



Operator Manual

Our energy working for you.™



**Power
Generation**

Generator Set with PowerCommand® Control PCC 3100 **DGBB, DGBC, DGCA, DGCB, DGCC, DGDA, DGDB, DGDK, DGEA, DGFA, DGFB, DGFC**

Table of Contents

SECTION	TITLE	PAGE
	IMPORTANT SAFETY INSTRUCTIONS	iii
1	INTRODUCTION	
	General	1-1
	How to Obtain Service	1-2
2	SPECIFICATIONS	2-1
3	OPERATION (PCC CONTROL)	
	General	3-1
	Prestart Checks	3-2
	PCC Power On/Standby Mode	3-3
	Front Panel	3-4
	Starting	3-5
	Stopping	3-6
	Customer Inputs	3-6
	Menu Display and Switches	3-7
	Main Menu	3-8
	Engine Menu	3-10
	Gen Menu	3-12
	Adjust Menu	3-16
	Version Menu	3-18
4	TROUBLESHOOTING (PCC)	
	Safety Considerations	4-1
	Status Indicators	4-1
	Resetting the Control	4-2
	Warning and Shutdown Codes	4-3
	Troubleshooting Charts	4-4
	Oil Pressure Warning/Shutdown Limits	4-11

California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

SECTION	TITLE	PAGE
5	OPERATION (DETECTOR CONTROL)	
	General	5-1
	Prestart Checks	5-1
	Control Panel	5-1
	Generator AC Voltage Regulator	5-5
	Engine Control Module	5-5
	Starting	5-6
	Stopping	5-6
6	TROUBLESHOOTING (DETECTOR CONTROL)	
	Safety Considerations	6-1
	Resetting the Control	6-1
	Line Circuit Breaker (Optional)	6-1
	Troubleshooting Charts	6-2
7	OPERATION (SENTINEL CONTROL)	
	General	7-1
	Prestart Checks	7-1
	Control Panel	7-1
	Generator AC Voltage Regulator	7-3
	Engine Monitoring	7-3
	Starting	7-3
	Stopping	7-4
8	TROUBLESHOOTING (SENTINEL CONTROL)	
	Safety Considerations	8-1
	Troubleshooting Charts	8-2
9	MAINTENANCE	
	General	9-1
	Maintenance Schedule	9-2
	Generator Set Inspection	9-3
	Generator Set Maintenance (Battery Disconnected)	9-4
	Lubrication System	9-5
	Oil and Filter Change	9-6
	Cooling System	9-7
	Charge Air Cooler System	9-8
	Fuel System	9-8
	Air Cleaner	9-9
	Batteries	9-10
10	OPERATING RECOMMENDATIONS	
	No-Load Operation	10-1
	Exercise Period	10-1
	Low Operating Temperature	10-1
	High Operating Temperature	10-1

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions that should be followed during installation and maintenance of the generator and batteries.

Before operating the generator set (genset), 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 zinc coated or copper fuel lines with diesel fuel.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

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. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.
- Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

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 battery charger from its AC source, then 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.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause an engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. Do not operate a genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Cummins Power Generation distributor for more information.

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. Do not wear jewelry. Jewelry can short out electrical contacts and cause shock or burning.
- 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 and lock 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.
- 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.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10).
- Make sure that rags are not left on or near the engine.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.
- 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.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breathe or ingest or come into contact with exhaust gases.
- Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.
- Wear hearing protection when going near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator, turbo charger and exhaust system.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

GENERAL

This manual covers models produced under the Cummins®/Onan® and Cummins Power Generation brand names.

Each operator should read this manual before operating the set for the first time. A generator set (genset) must be operated and maintained properly if you are to expect safe, reliable and quiet operation. The manual includes a troubleshooting guide and a maintenance schedule.

The engine manual is included with the genset. Where there is conflicting information, this manual takes precedence over the engine manual.

There are separate *Operation* and *Troubleshooting* sections for gensets using the PowerCommand® Control 3100 (PCC), the Sentinel control or the Detector™ control (Figure 1-1). Refer to the *Table of Contents* for specific information relating to your genset. The remaining sections apply to all versions.

⚠ WARNING *Improper operation and maintenance can lead to severe personal injury or loss of life and property by fire, electrocution, mechanical breakdown or exhaust gas asphyxiation. Read and follow the safety precautions on page iii and carefully observe all instructions and precautions in this manual.*

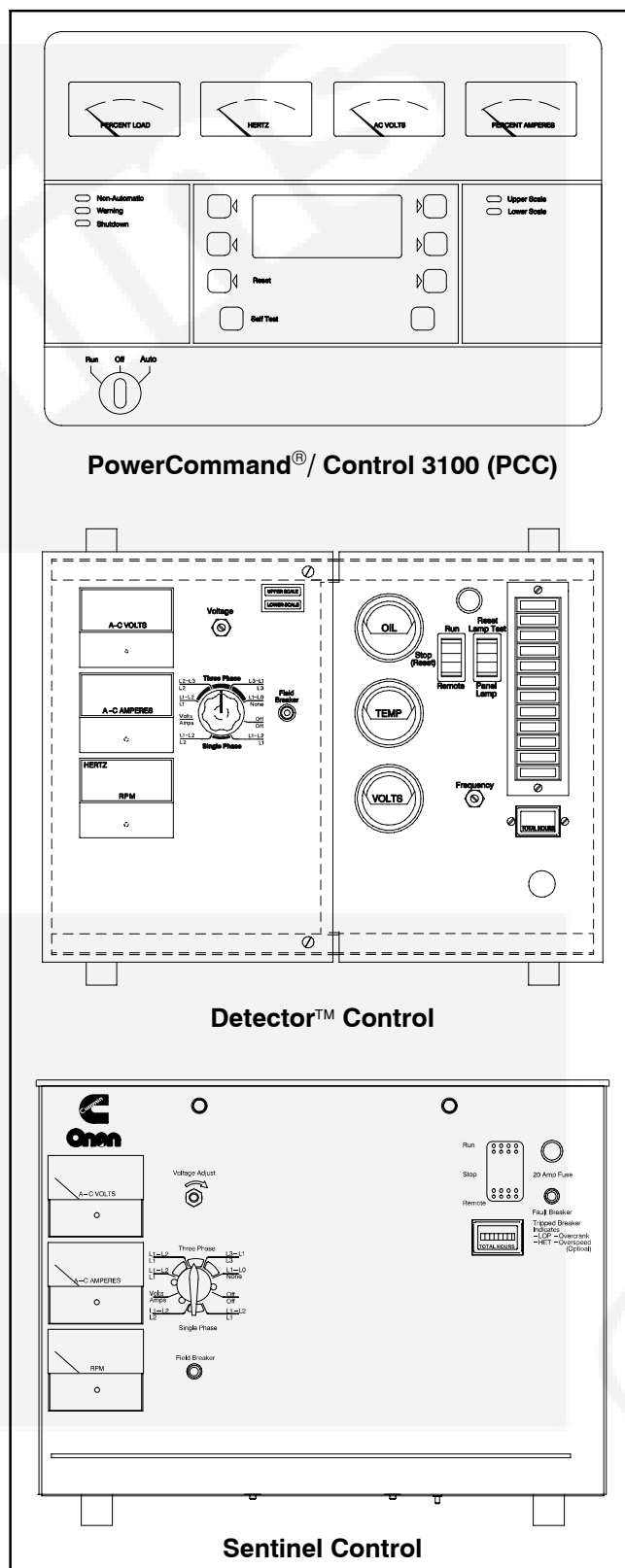


FIGURE 1-1. CONTROL PANEL CONFIGURATIONS

HOW TO OBTAIN SERVICE

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

To contact your local Cummins Power Generation distributor in the United States or Canada, call 1-800-888-6626 (this automated service utilizes touch-tone phones only). By selecting Option 1 (press 1), you will be automatically connected to the distributor nearest you.

If you are unable to contact a distributor using the automated service, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC or
ELECTRICAL PRODUCTS

For outside North America, call Cummins Power Generation, 1-763-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday. Or, send a fax to Cummins Power Generation using the fax number 1-763-574-8087.

When contacting your distributor, always supply the complete Model, Specification, 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 TRAINED AND EXPERIENCED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

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Detector is a trademark of Cummins Inc.

2. Specifications

MODEL	DGBB, DGBC, DGCA, DGCB	DGCC	DGDA, DGDB	DGDK
Engine Cummins Diesel Series	4B3.9	4BTA3.9	6BT5.9	6BTA5.9
Generator kW Rating	See Genset Nameplate for rating information			
Electrical System Starting Voltage Battery Group Number CCA (minimum) Cold Soak @ 0° F (-18° C)	12 Volts DC One, 12 Volt 4D 1080			
Cooling System Capacity with Standard Radiator	5.5 Gal (21 L)	5.7 Gal (22 L)	6.5 Gal (25 L)	8.3 Gal (31.5 L)
Lubricating System Oil Capacity with Filters Oil Type*	12 Qts (11 L)	12 Qts (11 L)	17 Qts (16 L)	17 Qts (16 L)
* Refer to Cummins engine <i>Operation and Maintenance Manual</i> for lubricating oil recommendations/specifications.				

FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)

MODEL	DGBB	DGBC	DGCA	DGCB	DGCC	DGDA	DGDB	DGDK
US gph (L/hr)	2.9 (11)	3.4 (12.9)	4.2 (15.9)	4.7 (17.8)	4.6 (17.4)	6.1 (23.1)	7.5 (28.5)	8.5 (35.6)

MODEL	DGEA	DGFA	DGFB	DGFC
Engine Cummins Diesel Series	6CT8.3	6CTA8.3	6CTA8.3	6CTAA8.3
Generator kW Rating	See Genset Nameplate for rating information			
Electrical System Starting Voltage Battery Group Number CCA (minimum) Cold Soak @ 0° F (-18° C)	12 Volts DC One, 12 Volt 4D 1080			
Cooling System Capacity with Standard Radiator	6.8 Gal (26 L)	7.5 Gal (28 L)	7.5 Gal (28 L)	6.8 Gal (26 L)
Lubricating System Oil Capacity with Filters Oil Type*	20 Qts (19 L)	20 Qts (19 L)	20 Qts (19 L)	20 Qts (19 L)
* Refer to Cummins engine <i>Operation and Maintenance Manual</i> for lubricating oil recommendations/specifications.				

FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)

MODEL	DGEA	DGFA	DGFB	DGFC
US gph (L/hr)	9.9 (37.5)	11.3 (42.8)	13.2 (50)	14.4 (54.6)

3. Operation (PCC)

GENERAL

The following describes the function and operation of the PowerCommand™ generator set control. All indicators, displays, meters and control switches are located on the face of the control panel as illustrated in Figure 3-1.

Normally, generator set configuration options are set at the factory. When a new control is installed on a generator set, the control must be configured for that generator set with the use of the “setup” portion of the internal software. Setup and calibration procedures are described in the *Installation manual*.

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 and the PCC control. Refer to *Section 10* for operating recommendations.

⚠ WARNING *The PCC control cabinet must be opened only by technically qualified personnel. Lower voltages (up to 15 VDC and 18 VAC) are present in PCC control cabinet. These voltages can cause electrical shock, resulting in personal injury.*

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.

PRESTART CHECKS

Before starting, be sure the following checks have been made and the unit is ready for operation.

Lubrication

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

Coolant

With Coolant Recovery Tank: Check the coolant recovery tank level. Note the normal level when the engine is cool. Add coolant to the recovery tank to replace the normal loss of coolant.

Without Coolant Recovery Tank: Check the engine coolant level. The coolant should be about 3/4 inch (18 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. Check to make sure there are no leaks and that all fittings are tight.

Exhaust

Check to make sure entire exhaust system is tight, that no combustible materials are near system, and gases are discharged away from building openings.

PCC POWER ON / STANDBY MODE

The control panel can be set to function in one of the following modes; Power On or Standby.

To select the alternate mode, contact an authorized service center.

Power On Mode: In this mode, power is continuously supplied to the control panel. The control's operating software and control panel LED's/display will remain active.

Standby Mode: In this mode, the control's operating software is inactive and the LED's and displays on the front panel are all off. The operating software is initialized and the front panel is turned on in response to one of the following:

- moving the Run/Off/Auto switch to the Run position,
- pressing the Self Test button,
- a remote start input signal (generator set in Auto mode), or
- any one of several "wake-up" signals from external switches.

The wake up signals are:

Low Engine Coolant Level
Low Engine Coolant Temperature
Low Fuel
Customer Fault Inputs 2 and 3
Run Selected on Run/Off Auto Switch
Remote Start Signal in Auto Mode
Emergency Stop

With the switch set to Standby mode, pressing the Self Test button will allow you to activate and view the menu displays without starting the generator set. If no menu selections are made, a software timer will shut down the power after 30 seconds.

When left in the Standby Mode, and a "Warning" signal is sensed by the PCC (for example, low coolant temp), the control will wake-up and display the warning message. The control will remain active until the warning condition is corrected and the Reset button is pressed to clear the warning message.

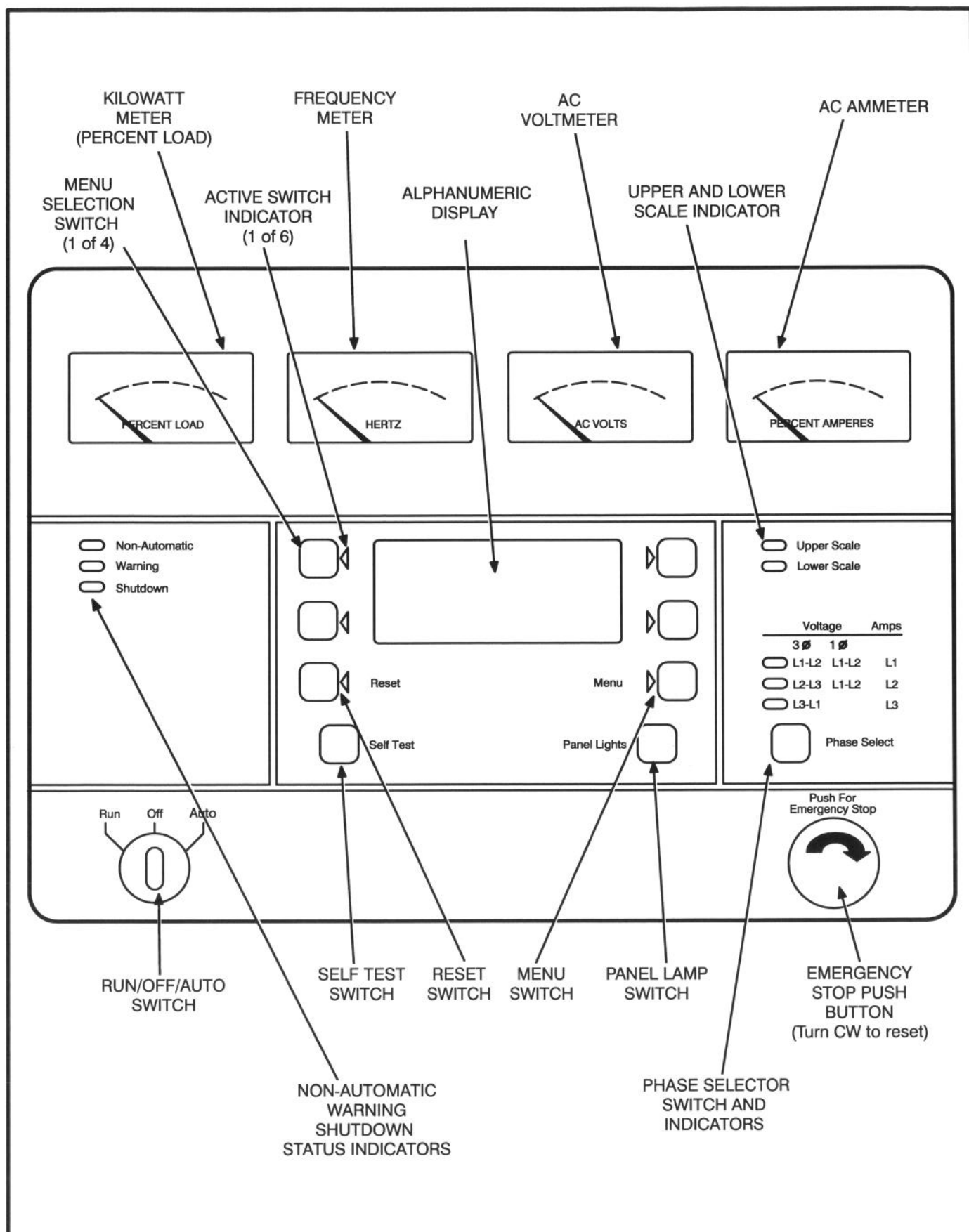


FIGURE 3-1. FRONT PANEL

FRONT PANEL

Figure 3-1 shows the features of the front panel.

AC Voltmeter: Dual scale instrument indicates AC voltage. Measurement scale in use is shown on scale indicator lamp.

AC Ammeter: Indicates current output in percent of maximum rated current.

Kilowatt Meter: Indicates 3-phase AC power output as percent of rated load.

Frequency Meter: Indicates generator output frequency in hertz.

Upper and Lower Scale Indicator Lamps: Indicate AC voltmeter scale.

Digital Display: This two-line, 16-character per line alphanumeric display is used in the menu-driven operating system, in conjunction with the display menu selection switches and the Menu switch. Refer to the menu trees later in this section. The display is also used to show warning and shutdown messages.

Display Menu Selection Switches: Four momentary switches—two on each side of the digital display window—are used to step through the various menu options and to adjust generator set parameters. The green arrow adjacent to the switch is lit when the switch can be used (switch is “active”).

Menu Switch: Press this switch to return the digital display to the MAIN MENU. Refer to the menu trees later in this section.

Reset Switch: Press this switch to reset warning and shutdown messages after the condition has been corrected. To reset a shutdown message with the Reset switch, the Run/Off/Auto switch must be in the Off position.

In Auto mode, shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

Self Test Switch: Press and hold this switch to light all front panel LEDs and cycle through all shutdown and warning messages.

Panel Lights Switch: Press this switch to turn control panel illumination on and off. The illumination will shut off after about eight minutes.

Phase Selector Switch and Indicators: Press this momentary switch to select phases of generator output to be measured by AC voltmeter and ammeter. LEDs indicate the selected phase.

Run/Off/Auto Switch: This switch starts and stops the set locally, or enables start/stop control of the engine from a remote location. (Ground to start.)

Emergency Stop Button: Push the switch in for emergency shutdown of the engine.

To reset:

- Turn the switch clockwise and allow it to pop out.
- Move the Run/Off/Auto switch to Off.
- Press the front panel Reset switch.
- Select Run or Auto, as required.

Non-Automatic Status Indicator: This red lamp flashes continuously when the Run/Off/Auto switch is not in the Auto position.

Warning Status Indicator: This yellow lamp is lit whenever the control detects a warning condition. After the condition is corrected, warning indicators can be reset by pressing the Reset switch. (It is **not** necessary to stop the generator set.) In auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected.

Shutdown Status Indicator: This red lamp is lit whenever the control detects a shutdown condition. After the condition is corrected, shutdown indicators can be reset by turning the Run/Off/Auto switch to the Off position, and pressing the Reset switch. In auto mode, shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

Emergency Stop shutdown status (Code 102) can be reset only at the PCC front panel.

STARTING

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

Before starting the generator set, make sure that exhaust and fuel fittings are tight and properly positioned and that proper maintenance has been performed. See *Prestart Checks* in this section.

Starting at Control Panel

Move the Run/Off/Auto switch 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 will start and the starter will disconnect.

If the engine does not start, the starter will disengage after a specified period of time and the control will indicate an overcrank shutdown.

Generator sets with the cycle cranking option selected will alternately crank and rest for 3, 4, or 5 cycles. The crank times and rest times can be individually preset for 7 to 20 seconds.

To change the cycle number, and the crank and rest times, contact an authorized service center.

Generator sets with the cycle cranking option **not** selected will crank continuously for up to 75 seconds before disengaging the starter.

To clear an overcrank shutdown, place the Run/Off/Auto switch in the Off position and momentarily press 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, refer to the *Troubleshooting* section.

Starting from Remote Location

Place the Run/Off/Auto switch in the Auto position. This allows the generator set to be started from a remote switch.

The operating software is initialized in response to a remote run signal. Closing the remote switch initiates the starting sequence described in the previous section.

Starter cranking will begin after the start time delay timer (0–300 seconds) has timed out. Refer to Time Delay Start in the Adjust menu.

Automatic Starting from ATS

Place the Run/Off/Auto switch in the Auto position if an automatic transfer switch (ATS) is used. The operating software is initialized in response to a remote run signal from the transfer switch. This allows the transfer switch to start the generator set if a power outage occurs and stop it when the power returns.

Starter cranking will begin after the start time delay timer (0–300 seconds) has timed out. Refer to Time Delay Start in the Adjust menu.

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. Most Onan generator sets will start in temperatures down to –25°F (–32°C) when equipped with coolant heaters, but it may take more than 10 seconds to warm the engine up before a load can be applied when ambient temperatures are below 40°F (4°C).

The **Low Coolant Temp (Code 210)** message, in conjunction with illumination of the Warning LED, is provided to meet the requirements of NFPA 110. The low coolant temperature sensing logic initiates a warning when the engine coolant temperature falls below 70°F (21°C). In applications where the ambient temperature falls below 40°F (4°C), Low Coolant Temp may be indicated 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 may 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.

Stopping at Control Panel

If the set was started at the set control panel, move the Run/Off/Auto switch to the Off position. The set will stop immediately. The control will respond to “wake up” signals from the external sensing switches when the Run/Off/Auto switch is in the Off position.

Stopping from Remote Location

Move the remote starting switch to the Off position.

The set will stop after the stop time delay timer (0–600 seconds) has timed out. Refer to Time Delay Stop in the Adjust menu.

Automatic Stopping from ATS

If the set was started by an automatic transfer switch, the transfer switch control will send a remote stop signal after the normal power source returns.

The set will stop after the stop time delay timer (0–600 seconds) has timed out. Refer to Time Delay Stop in the Adjust menu.

Emergency Stop (Code 102)

The emergency stop button is located on the lower right side of control panel (Figure 3-1). Push the button in for emergency stop. The red Shutdown status LED will light, and the digital display message will be:

“EMERGENCY STOP
102 – SHUTDOWN”

To reset, turn the switch clockwise and allow it to pop out. Move the Run/Off/Auto switch to the Off position. Then momentarily push the Reset switch.

Emergency Stop shutdown status can be reset only at the PCC front panel.

CUSTOMER INPUTS

Remote Start Input: When the Run/Off/Auto switch is in the Auto position, selecting this input initiates the engine cranking and start sequence.

Remote Reset Input: When the Run/Off/Auto switch is in the Auto position and the remote start switch is open, selecting this input resets any latched shutdown fault (except Emergency Stop, which must be reset at the front panel.)

Engine Idle Input: When the set is operating in the RUN mode, selecting this input causes generator build up to be inhibited and the engine to be governed at 800 RPM. When ground is removed from this input, the set returns to normal speed and voltage.

Engine idle operation is applicable only in the RUN mode. The PCC operating program does not permit engine idle operation when the set is operating in AUTO mode.

When the engine idle function is enabled, the control automatically sets lower oil pressure warning and shutdown trip points to reflect the lower operating speed. When the engine idle function is removed and the set reverts to normal operating speed, the control automatically resets oil pressure warning and shutdown trip points to the normal settings.

Remote Emergency Stop Input: Grounding this input causes an immediate shutdown. Emergency stop must be reset at the front panel.

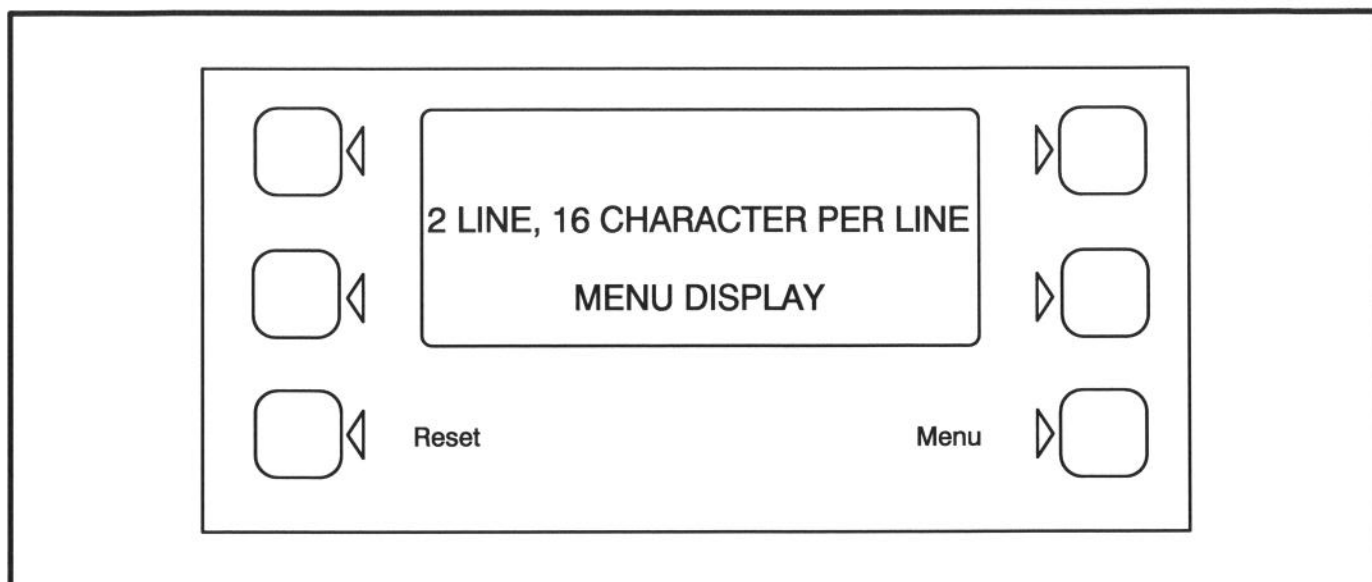


FIGURE 3-2. DIGITAL DISPLAY AND MENU SELECTION SWITCHES

MENU DISPLAY AND SWITCHES

Figure 3-2 shows the digital display and the menu selection switches.

In Standby Mode, to activate and view the menu displays without starting the generator set, press and release the Self Test switch. This will initialize the PCC operating software and permit operation of the menu display panel. If no menu selections are made, a software timer will shut down the display power after 30 seconds. In Power On Mode, power is continuously supplied to the control panel. Display will always remain active.

Digital Display: This two-line, 16-character per line alphanumeric display is used in the menu-driven operating system, in conjunction with the display menu selection switches and the Menu switch.

Display Menu Selection Switches: Four momentary switches—two on each side of the digital display window—are used to step through the various menu options and to adjust generator set parameters.

The green arrow adjacent to the switch is lit when the switch is available for use (is active).

Menu Switch: Press this momentary switch to return the digital display to the main menu. (Refer to the main menu diagram on the next page.

Reset Switch: Press this momentary switch to reset warning and shutdown messages after the condition has been corrected.

In the digital display, the ">>" symbol indicates that selecting the adjacent button causes the operating program to branch to the next menu display—as shown in the menu diagrams.

In the digital display, the "<<" symbol indicates that selecting the adjacent button causes the operating program to go back to the previous menu display.

MAIN MENU

The facing page shows the main menu and a block representation of the available submenus.

As shown in the diagram, the main menu can branch into one of four directions.

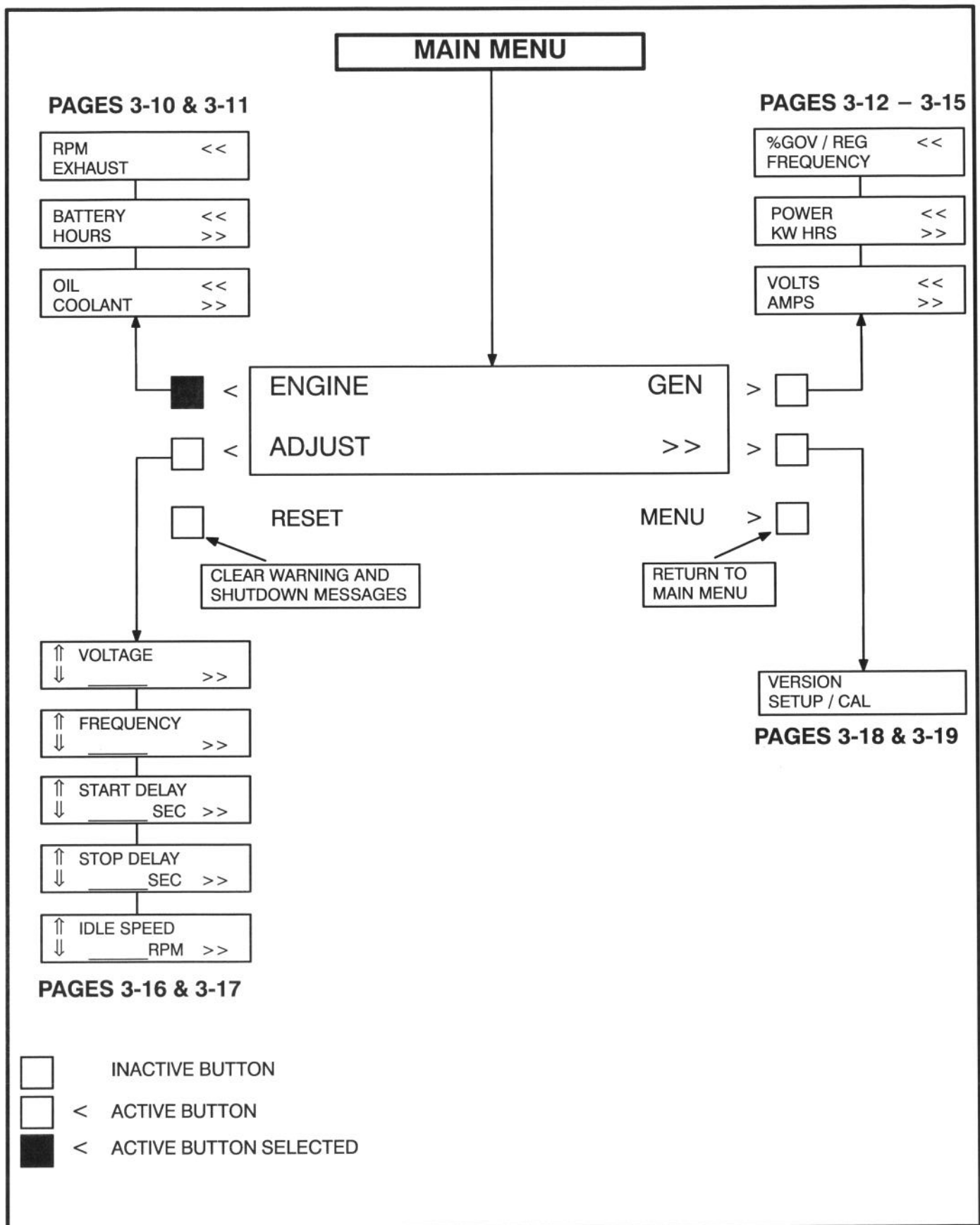
To display engine parameters, such as oil pressure and temperature, water temperature, engine speed (RPM), and exhaust temperature, press the button next to the word "ENGINE" in the display. Turn to the ENGINE menu diagram on page 3-11.

To display generator parameters, such as volts, amps, power (kW), and frequency, press the button

next to the word "GEN" in the display. Turn to the GEN menu diagram on page 3-13.

To adjust output voltage and frequency, or start and stop delays, press the button next to the word "ADJUST" in the display. Turn to the ADJUST menu diagram on page 3-15.

To display the selected generator set model and the resident version software, press the button next to the ">>" in the display. From this selection, you can also review a History file that can record and save up to 20 error messages. Turn to the VERSION menu diagram on page 3-17.



ENGINE MENU

The facing page shows a block representation of the ENGINE menu. If you press the button next to the word "ENGINE" in the display, the first ENGINE submenu will appear.

As shown in the diagram, the ENGINE menu has three submenus.

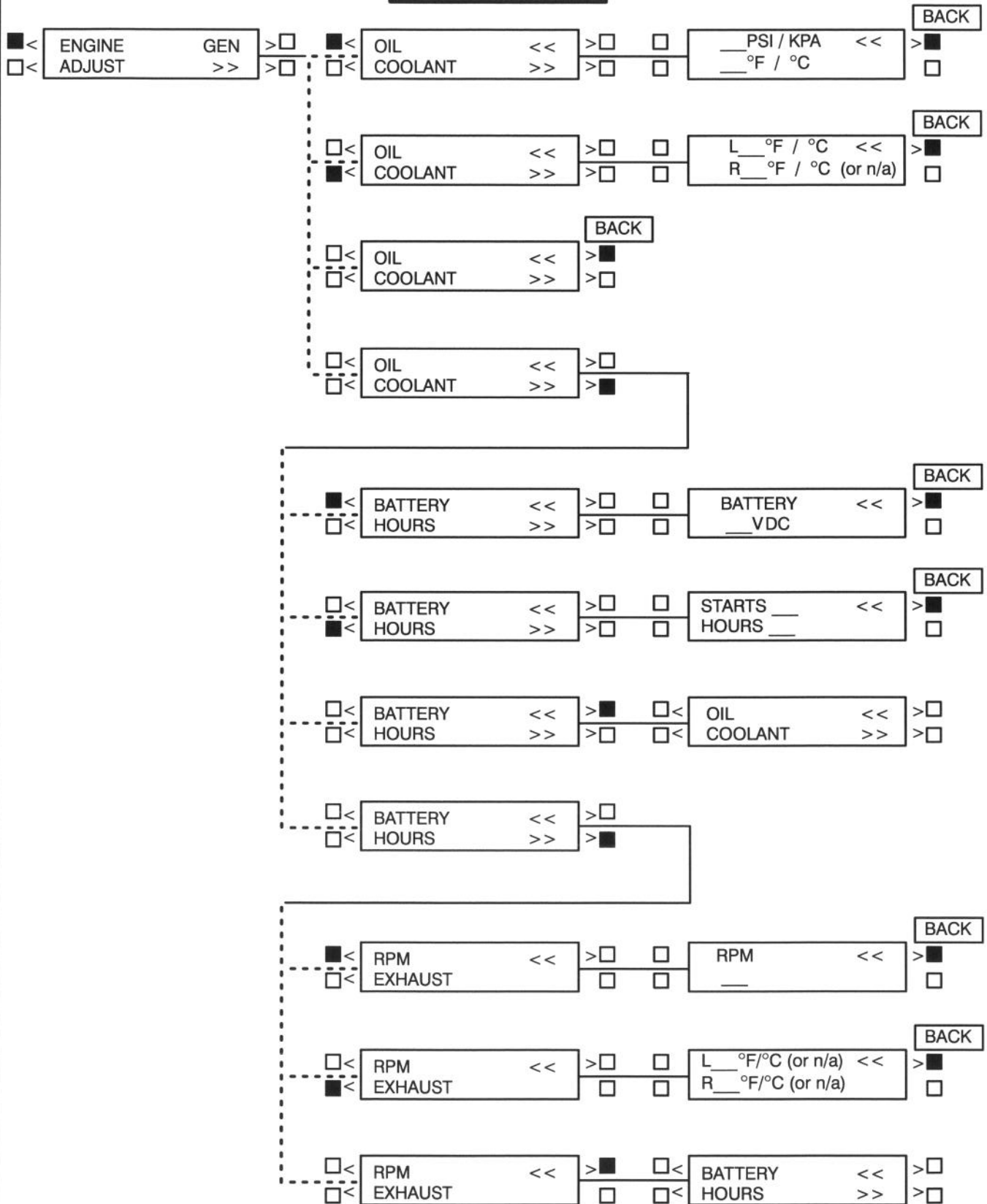
OIL/COOLANT submenu: This is the first submenu. Select OIL for a display of oil pressure and oil temperature. Select COOLANT for a display of coolant temperature. When oil or coolant parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the OIL/COOLANT submenu.

To check oil pressure or coolant temperature during a warning, access the oil pressure or coolant temperature menu prior to clearing the fault.

BATTERY/HOURS submenu: From the OIL/COOLANT submenu, press the button next to the ">>" in the display to move to the BATTERY/HOURS submenu. Select BATTERY for a display of battery voltage. Select HOURS for a display of the number of starts and the running hours. When battery or hours parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the BATTERY/HOURS submenu.

RPM/EXHAUST submenu: From the BATTERY/HOURS submenu, press the button next to the ">>" in the display to move to the RPM/EXHAUST submenu. Select RPM for a display of engine RPM. Select EXHAUST for a display of the (optional) exhaust temperature. When RPM or exhaust parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the RPM/EXHAUST submenu.

ENGINE MENU



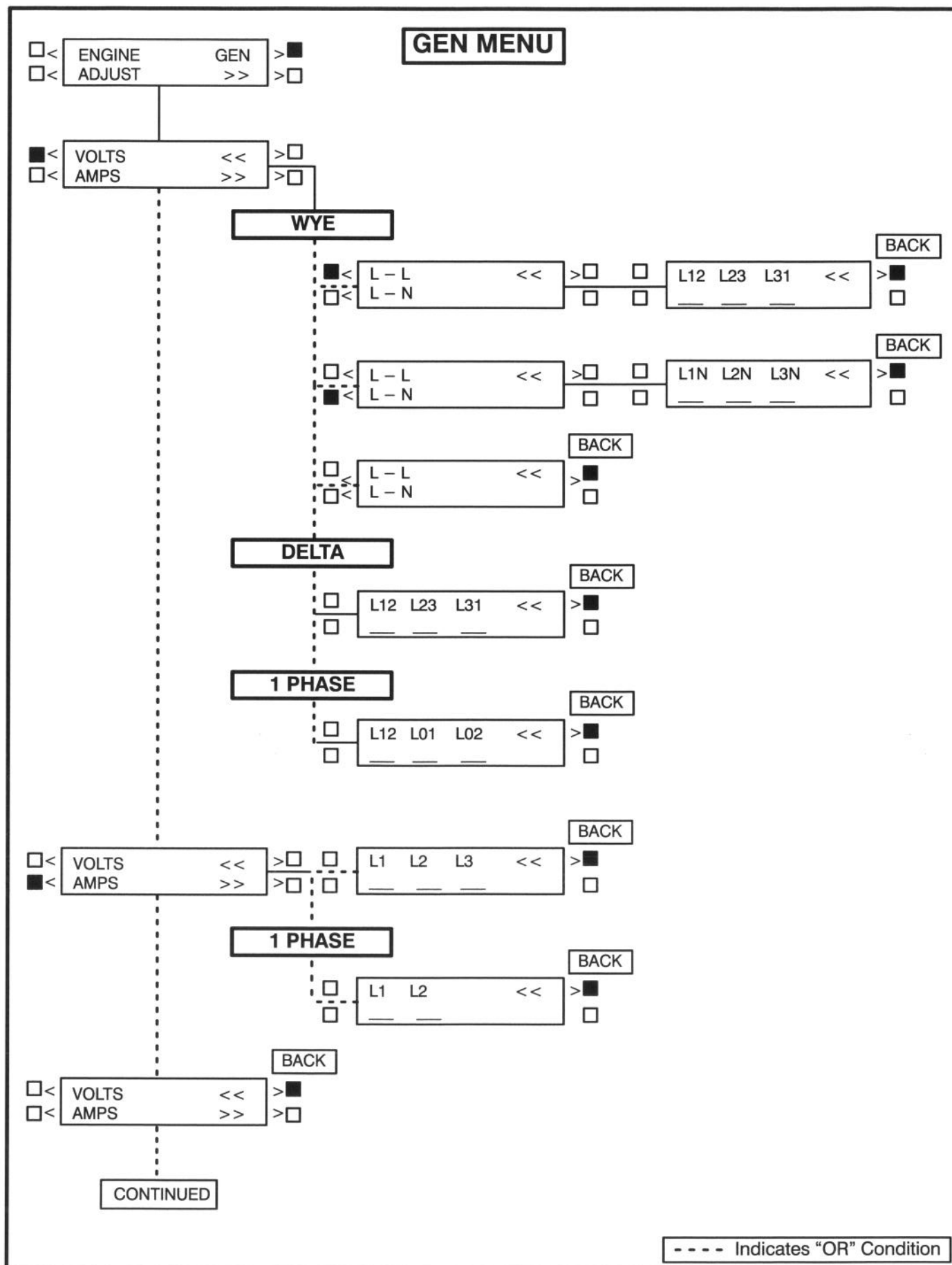
--- Indicates "OR" Condition

GEN MENU

The facing page shows a block representation of the GEN menu. If you press the button next to the word "GEN" in the display, the first GEN submenu will appear.

As shown in the diagram, the GEN menu has three submenus. Within these submenus, bold boxes indicate the possible selections made in the "Initial Start Setup" submenus (e.g., DELTA or WYE) and how the submenus will vary dependent on these selections.

VOLTS/AMPS submenu: This is the first submenu. Select VOLTS for a display of a line-line or line-neutral selection. Select line-line or line-neutral for the desired voltage display. Select AMPS for a display of L1, L2, and L3 current in amps. When voltage or current parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the L-L/L-N submenu.



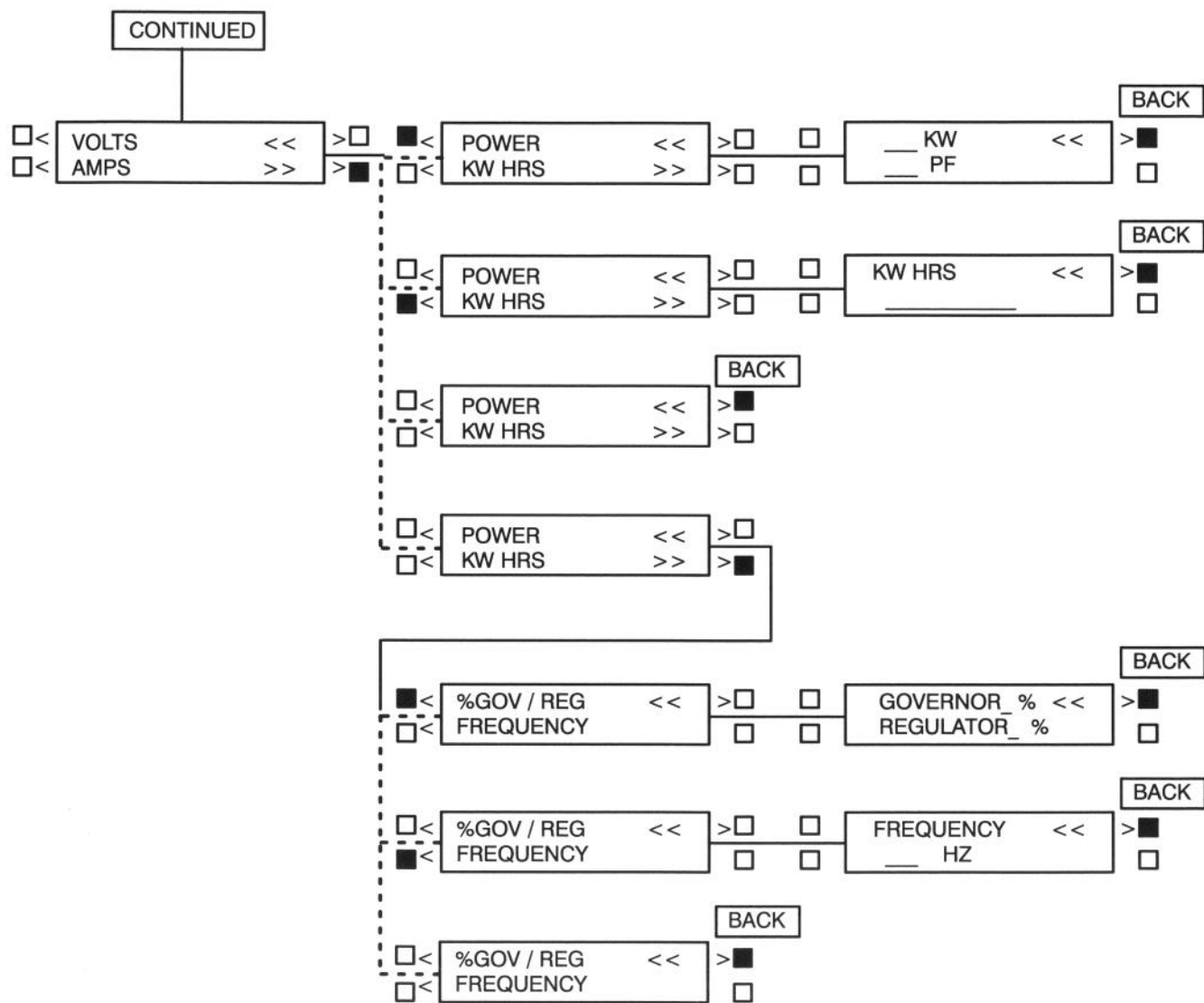
GEN MENU (Cont.)

POWER / KW HOURS submenu: From the VOLTS/AMPS submenu, press the button next to the ">>" in the display to move to the POWER/KW HOURS submenu. Select POWER for a display of power output in kilowatts and a power factor value. Select KW HOURS for a display of kilowatt hours. When power or kW hours parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the POWER/KW HOURS submenu.

The PF reading will contain an asterisk if the power factor is leading (for example, *.3PF).

N/A is displayed in the PF field when the generator set is not running.

%GOV/REG/FREQUENCY submenu: From the POWER/KW HOURS submenu, press the button next to the ">>" in the display to move to the %GOV/REG/FREQUENCY submenu. Select %GOV/REG for a display of voltage regulator and governor duty cycle (drive) levels in percentage of maximum. Select FREQUENCY for a display of the generator output frequency. When voltage regulator and governor or frequency parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the %GOV/REG/FREQUENCY submenu.

GEN MENU (Cont.)

- - - - Indicates "OR" Condition

ADJUST MENU

The facing page shows a block representation of the ADJUST menu. If you press the button next to the word "ADJUST" in the display, the VOLTAGE ADJUST submenu will appear.

As shown in the diagram, the ADJUST menu has five submenus, including a save/exit procedure.

Voltage and frequency can be adjusted only when the generator set is running under normal operating parameters (not in idle mode). For example, if voltage adjustment is selected when the set is in Idle mode or not running, the digital display will be:

“↑↑	VOLTAGE ”
“↓↓	N/A >>”

VOLTAGE submenu: This is the first submenu. Use the buttons next to the “↑↑” and “↓↓” symbols to adjust output voltage $\pm 5\%$.

FREQUENCY submenu: From the VOLTAGE submenu, press the button next to the “>>” in the display to move to the FREQUENCY submenu. Use the buttons next to the “↑↑” and “↓↓” symbols to adjust output frequency $\pm 5\%$.

START DELAY submenu: This delay applies only to remote starting in the Auto mode. From the FREQUENCY submenu, press the button next to the “>>” in the display to move to the START DELAY submenu. Use the buttons next to the “↑↑” and “↓↓” symbols to set the start delay. The start delay adjustment range is 0 to 300 seconds.

STOP DELAY submenu: This delay applies only to remote stopping in the Auto mode. From the START DELAY submenu, press the button next to the “>>” in the display to move to the STOP DELAY submenu. Use the buttons next to the “↑↑” and “↓↓” symbols to set the stop delay. The stop delay adjustment range is 0 to 600 seconds.

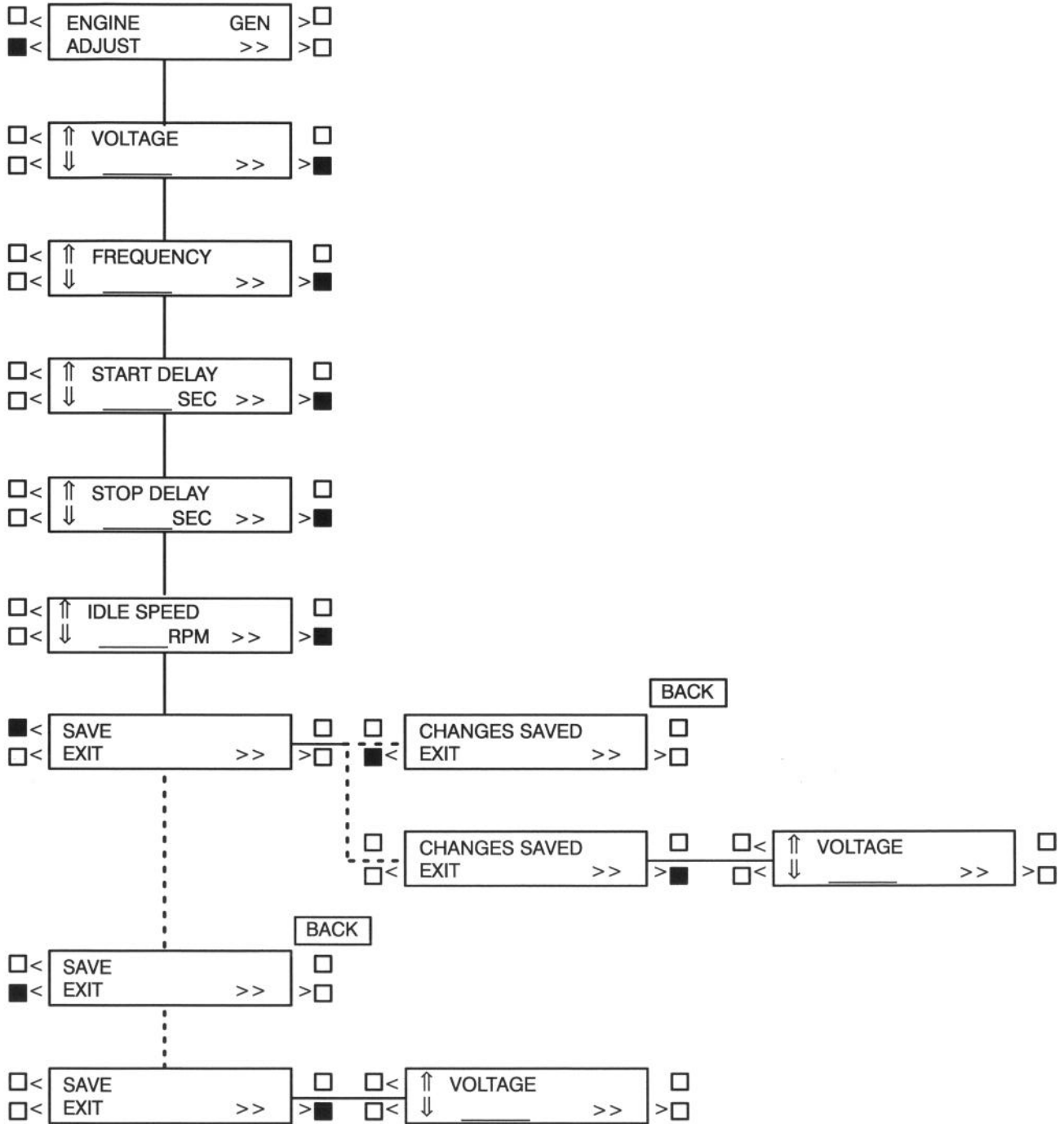
IDLE SPEED submenu: From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the IDLE SPEED submenu. Use the buttons next to the “↑↑” and “↓↓” symbols to set the idle speed. The idle speed adjustment range is 800 RPM ± 100 RPM. (Default value is 800 RPM.)

The idle speed can be adjusted only when the generator set is running in the idle mode. When not in idle mode, N/A is displayed in RPM field.

SAVE/EXIT submenu: From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the main menu.

If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the generator set is shut down, but will be reset (and will not be in effect) when the set is restarted.

ADJUST MENU



---- Indicates "OR" Condition

VERSION MENU

The facing page shows a block representation of the VERSION submenus. If you press the button next to the ">>" in the Main menu display, the VERSION/SETUP/CAL menu will appear.

VERSION submenu: If you select VERSION, the display will show the generator set model number, frequency, and kW rating, and the date and version of the operating software.

To display the generator set configuration options, press the button next to the ">>" in the submenu that displays the model number, frequency, etc.. This menu provides the following information:

- Generator set voltage
- WYE or DELTA and Full or Standard
- Standby or Prime
- 1 or 3 phase

To modify any of these entries, you must return to the "Initial Start Setup" submenus described in the *Service* manual.

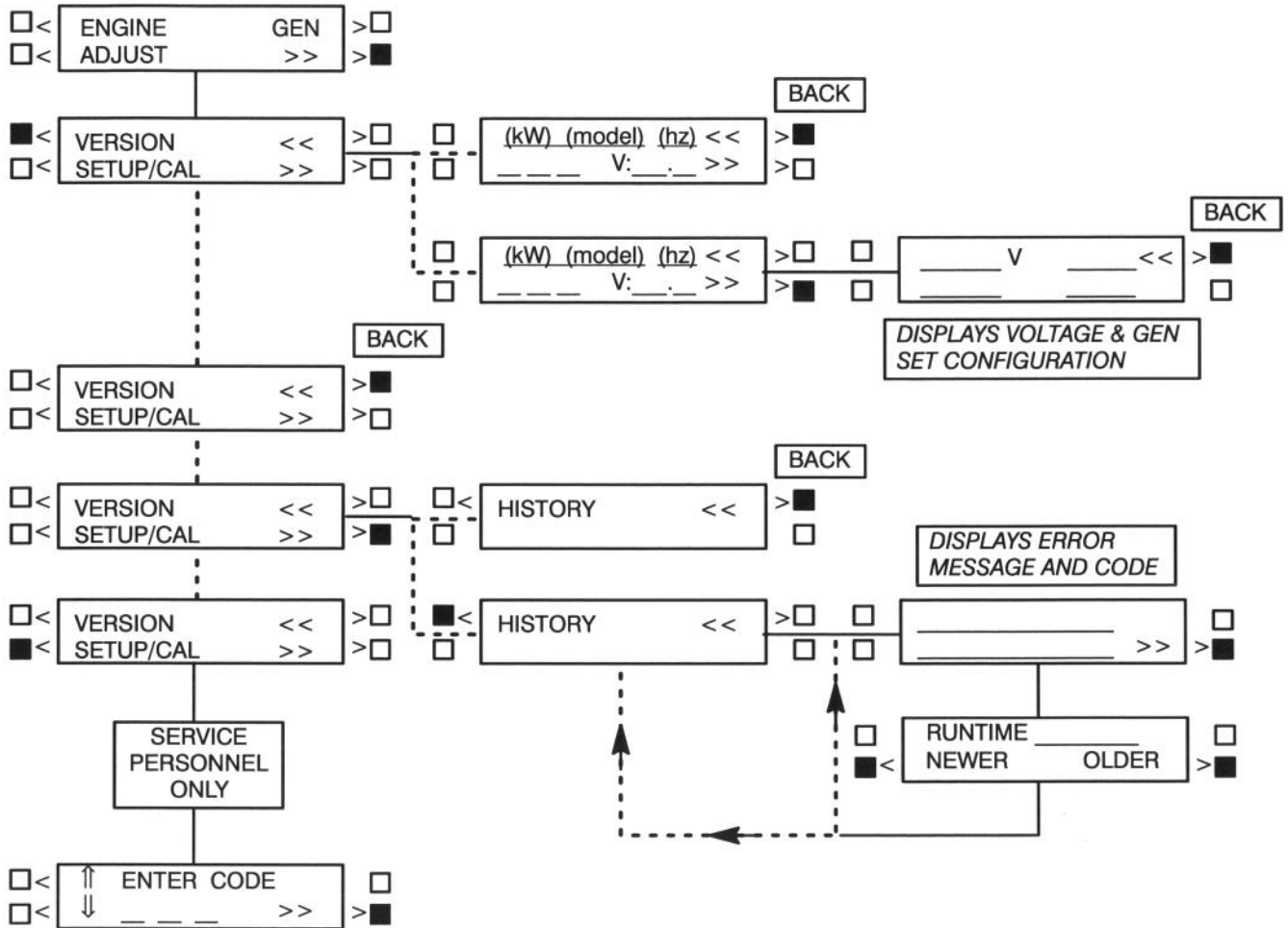
HISTORY: From the VERSION menu, press the button next to the ">>" in the display to move to the HISTORY submenu. Press the button next to "HISTORY" to display the last (latest) recorded error message.

The software will record (save) up to 20 error messages. The last error detected will always be displayed first. As each new error is detected, the oldest error recorded after 20 will be deleted.

To view the generator set runtime at which the error occurred and to scroll through the remaining recorded errors, press the button next to the ">>" in the error message menu to display the RUNTIME, NEWER/OLDER menu.

The buttons next to NEWER and OLDER are used to scroll up and down through the error messages. For example, pressing OLDER will display the next oldest recorded error message. When pressing NEWER and the last (newest) error message is displayed, or OLDER and oldest error is displayed, the display will return to the HISTORY menu.

VERSION MENU



--- Indicates "OR" Condition

4. Troubleshooting (PCC)

The PowerCommand™ Control continuously monitors engine sensors for abnormal conditions, such as low oil pressure and high coolant temperature. If any of these conditions occur, the PCC will light a yellow Warning lamp or a red Shutdown lamp and display a message on the digital display panel.

In the event of a shutdown fault (red Shutdown lamp), the PCC will stop the engine and close a set of contacts that can be wired to trip a circuit breaker. If the generator set is stopped for this reason, the operator can restart the set after making adjustments or corrections. This section lists the warning and shutdown messages (Table 4-1), and suggests troubleshooting procedures (Table 4-2).

Table 4-3 lists the PCC oil pressure warning and shutdown limits.

SAFETY CONSIDERATIONS

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

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

When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. Place the Run/Off/Auto switch in the Off position. Turn off or remove AC power from the battery charger and then 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 condition occurs 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.

STATUS INDICATORS

Non-Automatic Status Indicator: This red lamp flashes continuously when the Run/Off/Auto switch is not in the Auto position.

Warning Status Indicator: This yellow lamp is lit whenever the control detects a warning condition. After the condition is corrected, warning indicators can be reset by pressing the Reset switch. (It is **not** necessary to stop the generator set.) In auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected.

Shutdown Status Indicator: This red lamp is lit whenever the control detects a shutdown condition. After the condition is corrected, shutdown indicators can be reset by turning the Run/Off/Auto switch to the Off position, and pressing the Reset switch. In auto mode, shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

Emergency Stop shutdown status (Code 102) can be reset only at the PCC front panel.

Digital Display: This two-line, 16-character per line alphanumeric display is used in the menu-driven operating system and to show shutdown and warning messages. Refer to Tables 4-1 and 4-2.

RESETTING THE CONTROL

Press the momentary **Reset Switch** to reset warning and shutdown messages after the condition has been corrected. To reset a shutdown message with the Reset switch, the Run/Off/Auto switch must be in the Off Position. **(The control cannot go into standby [sleep] mode until all faults have been reset.)**

In Auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected. Shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

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.

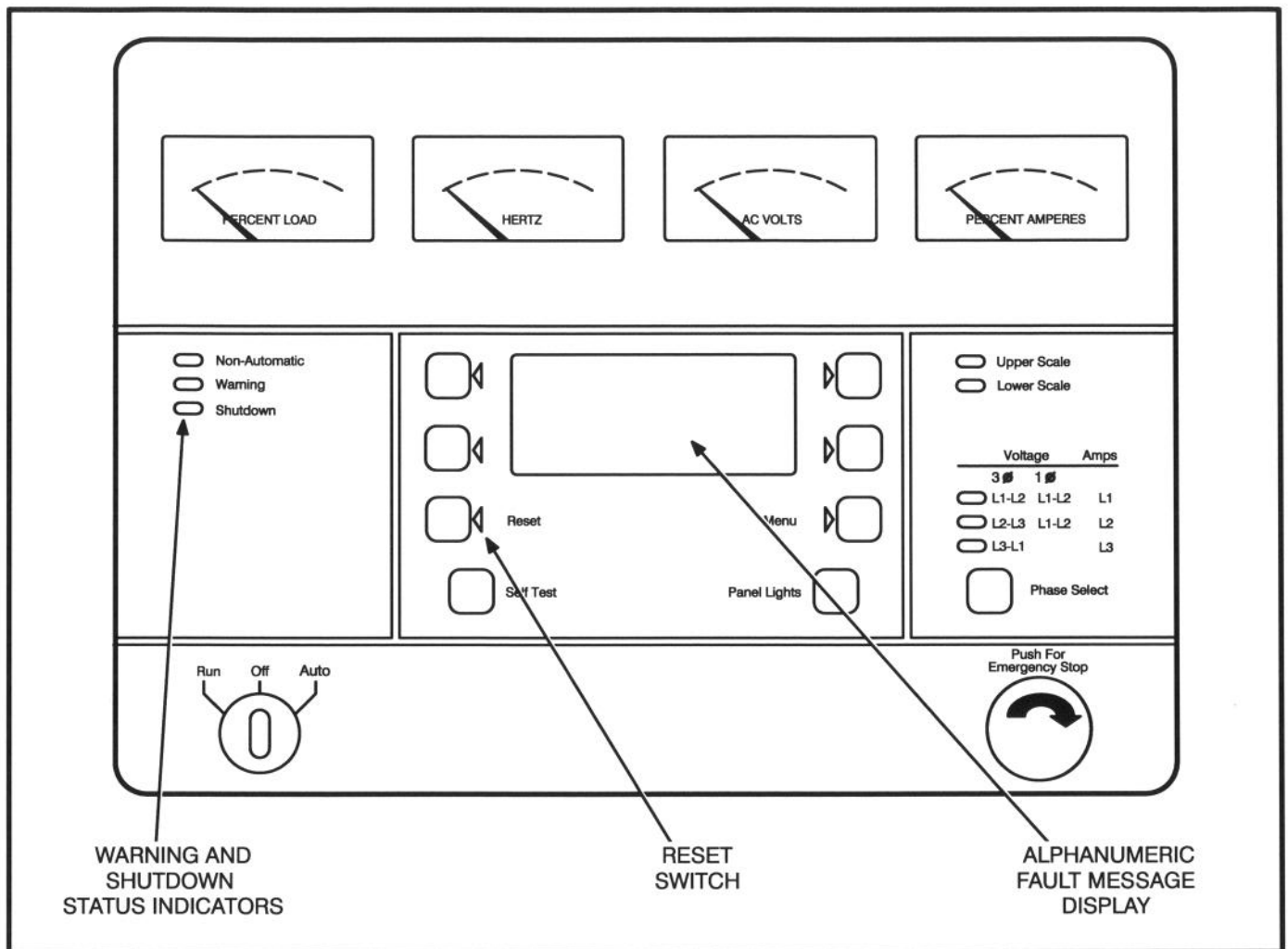


FIGURE 4-1. CONTROL PANEL

TABLE 4-1. WARNING AND SHUTDOWN CODES

CODE	MESSAGE	STATUS LED	PAGE
101	IDLE MODE	none	4-4
102	EMERGENCY STOP	Shutdown	4-4
200	LOW OIL PRESSURE	Warning	4-4
201	LOW OIL PRESSURE	Shutdown	4-4
204	OIL PRES SENDER	Warning	4-5
210	LOW COOLANT TEMP	Warning	4-5
211	HIGH COOLANT TEMP	Warning	4-5
212	HIGH COOLANT TEMP	Shutdown	4-5
213	COOLANT SENDER	Warning	4-6
214	LOW COOLANT LVL	Warning	4-6
215	LOW COOLANT LVL	Shutdown	4-6
220	MAG PICKUP	Shutdown	4-6
221	FAIL TO CRANK	Shutdown	4-6
222	OVERCRANK	Shutdown	4-6
223	OVERSPEED	Shutdown	4-7
230	LOW DC VOLTAGE	Warning	4-7
231	HIGH DC VOLTAGE	Warning	4-7
232	WEAK BATTERY	Warning	4-7
240	LOW FUEL – DAY	Warning	4-7
241	LOW FUEL	Warning	4-7
250	EEPROM ERROR	Shutdown	4-7
251	EEPROM ERROR	Warning	4-8
252	EEPROM ERROR	Warning	4-8
260	CUSTOMER FAULT 1*	Warning	4-8
261	GROUND FAULT*	Warning/Shutdown	4-8
262	RUPTURE BASIN*	Warning/Shutdown	4-8
263	HIGH GEN TEMP*	Warning/Shutdown	4-8
301	HIGH AC VOLTAGE	Shutdown	4-9
303	LOW AC VOLTAGE	Shutdown	4-9
313	UNDER FREQUENCY	Shutdown	4-9
320	OVERCURRENT	Warning	4-9
321	OVERCURRENT	Shutdown	4-9
322	SHORT CIRCUIT	Shutdown	4-10
330	OVERLOAD	Warning	4-10
335	REVERSE POWER	Shutdown	4-10

* Default message. Editable for customer site requirements.

TABLE 4-2. 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 mechanical hazards should perform service procedures. Review safety precautions.

SYMPTOM	CORRECTIVE ACTION
Control does not power up when the Run/Off/Auto switch is set to Run or the Self Test switch is pressed.	There is no DC power to the control. Check battery. Check for battery disconnected, discharged, or improperly connected. Contact an authorized service center.
Warning, Shutdown, and Non-Auto-matic lamps are not lit. Digital display shows main menu or selected menu.	Indicates all engine systems are normal. No corrective action required.
Non-Automatic lamp flashes.	Indicates Run/Off/Auto switch is not in the Auto position. This will prevent automatic starting if an automatic transfer switch is used. Move the Run/Off/Auto switch to the Auto position for automatic operation.
MESSAGE: IDLE MODE 101 – WARNING Engine continues to operate at reduced RPM.	Indicates that the engine is operating in idle mode. When the set is operating in the RUN mode, grounding the engine idle input causes generator build-up to be inhibited and the engine to be governed at 800 RPM. When ground is removed from this input, the set returns to normal speed and voltage. When the engine idle function is enabled, the control automatically sets lower oil pressure warning and shutdown trip points to reflect the lower operating speed. When the engine idle function is removed and the set reverts to normal operating speed, the control automatically resets oil pressure warning and shutdown trip points to the normal settings.
Shutdown lamp lights. MESSAGE: EMERGENCY STOP 102 – SHUTDOWN Engine shuts down and will not crank.	Indicates local or remote Emergency Stop. To reset the local Emergency Stop button : Turn the switch clockwise and allow it to pop out. Move the Run/Off/Auto switch to Off. Press the Reset switch. Select Run or Auto, as required.
Warning lamp lights. MESSAGE: LOW OIL PRESSURE 200 – WARNING	Indicates engine oil pressure has dropped to an unacceptable level. If generator is powering critical loads and cannot be shut down, wait until next shutdown period then follow, 201 Low Oil Pressure procedure. If engine can be stopped, follow 201 procedure. To check oil pressure, access Oil Pressure menu prior to clearing the fault.
Shutdown lamp lights. MESSAGE: LOW OIL PRESSURE 201 – SHUTDOWN	Indicates engine oil pressure has dropped below the shutdown trip point. Check oil level, lines and filters. If oil system is OK but oil level is low, replenish. Reset control and restart. Oil pressure limits are listed in Table 4-3. Contact an authorized service center.

TABLE 4-2. 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 mechanical hazards should perform service procedures. Review safety precautions.

SYMPTOM	CORRECTIVE ACTION
<p>Warning lamp lights. MESSAGE: OIL PRES SENDER 204 – WARNING</p>	<p>Indicates that the engine oil pressure sender is not functioning correctly. Check that the engine oil pressure sender is properly connected. Contact an authorized service center.</p>
<p>Warning lamp lights. MESSAGE: LOW COOLANT TEMP 210 – WARNING</p> <p>Set is in standby mode but is not operating. Warning occurs when engine coolant temperature is 70° F (21° C) or lower. NOTE: In applications where the ambient temperature falls below 40°F (4°C), Low Engine Temp may be indicated even though the coolant heaters are operating.</p>	<p>Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions:</p> <ol style="list-style-type: none"> Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. Contact an authorized service center if none of the above.
<p>Warning lamp lights. MESSAGE: HIGH COOLANT TEMP 211 – WARNING</p>	<p>Indicates engine has begun to overheat and coolant temperature has risen to an unacceptable level: (215° F – standby / 207° F – prime). If generator is powering non-critical and critical loads and cannot be shut down, use the following:</p> <ol style="list-style-type: none"> Reduce load if possible by turning off non-critical loads. Check air inlets and outlets and remove any obstructions to airflow. <p>If engine can be stopped, follow the next procedure.</p> <p>To check coolant temperature, access Coolant Temp menu prior to clearing the fault.</p>
<p>Shutdown lamp lights. MESSAGE: HIGH COOLANT TEMP 212 – SHUTDOWN</p>	<p>Indicates engine has overheated (coolant temperature has risen above the shutdown trip point: 223° F – standby / 215° F – prime) or the coolant level is low. Allow engine to cool down completely before proceeding with the following checks:</p> <ol style="list-style-type: none"> Check coolant level and replenish if low. Look for coolant leakage and repair if necessary. Check for obstructions to cooling airflow and correct as necessary. Check fan belt and repair or tighten if necessary. Reset control and restart after locating and correcting problem. Contact an authorized service center if none of the above.

TABLE 4-2. 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 mechanical hazards should perform service procedures. Review safety precautions.

SYMPTOM	CORRECTIVE ACTION
Warning lamp lights. MESSAGE: ENG COOLANT SENDER 213 – WARNING	Indicates that the resistance of the coolant temperature sender is out of range. Contact an authorized service center.
Shutdown lamp lights. MESSAGE: LOW COOLANT LVL 214 – WARNING or LOW COOLANT LVL 215 – SHUTDOWN	Indicates engine coolant level has fallen below the trip point. Allow engine to cool down completely before proceeding. <ol style="list-style-type: none"> Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. Reset control and restart after locating and correcting problem. Contact an authorized service center. LOW COOLANT LVL Shutdown will not occur if generator set is in Idle mode (low coolant warning only).
Shutdown lamp lights. MESSAGE: MAG PICKUP 220 – SHUTDOWN	Indicates mag pickup speed indication is not being sensed or does not match generator set output frequency. <ol style="list-style-type: none"> Restart and check RPM on the digital display. Contact an authorized service center.
Engine will not crank. Shutdown lamp lights. MESSAGE: FAIL TO CRANK 221 – SHUTDOWN	Indicates possible fault with control or starting system. Check for the following conditions: <ol style="list-style-type: none"> Poor battery cable connections. Clean the battery cable terminals and tighten all connections. Discharged or defective battery. Recharge or replace the battery. Contact an authorized service center for service of starter and starting system.
Shutdown lamp lights. Engine stops cranking. MESSAGE: OVERCRANK 222 – SHUTDOWN	Indicates possible fuel system problem. <ol style="list-style-type: none"> Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. Check for dirty fuel filter and replace if necessary. Check for dirty or plugged air filter and replace if necessary. Reset the control and restart after correcting the problem. Contact an authorized service center if none of the above.

TABLE 4-2. 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 mechanical hazards should perform service procedures. Review safety precautions.

SYMPTOM	CORRECTIVE ACTION
Engine runs and then shuts down, Shutdown lamp lights. MESSAGE: OVERSPEED 223 – SHUTDOWN	Indicates engine has exceeded normal operating speed. (2070 rpm @ 60 hz; 1800 rpm @ 50 hz) Contact an authorized service center.
Warning lamp lights. MESSAGE: LOW DC VOLTAGE 230 – WARNING	Indicates battery voltage is below 10 VDC. a. Discharged or defective battery. Check the battery charger fuse. Recharge or replace the battery. b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c. Contact an authorized service center if none of the above.
Warning lamp lights. MESSAGE: HIGH DC VOLTAGE 231 – WARNING	Indicates battery voltage exceeds 16 VDC. Contact an authorized service center.
Warning lamp lights. MESSAGE: WEAK BATTERY 232 – WARNING	Indicates battery voltage drops below 7 VDC for two seconds, during starting. Discharged or defective battery. See Warning message 230, LOW DC VOLTAGE .
Warning lamp lights. MESSAGE: LOW FUEL DAY 240 – WARNING	Indicates day tank fuel supply is running low. Check fuel supply and replenish as required.
Warning lamp lights. MESSAGE: LOW FUEL 241 – WARNING	Indicates fuel supply is running low. Check fuel supply and replenish as required.
Shutdown lamp lights. MESSAGE: EEPROM ERROR 250 – SHUTDOWN	Indicates PCC memory error. Data corruption of critical operating parameters. Contact an authorized service center.

TABLE 4-2. WARNING AND SHUTDOWN CODES (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 mechanical hazards should perform service procedures. Review safety precautions.*

SYMPTOM	CORRECTIVE ACTION
<p>Warning lamp lights. MESSAGE: EEPROM ERROR 251 – WARNING or 252 – WARNING</p>	<p>Indicates PCC memory error. Data corruption of non-critical operating parameters. Contact an authorized service center.</p>
<p>Shutdown lamp lights. MESSAGE: CUSTOMER FAULT 1 260 – SHUTDOWN or GROUND FAULT 261 – SHUTDOWN or DAY TANK 262 – SHUTDOWN or HIGH GEN TEMP 263 – SHUTDOWN</p>	<p>When any one of these customer defined inputs is closed to ground, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. These fault functions can be programmed to initiate a shutdown or a warning. As indicated by the Shutdown lamp, a shutdown response has been preselected. Contact an authorized service center. Note: Customer fault messages are editable. The message displayed for the code shown (260 thru 263) may have been edited and may not appear as shown in this table.</p>
<p>Warning lamp lights. MESSAGE: CUSTOMER FAULT 1 260 – WARNING or GROUND FAULT 261 – WARNING or RUPTURE BASIN 262 – WARNING or HIGH GEN TEMP 263 – WARNING</p>	<p>When any one of these customer defined inputs is closed to ground, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. These fault functions can be programmed to initiate a shutdown or a warning. As indicated by the Warning lamp, a warning response has been preselected. Note: Customer fault messages are editable. The message displayed for the code shown (260 thru 263) may have been edited and may not appear as shown in this table.</p>

TABLE 4-2. 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 mechanical hazards should perform service procedures. Review safety precautions.*

SYMPTOM	CORRECTIVE ACTION
Shutdown lamp lights. MESSAGE: HIGH AC VOLTAGE 301 – SHUTDOWN	Indicates that one or more of the phase voltages has exceeded 130% of nominal, or has exceeded 110% of nominal for 10 seconds. Contact an authorized service center.
Shutdown lamp lights. MESSAGE: LOW AC VOLTAGE 303 – SHUTDOWN	Indicates that one or more of the phase voltages has dropped below 85% of nominal for 10 seconds. Contact an authorized service center.
Shutdown lamp lights. MESSAGE: UNDER FREQUENCY 313 – SHUTDOWN	Indicates that engine speed has dropped below 90% of nominal for 10 seconds. NOTE: Five seconds before shutdown, a Load Dump signal is initiated. Contact an authorized service center.
Warning lamp lights. MESSAGE: OVERCURRENT 320 – WARNING	Indicates that generator output current has exceeded 110% of rated for 60 seconds. Contact an authorized service center.
Shutdown lamp lights. MESSAGE: OVERCURRENT 321 – SHUTDOWN	Indicates that generator output current has exceeded 110% of rated, and that a PCC time/current calculation has initiated an overcurrent shutdown. Contact an authorized service center.

TABLE 4-2. 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 mechanical hazards should perform service procedures. Review safety precautions.

SYMPTOM	CORRECTIVE ACTION
Shutdown lamp lights. MESSAGE: SHORT CIRCUIT 322 – SHUTDOWN	Indicates that generator output current has exceeded 175% of rated. Contact an authorized service center.
Warning lamp lights. MESSAGE: OVERLOAD 330 – WARNING	Indicates that power output exceeds 105% of standby (or 115% of prime) rating. After five seconds, the Load Dump output is activated. After 60 seconds, the OVERLOAD warning is activated. Contact an authorized service center.
Shutdown lamp lights. MESSAGE: REVERSE POWER 335 – SHUTDOWN	Indicates improper CT or PT phasing. (Non-parallel units only.) Contact an authorized service center.
Engine starts from generator control panel but will not start automatically or from a remote panel. (Note: The Run/Off/Auto switch must be in the Auto position for automatic or remote starting).	Check the control wiring between the remote switch and the PCC. Contact an authorized service center.
No AC output voltage.	Contact an authorized service center.

TABLE 4-3. OIL PRESSURE WARNING/SHUTDOWN LIMITS

ENGINE MODEL	4B/6B/6C
Normal Oil Pressure Warning Limit Shutdown Limit	40 - 70 psi (276 - 483 kPa) 20 psi (138 kPa) 15 psi (103 kPa)
Idle Oil Pressure Warning Limit Shutdown Limit	10-30 psi (69-207 kPa) 12 psi (83 kPa) 8 psi (55 kPa)

5. Operation (Detector Control)

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. Refer to *Section 10* for operating recommendations.

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 cold coolant level should be about 3/4 inch (18 mm) below the radiator cap lower sealing surface. Do not check while the engine is hot.

⚠ WARNING *To prevent severe scalding, let engine cool down before removing coolant pressure cap. Turn cap slowly, and do not open it fully until the pressure has been relieved.*

Fuel

Make sure the fuel tanks have sufficient fuel and that fuel system is primed. Check to make sure there are no leaks and that all fittings are tight.

Exhaust

Check to make sure entire exhaust system is tight, that no combustible materials are near system, and gases are discharged away from building openings.

CONTROL PANEL

The following describes the function and operation of the Detector Control panel. All instruments and control switches are located on the face of the control panel as illustrated in Figures 5-1 through 5-3. 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.

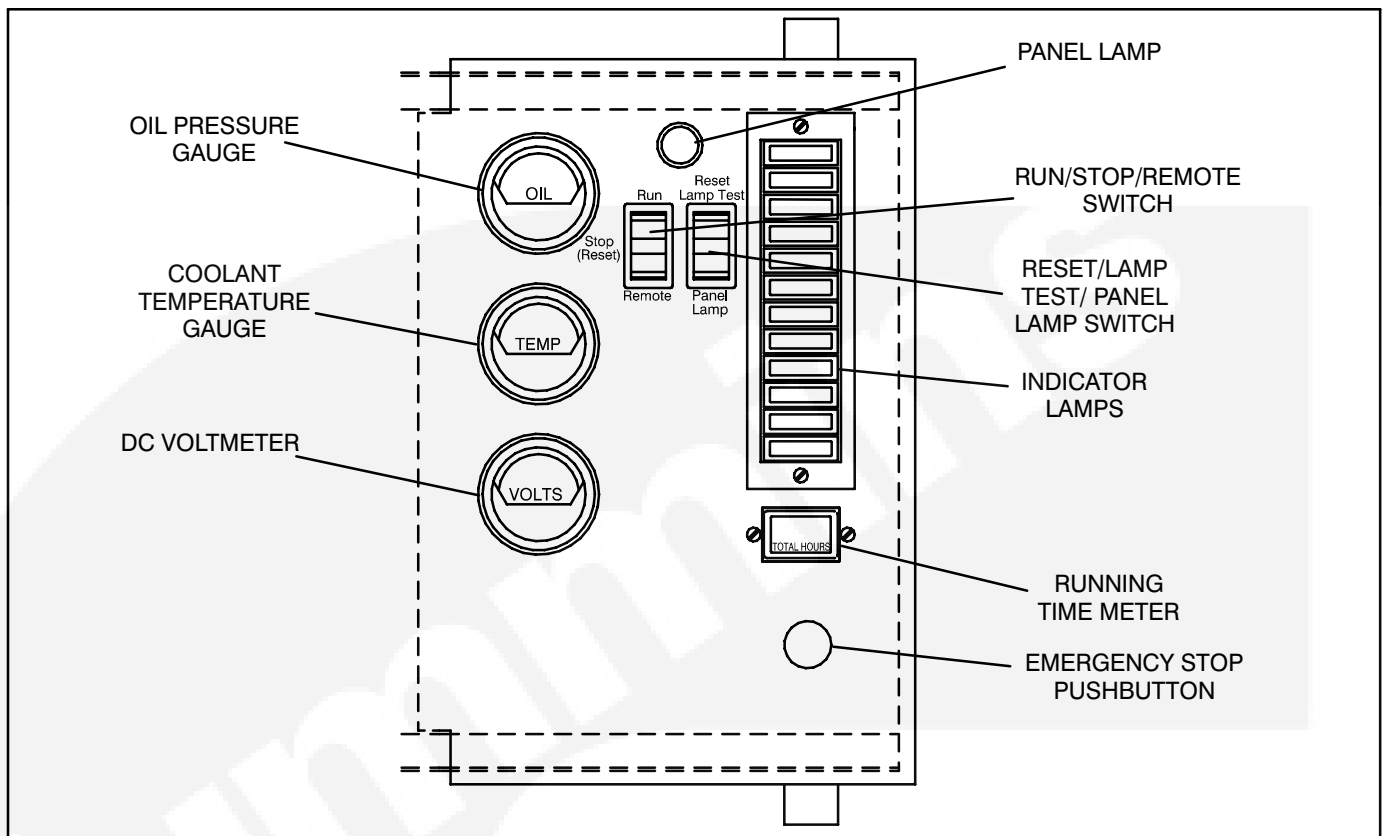


FIGURE 5-1. DC CONTROL PANEL

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). Normal oil pressure is 30 to 65 psi (207 to 449 kPa) at normal operating temperature.

Coolant Temperature Gauge: Indicates temperature of circulating coolant in engine (wired to a sensor located on engine). Engine coolant temperature should be between 165° to 195° F (74° to 91° C).

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.

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.

Indicator Lamps: The control panel has twelve 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.
- 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.
- OVERSPEED (red) indicates engine has shut down because of excessive speed.
- OVERCRANK (red) indicates engine has failed to start during the cranking period.
- 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),
OR
BASIN (yellow) lamp (optional) indicates inner fuel tank leaking to outer basin. (Normally set for warning while running or during standby.)
- FAULT 2 (red) lamp indicates same features as Fault 1 (normally set for non-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 is marginally low.
- SWITCH OFF (flashing red) indicates generator set is not in automatic start mode.

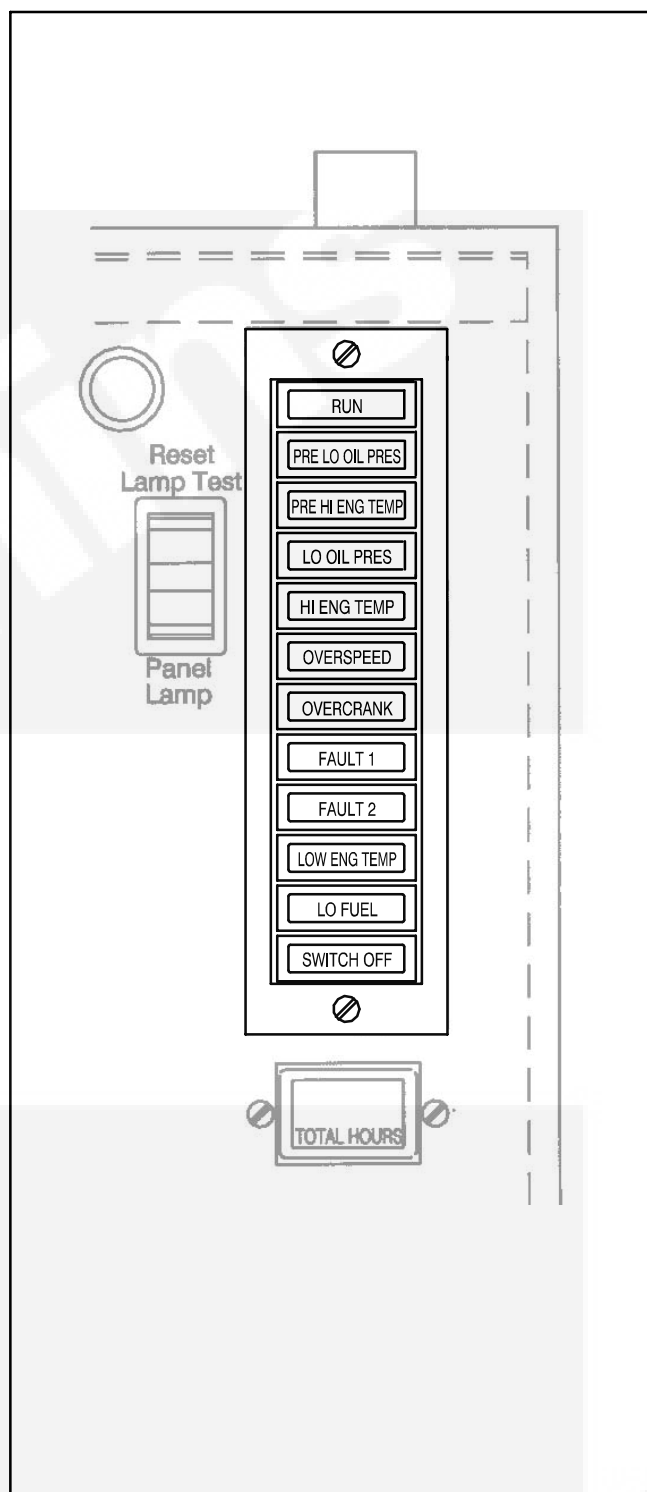


FIGURE 5-2. INDICATOR LAMPS

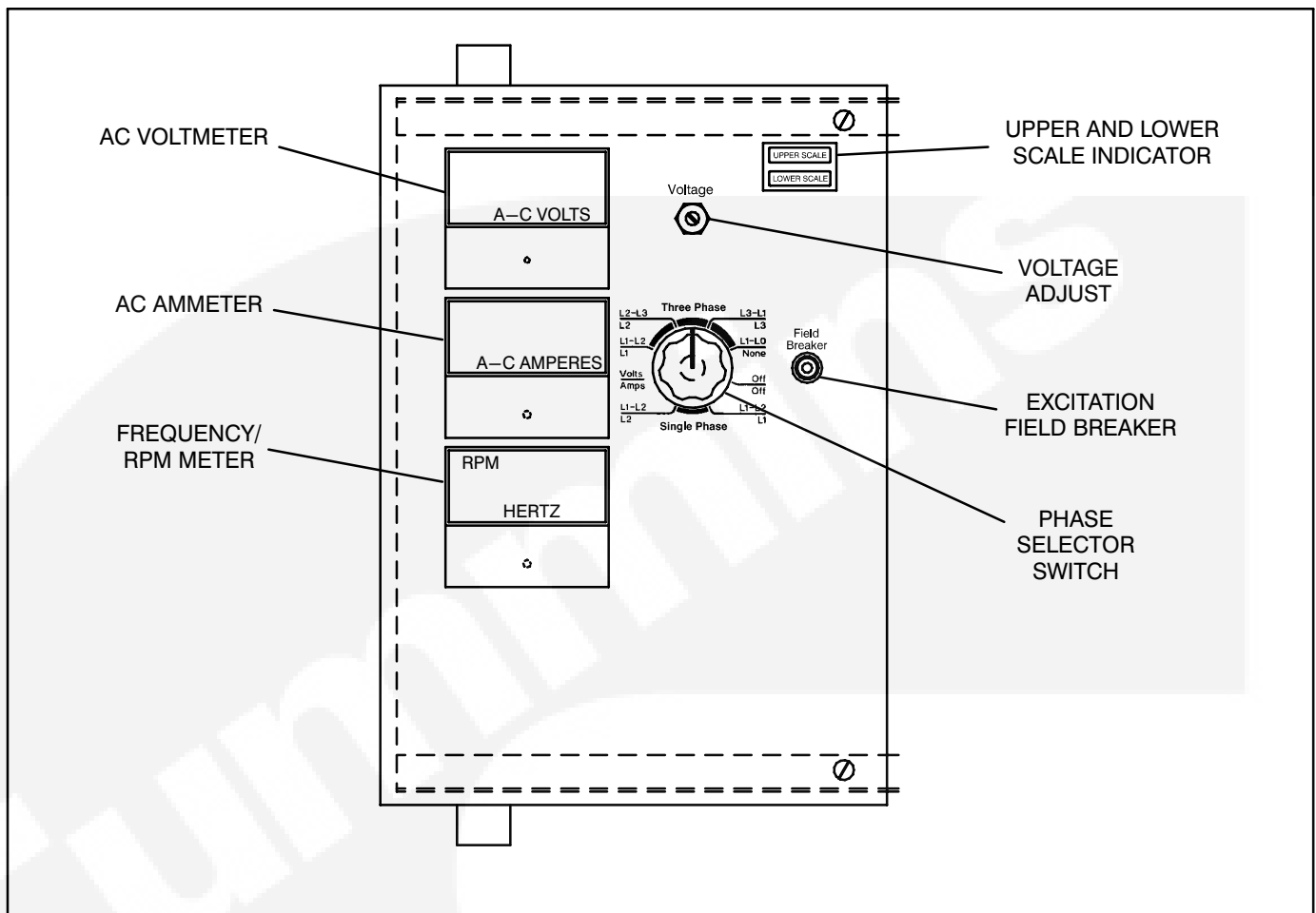


FIGURE 5-3. AC CONTROL PANEL

AC Panel

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

AC Ammeter: Dual range instrument indicates AC generator line current.

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

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

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

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

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. Refer to the genset Specification Sheet for the voltage regulation and random voltage variation specifications.

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 - The standard cycle cranking feature allows three 15-second cranking cycles with two 15-second rest periods. If engine fails to start, the module lights a fault lamp and opens the cranking circuit.

The overcrank option limits engine cranking to 75 seconds. If engine fails to start, the module lights a fault lamp and opens the cranking circuit.

- Overspeed - Shuts down the engine immediately if overspeed occurs and lights a fault lamp. Overspeed shut down settings: 60 hertz units at 2100 \pm 90 r/min, 50 hertz units at 1850 \pm 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 230° F (110° 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, 220° F (104° C). The cause should be found and corrected as soon as possible.

⚠ CAUTION *Loss of coolant can prevent sensor operation and allow the engine to overheat causing severe damage to the engine. Maintain coolant level for proper operation of the high engine temperature shutdown system.*

- Low Coolant Level Alarm/Shutdown (Optional)
 - An electronic switch that provides engine alarm or shutdown if coolant level falls too low. It also turns on the fault lamp.

STARTING

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

Before starting the generator set, make sure that exhaust and fuel fittings are tight and properly positioned and that proper maintenance has been performed. See *Prestart Checks* in this section.

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 automatically.

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 optional overcrank control will crank continuously for up to 75 seconds before disengaging the starter. Generator sets with the standard cycle cranking feature 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 press 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 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 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, Cummins Power Generation recommends installing standby gen-

erator 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 generator sets will start in temperatures below 40°F (4°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 Detector™ control is provided to meet the requirements of NFPA 110. The LET sensor signals an alarm 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 and operable. 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 transfer switch will send a remote (timed delay) stop signal after the normal power source returns.

Emergency Stop

An optional emergency stop button is located on the right side of control panel (Figure 5-1). 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.

7. Operation (Sentinel Control)

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. Refer to *Section 10* for operating recommendations.

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. Refer to "Cooling Systems" in the Maintenance section of this manual for proper procedure.

Fuel

Make sure the fuel tanks have sufficient fuel and that fuel system is primed. Check to make sure there are no leaks and that all fittings are tight.

Exhaust

Check to make sure entire exhaust system is tight, that no combustible materials are near system, and gases are discharged away from building openings.

CONTROL PANEL

The following describes the function and operation of the Sentinel control. All instruments and control switches are located on the face of the control panel as illustrated in Figure 7-1.

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.

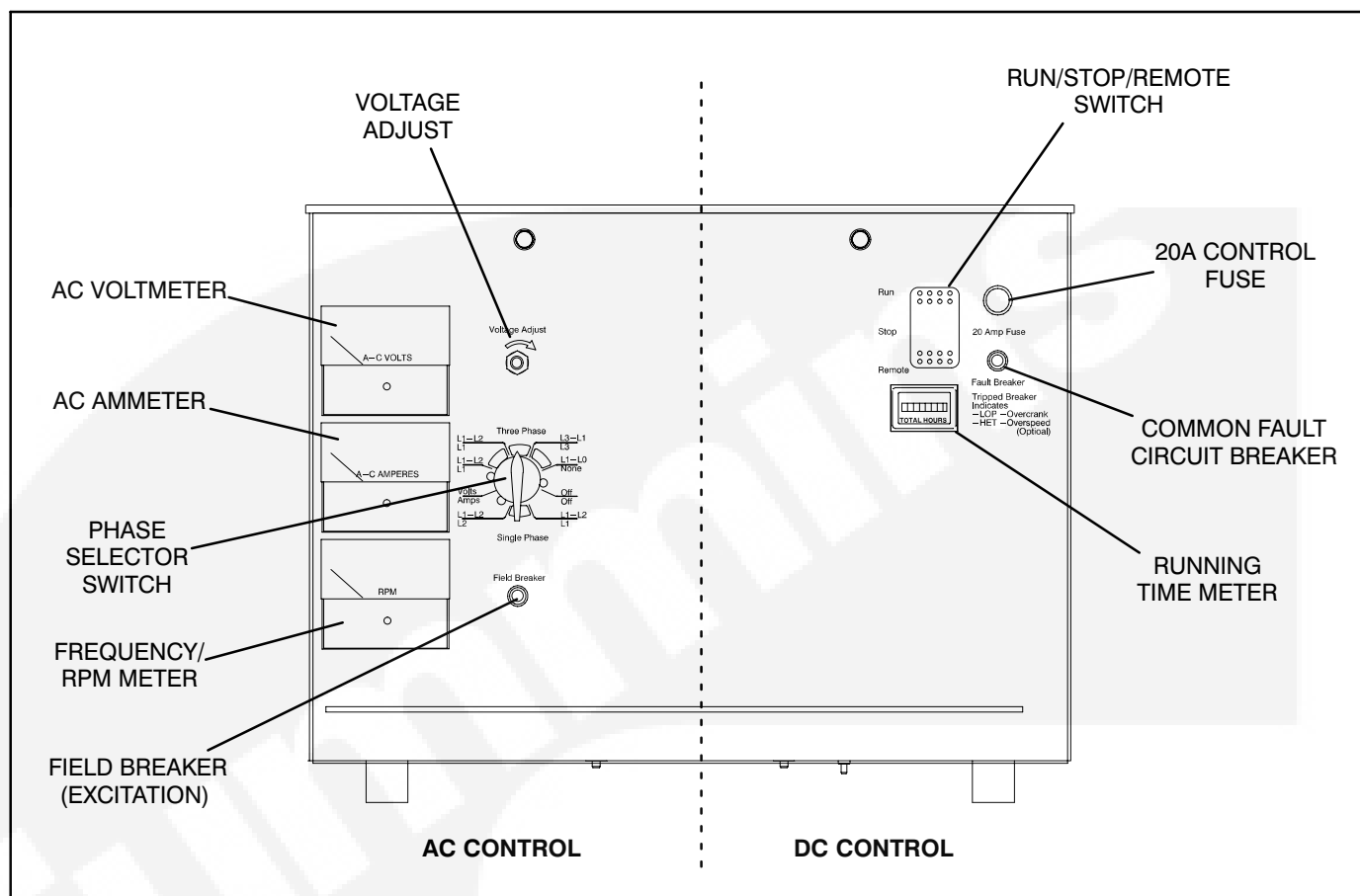


FIGURE 7-1. SENTINEL CONTROL PANEL

DC Control

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

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.

20A Control Fuse: Protects control components and wiring from current overload.

Common Fault Circuit Breaker: The common fault circuit breaker shuts down the engine when any fault shutdown sensor activates. Fault shutdown is indicated when the breaker reset button extends out past normal. Push the button to restore operation (after the engine has been properly serviced).

The standard fault shutdowns are low oil pressure, high engine temperature, overspeed, and overcrank. Optional fault shutdowns are low coolant level, low fuel level, and rupture basin.

AC Control

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.

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.

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

Field Breaker (Excitation): 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 MONITORING

Electronic and relay components of the engine monitoring circuit are mounted inside the control box. An optional Dry Contact Module (DCM) can also be installed in the control box to enable remote monitoring of these components. The components provide the following functions of unit protection.

Note: Refer to the *Installation Manual* for a functional description of the Dry Contact Module option.

- Overcrank - Limits engine cranking to 60 seconds. If engine fails to start, the Fault Breaker trips and opens the cranking circuit.
- Overspeed - Shuts down the engine immediately and trips the common fault circuit breaker if overspeed occurs. The shut down limits are: 60 hertz units at 2100 \pm 90 r/min, 50 hertz units at 1850 \pm 50 r/min.
- Low Oil Pressure - Shuts down the engine immediately if oil pressure drops below 14 psi (97 kPA) and trips the common fault circuit breaker. 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.
- High Engine Temperature - Shuts down the engine immediately if coolant temperature rises above 230° F (110° C) and trips the common fault circuit breaker. Fault condition cannot be cleared until sensor detects coolant temperature of lower than 222° F (106° C).
- Low Coolant Level (optional w/DCM) - Shuts down the engine immediately if coolant level

falls too low. Fault condition cannot be cleared until sensor detects coolant in radiator.

- Low Fuel Level (optional w/DCM) - Shuts down the engine immediately if fuel level falls too low. Fault condition cannot be cleared until sensor detects fuel in fuel tank.
- Rupture Basin (optional w/DCM) - Indicates that the inner fuel tank is leaking to the outer basin. Engine continues to run. Fault condition cannot be cleared until fuel leak is corrected. (Remote panel must be attached to control to monitor this error.)

⚠ CAUTION *Loss of coolant can prevent sensor operation and allow the engine to overheat causing severe damage to the engine. Maintain coolant level for proper operation of the high engine temperature shutdown system.*

STARTING

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

Before starting the generator set, make sure that exhaust and fuel fittings are tight and properly positioned and that proper maintenance has been performed. See *Prestart Checks* in this section.

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 60 seconds and the control will indicate an overcrank fault. To clear an overcrank fault, place the Run-Stop-Remote switch in the STOP position and reset the common fault circuit breaker. 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 (Sentinel Control)* section.

Starting From Remote Location

Move the Run/Stop/Remote switch on the generator set 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 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, Cummins Power Generation 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 applica-

tions, accept the emergency load in 10 seconds or less. Although most generator sets will start in temperatures below 40°F (4°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).

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 transfer switch will send a remote (timed delay) stop signal after the normal power source returns.



8. Troubleshooting (Sentinel Control)

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 common fault circuit breaker trips, and the engine shuts down. After the problem is corrected, reset the common fault circuit breaker to restart the generator set. This section describes the fault condition system, and suggests troubleshooting procedures.

SAFETY CONSIDERATIONS

⚠ 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.*

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 *Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.*

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

⚠ CAUTION *Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.*

⚠ WARNING *Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.*

When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted as follows:

1. Move the Run/Stop/Remote switch on the control panel to the Stop position.
2. Turn off or remove AC power from the battery charger.
3. Remove the negative (–) battery cable from the generator set starting battery.

When a fault condition occurs during operation, follow the procedures in Table 8-1 to locate and correct the problem. For any symptom not listed, contact an authorized service center for assistance.

TABLE 8-1. TROUBLESHOOTING

<p>⚠WARNING <i>Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.</i></p>	
SYMPTOM	CORRECTIVE ACTION
1. Engine will not crank.	<p>1. Indicates possible fault with control or starting system. Check for the following conditions.</p> <ul style="list-style-type: none"> a. Correct fault and reset common fault circuit breaker. 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. Replace the control circuit fuse (located inside the control panel) if it has blown.
2. The engine cranks, but does not start.	<p>2. 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 Maintenance section). c. Check for dirty or plugged air filter and replace if necessary (see Maintenance section). d. Reset the tripped common fault circuit breaker and restart after correcting the problem. Contact an authorized service center for service if none of the above.
3. The engine shuts down due to high engine temperature or low coolant level.	<p>3. Indicates engine has overheated (engine temperature has risen above 230°F/110°C). 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 the tripped common fault circuit breaker. Contact an authorized service center for service if none of the above.
4. Engine shuts down due to low oil pressure.	<p>4. 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 the tripped common fault circuit breaker. Contact an authorized service center if oil pressure is not in the range of 25 to 65 psi (172 to 449 kPa).</p>
5. The engine shuts down due to over-speed.	<p>5. Indicates engine has exceeded normal operating speed. Contact an authorized service center for service.</p>

TABLE 8-1. TROUBLESHOOTING (CONT.)

<p>⚠WARNING <i>Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.</i></p>	
SYMPTOM	CORRECTIVE ACTION
6. The engine shuts down due to low coolant level.	6. Indicates low coolant level. Replenish coolant and look for possible coolant leakage points and repair as required.
7. The engine shuts down due to low fuel level. (Sets with optional low fuel level sensor.)	7. Indicates diesel fuel supply is running low. Check fuel supply and replenish as required.
8. The engine shuts down due to any of six faults but remote monitor device does not detect fault.	8. Indicates possible fault with controller external wiring.
9. 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).	9. Remote circuit breaker is tripped. Reset breaker and restart. Contact an authorized service center if breaker trips after resetting.

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9. Maintenance

GENERAL

Establish and adhere to a definite schedule for maintenance and service based on the application and severity of the environment. Table 9-1 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 affect the maintenance schedule are the following:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to weather

- Exposure to salt water
- Exposure to dust, sand or other airborne contaminants

Consult with your local Cummins Power Generation 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 (Figure 9-1) 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 9-1 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

TABLE 9-1. MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	SERVICE TIME				
	Daily or after 8 Hours	Weekly or after 50 Hours	Monthly or after 100 Hours	3 Months or after 250 Hours	6 Months or after 500 Hours
Inspect Genset	X ¹				
Check Coolant Heater	X				
Check Oil Level	X				
Check Coolant Level	X				
Check Fuel Level	X				
Check Charge Air Piping	X				
Check Air Cleaner (Clean if required)		X ²			
Check Battery Charging System		X			
Drain Fuel Filter(s)		X ^{4, 5}			
Drain Water and Sediment from Fuel Tanks		X ⁴			
Check Anti-freeze and DCA Concentration			X ⁵		
Check Drive Belt Tension			X ^{3, 5}		
Drain Exhaust Condensate Trap			X		
Check Starting Batteries			X		
Change Crankcase Oil and Filter				X ⁶	
Change Coolant Filter				X ⁵	
Clean Crankcase Breather				X ⁵	
Change Air Cleaner Element				X ²	
Check Radiator Hoses for Wear & Cracks				X	
Check Governor Adjustment				X	
Change Fuel Filters					X ⁵
Clean Cooling System					X ⁵
Adjust Valve Lash	After 1000 hours ⁷				

X¹ Check for oil, fuel, cooling and exhaust system leaks. Check exhaust system audibly and visually with set running and repair any leaks immediately.

X² Perform more often in dusty conditions.

X³ Visually check belt for evidence of wear or slippage. Replace if hard or brittle.

X⁴ Drain 1 cup or more of fuel to remove water and sediment.

X⁵ Refer to engine operation and maintenance manual for procedure.

X⁶ If genset is used for prime power applications, change oil and filter every 3 months or 250 hours. If used for standby applications, change oil every 12 months or 250 hours, whichever comes first.

X⁷ Contact an authorized service center for service.

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 for continued 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, vents or other inlets to building and not allowed to accumulate in inhabitable areas.*

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, arcing switch or equipment, pilot light, or other igniter near the fuel system or in areas sharing ventilation.*

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 the genset 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 genset 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 (Detector Only): 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. Refer to *BATTERIES* later in this section for cleaning and safety precautions.

Engine

Monitor fluid levels and oil pressure and coolant temperatures frequently. Most engine problems give an early warning. Look and listen for changes in engine performance, sound, or appearance that can indicate service or repair is needed. Some engine changes to look for are as follows:

- Misfire
- Vibration
- Unusual noises
- Sudden changes in engine operating temperatures or pressures
- Excessive exhaust smoke
- Loss of power
- An increase in oil consumption
- An increase in fuel consumption
- Fuel, oil, or coolant leaks.

GENERATOR SET MAINTENANCE (Battery Disconnected)

⚠WARNING *Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.*

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last.

⚠CAUTION *Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.*

⚠WARNING *Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (-) cable from the battery terminal before beginning maintenance procedures.*

When performing the following maintenance procedures, make certain the generator set cannot be accidentally restarted as follows:

1. Place the run switch on the control panel to the OFF or STOP position.
2. Turn off or remove AC power from the battery charger.
3. Remove the negative (-) battery cable from the generator set starting battery.

Mechanical Inspection

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.

LUBRICATION SYSTEM

Gensets are shipped with oil added. Be sure to check oil level before initial start.

Oil API Classification

Refer to the Cummins engine *Operation and Maintenance Manual* for lubricating oil classification.

Oil Viscosity

Refer to the Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

Engine Oil Level

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table. The oil filter location is shown in Figure 9-2. 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. The dipstick and oil fill are located on the same side of the engine as shown in Figure 9-3.

⚠ 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 high mark on the dipstick. Remove the oil fill cap (see Figure 9-3) and add oil of the same quality and brand when necessary. Install the oil fill cap after adding oil.

⚠ 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 may cause loss of oil pressure.*

OIL AND FILTER CHANGE

Change the oil and filter at the intervals recommended in the maintenance table. Use oil that meets Cummins recommendations/specifications.

Engine Oil Change

Refer to the Cummins engine *Operation and Maintenance Manual* for lubricating oil and filter changing procedure. Refer to *Specifications* in Section 2 of this manual for oil capacity. Use oil that meets Cummins recommendations/specifications.

⚠WARNING *State or federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Do not contact oil or breath vapors. Use rubber gloves and wash exposed skin.*

Used oil and filters must be disposed of properly to avoid environmental damage and clean-up liability. Check all federal, state and local regulations for disposal requirements.

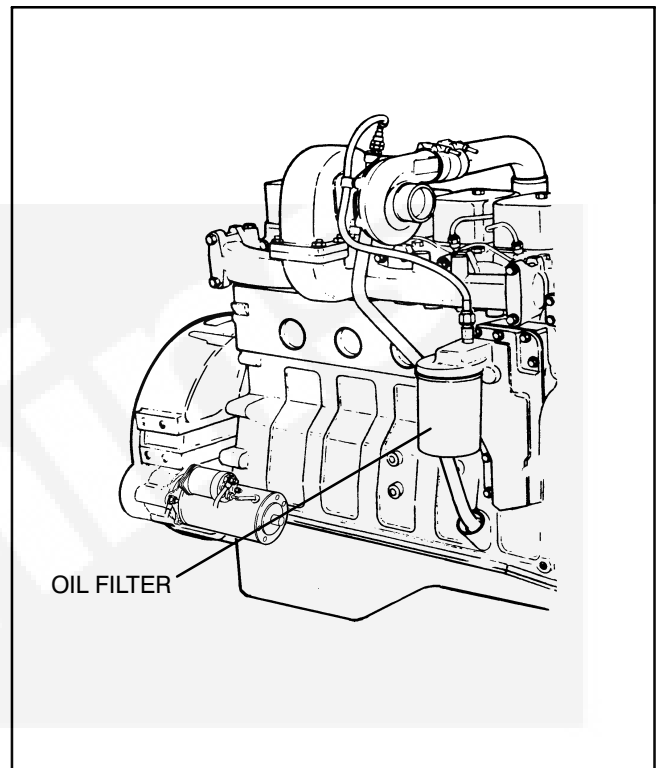


FIGURE 9-2. OIL FILTER

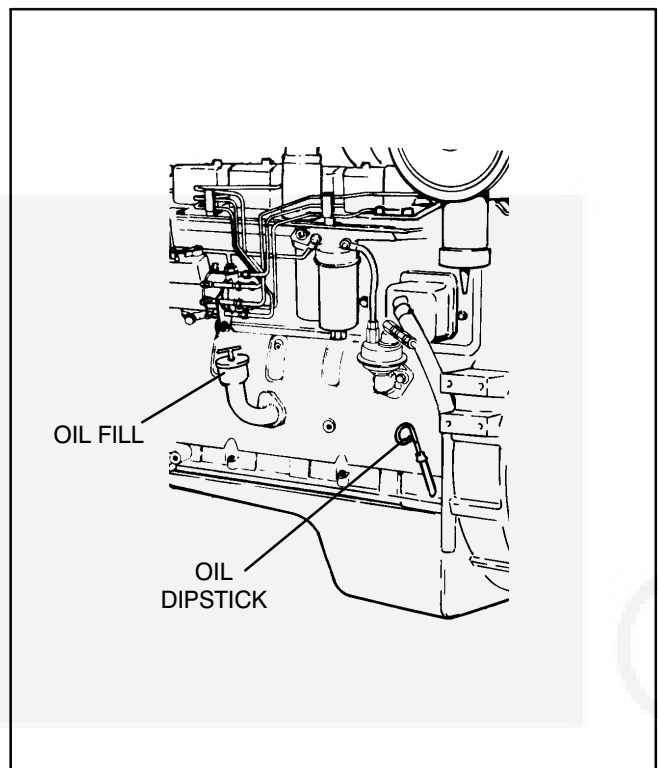


FIGURE 9-3. OIL FILL AND DIPSTICK LOCATIONS

COOLING SYSTEM

Gensets are shipped with coolant added. Be sure to check coolant level before initial start.

⚠ CAUTION *The 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.*

⚠ CAUTION *Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 120° F (50° C) before adding coolant.*

⚠ CAUTION *Engine damage and coolant heater failures can result from improper filling of the cooling system.*

Filling The Cooling System

When filling the cooling system, the vent valves must be opened. If the valves are not opened, the cylinder block and head will not fill completely with coolant. Running the engine, even for hours under load, will NOT vent air from the cooling system. The proper filling procedure is:

1. Consult the Operator's Manual for cooling system capacities and important safety considerations.
2. Be sure the genset is cool. Remove radiator cap, and open both the cylinder block and aftercooler vent valves (on units with aftercoolers).
3. Using a jug (not a hose!) pour the 50/50 mix of water and antifreeze into the radiator, closing the vent valves when water, free of air bubbles, runs from them.
4. Replace the radiator cap.
5. Operate the engine under load, until the coolant reaches operating temperature.
6. Allow the unit to cool, and carefully remove the radiator cap.
7. Top off the coolant level and replace the radiator cap.

Coolant Level

With Coolant Recovery Tank: Check the coolant recovery tank level. Note the normal level when the

engine is cool. Add coolant to the recovery tank to replace the normal loss of coolant.

Without coolant recovery tank: 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.

Refer to the Cummins engine *Operation and Maintenance Manual* for coolant recommendations/specifications.

⚠ WARNING *To prevent severe scalding, let engine cool down before removing coolant pressure cap. Turn cap slowly, and do not open it fully until the pressure has been relieved.*

⚠ CAUTION *Loss of coolant can allow engine to overheat without protection of shutdown device and cause severe damage to the engine. Maintain coolant level for proper operation of the high engine temperature shutdown system.*

Coolant Requirements

Heavy duty diesel engines require a balanced coolant mixture of water, antifreeze and coolant additives. Drain and replace the mixture every 6 months or after 500 hours of operation (whichever occurs first) to eliminate buildup of harmful chemicals.

Refer to the Cummins engine *Operation and Maintenance Manual* for all cooling system maintenance, such as, coolant requirements, filling of cooling system, coolant filter replacement and flushing and cleaning.

Radiator

Inspect the exterior of the radiator for obstructions. Remove all dirt or foreign material with a soft brush or cloth. Use care to avoid damaging the fins. If available, use low pressure compressed air or stream of water (maximum of 35 psi/242 kPa), in opposite direction of normal air flow to clean radiator. If using water, protect the engine and the generator from over spray.

Coolant Heater

Check the operation of the coolant heater by verifying that hot coolant is being discharged from the outlet hose. **Do not touch outlet hose** – if heater is operational, radiant heat should be felt with hand held close to outlet hose.

⚠WARNING *Contact with cooling system or engine can result in serious burns. Do not touch cooling system or engine during genset maintenance until they are cool.*

CHARGE AIR COOLER SYSTEM

Refer to the Cummins engine *Operation and Main-*

tenance Manual for the instructions to perform the charge air cooler system maintenance checks.

FUEL SYSTEM

Refer to the Cummins engine *Operation and Maintenance Manual* for fuel system maintenance.

AIR CLEANER

The filter element should be replaced yearly or sooner if the service indicator button pops up indicating air restriction. Two types of air filter assemblies are used on the generator set. Refer to Figure 9-5 to determine which procedure to use to replace the air filter.

The vacuator valve dumps collected dust automatically.

Inspect all components of the air filtering system including all ducts and hoses. Verify that all connections and clamps are tight and inspect each component for cracks, dents, or other damage. Repair or service as required.

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

The following procedure should be followed when replacing the element.

Type A Filter Assembly

1. Release the three cover clips and remove the air cleaner cover.
2. Slowly remove the air filter to reduce the amount of dust dislodged. There may be some initial resistance when removing the filter.

Gently move the end of the filter up and down and side to side or twist to break the seal.

3. Wipe out the interior of the air cleaner housing and cover with a clean, damp cloth. Make sure that **ALL** dust is removed from **ALL** interior surfaces of the air cleaner housing. Be careful not to damage the sealing area on the outlet tube.
4. Inspect new air filter for shipping damage. Pay attention to the inside of the open end (sealing area). Do not install a damaged filter.
5. Install new air filter. The seal area is on the inside of the open end of the filter. The sealing area will stretch slightly and adjust itself over the outlet tube. To complete the seal, apply pressure at the outer rim of the filter, not the flexible center. No cover pressure is required to hold the seal.
5. Put on the air cleaner cover and secure with the three cover clips.

Type B Filter Assembly

1. Remove the air cleaner cover.
2. Remove thumb screw and gasket washer, then remove the element from air cleaner.
3. Wipe out the interior of the air cleaner housing and cover with a clean, damp cloth.
4. Install new element and secure with gasket washer and thumb screw.
5. Put on the air cleaner cover and secure.

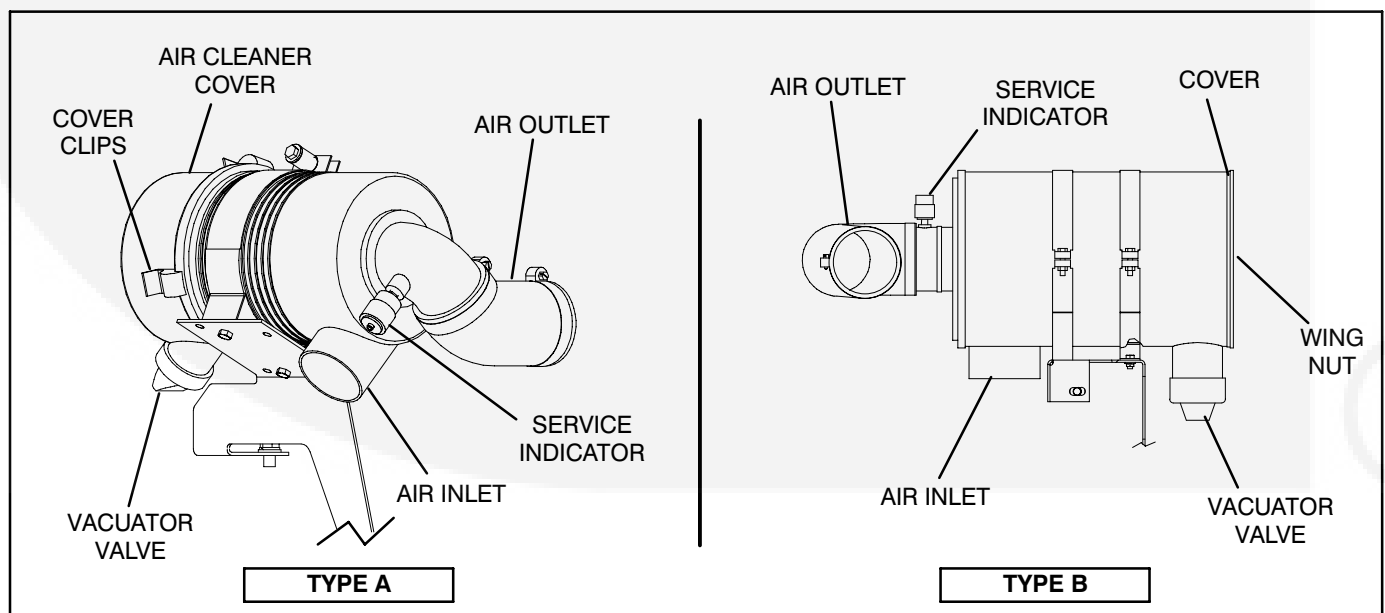


FIGURE 9-5. AIR CLEANER

BATTERIES

⚠WARNING *Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.*

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last.

⚠CAUTION *Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.*

Check the condition of the starting batteries at the interval specified in the Maintenance Table. To prevent dangerous arcing, always disconnect the negative ground cable from the battery before working on any part of the electrical system or the engine. Disregard the sections On Checking Specific Gravity and Checking Electrolyte Level if using a “maintenance-free” battery.

Cleaning Batteries

⚠WARNING *Electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. Do not get the substance in your eyes or contact with skin. Wear goggles and protective, rubber gloves and apron when servicing batteries.*

In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN.

Keep the batteries clean by wiping them with a damp cloth whenever dirt appears excessive.

If corrosion is present around the terminal connections, remove battery cables and wash the terminals with a solution consisting of 1/4 pound of baking soda added to 1 quart of water. (This solution is also used for washing down spilled electrolyte.)

Be sure the vent plugs are tight to prevent cleaning solution from entering the cells.

After cleaning, flush the outside of the battery and surrounding areas with clean water.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or non-conductive grease to retard corrosion.

Checking Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell.

Hold the hydrometer vertical and take the reading. Correct the reading by adding four gravity points (0.004) for every ten degrees the electrolyte temperature is above 80° F (27° C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if the reading is below 1.215.

Checking Electrolyte Level

⚠CAUTION *Do not add water in freezing weather unless the engine will run long enough (two to three hours) to assure a thorough mixing of water and electrolyte.*

Check the level of the electrolyte (acid and water solution) in the batteries at least every 200 hours of operation.

Fill the battery cells to the bottom of the filler neck. If cells are low on water, add distilled water and recharge. If one cell is low, check case for leaks. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

Battery Replacement

Always replace the starting battery with the same number and type (vented, lead acid). Properly dispose of battery in accordance with local environmental agency requirements.

⚠WARNING *Electrolyte or explosion of battery can cause severe personal injury or death. Do not mutilate or burn the battery in a fire for disposal.*

Damage to case will release electrolyte which is harmful to the skin and eyes and is also toxic. Burning of battery may cause an explosion.

10. Operating Recommendations

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 load bank of at least 30 percent of nameplate rating.

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 month for a minimum of 30 minutes, under not less than 30 percent of the nameplate rating.

LOW OPERATING TEMPERATURE

Use a coolant heater if a separate source of power is available. The optional heater 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.

HIGH OPERATING TEMPERATURE

Refer to the genset nameplate for the maximum ambient operating temperature, if applicable.

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