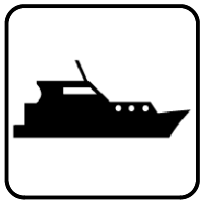
Operation

Marine Generator Sets



Models:

4EFOZ/5EOZ, 6.5EFOZ/8EOZ
9EFOZ/10EOZ, 8.5EFOZ, 11EFOZ/13EOZ
11.5EFOZ/14EOZ, 13EFOZ/15.5EOZ
16EFOZ/20EOZ, 17.5EFOZ/20EOZ
19EFOZ/23EOZ, 20EFOZ/24EOZ
23EFOZ/28EOZ, 27EFOZ/32EOZ

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6068 10/02b

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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***.

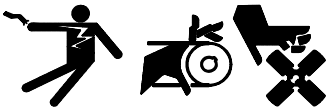
NOTICE

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.

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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.

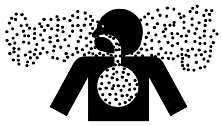
Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner/silencer removed.

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.

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

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.

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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.

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



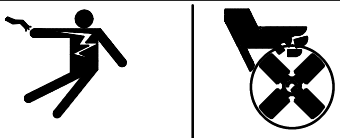
Hazardous noise.
Can cause hearing loss.

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.

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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.

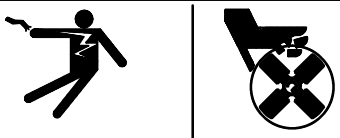
Do not work on the generator set until it cools.

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

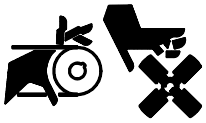
⚠ WARNING



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.

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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.

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Notes

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Introduction

This manual provides operation instructions for 4-27EFOZ/5-32EOZ 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

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	Models				
	4EFOZ/ 5EOZ	6.5EFOZ/ 8EOZ	8.5EFOZ, 9EFOZ/ 10EOZ	11–20EFOZ/ 13–24EOZ	23/27EFOZ/ 28/32EOZ
Air Cleaner	N/A	N/A	N/A	N/A	A-344931 (w/sound shield) A-344930 (w/o sound shield) for Specs: PA-126212 PA-126213 PA-126214 PA-126215 PA-126177 PA-126178 PA-126185 PA-126186
Air Filter Element	278612	278858	278858	250902 13/20EOZ and 11/16/17.5EFOZ models with serial numbers after 0723548, use air filter element number GM24456	GM16944 for Specs: GM24459-GA1 GM24459-GA2 GM24459-GA3 GM24459-GA4 GM24459-GA5 GM24459-GA6 GM24459-GA7 GM24459-GA8
Battery Charging Fuse (10 amp)	223316	223316	223316	223316	223316
DC Circuit Breaker (10 amp)	250719	250719	250719	250719	250719
Fuel Filter Element	229715	229715	252898	252898	363418
Oil Filter	229678	229678	252834	252834	252834
Seawater Pump Impeller Kit	229826	229826	229826	229955	229826
Spray Paint (White)	221335	221335	221335	221335	221335
Touch-Up Paint (White)	GM19490	GM19490	GM19490	GM19490	GM19490
V-Belt (Alternator)	229553	363064	225428 (12-volt models) 344920 (24-volt models)	GM11551 (12-volt models) 344829 (24-volt models)	363205 (12-volt models) 258955 (24-volt models)
V-Belt (Seawater Pump)	GM13660	GM13660	229125	256503	249989
Voltage Regulator Fuse (8 amp)	258405	258405	258405	258405	258405
Zinc Anode	267928	267928	267928	N/A	267928

Figure 1 Maintenance and Service Parts

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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	Models			
	8.5EFOZ, 4/9EFOZ, and 5/10EOZ	**6.5EFOZ and 8EOZ**	**11-20EFOZ and 13-24EOZ**	**23/27EFOZ and 28/32EOZ**
Installation Manual	TP-6069	TP-6069	TP-6069	TP-6069
Operation Manual	TP-6068	TP-6068	TP-6068	TP-6068
Parts Catalog*	TP-5616 (4EFOZ/5EOZ) TP-5587 (8.5EFOZ, 9EFOZ/ 10EOZ)	TP-5616	TP-5591 (11-13EFOZ/ 13-15.5EOZ) TP-5593 (16-20EFOZ/ 20-24EOZ)	TP-5998
Service Manual (Engine)	TP-5876	TP-5876	TP-5876	TP-6054
Service Manual (Generator)	TP-6053	TP-6053	TP-6071	TP-5936

* Includes the generator and engine information.

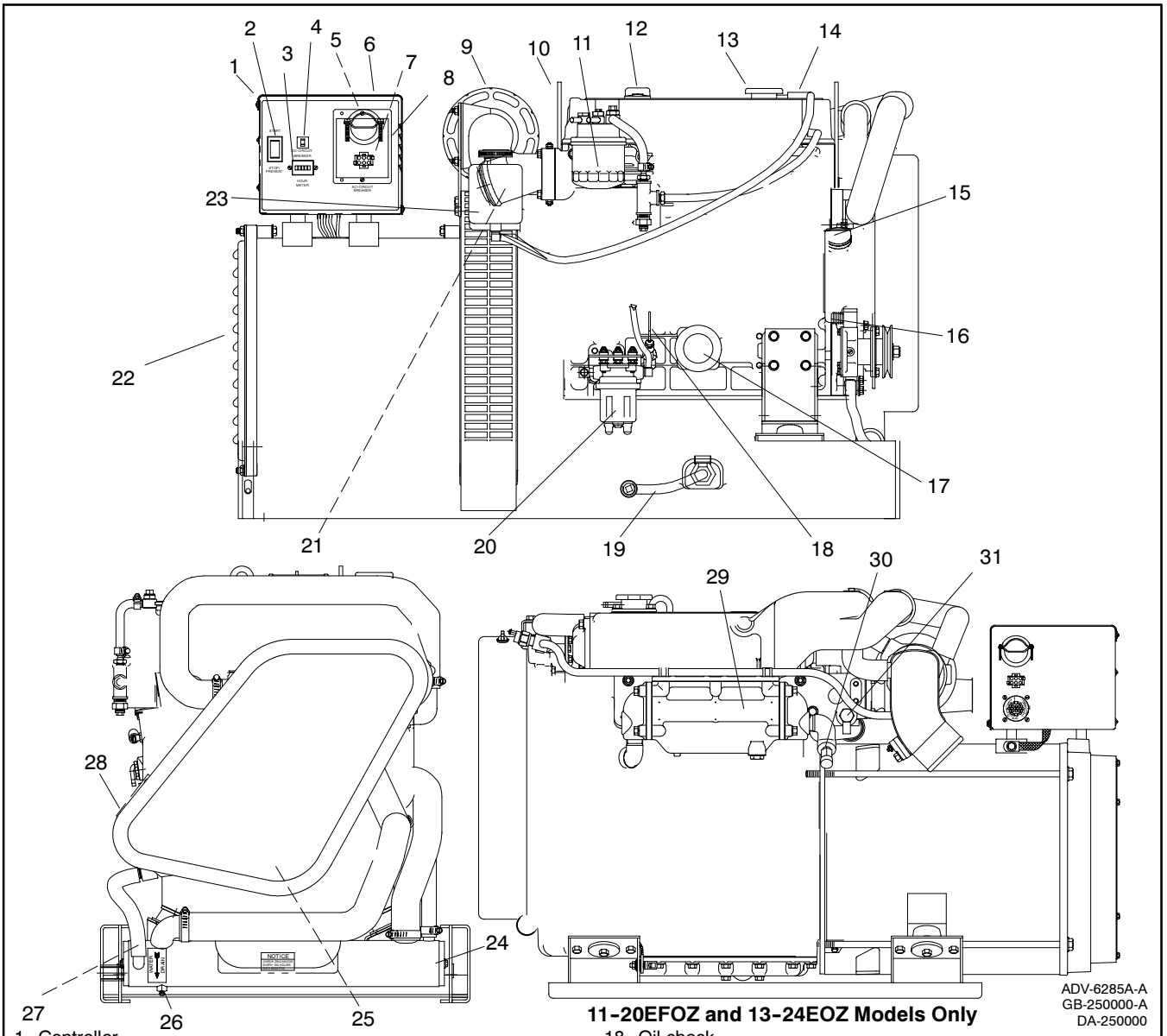
Figure 2 Generator Set Literature

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Notes

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1. Controller
2. Start/Stop switch
3. Hourmeter
4. DC circuit breaker
5. AC load lead connector (rear)
6. Nameplate (top)
7. Remote start connector (rear)
8. AC circuit breaker
9. Air intake silencer
10. Lifting eye
11. Fuel filter
12. Oil fill
13. Pressure cap
14. Overflow tube
15. Oil fill
16. Seawater pump (water inlet)
17. Lube oil filter

11-20EFOZ and 13-24EOZ Models Only

18. Oil check
19. Oil drain valve and hose
20. Fuel feed pump
21. Mixing elbow (water outlet/exhaust outlet)
22. Cooling air inlet
23. Coolant overflow bottle (location varies by model)
24. Heat exchanger (all models except 11-20EFOZ & 13-24EOZ)
25. V-belts
26. Coolant (freshwater) drain (all models except 11-20EFOZ & 13-24EOZ)
27. Anticorrosion zinc anode (seawater drain) (all models except 11-20EFOZ & 13-24EOZ)
28. Belt guard
29. Heat exchanger (located on nonservice side of unit for 11-20EFOZ & 13-24EOZ models)
30. Coolant (freshwater) drain (11-20EFOZ & 13-24EOZ models)
31. Seawater drain (11-20EFOZ & 13-24EOZ models)

Figure 1-1 Service Views—Typical

Note: Consult installation drawings in the spec sheet or installation manual for fuel and battery connection points. Consult an authorized distributor/dealer or the service manual for items not shown.

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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.

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

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.

Drive Belts. Check the belt condition and tension of the water pump and battery charging alternator belt(s).

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

Inspect the 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.

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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.

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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

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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.

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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.		

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2.6.1 Controls and Indicators

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

Name	Description
Start/Stop Switch	Use this switch to start and stop the generator set. Press the switch to the START position to start the generator set. Press the switch to the STOP position to stop the generator set.
AC Circuit Breaker (optional)	The circuit breaker trips when a fault occurs in the output circuit. During maintenance of craft or generator set wiring, the circuit breaker disconnects the generator set. Place the circuit breaker(s) in the ON position to close the circuit breaker.
DC Circuit Breaker	The circuit breaker trips when a fault occurs in the controller circuit. After a fault correction, depress the circuit breaker's center button to reset the circuit breaker.
Remote Start Connector	A 6-pin connector on the controller's back panel allows the connection of (optional) remote start kits.
Hourmeter	The 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.

Step	Action
1	**Preheat/cold weather starts** During cold weather starts** place the controller's start/stop switch in the STOP/PREHEAT position for 15–20 seconds before attempting to start the generator set to energize the air heater coil (8.5–27EFOZ and 10–32EOZ) or glow plugs (4–6.5EFOZ and 5–8EOZ). Do not energize the preheat feature for more than 30 seconds or damage to the preheat feature may occur. **NOTE:** All controller start/stop switches indicate preheat; however, an optional preheat kit is required to make the preheat feature functional.
2	**Fuel shutoff valve** Open the manual fuel shutoff valve, if equipped.
3	**Starting** Hold the generator set controller start/stop switch or the remote start/stop switch in the START position until the generator set starts.

**Below –5°C (23°F) 4/8.5/9/23/27EFOZ and 5/10/28/32EOZ
Below 5°C (41°F) 6.5EFOZ/8EOZ
Below 4°C (40°F) 11–20EFOZ and 13–24EOZ

2.6.3 Remote Panel Gauge Operation

If the generator set has an optional remote panel with gauges, observe the gauges upon engine startup. 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	77–91°C (170–195°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 the generator set at no load for 5 minutes to ensure adequate engine cooldown.
2	**Stopping** Place the controller start/stop switch or remote start/stop switch in the STOP position. **NOTE:** Do not place the start/stop-preheat switch, if equipped, in the STOP-PREHEAT position for more than 30 seconds or damage to the preheat feature may occur.
3	**Fuel shutoff valve** Close the manual fuel shutoff valve, if equipped.

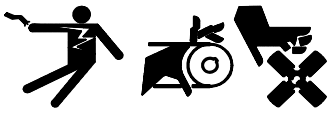
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3.1 General Maintenance

⚠ WARNING

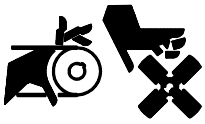


Accidental starting.
Can cause severe injury or death.

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



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.

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.

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3.2 Service Schedule—4-20EFOZ and 5-24EOZ Models

Perform Service at Intervals Indicated (X)	Reference Section	Daily	Every 50 Hrs. or 1 Month	Every 200 Hrs. or 3 Months	Every 400 Hrs. or 6 Months	Every 1000 Hrs. or Yearly
FUEL SYSTEM						
Check the fuel level and fill as necessary	3.5	X (Before operation)				
Check for any abnormal fuel injection sound †		X (During operation)				
Remove the sediment from the fuel tank and drain the fuel tank †§				X		
Clean the fuel filter * (4/6.5EFOZ and 5/8EOZ models only)	3.5.2			X		
Replace the fuel filter element *	3.5.2				X	
Check the fuel injection nozzles/check the injection spray condition *†‡					X	
Check the fuel injection timing *†‡					X	
Check the fuel injection pump *†‡						X
LUBRICATION SYSTEM						
Check the crankcase oil level and add oil as necessary	3.4.2	X (Before operation)				
Replace the oil in the crankcase *	3.4.3		X (Break-in period)	X		
Replace the lube oil filter element *	3.4.3		X (Break-in period)		X	
COOLING SYSTEM						
Check the coolant level and fill as necessary *	3.8.2	X (Before operation)				
Check the seawater outlet and clean as necessary	3.7	X				
Adjust the seawater pump belt tension *	3.9.1		X (Break-in period)	X		
Check the function of the siphon break, if equipped	3.8.6			X		
Check the heat exchanger anticorrosion zinc condition, if equipped *	3.8.7			X		
Check/replace the seawater pump impeller *†	3.8.5				X (Check)	X (Replace)
Replace the coolant *†	3.8.3					X
Replace the heat exchanger anticorrosion zinc anode, if equipped *†	3.8.7					X

* Requires removal of the sound shield door, if installed

† Consult your local distributor/dealer for service

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

§ Consult the operating instructions supplied with the craft

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Service Schedule—4-20EFOZ and 5-24EOZ Models, continued

Perform Service at Intervals Indicated (X)	Reference Section	Daily	Every 50 Hrs. or 1 Month	Every 200 Hrs. or 3 Months	Every 400 Hrs. or 6 Months	Every 1000 Hrs. or Yearly
INTAKE/EXHAUST SYSTEM						
Inspect the exhaust system components *†	3.7	X (Before operation)				
Check the exhaust gas condition. If the exhaust is blue or black, contact your local distributor/dealer	3.7	X (During operation)				
Clean the intake silencer element * (11-20EFOZ and 13-24EOZ models)	3.6			X		
Clean the intake silencer element * (4-9EFOZ and 5-10EOZ models)	3.6				X	
Replace the intake silencer element *	3.6					X
Clean the exhaust/water mixing elbow *†	3.7				X	
Check the breather pipe for obstructions *†					X	
Inspect the turbocharger compressor, if equipped *†				X		
Check for abnormal turbocharger rotor noise during operation, if equipped *†				X		
Check the turbo rotor shaft for wear, if equipped *†						X
Inspect the complete exhaust system ‖	2.2					X
ELECTRICAL SYSTEM						
Keep the battery charged and in good condition §	3.10	X (Before operation)				
Adjust the alternator driving belt tension *	3.9.2		X (Break-in period)	X		
Check and tighten the electrical connections *			X			
Clean the battery cables †						X
ENGINE AND MOUNTING						
Check for water, fuel, coolant, and oil leakage *†‡		X (After operation)				
Retighten any loose nuts and bolts *		X (Before operation)				
Check the mounting bolts/vibromounts and tighten if necessary *					X	
Adjust the intake/exhaust valve clearance *†					X	
Check the compartment condition (fuel, oil, or water leaks)		X (Before operation)				
REMOTE CONTROL SYSTEM						
Check the remote control operation	2.6.3		X (Break-in-period)			X
GENERATOR						
Test run the generator set	2.5		X (Weekly)			
Blow dust out of the generator *†	3.1					X

* Requires removal of the sound shield door, if installed

† Consult your local distributor/dealer for service

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

§ Consult the battery manufacturer's instructions

‖ Should be performed by your local distributor/dealer

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3.3 Service Schedule—23/27EFOZ, 28/32EOZ Models

Perform Service at Intervals Indicated (X)	Reference Section	Before Starting	Every 50 Hrs. or 1 Month	Every 200 Hrs. or 3 Months	Every 400 Hrs. or 6 Months	Every 1000 Hrs. or Yearly
FUEL SYSTEM						
Check the fuel level and fill as necessary	3.5	X				
Remove the sediment from the fuel tank †§			X			
Check for any abnormal fuel-injection sound †		X During operation				
Clean the fuel filter *	3.5.2			X		
Replace the fuel filter element *	3.5.2				X	
Check the fuel injection nozzles/check the injection spray condition *†‡						X
Check the fuel injection timing *†‡						X
Check the fuel injection pump *†‡						X
Check the governor operation and adjust as necessary *†‡						X
LUBRICATION SYSTEM						
Check the crankcase oil level and add oil as necessary	3.4.2	X				
Replace the oil in the crankcase *	3.4.3		X (Break-in period)	X		
Replace the lube oil filter element *	3.4.3		X (Break-in period)		X	
COOLING SYSTEM						
Check the coolant level and fill as necessary *	3.8.2	X				
Check the seawater outlet and clean as necessary	3.7	X				
Check the function of the siphon break, if equipped	3.8.6			X		
Adjust the seawater pump belt tension *	3.9.1		X (Break-in period)	X		
Check the heat exchanger anticorrosion zinc condition *	3.8.7			X		
Replace the seawater pump impeller *†	3.8.5				X Check	X
Check the thermostat function *†						X
Flush the cooling system *†						X
Replace the heat exchanger anticorrosion zinc anode *†	3.8.7					X

* Requires removal of the sound shield door, if installed

† Consult your local distributor/dealer for service

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

§ Consult the operating instructions supplied with the craft

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Service Schedule—23/27EFOZ, 28/32EOZ Models, continued

Perform Service at Intervals Indicated (X)	Reference Section	Before Starting	Every 50 Hrs. or 1 Month	Every 200 Hrs. or 3 Months	Every 400 Hrs. or 6 Months	Every 1000 Hrs. or Yearly
INTAKE/EXHAUST SYSTEM						
Inspect the exhaust system components *†	3.7	X				
Check the exhaust gas condition. If the exhaust is blue or black, contact your local distributor/dealer	3.7	X During operation				
Replace the intake silencer *	3.6				X	
Clean the exhaust/water mixing elbow *†	3.7			X		
Check the breather pipe for obstructions *†				X		
Inspect the complete exhaust system ‖	2.2					X
ELECTRICAL SYSTEM						
Keep the battery charged and in good condition §	3.10	X				
Adjust the alternator driving belt tension *	3.9.2		X (Break-in period)	X		
Check and tighten the electrical connections *			X			
Clean the battery cables †						X
ENGINE AND MOUNTING						
Check for water, fuel, coolant, and oil leakage *†‡		X	X			
Retighten all major nuts and bolts *		X	X			
Check the mounting bolts/vibromounts and tighten if necessary *				X		
Adjust the intake/exhaust valve clearance *†						X
Check the compartment condition (fuel, oil, or water leaks)		X				
REMOTE CONTROL SYSTEM						
Check the remote control operation	2.6.3		X (Break-in period)		X	
GENERATOR						
Test run the generator set	2.5		X (Weekly)			
Blow dust out of the generator *†	3.1				X	

* Requires removal of the sound shield door, if installed

† Consult your local distributor/dealer for service

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

§ Consult the battery manufacturer's instructions

‖ Have performed by the your local distributor/dealer

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3.4 Lubrication System

See the Scheduled Maintenance section for oil change and oil filter replacement intervals. See Section 1 for the oil drain, oil check, oil fill, and oil filter locations.

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3.4.1 Oil Specifications

Use oil that meets the American Petroleum Institute (API) classification of CD, CC/CD, or CC. Using an unsuitable oil or neglecting an oil change may result in damage and a shorter engine life. Figure 3-1 shows the recommended Society of Automotive Engineers (SAE) viscosity designation for given operating temperature ranges.

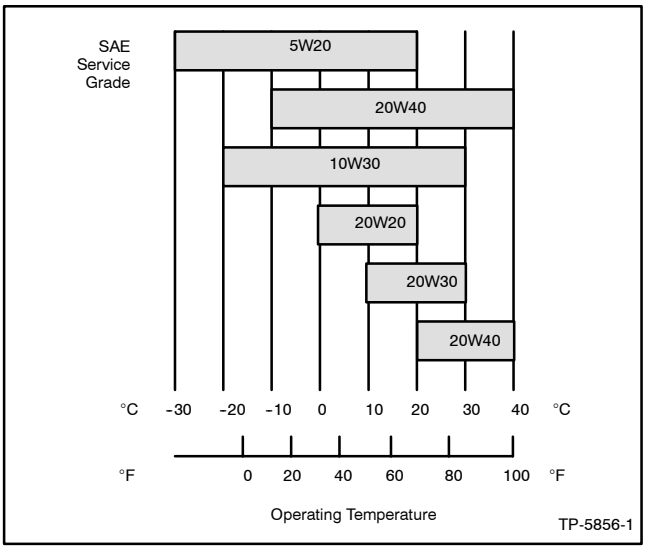


Figure 3-1 Engine Oil Selection

Note: Failure to observe the oil specifications may cause inadequate lubrication/oil pressure and cold-starting difficulties.

3.4.2 Oil Check

Check the oil level in the crankcase daily or before each startup to ensure that the level is in the safe range. To check the oil level, remove the dipstick and wipe the end clean, reinsert as far as possible, and remove. Maintain the oil level between the Min and Max marks on the dipstick, as shown in Figure 3-2. See Section 1 for dipstick location.

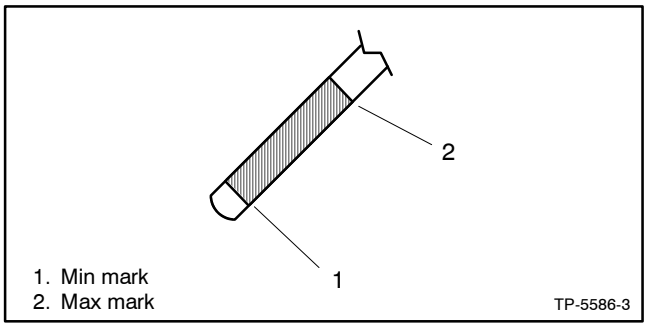


Figure 3-2 Oil Level Check Marks

Note: Do not operate the set if the oil level is below the Min mark or above the Max mark.

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3.4.3 Oil Change

Change the oil more frequently if the generator operates under dirty, dusty conditions. See Figure 3-3 for oil capacities.

Model	L (Qts.)
4EFOZ and 5EOZ	3.0 (3.2)
6.5EFOZ and 8EOZ	2.3 (2.4)
8.5EFOZ, 9EFOZ and 10EOZ	5.2 (5.5)
11/11.5/13EFOZ and 13/14/15.5EOZ	4.7 (5.0)
16/17.5/19/20EFOZ and 20/23/24EOZ	5.8 (6.1)
23/27EFOZ and 28/32EOZ	10.2 (10.8)

Figure 3-3 Oil Capacities

Oil Change Procedure

Whenever possible, drain the oil while it is still warm.

1. **Drain the oil.**

   a. Place the generator set start/stop switch in the STOP position.

   b. Disconnect the power to the battery charger, if equipped.

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

   d. 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.

      Electric Oil Drain/Oil Fill Pump Procedure: Connect the pump to the end of the oil drain hose. Place the outlet of the pump into an oil collection container. Remove the oil fill cap(s).

   e. Open the oil drain valve on the engine.

   f. Allow time for the engine oil to drain completely.

      Electric Oil Drain/Oil Fill Pump Procedure: Activate the pump until all of the oil is removed. Go to step 2.

   g. Close the oil drain valve.

   h. Replace the cap on the oil drain hose. Replace the oil drain hose in its retaining clip.

2. **Replace the oil filter.**

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

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

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

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

3. **Fill with oil.** Add new oil of the weight, grade, and quantity specified in Section 3.4.

   Electric Oil Drain/Oil Fill Pump Procedure: Disconnect the pump. Close the oil drain valve. Replace the cap on the oil drain hose.

4. **Check for leaks.**

   a. Check that the generator set start/stop switch is in the STOP position.

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

   c. Reconnect the power to the battery charger, if equipped.

   d. Start the generator set and check for leaks around the oil filter.

   e. Stop the generator set and tighten the oil filter to stop any leaks.

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3.5 Fuel System

3.5.1 Fuel Specifications

Use a clean, good quality diesel fuel oil with a cetane number of 45 or greater. Clean fuel prevents the diesel fuel injectors and pumps from clogging.

Fuel Recommendations	
United States	ISO 8217 DMA, BS 2869 Part 1 Class A1 or Part 2 Class A2
United Kingdom	BS 2869-1983, Part 2 Class A2
Germany	DIN 51 601-1978

Note: Never store diesel fuel in galvanized containers; diesel fuel and the galvanized coating react chemically to produce flaking that quickly clogs filters or causes fuel pump or injector failure.

Note: Avoid storing fuel for more than one month. Take special precautions to keep all dirt, water, and other contaminants out of fuel to prevent the growth of microbes. Microbes form slime that clogs the fuel filter and lines.

Note: Do not run the generator set out of fuel because the fuel lines will draw in air and necessitate bleeding the fuel system before restarting the unit.

3.5.2 Fuel Filter

The quality and condition of the fuel largely determine the filter's useful life. Replace the fuel filter element as listed in the service schedule. Section 1 shows the typical location of a fuel filter. Use the applicable procedure below to replace the fuel filter.

Fuel Filter Cleaning/Replacement Procedure

4/6.5EFOZ and 5/8EOZ Models:

1. Close the fuel supply valve.
2. Remove the collar from the fuel filter adapter while holding the filter bowl in place.
3. Remove the filter bowl and fuel filter. Clean the fuel filter with fresh fuel oil and blow compressed air from the inside outward. Replace a damaged fuel filter. Dispose of the fuel filter in an approved manner.
4. Wipe off all parts with a clean rag. Inspect all mating surfaces and threads for damage; replace as necessary.
5. Place the fuel filter into the filter bowl and lubricate the rubber seal with fresh fuel oil. Wash hands after any contact with fuel oil.
6. With the collar against the filter bowl flange, position the fuel filter against the adapter and hand-tighten the collar.
7. Open the fuel supply valve.
8. Bleed the system. See Section 3.5.3, Bleeding the Fuel System.

8.5-27EFOZ and 10-32EOZ Models:

1. Close the fuel supply valve.
2. Loosen the fuel filter by turning it counterclockwise. Remove the fuel filter and use rags to clean up spilled fuel oil. Dispose of the fuel filter in an approved manner.
3. Clean the contact surface of the fuel oil filter adapter.
4. Lightly lubricate the gasket surface of the new fuel filter with fresh fuel oil. Thread the filter on the adapter until the gasket makes contact; hand-tighten the filter an additional one-half turn. Wash hands after any contact with fuel oil.
5. Open the fuel supply valve.
6. Bleed the system. See Section 3.5.3, Bleeding the Fuel System.

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3.5.3 Bleeding the Fuel System

Bleed air from the fuel system to prevent starting failures and/or erratic operation. One or more of the following causes air to collect in the fuel system:

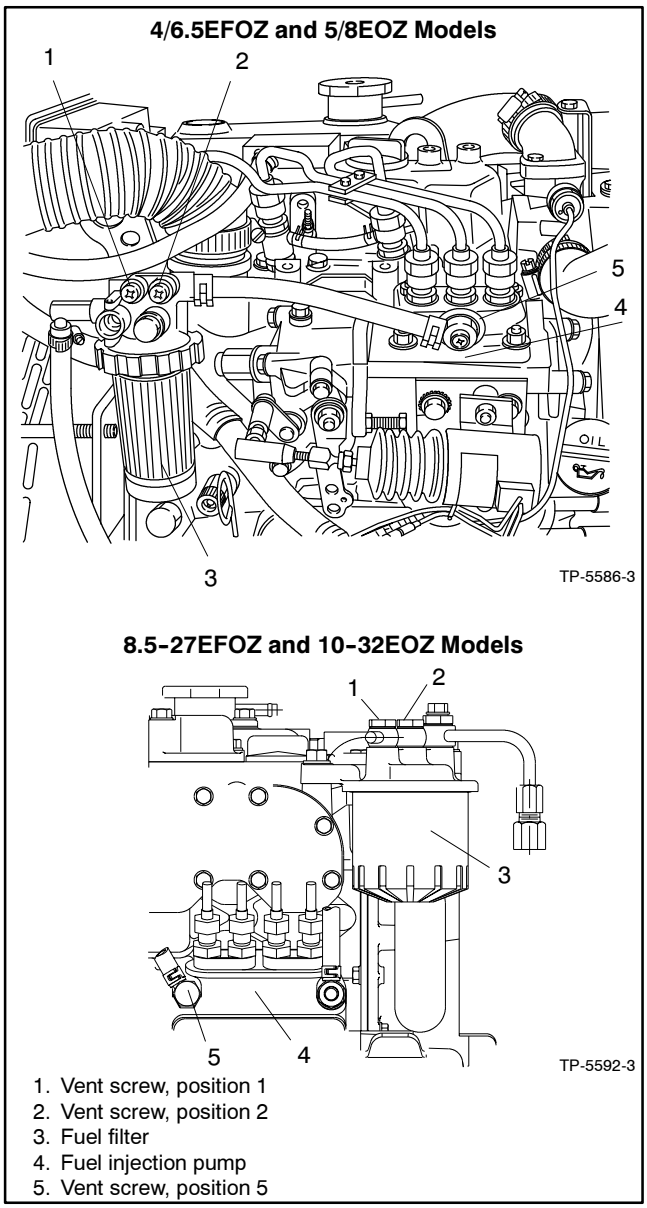
- Operating the generator set until the fuel supply is emptied.
- Developing air leaks in the suction side of the fuel system.
- Replacing the fuel filter.

Note: Connect the battery during the priming procedure to allow engine cranking. Do not allow the engine/generator to start. To prevent starting, *toggle* the start/stop switch by momentarily placing the start/stop switch in the START position for a few seconds and then placing the switch in the STOP position. Close the seacock during bleeding.

Procedure to Bleed the Fuel System

1. Loosen the fuel filter screw at position 1. See Figure 3-4.
2. Toggle the start/stop switch until fuel, free of air bubbles, flows from the vent screw at position 1. Tighten the screw.
3. Loosen the fuel filter screw at position 2.
4. Toggle the start/stop switch until fuel, free of air bubbles, flows from the vent screw at position 2. Tighten the screw.
5. Loosen the fuel injection pump screw at position 5.
6. Toggle the start/stop switch until fuel, free of air bubbles, flows from the vent screw at position 5. Tighten the screw.

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



1. Vent screw, position 1
2. Vent screw, position 2
3. Fuel filter
4. Fuel injection pump
5. Vent screw, position 5

Figure 3-4 Fuel System (Typical)

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3.6 Air Intake Silencer/Cleaner

At the interval specified in the service schedule, clean *or replace* the air intake silencer. Clean the silencer more frequently if the generator set operates in dirty, dusty conditions. Follow one of the procedures described below.

Air Cleaner Service/Replacement

4/6.5/8.5/9/11/16/17EFOZ, 5/8/10/13/20EOZ Models & 23/27EFOZ, 28/32EOZ Models, Spec Numbers:

GM24459-GA1
GM24459-GA2
GM24459-GA3
GM24459-GA4
GM24459-GA5
GM24459-GA6
GM24459-GA7
GM24459-GA8

A dry-type air cleaner silences and filters the intake air. The air intake silencer assembly connects to the intake manifold via a flexible hose.

1. Release the spring clips to open the housing and remove the air silencer element.
2. Tap the element lightly against a flat surface to dislodge loose surface dirt. Do not clean in any liquid or use compressed air as these will damage the filter element.
3. Examine the element and housing for damage and wear. Replace the element or housing if necessary.
4. Wipe the cover and base with a clean rag to remove any dirt. Make sure that the sealing surfaces fit correctly, and reattach the spring clips.

11.5/13EFOZ and 14/15.5EOZ Models:

A round air cleaner silences and filters the intake air. Replace a damaged or dirt-contaminated air silencer. See Section 1 and refer to the following procedure:

1. Release the two spring clips and remove the intake silencer cover.
2. Remove the element from the cover and inspect. If the element is not damaged, continue with step 3. If the element is damaged, replace it, skip step 3, and go to step 4.
3. Wash the element in mild detergent and water solution. Rinse and air dry the element. See Figure 3-5.
4. Wipe the intake silencer cover and base with a clean rag to remove any dirt. Check the base for damage; replace as necessary.

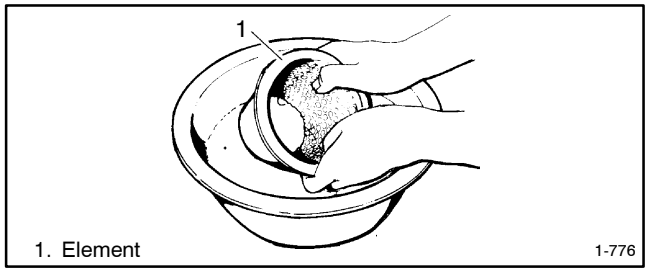


Figure 3-5 Element Washing (11.5/13EFOZ and 14/15.5EOZ Models)

5. Reassemble the element and cover assembly to the intake silencer base. Make sure that the sealing surfaces fit and reattach the spring clips. The air intake silencer duct should be at the 5 o'clock position as viewed from the generator end.

23/27EFOZ, 28/32EOZ Models, Spec Numbers:

PA-126212
PA-126213
PA-126214
PA-126215
PA-126177
PA-126178
PA-126185
PA-126186

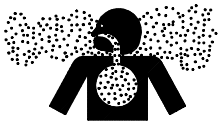
The air cleaner silences and filters the intake air. The air intake silencer assembly connects to the air intake manifold.

1. Release the clamp (two clamps if equipped with a sound shield).
2. Remove the air intake silencer assembly.
3. Replace with a new air intake silencer assembly.
4. Wipe the cover and base with a clean rag to remove any dirt. Make sure that the sealing surfaces fit correctly and reattach the clamp(s).

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3.7 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. See Section 1 for the exhaust outlet location.

Inspection Points

Inspect the 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 is (1) in the craft, (2) functional, and (3) energized whenever the generator set operates.

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3.8 Cooling System

3.8.1 Closed Heat Exchanger

In a closed cooling system, the seawater circulates through separate chambers within the heat exchanger or manifold to cool the engine water. The seawater then mixes with the engine exhaust and ejects out of the exhaust outlet. See Figure 3-6 for coolant capacities (include coolant recovery tank capacity of 0.24 L (8 oz.).

Model	L (Qts.)
4EFOZ and 5EOZ	1.8 (1.9)
6.5EFOZ and 8EOZ	3.9 (4.1)
8.5EFOZ, 9EFOZ and 10EOZ	2.5 (2.6)
11/11.5/13EFOZ and 13/14/15.5EOZ	4.4 (4.6)
16/17.5/19/20EFOZ and 20/23/24EOZ	6.0 (6.3)
23/27EFOZ and 28/32EOZ	7.6 (8.0)

Figure 3-6 Coolant Capacities

3.8.2 Checking and Filling Coolant

⚠ 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.

Maintain the coolant level in the 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 solution, 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 the level in the coolant recovery tank. Add fresh coolant until the level is just below the overflow tube opening.

Note: 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.

Note: 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 the engine has cooled.

Note: Pay special attention to the coolant level. After the coolant drains, allow time when re-filling the coolant for a complete refill of the engine water jacket. Check the coolant level as prescribed in the Prestart Checklist.

3.8.3 Flushing and Cleaning

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

Flushing and Cleaning Procedure

1. Open the pressure cap and open petcocks located at the heat exchanger, engine block, and cooling system, and let the system drain completely. Some models may have petcocks located behind the belt guard. Remove the pressure cap to simplify draining.
2. Drain, clean, and flush the coolant recovery tank.
3. Flush the system with clean water.
4. Fill the system with recommended coolant.

3.8.4 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. The pressure cap typically has the pressure rating stamped on the cap body.

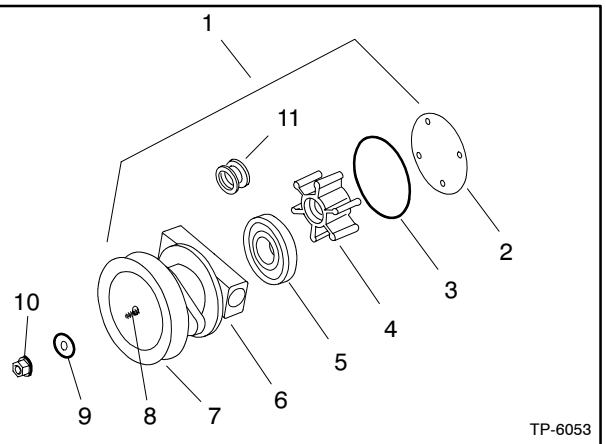
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3.8.5 Seawater Pump

The belt-driven seawater pump is located on the service side 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:

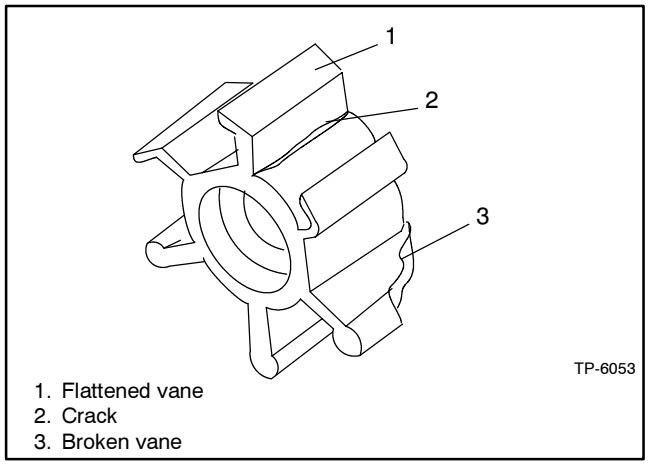
Impeller Inspection and Replacement Procedure:

1. Close the seacock.
2. Remove the seawater pump coverplate. See Figure 3-7.
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 3-8. 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 3-7 Seawater Pump, Typical



1. Flattened vane
2. Crack
3. Broken vane

Figure 3-8 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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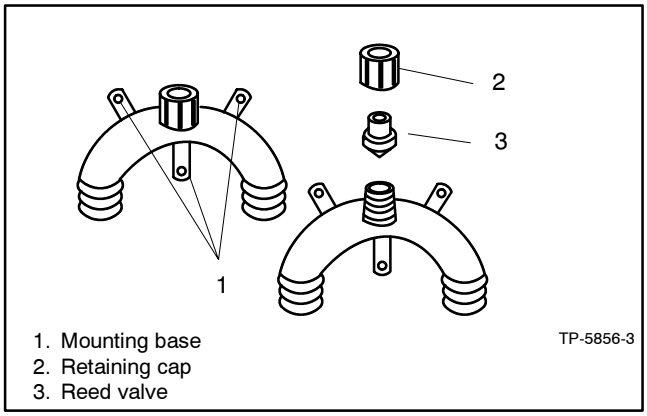
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3.8.6 Siphon Break

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 3-10. 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 3-9.
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 3-9, item 3.
7. Install and only finger tighten the retaining cap. Do not overtighten it.

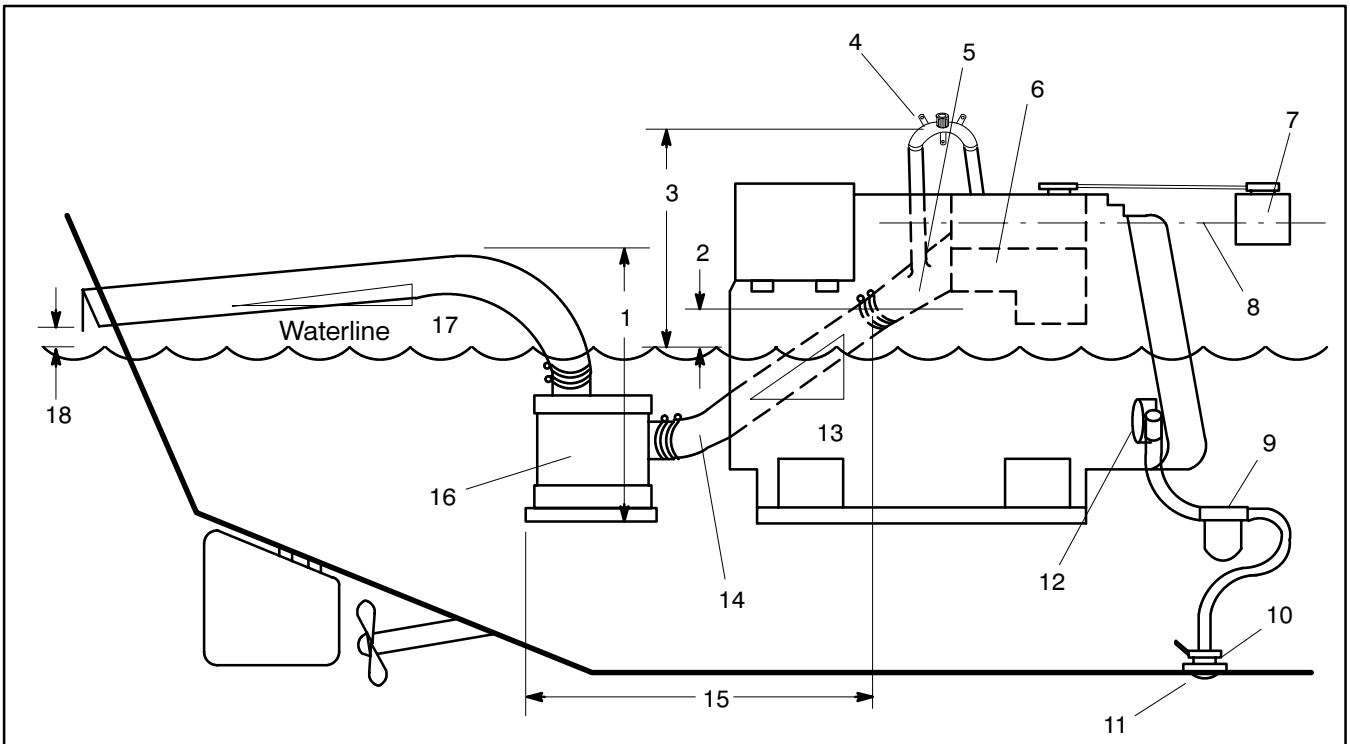


1. Mounting base
2. Retaining cap
3. Reed valve

Figure 3-9 Siphon Break

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

Figure 3-10 Siphon Break (Plastic “U” Type) Installation

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

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3.8.7 Anticorrosion Zinc Anode

The heat exchanger on models 4-9EFOZ, 5-10EOZ, 23/27EFOZ, and 28/32EOZ 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 for the location and use the following procedure.

Anticorrosion Zinc Anode Replacement

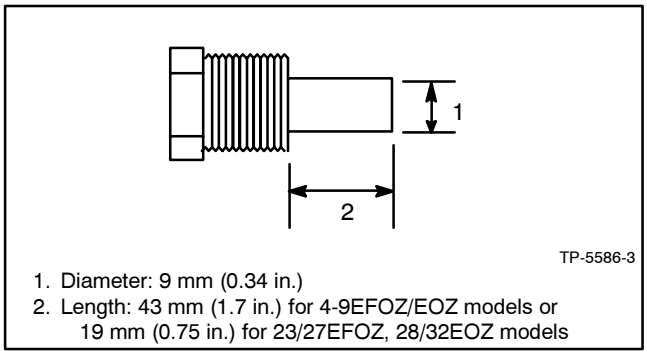
1. With the generator set cooled, close the seacock, open the petcock on the engine, and drain the coolant into a suitable container.

2. Remove the anticorrosion zinc anode (plug) from the heat exchanger.

3. Use a wire brush to remove the loose corrosion on the anticorrosion zinc anode. Replace the anode according to Figure 3-11 and Figure 3-12.

Anticorrosion Zinc Anode Replacement		
Models	**New Anode Dimensions mm (in.)**	**Replace When Percent of Zinc Remaining Is:**
4-9EFOZ 5-10EOZ	9 (0.34) x 43 (1.7)	<50% of length/diameter
23/27EFOZ 28/32EOZ	9 (0.34) x 19 (0.75)	<50% of length/diameter

Figure 3-11 Anticorrosion Zinc Anode (Plug) Measurements



1. Diameter: 9 mm (0.34 in.)
2. Length: 43 mm (1.7 in.) for 4-9EFOZ/EOZ models or 19 mm (0.75 in.) for 23/27EFOZ, 28/32EOZ models

Figure 3-12 Anticorrosion Zinc Anode (Plug)

4. 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. Cut the anticorrosion zinc to the correct length. Install the anticorrosion zinc anode into the heat exchanger.

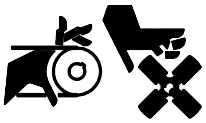
5. Close the petcock on the engine and open the seacock. Refill the cooling system.

6. Start the generator set and check for leaks at the anticorrosion zinc anode location. The pump is operating if the cooling water flows from the exhaust outlet. If water is not discharging at the exhaust outlet, see Section 2.1, Prestart Checklist—Seawater Pump Priming.

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3.9 Belt Tension

⚠ WARNING

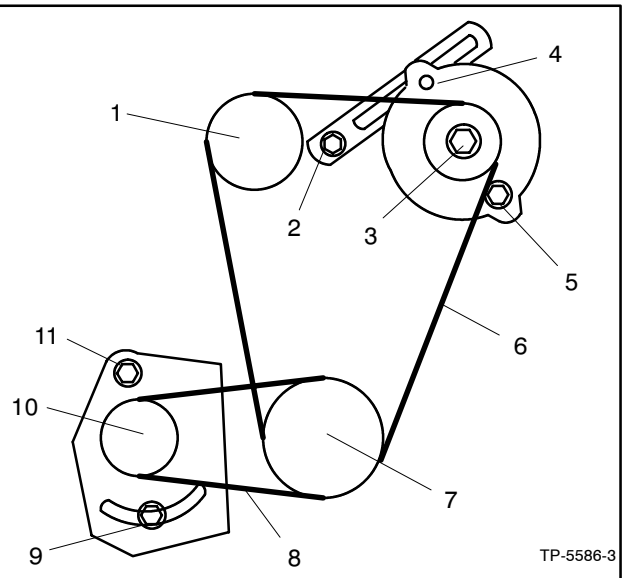


Rotating parts.
Can cause severe injury or death.

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.

Check the belt tensions at the interval specified in the service schedule. If tensions are not within the specifications, adjust as necessary using the following procedures.



1. Engine-driven water pump pulley
2. Adjusting arm pivot screw
3. Battery charging alternator pulley
4. Alternator adjusting screw
5. Alternator pivot screw
6. Check the alternator belt tension here
7. Crankshaft pulley
8. Check the seawater pump belt tension here
9. Seawater pump adjusting screw
10. Seawater pump pulley
11. Pivot screw

Figure 3-13 Belt Tension (Typical)

3.9.1 Seawater Pump Belt Tensioning Procedure

1. Remove the belt guard.
2. Check the belt tension at the midpoint of the longest span of the belt using a belt-tensioning tool set to 55 ft. lbs. See Figure 3-13. Recheck a new belt tension after 10 minutes of operation.

   Note: If the belt tension is not within specifications, go to step 3. If the belt tension is within specifications, go to step 7.

3. Loosen the pivot and adjusting screws.
4. While prying the seawater pump outward, tighten the adjusting screw.
5. Tighten the pivot screw.
6. Recheck and adjust as necessary.
7. Replace the belt guard.

3.9.2 Battery Charging Alternator Belt Tensioning Procedure

1. Remove the belt guard.
2. Check the belt tension at the midpoint of the longest span of the belt by pressing with your finger. See Figure 3-13 and Figure 3-14. If the belt is not within the specifications, go to step 3. If the belt is within the specifications, go to step 7.

Belt Type	Deflection mm (in.)
New	7–9 (0.3–0.4)
Used	10–15 (0.4–0.6)

Figure 3-14 Belt Specifications

3. Loosen the adjusting arm pivot screw, alternator pivot screw, and alternator adjusting screw.
4. While prying the alternator outward, tighten the alternator adjusting screw.
5. Tighten the adjusting arm pivot screw and alternator pivot screw.
6. Recheck and adjust as necessary.
7. Replace the belt guard.

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3.10 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.

3.11 Generator Storage Procedure

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

Generator Set Storage Procedure

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 3.4.3.
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 the coolant mixture is depleted. Do not allow coolant mixture to flow into waterways.
6. Stop the generator set.
7. Connect a 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. 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.
10. 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.
11. Select a well-ventilated (not humid or dusty) location to store the generator.
12. Cover the entire unit with a dust cover.

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

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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.

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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
						x				Cooling water pump inoperative	Tighten or replace the belt. Replace the water pump.	Eng. O/M or 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.

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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
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		x			x		Governor inoperative	Adjust the governor.†	Gen. S/M
					x				x	Valve clearance incorrect	Adjust the valves.†	Eng. S/M
									x	Vibration excessive	Tighten all loose hardware.	—

* 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.

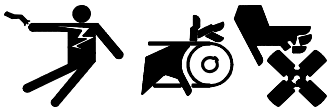
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Trouble Symptoms										Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	Cranks but does not start	Starts hard	No or low output voltage	Stops suddenly	Lacks power	Overheats	Low oil pressure	High fuel consumption	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		x	x					Fuel filter restriction	Clean or replace the fuel filter.	Eng. O/M
	x									Fuel solenoid inoperative	Troubleshoot the fuel solenoid.†	Eng. S/M
	x	x			x					Air in fuel system (diesel only)	Bleed the diesel fuel system.	Eng. O/M
	x	x			x					Fuel or fuel injectors dirty or faulty (diesel only)	Clean, test, and/or replace the inoperative fuel injector.†	Eng. S/M
	x	x			x			x		Fuel injection timing out of adjustment (diesel only)	Adjust the fuel injection timing.†	Eng. S/M
	x				x			x		Fuel feed or injection pump inoperative (diesel only)	Rebuild or replace the injection 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	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

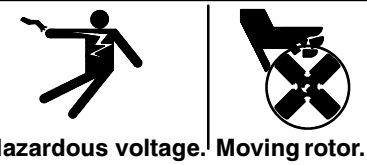


Accidental starting.
Can cause severe injury or death.

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.

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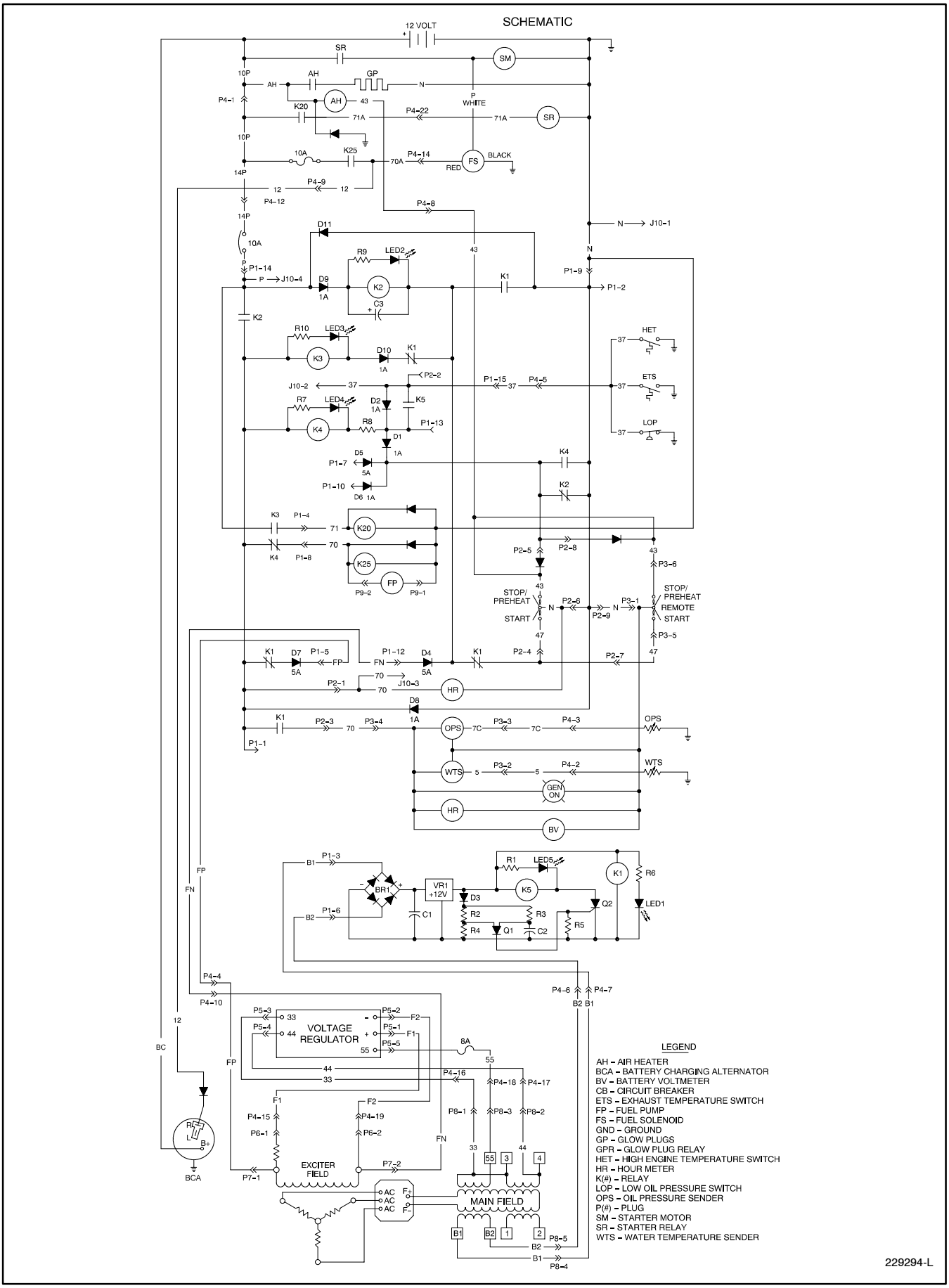


Figure 5-1 Schematic Wiring Diagram—4/6.5/9EFOZ and 5/8/10EOZ (1-Phase Models)

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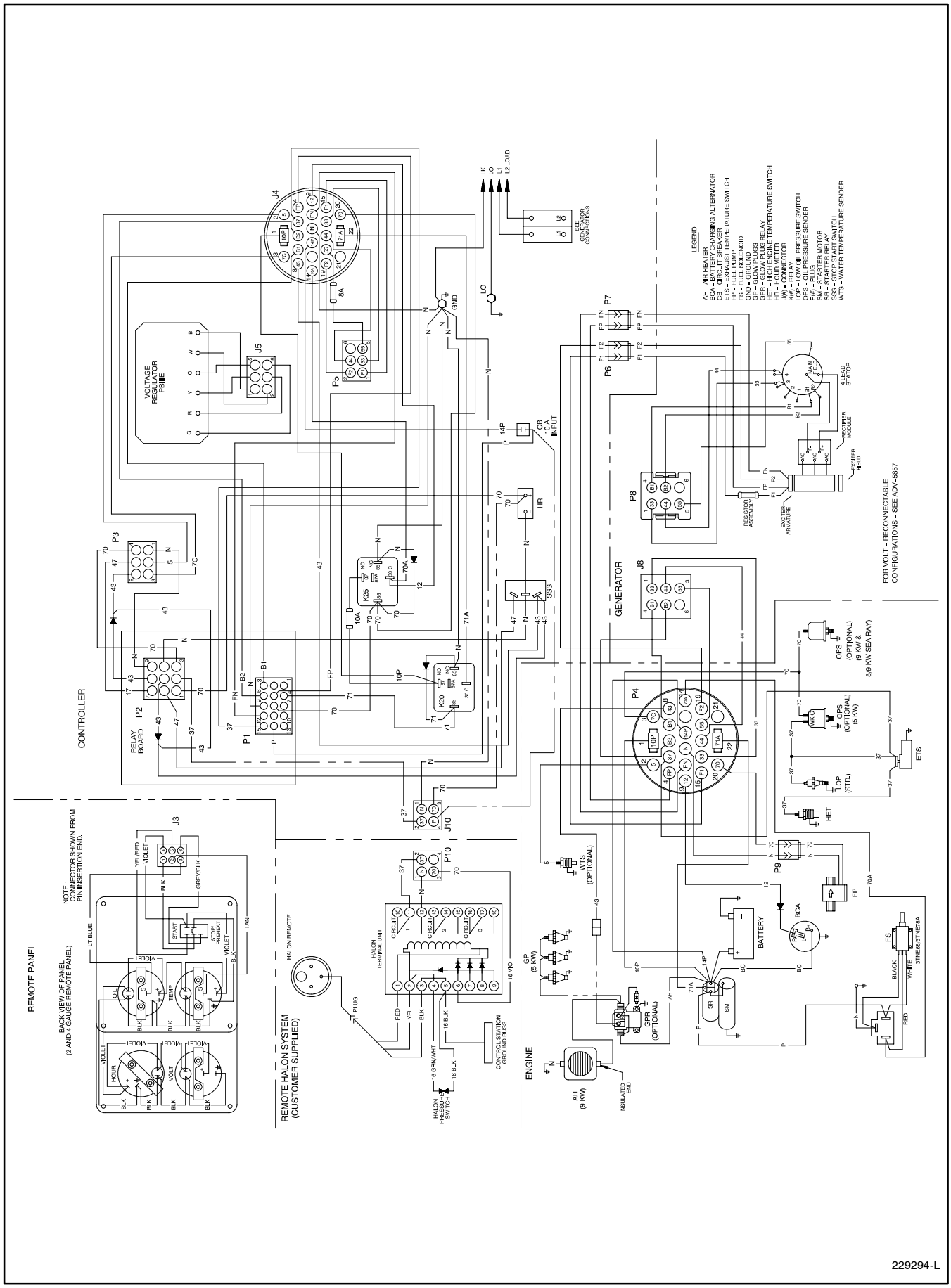


Figure 5-2 Point-to-Point Wiring Diagram—4/6.5/9EFOZ and 5/8/10EOZ (1-Phase Models)

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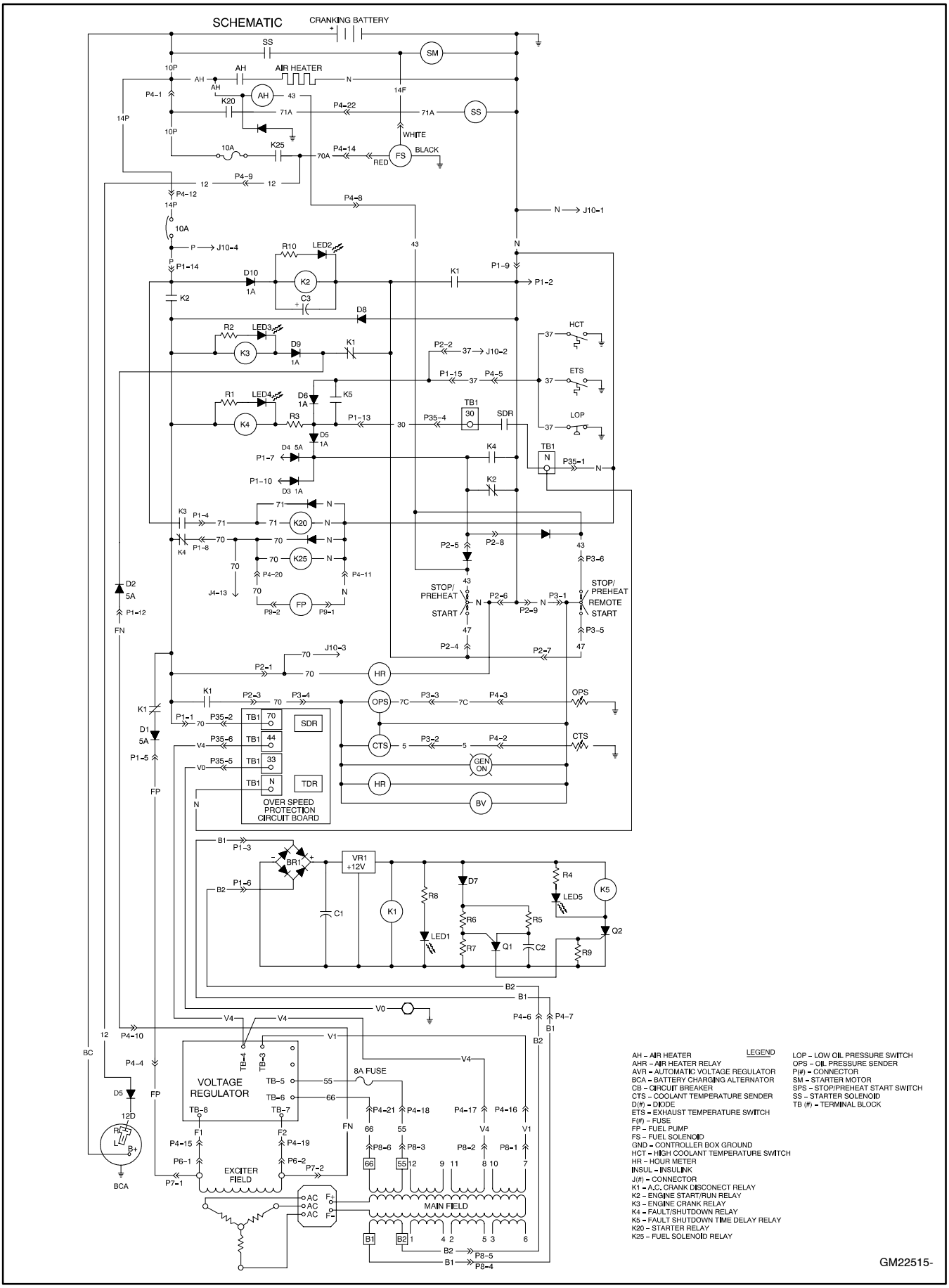


Figure 5-3 Schematic Wiring Diagram—8.5EFOZ (3-Phase Models)

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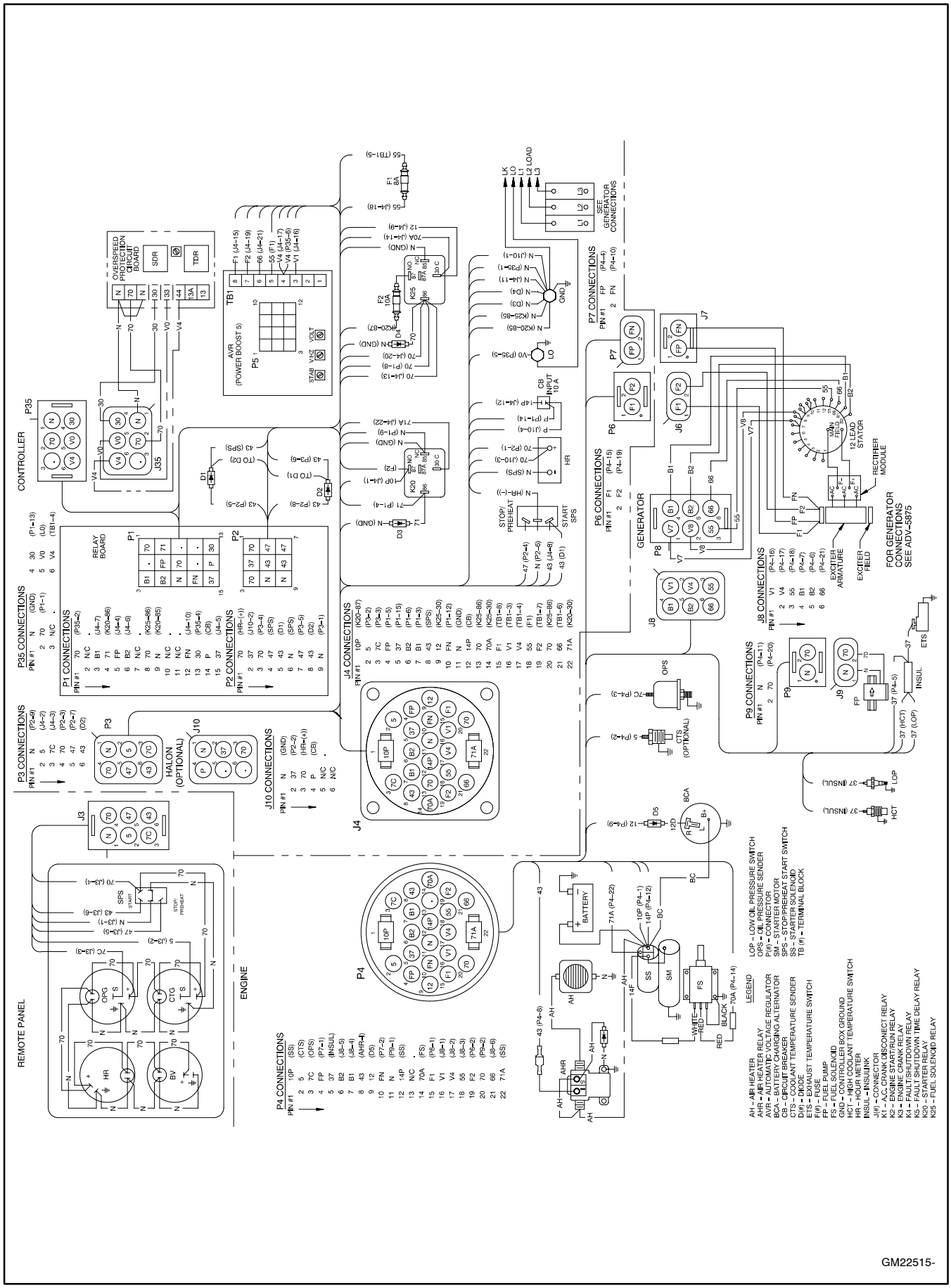


Figure 5-4 Point-to-Point Wiring Diagram—8.5EFOZ (3-Phase Models)

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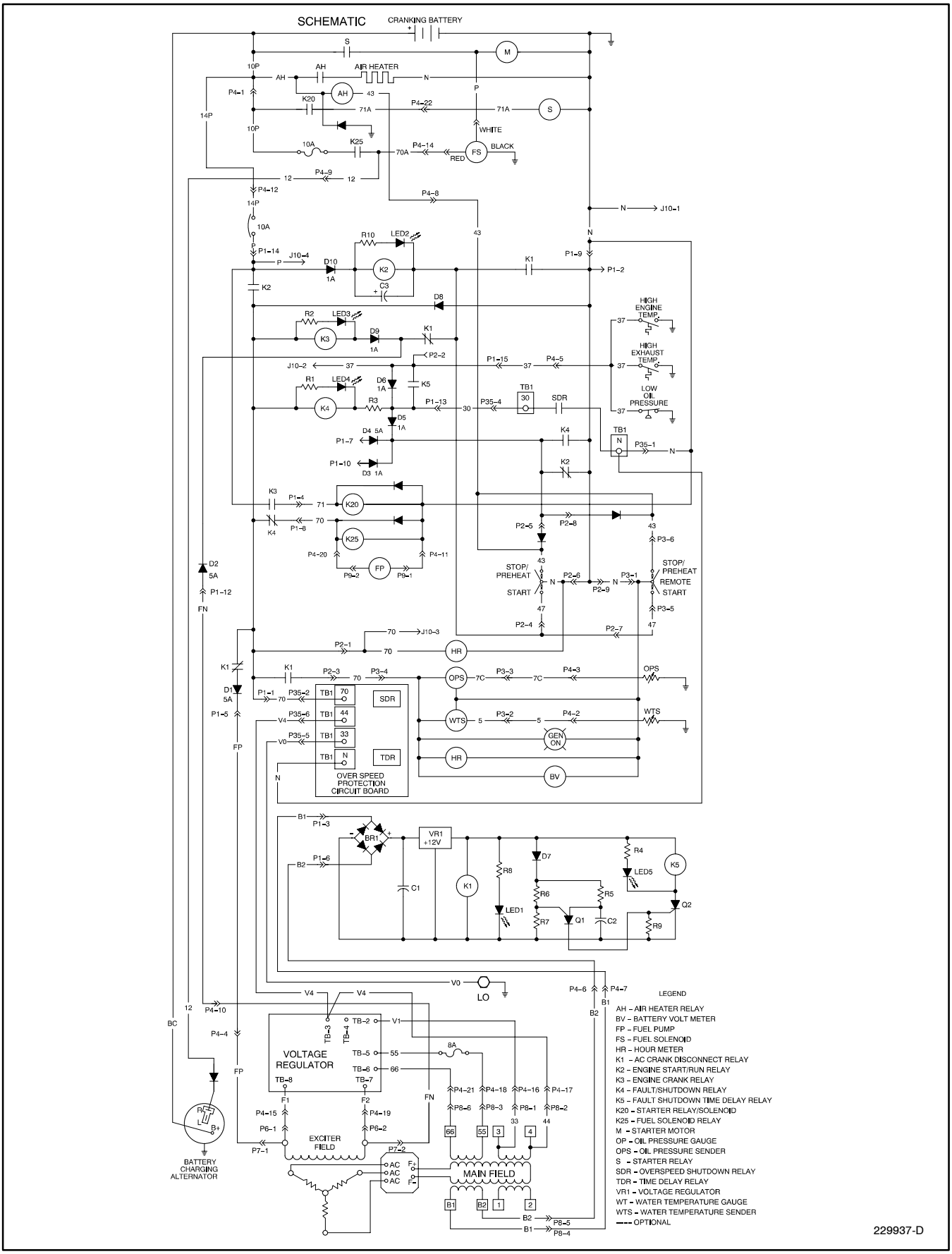


Figure 5-5 Schematic Wiring Diagram—11/13/16/19/23/27EFOZ and 13/15.5/20/23/28/32EOZ (1-Phase Models)

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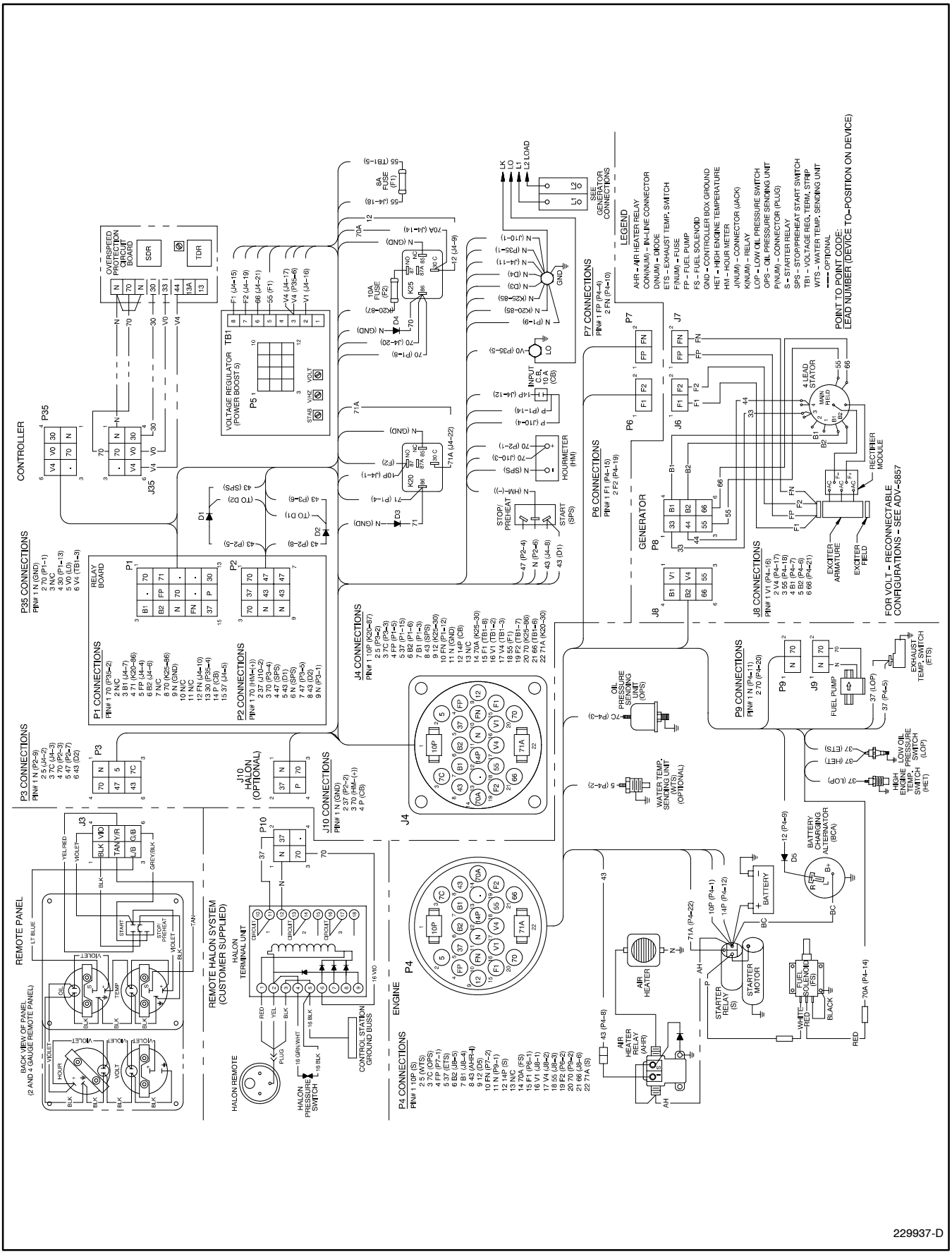


Figure 5-6 Point-to-Point Wiring Diagram—11/13/16/19/23/27EFOZ and 13/15.5/20/23/28/32EOZ (1-Phase Models)

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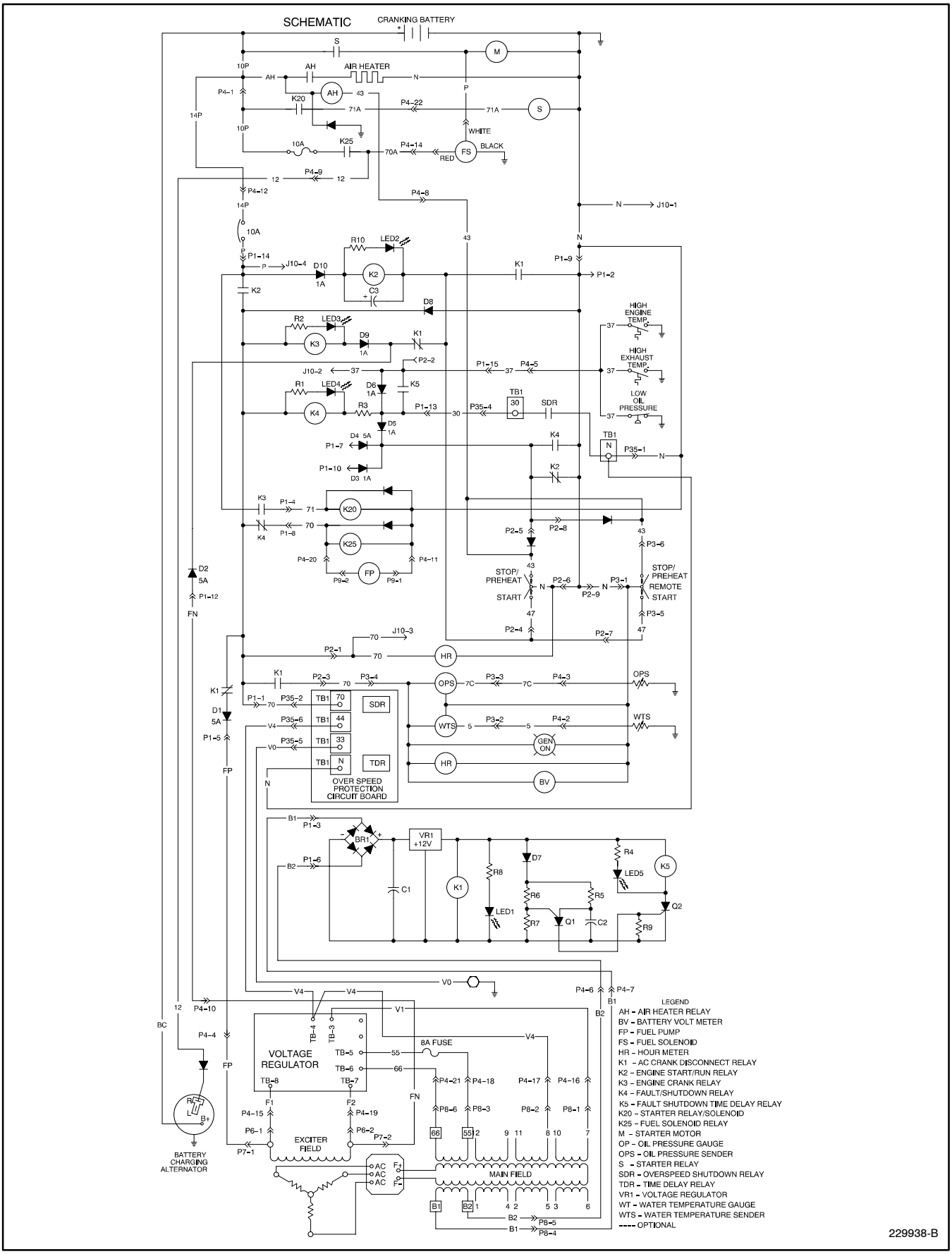


Figure 5-7 Schematic Wiring Diagram—11.5/17.5/20/23/27EFOZ and 14/20/24/28/32EOZ (3-Phase Models)

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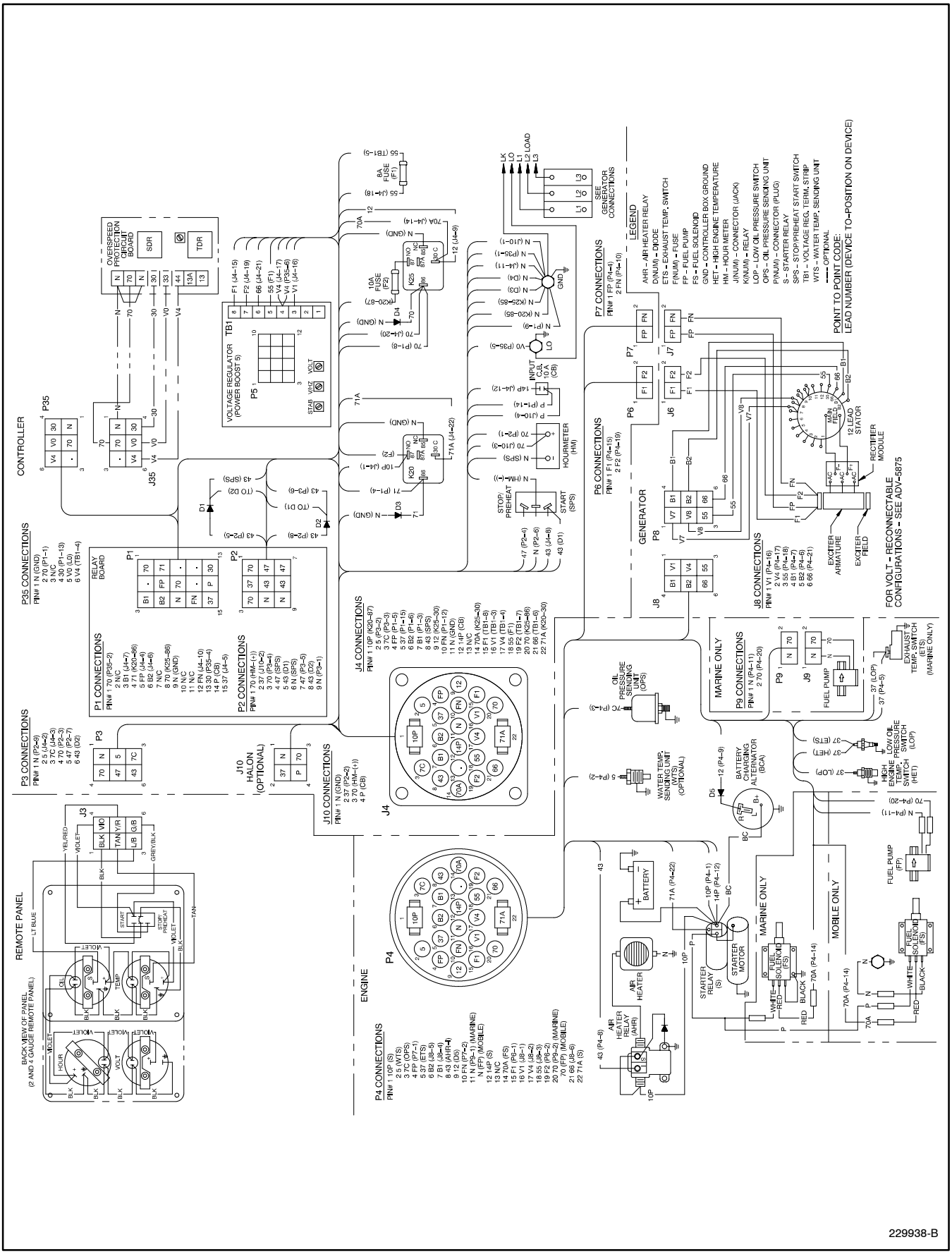


Figure 5-8 Point-to-Point Wiring Diagram—11.5/17.5/20/23/27EFOZ and 14/20/24/28/32EOZ (3-Phase Models)

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Notes

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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)

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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

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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.

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

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