Service Manual

Mobile Generator Sets

Model:
10CCOZ61

Brushless Single Phase

KOHLER®
POWER SYSTEMS

TP-5648 9/93

Table of Contents

Glossary of Abbreviations

Abbreviations are used throughout this manual. Normally in the text they will appear in complete form with the abbreviation following in parenthesis the first time they are used. After that they will appear in the abbreviated form. The commonly used abbreviations are shown below.

Abbreviation	Description
AC	alternating current
AHWT	anticipatory high water temp.
ALOP	anticipatory low oil pressure
AM	amplitude modulation
Amp.	ampere
Amps.	amperes
ANSI	American National Standard Institute
API	American Petroleum Institute
approx.	approximate, approximately
A/R	as required, as requested
A/S	as supplied, as stated, as suggested
ASA	American Standards Association
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
aux.	auxiliary
AWG	American Wire Gauge
AWM	appliance wiring material
bhp	brake horsepower
bmep	brake mean effective power
Btu	British thermal unit
°C	Celsius degree
cc	cubic centimeter
CCA	cold cranking Amps.
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CID	cubic inch displacement
cm	centimeter, centimeters
cmm	cubic meters per minute
co.	company
cont'd.	continued
C.S.A.	Canadian Standards Association
cu. in.	cubic inch, cubic inches
cyl.	cylinder
dBA	decibels
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
e.g.	example given
EMI	electromagnetic interference
etc.	etcetera, (and so forth)
ext.	external
°F	Fahrenheit degree
fl. oz.	fluid ounce, fluid ounces
FM	frequency modulation
fs	full scale
ft.	foot, feet
ft. lbs.	foot pound, foot pounds
ga.	gauge
gal., gals.	gallon, gallons
gal./hr.	gallons per hour
gph	gallons per hour
gpm	gallons per minute
gr.	grade
grd.	ground
HCHT	high cylinder head temperature
HET	high exhaust temperature
Hg	mercury (element)
H_2O	water
hp	horsepower
hr, hrs	hour
HWT	high water temperature
Hz	hertz (cycles per second)
ID	inside diameter
in.	inch(es)
inc.	incorporated
in. lbs.	inch pounds
int.	internal
int.-ext.	internal-external
ISO	International Standards Organization
J	joule, joules
JIS	Japanese Industry Standard
kg	kilogram, kilograms
kg/cm^2	kilograms per square centimeter
kgm	kilogram meter(s)
km	kilometer, kilometers
kPa	kiloPascal, kiloPascals

Abbreviation	Description
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt, kilowatts
kWH	kilowatt hour
L	liter, liters
LxWxH	length x width x height
LED, LEDs	light emitting diode
lb., lbs.	pound, pounds
L/hr.	liter per hour, liters per hour
L/min.	liter(s) per minutes
LOP	low oil pressure
LP	liquefied petroleum
LWT	low water temperature
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
mi.	mile, miles
mil	one one-thousandth of an inch
min.	minimum
mJ	millijoule, millijoules
MJ	mega joule, mega joules
mm	millimeter, millimeters
m^3/min	cubic meters per minute
MPa	megaPascal
mph	miles per hour
MS	military standard
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	Newton meter, Newton meters
no., nos.	number, numbers
NPT	National Standard taper pipe thread per general use

Abbreviation	Description
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
OV	overvoltage
oz.	ounce, ounces
PF	power factor
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
rms	root mean square
rpm	revolutions per inch
SAE	Society of Automotive Engineers
sec.	second, seconds
SCR	silicon controlled rectifier
spec, specs	specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
temp.	temperature
TIF	telephone influence factor
turbo	turbocharger
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter ъ Laboratories, Inc.
US	undersize
V	volt, volts
VAC	Volts alternating current
VDC	volts direct current
W	watt, watts

Safety Precautions and Instructions

A generator set, like any other electro-mechanical device, can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best way to prevent accidents is to be aware of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating the to operating of a generator set follow. Keep these in mind. This manual contains several types of safety precautions which are explained below.

DANGER

Danger is used to indicate the presence of a hazard that *will* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

WARNING

Warning is used to indicate the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

CAUTION

Caution is used to indicate the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the warning is ignored.

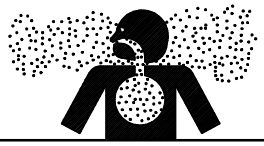
NOTE

Note is used to notify people of installation, operation, or maintenance information that is important but not hazard-related.

Safety decals are affixed to the generator set in prominent places to advise the operator or service technician of potentially hazardous situations. The decals are reproduced here to improve operator recognition and thereby increase decal effectiveness. For a further explanation of decal information, reference the accompanying safety precautions. Before operating or servicing the generator set, be sure the message of these decals are understood. Replace decals if missing or damaged.

EXHAUST SYSTEM

⚠ WARNING



Carbon monoxide.
Can cause severe nausea, fainting, or death.

The exhaust system must be leakproof and routinely inspected.

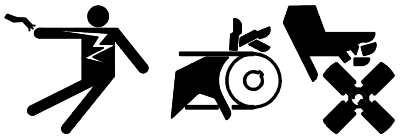
Carbon monoxide can cause severe nausea, fainting, or death. Install exhaust system tail pipe so discharged exhaust gases will not be drawn into vehicle interior through windows, doors, air conditioners, etc. Do not use flexible tail piping since this type could crack and allow lethal exhaust fumes to enter the vehicle.

Carbon monoxide can cause severe nausea, fainting, or death. Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate in any area where exhaust gas could accumulate and seep back inside an occupied building or vehicle. Be careful when parking the vehicle to avoid obstructing the exhaust outlet. The exhaust gases must discharge freely, otherwise carbon monoxide may deflect into the vehicle. Avoid breathing exhaust fumes when working on or near the generator set. Carbon monoxide is particularly dangerous because it is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short period of time.

Carbon monoxide can cause severe nausea, fainting, or death. Diesel fumes can rapidly destroy copper tubing in diesel exhaust systems. Do not use copper tubing in diesel exhaust systems. Exhaust sulphur will cause rapid deterioration and this could result in exhaust leakage.

ACCIDENTAL STARTING

⚠ WARNING



Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by remote start/stop switch unless this precaution is followed.

MOVING PARTS

⚠ WARNING

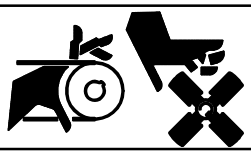
Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, or covers in place.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. When making adjustments or servicing generator set, do not loosen crankshaft hardware or rotor thru-bolt. If rotating crankshaft manually, direction should be clockwise only. Turning crankshaft bolt or rotor thru-bolt counterclockwise can loosen hardware and result in serious personal injury from hardware or pulley flying off engine while unit is running.

ENGINE BACKFIRE/FLASH FIRE

⚠ WARNING

Fire.
Can cause severe injury or death.

Do not smoke or permit flame or spark to occur near fuel or fuel system.

A sudden backfire can cause severe injury or death. Do not operate with air cleaner removed.

HAZARDOUS VOLTAGE/ ELECTRICAL SHOCK

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING

Hazardous voltage.
Backfeed to utility system can cause severe injury, death, or property damage.
Do not connect to any building electrical system without connecting through an approved device and after building main switch is open.

Hazardous voltage can cause severe injury or death. The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule– replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous "backfeed" voltage can cause severe injury or death. The generator must not be used to "backfeed" by connecting it to building/campground electrical circuits. Install a transfer switch in vehicle generator installations to prevent connection of vehicle and other sources of power. Electrical backfeed into a utility electrical system can cause serious injury or death to utility personnel working on transmission lines.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

FUEL SYSTEM

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

Explosive fuel vapors can cause severe injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling, storing, and using fuels. Store fuel in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running since spilled fuel may ignite on contact with hot parts or from ignition spark. Do not smoke or permit flame or spark to occur near potential sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition– don t replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. Should any fuel leakage, fuel accumulation, or electrical sparks be noted, DO NOT OPERATE GENERATOR SET. Have systems repaired before resuming generator operation.

Explosive fuel vapors can cause severe injury or death. Spilled fuel can cause an explosion. Use a container to catch fuel when draining fuel system. Wipe up all spilled fuel after draining system.

HAZARDOUS NOISE

⚠ CAUTION

Hazardous noise.
Can cause loss of hearing.
Never operate generator without a muffler or with faulty exhaust system.

BATTERY

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

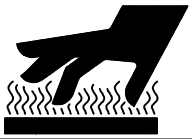
HOT PARTS

⚠ WARNING

Hot coolant and steam.
Can cause severe injury or death.

Before removing pressure cap stop generator, allow to cool and loosen pressure cap to relieve pressure.

⚠ WARNING



Hot engine and exhaust system.
Can cause severe injury or death.

Do not work on generator set until unit is allowed to cool.

Fire can cause severe injury or death. Hot exhaust system can ignite adjacent combustible materials. Do not locate electrical wiring, fuel lines, or combustible material above the exhaust muffler. Be careful when parking the vehicle to prevent grass fires started by exhaust system and hot exhaust gases.

Fire can cause severe injury or death. Hot generator can ignite debris in compartment. Keep the compartment and generator set clean and free of debris and combustible materials to minimize chances of fire. Do not block fuel/oil drain opening in generator mounting tray. If sub-flooring is used, cut a corresponding hole in the sub-flooring for drain opening.

Hot parts can cause severe injury or death. Do not touch hot engine parts. An engine gets hot while running and exhaust system components get extremely hot.

Hot coolant can cause severe injury or death. Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

NOTES

NOTE

This generator set does not comply with United States Coast Guard (U.S.C.G.) requirements and must not be used for marine applications. Use only generator sets specified for marine use in marine installations. U.S.C.G. Regulation 33CFR183 requires a generator set to be "ignition protected" when used in a gasoline-fueled environment.

NOTE

Do not "tee" into fuel injected fuel systems. Use a two dip tube arrangement for fuel supply. Consult an authorized Kohler service dealer for further fuel system installation information.

NOTE

Wipe up all spilled diesel fuel after bleeding system. Wash hands after any contact with fuel oil.

NOTE

ENGINE DAMAGE! Failure to bleed air from cooling system may cause overheating and subsequent damage to engine.

NOTE

Special attention should be given when checking for proper coolant level. After the coolant has been drained, it normally requires some time before complete refill of the engine water jacket takes place.

Section 1. Introduction

Service requirements are minimal, but are very important to the safe and efficient operation of the generator set.

Please take a few moments to read this manual, then carefully follow all service recommendations to keep the generator set in top condition. See Figure 1-1 for identification and location of components.

All information in the publication is based on data available at time of printing. Kohler Co. reserves the right to make changes to this literature and the products represented at any time without notice or incurring obligation.

Keep this manual in the vehicle for future reference.

The illustrations in the manual are representative of most units. This generator set may differ slightly from that shown.

Specifications

Generator

Model Series	Voltage Code	Voltage	Amps	kW/kVA PH
10CCOZ61	61/67	120/240	83.4/41.7	10/10 1

NOTE

DERATING: All units are rated 1.0 power factor. The kilowatts of the generator set will decrease 3.5% per 1000 ft. (305 m) above 500 ft. (152 m) above sea level. Derate 1% for every 10°F (5.5°C) above 85°F (30°C).

Engine

The 10CCOZ is powered by a Kubota V1305BG-2 four-cylinder, four-cycle diesel engine.

Service Guidelines

In any communications regarding the generator set, please include the MODEL, SPECIFICATION, SERIAL and ENGINE SPEC. numbers as found on the nameplate attached to the generator's frame or engine block. The authorized service dealer/distributor will need these numbers to provide the correct parts and information for the generator set. Do not attempt to replace anything that calls for special tools or procedures–have this done only by qualified Kohler generator specialists. Check the yellow pages of the telephone directory under the heading GENERATORS-ELECTRIC for Kohler generator service dealers/distributors.

KOHLER CO., Kohler, Wisconsin 53044
Phone 414-565-3381
Fax 414-459-1646 (North American Sales)
Fax 414-459-1614 (International)
For Sales & Service in U.S.A. & Canada
Phone 1-800-544-2444

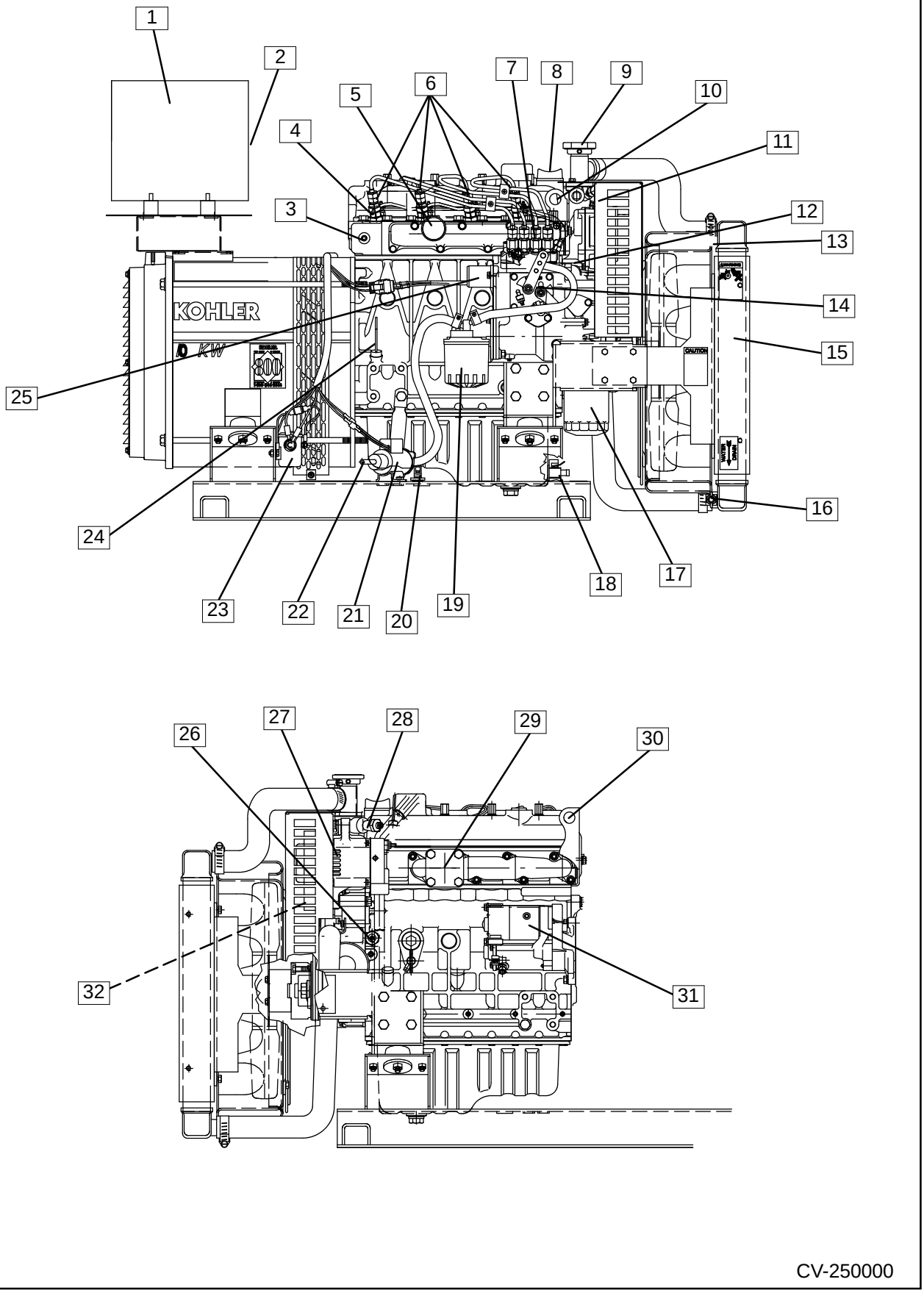


Figure 1-1. Service View - Typical (10CCOZ).

Service Views

1. Controller
2. Voltage Regulator
3. High Water Temperature Shutdown Switch
4. Fuel Return Connection Point
5. Intake Manifold
6. Injectors
7. Injector Pump
8. Oil Fill
9. Pressure Cap/Initial Coolant Fill
10. Lifting Eye
11. Generator Nameplate
12. Oil Fill
13. Low Coolant Level Shutdown Switch
14. Governor
15. Inline Radiator
16. Coolant Drain
17. Oil Filter
18. Oil Drain
19. Fuel Filter
20. Equipment Ground Location
21. Fuel Pump
22. Fuel Inlet Connection Point
23. Glow Plug Relay
24. Oil Level Check
25. Fuel Solenoid
26. Low Oil Pressure Shutdown Switch and Sender
27. Battery Charging Alternator
28. Water Temperature Sender
29. Exhaust Outlet
30. Lifting Eye
31. Starter
32. Belt Guard

Section 2. Operation

To insure continued satisfactory operation, the following items should be checked before each startup.

Prestart Checklist

OIL LEVEL: Should be at or near full mark (not over).

AIR INLETS: Must be clear and unobstructed.

COMPARTMENT: Interior must be clean. Check the condition of fuel system, exhaust piping, hoses, and muffler. If fuel leaks, fumes, exhaust gases, or electrical sparks are noted, contact a qualified service technician before operating generator set.

AIR CLEANER: Must be clean and properly installed to prevent unfiltered air from entering the engine.

ELECTRICAL: All connections (including battery) must be tight.

FUEL LEVELS: Make sure the fuel tank(s) are full and the fuel system primed for operation.

COOLING: If the cooling system is equipped with a coolant recovery tank, check coolant level (and refill coolant as necessary) at tank. Maintain level according to markings on the tank. Coolant level should be just below the filler neck [approx. 3/4 to 1 1/2 in. (19.38 mm)] when the engine is cold.

BATTERY: Check connections and level of battery electrolyte.

DRIVE BELTS: Check radiator fan, water pump, and the battery charging belt to make sure it is properly tensioned and in good condition. Exhaust gas must be vented safely outside.

OPERATING AREA: Make sure there are no obstructions that could block the flow of cooling air. Make sure the area is clean. Rags, tools, or debris must not be left on or near the generator set.

EXHAUST SYSTEM: Exhaust outlet must be clear; silencer and piping must be tight and in good condition. Exhaust gas must be vented safely outside.

Exercising the Generator

Run the generator set once a week for one hour (under load). The operator should be in attendance during this period. Be sure to make all "Prestart Checks" before starting the exercise procedure. Start the generator set according to the procedure given for the generator controller.

Manual Controller Operation

The manual controller is designed for prime power applications and is used on the 10CCOZ-Mobile diesel generator. For identification of manual controller components and an explanation of their function, refer to Figure 2-1 and the following descriptions.

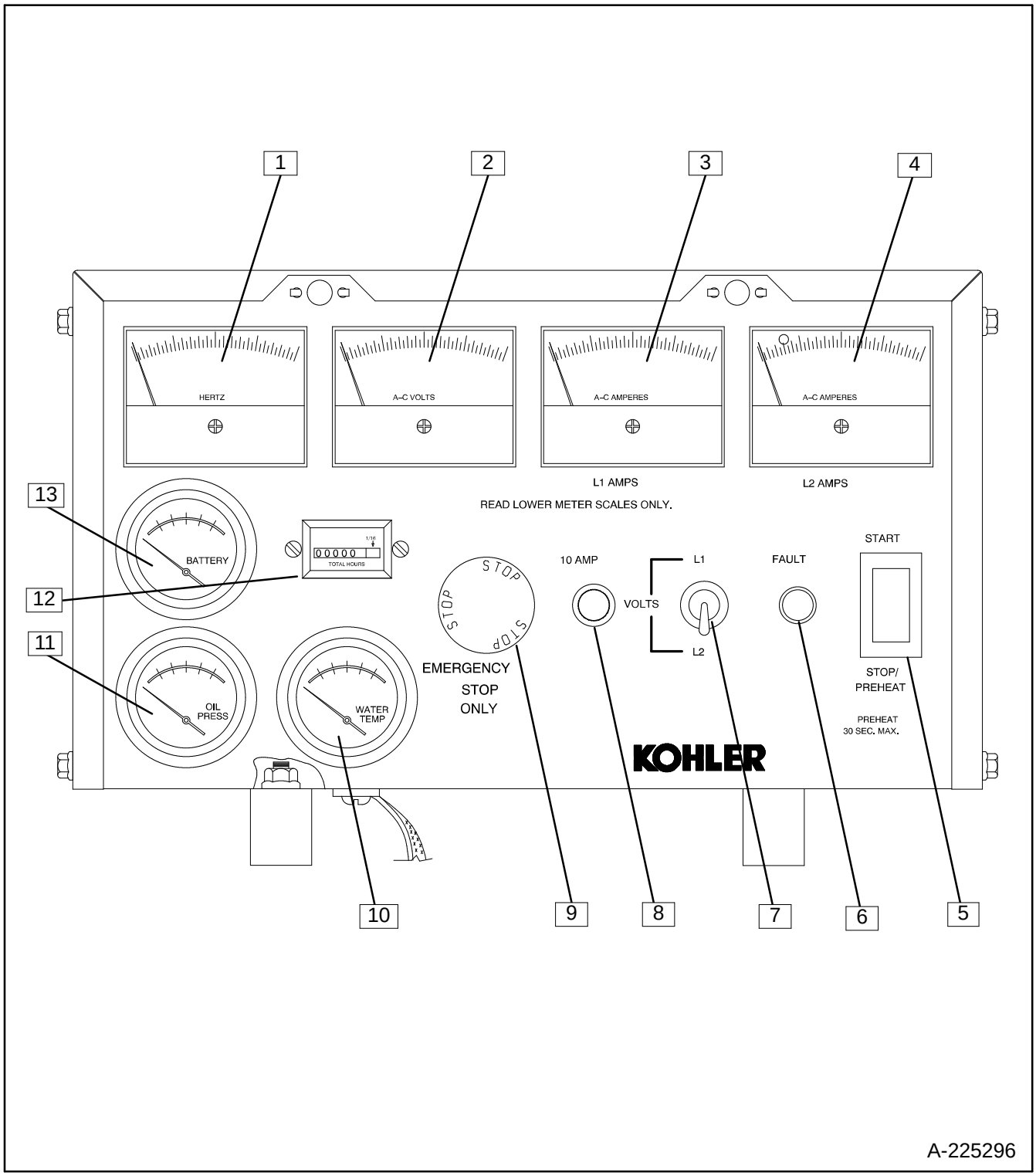


Figure 2-1. Controller

Features

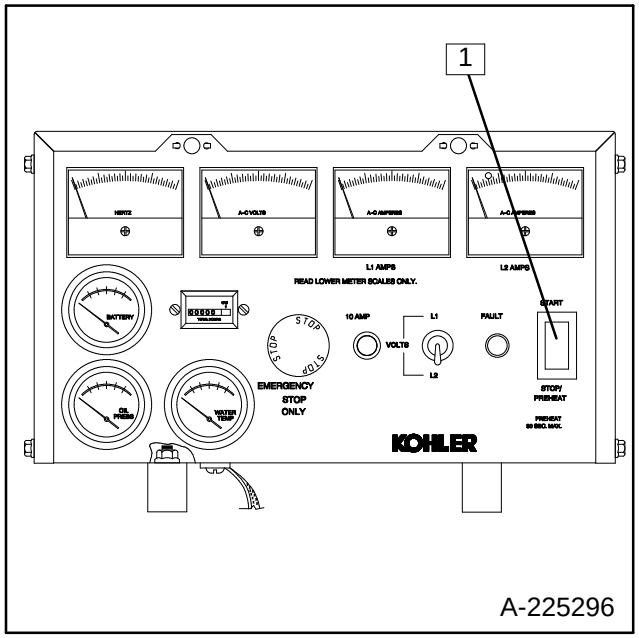
1. **Frequency Meter** measures frequency (Hz) of generator output voltage.
2. **AC Voltmeter** measures voltage across output leads indicated by the voltage toggle switch.
3. **AC Ammeter (L1 Amps)** measures amperage from output lead L1.
4. **AC Ammeter (L2 Amps)** measures amperage from output lead L2.
5. **Start-Stop/Preheat Switch** is used to start, stop, and preheat the generator set. The start-stop/preheat switch serves a dual function of generator operation and generator preheat. When pressed to the "preheat" position, the preheat switch aids in cold-weather starting. Refer to "Starting" procedure following.
6. **Fault Lamp** illuminates during engine shutdown if the engine has shut down due to high engine temperature, low oil pressure, low water level, low fuel level, or overspeed faults. See "Fault Shutdowns" following for additional shutdown information. (Fault lamp will not stay lit after unit shuts down. Fault lamp will only light as fault occurs. Fault lamp will also light for an emergency stop.)
7. **Voltage Toggle Switch** selects the Line 1 (L1) or Line 2 (L2) output voltages to be measured.
8. **10 Amp. Fuse** protects the controller circuitry from short circuits and overloads.
9. **Emergency Stop Switch** instantly shuts down the generator set in emergency situations. Reset the switch after the shutdown by rotating the switch clockwise. *THE EMERGENCY STOP SWITCH IS INTENDED FOR EMERGENCY SHUTDOWNS ONLY.* Use the generator stop switch to stop the set under normal circumstances.
10. **Water Temperature** indicates engine coolant temperature.
11. **Oil Pressure** indicates engine oil pressure.
12. **Hourmeter** records generator set total operating hours for reference in scheduling maintenance.
13. **DC Voltmeter** indicates voltage of battery(ies).

Starting Procedure

The generator is equipped with a preheat feature. Place controller start switch (Figure 2-2) in STOP/PREHEAT position for the amount of time shown in Figure 2-3 before attempting to start the generator set. This action preheats the glow plugs. Do not energize preheat feature for more than 20 seconds or damage may occur. Move the START-STOP switch (Figure 2-2) into the START position and hold in this position until the engine is running, then release. **Do not crank engine continuously for more than 10 seconds at a time.** A *60-second* cooldown period must be allowed between cranking attempts if the engine does not start. If the unit fails to start after three attempts contact an authorized service dealer/distributor for repair. Failure to follow these guidelines may result in damage to the starter motor.

NOTE

Do not use ether or any other starting fluid to assist in starting the unit under cold conditions. This is an indirect fuel-injected engine and severe engine damage is likely.



1. Preheat Switch

Figure 2-2. Preheat Switch Location

Ambient Temperature	Preheating Time
Above 23°F (–5°C)	Approx. 5 Seconds
Below 23°F (–5°C)	Approx. 10 Seconds
Limit of Continuous Use	20 Seconds

Figure 2-3. Preheating Time

NOTE

If the engine starts and then stops, allow the engine to come to a complete stop before making a restart attempt. If the flywheel ring gear is still rotating when the starter pinion gear is engaged, the pinion gear will clash damaging the ring gear teeth.

Stopping Procedure

Whenever possible, allow a brief cooling period by running the set at low or no load for a few minutes just prior to shutdown. To stop, push the switch into the STOP/PREHEAT position. If the generator set shuts down automatically, identify and correct the problem before attempting to restart.

NOTE

Do not place Start-Stop/Preheat Switch in STOP/PREHEAT position for more than 20 seconds or damage may occur to the preheat feature.

Coolant System Filling

The low-profile coolant system of the 10CCOZ-Mobile generator set requires a coolant recovery system to ensure that the cooling system remains full of coolant. The system also requires that the unit be filled using special precautions to ensure that it does, in fact, get filled with fluid before the unit is placed into service. To protect against operation with low coolant, the unit includes a Low Coolant Level (LCL) switch.

Due to the configuration of the system and its extremely low profile, it is necessary to fill the system with coolant *VERY SLOWLY* to allow air to escape fully from the radiator and the engine block. Once the coolant system seems to be full, some air may still remain trapped in the system. Often, when the unit has started and runs for approximately 10-15 minutes after filling, a shutdown will be experienced or the unit may continue to run but will not start at the next attempt. If either of these conditions occur, the shutdown may be due to low coolant level in the radiator. As a remedy for this, add one to two cups of coolant to the radiator. Be sure to connect the coolant recovery tank to the system, as it is an integral and required part of the cooling system. Once the radiator is topped off, the coolant recovery system will replace the last small amounts of air, which remain trapped in the cooling system, with coolant.

Often a low coolant level or a low fuel level is overlooked as possible causes for a shutdown. Any time a unit shuts down, and no other cause can be found, check for a low fuel or low coolant level condition. Remove the radiator pressure cap from the engine very slowly. If the unit is hot, it will release coolant into the recovery tank.

At scheduled maintenance intervals, check the coolant while it is cold in the coolant recovery tank, as well as at the pressure cap prior to starting the unit for its maintenance. If it is not completely full, add coolant at the recovery tank and the pressure cap to bring the level to its appropriate mark.

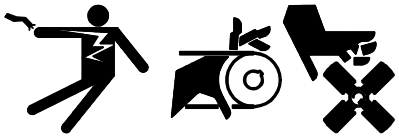
Circuit Protection

Refer to the following descriptions to identify controller components.

1. **Input (Controller) Fuse (10 Amp)** protects controller circuitry. If the generator will not crank and the battery and/or connections appear okay, the controller fuse may be "blown". If this fuse is replaced then "blows" again, locate the cause of the problem.

2. **Fuel Solenoid Fuse (10 Amp)** protects the fuel solenoid. If this fuse is "blown," the generator will shut down. If the fuse is replaced then "blows" again, locate the cause of the problem. The Fuel Solenoid Fuse is located in the wiring harness within the controller.
3. **Voltmeter Fuses (2) (1.5 Amp)** protect the voltmeter and the voltage protection board. If one of these fuses is "blown", the voltmeter fails to indicate the rated line voltage. If this fuse is replaced then "blows" again, locate and correct the cause of the problem. The voltmeter fuses are mounted on a fuse board within the controller.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by remote start/stop switch unless this precaution is followed.

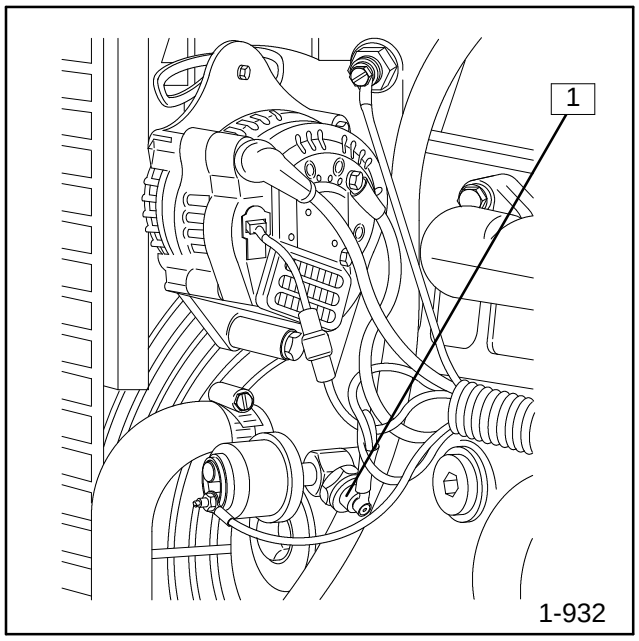
Fault Shutdowns

Low Oil Pressure Shutdown Switch

The low oil pressure (LOP) shutdown feature protects the engine against internal damage if the oil pressure drops below 7 psi (48.3 kPa) due to an oil pump fault or other engine malfunction. The LOP shutdown does not protect the set from damage due to operating with the oil level below the safe range– IT IS NOT A LOW OIL *LEVEL* SHUTDOWN. The only protection against running out of oil is to check the oil level regularly and add oil as needed. Location of the LOP shutdown switch is shown in Figure 2-4.

NOTE

This is not a low oil *level* shutdown. Proper oil level must be maintained for low oil pressure shutdown switch to function.

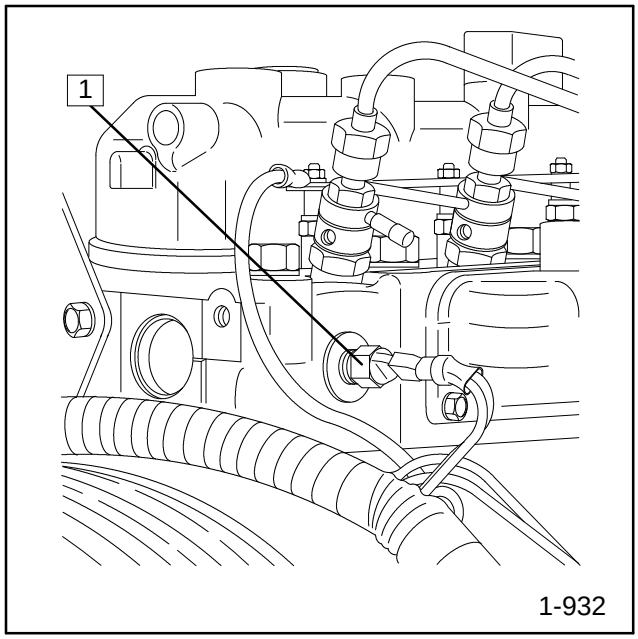


1. Low Oil Pressure Switch

Figure 2-4. Low Oil Pressure Shutdown Switch

High Water Temperature Shutdown Switch

The generator set is also equipped with a high water temperature (HWT) shutdown switch. See Figure 2-5. The unit will automatically shut down when the engine coolant temperature exceeds 230°F (110°C). Cause of the shutdown must be corrected before the generator can be restarted.



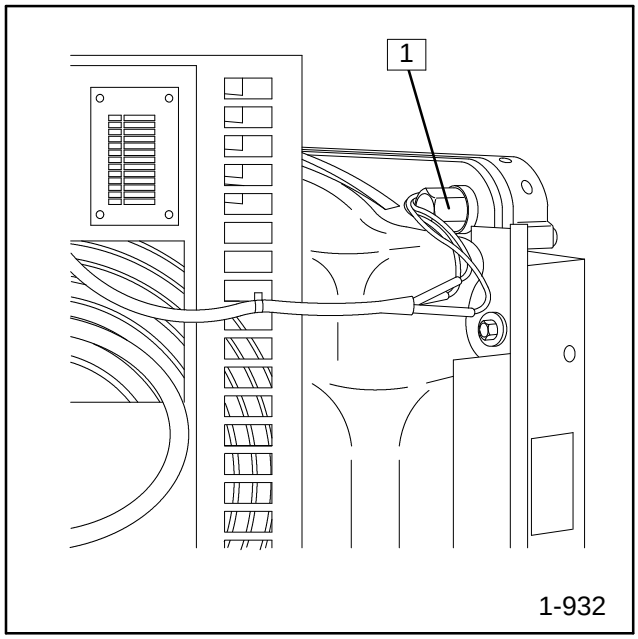
1. High Water Temperature Switch

Figure 2-5. High Water Temperature Shutdown Switch

Accessories

Low Coolant Level Shutdown Switch

If the engine coolant falls below the "safe" range in the radiator, the generator will automatically shutdown. The generator set will not run until coolant is added to the specified level. The Low Coolant Level (LCL) shutdown switch will not function during the first five seconds after startup. Location of the LCL shutdown switch is shown in Figure 2-6.



1. Low Coolant Level Switch

Figure 2-6. Low Coolant Level Shutdown Switch

Low Fuel Level Shutdown Switch

Provisions have been made in the wiring harness for wiring a Low Fuel Level (LFL) switch to the generator. A LFL switch will shut the unit down in the event that the fuel nears empty. Running a diesel engine out of fuel completely results in a dry fuel injection system which must be completely bled in order to restart the engine after refilling the fuel tank. The LFL switch prevents the fuel system from being run dry, thus allowing immediate restarting, once the fuel tank has been refilled.

Section 3. Scheduled Maintenance

Perform routine maintenance using the "Maintenance Schedule" on the following page and the hourmeter located on the generator controller. If the generator will be subject to extreme operating conditions, service the unit more frequently. Instructions to perform most of the scheduled services are provided on the following pages. Items in the maintenance schedule marked with an asterisk (*) should be performed more often if the generator set is operated in dirty, dusty conditions. Items identified with two asterisks (**) should be performed only by an authorized Kohler service dealer/distributor. Of items marked with three asterisks (***) the manufacturer suggests frequent inspection, change when recommended. Tools and instruments required for these additional steps are usually not available to the generator set owner. For this reason, the set should be returned periodically to an authorized service dealer/distributor for complete servicing and tune-up. The benefits of such maintenance will be improved performance and continuous satisfactory operation for a long, trouble-free service life.

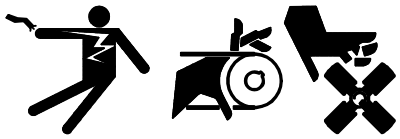
NOTE

The items listed in the maintenance schedule must be performed at the designated intervals for the life of the generator. For example, an item to be serviced "Every 100 Hours or 3 Months" must also be serviced after 200 Hours or 6 Months, 300 Hours or 9 Months, etc. The generator will eventually accumulate enough hours to warrant a complete overhaul. The exact time when extensive service will be necessary cannot be predicted. However, rough operation, lack of power, and excessive oil use indicate serious generator set problems. As part of a preventive maintenance program, service the engine and generator (replace bearing, inspect wiring, remove debris, etc.) at the earliest indication that a serious problem exists.

NOTE

HARDWARE DAMAGE! Engine and generator may make use of both American Standard and metric hardware. Be sure to use the correct size tools to prevent rounding of bolt heads and nuts.

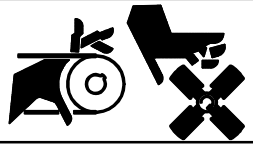
WARNING



Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by remote start/stop switch unless this precaution is followed.

WARNING



Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, or covers in place.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

Maintenance Schedule

Perform Service at Intervals Indicated (X)	Before Each Start-Up	Every 50 Hours or 1 Month	Every 100 Hours or 3 Months	Every 400 Hours or 6 Months	Every 500 Hours or Yearly
FUEL SYSTEM					
Check the fuel level	X				
Fill fuel tank	X				
Check fuel pipes and clamps		X			
Remove sediment from fuel tank				X	
Replace the fuel filter element				X	
Check governor operation and adjust as necessary**					X
Check the nozzle injection pressure**					X (1000 Hrs)
Check and/or replace fuel filter (supplied loose)			X		
LUBRICATION SYSTEM					
Check the oil level in crankcase	X				
Replace the oil in crankcase*		X (Break-in Period)	X		
Replace the lube oil filter element*		X (Break-in Period)	X		
COOLING SYSTEM					
Check coolant level	X				
Check water pipes and clamps			X		
Adjust the tension of water pump V-belt		X (Break-in Period)	X		
Change coolant					X
Clean radiator fins, inspect hoses*			X		
AIR CLEANER, ETC.					
Replace the air cleaner element*, ***				X (300 Hrs)	
Clean the breather pipe*, ***			X		
ELECTRICAL SYSTEM					
Verify proper operation of gauges (if equipped)	X				
Check the electrolyte level in the battery			X		
Check the electrical connections		X			
Check the battery specific gravity					X
CYLINDER HEAD, ETC.					
Check for leakage of water and oil	X	X			
Retighten all major nuts and bolts		X (Break-in Period)			X
Check mounting bolts and vibro mounts for tightness				X	
Adjust intake exhaust valve clearance**					X (800 Hrs)
GENERATOR					
Blow dust out of generator*					X

* Service more frequently if operated in dusty areas.
** Should be performed by an authorized Kohler service dealer/distributor.
*** Manufacturer suggests frequent inspection, change when recommended.

Lubrication System

This engine has a positive pressure lubrication system and a low oil pressure shutdown.

Oil Selection

The selection of engine oil is very important to a diesel engine. If an unsuitable oil is used or an oil change is neglected, it may result in damage and a shorter engine life. Oil must meet the API (American Petroleum Institute) classification of CC, CD or CE. Avoid mixing different brands of oils and lubricants; oils of different manufacturers may be incompatible and deteriorate when mixed. Recommended SAE (Society of Automotive Engineers) viscosity designation for given temperature ranges in which the generator set will be operated are listed in Figure 3-1.

Air Temperature	Oil Viscosity
Below 32°F (0°C)	SAE10W or 10W-30
32°–77°F (0°–25°C)	SAE 20 or 10W-30
Above 77°F (25°C)	SAE 30 or 10W-30

Figure 3-1. Engine Oil Selection

NOTE

Failure to observe these standards may cause inadequate oil pressure and cold-starting difficulties.

Oil Check

Check crankcase oil level daily or before each start to insure that the level is in the "safe range." To check oil level, remove oil dipstick and wipe dipstick clean. Reposition dipstick in crankcase and push it all the way down into the tube. Remove dipstick and check the level. Oil level should read between MIN and MAX marks on dipstick. Do not operate set if the oil level exceeds the MAX mark or registers below the MIN mark on the dipstick.

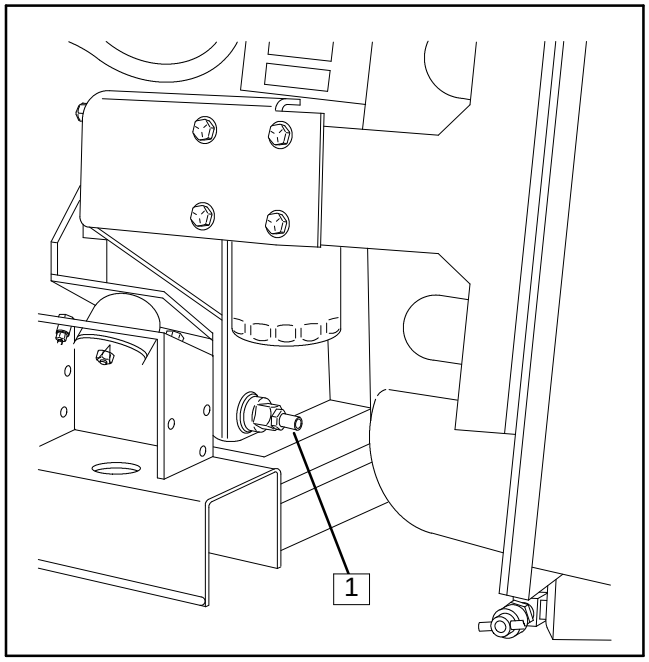
NOTE

Do not check oil level when the set is in operation. The engine must be stopped and on a level surface when checking oil. Most accurate oil readings are obtained by shutting down the generator and waiting several minutes before checking oil.

Oil Change

On a new engine, change the oil after the first 50 hours of operation and thereafter at 100-hour intervals or 3 months, whichever occurs first. Change oil more frequently under dirty, dusty conditions. Change oil while the engine is still warm.

1. Place a container below the oil drain and open the oil drain valve. See Figure 3-2. Allow sufficient time for the old oil to drain completely. Close the oil drain valve. Dispose of used engine oil in an environmentally safe manner. Take used oil to a suitable collection facility in your area. *DO NOT POUR USED OIL ON THE GROUND, DOWN SEWERS, OR INTO STREAMS OR OTHER BODIES OF WATER.*



1. Oil Drain

Figure 3-2. Oil Drain Location

2. Remove either oil fill cap. One is located on the rocker arm cover and one is located near the fuel injector pump. See Figure 3-4.

3. If the engine oil filter is to be replaced, see "Oil Filter" following.

4. Fill crankcase with proper amount and type of oil, see Figure 3-1 and Figure 3-3.

5. Replace oil fill cap. Start the generator set and check for oil leaks.

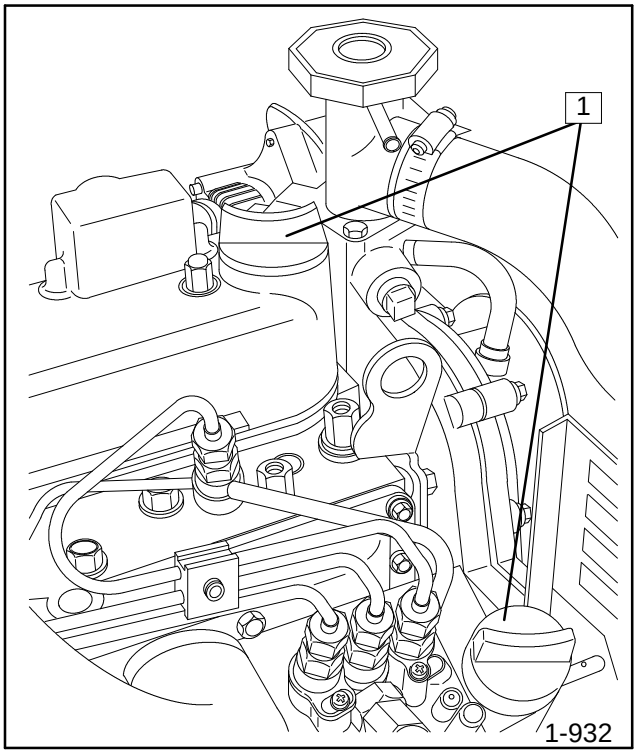
6. Stop the generator set. Remove the dipstick and wipe clean, reinsert as far as possible, and remove to check oil level. Add oil, as necessary, to bring level up to MAX mark.

OIL CAPACITY (with Filter) qts. (L)	
10CCOZ	6.3 (6.0)

Figure 3-3. Oil Capacity

NOTE

Too high an oil level causes increased oil consumption and carbonizing of the engine. Low oil level will cause engine damage.

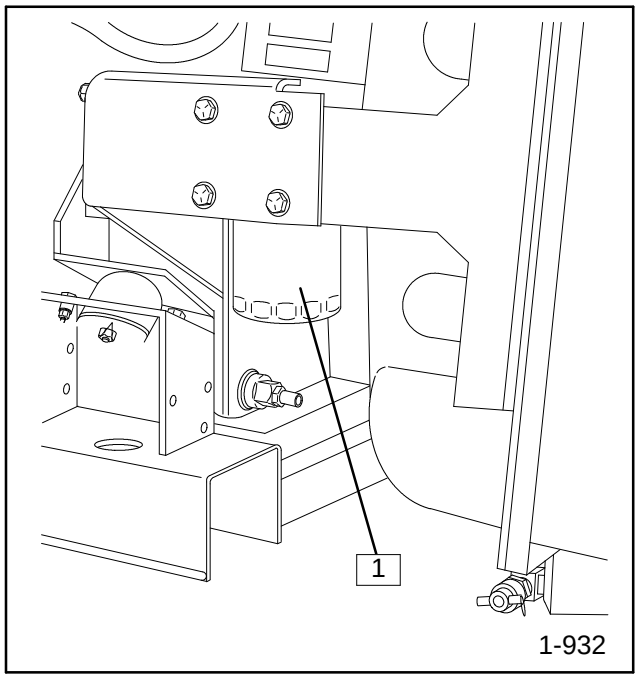


1. Oil Fill

Figure 3-4. Oil Fill Locations

Oil Filter

Replace the oil filter for the first time after 50 hours or 1 month of operation; then every 100 hours or 3 months. Change more frequently if operating in dirty, dusty conditions. See Figure 3-5 and refer to the following procedure.



1. Oil Filter

Figure 3-5. Oil Filter Location

1. With oil system drained, loosen oil filter by turning it counterclockwise with a filter wrench . Use rags to clean up spilled oil. Remove and discard filter.
2. Clean contact surface on oil filter adapter.
3. Lightly lubricate the gasket surface of the new oil filter with fresh engine oil. Thread oil filter to adapter until gasket makes contact. Then hand-tighten filter an additional one-half turn.
4. Replace engine oil. See "Oil Change" section for proper oil capacity.
5. Start the generator set and check for oil leaks.
6. Stop the generator set. Remove dipstick and wipe clean, reinsert as far as possible, and remove to check oil level. Add oil as necessary to bring level up to MAX level.

Fuel System

Specification

Use a clean, good quality No. 2-D (DIN 51 601) diesel fuel oil. The fuel must meet the requirements of the American Society of Testing and Materials (ASTM) diesel fuel classification D975 (Federal Specification W-F-800a). Cleanliness of the fuel is especially important on diesel engines with precision fuel injectors and pumps that are easily clogged. See chart below.

United States	ASTM/D975	No. 2-D Diesel
United Kingdom	BS2869	Class A1

Other Considerations:
Sulfur Content . . . . . Less than 0.5%
Sediment/Water Content . . . . . Not to exceed 0.05%
Cetane Number . . . . . 45 minimum
Flash point . . . . . At least 125°F (52°C)

NOTE

Never store diesel fuel in galvanized containers; diesel fuel and the galvanized coating react chemically to produce flaking which quickly clogs filters or causes the fuel pump or injectors to fail. Do not run the generator set out of fuel; air will be drawn into the fuel lines and the entire system will have to be bled before the unit can be restarted.

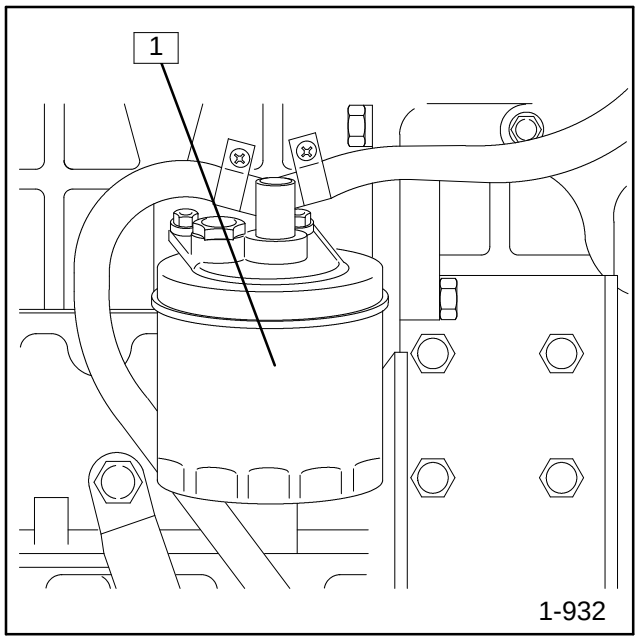
NOTE

Avoid storing fuel over long periods of time. Take special precautions to keep all dirt, water, and other contaminants out of the fuel. Contaminating diesel fuel storage tanks with water may cause the growth of "microbes." The presence of microbes forms a slime that clogs fuel filters and lines.

Fuel Filter

The fuel filter serves to remove water and dirt contained in the fuel. The engine-mounted fuel filter element is paper and no attempt should be made to clean it. Its useful life will be determined largely by the quality and condition of the fuel used. Under normal conditions, the fuel filter element should be replaced every 400 hours or six months. See Figure 3-6 for location and use the following procedure to service the fuel filter.

1. Loosen the fuel filter by using a filter wrench and turning in a counterclockwise direction. Use rags to clean up spilled fuel oil. Remove and discard filter.
2. Clean contact surface on the fuel filter adapter.
3. Lightly lubricate the gasket surface of the new fuel filter with fresh fuel oil. Thread the fuel filter to the adapter until the gasket makes contact, hand-tighten an additional one-half turn.
4. See "Bleeding" section following.



1. Fuel Filter

Figure 3-6. Fuel Filter Location.

Fuel Filter (Supplied Loose)

The fuel filter, supplied loose with the unit, serves as a preliminary source to remove dirt and metal particles from the fuel system before they reach the electric fuel pump. If the fuel filter is clogged with debris, the generator may be difficult to start or may run rough. The service life of the fuel filter is solely dependent on the quality of the diesel fuel used and the amount of debris entering the fuel system when refueling. As part of a regular maintenance program, the fuel filter should be checked and/or replaced every 3 months or 100 hours of operation. The fuel filter cannot be cleaned and should be replaced if fuel starvation or poor engine performance is evident.

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

Explosive fuel vapors can cause severe injury or death. Spilled fuel can cause an explosion. Use a container to catch fuel when draining fuel system. Wipe up all spilled fuel after draining system.

Bleeding the Fuel System

If the generator set engine runs out of fuel, air leaks develop in the suction side of the fuel system, or the fuel filter is replaced, it will be necessary to bleed the entire system to prevent starting failures and/or erratic operation. See Figure 3-7 and refer to the following procedure.

1. Disconnect lead 71A from the starter motor to disable cranking during the bleeding procedure.

2. Fill the fuel tank.

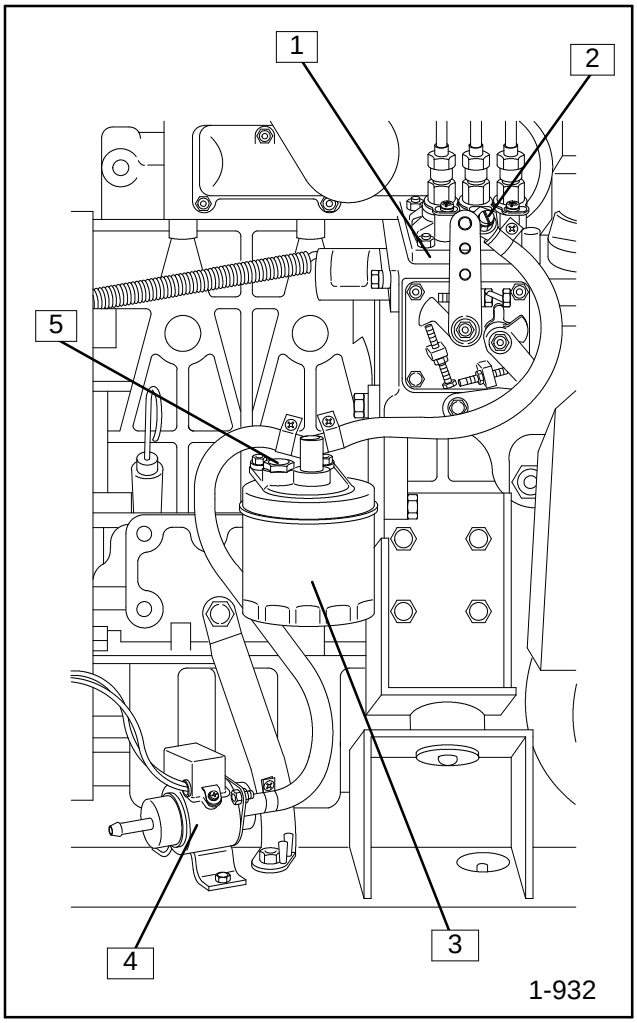
3. Loosen the small vent screw on the fuel filter a few turns.

4. Using start switch on the controller, operate the fuel pump until fuel, free from air bubbles, flows from this point. Tighten vent screw.

5. Loosen the line connection (bleed point) at fuel injection pump inlet.

6. Using start switch on the controller, operate the fuel pump until fuel, free from air bubbles, flows from this point. Tighten line connection.

7. Reconnect lead 71A to the starter motor.



1. Fuel Injection Pump
2. Line Connection (Bleed Point)
3. Fuel Filter
4. Electric Fuel Pump
5. Vent Screw

Figure 3-7. Bleeding the Fuel System

Air Cleaner Service

The air cleaner for this unit is **not** provided by Kohler Co., but has been specified by the trailer manufacturer. The element should be replaced at 400-hour or 6-month intervals (if this schedule conflicts with the manufacturer's instructions, follow the manufacturer's recommendation); change more frequently if operating under extremely dirty, dusty conditions. Operating the generator set with a dirty air cleaner element may cause engine damage and also increase fuel consumption.

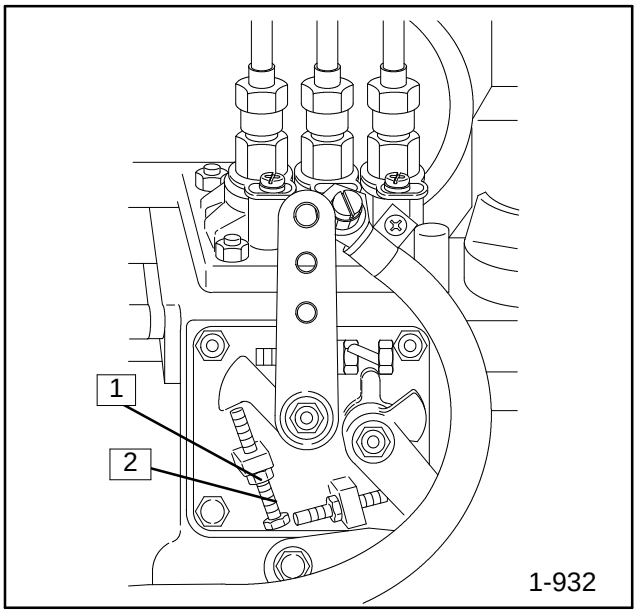
NOTE

Do not attempt to clean dry-type element in any liquid or with compressed air as this will damage paper filter material.

Governor

The mechanical-type governor is designed to keep the engine speed constant by automatically adjusting the amount of fuel supplied to the engine as the load changes. No regular service is required on the unit. The governor is adjusted during run-in at the factory, and further adjustment should be needed only if greatly varying load conditions are encountered or if the governor control degrades after extended usage.

This set is designed to operate at 60-63 Hz, 1800 rpm under full load and 1890 rpm under no load. To check speed, use a hand-held tachometer or a frequency meter. See Figure 3-8. Loosen locking nut on the speed-adjusting screw. Turn the screw in a clockwise direction to increase speed (frequency) or in a counterclockwise direction to decrease speed. Tighten the locknut to secure screw at new setting.



1. Locking Nut
2. Speed Adjusting Screw

Figure 3-8. Governor

Cooling Systems

Filling and Checking

Before filling the cooling system, verify that all petcocks are closed and all hose clamps are tight. Remove pressure cap located on the top of the engine and fill with the recommended coolant until level is just below overflow tube opening. If a coolant recovery tank is used, fill to just below the HOT (full) mark. Maintain proper coolant level in coolant recovery tank. The COLD (add) mark indicates full when cold and the HOT (full) mark indicates full when hot. Coolant level should always be between these marks. The coolant level can be checked using the coolant recovery tank markings, but it is recommended to periodically remove the pressure cap and check coolant level.

⚠ WARNING

Hot coolant and steam.
Can cause severe injury or death.

Before removing pressure cap stop generator, allow to cool and loosen pressure cap to relieve pressure.

Hot coolant can cause severe injury or death. Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

Flushing and Cleaning

For optimum protection, the cooling system should be periodically drained, flushed, and refilled, see Service Schedule. Open petcocks located at the radiator and engine block and let the system completely drain. Removal of the pressure cap will make draining easier. Drain, clean, and flush coolant recovery tank, if used. Chemical cleaners are available for badly rusted or corroded cooling system; follow manufacturer's instructions. Flush system with clean water before filling with recommended coolant.

Pressure Cap

The coolant system incorporates a pressurized cap(s) to raise the boiling point of the coolant and make use of higher operating temperatures. If leakage or malfunction occurs, replace with same rating type of cap. The pressure cap ratings are as follows:

10CCOZ Pressure Cap on Coolant Fill . . . . . 13psi (88 kPa)

Filling Sequence

To prevent the inconvenience of having the generator set shut down or become damaged due to overheating, keep the cooling air inlets to the system clean and unobstructed at all times. Inspect the exterior of the radiator for obstructions; remove all dirt and foreign material with a soft brush or cloth (to avoid damaging radiator fins). Check all hoses and connections for leaks and replace any hoses that are cracked, frayed, or feel spongy. When coolant level checks are made, check condition of the radiator cap rubber seal; replace if cracked or deteriorating. Remove dirt and other debris from the radiator cap and filler neck.

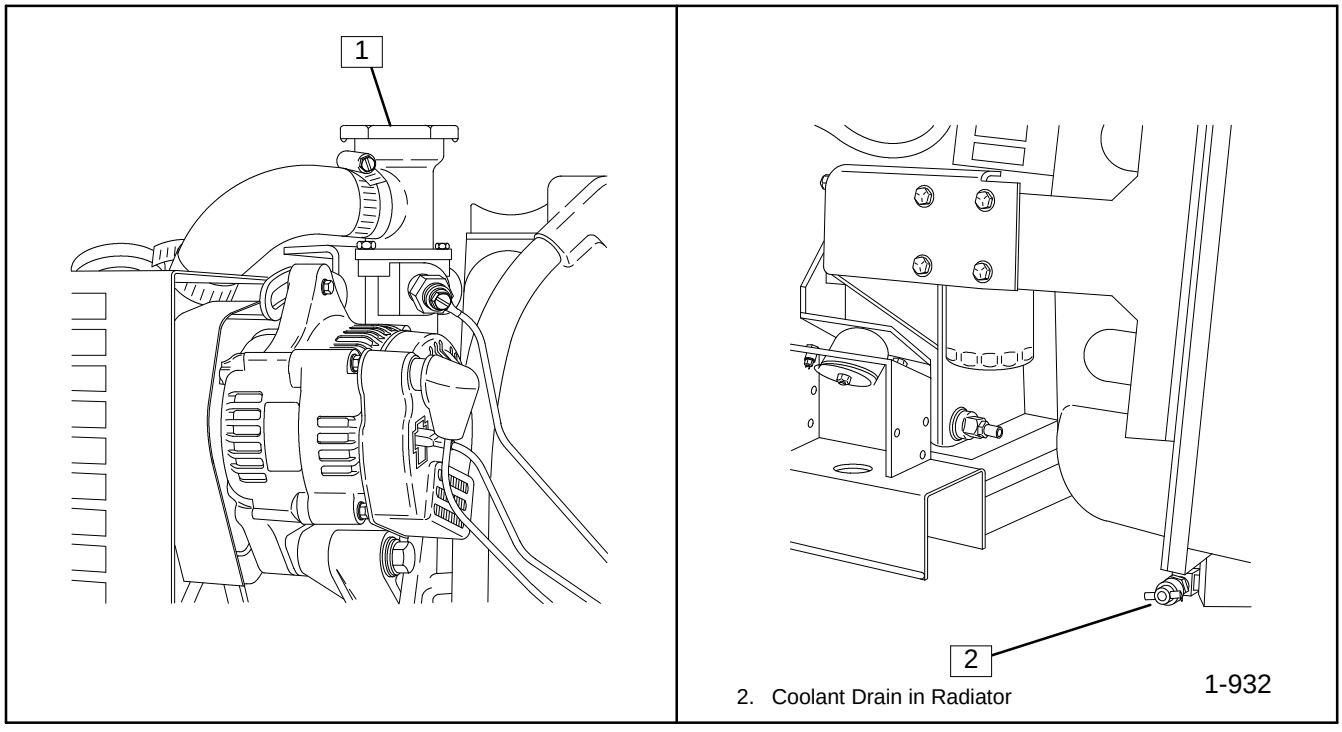
Coolant capacity for the 10CCOZ-Mobile inline radiator model is 5.1 qts. (4.8 L). Drain petcocks are provided on the bottom tank of the radiator and another in the engine block to drain the system. When draining the coolant, remove the radiator cap and open the block drain located near the flywheel housing and the radiator drain; this will allow the entire system to drain and prevent air pockets from forming and restricting coolant passage in the block. To refill the cooling system, close both drains and fill the radiator to the proper level with the recommended coolant mixture. See Figure 3-9 for coolant fill location. Replace the radiator cap and operate the engine until the thermostat opens and the radiator upper hose becomes hot. Stop the engine and allow to cool. Add coolant to the radiator to raise coolant level just below the overflow tube on the filler neck. Replace the radiator cap.

A coolant solution of 50% ethylene glycol and 50% clean, softened water is required to inhibit corrosion, prevent freezing to −34°F (−37°C), and to improve cooling. The antifreeze should contain a rust inhibitor and be changed every two years. Do not use alcohol or methanol antifreeze or mix them with the coolant. Do not add coolant to an engine that has overheated until the engine has cooled. Adding coolant to an extremely hot engine can cause a cracked block or cylinder head.

Check coolant level frequently and add antifreeze solution as needed to maintain level just below the overflow tube and at the min. level in the overflow tank when cold (max. when hot).

NOTE

Special attention should be given when checking for proper coolant level. After a radiator has been drained, it normally requires some time before complete refill of all air cavities take place.



1. Initial Coolant Fill (after initial fill, use coolant recovery tank to maintain coolant level)
2. Coolant Drain in Radiator

Figure 3-9. Coolant Fill/Drain Locations

Servicing Cooling System

For servicing the 10CCOZ generator set, refer to Figure 3-10 for proper coolant system disassembly and reassembly sequence. During the reassembly procedure, follow the General Torque Specifications found in Section 10. This generator set features a blower-type fan mounted to the hub, which is mounted to the crankshaft pulley. The blower fan draws air over the generator set and blows it through the radiator to cool the engine. See Figure 3-11.

Check and maintain the coolant level at the coolant recovery tank. See Figure 3-12 for tank location and Figure 3-13 for coolant capacities.

Observe the following recommendations for properly maintaining the generator set's coolant system:

- Never use dirty water or sea water as coolant.
- Always use a 50% mixture of clean water and antifreeze for coolant.
- Make sure the pressure cap is tightened after using.
- Do not fill the coolant beyond the "HOT" mark on the coolant recovery tank.

Refer to Figure 3-14 for remote radiator specifications.

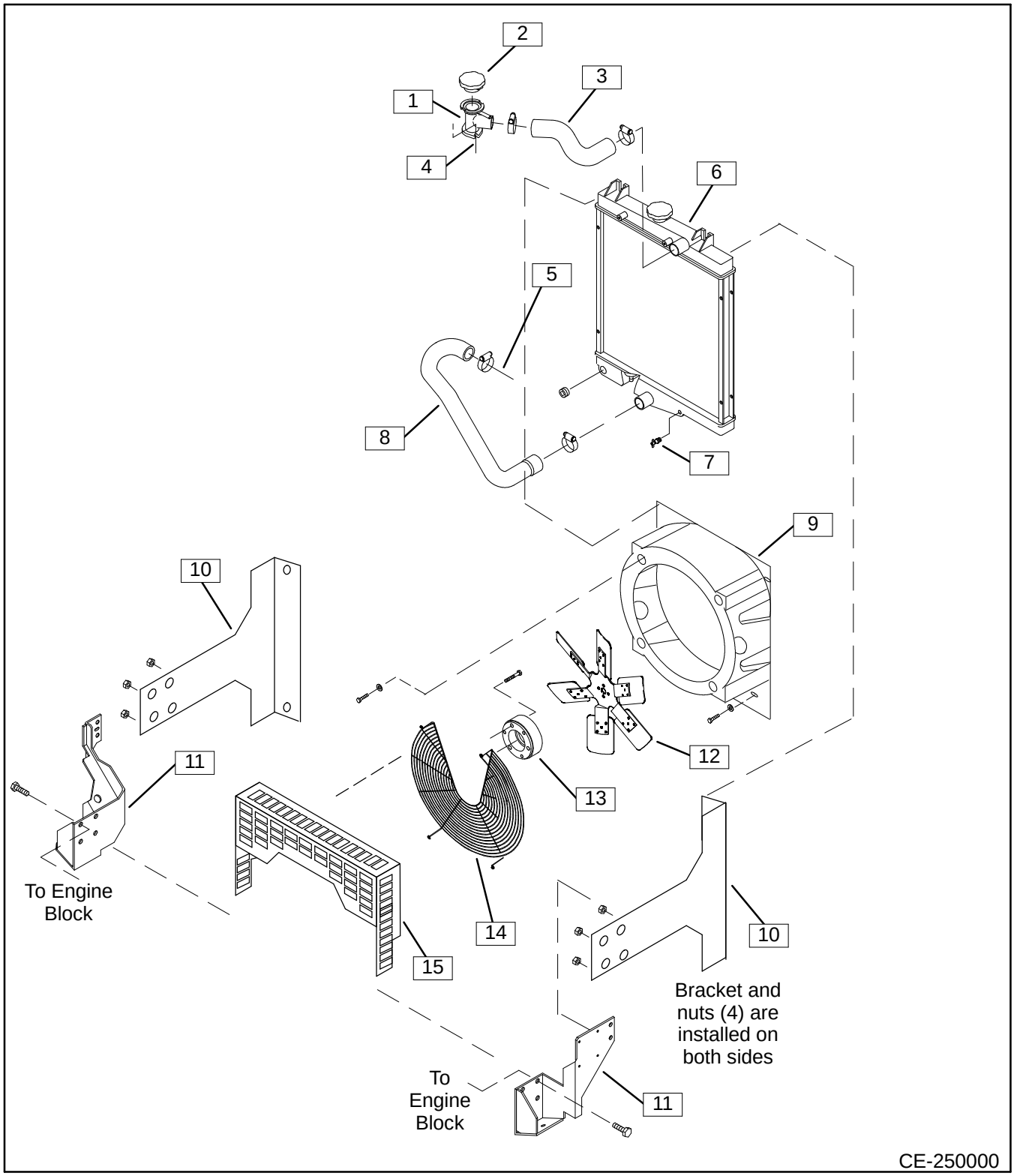


Figure 3-10. 10CCOZ Coolant System Exploded View

1. Coolant Fill
2. Pressure Cap 13 psi (89 kPa)
3. Upper Radiator Hose
4. To Engine
5. To Engine Water Pump
6. Radiator Assembly
7. Drain Petcock
8. Lower Radiator Hose
9. Fan Shroud
10. Engine Mounting Bracket
11. Engine Mounting Bracket
12. Suction Fan
13. Spacer
14. Wire Fan Guard
15. Belt Guard

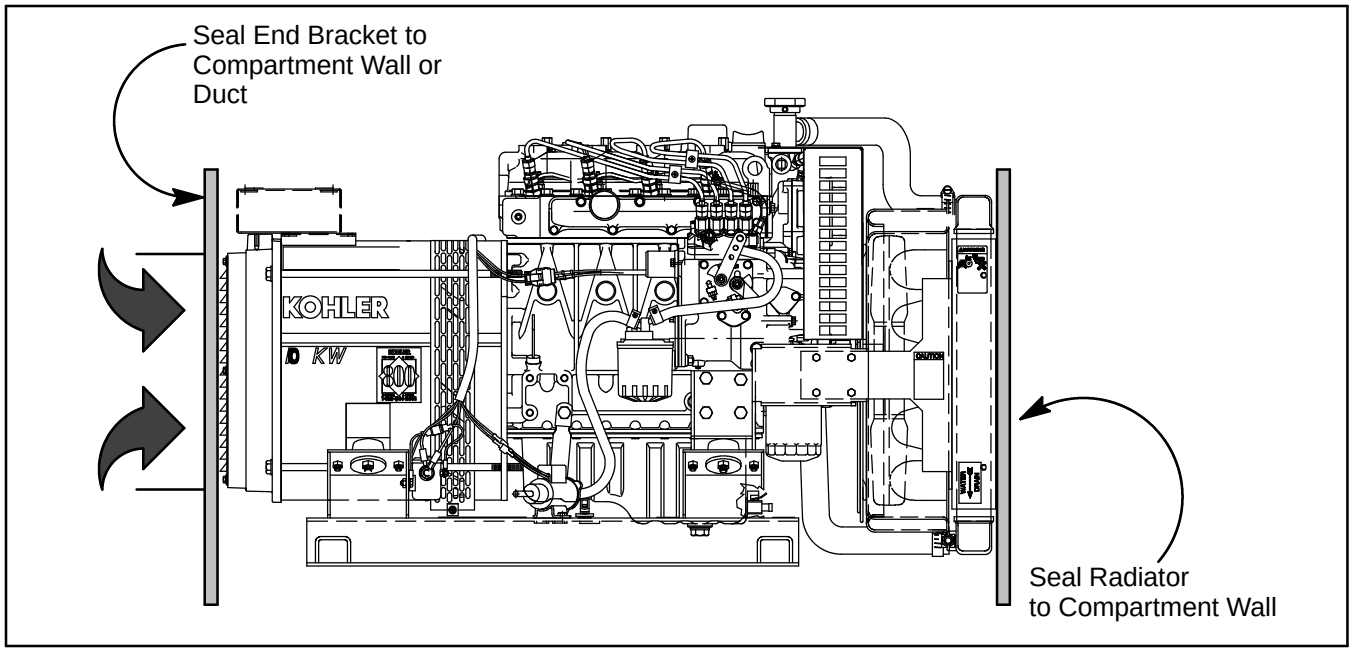
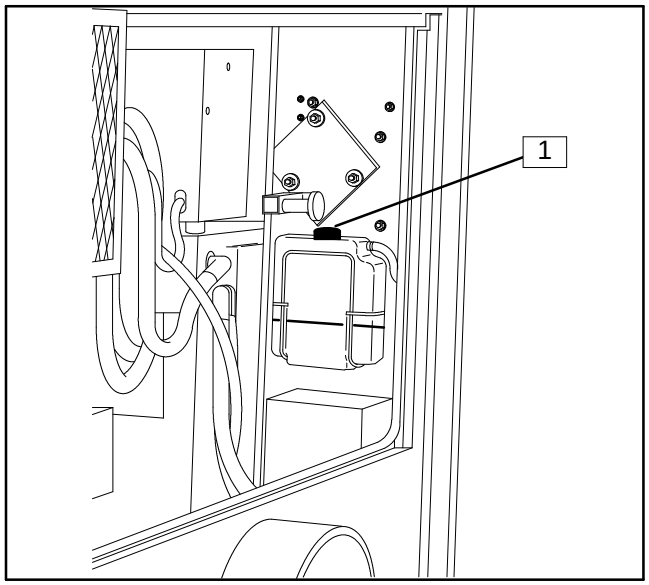


Figure 3-11. 10CCOZ Air Flow Direction Using Push Fan

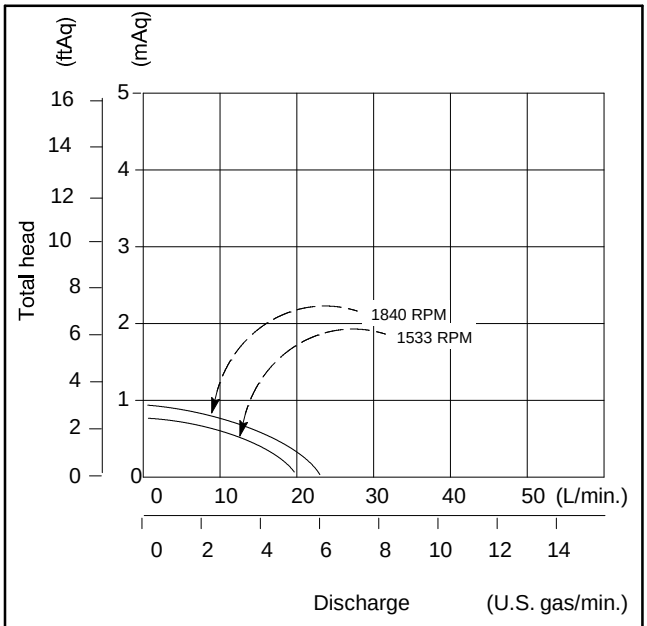


1. Coolant Fill

Figure 3-12. Cooling System Fill (Coolant Recovery Tank)

10CCOZ	Inline Radiator	5.1 qts. (5.4 L)

Figure 3-13. Coolant Capacity



10CCOZ Water Pump RPM @ 1800 is 1840 RPM
10CCOZ Water Pump RPM @ 1500 is 1533 RPM

Heat Rejection To Cooling Water:
10CCOZ is 56,500 Btu/Hr

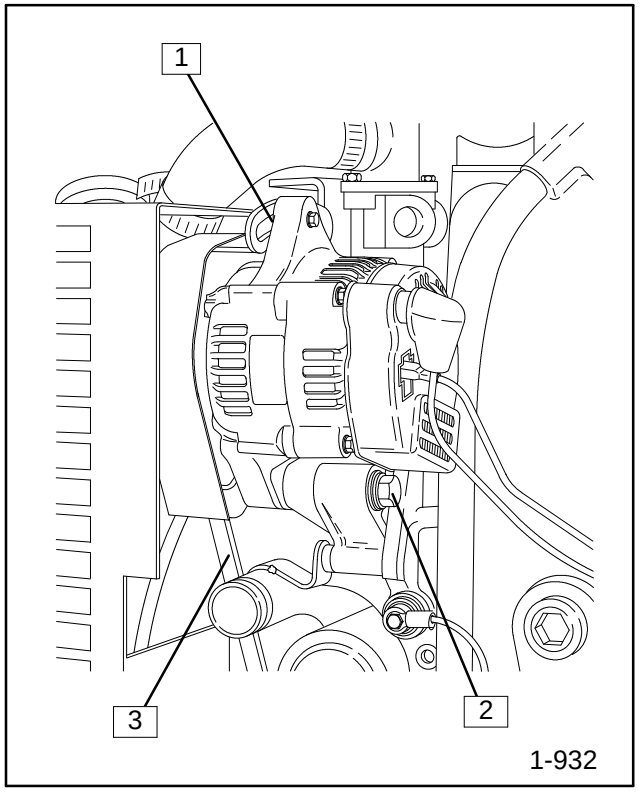
Figure 3-14. Water Pump Flow Rates and Engine Heat Rejection Values

Drive Belt

The alternator, fan, and water pump are belt driven. The drive belt must be properly adjusted at all times since a loose drive belt can overheat and results in improper operation of belt-driven components. Overtightening the belt may cause excessive wear on the alternator and water pump bearings, as well as premature belt wear. See Belt Tension following.

Belt Tension

The belt tension should be adjusted so that it can be depressed about 0.28 to 0.35 in. (7 to 9 mm) with about 22 lbs. (10 kg) of force, see Figure 3-15.



1. Adjusting Screw
2. Pivot Screw
3. Fan Belt

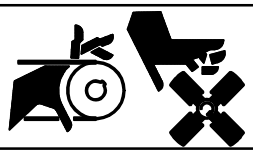
Figure 3-15. Belt Tension

1. Loosen pivot and adjusting screws.
2. While prying alternator outward, tighten adjusting screw.
3. Tighten pivot screw.
4. Recheck and adjust as necessary.

NOTE

Also, check fan belt for cracks or tears and replace if necessary.

⚠ WARNING



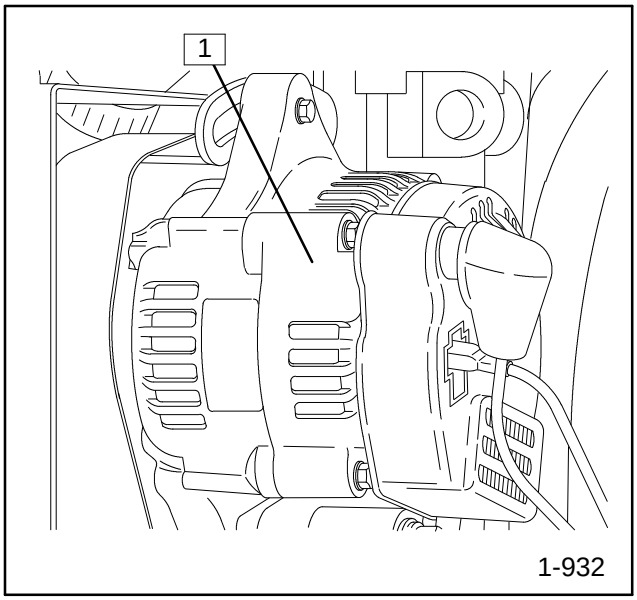
Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, or covers in place.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

Battery Charging

This generator is equipped with a 20-ampere, belt-driven battery charging alternator. See Figure 3-16. It is attached to the engine block by a bracket and serves to keep the battery constantly charged. Be sure to observe battery polarity when connecting the battery to the generator set. The alternator requires no maintenance other than maintaining belt tension. To adjust the alternator belt tension, see "Belt Tension."



1. Battery Charging Alternator

Figure 3-16. Battery Charging Alternator

Generator Service

General

Under normal conditions generator service will not be required on a regular basis. If operating under extremely dusty and dirty conditions, use DRY compressed air to blow out the generator at frequent intervals. Do this with the generator set operating and direct the stream of air in through the cooling slots at the end of the generator. Because of the generator set design, brush service should be practically nonexistent. The brushes operate at a very low amperage and should last indefinitely. Abrasive dust on the slip rings could, however shorten the life of the brushes. If brush replacement becomes necessary due to poor or no AC output, contact an Authorized Service Dealer to have this done.

The end bracket bearing should be replaced every 10,000 hours of operation. Service more frequently if bearing inspection indicates excessive rotor end play or bearing damage from corrosion or heat build-up. The end bracket bearing is sealed and requires no additional lubrication. All generator service must be performed by an authorized service dealer.

Storage Procedure

1. Drain the oil (while hot) from the crankcase, then refill with regular grade oil. See Section 3, "Oil Selection" in this manual.
2. Drain the fuel from the fuel tank to prevent accumulated moisture from mixing with the fuel.
3. Check the engine coolant level and specific gravity. See Section 3, "Cooling System" for additional information.
4. Disconnect battery (negative lead first) and place in storage.
5. Seal all openings in the engine with non-absorbent adhesive tape. Mask off all areas to be used for electrical contact.
6. Clean exterior surface of the generator. Spread a light film of oil over unpainted metallic surfaces which could rust or corrode.

Section 4. General Troubleshooting

Use the following tables as a quick reference in troubleshooting individual problems. Generator set faults are listed by specific groups and include likely causes and remedies. The source of more detailed information needed to correct a problem is indicated. These sources include various sections of this manual, the Operation and Installation Manual (TP-5647), and the Kubota Engine Service Manual (TP-5546).

When troubles occur, don t overlook simple causes. A starting problem could be caused, for example, by improper fuel or an empty fuel tank. Make sure all electrical connections are secure. Remember the battery negative must have a good ground.

Corrective action and testing in many cases requires knowledge of electrical and electronic circuits. It is recommended that service be done only by authorized Service dealers/distributors. Improper repair by unqualified personnel can lead to additional failures.

Problem	Possible Cause	Corrective Action	Reference
Will not start (cranks okay)	No fuel in tank	Replenish	
	Defective fuel solenoid	Check continuity	Section 7. Fuel Solenoid
	Defective fuel pump	Replace fuel pump **NOTE:** Fuel pump is polarity sensitive and will fail if the lead connections are made in reverse. (Black lead is positive, White/Black lead is negative)	Engine Service Manual
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Air in fuel system	Bleed air	Section 3. Fuel System
	Water, dirt in fuel system	Drain, flush fuel system	
	Improper type of fuel	Use proper type of fuel; consult fuel supplier	Section 3. Fuel System
	Dirty or faulty injectors	Check injectors	Engine Service Manual
	Improper valve timing	Correct or replace timing gear	Engine Service Manual
	Incorrect injection timing	Adjust injection timing	Engine Service Manual
	Defective injection timing	Repair/replace injection pump	Engine Service Manual
	Fuel cam shaft worn	Replace fuel cam shaft	Engine Service Manual
	Fuel leak	Tighten fittings	Engine Service Manual
	Improper compression	Check compression	Engine Service Manual
	Improper type of crankcase lube oil	Use proper lube oil	Section 3. Lubrication System
	Improper valve clearance	Check valve clearance	Section 3. Valve adjustment/ Engine Service Manual
	Clogged fuel filter	Replace filter	Section 3. Fuel Filter Service/Engine Service Manual
	Open wiring, terminal, or pin (P2 connector)	Check continuity	Section 9. Wiring Diagrams
	K4 relay defective (K2 relay must be energized)	Check relay coil continuity	Section 7. Controller Circuit Board Section 9. Wiring Diagrams

Problem	Possible Cause	Corrective Action	Reference
ENGINE			
Will not crank (dead)	Controller 10 Amp supply fuse blown	Replace fuse. If fuse failure continues, replace fuse and troubleshoot DC circuit and wiring.	Section 7. Engine/ Generator Components Section 8. Wiring Diagrams
	Battery disconnected or improperly connected	Check connections	Section 9. Wiring Diagrams Section 3. Battery
	Dead battery	Check electrolyte level and specific gravity (batteries with filler caps only). Perform load test	Section 3. Battery
	Corroded or loose battery connections	Clean or replace	Section 3. Battery
	Defective battery charging alternator	Replace alternator	Section 3. Battery Charging
	Loose battery charging alternator belt	Check/tighten or replace belt	Section 3. Drive Belt
	Open wiring, terminal, pin, foil, etc.	Check continuity	Section 7. Component Testing Section 9. Wiring Diagrams
	Defective starter	Service or replace	Engine Service Manual
	Defective starter solenoid	Check continuity of circuit. Bypass solenoid using jumper wire. If starter cranks, replace solenoid.	Section 7. Engine/ Generator Components Section 9. Wiring Diagrams Engine Service Manual
	Defective start/stop switch	Check continuity	Section 7. Component Testing Section 9. Wiring Diagrams
	Defective K2, K3, or K25 relay	Check/replace defective relay	Section 7. Engine/Generator Components Testing

Problem	Possible Cause	Corrective Action	Reference
Will not start (cranks okay) (cont'd.)	Weak or dead battery	Recharge battery. Check electrolyte level and specific gravity (batteries with filler caps only). Perform load test, or replace battery.	Section 3. Battery
	Defective glow plugs	Check/replace glow plugs	Engine Service Manual
	Defective GP relay	Check/replace GP relay	Section 7. Engine/Generator Components

Problem	Possible Cause	Corrective Action	Reference
Engine starts, but stops after start switch is released	Incorrect generator output voltage	Check AC output voltage.	Section 9. Wiring Diagrams Section 7. Component Testing–Separate Excitation
	Open wiring (P1 or P2 connector)	Check continuity	Section 9. Wiring Diagrams
	K1 relay coil defective	Check continuity	Section 7. Controller Circuit Board Section 9. Wiring Diagrams
	If LED1 is not lit, K1 relay is not receiving power from stator B1/B2 winding		Section 7. Stator Section 7. Engine/ Generator Components
	No/low oil pressure	Check oil level Check/repair oil pump	Add oil if low Engine Service Manual
	High water temperature	Check engine cooling system	Engine Service Manual
	Low oil pressure switch, high engine temperature switch	Disconnect lead from one switch and isolate the lead from ground. If engine continues to run, replace that switch. **NOTE:** Verify proper pressure or temperature before replacing switch.	

Problem	Possible Cause	Corrective Action	Reference
Hard starting	Stale or bad fuel	Replace	
	Air in fuel system	Bleed air	Section 3. Fuel System
	Water, dirt in fuel system	Drain fuel system and/or replace fuel filters	
	Dirty or faulty injectors	Check injectors	Engine Service Manual
	Improper type of fuel	Use proper type of fuel; consult fuel supplier	Section 3. Fuel System
	Air cleaner clogged	Clean or replace element	Section 3. Service Air Cleaner
	Worn piston rings, valves, etc.	Check compression and oil consumption	Engine Service Manual
	Improper cooling (hot engine only)	Inspect cooling system	Section 3. Cooling System
	Defective glow plugs	Check/replace glow plugs	Engine Service Manual
	Defective GP relay	Check/replace GP relay	Section 7. Engine/Generator Components

Problem	Possible Cause	Corrective Action	Reference
Generator set shuts down by itself	No fuel in tank	Replenish	
	Fuel line restriction	Inspect fuel lines and tank	
	Clogged fuel filter	Replace filter	Section 3. Fuel System
	Defective fuel pump	Check fuel pump **NOTE:** Fuel pump is polarity sensitive and will fail if the lead connections are made in reverse. (Black lead is positive, White/Black lead is negative)	Engine Service Manual
	Air in fuel system	Bleed air	Section 3. Fuel System
	Engine overloaded	Reduce electrical load	Section 3. Wattage Requirements
	Engine overheated (hot engine only)	Check air intake, governor adjustment, oil level, etc.	Section 3. Scheduled Maintenance Engine Service Manual
	Loss of generator output voltage to K1 relay (LED1 not lit)	Check AC voltage at rectifier (BR1) Check continuity of B1/B2 stator leads	Section 9. Wiring Diagrams Section 7. Stator
	Air cleaner clogged	Clean or replace element	Section 3. Servicing Air Cleaner

Problem	Possible Cause	Corrective Action	Reference
Generator set shuts down by itself (cont'd.)	No/low oil pressure	Check oil level, oil pressure, oil pump, and low oil pressure shutdown switch	Engine Service Manual
	High water temperature shutdown	Check engine cooling system	Engine Service Manual
	Low oil pressure switch, high engine temperature switch	Disconnect lead from one switchand isolate the lead from ground. If engine continues to run, replace hat switch. **NOTE:** Verify proper pressure, or temperature before replacing switch.	

Problem	Possible Cause	Corrective Action	Reference
Will not carry load or runs rough	Excessive load connected to generator	Reduce electrical load	Section 3. Wattage Requirements
	Improper cooling (hot engine only)	Inspect cooling system	Section 3. Cooling System
	Governor not properly adjusted or defective (Engine not operating at rated rpm)	Check speed using tachometer or frequency meter. **NOTE:** For 60 Hz–1800 RPM For 50 Hz–1500 RPM	Section 3. Governor
	Engine in need of overhaul	Contact Kohler distributor	Engine Service Distributor

Problem	Possible Cause	Corrective Action	Reference
Will not carry load or runs rough (cont'd.)	Fuel line restriction	Inspect fuel lines and tank.	
	Vent in fuel tank cap obstructed	Clean cap in solvent, blow dry	
	Dirty fuel filter	Replace fuel filter	Section 3. Fuel System
	Improper type of fuel	Use proper type of fuel; consult fuel supplier	Section 3. Fuel System
	Water, dirt, or air in fuel system	Drain, fill, and bleed air in the system Replace fuel filters	Section 3. Fuel System
	Defective fuel pump	Check fuel pump **NOTE:** Fuel pump is polarity sensitive and will fail if the lead connections are made in reverse (Black lead is positive, White/Black lead is negative)	Engine Service Manual
	Fuel leak	Tighten fittings	Engine Service Manual
	Valves not sealing	Compression test	Engine Service Manual
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Incorrect fuel injection timing	Check injection timing	Engine Service Manual
	Dirty or faulty injectors	Check injectors	Engine Service Manual
	Improper cylinder top clearance	Check clearance	Engine Service Manual
	Defective piston or piston rings	Check compression	Engine Service Manual
	Defective crankshaft bearing or piston pin bearing	Check components	Engine Service Manual
	Improper valve clearance	Adjust proper valve clearance	Engine Service Manual

Problem	Possible Cause	Corrective Action	Reference
Will not carry load or runs rough (cont'd.)	Defective injection pump	Check injection pump	Engine Service Manual
	Improper lube oil	Use proper viscosity oil	Section 3. Lubrication System

Problem	Possible Cause	Corrective Action	Reference
Lacks power	Governor not properly adjusted or defective (Engine not operating at rated RPM)	Check engine speed using frequency meter or tachometer. **NOTE:** For 60 Hz–1800 RPM For 50 Hz–1500 RPM	Section 3. Governor
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Improper cooling	Inspect cooling system	Section 3. Cooling System
	Engine overloaded	Reduce electrical load	Section 3. Wattage Requirements
	Stale or bad fuel	Replace	
	Fuel line restriction	Check fuel lines and tank	
	Dirty fuel filter	Replace fuel filter	Section 3. Fuel System
	Incorrect injection timing	Adjust injection timing	Engine Service Manual
	Uneven fuel injection	Repair/replace injectors and/or injection pump	Engine Service Manual
	Compression leak	Replace head gasket. Tighten cylinder head bolt, glow plug, and nozzle holder	Engine Service Manual

Problem	Possible Cause	Corrective Action	Reference
Overheats	Low coolant	Replenish water coolant system	Section 3. Cooling System
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Fan belt broken or loose	Tighten/replace fan belt	Section 3. Drive Belt
	Radiator clogged or dirty	Clean radiator (inside and outside)	
	Radiator cap defective	Replace radiator cap	
	Defective water pump	Check water pump	Engine Service Manual
	Engine malfunction	Troubleshoot engine	Engine Service Manual

Problem	Possible Cause	Corrective Action	Reference
Operates erratically	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Stale or bad fuel	Replace	
	Governor not properly adjusted or defective (Engine not operating at rated RPM)	Check engine speed using frequency meter or tachometer. **NOTE:** For 60 Hz−1800 RPM For 50 Hz−1500 RPM	Section 3. Governor
	Fuel line restriction	Inspect fuel lines and tank.	

Problem	Possible Cause	Corrective Action	Reference
Unit is noisy	Exhaust system leak	Check and replace as necessary	Operation and Installation Manual–Exhaust Systems
	Broken or damaged vibro mounts	Check and replace as necessary	Section 8. Disassembly/ Reassembly
	Loose or vibrating sheet metal/housing	Retighten screws	
	Inadequate compartment clearances	Check clearances	Operation and Installation Manual–Compartment Size
	Exhaust piping or air inlets/outlets not securely installed	Inspect for loose parts	Operation and Installation Manual–Exhaust Systems
	No compartment sound insulation	Install fireproof insulation	Operation and Installation Manual–Compartment Size
	Excessive vibration–engine/generator	Check rotor, crankshaft, bearing, etc. (Disassembly of engine and/or generator may be required)	Section 8. Disassembly/ Reassembly Engine Service Manual Kohler Service Distributor

Problem	Possible Cause	Corrective Action	Reference
ELECTRICAL SYSTEM			
Battery will not charge or goes dead	Loose or corroded connections	Clean and tighten connections	Section 3. Battery
	Sulfated or worn-out battery	Check electrolyte level and specific gravity (batteries with filler caps only)	Section 3. Battery
	Defective alternator	Test and replace, if necessary	Section 7. Component Testing
	Loose or defective alternator belt	Adjust belt tension or replace belt	Section 3. Belt Tension
	Defective alternator voltage regulator	Test and replace, if necessary	Section 7. Component Testing
	Loose or corroded engine ground strap	Clean and tighten	Section 3. Battery

Problem	Possible Cause	Corrective Action	Reference
Starter does not work properly	Loose or corroded connections	Clean and tighten loose connections	Section 3. Battery
	Low battery output	Check electrolyte level and specific gravity (batteries with filler caps only)	Section 3. Battery
	Defective starter solenoid	Check starter solenoid Replace starter solenoid, as necessary	Section 7. Component Testing Engine Service Manual
	Defective start/stop switch	Replace switch	Section 7. Component Testing
	Defective wiring	Check wiring	Section 8. Wiring Diagrams
	Defective starter	Replace starter	Engine Service Manual
	Battery cables undersize	Select proper size cable	Section 1. Specifications Chart–Installation Operation and Installation Manual–Electrical System
	Loose or corroded engine ground strap	Clean and tighten	Section 3. Battery

Problem	Possible Cause	Corrective Action	Reference
Starter cranks slowly	Low battery output	Check electrolyte level and specific gravity (batteries with filler caps only)	Section 3. Battery
	Too heavy viscosity lube oil	Use proper viscosity oil	Section 3. Lubrication System
	Loose or corroded wiring	Clean and tighten loose connections	Section 3. Battery
	High starter current draw	Repair/Replace starter	
	Battery cable undersize	Select proper size cable	Operation and Installation Manual–Electrical Systems

Problem	Possible Cause	Corrective Action	Reference
GENERATOR			
No generator output voltage	Optional AC output circuit breaker open or defective	Check position of circuit breaker Check AC voltage on generator side of circuit breakers	Section 2. Circuit Protection Section 9. Wiring Diagrams
	Optional AC circuit breaker tripping due to overload on unit	Reduce load Reset and attempt startup	Section 3. Wattage Requirement
	Short circuit in vehicle wiring causing circuit breaker to trip	Reset circuit breaker. If breaker trips again, check wiring.	Section 9. Wiring Diagrams Load Wiring Diagram
	No battery voltage to exciter field during cranking	Check flashing current	Section 7. Separate Excitation Test
	Open D4 or D7 diode	Check for open or shorted diode (a good diode has high resistance one way and low resistance the other way, when tested with ohmmeter)	Section 9. Wiring Diagrams Section 7. Circuit Board
	K1 relay (Normally Closed) contacts open	Check continuity	Section 9. Wiring Diagrams Section 7. Circuit Board
	Defective rotor (open, grounded, or shorted windings)	Test and/or replace	Section 7. Rotor
	Defective stator (open, grounded, or shorted windings)	Test and/or replace	Section 7. Stator

Problem	Possible Cause	Corrective Action	Reference
No output voltage (cont'd.) generator	Defective voltage regulator Misadjusted voltage regulator	Excite (rotor) separately	Section 7. Separate Excitation Section 7. Voltage Regulator

Problem	Possible Cause	Corrective Action	Reference
Low generator output voltage	Low engine rpm	Check engine speed using frequency meter or tachometer. **NOTE:** For 60 Hz–1800 RPM For 50 Hz–1500 RPM	Section 3. Governor Adjustments
	Set overloaded	Make sure capacity is not being exceeded	Section 3. Wattage Requirements
	Defective rotor	Test and/or replace	Section 7. Rotor
	Defective stator	Test and/or replace	Section 7. Stator
	Defective voltage regulator	Test and/or replace	Section 7. Voltage Regulator
	Improperly adjusted voltage regulator	Readjust	Section 7. Voltage Regulator

Problem	Possible Cause	Corrective Action	Reference
High generator output voltage	Defective voltage regulator	Test and/or replace	Section 7. Voltage Regulator
	Voltage regulator misadjusted	Readjust	Section 7. Voltage Regulator
	Open or poor splice connection at terminals 1 or 4 on stator (regulator sensing); or poor pin connection at voltage regulator	Check continuity and clean connections	Section 7. Stator Section 9. Wiring Diagrams

Section 5. Controller Troubleshooting

Sequence of Operation

The following text describes the controller sequence of operation during starting, running, and stopping of the generator set. Use this section as a starting point for controller fault identification.

Starting

Preheating. Preheating of the glow plugs in the diesel engine is initiated by rocking the start/stop switch on the control panel to the STOP/PREHEAT position for the time period specified in Section 2. This action energizes the GP relay. As a result, normally open contacts of the GP relay close to energize the glow plugs.

At the end of the specified time period, the start/stop switch is released or switched out of the STOP/PREHEAT position. Either of these actions opens the ground path to the GP relay, de-energizing the GP relay and the glow plugs.

Engine Startup. The engine is started after glow plug preheating by rocking the start/stop switch on the control panel to the START position. At this point, the ES (Emergency Stop) switch on the control panel must be in its normal position and the 10 ampere fuse must be good. If not, power to the starting circuits is interrupted and none of the other actions described in this paragraph occur.

Setting the Start/Stop switch to the START position energizes the K2 relay (LED2 lights). As a result, normally open contacts of K2 close to energize the K3 relay, the K25 relay, and the FP (Fuel Pump) motor.

Energizing the K3 relay (LED3 lights) causes a set of normally open contacts to close and energize relay K20. A set of normally open contacts of K20 then close to energize the S solenoid (Starter Solenoid). As a result, normally open contacts of the S relay close to energize the M (starter) motor and the starter motor gear engages the ring gear on the engine flywheel to begin cranking the engine. At the same time, the power supplied to starter motor also energizes the pull-in coil of the FS (Fuel Solenoid).

Energizing the K25 relay closes a set of normally open contacts to energize the hold coil of the fuel solenoid to complete the conditions necessary for engine startup.

Releasing the Start/Stop switch allows the switch to return to its neutral position. If the switch is released before the engine starts (the K1 relay is still de-energized), the K2 relay de-energizes. The normally open contacts of the K2 relay then open to interrupt power to the engine startup circuits. As a result the K3 relay, the K25 relay, the K20 relay, the Fuel Pump, the Fuel Solenoid, and the Starter Solenoid all de-energize to cease startup of the engine.

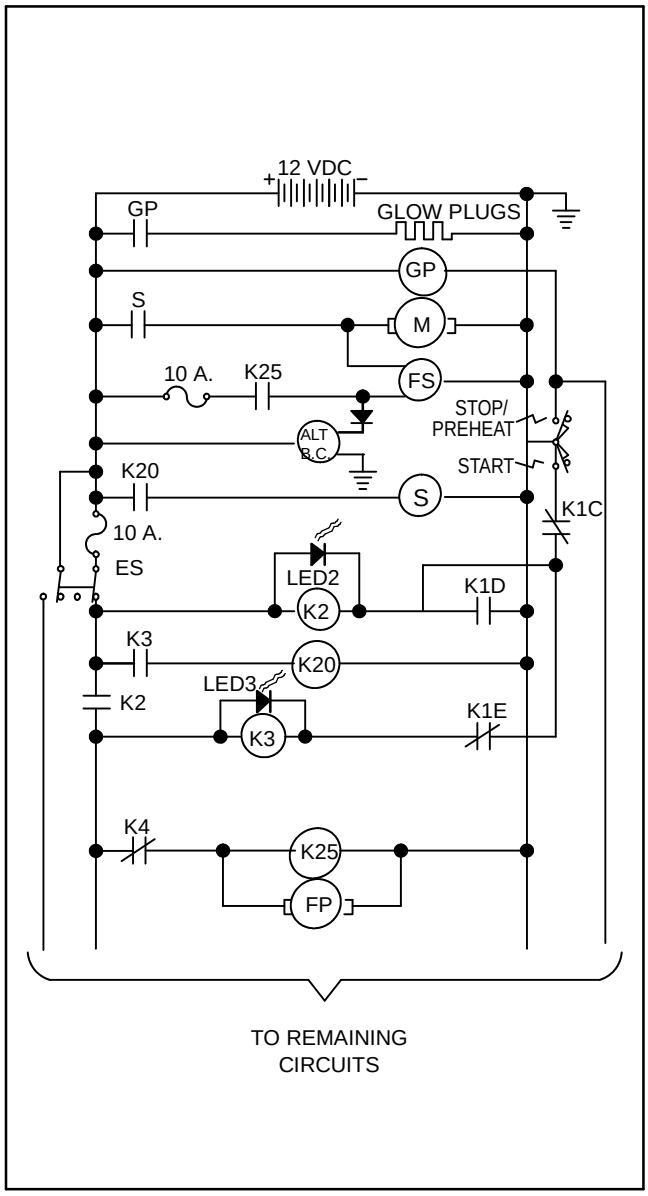


Figure 5-1. Sequence of Operation, Starting

Running

During engine startup, flashing current is provided to the generator exciter field through a normally open contact of the K2 relay and normally closed contacts of the K1 relay. The resulting generator output from the B1/B2 stator winding, rectified and limited to a 12 VDC level, energizes the K1 relay (LED1 lights). After a 5 to 10 second delay, the K5 relay is energized (LED5 lights). Both relays remain energized during normal running.

Energizing the K1 relay opens the normally closed K1A and K1B contacts that supply flashing current to the generator exciter field. Field exciter current for continued operation is then supplied by the voltage regulator, operating from an input supplied by generator stator winding 55/66.

Energizing the K1 relay opens the normally closed K1C contacts between the Start/Stop switch and the K2 relay in the engine startup circuit. However, at the same time, the normally open K1D contacts close to keep the K2 relay energized in order to maintain operating power for the other relays and the hourmeter, oil pressure gauge, water temperature gauge, and battery voltage gauge on the controller front panel as well as the overspeed protection circuit board within the controller.

Energizing the K1 relay opens the normally closed K1E contacts to de-energize the K3 relay. As a result, K20 and the S (Starter) solenoid de-energize to disengage and de-energize the starter motor, even when the Start/Stop switch is held in the Start position. The other devices energized during engine starting, that is relay K25, the fuel pump, and the fuel solenoid, remain energized to keep the engine running and to supply excitation to the B.C. Alt (battery charging alternator).

Finally, energizing the K1 relay closes the normally open K1F contacts to supply a high to the F (Fault) light. The fault light and the shutdown switches that activate it are explained in the Safety Shutdown paragraph on the next page.

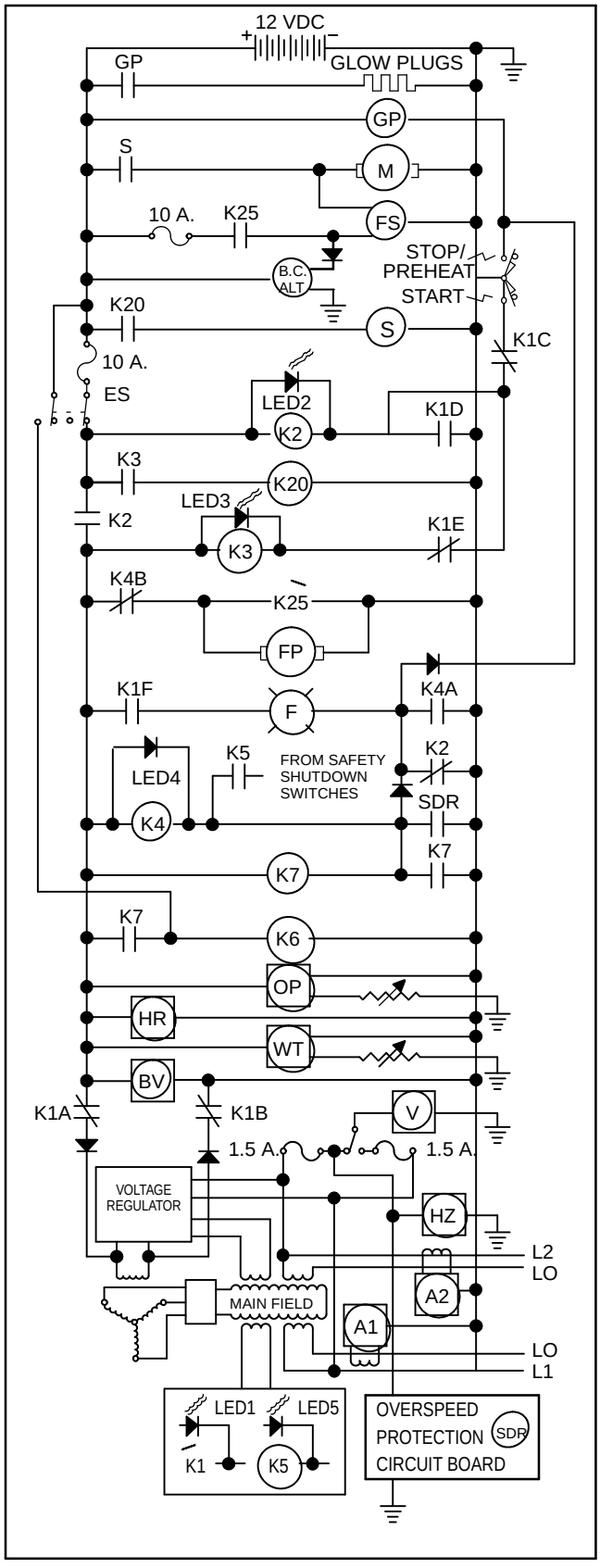


Figure 5-2. Sequence of Operation, Running

Stopping

Normal Stop. A normal stop is initiated by rocking the Start/Stop Switch on the controller front panel to the Stop position and then releasing the switch. ***Holding the switch in the Stop position energizes the GP relay, causing further, unnecessary heating of the glow plugs.*** In the Stop position, the Start/Stop switch provides a ground through two blocking diodes to energize the K4 relay (LED4 lights). The normally open K4A contacts then close, latching the K4 relay in an energized condition.

At the same time, normally closed K4B contacts open to de-energize the FP (fuel pump) motor and the K25 relay. The normally open K25 contacts then open to de-energize the FS (fuel) solenoid, turning off the flow of fuel. With the fuel supply and fuel pump both turned off, the engine turns off.

With the engine turned off, the generator output decays and causes relays K1 and K5 to de-energize (LED1 and LED5 go out). The normally open K1D contacts then open, de-energizing the K2 relay (LED2 goes out) and opening the normally open K2 contacts to interrupt power to the remaining controller relay circuits, including relay K4. As a result, the latch-up of the K4 relay is broken to return the controller circuits to a normal pre-start condition.

Emergency Stop. An emergency stop is initiated by depressing the Emergency Stop Switch on the controller front panel. ***The Emergency Stop Switch is intended only for emergency conditions; the Start/Stop Switch should be used for normal stops.*** Depressing the Emergency Stop Switch (ES) opens the normally closed ES contacts, interrupting power to the controller relay circuits to cause immediate turnoff of the FP (fuel pump) motor and the FS (fuel) solenoid. With the fuel supply and fuel pump both turned off, the engine turns off and the generator output decays.

When it is activated, the Emergency Stop Switch locks in the depressed position. Before the set can be started again, it is necessary to rotate the switch and release the locking mechanism so the normally closed ES contacts can close and restore power to the controller circuits.

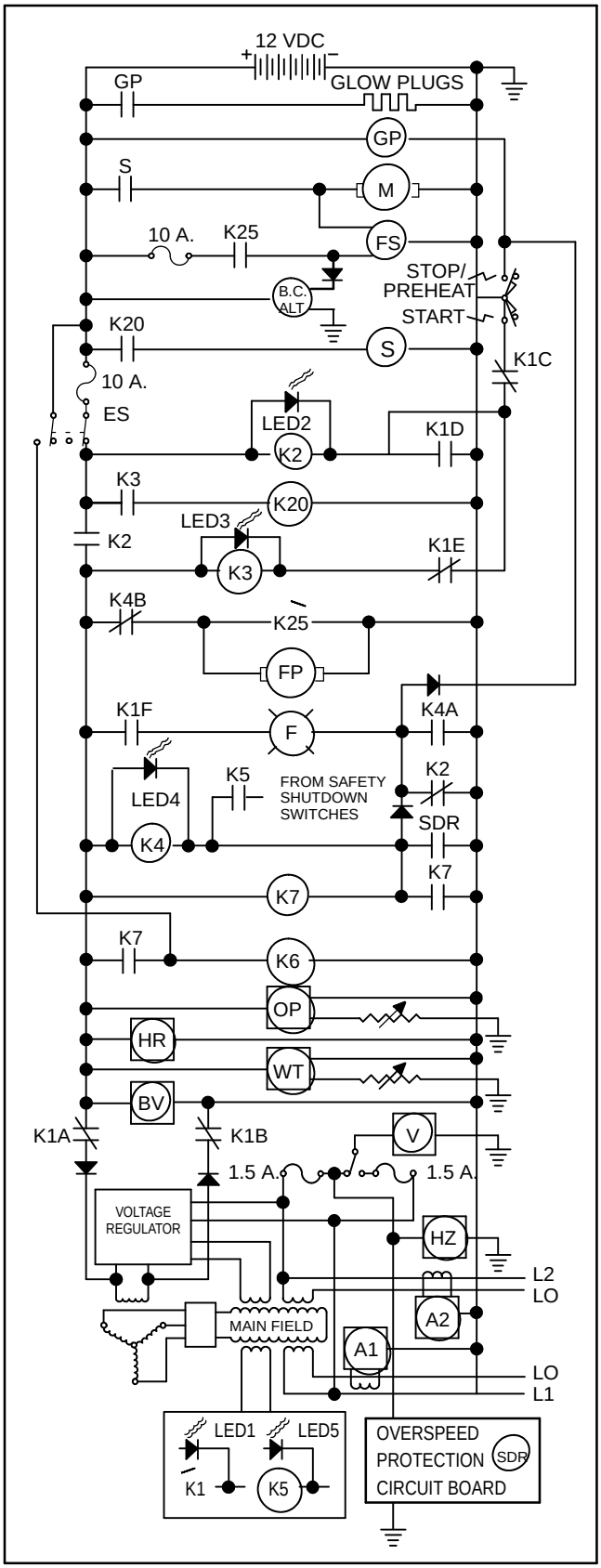


Figure 5-3. Sequence of Operation, Stopping

Automatic Safety Shutdowns

Overspeed. The overspeed protection circuit board monitors the frequency of the L2 output of the generator set. If the frequency is too high, the SDR relay on the circuit board energizes. Normally open SDR contacts then close to energize the K4 relay (LED4 lights). As a result, the normally open K4A contacts close to latch the K4 relay energized.

At the same time the K4A contacts close, normally closed K4B contacts open to de-energize the FP (fuel pump) motor and the K25 relay. The normally open K25 contacts then open to de-energize the FS (fuel) solenoid, turning off the flow of fuel. With the fuel supply and fuel pump both turned off, the engine turns off.

With the engine turned off, the generator output decays and causes relays K1 and K5 to de-energize (LED1 and LED5 go out). The normally open K1D contacts then open, de-energizing the K2 relay (LED2 goes out) and opening the normally open K2 contacts to interrupt power to the remaining controller relay circuits, including relay K4. As a result, the latch-up of the K4 relay is broken to return the controller circuits to a normal pre-start condition.

Engine Safety Switches. The engine is equipped with up three to five switches that monitor critical operating conditions. These switches include:

- A High Engine Temperature Switch that closes when the cooling water is not circulating properly and the engine temperature rises toward an unsafe level.
- A Low Oil Pressure Switch, which closes when the oil pressure is insufficient, to indicate inadequate lubrication of the engine.
- An optional Water Temperature Switch, which closes when the cooling water temperature is too high, to indicate inadequate cooling of the engine.
- An optional, customer-installed Low Fuel Level Switch to detect near empty conditions of the fuel storage tank and thereby prevent complete emptying of the fuel supply lines and pump.

During normal running, closing any one of the above switches results in an engine shutdown. During startup, this shutdown function is disabled by normally open contacts of the K5 relay until the generator output stabilizes at acceptable levels as described on page 5-2.)

Once the normally open contacts of K5 close, the engine safety switches are enabled. If any of the switches close, the K4 relay is energized to produce a shutdown in the same manner as described above for an Overspeed condition.

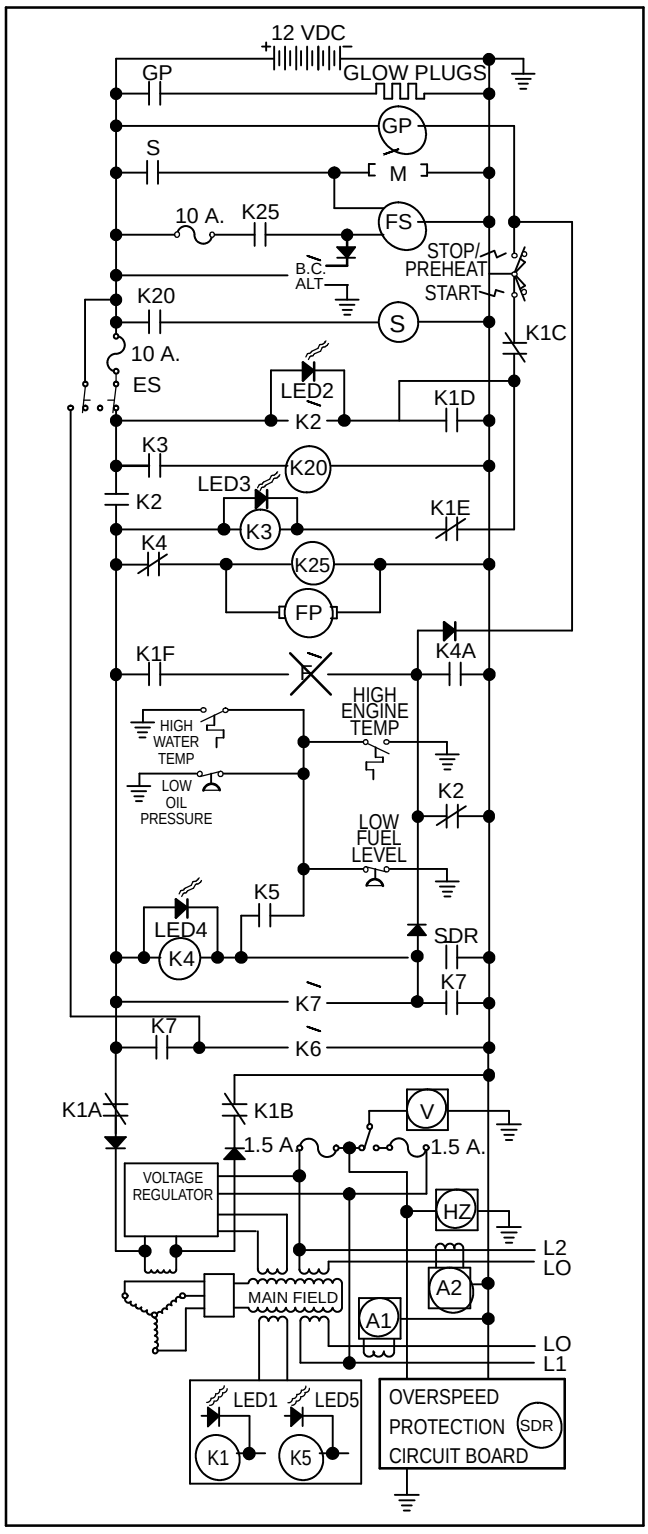


Figure 5-4. Sequence of Operation, Emergency Shutdowns

Section 6. Generator/Controller Troubleshooting

The section contains flow charts to troubleshoot the generator set including the controller circuit board. Before beginning the troubleshooting, read all safety precautions at the beginning of this manual. Additional safety precautions are included with the tests; DO NOT NEGLECT THESE PRECAUTIONS.

Controller Circuit Board

The controller circuit board is equipped with LEDs (light emitting diodes) to indicate the presence of relay coil power and aid in circuit board and generator fault detection. See Figure 6-1.

When K1, K2, K3, K4, or K5 relays are receiving power, the corresponding LED will light. The LED does not indicate whether the relay coil is good or bad. This conclusion can only be reached through analysis of the fault.

Use the flow chart (Figure 6-2) as an aid in troubleshooting the generator set.

Where a check or test is referenced, go to the procedure for detailed instructions.

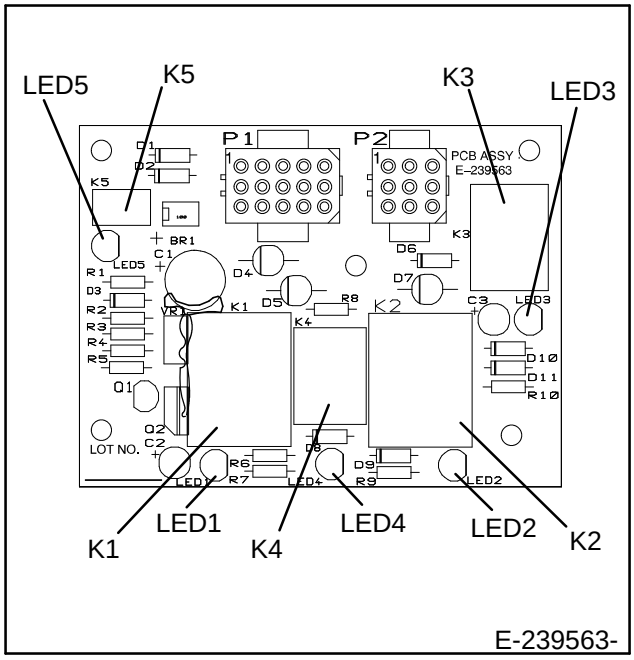


Figure 6-1. Controller Circuit Board E-239563

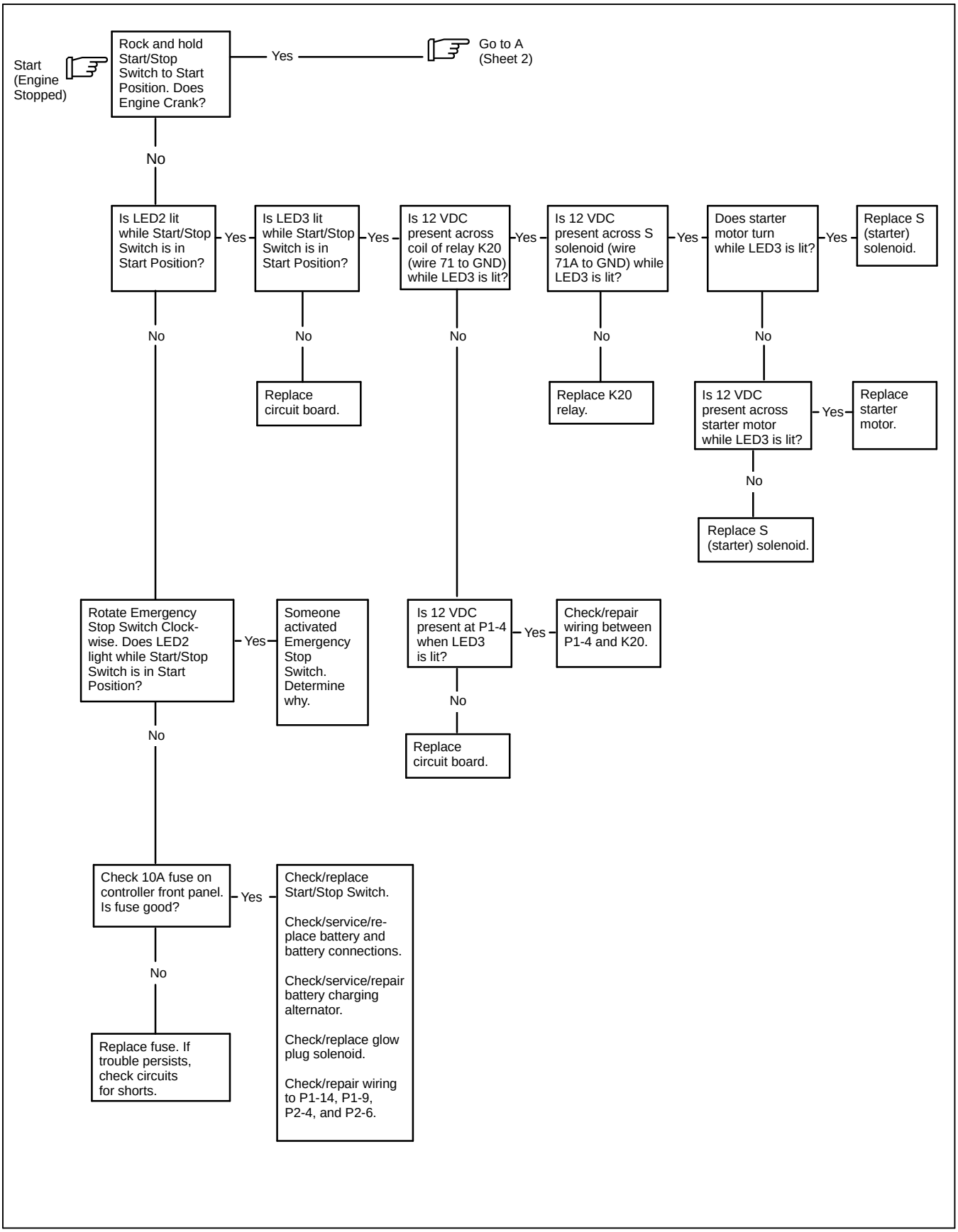


Figure 6-2. Troubleshooting Flow Chart (Sheet 1 of 4)

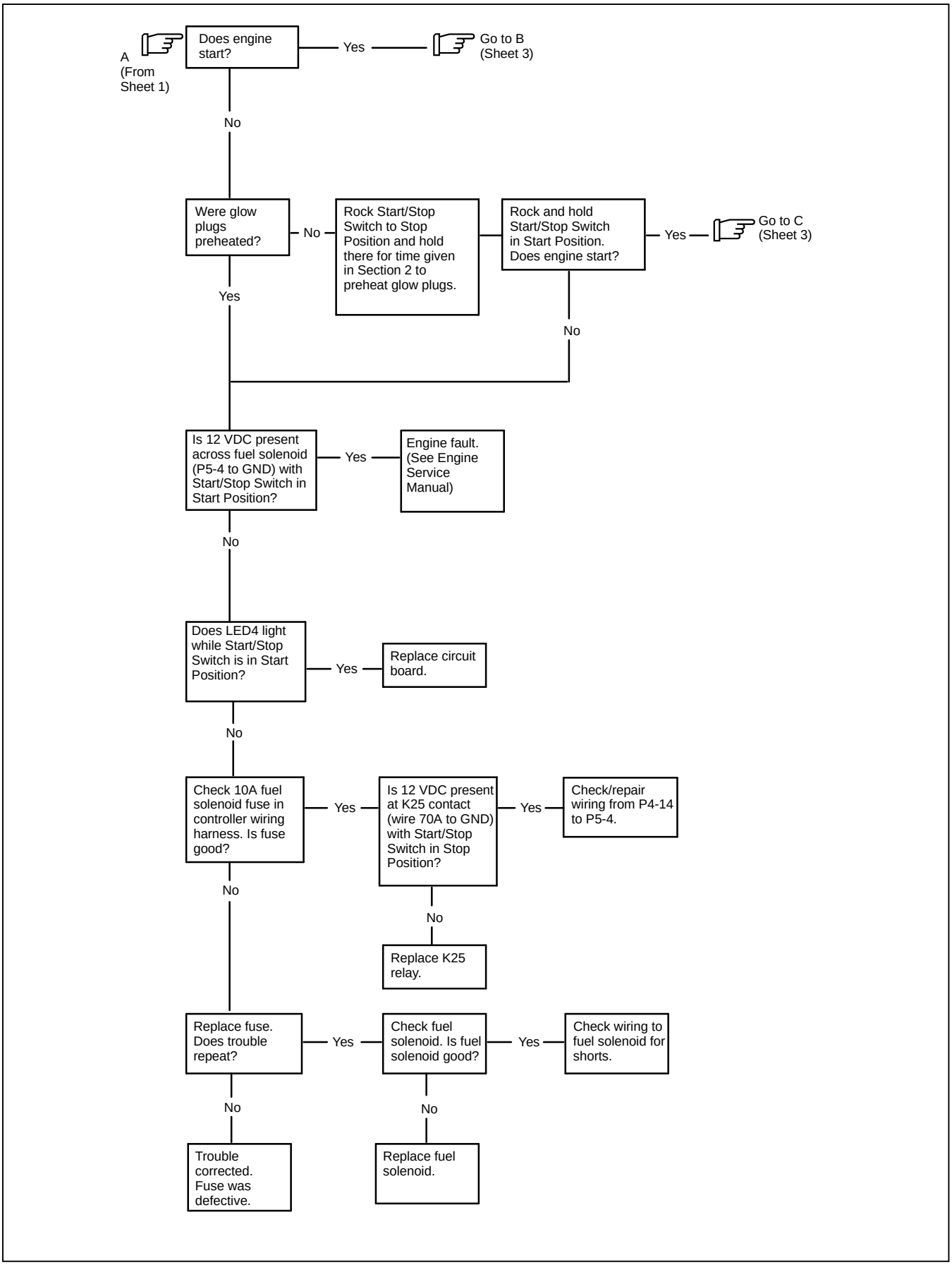


Figure 6-2. Troubleshooting Flow Chart (Sheet 2 of 4)

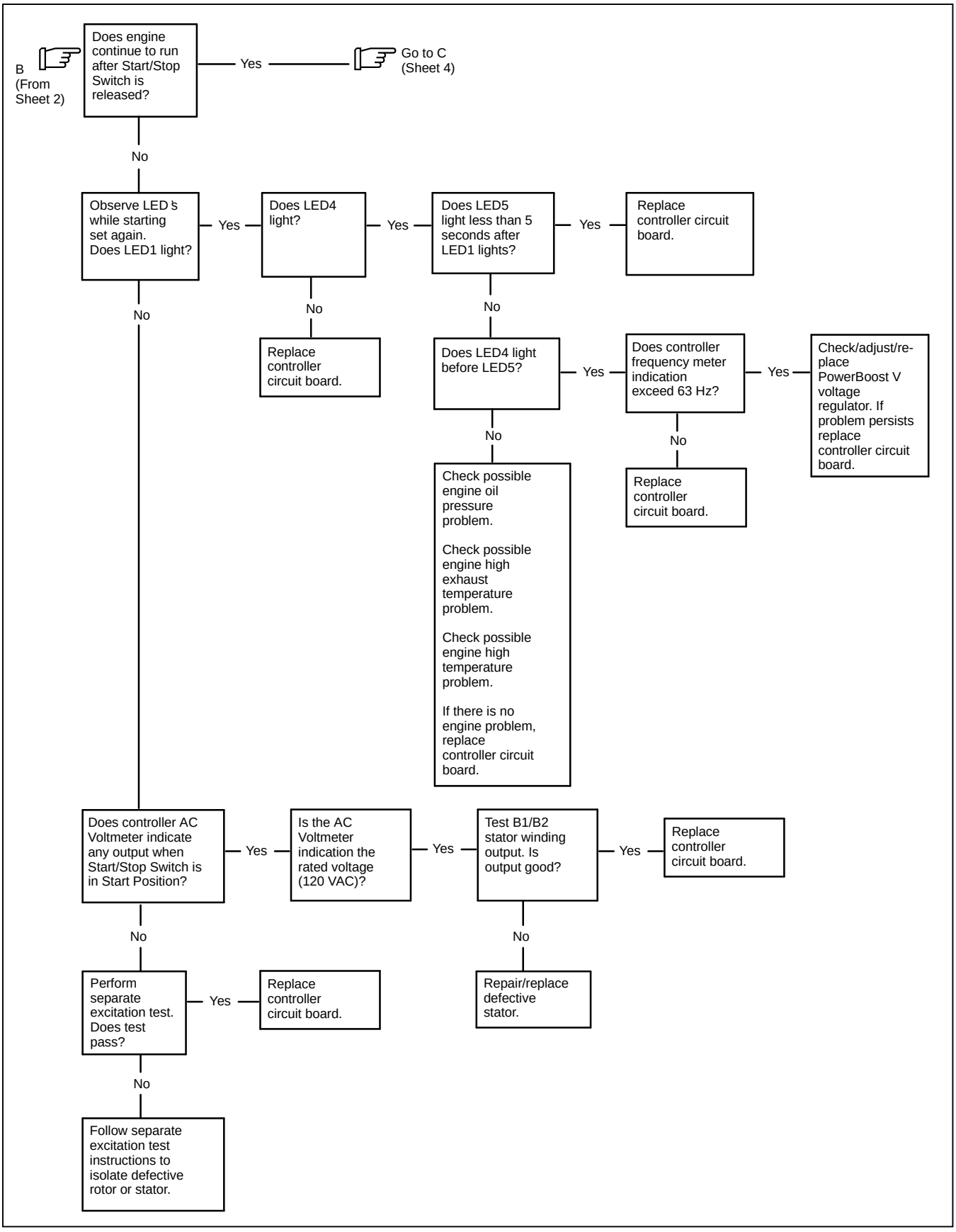


Figure 6-2. Troubleshooting Flow Chart (Sheet 3 of 4)

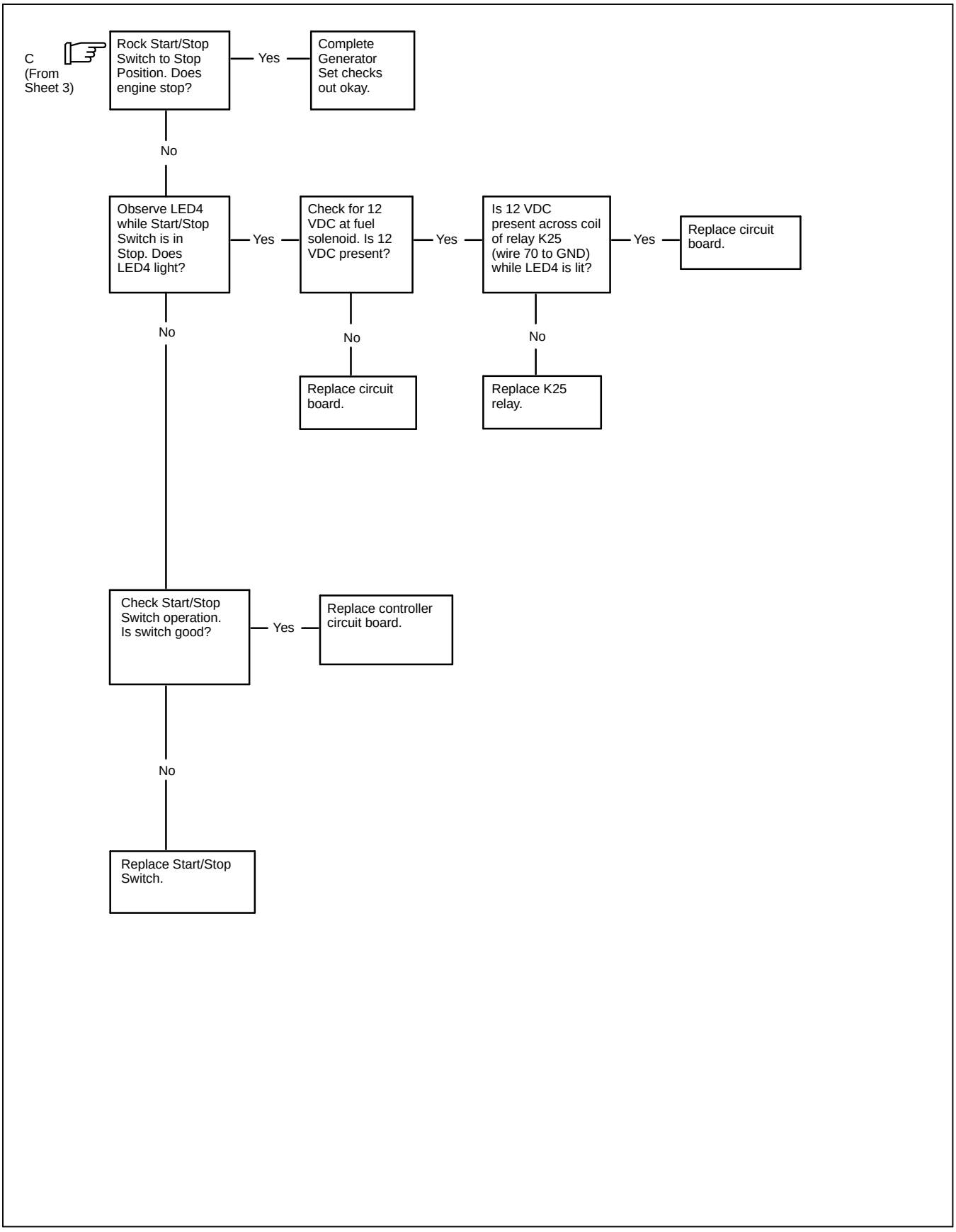


Figure 6-2. Troubleshooting Flow Chart (Sheet 4 of 4)

Section 7. Component Testing and Adjustment

This section is a guide for checking generator, controller, and some engine components for improper operation. Follow the safety precautions at the beginning of this manual during all test procedures. Additional safety precautions are included with the tests; OBSERVE THESE PRECAUTIONS!

Separate Excitation

To determine the cause of no AC output, separately excite the generator. The generator field (rotor) may be excited (magnetized) using an outside DC power source or 12-volt automotive battery and the following procedures. While separately exciting the generator to determine the presence of a faulty voltage regulator, it is possible to determine if a running fault exists in the rotor and/or stator. A generator component appearing good while static (stationary), may exhibit a running open or short while dynamic (moving). This fault can be caused by centrifugal forces acting on the windings while rotating or insulation breakdown as temperatures increase.

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule– replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

⚠ WARNING

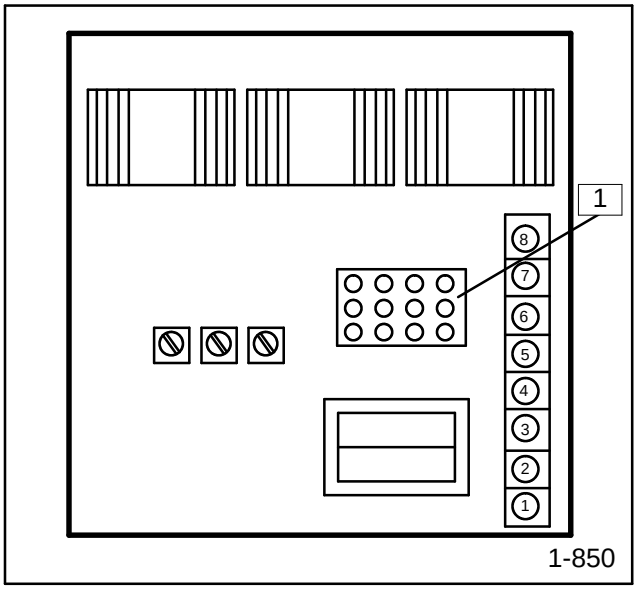
Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

1. Disconnect plug P5 of wiring harness from P1 on voltage regulator. See Figure 7-1. Also disconnect plug P7.



1. Plug P1

Figure 7-1. PowerBoost® V Voltage Regulator

2. Connect an ammeter and a 12-volt automotive battery to the positive (+) and negative (-) brush leads. Include a 10-amp. fuse to protect the circuit in case of a shorted rotor. Refer to Figure 7-2. Note and record the ammeter reading.

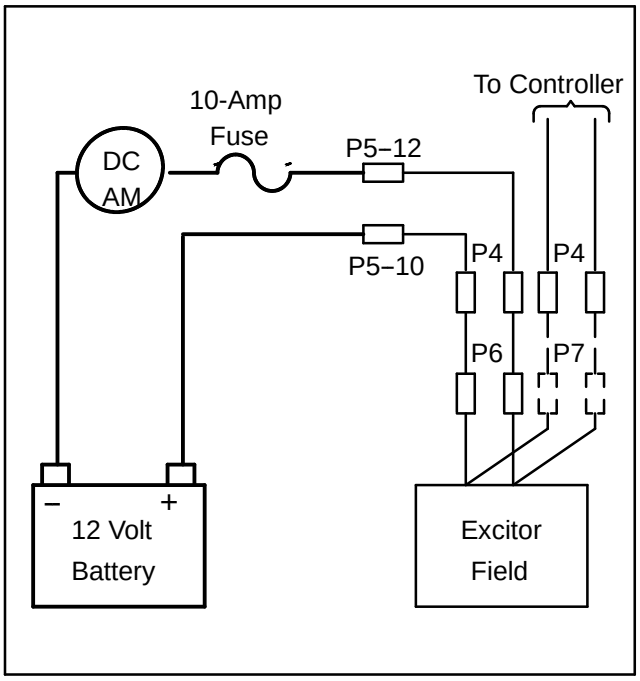


Figure 7-2. Separate Excitation Connections

3. The approximate ammeter reading should be battery voltage divided by specified rotor resistance. For rotor resistance, see Specifications−Generator in Section 1.

   Example:

   $$\frac{\textbf{12 Volts (Battery Voltage)}}{\textbf{4.7 Ohms (Rotor Resistance)}} = \textbf{2.6 Amps. (Rotor Current)}$$

4. Start engine and check that ammeter reading remains stable. An increasing meter reading indicates a shorted rotor. A decreasing meter reading to zero or an unstable reading suggests a running open (see Rotor heading later in this section). If ammeter is stable proceed to Step 5.

5. Check for AC output across stator leads (see Stator heading later in this section) and compare to readings in Specifications−Generator of Section 1. If readings vary considerably from specified values, a faulty stator is likely (see Stator heading later in this section).

6. If rotor and stator test good in prior steps, the voltage regulator is probably defective. (Refer to Voltage Regulator heading later in this section.)

NOTE

Stator Output Voltages found in Specifications−Generator of Section 1 are based on a battery voltage of 12 Volts. Should actual battery voltage vary (11-14 Volts), resulting values will also vary.

Voltage Regulator Powerboostä V

The voltage regulator used on these models is PowerBoostä V. See Figure 7-3.

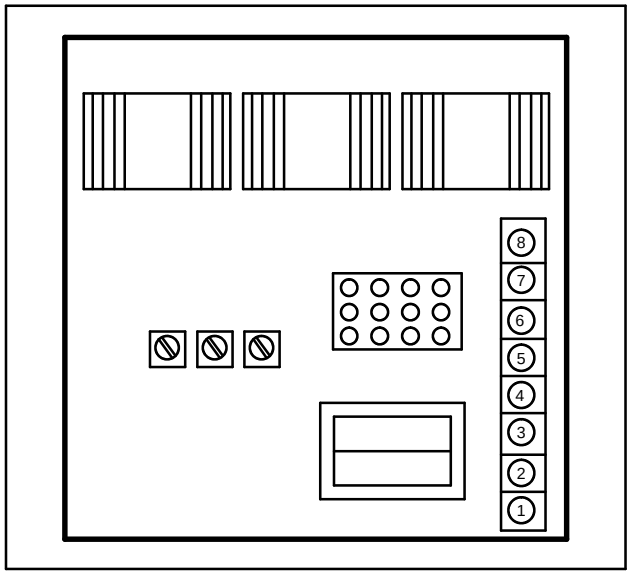


Figure 7-3. PowerBoostä V Voltage Regulator

The PowerBoostä V voltage regulator monitors output voltage magnitude to control current to the generator exciter field. The voltage regulator has an underfrequency unloading feature which is referred to as Volts-per-Hz (V/Hz). To determine if the voltage regulator is functioning properly, reduce engine speed (Hz) and watch for a corresponding drop in AC voltage. AC voltage should remain constant until engine speed drops below 57.5 Hz (on 60 Hz models) or 47.5 Hz (on 50 Hz models). When frequency drops below 57.5/47.5 Hz, AC voltage should decline. To further check the voltage regulator for proper function, perform the following test to check regulator output. To test the voltage regulator the following components will be needed:

- Step-up Transformer, 1:2, 120 to 240 Volts (1.0 Amp. minimum)
- Variable Transformer, 0–140 Volts (1.0 Amp. minimum)
- 120 Volt, 100 watt Lamp
- AC Voltmeter 250 Volt (minimum)
- 1 Amp. Fuse
- 1 SPST Switch, 1 Amp. (minimum)
- 120 Volt AC Plug
- #14 AWG Copper Wire (minimum)

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule–replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

Voltage Regulator Test Procedure

1. Disconnect P5 of wiring harness from P1 on voltage regulator. (See Figure 7-1.)
2. Connect components as shown in Figure 7-4.
3. Turn variable transformer setting to zero. Plug in variable transformer. Plug in power source to terminals 5 and 6.
4. Turn variable transformer on. Turn SPST switch on. Slowly increase variable transformer voltage. The lamp should go on. Continue to increase variable transformer voltage and when the preset voltage is reached (observe voltmeter) the lamp will turn off and continue to stay off as voltage is further increased. The preset voltage is determined by the setting of the **Volts** adjustment pot. on the voltage regulator. The preset voltage for a 120/240 Volt system is 240 Volts, for a 110/220 Volt system it would be 220 Volts, etc. If the voltage regulator functions as described, the voltage regulator is okay.

   If the lamp does not turn on, turn the voltage regulator **Volts** adjustment pot. to the approximate midpoint and repeat test. If the lamp fails to go on after adjusting the **Volts** pot., replace the voltage regulator. A voltage regulator testing bad as described would cause a generator to have a no/low voltage condition.

   If the lamp fails to turn off as voltage is increased, turn the voltage regulator **Volts** adjustment pot. to the approximate midpoint and repeat test. If the lamp fails to go off after adjusting the **Volts** pot., replace the voltage regulator. A voltage regulator testing bad as described would cause a generator to have a high voltage condition.

5. Turn variable transformer to zero and unplug AC cord. Turn SPST switch off and unplug cord.

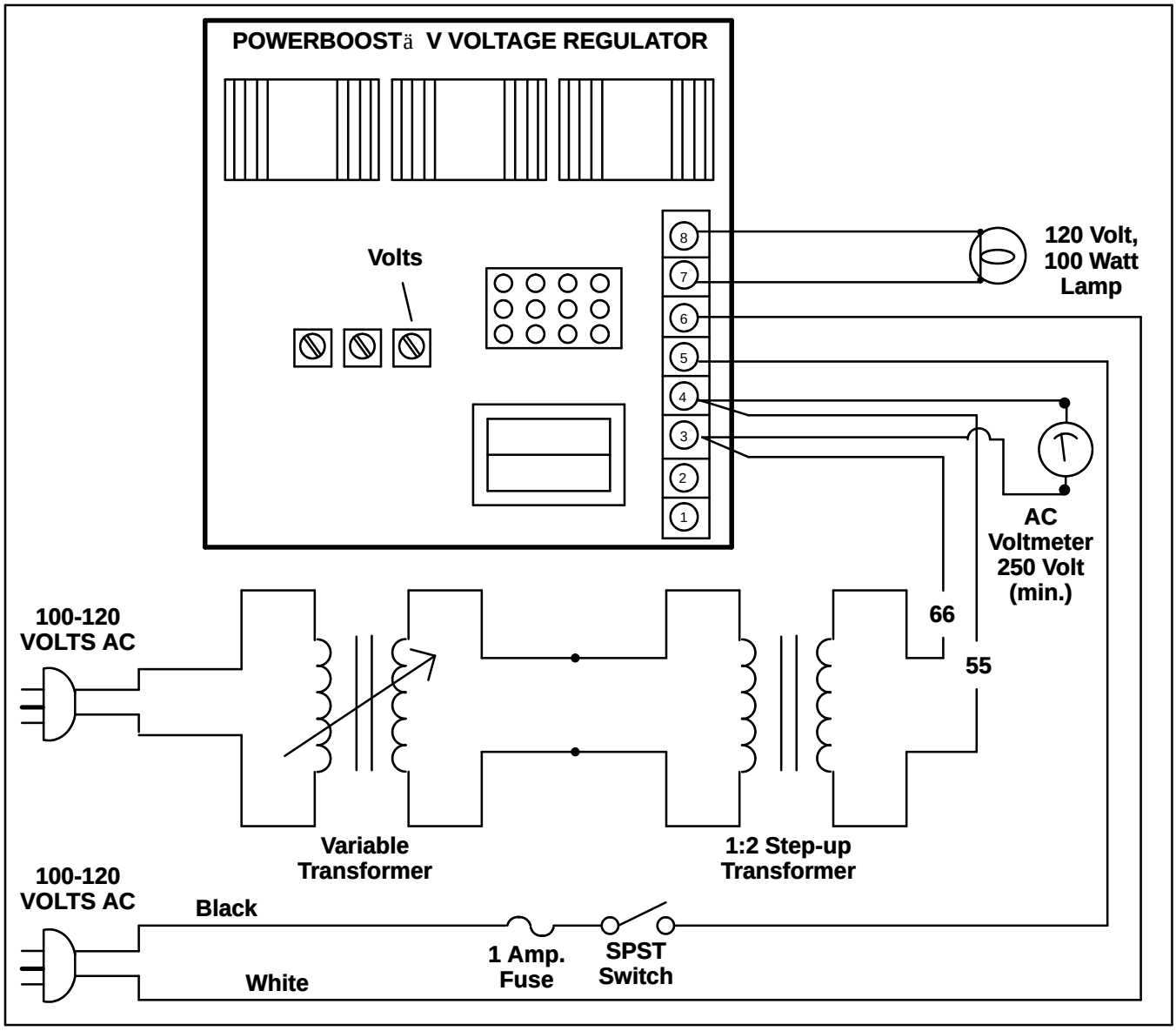


Figure 7-4. PowerBoost ä V Voltage Regulator Test

Voltage Regulator Adjustment

The PowerBoostä V voltage regulator monitors generator output to control current flow to the generator field. PowerBoostä V maintains generator output under load until the generator engine speed drops to a pre-set level (factory setting 57.5 Hz on 60 Hz models and 47.5 Hz on 50 Hz models). At this point (under factory settings) the regulator allows generator voltage and current to drop to a level sufficient to handle load. When the generator speed returns to normal (60 Hz or 50 Hz) as load is accepted, generator output also returns to normal. The voltage regulator is factory set for proper generator operation under a variety of load conditions. Under normal circumstances, no further adjustment is necessary. However, if the regulator is replaced, has been tampered with, or voltage/frequency reconnection has been done, readjust according to the following procedure. Voltage regulator components are identified in Figure 7-5 and Figure 7-6 and described in the following paragraphs.

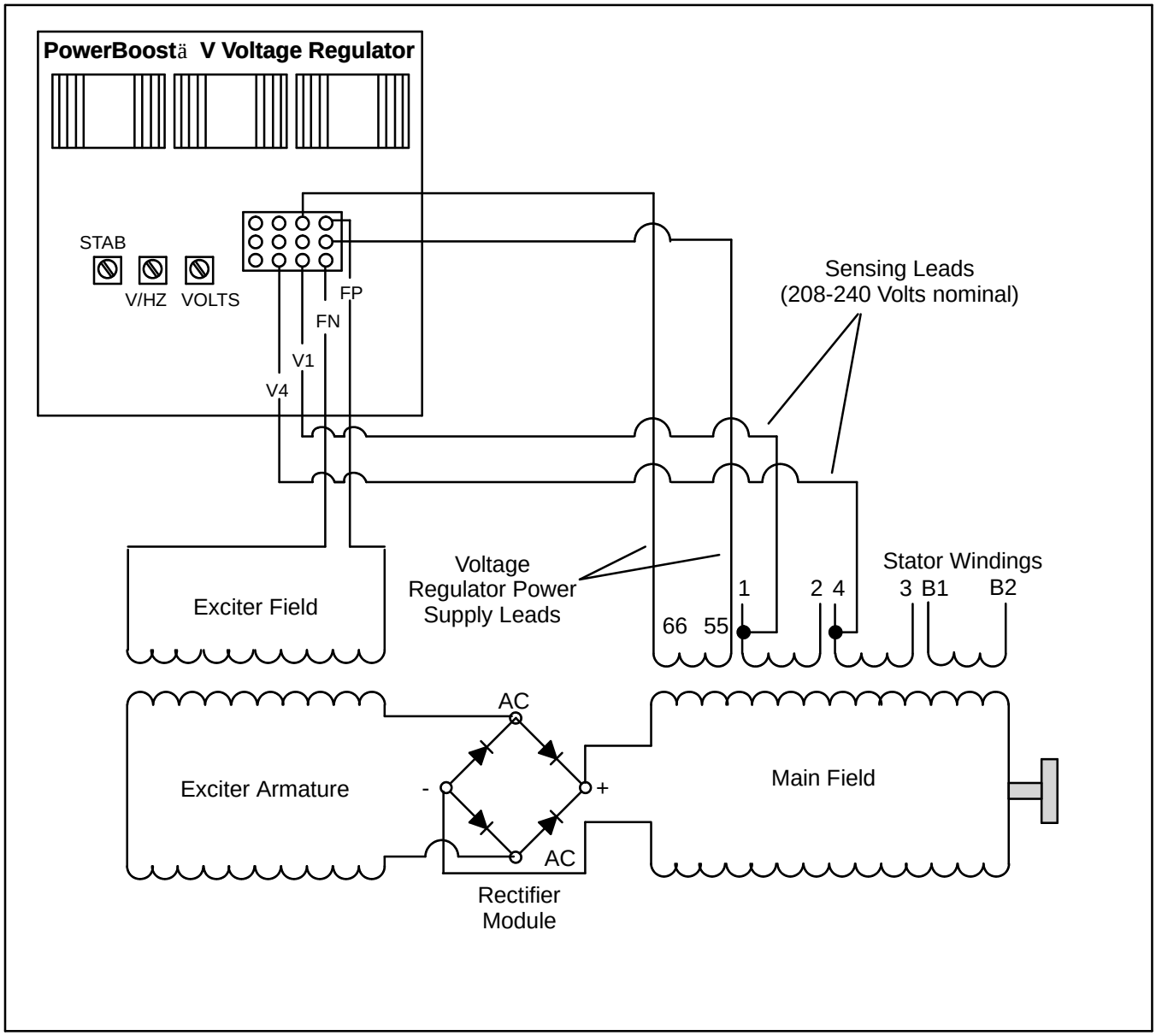
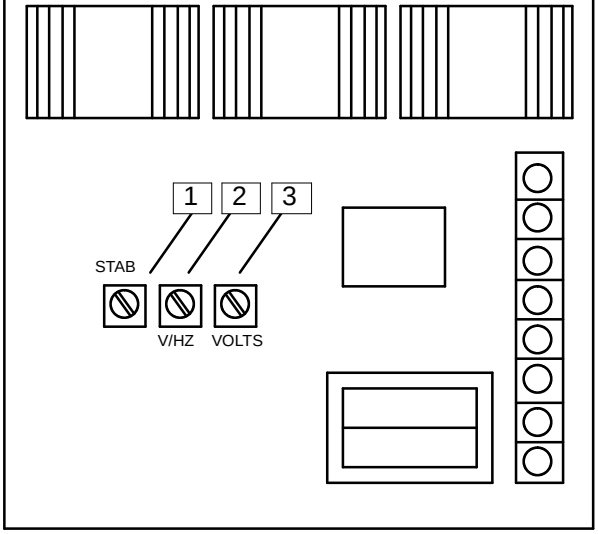


Figure 7-5. PowerBoostä V Voltage Regulator



NOTE

The voltage regulator is located in the generator junction box and is serviceable by removing four screws.

1. **Voltage Adjustment Pot.** - Adjusts generator output within range of 190–270 Volts (line-to-line).
2. **Stability Pot.** - "Fine-tunes" regulator to reduce light flicker.
3. **Volts/Hz Pot.** - Adjustment determines engine speed (Hz) at which generator output voltage will begin to drop.

Figure 7-6. PowerBoostä V Adjustments

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

Adjustment Procedure

1. Turn **Voltage, Volts/Hz, and Stability pots.** fully counterclockwise. Connect voltmeter to AC circuit or an electrical outlet.

2. Start generator set. **Rotate Voltage Adjustment pot.** clockwise (increase voltage) or counterclockwise (decrease voltage) until desired output voltage is achieved.

3. Rotate **Stability pot.** clockwise until minimum light flicker is obtained.

4. Readjust **Voltage Adjustment pot.** (if necessary).

5. **Mechanical Governor:**
   Adjust engine speed to desired cut-in frequency (factory setting 57.5–58 Hz for 60 Hz models or 47.5–48 Hz for 50 Hz models) as measured on frequency meter. See Section 3. Governor.

6. Rotate **Volts/Hz Adjustment pot.** clockwise until voltage level begins to drop (as measured on voltmeter). When set to these specifications, the generator will attempt to maintain normal output until engine speed drops below the frequency set in step 5 (as load is applied).

7. **Mechanical Governor:**
   Readjust engine speed to normal (63 Hz/1890 rpm for 60 Hz or 52.5 Hz/1575 rpm for 50 Hz). See Section 3. Governor.

8. Readjust **Voltage Adjustment pot.** (if necessary).

9. Readjust **Stability pot.** (if necessary).

10. STOP GENERATOR SET.

Controller Circuit Board

It is possible to check some controller circuit board components (relays) without removing the component from the board. These checks should be made prior to installing a new board and attempting startup. Most of the tests are referenced in Section 4. General Troubleshooting. Use a high quality multimeter and follow the manufacturer's instructions. To obtain accurate readings when testing, remove all circuit board connectors and conformal coating (transparent insulation) from component terminals. Use the chart Figure 7-7 for the controller circuit board layout and schematic .

Component	Ohmmeter Connections	Remarks	Results
K1 Relay Coil	K1 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	If good–approx. 160 ohms. Low resistance (continuity)–shorted coil. High resistance–open coil.
K2 Relay Coil	K2 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	If good–approx. 160 ohms. Low resistance (continuity)–shorted coil. High resistance–open coil.
K3 Relay Coil	K3 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	If good–approx. 400 ohms. Low resistance (continuity)–shorted coil. High resistance–open coil.
K4 Relay Coil	K4 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	If good–approx. 125 ohms. Low resistance (continuity)–shorted coil. High resistance–open coil.
K5 Relay Coil	K5 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	If good–approx 510 ohms. Low resistance (continuity)–shorted coil. High resistance–open coil.

Figure 7-7. E-239563 Circuit Board Tests

Engine/Generator Components

With the generator set battery connected, the wiring harness and some engine/generator components can be checked with a voltmeter as described in Figure 7-8. Place the controller or remote start/stop switch in the prescribed position and check for 12 volts DC at each component using a DC voltmeter. This will verify that the switches function and 12 volt DC is present at each component.

Component	Voltmeter Connections	Remarks	Results
Hourmeter and wiring	Red test clip to hourmeter (+) terminal. Black test clip to (–) terminal.	Voltmeter setting 12 volts.	If wiring harness is good–12 Volts DC or greater. To determine if hourmeter is good, proceed to next step.
	None (see Remarks)	Disconnect hourmeter leads and apply 12 volts DC to hourmeter. **NOTE:** Hourmeter is polarity sensitive.	If good–hourmeter will operate.
B1 and B2 stator auxiliary winding	Disconnect B1/B2 leads. Connect AC voltmeter to leads. **NOTE:** Voltage can only be measured momentarily since unit will not continue to run after start switch is released.	Voltmeter setting 20 volts AC or greater. Start generator set by holding Start/Stop switch in Start and allow to reach proper speed. Take reading and then stop generator.	Reading of 12–15 Volts indicates B1/B2 winding is good.
Fuel solenoid (three-lead)	Red test clip to #6 lead of solenoid and black test clip to engine block (ground). Place controller switch to Start position. STOP generator set	Voltmeter setting 12 volts or greater. If lead can not be disconnected, cut leads and crimp-on fully insulated push-on terminals.	If wiring is good–12 Volts DC. To determine if fuel solenoid is good, proceed to next step.
	None (see Remarks)	Push out leads #6 and "P" at the 4-pin connector. Apply 12 Volts DC to #6 lead and momentarily apply 12 Volts DC to "P" lead. Volts DC to "P" lead. **NOTE:** Apply voltage only momentarily to "P" lead to prevent fuel solenoid damage. This coil draws 50 Amps. and is intended only to energize the solenoid.	If good–fuel solenoid will energize and move plunger when voltage is applied to "P" lead and remain held in after "P" lead is disconnected as long as #6 lead has voltage applied to it.

Figure 7-8. Engine/Generator Component Testing with Voltmeter

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

To further check generator set components, disconnect the battery and remove wiring harness plugs from the controller circuit board. Use an ohmmeter to check continuity and to isolate defective components as described in Figure 7-9. Also refer to the proper wiring diagram in Section 9.

NOTE

Before performing ohmmeter checks, disconnect generator set battery to prevent damage to the ohmmeter.

Component	Ohmmeter Connections	Remarks	Results
Controller switch	P2-6 and P2-4	Ohmmeter on R x 1 scale. Place rocker switch in START position.	If good–zero ohms (continuity). Any resistance other than zero or very low ohms–replace switch.
	P2-6 and P2-5	Ohmmeter on R x 1 scale. Place rocker switch in STOP position.	If good–zero ohms (continuity). Any resistance other than zero or very low ohms–replace switch.
K20 relay coil	P1-4 and P1-9	Ohmmeter on R x 1 scale	If good–85 ohms. Low resistance–shorted K20 relay coil and/or wiring. High resistance–open K20 relay and/or wiring.
K25 relay coil	P1-8 and P1-9	Ohmmeter on R x 1 scale	If good–85 ohms. Low resistance–shorted K25 relay coil and/or wiring. High resistance–open K25 relay and/or wiring.
Starter relay (S' relay)	P4-4 and battery (–) cable. **NOTE:** J4 and P4 must be disconnected to perform this test.	Ohmmeter on R x 1 scale.	If good–approx. 0.20–0.35 ohms at 80° F (27° C).
Controller 10 Amp. fuse and wiring	Battery positive (+) cable and P1-14 **NOTE:** J4 and P4 must be connected to perform this test.	Ohmmeter on R x 1 scale.	If good–zero or very low ohms. No reading (infinity)–open circuit or fuse blown.
Glow plug relay (C1)	P4-8 and P4-1	Ohmmeter on R x 1 scale.	If good–approx. 16–20 ohms at 80°F (27°C).

Figure 7-9. Engine/Generator Set Component Testing with Ohmmeter (Sheet 1 of 2)

Component	Ohmmeter Connections	Remarks	Results
P1 ground connection	P1-9 and ground	Ohmmeter on R x 1 scale.	If good–zero ohms (continuity). Any other reading indicates a poor ground connection.
Low oil pressure (LOP) safety shutdown switch	P1-15 and engine block (ground) **NOTE:** J4 and P4 must be connected to perform this test.	Ohmmeter on R x 1 scale. This test is not conclusive until the temperature shutdown switches are checked.	If good–zero ohms (continuity). Then, disconnect LOP switch lead and isolate terminal. Meter reading reading should show an open circuit.
High water temperature (HWT) safety shutdown switch	P1-15 and engine block (ground) **NOTE:** LOP switch lead should be removed and isolated. **NOTE:** J4 and P4 must be connected to perform this test.	Ohmmeter on R x 1 scale.	If good–open circuit. Any continuity suggests that temperature switch(es) are defective. Disconnect individual leads to determine which switch is defective.
Rotor	See separate paragraph with same title.	See separate paragraph with same title.	See separate paragraph with same title.
Stator	See separate paragraph with same title.	See separate paragraph with same title.	See separate paragraph with same title.
Excitor Field	See separate paragraph with same title.	See separate paragraph with same title.	See separate paragraph with same title.
Excitor Armature	See separate paragraph with same title.	See separate paragraph with same title.	See separate paragraph with same title.
Fuel Solenoid	See separate paragraph with same title.	See separate paragraph with same title.	See separate paragraph with same title.

Figure 7-9. Engine/Generator Set Component Testing with Ohmmeter (Sheet 2 of 2)

Rotor

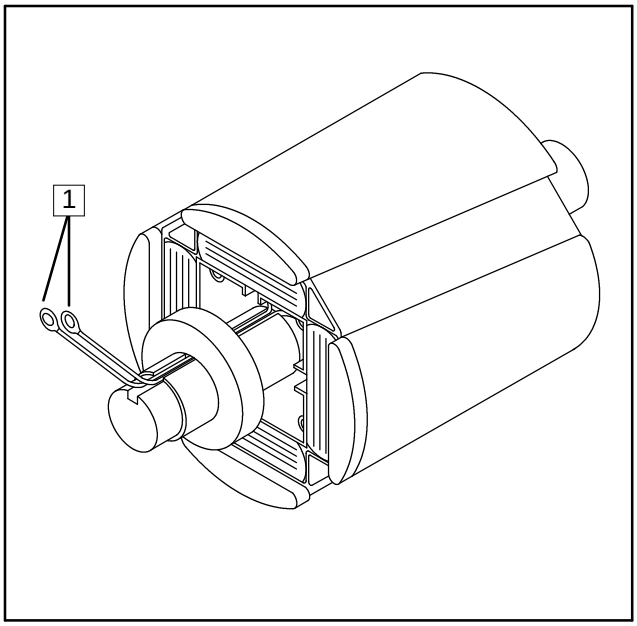
The four-pole rotor creates the magnetic field needed to produce alternating current in the stator windings. Prior to testing, inspect the rotor for visible damage. Check rotor bearing for noisy operation, excessive wear, and heat discoloration. Replace or repair these components if any of the above conditions exist.

Check the rotor for continuity and resistance. Measure the rotor resistance (ohms) between the two rotor leads (Figure 7-10). See Specifications–Generator in Section 1 for typical readings.

NOTE

Since ohmmeters do vary in their accuracy, use values in Section 1 as a reference for approximate readings. Readings must be at room temperature or about 70°F (21°C). Rotor resistance will vary directly with increase in temperature.

To check for rotor shorted to ground, adjust ohmmeter to zero ohms. Touch one ohmmeter lead to either rotor lead and other lead to rotor poles or shaft. Meter should register no continuity.



1. Rotor Leads

Figure 7-10. Rotor Resistance Check

The rotor must be repaired or replaced if any faults are detected in the previous tests.

Stator

The stator consists of a series of coils of wire placed in a laminated steel frame. The stator leads supply voltage to the AC load and exciter regulator.

Prior to testing, inspect the stator for heat discoloration and visible damage to housing lead wires, exposed coil windings, and exposed and varnished areas of frame laminations. Be sure the stator is securely riveted in the stator housing.

Checking Stator Continuity and Resistance

1. To check stator continuity, set ohmmeter on R x 1 scale. Contact the red and black meter leads; adjust ohmmeter to zero ohms. Check stator continuity by connecting meter leads to stator leads.

NOTE

Disconnect all stator leads prior to performing stator continuity tests.

Leads 1, 2, 3, and 4 are the generator output leads. Leads 55 and 56 are the voltage regulator power supply. Leads B1 and B2 are the generator output interlock circuit for the controller. Refer to the schematic in Figure 7-11 when performing the following tests.

- There must be continuity between leads 1 and 2.
- There must be continuity between leads 3 and 4.
- There must be continuity between leads 55 and 66.
- There must be continuity between leads B1 and B2.
- There must be NO continuity between lead 1 and leads 3, 4, 55, 66, B1, or B2.
- There must be NO continuity between lead 4 and leads B1, B2, 55, or 56.
- There must be NO continuity between any stator lead and ground on stator housing or frame laminations.

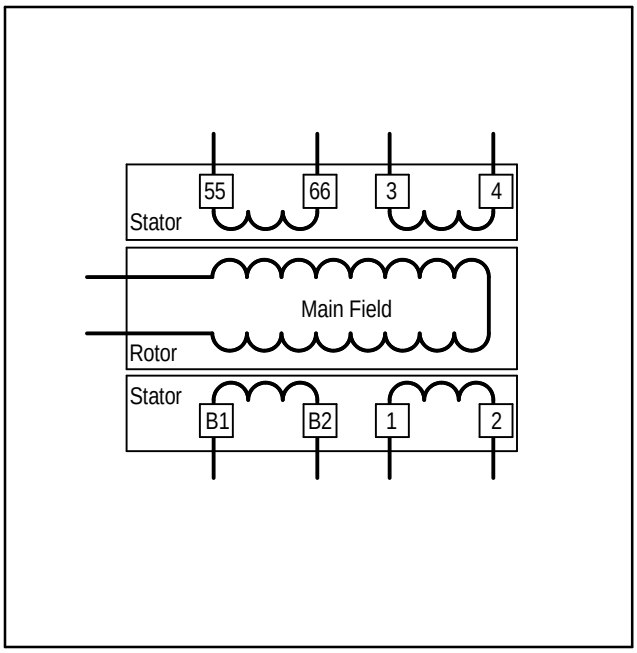


Figure 7-11. Stator Resistance Check

Exciter Field

The exciter field is magnetized by DC from the battery. When the exciter armature is rotated within the magnetized exciter field windings, an electrical current develops within the exciter armature. Test the exciter field according to the following procedure.

1. Disconnect generator starting battery (negative lead first) and power to battery charger (if equipped). Disconnect plug P5 of wiring harness from P1 on the voltage regulator.

2. Check exciter field resistance by connecting an ohmmeter across exciter field F1 and F2 (pins 10 and 12 of P5). See Figure 7-12. The resistance reading for a cold exciter field is found in Specifications–Generator of Section 1. A low reading indicates an internal short and a high reading indicates an open winding. Repair or replace exciter field if ohmmeter readings indicate exciter field is defective. If resistance test proves inconclusive, perform a megohmmeter test on exciter field as described in the next step.

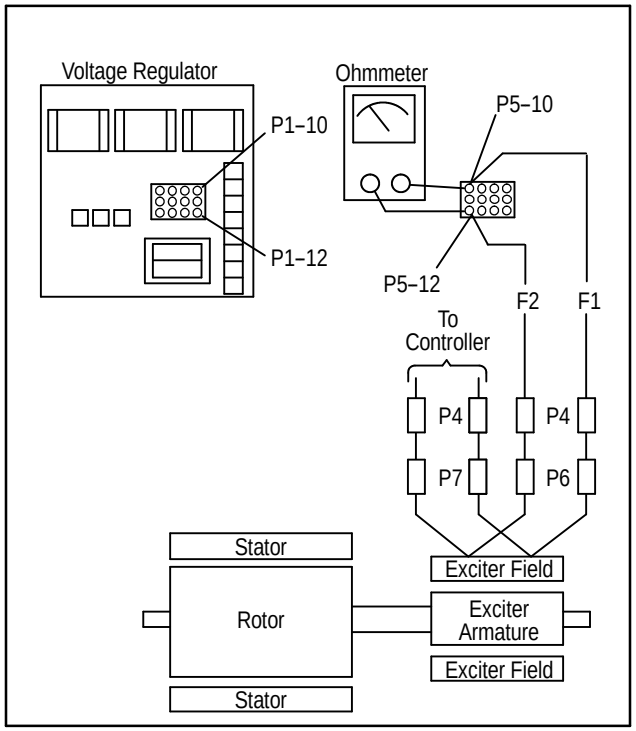


Figure 7-12. Checking Exciter Field Resistance

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule–replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

3. Check exciter field for a grounded condition. Disconnect P5, P6, and P7. Using a megohmmeter, apply 500 Volts DC to F1 or F2 lead and exciter field frame. See Figure 7-13. (Follow the instructions of the megohmmeter manufacturer when performing this test.) A reading of approximately 500K ohms (1/2 megohm) and higher indicates the field winding is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the exciter field is necessary.

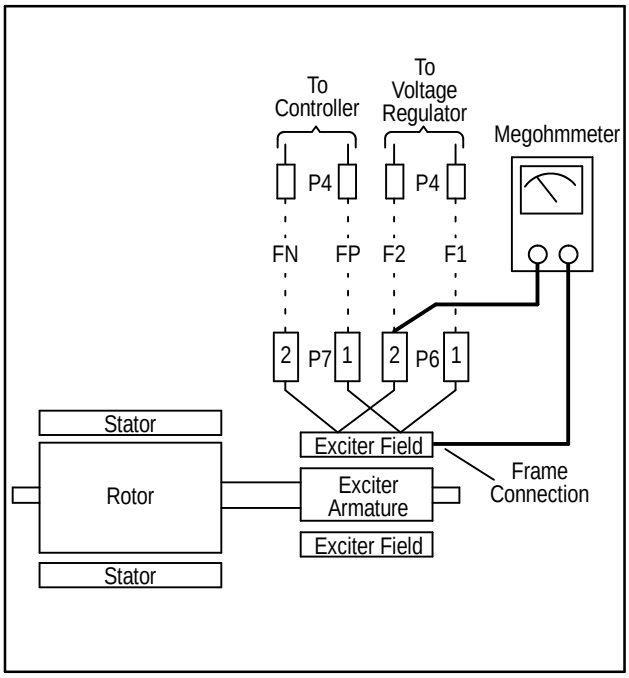


Figure 7-13. Megohmmeter Connections on Exciter Field

Exciter Armature

The exciter armature supplies excitation current to the generator main field (through the rectifier module). Test the exciter armature as described in the following steps. (The generator must be disassembled prior to performing this test.)

1. With generator disassembled, disconnect armature leads from rectifier module AC terminals.

2. With an ohmmeter on the R x 1000 scale, check resistance across exciter armature leads. See Figure 7-14. The armature resistance is found in Specifications–Generator of Section 1. No continuity indicates an open armature winding. If the resistance test proves inconclusive, perform a megohmmeter test on the exciter armature as described in the next step.

NOTE

Most ohmmeters will not provide accurate readings when measuring less than one ohm. The exciter armature can be considered good if a low resistance reading is obtained (continuity) and there is no evidence of shorted windings (heat discoloration).

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule–replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

3. Check exciter armature for a grounded condition. Using a megohmmeter, apply 500 Volts DC to either armature lead and armature frame. (Follow the instructions of the megohmmeter manufacturer when performing this test.) See Figure 7-15. A reading of approximately 500K ohms (1/2 megohm) and higher indicates the exciter armature is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the exciter armature is necessary.

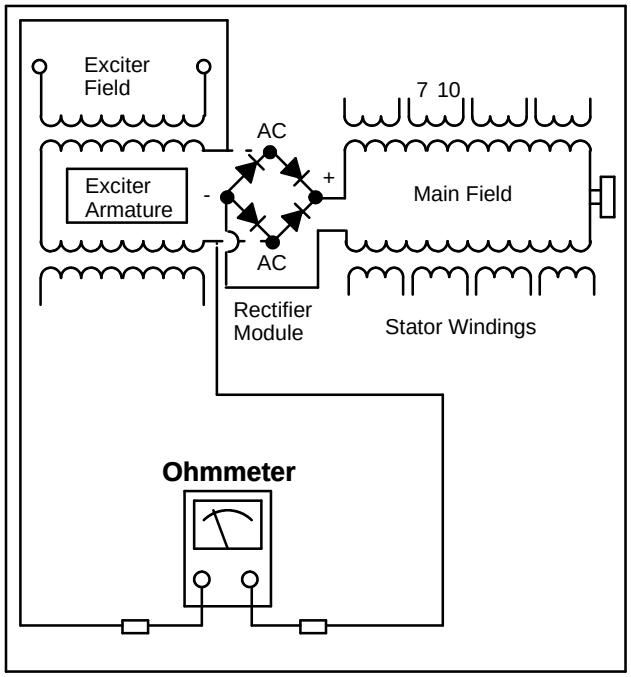


Figure 7-14. Exciter Armature Ohmmeter Test

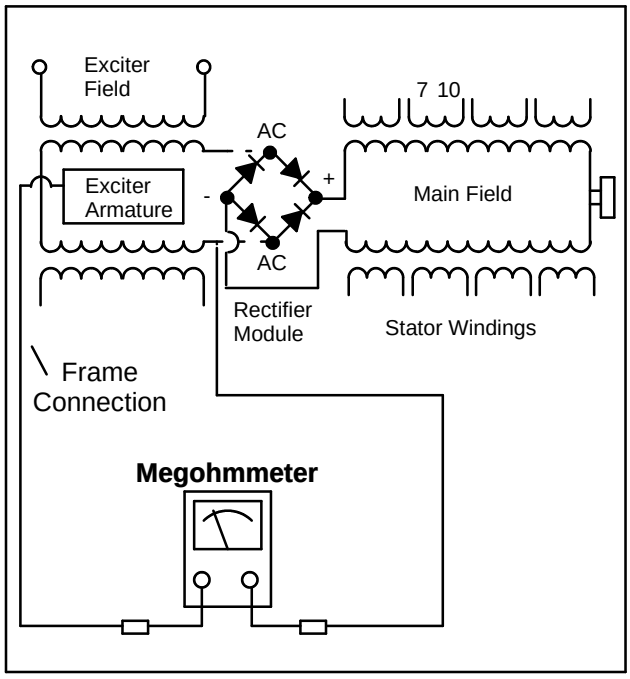


Figure 7-15. Megohmmeter Connections on Exciter Armature

Fuel Solenoid

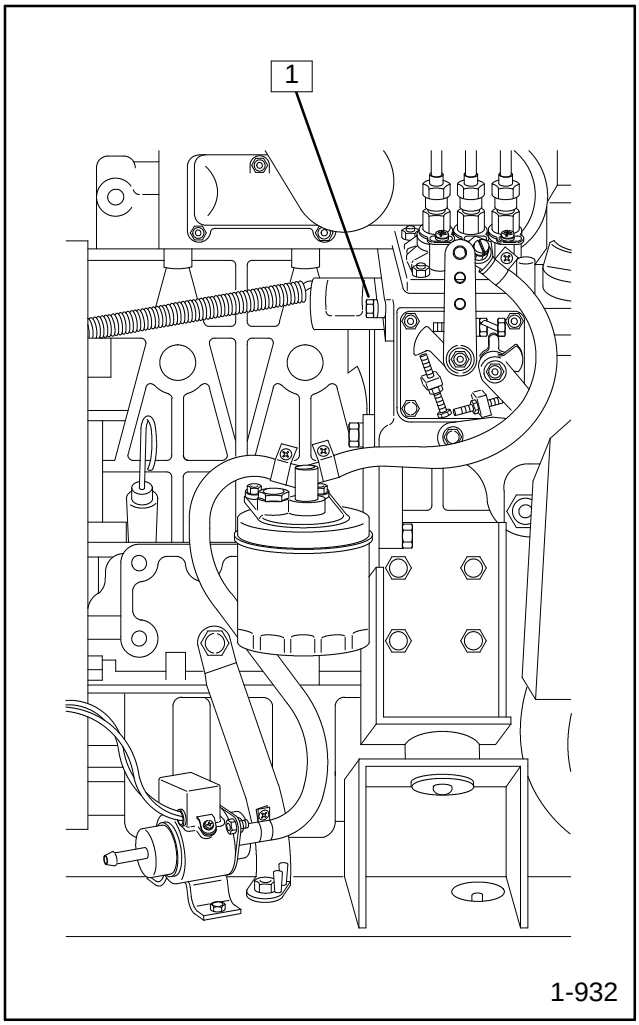
The fuel solenoid serves to pull the injector pump lever to the "fuel on" position when energized. The fuel solenoid is spring loaded to return the injector pump lever to the "fuel off" position when de-energized.

The 10CCOZ models use a three-lead fuel solenoid. This solenoid has a lead marked "P," which energizes the "pull" coil only during cranking. During operation, the lead "6" energizes the "hold" coil and the lead marked "N" is the common ground.

Current (amps.) and resistance readings are shown in Figure 7-16. Resistance readings can be taken to determine if the solenoid windings are open or shorted. These tests must be made with fuel solenoid disconnected from engine wiring harness. See Figure 7-17 for fuel solenoid location.

Fuel Solenoid	**Reading**
"pull" current	31 amps.
"hold" current	0.8 amps.
Plunger "pull" resistance	0.387 ohms
Plunger "hold" resistance	14.94 ohms

Figure 7-16. Fuel Solenoid Readings



1. Fuel Solenoid

Figure 7-17. Fuel Solenoid Location

Section 8. Disassembly/Reassembly

Prior to disassembly, the generator set must be unbolted from the vehicle compartment. Disconnect all external devices−battery cables at the battery (negative lead first), AC output loads at the controller, fuel line at the fuel pump filter inlet, and the exhaust connections. Observe all safety precautions listed at the beginning of this manual during the disassembly/reassembly procedure.

NOTE

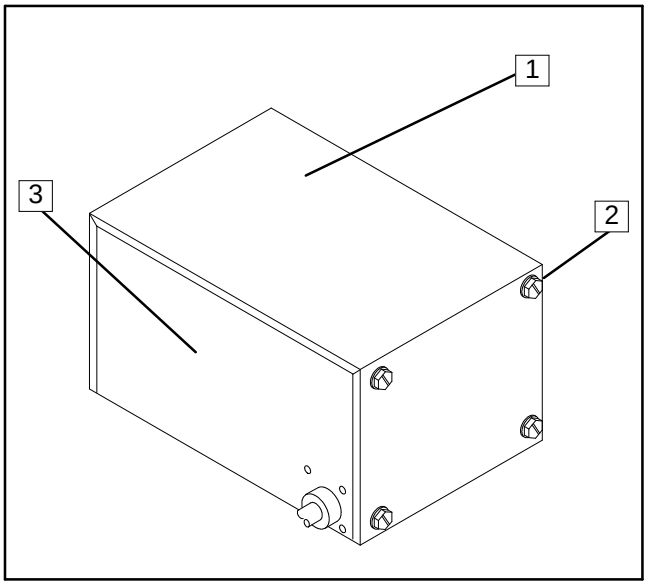
The procedure for disassembly/reassembly may vary due to product updates and assembly variations. Major differences are noted where appropriate.

NOTE

The voltage regulator is located in the controller chassis. Adjustments are possible without removing the controller or chassis.

NOTE

HARDWARE DAMAGE! Engine and generator may make use of both American Standard and metric hardware. Be sure to use the correct size tools to prevent rounding of bolt heads and nuts.



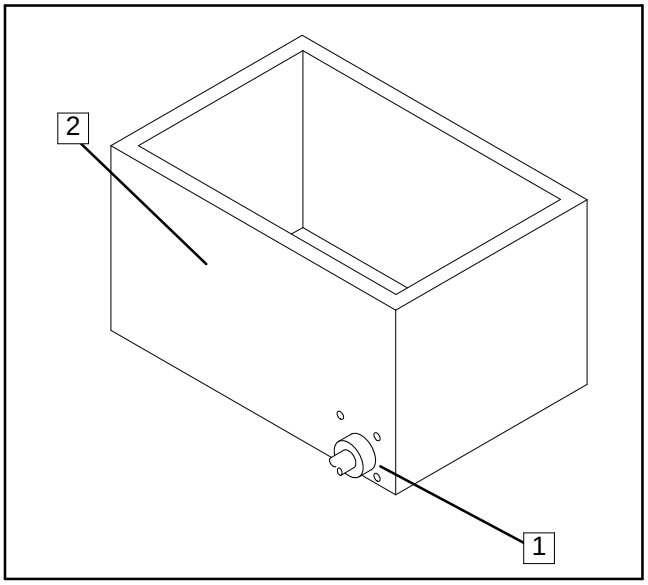
1. Cover
2. Screw
3. Controller

Figure 8-1. Removing the Controller Cover

Disassembly

1. Remove the nine screws securing the controller cover. Separate the cover from the controller. See Figure 8-1.

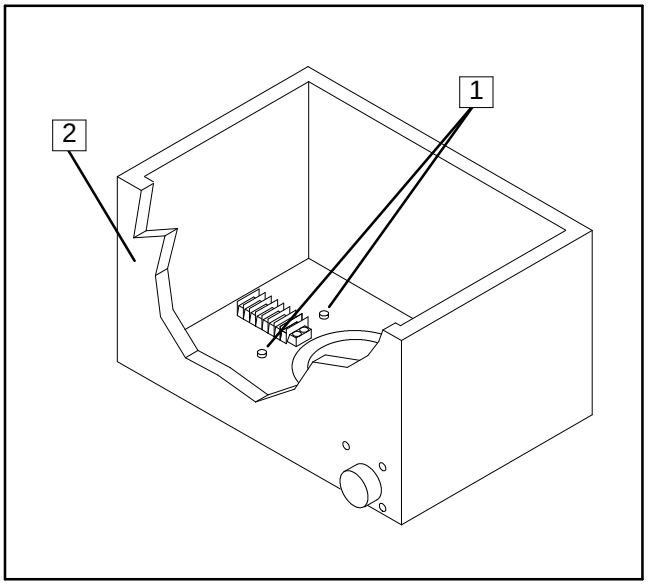
2. Disconnect the 22-pin harness connector from the stationary connector at the back of the controller. See Figure 8-2.



1. Connector, 22-Pin
2. Controller

Figure 8-2. Disconnecting the 22-Pin Connector

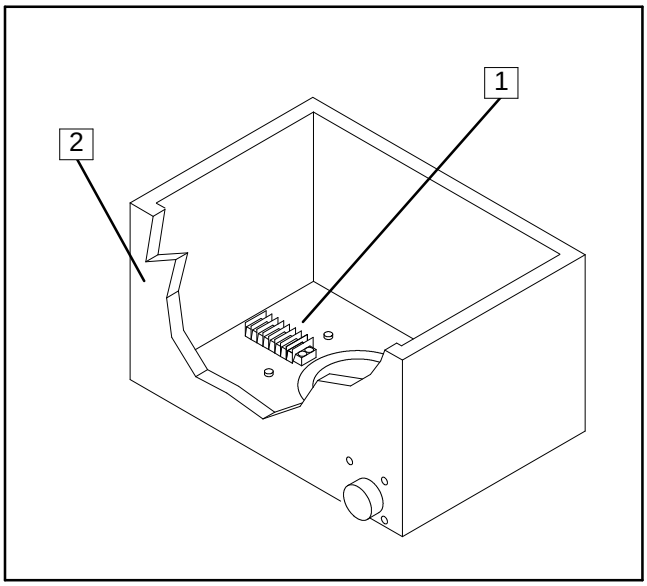
3. Remove the plug caps from the ends of the bumper studs within the controller. Remove the nuts securing the controller to the bumpers using a 1/2-inch wrench or nut driver. See Figure 8-3.



1. Bumper Nuts
2. Controller

Figure 8-3. Removing the Bumper Nuts

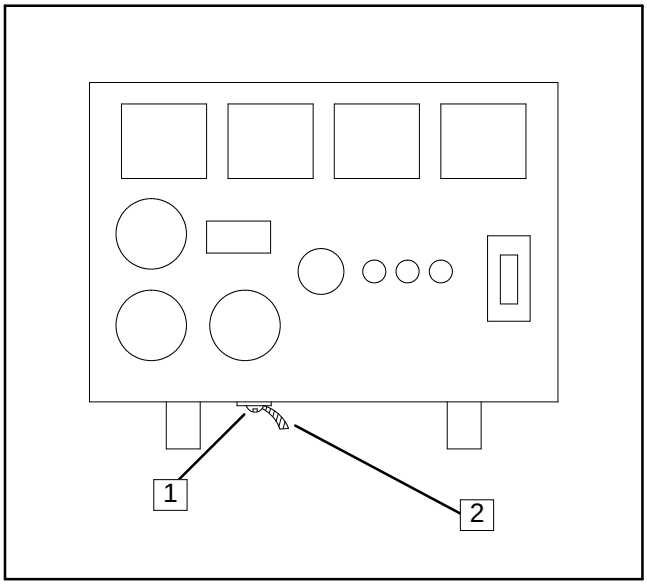
4. Remove any external connections to terminals labeled GND, ST1, ST2, and BAT on the controller chassis. Also disconnect and remove leads from terminals labeled C0, C1, and C2 on the controller chassis. See Figure 8-4.



1. Terminal Board
2. Controller

Figure 8-4. Disconnecting Terminal Strip Leads

5. Remove the slotted screw and disconnect the ground strap from the controller. See Figure 8-5.



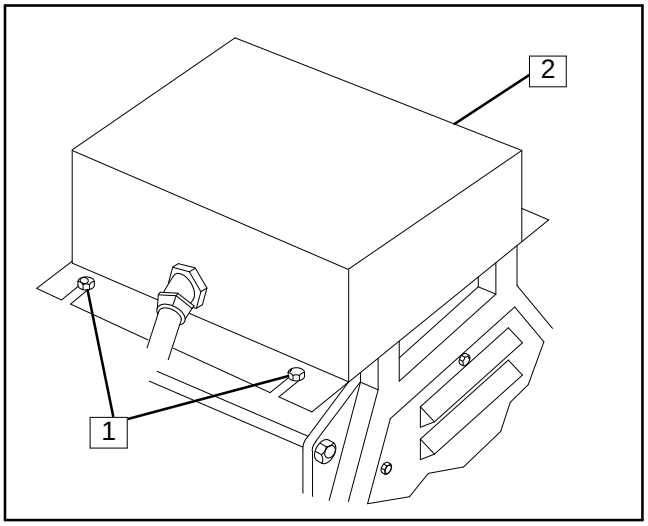
1. Screw
2. Ground Strap

Figure 8-5. Disconnecting the Controller Ground Strap

6. Remove the controller.

7. Disconnect P8 from J8.

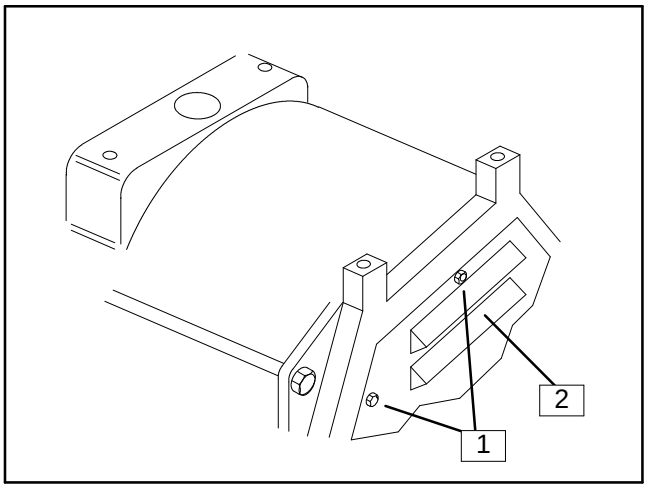
8. Remove the four screws securing the junction box to the generator using a 3/8-inch wrench or nut driver. Remove the junction box from the generator. See Figure 8-6.



1. Screw
2. Junction Box

Figure 8-6. Removing the Junction Box

9. Remove the six screws securing the end bracket panel to the end bracket using a 5/16-inch wrench or nut driver. Remove the end bracket panel to expose the exciter. See Figure 8-7.

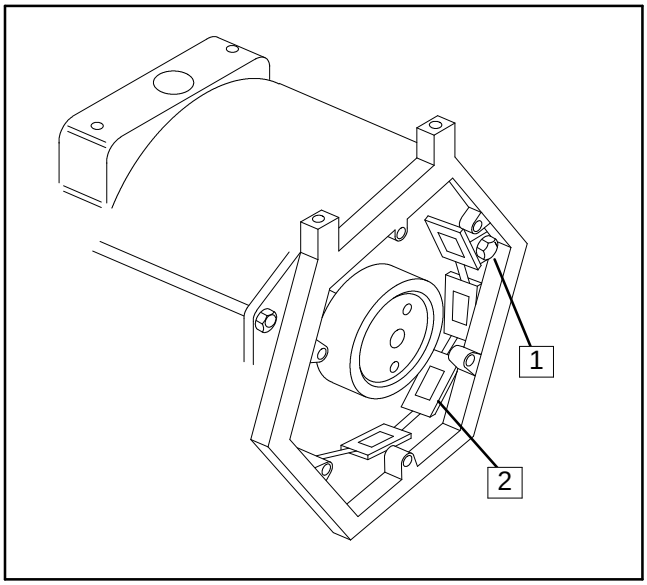


1. Screw
2. End Bracket Panel

Figure 8-7. Removing the End Bracket Panel

10. Disconnect P6 from J6 and P7 from J7.

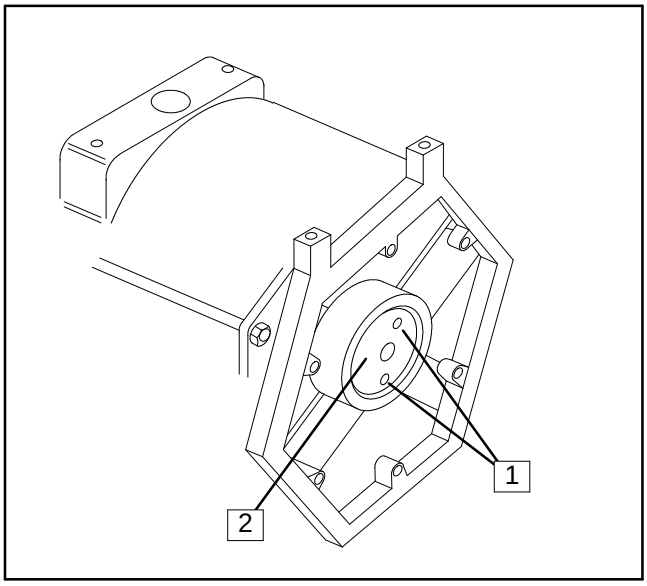
11. Remove the four screws securing the exciter field to the end bracket. Carefully remove the exciter field from the generator. See Figure 8-8.



1. Screw
2. Exciter Field

Figure 8-8. Removing the Exciter Field

12. Remove the three screws and spacers securing the rotating diode circuit board to the rotor armature. See Figure 8-9.



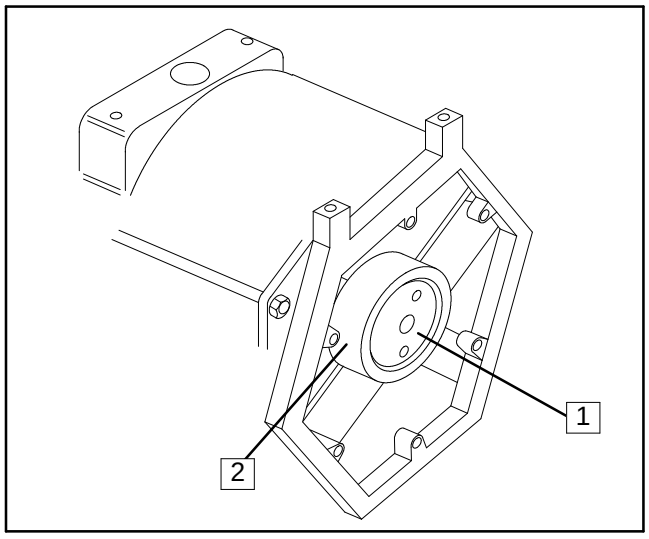
1. Screw
2. Diode Circuit Board

Figure 8-9. Removing the Diode Circuit Board

13. Remove the five screws securing the leads to the rotating diode circuit board. Carefully separate the

rotating diode circuit board from the rotor assembly.

14. Remove the screw and flat washer securing the exciter armature using a 9/16-inch wrench. Remove the exciter armature from the rotor assembly. See Figure 8-10.



1. Screw
2. Exciter Armature

Figure 8-10. Removing the Exciter Armature

15. Remove the bolts from the two generator vibromounts using a 1/2-inch wrench. See Figure 8-11.

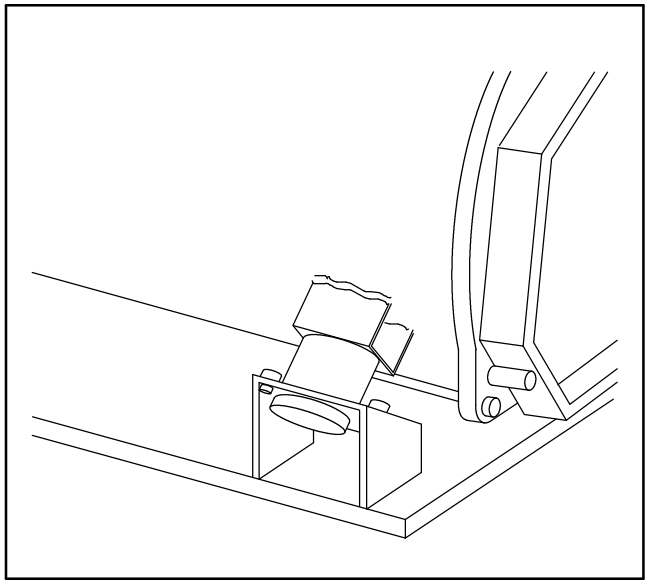


Figure 8-11. Removing the Vibromount Bolts

16. Using a hoist, raise the alternator end of the generator. See Figure 8-12.

NOTE

Use a hoist with a lifting capacity of one-half ton or greater.

17. Place a wood block under the flywheel housing and lower generator until block supports alternator. See Figure 8-12.

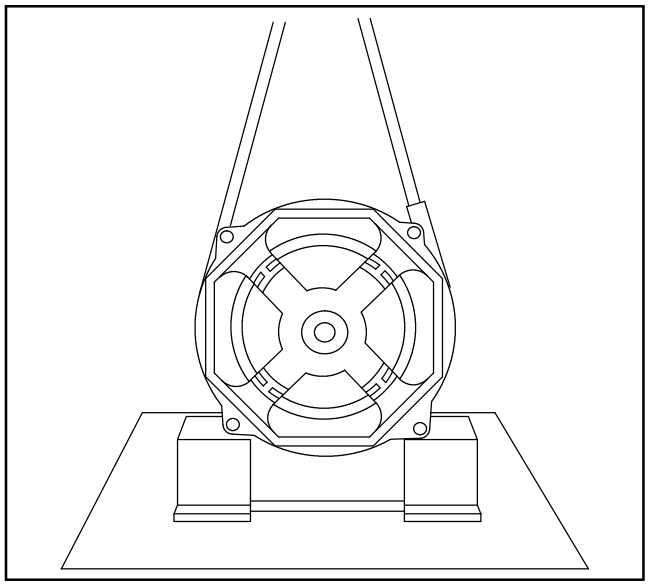


Figure 8-12. Using Hoist to Raise Generator Set

18. Remove the four overbolts securing the end bracket using a 17-mm socket and ratchet. See Figure 8-13.

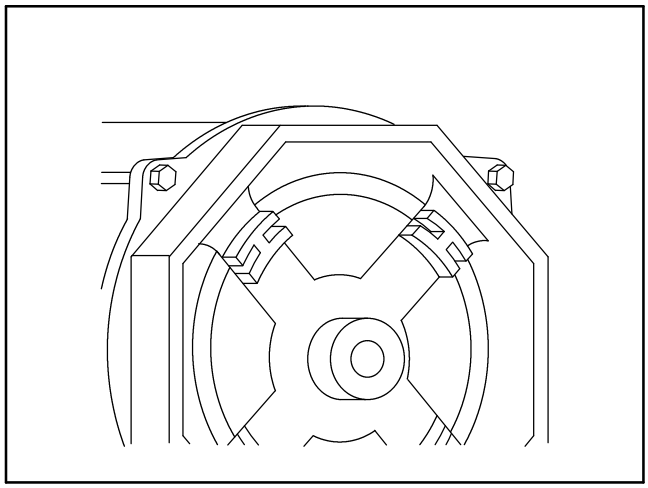


Figure 8-13. Removing the Overbolts

19. Remove the end bracket by bumping the end bracket flanges with a soft rubber mallet. See Figure 8-14.

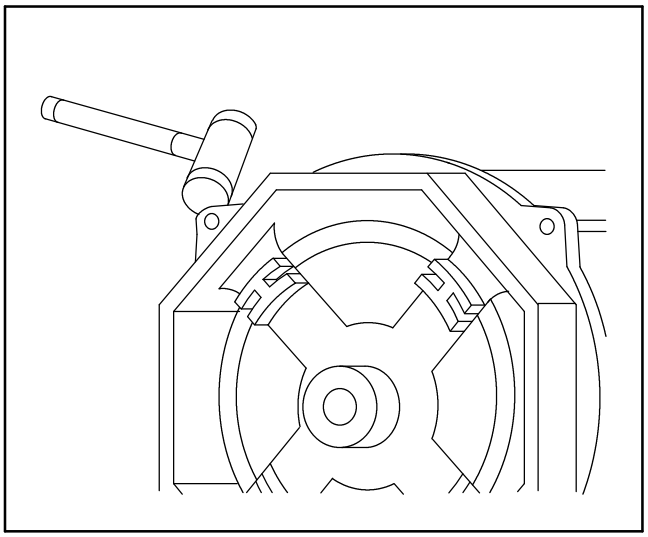


Figure 8-14. Removing the End Bracket

20. Carefully remove the stator by pulling the stator over the rotor assembly. See Figure 8-15.

NOTE

Due to the heavy weight, it is recommended that the stator be supported by a hoist during removal to prevent damage to the stator, rotor, and/or armature drive disks.

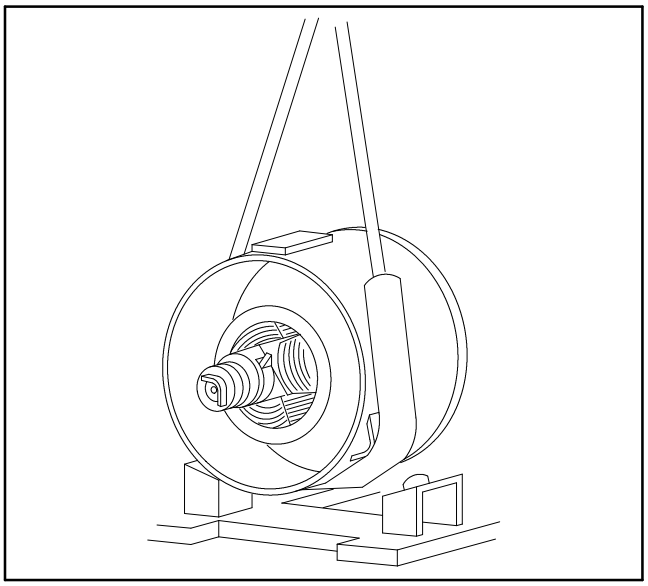


Figure 8-15. Removing the Stator

21. Remove the eight screws and four spacers securing the generator fan. Then carefully remove the cooling fan. See Figure 8-16.

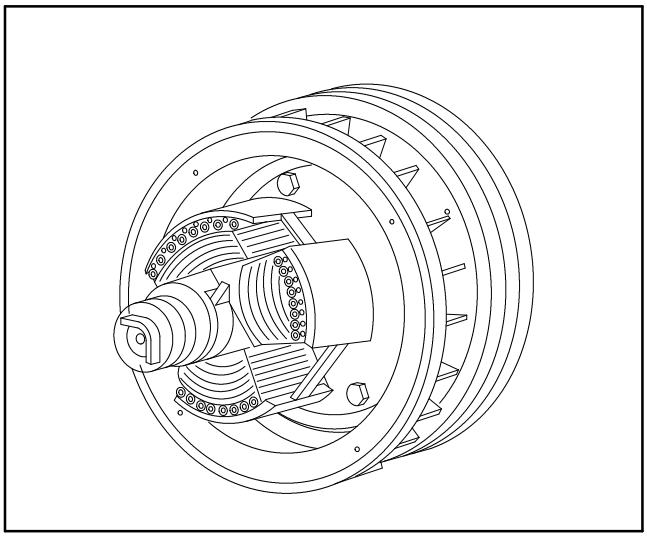


Figure 8-16. Removing the Generator Cooling Fan

22. Support the rotor assembly with a strap and hoist. Remove the eight screws securing the armature drive disks to the engine using a 13-mm socket wrench and ratchet. Remove the rotor assembly and place it on a bench. See Figure 8-17.

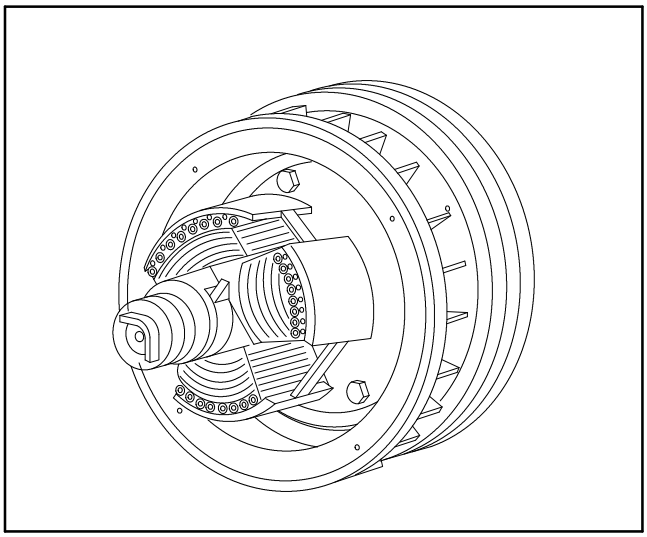


Figure 8-17. Removing the Rotor Assembly

23. Remove the eight screws securing the armature drive disks to the rotor assembly using a 9/16-inch socket wrench and ratchet. See Figure 8-18.

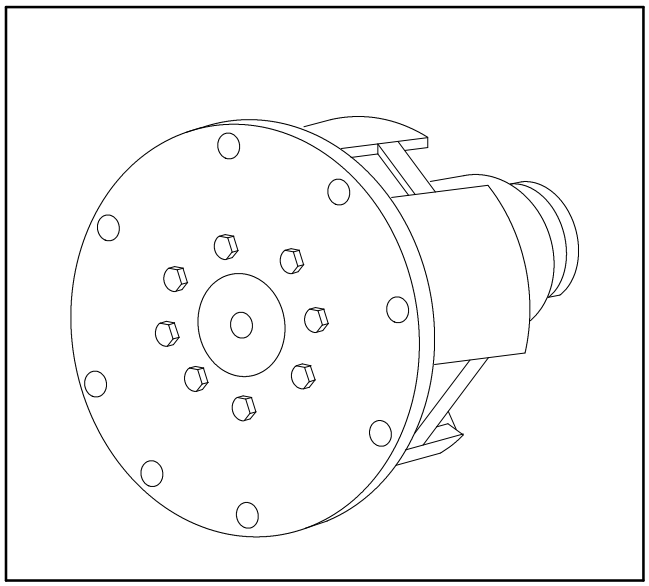


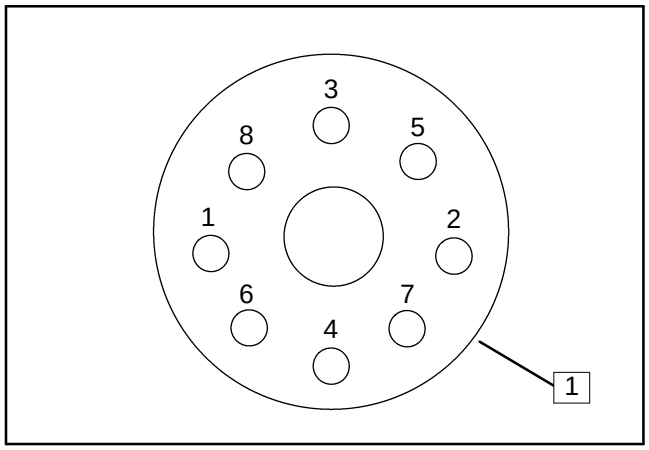
Figure 8-18. Removing the Armature Drive Disks

Reassembly

1. Secure the armature drive disks to the rotor assembly with eight screws. Tighten the screws to a torque of 28 ft. lbs. (338 in. lbs.) in the sequence shown in Figure 8-19.

NOTE

Check the armature drive disks for flatness. Replace the disks if they are uneven or bent. Disks that are not flat will cause vibration and excessive wear of the end bracket bearing.



1. Drive Disk

Figure 8-19. Tightening Sequence for Drive Disks

2. Position the rotor assembly on the engine flywheel. Align holes in armature disks and flywheel and secure the rotor assembly by installing eight screws. Tighten these screws to a torque of 14 ft. lbs. (168 in. lbs.) in the sequence shown in Figure 8-19.

3. Slide the generator cooling fan over the rotor assembly with the blades facing the flywheel. Coat the threads of the eight mounting screws with Locktiteâ #271. Then use the eight mounting screws and four spacers to secure the cooling fan to the flywheel.

4. Using a hoist, carefully reposition the stator over the rotor assembly and onto the adapter lip. When installed, the screened portion of the stator should be over the generator cooling fan and the stator leads should exit the top of the housing.

5. Position the end bracket over the open end of the stator and use a rubber hammer to drive the rim of the end bracket into the stator housing.

6. Install the overbolts to secure the end bracket and stator. Tighten the overbolts to a torque of 25 ft. lbs. (300 in. lbs.).

7. Use a hoist to raise the alternator end of the generator. Remove the wood block(s) below the flywheel housing. Then lower the generator back onto the vibromounts.

8. Install the two bolts to secure the stator mounting brackets to the vibromounts.

9. Install a new O-ring in the groove of the end bracket.

10. Place the exciter armature on the end of the rotor shaft. Install a flat washer and screw to secure the exciter armature. Tighten the screw to a torque of 35 ft lbs.

11. Route the two main field leads through the exciter armature. Connect these two leads to terminals marked "+" and "–" on the diode assembly. Connect the three leads of the exciter armature to the terminals marked "A", "B", and "C" on the diode assembly. Secure each lead using a 8-32 x 3/4 screw and a No. 8 lockwasher.

12. Slide the diode assembly onto the exciter armature. Secure the diode assembly in place to the exciter assembly using three spacers and self-tapping screws.

13. Secure the exciter field to the end bracket using four screws. Tighten these screws to a torque of 70 in. lbs.

14. Install the end bracket panel and secure it to the end bracket with six self-tapping screws.

15. Place the junction box atop the generator, routing the stator leads into the junction box. Secure the junction box in place using four screws.

16. Reconnect P6 to J6, P7 to J7, and P8 to J8.

17. Place the controller atop the rubber bumpers.

18. Route any external leads into the controller and secure the ground cable to the controller chassis.

19. Install the four nuts to secure the controller to the mounting bumpers.

20. Connect leads from junction box labeled C0, C1, and C2 to terminals with same labels on controller chassis. Also connect external leads labeled BAT, GND, ST1, and ST2 (if used) to terminals with same labels on controller chassis.

21. Connect 22-pin harness connector J4 to fixed connector at rear of controller.

22. Reinstall cover on controller and secure by installing nine screws.

Section 9. Wiring Diagrams

Four-Lead Reconnectable (Single-Phase) Generator Sets Where Generator Output Can Be Reconnected For 120/240 volt, 60 Hz; or 110/220 volt, 50 Hz

To illustrate the proper reconnection of 4-lead generator sets, the following information is provided. In all cases, the National Electrical Code (NEC) should be followed.

NOTE

When a generator set is reconnected to a voltage different than nameplate voltage, notice should be placed on the unit indicating this change. A decal (part no. 246242) is available for this purpose from an authorized Kohler dealer/distributor.

120/240-volt (or 110/220-volt) Configurations–Figure 9-1 (View A)

Circuit breaker MUST be a circuit breaker manufacturer two-pole circuit breaker. Two single-pole circuit breakers do not conform to NEC requirements when supplying a 240-Volt (or 220-Volt) load. This is true even if they are mechanically attached together. Leads L1 and L2 are different phases and must never be connected together.

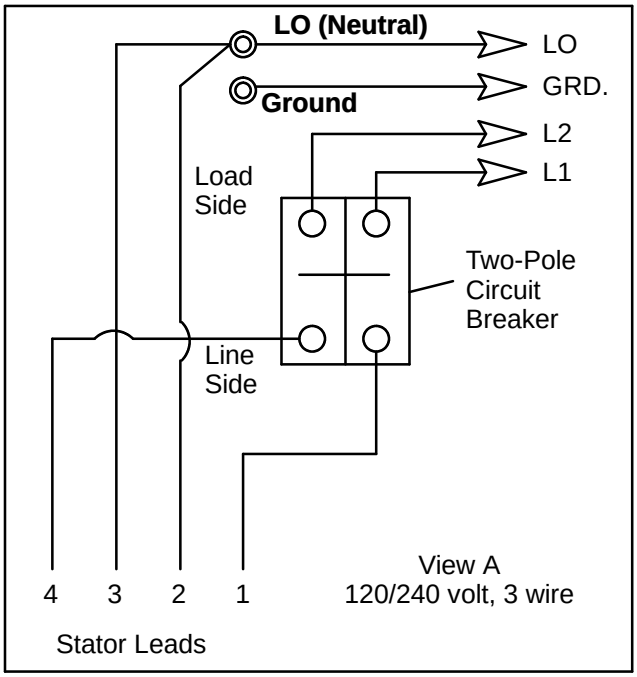
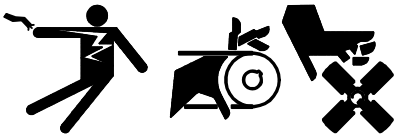


Figure 9-1. 120/240-volt (or 110/220-volt) Configuration

	60 Hz	50 Hz
L0-L1	120 volt	110 volt
L0-L2	120 volt	110 volt
L1-L2	240 volt	220 volt

⚠ WARNING



Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by remote start/stop switch unless this precaution is followed.

NOTE

Keep load lead circuit away from the generator, specifically fuel and exhaust system components.

NOTE

All field supplied wiring must be capable of withstanding temperatures of 167°F (75°C).

NOTE

A triple-pole, double-throw transfer switch, rated for the calculated load, must be used to transfer the load from one source to the other. A ground-fault circuit interrupter should be installed in the wiring system to protect all branch circuits.

NOTE

The AC load circuit of the generator set must be protected by a circuit breaker(s) against overload or short circuit.

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule– replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

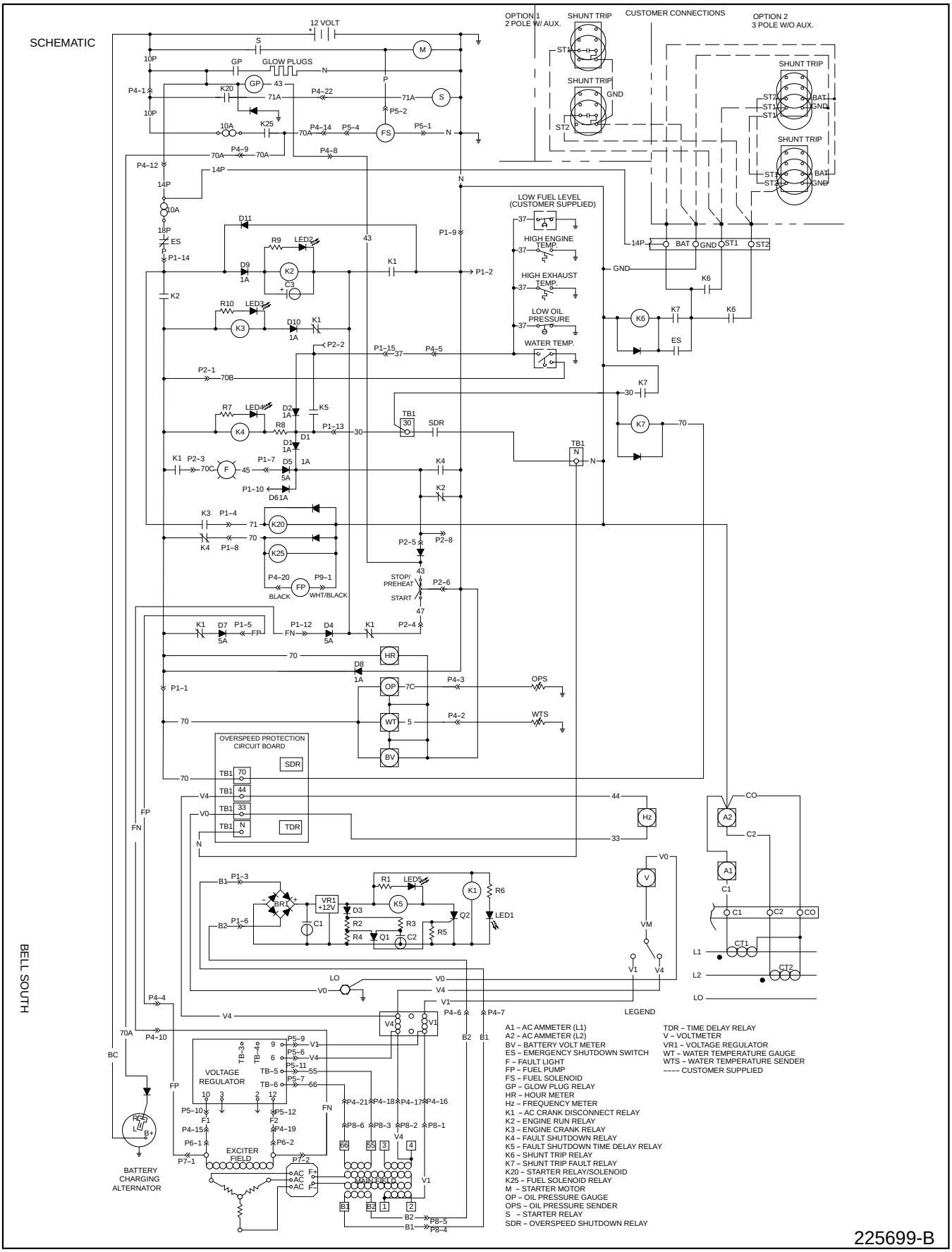


Figure 9-2. Schematic Wiring Diagram for 10CCOZ Single Phase

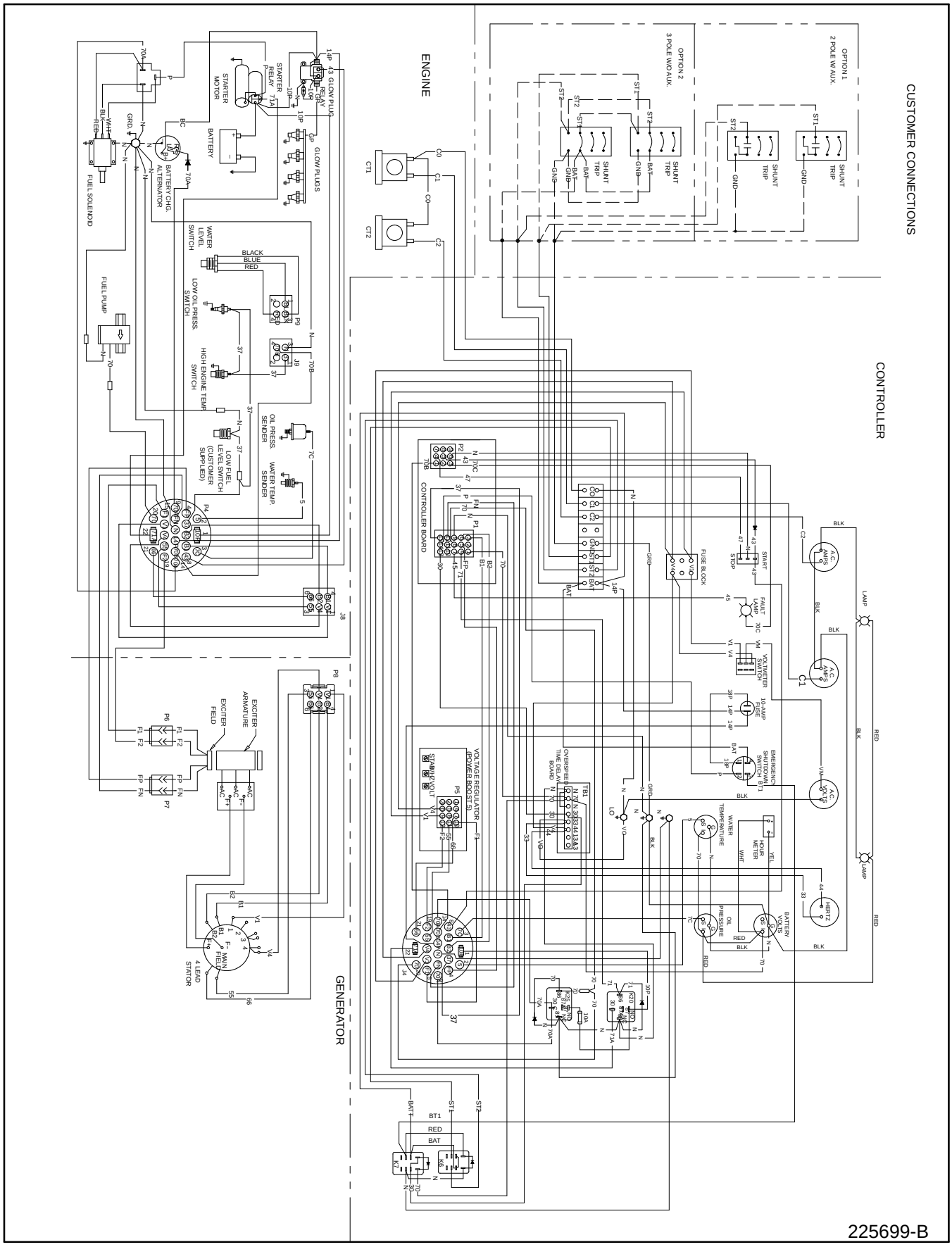


Figure 9-3. Point-to-Point Wiring Diagram for 10CCOZ Single Phase

Section 10. Common Hardware

Application Guidelines, Specification G-585

Starting late 1991, many Parts Catalogs and Service Manuals will contain common hardware entries and hardware references (see "Hardware References") instead of part numbers for common hardware.

Kohler Specification G-585 gives common hardware application guidelines. Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

- *Bolt/Screw Length*: When bolt/screw length is not given, use Figure 10-1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.
- *Split Lock Washers*: Split lock washers will no longer be used as a locking device. For hardware up to 1/2 in. diameter a whiz nut (serrated flange) will be used. The locking method used for hardware above 1/2 in. diameter will be SAE flat washers with preloading (torque) of the bolt/screw. See "General Torque Specifications" and other torque specifications in the service literature.
- *Common Hardware Entries*: When hardware size (diameter and threads per inch) is given but no indication of type of additional hardware is shown, use the illustration in Figure 10-2 as a guide.

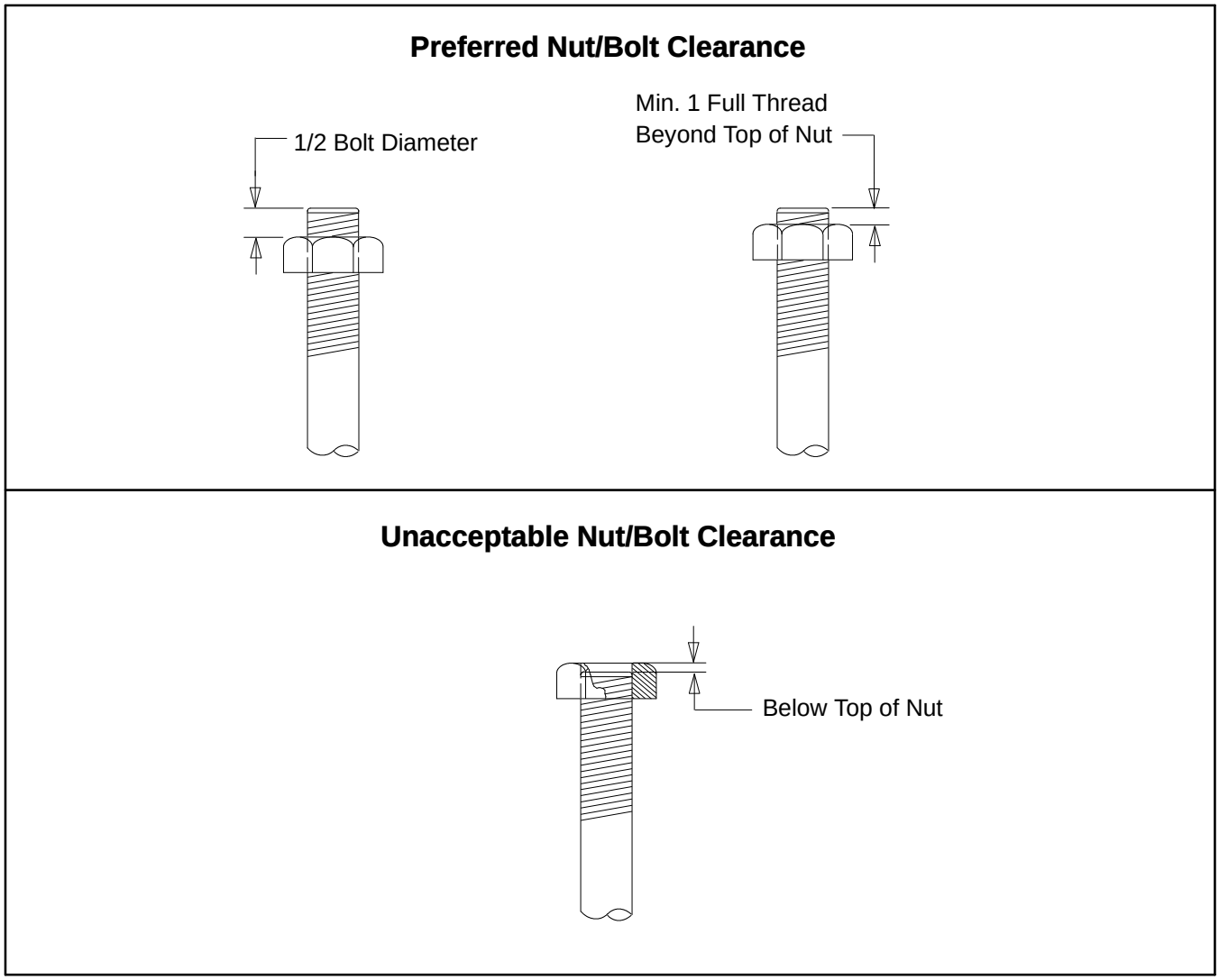


Figure 10-1. Acceptable Bolt Lengths

Common Hardware Application (G-585)

Steps for common hardware application:

1. Determine entry hole type: round, or slotted.

2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

   For round and slotted exit holes, determine if hardware is greater than 1/2 in. in diameter, or 1/2 in. in diameter or less. Hardware that is *greater than 1/2 in.* in diameter takes a standard nut and SAE washer. Hardware *1/2 in. or less* in diameter can take a properly torqued whiz nut. See the diagram below.

3. Follow these SAE washer rules after determining exit hole type:

   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut (see 2. above for exception).
   c. Use a washer under a bolt when the female thread is fixed (weld nut).

4. Refer to the diagram below, which depicts the preceding hardware configuration possibilities.

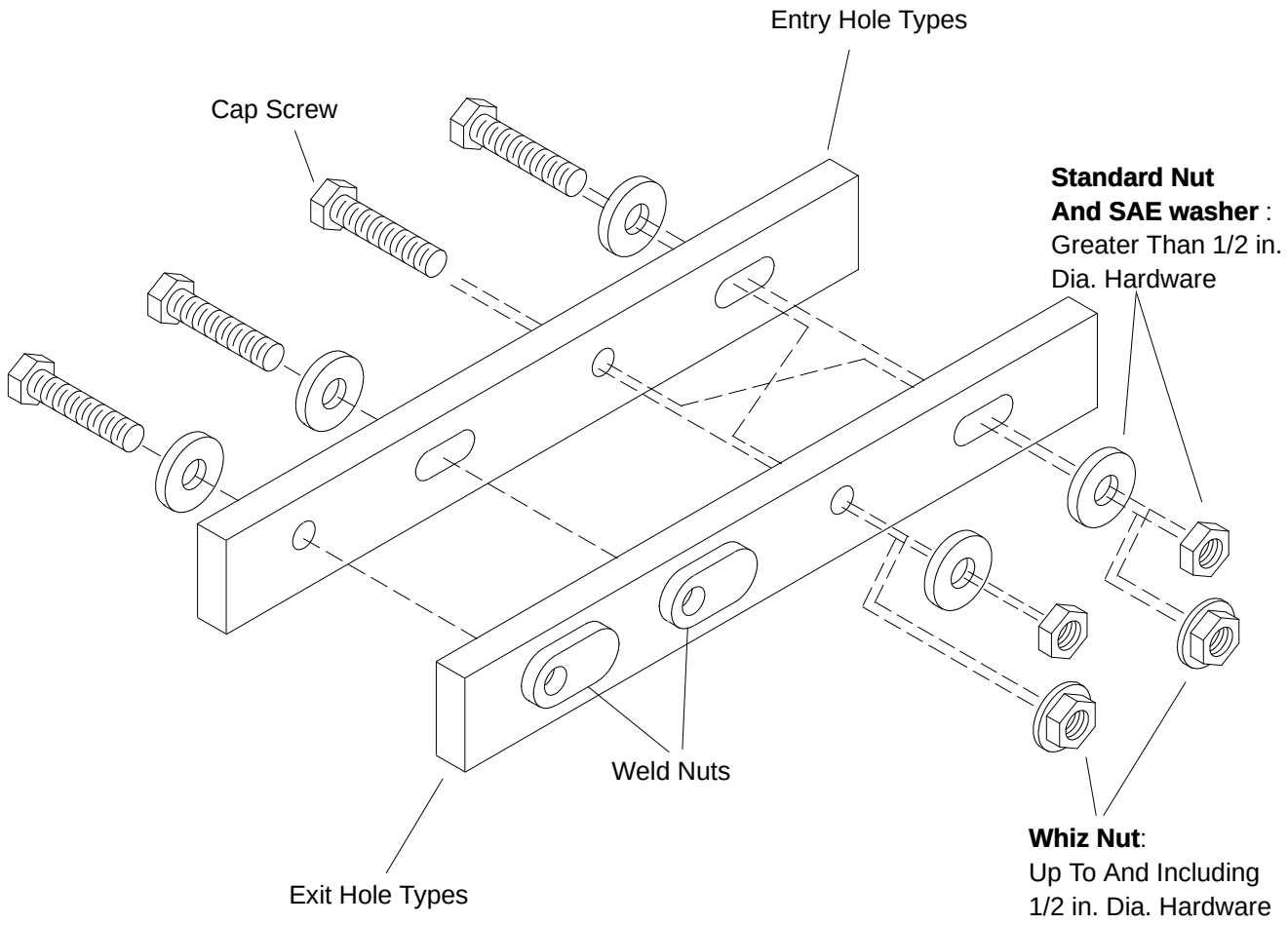


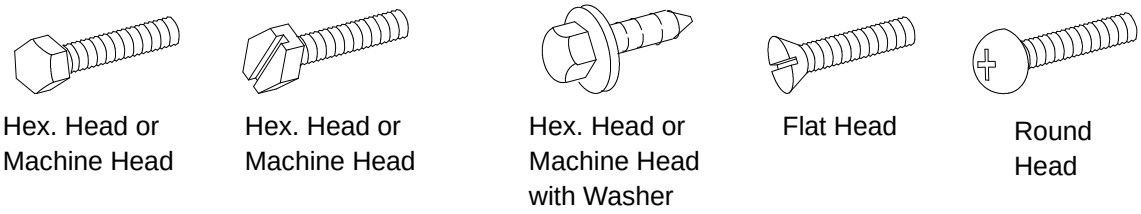
Figure 10-2. Acceptable Hardware Combinations

Common Hardware Identification

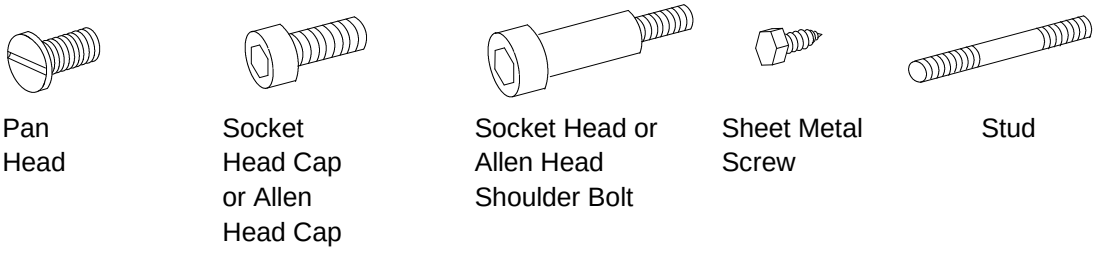
Common hardware has many different head, drive, and grade (hardness) styles. Some of the more common types are shown in Figure 10-3, below, and in Figure 10-4, next page. This is a guide for identification purposes. Not all generator hardware used is shown.

Screws/Bolts/Studs

HEAD STYLES



Hex. Head or Machine Head | Hex. Head or Machine Head | Hex. Head or Machine Head with Washer | Flat Head | Round Head



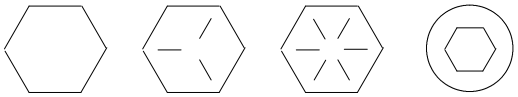
Pan Head | Socket Head Cap or Allen Head Cap | Socket Head or Allen Head Shoulder Bolt | Sheet Metal Screw | Stud

DRIVE STYLES

Hex. | Hex. and Slotted | Phillips | Slotted | Hex. Socket

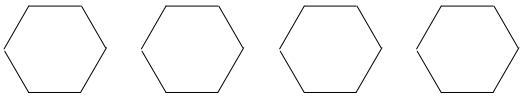
GRADE (HARDNESS)

American Standard



Grade 2 | Grade 5 | Grade 8 | Grade 8/9

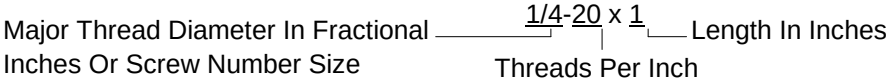
Metric



6.8 | 8.8 | 10.9 | 12.9

SAMPLE DIMENSIONS

American Standard



Metric

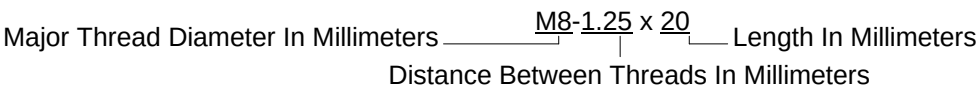


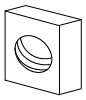
Figure 10-3. Screws/Bolts/Studs

Nuts

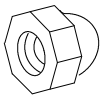
STYLES

Hex. Head

Lock Nut or
Nylock Nut



Square Nut



Cap Nut or
Acorn Nut

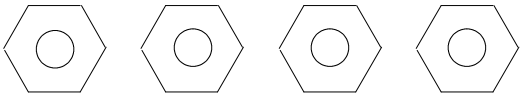
Wing Nut

GRADE (HARDNESS)

American Standard

Grade 2 Grade 5

Metric



6.8 8.8 10.9 12.9

SAMPLE DIMENSIONS

American Standard

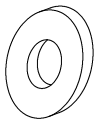
Major Thread Diameter In Fractional Inches Or Screw Number Size — 1/4-20 — Threads Per Inch

Metric

Major Thread Diameter In Millimeters — M8-1.25 — Distance Between Threads In Millimeters

Washers

STYLES

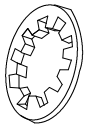


Plain
Washer

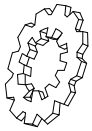
Split Lock
Washer or
Spring Washer

Spring Washer
or Wave Washer

External
Tooth Lock
Washer



Internal
Tooth Lock
Washer



Internal-External
Tooth Lock Washer

GRADE (HARDNESS)

There is no marking to identify hardness. Usually hardened washers have a black oxide or black phosphate finish rather than a zinc (silver-colored) finish.

SAMPLE DIMENSIONS

Plain Washers

Internal Dimension — 9/32 x 5/8 x 1/16 — Thickness

External Dimension

Lock Washers

5/8

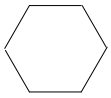
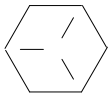
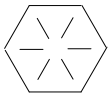
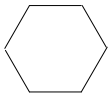
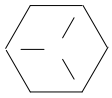
Internal Dimension

Figure 10-4. Nuts and Washers

General Torque Specifications

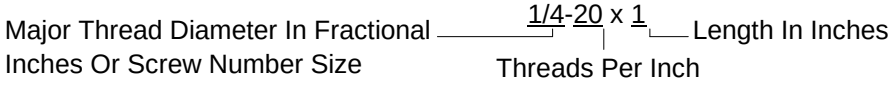
The values given are for clean, dry threads.

AMERICAN STANDARD

		Assembled in Cast Iron or Steel			Assembled in Aluminum
					 
Size	**Measurement**	**Grade 2**	**Grade 5**	**Grade 8**	**Grade 2 or 5**
8-32	in. lbs. (Nm)	20 (2.3)	25 (2.8)	-	20 (2.3)
10-24	in. lbs. (Nm)	32 (3.6)	40 (4.5)	-	32 (3.6)
10-32	in. lbs. (Nm)	32 (3.6)	40 (4.5)	-	-
1/4-20	in. lbs. (Nm)	70 (7.9)	115 (13)	165 (18.6)	70 (7.9)
1/4-28	in. lbs. (Nm)	85 (9.6)	140 (15.8)	200 (22.6)	-
5/16-18	in. lbs. (Nm)	150 (17)	250 (28.2)	350 (40)	150 (17)
5/16-24	in. lbs. (Nm)	165 (18.6)	270 (30.5)	360 (41)	-
3/8-16	ft. lbs. (Nm)	22 (30)	35 (45)	50 (65)	
3/8-24	ft. lbs. (Nm)	25 (35)	40 (54)	60 (80)	
7/16-14	ft. lbs. (Nm)	35 (45)	55 (75)	80 (108)	
7/16-20	ft. lbs. (Nm)	45 (54)	75 (105)	105 (142)	
1/2-13	ft. lbs. (Nm)	50 (65)	80 (110)	115 (155)	
1/2-20	ft. lbs. (Nm)	70 (95)	105 (140)	165 (224)	
9/16-12	ft. lbs. (Nm)	75 (105)	125 (165)	175 (237)	
9/16-18	ft. lbs. (Nm)	100 (136)	165 (224)	230 (312)	
5/8-11	ft. lbs. (Nm)	110 (149)	180 (244)	260 (353)	
5/8-18	ft. lbs. (Nm)	140 (190)	230 (312)	330 (447)	
3/4-10	ft. lbs. (Nm)	150 (203)	245 (322)	350 (475)	
3/4-16	ft. lbs. (Nm)	200 (271)	325 (440)	470 (637)	

Sample Dimensions

American Standard



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