



Operator Manual

Our energy working for you.™



Generator Set
with PowerCommand® 3100 Controller or with Detector™ Control

DFGA (Spec D–H)

DFGB (Spec D–H)

DFGE (Spec A)

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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.

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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.

MEDIUM VOLTAGE GENERATOR SETS

(601V to 15kV)

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

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

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), or the optional 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.*

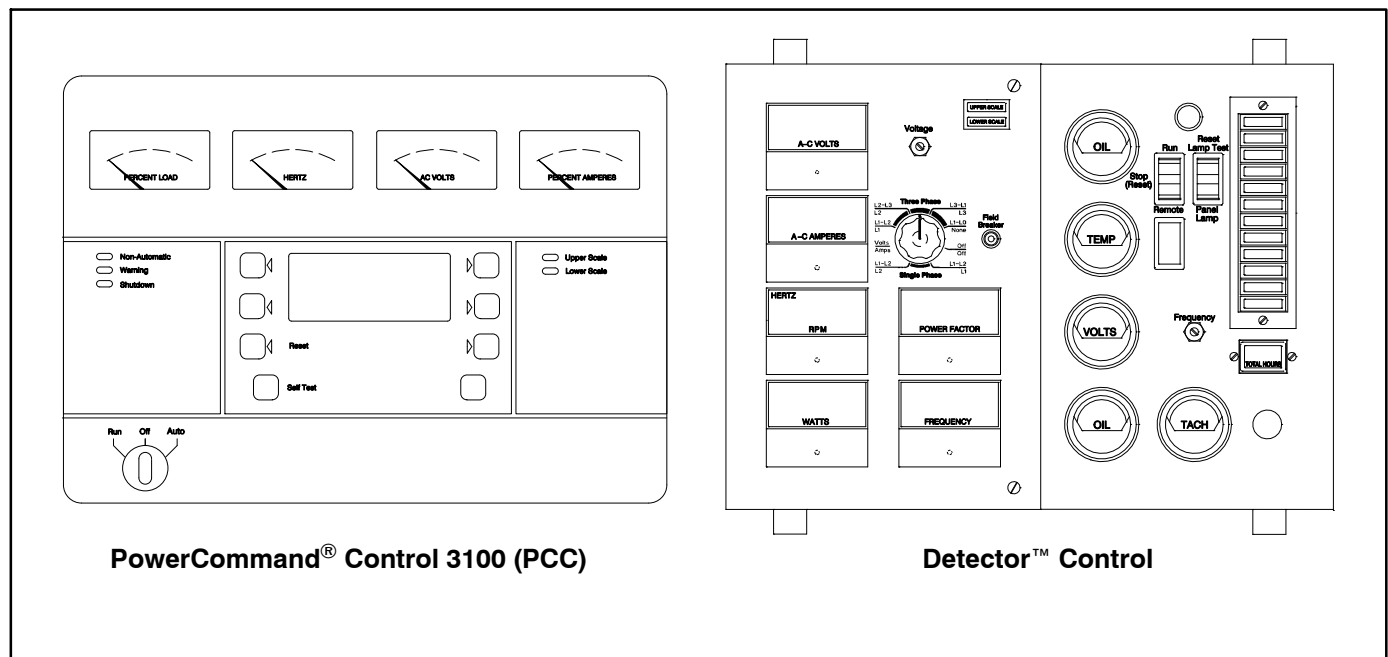


FIGURE 1-1. CONTROL PANEL CONFIGURATIONS

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 1-763-528-7229.

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.

2. Specifications

MODEL	DFGA, DFGB, DFGE
Engine Cummins Diesel Series	VTA28
Generator kW Rating	See Genset Nameplate for rating information.
Electrical System Starting Voltage Battery Group Number CCA (minimum) Cold Soak @ 0°F (-18° C)	24 Volts DC Four, 12 Volt 8D 1400
Cooling System Capacity with Standard Radiator	44 Gal (167 L)
Lubricating System Oil Capacity with Filters Oil Type*	22.25 Gal (84 L)
* Refer to Cummins engine <i>Operation and Maintenance Manual</i> for lubricating oil recommendations/specifications.	

FUEL CONSUMPTION (STANDBY/FULL LOAD/60HZ)

MODEL	DFGA	DFGB	DFGE
US gph (L/hr)	37.4 (141.7)	44.2 (167.5)	58.5 (221)

OIL PRESSURE WARNING AND SHUTDOWN LIMITS (PCC ONLY)	
Normal Oil Pressure	50-90 psi (345-620 kPa)
Warning Limit	40 psi (276 kPa)
Shutdown Limit	35 psi (241 kPa)
Idle Oil Pressure	20 psi (138 kPa)
Warning Limit	15 psi (103 kPa)
Shutdown Limit	10 psi (69 kPa)

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3. Operation (PCC)

GENERAL

The following describes the function and operation of the PowerCommand® Control 3100 (PCC). All indicators, displays, meters and control switches are located on the face of the control panel as illustrated in Figure 3-1.

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 9* for operating recommendations.

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

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.

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 | ● Throbbing in Temples |
| ● Nausea | ● Muscular Twitching |
| ● Headache | ● Vomiting |
| ● Weakness and Sleepiness | ● 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.

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, refer to the Installation manual.

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.

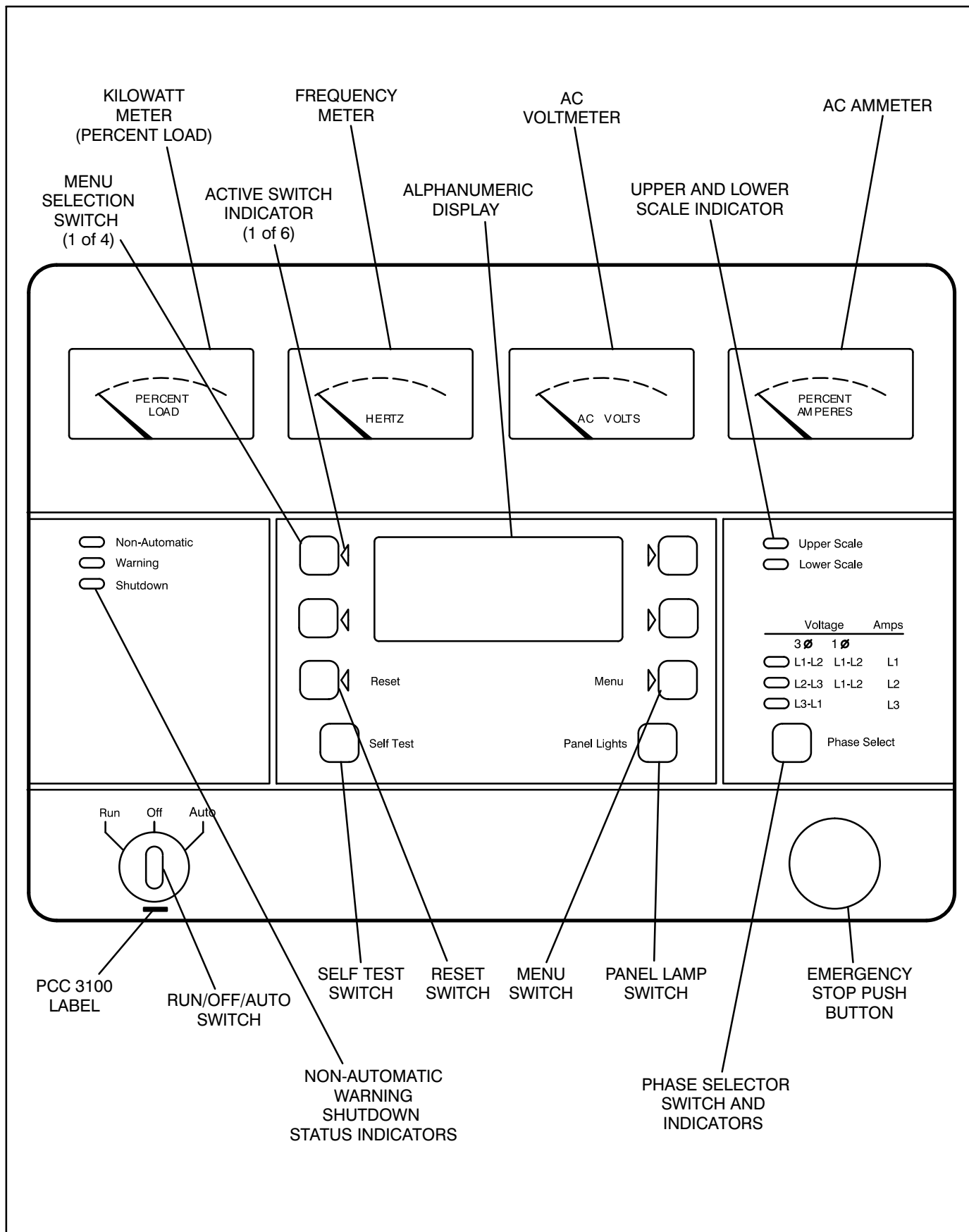


FIGURE 3-1. FRONT PANEL (PCC 3100)

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:

Pull the button out or turn the button clockwise (button with arrow) 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 and the front panel is turned on 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.

When the generator set is operating in the Remote Start mode, removing the Remote Start command does not shut off the engine if the load is more than

10 per cent, the cooldown timer is set to zero, and the control is configured for a single unit (not in parallel). The generator set continues to operate until it runs out of fuel, the E-stop button is used, or the load is removed.

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, Cummins Power Generation recommends installing diesel standby generator sets (life safety systems) equipped with engine jacket water coolant heaters in locations where the minimum ambient temperature is above 40°F (4°C). NFPA also requires that the engine be heated as necessary to maintain the water jacket temperature determined by the manufacturer for cold start and load acceptance for the type of system. Although most Cummins Power Generation generator sets will start in temperatures down to –25°F (–32°C) when equipped with engine jacket water coolant heaters, it might take more than 10 seconds to warm the engine before a load can be applied when ambient temperatures are below 40°F (4°C).

On generator sets equipped with a graphic display, the **Low Coolant Temperature (Code 210)** message, in conjunction with illumination of the Warning LED, is provided to meet the requirements of NFPA 110. The engine cold sensing logic initiates a warning when the engine jacket water coolant temperature falls below 70°F (21°C). In applications where the ambient temperature falls below 40°F (4°C), a cold engine may be indicated even though the coolant heaters are connected and operating correctly. 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, pull the button out or turn the button clockwise (button with arrow) 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.

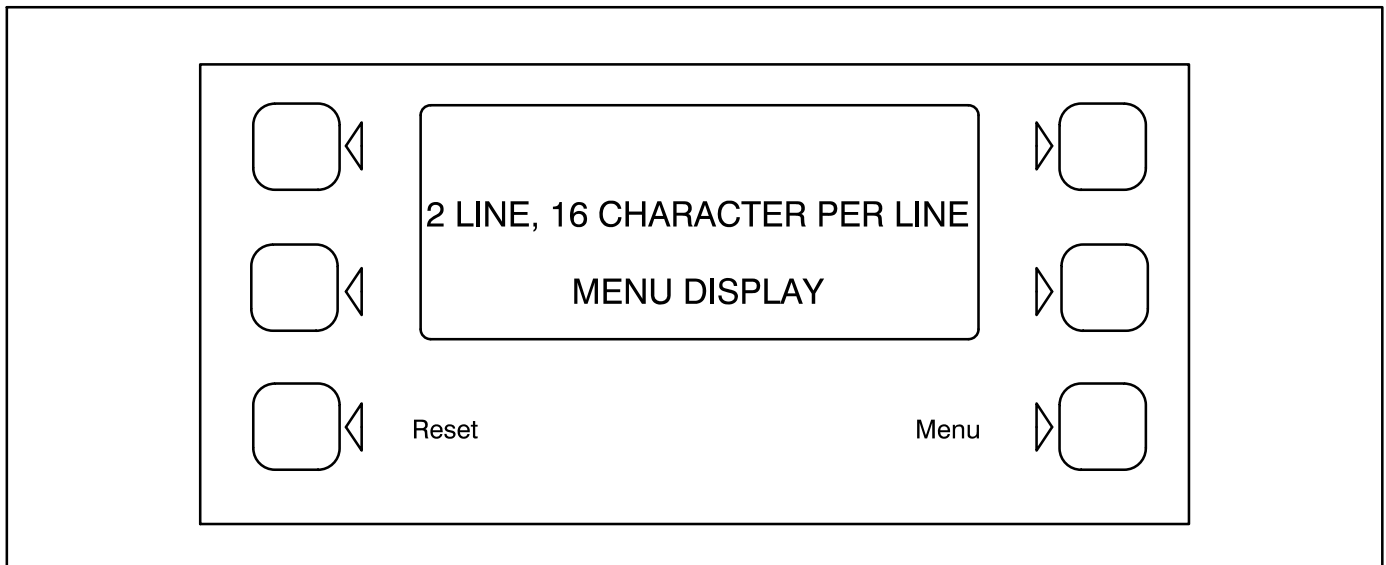


FIGURE 3-2. DIGITAL DISPLAY AND MENU SELECTION SWITCHES

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.

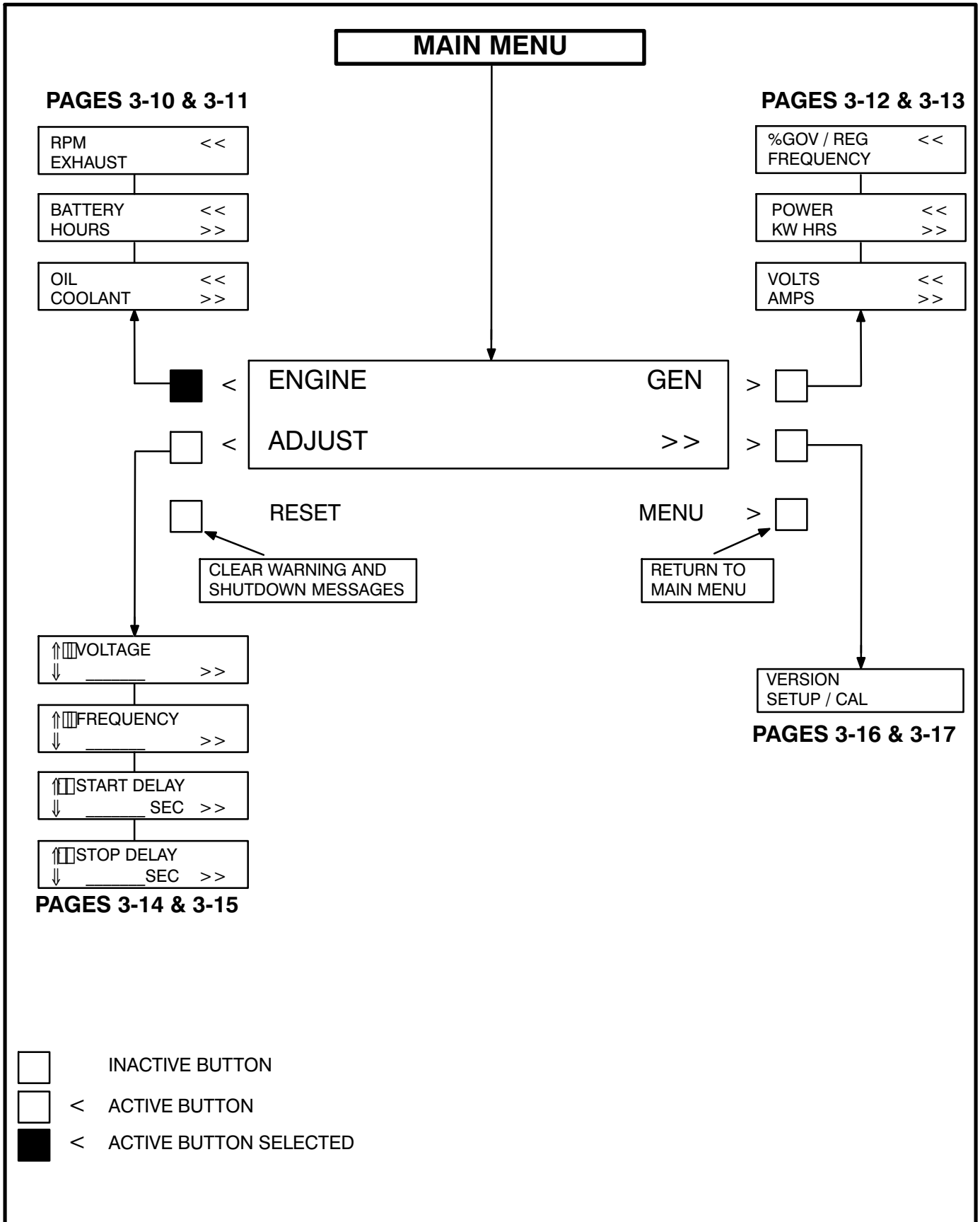
To display engine parameters, such as oil pressure and temperature, water temperature, engine speed (RPM), and exhaust temperature, press the button next to the word “ENGINE” in the display. Turn to the ENGINE menu diagram on page 3-11.

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.

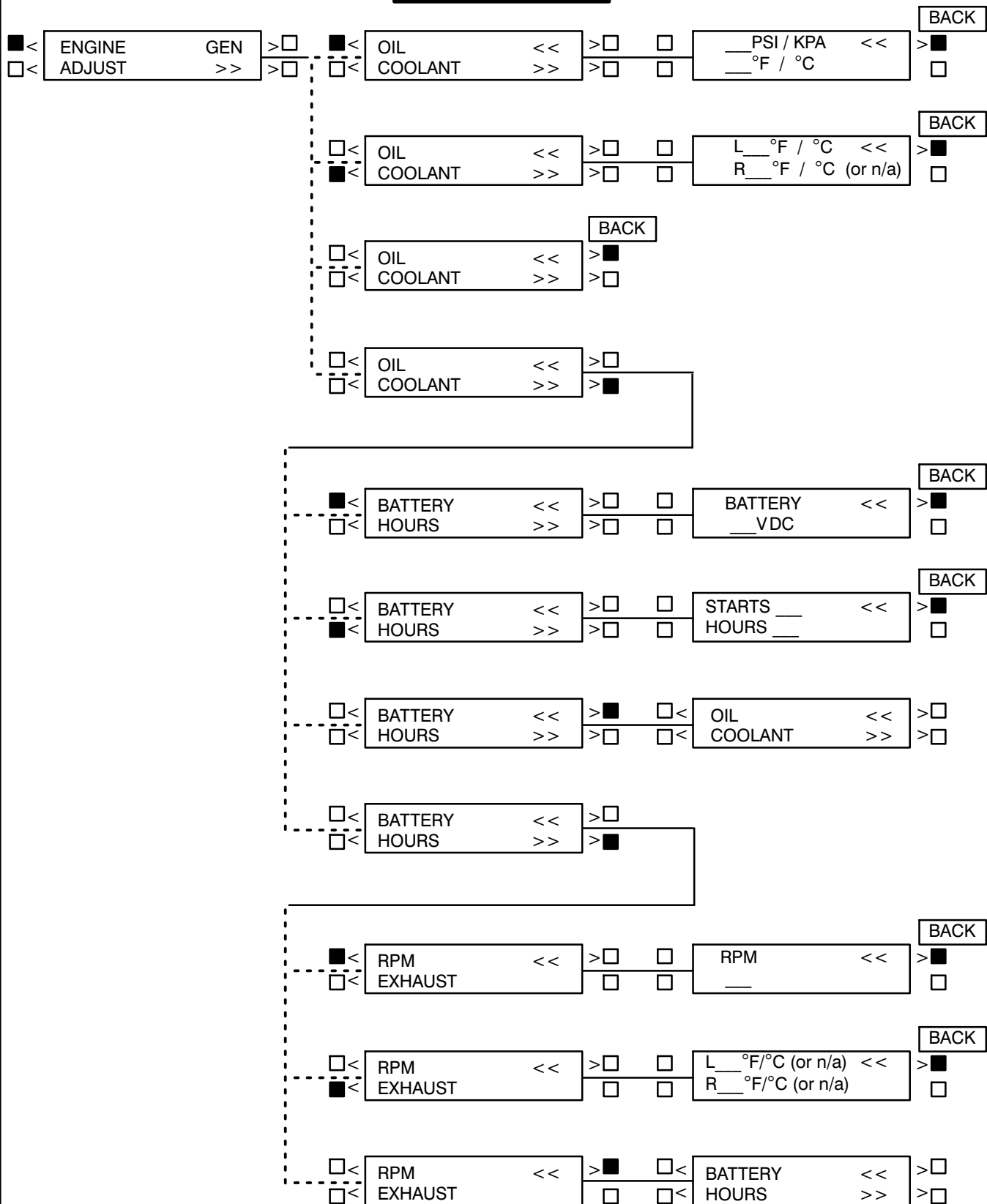
OIL/COOLANT submenu: This is the first submenu. Select OIL for a display of oil pressure and oil temperature. Select COOLANT for a display of coolant temperature. When oil or coolant parameters are displayed, pressing the button next to the "<<" will return the display ("BACK") to the OIL/COOLANT submenu.

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.

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.

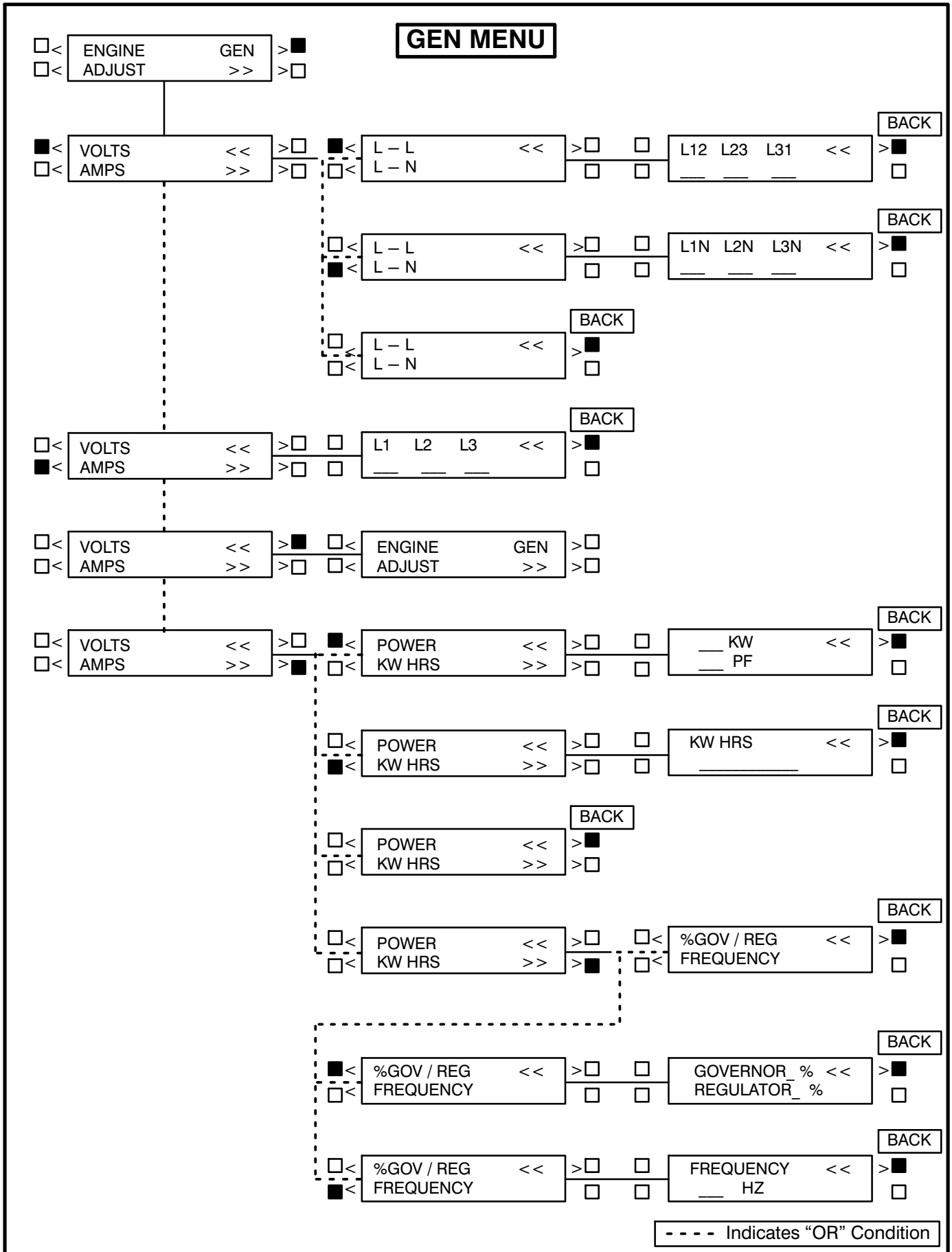
If DELTA is selected in the Initial Start Setup submenu, when selecting VOLTS, the "line-line" or "line-neutral" submenus will not be displayed, only the L12, L23, L31 submenu will be displayed.

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).

Beginning Version 1.06, 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.



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.

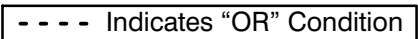
IDLE SPEED submenu: From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the IDLE SPEED submenu. Use the buttons next to the “↑” and “↓” symbols to set the idle speed. The idle speed adjustment range is 800 RPM ± 100 RPM. (Default value is 800 RPM.)

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 genset is shut down, but will be reset (and will not be in effect) when the set is restarted.

ADJUST



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 and etc. This menu provides the following information:

- Generator set voltage
- WYE or DELTA
- Standby or Prime
- Parallel or Single

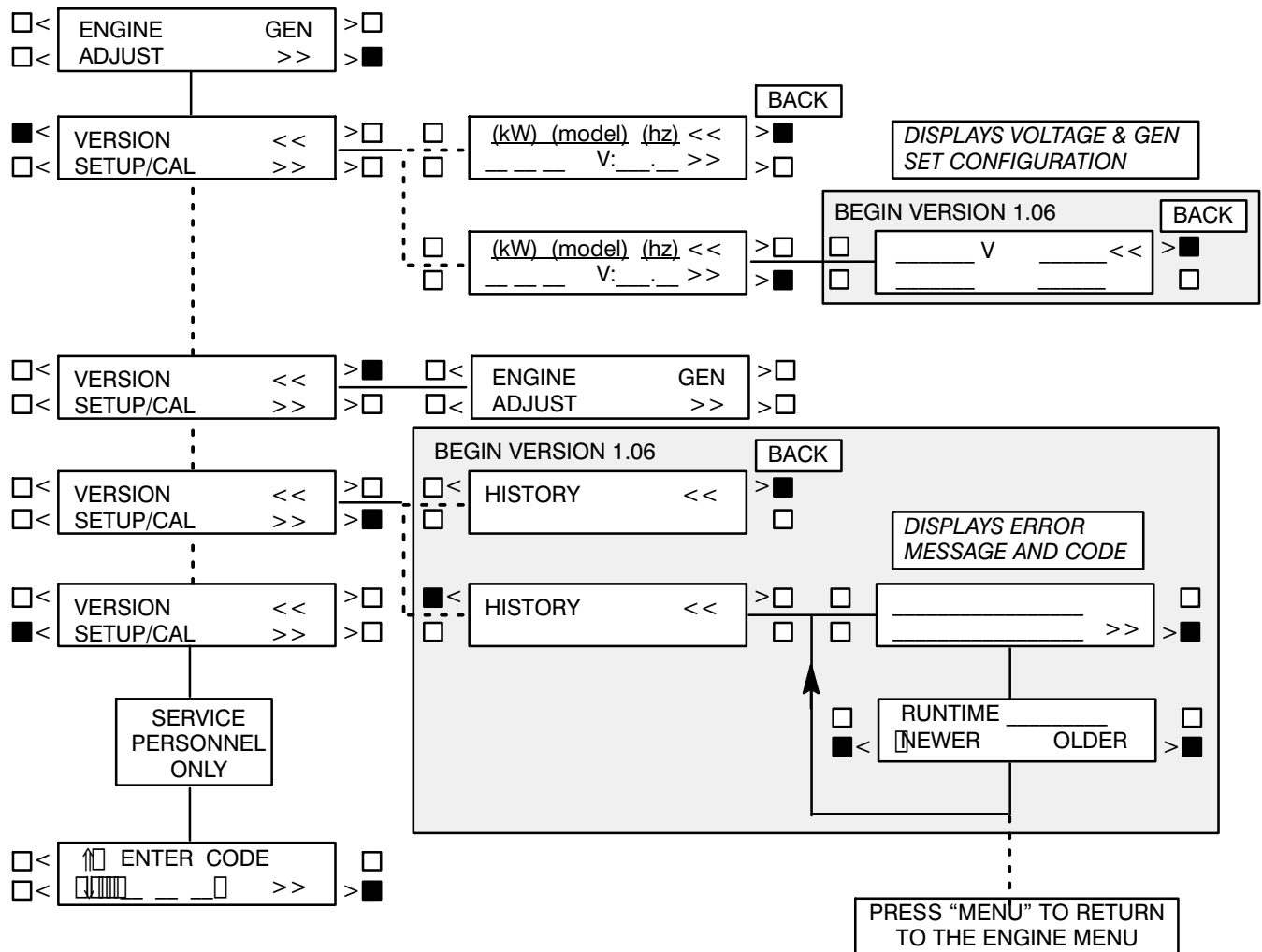
HISTORY: (Beginning Version 1.06) From the VERSION menu, press the button next to the ">>" in the display to move to the HISTORY submenu. Press the button next to "HISTORY" to display the last (latest) recorded error message.

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.

VERSION MENU



- - - - Indicates "OR" Condition

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4. Troubleshooting (PCC)

The PowerCommand® Control 3100 (PCC) 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).

Specifications section lists the PCC oil pressure warning and shutdown limits.

SAFETY CONSIDERATIONS

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

High voltages are present when the set is running. Do not open the 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/Off/Auto switch on the control panel to the OFF 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 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.

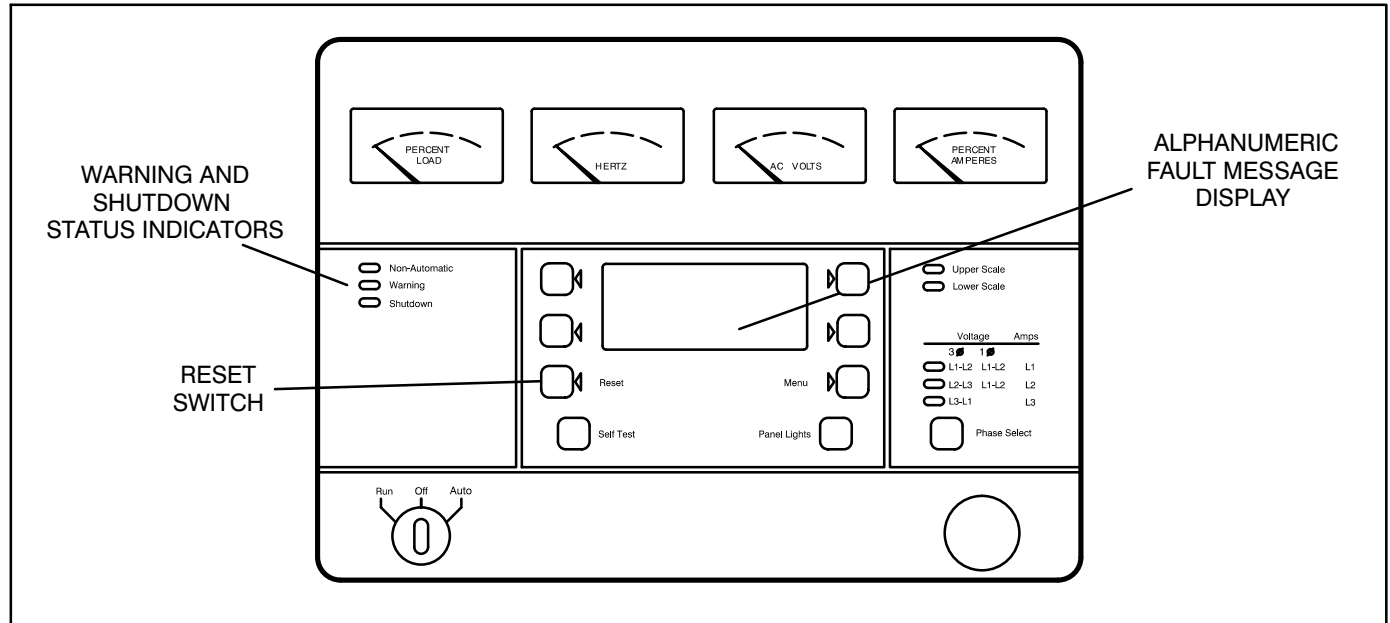


FIGURE 4-1. CONTROL PANEL (PCC 3100)

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/Shutdown	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 <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>	
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 for battery disconnected, discharged, or improperly connected. - Contact an authorized service center.
Warning, Shutdown, and Non-Automatic lamps are not lit. Digital display shows main menu or selected menu.	Indicates all engine systems are normal. No corrective action require
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 : - Pull the button out or turn the switch clockwise (button with arrow) 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.

TABLE 4-2. TROUBLESHOOTING (CONT.)

⚠ 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>	
SYMPTOM	CORRECTIVE ACTION
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 <i>Specifications</i>. Contact an authorized service center.
Warning lamp lights. MESSAGE: OIL PRES SENDER 204 – WARNING	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.
Warning lamp lights. MESSAGE: LOW COOLANT TEMP 210 – WARNING 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.	Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions: - 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.
Warning lamp lights. MESSAGE: HIGH COOLANT TEMP 211 – WARNING	Indicates engine has begun to overheat and coolant temperature has risen to an unacceptable level: (215° F – standby / 207° F – primary). If generator is powering non-critical and critical loads and cannot be shut down, use the following: - Reduce load if possible by turning off non-critical loads. - Check air inlets and outlets and remove any obstructions to airflow. If engine can be stopped, follow the next procedure. To check coolant temperature, access Coolant Temp menu prior to clearing the fault.

TABLE 4-2. TROUBLESHOOTING (CONT.)

⚠ 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>	
SYMPTOM	CORRECTIVE ACTION
Shutdown lamp lights. MESSAGE: HIGH COOLANT TEMP 212 – SHUTDOWN	Indicates engine has overheated (coolant temperature has risen above the shutdown trip point: 223° F – standby / 215° F – primary) or the coolant level is low. Allow engine to cool down completely before proceeding with the following checks: - 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.
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 – WARNINGor LOW COOLANT LVL 215 – SHUTDOWN	Indicates engine coolant level has fallen below the trip point. Allow engine to cool down completely before proceeding. - 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. - Restart and check RPM on the digital display. - Contact an authorized service center.

TABLE 4-2. TROUBLESHOOTING (CONT.)

⚠ 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>	
SYMPTOM	CORRECTIVE ACTION
Shutdown lamp lights. Engine will not crank. MESSAGE: FAIL TO CRANK 221 – SHUTDOWN	Indicates possible fault with control or starting system. Check for the following conditions: a. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. b. Discharged or defective battery. Recharge or replace the battery. c. 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. 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. c. Check for dirty or plugged air filter and replace if necessary. d. Reset the control and restart after correcting the problem. Contact an authorized service center if none of the above.
Shutdown lamp lights. Engine runs and then shuts down. 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 24 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 32 VDC. Contact an authorized service center.

TABLE 4-2. TROUBLESHOOTING (CONT.)

⚠ 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>	
SYMPTOM	CORRECTIVE ACTION
Warning lamp lights. MESSAGE: WEAK BATTERY 232 – WARNING	Indicates battery voltage drops below 60% of nominal 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.
Warning lamp lights. MESSAGE: EEPROM ERROR 251 – WARNING or 252 – WARNING	Indicates PCC memory error. Data corruption of noncritical operating parameters. Contact an authorized service center.
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	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.

TABLE 4-2. TROUBLESHOOTING (CONT.)

⚠ 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>	
SYMPTOM	CORRECTIVE ACTION
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	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 pre-selected. 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.
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 (CONT.)

⚠ 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>	
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 three-phase 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.

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 9* 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 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.

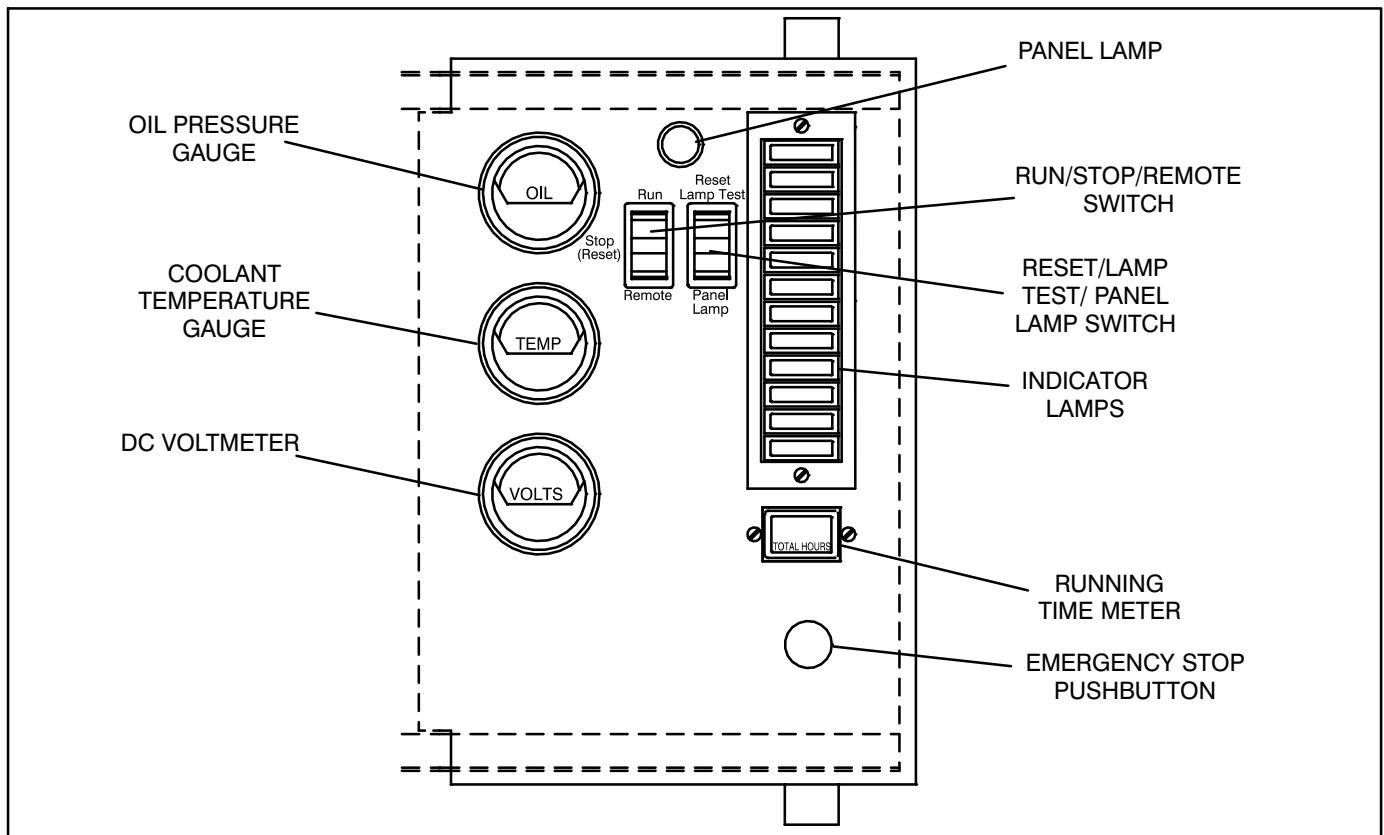


FIGURE 5-1. DC CONTROL PANEL

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).

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

DC Voltmeter: Indicates the battery charging system voltage.

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

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

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

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.

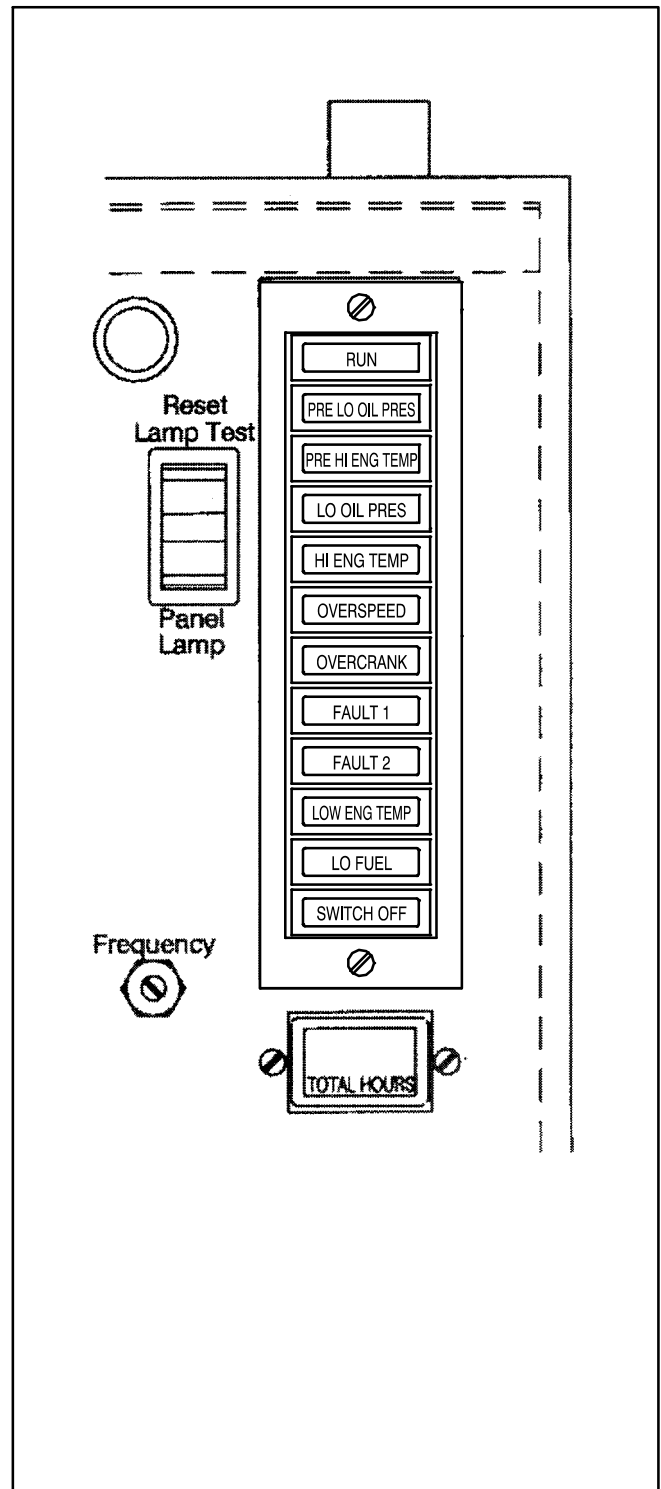


FIGURE 5-2. INDICATOR LAMPS

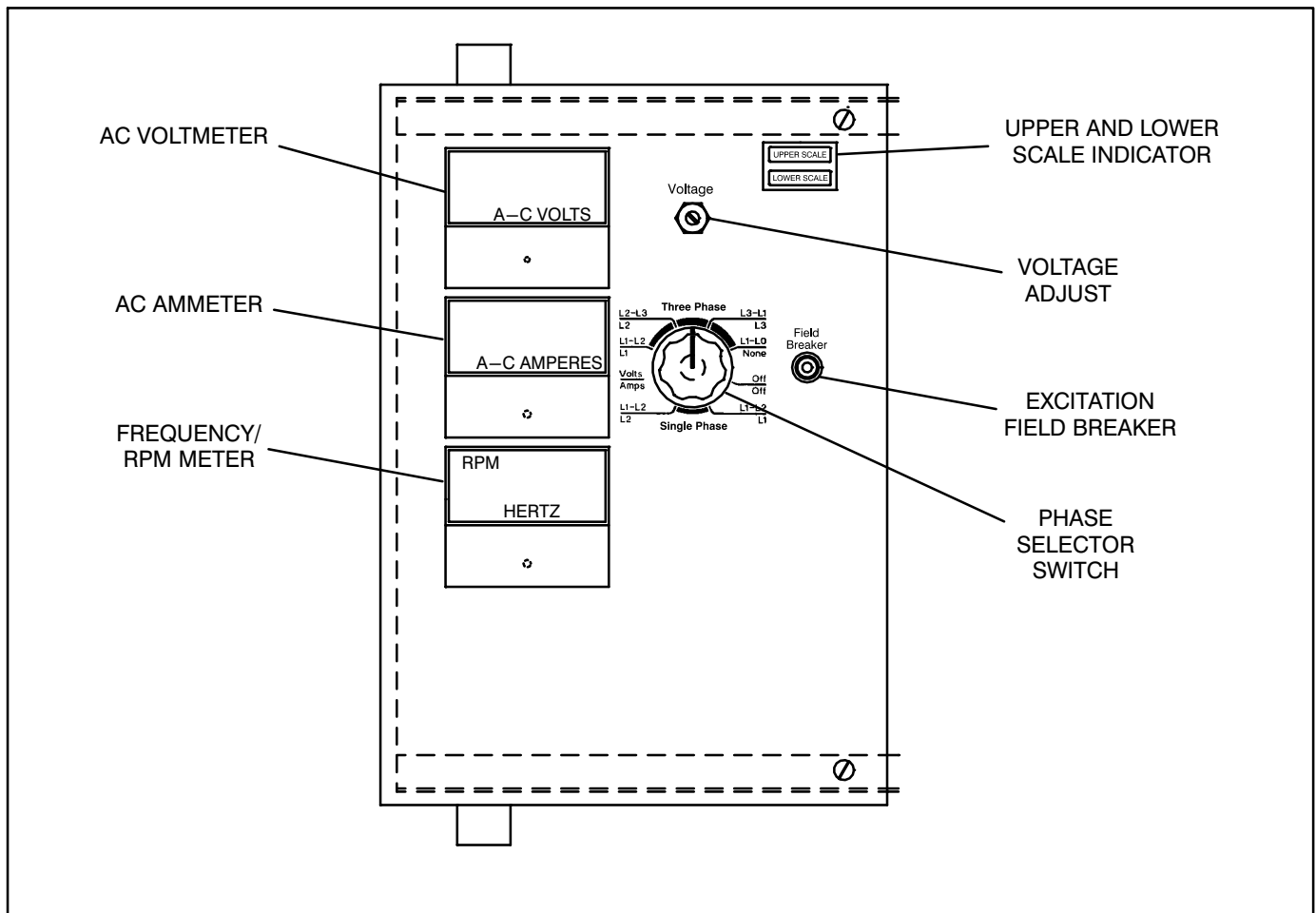


FIGURE 5-3. AC CONTROL PANEL

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 222°F (106° C) and lights a fault lamp. The fault is time-delayed about 10 seconds following starter disconnect and inhibited during cranking. This delay allows coolant in a hot engine time to circulate and return the water jacket to normal before the electronic control module monitors this system.

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

⚠ 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 gener-

ator 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.

6. Troubleshooting (Detector 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 engine monitor activates a fault lamp, and may also stop the engine (depending on the condition). If the generator set is stopped for this reason, the operator may be able to restart the set after making adjustments or corrections. This section describes the fault condition system, and suggests troubleshooting procedures.

The control has a single green light to indicate RUN, four amber lights and seven red fault lights. The control also has a terminal connection for an audible alarm, which sounds when a fault occurs.

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 lamp turns on during operation, follow the procedures listed in Table 6-1 to locate and correct the problem. For any symptom not listed, contact an authorized service center for assistance.

RESETTING THE CONTROL

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

LINE CIRCUIT BREAKER (OPTIONAL)

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

TABLE 6-1. TROUBLESHOOTING

⚠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>	
SYMPTOM	CORRECTIVE ACTION
1. Green RUN lamp lights following engine startup.	1. Indicates all engine systems are normal. No corrective action required.
2. PRE HI ENGINE TEMP lamp lights. Engine continues to operate. (Engine can be programmed to shut down.)	2. Indicates engine has begun to overheat and engine temperature has risen to approximately 215°F (102° C) or coolant level is low on optionally wired sets. If generator is powering non-critical and critical loads and cannot be shut down, use the following: a. Reduce load if possible by turning off non-critical loads. b. Check air inlets and outlets and remove any obstructions to air flow. If engine can be stopped, follow procedure in step 3.
3. HI ENG TEMP lamp lights. Engine shuts down.	3. Indicates engine has overheated (engine temperature has risen above 222°F/106°C) or coolant level is low. Allow engine to cool down completely before proceeding with the following checks: a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b. Check for obstructions to cooling airflow and correct as necessary. c. Check for a slipping fan belt and tighten if loose. d. Reset control and restart after locating and correcting problem. Contact an authorized service center if none of the above.
4. PRE LO OIL PRES lamp lights. Engine continues to operate. (Engine can be programmed to shut down.)	4. Indicates engine oil pressure has dropped to 20 psi (138 kPa). If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow step 5 procedure. If engine can be stopped, follow procedures in step 5.
5. LO OIL PRES lamp lights. Engine shuts down. NOTE: See also step 6.	5. Indicates engine oil pressure has dropped to 14 psi (97 kPa). Check oil level, lines and filters. If oil system is OK but oil level is low, replenish. Reset control and restart. Contact an authorized service center if oil pressure is not in the range of 25 to 40 psi (172 to 275 kPa).

TABLE 6-1. TROUBLESHOOTING (CONT.)

⚠ 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>	
SYMPTOM	CORRECTIVE ACTION
6. OVERCRANK lamp lights and engine stops cranking. or Engine runs, shuts down, and LO OIL PRES lamp lights..	6. Indicates possible fuel system problem. - Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. - Check for dirty fuel filter and replace if necessary (see <i>Maintenance</i> section). - Check for dirty or plugged air filter and replace if necessary (see <i>Maintenance</i> section). - Reset the control and restart after correcting the problem. Contact an authorized service center for service if none of the above.
7. OVERSPEED lamp lights and the engine shuts down.	7. Indicates engine has exceeded normal operating speed. Contact an authorized service center for service.
8. SWITCH OFF lamp flashes.	8. Indicates Run/Stop/Remote switch is in the Stop position which will prevent automatic starting if an automatic transfer switch is used. Move the Run/Stop/Remote switch to the Remote position for automatic starting.
9. LO FUEL lamp lights. Engine continues to run.	9. Indicates diesel fuel supply is running low. Check fuel supply and replenish as required.
10. LO FUEL LAMP lights. Engine shuts down and LO OIL PRES lamp lights.	10. Indicates engine has run out of fuel. Check fuel level and replenish as required.
11. LO ENG TEMP lamp lights. Set is in standby mode but is not operating. (Lamp lights when engine coolant temperature is 70° F (21° C) or lower. Since the lamp goes out after the engine warms up, there should be no cause for alarm even during initial generator set operation.)	11. Indicates engine coolant heater is not operating, not circulating coolant or ambient temperature too cold for heater to keep up with demand. Check for the following conditions: - 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.

TABLE 6-1. TROUBLESHOOTING (CONT.)

⚠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>	
SYMPTOM	CORRECTIVE ACTION
12. The FAULT 1 or FAULT 2 fault lamp lights. Engine shuts down immediately, engine runs for several seconds and then shuts down, or engine continues to run.	12. The standard undesigned fault functions are programmed to shut down the set when a fault is sensed. Fault 1 is time delayed while Fault 2 is immediate. The nature of the fault is an optional selection that is determined when the set installation is designed. The undesigned fault functions may also be programmed for non-shutdown or non-time delay.
13. Fault lamp lights but no fault exists. Engine gauges show oil pressure, engine temperature, and frequency (speed) are within normal limits.	13. The monitor board or a sensor may be at fault. Contact an authorized service center for service.
14. The BASIN (optional) fault lamp lights. Engine continues to run or is in stand-by mode. (Engine can be programmed to shut down.)	14. Indicates fuel is leaking from inner tank to outer basin or the sensor may be defective. Contact an authorized service center for service.
15. 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).	15. Remote circuit breaker is tripped. Reset breaker and restart. Contact an authorized service center if breaker trips after resetting.
16. Engine will not crank.	16. Indicates possible fault with control or starting system. Check for the following conditions: a. Fault lamp on. Correct fault and reset control. b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c. Discharged or defective battery. Recharge or replace the battery. d. Emergency stop button (if equipped) pushed in. To reset, pull switch out and move Run/Stop/Remote switch to Stop position. Then push test switch to Reset/ Lamp position. e. Contact an authorized service center if none of the above.
17. No AC output voltage.	17. Field breaker is tripped. Reset breaker. Contact an authorized service center if voltage buildup causes breaker to trip.

TABLE 6-1. TROUBLESHOOTING (CONT.)

⚠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>	
SYMPTOM	CORRECTIVE ACTION
18. RUN or fault lamp(s) does not light when Lamp Test switch is engaged.	18. Contact an authorized service center for assistance.
19. Green RUN lamp does not light following engine startup.	19. Indicates possible Start/Disconnect relay failure. Contact an authorized service center for assistance.

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7. Maintenance

Establish and adhere to a definite schedule for maintenance and service based on the application and severity of the environment. Table 7-1 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 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 7-1 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

TABLE 7-1. MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	SERVICE TIME					
	See Engine Schdl.	Daily or after 8 Hours	Weekly or after 50 Hours	Monthly or after 100 Hours	6 Months or after 250 Hours	Yearly or after 500 Hours
General Genset Inspection	X ¹	X ²				
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 ³			
Check Battery Charging System			X			
Drain Water and Sediment from Fuel Tank			X ⁵			
Drain Exhaust Condensate Trap				X		
Check Starting Batteries				X		
Change Air Cleaner Element					X ³	
Check Radiator Hoses for Wear & Cracks					X	
Test Generator Insulation Resistance						X ⁷
Drain Fuel Filter(s)	X ¹					
Check Anti-freeze and DCA Concentration	X ¹					
Change Crankcase Oil and Filter	X ^{1, 6}					
Check Drive Belt Tension	X ¹					
Change Coolant Filter	X ¹					
Clean Crankcase Breather	X ¹					
Change Fuel Filters	X ¹					
Clean Cooling System	X ¹					
Test Rupture Basin Leak Detect Switch						X ⁸

X¹ Refer to Cummins Engine Operation and Maintenance Manual for maintenance interval and/or procedure.

X² Check for oil, fuel, cooling and exhaust system leaks. Check exhaust system audibly and visually with set running and repair any leaks immediately.

X³ Perform more often in dusty conditions.

X⁴ Visually check belt for evidence of wear or slippage. Replace if hard or brittle.

X⁵ Drain 1 cup or more of fuel to remove water and sediment.

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

X⁷ This procedure should be followed periodically throughout the life of the generator set, or if the generator has set idle for a period of time with no generator heaters used. Contact your authorized service center.

X⁸ Check leak detect switch in sub-base fuel tank of optional enclosure, once a year or as required by safety code. Contact your authorized service center.

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 Table 7-1. The oil filter location is shown in Figure 7-2. 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.

⚠ 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 7-1) and add oil of the same API viscosity 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.*

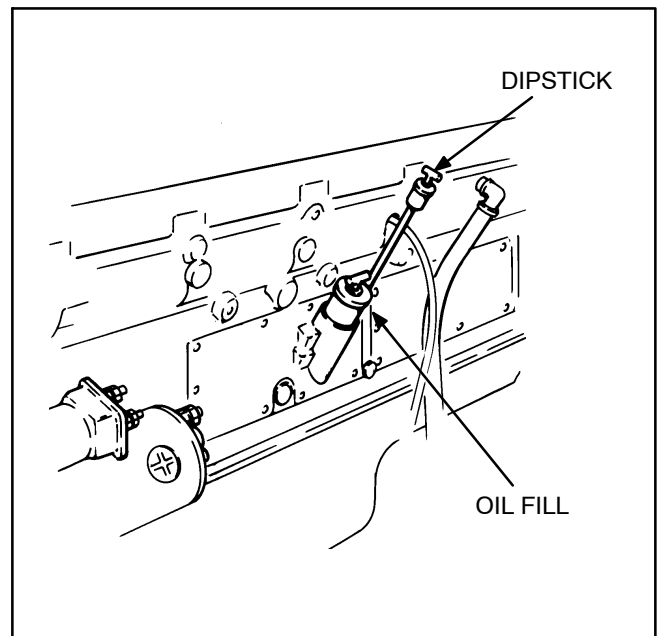


FIGURE 7-1. OIL FILL AND DIPSTICK LOCATION

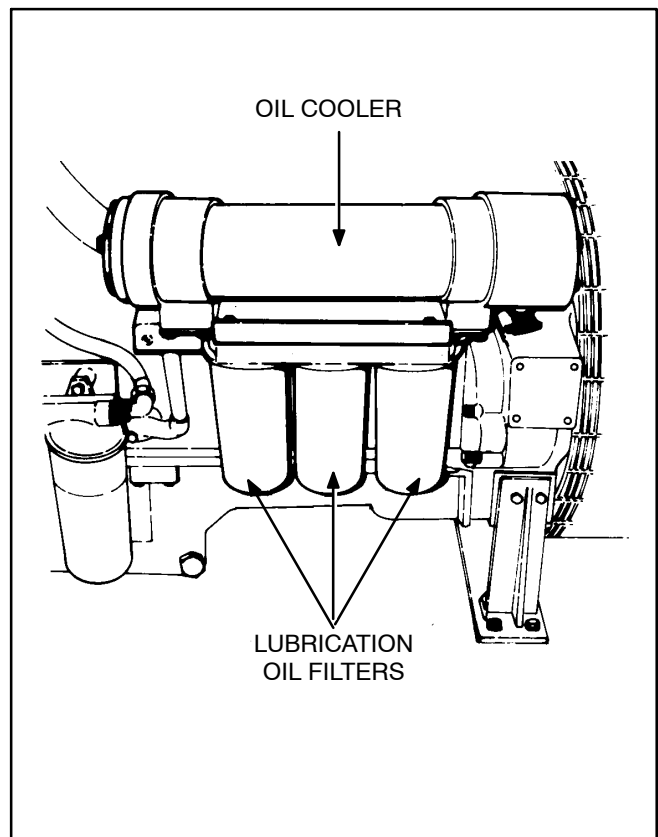


FIGURE 7-2. OIL FILTERS

COOLING SYSTEM

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

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

⚠ CAUTION *Remove AC power to the heater before disconnecting battery cables. Heater will run continuously without DC power and can overheat and damage heater.*

⚠ 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.*

Coolant Level

Check the coolant level during shutdown periods at the intervals specified in Table 7-1. Remove the radiator cap after allowing the engine to cool and if necessary, add coolant until the level is near the top of the radiator. 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.*

Cooling System Maintenance

Heavy duty diesel engines require a balanced coolant mixture of water, antifreeze and coolant additives. Drain and replace the mixture every year 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.

Flushing and Cleaning

The cooling system must be clean and free of rust and scale if it is to perform properly. Refer to the Cummins engine *Operation and Maintenance Manual* to flush and clean the cooling system.

Heat Exchanger Plugs

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

Coolant Heater

Check the operation of the 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 PIPING

Inspect the charge air piping and hoses, daily, for leaks, holes, cracks, or loose connections. Tighten the hose clamps if necessary.

Inspect the charge air cooler for dirt and debris blocking the fins. Check for cracks, holes, or other damage.

FUEL SYSTEM

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

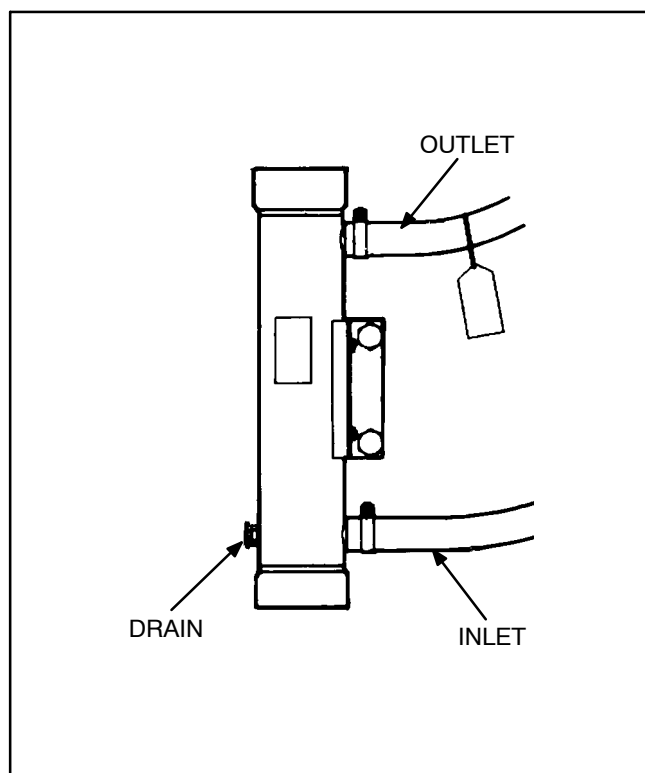


FIGURE 7-3. COOLANT HEATER

AIR CLEANER

The engine air intake components should be checked at the interval indicated in Table 7-1. The frequency of cleaning or replacing air cleaner filter elements is primarily determined by the conditions that the generator set operates in. The standard air cleaner and optional heavy duty air cleaner contain a paper cartridge filter element which can be cleaned and reused if not damaged, or discarded and replaced.

To Service the Air Cleaner:

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

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

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.

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8. Optional Enclosure Features

GENERAL

This section describes the function and operation of the optional enclosure features. Figure 8-1 shows the location of the optional features within the enclosure.

EXTERNAL RECEPTACLE

This receptacle is located on the outside of the enclosure (Figure 8-1) and provides shore power at 20A, 120 VAC. With the AC distribution panel provided, this receptacle is GFCI protected. If power to the external receptacle is lost, reset the GFCI receptacle (J5) that is mounted to the side of the AC distribution panel (Figure 8-4).

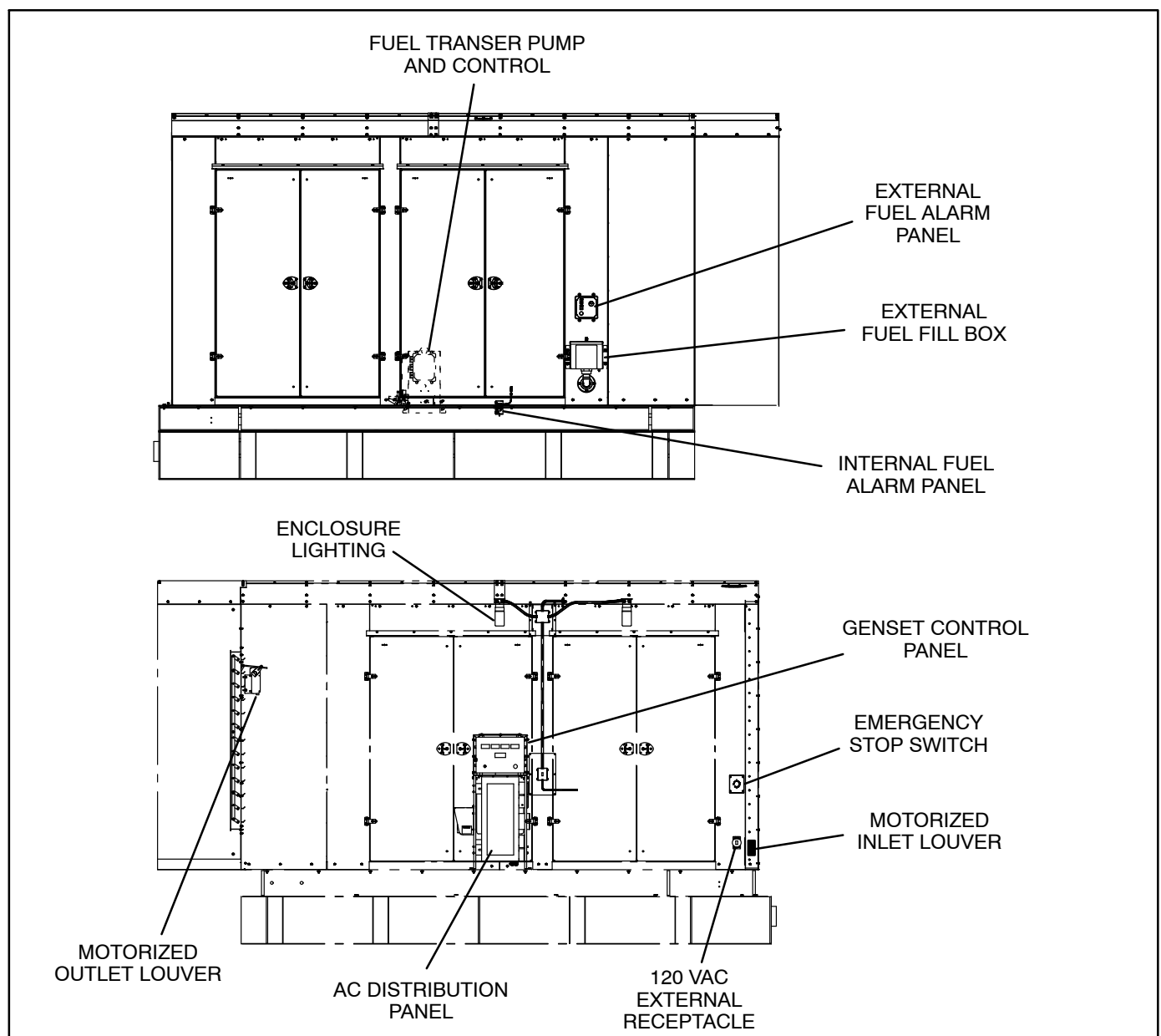


FIGURE 8-1. OPTIONAL ENCLOSURE FEATURES

EXTERNAL/INTERNAL ALARM PANELS

The following paragraphs describe the operation of the external/internal alarm panel components.

Overfill Indicator/Horn/Silence Button

The overfill alarm Indicates that the fuel has reached an abnormally high level (95%). Immediately stop adding fuel. It also indicates a possible failure of the “pump-off” float gauge for fuel systems that contain the fuel transfer pump.

Note: The automatic shutoff of a fuel truck nozzle is approximately 95% of fuel tank capacity.

The horn can be turned off by pressing the mute button. The indicator will turn off when the fuel level drops to normal.

Fuel Gauge

Indicates the amount of fuel that is contained in the sub-base tank.

Test Button

Press the TEST switch to test the indicator light and the horn. The test will remain active for as long as the button is pressed.

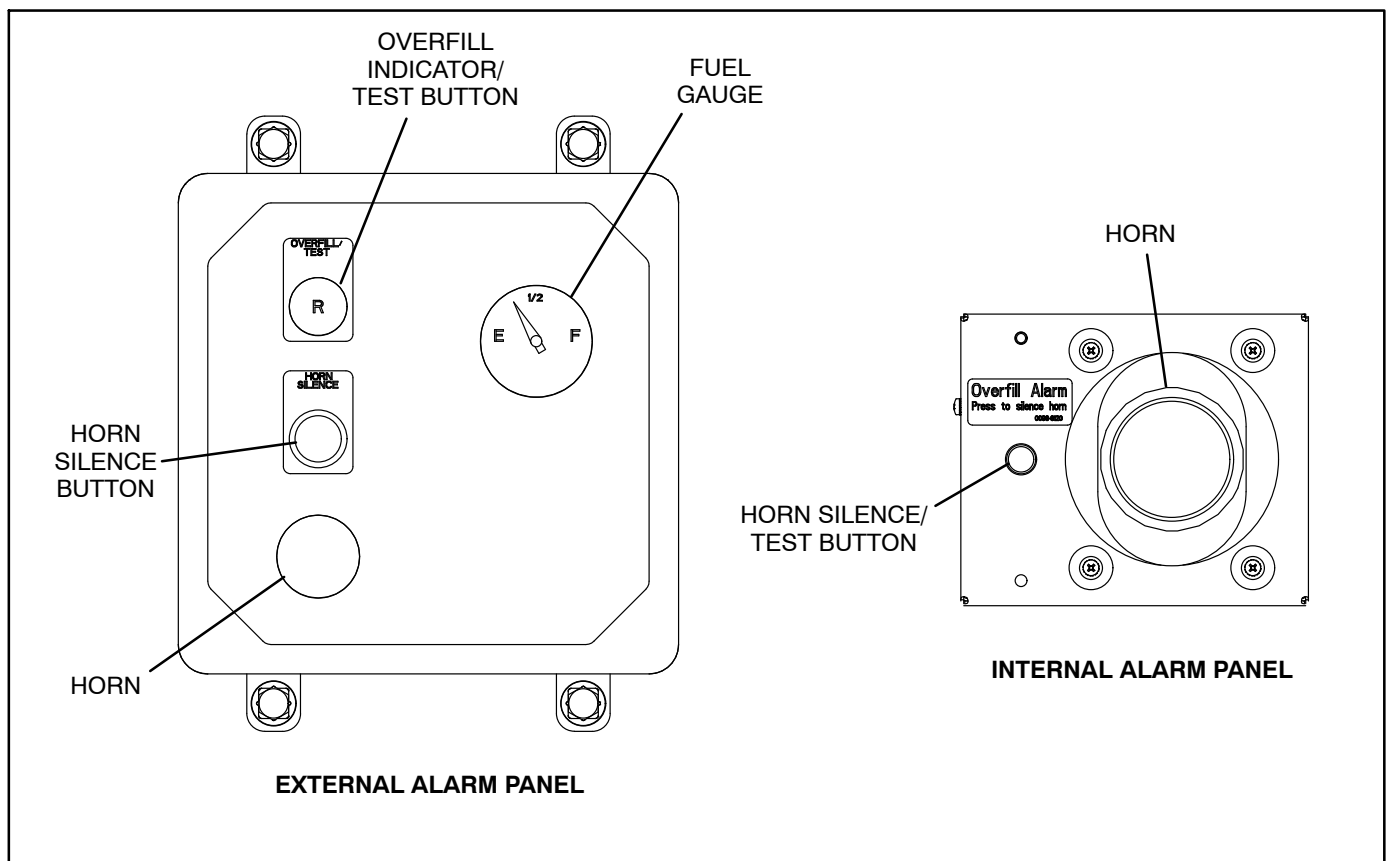


FIGURE 8-2. EXTERNAL AND INTERNAL ALARM PANELS

EXTERNAL EMERGENCY STOP SWITCH

Push this button in for emergency shutdown of the generator set. This will stop the generator set immediately and prevent starting of the genset from any location (local or remote).

Emergency Stop shutdown can be reset only at the generator set control panel.

To reset:

1. Pull the button (external) and allow it to pop out.
2. Turn the O/Manual/Auto switch to O (Off).
3. Press the front panel Fault Acknowledge/Reset button.
4. Select Manual or Auto, as required.

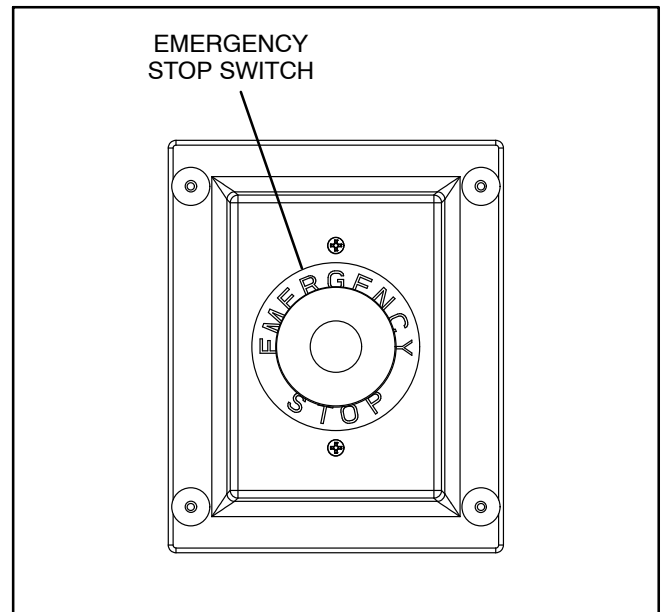


FIGURE 8-3. EXTERNAL EMERGENCY STOP SWITCH

AC DISTRIBUTION PANEL

The AC distribution panel provides a centralized power source (120 VAC) for all optional enclosure features. Figure 8-4 shows the locations of the circuit breakers and optional feature connection points.

GFCI RECEPTACLE (J5): 120VAC/20A ground fault protected outlet. For use by service personnel. (GFCI receptacle also supplies power to external receptacle [J6].)

RECEPTACLES (J1–J4, J7): For internal use only (not GFCI protected). 120VAC/20A outlets for optional enclosure features.

⚠WARNING *Electrical shock can cause severe personal injury or death. Receptacles J1 through J4 and J7 are not GFCI protected and must not be used by service personnel as a power source for tools/lighting.*

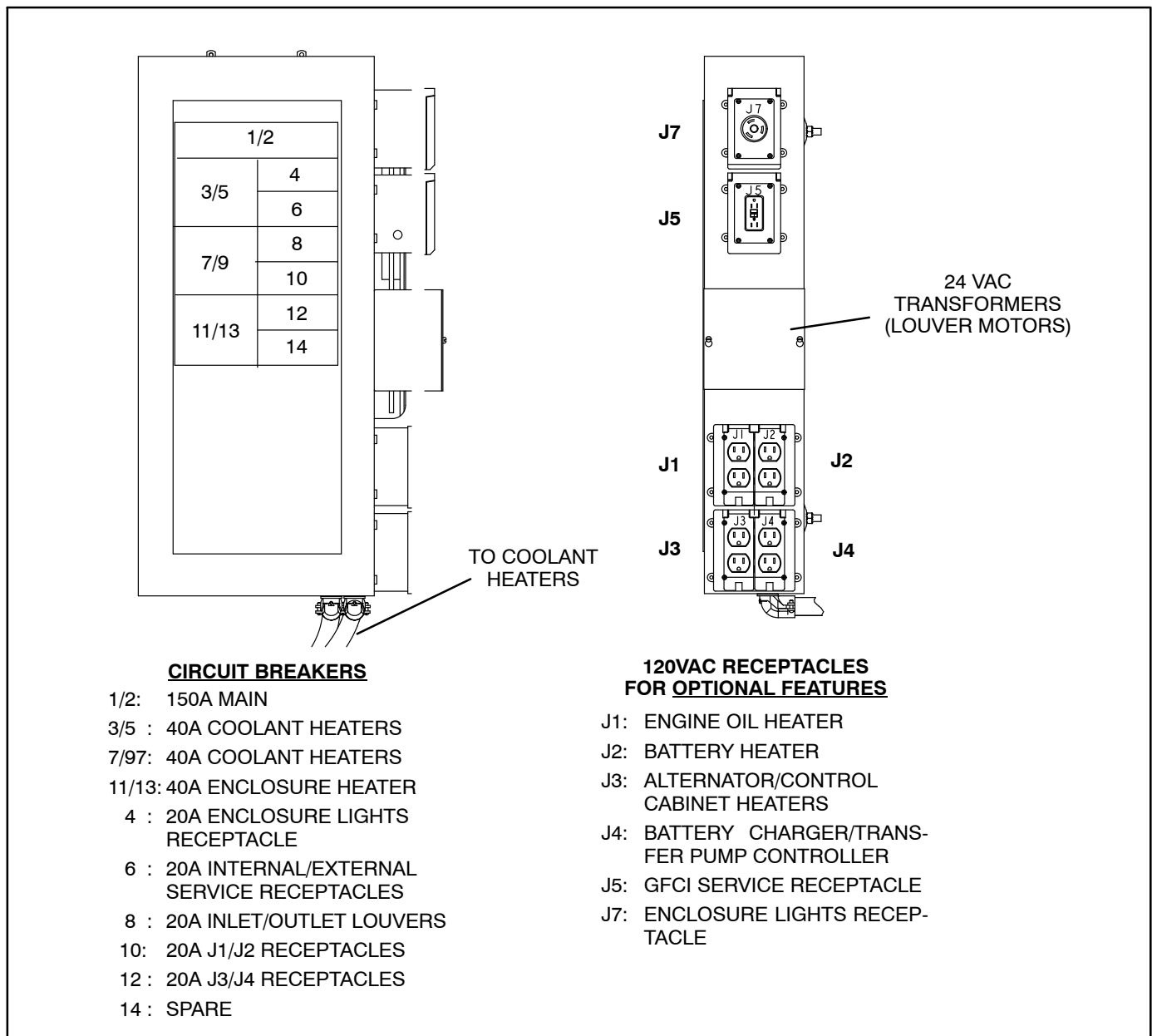


FIGURE 8-4. AC DISTRIBUTION PANEL FEATURES

FUEL TRANSFER PUMP

The fuel transfer pump and control are available as an option when a sub-base fuel tank is provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the sub-base tank.

This section explains functions of the control panel lamps, components and operation/testing of the day tank fuel control system.

Control Panel Switches and Indicators

The following paragraphs describe the operation of the control switches and indicators.

Indicators:

- **POWER:** indicates that AC power is available to the control.
- **PUMP:** indicates that the fuel pump is running. It will go on and off as fuel is pumped to maintain the fuel tank level.
- **CRITICAL HIGH:** indicates that the fuel has reached an abnormally high level. It indicates a possible failure of the "pump-off" float gauge in the sub-base tank. The lamp will turn off when the fuel level drops to normal.
- **LOW FUEL SUPPLY TANK:** indicates that the fuel level in the main fuel tank has dropped below the customer set low fuel level. This signal is used by the fuel system control to stop the operation of the fuel transfer pump to prevent pump damage. The control will enable the fuel transfer pump operation after tank fuel level is restored.
- **RUPTURE BASIN:** indicates that the fuel has flooded the safety basin surrounding the fuel tank. The basin float switch turns off the fuel pump. The pump cannot function again until the basin is drained of fuel. Possible cause, leak in fuel tank.

Switches:

- **ON:** This switch activates the control.
- **OFF:** This switch disables the control for routine maintenance to the tank system without disrupting the control.
- **TEST:** This switch will activate the pump for as long as the switch is in the Test position. All alarm functions will operate accordingly. Pump-on and pump-off float switches will remain de-energized.

- **SYSTEM TEST:** This switch will test all front panel lamps and activate pump/motor for as long as the switch is in the System Test position. All alarm relays will not activate but will maintain their original state.
- **RESET:** This switch will reset the control system after a latched alarm event.

Operation

The following steps describe how to operate the day tank controller.

1. Activate the control ON switch for automatic operation. The PUMP light will come on and the pump will fill the tank. The level of fuel in the tank will be automatically kept between a set of pump-on and pump-off float gauge switches.
2. The PUMP light indicates when the pump is running. It will go on and off as fuel is pumped to maintain the proper level in the tank.

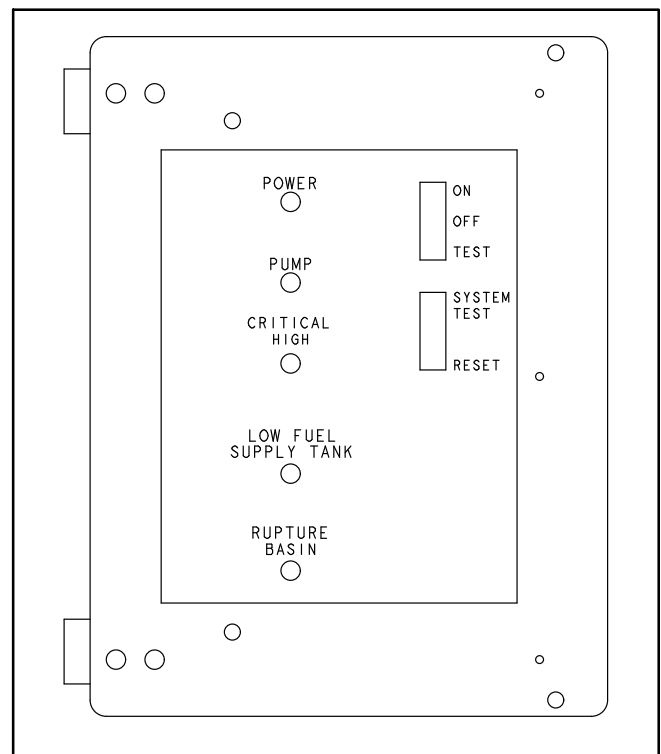


FIGURE 8-5. TRANSFER PUMP CONTROL FRONT PANEL

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9. Operating Recommendations

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.

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

HIGH OPERATING TEMPERATURE

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

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