operator be completely familiar with the set for 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 mark without overfilling.

Coolant

Check the engine coolant level. The coolant should be about two inches (50 mm) below the radiator cap opening. Do not check while the engine 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 that fuel system is primed.

CONTROL PANEL

The following describes the function and operation of the standard Detector 7 and optional Detector 12 generator set control. All instruments and control switches are located on the face of the control panel as illustrated in Figures 3-1 through 3-3. The control panel is separated into a DC panel for monitoring the engine and an AC panel for monitoring the generator.

EXHAUST GAS IS DEADLY!

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

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

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

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

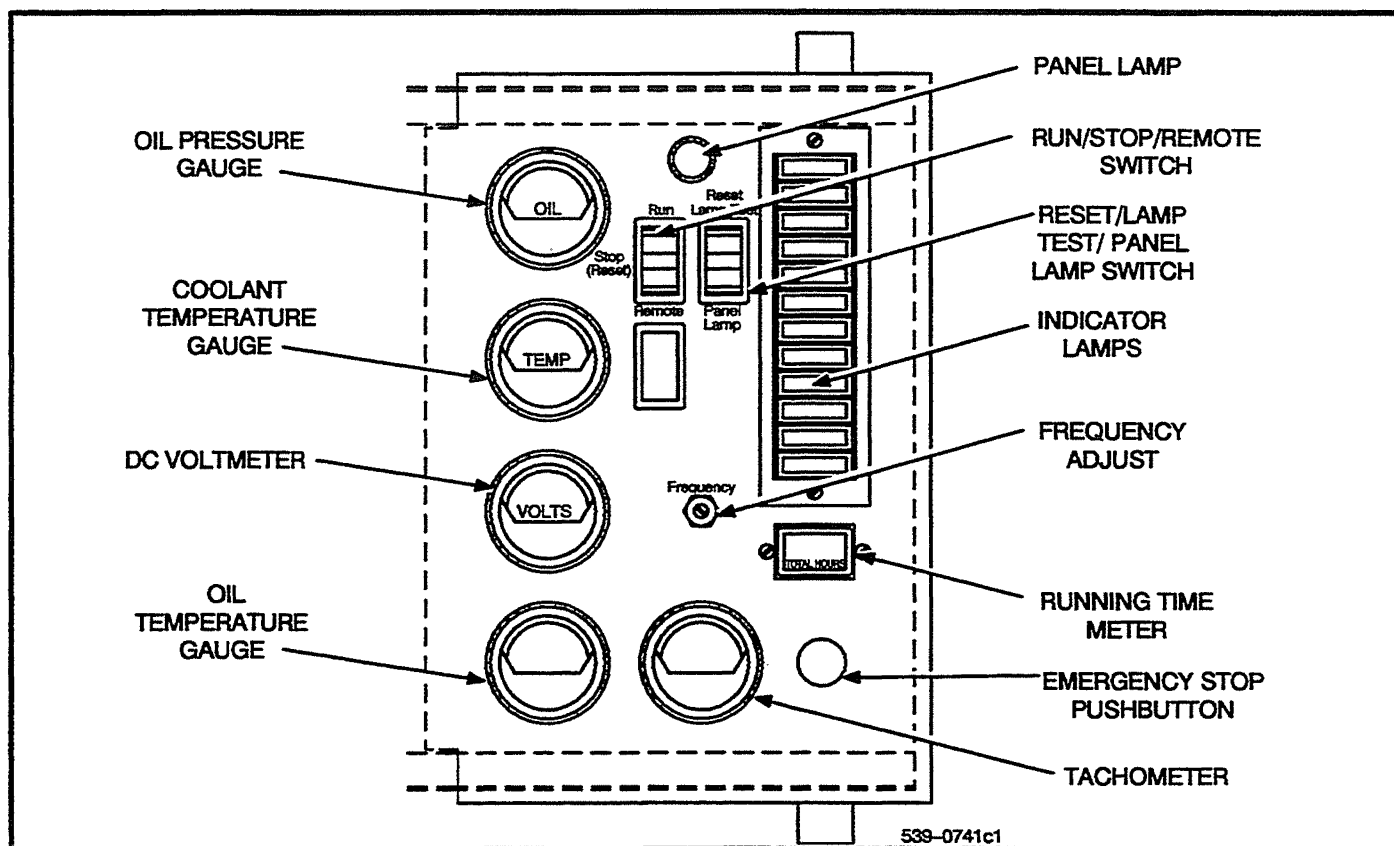


FIGURE 3-1. DC CONTROL PANEL (DETECTOR 12 SHOWN)

DC Panel

Panel Lamp: Illuminates control panel.

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

Coolant Temperature Gauge: Indicates temperature of circulating coolant in engine (wired to a sensor located on engine).

DC Voltmeter: Indicates the battery charging system voltage.

Run/Stop/Remote Switch: Starts and stops the set locally, or from a remote location 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.

Speed Adjusting Rheostat (Optional): Used in conjunction with an optional electronic governor to adjust engine speed.

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

Emergency Stop Button (Optional): Push-in switch for emergency shutdown of the engine. To reset, pull switch out and move Run/Stop/Remote switch to Stop position. Then push test switch to Reset/Lamp Test position.

Detector 7 Indicator Lamps: The standard control panel has seven indicator lamps which are described as follows:

- RUN (green) lamp comes on when starter circuit opens after set starting.
- PRE LO OIL PRES (yellow) indicates engine oil pressure is marginally low.
- PRE HI ENG TEMP (yellow) indicates engine temperature is marginally high (or coolant level is low on optionally wired sets).
- 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 engine temperature or low coolant level.
- OVERSPEED (red) indicates engine has shut down because of excessive speed.
- OVERCRANK (red) indicates engine has failed to start during the cranking period.

Detector 12 Indicator Lamps: The optional twelve lamp control includes all the features of the seven lamp control plus the following:

- FAULT 1 (red) lamp indicates an undedicated fault. May be field programmed as a shutdown or non-shutdown, and as a timed or non-timed fault. (Normally set for timed shutdown).
- FAULT 2 (red) lamp indicates same features as Fault 1 (normally set for timed shutdown).
- LOW ENG TEMP (yellow) lamp lights if engine temperature is marginally low for starting. It may indicate an inoperative coolant heater.
- LO FUEL (yellow) indicates fuel supply is marginally low.
- SWITCH OFF (flashing red) indicates generator set is not in automatic start mode.

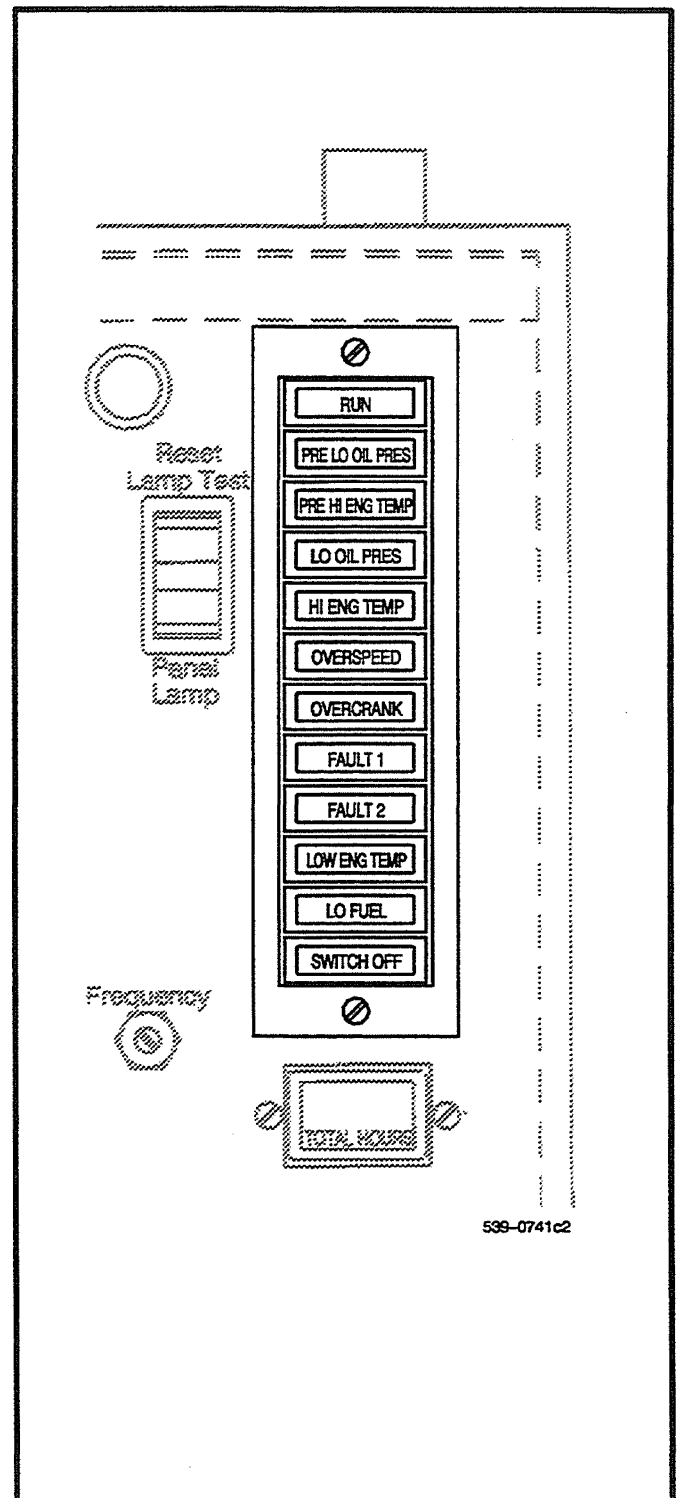


FIGURE 3-2. INDICATOR LAMPS

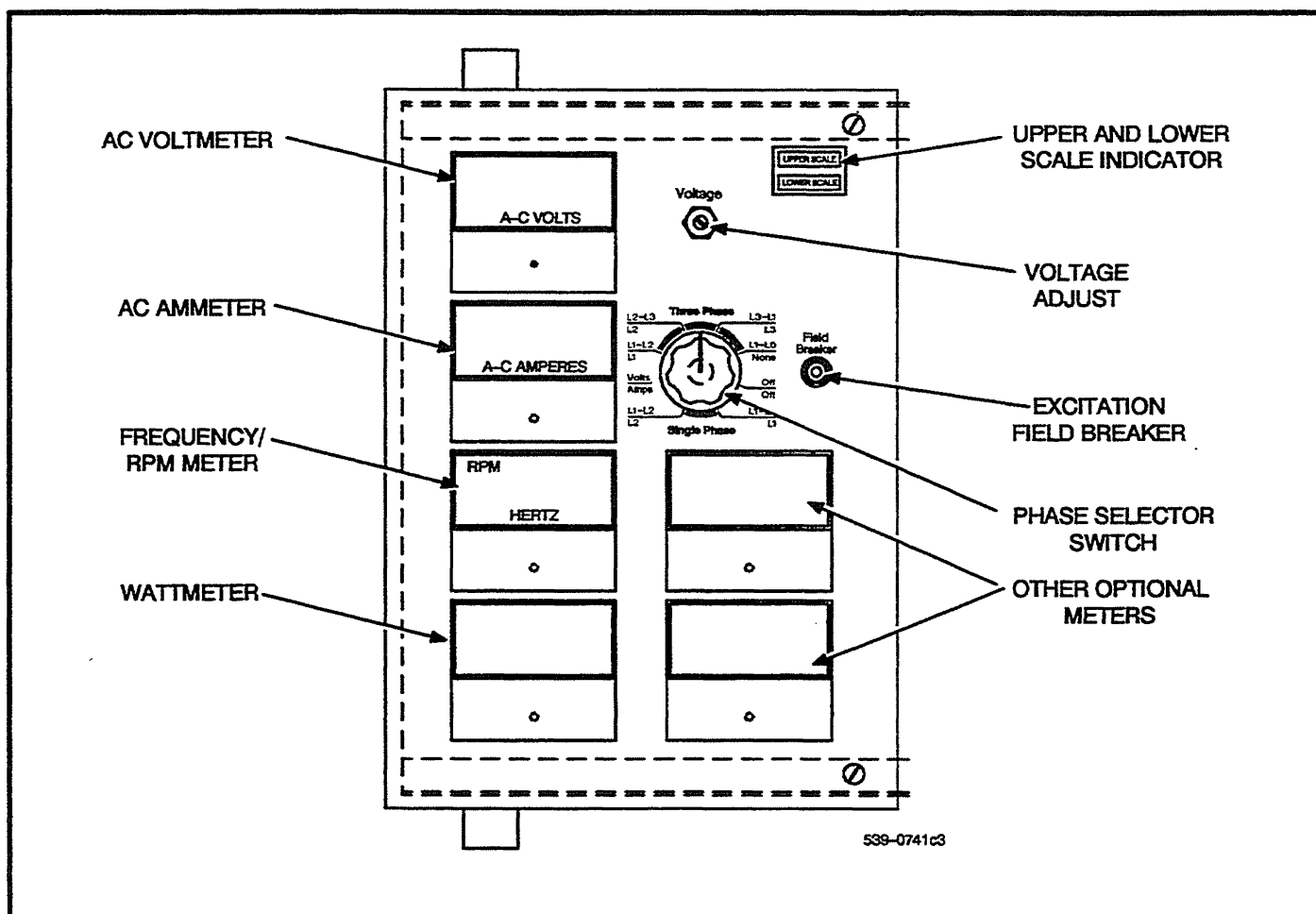


FIGURE 3-3. AC CONTROL PANEL

AC Panel

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

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

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

Power Factor Meter (Optional): Indicates percent power factor of AC output.

Frequency/RPM Meter (Optional): Indicates generator output frequency in hertz and engine speed in revolutions-per-minute (RPM).

Voltage Adjusting Rheostat (Optional): Provides approximately plus or minus five percent adjustment of the rated output voltage.

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

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

Engine Pyrometers (Optional): Indicate engine exhaust and inlet air temperatures.

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

GENERATOR AC VOLTAGE REGULATOR

The solid-state regulator controls AC output voltage from the generator at a predetermined level regardless of load. Voltage regulation is plus or minus two percent from no load to full load. Random voltage variation is plus or minus one percent for constant loads.

ENGINE CONTROL MODULE

Electronic and relay components of the engine monitoring circuit are on a circuit board assembly. Sensor inputs are connected by the wiring harness to plug connectors on the board. 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 option allows three 15-second cranking cycles with two 15-second rest periods on the 12-lamp control.
- **Overspeed** - Shuts down the engine immediately if overspeed occurs and lights a fault lamp. The sensor switch is mounted in the end bell on the generator shaft. It is factory adjusted to shut down 60 hertz units at 2100 ± 90 r/min, 50 hertz 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 provides an alarm that oil pressure is marginally low, 20 psi (137 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 222°F (106°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 monitors this system.

A pre-high engine temperature sensor and lamp provides an alarm that engine temperature is marginally high, 215°F (102°C). The cause should be found and corrected as soon as possible.

- **Low Coolant Level Shutdown** - An electronic switch that provides engine shutdown and turns on the high engine temperature fault lamp if coolant level falls too low.
Optionally Wired Set: Indicates a warning on the Pre-high engine temperature fault lamp.

STARTING

The following sections cover the three systems used to start the generator set.

Starting at Control Panel

Move the Run-Stop-Remote switch on the DC panel 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 RPM.

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 in each cycle 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 generator set DC panel to the REMOTE position. This al-

lows 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 generator set DC panel in the REMOTE position if an automatic transfer switch is used. This allows the transfer switch to start the generator set if a power outage occurs and stop it when the power returns.

Cold Starting With Loads

In accordance with NFPA 110, Onan recommends installing diesel standby generator sets (life safety systems) equipped with coolant heaters in locations where the minimum ambient temperature is above 40°F (4°C). NFPA also requires that the engine coolant be maintained at a minimum of 90°F (32°C) and for most applications, accept the emergency load in 10 seconds or less. Although most Onan generator sets will start in temperatures down to -25°F (-32°C) when equipped with coolant heaters, it might take some running time to warm the engine up before a load can be applied when ambient temperatures are below 40°F (4°C).

The Low Engine Temperature (LET) lamp on the Onan Detector 12 control is provided to meet the requirements of NFPA 110. The LET sensor alarms when the engine coolant temperature falls below 70°F (21°C). In applications where the ambient temperature falls below 40°F (4°C), the LET may be lit even though the coolant heaters are connected. Under these conditions, although the generator set may start, it may not be able to accept load within 10 seconds. When this condition occurs, check the coolant heaters for proper operation. If the coolant heaters are operating properly, other precautions might be necessary to warm the engine before applying a load.

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 about 15 minutes after the normal power source returns.

Emergency Stop

An optional emergency stop button is located on the right side of control panel (Figure 3-1). Push button in for emergency stop. To reset, pull switch out and move Run/Stop/Remote switch to Stop position. Then push test switch to Reset/Lamp Test position.

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 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 element, etc.

EXERCISE PERIOD

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts.

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps provide 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.

Onan automatic transfer switches have as an option an exerciser 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

Use a coolant heater if a separate source of power is available. The optional heater available from Onan will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

⚠ 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 set running on diesel fuel and operating at an altitude of 300 feet (92 m) with an ambient temperature of 81°F (27°C). For a rating relative to other applications, altitudes, cooling systems, or ambient temperatures, contact your authorized distributor.

4. Troubleshooting

The generator set has sensors that continuously monitor the engine for abnormal conditions, such as low oil pressure or high coolant temperature. If these conditions occur, the engine monitor activates a fault lamp, and may also stop the engine (depending on the condition). If the generator set is stopped for this reason, the operator may be able to restart the set after making adjustments or corrections. This section describes the fault condition system, and suggests troubleshooting procedures.

The standard seven-light control has a single green light to indicate RUN, two amber pre-fault lights and four red fault lights. The optional twelve-light control has a single green light to indicate RUN, four amber lights and seven red fault lights. Both controls also have a terminal connection for an audible alarm, which sounds when a fault occurs.

SAFETY CONSIDERATIONS

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

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

When troubleshooting a set that is shut down, make certain the generator set cannot be acciden-

tally 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 lamp turns on during operation, follow the procedures listed below to locate and correct the problem. For any symptom not listed, contact an authorized service center for assistance.

Resetting the Control

The external alarm and fault lamp may be deactivated by moving the Run/Stop/Remote switch to the Stop position and pressing the Reset/Lamp Test/Preheat switch. Locate the problem and correct it before restarting the set. While pressing the Reset/Lamp Test/Preheat switch, make certain that all lamps light.

Line Circuit Breaker (Optional)

The optional line circuit breaker mounts on the generator output box. If the load exceeds the generator current rating, the line circuit breaker will open, preventing the generator from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as necessary. Manually reset the breaker to reconnect the load to the generator.

TABLE 4-1. TROUBLESHOOTING

⚠ WARNING *Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages ii and iii.*

SYMPTOM	CORRECTIVE ACTION
1. Green RUN lamp lights following engine startup.	1. Indicates all engine systems are normal. No corrective action required.
2. PRE HI ENGINE TEMP lamp lights. Engine continues to operate.	<p>2. Indicates engine has begun to overheat and engine temperature has risen to approximately 215°F (102°C) or coolant level is low on optionally wired sets. If generator is powering non-critical and critical loads and cannot be shut down, use the following:</p> <ul style="list-style-type: none"> a. Reduce load if possible by turning off non-critical loads. b. Check air inlets and outlets and remove any obstructions to airflow. <p>If engine can be stopped, follow procedure in step 3.</p>
3. HI ENG TEMP lamp lights. Engine shuts down.	<p>3. Indicates engine has overheated (engine temperature has risen above 222°F/106°C) or coolant level is low. Allow engine to cool down completely before proceeding with the following checks:</p> <ul style="list-style-type: none"> 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 and tighten if loose. d. Reset control and restart after locating and correcting problem. Contact an authorized service center if none of the above.
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 procedures 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, lines and filters. If oil system is OK but oil level is low, replenish. Reset control and restart. Contact an authorized service center if oil pressure is not in the range of 25 to 40 psi (172 to 275 kPa).

TABLE 4-1. TROUBLESHOOTING (continued)

⚠WARNING *Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages ii and iii.*

SYMPTOM	CORRECTIVE ACTION
<p>6. OVERCRANK lamp lights and engine stops cranking.</p> <p>or</p> <p>Engine runs, shuts down, and LO OIL PRES lamp lights..</p>	<p>6. Indicates possible fuel system problem.</p> <ul style="list-style-type: none"> 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 <i>Maintenance</i> section). c. Check for dirty or plugged air filter and replace if necessary (see <i>Maintenance</i> section). d. Reset the control and restart after correcting the problem. Contact an authorized service center for service if none of the above.
<p>7. Engine runs and then shuts down, OVERSPEED lamp lights.</p>	<p>7. Indicates engine has exceeded normal operating speed. Contact an authorized service center for service.</p>
<p>*8. SWITCH OFF lamp flashes.</p>	<p>8. Indicates Run/Stop/Remote switch is in the Stop position which will prevent automatic starting if an automatic transfer switch is used. Move the Run/Stop/Remote switch to the Remote position for automatic starting.</p>
<p>*9. LO FUEL lamp lights. Engine continues to run.</p>	<p>9. Indicates diesel fuel supply is running low. Check fuel supply and replenish as required.</p>
<p>*10. LO FUEL LAMP lights. Engine shuts down and LO OIL PRES lamp lights.</p>	<p>10. Indicates engine has run out of fuel. Check fuel level and replenish as required.</p>
<p>*11. LO ENG TEMP lamp lights. Set is in standby mode but is not operating.</p> <p>(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 even during initial generator set operation.)</p>	<p>11. Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions:</p> <ul style="list-style-type: none"> 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 an authorized service center if none of the above.

* 12-Light Control Only.

TABLE 4-1. TROUBLESHOOTING (continued)

⚠WARNING Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages ii and iii.

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 undesigned fault functions are programmed to shut down the set when a fault is sensed. Fault 1 is time 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 undesigned 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 an authorized service center 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 an authorized service center if breaker trips after resetting.
15. Engine will not crank.	15. Indicates possible fault with control or starting system. Check for the following conditions: <ul style="list-style-type: none"> 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. Emergency stop button (if equipped) pushed in. To reset, pull switch out and move Run/Stop/Remote switch to Stop position. Then push test switch to Reset/ Lamp position. e. Contact an authorized service center if none of the above.
16. No AC output voltage.	16. Field breaker is tripped. Reset breaker. Contact an authorized service center if voltage buildup causes breaker to trip.
17. Green RUN lamp does not light following engine startup.	17. Indicates possible Start/Disconnect relay failure. Contact an authorized service center for assistance.

* 12-Light Panel Only.

5. Maintenance

Establish and adhere to a definite schedule for maintenance and service based on the application and severity of the environment. Table 5-1 covers the recommended service intervals for a generator set on STANDBY service. If the set will be subjected to extreme operating conditions such as high temperatures, dusty conditions, salt water or prime power, reduce the service intervals accordingly.

Consult with an authorized service center 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 comes first. Use Table 5-1 to determine the maintenance required and then refer to the sections that follow for correct service procedures.

CAUTION To prevent arcing, always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.

WARNING Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

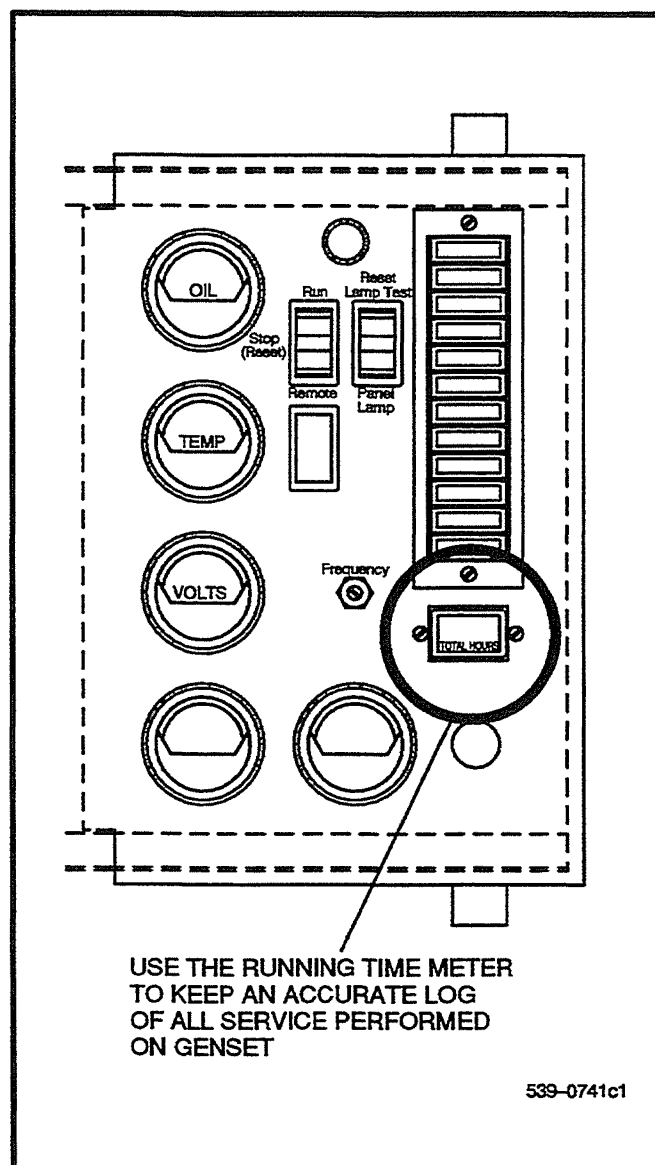


FIGURE 5-1. RUNNING TIME METER

TABLE 5-1. 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 Set	x1				
Check Oil Level	x				
Check Coolant Level	x				
Check Coolant Heater	x				
Check Air Cleaner (Clean if required)		x2			
Check Battery Charging System		x			
Drain Fuel Filter(s)		x4,5			
Check Anti-freeze and DCA Concentration			x5		
Check Drive Belt Tension			x3,5		
Check Fuel Level			x		
Drain Exhaust Condensate Trap			x		
Check Starting Batteries			x		
Check Generator Air Outlet			x		
Change Crankcase Oil and Filter				x2	
Change Coolant Filter				x5	
Clean Crankcase Breather				x5	
Change Air Cleaner Element				x2	
Check Radiator Hoses for Wear & Cracks				x	
Change Fuel Filters				x5	
Clean Cooling System					x5

1. Check for oil, fuel, cooling and exhaust system leaks. Check exhaust system audibly and visually with set running and repair any leaks immediately.
2. Perform more often in extremely dusty conditions
3. Visually check belts for evidence of wear or slippage.
4. Drain 1 cup or more of fuel to remove water and sediment
5. Refer to engine operation and maintenance manual for procedure.

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 ensure safe operation.

Exhaust System

With the generator set operating, inspect the entire exhaust system visually and audibly including the exhaust manifold, 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 genset and have leaks corrected immediately.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Be sure deadly exhaust gas is piped outside and away from any 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 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 severe personal injury or death by fire or explosion. Do not permit any flame, cigarette or other igniter near the fuel system.*

AC Electric System

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

Frequency/RPM Meter: The generator frequency should be stable and the reading should be the same as nameplate rating (50 or 60 hz/1500 or 1800 RPM).

AC Voltmeter: Turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2, L2-L3 and L3-L1). Read the AC voltmeter using the upper or lower scale as indicated by the scale indicator lamp. At no 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, L2 and L3). Read the ammeter using the upper or lower scale as indicated by the scale indicator lamp. At no load the current ratings should be zero. With a load applied, each line current should be about the same.

Fault Lamps(Seven or 12 lamp Control): Push the Reset/Lamp switch on the control panel. All indicator lamps should light. Verify that all the bulbs are on and then release the switch. Replace any bulbs that are burned out.

DC Electrical System

Check the terminals on the batteries 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 make sure 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 or allow any igniter near the batteries.*

⚠ CAUTION *To prevent arcing, always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

⚠ WARNING *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

LUBRICATION SYSTEM

The engine oil was drained from the crankcase before shipment. Before the initial start, the lubrication system must be filled with oil as recommended in the engine operation and maintenance manual. See *Specifications* section for lubricating oil capacity.

Engine Oil Level

Check the engine oil level during engine shutdown periods at the intervals specified in Table 5-1. The oil dipstick and oil fill are located on the side of the engine as shown in Figure 5-1. The dipstick is stamped with FULL and ADD to indicate the crankcase oil level. For accurate readings, shut off the engine and wait approximately 10 minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.

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

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

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

Oil and Filter Change

Change the oil and filter at the intervals recommended in the Maintenance Table 5-1. The engine operation and maintenance manual contains the procedure to drain the oil and replace the oil filter.

The *Specifications* section in this manual shows oil recommendations according to ambient temperatures.

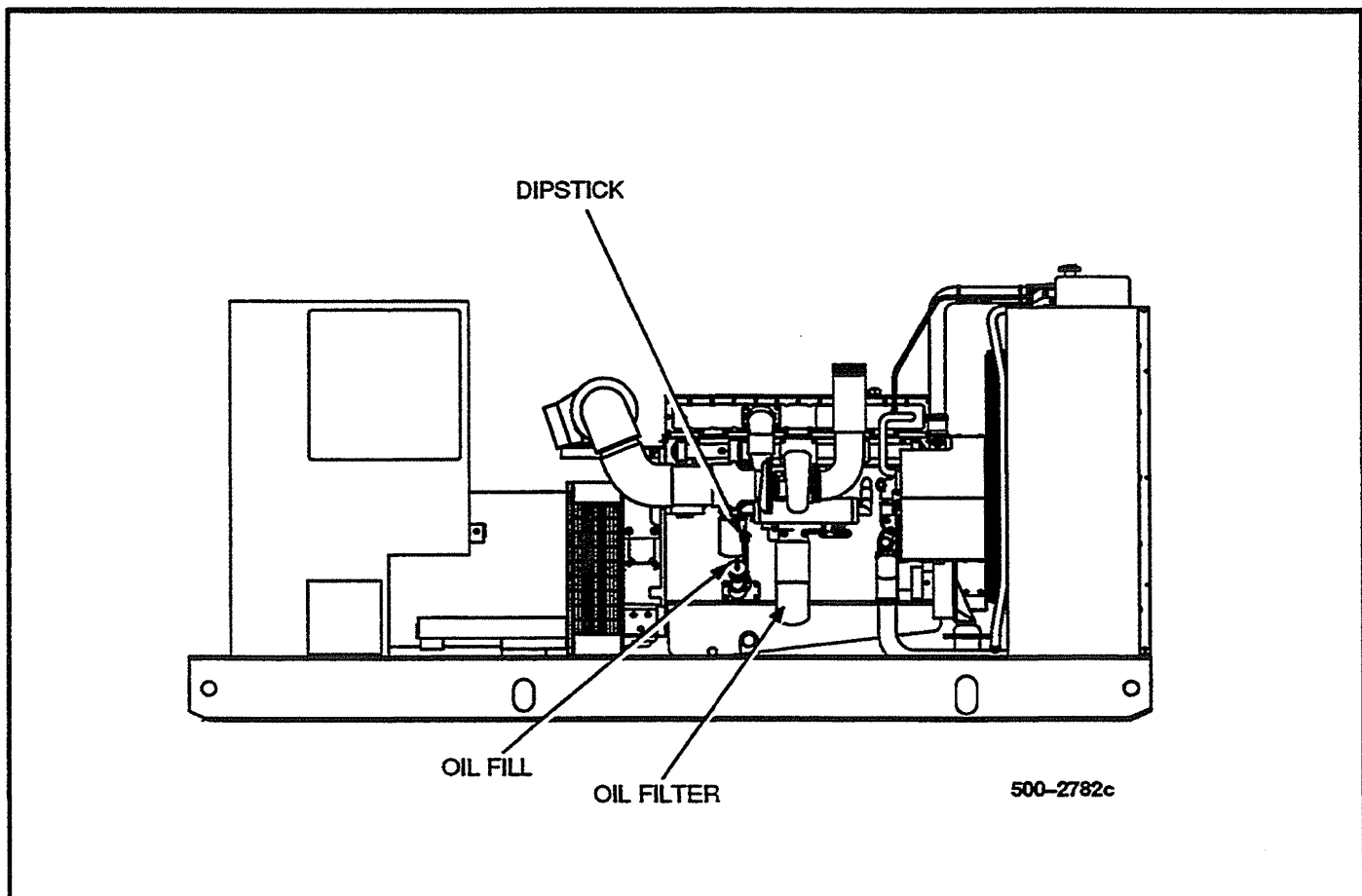


FIGURE 5-1. LUBRICATION SYSTEM

BATTERIES

Check the battery connections to make sure they are clean and tight. A light coating of non-conductive grease will retard terminal corrosion. Keep electrolyte at the proper level above the plates by adding distilled water. Check specific gravity using a hydrometer and recharge if below 1.260.

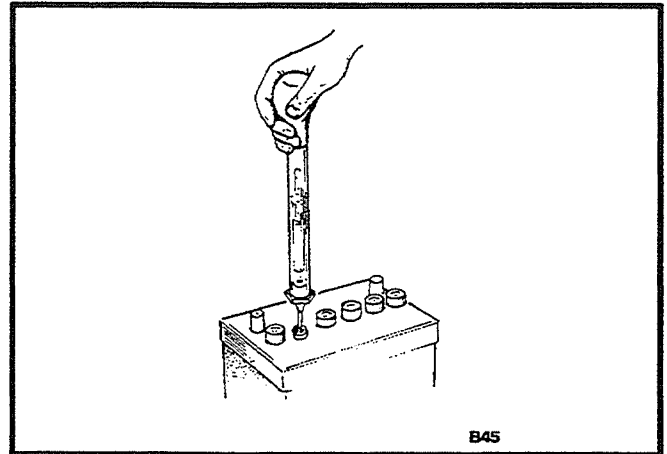


FIGURE 5-2. CHECKING BATTERY

COOLANT SYSTEM

The coolant system must be filled before operating the genset. The coolant capacity of a standard unit with a set mounted radiator is shown in *Specifications* section.

CAUTION *The optional coolant 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 interval specified in Table 5-1. 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 as recommended in engine operation and maintenance manual.

WARNING *Contact with hot coolant can result in severe burns. Allow engine to cool before releasing pressure and removing radiator cap.*

Other coolant system maintenance procedures are shown in engine operation and maintenance manual.

FUEL SYSTEM

Refer to engine operation and maintenance manual for fuel system maintenance.

AIR CLEANER

The engine air intake components should be checked at the interval indicated in Table 5-1. The frequency of cleaning or replacing air cleaner filter elements is primarily determined by the conditions in which the genset operates. The standard air cleaner and optional heavy duty air cleaner contain a paper cartridge filter element which can be cleaned and reused if not damaged, or discarded and replaced.

To Service the 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 to remove soot, carbon and 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.

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

ELECTRONIC GOVERNOR

Generator frequency is in direct ratio to engine speed. The genset uses a Cummins model EFC electronic governor which is factory adjusted. If maintenance or adjustments are required, contact your authorized service center.

EXHAUST CONDENSATION TRAP

If exhaust system has a condensation trap installed, water must be drained to prevent it from flowing back into the engine. See Figure 5-4 for a typical trap installation.

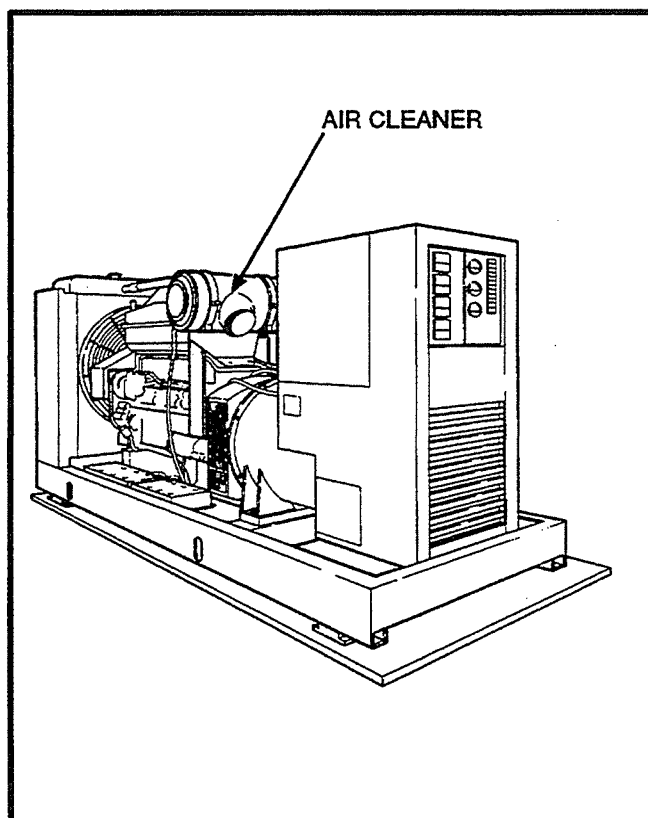


FIGURE 5-3. AIR CLEANER

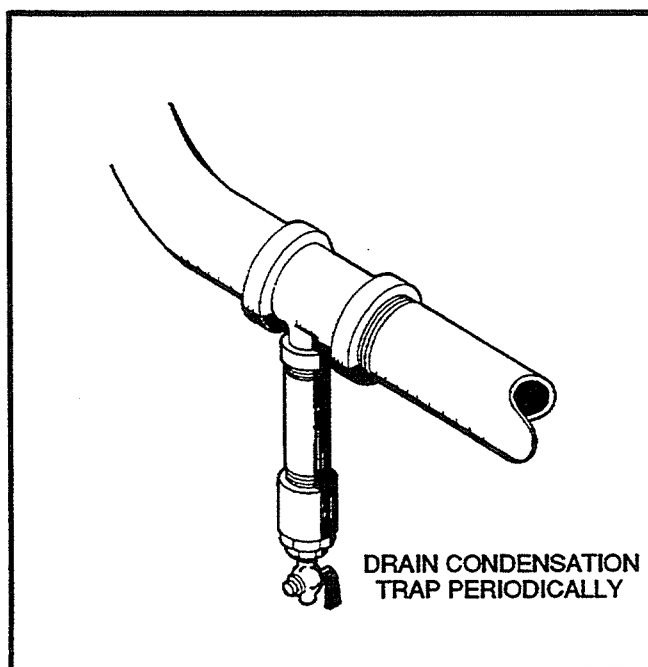


FIGURE 5-4. EXHAUST CONDENSATION TRAP



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