# Operation

## Residential/Commercial Generator Sets

Models:

**14/20RES**

**14/20RESL**

Controller:

RDC Residential Digital Control
DC Digital Control
Version 2.08 or higher

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6734 1/11b

**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.

# Product Identification Information

Product identification numbers determine service parts. Record the product identification numbers in the spaces below immediately after unpacking the products so that the numbers are readily available for future reference. Record field-installed kit numbers after installing the kits.

### Generator Set Identification Numbers

Record the product identification numbers from the generator set nameplate(s).

Model Designation _____

Specification Number _____

Serial Number _____

| Accessory Number | Accessory Description |
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### Controller Identification

Record the controller description from the generator set operation manual, spec sheet, or sales invoice.

Controller Description _____

### Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer _____

Model Designation _____

Serial Number _____

# Table of Contents

# Table of Contents, continued

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

**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 safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

## Accidental Starting

**WARNING**

**Accidental starting.**
**Can cause severe injury or death.**

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

**Disabling the 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) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

## Battery

**WARNING**

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

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

**WARNING**

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

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

**Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death.** Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the 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 acid cleanup. Battery acid can cause severe injury or death.** Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

**Battery gases. Explosion can cause severe injury or death.** Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

**Battery short circuits. Explosion can cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

## Engine Backfire/Flash Fire

**⚠ WARNING**

**Fire.**
**Can cause severe injury or death.**

Do not smoke or permit flames or sparks near fuels or the fuel system.

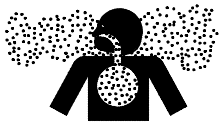
**Servicing the air cleaner. A sudden backfire can cause severe injury or death.** Do not operate the generator set with the air cleaner removed.

**Servicing the fuel system. A flash fire can cause severe injury or death.** Do not smoke or permit flames or sparks near the carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or carburetor.

**Combustible materials. A fire can cause severe injury or death.** Generator set engine fuels and fuel vapors are flammable and explosive. Handle these materials carefully 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 the local fire code or an 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.** Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building. Never operate the generator set where exhaust gas could seep inside or be drawn into a potentially occupied building through windows, air intake vents, or other openings.

**Carbon monoxide detectors. Carbon monoxide can cause severe nausea, fainting, or death.** Install carbon monoxide detectors on each level of any building adjacent to the generator set. Locate the detectors to adequately warn the building's occupants of the presence of carbon monoxide. Keep the detectors operational at all times. Periodically test and replace the carbon monoxide detectors according to the manufacturer's instructions.

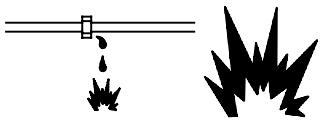
**Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death.** Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Carbon monoxide poisoning 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, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

## Fuel System

**⚠ WARNING**



**Explosive fuel vapors.**
**Can cause severe injury or death.**

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

**The fuel system. Explosive fuel vapors can cause severe injury or death.** Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels 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 sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.

**Gas fuel leaks. Explosive fuel vapors can cause severe injury or death.** Fuel leakage can cause an explosion. Check the LP vapor gas or natural gas fuel system for leakage by using a soap and water solution with the fuel system test pressurized to 6–8 ounces per square inch (10–14 inches water column). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

## Hazardous Noise

**⚠ CAUTION**

**Hazardous noise.**
**Can cause hearing loss.**

Never operate the generator set without a muffler or with a faulty exhaust system.

**Engine noise. Hazardous noise can cause hearing loss.** 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/ Moving Parts

**⚠ WARNING**

**Hazardous voltage. Moving parts.**
**Can cause severe injury or death.**

Operate the generator set only when all guards and electrical enclosures are in place.

**⚠ WARNING**

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

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

**⚠ CAUTION**

**Welding the generator set.**
**Can cause severe electrical equipment damage.**

Never weld components of the generator set without first disconnecting the battery, controller wiring harness, and engine electronic control module (ECM).

**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

**Welding on the generator set. Can cause severe electrical equipment damage.** Before welding on the generator set perform the following steps: (1) Remove the battery cables, negative (–) lead first. (2) Disconnect all engine electronic control module (ECM) connectors. (3) Disconnect all generator set controller and voltage regulator circuit board connectors. (4) Disconnect the engine battery-charging alternator connections. (5) Attach the weld ground connection close to the weld location.

**Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death.** Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the 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 all jewelry before servicing the equipment.

**Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death.** Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

## Heavy Equipment

**⚠ WARNING**

**Unbalanced weight.**
**Improper lifting can cause severe injury or death and equipment damage.**

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

## Hot Parts

**⚠ WARNING**

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

Do not work on the generator set until it cools.

**Servicing the exhaust system. Hot parts can cause severe injury or death.** Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

**Servicing the engine heater. Hot parts can cause minor personal injury or property damage.** Install the heater before connecting it to power. Operating the heater before installation can cause burns and component damage. Disconnect power to the heater and allow it to cool before servicing the heater or nearby parts.

## Notice

**NOTICE**

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

This manual provides operation and maintenance instructions for residential/commercial model 14/20RES and RESL generator sets equipped with Residential Digital Control (RDC) or Digital Control (DC) generator set/transfer switch controllers. The RDC and DC controllers control the generator set and the optional Model RRT transfer switch. See Figure 1.

This generator set is approved for use in stationary applications in locations served by a reliable utility power source. Have the generator set installed by an authorized distributor/dealer or service technician. Refer to TP-6733, Installation Manual, for installation instructions.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

Read 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 the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect the parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.


**Figure 1** RES/RESL Generator Set and Optional Model RRT Transfer Switch

## List of Related Literature

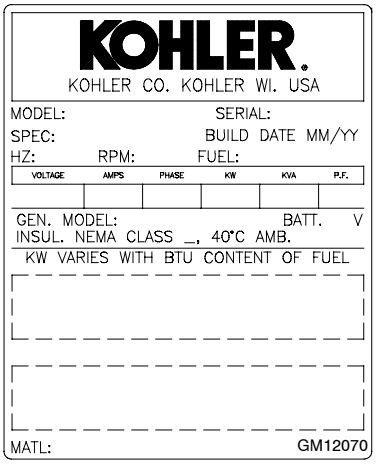
Figure 2 identifies related literature available for the generator sets covered in this manual. Only trained and qualified personnel should install or service the generator set.

| Literature Type | Part Number |
|---|---|
| 14/20RES/RESL Generator Set Installation Manual | TP-6733 |
| 14/20RES/RESL Generator Set Service Manual | TP-6735 |

**Figure 2** Related Literature

## Nameplate

The following illustration shows a typical generator set nameplate. Copy the model, serial, and specification numbers from the nameplate into the spaces provided in the product information section on the inside front cover of this manual. See Section 1.7 for the nameplate location.



## Emission Information

The Kohler® Model CH740 engine used on the 14RES/RESL generator set is certified to operate using natural gas or propane fuel.

The Kohler Model CH1000 engine used on the 20RES/RESL generator set is certified to operate using propane fuel. The CH1000 engine used on the 20RES/RESL may be operated on natural gas fuel because it is excluded from the requirements of 40 CFR 1048 as a stationary engine.

The engine used in the Model 20RES/RESL generator set is certified for emergency standby use only.

The Emission Compliance Period referred to on the Emission Control or Air Index label indicates the number of operating hours for which the engine has been shown to meet CARB or EPA emission requirements. Figure 3 provides the engine compliance period (in hours) associated with the category descriptor, which may be found on the certification label.

| Emission Compliance Period | | | |
|---|---|---|---|
| EPA | Category C<br>250 hours | Category B<br>500 hours | Category A<br>1000 hours |
| CARB | Moderate<br>125 hours | Intermediate<br>250 hours | Extended<br>500 hours |

**Figure 3** Emission Compliance Period

Refer to the certification label for engine displacement.

The exhaust emission control system for the CH740 engines (14RES/RESL) is EM for U.S. EPA, California, and Europe.

The exhaust emission control system for the CH1000 engine (20RES/RESL) is EM for U.S. EPA, California, and Europe.

# Service Assistance

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KohlerPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

**Headquarters Europe, Middle East, Africa (EMEA)**
Kohler Power Systems
3 rue de Brennus
93200 Saint Denis
France
Phone: (33) 1 49 178300
Fax: (33) 1 49 178301

**Asia Pacific**
Power Systems Asia Pacific Regional Office
Singapore, Republic of Singapore
Phone: (65) 6264-6422
Fax: (65) 6264-6455

**China**
North China Regional Office, Beijing
Phone: (86) 10 6518 7950
(86) 10 6518 7951
(86) 10 6518 7952
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai
Phone: (86) 21 6288 0500
Fax: (86) 21 6288 0550

**India, Bangladesh, Sri Lanka**
India Regional Office
Bangalore, India
Phone: (91) 80 3366208
(91) 80 3366231
Fax: (91) 80 3315972

**Japan, Korea**
North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

**Latin America**
Latin America Regional Office
Lakeland, Florida, USA
Phone: (863) 619-7568
Fax: (863) 701-7131

# Notes

## 1.1 Introduction

The generator set specification sheets provide specific generator and engine information. Refer to the spec sheet for data not supplied in this manual. Consult the generator set service manual, engine operation manual, and engine service manual for additional specifications. Obtain copies of the latest spec sheets, manuals, diagrams, and drawings from your local distributor/ dealer.

## 1.2 Engine

The generator set has a four-cycle, twin cylinder, air-cooled Kohler® engine. The engine operates on clean-burning natural gas or propane (LP) vapor. Engine features include:

- Efficient overhead valve design and full pressure lubrication for maximum power, torque, and reliability under all operating conditions.
- Dependable, maintenance-free electronic ignition.
- Precision-formulated cast iron construction of parts subjected to the most wear and tear.
- Field-convertible multi-fuel systems that allow fuel changeover from natural gas to LP vapor (and vice-versa) while maintaining CARB emission certification.
- Digital spark advance optimizes ignition timing for the selected fuel.

## 1.3 Alternator

The generator uses Kohler's unique PowerBoost™ voltage regulation system, which provides instant response to load changes.

PowerBoost™ ensures reliable motor starting and consistent voltage levels. PowerBoost™ utilizes a voltage excitation system that employs a winding independent of the main output windings to provide excitation voltage.

## 1.4 Transfer Switch

The RDC and DC controllers are designed to interface with and control the Kohler Model RRT Automatic Transfer Switch (ATS).

If the power system uses a transfer switch other than the Kohler® Model RRT ATS, the RDC controller functions as a generator set controller only. An ATS other than the Model RRT must provide engine start contacts that connect to the remote engine start leads on the generator set.

## 1.5 Controllers

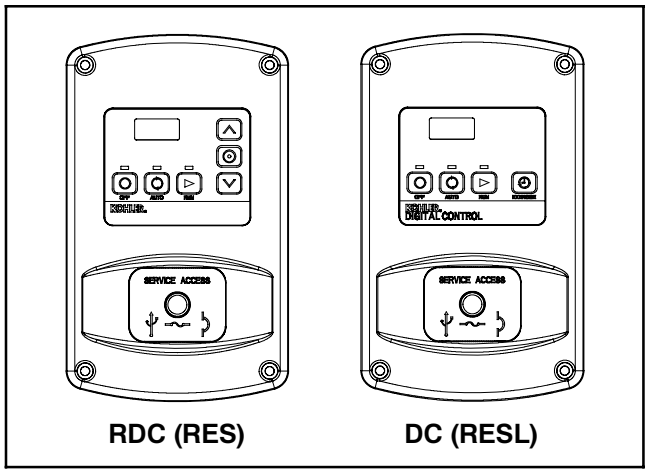



**Figure 1-1** Controllers

RES models are equipped with the Residential Digital Control (RDC). RESL models use the Digital Control (DC). See Figure 1-1.

## Controller Features

- Integrated control for the generator set and Kohler® Model RRT transfer switch
- Automatic start with programmed cranking cycle
- Digital isochronous governor to maintain steady-state speed at all loads
- Digital voltage regulation: ±1.5% RMS no-load to full-load
- Smart engine cooldown senses engine temperature
- Master switch pushbuttons (Off, Auto, Run, Exercise/down arrow)
- Off, Auto, and Run LED indicators
- LED display:
  - Crank cycle status
  - Setup information (RDC only)
  - Firmware version
  - Faults
  - Event history
- Scrolling system status display when generator set is running includes:
  - Engine runtime hours
  - Battery voltage
  - Generator voltage
  - Engine temperature
  - Utility voltage*
- Membrane keypad for configuration and adjustment (RDC only)
  - Password-protected access to system configuration and adjustment menus
  - System voltage/frequency selection and engine configuration
  - Voltage, gain, and engine speed adjustment
- Selectable exercise and test modes:
  - Weekly unloaded variable-speed exercise with complete system diagnostics
  - Weekly loaded full-speed exercise *
  - Unloaded full-speed test
  - Loaded full-speed test *
- Faults displayed:
  - ATS communication error
  - Auxiliary fault
  - High battery voltage
  - High engine temperature
  - Internal faults
  - Locked rotor
  - Loss of AC sensing
  - Low battery voltage
  - Low cranking battery voltage
  - Low oil pressure
  - Overcrank
  - Overfrequency
  - Overspeed
  - Overvoltage
  - Speed sensor fault
  - Underfrequency
  - Underspeed
  - Undervoltage
- Front-access mini USB connector for controller firmware upgrade †
- Front access fuses and mini-breaker
- Remote two-wire start/stop capability for optional connection of Model RDT or RSB transfer switches
- Load control output allows delayed start of large motor loads *
- Generator output voltage and frequency sensing with adjustable voltage pickup and dropout settings †
- Engine start and load transfer time delays* (adjustable using Kohler® SiteTech™ software †)
- Provides utility voltage sensing data and transfer signals with the Model RRT transfer switch *

* Model RRT transfer switch required

† Requires Kohler® SiteTech™ software, available only to Kohler authorized distributors and dealers

## 1.6 Accessories

The following optional accessories are offered for the RES and RESL generator sets.

### 1.6.1 Carburetor heater

An optional carburetor heater is recommended for improved cold starting in locations where the ambient temperature drops below 0°C (32°F). The carburetor heater prevents condensation and carburetor icing. The heater requires a continuous source of 120 VAC power.

See the generator set Installation manual for more information.

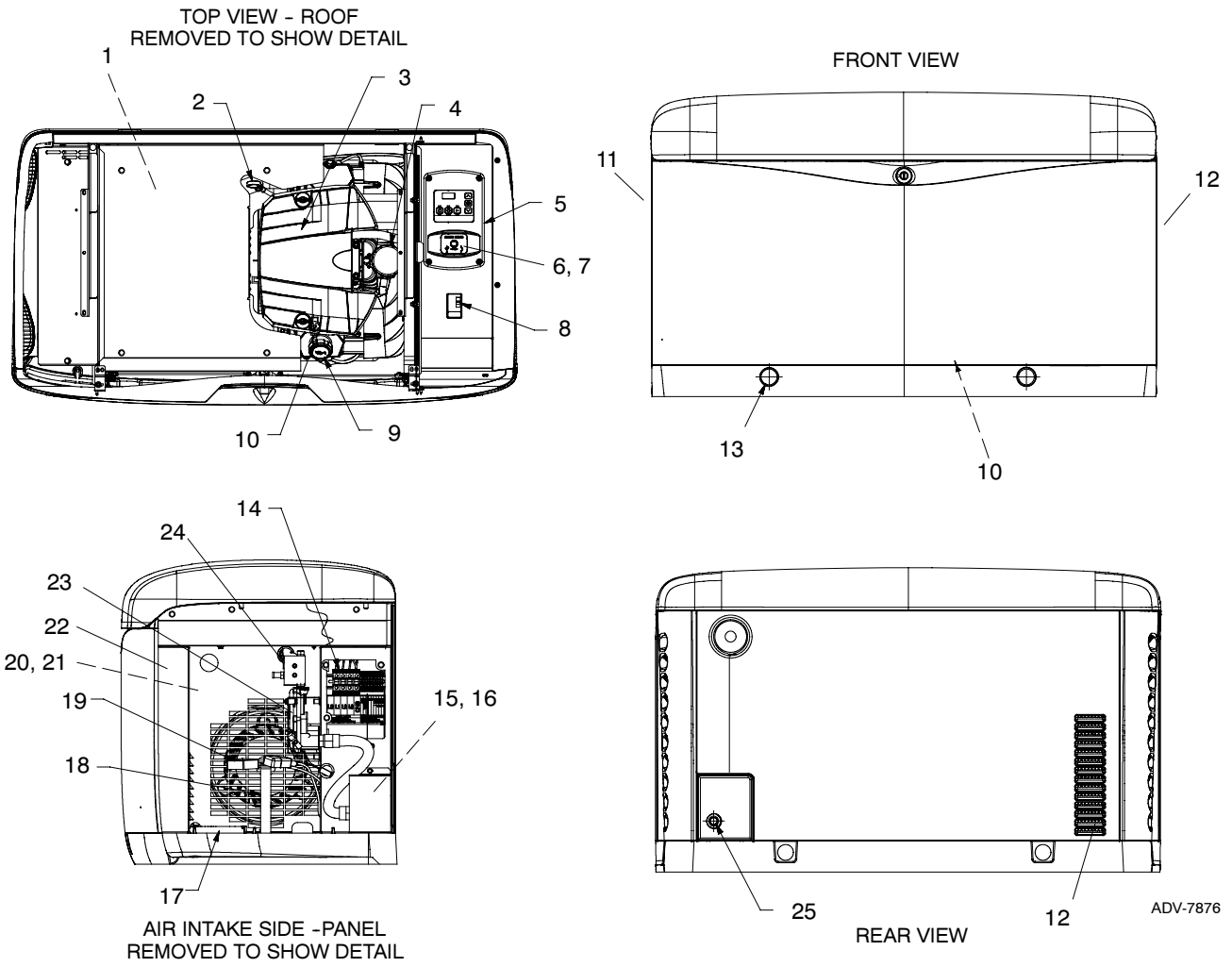
### 1.6.2 OnCue™ Home Generator Management System

The Kohler® OnCue™ Home Generator Management System allows monitoring and control of your RES or RESL generator set from a personal computer located in your home or at other remote locations. OnCue™ can also be configured to send email or text message notifications in the event of a generator set fault.

**Note:** Be sure to obtain the correct version of the OnCue™ kit for the RDC/DC controller.

OnCue™ version 3.0 with the Ethernet option board is required for RES/RESL generator sets equipped with the RDC/DC controller. Earlier versions of the OnCue™ kit are not compatible with the RDC/DC controller.

## 1.7 Service Views for Maintenance




1. Muffler (located below cover plate)
2. Oil check dipstick
3. Air cleaner
4. Oil filter
5. RDC or DC controller
6. Fuses
7. USB connector (for firmware updates)
8. Line circuit breaker
9. Oil fill
10. Oil drain valve
11. Exhaust outlet
12. Air intake
13. Lifting holes
14. Field-connection terminal block location
15. Digital spark advance ignition (DSAI) leads
16. Fuel solenoid valve
17. Oil drain hose
18. Engine starting battery location (battery purchased separately)
19. Battery cables
20. Battery charger location (charger not shown)
21. 120 VAC receptacles for battery charger and optional carburetor heater (not shown)
22. Nameplate location
23. Gas regulator assembly
24. Fuel block or LP orifice location (inside hose fitting)
25. Fuel inlet

**Figure 1-2** Generator Set Components

## 2.1 Prestart Checklist

To ensure continued satisfactory operation, perform the following checks or inspections before or at each startup, as designated, and at the intervals specified in the service schedule. In addition, some checks require verification after the unit starts.

**Air Cleaner.** Check for a clean and installed air cleaner element to prevent unfiltered air from entering the engine.

**Air Inlets.** Check for clean and unobstructed air inlets.

**Battery.** Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.

**Exhaust System.** Check for exhaust leaks and blockages. Check the muffler condition.

- Inspect the exhaust system components for cracks, leaks, and corrosion. Check for tight exhaust system connections.
- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is unobstructed.

**Oil Level.** Check the oil level before starting the generator set and at the intervals given in Section 3, Scheduled Maintenance. Maintain the oil level at or near, not over, the full mark on the dipstick.

**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 Set

Operate the generator set without load once each week for 20 minutes. Perform all of the prestart checks before starting the exercise procedure. See Section 2.8 for instructions to set the exerciser.

## 2.3 RDC and DC Generator Set/ Transfer Switch Controllers

Model RES generator sets are equipped with the Residential Digital Control (RDC). Model RESL generator sets are equipped with the Digital Control (DC).

The RDC and DC control the power system generator set and Model RRT automatic transfer switch (ATS) (if equipped). The controller receives voltage sensing data from the Model RRT ATS and operates the generator set and transfer switch to provide standby power when utility power is lost.

## 2.4 Controller Power

The RDC and DC controllers are powered by the generator set engine starting battery.

**Note:** The generator sets are equipped with factory-installed battery chargers to prevent battery discharge. The battery charger must be connected to utility power.

## 2.5 Controller Firmware Version

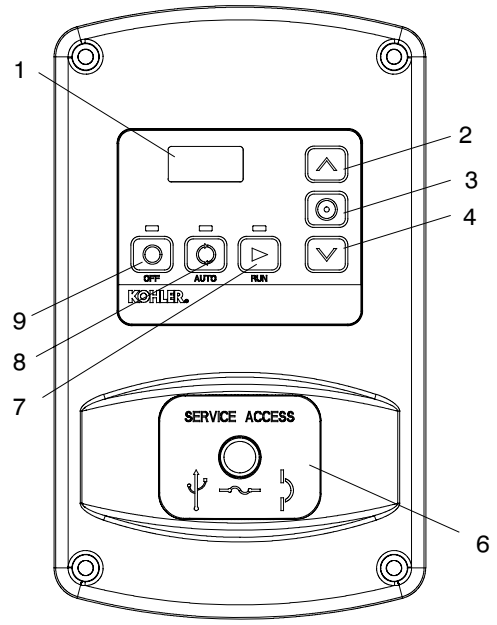
The information in this manual applies to RDC and DC controllers with firmware version number 2.08 or higher. To check the firmware version number:

**RDC controllers:** Press and hold the Select button and the up arrow button simultaneously for about 5 seconds, until the firmware version number appears on the controller display.

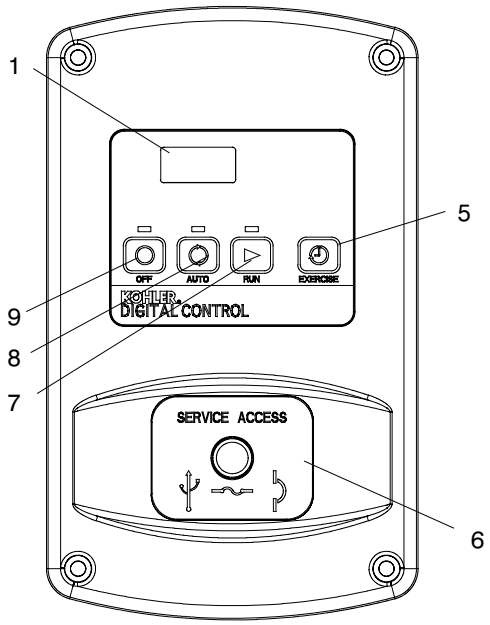
**DC controllers:** The firmware version number is displayed during the first 2 seconds of the engine crank cycle.

## 2.6 Controls and Indicators

Figure 2-1 illustrates the RDC and DC controller user interfaces.




**Residential Digital Controller (RDC)**




**Digital Controller (DC)**

1. LED display
2. Up button (RDC only)
3. Select button (RDC only)
4. Down/Exercise button (RDC)
5. Exercise button (DC)
6. Service access (see Section 4.2)
7. RUN button and LED
8. AUTO button and LED
9. OFF button and LED

**Figure 2-1** RDC and DC Controls and Indicators

### 2.6.1 Controller Keypad

The Run, Off, Auto, and Down arrow or Exercise buttons control the generator set as described in Figure 2-2. See Section 2.7 for operation instructions.

**RDC controller only:** The Select, Up, and Down buttons on the controller keypad are used to adjust the controller parameters. The system configuration and performance is factory-set and should not require changes under normal operating conditions. To prevent inadvertent changes, a pass code is required to access the controller parameter settings. Contact an authorized distributor/dealer or service technician if adjustments are required.

| Button | Button Function |
|---|---|
| RUN | Starts the generator set. The engine start time delay is ignored. |
| OFF | Shuts down the generator set. The cooldown time delay is ignored.<br>During the engine crank cycle, pressing OFF will stop the crank cycle.<br>Press and hold for 3 seconds to view event history. See Section 2.10.5. |
| AUTO | Places the generator set in Auto mode. See Figure 2-5. |
| DOWN arrow (RDC) or EXERCISE (DC) | Starts an unloaded exercise.<br>Press *during* test or exercise to change from unloaded to loaded (with RRT only). |
| Select | RDC only. Used to change parameter settings. Password-protected. Contact your distributor/dealer if necessary. |
| UP arrow | |

**Figure 2-2** Pushbutton Operation

## 2.6.2 LED Display

Figure 2-3 lists status messages that may be shown on the controller's LED display.

When the system is in AUTO and the generator set is not running, the LED display shows the engine run time hours. During cranking, the display shows CC1, CC2, or CC3.

When the generator is running, the display steps through the status messages shown in Figure 2-4, as applicable. The generator set must be connected to a Model RRT transfer switch for the utility voltage display.

When a fault or warning condition exists, the controller will show the corresponding message. See Section 2.10 for more information on fault and warning codes.

| Display | Description |
|---|---|
| Blank (dark) | Controller is off. |
| u#.# | Controller software version number |
| XXX.X | Engine hours to 999.9 |
| XXXX | Engine hours, 1000 to 9999 |
| bXX.X | Battery voltage |
| tXX.X | Engine temperature |
| UXXX * | Utility voltage |
| EXXX | Generator voltage |
| tnLd * | Test, no load |
| t Ld * | Test, loaded |
| EnLd | Exercise, no load |
| E Ld * | Exercise, loaded |
| CC1, 2, or 3 | Engine crank cycle 1, 2, or 3. Flashes during crank pause. |
| Fault code | Warning or fault. See Figure 2-8. |
| * Model RRT ATS is required for this display. | |

**Figure 2-3** RDC Controller Display

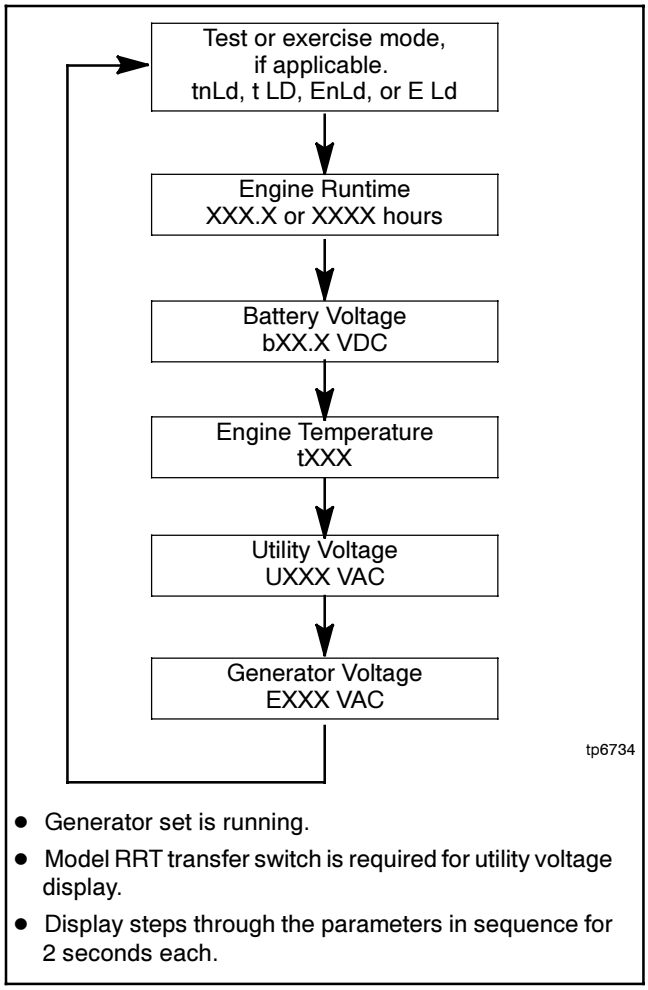



**Figure 2-4** Data Displays, Generator Running

## 2.6.3 LED Indicators

LEDs above the RUN, OFF, and AUTO buttons indicate the mode of operation as shown in Figure 2-5.

| Mode | LED Indication | Description |
|---|---|---|
| RUN | RUN LED is on | The generator set was started by pressing the RUN button. Generator set is running. Remote start and stop commands are ignored. |
| OFF | OFF LED lights for 2 seconds, then flashes every 2 seconds. | The OFF button was pressed. Generator set and controller are off. Remote start/stop commands have no effect. The exercise cycle will not run. |
| AUTO | AUTO LED is on | Automatic mode. Generator set will respond to engine start and stop commands from the controller (for example, exercise start and stop commands) or an ATS. Time delays operate as described in Section 2.7. |

**Figure 2-5** Operation Modes and LED Indicators

## 2.7 Generator Set Operation

### 2.7.1 Local Starting and Stopping

**Start**

Press the RUN button to immediately start the generator set. The engine start time delay will be ignored.

The controller attempts to start the generator set three times. See Section 2.7.2, Engine Start Crank Cycle.

**Stop**

1. Run the generator set with no load for at least 2 minutes to ensure adequate engine cooldown.
2. Press the OFF button. The engine stops.

Also see Section 2.9, Test.

### 2.7.2 Engine Start Crank Cycle

The controller attempts to start the generator set three times (three crank cycles, 15 seconds crank and 15 seconds off). See Figure 2-3 for display information during the crank cycle. If the generator set does not start in three attempts, the system shuts down on an overcrank fault. See Section 2.10.

Pressing the OFF button during the crank cycle stops the cranking. No other buttons are acknowledged during the crank cycle.

### 2.7.3 Engine Cooldown

The engine cooldown time delay allows the engine to run after the loads have been removed. COOL is displayed on the controller during engine cooldown.

The engine cooldown time delay is set to 5 minutes. The engine stops before the cooldown time delay expires if the temperature drops below the cooled-down temperature level, or if the temperature rises during the cooldown cycle.

If a transfer switch other than the Model RRT is used, an engine cooldown time delay may be programmed on the transfer switch. To allow the smart engine cooldown on the RDC/DC controller to operate most efficiently, set the cooldown time on the ATS controller to zero or the minimum time allowed. Refer to the instructions provided with the ATS for more information.

### 2.7.4 Automatic Operation with Model RRT Transfer Switch

The Model RRT transfer switch connects to the RDC/DC controller through the ATS interface board on the transfer switch. Also see Section 2.11, Model RRT Transfer Switch Operation.

The controller must be in AUTO mode. Press the AUTO button to put the controller into automatic mode.

**Automatic Start**

The RDC/DC controller receives utility source voltage sensing data from the Model RRT transfer switch.

1. If the utility source voltage falls below an acceptable level, the controller starts the engine start time delay.
2. If the utility source is not restored before the time delay expires, the generator set starts.
3. After the Normal-to-Emergency time delay, the ATS is signaled to transfer the load to the emergency source.

**Automatic Stop with Engine Cooldown**

1. When the utility source is restored, the Emergency-to-Normal time delay starts.
2. When the Emergency-to-Normal time delay expires, the load is transferred to the utility.
3. The generator set runs through the engine cooldown cycle and then stops.

### 2.7.5 Automatic Operation with Model RDT or RSB Transfer Switches

If a Kohler Model RDT or RSB transfer switch is used, the engine start contacts from the ATS must be connected to engine start leads 3 and 4 on the generator set.

The controller must be in AUTO mode to respond to remote start/stop signals from an ATS or remote switch. Press the AUTO button to put the controller into automatic mode.

**Automatic Start**

The engine start contacts on the ATS close to signal the generator set to start, and remain closed while the generator set is running.

**Automatic Stop**

Open the contact across engine start leads 3 and 4 to signal the generator set to stop.

## 2.8 Exercise

The RDC and DC controllers can be set to automatically run the generator set at the same time and day each week. Exercising the generator set weekly is required in order to keep the engine and alternator in good operating condition.

Follow the instructions in this section to start a 20-minute exercise run and set the exerciser to run at the same time every 7 days.

**Note:** RDC/DC controllers with firmware version 2.08 or higher support the unloaded variable-speed exercise with Kohler Model RRT, RDT, and RSB transfer switches.

**Note:** With the RDT and RSB transfer switches, it is possible to have two exercise settings (one unloaded exercise set at the generator set controller, and another exercise set at the ATS controller). If the exercise times overlap, the ATS exercise setting takes priority.

Set the exercise at the RDC/DC controller or the ATS controller as shown in Figure 2-6. If a Model RDT or RSB transfer switch is used, refer to the instructions provided with the transfer switch to set an exercise at the ATS, if desired.

| Transfer Switch Model | Exercise | | |
|---|---|---|---|
| | Unloaded Variable Speed | Unloaded Full Speed | Loaded Full Speed |
| RRT | RDC/DC | N/A | RDC/DC |
| RDT | RDC/DC | ATS | ATS |
| RSB | RDC/DC | ATS | ATS |

**Figure 2-6** Setting the Exerciser

### 2.8.1 Unloaded Variable-Speed Exercise with Complete System Diagnostics

An unloaded exercise runs the generator set without signalling the transfer switch to transfer the electrical load from the utility source to the generator set. The unloaded variable speed exercise runs at low speed for 15 minutes, then ramps up to full speed during the last 5 minutes.

The initial low-speed exercise allows generator set operation at lower noise levels and fuel consumption while properly warming up the engine for longer life and better lubrication of critical components.

The full-speed portion of the exercise cycle provides the best test of engine and alternator power backup capability. Diagnostic tests at full speed can identify potential problems with the power output and alert the operator before an emergency event.

**Procedure to Set Unloaded Variable-Speed Exercise**

1. Verify that the control is in the AUTO mode with the AUTO LED ON and the Utility power available.
2. Press the down arrow button (RDC) or exercise button (DC) to initiate the engine start signal.
3. The generator begins its crank cycles. During the crank cycles **CCn** appears on the display. No button presses are acknowledged during the crank cycles.
4. The generator runs at low speed for 15 minutes. **EnLd** appears on the display. The AUTO LED is illuminated. The controller monitors the system during the unloaded exercise as described in the Section 2.8.2, System Diagnostics.
5. During the last 5 minutes, the engine ramps up to full speed and then shuts down. Generator output frequency and voltage diagnostics are active as described in the Section 2.8.2, System Diagnostics.

The exercise time is set to the time the down arrow or exercise button is pressed. An unloaded variable-speed exercise will occur at the same time every seven days.

### 2.8.2 System Diagnostics

During the unloaded variable-speed exercise, the controller monitors the following data. The controller display indicates an unloaded exercise run (EnLd) during the diagnostics, unless a fault is detected as described below.

- **ATS connection.** The controller verifies that the Model RRT ATS interface board, if connected, remains connected. An ATS fault is displayed if the connection is lost.
- **Battery voltage.** Battery voltage is checked before exercise to verify engine starting capability. Battery voltage provides a measurement of battery health. If the controller detects low battery voltage, Lb (low battery) or LCb (low charging battery) is displayed and the exercise does not start.

- **Engine speed.** Engine speed is measured at low speed and full speed. An overspeed (OS) or underspeed (US) condition will result in a fault condition and shutdown.

- **Generator output frequency and voltage.** Operating the generator at full speed allows the RDC/DC controller to check the output power for correct voltage, frequency, and stability. When the engine is running at full speed, the controller verifies that the voltage and frequency are within acceptable limits. UU (undervoltage), OU (overvoltage), UF (underfrequency), or OF (overfrequency) is displayed if the voltage or frequency is out of range.

- **Oil pressure.** Oil pressure is verified to ensure proper lubrication of critical engine components. Pressure is monitored at both low and full speeds. If the oil pressure is low, LOP (low oil pressure) is displayed and the generator set shuts down.

### 2.8.3 Loaded Exercise (with RRT only)

A loaded exercise starts the generator set, ramps up to full speed, and then transfers the electrical load from the utility source to the generator set. The load is transferred back to the utility source before the generator set shuts down.

**Procedure to Set a Loaded Exercise**

1. Verify that the control is in the AUTO mode with the AUTO LED ON and the Utility power available.

2. Press the down arrow button (RDC) or the exercise button (DC) to initiate the engine start signal.

3. The generator begins its crank cycles. During the crank cycles **CCn** appears on the display. No button presses are acknowledged during the crank cycles.

4. When the generator is running, **EnLd** appears on the display and the AUTO LED is illuminated. The generator runs at low speed with no load.

5. Press the down arrow button (RDC) or exercise button (DC) a second time. The generator ramps up to normal operating speed (typically 3600 RPM) and the ATS transfers the load.

6. **E Ld** appears on the display and the AUTO LED is illuminated. The generator runs at normal operating speed for twenty minutes with load.

7. After 20 minutes, the ATS transfers the load back to utility power. The engine runs for 5 minutes or until cool, and then shuts down.

The exercise time is set to the time the down arrow button (RDC) or exercise button (DC) was initially pressed. A loaded, full-speed exercise will occur at the same time every seven days.

**Other transfer switches:** For a loaded exercise with a transfer switch other than a Kohler® Model RRT, refer to the transfer switch operation manual.

### 2.8.4 Power Failure During Exercise Cycle

If the utility power is lost during an unloaded exercise, the ATS transfers to the emergency source, the exercise is ended and the control remains in the AUTO mode.

If the utility power is lost during a loaded exercise, the exercise is ended. The ATS remains in the emergency position and the control goes into the AUTO mode.

The generator set continues to run and supply power to the load for the duration of the utility power outage. When Utility power is restored, the ATS will re-transfer to the utility source through normal timing sequences.

### 2.8.5 Exerciser Reset

To reset the exerciser to run at a different day and/or time, or to switch between a loaded and unloaded exercise, follow the procedures above to start an unloaded or loaded exercise on the desired time and day. The previous exercise setting is replaced by the new time, day, and loaded or unloaded condition.

### 2.8.6 Exercise Disable

**Note:** With the RDT and RSB transfer switches, it is possible to have two exercise settings (one set at the generator set controller, and one set at the ATS controller). If the exercise times overlap, the ATS exercise setting takes priority.

If a transfer switch other than the Model RRT is used and the exerciser is set at the transfer switch controller, you can disable the exercise on the RDC/DC controller.

To disable the exerciser on the RDC/DC controller, press and hold the OFF and DOWN arrow or EXERCISE buttons together for 3 seconds.

## 2.9 Test

An operator can use the buttons on the RDC/DC controller to test the generator set operation. Follow the instructions below to manually start and stop an unloaded or loaded full-speed test.

### 2.9.1 Unloaded Test

An unloaded test runs the generator set at full speed without signalling the transfer switch to transfer the electrical load from the utility source to the generator set.

**Procedure to Run an Unloaded Full-Speed Test**

1. Press the RUN button to start an unloaded test. The engine cranks and starts.
2. When the generator is running, **tnLd** appears on the display and the RUN LED is illuminated. The engine runs at normal operating speed (3600 RPM) during the test sequence.
3. There are two ways to end an unloaded test. Perform a or b:
   a. Press the AUTO button to enter AUTO mode. If utility is available, the generator set shuts down through normal timing sequences.
   b. Press the OFF button to shut down the generator set. The cooldown time delay is ignored.

Also see Section 2.7.1, Local Starting and Stopping.

Figure 2-7 describes the effect of pressing the buttons during a test, with the engine running and no active faults.

| Button Press | Response |
|---|---|
| RUN | Press RUN to start the test. Pressing again when the engine is running has no effect . |
| AUTO | Puts the generator set into AUTO mode. Shuts down the engine through normal timing sequences if utility is available. AUTO LED turns ON. RUN LED turns OFF. |
| OFF | Ends the test and shuts down the generator set. The cooldown time delay is ignored. The RUN LED turns OFF. The OFF LED turns ON and then flashes every 2 seconds. |
| DOWN arrow/ EXERCISE | Press during the test to signal the Model RRT ATS to transfer to the emergency source. The display indicates a Loaded Test, **t Ld.** |

**Figure 2-7** Button Functions During Test

### 2.9.2 Loaded Test (with RRT only)

A loaded test starts the generator set and then signals the Model RRT transfer switch to transfer the electrical load from the utility source to the generator set. The load is transferred back to the utility source before the generator set shuts down.

**Note:** If a Model RDT or RSB transfer switch is used, a *loaded* test cannot be initiated from the RDC or DC controller. To run a loaded test, refer to the instructions provided with the transfer switch.

**Procedure to Run a Loaded Full-Speed Test**

1. Press the RUN button to start an unloaded test as described in Section 2.9.1. When the generator is running, **tnLd** appears on the display.
2. Press the down arrow button (RDC) or the exercise button (DC) to signal the ATS to transfer the load. The display indicates a loaded test, **t Ld.**
3. To end the test, press the AUTO button to shut down the generator set through normal timing sequences. The generator set goes into Auto mode. The load is transferred to utility power, if available. The engine cooldown cycle runs before the generator set engine stops.

**Immediate Shutdown During a Loaded Test**

Press the OFF button to shut the generator set down immediately, if necessary. The cooldown time delay is ignored, and the controller goes to OFF mode. The controller signals the RRT transfer switch to transfer the load back to utility power.

**Note:** Running the generator set with no load for at least 2 minutes is recommended to ensure adequate engine cooldown. Use the OFF button to stop a loaded test only if necessary.

### 2.9.3 Power Failure During Test Cycle

If the utility power is lost during an unloaded test, the controller goes into the AUTO mode and the ATS transfers to the emergency source.

If the utility power is lost during a loaded test, the controller goes into the AUTO mode. The ATS remains in the emergency position.

The generator set continues to run and supply power to the load for the duration of the Utility power outage. When Utility power is restored, the ATS re-transfers to the utility source through normal timing sequences.

## 2.10 Faults

Fault conditions are shown in Figure 2-8. Fault conditions are classified as warnings or shutdowns.

### 2.10.1 Warnings

The controller displays a fault code but the generator set does not shut down on a warning. The controller resets automatically after a warning condition is corrected.

### 2.10.2 Shutdowns

Under a fault shutdown condition, the generator set shuts down automatically and the controller displays a fault code. In some cases, the engine cooldown cycle runs before the engine shuts down. See Figure 2-8.

Shutdown switches (such as the low oil pressure switch or high engine temperature switch) on the generator set will automatically reset when the problem is corrected. However, the fault condition at the controller does not clear until the controller is reset.

The generator set cannot be restarted until the fault condition is corrected and the controller is reset. See Section 2.10.4 to reset the controller after a fault shutdown.

### 2.10.3 ATS Communication Errors

An ATS fault can be caused by two conditions.

- When a Model RRT transfer switch is used, an ATS fault indicates that the connection to the interface board on the transfer switch has been lost. The generator set shuts down. Check the connection to the ATS interface board.
- If an RRT transfer switch is connected after the controller has powered up, the ATS warning is displayed. To clear the fault, disconnect and then reconnect battery power to the controller.

| Code | Fault | Warning (W) or Shutdown (SD) | Condition | Check |
|---|---|---|---|---|
| AC | Loss of AC sensing | W (1 sec.)<br>SD (3 sec.) * | Generator output AC sensing is lost. Starts 10 seconds after crank disconnect.<br>Warning: after 1 second if no output detected after crank disconnect.<br>Shutdown: after 3 seconds if voltage was present and then lost. | Contact an authorized distributor/dealer for service. |
| AF | Auxiliary fault input | SD * | An optional customer-connected input is closed. | Check customer-supplied equipment. |
| ATS | ATS communication error | SD * | Shutdown if ATS interface connection is lost. See Section 2.10.3. | Check connection to Model RRT transfer switch interface board. |
| | | W | Warning is displayed if RRT interface board is connected after controller is powered up. See Section 2.10.3. | Disconnect and then reconnect battery power to controller. |
| Hb | High battery voltage | W | Engine starting battery voltage rises above 125% of the battery voltage setting for more than 10 seconds when the engine is running. Not operative during the engine crank cycle.<br>Clears when the battery voltage returns to an acceptable level. | Check the battery rating and condition.<br>Check the battery charger operation. |
| HE | High engine temperature | SD * | Engine coolant temperature exceeds the maximum temperature for more than 5 seconds. Function becomes active after crank disconnect. | Check for blocked air inlets and exhaust outlets. |
| Lb | Low battery voltage | W | Engine starting battery voltage falls below the battery voltage setting (typically 12 volts) for more than 90 seconds when the engine is not running. Not operative during the engine crank cycle.<br>Clears when the battery voltage returns to an acceptable level. | Check the battery rating and condition.<br>Check the battery charger operation.<br>Charge or replace the battery. |
| * Engine cooldown runs before shutting down. | | | | |

| Code | Fault | Warning (W) or Shutdown (SD) | Condition | Check |
|---|---|---|---|---|
| LCb | Low cranking voltage | W | Battery voltage falls below 60% of system battery voltage for more than 6 seconds while the starter is engaged. | Charge or replace the battery. |
| LOP | Low oil pressure | SD * | The LOP switch indicates low oil pressure for more than 5 seconds. Function becomes active 30 seconds after crank disconnect (30 second inhibit).<br>**Note:** The low oil pressure shutdown does not protect against low oil level. Check the engine oil level regularly as recommended in Section 3. | Check for leaks in the lubrication system.<br>Check the oil level and add oil if the level is low. |
| Lr | Locked rotor | SD | No engine rotation is sensed during cranking. Shuts down 3 seconds after the fault is detected. | Check the fuel supply, spark plug, and battery.<br>Check for loose connections.<br>Contact an authorized distributor/dealer for service. |
| LrC | Loss of voltage regulator communication | SD * | No communication between controller and voltage regulator. | Contact an authorized distributor/dealer for service. |
| OC | Overcrank | SD | Three unsuccessful starting attempts. | Check the fuel supply, spark plug, and battery.<br>Check for loose connections.<br>Contact an authorized distributor/dealer for service. |
| OF | Overfrequency | SD * | Governed frequency exceeds 110% of the system's frequency setpoint for more than 5 seconds. Function becomes active 10 seconds after engine start (10 second inhibit). | Contact an authorized distributor/dealer for service. |
| OS | Overspeed | SD * | Engine speed exceeds 115% of the normal running speed for more than 0.3 seconds. | Contact an authorized distributor/dealer for service. |
| OU | Overvoltage | SD * | Output voltage exceeds 120% of the system nominal voltage for more than 2 seconds. | Contact an authorized distributor/dealer for service. |
| SS | Speed sensor failure | SD | Engine speed sensor has failed. | Contact an authorized distributor/dealer for service. |
| UF | Underfrequency | SD * | Governed frequency falls below 90% of the system frequency setting for more than 5 seconds, or 1 Hz below the system frequency setting for more than 60 seconds.<br>Function becomes active 10 seconds after engine start (10 second inhibit). | Reduce the load and restart the generator set.<br>Contact an authorized distributor/dealer for service. |
| US | Underspeed | SD * | Engine speed drops below 85% of the normal running speed for more than 0.3 seconds. | Reduce the load.<br>Contact an authorized distributor/dealer for service. |
| UU | Undervoltage | SD * | Output voltage falls below 80% of the nominal system voltage for more than 10 seconds. | Reduce the load and restart the generator set.<br>Contact an authorized distributor/dealer for service. |
| * Engine cooldown runs before shutting down. | | | | |

**Figure 2-8** Controller Fault Codes

### 2.10.4 Resetting the Controller after a Fault Shutdown

Always identify and correct the cause of a fault shutdown before resetting the controller. Check the fault code displayed on the controller and refer to Figure 2-8 to identify and correct the fault condition before proceeding. Contact an authorized distributor/dealer for service, if necessary.

**Procedure to Reset the Controller after a Fault Shutdown**

1. Press OFF to turn off the generator set.
2. Disconnect the generator set from the load using the line circuit breaker or ATS. See the safety precautions at the beginning of this manual before proceeding.
3. Identify and correct the cause of the fault shutdown. See the safety precautions at the beginning of this manual before proceeding. Refer to Section 4, Troubleshooting.
4. Start the generator set by pressing RUN. Check the generator set operation to verify that the cause of the shutdown has been corrected.
5. Press the OFF button to stop the generator set.
6. Reconnect the generator set to the load using the line circuit breaker or ATS.
7. Press AUTO to put the generator set into automatic mode.

### 2.10.5 Event History

The last ten controller faults can be viewed from the controller display when the controller is off. Each event is displayed with the fault code followed by the engine hours at which time the event occurred. During event history viewing, the OFF LED flashes once per second.

NIA (not in Auto) will be listed in the event history, but is not displayed on the controller when active.

**Procedure to View Event History**

1. Press and hold the OFF button for 3 seconds. The first event appears on the screen. The OFF LED flashes once per second.
2. Press the OFF button to cycle through the engine hours and subsequent events. After cycling through all ten events, the control automatically turns off. The OFF LED flashes once every 2 seconds.

To stop viewing the event history before the last event, press the down arrow or exercise button. The controller will turn off.

## 2.11 Model RRT Transfer Switch Operation

The RDC/DC generator set/transfer switch controller manages automatic transfer switch (ATS) functions when connected to a Kohler® Model RRT transfer switch through the ATS interface board.

### 2.11.1 Source Availability

The Model RRT transfer switch supplies voltage sensing data to the RDC/DC controller through the ATS interface board. If the source voltage falls below the undervoltage dropout setting, the source is considered to have failed. See Figure 2-9.

| Item | Setting |
|---|---|
| Accuracy | ±5% |
| Undervoltage Dropout | 90% of Pickup |
| Undervoltage Pickup | 90% of Nominal |

**Figure 2-9** Voltage Sensing Parameters

### 2.11.2 ATS Control Sequence of Operation

See Figure 2-10 for time delay settings.

**Preferred Source Fails:**

1. The load control contact opens.
2. The engine start time delay times out.
3. The generator set is signaled to start.
4. The generator starts and the emergency source becomes available.
5. The normal-to-emergency time delay times out.
6. The transfer switch transfers to the emergency source.
7. The load control contact time delay times out.
8. The load control contact closes.

**Normal Source Returns:**

1. The emergency-to-normal time delay times out.
2. The contactor transfers to the normal source.
3. The engine cooldown time delay times out.
4. The generator is signaled to stop.

### 2.11.3 Time Delays

Time delays are factory-set to the values shown in Figure 2-10. An authorized distributor/dealer can adjust time delays using a personal computer and Kohler® SiteTech™ software.

Time delays described in this section operate only when the controller is connected to a Kohler® Model RRT transfer switch.

The engine start and load transfer time delays prevent engine start and load transfer caused by brief variations in the utility power source.

### 2.11.4 Load Control Time Delay

The load control time delay allows delayed starting of large motor loads (such as air conditioners), preventing simultaneous starting of large motors after transfer to the generator set. The load control time delay is fixed at 5 minutes. It is not adjustable.

The load must be connected to the load control output on the interface board of the Model RRT transfer switch. See the transfer switch operation and installation manual for connection instructions.

| Time Delay | Setting | Description |
|---|---|---|
| Engine Start | 3 seconds | Time delay after utility source is lost until the engine start cycle begins. Guards against starting the generator set because of a brief change in the utility source. |
| Transfer, Normal to Emergency | 3 seconds | Time delay after emergency source becomes available until transfer to emergency source. |
| Transfer, Emergency to Normal | 2 minutes | Time delay after the utility source returns until transfer back to normal. Ensures that the the utility source is stable before transferring from the emergency source. |
| Load Control | 5 minutes | Allows delayed connection of selected loads to the generator set. Prevents simultaneous starting of large motors after transfer to the emergency source. Recommended for delayed starting of air conditioners. |

**Figure 2-10** Time Delays

# Notes

**⚠ WARNING**

**Accidental starting.**
**Can cause severe injury or death.**

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

**Disabling the 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) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

**⚠ WARNING**

**Hazardous voltage. Moving parts.**
**Can cause severe injury or death.**

Operate the generator set only when all guards and electrical enclosures are in place.

**⚠ WARNING**

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

Do not work on the generator set until it cools.

**Servicing the exhaust system. Hot parts can cause severe injury or death.** Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

## 3.1 Scheduled Maintenance

Refer to the following service schedules and the runtime hours displayed on the controller display to schedule routine maintenance. Intervals are shown in hours of operation and/or time intervals (i.e. weekly, monthly, quarterly, etc.) Have an authorized distributor/dealer service the generator set at the designated intervals in the service schedule for the life of the generator set. Service units subject to extreme weather, long operating hours, or dusty or dirty conditions more frequently.

Contact an authorized distributor/dealer for parts.

### 3.1.1 Service Schedule, 14RES/RESL Models

| System Component or Procedure | See Section | Procedure | | | | | Frequency |
|---|---|---|---|---|---|---|---|
| | | Visually Inspect | Check | Change | Clean | Test | |
| **Fuel** | | | | | | | |
| Flexible lines and connections | | X | | R | | | Quarterly |
| Main tank supply level | | | X | | | | Weekly |
| Fuel piping | | X | | | | | Yearly |
| **Lubrication** | 3.2 | | | | | | |
| Oil level | | X | X | | | | 8 hours or before use |
| Crankcase breather hose | | X | | | | | Yearly or 500 hours |
| Change oil | | | | X | | | Yearly or 100 hours |
| Replace filter | | | | X | | | Yearly or 200 hours |
| **Cooling** | 3.5 | | | | | | |
| Air ducts, louvers | | | X | | X | | Yearly |
| **Exhaust Line** | 3.6 | | | | | | |
| Leakage | | X | X | | | | Weekly |
| Insulation, fire hazards | | X | | | | | Yearly |
| Obstructions or combustible materials near exhaust outlet | | X | | | | | Weekly |
| **DC Electrical System** | 3.7 | | | | | | |
| Battery charger operation, charge rate (if equipped) | | X | | | | | Monthly |
| Remove corrosion, clean and dry battery and rack | | X | | | X | | Yearly |
| Clean and tighten battery terminals and inspect boots | | X | X | | | | Yearly |
| Battery electrolyte level and specific gravity * | | | X | | | | Yearly |
| **AC Electrical System** | | | | | | | |
| Tighten control and power wiring connections | | | X | | | | Yearly |
| Remote control system, if equipped | | | | | | X | Monthly |
| Visible wear or damage | | X | | | | | Quarterly |
| Wire abrasions where subject to motion | | X | X | | | | Six Months |
| Wire-cable insulation condition | | X | | | | | 3 Years or 500 hours |
| **Engine and Mounting** | | | | | | | |
| Visible wear or damage | | X | | | | | Weekly |
| Air cleaner and precleaner service † | 3.4 | | | R | | | Yearly or 100 hours |
| Spark plugs | 3.3 | | | X | | | Yearly or 300 hours |
| Replace stepper motor coupling and bushing | | | | D | | | 500 hours |
| **Generator** | | | | | | | |
| Visible wear or damage | | X | | | | | Quarterly |
| Exercise generator set | | | | | | X | Weekly |
| Brushes and collector ring | | D | | | D | | Yearly |
| Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier and load leads disconnected) * | | | | | | D | 3 Years |
| **General Condition of Equipment** | | | | | | | |
| Evidence of vibration, leakage, excessive noise, temperature, or deterioration | | X | X | | X | | Weekly |
| Interior of sound enclosure | | X | | | X | | Quarterly |

* Not necessary for maintenance-free batteries.

† Service more frequently under extremely dusty/dirty conditions.

Megger® is a registered trademark of Biddle Instruments.

X Action

D Authorized distributor/dealer only

R Replace as necessary

## 3.1.2 Service Schedule, 20RES/RESL Models

| System Component or Procedure | See Section | Procedure | | | | | Frequency |
|---|---|---|---|---|---|---|---|
| | | Visually Inspect | Check | Change | Clean | Test | |
| **Fuel** | | | | | | | |
| Flexible lines and connections | | X | | R | | | Quarterly |
| Main tank supply level | | | X | | | | Weekly |
| Fuel piping | | X | | | | | Yearly |
| **Lubrication** | 3.2 | | | | | | |
| Oil level | | | X | | | | 8 hours or before each use |
| Change oil | | | | X | | | Yearly or 150 hours |
| Replace filter | | | | X | | | Yearly or 150 hours |
| Crankcase breather hose | | X | | | | | Yearly or 500 hours |
| Oil cooler | | X | | | X | | Yearly or 100 hours |
| **Cooling** | 3.5 | | | | | | |
| Air ducts, louvers | | | X | | X | | Yearly |
| **Exhaust System** | 3.6 | | | | | | |
| Leakage | | X | X | | | | Weekly |
| Insulation, fire hazards | | X | | | | | Yearly |
| Obstructions or combustible materials near exhaust outlet | | X | | | | | Weekly |
| **DC Electrical System** | 3.7 | | | | | | |
| Battery charger operation, charge rate | | X | | | | | Monthly |
| Remove corrosion, clean and dry battery and rack | | X | | | X | | Yearly |
| Clean and tighten battery terminals and inspect boots | | X | X | | | | Yearly |
| Battery electrolyte level and specific gravity * | | | X | | | | Yearly |
| **AC Electrical System** | | | | | | | |
| Tighten control and power wiring connections | | | X | | | | Yearly |
| Remote control system, if equipped | | | | | | X | Monthly |
| Visible wear or damage | | X | | | | | Quarterly |
| Wire abrasions where subject to motion | | X | X | | | | Six Months |
| Wire-cable insulation condition | | X | | | | | 3 Years or 500 hours |
| **Engine and Mounting** | | | | | | | |
| Visible wear or damage | | X | | | | | Weekly |
| Air cleaner service † | 3.4 | | 150 | 300 | | | Yearly or hours shown |
| Spark plugs | 3.3 | | 150 | 300 | | | Yearly or hours shown |
| Replace stepper motor coupling and bushing | | | | D | | | 500 hours |
| **Generator** | | | | | | | |
| Visible wear or damage | | X | | | | | Quarterly |
| Exercise generator set | | | | | | W | Weekly |
| Brushes and collector ring | | D | | | D | | Yearly |
| Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier and load leads disconnected) | | | | | | D | 3 Years |
| **General Condition of Equipment** | | | | | | | |
| Evidence of vibration, leakage, deterioration, unusual or excessive noise or temperature | | X | X | | X | | Weekly |
| Interior of sound enclosure | | X | | | X | | Quarterly |

* Not necessary for maintenance-free batteries.

† Service more frequently under extremely dusty/dirty conditions.

Megger® is a registered trademark of Biddle Instruments.

X Action
D Authorized distributor/dealer only
R Replace as necessary

## 3.2 Lubrication System

See the service schedules in Section 3.1 for oil change and oil filter replacement intervals. See the service views in Section 1.7 for the oil drain, oil check, oil fill, and oil filter locations.

### 3.2.1 Low Oil Pressure Shutdown

The low oil pressure (LOP) shutdown feature protects the engine against internal damage if the oil pressure drops below a minimum pressure because of oil pump failure or other malfunction.

**Note:** The LOP shutdown feature does not protect against damage caused by operating when the oil level is low; it is not a low oil level shutdown. Check the oil level regularly, and add oil as needed.

### 3.2.2 Oil Check

The generator set is shipped with oil. Before operating the generator set, check the engine oil in the crankcase. See Figure 3-1.

Maintain the oil level at or near, not over, the full mark on the dipstick. Add 5W-30 synthetic oil when the oil level is low.

Check the oil level before each use. For extended operation, check the oil level every 8 hours. Do not check the oil level when the generator set is running. Shut down the generator set and wait several minutes before checking the oil.

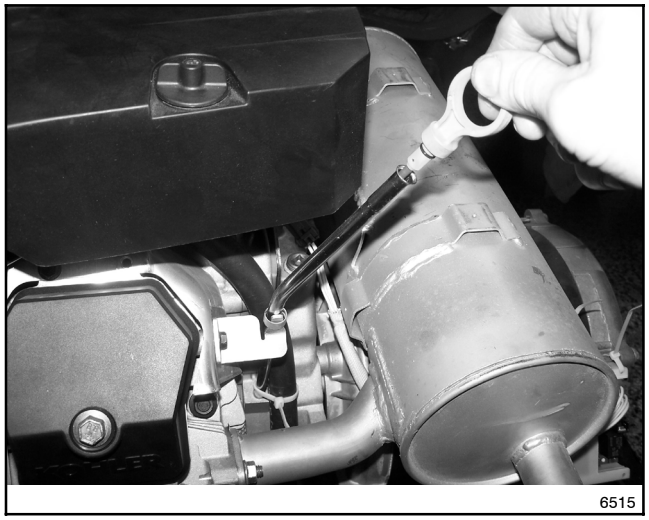



**Figure 3-1** Oil Check (typical)

### 3.2.3 Engine Oil Recommendation

Use 5W-30 API (American Petroleum Institute) Service Class SG, SH, or SJ synthetic oil. Synthetic oil oxidizes and thickens less than other oils and leaves the engine intake valves and pistons cleaner.

### 3.2.4 Oil Change Procedure

**Note:** Dispose of all waste materials (engine oil, fuel, filter, etc.) in an environmentally safe manner.

Drain the oil while it is still warm.

1. **Drain the oil.**

   a. Press the OFF button on the generator set controller.

   b. Disconnect the power to the battery charger.

   c. Disconnect the generator set engine starting battery, negative (–) lead first.

   d. Remove the housing side panel.

   e. Clean the area around the dipstick and oil fill cap.

   f. Remove the oil drain hose from its retaining clip. Remove the cap from the oil drain hose and lower the hose into an oil collection container.

   g. Open the oil drain valve on the engine.

   h. Remove the dipstick and oil fill cap. Allow time for the engine oil to drain completely.

   i. Close the oil drain valve. Replace the cap on the oil drain hose. Replace the oil drain hose in its retaining clip.

   j. Replace the dipstick.

2. **Replace the oil filter.**

   a. Clean the area around the oil filter. Remove the oil filter by rotating it counterclockwise with an oil filter wrench.

   b. Clean the gasket sealing surface of the oil filter adapter.

   c. Apply a light coat of clean oil to the rubber seal of the new oil filter.

   d. Install the new oil filter following the instructions provided with the filter.

3. **Fill with oil.**

   a. Fill the engine to the F mark on the dipstick. The engine oil capacity is shown in Figure 3-2. See Section 3.2.3, Engine Oil Recommendation, for oil selection.

| Generator Set Model | Oil Capacity, L (qt.) |
|---|---|
| 14RES/RESL | 1.9 (2.0) |
| 20RES/RESL | 2.8 (3.0) |

**Figure 3-2** Engine Oil Capacity

   b. Reinstall the dipstick and the oil fill cap.

   c. Check that the generator set master switch is in the OFF position.

   d. Reconnect the generator set engine starting battery, negative (-) lead last.

   e. Reconnect the power to the battery charger.

   f. Start and run the generator set for a minute to allow the oil pressure to reach operating range.

   g. Stop the generator set, wait 1 minute, and then recheck the oil level. Add oil to bring the level up to the F mark on the dipstick.

4. **Check for leaks.**

   a. Check for oil leaks.

   b. Fix leaks and recheck the oil level.

   c. Reinstall the housing side panel.

## 3.2.5 Oil Cooler 20RES/RESL

Inspect and clean the oil cooler at the intervals indicated in the service schedule. The oil cooler must be kept free of debris.

See Figure 3-3 for the oil cooler location. The oil cooler is located under the No. 2 cylinder shroud. Remove the top mounting screw and loosen the two side screws, then lift off the cylinder shroud.

Clean the outside of the oil cooler fins with a brush or with compressed air.

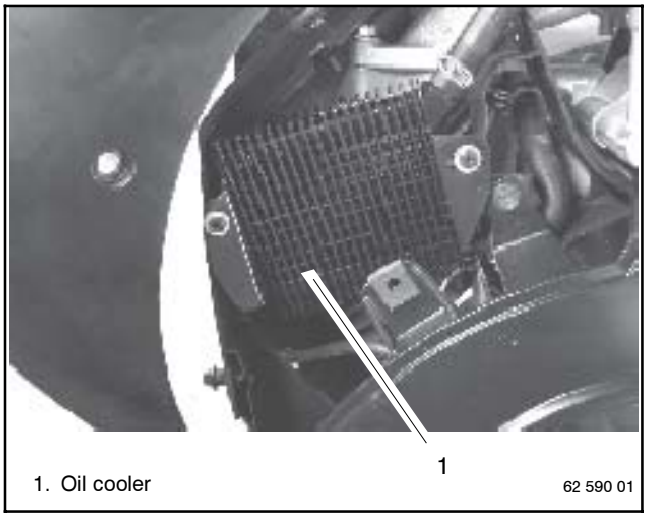



**Figure 3-3** Oil Cooler Location

## 3.3 Spark Plugs

Reset the spark plug gap or replace the plugs with new plugs as necessary.

1. Clean the area around the base of the spark plug to keep dirt and debris out of the engine.

2. Remove the spark plug and check its condition. Replace the spark plug if it is worn or if its reuse is questionable.

3. Check the spark plug gap using a wire feeler gauge. See Figure 3-4 for the recommended spark plug gap. Adjust the gap by carefully bending the ground electrode. See Figure 3-5 and Figure 3-6.

4. Reinstall the spark plug into the cylinder head. Torque the spark plug to 24.4–29.8 Nm (18–22 ft. lb.)

| Generator Set Model | Spark Plug Gap |
|---|---|
| 14/20RES/RESL | 0.76 mm (0.030 in.) |

**Figure 3-4** Spark Plug Gap

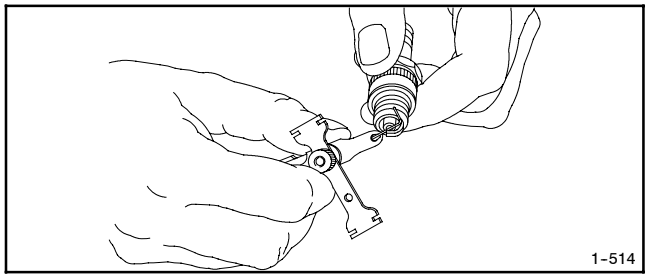



**Figure 3-5** Checking the Spark Plug Gap

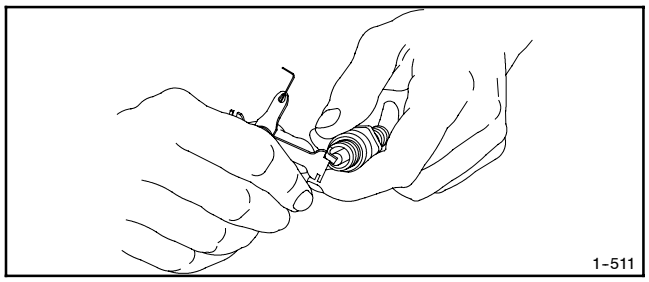
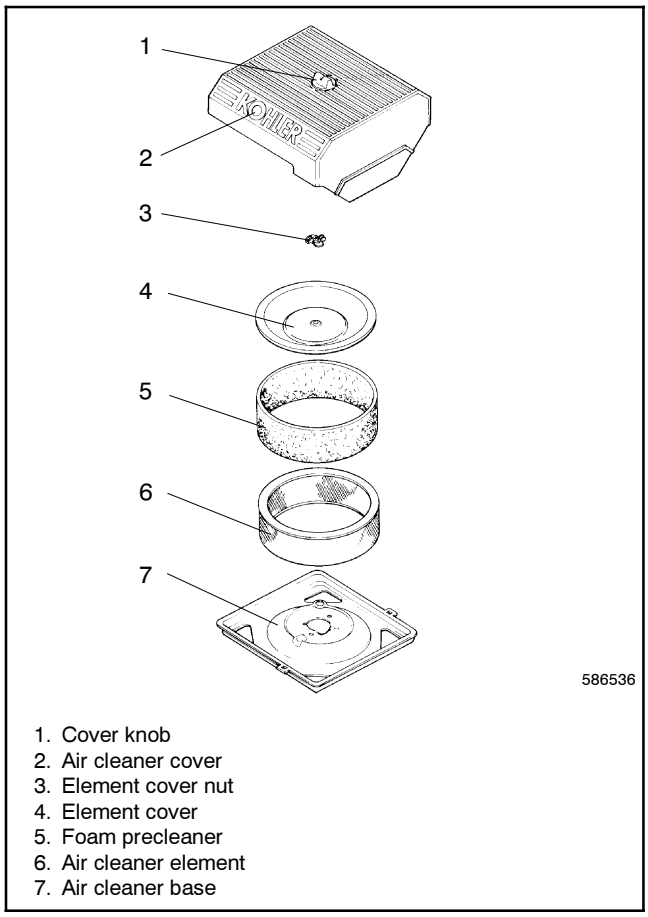



**Figure 3-6** Adjusting the Spark Plug Gap

## 3.4 Air Cleaner Service

### 3.4.1 Air Cleaner, 14RES/RESL Models

The engine has a replaceable high-density paper air cleaner element with an oiled foam precleaner. See Figure 3-7.




1. Cover knob
2. Air cleaner cover
3. Element cover nut
4. Element cover
5. Foam precleaner
6. Air cleaner element
7. Air cleaner base

**Figure 3-7** Air Cleaner Components

Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

**Note:** Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

#### Precleaner Service

Use the following procedure to wash and reoil the precleaner as indicated in the service schedule. Wash and reoil the precleaner more often under extremely dusty or dirty conditions.

1. Press the OFF button on the generator set controller.

2. Disconnect the power to the battery charger.

3. Disconnect the battery, negative (-) lead first.

4. Loosen the cover retaining knob and remove the cover. Remove the precleaner from the paper element. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.

5. Saturate the precleaner with new engine oil. Squeeze out all of the excess oil.

6. Reinstall the precleaner over the paper element.

7. Reinstall the air cleaner cover. Secure the cover with the cover retaining knob.

8. Reconnect the power to the battery charger.

9. Reconnect the generator set engine starting battery, negative (-) lead last.

**Paper Element Service**

Use the following procedure to replace the paper element at the intervals specified in the service schedule. Replace the paper element more often under extremely dusty or dirty conditions.

1. Press the OFF button on the generator set controller.

2. Disconnect the power to the battery charger.

3. Disconnect the generator set engine starting battery, negative (-) lead first.

4. Loosen the cover retaining knob and remove the cover.

5. Remove the element cover nut, element cover, and the paper element with precleaner.

6. Remove the precleaner from the paper element.

   **Note:** Do not wash the paper element or clean it with pressurized air, as this will damage the element.

7. Replace the element if it is dirty, bent, or damaged.

8. Check the air cleaner base. Make sure it is secure and not bent or damaged. Also check the element cover for damage and fit. Replace all damaged air cleaner components. Remove any loose dirt or debris from the air cleaner base. Wipe the base carefully so that no dirt drops into the intake throat. Check the condition of the rubber seal on the air cleaner stud and replace the seal if necessary.

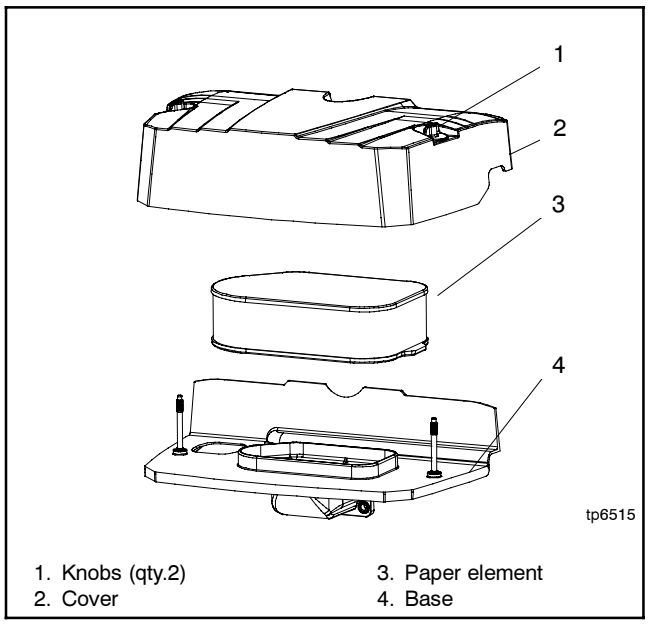
9. Reinstall the paper element, precleaner, element cover, element cover nut, and the air cleaner cover. Secure the cover with the cover retaining knob.

10. Reconnect the power to the battery charger.

11. Reconnect the generator set engine starting battery, negative (-) lead last.

## 3.4.2 Air Cleaner, 20RES/RESL Models

The engine is equipped with a replaceable, high density paper air cleaner element. See Figure 3-8.




1. Knobs (qty.2)
2. Cover
3. Paper element
4. Base

**Figure 3-8** Air Cleaner Components

Check the air cleaner daily or before starting the engine. Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

**Note:** Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

**Paper Element Service**

Replace the paper element at the intervals indicated in the service schedule. See Section 3.1.2 for the service schedule. See Figure 3-8 for the air cleaner components.

1. Loosen the two cover retaining knobs and remove the cover.
2. Remove the paper element.
3. Do not wash the paper element or use pressurized air, as this will damage the element. Replace a dirty, bent, or damaged element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
4. When servicing the air cleaner, check the air cleaner base. Make sure it is secured and not bent or damaged. Also, check the element cover for damage or improper fit. Replace all damaged air cleaner components.

**Note:** If any loose dirt or debris fell on the air cleaner base when the element was removed, carefully remove it and wipe the base clean. Be careful that none of it drops into the intake throat.

5. Reinstall the paper element onto the air cleaner base. Make sure the element is flat and properly seated.
6. Install the air cleaner cover and secure with the two retaining knobs.
7. When element replacement is necessary, order genuine Kohler parts.

## 3.5 Cooling System

The engine fan draws cooling air through the openings in the sides and end near the battery. The alternator fan draws cooling air through openings on the side walls of the enclosure. The cooling air mixes with the engine exhaust and is discharged at the exhaust outlet. See Figure 1-2, Service View, for air intake and exhaust locations. To prevent generator set damage caused by overheating, keep the housing cooling inlets and outlets clean and unobstructed at all times.

**Note:** Do not block the generator set cooling air inlets or mount other equipment above them. Overheating and severe generator damage may occur.

## 3.6 Exhaust System

Remove all combustible materials from the exhaust location. Combustible materials include building materials as well as natural surroundings. Keep dry field grass, foliage, and combustible landscaping material a minimum of 1.5 m (5 ft.) from the exhaust outlet.

Periodically inspect the exhaust system components for cracks, leaks, and corrosion.

- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is clear.

## 3.7 Battery

**⚠ WARNING**

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

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

**Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death.** Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the 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.

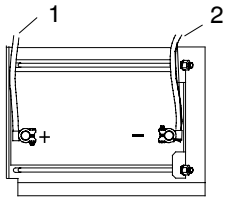
**Battery acid cleanup. Battery acid can cause severe injury or death.** Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

**Battery gases. Explosion can cause severe injury or death.** Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

**Battery short circuits. Explosion can cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Refer to this section for general battery information and maintenance. Also consult the battery manufacturer's instructions for battery maintenance.

All generator set models use a negative ground with a 12-volt engine electrical system. Consult the generator set nameplate for the engine electrical system voltage. Consult the generator spec sheet for battery capacity recommendations for replacement purposes. Wiring diagrams provide battery connection information. See Figure 3-9 for typical battery connections.




1. To positive (+) terminal on starter solenoid.
2. To ground (-) terminal on or near starter motor.

**Figure 3-9** 12-Volt Engine Electrical System Single Starter Motor, Typical Battery Connection

Clean the battery and cables and tighten battery terminals using the service schedule recommendations. To prevent corrosion, maintain tight, dry electrical connections at the battery terminals. To remove corrosion from battery terminals, disconnect the cables from the battery and scrub the terminals with a wire brush. Clean the battery and cables with a solution of baking soda and water. After cleaning, flush the battery and cables with clean water and wipe them with a dry, lint-free cloth.

After reconnecting the battery cables, coat the battery terminals with petroleum jelly, silicone grease, or other nonconductive grease.

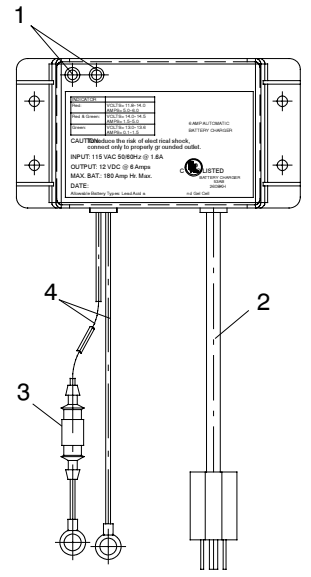
## 3.8 Battery Charger

The generator set is equipped with a battery charger to maintain the engine starting battery. The charger's DC leads are factory-wired. Periodically check and tighten all connections.

### 3.8.1 RES Battery Charger

RES model generator sets are equipped with a 6-amp float/equalize battery charger to maintain the engine starting battery. The charger's power cord must be connected to a 120 VAC power source. Figure 3-10 illustrates the battery charger.

The battery charger uses an AGS 10 inline fuse. The fuse is located in the battery lead. See Figure 3-10.




1. LED indicators
2. AC power cord
3. Fuse
4. Battery leads, 12 VDC

**Figure 3-10** 6-Amp Float/Equalize Battery Charger

**Battery Charger Operation**

Figure 3-11 illustrates the three-stage charging method. Red and green LEDs indicate charger operation. The chart in Figure 3-12 describes the LED indicator operation during each stage of the charging process. See Section 4.4 for battery charger troubleshooting information, if necessary.

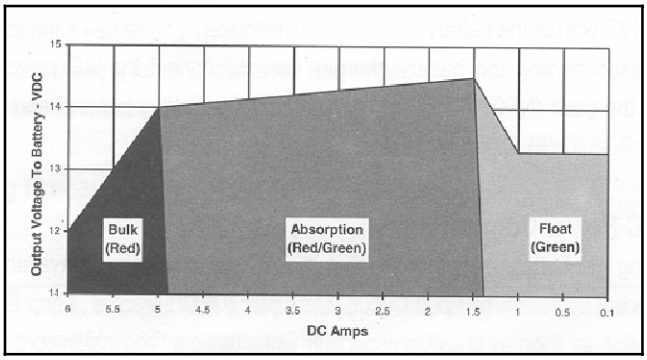



**Figure 3-11** Charging Method

| Display | Operating Condition |
|---|---|
| Red ON<br>Green<br>OFF | When the red LED is on, it indicates the battery is discharged and the battery charger is recharging at the BULK rate (stage 1). This charging rate is 6 amps. While the red LED is on, the voltage measured (with the battery charger on) will be 11.8–14 volts.<br>If the red LED stays on for more than 24 hours, refer to Section 4.4 in this manual. |
| Red ON<br>Green ON | When both the green and the red LEDs are on, the battery charger is charging at an ABSORPTION rate of between 1.5 and 5 amps (stage 2). This mode of charging gradually tops off your battery, and reduces harmful sulfating. While both LEDs are on, the voltage measured (with the battery charger on) should be approximately 14.0–14.5 VDC.<br>If both LEDs stay on longer than 24 hours, refer to Section 4.4 in this manual. |
| Red OFF<br>Green ON | When the green LED is on, the battery charger is charging at a FLOAT or MAINTENANCE rate of less than 1.5 amps (stage 3). Your battery is now 90% charged and ready for use. This float charging current will gradually decrease to as low as 0.1 amps as the battery reaches 100% charge. It will now be kept at full charge without overcharging.<br>If the green LED stays on when your battery is known to be low, refer to Section 4.4 in this manual. |

**Figure 3-12** Battery Charger LED Indicator Functions

## 3.9 Circuit Protection

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

### 3.9.1 Line Circuit Breaker

A line circuit breaker interrupts the generator output in the event of a fault in the wiring between the generator and the load. The line circuit breaker location is shown in Figure 1-2. If the circuit breaker trips, reduce the load and switch the breaker back to the ON position. With the breaker in the OFF position the generator set runs but the generator output is disconnected from the load.

### 3.9.2 Fuses

A 20-amp circuit breaker protects the alternator and two fuses protect the electrical controls. See Section 4.2 for fuse locations. A 10-amp inline fuse protects the battery charger.

See Figure 3-13 for fuse part numbers. Always identify and correct the cause of a blown fuse before restarting the generator set. Refer to Section 4, Troubleshooting, for conditions that may indicate a blown fuse. Replace blown fuses with identical replacement parts.

| Fuse | Label | Rating, Amp | Part Number |
|---|---|---|---|
| Controller power | F3 | 3 | GM66128 |
| Fuel solenoid/ Starter relay/ Throttle control | F2 | 7.5 | GM66129 |
| Battery charger (RES) | — | 10 | 223316 |

**Figure 3-13** Fuses

## 3.10 Storage Procedure

Perform the following storage procedure before removing the generator set from service for three months or longer. Follow the engine manufacturer's recommendations for storage, if available.

**Note:** Run the generator set monthly whenever possible.

### 3.10.1 Lubricating System

1. Operate the 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 engine crankcase.
4. Refill engine crankcase with oil. See Section 3.2.3 for oil recommendations.
5. Run the generator set for a few minutes to distribute the clean oil.
6. Stop the generator set.

### 3.10.2 Fuel System

1. Start the generator set.
2. With the generator set running, shut off the gas supply.
3. Run the generator set until the engine stops.
4. Press the OFF button on the generator set controller.

### 3.10.3 Cylinder Lubrication

1. Remove the spark plugs.
2. Pour one tablespoon of engine oil into each spark plug hole. Install the spark plugs and *ground* the spark plug leads. *Do not connect the leads to the plugs.*
3. Crank the engine two or three revolutions to lubricate the cylinders.

### 3.10.4 Exterior Preparation

1. Clean the exterior surface of the generator set.
2. Seal all openings in the engine with nonabsorbent adhesive tape.
3. Mask all areas to be used for electrical contact.
4. Spread a light film of oil over unpainted metallic surfaces to prevent rust and corrosion.

### 3.10.5 Battery

Perform battery storage last.

1. Press the OFF button on the generator set controller.
2. Disconnect the battery, negative (–) lead first.
3. Clean the battery.
4. Place the battery in a warm, dry location.
5. Connect the battery to a float/equalize battery charger, or charge the battery monthly using a trickle charger. Follow the battery charger manufacturer's recommendations.

## 4.1 Introduction

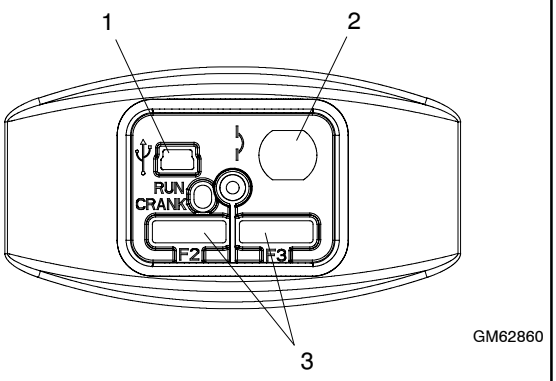
Use the following charts to diagnose and correct common problems. First check for simple causes such as a dead engine starting battery, loose connections, or an open circuit breaker. The charts include a list of common problems, possible causes of the problem, and recommended corrective actions.

If the procedures in this manual do not explain how to correct the problem, contact an authorized distributor/dealer. Maintain a record of repairs and adjustments performed on the equipment. Use the record to help describe the problem and repairs or adjustments made to the equipment.

## 4.2 Controller Service Access

The controller fuses and alternator winding circuit breaker are accessible from the front of the controller. Remove the service access door to reach the circuit breaker and fuses. See Figure 4-1.

Obtain replacement fuses from a Kohler authorized distributor/dealer.




1. USB port (for service)
2. Alternator winding circuit breaker
3. Controller fuses F2 and F3

**Figure 4-1** Controller Service Access (cover removed)

## 4.3 Generator Set Troubleshooting

Figure 4-2 contains generator set troubleshooting, diagnostic, and repair information. Check for loose connections before replacing parts.

### Fault Codes

The controller displays fault codes to aid in troubleshooting. Fault codes, descriptions, and recommended actions are listed in Section 2.10.

If a fault code is displayed, identify and correct the cause of the fault condition. Then reset the controller. See Section 2.10.4.

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| Controller LED display is off. | Controller is OFF (check the OFF LED) | Press RUN to start the generator set or AUTO for automatic operation. |
| | Controller fuse (F3) is blown. | Replace the fuse. If the fuse blows again, contact an authorized distributor/dealer. |
| | Low or no battery voltage. | Check battery connections.<br>Check the engine starting battery and battery charger. See Figure 4-3. |
| The generator set does not crank. | Fault shutdown | Check for a fault code on the controller display. See Section 2.10. |
| | Battery weak or dead | Check power to the battery charger. See Figure 4-3.<br>Recharge or replace the battery. |
| | Battery charger fuse blown | Replace the fuse. Contact an authorized distributor/ dealer for service if fuse blows repeatedly. |
| | Battery connections reversed or poor | Check battery connections. |
| | Fuse F2 blown | Replace the fuse. Contact an authorized distributor/ dealer for service if fuse blows repeatedly. |
| | Fuse F3 blown | Replace the fuse. Contact an authorized distributor/ dealer for service if fuse blows repeatedly. |
| | Controller is OFF (check the OFF LED) | Press AUTO for remote start or RUN for local start. |
| The generator set cranks but does not start, starts hard, lacks power, or operates erratically. | Air cleaner clogged | Clean and/or replace the air cleaner. |
| | Battery weak or dead | Check power to the battery charger.<br>Recharge or replace the battery. |
| | Battery connection poor | Clean and tighten the battery connections. |
| | Spark plug wire connection loose | Check the spark plug wires. |
| | Low oil pressure shutdown | Check the oil level. |
| | Fuel pressure insufficient | Check the fuel supply and valves. |
| | Engine malfunction | Contact an authorized distributor/dealer. |
| No AC output. | AC circuit breaker in the OFF position | Place the circuit breaker in the ON position. |
| | AC circuit breaker tripping because of overload | Reduce the load on the generator set. |
| | AC circuit breaker tripping because of short circuit | Contact an authorized distributor/dealer for service. |
| | Auxiliary winding circuit breaker tripped | Reset the circuit breaker. See Figure 4-1. Contact an authorized distributor/ dealer for service if circuit breaker trips repeatedly. |
| Low output or excessive drop in voltage. | Generator set overloaded | Reduce the load. |
| Generator set stops suddenly. | Low oil pressure shutdown | Check the oil level. Check for signs of oil leaks. |
| | No fuel | Check fuel supply. Contact fuel supplier. |
| | Overcrank shutdown | Reset the controller. If the overcrank fault occurs again, contact an authorized distributor/dealer. |
| | Controller fuse (F3) blown | Replace the fuse. If the fuse blows again, contact an authorized distributor/dealer. |
| | Overspeed shutdown | Reset the controller. If the overspeed fault occurs again, contact an authorized distributor/dealer. |
| | Generator set master switch in the OFF/RESET position | Move the switch to the correct position (RUN or AUTO). |
| | Remote stop command received from a remote switch or ATS | Check the remote switch position. |
| | Engine malfunction | Contact an authorized distributor/dealer. |
| | Auxiliary winding circuit breaker tripped | Reset the circuit breaker. See Figure 4-1. Contact an authorized distributor/dealer for service if circuit breaker trips repeatedly. |

**Figure 4-2** General Troubleshooting Chart

## 4.4 Battery Charger Troubleshooting

Use the battery charger's LED indicators and the table in Figure 4-3 to troubleshoot battery charger operation problems.

| Problem | Cause | Solution |
|---|---|---|
| Red LED stays on for more than 24 hours | One or more inoperative or damaged cells. | Load test the battery and replace, if necessary. |
| | Battery charger has reduced its output voltage below the normal level due to a DC overload or a DC short. | Remove the source of the overload or short. Disconnect the battery charger's black (NEGATIVE) ring terminal from the battery. Reapply AC power and the green LED only should now light. |
| | Onboard DC systems are drawing more current than the battery charger can replace. | Turn off all DC equipment while charging. |
| Red and green LEDs stay on for more than 24 hours | Onboard DC systems are drawing between 1.5 and 5 amps. | Turn off all DC equipment while charging. |
| | One or more inoperative or damaged cells. | Load test the battery and replace, if necessary. |
| | Extremely low AC voltage at the battery charger. | Apply a higher AC voltage source or reduce the length of the extension cord. |
| Green LED stays on when the battery is known to be low | Open DC output fuse. | Replace AGS-10 fuse. |
| | Faulty or contaminated terminal connections. | Clean and tighten or repair all terminal connections. |
| | One or more inoperative or damaged cells. | Load test the battery and replace, if necessary. |
| Neither of the LEDs turn on when the AC power is applied | No AC power available at the battery charger. | Connect AC power or reset the AC breaker on the main panel. |
| | Component failure. | Replace battery charger. |

**Figure 4-3** 6-Amp Battery Charger Troubleshooting

# Notes

# Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

| | |
|---|---|
| A, amp | ampere |
| ABDC | after bottom dead center |
| AC | alternating current |
| A/D | analog to digital |
| ADC | advanced digital control; analog to digital converter |
| adj. | adjust, adjustment |
| ADV | advertising dimensional drawing |
| Ah | amp-hour |
| AHWT | anticipatory high water temperature |
| AISI | American Iron and Steel Institute |
| ALOP | anticipatory low oil pressure |
| alt. | alternator |
| Al | aluminum |
| ANSI | American National Standards Institute (formerly American Standards Association, ASA) |
| AO | anticipatory only |
| APDC | Air Pollution Control District |
| API | American Petroleum Institute |
| approx. | approximate, approximately |
| APU | Auxiliary Power Unit |
| AQMD | Air Quality Management District |
| AR | as required, as requested |
| AS | as supplied, as stated, as suggested |
| ASE | American Society of Engineers |
| ASME | American Society of Mechanical Engineers |
| assy. | assembly |
| ASTM | American Society for Testing Materials |
| ATDC | after top dead center |
| ATS | automatic transfer switch |
| auto. | automatic |
| aux. | auxiliary |
| avg. | average |
| AVR | automatic voltage regulator |
| AWG | American Wire Gauge |
| AWM | appliance wiring material |
| bat. | battery |
| BBDC | before bottom dead center |
| BC | battery charger, battery charging |
| BCA | battery charging alternator |
| BCI | Battery Council International |
| BDC | before dead center |
| BHP | brake horsepower |
| blk. | black (paint color), block (engine) |
| blk. htr. | block heater |
| BMEP | brake mean effective pressure |
| bps | bits per second |
| br. | brass |
| BTDC | before top dead center |
| Btu | British thermal unit |
| Btu/min. | British thermal units per minute |
| C | Celsius, centigrade |
| cal. | calorie |
| CAN | controller area network |
| CARB | California Air Resources Board |
| CAT5 | Category 5 (network cable) |
| CB | circuit breaker |
| CC | crank cycle |
| cc | cubic centimeter |
| CCA | cold cranking amps |
| ccw. | counterclockwise |
| CEC | Canadian Electrical Code |
| cert. | certificate, certification, certified |
| cfh | cubic feet per hour |
| cfm | cubic feet per minute |
| CG | center of gravity |
| CID | cubic inch displacement |
| CL | centerline |
| cm | centimeter |
| CMOS | complementary metal oxide substrate (semiconductor) |
| com | communications (port) |
| coml | commercial |
| Coml/Rec | Commercial/Recreational |
| conn. | connection |
| cont. | continued |
| CPVC | chlorinated polyvinyl chloride |
| crit. | critical |
| CSA | Canadian Standards Association |
| CT | current transformer |
| Cu | copper |
| cUL | Canadian Underwriter's Laboratories |
| CUL | Canadian Underwriter's Laboratories |
| cu. in. | cubic inch |
| cw. | clockwise |
| CWC | city water-cooled |
| cyl. | cylinder |
| D/A | digital to analog |
| DAC | digital to analog converter |
| dB | decibel |
| dB(A) | decibel (A weighted) |
| DC | direct current |
| DCR | direct current resistance |
| deg., ° | degree |
| dept. | department |
| dia. | diameter |
| DI/EO | dual inlet/end outlet |
| DIN | Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss) |
| DIP | dual inline package |
| DPDT | double-pole, double-throw |
| DPST | double-pole, single-throw |
| DS | disconnect switch |
| DVR | digital voltage regulator |
| $E^2$PROM, EEPROM | electrically-erasable programmable read-only memory |
| E, emer. | emergency (power source) |
| ECM | electronic control module, engine control module |
| EDI | electronic data interchange |
| EFR | emergency frequency relay |
| e.g. | for example (*exempli gratia)* |
| EG | electronic governor |
| EGSA | Electrical Generating Systems Association |
| EIA | Electronic Industries Association |
| EI/EO | end inlet/end outlet |
| EMI | electromagnetic interference |
| emiss. | emission |
| eng. | engine |
| EPA | Environmental Protection Agency |
| EPS | emergency power system |
| ER | emergency relay |
| ES | engineering special, engineered special |
| ESD | electrostatic discharge |
| est. | estimated |
| E-Stop | emergency stop |
| etc. | et cetera (and so forth) |
| exh. | exhaust |
| ext. | external |
| F | Fahrenheit, female |
| FHM | flat head machine (screw) |
| fl. oz. | fluid ounce |
| flex. | flexible |
| freq. | frequency |
| FS | full scale |
| ft. | foot, feet |
| ft. lb. | foot pounds (torque) |
| ft./min. | feet per minute |
| ftp | file transfer protocol |
| g | gram |
| ga. | gauge (meters, wire size) |
| gal. | gallon |
| gen. | generator |
| genset | generator set |
| GFI | ground fault interrupter |
| GND, ⏚ | ground |
| gov. | governor |
| gph | gallons per hour |
| gpm | gallons per minute |
| gr. | grade, gross |
| GRD | equipment ground |
| gr. wt. | gross weight |
| H x W x D | height by width by depth |
| HC | hex cap |
| HCHT | high cylinder head temperature |
| HD | heavy duty |
| HET | high exhaust temp., high engine temp. |
| hex | hexagon |
| Hg | mercury (element) |
| HH | hex head |
| HHC | hex head cap |
| HP | horsepower |
| hr. | hour |
| HS | heat shrink |
| hsg. | housing |
| HVAC | heating, ventilation, and air conditioning |
| HWT | high water temperature |
| Hz | hertz (cycles per second) |
| IBC | International Building Code |
| IC | integrated circuit |
| ID | inside diameter, identification |
| IEC | International Electrotechnical Commission |
| IEEE | Institute of Electrical and Electronics Engineers |
| IMS | improved motor starting |
| in. | inch |
| in. $H_2O$ | inches of water |
| in. Hg | inches of mercury |
| in. lb. | inch pounds |
| Inc. | incorporated |
| ind. | industrial |
| int. | internal |
| int./ext. | internal/external |
| I/O | input/output |
| IP | internet protocol |
| ISO | International Organization for Standardization |
| J | joule |
| JIS | Japanese Industry Standard |
| k | kilo (1000) |
| K | kelvin |
| kA | kiloampere |
| KB | kilobyte ($2^{10}$ bytes) |
| KBus | Kohler communication protocol |
| kg | kilogram |

| | |
|---|---|
| $kg/cm^2$ | kilograms per square centimeter |
| kgm | kilogram-meter |
| $kg/m^3$ | kilograms per cubic meter |
| kHz | kilohertz |
| kJ | kilojoule |
| km | kilometer |
| kOhm, kΩ | kilo-ohm |
| kPa | kilopascal |
| kph | kilometers per hour |
| kV | kilovolt |
| kVA | kilovolt ampere |
| kVAR | kilovolt ampere reactive |
| kW | kilowatt |
| kWh | kilowatt-hour |
| kWm | kilowatt mechanical |
| kWth | kilowatt-thermal |
| L | liter |
| LAN | local area network |
| L x W x H | length by width by height |
| lb. | pound, pounds |
| $lbm/ft^3$ | pounds mass per cubic feet |
| LCB | line circuit breaker |
| LCD | liquid crystal display |
| LED | light emitting diode |
| Lph | liters per hour |
| Lpm | liters per minute |
| LOP | low oil pressure |
| LP | liquefied petroleum |
| LPG | liquefied petroleum gas |
| LS | left side |
| $L_{wa}$ | sound power level, A weighted |
| LWL | low water level |
| LWT | low water temperature |
| m | meter, milli (1/1000) |
| M | mega ($10^6$ when used with SI units), male |
| $m^3$ | cubic meter |
| $m^3/hr.$ | cubic meters per hour |
| $m^3/min.$ | cubic meters per minute |
| mA | milliampere |
| man. | manual |
| max. | maximum |
| MB | megabyte ($2^{20}$ bytes) |
| MCCB | molded-case circuit breaker |
| MCM | one thousand circular mils |
| meggar | megohmmeter |
| MHz | megahertz |
| mi. | mile |
| mil | one one-thousandth of an inch |
| min. | minimum, minute |
| misc. | miscellaneous |
| MJ | megajoule |
| mJ | millijoule |
| mm | millimeter |
| mOhm, mΩ | milliohm |
| MOhm, MΩ | megohm |
| MOV | metal oxide varistor |
| MPa | megapascal |
| mpg | miles per gallon |
| mph | miles per hour |
| MS | military standard |
| ms | millisecond |
| m/sec. | meters per second |
| mtg. | mounting |
| MTU | Motoren-und Turbinen-Union |
| MW | megawatt |
| mW | milliwatt |
| μF | microfarad |
| N, norm. | normal (power source) |
| NA | not available, not applicable |
| nat. gas | natural gas |
| NBS | National Bureau of Standards |
| NC | normally closed |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| Nm | newton meter |
| NO | normally open |
| no., nos. | number, numbers |
| NPS | National Pipe, Straight |
| NPSC | National Pipe, Straight-coupling |
| NPT | National Standard taper pipe thread per general use |
| NPTF | National Pipe, Taper-Fine |
| NR | not required, normal relay |
| ns | nanosecond |
| OC | overcrank |
| OD | outside diameter |
| OEM | original equipment manufacturer |
| OF | overfrequency |
| opt. | option, optional |
| OS | oversize, overspeed |
| OSHA | Occupational Safety and Health Administration |
| OV | overvoltage |
| oz. | ounce |
| p., pp. | page, pages |
| PC | personal computer |
| PCB | printed circuit board |
| pF | picofarad |
| PF | power factor |
| ph., ∅ | phase |
| PHC | Phillips® head Crimptite® (screw) |
| PHH | Phillips® hex head (screw) |
| PHM | pan head machine (screw) |
| PLC | programmable logic control |
| PMG | permanent magnet generator |
| pot | potentiometer, potential |
| ppm | parts per million |
| PROM | programmable read-only memory |
| psi | pounds per square inch |
| psig | pounds per square inch gauge |
| pt. | pint |
| PTC | positive temperature coefficient |
| PTO | power takeoff |
| PVC | polyvinyl chloride |
| qt. | quart, quarts |
| qty. | quantity |
| R | replacement (emergency) power source |
| rad. | radiator, radius |
| RAM | random access memory |
| RDO | relay driver output |
| ref. | reference |
| rem. | remote |
| Res/Coml | Residential/Commercial |
| RFI | radio frequency interference |
| RH | round head |
| RHM | round head machine (screw) |
| rly. | relay |
| rms | root mean square |
| rnd. | round |
| RO | read only |
| ROM | read only memory |
| rot. | rotate, rotating |
| rpm | revolutions per minute |
| RS | right side |
| RTDs | Resistance Temperature Detectors |
| RTU | remote terminal unit |
| RTV | room temperature vulcanization |
| RW | read/write |
| SAE | Society of Automotive Engineers |
| scfm | standard cubic feet per minute |
| SCR | silicon controlled rectifier |
| s, sec. | second |
| SI | *Systeme international d'unites,* International System of Units |
| SI/EO | side in/end out |
| sil. | silencer |
| SMTP | simple mail transfer protocol |
| SN | serial number |
| SNMP | simple network management protocol |
| SPDT | single-pole, double-throw |
| SPST | single-pole, single-throw |
| spec | specification |
| specs | specification(s) |
| sq. | square |
| sq. cm | square centimeter |
| sq. in. | square inch |
| SMS | short message service |
| SS | stainless steel |
| std. | standard |
| stl. | steel |
| tach. | tachometer |
| TB | terminal block |
| TCP | transmission control protocol |
| TD | time delay |
| TDC | top dead center |
| TDEC | time delay engine cooldown |
| TDEN | time delay emergency to normal |
| TDES | time delay engine start |
| TDNE | time delay normal to emergency |
| TDOE | time delay off to emergency |
| TDON | time delay off to normal |
| temp. | temperature |
| term. | terminal |
| THD | total harmonic distortion |
| TIF | telephone influence factor |
| tol. | tolerance |
| turbo. | turbocharger |
| typ. | typical (same in multiple locations) |
| UF | underfrequency |
| UHF | ultrahigh frequency |
| UIF | user interface |
| UL | Underwriter's Laboratories, Inc. |
| UNC | unified coarse thread (was NC) |
| UNF | unified fine thread (was NF) |
| univ. | universal |
| URL | uniform resource locator (web address) |
| US | undersize, underspeed |
| UV | ultraviolet, undervoltage |
| V | volt |
| VAC | volts alternating current |
| VAR | voltampere reactive |
| VDC | volts direct current |
| VFD | vacuum fluorescent display |
| VGA | video graphics adapter |
| VHF | very high frequency |
| W | watt |
| WCR | withstand and closing rating |
| w/ | with |
| WO | write only |
| w/o | without |
| wt. | weight |
| xfmr | transformer |

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