Operation

Marine Generator Sets

Models:

5E/4EF
7.3E/6EF

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-5985 10/02e

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

Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer _____

Model Designation _____

Serial Number _____

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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***.

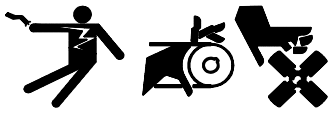
NOTICE

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 equipment connected to the set, disable the generator set as follows: (1) Place the generator set start/stop switch in the STOP position. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

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.

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 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.

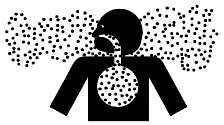
Servicing the backfire flame arrester. A sudden backfire can cause severe injury or death. Do not operate the generator set with the backfire flame arrester removed.

Combustible materials. A sudden flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the fuel system. Keep the compartment and the generator set clean and free of debris to minimize the risk of fire. Wipe up spilled fuels and engine oil.

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.

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

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

If experiencing any of these symptoms and carbon monoxide poisoning is possible, 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.

Inspecting the exhaust system. Carbon monoxide can cause severe nausea, fainting, or death. For the safety of the craft's occupants, install a carbon monoxide detector. Consult the boat builder or dealer for approved detector location and installation. Inspect the detector before each generator set use. In addition to routine exhaust system inspection, test the carbon monoxide detector per the manufacturer's instructions and keep the detector operational at all times.

Operating the generator set. 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. Use the following precautions when installing and operating the generator set. Do not install the exhaust outlet where exhaust can be drawn in through portholes, vents, or air conditioners. If the generator set exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or restrict the flow of exhaust. Never operate the generator set without a functioning carbon monoxide detector. Be especially careful if operating the generator set when moored or anchored under calm conditions because gases may accumulate. If operating the generator set dockside, moor the craft so that the exhaust discharges on the lee side (the side sheltered from the wind). Always be aware of others, making sure your exhaust is directed away from other boats and buildings. Avoid overloading the craft.

Fuel System

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

⚠ WARNING

Explosion.
Gasoline vapors can cause explosion and severe injury or death.

Before starting the generator set, operate the blower 4 minutes and check the engine compartment for gasoline vapors.

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.

Explosive fuel vapors can cause severe injury or death. Take additional precautions when using the following fuels:

Gasoline—Store gasoline only in approved red containers clearly marked GASOLINE.

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

Installing the fuel system. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Do not modify the tank or the propulsion engine fuel system. Equip the craft with a tank that allows one of the two pickup arrangements described in the installation section. The tank and installation must conform to USCG Regulations.

Pipe sealant. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Use pipe sealant on all threaded fittings to prevent fuel leakage. Use pipe sealant that resists gasoline, grease, lubrication oil, common bilge solvents, salt deposits, and water.

Ignition-protected equipment. Explosive fuel vapors can cause severe injury or death. Gasoline vapors can cause an explosion. USCG Regulation 33CFR183 requires that all electrical devices (ship-to-shore transfer switch, remote start panel, etc.) must be ignition protected when used in a gasoline and gaseous-fueled environment. The electrical devices listed above are not ignition protected and are not certified to operate in a gasoline and gaseous-fueled environment such as an engine room or near fuel tanks. Acceptable locations are the wheelhouse and other living areas sheltered from rain and water splash.

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/ Electrical Shock

⚠ WARNING

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

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

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

Disconnecting the electrical load. Hazardous voltage can cause severe injury or death. Disconnect the generator set from the load by opening the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.

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.

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

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Connect the generator set to the building/marina electrical system only through an approved device and after the building/marina main switch is opened. Backfeed connections can cause severe injury or death to utility personnel working on power lines and/or personnel near the work area. Some states and localities prohibit unauthorized connection to the utility electrical system. Install a ship-to-shore transfer switch to prevent interconnection of the generator set power and shore power.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically. *(600 volts and under)*

Hot Parts

⚠ WARNING

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

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

⚠ WARNING

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

Do not work on the generator set until it cools.

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

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.

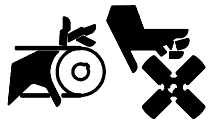
Moving Parts

⚠ WARNING

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

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

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Operate the generator set only when all guards, screens, and covers are in place.

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

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

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

Sound shield removal. Exposed moving parts can cause severe injury or death. The generator set must be operating in order to perform some scheduled maintenance procedures. Be especially careful if the sound shield has been removed, leaving the belts and pulleys exposed. *(Sound-shield-equipped models only)*

Notice

NOTICE

This generator set has been rewired from its nameplate voltage to

246242

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

NOTICE

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

NOTICE

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

NOTICE

Fuse replacement. Replace fuses with fuses of the same ampere rating and type (for example: 3AB or 314, ceramic). Do not substitute clear glass-type fuses for ceramic fuses. Refer to the wiring diagram when the ampere rating is unknown or questionable.

NOTICE

Saltwater damage. Saltwater quickly deteriorates metals. Wipe up saltwater on and around the generator set and remove salt deposits from metal surfaces.

Notes

Introduction

This manual provides operation instructions for 5/7.3E and 4/6EF model generator sets.

Refer to the engine operation manual for generator set engine scheduled maintenance information.

This manual may be used for models not listed on the front cover.

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.

Before installing a marine generator set, obtain the most current installation manual from your local distributor/dealer. Only qualified persons should install the generator set.

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Service Assistance

For professional advice on generator 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 KohlerPowerSystems.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

Africa, Europe, Middle East
London Regional Office
Langley, Slough, England
Phone: (44) 1753-580-771
Fax: (44) 1753-580-036

Asia Pacific
Power Systems Asia Pacific Regional Office
Singapore, Republic of Singapore
Phone: (65) 264-6422
Fax: (65) 264-6455

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

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Maintenance and Service Parts/Related Literature

Maintenance and Service Parts

Figure 1 identifies maintenance and service parts for your generator set. Obtain a complete list of maintenance and service parts from your authorized generator distributor/dealer.

Part Description	Part Number
Battery Charging Fuse (25 amp)	262389
Input Fuse (10 amp)	223316
Oil Filter	359771
Seawater Pump Impeller Kit	359978
Spark Plug For Engine Model AS 04	359796
Spark Plug For Engine Model BS 04	359979
Spray Paint (White)	221335
Touch-Up Paint (White)	GM19490
Voltage Regulator Fuse (10 amp)	223316
Zinc Anode	267928

Figure 1 Maintenance and Service Parts

x:in:001:004

List of Related Literature

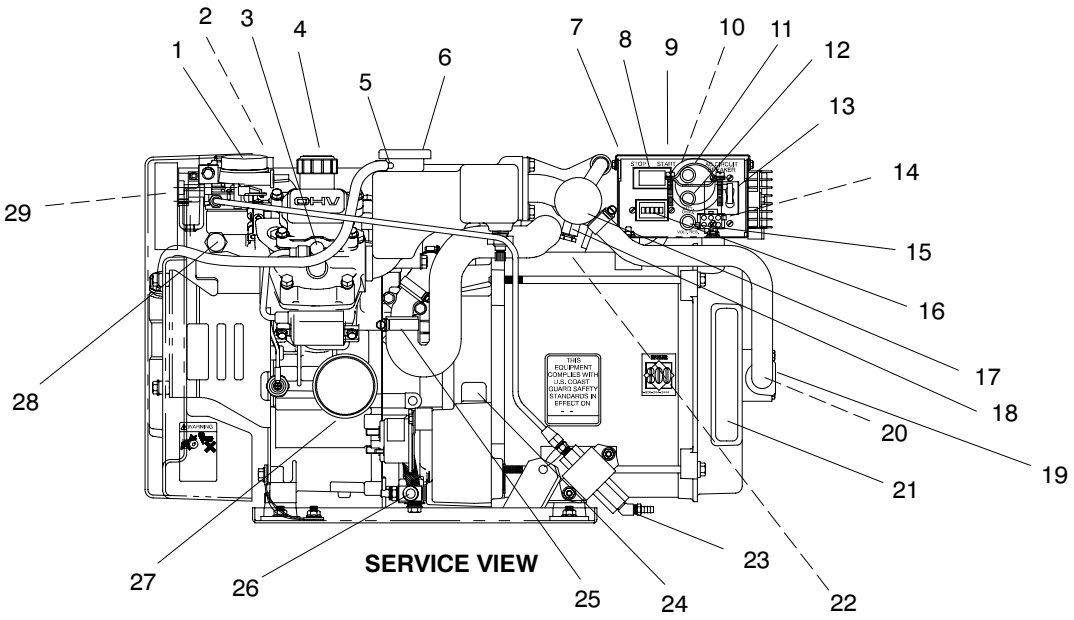
Figure 2 identifies related literature available for the generator sets covered in this manual. Only trained and qualified personnel should install or service the generator set.

Literature Type	Part Number
Installation Manual	TP-5982
Operation Manual (Generator)	TP-5985
Operation Manual (Engine)	TP-6001
Parts Catalog*	TP-5987
Service Manual (Generator)	TP-5986
Service Manual (Engine)	TP-6002
Service Manual Supplement (Engine)	TP-6008

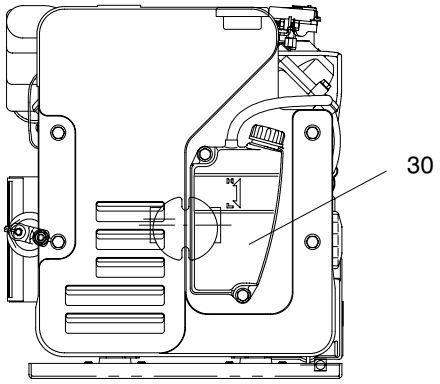
* One manual combines Generator and Engine information.

Figure 2 Generator Set Literature

x:in:001:005



SERVICE VIEW



ENGINE-END VIEW

ADV-6395-A
GY-250000-A

1. Electric choke (on carburetor)
2. Carburetor/choke linkage
3. Spark plugs (also one on nonservice side)
4. Oil fill
5. Overflow tube
6. Pressure cap (coolant fill location after draining coolant)
7. Controller
8. Start/Stop switch
9. Nameplate (top)
10. AC load lead connector (nonservice side)
11. Input fuse
12. Battery charging fuse
13. AC circuit breaker
14. Remote start connector (nonservice side)
15. Voltage regulator fuse
16. Hourmeter
17. Heat exchanger
18. Anticorrosion zinc anode
19. Seawater drain (remove plate)
20. Seawater pump (water inlet)
21. Cooling air inlet
22. Mixing elbow, water outlet/exhaust outlet (nonservice side)
23. Fuel feed pump (fuel inlet)
24. Oil check
25. Coolant drain (remove hose clamp to drain coolant)
26. Oil drain valve
27. Lube oil filter
28. Antidieseling solenoid (on carburetor)
29. Air intake silencer/backfire flame arrestor
30. Coolant overflow bottle (daily coolant check/fill location)

Note: Consult installation drawings in Spec Sheet or Installation Manual for fuel- and battery-connection points.

Note: Consult distributor/dealer or Service Manual for items not shown.

Figure 1-1 Service Views

Notes

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 Inlets. Check for clean and unobstructed air inlets.

Air Shrouding. Check for securely installed and positioned air shrouding.

Backfire Flame Arrester. Check for a clean and installed backfire flame arrester to prevent unfiltered air from entering the engine.

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

Coolant Level. Check the coolant level according to the cooling system maintenance information.

Exhaust System. Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.

Inspect the exhaust system components (exhaust manifold, mixing elbow, exhaust line, hose clamps, silencer, and outlet flapper) for cracks, leaks, and corrosion.

- Check the hoses for softness, cracks, leaks, or dents. Replace the hoses as needed.
- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps. Tighten or replace the hose clamps and/or hangers as needed.
- Check that the exhaust outlet is unobstructed.
- Visually inspect for exhaust leaks *(blowby)*. Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.
- Ensure that the carbon monoxide detector(s) is (1) in the craft, (2) functional, and (3) energized whenever the generator set operates.

Note: Never operate the generator set without a functioning carbon monoxide detector.

Fuel Level. Check the fuel level and keep the tank(s) full to ensure adequate fuel supply.

Oil Level. 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.

Seawater Pump Priming. Prime the seawater pump before initial startup. To prime the pump: (1) close the seacock, (2) remove the hose from the water-filter outlet, (3) fill the hose and seawater pump with clean water, (4) reconnect the hose to the water filter outlet, and (5) open the seacock. Confirm seawater pump operation on startup as indicated by water discharge from the exhaust outlet.

2.2 Marine Inspection

Kohler Co. recommends that all boat owners have their vessels—especially the exhaust system attached to the generator set—inspected at the start of each boating season by the local Coast Guard Auxiliary. If there is no Coast Guard Auxiliary in the area, contact an authorized Kohler distributor/dealer for the inspection.

m:op:001:003

2.3 Angular Operation

See Figure 2-1 for angular operation limits for units covered in this manual.

Continuous	Intermittent— 3 minutes or less
25°	30°
Maximum value for all directions	

Figure 2-1 Angular Operation

m:op:001:004

2.4 Operation in European Union Member Countries

This generator set is specifically intended and approved for operation below the deck in the engine compartment. Operation above the deck and/or outdoors would constitute a violation of European Union Directive 2000/14/EC noise emission standard.

2.5 Exercising the Generator Set

Operate the generator set under load once each week for one hour with an operator present.

The operator should perform all of the prestart checks before starting the exercise procedure. Start the generator set according to the starting procedure in the controller section of this manual. While the generator set is operating, listen for a smooth-running engine and visually inspect the generator set for fluid or exhaust leaks.

x:op:001:005

2.6 Starting and Stopping Procedure

Note: Opening seacock. Before starting the generator set, open the seacock to allow cooling water passage. Failure to do so could damage the seawater pump impeller and cause serious engine overheating damage.

Note: Transfer switch. Check that the marine ship-to-shore transfer switch, if equipped, is in the ship position.

Note: Close seacock if engine fails to start. If the engine fails to start after the first attempt, close the seacock before the next starting attempt. Failure to close the seacock may cause seawater to enter the exhaust piping, silencer, and/or engine. A water-filled exhaust piping and silencer may further hinder generator starting and cause seawater entry into the engine cylinders through the exhaust valve. Water ingested into the engine may cause major engine damage that the Kohler Co. warranty does not cover.

Note: Close seacock if water enters the exhaust system. If water enters the exhaust system, close the seacock and drain the water from the exhaust system at the silencer's drain plug before attempting to start the generator set. If excessive cranking is a chronic problem, have the unit, including the exhaust system, serviced by an authorized Kohler® distributor/dealer.

Note: Starter motor cooldown. Do not crank the engine continuously for more than 10 seconds at a time. Allow a 60-second cooldown period between cranking attempts if the engine does not start. If the unit fails to start after 3 attempts, contact an authorized Kohler® distributor/ dealer for repair. Failure to follow these guidelines may result in starter motor burnout.

The following table describes the allowable cranking time:

Cranking Attempts	Seacock Position	Cranking Time
1	Open	up to 10 seconds
2	Close	up to 10 seconds
3	Close	up to 10 seconds
Allow a 60-second cooldown period between cranking attempts.		
If the units fails to start after 3 attempts, contact an authorized Kohler® distributor/dealer for repair.		
Once unit is running, immediately open the seacock.		

2.6.1 Controls and Indicators

The following table describes the controls and indicators located at the controller.

Name	Description
Start/Stop Switch	Use switch to start and stop the generator set. Press the switch to the START position to start generator set. Press the switch to the STOP position to stop the generator set.
AC Circuit Breaker (optional)	Circuit breaker trips when a fault occurs in the output circuit. During maintenance of craft wiring, the circuit breaker disconnects the generator set. Place the circuit breaker(s) in the ON position to close circuit breaker.
Input Fuse	Protects the controller circuitry.
Battery Charging Fuse	Protects the battery charging circuitry.
Voltage Regulator Fuse	Protects the voltage regulator circuitry.
Remote Start Connector	A 6-pin connector on controller back panel allows connection of (optional) remote start kits.
Hourmeter	Meter records total generator set operating hours for reference in maintenance scheduling.

2.6.2 Starting the Generator Set

The following table describes the actions required to start the generator set.

⚠ WARNING

Explosion.
Gasoline vapors can cause explosion and severe injury or death.

Before starting the generator set, operate the blower 4 minutes and check the engine compartment for gasoline vapors.

Step	Action
1	**Operate the blower.** Operate the blower 4 minutes and check the engine compartment for gasoline vapors.
2	**Fuel shut-off valve.** Open the manual fuel shut-off valve, if equipped.
3	**Starting.** Place the generator set controller start/stop switch or the remote start/stop switch in the START position.

2.6.3 Remote Panel Gauge Operation

If the generator set has an optional remote panel with gauges, observe the gauges upon engine start-up. If gauge readings are not within the ranges specified, contact an authorized service distributor/dealer.

Gauge	Normal Operating Range
Oil pressure	276-414 kPa (40-60 psi)*
Water temperature	91-104°C (195-219°F)
DC voltmeter	12-14 volts

*50 Hz models show a slightly lower pressure range.

2.6.4 Stopping the Generator Set

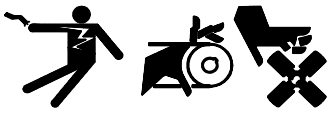
The following table describes the actions required to stop the generator set.

Step	Action
1	**Cooldown** Run generator set at no load for 5 minutes to ensure adequate engine cooldown.
2	**Stopping** Place controller start/stop switch or remote start/stop switch in the stop position and wait until the generator set comes to a complete stop.
3	**Fuel shut-off valve** Close the manual fuel shut-off valve, if equipped.

Notes

3.1 General Maintenance

⚠ 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 equipment connected to the set, disable the generator set as follows: (1) Place the generator set start/stop switch in the STOP position. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

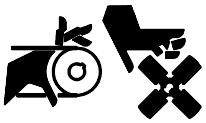
⚠ WARNING

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.

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Operate the generator set only when all guards, screens, and covers are in place.

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

Sound shield removal. Exposed moving parts can cause severe injury or death. The generator set must be operating in order to perform some scheduled maintenance procedures. Be especially careful if the sound shield has been removed, leaving the belts and pulleys exposed.
(Sound-shield-equipped models only)

NOTICE

Saltwater damage. Saltwater quickly deteriorates metals. Wipe up saltwater on and around the generator set and remove salt deposits from metal surfaces.

NOTICE

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

Annual Inspection. Kohler Co. recommends that all boat owners have their vessels—especially the exhaust system attached to the generator set—inspected at the start of each boating season by their local Coast Guard Auxiliary. If there is no Coast Guard Auxiliary in the area, contact an authorized Kohler distributor/dealer for the inspection.

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

Engine Service. Perform generator set engine service at the intervals specified by the engine operation manual.

Generator Set Service. Perform generator set service at the intervals specified by the generator set operation manual.

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

Routine Maintenance. Refer to the following generator set service schedule, the engine service schedule, and the hourmeter located on the generator set controller to determine when to schedule routine maintenance. Service more frequently generator sets that are subject to extreme weather or dusty or dirty conditions.

Service Log. Use the Operating Hour Service Log located in the back of this manual to document performed services.

Service Schedule. Perform maintenance on each item in the service schedule at the designated intervals for the life of the generator set. For example, an item requiring service every 100 hours or 3 months also requires service after 200 hours or 6 months, 300 hours or 9 months, and so on.

x:sm:004:001

3.2 Service Schedule

Perform Service at Intervals Indicated (X)	Reference Section	Before Starting	After 50 Hrs or 1 Month	Every 100 Hrs or 3 Months	Every 300 Hrs or 6 Months	Every 500 Hrs or Yearly
FUEL SYSTEM						
Check the fuel level and fill as necessary	2.1	X				
Lubricate carburetor and choke linkage *	3.4.2			X (200 hrs)		
Check fuel lines and replace as necessary *†					X	
LUBRICATION SYSTEM						
Check crankcase oil level and add as necessary	3.3.2	X				
Replace the oil in crankcase *	3.3.4		X (20 hrs break-in period)	X		
Replace the lube oil filter element *	3.3.5		X (20 hrs break-in period)	X (200 hrs)		
COOLING SYSTEM						
Check coolant level and fill as necessary *	3.7.1	X				
Check seawater outlet and clean as necessary †	3.7.6	X (during operation)				
Check function of siphon break, if equipped	3.7.4			X		
Replace seawater pump impeller *†	3.7.3				X (check)	X
Check heat exchanger anticorrosion zinc condition *	3.7.5			X		
Replace heat exchanger anticorrosion zinc *	3.7.5					X
Flush cooling system *†	3.7.1					X (400 hrs)
IGNITION SYSTEM						
Clean and regap spark plugs *	3.8			X		
Replace spark plugs *	3.8				X	

* Requires removal of sound shield, if installed.

† Consult your local distributor/dealer for service.

Service Schedule, continued

Perform Service at Intervals Indicated (X)	Reference Section	Before Starting	After 50 Hrs or 1 Month	Every 100 Hrs or 3 Months	Every 300 Hrs or 6 Months	Every 500 Hrs or Yearly
INTAKE/EXHAUST SYSTEM						
Inspect exhaust system components *†	3.6	X				
Check the exhaust gas condition	3.6	X (during operation)				
Service backfire flame arrestor *	3.5			X		
Clean the exhaust/water mixing elbow *†	3.6			X (200 hrs)		
Check the crankcase breather pipe for obstructions *†					X	
Inspect the complete exhaust system ***	3.6					X
ELECTRICAL SYSTEM						
Keep battery charged and in good condition ⊕	3.9	X				
Check and tighten electrical connections *			X			
Clean battery cables †				X (200 hrs)		
ENGINE AND MOUNTING						
Check for water, fuel, coolant, and oil leakage *†‡		X				
Retighten all nuts and bolts *		X				
Check tightness of mounting bolts/vibromounts *				X (200 hrs)		
Check and adjust valve clearance *†					X	
Clean combustion chamber *†					X	
REMOTE CONTROL SYSTEM						
Check remote control operation	2.6.3		X (break-in period)			X
GENERATOR						
Test run generator set	2.5		X (weekly)			
Blow dust out of generator *†	3.1					X

* Requires removal of sound shield, if installed.

† Consult your local distributor/dealer for service.

‡ Read WARNING found at the beginning of manual regarding moving parts.

*** Should be performed by your local distributor/dealer.

⊕ Consult battery manufacturer's instructions.

3.3 Lubrication System

3.3.1 Oil Specifications

Use oil that meets the American Petroleum Institute (API) classification of SC, SD, SE, SF, SG, or SH. Using unsuitable oil or neglecting an oil change may result in engine damage that is not covered by the engine warranty. Figure 3-1 shows the recommended Society of Automotive Engineers (SAE) viscosity designation for given operating temperature ranges.

Do not mix different oil brands. Incompatibility could cause a breakdown of lubricating ingredients and reduce engine protection.

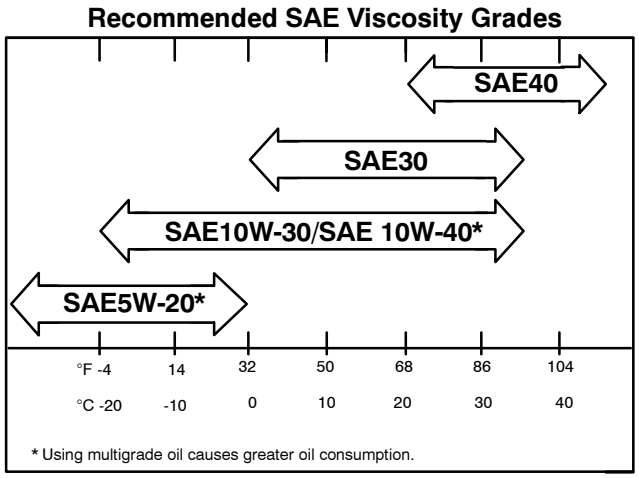


Figure 3-1 Engine Oil Selection

3.3.2 Oil Check

Check the oil level in the crankcase daily or before each start-up to ensure that the level is in the safe range. Do not check the oil level while operating the unit. Stop the generator set and keep the generator set level to get an accurate reading. To check the oil level, remove the dipstick and wipe the end clean, reinsert and remove. Maintain the oil level between the Full and Add marks on the dipstick, as shown in Figure 3-2. See Section 1—Service Views for the dipstick location.

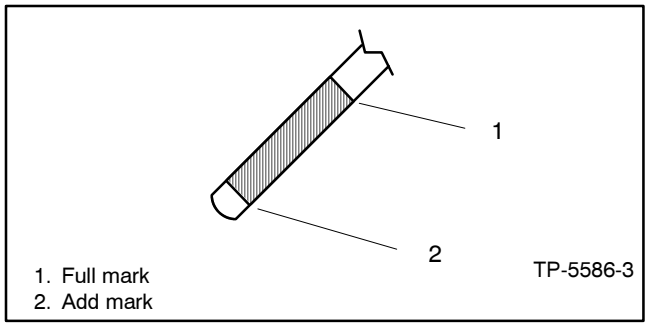


Figure 3-2 Oil Level Check

Note: Do not operate the set if the oil level is below the Add mark on the dipstick or above the Full mark on the dipstick.

3.3.3 Oil Additions

Adding some oil between oil changes is normal. The amount varies with generator set usage. Open the oil fill cap and pour in a small amount of oil using a funnel or other suitable pouring device. See Section 1—Service Views for the oil check and oil fill locations.

3.3.4 Oil Change

Change the oil according to the service schedule or before generator set storage. Change the oil more frequently if the generator set operates under dirty, dusty conditions. Change the oil while the engine is still warm. See Figure 3-3 for oil capacity. See Section 1—Service Views for oil fill, oil check, and oil filter locations.

Model	L (Qts.)
All models	1.36 (1.44)

Figure 3-3 Oil Capacity (with Filter)

Oil Change Procedure

1. Stop the generator set.
2. To drain the oil, open the oil-drain valve. See Section 1 for the valve location.
3. Drain the oil into a suitable container.
4. Allow ample time for all oil to drain.
5. Close the oil-drain valve.
6. Remove the oil-fill cap.
7. Replace the engine oil filter according to the service schedule and the procedure in Section 3.3.5.
8. Fill crankcase with oil. Section 1 shows the oil fill location. See Figure 3-1 for oil selection and Figure 3-3 for oil capacity. Replace the oil-fill cap.
9. Start the generator set and check for oil leaks.
10. Stop the generator set. Check the oil level. Add oil, as necessary, to bring the level up to the Full mark.

    Note: Too high an oil level causes high oil consumption and engine carbonizing. Too low a level damages the engine.

    Note: Do not pollute the environment. Dispose of used engine oil and other contaminants in a safe, approved manner.

3.3.5 Oil Filter Change

Replace the oil filter at the interval specified in the service schedule. Change the oil filter more frequently if the generator set operates under dirty, dusty conditions. Refer to the following procedure. See Section 1 for oil filter location.

Oil Filter Change Procedure

1. Loosen the oil filter by turning it counterclockwise. Remove the oil filter and use rags to clean up spilled oil. Dispose of the oil filter in an approved manner.
2. Clean the contact surface of the oil filter adapter.
3. Lightly lubricate the gasket surface of the new filter with fresh engine oil. Thread the filter on the adapter until the gasket makes contact and hand-tighten the filter an additional one-half turn. Wash hands after any contact with engine oil.

    Note: If also performing an oil change, skip steps 4 and 5 and go back to oil change procedure.

4. Start the generator set and check for oil leaks.
5. Stop the generator set. Check oil level. Add oil, as necessary, to bring level up to Full mark.

3.4 Fuel System

3.4.1 Fuel Specifications

Use a clean, good-quality unleaded fuel with an octane number of 87. Use fresh gasoline to ensure it is blended for the season and to reduce the possibility of the formation of gum deposits that could clog the fuel system. Do not use gasoline left over from the previous season.

Kohler Co. recommends unleaded fuel because it leaves fewer combustion chamber deposits. Never mix oil with fuel.

Note: Consult the engine owner's manual for oxygenated fuel recommendations.

3.4.2 Carburetor/Choke Lubrication

At the interval specified in the service schedule, lubricate the carburetor and choke linkage using a light oil. See Section 1 for the linkage's location.

3.4.3 Carburetor Adjustment

The carburetor is factory-set. No adjustments are possible.

3.5 Backfire Flame Arrestor

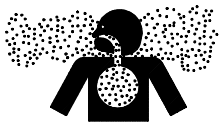
At the interval specified in the service schedule, inspect, clean, *or replace* the backfire flame arrestor. Clean the arrestor more frequently if the generator set operates in dirty, dusty conditions. Check the mesh element for accumulated oil or dirt that could clog the element and cause poor performance. See Section 1 for location. Replace a damaged flame arrestor. Use only USCG-approved Kohler replacement parts. Follow the procedure described below.

Backfire Flame Arrestor Cleaning Procedure

1. Loosen the hose clamp at the breather hose at the air silencer fitting and remove the hose.
2. Loosen the hose clamp attaching the air silencer assembly to the carburetor.
3. Lift off the air silencer assembly.
4. Clean the assembly in evaporative solvent and wipe clean. Allow to dry.
5. Reassemble using the reverse sequence.

3.6 Exhaust System

⚠ WARNING



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

The exhaust system must be leakproof and routinely inspected.

Inspecting the exhaust system. Carbon monoxide can cause severe nausea, fainting, or death. For the safety of the craft's occupants, install a carbon monoxide detector. Consult the boat builder or dealer for approved detector location and installation. Inspect the detector before each generator set use. In addition to routine exhaust system inspection, test the carbon monoxide detector per the manufacturer's instructions and keep the detector operational at all times.

At the interval specified in the service schedule, inspect the exhaust system components (exhaust manifold, mixing elbow, exhaust line, hose clamps, silencer, and outlet flapper) for cracks, leaks, and corrosion.

Exhaust System Inspection Points

Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.

- Check the hoses for softness, cracks, leaks, or dents. Replace the hoses as needed.
- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps. Tighten or replace the hose clamps and/or hangers as needed.
- Check that the exhaust outlet is unobstructed.
- Visually inspect for exhaust leaks *(blowby)*. Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.
- Ensure that the carbon monoxide detector is (1) in the craft, (2) functional, and (3) energized whenever the generator set operates.

3.7 Cooling System

3.7.1 Closed Heat Exchanger

In a closed cooling system, the seawater circulates through separate chambers within the heat exchanger to cool the engine water. The seawater then mixes with engine exhaust and ejects out the exhaust outlet. See Figure 3-4 for coolant capacity (include coolant recovery tank capacity of 0.8 L (0.85 qts.). See Figure 3-5 for thermostat and pressure cap ratings.

Model	L (Qts.)
All models	2.84 (3.0)

Figure 3-4 Coolant Capacity

⚠ WARNING

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

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

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

NOTICE

Saltwater damage. Saltwater quickly deteriorates metals. Wipe up saltwater on and around the generator set and remove salt deposits from metal surfaces.

Checking and Filling Coolant

Maintain the coolant level in coolant recovery tank at approximately 1/4 full. Before filling the cooling system, close all petcocks and tighten all hose clamps. Use a solution of 50% ethylene glycol and 50% clean, softened water to inhibit rust/corrosion and prevent freezing. Add additional coolant, as necessary, to the coolant recovery tank. Periodically check the coolant level on closed systems by removing the pressure cap. Do not rely solely on level in coolant recovery tank. Add fresh coolant until the level is just below the overflow tube opening.

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

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

Model	5/7E
Pressure Cap Rating	96.5 kPa (14 psi)
Thermostat Rating	71°C (160°F)

Figure 3-5 Pressure Cap and Thermostat Rating

Procedure for Flushing and Cleaning Cooling System

For optimum protection drain, flush, and refill the cooling system at the interval listed in the service schedule.

Pay special attention to the coolant level. After the coolant drains, allow time for complete refill of the engine water jacket. Check the coolant level as described earlier.

1. Remove the hose clamp at the coolant hose. See Section 1 for location of the hose.
2. Remove the pressure cap to make draining easier.
3. Drain, clean, and flush the coolant recovery tank.
4. Flush the system with clean water.
5. Replace the hose clamp to secure the coolant hose.
6. Fill the system with the recommended coolant.
7. Replace the pressure cap.

3.7.2 Pressure Cap

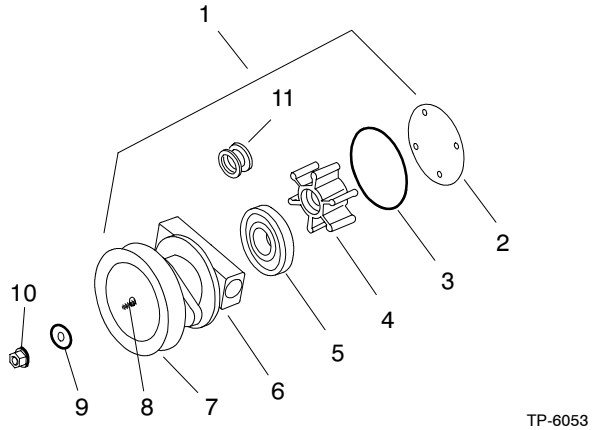
Closed heat exchanger systems utilize a pressure cap to raise the boiling point of the coolant, enabling higher operating temperatures. If the cap leaks, replace it with a cap of the same rating. Find the pressure cap rating in Figure 3-5.

3.7.3 Seawater Pump

The direct-driven seawater pump is located on the generator end of the generator set. Check and change the seawater pump impeller at the interval specified in the service schedule. Follow the instructions included with the impeller kit. If the instructions are not included with the kit, use the following procedure:

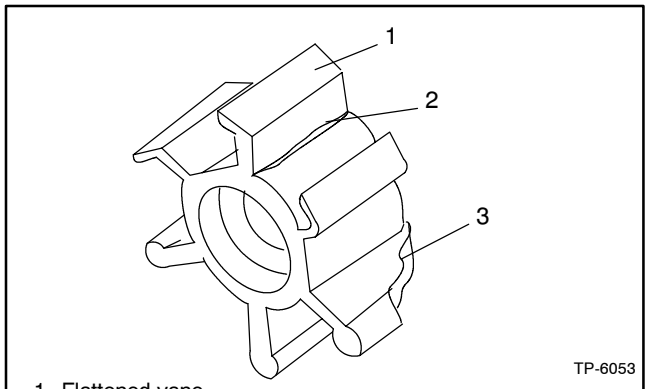
Impeller Inspection and Replacement Procedure:

1. Close the seacock.
2. Remove the seawater pump coverplate. See Figure 3-6.
3. Remove the impeller.
4. Inspect the impeller for damaged, cracked, broken, missing or flattened vanes. The impeller vanes should be straight and flexible. See Figure 3-7. Replace the impeller if it is damaged.



1. Seawater pump
2. Coverplate
3. Gasket
4. Impeller
5. Bearing
6. Housing
7. Pulley
8. Drive shaft
9. Washer
10. Nut
11. Mechanical seal, if equipped

Figure 3-6 Seawater Pump, Typical



1. Flattened vane
2. Crack
3. Broken vane

Figure 3-7 Worn Impeller

5. Lubricate the impeller with soapy water before installation.
6. Install the impeller.

   Note: During installation push and rotate the impeller in the same direction as the engine rotation until it is thoroughly seated in the impeller housing.

7. Inspect the coverplate and gasket for corrosion and/or damage. Replace components as necessary.
8. Lubricate the gasket with silicon grease and attach the gasket and coverplate to the seawater pump housing.
9. Open the seacock.
10. Start the generator set and check for leaks.
11. Stop the generator set and repair leaks or replace damaged or worn components.

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3.7.4 Siphon Break

A siphon break prevents seawater entry into the generator set's engine when the engine exhaust manifold outlet is less than 230 mm (9 in.) above the waterline of a fully loaded, docked or stationary craft. See Figure 3-9. The siphon break may malfunction when the generator set operates while the craft is in contaminated waters or saltwater. Use the following procedure to inspect the siphon break at the intervals listed in the service schedule.

Siphon Break Inspection

1. Stop the generator set.
2. Remove the retaining cap and remove the reed valve for inspection. See Figure 3-8.
3. Use a mild detergent to remove residue and oxidation from the reed valve.
4. Clear blockage from the reed valve opening.
5. Replace the siphon break if the reed valve is cracked or if the reed valve material has hardened or deteriorated.
6. Install the reed valve into the mounting base with the valve downward. See Figure 3-8, item 3.
7. Install and only finger tighten the retaining cap. Do not overtighten it.

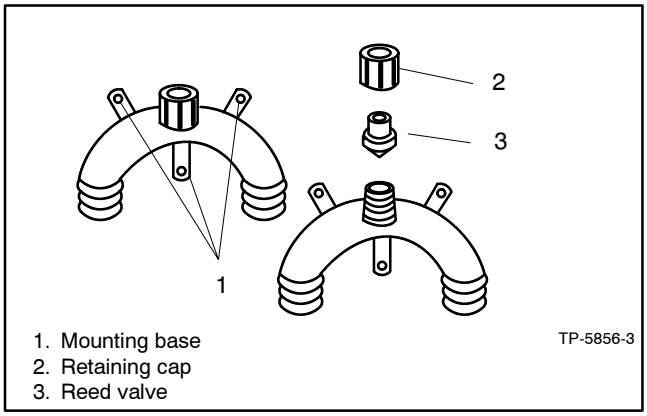

Figure 3-8 Siphon Break

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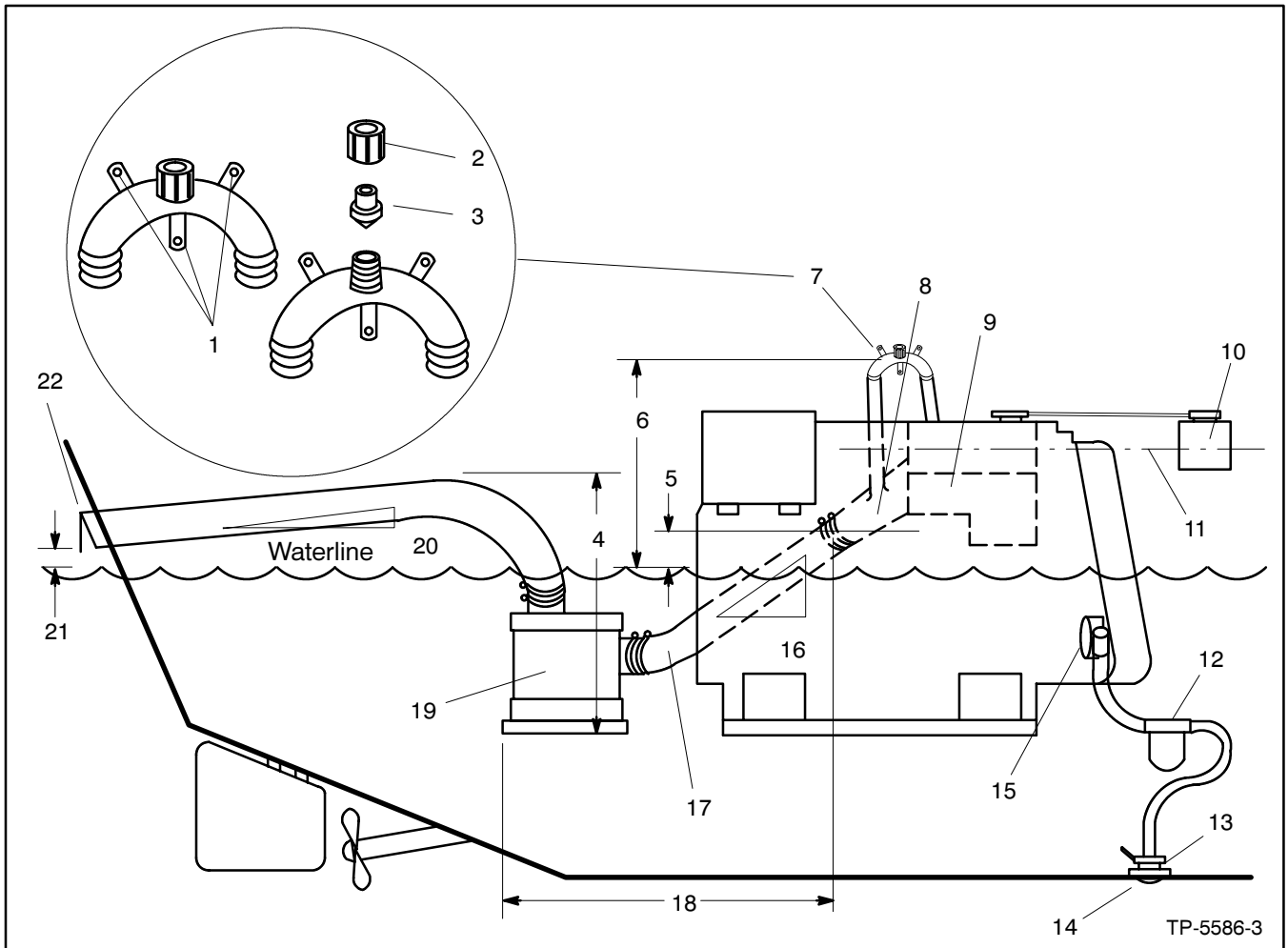


1. Mounting base
2. Retaining cap
3. Reed valve assembly
4. Silencer vertical lift 1.2 m (4 ft.) max.
5. Exhaust mixer elbow distance above waterline. If less than 23 cm (9 in.), siphon break is required.
6. Siphon break distance above waterline 30.5 cm (1 ft.) min.
7. Siphon break
8. Exhaust mixer elbow
9. Heat exchanger (locations vary by model)
10. Coolant recovery tank
11. Locate coolant recovery tank at same height as heat exchanger
12. Seawater strainer
13. Seacock
14. Intake strainer
15. Engine-driven seawater pump
16. Exhaust hose pitch 1.3 cm per 30.5 cm (0.5 in. per ft.) min.
17. Water lock (optional)
18. Silencer distance from exhaust mixer elbow 3 m (10 ft.) max.
19. Silencer (customer-supplied)
20. Exhaust hose pitch 1.3 cm per 30.5 cm (0.5 in. per ft.) min.
21. Exhaust outlet distance above waterline 10 cm (4 in.) min.
22. Seawater outlet

Figure 3-9 Siphon Break (Plastic “U” Type) Installation

Note: Consult the installation manual for complete explanation of dimensions and other installation considerations.

3.7.5 Anticorrosion Zinc Anode

The heat exchanger on these models contains an anticorrosion zinc anode (plug) to prevent electrolytic corrosion by seawater.

Check and replace the anticorrosion zinc anode at intervals recommended in the service schedule. Depending upon operating conditions and seawater properties, the anticorrosion zinc anode may require more frequent replacement. See Section 1—Service Views for location and use the following procedure.

Anticorrosion Zinc Anode Replacement Procedure

1. With the generator set cooled, close the seacock, remove the anticorrosion zinc plug from the heat exchanger, and drain the coolant into a suitable container.

2. Use a wire brush to remove the loose corrosion on the anticorrosion zinc anode. Replace the anode according to Figure 3-10 and Figure 3-11.

Anticorrosion Zinc Anode Replacement		
Models	**New Anode Dimensions mm (in.)**	**Replace When Percent of Zinc Remaining Is:**
5/7.3E and 4/6EF	9 (0.34) x 43 (1.7)	<50% of length/diameter

Figure 3-10 Anticorrosion Zinc Anode (Plug) Measurements

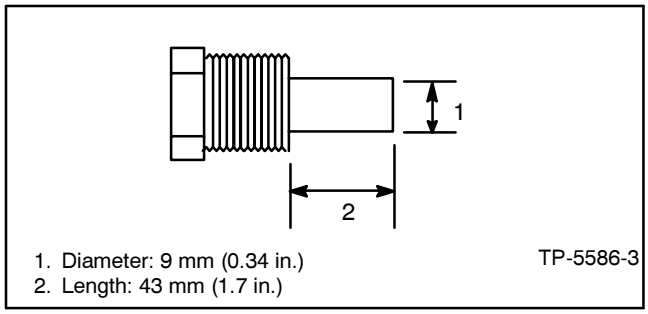


Figure 3-11 Anticorrosion Zinc Anode (Plug)

3. Clean the threaded hole of the heat exchanger and coat the threads of the anticorrosion zinc anode (plug) with pipe sealant suitable for marine applications. Install the anticorrosion zinc anode into the heat exchanger.

4. Open the seacock. Refill the cooling system.

5. Start the generator set and check for leaks at the anticorrosion zinc anode location. The pump is operating if cooling water flows from the exhaust outlet. If water is not discharging at the exhaust outlet, see Prestart Checklist—Seawater Pump Priming.

3.7.6 Seawater Outlet

Check the seawater outlet at the interval specified in the service schedule. See Figure 3-9 for location. Remove any obstructions to keep the outlet clear.

3.8 Ignition System

Service spark plugs at the interval specified in the service schedule using the following procedure.

Spark Plug Service Procedure

1. Remove spark plug wires by grasping the spark plug boot and turning slightly while pulling. Do not pull the wire. Pulling on the wire rather than the boot may damage the wire or terminal.

2. Loosen the spark plug with a ratchet and 5/8-in. spark plug socket with a rubber insert to prevent spark plug damage.

3. Use compressed air to remove dirt from around each spark plug to prevent dirt particles from falling into the combustion chamber.

4. Remove spark plugs, one at a time, and examine. Identify a normal spark plug in good operating condition by observing a light tan or gray deposit on the firing tip. See Figure 3-12 to evaluate engine condition by color/condition of a problem spark plug.

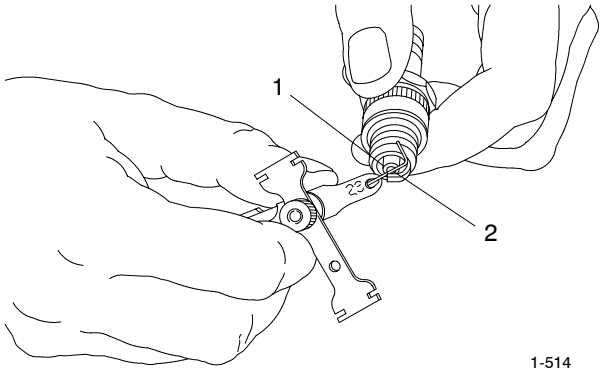
Problem/Condition	Means of Identification	Possible Cause/Solution
Gap-bridged spark plug	Built-up deposits and gap between electrodes closing.	Oil or carbon fouling. Clean and regap the spark plug.
Oil-fouled spark plug	Wet, black deposits on the insulator shell, bore, and electrodes.	Excessive oil entering combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. Replace the spark plug.
Carbon-fouled spark plug	Black, dry, fluffy carbon deposits on insulator tips, exposed shell surfaces and electrodes.	Incorrect spark plug, weak ignition, clogged air intake, defective fuel pump, overrich fuel mixture, or excessive no-load operation. Clean and regap the spark plug.
Lead-fouled spark plug	Dark gray, black, yellow, or tan deposits; or a glazed coating on the insulator tip.	Caused by highly leaded fuel. Replace the spark plug.
Preignition damaged spark plug	Melted electrodes and possibly blistered insulator. Metallic deposits on insulator suggest internal engine damage.	Wrong type of fuel, incorrect timing or advance, too hot a plug, burned valves, or engine overheating. Replace the spark plug.
Overheated spark plug	White or light gray insulator with small black or gray/brown spots with bluish (burned) appearance on electrodes.	Engine overheating, wrong type of fuel, loose spark plugs, too hot a plug, low fuel pump pressure or incorrect ignition timing. Replace the spark plug.
Worn spark plug	Severely eroded or worn electrodes.	Caused by normal wear and failure to replace spark plug at prescribed interval. Replace the spark plug.

Figure 3-12 Engine Evaluation Using Spark Plug Condition

5. Clean spark plugs by wiping them with a rag. File the center electrode to keep it parallel to the side electrode.

   Note: Do not sandblast, wire brush, scrape, or otherwise service spark plug in poor condition. Obtain a new plug for best results.

6. Check the spark plug gap before installing any spark plug. See Figure 3-13. Attain a correct gap when the feeler (or wire) passes between the spark plug electrode. It should pass easily but with some resistance or drag; otherwise adjust as necessary. The correct gap is 0.6-0.7 mm (0.024-0.028 in.).



1. 0.6-0.7 mm (0.024-0.028 in.) gap
2. Spark plug electrodes

Figure 3-13 Spark Plug Gap Inspection

7. Use a gapping tool to gently bend the side electrode closer to or farther from the center electrode to set the correct gap. See Figure 3-14. Position the side electrode directly over the center electrode.

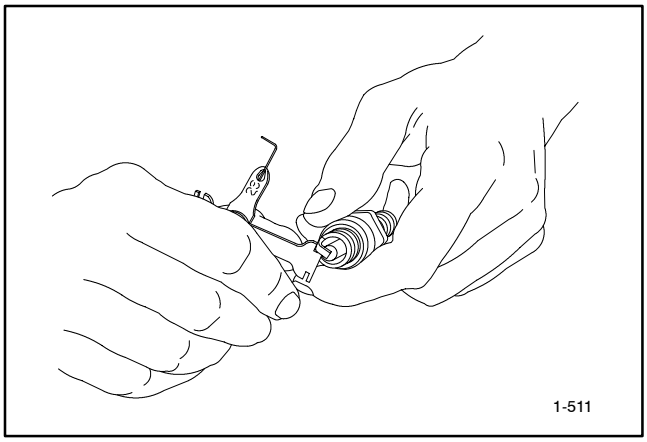


Figure 3-14 Spark Plug Gap Adjustment

8. Reinstall the spark plug. Do not bump the electrode against the cylinder head. Rotate the spark plug clockwise until feeling resistance.

9. Use a torque wrench to torque each spark plug to 12-17 Nm (9-12 ft. lbs.). Otherwise, hand-tighten spark plug until feeling resistance.

10. Use a ratchet wrench to final tighten an additional 1/4 turn. Do not overtighten, as doing so may strip threads or alter electrode gap setting.

11. Check spark plug wire connector in boot for accumulated dirt, grease, and other debris, and clean as necessary.

12. Firmly push spark plug boot onto spark plug.

3.9 Battery

Consult the battery manufacturer's instructions regarding battery care and maintenance.

⚠ 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 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.

3.10 Generator Storage Procedure

Keep the craft afloat for generator operation during the storage procedure. Follow the procedure below when storing your generator set for a long period (3 months or more).

1. Start and run the generator set until it reaches operating temperature or about 15 minutes.
2. Stop the generator set.
3. Change the oil and oil filter; see Section 3.3.4—Oil Change and Section 3.3.5—Oil Filter Change.
4. Close the seacock and remove the hose at the seacock. Place the hose in a container having approximately 3.7-7.5 L (1-2 U.S. gallons) of coolant/antifreeze. Kohler Co. recommends using an environmentally friendly potable antifreeze such as Peak® RV/marine propylene glycol/water mix or equivalent.
5. With a suitable container at the exhaust outlet, run the generator set until coolant discharges at the exhaust outlet or until depleting the coolant mixture. Do not allow coolant mixture to flow into waterways.
6. Stop the generator set.
7. Connect the hose to the seacock. Leave the seacock closed.
8. Check the coolant level of the heat exchanger and add coolant if necessary.

   Note: Use antifreeze capable of withstanding the lowest possible temperatures.

9. Drain fuel completely from the fuel tank.
10. Clean the exterior of the generator set and spread a light film of oil or silicon spray over any exposed surfaces that may be subject to rust or corrosion.
11. Keep spark plugs in their holes or seal spark plug holes with suitable threaded metal plugs.
12. Seal the air inlet, exhaust pipe, and fuel tank cap with tape.
13. Disconnect and remove the battery. Place the battery in a warm, dry location for the storage period. Recharge the battery once a month to maintain a full charge.
14. Select a well-ventilated (not humid or dusty) location to store the generator.
15. Cover the entire unit with a dust cover.

    Note: Run the generator set once a month whenever possible.

Section 4 Troubleshooting

This section contains generator set troubleshooting, diagnostic, and repair information.

Use the following chart as a quick troubleshooting reference. The table groups generator set faults and suggests likely causes and remedies. The table also refers you to more detailed information including sections of this manual, the generator set service manual (S/M), the generator set installation manual (I/M), and the engine service manual (Engine S/M) to correct the indicated problem.

Corrective action and testing often require knowledge of electrical and electronic circuits. To avoid additional problems caused by incorrect repairs, have an authorized service distributor/dealer perform service.

NOTICE

Fuse replacement. Replace fuses with fuses of the same ampere rating and type (for example: 3AB or 314, ceramic). Do not substitute clear glass-type fuses for ceramic fuses. Refer to the wiring diagram when the ampere rating is unknown or questionable.

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

x:gt:001:002a:

Trouble Symptoms										Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	Cranks but does not start	Starts hard	No or low output voltage	Stops suddenly	Lacks power	Overheats	Low oil pressure	High fuel consumption	Excessive or abnormal noise			
Controller												
x										Controller start/stop switch in the STOP position	Move the controller start/stop switch to the START position.	Section 2
x	x			x						Controller fuse blown	Replace the blown controller fuse. If the fuse blows again, troubleshoot the controller.†	Section 2, W/D
x				x						Controller circuit breaker tripped	Reset the controller circuit breaker.	Section 2
x										Controller master or start/stop switch inoperative	Replace the controller master or start/stop switch.	—
				x						Controller fault	Troubleshoot the controller.†	Gen. S/M
x	x									Controller circuit board(s) inoperative	Replace the controller circuit board.	Gen. S/M
Cooling System												
						x		x		Air openings clogged	Clean the air openings.	—
						x				Impeller inoperative	Replace the impeller	Section 3
						x		x		Seawater strainer clogged or restricted	Clean the strainer.	Section 3
				x						High temperature shutdown	Allow the engine to cool down. Then troubleshoot the cooling system.	Sec. 3, Eng. O/M
				x						Low coolant level shutdown, if equipped	Restore the coolant to normal operating level.	Section 3
						x				Coolant level low	Restore the coolant to normal operating level.	Section 3
						x				Thermostat inoperative	Replace the thermostat.	Eng. S/M

* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

Trouble Symptoms										Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	Cranks but does not start	Starts hard	No or low output voltage	Stops suddenly	Lacks power	Overheats	Low oil pressure	High fuel consumption	Excessive or abnormal noise			
Electrical System (DC circuits)												
x	x									Battery connections loose, corroded, or incorrect	Verify that the battery connections are correct, clean, and tight.	Section 3
x	x									Battery weak or dead	Recharge or replace the battery. The spec sheet provides recommended battery CCA rating.	Section 3, S/S
x				x						Engine harness connector(s) not locked tight	Disconnect the engine harness connector(s) then reconnect it to the controller.	W/D
				x						Fault shutdown	Reset the fault switches and troubleshoot the controller.	Section 2
				x						High exhaust temperature switch inoperative	Replace the inoperative switch.	Gen. S/M or W/D
x	x									Starter/starter solenoid inoperative	Replace the starter or starter solenoid.	Eng. S/M
				x						High water temperature switch inoperative	Replace the inoperative switch.	Gen. S/M or W/D
	x									Faulty ground connection	Clean and retighten the connection.	—
Engine												
	x	x			x			x		Air cleaner/backfire flame arrestor clogged	Clean or replace the filter element.	Section 2
	x	x				x		x	x	Compression weak	Check the compression.†	Eng. S/M
			x		x	x		x	x	Engine overload	Reduce the electrical load. See the generator set installation manual for wattage specifications.	I/M
									x	Exhaust system leak	Inspect the exhaust system. Replace the inoperative exhaust system components.†	Section 3, I/M
									x	Exhaust system not securely installed	Inspect the exhaust system. Tighten the loose exhaust system components.†	Section 3, I/M
					x				x	Valve clearance incorrect	Adjust the valves.†	Eng. S/M
									x	Vibration excessive	Tighten all loose hardware.	—
	x	x			x					Ignition system inoperative (gas/gasoline only)	Check the ignition system (ignition module, spark plugs, spark plug wires, etc.).	Eng. O/M

* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram

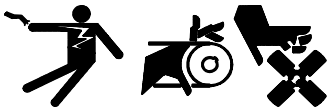
† Have an authorized service distributor/dealer perform this service.

Trouble Symptoms										Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	Cranks but does not start	Starts hard	No or low output voltage	Stops suddenly	Lacks power	Overheats	Low oil pressure	High fuel consumption	Excessive or abnormal noise			
Fuel System												
	x			x						Fuel tank empty or fuel valve shut off	Add fuel and move the fuel valve to the ON position.	—
	x				x					Fuel pressure insufficient (gas only)	Check the fuel supply and valves.†	S/S, Gen. O/M
	x	x		x	x					Fuel line restriction	Check the fuel lines and fuel tank.	Eng. O/M
	x									Antidieseling solenoid inoperative	Replace the solenoid.†	Eng. S/M
	x	x			x					Stale or bad fuel. Incorrect type of fuel	Replace fuel. Clean the carburetor.	Sec. 3, Eng S/M
	x				x			x		Fuel feed pump inoperative	Replace the fuel feed pump.†	Eng. S/M
Generator												
			x							AC output circuit breaker open	Reset the breaker and check for AC voltage at the generator side of the circuit breaker.	—
x										Transfer switch test switch in the OFF position	Move the transfer switch test switch to the AUTO position.	ATS O/M
			x							Wiring, terminals, or pin in the exciter field open	Check for continuity.	Gen. S/M, W/D
			x							Main field (rotor) inoperative (open or grounded)	Test and/or replace the rotor.†	Gen. S/M
			x							Stator inoperative (open or grounded)	Test and/or replace the stator.†	Gen. S/M
									x	Vibration excessive	Tighten loose components.†	—
			x	x						Voltage regulator out of adjustment	Adjust the voltage regulator.	Gen. S/M
			x	x						Voltage regulator inoperative	Replace the voltage regulator fuse, If the fuse blows again, troubleshoot the voltage regulator.	Gen. S/M
Lube System												
						x	x		x	Oil level low	Restore the oil level. Inspect the generator set for oil leaks.	Eng. O/M
				x						Low oil pressure shutdown	Check the oil level.	Eng. O/M
				x						Low oil pressure (LOP) switch inoperative	Replace the LOP switch.	W/D
	x	x					x		x	Crankcase oil type incorrect for ambient temperature	Change the oil. Use oil with a viscosity suitable for the operating climate.	Eng. O/M

* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

⚠ WARNING

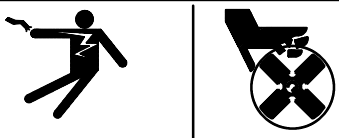


Accidental starting.
Can cause severe injury or death.

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 equipment connected to the set, disable the generator set as follows: (1) Place the generator set start/stop switch in the STOP position. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

⚠ WARNING



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

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

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

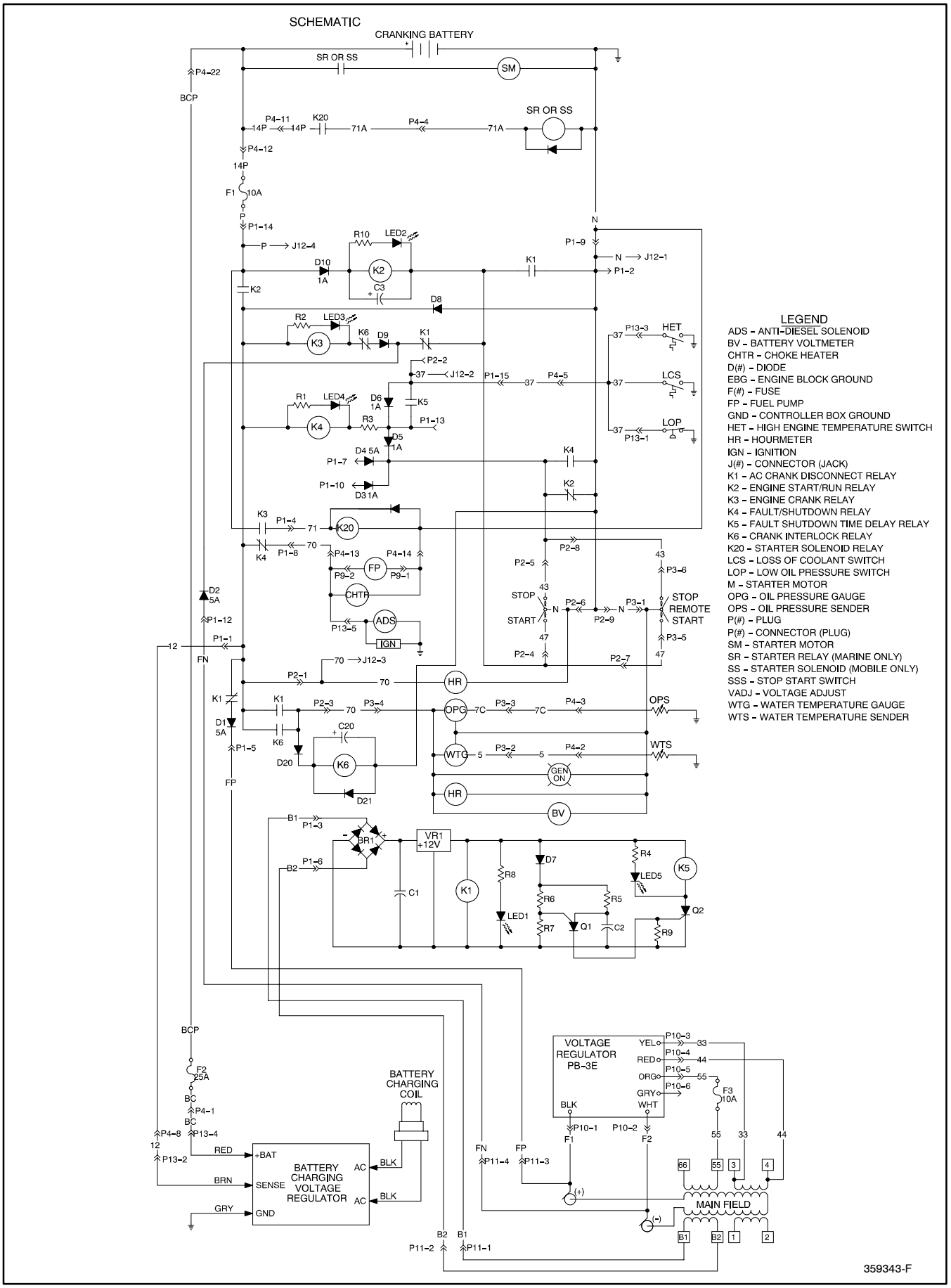


Figure 5-1 Schematic Wiring Diagram

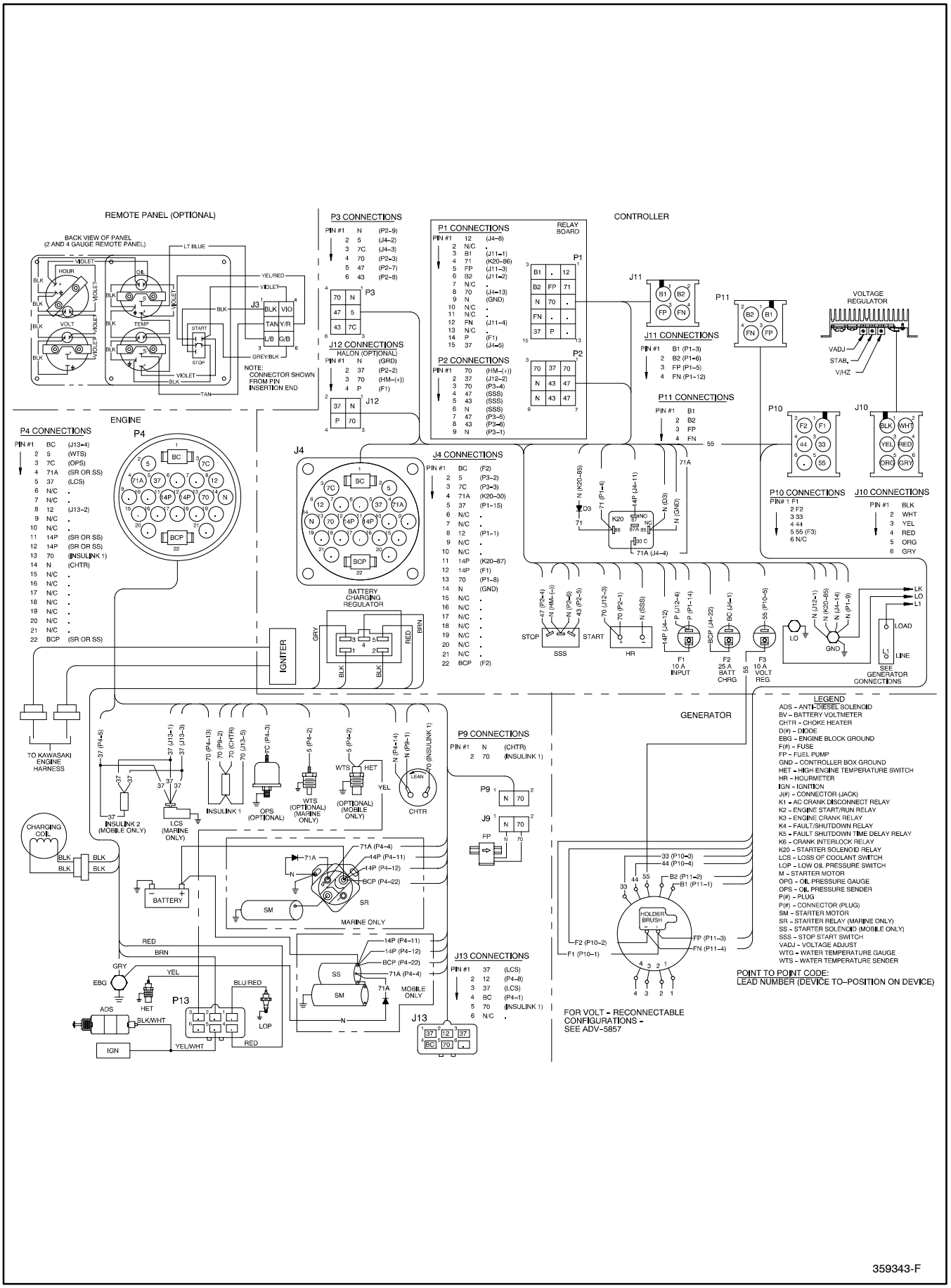


Figure 5-2 Point-to-Point Wiring Diagram

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	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
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
API	American Petroleum Institute
approx.	approximate, approximately
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
A/V	audiovisual
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
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
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)
cogen.	cogeneration
Com	communications (port)
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	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, emer.	emergency (power source)
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
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lbs.	foot pounds (torque)
ft./min.	feet per minute
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 temperature
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)
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. lbs.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard
k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)

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
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
ld. shd.	load shed
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/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCM	one thousand circular mils
MCCB	molded-case circuit breaker
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
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
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
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTV	room temperature vulcanization
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
SN	serial number
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec, specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
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
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
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
w/o	without
wt.	weight
xfmr	transformer

Appendix B Operating Hour Service Log

Use the log below to keep a cumulative record of operating hours on your generator set and the dates required services were performed. Enter hours to the nearest quarter hour.

DATE RUN	OPERATING HOURS		SERVICE RECORD	
	HOURS RUN	TOTAL HOURS	SERVICE DATE	SERVICE

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