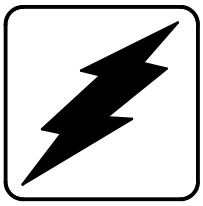
Operation

Industrial Generator Sets



Models:

6-15ROY/ROZ
6-15RFOY/RFOZ

Controllers:

Decision-Maker **t** 3, 5-Light Relay

ISO 9001
KOHLER GENERATORS
INTERNATIONALLY REGISTERED
U.S.A. Plant ISO Registered

KOHLER®
POWER SYSTEMS

TP-5934 1/98

California Proposition 65

⚠ WARNING

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

Table of Contents

Safety Precautions and Instructions I

Introduction i

Service Assistance ii

Section 1. Specifications and Features 1

1.1 Introduction 1
1.2 Generator 1
1.3 Controller 1
1.3.1 Relay Controller 1
1.3.2 5-Light Controller 1

Section 2. Operation 3

2.1 Prestart Checklist 3
2.2 Exercising the Generator 3
2.3 Microprocessor Controller Operation 4
2.3.1 5-Light Microprocessor Controller Features 4
2.3.2 Starting Procedure 7
2.3.3 Stopping Procedure 7
2.3.4 Circuit Protection 8
2.3.5 Fault Shutdowns 9
2.3.6 Controller Resetting Procedure (following fault shutdown) 10
2.3.7 Resetting Remote Emergency Stop Switch(es) 10
2.4 Relay Controller Operation 11
2.4.1 Starting Procedure 11
2.4.2 Stopping Procedure 11
2.4.3 Fault Shutdowns (relay controller) 11
2.4.4 Circuit Protection 12
2.4.5 Controller Resetting Procedure (following fault shutdown) 12

Section 3. Scheduled Maintenance 13

3.1 Service Schedule 14
3.2 Lubrication System 16
Low Oil Pressure (LOP) Shutdown 16
3.3 Fuel System 16
Bleeding the Fuel System 16
3.4 Governor 17
3.5 Cooling System 18
3.5.1 Coolant Drain Procedure 18
3.5.2 Coolant Fill Procedure 18
3.5.3 Coolant System Service 19
3.5.4 Low Coolant Level (LCL) Shutdown 19
3.5.5 High Engine Temperature (HET) Shutdown 19
3.6 Battery 20
Battery Charging System 20
3.7 Storage Procedure 20

Section 4. Troubleshooting 21

Appendix A. Glossary of Abbreviations A-1

A generator set, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or operated. The best way to prevent accidents is to be aware of potential dangers and act safely. Please read and follow the safety precautions and instructions below to prevent harm to yourself and others. This manual contains several types of safety precautions and instructions which are explained below. SAVE THESE INSTRUCTIONS.

DANGER

Danger indicates the presence of a hazard that *will* cause *severe* personal injury, death, or substantial property damage.

WARNING

Warning indicates the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage.

CAUTION

Caution indicates the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage.

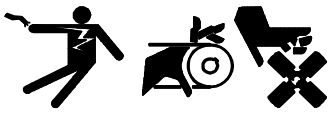
NOTICE

Notice communicates installation, operation, or maintenance information that is important but not hazard related.

Safety decals affixed to the generator set in prominent places advise the operator or service technician of potential hazards and how to act safely. The decals are reproduced in this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set. (Remove negative (–) lead first when disconnecting battery. Reconnect negative (–) lead last when reconnecting battery.)

Disabling generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: 1) Turn the generator set master switch to OFF position. 2) Disconnect power to battery charger. 3) Remove battery cables (remove negative (–) lead first). Reconnect negative (–) lead last when reconnecting battery. Follow these precautions to prevent starting of generator set by an automatic transfer switch or remote start/stop switch.

Battery

WARNING

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

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

WARNING

Explosion.
Can cause severe injury or death.
Relays in battery charger cause arcs or sparks.

Locate battery in a well-ventilated area. Isolate battery charger from explosive fumes.

Battery acid. 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 near the battery. If battery acid is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery gases. 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 charging. Avoid touching terminals with tools, etc., to prevent burns and 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. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is charging. Always turn battery charger off before disconnecting battery connections. Remove negative (–) lead first when disconnecting battery. Reconnect negative (–) lead last when reconnecting battery.

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.

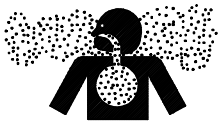
Servicing fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flame or spark to occur near carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Catch all fuel in a suitable container when removing fuel line or carburetor.

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

Combustible materials. A fire can cause severe injury or death. Generator set engine fuels and fuel fumes are flammable and explosive. Use care in handling these materials to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. Select a fire extinguisher rated ABC or BC for electrical fires or as recommended by local fire code or authorized agency. Train all personnel on fire extinguisher operation and fire prevention procedures.

Exhaust System

⚠ WARNING



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

The exhaust system must be leakproof and routinely inspected.

Generator set operation. 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 a potentially occupied building. 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 symptoms. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas which is present in exhaust gases. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, affected persons should seek fresh air immediately. They should remain active. They should not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. If the condition of affected persons does not improve within minutes of breathing fresh air, they should seek medical attention.

Copper tubing exhaust systems. Carbon monoxide can cause severe nausea, fainting, or death. Do not use copper tubing in diesel exhaust systems. Sulfur in diesel exhaust causes rapid deterioration of copper tubing exhaust systems resulting in exhaust leakage.

Fuel System

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

Fuel system. Explosive fuel vapors can cause severe injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling and storing 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 because spilled fuel may ignite on contact with hot parts or from spark. Do not smoke or permit flame or spark to occur near sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid breakage caused by vibration. Do not operate generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair systems before resuming generator set operation.

Fuel tanks. Explosive fuel vapors can cause severe injury or death. Gasoline and other volatile fuels stored in day tanks or subbase fuel tanks can cause an explosion. Store only diesel fuel in tanks.

Draining fuel system. 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 set without a muffler or with a faulty exhaust system.

Engine noise. Hazardous noise can cause loss of hearing. Generator sets not equipped with sound enclosures can produce noise levels greater than 105 dBA. Prolonged exposure to noise levels greater than 85 dBA can cause permanent hearing loss. Wear hearing protection when near an operating generator set.

Hazardous Voltage/ Electrical Shock

⚠ WARNING

Hazardous voltage. Moving rotor.
Can cause severe injury or death.

Operate generator set only with all guards and electrical enclosures in place.

⚠ WARNING

Hazardous voltage.
Backfeed to utility system can cause property damage, severe injury, or death.

If generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

Grounding generator set. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open main circuit breakers of all power sources before servicing equipment. Configure the installation to electrically ground the generator set and electrical circuits when in use. Never contact electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution increases under such conditions.

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

Installing battery charger. Hazardous voltage can cause severe injury or death. Electrical shock may occur if battery charger is not electrically grounded. Connect battery charger enclosure to ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect to equipment grounding terminal or lead on battery charger. Perform battery charger installation as prescribed in equipment manual. Install battery charger in compliance with local codes and ordinances.

Connecting battery and battery charger. Hazardous voltage can cause severe injury or death. Reconnect battery correctly to avoid electrical shock and damage to battery charger and battery(ies). Have a qualified electrician install battery(ies).

Short circuits. Hazardous voltage/current 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 making adjustments or repairs. Remove wristwatch, rings, and jewelry before servicing equipment.

Testing voltage regulator. Hazardous voltage can cause severe injury or death. High voltage is present at the voltage regulator heat sink. Do not touch voltage regulator heat sink when testing voltage regulator or electrical shock will occur. *(PowerBoost* **t** *, PowerBoost* **t** *III, and PowerBoost* **t** *V voltage regulator models only.)*

Engine block heater. Hazardous voltage can cause severe injury or death. Engine block heater can cause electrical shock. Remove engine block heater plug from electrical outlet before working on block heater electrical connections.

Electrical backfeed to utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent connection of standby 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.

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lift can cause severe injury or death and/or equipment damage.

Do not use lifting eyes.
Lift generator set using lifting bars inserted through skid lifting holes.

Hot Parts

⚠ WARNING

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

Before removing pressure cap, stop generator set and allow it to cool. Then 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 it is allowed to cool.

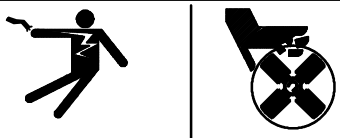
Servicing generator. Hot parts can cause severe injury or death. Avoid touching generator set field or exciter armature. Generator set field and exciter armature when shorted become hot enough to cause severe burns.

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

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

Moving Parts

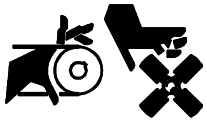
⚠ WARNING



Hazardous voltage. Moving rotor.
Can cause severe injury or death.

Operate generator set only with 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, and covers in place.

Tightening hardware. Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. Do not loosen crankshaft hardware or rotor thrubolt when making adjustments or servicing generator set. Rotate crankshaft manually in a clockwise direction only. Turning crankshaft bolt or rotor thrubolt counterclockwise can loosen hardware. Loose hardware can cause hardware or pulley to release from engine of generator set and can cause personal injury.

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

Notice

NOTICE

This generator set has been rewired from its nameplate voltage to:

246242

NOTICE

Voltage reconnection! Affix notice to generator set after reconnecting to a voltage different from the nameplate. Order voltage reconnection decal 246242 from authorized service distributors/dealers.

NOTICE

Hardware damage! Engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of bolt heads and nuts.

NOTICE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. American Standard hardware uses a series of markings and metric hardware uses a numeric system to indicate hardness. Check markings on bolt head and nuts for identification.

NOTICE

Canadian installations only:
For standby service connect output of generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

Notes

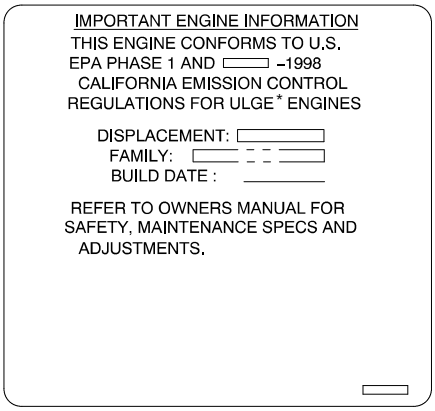
All information in this publication represents data available at time of printing. Kohler Co. reserves the right to change this literature and the products represented without incurring obligation.

Read through this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with equipment for future reference.

Equipment service requirements are minimal but are very important to safe and efficient operation; therefore, inspect parts often and perform required service at the prescribed intervals. An authorized service distributor/dealer should perform required service to keep equipment in top condition.

California Emission Certification

If your engine/generator set has an identification label similar to the one below, it is certified for operation in the state of California.



* Utility Lawn and Garden Equipment

Service Assistance

For sales and service in the U.S.A. and Canada check the yellow pages of the telephone directory under the heading GENERATORS– ELECTRIC for an authorized service distributor/dealer or call 1-800-544-2444.

For sales and service outside the U.S.A. and Canada, contact your local distributor.

For further information or questions, contact the company directly at:

KOHLER CO., Kohler, Wisconsin 53044 U.S.A.
Phone: 920-565-3381
Fax: 920-459-1646 (U.S.A. Sales)
920-459-1614 (International)

Kohler Power Systems, Asia Pacific Headquarters
7 Jurong Pier Road, Singapore 619159
Phone: (65)264-6422
Fax: (65)264-6455

To ensure supply of correct parts or information, make note of the following identification numbers in the spaces provided:

GENERATOR SET

MODEL, SPEC, and SERIAL numbers are found on the nameplate attached to the generator set.

Model No. _____

Specification No. _____

Serial No. _____

GENERATOR SET ACCESSORIES

An alternate nameplate inside the junction box identifies factory-installed generator set accessories.

Accessory Nos. _____

_____

_____

_____

_____

_____

_____

_____

_____

ENGINE

The engine serial number is found on the engine nameplate.

Engine Serial No. _____

Section 1. Specifications and Features

1.1 Introduction

The spec sheets for each generator set provide specific generator and engine information. The controller spec sheet provides specifications particular to each controller. Refer to the respective spec sheet for data not supplied in this manual. Consult the generator set service manual, wiring diagram manual, installation manual, engine operation manual, and engine service manual for additional specifications.

1.2 Generator

The generator is equipped with Kohler's PowerBoost **t** voltage regulation system which provides instant response to load changes.

PowerBoost **t** is a unique system that ensures reliable motor starting and consistent voltage levels.

PowerBoost **t** utilizes a voltage excitation system that employs a winding independent of the main output windings to provide excitation voltage.

1.3 Controller

The generator set is equipped with a relay controller or a 5-light microprocessor controller. For a description of the controller, see Section 2– Operation. Controller features include the following:

1.3.1 Relay Controller

The relay controller features include the following:

- Fault shutdowns with common indicator:
  - Level, low coolant
  - Overcrank
  - Overspeed
  - Pressure, low oil
  - Temperature, high engine
- Running time meter
- Switches and standard features:
  - Cranking, cyclic
  - Start, remote two-wire
  - Switch, run/off-reset/auto (engine start)

1.3.2 5-Light Controller

The 5-light controller features include the following:

- Analog gauges, 2 in. (51 mm), 2% full-accuracy:
  - Pressure gauge, oil
  - Temperature gauge, engine water
  - Voltmeter, DC only
- Analog meters, 3.5 in. (89 mm):
  - AC ammeter, 2% full-scale accuracy
  - AC voltmeter, 2% full-scale accuracy
  - Frequency meter, 0.5% full-scale accuracy
- Fault shutdowns and status indicators:
  - Auxiliary (red)
  - Level, low coolant (uses auxiliary fault indicator)
  - Overcrank (red)
  - Overspeed (red)
  - Pressure, low oil (red)
  - Temperature, high engine (red)
  - Temperature, low water (red*)

  *Requires optional kit or user-provided device for lamp to function.
- Running time meter
- Switches and standard features:
  - Cranking, cyclic
  - Horn, alarm (with silence switch)
  - Rheostat, generator output voltage-adjusting (front panel mounted, ±5% of nominal voltage)
  - Start, remote two-wire
  - Switch, lamp-test
  - Switch, meter range selector
  - Switch, run/off-reset/auto (engine start)
  - Timer, engine cooldown (5-minute fixed)

Notes

2.1 Prestart Checklist

To ensure continued satisfactory operation, check the following items before each startup and at regular intervals. Refer to the engine service manual for specific service procedures.

Air Cleaner. Keep air cleaner element clean. Install element to keep unfiltered air from entering engine.

Battery. Ensure tight battery connections. Maintain full battery electrolyte level.

Coolant Level. Check level after the engine has cooled. Maintain coolant level at just below the overflow tube on the radiator filler neck. Open air-bleed petcocks, if equipped, when filling radiator. Close air-bleed petcock when coolant begins to flow from petcock. If equipped with a coolant recovery tank, maintain level in tank between 1/3 full (cold) and 2/3 full (hot). Use a coolant solution of 50% ethylene glycol and 50% clean, softened water to inhibit rust/corrosion.

A coolant solution of 50% ethylene glycol provides freezing protection of −34°F (−37°C) and overheating protection to 265°F (129°C). A coolant solution with less than 50% ethylene glycol may not provide adequate freezing and overheating protection. A coolant solution with more than 50% ethylene glycol can cause engine or component damage. Do not use alcohol or methanol antifreeze or mix them with the specified coolant. Consult the engine manufacturer's operation manual for engine coolant specifications.

Do not add coolant to a hot engine. Wait until engine has cooled. Adding coolant to a hot engine can cause the cylinder block or cylinder head to crack.

Do not energize block heater before filling cooling system. Before energizing block heater, run engine until it is warm and refill radiator to purge air from the system. Immerse heater element in coolant to prevent block heater failure.

Exhaust System. Keep exhaust outlet clear. Keep silencer and piping tight and in good condition.

Fuel Level. Keep tank(s) full to ensure adequate fuel supply.

Lamp Test. Press the lamp test button (if equipped) to verify operation of all controller LEDs.

Oil Level. Maintain oil level at or near full mark on dipstick but not over. Keep the oil level in the mechanical governor (if equipped) at or near the full level.

Operating Area. Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.

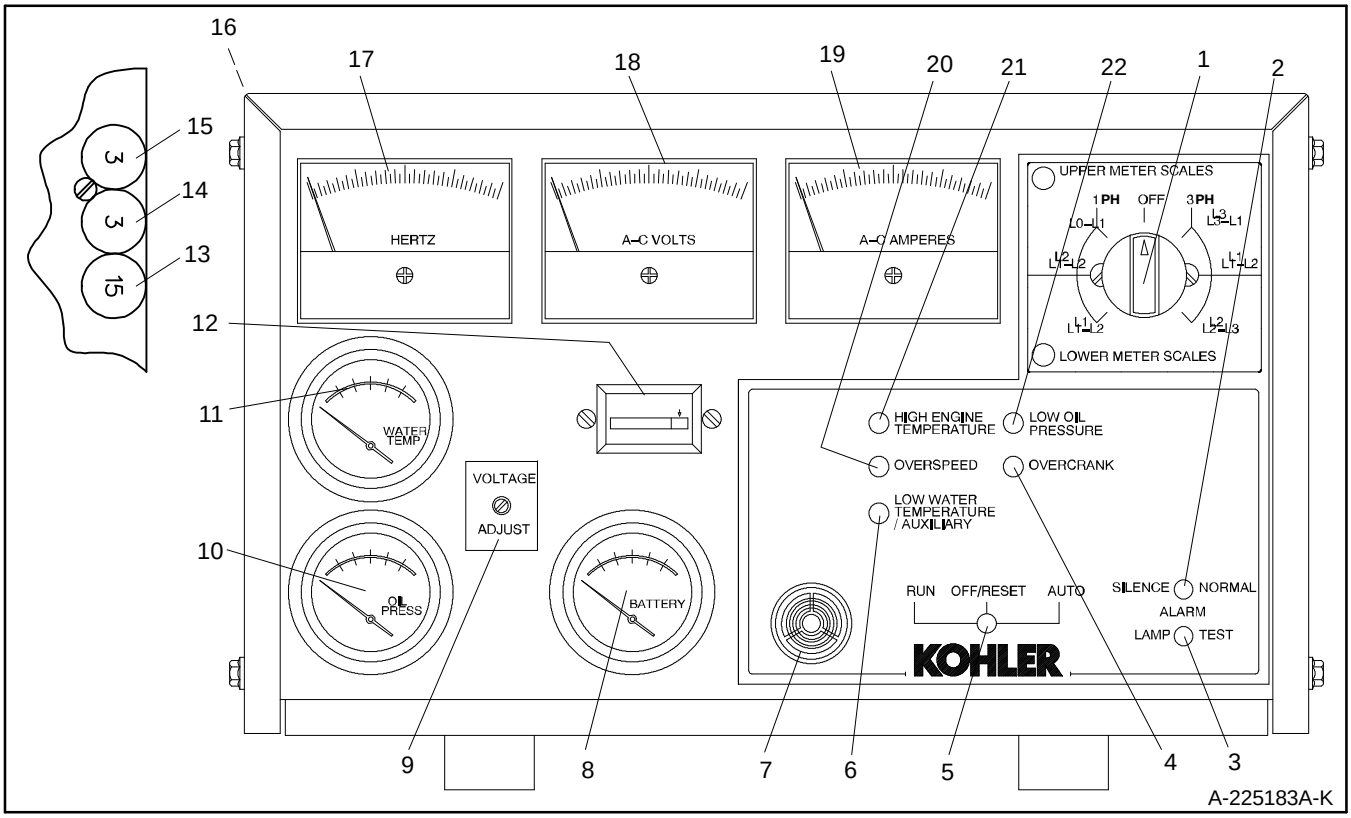
2.2 Exercising the Generator

Run the generator set under load once each week for one hour. Perform this exercise in the presence of an operator if the generator set does not have an automatic transfer switch with an exercise option.

Operator should perform all prestart checks before starting the exercise procedure. While the generator set is running, listen for a smooth-running engine and visually inspect the generator set to ensure there are no fluid or exhaust leaks.

Start the generator set according to the starting procedure in the controller section of this manual.

2.3 Microprocessor Controller Operation



1. Selector switch
2. Alarm silence switch
3. Lamp test
4. Overcrank
5. Generator master switch
6. Auxiliary light
7. Alarm horn
8. DC voltmeter
9. Voltage adjustment potentiometer
10. Oil pressure gauge
11. Engine water temperature gauge
12. Hourmeter
13. 15-amp engine and accessories fuse
14. 3-amp controller fuse
15. 3-amp remote annunciator fuse
16. Fuse location
17. Frequency meter
18. AC voltmeter
19. AC ammeter
20. Overspeed light
21. High engine temperature
22. Low oil pressure lamp

Figure 2-1. 5-Light Microprocessor Controller Features

2.3.1 5-Light Microprocessor Controller Features

Microprocessor controller features include the annunciator panel lamps, analog meters, switches and controls, fuses, and terminal strip. The following paragraphs cover each of these topics.

Lamps

Auxiliary Fault. Lamp flashes or lights when fault is detected.

Flashing Lamp Conditions

No AC Output.

The auxiliary lamp flashes immediately if the controller senses no AC output while the generator set is running (except during the first 10 seconds after start-up). The flashing stops and the light is off when AC output is sensed. Condition requires no manual reset.

Battery.

The auxiliary lamp flashes if the battery power was reconnected or was low and then rose again while the generator set master switch was in the RUN or AUTO position. A weak or undersized battery may cause a temporarily low battery condition. Place the generator set master switch in the OFF/RESET position to reset the flashing lamp condition.

Continuous On Lamp Conditions

Emergency Stop Activated.

The auxiliary lamp lights and generator set shuts down immediately if operator activates the emergency stop switch, if generator set has the optional emergency stop shutdown switch.

Emergency Stop Reset.

The auxiliary lamp lights if the operator resets the optional emergency stop switch while the generator set master switch is in the AUTO or RUN position. Place the generator set master switch in OFF/RESET position to clear this fault condition.

Engine Fault.

The auxiliary lamp lights and engine shuts down 5 seconds after high oil temperature (P1-13) or auxiliary delay shutdown (P1-15) faults occur, if equipped. These fault conditions are inhibited during first 30 seconds after crank disconnect.

Overvoltage.

The auxiliary lamp lights and engine shuts down immediately if an overvoltage condition occurs, if equipped with overvoltage shutdown kit.

Auxiliary Shutdown.

The auxiliary lamp lights and engine shuts down immediately if activated by any customer- supplied sensing devices connected to auxiliary immediate shutdown ports (P1-17 and P1-18).

Low Oil Pressure. Lamp illuminates if generator set shuts down because of low oil pressure. Shutdown occurs 5 seconds after engine reaches pressure shutdown range.

Overcrank. Lamp illuminates and cranking stops if engine does not start after 45 seconds of continuous cranking or 75 seconds of cyclic cranking. See Auto Starting.

- Cranking stops and overcrank lamp illuminates after 15 seconds if starter or engine does not turn (locked rotor).
- Overcrank lamp flashes if speed sensor signal is absent longer than one second.

NOTE

The controller is equipped with an automatic restart function. The generator set attempts to restart if the engine speed drops below 13 Hz (390 RPM). Continued decreased engine speed causes an overcrank fault condition.

Overspeed. Lamp illuminates if generator set shuts down because governed frequency on 50 and 60 Hz models exceeds 70 Hz (2100 RPM).

Analog Meters

AC Ammeter. Meter measures amperage from output leads. Use selector switch to choose output lead circuits.

AC Voltmeter. Meter measures voltage across output leads. Use selector switch to choose output lead circuits.

DC Voltmeter. Meter measures voltage of starting battery.

Frequency Meter. Meter measures frequency (Hz) of generator set output voltage.

Hourmeter. Hourmeter records generator set total operating hours for reference in scheduling maintenance.

Switches and Controls

Alarm Horn. Horn sounds if any fault or anticipatory condition exists. Place the generator set master switch in the AUTO position before silencing alarm horn. See Controller Resetting Procedure later in this section.

Alarm Silence. Switch disconnects alarm during service (place the generator set master switch in the AUTO position before silencing alarm horn). Restore alarm horn switches at all locations (controller, remote annunciator, and audio/visual alarm) to normal position after correcting fault shutdown to avoid reactivating alarm horn. See Controller Resetting Procedure later in this section.

Generator Master Switch(RUN/OFF-RESET/AUTO). Switch functions as controller reset and generator set operation switch. Refer to Starting, Stopping, and Controller Resetting Procedure later in this section.

Lamp Test. Switch tests the controller indicator lamps.

Selector Switch. Switch selects which generator output circuits to measure. When switched to a position with three circuit lead labels, ammeter displays amperage measured on the upper lead and voltmeter displays voltage measured between the lower two leads. AC ammeter and voltmeter do not register with switch in the OFF position.

Voltage Adjustment Potentiometer. Fine adjustment (±5%) for generator output voltage. See Wiring Diagrams, Voltage Reconnection.

Fuses and Terminal Strip

Fuses. Fuses are located on controller circuit board.

- **3-amp Remote Annunciator (F1).** Fuse protects remote annunciator circuit, A/V alarm, and isolated alarm kit, if equipped.
- **3-amp Controller.** Fuse protects controller circuit board, speed sensor, and lamp circuit board.
- **15-amp Engine and Accessory.** Fuse protects engine/starting circuitry and accessories.

Controller TB1 Terminal Strip (on Circuit Board). Connect generator set accessories such as emergency stop switch, remote start stop/switch, audio/visual alarms, etc., to the TB1 terminal strip. Make crank mode selection (cyclic or continuous) on the TB1 terminal strip. Figure 2-2 shows the location of the TB1 terminal strip on the controller circuit board. Refer to wiring diagrams for additional information on connecting accessories to the TB1 terminal strip.

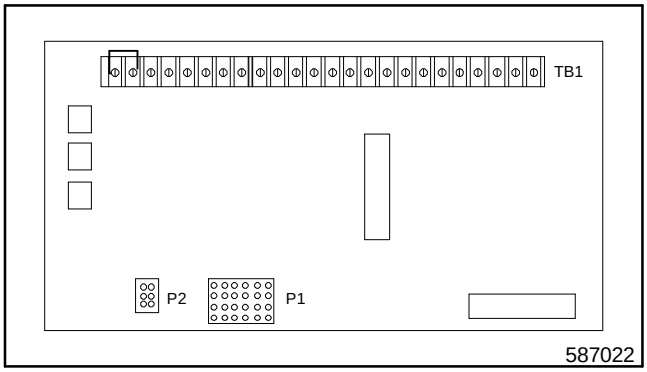


Figure 2-2. Controller TB1 Terminal Strip

2.3.2 Starting Procedure

Local Starting

Place the generator set master switch in the RUN position to start the generator set at the controller.

NOTE

The alarm horn sounds whenever the generator set master switch is not in the AUTO position.

NOTE

The microprocessor controller is equipped with a transient start/stop function to avoid accidental cranking of the rotating engine. If the generator set master switch is momentarily placed in the OFF/RESET position, then quickly returned to RUN, the genset slows to 249 rpm and recranks before returning to rated speed.

NOTE

The microprocessor controller is equipped with an automatic restart function. The generator set attempts to restart if the engine speed drops below 13 Hz (390 rpm). Failure to correct the cause of the decreased engine speed results in an overcrank condition.

Auto (Remote) Starting

Place the generator set master switch in the AUTO position for start-up by automatic transfer switch or remote start/stop switch (connected to controller terminals TB1-3 and TB1-4).

Crank Mode Selection

The microprocessor controller provides up to 45 seconds of continuous cranking or 75 seconds of cyclic cranking (crank 15 seconds, rest 15 seconds, crank 15 seconds, etc.) before overcrank shutdown. Make the cranking mode (cyclic or continuous) selection on the controller circuit board terminal strip. For cyclic cranking, leave circuit board terminal TB1-9 open. Place a jumper between circuit board terminal TB1-2 (ground) and terminal TB1-9 for continuous cranking.

2.3.3 Stopping Procedure

Normal Stopping

1. Disconnect load from generator set and allow it to run without load for 5 minutes.

NOTE

Run the generator set at no load for 5 minutes prior to stopping to ensure adequate cooling of the set.

2. Place the generator set master switch in the OFF/RESET position. The engine stops.

NOTE

The generator set runs for a 5-minute cooldown cycle if a remote switch or automatic transfer switch signals engine stop.

Emergency Stopping

Place the generator set master switch in the OFF/RESET position or activate remote emergency stop, if equipped, for immediate shutdown. Activating the emergency stop switch causes the controller AUXILIARY lamp to light and the generator set to shut down. The remote annunciator and/or audio-visual alarms, if equipped, signal an emergency stop.

NOTE

Use the emergency stop switch(es) for emergency shutdowns only. Use the generator set master switch to stop the generator set under normal operating conditions.

2.3.4 Circuit Protection

The line circuit breaker interrupts generator output in the event of an overload or short circuit in the wiring between the alternator and components. If the circuit breaker trips, reduce the load and switch the breaker to the ON position. With the breaker in the OFF position, the generator set runs but there is no output voltage.

NOTE

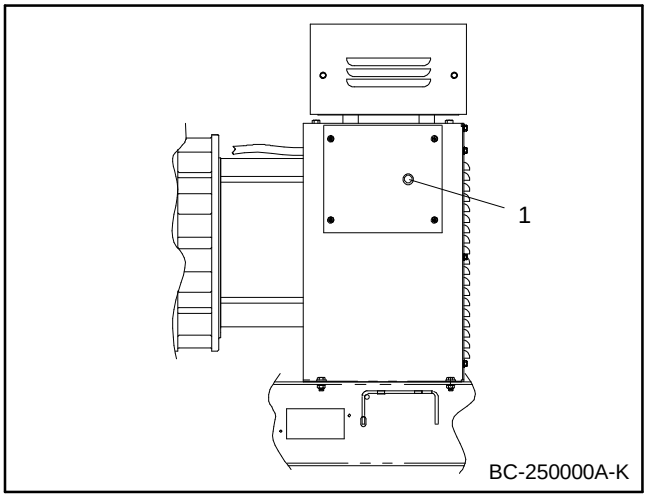
If the generator set circuit breaker trips repeatedly, see Section 4, Troubleshooting for possible causes.

Fuses F1 (3-amp), F2 (3-amp), and F3 (15-amp) on the controller circuit board protect the engine and controller circuitry. (See Fuses earlier in this section.) If the generator set does not crank or accessories do not work, and the battery/connections appear okay, check condition of F1, F2, and F3 fuses.

Fuses V7, V8, and V9 on the AC terminal block (TB2) protect the controller meters and lights. If the controller lights and meters do not function, check the condition of the V7, V8, and V9 fuses. If a replaced fuse blows again, see Section 4– Troubleshooting for possible causes.

Voltage Regulator Fuse

A 10-amp fuse protects the voltage regulator circuitry from damage because of overload or short circuits. If this fuse blows, the generator set shuts down. If a replaced fuse blows again, see Section 4– Troubleshooting for possible causes. See Figure 2-3 for location of the voltage regulator fuse.



1. 10-amp fuse

Figure 2-3. Voltage Regulator Fuse Location

2.3.5 Fault Shutdowns

The generator set shuts down automatically under the following fault conditions. The generator set will not run until the fault condition has been corrected. The shutdown switches automatically reset when the problem is corrected or the generator set cools (if high engine temperature was the fault).

NOTE

Low oil pressure does not function during the first 30 seconds after start-up.

Overcrank. Shutdown occurs after 45 seconds of continuous cranking. Shutdown occurs after 75 seconds of cyclic cranking (crank 15 seconds, rest 15 seconds, crank 15 seconds, etc. for a total of 75 seconds). Shutdown occurs after 15 seconds if engine or starter does not turn (locked rotor).

Overspeed. Generator set shuts down immediately when governed frequency exceeds 70 Hz (2100 rpm) on 50 and 60 Hz models.

Low Oil Pressure. Shutdown occurs 5 seconds after fault. Low oil pressure shutdown does not function during the first 30 seconds after start-up.

Overvoltage. The generator set shuts down and auxiliary lamp lights when voltage is 15% or more over nominal voltage for 2 seconds or more.

Low Water Temperature. Lamp illuminates if water temperature approaches shutdown range. Optional prealarm sender kit required for lamp to function.

NOTE

Overvoltage can damage sensitive equipment in less than one second. Install separate overvoltage protection on on-line equipment requiring faster shutdowns.

2.3.6 Controller Resetting Procedure (following fault shutdown)

Use the following procedure to restart the generator set after a fault shutdown. Refer to Resetting Emergency Stop Switches in this section to reset the generator set after an emergency stop.

1. Place controller alarm horn switch in the SILENCE position.

   Place A/V annunciator alarm switch in SILENCE position to stop alarm horn for generator sets equipped with an optional A/V annunciator. A/V annunciator lamp stays lit with the alarm switch in the SILENCE position. (The A/V alarm uses one lamp to indicate a fault shutdown; the corresponding fault lamp lights on the remote annunciator to indicate a fault condition.)

2. Disconnect generator set from load with line circuit breaker or automatic transfer switch.
3. Correct cause of fault shutdown.
4. Place the generator set master switch in the OFF/RESET position and then in the RUN position to start generator set. A/V annunciator alarm horn sounds and lamp, if equipped, darkens.
5. Test operate generator set to verify that cause of shutdown has been corrected.
6. Reconnect generator set to load via line circuit breaker or automatic transfer switch.
7. Place generator set master switch in AUTO position for start-up by remote transfer switch or remote start/stop switch. Place A/V annunciator alarm switch, if equipped, in NORMAL position.

NOTE

Place generator set master switch in the AUTO position before silencing alarm horn.

8. Place controller alarm horn switch in the NORMAL position.

2.3.7 Resetting Remote Emergency Stop Switch(es)

Use the following procedure to restart the generator set after remote emergency stop switch shutdown. Refer to the Controller Resetting procedure in this section to restart the generator set following a fault shutdown.

1. Determine cause of emergency stop and correct problem(s).
2. Replace glass piece in remote emergency stop switch, if equipped, to reset switch.

NOTE

The controller auxiliary lamp lights if the generator set master switch is in the RUN or AUTO position during the resetting procedure.

3. Toggle the generator set master switch to OFF/RESET and then to RUN or AUTO to restart generator set. The generator set does not crank until the operator completes the resetting procedure.

2.4 Relay Controller Operation

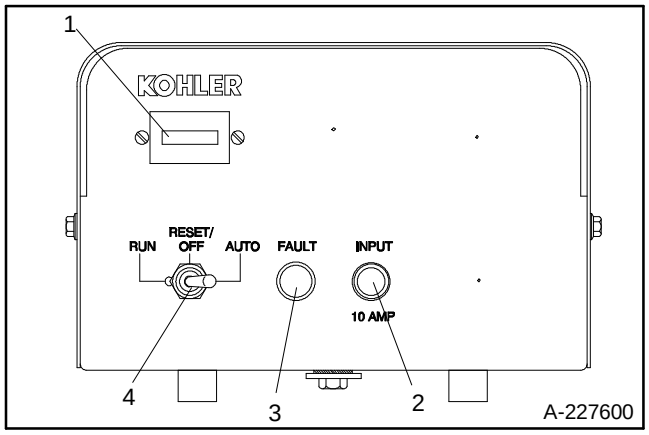
For generator sets equipped with a relay controller, refer to Figure 2-4 and the following descriptions to identify controller components.

Fault Lamp. Lamp lights to indicate a fault condition. Generator set shuts down on Overcrank, Overspeed, and Low Oil Pressure faults. See Fault Shutdowns following. Fault lamp does not stay lit after generator set shuts down. Fault lamp lights as fault occurs.

Hourmeter. Hourmeter records generator set operating hours for reference in maintenance scheduling.

Generator Master Switch (Run/Off-Rest/Auto). Switch functions as controller reset and generator set operation switch. Refer to Starting, Stopping, and Controller Resetting procedure in this section.

Controller Fuse. Fuse (10-amp) protects the engine, DC circuits, and the controller.



1. Hourmeter
2. Controller fuse
3. Fault lamp
4. Generator master switch
5. AC circuit breaker (not shown)

Figure 2-4. Relay Controller Features

2.4.1 Starting Procedure

Place the generator master switch or remote Start/Stop switch in the RUN position until the engine starts. If the engine fails to start after three 8-second attempts, the generator set stops cranking because of overcrank fault shutdown. Wait for the engine to come to a complete stop before attempting restart. Place switch in RESET/OFF position and then in RUN position.

NOTE

Do not crank engine continuously for more than 30 seconds at a time. Allow a 60-second cooldown period between cranking attempts if the engine does not start. If the generator set does not start after three attempts, see Section 4– Troubleshooting for possible causes.

2.4.2 Stopping Procedure

1. Disconnect load from generator set and allow generator set to run without load for 5 minutes.

NOTE

Run the generator set at no load for 5 minutes prior to stopping to ensure adequate cooling of the set.

2. Place generator master switch or remote start/stop switch in the OFF/RESET position. The generator set shuts down.

2.4.3 Fault Shutdowns (relay controller)

The generator set shuts down automatically under the following fault conditions and cannot be restarted until the fault condition is corrected. The shutdown switches automatically reset when the problem is corrected or the generator set cools (if overheating was the fault).

Overcrank. Shutdown occurs after 30-60 seconds of continuous cranking.

Overspeed. Generator set shuts down immediately if governed frequency exceeds 70 Hz (2100 rpm) on 50 and 60 Hz models.

Low Oil Pressure. Shutdown occurs approximately 8 seconds after fault. Fault occurs when engine oil pressure drops below specified limit.

NOTE

Low oil pressure shutdown does not protect against low oil level. Check oil level at engine.

NOTE

If the cause of a low oil pressure shutdown is not corrected, the generator set can be restarted (after controller reset) and will run approximately 8 seconds before shutting down again. See Resetting Fault Shutdown procedure following.

2.4.4 Circuit Protection

Line Circuit Breaker (if equipped)

The line circuit breaker interrupts generator output in the event of an overload or short circuit in the wiring between the alternator and generator set components. If the circuit breaker trips, reduce the load and switch the breakers to the ON position. With the breaker in the OFF position, the generator set runs but there is no output voltage.

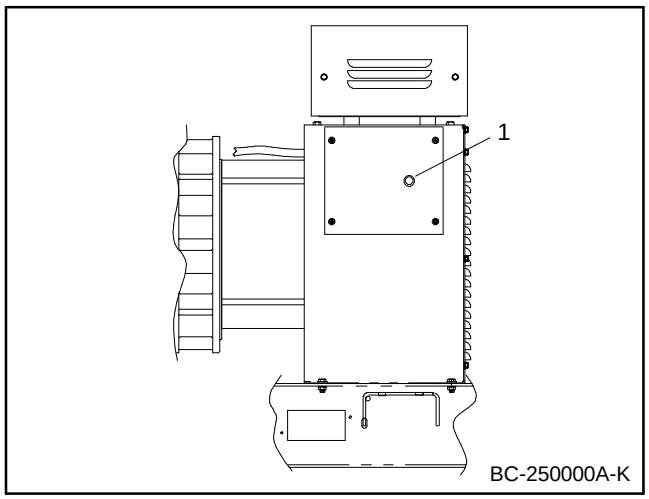
NOTE

If the generator set circuit breaker trips repeatedly, see Section 4– Troubleshooting for possible causes.

A replaceable 10-amp fuse protects the controller and engine DC circuitry. Check the controller fuse if the generator set does not crank and the battery and/or connections appear correct. Replace fuse. If fuse blows again, see Section 4– Troubleshooting for possible causes.

Voltage Regulator Fuse

A replaceable 10-amp fuse protects the voltage regulator circuitry. The generator set shuts down if the voltage regulator fuse blows. Typically with a blown voltage regulator fuse the generator set starts and then shuts down in 8 seconds. If a replaced fuse blows again, see Section 4– Troubleshooting for possible causes. See Figure 2-5 for location of the voltage regulator fuse.



1. 10-amp fuse

Figure 2-5. Voltage Regulator Fuse Location

2.4.5 Controller Resetting Procedure (following fault shutdown)

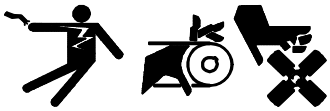
Use the following procedure to restart the generator set after a fault shutdown. Reset the controller and correct the fault before restarting the generator set.

NOTE

If the fault is not corrected, the generator set starts and then shuts down in 8 seconds.

1. Place the generator set master switch in the OFF/RESET position until the fault lamp darkens. See Safety Precautions before proceeding.
2. Disconnect generator set from load using line circuit breaker or automatic transfer switch.
3. Place generator set master switch in the RUN position to restart the generator set. Refer to Section 4– Troubleshooting for possible causes of fault shutdown.
4. Place the generator set master switch in the OFF/RESET position.
5. Correct cause of fault shutdown.
6. Place the generator set master switch in NORMAL position (RUN or AUTO) for start-up.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set. (Remove negative (–) lead first when disconnecting battery. Reconnect negative (–) lead last when reconnecting battery.)

Disabling generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: 1) Turn the generator set master switch to OFF position. 2) Disconnect power to battery charger. 3) Remove battery cables (remove negative (–) lead first). Reconnect negative (–) lead last when reconnecting battery. Follow these precautions to prevent starting of generator set by an automatic transfer switch or remote start/stop switch.

⚠ WARNING

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

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

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

⚠ WARNING

Hazardous voltage. Moving rotor.
Can cause severe injury or death.

Operate generator set only with all guards and electrical enclosures in place.

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

Alternator service. Under normal operating conditions the generator set alternator does not require scheduled service. Refer to the service schedule for items that require maintenance.

Engine service. Perform generator set engine service at the intervals specified by the engine service literature. Contact an authorized Kohler service distributor/dealer to obtain engine service literature.

Generator set service. If the generator set operates under dusty or dirty conditions, use *dry* compressed air to blow dust out of the generator. With the generator set running, direct the stream of air in through the cooling slots at the generator end.

See Safety Precautions and Instructions at the beginning of this manual before attempting to service, repair, or operate the generator set. Have an authorized Kohler service distributor/dealer perform all generator service.

Routine maintenance. Refer to the service schedule following and the hourmeter located on the generator set controller to schedule routine maintenance. Service units subject to extreme weather, long operating hours, or dusty or dirty conditions, more frequently.

Service schedule. Perform maintenance on each item in the service schedule at the designated interval for the life of the generator set.

Tools. Tools and instruments to perform some maintenance items are not generally available to the generator set owner. Therefore, have service performed by an authorized distributor/dealer.

Tune-ups. Have the generator set tuned-up by an authorized distributor/dealer. Tune-ups improve performance and ensure continuous satisfactory operation during a long, trouble-free service life.

3.1 Service Schedule

System– Component	Procedure					Frequency
D Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual. If not indicated, follow this service schedule. Some items may not pertain to specific generator sets. X Action R Replace as necessary	**Visually Inspect**	**Check**	**Change**	**Clean**	**Test**	W=Weekly M=Monthly Q=Quarterly S=Six Months Y=Yearly No.=Hours
FUEL						
Day tank level	X	X				W
Flexible lines and connections	X		R			W
Fuel level switch	X				X	W
Main tank supply level		X				W
Transfer pump operation	X				X	W
Water in system, remove		D		D		W
Filter(s)			D			Q
Fuel supply			R			S
Fuel piping	X					Q
Tank vents and return lines for obstructions		X				Q
LUBRICATION						
Oil level	D	D				W
Crankcase breather	D		D			Q
Change oil			D			50 or Y
Replace filter(s)*			D			50 or Y
COOLING						
Air cleaner to room/enclosure		X				W
Block heater operation		X				W
Coolant level	D	D				W
Flexible hoses and connectors	X	X				W
Water pump(s)	D					W
Fan and alternator belts	D	D	R			M
Coolant condition and level					D	S
Air ducts, louvers		X		X		Y
Coolant			D			Y
Louver motors and controls	X			X	X	Y
Radiator exterior				X		Y
Water supply to heat exchanger		X				Y
EXHAUST LINE						
Drain condensate trap		X				W
Leakage	X	X				W
Insulation, fire hazards	X					Q
Flexible connector(s)	X					W
Excessive back pressure					X	Y
Hangers and supports	X					Y
DC ELECTRICAL SYSTEM						
Battery charger operation, charge rate	X					M
Battery electrolyte level		X				M
Battery specific gravity, charge state					X	M
Recharge after engine start		X				M
Remove corrosion, clean and dry battery and rack	X			X		S
Clean and tighten battery terminals	X	X				Q
Tighten DC electrical connections		X				S

* Service more frequently if operated in dusty areas

Service Schedule (continued)

System– Component	Procedure					Frequency
D Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual. If not indicated, follow this service schedule. Some items may not pertain to specific generator sets. X Action R Replace as necessary	**Visually Inspect**	**Check**	**Change**	**Clean**	**Test**	W=Weekly M=Monthly Q=Quarterly S=Six Months Y=Yearly No.=Hours
AC ELECTRICAL SYSTEM						
Controller lamp test	X				R	W
General Inspection	X					W
Circuit breakers, fuses**	X	X	R	X	X	M
Wire abrasions where subject to motion	X	X				Q
Safety and alarm operation		X			X	S
Tighten control and power wiring connections		X				Y
Wire-cable insulation breakdown	X				X	3 Y or 500
ENGINE AND MOUNTING						
General inspection	D					W
Governor operation, lubricate moving parts	D	D				M
Air cleaner service		D	D			S
Injector pump and injector flow rate, pressure, spray pattern		D			D	Y
Valve clearance		D				3 Y or 500
Bolt torque		D			D	3 Y or 500
REMOTE CONTROL SYSTEM, ETC.						
Compartment condition	X			X		W
Remote control					X	M
Run generator set					X	M
GENERATOR						
General inspection	X					W
Rotor and stator	X			X		Y
Bearing condition	X	X	R			Y
Exciter	X	X		X		Y
Voltage regulator	X	X		X		Y
Measure and record resistance readings of windings with insulation tester (Megger, with SCR assembly or rectifier disconnected)					X	Y
Blow dust out of generator*	X			D		2 Y or 300
GENERAL CONDITION OF EQUIPMENT Any condition of vibration, leakage, noise, temperature, or deterioration	X	X		X		W
Ensure that system is set for automatic operation	X					W
Interior of equipment room or outdoor weather housing	X			X		W

* Service more frequently if operated in dusty areas

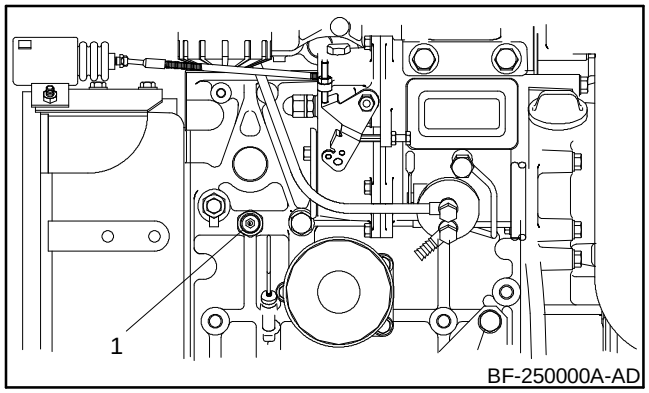
** Do not break manufacturer's seals or internally inspect these devices

3.2 Lubrication System

The engine has a forced lubrication system and a low oil pressure shutdown.

Low Oil Pressure (LOP) Shutdown

The LOP shutdown feature protects the engine against internal damage if the oil pressure drops below 7.1 psi (49 kPa) because of oil pump fault or other engine malfunction. The LOP shutdown does not protect the generator set from damage caused by operating with the oil level below the safe range– **the LOP shutdown is not a low oil level shutdown.** Check the oil level regularly and add oil as needed to protect against running out of oil. See Figure 3-1 for location of the LOP shutdown switch.



1. Low oil pressure shutdown switch

Figure 3-1. Engine– Service Side

3.3 Fuel System

Bleeding the Fuel System

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

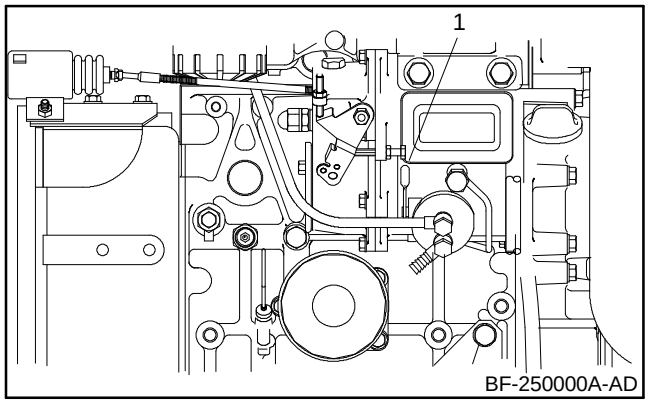
Use extreme care when handling, storing, and using fuels.

Fuel system. Explosive fuel vapors can cause severe injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling and storing 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 because spilled fuel may ignite on contact with hot parts or from spark. Do not smoke or permit flame or spark to occur near sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid breakage caused by vibration. Do not operate generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair systems before resuming generator set operation.

If the generator set engine runs out of fuel and develops air leaks in the suction side of the fuel system, or the fuel filter is replaced, bleed the entire fuel system to prevent starting failures and/or erratic operation. Perform the following procedure to bleed air from the fuel system. See Figure 3-3 for bleed points.

1. Loosen fuel line at fuel filter.
2. Use injection pump priming lever (6 kW models) or crank engine (10 and 15 kW models) until fuel free of bubbles, flows from the loose connection.
3. Retighten fuel line connection at fuel filter.

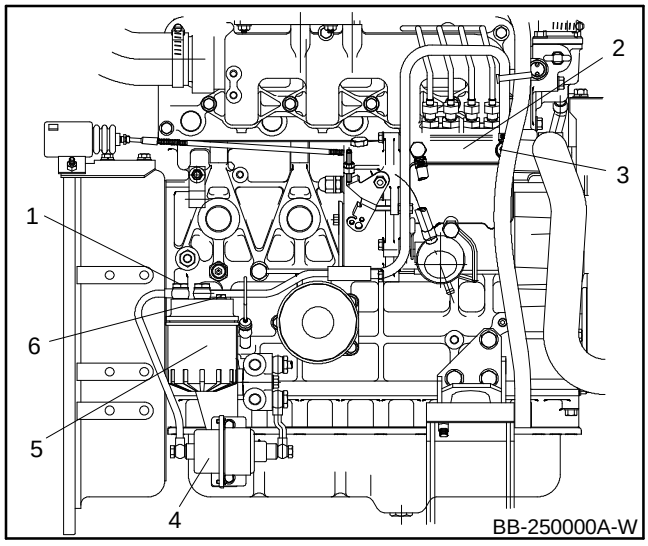
4. Loosen small Phillips head vent screw on fuel filter.
5. Use priming lever (6 kW models) or crank engine (10 and 15 kW models) until fuel, free of air bubbles flows from the vent screw.



1. Injection pump priming lever

Figure 3-2. 6 kW Engine– Service Side

6. Retighten vent screw on fuel filter.
7. Loosen line connection (bleed point) at fuel injection pump inlet.
8. Crank engine to operate fuel pump until fuel, free of air bubbles, flows from the loosened connection.
9. Retighten line connection at fuel injection pump inlet.



1. Line connection bleed point
2. Fuel injection pump
3. Line connection bleed point
4. Electric fuel pump
5. Fuel filter
6. Vent screw

Figure 3-3. Fuel System Bleed Points (typical)

3.4 Governor

The centrifugal, mechanical type governor keeps engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in load. The governor requires no regular service. The factory adjusts the governor at run-in. The governor requires no further adjustment unless reconnecting the generator to a different voltage, or poor governor control develops after extended use.

3.5 Cooling System

⚠ WARNING

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

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

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

NOTE

Pay special attention to the coolant level. After draining the coolant, allow time for complete refill of the engine water jacket. Check coolant level as prescribed in the Prestart Checklist of the Operation Manual.

NOTE

Do not turn on block heater before filling cooling system. Run engine until warm and refill radiator to purge air from the system before energizing block heater. If heater element is not immersed in water, block heater will fail.

Use only a permanent type coolant that meets specifications. Use a coolant solution of 50% ethylene glycol and 50% clean, softened water to inhibit corrosion and prevent freezing. Do not use alcohol or methanol antifreeze or mix them with the coolant.

The coolant system is equipped with an air bleed feature.

3.5.1 Coolant Drain Procedure

Use the following procedure to drain the engine coolant.

1. Place the generator set master switch in the OFF position.
2. Disconnect the generator set engine starting battery, negative (–) lead first. Disconnect power to battery charger, if equipped.
3. With the engine and radiator cool open the petcock on the bottom of the radiator and drain the coolant into a suitable container.
4. Remove the drain plug from the engine.
5. Remove radiator cap.

3.5.2 Coolant Fill Procedure

Use the following procedure to fill the engine coolant.

1. Replace drain plug in engine block.
2. Close petcock on the bottom of the radiator.
3. Fill radiator with recommended coolant mixture.
4. Replace radiator cap.
5. Check that the generator master switch is in the OFF position.
6. Reconnect the generator set engine starting battery, negative (–) lead last. Reconnect power to battery charger, if equipped.
7. Start and operate generator set until engine thermostat opens and the radiator upper hose becomes warm.
8. Stop generator set.
9. With the engine and radiator cool remove the radiator cap and add coolant to radiator until coolant level in radiator is just below the overflow tube on the radiator filler neck.
10. Reinstall radiator cap.

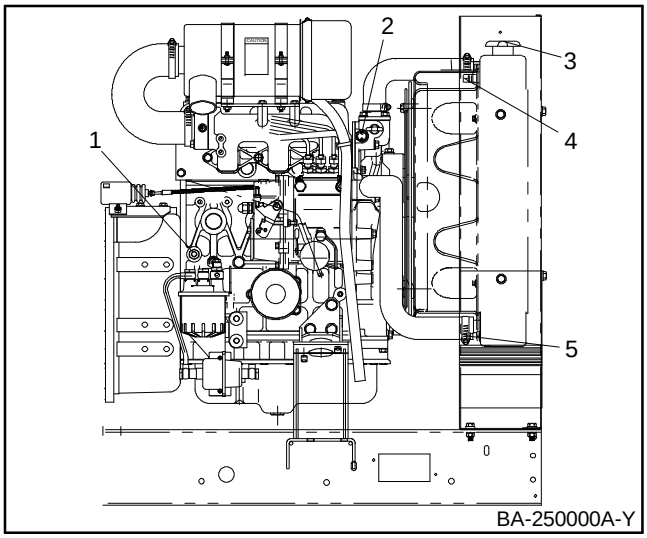
3.5.3 Coolant System Service

To prevent generator set shutdown and/or damage from overheating, service the cooling system at the intervals specified in the maintenance schedule.

1. Inspect the exterior of the radiator for obstructions. Remove all dirt and foreign material with a soft brush or cloth to avoid damaging the radiator fins. If available, clean radiator with compressed air or a stream of water in the direction opposite normal air flow.
2. Check all hoses and connections for leaks and replace any frayed, cracked, or spongy hoses.
3. Check condition of the radiator cap rubber seal. Replace cracked or deteriorating seal.
4. Remove dirt and other debris from the radiator cap and filler neck.

3.5.4 Low Coolant Level (LCL) Shutdown

The generator set automatically shuts down when the engine coolant level falls below the safe range in the radiator. Add coolant to the radiator and reset the generator set controller to restart generator set. See Figure 3-4 for location of the shutdown switch.



1. Engine block drain plug
2. High engine temperature shutdown switch
3. Cooling system fill
4. Low coolant level sensor
5. Cooling system drain

Figure 3-4. Cooling System

3.5.5 High Engine Temperature (HET) Shutdown

The engine automatically shuts down after the engine temperature reaches 230 _F (110 _C). See Section 2 to determine each controller shutdown time delay. Correct the cause of the shutdown before attempting to restart the generator set. See Figure 3-4 for location of the shutdown switch.

3.6 Battery

Use a 12-volt battery with a rating of at least 500 cold cranking amps (CCA). When using a maintenance free battery, it is not necessary to check the specific gravity or electrolyte level. Perform these procedures at the intervals specified in the Service Schedule. A negative ground system is used. See the Wiring Diagrams manual for battery connections. Make sure battery is correctly connected and terminals are tight.

3.6.1 Battery Charging Systems

The generator set is equipped with a belt-driven battery charging alternator to keep the engine starting battery fully charged. The alternator requires no maintenance other than maintaining belt tension. To adjust alternator belt tension, see the Engine Operation Manual.

Generator sets used as a standby to utility power where the generator set is not used regularly require an external battery charger to keep the starting battery fully charged. Observe battery polarity when connecting battery to the generator set.

NOTE

The generator set will not start and possible circuit board damage may result if the battery connections are made in reverse.

⚠ WARNING

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

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

⚠ WARNING

Explosion.
Can cause severe injury or death.
Relays in battery charger cause arcs or sparks.

Locate battery in a well-ventilated area. Isolate battery charger from explosive fumes.

Battery acid. 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 near the battery. If battery acid is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery gases. 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 charging. Avoid touching terminals with tools, etc., to prevent burns and 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. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is charging. Always turn battery charger off before disconnecting battery connections. Remove negative (–) lead first when disconnecting battery. Reconnect negative (–) lead last when reconnecting battery.

3.6.2 Cleaning

Keep battery clean by wiping it with a damp cloth. Keep all electrical connections dry and tight. If corrosion is present, disconnect cables from battery and remove corrosion with a wire brush. Clean battery and cables with a solution of baking soda and water. Be careful that cleaning solution does not enter battery cells. When cleaning is complete, flush battery and cables with clean water and wipe with a dry cloth. Coat terminals with petroleum jelly or other nonconductive grease after the battery cables are reconnected.

3.6.3 Checking Electrolyte Level

It is not possible to check the electrolyte level of a maintenance free battery. Check the electrolyte level before each start-up. Remove filler caps and verify that electrolyte level is up to bottoms of filler holes. Refill as necessary with distilled water or clean tap water. DO NOT add fresh electrolyte! Tighten all filler caps.

3.6.4 Checking Specific Gravity

It is not possible to check the specific gravity of a maintenance free battery. Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. While holding the hydrometer vertical, read the number on the glass bulb at the top of the electrolyte level. Use the correction table in Figure 3-5 if the hydrometer used does not have a correction table. Determine specific gravity and electrolyte temperature of battery cells. Locate temperature in Figure 3-5 and adjust specific gravity by amount shown. The battery is fully charged if the specific gravity is 1.260 at an electrolyte temperature of 80°F (26.7°C). The difference between specific gravities of each cell should not exceed ±0.01. The battery should be charged if the specific gravity is below 1.215 at an electrolyte temperature of 80°F (26.7°C).

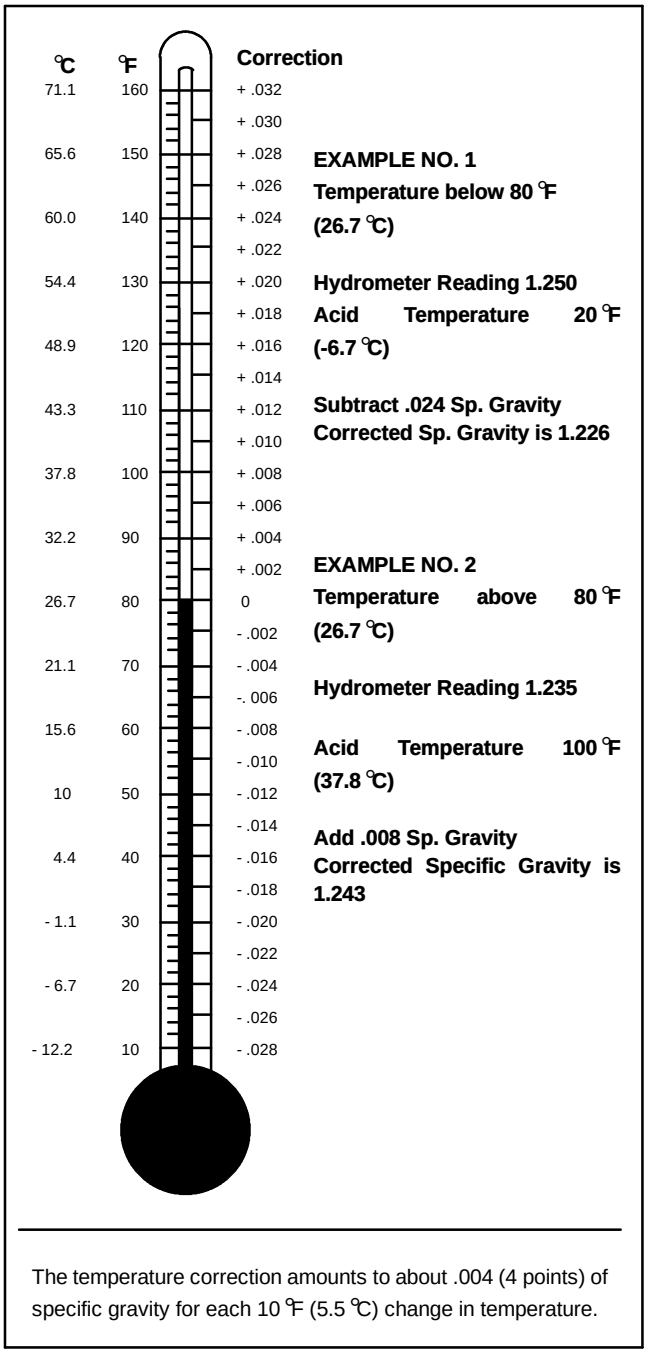


Figure 3-5. Specific Gravity Temperature Correction

3.7 Storage Procedure

Perform the following steps if the generator set is out of service for three months or longer.

1. Operate generator set until it reaches operating temperature or about 15 minutes.
2. Stop the generator set.
3. While the engine is still warm, drain the engine lubrication oil from the crankcase.
4. Refill the engine crankcase with an oil having a viscosity appropriate for the particular climate.
5. Run the generator set for a few minutes to distribute the clean oil.
6. Stop the generator set.
7. Check engine coolant protection and level.

NOTE

Ensure antifreeze is capable of withstanding the lowest possible temperature.

8. Clean exterior surface of generator set and spread a light film of oil or silicon spray over any exposed surfaces which may be subject to rust or corrosion.
9. Seal air inlet, exhaust pipe, and fuel tank cap with tape.
10. Disconnect and remove engine starting battery. Place battery in a warm, dry location for storage period. Recharge battery once a month to maintain full charge.
11. Select a well-ventilated (not humid or dusty) location to store generator set.
12. Cover entire generator set with a dust cover.

General Troubleshooting Chart (Sheet 1 of 4)

When troubles occur, do not overlook simple causes which might seem too obvious to be considered. A starting problem, for example, could be attributed to an empty fuel tank. As a general aid to diagnosing common problems, refer to the Troubleshooting Table below. If the trouble cannot be corrected through routine servicing, contact an authorized service distributor/dealer for assistance.

Problem	Possible Cause	Corrective Action
Generator set does not crank	Weak or dead battery	Recharge or replace; check battery charger operation. Check battery charging circuit (circuit breaker, module, and wiring), if equipped.
	Reversed or poor battery connections	Check connections
	Fuse blown in controller	Replace fuse
	Defective starter/starter solenoid	Test function
	Defective start/stop switch (master switch)	Test function
	Generator master switch in OFF position (attempting start-up from remote switch)	Move master switch to AUTO position
	Fault shutdown	Correct cause of fault shutdown and reset controller. See Section 2– Fault Shutdowns and Resetting Procedure– Fault Shutdowns
Generator set cranks but does not start, starts hard, lacks power, or operates erratically	Incorrect fuel	Replace fuel
	No fuel	Add fuel; check fuel control circuit
	Air cleaner clogged	Clean and/or replace
	Weak or dead battery	Recharge or replace
	Faulty ground (–) connection	Clean and tighten ground connections
	Defective ignition system	Check ignition coil, module, and wiring
	Engine malfunction	Troubleshoot engine
	Defective cold weather starting aid	Check cold weather starting device
	Low oil pressure shutdown switch	Check oil level, oil pressure, and check switch for function
	Carbon buildup on cylinder heads	Service cylinder heads
	Blown controller fuse	Replace fuse
	Defective fuel solenoid	Contact authorized service dealer
	Defective fuel pump	Contact authorized service dealer
	Air in fuel system	Bleed air from fuel system
	Bad fuel mixture	Replace fuel
	Water, dirt in fuel system	Drain, flush fuel system
	Poor engine compression	Contact authorized service dealer
	Oil viscosity too heavy	Use correct viscosity oil
	Incorrect cooling	Check coolant level, fan belt tension, and radiator
	Clogged fuel filter	Replace fuel filter
Engine knocks	Faulty fuel injector(s)	Contact authorized service dealer
	Fuel problems	Use correct fuel; consult fuel supplier
	Incorrect fuel injection timing	Contact authorized service dealer
	Incorrect cylinder top clearance	Contact authorized service dealer
	Defective piston or piston ring	Contact authorized service dealer
	Defective crankshaft bearing or piston pin bearing	Contact authorized service dealer
	Incorrect valve clearance	Contact authorized service dealer
	Air in fuel injectors	Bleed air from fuel system

General Troubleshooting Chart (Sheet 2 of 4)

Problem	Possible Cause	Corrective Action
Starter does not work correctly	Loose or corroded connections	Clean and tighten connections
	Battery not fully charged	Check condition of battery, recharge/replace as required
	Defective starter solenoid	Replace solenoid
	Defective starter switch	Replace switch
	Engine lube oil viscosity too heavy	Use correct viscosity oil
Engine runs irregularly or stalls frequently	Vent in fuel tank obstructed	Remove obstruction
	Clogged fuel filter	Replace fuel filter element
	Water, dirt, or air in fuel system	Drain, flush, bleed fuel system
	Dirty or faulty fuel injectors	Contact authorized service dealer
	Faulty governor linkage or governor incorrectly adjusted	See Section 3– Governor
	Defective fuel feed pump	Replace fuel pump
	Incorrect valve clearance	Contact authorized service dealer
	Defective valve spring(s)	Contact authorized service dealer
	Poor engine compression	Contact authorized service dealer
Generator set stops suddenly	Low coolant level shutdown	Add coolant
	Low oil pressure shutdown	Check oil level, oil pressure, and switch for function
	Out of fuel	Add fuel
	Overcrank shutdown	Reset controller. If overcrank fault reoccurs, troubleshoot generator and/or controller
	Fuse blown in controller	Replace fuse. If fuse blows again, troubleshoot controller
	Engine malfunction	Troubleshoot engine
	Overspeed shutdown	Reset controller. If generator set overspeeds again, troubleshoot generator and controller
	Overvoltage shutdown, if equipped	Troubleshoot generator and controller
	Generator master switch in OFF/RESET position	Move switch to correct position (RUN or AUTO)
	Emergency stop switch activated (local or remote)*	Check reason for emergency shutdown; reset switch
* 5-light microprocessor controller only.		

General Troubleshooting Chart (Sheet 3 of 4)

Problem	Possible Cause	Corrective Action
Engine lacks power	Air cleaner clogged	Replace air cleaner element
	Generator overload	Reduce load
	Bad or stale fuel	Replace fuel
	Engine not running at rated RPM	Contact authorized service dealer
	Governor defective or misadjusted	Contact authorized service dealer
	Incorrect cooling	Check engine coolant level, fan belt tension, radiator obstructions
	Fuel line restriction	Inspect fuel lines
	Dirty fuel filter	Replace fuel filter
	Incorrect fuel valve clearance	Contact authorized service dealer
	Dirty or faulty fuel injectors	Contact authorized service dealer
	Incorrect fuel injection timing	Contact authorized service dealer
	Poor engine compression	Contact authorized service dealer
	Fuel tank vent obstructed	Remove obstruction
Engine Overheats	Incorrect cooling	Check engine coolant level, fan belt tension, radiator obstructions
	Clogged air cleaner	Replace air cleaner element
	Generator set overloaded	Reduce load
	Low coolant level	Add coolant
Engine emits black or gray exhaust smoke	Incorrect type of fuel	Replace with correct fuel
	Clogged or dirty air cleaner	Replace air cleaner element
	Defective fuel injection pump	Contact authorized service dealer
	Faulty fuel injectors	Contact authorized service dealer
	Incorrect fuel injection timing	Contact authorized service dealer
	Incorrect valve clearance	Contact authorized service dealer
	Lube oil level too high	Remove excess lube oil
	Incorrect grade engine lube oil	Use correct viscosity oil
Low lube oil pressure	Low lube oil level	Add engine lube oil
	Incorrect lube oil viscosity	Replace with lube oil of correct viscosity
	Defective lube oil pump	Contact authorized service dealer
	Worn engine components	Contact authorized service dealer
High lube oil consumption	Incorrect viscosity oil	Use correct viscosity oil
	Oil leakage from engine	Check and fix leakage in lines, around gaskets, drain plug, etc.
	Clogged breather system	Clean breather system
	Defective piston ring, cylinder liner, valve guide, valve seat, etc.	Contact authorized service dealer
High fuel consumption	Incorrect type of fuel	Replace with correct fuel
	Clogged or dirty air cleaner element	Replace air cleaner element
	Engine overloaded	Reduce load
	Incorrect valve clearance	Contact authorized service dealer
	Incorrect fuel injection timing	Contact authorized service dealer
	Poor engine compression	Contact authorized service dealer
	Fuel leakage	Check for leakage at fuel tank, fuel lines, connections, etc.

General Troubleshooting Chart (Sheet 4 of 4)

Problem	Possible Cause	Corrective Action
No battery charging output	Defective battery charging alternator	Contact authorized service dealer
	Alternator belt loose	Retighten alternator belt
No AC output	AC circuit breaker in OFF position	Place circuit breaker in ON position
	AC circuit breaker tripping because of overload	Reduce load on generator set
	AC circuit breaker tripping because of short circuit	Correct cause of short circuit
	Voltage regulator fuse blown	Replace fuse
	Internal generator problem	Contact authorized service dealer
Low output or excessive drop in voltage	Generator set overloaded	Reduce load
	Engine speed too low	Check governor
	Faulty/misadjusted voltage regulator	Check voltage regulator adjustment and/or test voltage regulator
	Internal generator problem	Contact distributor
High output voltage (or high frequency)	Loose voltage regulator connections	Check connections
	Governor misadjusted (high frequency)	Check governor
	Faulty voltage regulator	Check voltage regulator adjustment and/or test voltage regulator
	Internal generator problem	Contact distributor

Appendix A. 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.

AC	alternating current
AISI	American Iron and Steel Institute
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
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
aux.	auxiliary
AWG	American Wire Gauge
AWM	appliance wiring material
BBDC	before bottom dead center
BDC	before dead center
BHP	brake horsepower
bmep	brake mean effective pressure
Btu	British thermal unit
℃	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
CSA	Canadian Standards Association
CT	current transformer
cu. in.	cubic inch, cubic inches
cyl.	cylinder
dB	decibel
dBA	decibels (A weighted)
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
e.g.	example given
EIA	Electronic Industries Association
EMI	electromagnetic interference
EPA	Environmental Protection Agency
etc.	et cetera (and so forth)
ext.	external
℉	Fahrenheit degree
fl. oz.	fluid ounce, fluid ounces
FM	frequency modulation
ft.	foot, feet
ft. lbs.	foot pound, foot pounds
ga.	gauge–
gal./ gals.	gallon, gallons
gph	gallons per hour
gpm	gallons per minute
gr.	grade
grd.	ground
HCHT	high cylinder head temperature
HET	high exhaust (or engine) temperature
Hg	mercury (element)
H_2O	water
HP	horsepower
hr, hrs	hour
Hz	hertz (cycles per second)
ID	inside diameter
IEEE	Institute of Electrical and Electronic Engineers
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)
kJ	kilojoules (btu cal)
km	kilometer, kilometers
kPa	kiloPascal, kiloPascals
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(s)	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
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
megger	megohmmeter
MHz	megahertz
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
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available or not applicable
NBS	National Bureau of Standards
N.C.	normally closed
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
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
O/S	oversize
OSHA	Occupational Safety and Health Act
OV	overvoltage
oz.	ounce, ounces
PF	power factor
PMG	permanent magnet generator
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
PVC	polyvinyl chloride
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
r.h.m.	round-head machine (screw)
rms	root mean square
RPM	revolutions per inch
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
SCR	silicon-controlled rectifier
sec.	second, seconds
spec.	specs, specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
tech. pub.	technical publications
temp.	temperature
TIF	telephone influence factor
TP, TPs	technical publications
turbo	turbocharger
UHF	ultrahigh frequency
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter's Laboratories, Inc.
U/S	undersize
U.S.A.	United States of America
V	volt, volts
vac	volts alternating current
vdc	volts direct current
VHF	very high frequency
W	watt, watts

KOHLER®
POWER SYSTEMS

KOHLER CO. Kohler, Wisconsin 53044
Phone 920-565-3381, Web site www.kohlergenerators.com
Fax 920-459-1646 (U.S.A. Sales), Fax 920-459-1614 (International)
For the nearest sales and service outlet in U.S.A. and Canada
Phone 1-800-544-2444

Kohler**r** Power Systems
Asia Pacific Headquarters
7 Jurong Pier Road
Singapore 619159
Phone (65)264-6422, Fax (65)264-6455

TP-5934 1/98