



LEVITATOR
PERFORMANCE AIRCRAFT ENGINES



CRUSADER
ENGINES

OWNERS OPERATION AND MAINTENANCE MANUAL

PERFORMANCE TO MOVE YOU



WELCOME

Thank you for your selection of Pleasurecraft Marine Engine Company (Pleasurecraft Marine) power for your boating needs. We welcome you to Team Pleasurecraft, which puts you in the company of tens of thousands of boaters who have relied on Pleasurecraft Marine inboards as their power of choice for over 40 years.

When you chose Pleasurecraft Marine, you selected the utmost in premium power for your boating application. Pleasurecraft Marine is the world's largest manufacturer of gasoline marine inboards, and the clear-cut leader in cutting edge technology. Over the years, we have introduced many breakthrough innovations that quickly became industry standards. The pyramidal exhaust system, light-weight transmission, computerized engine control and the Fuel Control Cell (FCC) are all Pleasurecraft Marine innovations. No matter which Pleasurecraft Marine model you purchased, you can be sure it is equipped with the latest in modern technology for added performance and durability.

Pleasurecraft Marine's Catanium™ Clean Emission System is available to reduce emissions without diminishing performance. Catanium™ CES is patented catalyst technology which uses precious metals to create clean emissions and greatly reduce dangerous carbon monoxide gases.

Before starting your engine(s), READ THIS MANUAL CAREFULLY AND COMPLETELY. If you do not understand any portion of the manual, contact your Pleasurecraft Marine Authorized Dealer for clarification or assistance. Ask your dealer for a demonstration of actual starting and operating procedures.

The descriptions and specifications contained in this manual were in effect at the time of printing. Pleasurecraft Marine's policy of continued improvement reserves the right to change specifications or design without notice and without obligation.

Thank you again for choosing Pleasurecraft Marine and we hope you have a safe and enjoyable boating experience.

Feel free to visit our website at anytime, www.pleasurecraft.com.





WARNING

CALIFORNIA PROPOSITION 65

Operating, servicing and maintaining a recreational marine vessel can expose you to chemicals including engine exhaust, carbon monoxide, phthalates, and lead, which are known to the State of California to cause cancer and birth defects or other reproductive harm. To minimize exposure, avoid breathing exhaust, service your vessel in a well-ventilated area and wear gloves or wash your hands frequently when servicing this vessel. For more information go to www.P65warnings.ca.gov/marine.

DISCLAIMERS

Pleasurecraft Marine Engine Company's (Pleasurecraft Marine) policy of continued improvement creates dated information and necessitates changes in procedures, specifications and methods used in trouble shooting and repair. In the event you have any questions regarding any of our products, the most up to date information may be obtained by contacting our service department to insure that any published information in your possession has not been updated. The information in the publication is believed to be true and correct at the time of publication. This publication is for informational purposes only and does not constitute a guarantee or warranty or in any way change or modify the written warranty, which is attached to Pleasurecraft Marine Products at the time of sale. The knowledge of this publication, the information revealed herein and/or the possession of this publication grants no license or authority to anyone to perform any action or make any statement or commitment, beyond the specific instructions stated herein, in behalf of or in the name of Pleasurecraft Marine. It is the sole responsibility of those using the information contained herein, to follow industry standard and common sense safety procedures when using the information contained herein and those using the information contained herein agree to defend and hold Pleasurecraft Marine harmless in all cases where injury and/or damage may occur during the use and/or application of the information contained herein.

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Introduction



NOTICE: Registration lists must be maintained by the factory and dealer on marine products sold in the United States and some foreign countries, should notification under **FEDERAL BOAT SAFETY ACT** be required. It is our desire to have all products registered at the factory, should it ever be necessary to contact you. Make sure your Dealer/Distributor fills out the registration card immediately and sends the card to the factory.

PLEASURECRAFT MARINE'S COMMITMENT TO YOU

Pleasurecraft Marine is committed to assuring your satisfaction with your new marine engine. Your Dealer also wants you to be completely satisfied, and invites you to return for all your servicing needs, both during and after the warranty period.

WARRANTY REGISTRATION

It is important that your selling dealer register your engine with Pleasurecraft Marine immediately upon the purchase of the new product. It identifies the name and address of the original purchaser, product model(s) and serial number(s), and the selling dealer's name and address. The dealer is also certifying that you are the original purchaser of the product.

Shortly after the product is registered with the factory, you will be issued an "Owner Warranty Registration Card." The "Owner Registration Card" is your only valid registration identification, and must be presented to the servicing dealer, should warranty service be required.

If your "Owner Registration Card" is not received within 30 days from the date of purchase, please contact your boat dealer or engine seller. The product can not be warrantied until it is registered with Pleasurecraft Marine.

This manual covers the generic information related to all models of Pleasurecraft Marine engines. This includes PCM, Challenger Series, Crusader Engines, and Levitator Engines.

NOTE: Not all information may be applicable to your specific brand or engine model.

Brand and engine model specific information can be found through the Owners Information portion of the respected website. This includes, but not limited to, specific engine specifications, winterization draining locations, accessory drive serpentine belt routing, etc.

Introduction

PLEASURECRAFT MARINE'S ENGINES TECHNICAL SPECIFICATIONS

Pleasurecraft Marine provides up to date and most accurate technical information on the Owner's Website for your corresponding product models. You can use the URL in your browser, or simply use a QR Reader and scan the appropriate brand for your product. Either way will take you right to the Owner's website where all the technical data and specifications for your particular brand and model are found.

<http://www.pcmengines.com/owners/>



<http://www.crusaderengines.com/challenger/>



<http://www.crusaderengines.com/offshore/#owners>



<http://levitatorengines.com/owners.html>



PLEASURECRAFT MARINE ENGINE CO.
FEDERAL/CALIFORNIA EMISSION CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

The United States Environmental Protection Agency (“USEPA”), the California Air Resources Board (“CARB”) and Pleasurecraft Marine Engine Co., through its Pleasurecraft Engines Division (“Pleasurecraft”), are pleased to explain the emission control system warranty on your inboard marine engine manufactured after January 1, 2008 for CARB and after January 1, 2011 for USEPA. Nationally, new inboard engines must be designed, built and equipped to meet USEPA’s and CARB’s emissions and stringent anti-smog standards. Pleasurecraft must warrant the emission control system on your inboard engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your inboard engine.

Your emission control system may include parts such as the carburetor or fuel injection system, the ignition system, and catalytic converter. Also included may be hoses, belts, connectors and other emission-related assemblies. Where a warrantable condition exists, Pleasurecraft will repair your inboard engine at no cost to you, including diagnosis, parts and labor.

MANUFACTURER’S WARRANTY COVERAGE:

Select emission control parts of inboard marine engines (manufactured after January 1, 2008 for CARB and after January 1, 2011 for USEPA) are warranted for 3 years or 480 hours of use, whichever first occurs. Models over 373 kilowatts (500 hp) select emission control parts are warranted for 3 years or 150 hours of use, whichever occurs first.

However, warranty coverage based on the hourly period is only permitted for engines that are equipped with appropriate hour meters as defined in California Code of Regulations Title 13, Chapter 9, Article 4.7 §2441(a)(13) or the equivalent. If any emission-related part on your engine is defective under warranty, the part will be repaired or replaced by Pleasurecraft.

OWNER’S WARRANTY RESPONSIBILITIES:

- As the inboard engine owner, you are responsible for the performance of the required maintenance listed in your owner’s manual. Pleasurecraft recommends that you retain all receipts covering maintenance on your inboard engine, but Pleasurecraft cannot deny warranty solely for the lack of receipts or your failure to ensure the performance of all scheduled maintenance.
- As the inboard engine owner, you should however be aware that Pleasurecraft may deny you warranty coverage if your inboard engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.
- You are responsible for presenting your inboard engine to an authorized Pleasurecraft dealer as soon as a problem exists. The warranty repairs will be completed in a reasonable amount of time, generally within 30 days.

If you have any questions regarding your warranty rights and responsibilities, you should contact Pleasurecraft at (803) 345-1337.

**PLEASURECRAFT MARINE ENGINE CO.
GENERAL EMISSIONS WARRANTY COVERAGE**

(for engines manufactured after January 1, 2008 for CARB and after January 1, 2011 for USEPA)

1. Pleasurecraft Marine Engine Co., through its Pleasurecraft Engines Division ("Pleasurecraft"), warrants to the first owner purchasing at retail, and all subsequent owners, of every Pleasurecraft inboard marine engine manufactured after January 1, 2008 for CARB and after January 1, 2011 for EPA, that the emissions control devices on Pleasurecraft inboard marine engines are free from defects in materials and workmanship when manufactured and will remain so for a period of 3 years or 480 hours of use, whichever first occurs. Models over 373 kilowatts (500 hp) select emission control parts are warranted for 3 years or 150 hours of operation, whichever occurs first. This coverage starts from the earlier of the date of sale to the first owner purchasing the engine at retail or the date the engine is first placed into service for demonstration or any other purpose prior to sale to the first owner purchasing the engine at retail.
2. Pursuant to the Code of Federal Regulations 40 CFR Part 1045 and Part 1068 and California Code of Regulations Title 13, Chapter 9, Article 4.7§ 2445.1, Pleasurecraft warrants that each Pleasurecraft engine is designed, built and equipped to conform with all applicable regulations adopted by USEPA and CARB pursuant to its authority in Chapters 1 and 2, Part 5, Division 26 of the California Health and Safety Code, and is free from defects in materials and workmanship that cause the failure of a warranted part to be identical in all material respects to that part as described in Pleasurecraft's application for certification.
3. Any part covered under this warranty that is not scheduled for replacement as required maintenance, in the written instructions to be found within the Pleasurecraft owners/operators manual, is warranted for the period of 3 years or 480 hours of use, whichever first occurs. If the part fails during the period of warranty coverage, Pleasurecraft will repair or replace the defective part at any Pleasurecraft warranty station. The repair or replacement will be performed at no charge to the owner. Any such part repaired or replaced under this warranty will be warranted for the remainder of the period of 3 years or 480 hours of use, whichever first occurs. Models over 373 kilowatts (500 hp) select emission control parts are warranted for 3 years or 150 hours of operation, whichever occurs first.
4. Any part covered under this warranty that is scheduled only for regular inspection in the written instructions to be found within the Pleasurecraft owners/operators manual, is warranted for the period of 3 years or 480 hours of use, whichever first occurs. If the part fails during the period of warranty coverage, Pleasurecraft will repair or replace the defective part at any Pleasurecraft warranty station. The repair or replacement will be performed at no charge to the owner. Any such part repaired or replaced under this warranty will be warranted for the remainder of the period of 3 years or 480 hours of use, whichever first occurs. Models over 373 kilowatts (500 hp) select emission control parts are warranted for 3 years or 150 hours of operation, whichever occurs first.
5. Any part covered under this warranty that is scheduled for replacement as required maintenance in the written instructions to be found within the Pleasurecraft owners/operators manual will be warranted for the period of time before the first scheduled replacement date for that part. If the part fails before the first scheduled replacement, Pleasurecraft will repair or replace the defective part at any Pleasurecraft warranty station. The repair or replacement will be performed at no charge to the owner. Any such part repaired or replaced under this warranty will be warranted for the remainder of the period prior to the first scheduled replacement date for the part.
6. Replacement of any part under this warranty with a Pleasurecraft-supplied part, will not shorten nor extend the warranty period(s) stated in paragraphs 1 through 4 above.

7. The engine owner will not be charged for diagnostic labor that is directly associated with diagnosis of a defective, emission-related warranted part, provided that such diagnostic work is performed at a Pleasurecraft warranty station.
8. To insure prompt repair under this warranty, Pleasurecraft will maintain a supply of warranted parts sufficient to meet the expected demand for such parts. Any replacement part may be used in the performance of any warranty maintenance or repairs and will be provided by Pleasurecraft without charge to the owner.
9. Parts covered under this warranty are:

Fuel Metering System

- A. Fuel Injectors
- B. Fuel Pressure Regulator
- C. Manifold Absolute Pressure Sensor
- D. Throttle Position Sensor
- E. Throttle Body - Port Fuel Injection Models
- F. Coolant Temperature Sensor
- G. Intake Valves
- H. Oxygen Sensors

Air Induction System

- A. Intake Manifold
- B. Air Filter (Flame Arrestor)

Ignition System

- A. Spark Plugs
- B. Electronic Ignition System
- C. Ignition Coil and/or Control Module
- D. Ignition Wires

Lubrication System

- A. Oil Pump and Internal Parts

Positive Crankcase Ventilation (PVC) System

- A. PCV Valve
- B. Oil Filler Cap

Exhaust System

- A. Exhaust Manifold(s)

- B. Exhaust Riser(s)
- C. Exhaust Valves
- D. Catalytic Converters

Miscellaneous Items Used on Above Systems

- A. Hoses, clamps, fittings, tubing, sealing gaskets or devices and mounting hardware
- B. Electronic Controls
- C. Electronic Control Module
- D. Pulleys, belts and idlers

10. Exclusions: The repair or replacement of any warranted part otherwise eligible for coverage under this warranty may be excluded from such warranty coverage if Pleasurecraft Marine demonstrates that the engine and/or part has been abused, neglected, or improperly maintained, and that such abuse, neglect, or improper maintenance was the direct cause of the need for repair or replacement of the part.
11. Pleasurecraft Marine original equipment parts are "identical in all material respects to that part as described in the engine manufacturer's application for certification". The use of any replacement parts not supplied by Pleasurecraft Marine may not meet this requirement and will be grounds for disallowing a claim made under this warranty. Pleasurecraft Marine will not be liable under this warranty or provide warranty coverage for product failures caused by parts other than Pleasurecraft Marine original equipment parts.
12. If you have any questions regarding your warranty rights and responsibilities, or the location of Pleasurecraft Marine warranty stations near you, please contact Pleasurecraft Marine at (803) 345-0050.

OPERATING FUELS

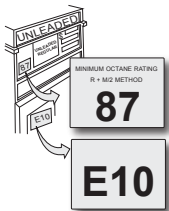


Fire and Explosion Hazard - Gasoline/Vapor is extremely flammable and highly explosive, and, if ignited, can cause serious bodily injury or death. Careful inspection of the entire fuel system including, but not limited to, fuel tanks, fuel lines, fuel filters and all fittings is mandatory, especially after periods of storage. Replace any component that shows signs of leakage, corrosion, deterioration, swelling, hardening or softening.

WARRANTY NOTICE: Damage caused to the engine through the use of improper gasoline, low-quality or gasoline with an octane rating below the minimum requirements listed below, is considered misuse of the engine. Such damage is not covered by the Pleasurecraft Marine warranty.

The use of a high-quality lead-free regular gasoline with the following minimum octane specification.

Pump Octane Number (R+M/2) (PUMP) - 87



NOTICE: These engines have been calibrated to operate on 87 octane fuel. Pleasurecraft Marine's engine control module incorporates Adaptive Learn Technology to ensure optimum engine performance is obtained when using fuel rated higher than 87 octane. Use of fuels lower than 87 octane will result in reduced performance, could cause engine damage and should be avoided.

ATTENTION: *For optimal performance, all engines can run premium 93 octane fuel in order to take advantage of the Adaptive Learn Technology. High performance engines, such as supercharged engines, require premium octane as a minimum. See your model specific information on the website for your specific fuel requirements. Octane boost products are not endorsed by Pleasurecraft Marine. There is no guarantee as to what the octane level would actually be unless the fuel is tested.*

GASOLINE CONTAINING ALCOHOL

The implementation of ethanol-based fuel is prevalent throughout the World. As such, Pleasurecraft Marine provides the following information regarding the use of this fuel.

This information addresses the use of ethanol fuels in Pleasurecraft Marine ENGINES ONLY. It does not address the use of ethanol fuels in vessel related components such as boat gas tanks, boat fuel lines, etc.

Ethanol blended fuel rated E10 or less is acceptable to use. Fuels rated higher than E10 SHOULD NOT BE USED. Ethanol fuels rated higher than E10 could potentially damage the engine and/or present an unsafe boating condition. Damage to the engine resulting from the use of ethanol fuel rated higher than E10 IS NOT covered by the warranty.



CAUTION

Do Not use any gasoline that contains METHANOL. This fuel is very corrosive and will create unsafe operating conditions. Serious damage will result from the continued use of fuel containing METHANOL. Any resulting engine damage will not be covered by the warranty.

If ethanol blended fuel rated E10 or less is used, or if the presence of alcohol is uncertain, more frequent inspections and service of the complete fuel system are required. Any sign of fuel leakage or deterioration must be repaired immediately before further engine operation.

It is important to note that ethanol blended fuel will act as a solvent and will attract and hold moisture. ***Without proper fuel stabilization and fuel filtration, ethanol blended fuel may cause the following:***

- Excessive moisture (water) may cause lean operation to include hard starting and operating difficulties such as, vapor lock, low speed stalling, and shortened fuel shelf life.
- Acting as a solvent, ethanol blended fuel may cause gum, sediment, sludge, and other particles to be loosened and carried through the fuel system to the engine.

Fuel system or engine damage caused by contamination from water, foreign particles, sludge, or gums entering or forming in the fuel system is not covered by the Pleasurecraft Marine Limited Warranty.

Fuel Stabilizer Recommendations for Ethanol Blend Fuel

The use of a commercially available fuel stabilizer is recommended at each fill-up or when storing ethanol-blended fuel for more than **2 weeks**.

OPERATING LUBRICANTS

ENGINE OIL RECOMMENDATIONS

Use of Supplemental Additives

Engine oils meeting Pleasurecraft Marine's recommendations already contain a balanced additive treatment. The use of supplemental additives which are added to the engine oil by the customer are unnecessary and may be harmful. Pleasurecraft Marine does not review, approve or recommend such products.

Synthetic Oils

Synthetic engine oils may be used in Pleasurecraft Marine engines. Synthetic oils must meet the Engine Oil Requirements for Classification and Viscosity listed for your model engine. The use of synthetic oil **does not** permit the extension of oil change intervals.

ENGINE OIL REQUIREMENTS

These engines are designed specifically the use of Dexos Gen 2 formulation engine oil. This formulation is now found in most major brands of engine oil. The use of any other oil formulations may cause engine performance issues and /or engine damage that would not be covered under warranty. Refer to the technical information on the website for your model engine to get the specific engine oil requirements.

IMPORTANT: The use of oils which contain “solid” additives, non-detergent oils or low quality oils specifically are not recommended.

WARRANTY NOTICE: Pleasurecraft Marine reserves the right to refuse warranty on part(s) and/or engine(s) damaged by using improper fuels and/or lubricants.

Crankcase Oil and Oil Filter Change Intervals

- Initial oil change - 1st 60 days or 5-25 hours of operation, whichever occurs first
- Regular oil changes - Every 50 hours of operation or 120 days, whichever occurs first
- Heavy Duty High RPM / High Load Use - Every 30 hours of operation or 120 days, whichever occurs first

NOTE: Never over-fill the engine with oil. Engines over-filled with oil can cause engine damage.

Transmission and VDrive Oil Requirements (if applicable)

Transmission and V-Drive	Recommended A.P.I. Classification and Viscosity
Pleasurecraft Transmissions	Dexron III Automatic Transmission Fluid (ATF)
Pleasurecraft V-Drive	PowerPlus V-Drive Lubricant Pleasurecraft Marine P/N - R190251

IMPORTANT: Dexron III should be used in all applications requiring Dexron III. Dexron VI MUST NOT be mixed with Dexron III when servicing. Damage caused by using incorrect fluid is not covered under warranty.

Safety Information



“Safety Warnings” and additional information or instructions are used to alert the installer/operator of possible safety hazards in performing certain service or maintenance procedures incorrectly or carelessly. DANGERS, WARNINGS, and CAUTIONS are accompanied by the international HAZARD symbol:

These “Safety Warnings” alone cannot eliminate the hazards that they signal. Strict compliance with these warning instructions while performing service and maintenance procedures, plus “common sense” operation, are major accident prevention measures. Prior to operating the boat for the first time, boat operators MUST read this Owner’s Manual in its entirety. It is also recommended to reread it prior to the first outing each boating season. Keeping the Owner’s Manual on-board the boat in a dry, secure location such as a glove box is highly recommended for referral purposes. Be sure to also read the boat Owner’s Manual, with particular attention to proper operation and safety concerns addressed within that publication. It is the boat owner’s and the operator’s responsibility to be aware of safety issues and concerns in the proper operation of the boat. All people on board, regardless of age, physical limitations and/or previous boating experience (or lack of experience), bear responsibility for determining the appropriate behavior and safety precautions, including care around the engine, the engine compartment, transmission and all moving parts. Key to safety is the prescribed maintenance of the engine and drive train as described in this Owner’s Manual, on www.pleasurecraft.com, and through information and directives provided through the authorized dealer network. A properly prepared and maintained engine is less likely to operate in a manner that could place the boat occupants, as well as others on the same body of water, in unsafe situations.

DANGER

Indicates an extremely hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor to moderate injury.

NOTICE

Indicates a situation which can cause damage to the engine, personal property and/or the environment, or cause the equipment to operate improperly.

IMPORTANT

Used to provide information to perform a procedure more easily.

Safety Information

REPLACEMENT PARTS

⚠ DANGER

Electrical, ignition and fuel system components are designed and manufactured to comply with U.S. Coast Guard rules and regulations to minimize the possibility of fire or explosion hazard.

Use of replacement parts (i.e. automotive, after-market, etc.) in the electrical, ignition and fuel systems, which are not U.S. Coast Guard approved, could cause a fire or explosion hazard and should be avoided.

Always request that genuine Pleasurecraft Marine replacement parts be used in any repairs or maintenance being performed on your engine(s).

CARBON MONOXIDE

⚠ DANGER

Carbon Monoxide (CO) is a colorless, odorless and tasteless gas. You cannot see it, smell it or taste it. Prolonged exposure to carbon monoxide can lead to unconsciousness, brain damage or death!

Carbon monoxide is produced when anything that contains carbon, such as gasoline, natural gas, oil, propane, coal or wood is burned. Carbon monoxide is commonly found in the exhaust of internal combustion engines (boat power plants, generators, etc.). In addition, open flame devices like cooking ranges, heaters and charcoal grills also produce carbon monoxide.

Carbon monoxide accumulation, in and around boats is affected by vessel geometry; overall vessel design; closeness to other structures; wind direction; boat speed; and many other variables. In no way can this section cover all of the possible variables. Do not rely on this section as the exclusive listing of measures to prevent the accumulation of carbon monoxide.

Consult your boat operators manual for detailed information on the inspection and/or maintenance of the exhaust system for your particular application. If an inspection reveals possible leaks, DO NOT operate your engine(s) until it can be serviced by a qualified technician.

Proper and adequate air circulation, around and throughout the boat, is absolutely necessary to aid in the prevention of carbon monoxide build-up. If you have any questions or concerns regarding the operation of your boat and carbon monoxide hazards, DO NOT operate your engines until you have contacted your boat manufacturer.

Safety Information



To find out more about making boating safer, including how you can prevent carbon monoxide poisoning on recreational boats, contact:

National Marine Manufacturers Association

200 East Randolph Drive
Suite 5100
Chicago, IL 60601-6528
www.nmma.org
312-946-6200

United States Coast Guard

Office of Boating Safety
CG Headquarters G-OPB-3
2100 Second Street SW
Washington, DC 20593
www.uscgboating.org
202-267-0984

American Boat & Yacht Council, Inc.

3069 Solomon's Island Road
Edgewater, MD 21037-1416
www.abyc.com
410-956-1050

FUEL

DANGER

Gasoline is extremely flammable and highly explosive under certain conditions. Explosive gasoline fumes may accumulate in the engine compartment. Failure to properly ventilate fumes with the bilge blower may result in an explosive atmosphere.

WARNING

Always operate the bilge blower at least 5 minutes prior to starting the engine. Raise the engine hatch to help ventilate any fumes. Inspect the bilge for gasoline, or any other fluid leaks.

- DO NOT smoke or allow open flames or sparks nearby when refueling.
- Always stop the engine prior to refueling.
- Maintain contact between the fuel nozzle and the fuel tank fill to prevent electrostatic spark.
- DO NOT block fuel vents.
- DO NOT store fuel in any containers or compartments that are not designated for fuel storage.

Safety Information

BATTERY

DANGER

Explosive battery fumes may accumulate in the engine compartment. While the engine is running, or the battery is charging, hydrogen gas is being produced by a lead acid battery and can be easily ignited. Failure to properly ventilate fumes with the bilge blower may result in an explosive atmosphere.

- Wear personal protective equipment when working on or around batteries.
- DO NOT smoke or exposed open flame near a battery.
- DO NOT recharge a weak battery in the boat. Remove the battery from the boat and recharge in a well ventilated area.

Follow maintenance instructions and warnings as supplied by the battery manufacturer. If this information is not available, follow these guidelines for the proper battery care.

- Do not switch the Battery Switch position while the engine is running, as this may cause damage to the alternator. Make sure that all connections are clean and secure.
- When removing the battery cables, always remove the negative (-) cable first, and then remove the positive (+) cable. When installing battery cables, install the positive (+) cable first, then install the negative (-) cable.
- Periodically check the battery for signs of corrosion, frayed battery leads or cracked case. Repair or replace as necessary.
- Periodically check the electrolyte level. Add distilled water to bring up to the proper levels.

IMPORTANT: Your engine is designed to work with the standard electronics installed in your boat. If you add other electrical components or accessories, you could change the way the fuel injection controls your engine or the overall electrical system functions. Before adding electrical equipment, consult your dealer. If you don't, your engine may not perform properly.

CAUTION

Add-on equipment may adversely affect the alternator output or overload the electrical system. Any damage caused as a result will not be covered by, and may void, your warranty.

ENGINE OIL

WARNING

Always wear protective equipment and use care when checking and changing the engine oil. The engine oil may be hot.

- Excessive contact with used engine oil may cause skin cancer. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.
- Keep engine oil out of reach of children.
- Used engine oil is a hazardous material and MUST be disposed of properly.

Safety Information



MOVING ENGINE COMPONENTS

WARNING

Rotating machinery can cause injury and even death if an accident should occur. Extreme care must be exercised if a problem exists that requires operation of the engine with the machinery space open. ***IT IS RECOMMENDED THAT UNCOVERED ENGINE OPERATION BE ATTEMPTED BY TRAINED AND QUALIFIED SERVICE PERSONNEL ONLY.***

- The machinery space must be closed anytime the engine is running to prevent injury to you or others on board.
- Never operate the engine with the engine machinery space open while someone is in the machinery space, either closed or open.
- Never open the machinery space unless the engine is shut off and the engines rotating parts are stationary.

ENVIRONMENTAL

ALWAYS be environmentally responsible when working on marine components. Follow all EPA, and any other government agency guidelines for properly disposing hazardous materials. These materials consist of, but not limited to, engine oil, fuel, transmission fluid, etc. Consult local authorities if you have any questions.

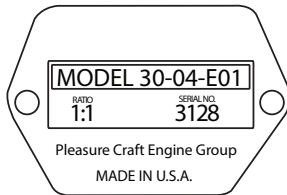
Engine Model Identification

When ordering service parts or obtaining information, ALWAYS give the engine model and the serial number. This information can be found on the engine identification decal.

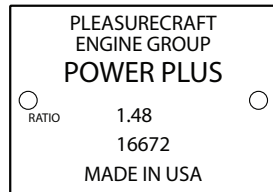
We suggest that you record the following information for quick reference when ordering parts or requesting service or warranty.



Transmission Identification Tag



VDrive Identification Tag



Engine Model Number:	
Serial Number:	
Trans. Model Number:	
Serial Number:	
VDrive Model Number:	
Serial Number:	
Boat Make:	
Boat Model:	
Hull Serial Number:	
Propeller Size:	
Ignition Key Number/ Code:	

NOTE: See your Registration Card for this information. If you need to locate the decals, specific locations of these decals for the various model engines can be found through the Owners Manual Information found on our websites.

General Information

OPERATION AND MAINTENANCE

It is the owner's/operator's responsibility to perform all safety checks before operating his/her boat. All lubrication and maintenance schedules must be adhered to assure optimum performance and dependability from your Pleasurecraft Marine engine. When service and maintenance are required, return to your authorized Pleasurecraft Marine Authorized Dealer.

ELECTRONIC FUEL INJECTION SYSTEM

The Pleasurecraft Marine engines covered in this manual are equipped with an Electronic Engine Management. This system allows for precise engine control to maintain low emissions and great driveability.

Most boats are equipped with digital dashes which will illuminate a light and/or display a pop-up message window whenever a fault with this system occurs. Some boats are simply equipped with a Malfunction Indicator Lamp (MIL) that illuminates whenever a fault is detected.

Whenever a fault is detected, contact your dealer for service.

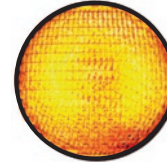
Certain conditions, or failures, will cause the engine to go into "Power Reduction" mode. Power reduction mode limits the engines throttle opening to a "safe maneuvering" speed to allow the operator to get the boat to a safe area for service.

Some of the conditions, but not limited to, that will cause power reduction mode are:

- Low Oil Pressure
- Engine Over Temperature
- Exhaust System Cooling Over Temperature

Electronic throttle failures will result in an **Idle Only** condition and will require service from your authorized dealer.

Service Required



Typical Malfunction Indicator Lamp (MIL)

If, for any reason, there is a malfunction detected, the engine control module has a built-in self-diagnostic system that will set a trouble code and turn on the "MIL" Malfunction Indicator Lamp to alert the operator of a malfunction.

In most cases, when the "MIL" is on, the engine(s) may lose some performance and/or efficiency, but remain running adequately. Also, the light may go out or become intermittent, but a trouble code will be logged for future diagnosis.

In any case, the operator must obtain service by a Pleasurecraft Marine Authorized Dealer to determine the exact cause of the malfunction.

Failure to schedule service as soon as possible when a fault is present may cause damage to your engine and/or emissions controls system.

General Information

FUEL SYSTEM

Most of the gasoline sold today in the United States contains ethanol, and the percentage is expected to increase over the next few years. Gasoline and ethanol are delivered to the gas stations separately and are blended together at gas stations during delivery. So what are the effects of ethanol in gasoline, and what can you do to prolong the life of your engines running on ethanol-blended fuel?

The Potential Problems

Phase separation in fuel from ethanol and water. Ethanol is added to gasoline as mandated by the EPA to lower carbon emissions to make running of such engines more Eco-friendly. Ethanol-blended fuels left untreated can start “phasing.” Phase separation is when ethanol in the fuel absorbs too much water, and separates from gasoline by dropping to the bottom of the tank since the ethanol and water mixture that results from phase separation is heavier than gasoline. Water-ethanol solutions can damage fuel systems and engines, and the system will need to get flushed to prevent further damage. Once phase separation has occurred, no additive can reverse it, and the fuel tank will require draining. If the fuel and ethanol have completely phase-separated, the fuel in the tank will be unusable and must be drained. Mechanics offer ‘pump-out’ services to drain and flush the fuel system.

Fuel Stabilizer Recommendations for Ethanol Blend Fuel

The use of a commercially available fuel stabilizer is recommended at each fill-up or when storing ethanol-blended fuel for more than **2 weeks**.

Fuel system or engine damage caused by contamination from water, foreign particles, sludge, or gums entering or forming in the fuel system is not covered by the Pleasurecraft Marine Limited Warranty.

WARNING

Never remove or modify any components of the engine’s fuel system. Tampering with fuel components may cause a hazardous condition that could result in severe personal injury or death. This work must be performed by your Pleasurecraft Marine Authorized Dealer.

WARNING

Do not attempt to repair or replace any components of the fuel system. They are special marine parts and may require special service tools. You could damage the fuel system by not using specified tools. This could cause a fire or explosion.

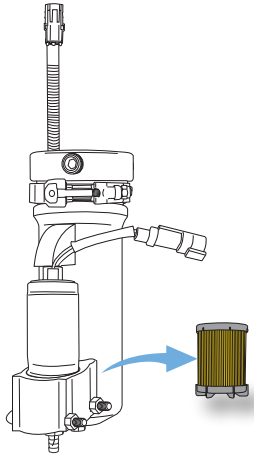
WARNING

Replacement of any part of the fuel system **MUST** be done with Pleasurecraft Marine Authorized Parts. All fuel system components must meet the requirements set forth by the U.S. Coast Guard.

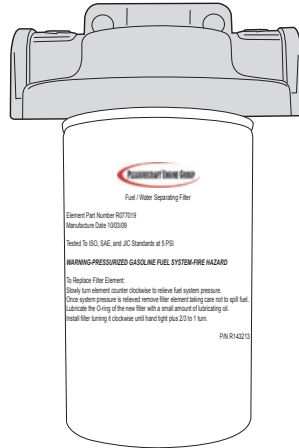
NOTICE

These engines are designed to run on unleaded fuel. The use of leaded fuel will cause damage to the catalytic converter emissions system.

General Information



Typical Fuel Control Cell (FCC) Fuel Filter/Water Separator



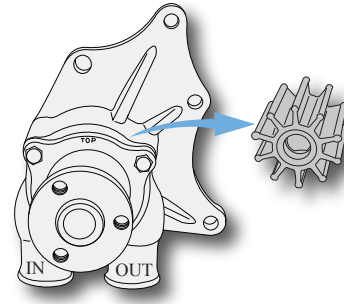
Typical Remote Mounted Fuel Filter/Water Separator

IMPORTANT

These fuel systems can tolerate a small amount of water without causing damage. Excessive water can cause the engine to run poorly and damage components. Use caution when refueling to prevent water from entering the fuel system. Make sure your fuel/water separating filters are maintained properly.

COOLING SYSTEM (not applicable to Levitator Models)

Marine cooling systems are much different than automotive cooling systems. Automotive uses air flow across a radiator in order to cool the system. Marine cooling systems use the body of water the boat is in to cool the system. A raw water pump, which utilizes a rubber impeller, draws water in through a water pickup in the bottom of the boat. This water is distributed through the engine, exhaust, heat exchanger and coolers in order to cool the system down. The raw water pump depends on water flowing through it in order to lubricate the impeller and keep the pump cool.



Typical Raw Water Pump (if applicable)

NOTICE

Levitator engines use a more automotive style cooling system which is a closed cooling system utilizing a radiator and air flow for cooling.

General Information

There are two main types of cooling systems, open cooling and closed cooling.

Open Cooling - Raw water supplied from the body of water circulates throughout the engine and exhaust system. Both the raw water pump and the engine circulation pumps work in conjunction to circulate the water through the cooling system and back out of the boat through the exhaust.

Closed Cooling - Engine coolant (or antifreeze) circulates throughout the engine and/or exhaust system. The raw water pump draws the water into the boat and circulates it to the heat exchanger and coolers. The engine circulation pump circulates the engine coolant (antifreeze) throughout the engine and/or exhaust manifolds.

NOTICE

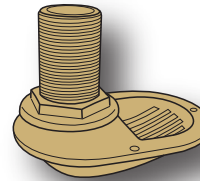
Never run your engine without a constant and adequate water supply to the cooling system. Ensure that the raw water pickup (located on the bottom of the boat) remains clean and clear of debris or blockage at all times.

IMPORTANT

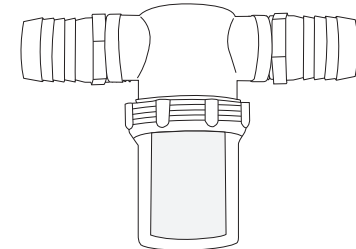
ALWAYS refer to the website for the correct technical information for your model year engine. There are many different types of cooling systems and this information provides the correct locations to drain the raw water system for winterization. Missing a raw water drain may cause severe engine damage that is not covered under warranty.

NOTICE

Ensure that the sea-strainer is clean, tight and no cracks or loose hoses. This can cause air to be sucked into the cooling system, limiting the amount of raw water, and does not provide adequate cooling.



Typical Raw Water Pickup
(if applicable)



Typical Raw Water Sea Strainer
(if applicable)

NOTICE

Regardless of the cooling system, it is recommended that you properly flush the raw water portion of the cooling system with fresh water after each use. Marine growth can develop from salt water, brackish water, and even high mineral content in bodies of fresh water.

General Information



EXHAUST HOSES

DANGER

Carbon monoxide (CO) is colorless, odorless, and extremely dangerous. Carbon monoxide poisoning is caused by inhaling combustion fumes. When too much carbon monoxide is in the air you're breathing, your body replaces the oxygen in your red blood cells with carbon monoxide. This prevents oxygen from reaching your tissues and organs.

Marine engines produce carbon monoxide. Normally the amount of carbon monoxide produced by these engines isn't cause for concern, but if they're exposed in a confined space, the carbon monoxide can build to dangerous levels.

Marine exhaust systems carry the engine exhaust gases from the engine to outside the boat. The exhaust systems also carry water that was used to cool the engine. This water also keeps the rubber exhaust hoses cooled, preventing them from melting.

If you experience a lack of raw water, or the engine has overheated, carefully inspect the rubber exhaust hoses for any damage. Damaged exhaust hoses can allow carbon monoxide gas to enter the boat.

ELECTRICAL SYSTEM

Pleasurecraft Marine engines use a 12 volt negative ground system. This system requires a marine battery with a minimum of 650 cold cranking amps. DO NOT connect the battery cables up backwards (reverse polarity) in order to prevent possible damage to electronic components.

WARNING

ALWAYS connect the positive (+) battery cable first, then attach the negative (-) battery cable. When disconnecting cables, ALWAYS disconnect the negative (-) battery cable first, then disconnect the positive (+) battery cable.

NOTICE

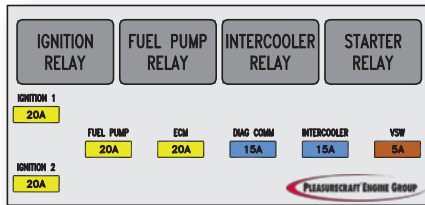
Whenever connecting or disconnecting battery cables, ensure the battery switch (if equipped) and ignition circuits are in the OFF position.

Pleasurecraft Marine engines are equipped with a 40 Amp PANEL fuse which provides electrical overload protection for the boat's instrumentation wiring and components. Should an electrical overload occur, the PANEL fuse will open and prevent electrical current flow.

When this fuse opens, the cause for the high current draw must be found and corrected. Check the battery and alternator connections and all other harness connectors between the boat and the engine main harness. Check for loose or disconnected lead wires and shorted circuits. Replace the PANEL fuse and resume operation.

General Information

Pleasurecraft Marine engines utilize fuses to protect critical engine components and devices. The fuel pump, ECM, ignition components, fuel injectors, starter and diagnostic devices are protected by fuses. The fuse block is mounted on a bracket on the engine.



Typical Fuse Block Layout

The electrical system wiring and connectors should be checked periodically for loose or dirty connections and damaged wiring. If electrical components or wiring show signs of corrosion, deterioration or damage, consult a Pleasurecraft Marine Authorized Dealer to make necessary repairs.

IMPORTANT

If the engine will not crank when the ignition key is turned to the START position, first check that the shift lever is in the neutral position and the safety lanyard (if equipped) is attached properly. If none of the Fuse Block fuses are open, check for a blown boat ignition fuse. The boat's ignition fuse may be located on the instrument panel, the fuse holder block or as part of the helm's instrument wiring harness. Check the wiring diagrams supplied from the boat manufacturer for the exact location.

PROPELLER SELECTION

Best all-around performance and maximum engine life is achieved when the engine is propped to run near the top of (but within) the recommended full throttle RPM range with a normal load.

Generally, gross weight (total weight of the entire boat, including full fuel and water, optional equipment, passengers and other miscellaneous gear) is one of the major factors and should be one of the primary considerations when selecting a propeller. Other factors to take into consideration are as follows:

- Warmer weather and higher humidity will cause an RPM loss.
- Operating the boat in a higher elevation will cause an RPM loss.
- Operating the boat with an increased load will cause an RPM loss (additional equipment, passengers, etc.).

General Information



If full throttle RPM is above or below the recommended range, the propeller must be changed to prevent loss of performance. A one-inch change in the pitch of a given propeller will generally change engine RPM by 150 to 250 RPM.

The propeller provided on your boat was chosen by the boat builder to be the best propeller for all around use. If you believe you require a different propeller, consult your dealer or boat builder for proper direction. Installing the wrong propeller can have adverse and possible damaging affect on the engine.

CAUTION

Prolonged WOT operation will shorten the life of your engine and could cause premature engine failure. Problems caused by prolonged WOT operation are considered abuse and are not covered under the Pleasurecraft Marine Warranty.

IMPORTANT

Your new Pleasurecraft Marine engine incorporates an RPM "MAX GOVERNOR" in order to prevent the engine from over-revving. Operation above the Maximum RPM is not recommended. If your engine is operating above the maximum RPM listed, a higher pitched propeller would be required to lower the engine maximum RPM to the Preferred RPM.

Engine Break-In

WARNING

Use this procedure ONLY when conditions are such that it can be done in complete safety.

The break-in period of your engine is the first 25 hours of operation. Proper engine break-in is essential to achieve maximum performance, longevity and minimum oil consumption. During the break-in period, the following operation guidelines must be adhered to:

- After the engine is thoroughly warmed up, and the boat is underway, open the throttle to wide open throttle until maximum RPM is reached. DO NOT EXCEED MAXIMUM RPM. (RPM should cease climbing after 10 to 20 seconds).

CAUTION

DO NOT operate at full throttle in neutral at any time, or at sustained full throttle during the first 5 hours of operation. Thereafter, use sustained wide open throttle in the event of an emergency.

- Reduce the throttle to 2800 - 3000 RPM, and cruise at or below this speed for 1/2 hour. Reduce the speed to idle. Go to wide open throttle until maximum RPM is reached and operate for approximately 1 minute. Reduce throttle to 2800-3000 RPM and operate for a few minutes. (Bringing the engine speed from idle to wide open throttle will load the engine and assist in seating the piston rings). This cycle should be repeated from time to time during the first 5 hours

of operation, but wide open throttle should not be sustained for more than 1 minute.

- During the remaining 20 hours of break in period, the engines can be run at cruise speeds that are approximately 75-80% of the wide open throttle RPM, occasionally varying the cruise speed by 100 RPM.
- During the early part of the break in period, the correct propeller selection can be confirmed. (With a normal load aboard, the engine's RPM should reach, but not exceed, the maximum RPM as listed in the specifications section).
- During the break in, all gauges should be observed carefully, and the speed should be reduced if abnormal readings become evident.

CAUTION

DO NOT attempt to break in any engine by prolong idling, or running at the dock.

The engine oil level should be checked often and oil added when necessary. It must be understood that every internal combustion engine will use a certain amount of oil during operation to act as a lubricating and cooling agent, especially during the break-in period. Oil consumption should decrease and become stabilized after approximately 100 hours of operation.

Somewhere before 25 hours of your break-in period, contact your dealer and have the recommended 25-hour inspection done.

25-Hour Engine Inspection



After the first 25 hours of operation, it is recommended that the engine be given an inspection. Your boat dealer or a Pleasurecraft Marine Authorized Dealer should be contacted to perform the necessary checks and adjustments to ensure the proper engine performance. The following maintenance should be performed:

- Change the engine oil and filter. This engine starts out with break-in oil and should be run in the engine for at least the first 5 hours of operation. Any time after 5 hours, but NO MORE than 25 hours, the engine oil and filter must be changed.
- Replace the spin-on fuel filter/water separator, P/N R077019.
- Check the engine alignment.
- Inspect the accessory drive belt(s) and check the tension.
- Check all the fluid levels.
- Check the throttle and the shift cable adjustments and check for freedom of movement.
- Cooling System - Inspect all the hoses for leaks, damage and deterioration. Check all the hose clamps for adequate tightness.
- Models with Thermostatically-Controlled Exhaust Cooling System - Inspect exhaust cooling system thermostat and housing inlet. Clean as necessary.
- Exhaust System - Inspect the entire exhaust system for leaks, damage and deterioration. Check all the hose clamps for adequate tightness.

- Battery - Check the electrolyte level and specific gravity. Inspect the case for damage. Check the battery cables and connections.
- Flame Arrestor - Inspect and/or clean as required.
- Engine Assembly - Check for loose, missing or damaged parts. Pay close attention to engine mounts, starter and alternator mounting fasteners.

NOTICE

Pleasurecraft Marine assumes no responsibility for the costs related to the 25-hour inspection. This is the owner's responsibility.

Operating Instructions

Pre-Operation

Prior to starting your engine, and before each time the engine is operated, the following inspections should be performed. If you have any questions, consult your Pleasurecraft Marine Authorized Dealer for assistance.

WARNING

ALWAYS review the Safety section of this manual prior to starting or operating your engine.

WARNING

Before starting engine, ventilate the engine compartment by operating the bilge blower for a minimum of five minutes to remove any gas fumes from the engine compartment. If the boat is not equipped with a blower, open the engine compartment hatches to ventilate and leave open while starting engine.

IMPORTANT

Do not start the engine without water being supplied to the sea water pick-up pump or sea-water pump impeller will be damaged, and subsequent overheating damage to the engine may result.

Engine Compartment

Carefully inspect the engine compartment for any signs of fluid leakage such as gasoline, oil, coolant, etc. If a problem is found, correct prior to operating the engine.

Check Engine Oil

CAUTION

Do Not overfill engine crankcase with oil. Excessive oil can lead to premature engine component failure and/or loss of performance.

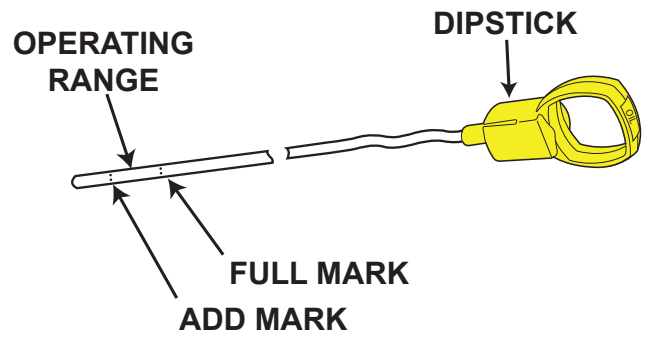
IMPORTANT

The engine oil level must be checked while the boat is in its normal, level, at rest position on the water. Excessive wave action side to side or fore and aft may cause you to obtain erroneous readings. If the oil level is being checked while the boat is on a trailer, ensure the trailer is on level ground, then adjust the trailer so the boat is at its normal, at rest position. Excess water in the bilge and ballast systems must be purged when checking the engine oil level, otherwise erroneous readings may be obtained.

If the engine was running, make sure the engine is off, and allow approximately 5 minutes for the oil to drain back into the oil pan.

1. Open the engine compartment hatch(es).
2. Remove the dipstick and wipe it clean. Reinstall the dipstick until it is fully seated into the dipstick tube. Remove the dipstick and observe the reading. The reading must be between the ADD and FULL marks on the dipstick.
3. If the oil level is below the "ADD" mark, add specified oil to bring the level up to, but not over, the "FULL" mark on the dipstick. If the oil level is above the "FULL" mark on the dipstick, remove the excess oil.

Operating Instructions



Typical Engine Oil Dipstick

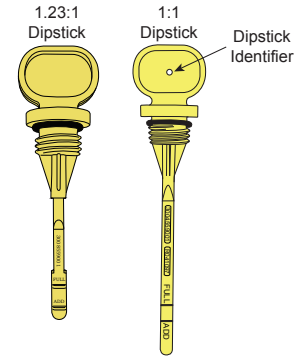
WARNING

The machinery space must be closed anytime the engine is running to prevent injury to you or others on board. Never operate the engine with the engine machinery space open while someone is in the machinery space, either closed or open. Never open the machinery space unless the engine is shut off and the engines rotating parts are stationary. Rotating machinery can cause injury and even death if an accident should occur. Extreme care must be exercised if a problem exists that requires operation of the engine with the machinery space open. it is recommended that uncovered engine operation be attempted by trained and qualified service personnel only.

Check Transmission Fluid Level (if applicable)

WARNING

Do not attempt to remove the transmission dipstick while the engine is running. Hot transmission fluid could be sprayed from the dipstick hole.



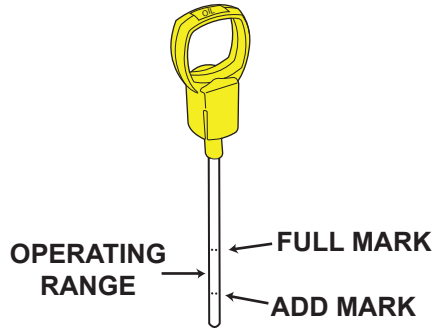
Typical Transmission Screw-In Dipstick

Screw-In Dipstick Type

1. The fluid level must be checked in one of the following conditions:
 - A. Engine/Transmission is cold;
 - B. Engine/Transmission has been shut off for at least 2 minutes to allow fluid to drain back.
2. Remove the dipstick by turning the T-handle counterclockwise. Wipe the dipstick off using a clean cloth.

Operating Instructions

3. Re-insert the dipstick to the threads (DO NOT screw the dipstick in) and remove. Observe the fluid level.
4. The fluid level should be at the "FULL" mark. If low, add the specified fluid in small increments through the dipstick hole in the transmission. Repeat the checking procedures until the fluid level is at the "FULL" mark.
5. Replace the dipstick and tighten securely.



Typical Transmission Push-In Dipstick

Push-In Dipstick Type

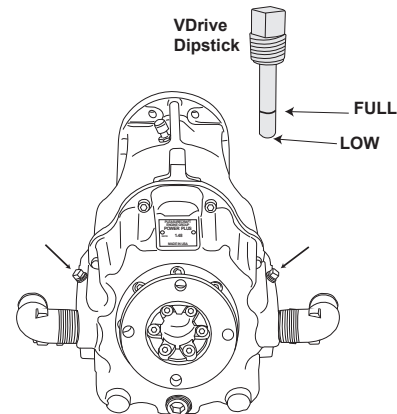
1. The fluid level must be checked in one of the following conditions:
 - A. Engine/Transmission is cold;
 - B. Engine/Transmission has been shut off for at least 2 minutes to allow fluid to drain back.
2. Remove the dipstick from the transmission. Wipe the dipstick off using a clean cloth.

3. Re-insert the dipstick until it fully seats in the dipstick tube. Remove the dipstick and observe the fluid level.
4. The fluid level should be at the "FULL" mark. If low, add the specified fluid in small increments through the dipstick hole in the transmission. Repeat the checking procedures until the fluid level is at the "FULL" mark.
5. Replace the dipstick securely.

Check VDrive Fluid Level (if applicable)

WARNING

Do not attempt to remove the VDrive dipstick while the engine is running. Hot gear fluid could be sprayed from the dipstick hole.



Typical VDrive Dipstick

Operating Instructions



All Pleasurecraft Marine Power-Plus VDrive gears are designed to extreme specifications to withstand the force of today's applications. Inspect fluid level after the first 25 hours of use and annually thereafter. Fluid should immediately be changed if evidence of contamination is present. Use Pleasurecraft Marine PowerPlus V-Drive Lubricant, P/N R190251.

1. Remove the dipstick from the VDrive housing. Wipe the dipstick clean and insert into VDrive - Do Not Screw the dipstick into the hole. Remove and observe the fluid level.
2. The fluid level should be between the FULL mark and the bottom of the dipstick. If the fluid level is within this range, do not add fluid. If the fluid level is not touching the bottom of the dipstick, add the specified Pleasurecraft Marine PowerPlus V-Drive Lubricant through the threaded hole to the proper level.

NOTE: The VDrive gear oil is a very high viscosity. To make adding fluid easier, remove both dipsticks.

3. Replace the dipstick and tighten securely.

NOTE: The VDrive gear oil must be checked every 100 hours and topped off or changed as required.

The VDrive gear oil must be changed once a year or every 300 hours of use.

Check Raw Water Drain Plugs (if applicable)

Ensure that ALL raw water drain plugs are installed in the engine block, exhaust system, coolers and VDrive.

Check Engine Coolant

If your model has a closed cooled system, check the coolant level at the coolant degas bottle.

WARNING

Do not attempt to remove the cap from the coolant degas bottle on a hot engine. Hot coolant can be under pressure and expel from the bottle.

Exhaust System

Inspect your exhaust system for any leaks, damaged exhaust hose or loose clamps.

Battery

Ensure the battery connections are clean and tight. Verify the battery is fully charged.

Serpentine Belt System

Inspect serpentine belt system for damage.

IMPORTANT

Consult your boat's Owner's Manual for any additional Pre-Operation Inspections that must be done.

Operating Instructions

Starting the Engine

WARNING

Before starting engine, ventilate the engine compartment by operating the bilge blower for a minimum of five minutes to remove any gas fumes from the engine compartment. If the boat is not equipped with a blower, open the engine compartment hatches to ventilate and leave open while starting engine.

1. Turn the battery switch ON (if equipped).
2. Open the seacock.
3. Make sure the Lanyard is securely installed.
4. Place the throttle control in the Neutral position. The system is equipped with a neutral safety switch, which will not allow the starter motor to operate unless the throttle control is in neutral.
5. Do not pump or open the throttle when starting the engine. The ECM will automatically regulate the fuel and control desired idle speed.

Your engine may be equipped with the engine auto-crank feature. This feature allows the engine to automatically crank, or turn over, when commanded. Once the operator has turned the key to the START position on a key switch, or depressed the START button on a touch pad, the engine will automatically turn over and start. The engine will turn over until the engine starts, or a maximum of 8 seconds. The key switch or stop button can always be utilized in order to cease the engine from cranking and/or starting.

IMPORTANT

In the event that the engine must be turned over WITHOUT automatically cranking or starting (i.e. bumping the engine to #1 position or performing a compression check) a remote starter button MUST be used, connected directly to the starter solenoid and the ignition system disabled.

6. Turn the ignition key to the start position, or depress the start button on the keypad.

NOTE: Engine idle speed is controlled by the ECM and is based on the operating temperature of the engine. Upon initial start-up, engine RPM will be slightly higher and will automatically decrease as the engine operating temperature increases.

IMPORTANT

To achieve Neutral Lockout, or throttle only operation, depress the Neutral Override button while moving the throttle lever. This will result in engine throttle but no shifting of the transmission. Consult your Boat Owner's manual for proper neutral lockout procedures.

IMPORTANT

If the engine fails to start within 20-30 seconds, turn the ignition key to the OFF position and allow 2 minutes for the starter motor to cool off before attempting to restart the engine. If the engine still fails to start, contact your Pleasurecraft Marine Authorized Dealer.

Operating Instructions




7. Check engine oil pressure immediately after the engine starts. If oil pressure is not within specifications (see Engine Specifications), immediately stop the engine and determine the cause.
8. Check voltmeter for proper charging system operation
9. Check the engine and transmission for fuel, oil, water and exhaust leaks.
10. Allow the engine to reach normal operating temperature. Check the temperature gauge to ensure the engine is operating within the normal temperature range. If the temperature is abnormally high, stop the engine immediately and determine the cause.

Electronic Speed Control (If Equipped)

Refer to your Boat Manufacturers Owners/Operation manual for specific operation and troubleshooting information for your speed control system.

Shifting the Transmission

 CAUTION
Never shift the transmission into or out of gear unless the throttle is at the idle position. Shifting the transmission above 1000 RPM can severely damage the boat, transmission and engine.

1. Set the throttle lever at the idle position.
2. Pull up on the Safety Collar and slowly push the throttle/shift handle into the Forward gear Idle position.

Throttle may be increased/decreased as required in the Forward Throttle Range.

3. Pull up on the Safety Collar and slowly pull the throttle/shift handle back into the Reverse gear Idle position.

Throttle may be increased/decreased as required in the Reverse Throttle Range.

4. Move the transmission lever to the center detent position to shift into Neutral.

Freezing Temperature Operation

If the possibility of freezing exists, the cooling system must be protected after the engine is shut off to prevent freeze damage to the engine. Refer to OUT-OF-SEASON STORAGE for draining instructions.

Operation In High Debris Areas

If the boat is to be operated in high debris areas, a sea strainer should be installed in the water inlet hose to prevent debris from entering the cooling system. The strainer used must be of sufficient size to allow an adequate supply of water for cooling the engine. A minimum of 30 gallons per minute (114 liters per minute) flow rate is required.

Operating Instructions

Weight Distribution

Positioning of the weight (gear and passengers) inside the boat has the following effects on handling:

- Trimming the bow up or shifting weight to the stern (rear).
 - Normally used for cruising (running) with a choppy wave condition (following sea) for running at full speed.
 - Will generally increase speed and engine RPM.
 - Will cause the bow to bounce in rough water.
 - In extreme, may cause the boat to porpoise.
 - When coming off plane, it increases the chances of following wave splashing into the stern of the boat.
- Positioning the weight to the bow (front).
 - Normally used for cruising (running) against a choppy wave condition, acceleration onto plane and operating at slow planing speeds.
 - Will improve rough water ride and handling.
 - In extreme, may cause the boat to bow steer (veer back and forth with little control).

Boat Bottom

To ensure maximum engine performance, fuel economy and boat speed, the bottom of your boat must be kept clean and free of marine growth and barnacles. Marine vegetation may accumulate when the boat is docked and should be removed before operation. If the boat is docked for long periods of time, the water inlets may become clogged with growth and will cause the engine to overheat.

In most areas, it is advisable to coat the boat bottom with anti-fouling paint to prevent the buildup of marine growth. Contact your dealer for advice on these requirements in your area.

CAUTION

Prolonged WOT operation will shorten the life of your engine and could cause premature engine failure. Problems caused by prolonged WOT operation are considered abuse and are not covered under the Pleasurecraft Marine Warranty.

IMPORTANT

Your new Pleasurecraft Marine engine incorporates an electronic RPM “MAX Governor” in order to prevent the engine from over-revving.

Engine Maintenance



Maintenance Schedule

Location and Service	Check Daily	After 1st 25 Hrs of Operation	Every 50 Hours of Operation	Every 100 Hours of Operation	Once Each Year
Check coolant level - Fresh-water cooled models only	X				
Check oil level - Engine crankcase	X				
Check oil level - Transmission	X				
Engine Assembly (complete - Check for obvious leaks (water, oil, fuel and exhaust)	X				
Remote Control and Steering System - Check for proper operation	X				
Sea Strainer - Check (if equipped)	X				
Partial Cooling System - Check and clean screen on inlet side of exhaust cooling thermostat housing as required.		X	X		X
Cooling System - Check condition and tightness of all hose clamps		X		X (1)	X
Cooling System - Inspect/Replace raw water pump impeller			X		X
Drive Belt - Inspect condition and check tension		X		X	X
Exhaust System - Check condition and tightness of all hose clamps		X		X (1)	X

Reference Page 39 for additional notes denoted in each column.

Engine Maintenance

Maintenance Schedule (cont'd)

Location and Service	Check Daily	After 1st 25 Hrs of Operation	Every 50 Hours of Operation	Every 100 Hours of Operation	Once Each Year
Exhaust System - Check for water leaks at the manifold, riser and elbow gaskets	X				
Ignition System and Spark Plugs - Clean and inspect condition		O		O	O
Engine Assembly (complete) - Check for loose, missing or damaged parts (especially engine mounts, starter and alternator mounting fasteners)		X		X	X
Change engine oil and filter		X	X		X
Engine Alignment - Check and adjust if necessary		O			O
Ignition Timing - Not Adjustable					
Battery - Check electrolyte level and specific gravity. Inspect case for damage. Check cables and connections.		X	X		X
Electrical System (complete) - Check for loose or dirty connections and damaged wiring			X (2)		X
Flame Arrestor and Crankcase Ventilation System - Clean and inspect		X		X	X

Reference Page 39 for additional notes denoted in each column.

Engine Maintenance



Maintenance Schedule (cont'd)

Location and Service	Check Daily	After 1st 25 Hrs of Operation	Every 50 Hours of Operation	Every 100 Hours of Operation	Once Each Year
Hoses (all) - Inspect for cracks, swelling, weather checking or other signs of deterioration				X	X
Shift and Throttle Cable Linkage - Inspect and lubricate (A)				X (1)	X
R077019 Spin-On Fuel Filter - Replace		O	O		O
Fuel Control Cell Fuel Filter - Replace			O		O
Transmission - Change fluid (B) and clean strainer, if equipped		O		O	O
PowerPlus V-Drive (C) - Inspect fluid level and top off or change as required.		O		O	O

Reference Page 39 for additional notes denoted in each column.



Engine Maintenance

Maintenance Schedule (cont'd)

Fresh-water cooled models - Clean sea-water section	As required X (3)
Fresh-water cooled models - Check coolant for alkalinity	At least once each year X (4)
Fresh-water cooled models - Change coolant	Every two years X (4)
Zinc Anodes - Heat exchanger and cooler - check condition	Every 30 days X (3)
Engine Assembly Exterior Surfaces - spray with rust-preventative oil (D)	Fresh water areas - Every 60 days X Salt water areas - Every 30 days X
Cooling System - Flush sea-water section	After use each day X

Reference Page 39 for additional notes denoted in each column.

Engine Maintenance



Notes:

- X Denotes service to be performed by the owner/operator
- O Denotes service to be performed by a Pleasurecraft Marine Authorized Dealer
- A Use SAE 30 engine oil
- B All Pleasurecraft Marine transmissions - Use Dexron III automatic transmission fluid - Inspect fluid level after the first 25 hours of use and every 100 hours, or annually, thereafter. Fluid should only be changed every 250 hours, or if evidence of contamination is present.
- C All Pleasurecraft Marine Power-Plus V-Drive Gear - Change fluid level after the first 25 hours of use. Inspect fluid every 100 hours, or annually, thereafter. Fluid should only be changed every 600 hours, or if evidence of contamination is present. Use Pleasurecraft Marine P/N: R190251
All other V-Drive transmissions - Use Dexron III automatic transmission fluid
- D Use a rust preventative oil

VISUAL INSPECTION

It is important for the owner/operator to visually inspect the complete engine assembly at regular intervals. Most often, costly repairs can be avoided if potential problems are corrected before there is a failure.

Inspect the complete engine assembly for obvious fuel, oil, water or exhaust leaks. Check for loose, damaged or missing parts. Check all hose clamps for adequate tightness. Check the electrical system for loose or dirty connections or damaged wiring.

- (1) In fresh-water areas, every 100 hours of operation or 120 days (whichever occurs first). In salt-water areas, every 50 hours of operation or 60 days (whichever occurs first).
- (2) In fresh-water areas, every 50 hours of operation or 60 days (whichever occurs first). In salt-water areas, every 25 hours of operation or 30 days (whichever occurs first).
- (3) Requires more frequent inspection if used in extremely salty, polluted or mineral-laden waters.
- (4) See COOLANT SPECIFICATIONS. These can be found using the appropriate QR code, or website address for your model engine.

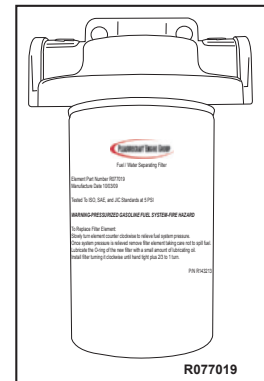
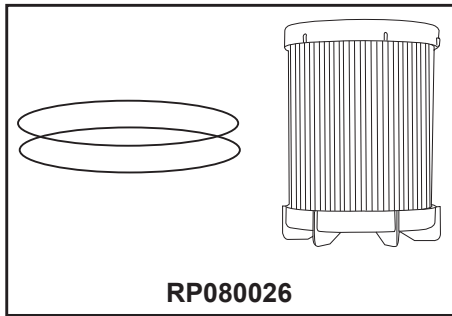
Pleasurecraft Marine recommends that all periodical and annual service be performed by your local, Pleasurecraft Marine Authorized Dealer.

Touch up scratches, nicks and corrosion damage to the exterior finish of the engine. Spray paint may be obtained from your local Pleasurecraft Marine Authorized Dealer. Protect engine finish from corrosion by periodically spraying the engine exterior finish with a rust preventative oil.

Engine Maintenance

Filter Requirements

Description	Part No.
Oil Filter (remote-mounted)	R077001
Primary Spin-On Fuel Pre-Filter/Water Separator	R077019
Fuel Control Cell (FCC) Fuel Filter Element	RP080026



Pleasurecraft Marine Power-Plus VDrive Lubricant

Description	Part No.
Pleasurecraft Marine Power-Plus V-Drive Lubricant (1qt. bottle)	R190251

Out-Of-Season Storage



Engine Storage

IMPORTANT
This service should be performed by a Pleasurecraft Marine Authorized Dealer.

WARNING
Extreme caution must be exercised when servicing the fuel system. The fuel system operates under high pressure. Use caution when removing or replacing components, as residual pressure may be present.

1. Fill the fuel tanks with gasoline and add a sufficient amount of gasoline stabilizer, to prevent the formation of fuel gum and varnish. Follow the instructions on the container.

WARNING
On fuel injected engines, you **MUST** bleed off fuel pressure before proceeding. Failure to do so may cause personal injury.

WARNING
Extreme caution must be exercised when servicing the fuel system and/or replacing fuel filter. Gasoline is extremely flammable and highly explosive under certain conditions. Be sure the ignition key is off and do not smoke or allow open flame in the area while servicing. Wipe up any spilled fuel immediately.

2. Remove, empty and clean the fuel filter assembly. Reinstall with a new fuel filter and gasket / seals.

NOTE: DO NOT re-use old fuel filter components. Always replace with new fuel filter element and gasket / seals.

WARNING
Accumulation of water and other fuel contaminants may form corrosive compounds that can damage the fuel filter, and result in fuel leakage. Ethanol blended fuel may increase this risk. For this reason, annual replacement of the fuel filter, at a minimum, is required to avoid risk of explosion or fire.

WARNING
Operate the bilge blower and be sure no fuel vapors are present when treating the engine. Be sure the engine compartment is well-ventilated to prevent a potential fire hazard.

3. Run the engine and allow it to reach normal operating temperature (a minimum of 10 minutes). Shut down the engine and change the oil and oil filter.
4. Flush the cooling system if operating in salt water or brackish water areas.
5. Restart the engine and allow it to idle for 5 minutes.

Out-Of-Season Storage

- Turn off the ignition. If fogging the engine is required for extended storage, remove the spark plugs. Use an aerosol-type fogging solution and spray a sufficient amount of oil into each cylinder spark plug hole. (Follow the instructions for the storage oil used.)

NOTE: DO NOT fog the engine through the throttle body/flame arrestor.

- Turn the crankshaft several revolutions by hand to spread the oil evenly throughout the cylinders. Install the spark plugs and connect the spark plug wires.

CAUTION

DO NOT turn the engine over with the ignition system. Spark can ignite the fuel and/or fogging oil when spinning over. Turning the engine over must be done by hand.

CAUTION

Excess storage oil in the engine's cylinders can cause hydrostatic locking to occur, and severe damage to the engine.

- Remove and clean the flame arrestor and the vent hoses, and reinstall on the engine. Cover the throttle body assembly to prevent the possibility of the water entering the engine through the throttle body assembly, during storage.
- Close the fuel shut-off valve (if equipped).

Draining Instructions

IMPORTANT

This service should be performed by a Pleasurecraft Marine Authorized Dealer.

CAUTION

If the boat is to remain in the water during or after draining, close the seacock to prevent a siphoning action that may occur, allowing sea water to flow from drain holes or removed hoses.

IMPORTANT

When removing the drain plugs, insert a wire into the hole to remove any obstruction which would prevent water from draining completely.

IMPORTANT

The fresh-water section of the cooling system must be kept filled year around with recommended coolant. Make certain that the cooling system is protected with a propylene glycol antifreeze mixture properly mixed to protect the engine to the lowest temperature that it will be exposed to.

IMPORTANT

Drain the sea-water section of the cooling system only.

Out-Of-Season Storage



1. Remove all the drain plugs and/or hoses according to the correct application found in the WATER DRAINING DIAGRAMS on the website.

NOTICE

It may be necessary to bend or lift the hoses to allow water to drain completely.

2. Remove the raw water pump impeller. If inspection proves the impeller to be in good condition, store it in an accessible spot for re-installation at the end of the storage period. A damaged or badly worn impeller should be discarded and a new one installed at the end of the storage period.

NOTE: Removal of the impeller during storage will prevent the impeller vanes from drying and taking a permanent "set".

3. After the water has completely drained, apply a light coat of pipe sealant to the threads of drain plugs, and reinstall in them the proper locations. Reinstall the hoses and tighten all the clamps securely.

After draining is completed, perform the additional required maintenance as outlined in the MAINTENANCE SCHEDULE under ONCE EACH YEAR.

Battery Storage

Follow the battery manufacturer's instructions for storage. If not available, use the following instructions:

- Remove the battery from the boat and clean, removing dirt and grease from the top of the battery.
- Fill the battery with distilled water to the manufacturer's specifications.
- Store the battery in a cool, dry place. Do not store on a concrete surface.
- Periodically (every 30 to 45 days), check the water level and recharge the battery to the manufacturer's specifications. Do not fast charge.



CAUTION

A discharged battery can be damaged by freezing.

Out-Of-Season Storage

Recommissioning Instructions

IMPORTANT

This service should be performed by a Pleasurecraft Marine Authorized Dealer.

When recommissioning the engine after storage, the following items should be checked:

1. Assemble the raw water pump and reinstall on the engine.
2. Check all the cooling system hoses. Be sure they are properly connected and all the hose clamps are tight. Install and tighten all the raw water drain plugs.

CAUTION

When installing the battery, make certain that you connect the POSITIVE (+) BATTERY CABLE to the POSITIVE (+) BATTERY TERMINAL first, and the NEGATIVE (-) BATTERY CABLE to the NEGATIVE (-) BATTERY TERMINAL last. If the battery cables are reversed, the electrical system will be damaged.

WARNING

Do not use jumper cables and/or a booster battery to start the engine. Do not recharge a weak battery in the boat. Remove the battery and recharge in a ventilated area away from fuel vapors, sparks or open flame.

3. Install the fully charged battery. Be sure that all the connections are clean and free from corrosion. Coat the battery terminal connections with an anti-corrosion battery terminal spray.
4. Inspect serpentine drive belt tension.
5. Check engine alignment.
6. Check engine and transmission oil levels.
7. Check engine mount fasteners.
8. Open the fuel shut-off valve (if equipped).
9. Refer to the OPERATING INSTRUCTIONS section and perform all the safety checks before starting the engine.
10. Ensure the lanyard is securely installed.
11. Cycle the ignition on and off several times to prime the fuel system. Inspect for fuel leaks prior to starting.

CAUTION

If the engine(s) is (are) to be started prior to launching, provide adequate water supply before proceeding to start the engine(s).

12. Open the seacock before starting the engine.
13. Start the engine and closely observe the instrument panel. Allow the engine to reach normal operating temperature. Inspect the engine carefully for fuel, exhaust, oil and water leaks.
14. Check the steering, shift and throttle controls for proper operation.

Troubleshooting



Engine performance complaints usually fall under one of the basic headings listed in the Troubleshooting Guide. When a problem cannot be easily diagnosed, consult a Pleasurecraft Marine Authorized Dealer for assistance.

Malfunction	Possible Cause	Corrective Action
<p>Engine will not crank with the starter motor, or cranks slowly.</p> <p>NOTICE: Battery voltage must be at or above 10 volts while the engine is cranking or the engine management system may not function properly.</p>	Problem with the engine management system.	Contact a Pleasurecraft Marine Authorized Dealer.
	Battery switch turned OFF (if equipped).	Turn the battery switch ON.
	Remote control (handle) not in Neutral position.	Position the remote control (handle) in the Neutral position.
	Blown ignition/starter fuse.	Replace the fuse.
	Loose and/or dirty battery/wiring connetions.	Check the battery cables and starter circuit wiring. Clean and tighten all connections. Repair or replace damaged wiring.
	Dead Battery.	Recharge, test and/or replace battery as necessary.

Troubleshooting

Malfunction	Possible Cause	Corrective Action
Engine oil pressure low.	Faulty oil pressure sending unit or gauge.	Test and replace as necessary.
	Oil level low.	Check engine for oil leaks. Top off oil level as necessary.
	Crankcase overfilled causing oil aeration.	Remove the required amount of oil. Determine the cause of overfilled condition (improper filling, etc.)
	Diluted or improper grade/viscosity of oil.	Change the oil and filter. Determine the cause of dilution (insufficient engine temperature, excessive idling, etc.)

Troubleshooting



Malfunction	Possible Cause	Corrective Action
Engine Overheats. <i>The following applies to engine equipped with closed cooling systems.</i>	Loose or worn serpentine belt.	Replace belt and/or belt tensioner as necessary.
	Collapsed, kinked or leaking hoses.	Replace the hose(s).
	Transmission and/or oil cooler plugged or restricted.	Remove the water hoses from the cooler(s) and flush water the opposite direction of normal flow.
	Faulty thermostat.	Replace the thermostat.
	Sea water intake valve closed or restricted.	Open the valve completely or replace if defective.
	Restricted sea water intake/pickup.	Remove or clean restriction.
	Coolant level low in the fresh water section of the cooling system.	Check cooling system for leaks. Refill the system. DO NOT remove the cap while the engine is hot.
	Heat exchanger passages plugged with scales/debris.	Clean and flush the heat exchanger.
	Improper coolant mixture.	Drain coolant from system and replace with proper mixture (dilute per antifreeze manufacturer's recommendations).

Malfunction	Possible Cause	Corrective Action
Insufficient engine temperature.	Faulty thermostat.	Replace the thermostat.
	Faulty temperature sender.	Replace the temperature sender.

Troubleshooting

Malfunction	Possible Cause	Corrective Action
Transmission slipping - erratic operation	Low transmission fluid.	Check for transmission leaks and top transmission fluid off as necessary.
	Transmission overfilled causing fluid aeration.	Drain transmission fluid until it is at the proper level.
	Transmission not shifting.	Possible bad handle/shifter. Inspect wiring and/or connections. Contact a Pleasurecraft Marine Authorized Dealer.
	Contaminated fluid.	Determine and correct the contamination source. Drain and change the transmission fluid, lines and cooler.

Malfunction	Possible Cause	Corrective Action
Engine misses, runs rough and/or backfires.	Ignition system malfunction.	Contact a Pleasurecraft Marine Authorized Dealer.
	Plugged fuel filters.	Replace the fuel filters.
	Faulty fuel pump.	Contact a Pleasurecraft Marine Authorized Dealer.
	Plugged or kinked fuel lines, or fuel tank vent.	Remove obstruction. Repair or replace faulty lines as necessary.
	Anti-siphon valve faulty.	Clean or replace as necessary.
	Dirty flame arrestor.	Clean or replace as necessary.

Troubleshooting



Malfunction	Possible Cause	Corrective Action
Poor engine or boat performance.	Ignition system malfunction.	Contact a Pleasurecraft Marine Authorized Dealer.
	Throttle not fully open.	Contact a Pleasurecraft Marine Authorized Dealer.
	Damaged or improper propeller.	Repair or replace as necessary.
	Excessive water in the bilge.	Pump excessive water out of bilge and determine cause of excessive water and repair.
	Excessive growth on the boat bottom.	Clean the boat bottom and paint with an anti-fouling paint.
	Boat overloaded.	Reduce or redistribute the weight load.
	Dirty flame arrestor.	Clean or replace as necessary.
	Engine overheating.	Repair the engine overheating issue.

Maintenance Log

Engine Model and Serial #	Port _____ Stbd. _____	Drive Serial #	Port _____ Stbd. _____	Ignition Key Number	Port _____ Stbd. _____
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Fire Extinguisher Checked

Batteries Tested

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Runs Made	Date	Gal of Fuel	Qts of Oil		Miles	Hours	Oil Change	Check Drive	Lay Up Date	Launch Date	Remarks
			Port	Stbd.							



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