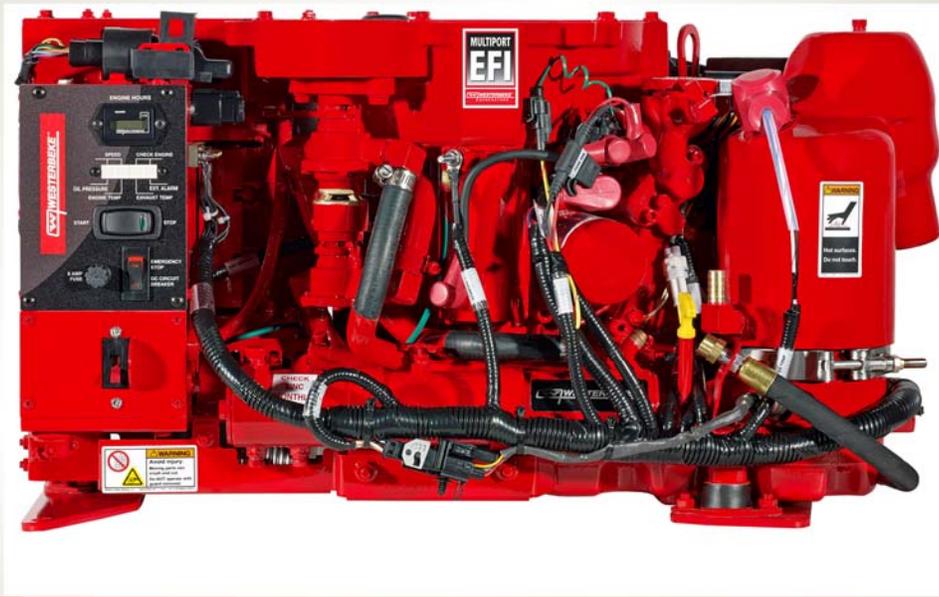


WESTERBEKE™ Engines & Generators



MULTI-PORT SINGLE-PHASE **MARINE GASOLINE GENERATORS**

OPERATORS MANUAL

3.5 MCGA/B 60 Hz
3.5 MCGA/B 50 Hz



CALIFORNIA PROPOSITION 65 WARNING

Breathing gasoline or diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov



WARNING: Exhaust fumes contain carbon monoxide, an odorless, colorless, and **POISONOUS** gas that can cause unconsciousness and death. Symptoms of carbon monoxide exposure can include:

- Dizziness
- Nausea
- Headache
- Weakness
- Sleepiness
- Throbbing in Temples
- Muscular Twitching
- Vomiting
- Impaired Judgement

IF YOU OR ANYONE ELSE EXPERIENCES ANY OF THESE SYMPTOMS, SEEK FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shutdown the unit and do not restart until it has been inspected and repaired.



A WARNING DECAL is provided by Westerbeke and should be fixed to a bulkhead near your engine or generator. Westerbeke also recommends installing CARBON MONOXIDE DETECTORS in the living/sleeping quarters of your vessel. They are cost affective and easily obtainable at your local marine store.



©2019 Westerbeke, Inc. All Rights Reserved.

This document may not be reproduced or distributed in any form or by any means, graphic, electronic, or mechanical, including but not limited to photocopying, scanning, recording, taping, e-mailing, or storing in information storage and retrieval systems without the written permission of Westerbeke. Products that are referenced in this document may be trademarks and/or registered trademarks of their respective owners. Westerbeke makes no claim to these trademarks. While every precaution has been taken in the preparation of this document, individually, as a series, in whole, or in part, Westerbeke, the publisher, editor, and other contributors assume no responsibility for errors or omissions, including any damages resulting from the express or implied application of information contained in this document or from the use of other products, services, recommendations, or policies that may accompany it. In no event shall Westerbeke, publishers, authors, or editors of this guide be liable for any loss of profit or any other commercial damage caused or alleged to have been caused directly or indirectly by this document.

WARNING: DO NOT USE E-15 WITH THIS PRODUCT!

Gasoline with an ETHANOL content rating higher than 10% (E-10) is not permitted and may void warranty.

Your use of unsupported fuels may reduce performance or cause damage. See precautions below.



WARNING: Gasoline with an ETHANOL content rating higher than 10% (E-10) is not allowed and may void warranty. Read the precautions below from E-10 Service Bulletin #251 issued by Westerbeke Corporation.

Since 1990, the U.S. government has mandated the use of oxygenated fuels to reduce carbon emissions into the atmosphere. Congress had previously mandated the use of MTBE (methyl tertiary butyl ether) as this oxygenate. This legislation expired in May 2006 because MTBE is a known carcinogen and is also a ground water contaminant. Since then, in new energy legislation, Congress mandated the use of ethanol as the oxygenate. Ethanol, an alcohol-based fuel produced from corn is more environmentally friendly.

About E-10

E-10 is a blend of 10% ethanol and 90% gasoline and is the mixture now offered at most fuel stations. The use of E-10 in your car should have no real effect on its operation. The use of E-10 in the marine marketplace, however, will cause us to take some precautions.

Ethanol, being an alcohol-based product, is quite different from MTBE which is an ether-based product. Ethanol is sort of a double-edged sword when it comes to its ability to mix with water. E-10 can hold up to four teaspoons of water per gallon but can hold only 0.15 teaspoons of water per gallon when in solution. This is good, as it will allow your engine to burn water that finds its way into your fuel tank up to this 4-teaspoon per gallon limit. The problem comes when one gets beyond this limit.

As was the case with MTBE fuel, E-10 will also *phase separate* when it gets beyond the saturation point. Phase separation occurs when the gasoline and water are separated and the gasoline floats on top of the water. With MTBE, one could simply pump the water out from under the fuel or let the filters remove it and burn the gasoline left behind. MTBE reacts quite differently with water than does ethanol. For this reason, the two fuel blends should not be mixed when transitioning from MTBE to E-10.

(Note: The original bulletin was written in 2006. In 2018 and future years, mixing with MTBE is no longer a primary concern since it is no longer available.)

Ethanol is a solvent and tends to clean any dirt or contaminants on contact. For the consumer, this means that any dirt currently in the fuel system will be mixed into solution and scrubbed out by the fuel filters. This results in the need for the consumer to change fuel filters frequently.

The shelf life of E-10 is only 60-90 days. It will start to break down over time and leave deposits in the fuel system. E-10 will also lose its volatility very quickly. We recommend using a NON-ALCOHOL based fuel stabilizer in your fuel all the time. The reason we are recommending a non-alcohol-based stabilizer is to avoid adding even more alcohol to the fuel. There are several good petroleum-based products on the market.

Another characteristic of E-10 is its ability to absorb water directly from the atmosphere through the open vent system of your boat tank. In just 100 days at 70% humidity, E-10 can absorb enough water to reach its phase separation point. To avoid this from occurring, use up the fuel as quickly as you can. Try to plan on turning the fuel over as quickly as possible by running the tank low before any extended periods of non-use. Then fill up just before the next trip out. Avoid having E-10 fuel sit unused in the tank for an extended period.

E-10 Precautions

- Do not mix MTBE fuel with E-10 fuel.
- Keep water out of your fuel tank.
- Run a non-alcohol-based fuel stabilizer additive at all times.
- The more you use your boat the less likely you are to have problems. Don't leave large loads of fuel in the boat for lengthy periods of time.
- There are approximately 5 to 8 percent fewer BTUs in E-10 (less power per gallon).
- Have a good water-separating fuel filter installed if you don't already have one.
- Keep several spare filters on board. You should also have a kit in a sealable bucket that will seal up old filters and gas for safety and the correct tools to change your filter. E-10 fuel will clean your fuel system and consequently will often clog filters after changing.
- Be aware of potential points of water intrusion into fuel tanks. Check deck fill cap O-rings and fuel vents.
- Ask your fuel supply source or marina about the ethanol content of their fuel.
- Check and, if necessary, replace rubber fuel lines.
- Check and clean carburetors on older models.

Damage caused by contamination from water, foreign particles, sludge, or gums entering or forming in the engine or fuel system is not covered by the Westerbeke Corporation limited warranty.

CONTENTS

1	Important Safety Information	1
2	Introduction	4
21	Quick Start Operators Guide	4
22	Documentation	4
23	Parts Diagram	5
24	Warranty Procedures	6
25	Conventions Used in this Manual	7
26	Manuals and Software	7
27	Checklist: Protecting Your Investment	7
28	Gasoline Engines	7
29	Amperage Drain	8
210	Ordering Parts	8
211	Spare Parts, Kits, and Accessories	8
3	Installation	11
31	Codes and Regulations	11
32	Carbon Monoxide Detector	11
33	Siphon-Break Requirements	11
34	Exhaust System Requirements	12
3.5	Remote Oil Filter	12
4	Startup and Basic Operation	14
41	Fuel Source	14
42	Fuel Supply Components	14
43	Engine Oil	14
44	Engine Coolant	14
45	Coolant Recovery Tank	15
46	How to Bleed the Fuel System	15
47	How to Start and Stop the Generator	16
48	Safety Shutdown Switches and LEDs	18
49	Break-In Procedure for Daily Operation	21
410	Checklist: Initial Startup	21
411	Checklist: Daily Startup	22
5	Maintenance	23
51	Maintenance Schedule	23
52	Maintenance: Fuel System	25
53	Maintenance: Cooling System	27
54	Maintenance: Engine	31
55	Maintenance: Connections, Motors, and Circuit Breakers	37
6	Diagnostics and Troubleshooting	41
61	Diagnostics Software for Microsoft Windows	41
62	Engine Troubleshooting	42
7	Wiring Diagrams	44
71	Remote Start/Stop Panels	44
8	Lay-Up and Recommissioning	45
81	Lay-Up Prep: Lubrication System	45
82	Lay-Up Prep: Batteries	45
83	Lay-Up Prep: Cylinder Lubrication	45
84	Lay-Up Prep: Fuel System	45
85	Lay-Up Prep: Starter Motor	46
86	Lay-Up Prep: Raw Water Cooling Circuit	46

87	Lay-Up Prep: Intake Manifold	46
88	Lay-Up Prep: Spare Parts.....	46
89	How to Recommission After a Lay-Up	46
9	Generator Specifications	48
9.1	Specifications: Engine	48
9.2	Specifications: Fuel System	48
9.3	Specifications: Electrical System	48
9.4	Specifications: Air Requirements	48
9.5	Specifications: Cooling System.....	49
9.6	Specifications: Lubrication System	49
9.7	Specifications: AC Generator (Single Phase).....	49
9.8	Specifications: Ignition System	49
9.9	Specifications: Engine Component Tightening Torque	49

LIST OF FIGURES

Figure 1: Parts Diagram.....	5
Figure 2: Customer Identification Card	6
Figure 3: Product Serial Number, Model Number, and Other Specifications	6
Figure 4: Spare Parts Kit.....	9
Figure 5: Suggested Spare Parts	10
Figure 6: Siphon-Break (Anti-Siphon Valve) with Stainless Steel Loop	12
Figure 7: Remote Oil Fill (Detailed View)	13
Figure 8: Engine Coolant Recovery Tank	15
Figure 9: Fuel System	16
Figure 10: Control Panel DC Circuit Breaker and Start/Stop Switch.....	17
Figure 11: Remote Start/Stop Panels	18
Figure 12: Exhaust Temperature Switch.....	19
Figure 13: Coolant Temperature Sensor.....	20
Figure 14: Control Panel DC Circuit Breaker	20
Figure 15: Engine Oil and Coolant System Components	22
Figure 16: Fuel System Components	25
Figure 17: Harness Lift Pump DC Auxiliary Power Adapter	26
Figure 18: Engine Coolant Fill.....	27
Figure 19: Cooling System Heat Exchanger (Left) and Thermostat (Right).....	28
Figure 20: Engine Oil Filter, Dip Stick, Drain Hose and Oil Fill Cap	31
Figure 21: Engine Oil Dipstick, Low, Correct Level and Overfull Mark	32
Figure 22: Spark Plug	32
Figure 23: Air Screen/Flame Arrestor.....	33
Figure 24: Engine Oil Filter, Oil Pressure Sender, and Oil Pressure Switch.....	34
Figure 25: Battery Charger	34
Figure 26: Catalyst Installation.....	35
Figure 27: AC Circuit Breaker (50 & 60Hz)	37
Figure 28: BC Generator AC Terminal Connection Schematic	39
Figure 29: Shore Power Transfer Switch	40
Figure 30: Shore Power Transfer Switch Configurations.....	40
Figure 31: Typical Diagnostic Software Kit (Control Box, Cable, and Other Components)	41
Figure 32: Wiring Diagram for Start/Stop Panel with Fault Display	44
Figure 33: Wiring Diagram for Start/Stop Panel Rocker Switch Only.....	44

1 Important Safety Information

Read this manual carefully. Most accidents are caused by failure to follow fundamental rules and precautions. Know when dangerous conditions exist and take the necessary precautions to protect yourself and other people, machinery, and property. As the owner or operator, always observe the following safety risks and advisories provided for your convenience. This important safety information aligns with American Boat and Yacht Council (ABYC) standards; however, safety risks are not limited to the following list and the responsibility for the identification of potential and actual risks and for compliance with all safety advisories, maintenance activities, and other conditions belongs exclusively to you as the owner or operator.



WARNING: Review all safety information. Failure to observe the risks, warnings, and required actions can result in damage, injury, or death.

Risk of Electric Shock

- Do not touch the high-voltage AC electrical connections while engine is running, or when connected to shore power.
- Do not operate this machinery without electrical enclosures and covers in place.
- Shut off electrical power before accessing electrical equipment.
- Use insulated mats whenever working on electrical equipment.
- Make sure your clothing and skin are dry, not damp (particularly shoes) when handling electrical equipment.
- Remove watches and jewelry before working on electrical equipment.

Risk of Accidental Start

- Accidental starts can cause injury or death.
- Turn off the DC breaker on the control panel or turn the battery selector switch to off before servicing the engine.
- Verify all covers, guards, and hatches are re-installed and all personnel are clear of the engine before starting.

Risk of Burns

- Do not touch hot engine parts or exhaust system components. A running engine gets very hot!



WARNING: Steam burns can cause injury or death.

- Monitor engine antifreeze coolant level at the plastic coolant recovery tank and periodically at the filler cap location on the water jacketed exhaust manifold, but only when the engine is COLD.
- In case of an engine overheat, allow the engine to cool before touching the engine or checking the coolant.
- Burns may also result from fires or explosions.

Risk of Fire

- Fires can cause injury or death.
- Gasoline and diesel fuel spills or vapors can ignite in a flash fire.
- Do not smoke or permit flames or sparks to occur near the fuel system, carburetor, fuel line, filter, fuel pump, while bleeding the fuel system or other potential sources of spilled fuel or fuel vapors.
- Use a suitable container to catch all fuel when removing the fuel line, carburetor, or fuel filters.
- Keep the compartment and the engine/generator clean and free of debris to minimize the chances of fire. Wipe up all spilled fuel and engine oil.
- Do not operate with the air cleaner/silencer removed. Backfire can cause severe injury or death.

Risk of Explosion

- Explosions from fuel vapors can cause injury or death.
- Follow re-fueling safety instructions. Keep the vessel hatches closed when fueling. Open and ventilate cabin after fueling. Check below for fumes or vapor before running the blower. Run the blower for four minutes before starting your engine.

- All fuel vapors are highly explosive. Use extreme care when handling and storing fuels. Store fuel in a well-ventilated area away from spark-producing equipment and out of the reach of children.
- Do not fill the fuel tank(s) while the engine is running.
- Shut off the fuel service valve at the engine when servicing the fuel system. Take care in catching any fuel that might spill. Do not allow any smoking, open flames, or other sources of fire near the fuel system or engine when servicing. Ensure proper ventilation exists when servicing the fuel system.
- Do not alter or modify the fuel system.
- Be sure all fuel supplies have a positive shut-off valve.
- Be certain fuel line fittings are adequately tightened and free of leaks.
- Make sure a fire extinguisher is installed nearby and is properly maintained. Be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications encountered in this environment.

Risk of Battery Explosion or Battery Acid Burns

- Battery explosions can cause injury or death.
- Do not smoke or allow an open flame near the battery being serviced. Lead acid batteries emit highly explosive hydrogen gas, which can be ignited by electrical arcing or lit tobacco products. Shut off all electrical equipment in the vicinity to prevent electrical arcs during servicing.
- 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. Sparks could ignite battery gases or fuel vapors.
- Ventilate any compartment containing batteries to prevent accumulation of explosive gases.
- To avoid sparks, do not disturb the battery charger connections while the battery is charging.
- Avoid contacting the terminals with body parts, tools, and other objects to prevent burns or sparks that could cause an explosion. Remove wristwatches, rings, jewelry, and other personal devices before handling the battery.
- Turn the battery charger off before disconnecting the battery connections. Remove the (-) negative lead first and reconnect it last when servicing the battery.
- Sulfuric acid in batteries can cause severe injury or death.
- Batteries contain corrosive sulfuric acid, which may splash on the skin or into the eyes inadvertently when removing electrolyte caps.
- When servicing the battery, or checking the electrolyte level, wear rubber gloves, a rubber apron, and eye protection. If acid contacts skin or eyes, wash it off at once with water.

Risk of Exposure to Toxic Exhaust Fumes and Gases

- Carbon monoxide (CO) is an invisible, odorless, and deadly gas. Inhalation produces flu-like symptoms, nausea, and even death. Symptoms of carbon monoxide inhalation or poisoning include vomiting, dizziness, headache, inability to think coherently, throbbing in temples, muscular twitching, nausea, weakness, and fatigue.
- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifold/water-injected elbow is securely attached.
- Be sure the unit and its surroundings are well ventilated. Run blowers when running the generator set or engine.
- Do not run the generator set or engine unless the boat is equipped with a functioning marine carbon monoxide detector that complies with ABYC A-24. Consult your boat builder or dealer for installation of approved detectors. For additional information, refer to educational information about carbon monoxide in ABYC TH-22.
- Do not use copper tubing in diesel exhaust systems. Diesel fumes can rapidly destroy copper tubing in exhaust systems. Exhaust sulfur causes rapid deterioration of copper tubing resulting in exhaust/water leakage.
- Do not install exhaust outlet where exhaust can be drawn through portholes, vents, or air conditioners. If the engine exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or restrict the flow of exhaust.
- Avoid overloading the craft.

Risk of Injury from Moving Parts

- Rotating parts can cause injury or death.
- Do not service the engine while it is running. If a situation arises in which it is necessary to make operating adjustments, use extreme care to avoid touching moving parts and hot exhaust system components.

- Do not wear loose clothing or jewelry when servicing equipment; tie back long hair and avoid wearing loose jackets, shirts, sleeves, rings, necklaces or bracelets that could be caught in moving parts.
- Do not work on machinery when you are mentally or physically incapacitated by fatigue.
- Make sure all attaching hardware is properly tightened.
- Always keep protective shields and guards in their respective places.
- Do not check fluid levels or drive belt tension while engine is running.
- Do not allow swimming or other activity near the exhaust discharge opening for the generator while the generator is operating. Carbon monoxide poisoning or death can occur.

Noise Hazard

- High noise levels can cause hearing loss.
- Never operate an engine without its muffler installed.
- Do not run the engine with the air intake (silencer) or flame arrestor removed.
- Do not run engines for long periods with their enclosures open (when installed).

Safety Standards for Gasoline Engines and Generators

Many standard safety tips, notes, cautions, and warnings are repeated in this manual to highlight critical information. Read all manuals carefully, maintain your equipment, and follow all safety procedures.

Installing a gasoline engine or generator should begin with a thorough examination of the American Boat and Yacht Council (ABYC) standards. These standards are from a combination of sources including the USCG and the NFPA. Applicable sections of the ABYC standards include:

- H-2 Ventilation for Boats using Gasoline
- H-24 Gasoline Fuel Systems
- P-1 Installation of Exhaust Systems for Propulsion and Auxiliary Engines
- P-4 Marine Inboard Engines and Transmissions
- E-11 AC and DC Electrical Systems on Boats

Read the following ABYC, NFPA, and USCG publications, safety codes, and standards. Follow their recommendations when installing all engines and generators. All installations in the United States must comply with the Code of Federal Regulations (CFR).

- ABYC Standards and Technical Information Reports for Small Craft*
American Boat and Yacht Council
613 Third Street, Suite 10
Annapolis, MD 21403
www.abycinc.org
- NFPA Fire Protection Standard for Motor Craft*
National Fire Protection Association
11 Tracy Drive
Avon Industrial Park
Avon, MA 02322
<http://www.nfpa.org>
- United States Coast Guard (USCG) 33CFR183: Boats and Equipment*
U.S. Government Printing Office
Washington, D.C. 20404
www.gpo.gov or www.ecfr.gov

Carbon Monoxide (CO)/ Multiport EFI Generators

Carbon monoxide (CO) is a component of engine exhaust. It is a colorless, tasteless, odorless, lighter than air poisonous gas that can kill you without any warning. CO poisoning is one of the major safety risks associated with boating. It is a threat that must not be underestimated. Westerbeke multiport EFI generators are designed to dramatically reduce normal levels of CO in the engine exhaust. Several standards for CO have been published, expressed in parts per million (ppm) and hours of exposure:

Table 1: Emissions Exposure Standards

Regulator	CO Level (ppm)	Max Exposure (Hours)
EPA	9	8.0
ACGIH	25	8.0
EPA	35	1.0
NIOSH	35	8.0
OSHA	50	8.0
ACGIH	125	0.5
NIOSH	200	0.0
NIOSH (IDLH)	1200	0.0

In the last row of the table, 1200 ppm is the so-called IDLH concentration: Immediately Dangerous to Life and Health.

A city in California characterizes the effect of CO concentration this way:

- 25 ppm:** Permissible exposure level, no apparent toxic symptoms.
- 100 ppm:** No poisoning for long period. Allowable for several hours.
- 200 ppm:** Should not be exposed above this level for any period of time. A possible mild frontal headache in two to three hours.

Even though the generator normally produces low levels of CO, an untreated exhaust leak would be extremely dangerous. For this reason, it is extremely important to install a CO detector near the generator and to be sure it is always turned on and functioning properly. If this detector sounds, do not turn it off, assuming it is a false signal.

You cannot taste, smell, or otherwise detect CO. Leave the detector on, turn off all engines and generators, evacuate the boat leaving ports and hatches open, and seek professional help.

As soon as CO leaves the exhaust outlet, the level is subject to dilution in the open air. The closer a person is to the exhaust outlet, the higher the concentration of CO.

In a closed space, such as the engine compartment, the boat, or underneath a stern swim platform, concentrations will potentially rise to the undiluted level emanating from the exhaust system due to a lack of fresh air to dilute the exhaust gas. Therefore, one should never rely on dilution of the exhaust to provide a margin of safety.

Westerbeke multiport EFI generators achieve reduction of CO by precise control of the engine air/fuel ratio coupled with after-treatment in a special catalyst. CO emissions are not the same for every model because each engine is different. Also, certain fuel system components are common across several engine models being adequate for some and extra-adequate for others, thus producing different CO levels for different models.

The fuel system which accomplishes the required precise air/fuel ratio control is comprised of many different components: purchased sub-assemblies, machined castings, sensors, electronics and others. Because of the extreme level of CO reduction, any variability in the functioning of any these components can and will cause variability of the CO output.

CO concentration also varies with load. Usually, but not always, the worst-case CO concentration occurs at maximum load.

Inspection

The catalyst is critical for minimizing engine CO exhaust emissions. Any water intrusion into the exhaust system can quickly compromise the proper operation of the catalyst. Inspection of the catalyst at the prescribed intervals is critically important.

Use a CO analyzer to check for the presence of CO while the engine is running. See 5.4.9 Exhaust System Maintenance.

Westerbeke exhaust system installation instructions must be adhered to.

NOTE: Water intrusion is not a product defect and is not covered under your Westerbeke product warranty or the emissions-specific warranty mandated by various regulating authorities such as EPA and CARB.

Maintenance of fuel filters, air filters, and any other components affecting the flow of air or the flow of fuel to the engine is critically important.

The catalyst must be inspected, and replaced if necessary, every 500 hours of engine operation: Catalyst performance will degrade over time. As the generator accumulates operating hours, CO concentrations will increase.

Verification of satisfactory CO levels must be done seasonally or every 250 hours (whichever occurs first): Verification involves actual sampling of exhaust gas with an appropriate CO analyzer.

There are two locations where exhaust gas can be sampled:

- Dry, but hot, exhaust can be sampled at the plugged tapped hole in the exhaust elbow intended for back pressure measurements. Measurements at this location may not be practical in all instances due to the high exhaust temperature, temperature limits of the analyzer, safety concerns over temperatures involved or the possibility of high levels of CO.
- The other location is the vessel exhaust outlet, which contains entrained cooling water (except dry stack exhaust systems). Only analyzers with probes should be used at this location and it is critical that the probe not ingest water. Probe-type analyzers have an air pump drawing a gas sample through the probe. They tend to ingest water when it is present.

Follow these tips:

- Read and follow the CO analyzer manufacturer's instructions for proper operation of the analyzer.

- Aim the probe downwards with the opening pointed in the direction of the water flow and just out of the flow.
- Position the analyzer as high as possible with the tubing leading to the probe running continuously downhill.
- Observe the usually translucent tubing between the probe and the analyzer and be sure no water is ingested. If any water is ingested into the analyzer, it must be repaired and recalibrated or replaced.
- When measuring CO at the exhaust outlet be aware of the ambient CO level by also measuring CO away from and upwind of the exhaust outlet, especially in marinas. The CO level at the exhaust outlet will be influenced upwards by the ambient level.
- Whenever taking the time to verify proper CO concentration from the exhaust with a CO analyzer, always use the analyzer to *sniff* around the engine looking for CO from exhaust leaks. Pay close attention to the connection of the cylinder head to the exhaust manifold, the exhaust manifold to the water-injected exhaust elbow, and all subsequent downstream exhaust components and hoses.
- Exhaust gas that has not yet passed through the catalyst is raw, untreated, and very high in CO content.
- Analyzers usually require periodic calibration. Follow the instructions that come with the analyzer very carefully regarding calibration.
- The following manufacturers offer CO analyzers: Extech, TIF, Testo, TSI, Bacharach, Fluke, Monoxor, Fyrite, Zellweger Analytics, Industrial Scientific, GFG, TPI, Teledyne, and others.
- Westerbeke recommends analyzers with a probe connected to the analyzer by a length of transparent tubing. They are slightly more expensive than those with the sensor built-in to one end of the analyzer, but they allow you to sample the exhaust coming out of the boat exhaust outlet.

California Exhaust Emissions Standards

This generator meets the requirements of the California Exhaust Emissions Standards as stated on the nameplate. California users of this generator should be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the engine label is prohibited.

Federal Emissions Compliance Period

The Federal Emissions Compliance Period referred to on the nameplate indicates the number of operating hours for which the engine has been shown to meet Federal Emissions requirements:

- Category A = 1000 hours
- Category B = 500 hours
- Category C = 250 hours

Carefully review operator, installation, and other manuals and information you receive with your generator. If you are unsure whether the installation, use, maintenance, or service of your generator is authorized, seek assistance from an approved Westerbeke dealer.

California generator users may use the table below as an aid in locating information related to the California Air Resources Board emissions control requirements.

Table 2: Emissions Control Information	
Emissions Warranty Information	See the California emissions control warranty statement in the same packet of information as this manual when the generator is shipped from the factory.
Engine Fuel Requirements	The engine is certified to operate on unleaded gasoline. See 9.2 Specifications: Fuel System.
Engine Lubricating Oil Requirements	See 4.3 Engine Oil and 9.6 Specifications: Lubrication System.
Engine Adjustments	To learn more about the Electronic Control Unit (ECU), see the Westerbeke Service Manual for your product model.
Engine Emission Control System	The engine emission control system consists of engine design and precision manufacturing.
Engine Valve Adjustment	See 5.1: Maintenance Schedule.
Engine Ignition Timing	
Catalyst	
Oxygen Sensor	
Back Pressure	

2 Introduction

This Westerbeke generator is a product of our many years of experience and advanced technology. We take great pride in the superior durability and dependable performance of our engines and generators. Thank you for selecting Westerbeke.

To get the full use and benefit from your generator, it is important that you operate and maintain it correctly. This manual is designed to help you do this. Please read this manual carefully and observe all the safety precautions throughout. Should your generator require servicing, contact your nearest Westerbeke dealer.

2.1 Quick Start Operators Guide

To get started quickly, refer to these sections:

- Important Safety Information
- Parts Diagram
- Checklist: Protecting Your Investment
- Checklist: Initial Startup
- Checklist: Daily Startup
- Maintenance Schedule
- Lay-Up and Recommissioning



WARNING: Carbon monoxide emissions can cause injury or death. Mount carbon monoxide detectors in all living quarters on the vessel.

2.2 Documentation

- This is your *Operators Manual*.
- An *Installation Manual* and associated parts information is furnished also.

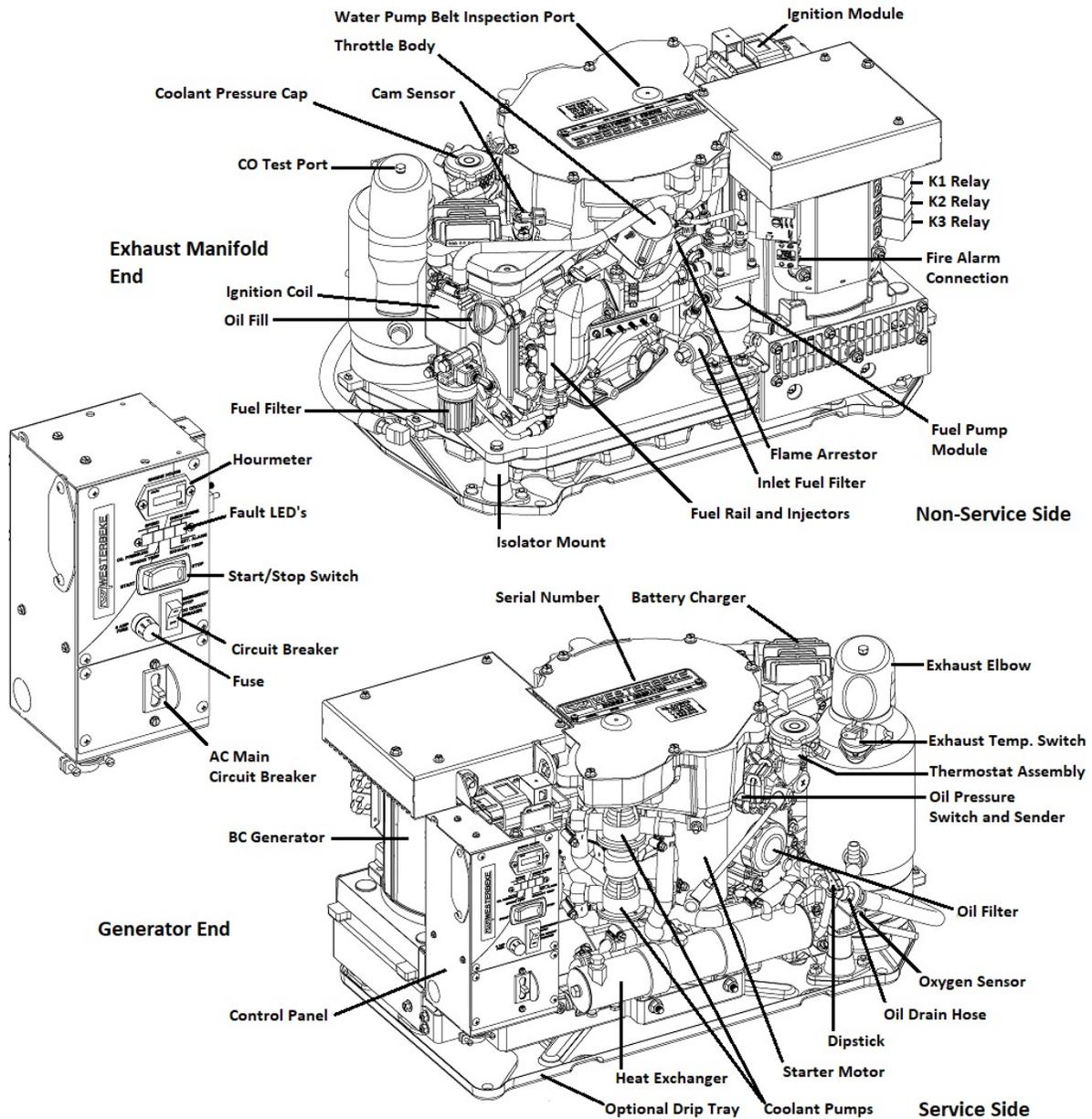
Visit www.westerbeke.com.

You can also order printed documentation from your local Westerbeke/Universal dealer. Fees and shipping charges may apply.

2.3 Parts Diagram

PARTS IDENTIFICATION 3.5 MCGA/B GENERATOR

Figure 1: Parts Diagram



2.4 Warranty Procedures

Your Westerbeke Warranty Statement is included in the product documentation package. Complete and return the included warranty registration card or register your product online at www.westerbeke.com.

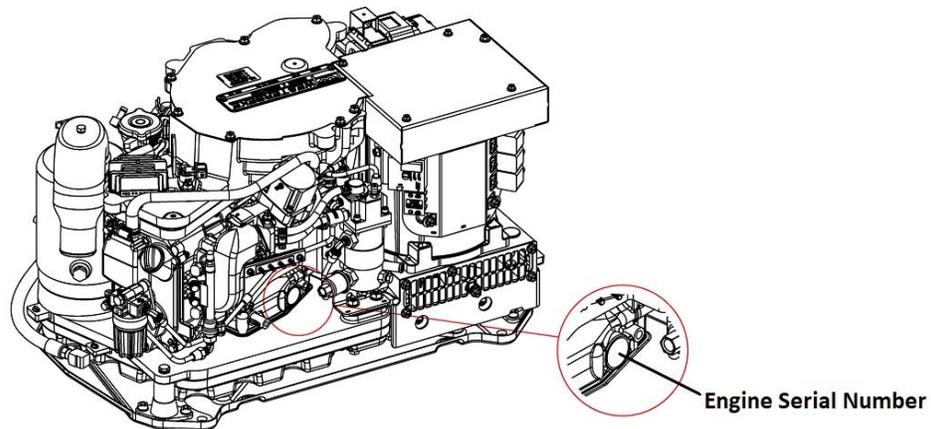
You should receive your customer warranty identification card in the mail within 30 days of registering. If you do not, contact the factory and have your product model designation, serial number, and in-service date available.

Figure 2: Customer Identification Card



Customer Identification
 WESTERBEKE OWNER
 MAIN STREET
 HOMETOWN, USA
 Model Ser. #
 Expires

Figure 3: Product Serial Number, Model Number, and Other Specifications



SERIAL NUMBER LOCATION

Fill in the information below for reference.



The engine model number and serial number are printed on a decal on the engine manifold.

The generator serial number is stamped on the top of the generator housing.

The generator specifications are printed on a decal on the side of the generator.

SPECIFICATION	50 HZ.	60 HZ.
MODEL		
RPM		
KW		
KVA		
VOLTS		
AMPS		
ENG. HP		
ENG. SER. NO.		
GEN. SER. NO.		
PF/PHASE	/	
WIRES		
RATING		
INSUL. CLASS		
TEMP. RISE		
BATTERY		
C.I.D.		

Fill in the information for your own reference.

2.5 Conventions Used in this Manual

This manual includes safety information, operating procedures, maintenance schedules, and troubleshooting tips. Information is sometimes highlighted when it meets the following criteria:

NOTE: An operating procedure essential to note.

TIP: A recommended best practice or suggestion.

CAUTION: Procedures, which can result in the damage or destruction of your engine if not properly followed.



WARNING: Procedures which can result in personal injury or death if not strictly observed.

2.6 Manuals and Software

Westerbeke frequently updates our manuals and software. For the latest information, consult your Westerbeke representative or visit www.westerbeke.com.

CAUTION: Technical information is provided in our documentation for your reference and convenience. Westerbeke recommends that your engine, generator or climate control system is serviced and/or installed only by a qualified Westerbeke distributor or dealer.

2.7 Checklist: Protecting Your Investment

Care at the factory during assembly and thorough testing have resulted in a Westerbeke generator capable of many hours of dependable service. However, the manufacturer cannot control where the generator is installed in the vessel or how well the unit is installed, operated, and serviced in the field. As the buyer or owner-operator, this responsibility is up to you.

To prolong the life of your generator, follow these important points:

- Properly install, configure, and prepare your unit for safe operation.
- Verify that you have an efficient well-designed exhaust system that includes an anti-siphon break to prevent water from entering the engine.
- Change the engine oil and filters, and maintain all engine and generator components, as directed in Chapter 5.1: Maintenance Schedule.
- Use clean, filtered unleaded fuel (maximum 10% ethanol).
- Winterize your engine as directed in Chapter 8: Lay-Up and Recommissioning.

2.8 Gasoline Engines

In many ways, the gasoline engine driving an AC generator is like a gasoline automobile engine. The cylinders are in-line, and the engine cylinder head has an overhead camshaft which is belt driven. The engine utilizes electronic ignition, no distributor. The engine incorporates a pressure type lubrication system and a fresh water-cooled engine block, which is thermostatically controlled.

To a large degree, the generator engine requires the same preventative maintenance that is required of a gasoline automobile engine. The most important factors to prolong generator longevity are proper ventilation, maintenance of the fuel system, ignition system, cooling system and the generator back-end.

2.9 Amperage Drain

Be aware of the following very important condition that will typically occur when you do not operate your generator for an extended period.

CAUTION: A very small amount of amperage is being drawn from the starting battery by the electronics on the unit when the generator is not in use. To prevent this very slow discharging of the starting battery, turn **OFF** either the panel DC breaker or the starting battery switch when the unit will not be operated for an extended time.

2.10 Ordering Parts

Whenever replacement or service parts are needed, always provide the generator model number, engine serial number, and generator serial number as they appear on the silver and black nameplate located on the generator end. You must provide us with this information, so we may properly identify your generator set.

Include a complete part description and part number for each part needed (see the separately furnished Parts Catalog). Insist upon Westerbeke genuine parts because aftermarket or generic parts are frequently not made to the same specifications as original equipment.

2.11 Spare Parts, Kits, and Accessories

Certain spare parts will be needed to support and maintain your Westerbeke generator. Your local Westerbeke dealer will assist you in preparing an inventory of suggested spare parts and accessories.

TIP: We also recommend carrying enough spare engine oil for an oil change and one gallon of premixed coolant for the cooling system.

Figure 4: Spare Parts Kit



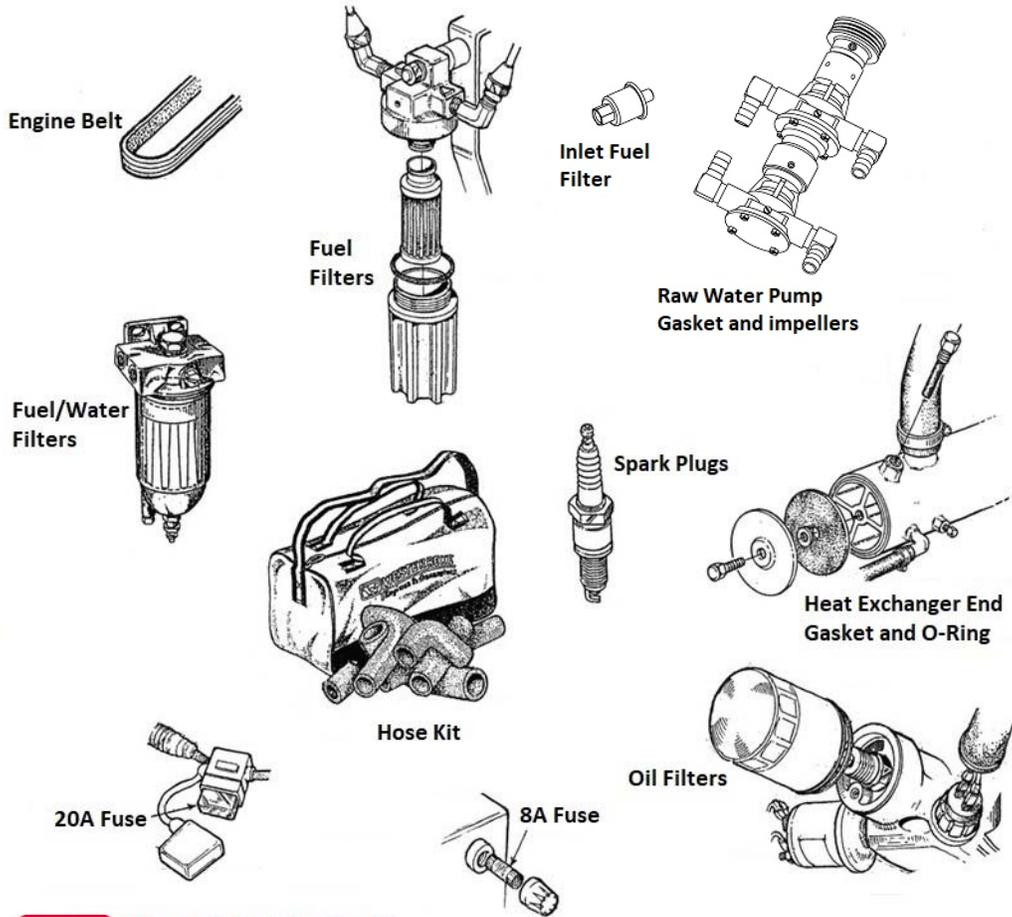
For your convenience, we offer two spare part kits, each packaged in a water-tight storage case:

- **Kit A** includes the basic set of the most essential recommended spare parts.
- **Kit B** includes everything in Kit A, plus additional spare parts for more extensive off-shore cruising.

Spare Part List	Kit A	Kit B
Drive Belt, Main	✓	✓
Drive Belt, Water Pump	✓	✓
Fuel Filters	✓	✓
Heat Exchanger Gasket	✓	✓
Impeller Kit	✓	✓
Oil Filter	✓	✓
Spark Plugs	✓	✓
Zinc Anodes	✓	✓
Complete Gasket Kit		✓
Thermostat Kit		✓
Water Pump Repair Kit		✓

- **Hose Kit**

Figure 5: Suggested Spare Parts



Insist on genuine high-quality parts from Westerbeke.

3 Installation

NOTE: When installing Westerbeke engines and generators, pay strict attention to all installation requirements.

In addition to the installation information in this chapter of this guide, also refer to the *Marine Installation Manual* supplied with your product. That installation guide covers engines and generators and is included with each gasoline and diesel unit. A PDF is available to download from our website at <https://www.westerbeke.com/installation-manuals/installation-manual.pdf>.

3.1 Codes and Regulations

Strict federal regulations, ABYC guidelines, Coast Guard standards, and NFPA safety codes must be complied with when installing engines and generators in a marine environment.

See [Safety Standards for Gasoline Engines and Generators](#) in Chapter 1: Important Safety Information.

3.2 Carbon Monoxide Detector

Westerbeke recommends mounting a carbon monoxide detector in all living quarters on the vessel.

The presence of carbon monoxide could indicate an exhaust leak from your engine or from the exhaust elbow/hose of the exhaust system from another vessel.



WARNING: If carbon monoxide is present, ventilate the area with clean air and correct the problem immediately!
Carbon monoxide, even in small amounts, is deadly.

3.3 Siphon-Break Requirements

For installations where the exhaust manifold/water injected exhaust elbow is close to or will be below the vessel waterline, provisions must be made to install a siphon-break in the raw water supply hose to the exhaust elbow. This hose must be looped a minimum of 24.0 inches (61.0 cm) above the vessel waterline.

CAUTION: Failure to use a siphon-break when the exhaust manifold injection port is at or below the load waterline will result in raw water damage to the engine and possible flooding of the boat.

If you have any doubt about the position of the water-injected exhaust elbow relative to the vessel waterline under the various operating conditions for your vessel, install a siphon-break, available from Westerbeke or your local authorized Westerbeke dealer.

Figure 6: Siphon-Break (Anti-Siphon Valve) with Stainless Steel Loop



NOTE: A siphon-break requires periodic inspection and cleaning to ensure proper operation. Failure to properly maintain a siphon-break can result in catastrophic engine damage. Consult the siphon-break manufacturer for proper maintenance.

3.4 Exhaust System Requirements

To install exhaust system components, see the installation manual.

- The system must be designed to prevent the entry of water into the exhaust system under any sea conditions and at any angle of vessel heel.
- The exhaust system hose must be certified for marine use.

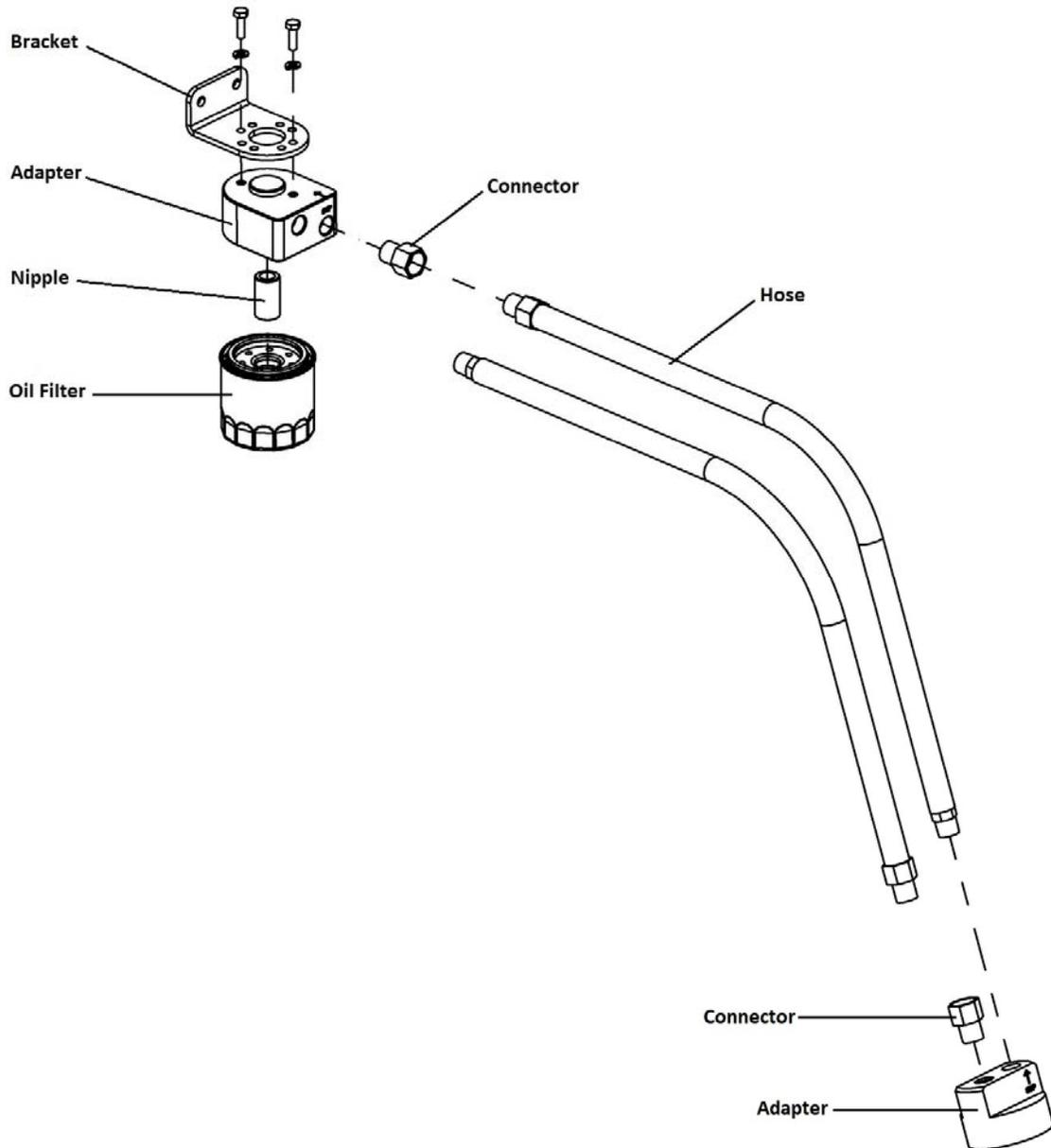
TIP: Corrugated marine exhaust hose is recommended. The use of this type of hose allows for extreme bends and turns without additional fittings and clamps. A single length of corrugated exhaust hose can often be used.

3.5 Remote Oil Filter

The optional remote oil filter kit is a popular accessory used to relocate the engine oil filter from the engine to a more convenient location such as an engine room bulkhead. The remote oil filter ships to you already fully assembled.

1. Remove your previous engine oil filter. Follow the steps in 5.4.2 How to Replace the Engine Oil Filter.
2. When installing this kit, apply a thin coat of clean oil to the O-ring and the filter gasket where the filter contacts the base. Tighten firmly by hand.
3. Thread on the optional Westerbeke remote oil filter kit. Always install this kit with the oil filter facing down.
4. Hand-tighten an additional three-quarters ($\frac{3}{4}$) turn after the O-ring contacts the base.
5. Fasten securely to a bulkhead (screws are owner-supplied for best fit).

Figure 7: Remote Oil Filter (Detailed View)



CAUTION: Do not disturb the oil lines. If the oil flows in the reverse direction, the bypass valve in the filter assembly will prevent the oil from reaching the engine, possibly causing internal engine failure. If there is no oil pressure reading, shut down immediately and check the hose connections.

NOTE: Westerbeke is not responsible for engine failure due to the improper installation of the remote oil filter.

4 Startup and Basic Operation

4.1 Fuel Source

The fuel source for this model is gasoline. Use only clean properly filtered fuel!

CAUTION: Use unleaded 89 octane gasoline or higher. Ethanol gasoline must not exceed E-10 (10%). Gasoline with higher ethanol content is not acceptable for use in this model and will void the warranty.

4.2 Fuel Supply Components

The fit and tolerance of some components in the fuel system are very critical. Dirt particles which might pass through the filter can damage these finely finished parts. It is important to buy clean fuel, and to keep it clean. The best fuel can be rendered unsatisfactory by careless handling or improper storage facilities.

Follow these suggestions:

- Always provide clean and pure fuel in the tank for your engine.
- Check the fuel supply frequently.
- Purchase a well-known brand of fuel.
- Install and regularly service a good, Coast Guard approved metal bowl type filter/water separator between the fuel tank and the engine.

4.3 Engine Oil

Use a good brand of engine oil with API and SAE designations as listed in 9.6 Specifications: Lubrication System. Change the engine oil and filter after the first 50 hours of engine break-in operation. Then follow the oil and filter change intervals as specified in 5.1: Maintenance Schedule. See 5.4.3. for proper procedures for filling oil.

Westerbeke does not approve or disapprove the use of synthetic oils. If synthetic oils are used, engine break-in must be performed using conventional oil. The required oil change intervals are listed in this manual and cannot be extended, even if synthetic oils are used.

NOTE: The information above supersedes all previous statements regarding synthetic oil usage.

CAUTION: The oil sump on this generator's engine can be unintentionally overfilled!

4.4 Engine Coolant

Westerbeke recommends a mixture of 50% antifreeze and 50% distilled water. Distilled water is free from the chemicals and minerals that can corrode internal engine surfaces.

The antifreeze performs double duty. It allows the engine to run at proper temperatures by transferring heat away from the engine to the coolant. It also lubricates and protects the cooling circuit from rust and corrosion. Use a good quality antifreeze that contains supplemental cooling additives (SCAs) to keep the antifreeze chemically balanced, crucial to long-term protection.

The distilled water and antifreeze should be pre-mixed before being poured into the cooling circuit.

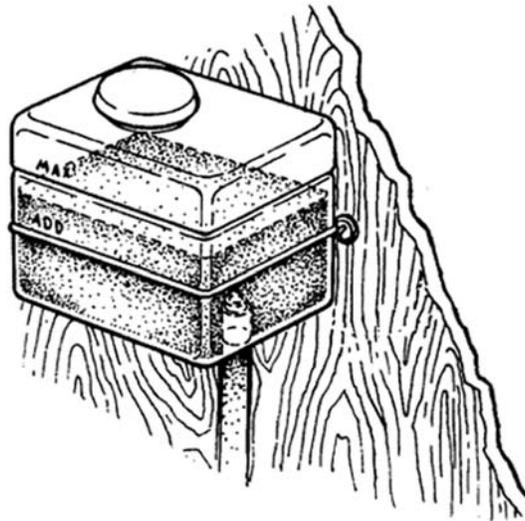
Refer to section 5.3 for filling the cooling system.

TIP: Use the environmentally-friendly, long-lasting antifreeze that is now available. A proper 50/50 mixture as recommended will protect the engine coolant at temperatures as low as -40° F.

4.5 Coolant Recovery Tank

A coolant recovery tank kit is supplied with each generator to allow for engine coolant expansion and contraction during engine operation without the loss of coolant and without introducing air into the cooling system. This tank is best located at or above the level of the engine exhaust manifold.

Figure 8: Engine Coolant Recovery Tank



4.6 How to Bleed the Fuel System

The initial setup of the generator requires that you or your mechanic bleed the air from the fuel system. This procedure, known as *priming* or *bleeding* the fuel system, is also required whenever the fuel filters are serviced.

1. Disconnect the fuel module from the engine wiring harness.
2. Attach your fuel pressure gauge set (Snap On #MT337B, OTC 7211) or equivalent to the Schrader valve on the fuel module. Direct the bleed hose from the pressure gauge into a proper container.
3. Open the bleed valve on the pressure gauge, press the STOP switch, and hold it depressed. This activates the low-pressure fuel pump.
4. Observe the fuel flow through the bleed hose. When no air bubbles are seen, release the STOP switch to close the bleed valve and observe the fuel pressure (typically about 8-10+ psi).
5. Remove the pressure gauge from the fuel module and connect it to the Schrader valve on the fuel rail.
6. Re-connect the fuel module to the engine harness.
7. Open the bleed valve on the fuel pressure gauge. Press the STOP switch and hold it depressed. This activates both the low-pressure and high-pressure fuel pumps. Observe the

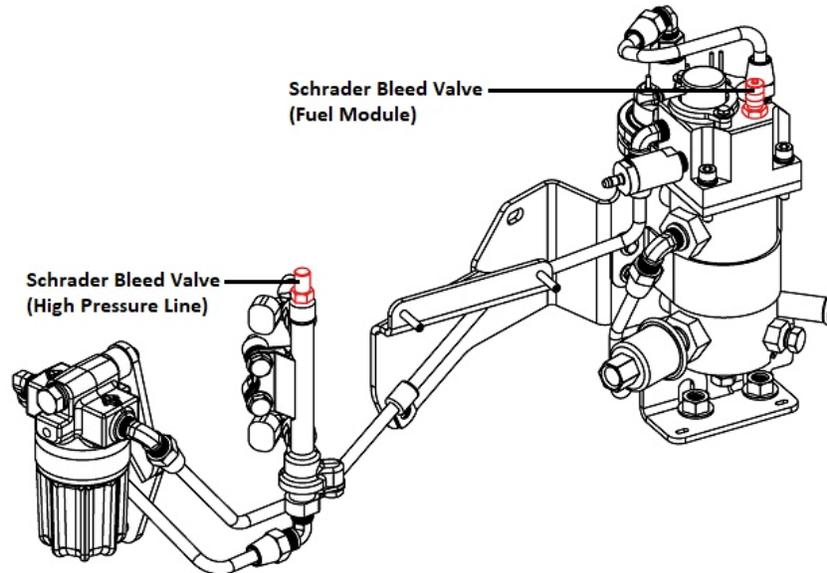
fuel flow through the bleed hose and when no air bubbles are seen, close the bleed valve and observe the fuel pressure. The pressure should be in the 40-psi range.

8. Remove the pressure gauge set and replace the caps on the two Schrader valves.
9. Insure that all harness connections are secure, operate the generator and check that there are no fuel leaks.



WARNING: The fuel is under extreme pressure! Do not allow any smoking or open flames in the area! Clean up spilled fuel and properly discard any used cloths, rags, and towels.

Figure 9: Fuel System



4.7 How to Start and Stop the Generator

4.7.1 How to Start and Stop the Generator (Control Panel)

The start/stop rocker switch is the only functional component on the generator control panel (and optional remote control panel) used to start and stop the generator. The start/stop rocker switch is a three-position switch with momentary contacts in the START and STOP positions and a stationary contact in the NORMAL center position. This position allows the generator to run once started and enables one or more remote start/stop panels to control the start/stop functions of the generator. The green light on the rocker switch may be dimly lit, indicating power to the ECU.

1. To start the unit turn the DC circuit breaker on.
2. Press the rocker switch to the **START** position and release it.

NOTE: There is a delay of a few seconds after the DC breaker is turned on, while the ECU self-tests, before the start switch responds.

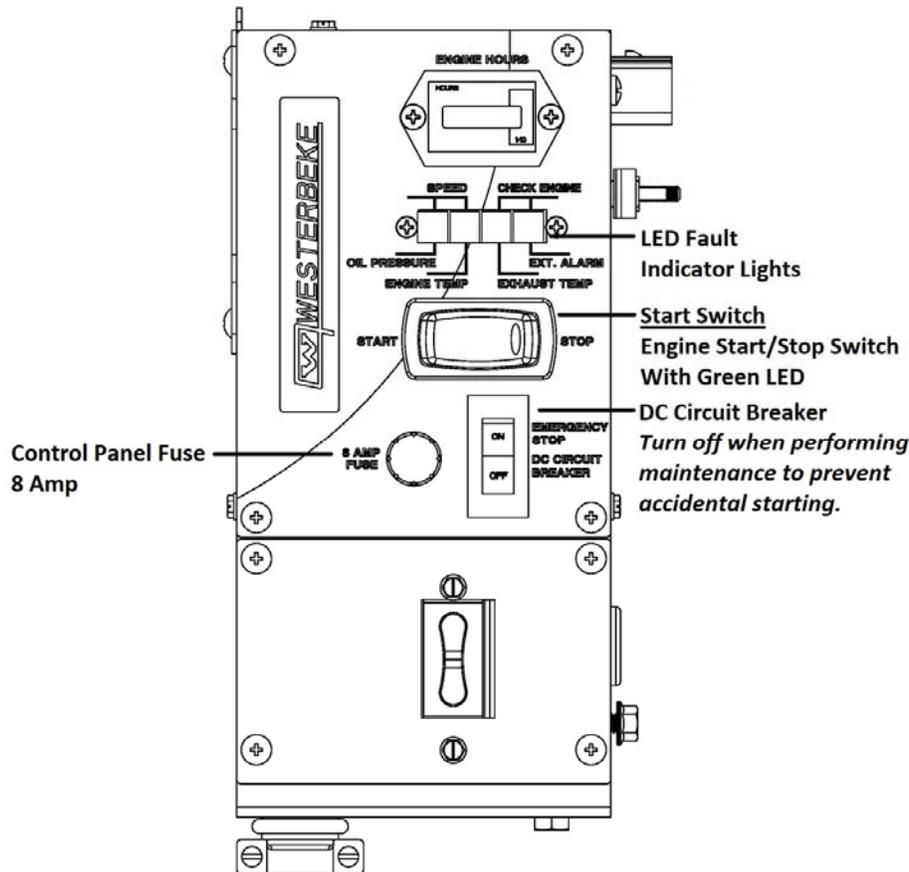
The switch returns to its center position. The LEDs sequence momentarily from left to right. The fuel pumps run (4-6 seconds). Then, the engine will crank and start. A **green** LED on the switch indicates the engine is running.

3. To stop the unit, press the rocker switch to the **STOP** position and release it. The **STOP** position stops the engine in normal operation as well as in an emergency.

NOTE: This position is also used to prime the fuel system when necessary. See 4.6 How to Bleed the Fuel System.

4. The **green** LED dims indicating the engine has shut down.

Figure 10: Control Panel DC Circuit Breaker and Start/Stop Switch



4.7.2 How to Start and Stop the Generator (Remote Control Panel)

You can also perform the same steps using an optional remote control panel. Two remote start/stop panels are available that allow for the engine/generator to be controlled from any location on the boat.

The remote panels connect to the main panel using a 15-foot or 30-foot wiring harness. You can combine them to form a 45-foot length. To connect a remote panel, refer to the Wiring Diagram section of this manual.

Once installed, the engine/generator can be started and stopped from either the remote or the main panel.

4.7.3 Remote Start/Stop Panel (With LED Fault Display)

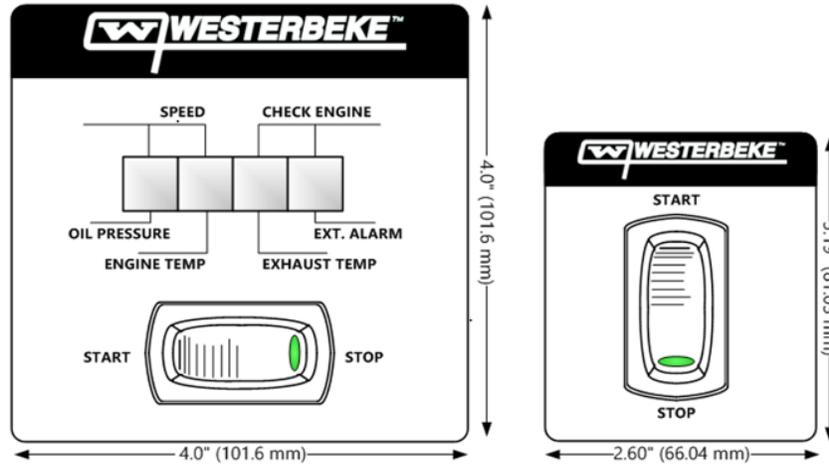
The components on this panel include:

- A three-position start/stop rocker switch.
- A **green** LED run indicator light on the rocker switch.
- A four-position LED fault shutdown display.

The start/stop rocker switch functions the same as the start/stop rocker switch on the generator control panel as previously explained.

The **green** LED run indicator light on the rocker switch is illuminated when the generator is running.

Figure 11: Remote Start/Stop Panels



4.7.4 Failure to Start

The start cycle will automatically terminate if the engine fails to start. Three crank cycles can be attempted before the ECU initiates a fault and prevents further crank cycle attempts. Investigate the cause of this no-start, correct it, and reset the power to the ECU.

CAUTION: Prolonged cranking can result in the exhaust filling with water and possible backflow into the engine. This could cause catastrophic damage to your generator/engine.

4.8 Safety Shutdown Switches and LEDs

The engine/generator is protected by switches and sensors that send signals to the ECU that it interprets as a fault and automatically shuts down the generator engine. When an automatic shutdown occurs, one or two of the control panel fault LED lights will illuminate indicating what fault caused the engine to shut down. To correct the fault, see 6.2 Engine Troubleshooting.

NOTE: Do not attempt to re-start the generator before correcting the fault.

The LED fault shutdown display includes the following six LED light combinations that indicate to the operator the cause of the engine automatic shutdown:

- CHECK ENGINE
- OIL PRESSURE
- ENGINE TEMPERATURE
- EXTERNAL ALARM
- EXHAUST TEMPERATURE
- SPEED

If the generator shuts down from one of these faults, the fault LED remains illuminated. To reset the LED, the DC breaker on the control box must be turned OFF and then back ON.

NOTE: The CHECK ENGINE light indicates a possible emissions control problem. Immediate action should be taken to troubleshoot and correct this problem.

The EXT ALARM light indicates a fault with the fire suppression circuit. Troubleshoot the circuit to determine the fault (the fire suppression circuit must be closed when the circuit is active).

The 8-amp fuse protects the control panel from high amperage or short circuit condition.

The 20-amp DC circuit breaker protects the K1, K2, and K3 relays (closed circuit) from a high-amperage or short-circuit condition.

4.8.1 Speed Sensor

A speed sensor is mounted under the flywheel. This sensor detects flywheel rotation and sends a voltage signal to the ECU that it uses to calculate crankshaft speed.

- If both speed LEDs are illuminated it indicates an engine speed fault.
- If a speed threshold is reached, either overspeed or underspeed, the ECU shuts the unit down.

4.8.2 Oil Pressure Switch and Sender

An oil pressure switch is located on the right side of the oil filter mounting bracket. See Figure 24: Engine Oil Filter, Oil Pressure Sender, and Oil Pressure Switch.

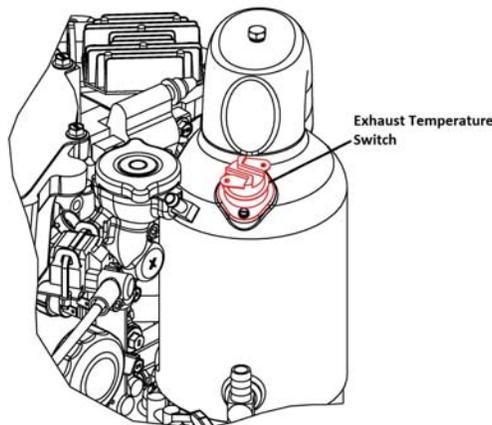
This is a normally open contact switch. It functions with the time relay circuit to ensure DC voltage to the fuel pump circuit is terminated when the unit shuts down.

An oil pressure sender (to the left of the oil filter) sends DC voltage to the ECU that it interprets as oil pressure. Should this voltage fall below a certain level, the ECU will shut the generator down and illuminate the low oil pressure LED. If this occurs, see 6.2 Engine Troubleshooting.

4.8.3 Exhaust Temperature Switch

A temperature switch is mounted on the exhaust elbow to monitor the temperature of the exhaust coolant and gases. Should the switch sense an excessive exhaust temperature, the ECU will shut the generator down and the exhaust temperature LED will illuminate on the control panel.

Figure 12: Exhaust Temperature Switch

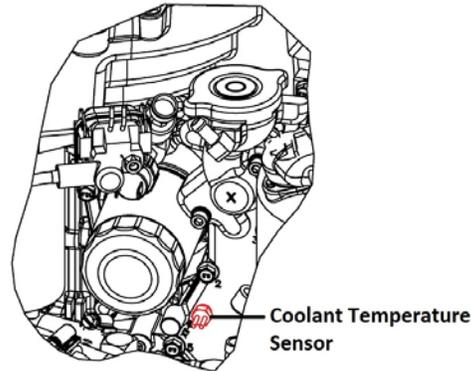


4.8.4 Coolant Temperature Sensor

This sensor is located on the underside of the intake manifold to monitor the engine coolant temperature. The sensor sends DC voltage to the ECU that interprets this reading as engine

coolant temperature. Should the temperature reach an overheat threshold, the ECU will shut the engine down and will illuminate the engine temperature fault LED light on the control panel.

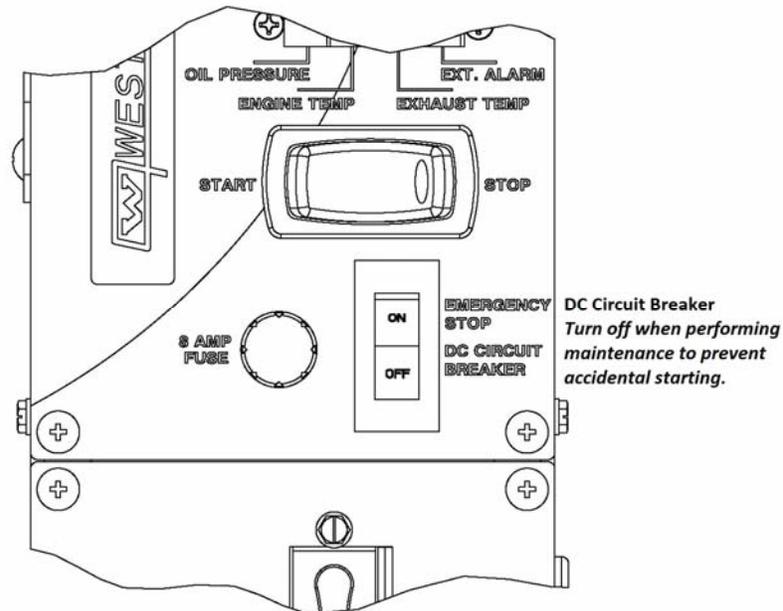
Figure 13: Coolant Temperature Sensor



4.8.5 DC Circuit Breaker

The engines electrical system is protected by a 20-amp manual reset circuit breaker. An electrical overload in the wiring harness or instrument panel will trip the breaker and shut down the engine/generator. Should this occur, inspect and repair the problem. Then reset the breaker and re-start the engine.

Figure 14: Control Panel DC Circuit Breaker



4.8.6 Fuse Protection

Four DC circuit protectors are found in the engines electrical circuit. A 20-amp DC breaker and an 8-amp buss fuse on the control panel. A 30-amp buss fuse in the control panel and a 30-amp blade fuse by the starter motor for the battery charge circuit.

4.9 Break-In Procedure for Daily Operation

After starting the generator, check for proper operation and then allow the generator to warm up a few minutes before applying a load. Run the generator between 20% and 60% of full-load for the first 10 hours.

CAUTION: Do not attempt to break-in your generator by running without a load.

After the first ten (10) hours of generator operation, you can increase the load to the full-load rated output, then periodically vary the load.

Monitor the current being drawn from the generator and keep it within the generator rating. Be aware of motor starting loads and their high current specifications. The starting amperage drawn can be 3 to 5 times normal running amperage.

CAUTION: Do not operate the generator for long periods of time without a load being placed on the generator.

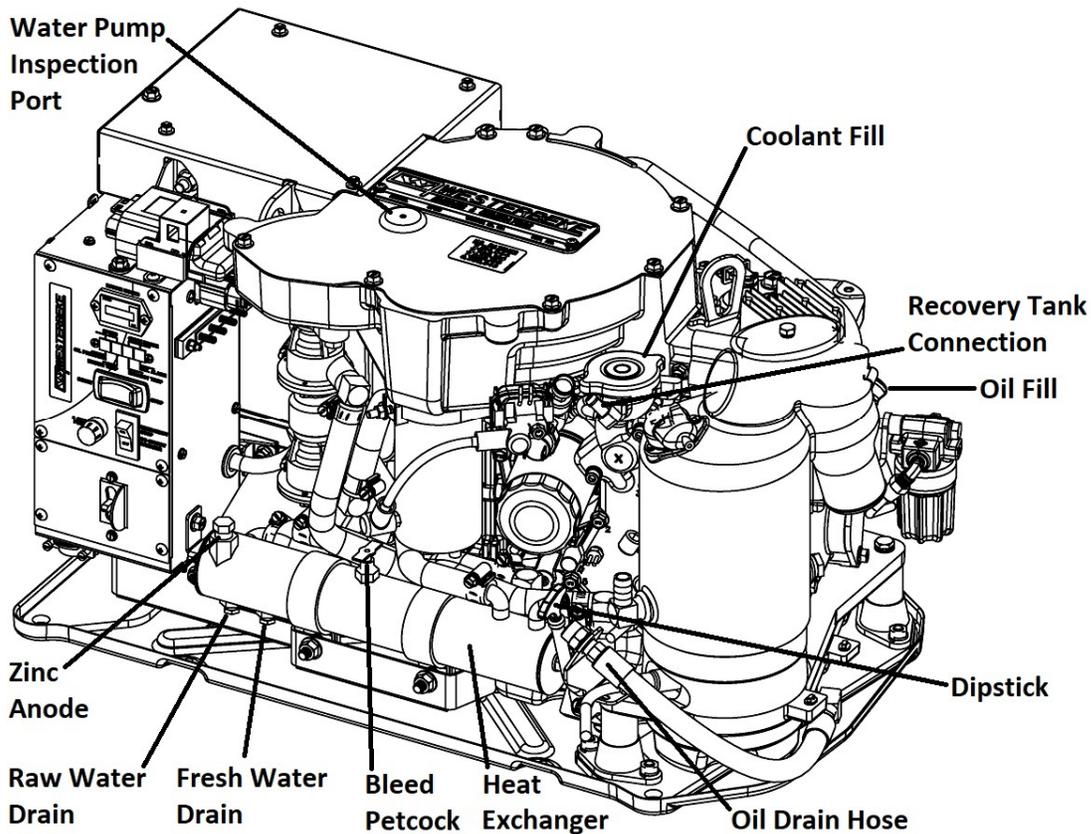
4.10 Checklist: Initial Startup

Before starting your generator for the first time, or after a long period of inactivity, inspect the following items:

- Check the engine oil level:** Add oil to maintain the level at the full mark on the dipstick.
- Check the fuel supply:** Examine the fuel filter/separator bowls for contaminants.
- Check the DC electrical system:** Inspect wire connections and battery cable connections.
- Check the battery:** Check that the starting battery is totally dedicated to the generator and maintained by the generator DC charging circuit and no other source.
- Check the coolant:** Check the coolant in the exhaust manifold and in the plastic coolant recovery tank. Ensure the exhaust manifold is full. Add coolant as needed. Maintain the coolant level in the plastic coolant recovery tank about $\frac{1}{2}$ full.
- Visually examine the unit:** Look for loose or missing parts, disconnected wires, unattached hoses, and check threaded connections. Search for any gasoline leaks, coolant leaks, loose clamps.
- Check the AC wiring:** Check AC wiring for correct connections as specified in the wiring diagrams.
- Inspect exhaust system connections:** Inspect the connections and catalyst.
- Check the grounding and neutrals:** Confirm that systems with a neutral line are properly grounded as the system requires, and that generator neutral is properly connected to the load neutral. In single phase systems, an incomplete or open neutral can supply the wrong line-to-neutral voltage on unbalanced loads.
- Check the load lines:** Be sure no other generator or utility power is connected to the load lines.
- Check the raw water intake thru-hull:** Make certain the raw water thru-hull is open.
- Prime the fuel system:** If necessary, bleed the air from the fuel system. See 4.6 How to Bleed the Fuel System.

CAUTION: When starting the generator, it is recommended that all AC loads, especially large motors, be switched **OFF** until the engine has come up to speed and, in cold climates, starts to warm up. This precaution will prevent damage caused by unanticipated operation of the AC machinery and will prevent a cold engine from stalling.

Figure 15: Engine Oil and Coolant System Components



4.11 Checklist: Daily Startup

Follow this check list each day before starting your generator.

- Visually inspect the generator for fuel, oil, water leaks or loose parts.
- Check the oil level on the dipstick.
- Check the coolant level in the coolant recovery tank.
- Check your fuel supply.
- Check drive belts for proper tension.
- Check for abnormal noise such as knocking, vibration and blow-back sounds.
- Inspect the exhaust system.
- Record the hour meter reading in your log to determine if any maintenance is required.

See 5.1 Maintenance Schedule.

NOTE: Some unstable running may occur when the engine is cold. This condition should lessen as normal operating temperature is reached and loads are applied.

5 Maintenance

5.1 Maintenance Schedule

The maintenance intervals specify operating hours or a time interval, whichever comes first. For example, if maintenance is due every 250 hours or six months, and you have logged 300 hours in only two months, do not delay maintenance another four months. Use the engine hour meter to log your engine running time.



WARNING: Never attempt to perform any service while the engine is running. Wear the proper safety equipment such as goggles or gloves and use the correct tools for each job. When servicing or replacing DC components, turn off the DC circuit breaker on the control panel or turn off the battery switch.

A  wrench symbol in the checklist indicates a service that we recommend you have performed by a knowledgeable mechanic.

5.1.1 Daily Check Before Startup

- Coolant Level:** Check at recovery tank, if empty, check at manifold. Add coolant if needed.
- Engine Oil Level:** Oil level should indicate between MAX and LOW on dipstick. Do not overfill!
- Fuel/Water Separator** (owner-installed): Check for water and dirt in fuel. Drain filter if necessary. Replace filter every 250 operating hours or once a year.
- Fuel Supply:** Fresh unleaded gasoline with an octane rating of 89 or higher. Lower octane will affect engine performance. 10% ethanol maximum.
- Visual Inspection of Engine:** Complete the daily startup checklist (see 4.11 Checklist: Daily Startup). Check for fuel, oil and water and exhaust leaks. Also, check that the water-injected exhaust elbow securing V-clamp is tight. Verify there are no exhaust leaks around the elbow. Inspect wiring and electrical connections. Look for loose bolts/hardware and possible corrosion.

5.1.2 First 50 Hours of Operation

-  **Spark Plugs:** Clean/re-gap.
- Engine Oil and Filter:** Initial engine oil and filter change at 50 hours. (Thereafter, every 100 hours.)
-  **Exhaust System:** Initial check at 50 hours, then every 250 hours or once a year. Carefully inspect for leaks. Check that the exhaust hoses are properly attached and that the securing clamps are tight. Check the integrity/mounting security of the water injected exhaust elbow.
-  **Air Screen/Flame Arrestor:** Remove, clean, and re-install screen pack. Inspect rubber ring and replace sealing if necessary. (Thereafter, check once every year.)
-  **Valve Adjustment:** Check adjustment of valves. (Check again at 500 hours.)
-  **Inlet Fuel Filter:** Initial change at 50 hours. (Thereafter, every 250 hours or once a year.)
-  **Fuel Filter and O-Rings:** Initial change at 50 hours. (Thereafter, every 250 hours or once a year.)

5.1.3 Every 50 Operating Hours or Monthly

- 🔧 Drive Belts:** Inspect drive belts in fresh water or raw water pump applications for proper tension (3/8" to 1/2" deflection) and adjust if needed. Check belt for slipping, cracking and wear. Adjust tension or replace as needed. Replace cover.
- Starting Batteries:** Check electrolyte levels. Make sure cables and connections are in good order. Clean off corrosion if needed. Apply petroleum jelly to terminals for corrosion protection.
- Electric Fuel Pump:** Inspect for leaks, ensure fuel and electrical connections are clean and tight.
- Zinc Anode:** Inspect zinc anode, replace if necessary.

5.1.4 Every 100 Operating Hours or Yearly

- Engine Oil and Filter:** Change engine oil and filter.
- 🔧 Air Screen/Flame Arrestor:** Remove, clean and re-install screen pack. Inspect rubber sealing ring and replace if necessary.
- 🔧 Exhaust Elbow/Exhaust System:** Check the structural integrity of the water injected exhaust elbow casting. Check the integrity of the exhaust system attached to the elbow. All hose connections should be secure. No chafing. No exhaust leaks. Hoses and muffler are in good serviceable condition.



WARNING: An exhaust leak will cause exposure to carbon monoxide!

5.1.5 Every 250 Operating Hours or Yearly

- 🔧 Fuel Filter and O-Rings:** Remove and replace fuel filter and all sealing O-rings.
- 🔧 Inlet Fuel Filter:** Remove and replace inlet fuel filter.
- 🔧 Spark plugs:** check and clean/gap/replace as needed.
- 🔧 Generator:** Check that AC connections are clean and secure. Ensure wires have no chafing.
- 🔧 Hoses:** Engine hoses should be firm and tight. Replace if hoses become spongy, brittle or delaminated. Check and tighten all hose clamps as needed.
- Vibration Isolators/Engine Mounts:** Check vibration isolators, brackets and mounting hardware. Replace as needed.
- 🔧 Heat Exchanger:** Open heat exchanger end cap(s) and clean out debris. Replace gasket and O-rings if needed.

5.1.6 Every 500 Operating Hours or Yearly

- 🔧 Raw Water Pump:** Remove the pump cover and inspect the pump assembly for wear, especially cam and wear plates. Replace the impeller and gasket. Lubricate the impeller when re-assembling.
- 🔧 Exhaust System Catalyst:** Inspect for proper operation. Replace at 500 operating hours, if needed.

5.1.7 Every 500 Operating Hours or Every Two Years

- 🔧 Ignition System:** Inspect for deterioration.
- 🔧 Coolant System:** Drain, flush, and refill the cooling system with the appropriate antifreeze mix. Replace the thermostat and coolant pressure cap.
- 🔧 Valve Clearances:** Adjust valves. Incorrect valve clearance will result in poor engine performance.

- ❑ **Starter Motor:** Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive using WD40 or equivalent.

5.1.8 Every 1,000 Hours or Every Five Years

- ❑ **Engine Timing Belt:** Remove and replace the timing belt.

CAUTION: Failure to replace the timing belt at the recommended interval could result in timing belt failure resulting in major damage to the engine.

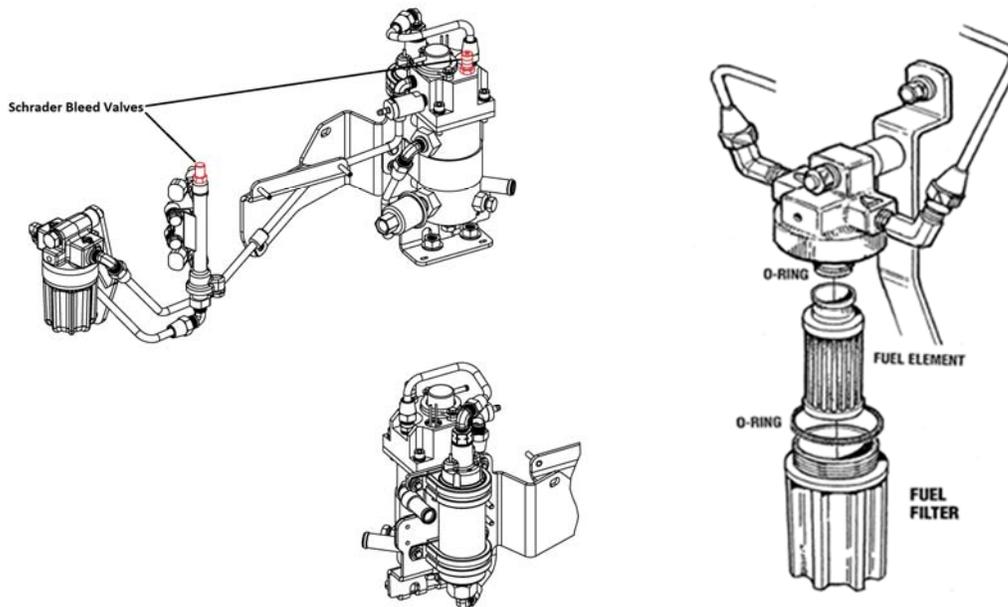
- ❑ **Heat Exchanger:** Remove the heat exchanger for professional cleaning and pressure testing.
- ❑ **Diverter Valve:** Remove and replace.
- ❑ **Oxygen Sensor:** Remove and replace the exhaust oxygen sensor.
- ❑ **Catalyst:** Remove and replace the exhaust catalyst and gasket.

5.2 Maintenance: Fuel System

Incoming fuel from the installer/OEM installed gasoline water separator and filter is pumped through the inlet fuel filter into the fuel module by the electric fuel pump. The fuel is cooled as it circulates through the fuel module and then is pumped by the electric fuel pump to the high-pressure pump module and to the secondary fuel filter. The fuel passes to the fuel rail and is delivered (under pressure) to the fuel injectors.

The engine fuel system should be primed (a procedure that bleeds the air out) at the initial commissioning of the unit, each time the fuel system is serviced, and once a season to ensure any air that may have accumulated in the system is removed. See 4.6 How to Bleed the Fuel System.

Figure 16: Fuel System Components



5.2.1 Gasoline Water Separator and Filter

A primary fuel filter of the water separating type must be installed between the fuel tank and the engine to remove water and other contaminants from the fuel before they can be carried to the fuel system on the engine. Most installers include a type of filter/water separator with

the generator installation package, as they are aware of the problems that contaminants in the fuel can cause.

These filters must meet U.S. Coast Guard specifications, which typically means these gasoline filters must have metal bowls (not see-through). The metal bowls have drain valves to use when checking for water and contaminants.

5.2.2 Fuel Pump

Periodically check the fuel connections to and from the pump. Verify that no leakage is present and that the fittings are tight and secure. The high-pressure fuel pump in the fuel module requires no additional maintenance.

5.2.3 Engine Fuel Filter

Periodically check the fuel connections and the bowl for leakage. Replace the filter element after the first 50 hours then follow the maintenance schedule.

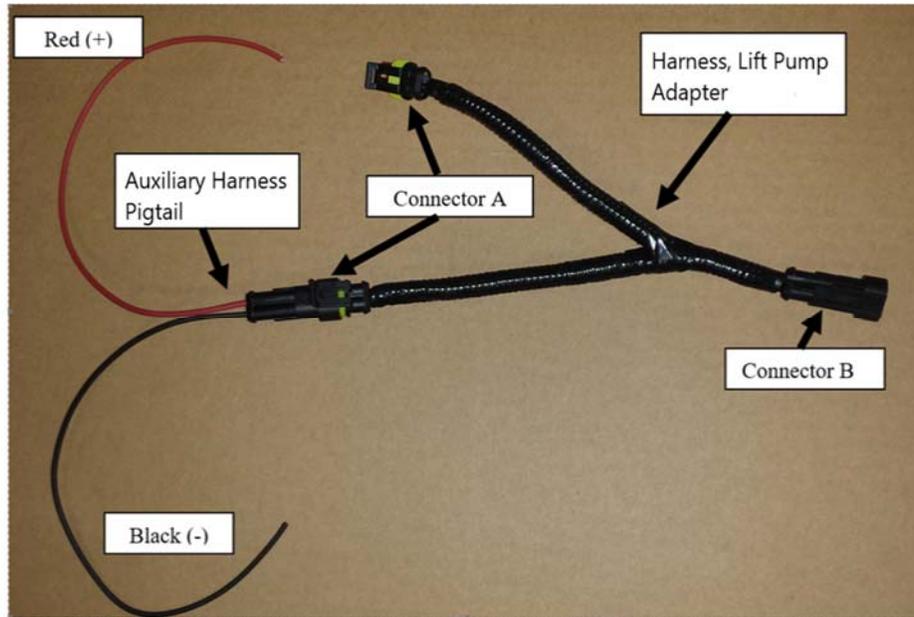
5.2.4 How to Change the Engine-Mounted Fuel Filter Element

1. Shut off the fuel supply to the generator.
2. Bleed the fuel system to reduce the fuel pressure to zero. See 4.6 How to Bleed the Fuel System.
3. Unscrew the fuel bowl from the housing and pull the filter element down and off. Use care to catch any fuel that may be present.
4. Replace the two sealing O-rings. Install the new filter element, thread on the fuel bowl, and tighten by hand.
5. Bleed the fuel system again (repeat Step 2) to remove trapped air from the system
6. Open the fuel supply to the generator and start the unit.
7. Verify that no leaks exist.

5.2.5 DC Auxiliary Power Adapter (Optional)

The auxiliary connection provides DC power only when the engine is running, or the fuel system is being primed. The maximum DC power available is 400 milliamps. The auxiliary power adapter is designed to plug into the engine wiring harness where the electric fuel pump is connected.

Figure 17: Harness Lift Pump DC Auxiliary Power Adapter



5.3 Maintenance: Cooling System

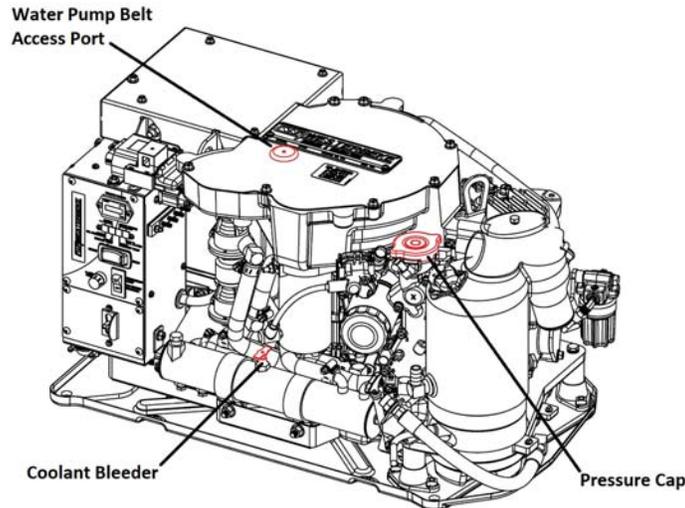
CAUTION: Proper cooling system maintenance is critical. Often times engine failures can be traced back to cooling system corrosion.

5.3.1 Fresh Water Cooling Circuit

Westerbeke marine engines are designed and equipped for fresh water cooling. Heat produced in the engine by combustion and friction is transferred to fresh water, which circulates throughout the engine. This circulating fresh water cools the engine block and its internal moving parts. The heat is transferred externally from the fresh water to sea water by means of a heat exchanger, similar in function to an automotive radiator. Sea water flows through the tubes of the heat exchanger while fresh water flows around the tubes, engine heat transferred to the fresh water is conducted through the tube walls to the sea water which is then pumped into the exhaust system where it is finally discharged overboard. In other words, the engine is cooled by fresh water, the fresh water is cooled by sea water, and the sea water carries the transferred heat over the side through the exhaust system. The fresh water and sea water circuits are independent of each other. Using only fresh water within the engine allows the cooling water passages to stay clean and free from harmful deposits.

5.3.2 How to Drain and Refill the Coolant

Figure 18: Engine Coolant Fill



Over time, without proper maintenance, the coolant can become contaminated. This condition can lead to overheating problems. Follow these steps to change (drain and refill) the coolant.

1. The engine coolant must be changed as directed in 5.1 Maintenance Schedule.
2. If maintenance is due, allow the engine to cool before continuing.

CAUTION: The engine must be allowed to cool down before attempting these procedures. Not only is the surface of the engine hot, but coolant temperatures can exceed 190° F (87° C).

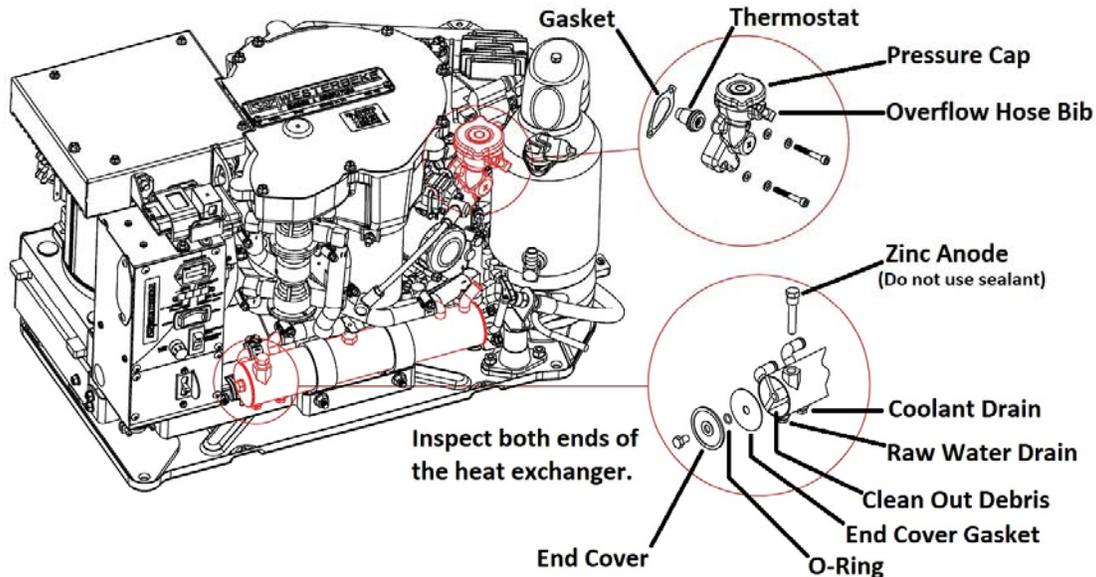
3. Drain the engine coolant.
 - a. Drain the engine block.
 - b. Remove the in-board drain plug on the heat exchanger.
 - c. Remove the pressure cap from the water jacketed exhaust manifold.
4. Re-install the coolant drain plugs.
5. Premix fresh coolant and distilled water or use Pre-mixed 50/50 coolant.
6. Open the air bleed petcock on the water jacketed exhaust manifold and slowly pour new pre-mixed coolant into the open filler neck until coolant is visible in the filler neck.
7. Start the engine.
 - a. Monitor coolant in the filler neck and add as needed. Check the air bleed petcock. When coolant flows from the petcock, close it.
 - b. Allow the engine to run and monitor coolant in the filler neck and add as needed. When the coolant level is stable, fill to the brim and install the pressure cap.
8. Remove the cap on the coolant recovery tank.
 - a. Fill with coolant mix to halfway between LOW and MAX.
 - b. Replace the cap.
 - c. Run the engine and observe the coolant expansion flow into the recovery tank.
9. Check for leaks. Stop the engine and allow it to cool. Coolant should draw back into the cooling system as the engine cools down.
 - a. Add coolant to the recovery tank if needed.
 - b. Verify the coolant is topped off at the pressure cap.
 - c. Clean up any spilled coolant.

NOTE: Periodically check the condition of the pressure cap. Ensure that the upper and lower rubber seals are in good condition and check that the vacuum valve opens and closes tightly. Carry a spare cap.

5.3.3 Cooling System Heat Exchanger

TIPS: Operating in silty and/or tropical waters may require that heat exchanger cleaning be performed more often.

Figure 19: Cooling System Heat Exchanger (Left) and Thermostat (Right)



5.3.4 Cooling System Zinc Anode

A zinc anode (or pencil) in the raw water cooling circuit in the heat exchanger sacrifices itself to electrolysis action taking place in the raw-water cooling circuit, reducing the effects of electrolysis on other components of the system. The condition of the zinc anode should be checked monthly to determine a change interval and the anode cleaned or replaced as required. Spare anodes should be carried on board.

If the zinc anode needs replacement, hold the hex boss into which the zinc anode is threaded with a wrench while loosening it with another wrench to avoid potential exchanger damage. After removing the zinc anode, note its condition. If the zinc is in poor condition, there are probably zinc flakes within the exchanger. Remove the end of the heat exchanger and clean the inside of all zinc debris.

Always have a spare heat exchanger end gasket in case the present one becomes damaged when removing the end cover. Replace the gasket (refer to the heat exchanger end gasket part number for your engine model). Also replace the O-ring and cover and install a new zinc anode.

NOTE: The threads of the zinc anodes are pipe threads and do not require sealant. Sealant should not be used because it may electrically insulate the zinc from the metal of the heat exchanger housing preventing electrolysis action on the zinc.

5.3.5 Cooling System Thermostat

The thermostat controls the coolant temperature as the coolant continuously flows through the closed fresh water cooling circuit. When the engine is first started, the closed thermostat prevents coolant from flowing (some coolant is by-passed around the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens. The thermostat is accessible and can be checked, cleaned, or replaced easily. Carry a spare thermostat and gasket.

5.3.6 How to Clean the Cooling System Raw Water Intake Strainer

A clean raw water intake strainer is a vital component of the engine cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

NOTE: A properly installed strainer is at or below the waterline so the strainer will always be self-priming.

Perform the following maintenance after every 100 hours of operation:

1. Close the raw water seacock.
2. Remove and clean the strainer filter.
3. Clean the glass.
4. Replace the washer if necessary.
5. Reassemble and install the strainer.
6. Open the seacock.
7. Run the engine and check for leaks.

NOTE: If you ever run hard aground, follow the above procedure before resuming normal operation.

5.3.7 Raw Water Pump

The raw water pump is a self-priming, non-ferrous housing with a Neoprene impeller. The impeller has flexible blades which wipe against a curved cam plate within the impeller housing, producing the pumping action. There should always be a spare impeller and impeller cover gasket aboard (an impeller kit).

Raw water pump impeller failures occur when raw water is not present during engine operation. Such failures are not covered by warranty, and operators are cautioned to make sure raw water flow is present at start-up.

CAUTION: Never allow the pump to run dry. Even a short period of dry running can destroy the impeller.

The raw water pump should be inspected periodically for broken or torn impeller blades. For details, see the maintenance schedule.

TIP: If the pump internal parts, seals, or bearings fail, it may be more cost-effective to purchase a new pump and rebuild the original pump to keep as a spare.

If silt, leaves, or grass are caught in the strainer, the flow of raw water through the cooling system may be restricted and the engine temperature warning light LED might illuminate.

NOTE: The external intake thru-hull opening should be of the flush type with a clear opening with no perforated or slot type external opening. Allow the filtering to occur on the inside of the hull where there is easy access to the strainer.

5.3.8 How to Change the Cooling System Raw Water Pump Impeller

1. Close the raw-water intake valve.
2. Remove the pump cover and, using an impeller puller, screw drivers, or pliers, carefully pry the impeller out of the pump.
3. Install the new impeller and gasket.
4. Move the blades to conform to the curved cam plate and push the impeller into the pumps housing.
5. When assembling, apply a thin coating of glycerin lubricant to the impeller and gasket.
6. Open the raw-water intake valve.

NOTE: If any of the blades have broken off the impeller, they must be found to prevent blockage in the cooling circuit. They can often be found in the heat exchanger.

5.4 Maintenance: Engine

5.4.1 How to Change the Engine Oil

1. Warm the engine/oil before draining.
2. Remove the oil drain hose from its attachment bracket and lower it into a container, and allow the oil to drain.
3. (Optional) You can also attach a pump to the end of the drain hose and pump the old oil out.
4. Make sure the oil drain hose is properly secured in its holder after all the old oil has been drained.
5. Always observe the old oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a competent mechanic if water is present in the oil. Raw water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a siphoning through the raw-water cooling circuit into the exhaust, filling into the engine.

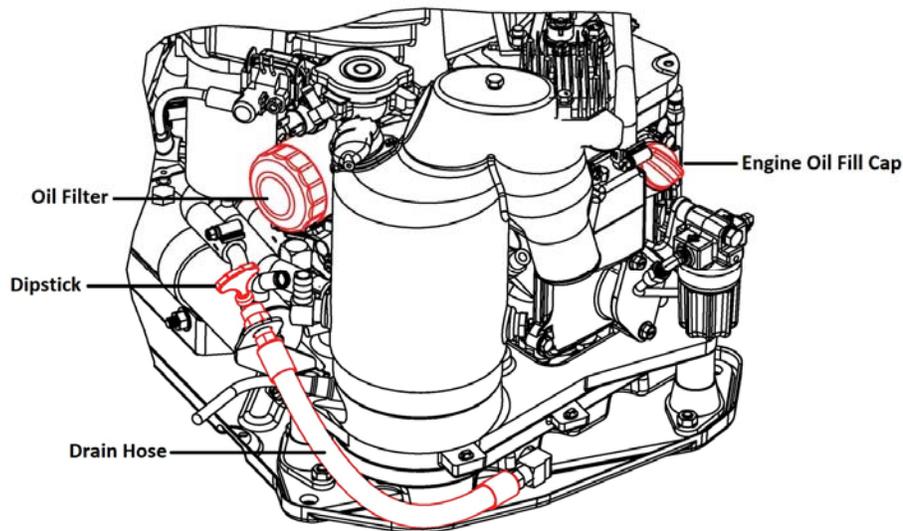


WARNING: Used engine oil contains harmful contaminants. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water. Launder or discard clothing or rags containing used oil. Recycle used oil properly.

5.4.2 How to Replace the Engine Oil Filter

1. Verify the current used filter can be loosened.
2. Remove the old oil filter with an automotive filter wrench. Place some paper towels and a plastic bag around the filter when unscrewing it to catch any oil from inside the filter.

Figure 20: Engine Oil Filter, Dip Stick, Drain Hose and Oil Fill Cap



3. Inspect the old oil filter as it is removed to make sure that the rubber sealing gasket comes off with the old oil filter. If this rubber sealing gasket remains sealed against the oil filter adapter, gently remove it.
4. When installing the new oil filter, wipe the filter gasket sealing surface on the oil filter adapter free of oil and apply a thin coat of clean engine oil to the rubber sealing gasket on the oil filter.
5. Screw the filter onto the threaded oil filter stub. Where the filter contacts the base, tighten firmly by hand.

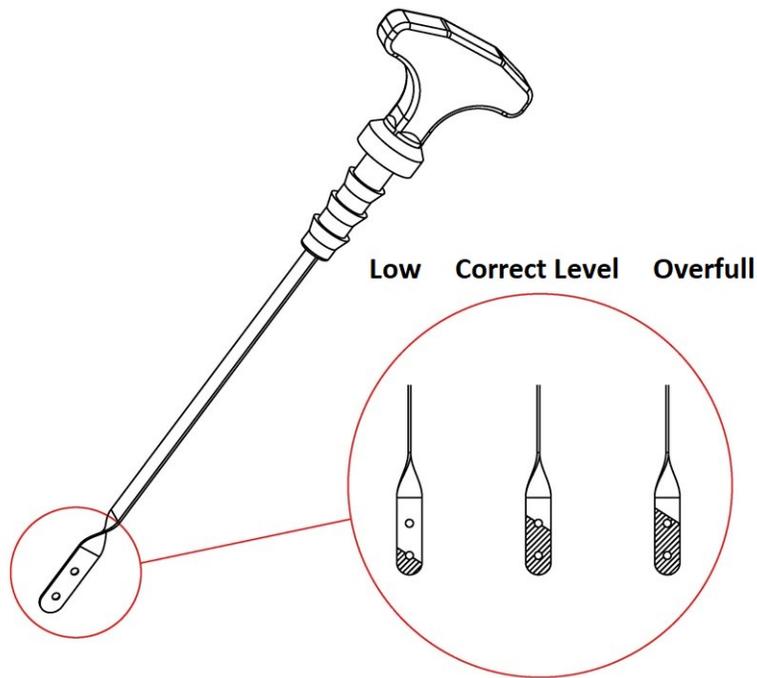
TIP: Use genuine Westerbeke oil filters. Generic filters are not recommended.

5.4.3 How to Refill the Engine Oil

1. Add fresh oil through the valve cover.
2. After refilling the oil, run the engine for a few moments.
3. Make sure there is no leakage around the new oil filter or from the oil drain system, and then stop the engine.
4. Check the quantity of oil with the lube oil dipstick. Fill to, but not over, the FULL mark on the dipstick.

CAUTION: The sump on this generator's engine can unintentionally be overfilled! Because of the angle of the dipstick, the oil mark will appear at an angle on the dipstick. The center of the oil mark indicates the proper oil level. The center of the mark should never be above the full line on the stick. Overfilling will oil can result in erratic oil pressure and nuisance shut-downs.

Figure 21: Engine Oil Dipstick, Low, Correct Level and Overfull Mark

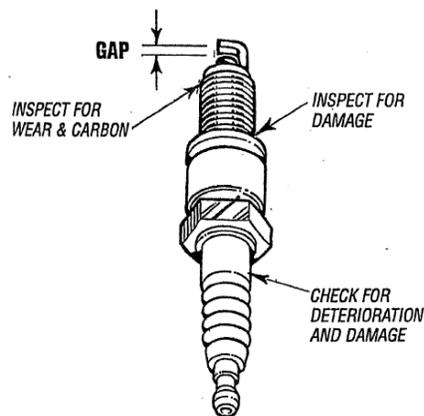


5.4.4 How to Inspect the Spark Plugs

It is important to maintain spark plugs in a proper operating condition. They are an important component in the ignition system in lowering carbon monoxide levels. The spark plugs should be cleaned and re-gapped after the first 50-hour break-in period, then follow the maintenance schedule in this manual.

- **SPARK PLUG GAP:** Refer to Specification Page
- **SPARK PLUG TORQUE:** Refer to Specification Page

Figure 22: Spark Plug



TIP: Loctite Anti-Seize applied to the threaded portion of the spark plugs will retard corrosion, making future removal of the spark plugs easier.

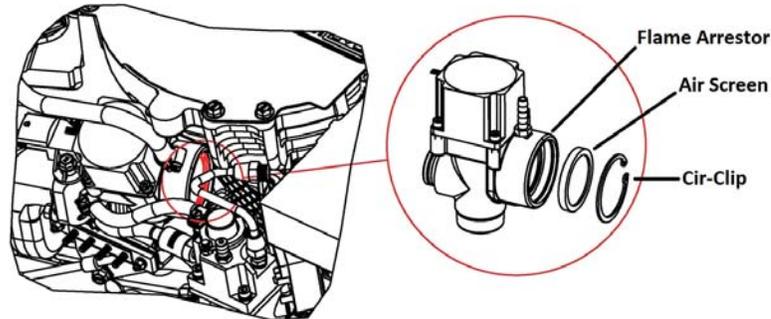
WARNING: Do not remove the spark plugs while the engine is hot. Allow the engine to cool before removing them.

5.4.5 How to Clean the Air Screen/Flame Arrestor

The air screen/flame arrestor should be cleaned after the first 50 hours of operation. Then refer to the maintenance schedule in this manual.

1. Clean using a good dish washing solution, rinse, and air dry.
2. Inspect the seal edges. If worn, install a new flame arrestor.

Figure 23: Air Screen/Flame Arrestor



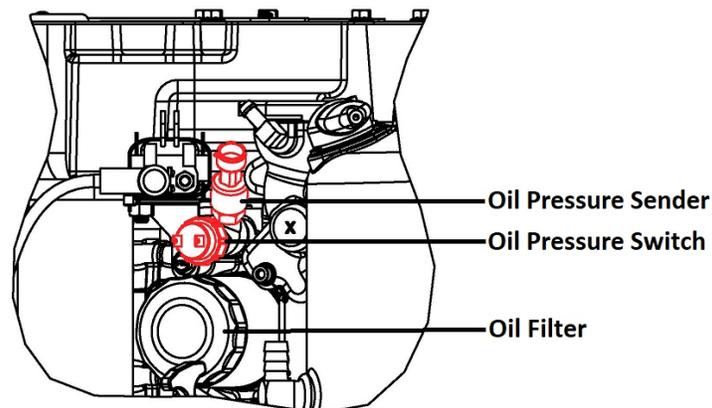
WARNING: The generator should never be started/operated without the air screen/flame arrestor properly installed.

5.4.6 How to Check the Engine Oil Pressure

The engine oil pressure is continuously monitored by the ECU and the generator control panel when the engine is running. Should the oil pressure fall below a safe operating level, the generator shuts down and the control panel low oil pressure fault LED illuminates. If this occurs, follow these steps:

1. Do not attempt to restart the generator.
2. Check the oil level and the condition of the oil.
3. If there is a loss of oil:
 - a. Inspect the engine for leaks.
 - b. Inspect the wire connections at the oil pressure sender and oil pressure switch.

Figure 24: Engine Oil Filter, Oil Pressure Sender, and Oil Pressure Switch

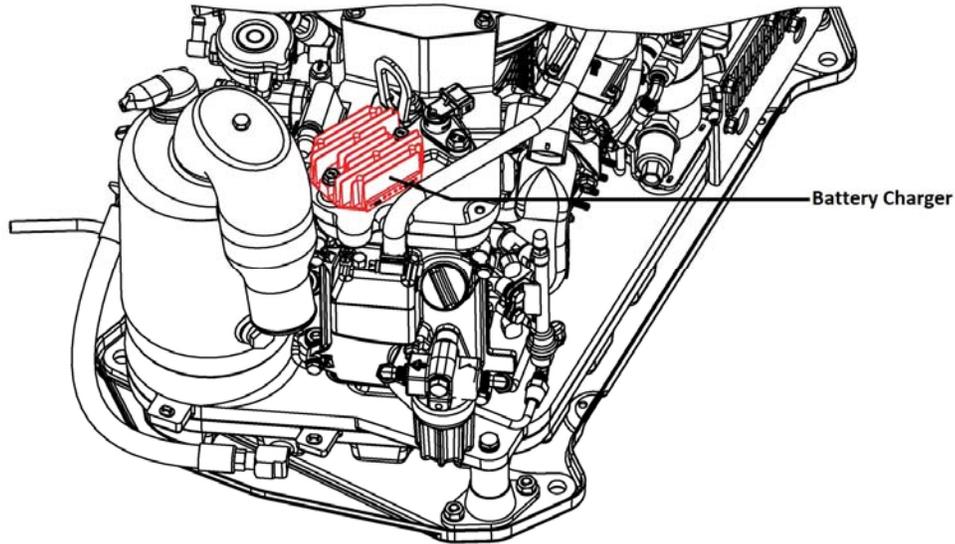


5.4.7 Battery Charging Circuit

The battery charger is an encapsulated, solid-state unit that supplies DC charging voltage to the generator starting battery while the generator is operating. The battery charging circuit is powered by a separate stator coil under the flywheel.

The unit senses the needs of the starting battery and supplies a DC charge when one is needed. A 20-amp blade type fuse is in the wiring harness near the starter.

Figure 25: Battery Charger



5.4.8 How to Check the Battery

See section 9.3 specifications Electrical System for battery size recommendation.

NOTE: You must use a dedicated battery.

1. Review the manufacturer recommendations and then establish a systematic maintenance schedule for your engine starting batteries and house batteries.
2. Monitor your voltmeter for proper charging during engine operation.
3. Check the electrolyte level and specific gravity with a hydrometer (except on sealed type batteries)
4. Use only distilled water to bring electrolytes to a proper level.
5. Make certain that battery cable connections are clean and tight to the battery posts (and to your generator).
6. Keep your batteries clean and free of corrosion.

TIP: There is a small DC amperage drain from the starting battery when the generator is not in use. To prevent this draw, turn **OFF** the DC breaker on the generator control panel (or turn **OFF** the DC battery switch to the generator).

CAUTION: To avoid electrical shorts when working on the engine electrical circuit, shut **OFF** the engine battery switch; however, to avoid damage to the battery charging circuit, never shut **OFF** the engine battery switch while the engine is still running.

5.4.9 Exhaust System Maintenance

The catalyst is critical to minimizing engine CO exhaust emissions. Any water intrusion into the exhaust system can quickly compromise the proper operation of the catalyst. Inspection of the catalyst at the prescribed intervals is critically important.

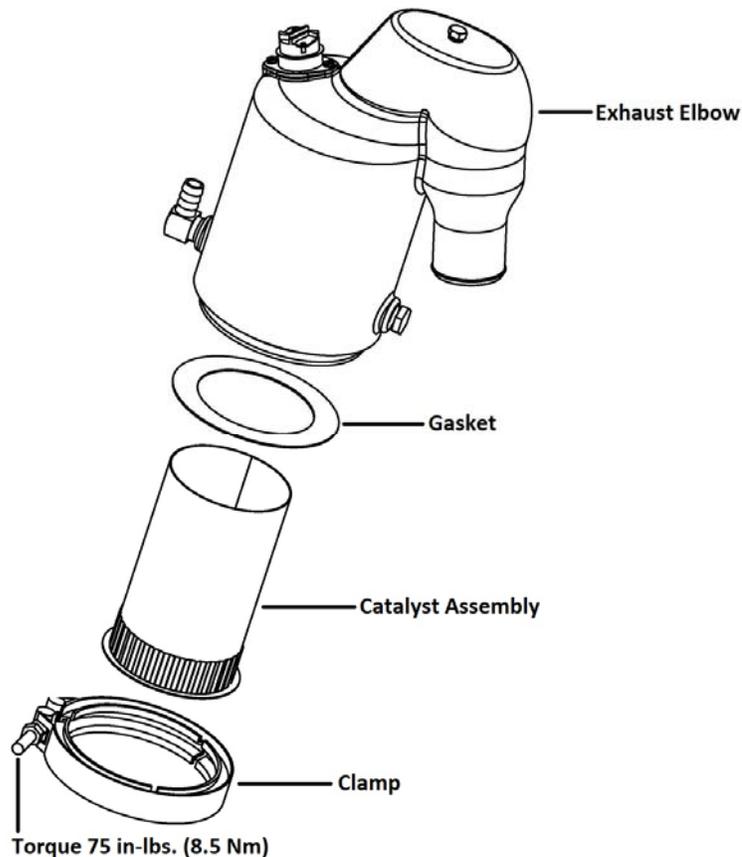
1. Remove the exhaust elbow by loosening the metal clamp to provide a view of the output surface of the catalyst.
2. Any visual irregularity of the normal flush, honeycomb appearance is most likely a result of water intrusion. The cause of the irregularity must be identified and addressed.
 - a. If there is irregularity, replace the catalyst and sealing gasket.
 - b. Inspect the water-injected exhaust elbow casting for corrosion and replace as needed.
3. Position the adjustable circular clamp over the two flanges and gasket, and then tighten for a secure fit.
4. Upon careful reassembly of the catalyst, new sealing gasket, and exhaust elbow, check for the presence of CO while the engine is running. This must be performed with a CO analyzer.



WARNING : Never reuse an exhaust sealing gasket. Always replace with a new gasket.

NOTE: For information on installing exhaust systems, see the *Installation Manual* available at www.westerbeke.com.

Figure 26: Catalyst Installation



5.5 Maintenance: Connections, Motors, and Circuit Breakers

Maintaining reasonable cleanliness is important to avoid corrosion on terminal board connections and rectifiers. Take steps to prevent the accumulation and build-up of salt, dust, engine exhaust particulates, and carbon, especially on insulation surfaces. Clogged ventilation openings may cause excessive heating and reduce the life of windings.

In addition to periodic cleaning, the generator should be inspected for tightness of all connections, evidence of overheated terminals and loose or damaged wires.

5.5.1 Use of Electric Motors

The power required to start an electric motor is considerably more than is required to keep it running after it is started. Some motors require much more current to start them than others. Split-phase (AC) motors require more current to start, under similar circumstances, than other types. They are commonly used on easy-starting loads, such as washing machines, or where loads are applied after the motor is started, such as small power tools. Because they require five (5), six (6), or even seven (7) times more current to start as to run, their use should be avoided whenever possible, especially if the electric motor is to be driven by a small generator. Capacitor and repulsion-induction motors require from two (2) to four (4) times as much current to start as to run. The current required to start any motor varies with the load connected to it. An electric motor connected to an air compressor, for example, will require more current than a motor to which no load is connected.

The following table shows the approximate current required to start a 115-volt motor connected to a medium starting load:

Table 3: Electric Motor Starting and Running Current Requirements

MOTOR SIZE (HP)	AMPS TO START	AMPS TO RUN
1/6	6.4 to 22.4	3.2
1/4	9.2 to 32.2	4.6
1/3	10.4 to 72.8	5.2
1/2	14.4 to 29.2	7.2
3/4	20.4 to 40.8	10.2
1	26.0 to 52.0	13.0

NOTE: The maximum **AMPS TO START** is greater for some smaller motors than for larger ones because the hardest starting types (split-phase) are not manufactured in larger sizes.

Because the heavy surge of current needed for starting motors is required for only a brief period, the generator will not be damaged if it can bring the motor up to speed quickly. If difficulty is experienced in starting motors, turn off all other electrical loads and, if possible, reduce the load on the electric motor. Some motor controllers can be configured to reduce the peak starting current. These are called *soft-start* controls.

5.5.2 Load Test

1. Run the generator with no load applied.
2. Run the generator at half capacity.
3. Run the generator loaded to its full capacity as indicated on the generator data plate.
4. Periodically check the output voltage to ensure proper operation of the generating plant and the appliances it supplies. Monitor voltage and load with a portable meter and amp probe.

5.5.3 BC Generator Single Phase

The BC generator is a brushless, self-excited generator, which requires only the driving force of the engine to produce an AC output. The stator houses two groups of windings: the main stator windings and the exciter windings.

When the generator is started, residual magnetism in the two rotating poles induces a current in the stator, which then generates an even larger current in the exciter windings. This mutual buildup of current in the four rotating poles and in the exciter windings quickly reaches the saturation point of the capacitor(s) and a regulated energy field is then maintained in the stator. At the same time, this regulated field produces a steady voltage in the stator windings, which can then be drawn off the generator AC terminals to operate AC equipment.

The generator is a single-phase, configured as either 120-volt AC two-wire at 60 Hertz or 115-volt AC two-wire or 230 volt AC two-wire, at 50 Hertz. For generator ratings, see [Generator Specifications](#) toward the end of this manual. The generator cannot be switched between 50 and 60Hz.

The generator data plate gives the normal voltage, current, and frequency rating of the generator. An AC wiring decal is affixed on the inside of the control box cover. It has diagrams of the various AC output wiring configurations.

5.5.4 AC Circuit Breaker

A circuit breaker is installed on all single-phase Westerbeke generators. This circuit breaker will automatically disconnect generator power in case of an electrical overload. The circuit breaker can be manually shut off when servicing the generator to ensure that no power is being supplied into the boat.

Figure 27: AC Circuit Breaker (50 & 60Hz)

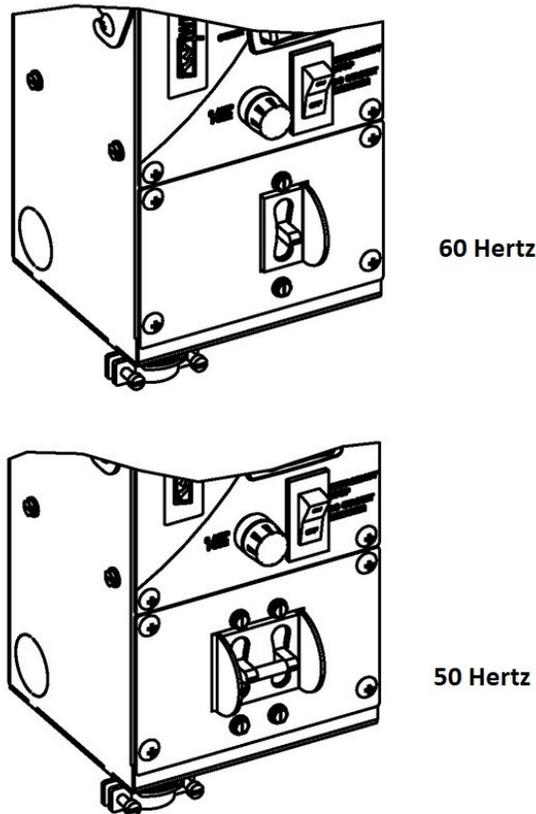
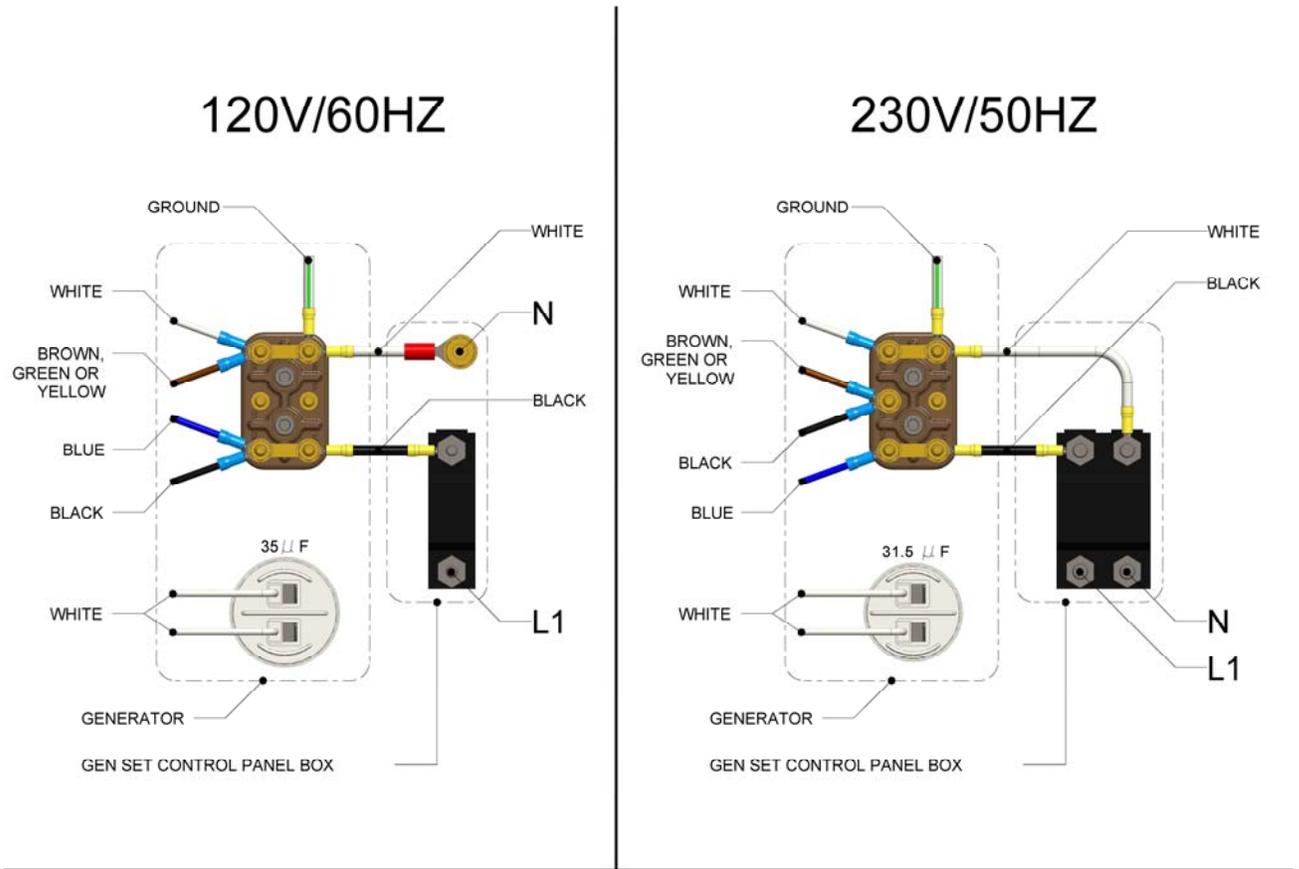


Figure 28: BC Generator AC Terminal Connection Schematic



NOTE: GENERATOR IS NOT FIELD CONVERTIBLE BETWEEN 50HZ AND 60HZ

5.5.5 Shore Power Transfer Switch

If the installer connects shore power to the AC circuit on your vessel, this must be done by means of a shore power transfer switch. Ship-to-shore switches are available from Westerbeke or an authorized dealer.

Figure 29: Shore Power Transfer Switch



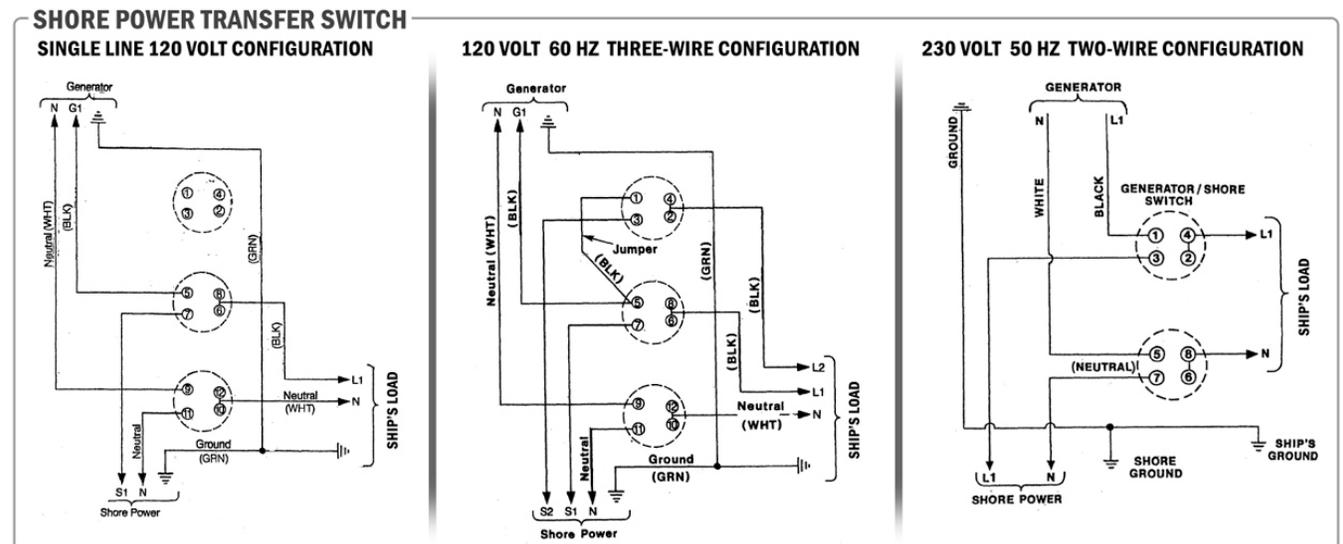
Set the transfer switch shown in the diagram to the **OFF** position. This switch prevents simultaneous connection of shore power to generator output.

Observe the following precautions before switching from shore power to generator power:

CAUTION: Heavy motor loads should be shut off before switching shore power to generator power or vice-versa because voltage surges induced by switching with heavy AC loads on the vessel being operated may cause damage to the exciter circuit components in the generator.

CAUTION: Damage to the generator can result if utility shore power and generator output are connected at the same time. This type of generator damage is not covered under warranty; it is the responsibility of the installer to make sure all AC connections are correct.

Figure 30: Shore Power Transfer Switch Configurations



The second configuration shows connections for a two-wire 120-volt system from the generator with a three-wire 120-volt boat system. In the second and third configurations, notice the repositioning of the white wire ground load on the terminal block to the generator case. No 240-volt equipment is permitted in the ship's load for the first and second configurations.

6 Diagnostics and Troubleshooting

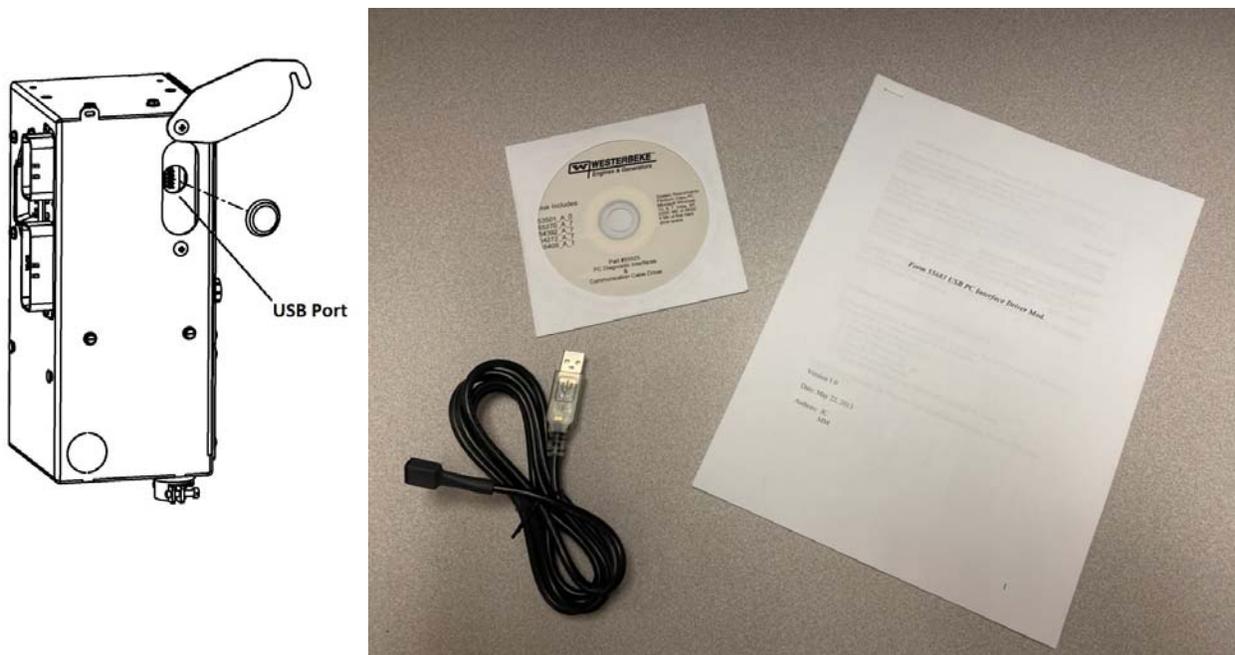
6.1 Diagnostics Software for Microsoft Windows

Westerbeke multiport EFI Generators are designed to help technicians monitor engine operation and ECU functions using Diagnostic Software. The software provides IDLE mode diagnostics, FAILURE recording and Runtime Data Logging to Microsoft Excel.

Diagnostic Software is available as part of a kit that contains a programmed USB interconnect cable to connect your laptop to the electronic control unit (ECU). You can purchase the Diagnostic Software Kit through your Westerbeke dealer or distributor.

TIP: Your local or regional distributor can be found online at www.westerbeke.com.

Figure 31: Typical Diagnostic Software Kit (Control Box, Cable, and Other Components)



The diagnostic software runs on most Microsoft Operating Systems. It requires a minimum of 128 MB of RAM. The communications cable plugs into a USB port.

NOTE: The Westerbeke communications cable is unique to this diagnostic software and must be used. An incompatible cable may damage the ECU.

The menu-driven software features easy-to-use tabbed pages to guide the user through the diagnostic process.

6.2 Engine Troubleshooting

The following troubleshooting chart describes common engine problems and possible causes.

CAUTION: When servicing the engine/generator, turn off the main AC circuit breaker to disconnect all AC power.

Problem:	Possible Cause:
Engine does not crank:	<ol style="list-style-type: none"> 1. DC panel breaker OFF. 2. DC battery OFF. 3. K1 relay faulty. 4. Faulty starter solenoid. 5. DC battery low/dead. 6. Water filled cylinder. 7. Faulty DC panel 8.0-amp bus fuse.
Engine cranks, does not start: (After 1 unsuccessful start attempt, engine will transition to idle and check engine light will illuminate. After 3 unsuccessful start attempts, the ECU will transition to shutdown not allowing further start attempts. Reset ECU by cycling battery power)	<ol style="list-style-type: none"> 1. Fuel starvation. 2. Air in fuel system. 3. Fouled spark plugs. 4. Faulty ignition coil.
Engine starts, runs, and then shuts down:	<ol style="list-style-type: none"> 1. Fuel starvation. 2. Air in fuel system. 3. Faulty shutdown switch/sensor. 4. Faulty fuel pump. 5. Open Oil Switch.
Engine hunts:	<ol style="list-style-type: none"> 1. Air in fuel system. 2. Faulty fuel pump. 3. Low octane fuel (lower than 89). 4. Faulty speed sensor (under flywheel).
Engine misfires or backfires:	<ol style="list-style-type: none"> 1. Low octane fuel (lower than 89). 2. Dirty air intake screen. 3. Faulty coil pack. 4. Exhaust restriction. 5. Worn/fouled spark plug. 6. CDI Ignition system. 7. Low or no fuel pressure. Poor quality fuel.
Engine overheats/engine temp LED is illuminated:	<ol style="list-style-type: none"> 1. Raw water coolant flow obstruction. 2. Coolant level low. 3. Faulty impeller. 4. Pump belt loose/broken. 5. Stuck thermostat. 6. Air in cooling system (fresh water).
Exhaust temp LED is illuminated:	<ol style="list-style-type: none"> 1. Loss of raw water flow/faulty pump. 2. Faulty exhaust temperature switch. 3. Possible low battery voltage (check with meter)
Low oil pressure/oil pressure LED is illuminated:	<ol style="list-style-type: none"> 1. Oil level too high 2. Oil level low. 3. Faulty oil pressure sensor. 4. Oil viscosity incorrect.
No DC charge to starting battery:	<ol style="list-style-type: none"> 1. Circuit fuse faulty/blown (two fuses). 2. Faulty circuit connection. 3. Faulty regulator/battery charger.
High DC Charge to battery:	<ol style="list-style-type: none"> 1. Battery charger faulty.
Starter stays energized after start:	<ol style="list-style-type: none"> 1. Faulty K1 relay. 2. Faulty starter solenoid.
Poor performance at generator speed:	<ol style="list-style-type: none"> 1. Low octane fuel. 2. Fuel supply issue. 3. High engine compartment temperature.
Black exhaust smoke:	<ol style="list-style-type: none"> 1. Dirty air screen. 2. Faulty injector. 3. Faulty pressure regulator.
Blue exhaust smoke:	<ol style="list-style-type: none"> 1. Lube oil is diluted. 2. Crankcase breather tube is clogged. 3. High lube oil level. 4. High crank case pressure. 5. Low compression.
Check engine LEDs are illuminated:	<ol style="list-style-type: none"> 1. Diagnostic software required.
Speed LEDs are illuminated:	<ol style="list-style-type: none"> 1. Faulty speed sensor. 2. Intake manifold vacuum leak. 3. AC generator overload.

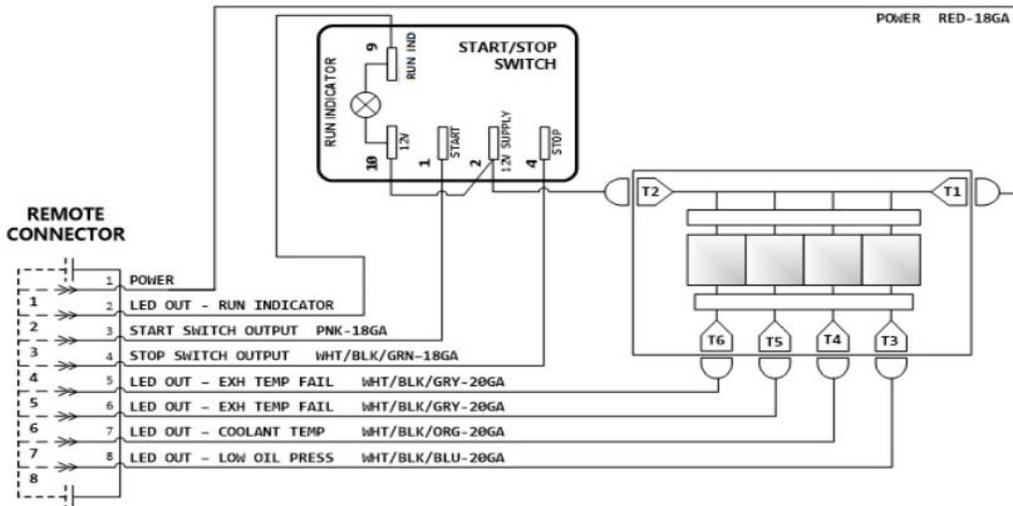
	4. Fuel starvation. 5. Throttle body malfunction.
External alarm LED is illuminated:	1. Loose connection. 2. Faulty fire suppression shutdown device.

7 Wiring Diagrams

The Wiring Diagram is available online and a printed copy is included in the standard equipment kit with your generator.

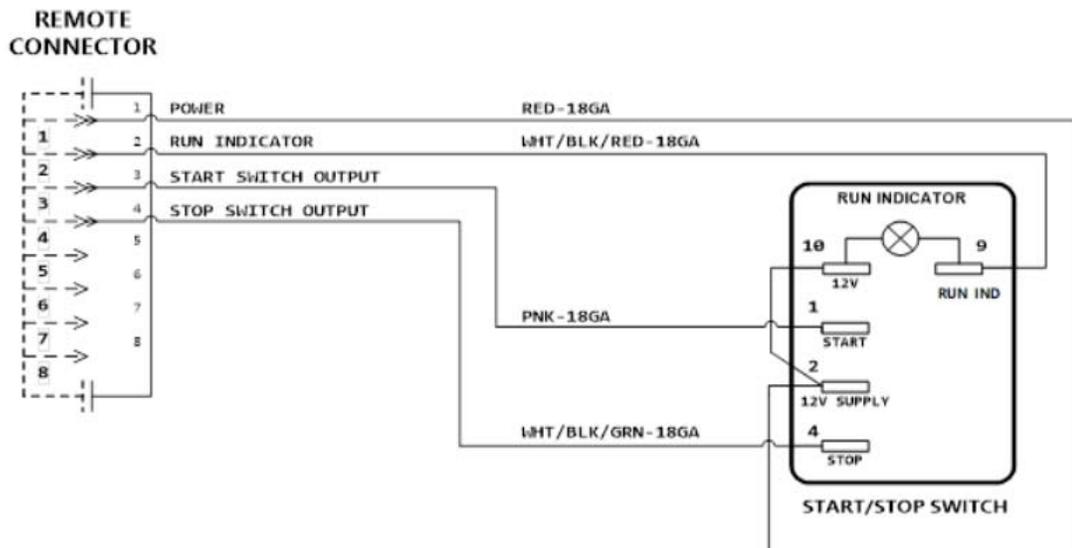
7.1 Remote Start/Stop Panels

Figure 32: Wiring Diagram for Start/Stop Panel with Fault Display



NOTE: A 15-foot or 30-foot extension harness is also available.

Figure 33: Wiring Diagram for Start/Stop Panel Rocker Switch Only



8 Lay-Up and Recommissioning

Many owners rely on their boatyards to prepare their craft, including engines and generators, for lay-up during the off-season or for long periods of inactivity. Others prefer to accomplish lay-up preparation themselves.

The following procedures allow you to perform your own lay-up and recommissioning, or you may use them as a checklist if others do the procedures. These procedures should afford your engine protection during a lay-up and help familiarize you with the maintenance needs of your engine.

If you have any questions regarding lay-up procedures, call your local servicing dealer for assistance.

8.1 Lay-Up Prep: Lubrication System

1. Warm up the engine.
2. Drain all the engine oil from the oil sump.
3. Remove and replace the oil filter and fill the sump with new oil. Use the correct grade of oil.
4. Run the engine. Check for proper oil pressure. Verify that there are no leaks.

CAUTION: Do not leave the old engine oil in the sump over the lay-up period. Lubricating oil and combustion deposits combine to produce harmful chemicals which can reduce the life of your engine and its internal parts.

8.2 Lay-Up Prep: Batteries

If batteries are to be left on board during the lay-up period, make sure that they are fully charged, and will remain that way, to prevent them from freezing. If there is any doubt that the batteries will not remain fully charged, or that they will be subjected to severe environmental conditions, remove the batteries and store them in a warmer, more compatible environment.

8.3 Lay-Up Prep: Cylinder Lubrication

After engine shutdown, remove the spark plugs and spray a small amount of catalyst & O2 sensor friendly fogging oil into each cylinder. Rotate the crankshaft manually two complete revolutions. Re-install the spark plugs loosely for winter lay-up.

NOTE: At spring commissioning, remove the plugs and rotate the crankshaft two full revolutions. Re-install the spark plugs, tighten each properly and connect the high tension leads or coil packs fully onto each spark plug.

8.4 Lay-Up Prep: Fuel System

Top off your fuel tanks with unleaded gasoline with an octane rating of 89 or higher. A fuel conditioner such as Sta-Bil gasoline stabilizer should be added. Change the element in your gasoline/water separator and clean the metal bowl. Re-install and make certain there are no leaks. Clean up any spilled fuel.

CAUTION: Gasoline with ethanol content higher than 10% (E-10) such as E-15 is not allowed and may void your warranty.

8.5 Lay-Up Prep: Starter Motor

Lubrication and cleaning of the starter drive pinion is advisable, if access to the starter permits its easy removal. Make sure the battery connections are shut off before attempting to remove the starter. Take care in properly replacing any electrical connections removed from the starter.

8.6 Lay-Up Prep: Raw Water Cooling Circuit

1. Close the intake through-hull seacock and remove the raw water intake hose.
2. Place the end of this hose into a five-gallon bucket of clean fresh water.
3. Before starting the engine, check the zinc anode found in the heat exchanger on the engine and clean or replace it as required.
4. Clean any zinc debris from inside the heat exchanger where the zinc anode is located. Also clean the raw water strainer.
5. Start the engine and allow the raw water pump to draw the fresh water through the system. When the bucket is empty, stop the engine.
6. Refill the bucket with an antifreeze solution that is slightly stronger than needed for winter freeze protection in your area.
7. Start the engine and allow the mixture to be drawn through the raw water system. When the bucket is empty, stop the engine. This antifreeze mixture should protect the raw water circuit from freezing during the winter lay-up, as well as providing corrosion protection.
8. Remove the impeller from your raw water pump. Be ready to capture and to contain any antifreeze mixture that may spill.
9. Examine the impeller. Acquire a replacement, and a cover gasket. Replace only the cover and gasket if needed. Do not replace the impeller (into the pump) until recommissioning.

8.7 Lay-Up Prep: Intake Manifold

Clean the filter screen in the flame arrestor, and place a clean cloth lightly soaked in lube oil around the flame arrestor to block any opening. Place an oil-soaked cloth in the through-hull exhaust port. Make a note to remove cloths prior to startup.



WARNING: Lead acid batteries emit hydrogen, a highly-explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut OFF all electrical equipment in the vicinity to prevent electrical arcing during servicing.

8.8 Lay-Up Prep: Spare Parts

Lay-up time provides an opportunity to inspect your Westerbeke engine to see if external items such as drive belts or coolant hoses need replacement. Check your basic spares kit and order items not on hand, or replace those items used during the lay-up, such as filters and zinc anodes. See 2.10 Ordering Parts.

8.9 How to Recommission After a Lay-Up

The recommissioning of your Westerbeke engine after a seasonal lay-up generally follows the same steps as those described in 4.10 Checklist: Initial Startup. However, some of the lay-up procedures will need to be counteracted before starting the engine.

1. Remove the oil-soaked cloths from the intake manifold.

2. Remove the raw water pump cover and gasket and discard the old gasket. Install the raw water pump impeller removed during lay-up (or a replacement, if required).
3. Install the raw water pump cover with a new cover gasket.
4. Reinstall the batteries that were removed before the lay-up period, and reconnect the battery cables.
5. Clean the terminals, tighten the connections, and verify that the batteries are fully charged.
6. Remove the spark plugs, wipe clean, rotate the crankshaft two full revolutions, re-gap, and re-install to proper tightness. Connect the high-tension leads or coil packs onto each spark plug.
7. Start the engine and follow the initial startup procedures in 4.10 Checklist: Initial Startup.

9 Generator Specifications

9.1 Specifications: Engine

Item	Description
Engine Type	2-cylinder, 4-cycle, overhead camshaft water cooled gasoline engine
Bore & Stroke	2.40 x 2.24 inches (61.0 x 57.0 mm.)
Total Displacement	20.32 cubic inches (0.333 liters)
Combustion Chamber	Semi-spherical
Compression Ratio	10.2:1
HP @ 2500 rpm	6.0 hp
Aspiration	Naturally aspirated
Direction of Rotation	Clockwise looking down on flywheel
Inclination	20° Maximum all directions
Governor	Electronic
Dry Weight	226 LBS. (102 KG)
Valve Clearance (cold)	Intake 0.005-0.007" [0.13-0.17mm] Exhaust 0.007-0.009" [0.18-0.22mm]

9.2 Specifications: Fuel System

Item	Description
Fuel System Type General	Multi-port fuel injection
Fuel Source	Unleaded gasoline with an octane rating of 89 or higher.
Fuel Consumption 100% load	0.58 GPH (2.2 LPH)
Fuel Hose Size (supply)	Minimum: 1/4" I.D. Maximum: 3/8" I.D.
Fuel Pumps	12-volt electric (high & low pressure)
Fuel Filter (on engine)	Replaceable element type
Air Cleaner (flame arrester)	Metal screen type -cleanable

9.3 Specifications: Electrical System

Item	Description
Starting Battery	12-Volt, (-) negative ground Battery must be totally dedicated to the generator and maintained only by the DC charge controller system in the AC generator
Battery Capacity	Minimum Rating of 800-1,000 Cold Cranking Amps (CCA)
Starter	12-Volt
DC Charging	5-Amp rated, solid state controller
DC Cold Cranking Amps	70 Amps @ 70 degrees F

9.4 Specifications: Air Requirements

Item	Description
Engine & Generator Cooling	250 CFM (7.0 cm/m)
Engine Combustion	13 CFM (0.360 cm/m)
Maximum Ambient	122 degrees F (50 degrees C)

NOTE: Forced ventilation should be provided to maintain generator compartment temperatures below 122° F (50° C).

9.5 Specifications: Cooling System

Item	Description
General	Fresh water-cooled block through raw water-cooled heat exchanger circuit
Fresh Water Pump	Positive displacement, rubber impeller, belt-driven
Raw Water Pump	Positive displacement, rubber impeller, belt-driven
Raw Water Flow Rate	3.4 US gpm (12.9 liters per minute) @ 2500 rpm (approx. measure before discharging into exhaust elbow)
Cooling Water Capacity	1.46 quarts (1.38 liters)
Operating Temperature	170°-190° F (77°-88° C)

9.6 Specifications: Lubrication System

Item	Description
General	Forced lubrication by gear pump
Oil Filter	Fuel flow, paper element, spin-on
Oil Capacity	1.75 quarts (1.66 liters)
Oil Pressure (Operating)	20-45 psi (1.4-3.2 kg/cm ²)
Oil Grade	API Service Category SJ, SL, SM, or SN or better SAE W-40

9.7 Specifications: AC Generator (Single Phase)

Item	Description
Single Phase	Brushless, two-pole capacitor regulated 3600 rpm 60 Hz
Ratings:	3000 rpm 50 Hz
3.5 KW	230 volts, 15 amps, 50 Hz single phase, 2-wire, 1.0 power factor
3.5 KW	120 volts, 29 amps, 60 Hz single phase, 2-wire, 1.0 power factor

9.8 Specifications: Ignition System

Item	Description
Ignition System	CD Ignition
Spark Plug Gap	0.032"-0.035" (0.8-0.9 mm)
Spark Plug Thread	12.0 mm x 1.25 pitch torque 10.8-14.5 lb.ft.
Ignition Timing	Electronic Control
Ignition Coil	Dual output CDI coil

9.9 Specifications: Engine Component Tightening Torque

Engine Component	Nm	Ft. Lbs.
Electrical Connections		
AC Power Breaker	1.8-2.2	1.3-1.6
AC Neutral Isolator	7-9	5-6.5
Battery (B+) Starter Connection	3.5-5.0	5-7
Battery (B-) Terminal (Main Ground)	3.5-5.0	5-7
Timing Belt		
Flywheel Bolt	86-88	63-65
Timing Belt Cover Bolts	10-12	7-9
Camshaft sprocket bolts	80-100	58-72
Oil pump sprocket nuts	50-57	36-41
Timing tensioner nuts	22-30	16-22
Timing belt rear cover bolts	10-12	7-9
Rocker Arms and Rocker Shaft		
Rocker cover shaft	29-35	21-25
Camshaft thrust plate bolt	10-12	7-9
Rocker arm adjust nut	8-10	6-7
Cylinder Head Bolts		
M8, first step	10	7
M6, first step	6	4
M8, final	30	22
M6, final	10	7
Spark plug	15-20.3	11-15
Rocker cover	12-13	9-10
Miscellaneous		
Coolant temperature sender	12-18	9-13
Coolant temperature switch	12-18	9-13
Generator mounts	34-47	23-34
Exhaust manifold	16-23	12-17
Thermostat housing	8-11	6-8
Front Crankshaft bolt	135-145	98-105
Front Case, Counterbalance Shaft		
Front case bolts	8-10	6-7
Oil pump cover bolts	8-10	6-7
Oil pan bolts	10-12	7-9
Oil drain plug	35-45	25-33
Oil screen bolts	15-22	11-16
Oil pump driven gear bolt	34-40	25-29
Rear cover bolts	10-12	7-9
Piston and Connecting Rod		
Connecting rod cap nut	10	7
Crankcase Bolts		
M8, first step	10	7
M6, first step	6	4
M8, final	23.5	18

M6, final	11.5	8
Cylinder Block		
Taper plug 1/16 NPT	8-12	6-9
Taper plug 1/8 NPT	15-22	11-16
Taper plug 1/4 NPT	35-45	25-33
Oil pressure switch	12-18	9-13
Oil pressure sender	12-18	9-13
Water drain plug	35-45	25-33
Water Pump		
Water pump	8-10	6-7

This page intentionally left blank.



©2022 Westerbeke, Inc. All Rights Reserved.

Westerbeke Corporation
Myles Standish Industrial Park
150 John Hancock Rd.

Taunton, MA 02780-7319 USA
Phone: (508) 823-7677
FAX: (508) 884-9688

www.westerbeke.com