



## STERNDRIIVE REPOWER PAK ENGINES

Thank you for your selection of Crusader Engines Marine Power for your boating needs. We welcome you to Team Crusader Engines, which puts you in the company of tens of thousands of boaters who have relied on Crusader Engines engines as their power of choice for over 30 years.

When you chose Crusader Engines, you selected the utmost in premium power for your boating application. Crusader Engines 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 Crusader Engines innovations. No matter which Crusader Engines model you purchased, you can be sure it is equipped with the latest in modern technology for added performance and durability.

### READ THIS MANUAL THOROUGHLY

Before starting your engine(s), READ THIS MANUAL CAREFULLY AND COMPLETELY. If you do not understand any portion of the manual, contact your 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. Crusader Engines' policy of continued improvement reserves the right to change specifications or design without notice and without obligation.

This manual will cover the following calendar year of manufacture Crusader Engines:

| Year | Model    |
|------|----------|
| 2013 | 5.7L MPI |

**PROPOSITION 65**



**WARNING**

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

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**OWNER WARRANTY CARD (Back of Manual) .**

## 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 and WARNINGS 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.

## 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 Crusader Marine Engines replacement parts be used in any repairs or maintenance being performed on your engine(s).

## SAFETY WARNINGS



### DANGER

Signals serious damage, failure or breakdown of equipment; severe injury or high probability of death to the user if proper precautions are not taken. This signal word is applied in extreme situations



### WARNING

Indicates a potential hazard which could result in personal injury.



### CAUTION

Indicates a hazard which could result in damage to equipment.

**IMPORTANT:** or **IMPORTANT:** Used to provide information to perform a procedure more easily.

**WARRANTY NOTICE:** Indicates a possible warranty exclusion.

# SERVICE AND WARRANTY - 1

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## OWNER'S SERVICE AND WARRANTY INFORMATION

### CRUSADER MARINE ENGINES' COMMITMENT TO YOU

Crusader Marine Engines is committed to assuring your satisfaction with your new Crusader 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.

### OWNER WARRANTY REGISTRATION

It is important that your selling dealer fill out the "Warranty Registration Card" completely and mail it to the factory 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.

Upon receipt of the "Warranty Registration Card" at 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 warranty is not effective until the Product is registered at the factory.

Mail registration information to:

Crusader Marine Engines  
P.O. Drawer 369  
Little Mountain, SC 29075

**NOTE: OWNERS WARRANTY REGISTRATION CARD IS LOCATED AT THE BACK OF THIS MANUAL.**

**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.

## ENGINE OPERATION AND CARE

Considering the investment that you have made in your new Crusader engine(s), we know you will want to operate and maintain it properly. We urge you to follow the maintenance instructions contained in your engine's "Operation and Maintenance Manual."

If you have any questions on how to keep your engine in good working condition, see your selling dealer, the place where many owners choose to have their maintenance work done. Your dealer can be relied on to use proper parts and practices.

## MAINTENANCE RECORDS

It is recommended that receipts covering the performance of regular maintenance be retained. Damage to your engine, caused by lack of maintenance, is not covered under your warranty. Receipts can be very important if a question arises as to whether a malfunction is caused by lack of maintenance or a defect in material or workmanship. An "Engine Maintenance Log" is provided in the MAINTENANCE SCHEDULE section of the OPERATION AND MAINTENANCE MANUAL for your convenience in recording the service performed.

## LOCAL REPAIR SERVICE

To obtain service or make a claim under your warranty, contact your selling dealer. They have trained technicians, knowledge and special tools and equipment to properly service your engine, if the need arises. They know you and your boat best.

# SERVICE AND WARRANTY - 1

## REPLACEMENT PART INQUIRIES

All inquiries concerning replacement parts should be directed to your local authorized dealer. The dealer has the necessary information to order parts for you if they are not in stock. Only authorized distributors can purchase parts from the factory. Crusader Marine Engines does not sell to unauthorized dealers or retail customers. When checking on parts, the dealer will require the engine model and serial number to order the correct parts.

## REPLACEMENT SERVICE PARTS

|                                                                                                                                                                                                                                                                                                                                                                                                       |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|                                                                                                                                                                                                                                                                                                                       | <b>WARNING</b> |
| <p>Electrical, ignition and fuel system components on Crusader engines are designed and manufactured to comply with U.S. Coast Guard rules and regulations to minimize the risks of fire or explosion. Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.</p> |                |

When servicing the electrical, ignition and fuel systems, it is extremely important that all the components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.

## APPLICABLE LIMITED WARRANTY

Following is the limited warranty applicable to Crusader Marine Engines sold and used in the United States and Canada.

Distributors and Dealers are not agents of Crusader. Crusader does not authorize any person to create any other obligation or liability in connection with this product.

# SERVICE AND WARRANTY - 1

## 1 Year Transferable Limited Warranty

Pleasurecraft Marine Engine Co. (PCM) warrants its new products to be free from defects in material and workmanship under normal use and service conditions, to the first registered user, and all subsequent user who, in accordance with PCM's warranty transfer policy, transfers any remaining portion of this warranty coverage within 30 days of any subsequent sale/purchases. All components of PCM products are covered under the PCM Warranty, except for those components that are warranted by PCM's suppliers. The obligation of PCM hereunder shall be limited to the repair or replacement with new or remanufactured components, at its option, of any product or parts thereof which has failed during the period of warranty and which is demonstrated upon examination to have failed due to defective material and/or workmanship.

PCM's policy is one of continued improvement of its products and PCM hereby reserves the right to improve and change the design and production of any of its products without assuming any obligation to modify products previously manufactured and/or sold.

### NO OTHER WARRANTY GIVEN

The obligations set forth in the preceding paragraph are PCM's sole obligation and owner's exclusive remedy. PCM makes no other express warranty to the extent that any additional warranty may be implied by law, the term of such implied warranty shall be limited to the warranty term stated herein, from the date of delivery of the PCM product to the parties outlined herein.

No distributor, dealer, agent or employee of PCM is authorized to grant any other or further warranty or incur any additional warranty obligation on PCM's behalf, in connection with the sale of its products. Any qualification or restriction contained herein which is prohibited by any law of mandatory application shall be deemed to be deleted herefrom, however, such deletion shall have no effect on the remaining provisions hereof, all of which shall remain in full force and effect.

### REMEDIES

The obligations of PCM set forth in the first paragraph of this Warranty shall be the exclusive remedy for any breach of Warranty hereunder, and any owner or user's sole remedy in the event of breach of the warranties which are made by PCM is repair or replacement of the product or any warranted part thereof as set forth herein: **with this sole exception, PCM shall not be liable for any direct, or indirect, incidental or consequential damages**, including without limitation, any damages for property damage, loss of use or loss of profits, loss of income, inconvenience, trailering, towing, haul out, launch and/or any other in and out of water expenses, storage charges, dockage charges, expenses to deliver or pick up the product being warranted to and from the dealer, telephone expenses, lodging expenses, travel expenses, mechanic travel time and mileage, damage caused by any occurrence of an insurable nature, rental of substitute equipment of any type, removal and replacement and/or modification of any boat parts to facilitate repairs, moving of furniture, carpets, cleaning, painting, carpenter work, or re-delivery charges.

Some States do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.

Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

**Any owner or user hereby waives for himself/herself/itself and his/her/its successor and assigns (a) any and all claims for punitive damages, and (b) all claims of negligence or strict liability or both. In no event will PCM's liability exceed the purchase price of the goods which is actually paid to PCM.**

### WARRANTY COVERAGE, TERM

This Warranty is extended only to the first registered owner or registered user, and all subsequent user who, in accordance with PCM's warranty transfer policy, transfers any remaining portion of this warranty coverage within 30 days of any subsequent sale/purchases, for the period specified below:

All components, other than and those itemized below, are warranted for a period of one (1) year from the date of delivery to the first registered owner or registered user, and all subsequent user who, in accordance with PCM's warranty transfer policy, transfers any remaining portion of this warranty coverage within 30 days of any subsequent sale/purchases in non-commercial use. In case of commercial use, the term of this Warranty shall be the shorter of (a) a period of six (6) months from the date of delivery to the first registered owner or registered user or (b) the expiration of 200 hours of use.

Items not covered under this warranty;

(A) Water pump impellers are not covered by this Warranty.

(B) Seals, gaskets, O-rings, and other material affected by time are not covered by this Warranty if their effectiveness is reduced by an extended storage period prior to sale or use.

### OBTAINING PERFORMANCE UNDER WARRANTY

PCM's warranty registration form should be prepared by your selling dealer, executed by you and the dealer and mailed, by you, to PCM within 30 days after the date of purchase. Upon receipt of the warranty registration form, PCM will issue to you a personalized owner's registration card which will be mailed directly to you. If the owner's registration card is not received within eight (8) weeks after the date of purchase, please write PCM at the address below.

At the time that a claim for warranty service is made, the owner's registration card should be presented to the person or entity providing warranty service. Authorized PCM dealers or distributors are entitled to be reimbursed by PCM for some or all of the expense of warranty repairs, thus, service under the terms of this Warranty will be performed by an authorized PCM dealer or distributor without charge for established flat rate labor or replacement parts, other than items not covered by the Warranty, such as, but not limited to, lubricants, spark plugs, points, and other items which are normally frequently replaced as part of routine maintenance. Charges for additional non-warranty work and/or additional dealer charges for labor relative to warranty work in excess of flat rate must be paid for by the owner.

Prior authorization in writing must be obtained from PCM for any warranty repairs over \$50.00 and in all cases where the owner fails to establish the purchase and warranty expiration dates with the owner's registration card sent upon receipt of the warranty registration form by PCM. While failure to present the owner's registration card will not prevent you from obtaining coverage hereunder, this Warranty shall not be effective and, therefore, cannot be honored until the product purchase date can be confirmed by PCM. If the card is lost, communicate with PCM at the address listed below, and, for a processing fee of \$10.00, a new owner's registration card will be issued to you.

Any questions concerning service, parts or this Warranty should be directed to your selling dealer. If your dealer is unable to assist or if you relocate or are travelling or need a referral to your nearest dealer contact: Pleasurecraft, P.O. Drawer 369, Little Mountain, SC 29075

### FAILURES EXCLUDED FROM WARRANTY

This Warranty will not apply to any failure which results from accidents, sinking, fire, neglect, abuse, or abnormal service or use, such as racing, towing or operation in water of insufficient depth, or to any failure resulting from improper installation, improper adjustments, repairs or improper delivery service, or to any failure resulting from the use of parts, fuels, oils or lubricants not suitable for use with the product and/or materials or parts not approved by PCM. This Warranty does not apply to any engine or drive which has been modified, or altered, or repaired in such a manner as, in the opinion of PCM, to affect its stability, reliability or performance. Further, this Warranty will not apply to failure resulting from use of non-recommended lubricants or fuels, failure to follow maintenance or lubrication schedules, failure caused or contributed to by contaminated fuel, failure caused by improper installation or misapplication of the engine or drive, failure resulting from the owner's or operator's failure to exercise due or normal care and precaution, or failure of components and/or assemblies that are warranted by PCM suppliers.

### OWNER'S RESPONSIBILITY

Performance under this Warranty shall be conditioned upon the first registered owner's or registered users's compliance with the following requirements:

- 1 Owner or user shall verify that the pre-delivery service has been performed, all requested information recorded and that the selling dealer has signed the warranty registration.
- 2 Owner or user shall promptly mail the warranty registration to PCM after accepting delivery.
- 3 Owner or user shall follow the instruction in the owner's manual regarding operation, break-in, lubrication, and fuel.
- 4 Owner or user shall follow or comply with the maintenance schedule, operation limits, and lay up instruction, as outlined in the owner's manual.

### CHOICE OF LAW

This Limited Warranty shall be governed by, and construed and interpreted in accordance with, the laws of the State of Ohio, except only to the extent replaced or precluded by other law of mandatory application.

### SPECIAL STATE LEGAL REQUIREMENTS

This Warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

The PCM California Emissions Warranty and California Emissions Control Warranty Statement is a separate document included in this Manual. Any questions concerning the Emissions Warranty can be obtained by calling 1-803-345-0050.

# SERVICE AND WARRANTY - 1

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## ITEMS NOT COVERED UNDER LIMITED WARRANTY

This Limited Warranty is limited to defects in material and workmanship. To avoid misunderstandings regarding warranty coverage, the following describes some, but not all, of the more common types of service that are not covered by this Limited Warranty.

- Normal service requirements arising during the warranty period, such as fuel system or ignition adjustments, tune-ups, filter, adjusting controls or lubrications.
- Damage caused by neglect, lack of maintenance, abnormal operation accident or improper installation or service.
- Normal wear of the piston rings, cylinders, water pump and other engine parts.
- Haul out, launching, towing charges, dockage or storage fees, removal and/or replacement of boat partitions or material, because of boat design, for necessary access to the product.
- All related transportation charges and/or travel time.
- The cost of shipping replacement parts by air freight or other premium freight methods.
- Additional service work requested by the customer or performed by the dealer other than that necessary to satisfy the warranty obligation.
- Labor performed by other than an authorized dealer may be covered only under the following circumstances: when performed on an emergency basis (providing there are no authorized dealers in the area who can perform the work required, and prior factory approval has been given to have the work performed at this facility).
- Damage from participating in, or preparing for, racing or other competitive activity.
- Water entering the engine cylinders or oiling system through the intake manifold system, exhaust system, submersion, or in any manner if not caused by a Crusader manufacturing defect.
- Water in starters.
- Improper winterizing resulting in freezing and breaking of the engine block, cylinder heads, exhaust manifolds, heat exchanger or other damage.
- Repairs made necessary by normal wear, rust, electrolysis or corrosion, or by the use of the parts or accessories which are either incompatible with the Crusader product or adversely affect its operation, performance or durability.
- Valve or valve seat grinding required because of wear.
- Failure or damage due to lack of cooling water caused by starting the Product out of the water or by foreign material blocking the water inlets.
- Cleaning of the engine fuel system due to water or dirt contamination of the boat fuel system.
- Use of fuel and lubricants which are not suitable for use with or on the Product. Refer to the Operation and Maintenance Manual.
- Damage to the engine and/or transmission caused by striking a submerged object. (This is considered a marine hazard).

10. This Limited Warranty shall be governed by, and construed and interpreted in accordance with, the laws of the State of Ohio, without application of its conflicts of laws principles, except only to the extent replaced or precluded by other law of mandatory application.

## 11. SPECIAL STATE LEGAL REQUIREMENTS

This Warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

The Crusader California Model Years 2003-2008 Emissions Warranty and California Emission Control Warranty Statement is a separate document included in this Manual. Any questions concerning the Emissions Warranty can be obtained by calling 1-803-345-0050.

## THINGS YOU SHOULD KNOW ABOUT THE WARRANTY

### Warranty Repair Component Exchanges

In the interest of customer satisfaction, Crusader Marine Engines may offer an exchange service on some engine components. This service is intended to reduce the amount of time that your boat is not available for use, due to repairs. Components used for the exchange service may be new, remanufactured, reconditioned or repaired, depending upon the component involved. All exchange components used meet Crusader standards and are warranted the same as new components.

### Production Changes

Crusader Marine Engines and its Distributors reserve the right to make changes in the engines built and/or sold by it at any time without incurring any obligation to make the same or similar changes on engines previously built and/or sold.

### Proof of Date of Purchase

Crusader will accept the return of a properly filled out "Warranty Registration Card", supplied with each engine, as proof of purchase. Failure of purchaser to return such card will require the owner to provide a copy of the original "Bill of Sale" (sales contract) for the Product to be serviced. Warranty claims will not be accepted until adequate "Proof of Purchase" is presented by the purchaser, and the date of purchase is substantiated.

### Access to Product

Reasonable access must be provided to the Product for warranty service. The warranty does not cover the removal and/or replacement of boat partitions and/or other components which must be removed for necessary access to the Product.

## This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal grey lines across its entire width, providing a guide for handwriting or typing. The paper itself is a clean, off-white color. There are no margins, text, or other markings present on the page.

## This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.

# BOATING RESPONSIBILITIES - 2

## CARBON MONOXIDE HAZARD



### 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.

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](http://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](http://www.uscgboating.org)  
202-267-0984

### American Boat & Yacht Council, Inc.

3069 Solomon's Island Road  
Edgewater, MD 21037-1416  
[www.abyc.com](http://www.abyc.com)  
410-956-1050

## SAFE BOATING SUGGESTIONS

The nation's waterways are becoming increasingly crowded and, in order to enjoy them safely, the operator should acquaint himself/herself with safe boating practices. Boating safely and seamanship courses are offered by the following national and state organizations:

- Power Squadrons
- Coast Guard Auxiliary
- Red Cross
- State, provincial or local agencies in charge of water safety enforcement

Crusader Engines highly recommends that all power boat operators attend one of these courses. To help locate a course being offered near you, contact Boat U.S. Foundation's toll-free national boating safety hotline, 1-800-336-BOAT, and in Virginia, 1-800-245-BOAT.

## WATER WISDOM

The following are suggestions for safe operation of your boat to ensure the safety of yourself and your passengers:

- Know your boat's loading and operating limitations. **DO NOT OVERLOAD!**
- Make periodic checks of safety equipment onboard.
- Do not consume alcoholic beverages or take illegal drugs when operating a boat. Some state laws apply to boats as well as motor vehicles.
- File a "float plan." Let someone know your destination and your expected time of return.
- Monitor the weather. Know the signs of weather change and avoid severe weather and rough seas whenever possible.
- Follow the "Rules of the Road" when boating. Always be on the alert and watch out for "the other guy."
- Plan and chart your course. Be aware of, and avoid, hazardous areas.
- Be sure your boat is equipped with the required safety equipment. Check with the Coast Guard and local government agencies as to the regulations and restrictions in your area. Contact your local Coast Guard Auxiliary and take advantage of their seasonal boat inspections.

The following is a list of suggested safety equipment and spare parts which may be useful in case of an emergency:

- Approved personal flotation devices (life jackets); one for each person on board.
- Approved throwable personal flotation device for man-overboard protection.
- Approved fire extinguishers.
- Signal devices: flares, spotlight, signal flag and horn or whistle.
- Crusader Engines' "Onboard Kit," plus spare fuses, bulbs, batteries, etc. Tools necessary for minor repairs.
- Spare propeller.
- Anchor and anchor line.
- First aid kit and first aid book.
- Ship-to-shore radio, compass and chart of the area in which you are traveling.
- Manual bilge pump and spare drain plugs.
- Waterproof storage containers.

## OPERATION AND MAINTENANCE

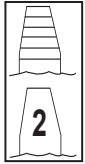
It is the owner's/operator's responsibility to perform all safety checks before operating his/her boat. All lubrication and maintenance schedules must be adhered to assure optimum performance and dependability from your Crusader engine. When service and maintenance are required, return to your authorized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

# BOATING RESPONSIBILITIES - 2

## RULES OF THE ROAD

### Channel Buoy Guide

The color of the paint is the only characteristic which has the same meaning on all buoys. Red buoys always indicate the starboard side of the channel from seaward. (Red Right Returning)



1. **Nun Buoy:** This buoy indicates the starboard side of the channel when returning from sea. It is conical shape, the color red and indicates even numbers. A nun buoy with red and green horizontal bands (top band red), and not numbered, indicates an obstruction. The principal channel is to the left of the buoy when returning from sea.



2. **Can Buoy:** This buoy indicates the port side of the channel when returning from sea. It is cylindrical shape, the color green and indicates odd numbers. A can buoy with green and red horizontal bands (top band green), and not numbered, indicates an obstruction. The principal channel is to the right of the buoy when returning from sea.



3. **Lighted Buoy (RED):** This buoy has a flashing red light. It indicates the starboard side of the channel when returning from sea.



4. **Lighted Buoy (GREEN):** This buoy has a quick flashing green light. It indicates the port side of the channel when returning from sea. The quick flashing light indicates special caution required.

|                                      |                           |                            |                                   |
|--------------------------------------|---------------------------|----------------------------|-----------------------------------|
|                                      |                           |                            |                                   |
| Small Craft<br>Winds up to<br>38 MPH | Gale Winds<br>38 - 54 MPH | Storm Winds<br>over 55 MPH | Hurricane<br>Winds over<br>63 MPH |
|                                      |                           |                            |                                   |

### Storm Warning Signals - Pennants (by day) Lights (by night)

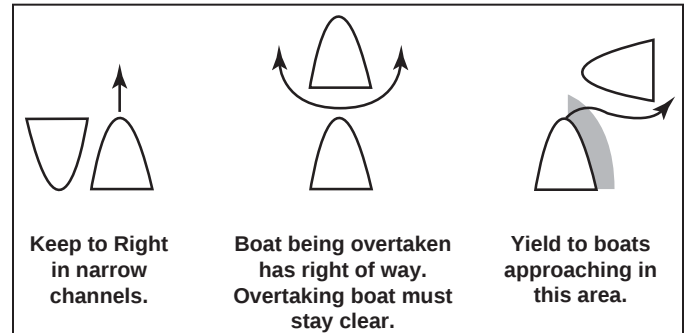
### Boat Capacity

- Load only to manufacturer's specifications.
- Distribute load evenly; keep it low.
- Passengers should only ride on the parts of the boat that are designed for that purpose.
- If water is rough, carry fewer passengers.

### Observe the Rules of the Road

PORT (Left) - Leaving the harbor with green buoys to your right.

STARBOARD (Right) - Entering the harbor with red buoys to your right.



### Know Your Horn Signals

- 1 Short Blast = Passing you on my port side.
- 2 Short Blasts = Passing you on my starboard side.
- 3 Short Blasts = I am going astern.
- 5 Short Blasts = Danger.

**Always refer to the latest U.S. Coast Guard Navigation Rules CG-169**

### Keep An Alert Lookout For:

Bad weather, Swimmers, Other boats, Water skiers, Fisherman, Divers and/or any other obstructions.

**Keep Your Wake Under Control**, particularly upon entering or leaving harbor areas. You are responsible for wake damage to other vessels and/or property.

### Do Not Fool With Fuel

**1/2 pint of gasoline = 15 sticks of dynamite**

1. During fueling, moor boat properly; remove all passengers.
2. Keep all doors, hatches and ports closed.
3. Shut down all electronic gear; extinguish galley fires, pilot lights and smoking materials.
4. Do not overload tanks.
5. Keep filling nozzles in contact with the fill pipe to prevent sparks.
6. Secure the fill cap tightly; wipe away any spillage.
7. Ventilate all components for a minimum of five minutes before starting engines.
8. Keep fuel lines and bilges clean.

ENGINE IDENTIFICATION

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

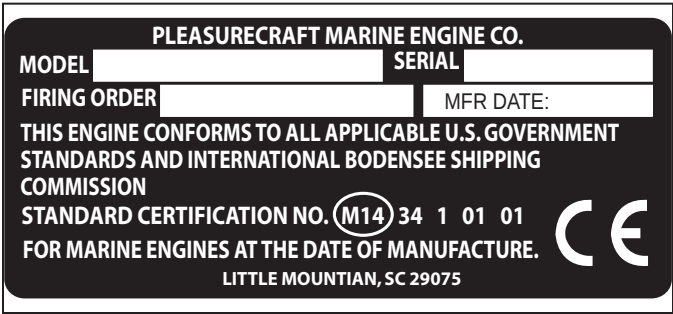


Figure 3-1 Engine Identification Decal

OWNER IDENTIFICATION AND REGISTRATION INFORMATION

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

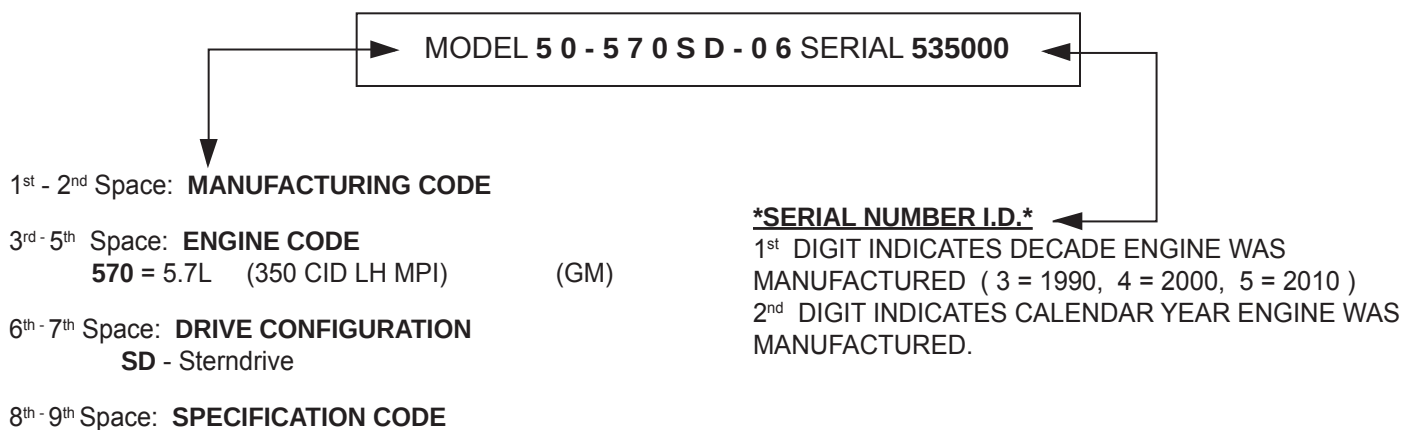
|                      | SINGLE (PORT) | STARBOARD |
|----------------------|---------------|-----------|
| Engine Model Number: |               |           |
| Serial Number(s):    |               |           |
| Boat Make:           |               |           |
| Boat Model:          |               |           |
| Hull Serial Number:  |               |           |
| Propeller Size:      |               |           |

## ENGINE IDENTIFICATION - 3

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### Crusader

## ENGINE MODEL IDENTIFICATION / ADVISORY



## ELECTRONIC FUEL INJECTION SYSTEM

The Crusader Engines covered in this manual are equipped with an Electronic Fuel Injection (EFI) system, which allows precise control of fuel and spark delivery. The fuel system components of the EFI system are:

- The electric fuel pumps
- The throttle body assembly
- The fuel injectors

The fuel injection system is controlled by an Electronic Control Module (ECM). The ECM is the decision center of the system. The ECM constantly monitors information from various sensors on the engine, and electronically processes the information, in order to control ignition timing and fuel delivery for optimum performance and fuel economy. The ECM incorporates an engine overspeed protection, calibrated to a specific RPM, to prevent engine damage from over-revving.

The sensors that the ECM monitors are:

- Engine Coolant Temperature (ECT) Sensor
- Throttle Position (TP) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Knock Sensor (KS) System
- Crankshaft Positioning (CKP) Sensor
- Camshaft Positioning (CMP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Control Position (TCP) Sensor

If, for any reason, one or more of these sensors or associated wiring malfunctions, the ECM's built-in self-diagnostic system sets a trouble code and turns 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. (See Engine Alarm System - page 16)

In any case, the operator must obtain service by an authorized Crusader Premier dealer to determine the exact cause of the malfunction.

# OPERATING INSTRUCTIONS - 5

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## ENGINE ALARM SYSTEM

The Crusader engine electronic system is programmed to control the engine alarm system. This system utilizes an indicator lamp ("MIL" or "Check Engine") and/or an optional audible alarm to warn the operator of possible engine problems.

The alarm circuit has a "self" checking feature programmed into the system. This feature will momentarily light the "MIL", and if equipped, sound the alarm for two short pulses upon initial start-up of the engine.

If the "MIL" lights and/or the alarm sounds during operation, observe the instrument panel readings for the possible source of the malfunction, such as low oil pressure or excessive engine temperature readings.

Other conditions that may sound the warning buzzer are a low drive lube warning (if equipped) and for an electronic throttle malfunction.

**IMPORTANT:** A failure involving the Electronic Throttle may result in *idle only* operation of the engine. The operator must obtain service by an authorized Crusader Premier dealer to determine the exact cause of this malfunction as soon as possible.

In most cases, when the "MIL" or "CGL" lights are on, the engine may lose some performance and/or efficiency, but remain running adequately. Also, the lights 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 an authorized Crusader Premier dealer to determine the exact cause of the malfunction.

**NOTICE:** Some boat builders may install their own alarm system. It is recommended that the boat owner check with his or her boat dealer for an explanation of the particular alarm system upon initial delivery.

## INSTRUMENTATION

Boat manufacturers install many different types of instrumentation on boats. Become familiar with the instrumentation on your boat and be aware of abnormal operating conditions. The following is a brief explanation of typical instrumentation found on most boats:

1. Tachometer - indicates the engine RPM (revolutions per minute)
2. Water Temperature Gauge - indicates the engine coolant temperature
3. Oil Pressure Gauge - indicates the engine oil pressure
4. Voltmeter - indicates the battery voltage and charging system voltage
5. Hour Meter - indicates the engine operating time
6. Fuel Level Gauge - indicates the fuel tank level
7. Malfunction Indicator Lamp (MIL) or Check Engine Lamp - indicates a problem with the engine control system

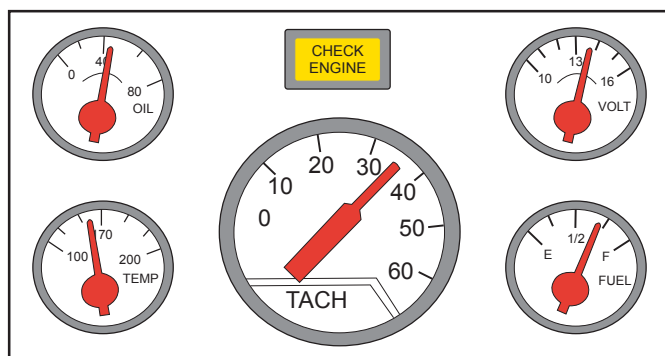
## ELECTRONIC SPEED CONTROL (IF EQUIPPED)

This engine is equipped with a Digital Throttle Control (DTC) system. The system uses a throttle cable connected between the throttle handle and a Throttle Control Positioning (TCP) sensor located on the engine. The Throttle Control Positioning sensor provides throttle position information to the engine management system which, in turn, electronically controls engine throttle movement.

This engine also has the option for an electronic speed control system for cruise control. When the boat is operated in a speed control mode, the operator **may not** have full control of the throttle until the speed control system is deactivated.

**Example:** If the speed control system is engaged at 3500 RPM, the throttle handle may be "dead" when trying to accelerate above 3500 RPM. The speed control system would need to be disengaged, then the operator will gain full control of the boat speed.

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



**Figure 5-1** Typical Instrument Panel

## STARTING ENGINE (FUEL INJECTED ENGINES)



### 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.

**IMPORTANT:** The following items should be checked before starting the engine, and each time the boat is operated:

- Fuel system for any signs of leakage
- Operation of remote controls and steering
- Engine and transmission oil levels
- Fuel tank levels
- Exhaust system for leaks and tightness of the clamps
- Battery connections and water level in battery cells
- Accessory drive belt(s)
- Cooling system for leaks. Check for signs of water leaks at the exhaust manifolds, risers and elbows. If the water is leaking externally, it is possible that the water is also leaking internally. This could result in internal engine damage. It is very important to service these maintenance items as soon as a problem is indicated. After performing the initial safety checks, proceed as follows to start the engine:

1. Turn the battery switch ON (if equipped).

2. Open the fuel valve.
3. Open the seacock.
4. Place the remote control in Neutral position. The transmission is equipped with a neutral safety switch, which will not allow the starter motor to operate unless the transmission is in neutral.
5. Do not pump or open the throttle when starting the engine (Figure 5-2). The ECM will automatically regulate the fuel and control desired idle speed.



### 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.***

6. Turn the ignition key to the start position. When the engine starts, release the key.

**NOTICE:** 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.

7. **In the event the engine becomes flooded,** ensure the Neutral Lockout is engaged and move the throttle lever to a 100% open position (Figure 5-2). At this throttle position, the ECM will command the injectors to deliver no fuel during engine cranking. When the engine starts, return the throttle lever back to the idle position.

**NOTICE:** Single lever throttle/shift handles use different mechanisms to achieve Neutral Lockout or throttle only operation. Some require you to push in on a button while moving the handle forward, others require the button to be pulled out. Refer to your boat owners manual for complete instructions on throttle/shift lever operation.

**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.

# OPERATING INSTRUCTIONS - 5

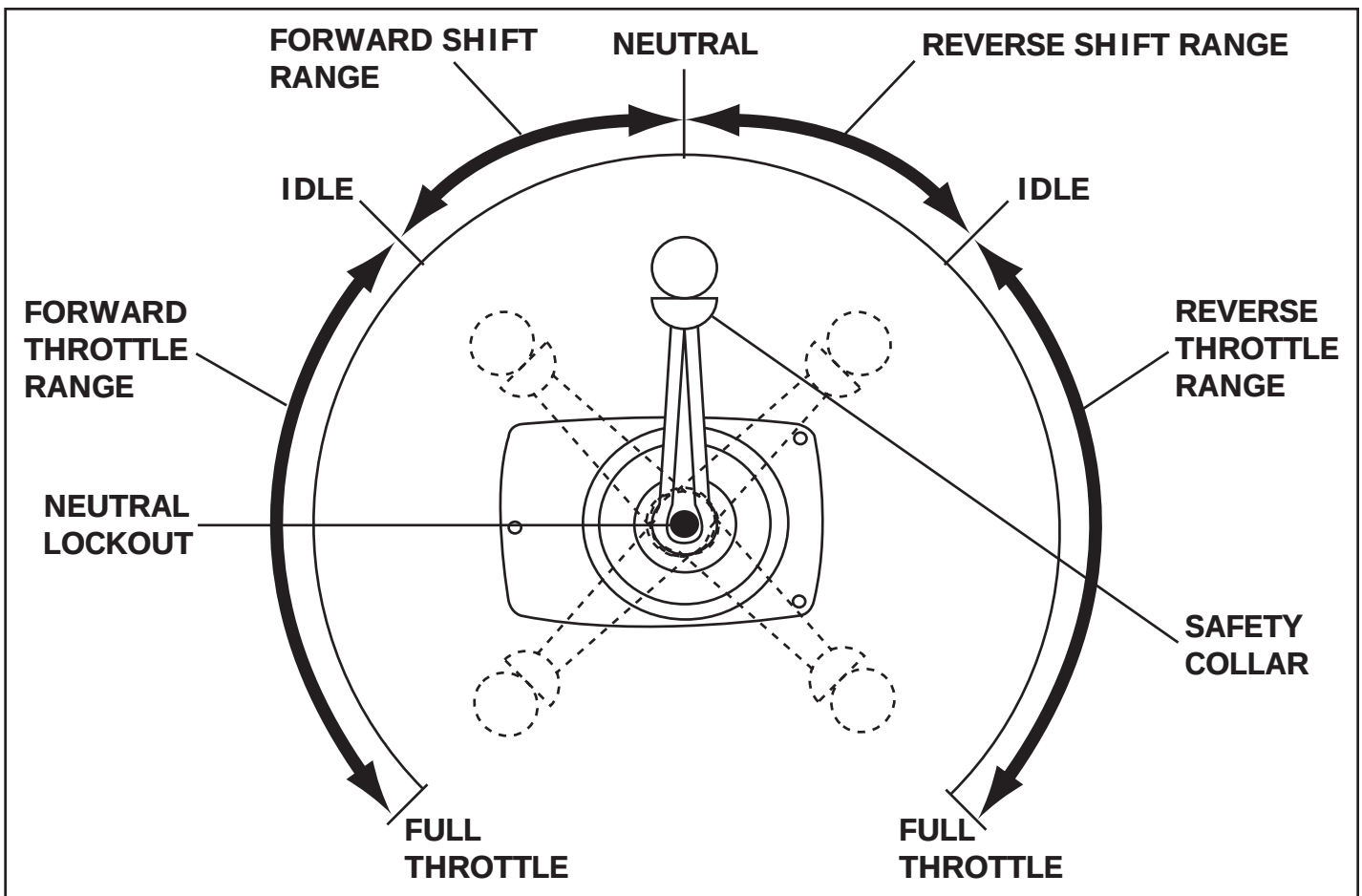


Figure 5-2 Typical Throttle / Shift Position Settings

**NOTICE:** If engine still fails to start, contact your Crusader Engines Dealer for service.

8. 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.
9. Check voltmeter for proper charging system operation.
10. Check the engine and transmission for fuel, oil, water and exhaust leaks.
11. 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.

## SHIFTING 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.

## STOPPING ENGINE

When returning to the dock, or whenever stopping the engine, bring the throttle back to the idle position and the transmission to Neutral. After the engine reaches idle speed, turn the ignition key to the OFF position.

Before stopping the engine after extended high speed operation, allow the engine to idle at 1200 RPM for 3 to 5 minutes to allow the engine to cool down before shutting off the ignition.

After stopping the engine, complete the following:

1. Turn the battery switch OFF, if equipped.
2. Close the fuel valve.
3. Close the seacock.
4. Flush the cooling system if in a salt water area.

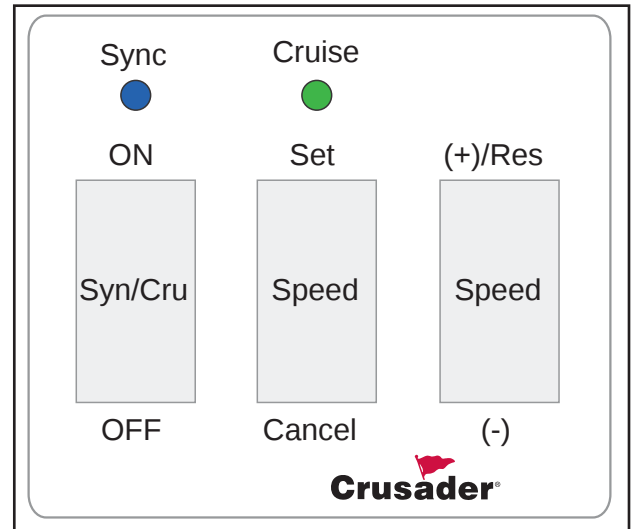
## FREEZING TEMPERATURE OPERATION

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.

## ELECTRONIC TWIN-ENGINE SYNCHRONIZATION and CRUISE (OPTIONAL)



**Figure 5-3** Sync/Cruise Control Panel (Typical)

Synchronization (Twin Engine Applications ONLY) allows single throttle handle operation of both engines. When you are in Sync Mode, both engines maintain the same RPM. The 'Master' engine is controlled by the Master throttle handle and the 'Slave' engine is electronically controlled to the same RPM as the Master engine.

Cruise Mode (Single and Twin Engine Applications) allows electronic control of the engine(s) at an operator selected engine speed. When you are in Cruise Mode, the engine(s) are electronically controlled to maintain the desired RPM regardless of sea conditions or maneuvers.

**IMPORTANT:** *The electronic Synchronization/Cruise system for twin engine applications requires one engine to be designated as a 'Master', and the other engine designated as a 'Slave'. The Master/Slave relationship is determined by a twin engine harness connected between the two main engine harnesses during engine installation; therefore if the installer does not identify which engine is the Master, the Master must be determined using the following procedure.*

## DETERMINING THE MASTER/SLAVE ENGINE POSITIONS

For first time operation of the Sync/Cruise Mode, you may need to determine which engine is the 'Master' engine and which is the 'Slave' engine. Perform the following procedure in neutral gear, while secure in your boat slip.

1. Ensure the **Syn/Cru** Mode switch is in the OFF position.
2. Perform the engine starting procedure for both engines. Refer to the Starting the Engine procedure in this section of the manual.

# OPERATING INSTRUCTIONS - 5

With both engines running, in neutral, and with both throttle handles pulled back to the Idle/Start position:

3. Press the **Syn/Cru** Mode switch to the ON position. The Sync Lamp should be blinking, or steady ON, at this point.
4. With the Sync Lamp blinking or steady ON, start with the Port engine, and **SLOWLY** push each throttle forward, one at a time, and note which throttle increases engine RPM's.
- 5.. Place the throttle that **DOES NOT INCREASE RPM'S** in the wide-open-throttle position.
6. Move the throttle handle that **does increase** RPM's forward *slowly* and observe that both engines increase in RPM's. This engine is the Master engine.

**Return the throttle handles to their Idle/Start positions, then place the Syn/Cru Mode Switch to the OFF position.**

## CRUSADER SYNCHRONIZATION / CRUISE PANEL FUNCTIONS

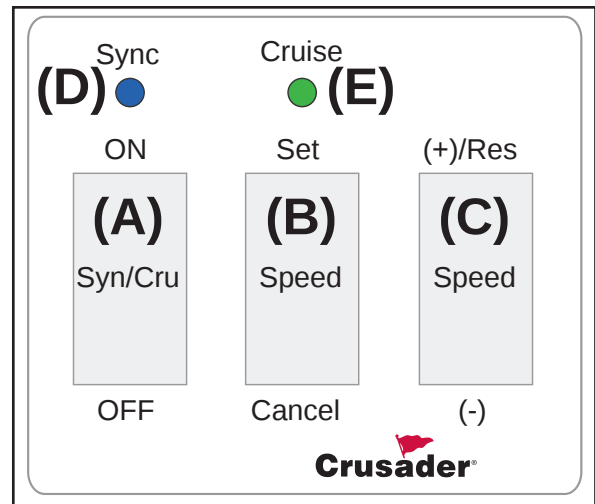
**(A) Syn/Cru Mode Switch** - Switch (A) is a two position switch, which turns the engine synchronization and cruise functions ON or OFF. The cruise functions will not operate until the Syn/Cru Mode Switch (A) is pushed to the ON position even for single engine applications.

**NOTE:** Sync and Cruise functions that have been enabled, when Switch (A) is pushed to the OFF position, will remain in control of the engines until **both** throttle handles are pulled back below the previous set point.

**(B) Speed Set/Cancel Switch** - Switch (B) is a Momentary ON - OFF - Momentary ON, three position switch, which controls the Cruise function. When you have reached the desired cruise speed, press Switch (B) to the **Set** position and move the Master throttle handle to the wide open throttle position. The engine ECM stores the Set value in memory and controls both engines to the Set RPM. Pressing Switch (B) to the **Cancel** position and moving the Master throttle handle below the Set point will disengage Cruise mode, engine Synchronization is not affected.

**NOTE:** If a cruise speed has been set and Switch (A) is pushed to the OFF position, or Cruise Mode is Cancelled by Switch (B), the Set speed will remain in the ECM memory. The stored Set speed may be resumed when the engines are brought back into Sync/Cruise Mode, even if the engines' ignitions have been turned off.

**(C) Speed (+)/Res / (-) Switch** - Switch (C) is the same type of switch as switch (B), it is used to modify or resume the Cruise mode Set speed. If Cruise Mode has been Cancelled and the previous Set speed is still desired, momentarily pressing Switch (C) to



**Figure 5-4** Sync/Cruise Control Panel (Typical)

the **(+)/Res** position then move the Master throttle handle past the previous set point this will Resume Cruise Mode at the previous Set speed. While in Cruise Mode, momentarily pressing Switch (C) to the **(+)/Res** position will increase the engine Set speed 20 RPM each time it is pressed. Pressing Switch (C) to the **(-)** position will decrease the engine Set speed 20 RPM each time it is depressed. Pressing and holding Switch (C), a minimum of 3 seconds, will slowly ramp engine speed up or down.

- (D) Sync Lamp** - Indicates the status of the Sync/ Cruise system. **OFF** - indicates the Sync/Cruise system is off; Switch (A) is in the OFF position. **ON** - indicates the Sync/Cruise system is enabled and in Synchronization Mode; Switch (A) is in the ON position and the Master throttle has control over both engines. **Flashing** - indicates that the Sync/ Cruise system is enabled but is unable to achieve synchronization because the Slave throttle is below the Master throttle position.
- (E) Cruise Lamp** - Indicate the status of Cruise Mode. **OFF** - indicates that a cruise speed has not been set or Cruise Mode has been Cancelled. **ON** - indicates that Cruise Mode has been engaged and the desired cruise speed has been achieved. **Flashing** - indicates that Cruise Mode is engaged but the cruise Set speed has not been met. The previous set speed may be Resumed and/or the Master throttle position is below the previous Set speed.

## NORMAL OPERATION

Prior to and/or after turning OFF the Crusader Sync/ Cruise system, the operator has total, independent control of the engines. The engines may be operated independent of each other as required by the location and circumstances of the operators' surroundings.

The use of Normal Operation is recommended when leaving the dock, operation in close maneuvering situations and when performing docking maneuvers.

## ENTERING SYNC MODE

Enter Sync Mode at idle, in Neutral gear. Once you have entered Sync Mode, you must have the Master handle in the Idle/Start position whenever you are shifting the transmissions into or out of gear. Remember that Sync Mode enables both engines to be operated by a single throttle handle, the Master.

1. Position both throttles to their Idle/Start position. Perform the engine starting procedure for both engines. Refer to the Starting the Engine procedure in this section of the manual.
2. Press the **Syn/Cru** Mode switch (A) to the **ON** position.
3. Press the **Speed Set/Cancel** switch (B) to the **Cancel** position.
4. With the **Sync** Lamp flashing or steady ON, slowly push the Slave engine throttle handle to the full forward position.
5. The operator now has control of both engine speeds by using the Master throttle handle, only.

**NOTE:** If the Slave throttle position is below the Master throttle position the Sync Lamp will be flashing. When the Slave handle is moved equal to or above the Master, the Sync Lamp will remain steady ON. The Master engine only has throttle authority up to the position of the Slave handle. For example, Sync is engaged at 1000 RPM, the Slave handle is then placed at the half throttle position. As the Master throttle position is increased, both engines will run at the same RPM up to the Slave handle position. If the Master handle is pushed beyond the Slave position, the Master engine will continue to increase in engine speed, but the Slave engine will remain at the engine speed allowed at the half throttle position. The Sync Lamp will begin flashing indicating that Sync Mode is requested, but the Slave engine cannot be synced with the Master. Sync Mode can be resumed by placing the Slave handle in a position equal to or beyond the Master handle. The Sync Lamp will be ON when you are synced.

## ENTERING CRUISE MODE

**NOTE:** You must be in Sync Mode prior to entering Cruise Mode, even with single engine applications.

1. Move the Master throttle to the desired engine speed.
2. Press the **Speed Set/Cancel** switch (B) to the **Set** position. Slowly, push the Master handle to the full forward position.
3. The **Cruise** Lamp (E) should be steady ON indicating that Cruise Mode is engaged.

**NOTE:** The operator may reduce the speed of the engines, at any time, by reducing the Master throttle handle position below the cruise speed set point. The

**Cruise** Lamp (E) will begin flashing. Returning the Master throttle handle to any point above the cruise speed set point will resume the previous set speed. The **Cruise** Lamp will be ON.

**NOTE:** The Master and Slave throttle handles should both be in the full forward positions. This allows the electronic engine control sufficient range to adjust and maintain the engines at the desired set speed.

## ADJUSTING THE CRUISE SET SPEED

1. Press the **Speed (+)/Res / (-)** switch (C) to the **(+)/Res** position will increase engine speed 20 RPM per switch cycle.
2. Press the **Speed (+)/Res / (-)** switch (C) to the **(-)** position will decrease engine speed 20 RPM per switch cycle.
3. Press and hold the **Speed (+)/Res / (-)** switch (C) for 3 seconds or longer will cause the speed to slowly ramp up **(+)/Res** or down **(-)**. Release the switch when the desired engine speed is achieved, this will be the new set speed.

## CANCELLING THE CRUISE SET-POINT

1. Press the Speed Cancel switch.
2. Pull the Master throttle handle back below the set point.
3. The Cruise Lamp will go OFF indicating that the operator has full synchronized throttle control over the engines.

**IMPORTANT:** *ONLY the Cruise speed set-point has been cancelled. The engines remain in Sync Mode with the Master throttle handle in control of both engine speeds. At this point, a new set speed can be selected or you may use the Resume Mode to go back to the previous set speed.*

## RESUME MODE

1. After cancelling Cruise, the previous set speed may be resumed by pressing the **Speed (+)/Res / (-)** switch (C), to the **(+)/Res** position.
1. Push the Master throttle handle forward above the previous Cruise set-point.

## EXITING SYNC/CRUISE MODES

1. Press the **Syn/Cru** Mode switch (A) to OFF.
2. The **Sync** (D) and **Cruise** (E) Lamps will go OFF.
3. Return both throttle handles back to the Idle/Start position.
4. The operator has full individual throttle control over the engines.

**IMPORTANT:** Sync/Cruise mode will remain engaged until both the Master and Slave throttles are returned below the sync/cruise set point.

# CONDITIONS AFFECTING OPERATION - 6

## TRIM AND WEIGHT DISTRIBUTION

Trimming of the boat and 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.
- Trimming the bow down or shifting 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 antifouling paint to prevent the build-up of marine growth. Contact your dealer for advice on these requirements in your area.

## 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. See ENGINE SPECIFICATIONS for rated full throttle RPM for your model engine.

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.).

If full throttle RPM is above or below the recommended range as stated in ENGINE SPECIFICATIONS, 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.

### ENGINE RPM CHART

| Model   | Minimum Full Load | Preferred | Maximum |
|---------|-------------------|-----------|---------|
| MP 5.7L | 4800              | 5000      | 5200    |



### CAUTION

Prolonged WOT operation will shorten the life of your engine and could cause premature engine failure. See NORMAL CRUISING SPEEDS in SPECIFICATIONS. Problems caused by prolonged WOT operation are considered abuse and are not covered under the Crusader Warranty.

**IMPORTANT NOTICE:** *Your new Crusader engine incorporates an RPM "MAX GOVERNOR" in order to prevent the engine from over-revving. Operation above the Maximum RPM listed, in the chart above, is not recommended.*

## ENGINE BREAK-IN PERIOD - 7



### 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 watched 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.

At the end of your 25-hour break-in period, contact your dealer and have the recommended 25-hour inspection done.

**NOTICE:** Crusader Engines assumes no responsibility for the costs related to the 25-hour inspection. This is the owner's responsibility.

## 25-HOUR ENGINE INSPECTION - 8

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After the first 25 hours of operation, it is recommended that the engine be given an inspection. Your boat dealer or a Crusader Premier servicing 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.
- Replace the primary fuel filter
- 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.
- 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.
- Engine Assembly - Check for loose, missing or damaged parts. Pay close attention to engine mounts, starter and alternator mounting fasteners.

**NOTICE:** Crusader Engines assumes no responsibility for the costs related to the 25-hour inspection. This is the owner's responsibility.

## GASOLINE REQUIREMENTS



### CAUTION

**Fire and Explosion Hazard** - Gasoline 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 Crusader Marine Engines warranty.

The ignition timing set by the factory requires the use of a high-quality lead-free regular gasoline with the following minimum octane specification.

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

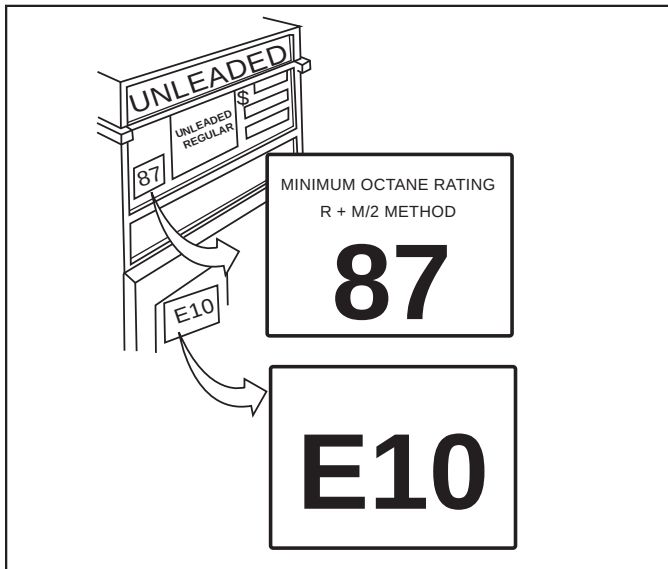


Figure 9-1 Fuel Requirements

**NOTICE:** Crusader Fuel Injected engines are calibrated to operate on and provide optimum performance when using fuel with at least an 87 octane fuel rating. Crusader's engine control module incorporates Adaptive Learn Technology to ensure optimum engine performance is obtained when using fuel rated higher than 87 octane.

If a slight pinging is heard during acceleration and the proper octane fuel is being used, it is considered normal. If a constant, heavy knock occurs, the engine should be evaluated by a Crusader Marine Engines Premier service technician.

## GASOLINE CONTAINING ALCOHOL

The implementation of ethanol-based fuel is spreading rapidly throughout the United States. As such, Crusader Engines provides the following information regarding the use of this fuel.

This information addresses the use of ethanol fuels in Crusader 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 Crusader Limited Warranty.**

### Fuel Stabilizer Recommendations for Ethanol Blend Fuel

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

# OIL REQUIREMENTS - 10

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## ENGINE OIL RECOMMENDATIONS

### Use of Supplemental Additives

Engine oils meeting Crusader Engines' 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. Crusader Engines does not review, approve or recommend such products.

### Synthetic Oils

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

### Engine Oil Requirements

The following chart shows the recommended oil viscosity for various ambient temperature ranges:

| Prevailing Ambient Temperature | Recommended A.P.I. Classification & Viscosity |
|--------------------------------|-----------------------------------------------|
| Above 50°F                     | SAE 15W-40 "GF-4/SM"                          |
| Below 50°F                     | SAE 5W-30 "GF-4/SM"                           |

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

**WARRANTY NOTICE:** Crusader Engines reserves the right to refuse warranty on part(s) and/or engine(s) damaged by using improper fuels and engine oils.

### Oil Change Intervals (Common)

Crankcase oil and oil filter change - Recommended intervals:

- Initial oil change - 1st 60 days or 25 hours of operation, whichever occurs first
- Regular oil changes - Every 50 hours of operation or 120 days, whichever occurs first

## ENGINE MAINTENANCE

Refer to the MAINTENANCE SCHEDULE for a complete listing of required maintenance and the frequency at which it should be performed. While some procedures may be performed by the owner/operator, Crusader Engines strongly recommends that all engine service and maintenance be performed by an authorized Crusader Engines Premier Dealer. Before performing any maintenance or repair procedure not covered in this manual, it is strongly recommended that a Crusader Engines repair manual be purchased and read thoroughly.

## CHECKING FLUID LEVELS

### Engine Crankcase 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, if equipped, ballast systems must be purged when checking the engine oil level, otherwise erroneous readings may be obtained.*

1. **Stop** the engine, if running. Allow approximately 5 minutes for the oil to drain back into the oil pan.
2. Remove the dipstick, wipe it clean, and reinstall it until it is within two (2") inches of being fully seated. Slowly move the dipstick up and down approximately one-half (1/2") several times; then fully seat the dipstick into the dipstick tube.
3. In order to obtain an accurate reading, wait two minutes for the oil to stabilize on the dipstick. Remove the dipstick and observe the oil level. The oil level must be between the "FULL" and "ADD" marks. 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. (Figure 11-1)

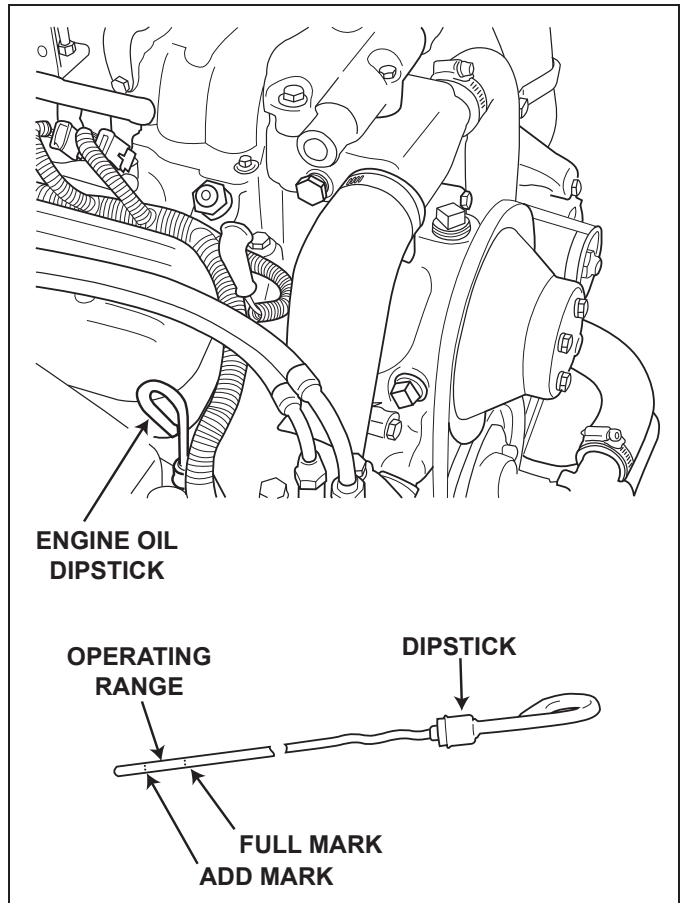


Figure 11-1 Engine Oil Dipstick (Typical)



#### WARNING

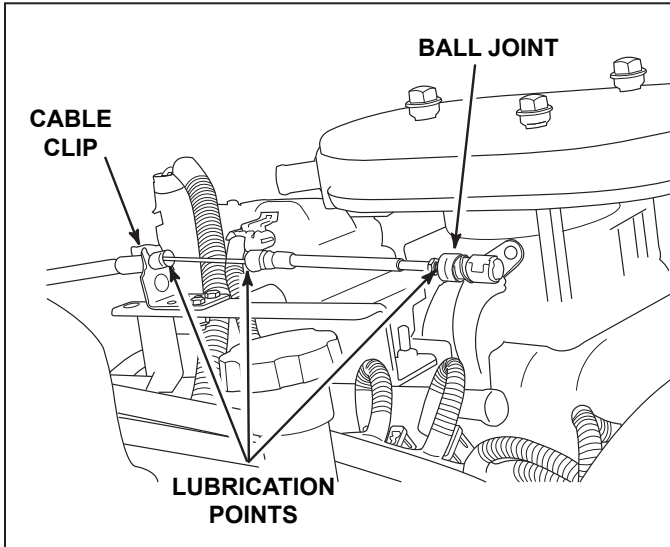
The machinery space must be closed anytime the engine is running to prevent injury to you or others on board. Never operate the engine with the engine machinery space open while someone is in the machinery space, either closed or open. Never open the machinery space unless the engine is shut off and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

# ENGINE MAINTENANCE - 11

## LUBRICATION

### Throttle Cable

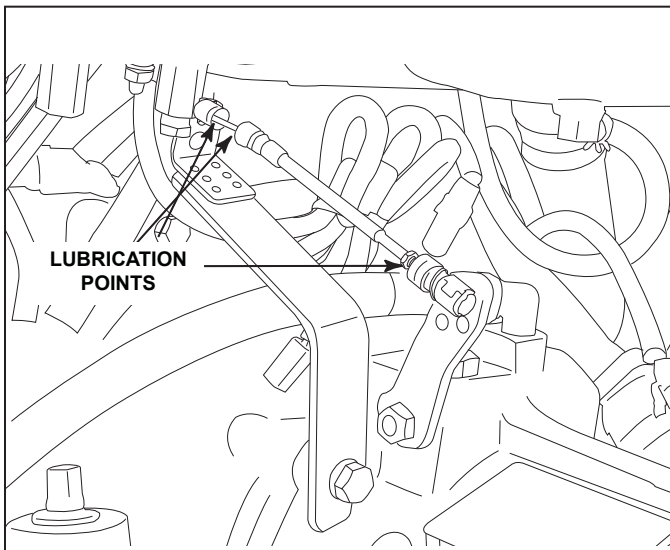
Lubricate pivot points and exposed cable (Figure 11-2) with SAE 30W-30 engine oil.



**Figure 11-2** Typical Throttle Cable

### Shift Cable

Lubricate pivot points and exposed cable (Figure 11-3) with SAE 30W-30 engine oil.



**Figure 11-3** Typical Shift Cable

## ELECTRICAL SYSTEM RELAY AND FUSE BLOCK

### MAIN PANEL FUSE

Crusader 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. If the cause of the overload cannot be found, consult an authorized Crusader Engines dealer to make necessary repairs.

### ELECTRICAL SYSTEM FUSES

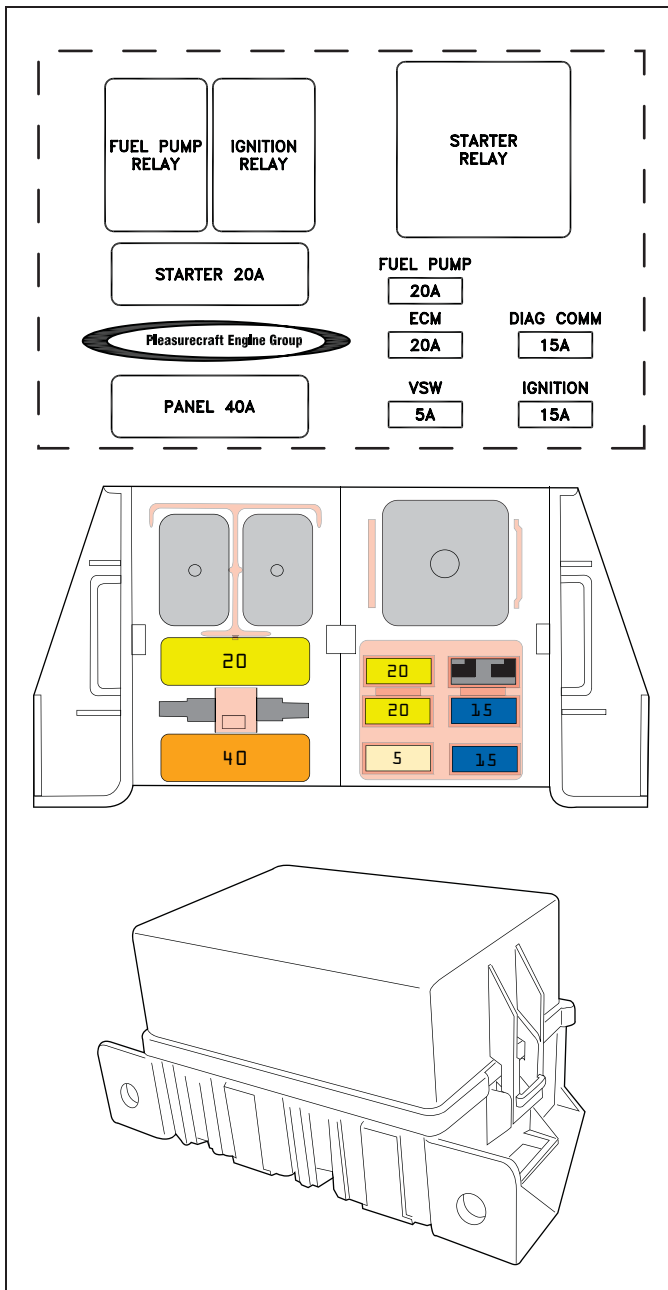
Crusader engines utilize fuses to protect critical engine components and devices. The fuel pump, ECM, ignition components, fuel injectors, starter and diagnostic devices are protected by fuses. The fuse block is mounted on a bracket near the rear of the engine.

### BOAT'S IGNITION FUSE

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.

## ELECTRICAL SYSTEM WIRING AND CONNECTORS

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 an authorized Crusader Engines dealer to make necessary repairs.



**Figure 11-4 Typical** Electrical System Relay and Fuse Block

## BATTERY



### WARNING

Battery electrolyte is a corrosive acid and should be handled with care. If electrolyte is spilled or splashed on any part of the body, **IMMEDIATELY** flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible. Safety glasses and rubber gloves are recommended when handling batteries or filling with electrolyte.



### WARNING

Hydrogen gases that escape from the battery when charging are highly explosive. Do not use jumper cables and a booster battery to start the engine. Do not recharge a weak battery in the boat. Remove the battery from the boat and recharge in a well ventilated area away from fuel vapors, sparks and open flames.

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 operate the engine with an open in the battery circuit, 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 MAINTENANCE - 11

## FLUSHING COOLING SYSTEM - SEA-WATER SECTION

To prevent silt and/or salt build-up in the cooling system (fresh or raw-water cooled), flush the sea-water section of the cooling system with fresh water at specified intervals. Close seacock (if applicable) before removing inlet hose.



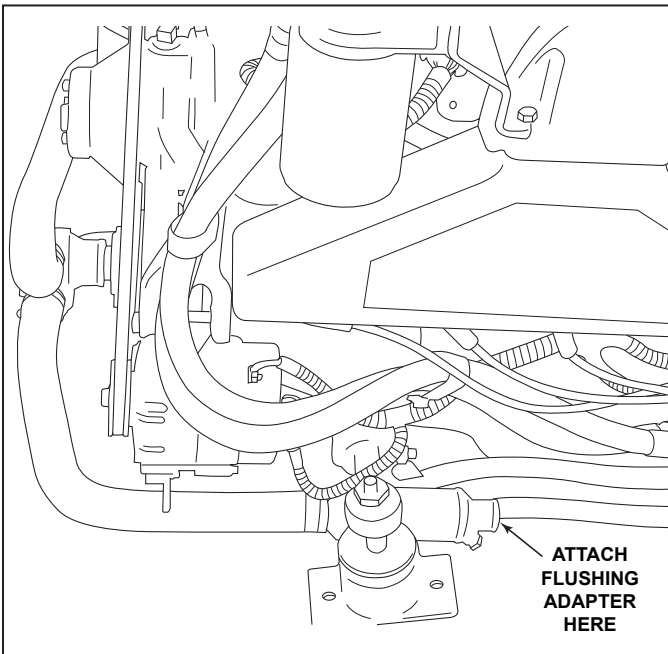
### CAUTION

Do not operate the engine without sufficient amount of water being supplied to the sea-water pump. The sea-water pump impeller may be damaged and subsequent overheating damage may result.



### CAUTION

Do not run the engine above 1500 RPM when flushing. Suction created by the sea-water pump may collapse the flushing hose, causing the engine to overheat. Watch the temperature gauge while flushing to ensure the engine does not overheat.



**Figure 11-5** Typical Sea-Water Inlet

## FUEL SYSTEM DESCRIPTION

This Crusader Marine engine is equipped with a "Returnless-Type" fuel system. This system requires a fuel feed line to supply fuel. Excess fuel, not used by the engine, is circulated through the FCC bowl.



### 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.



### 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

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.



### WARNING

Make sure that there are no fuel leaks before closing the engine hatch.



### WARNING

Visually inspect unit for fuel leaks before operating the engine. If fuel leaks are present, DO NOT operate the engine, contact your service center immediately.

## Fuel Control Cell (FCC) Fuel System

The Fuel Control Cell (FCC) eliminates vapor lock and air ingestion caused by fuel tank slosh, and provides the necessary filtration and water separation.

The FCC system incorporates two (2) fuel pumps to provide an uninterrupted flow of fuel to your Crusader marine engine. Fuel is fed into the FCC bowl by a low-pressure, high-volume electric fuel pump. This pump flows fuel at a volume much greater than the fuel flow rate required of the high-pressure pump and engine demands. The high-pressure pump, mounted inside the FCC bowl, provides the necessary fuel pressure and volume to maintain proper engine performance. The FCC constantly has an ample supply of fuel to meet the idle, cruise and acceleration fuel requirements of the engine.

The fuel pressure regulator, located on the fuel rail, controls the fuel pressure, and maintains a constant pressure across the fuel delivery system. 6.0L and 8.1L engines' fuel pressure regulator is located inside the FCC, therefore, they do not require a fuel return line from the fuel rail. Excess fuel, not used by the engine, returns to the FCC bowl.

The fuel delivered to the engine by the FCC is filtered by a filter and water separator element, which surrounds the high pressure pump inside the FCC bowl.

As indicated above, fuel enters the FCC bowl from two (2) locations, the low-pressure pump (initial input) and the fuel pressure regulator (unused, recirculating fuel). Fuel exits the FCC bowl at two (2) locations (Return-Type fuel system), the high-pressure output to the fuel injection system and all excess fuel in the FCC bowl is routed back to the tank via the return line.

## Servicing the FCC

The frequency of draining the water or replacing the filter element is determined by the contamination level of the fuel. Replace the filter element at least once a year, or when a loss of power is noticed (whichever occurs first).



### WARNING

Improper use, installation or servicing may cause an explosion or fire resulting in bodily injury, or death. This unit should only be serviced by a qualified technician. Read and follow all instructions before proceeding. Run the engine and check for fuel leaks after installation, element replacement or draining the bowl. DO NOT remove the FCC bowl unless servicing the filter element, otherwise contamination or bowl O-ring swelling may result.

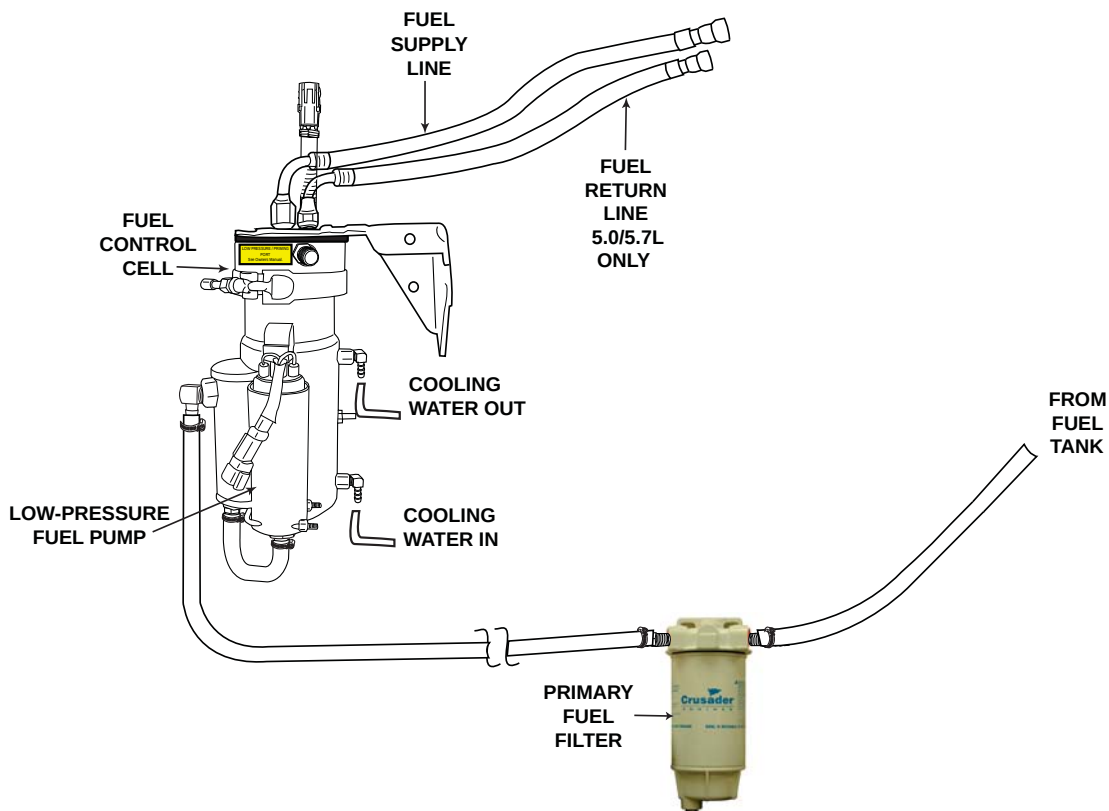


Figure 11-6 Fuel Control Cell (FCC) Fuel System -Returnless-Type (Typical)

# ENGINE MAINTENANCE - 11

## FCC Service Instructions (FCC Clamp-on Canister)



### 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.

### Draining the FCC Bowl, ENGINE OFF

1. Disconnect the two-wire electrical connectors from the FCC and the Low Pressure Fuel Pump (LPFP).
2. Remove the 7/16" plug, and drain the bowl contents into an approved container.

**CAUTION: Both fuel and water will drain from the FCC bowl.**

3. Apply pipe sealant, suitable for use with gasoline, to the threads of the 7/16" plug.
4. Tighten the 7/16" plug.
5. Reconnect the two-wire electrical connectors to the FCC and LPFP.
6. Cycle the ignition key several times to run the electric fuel pumps and fill the FCC bowl with fuel. Inspect the drain plug area for leaks. Correct any leaks prior to operating the engine.
7. Start the engine and inspect for fuel leaks. Correct any leaks prior to operating the engine any further.

### Filter Element Replacement, ENGINE OFF

#### FCC SERVICE KIT#: RP080026

1. Disconnect the two-wire electrical connectors from the FCC and the Low Pressure Fuel Pump (LPFP).
2. Disconnect the fuel supply line from the LPFP.



### WARNING

**Residual fuel will leak from the pump and the supply line. Elevate and plug the supply line to minimize fuel leakage. Capture/clean-up spilled fuel as required. Dispose of shop towels in an approved container.**

3. Remove the 7/16" plug, and drain the bowl contents into an approved container.

**CAUTION: Both fuel and water will drain from the FCC bowl.**

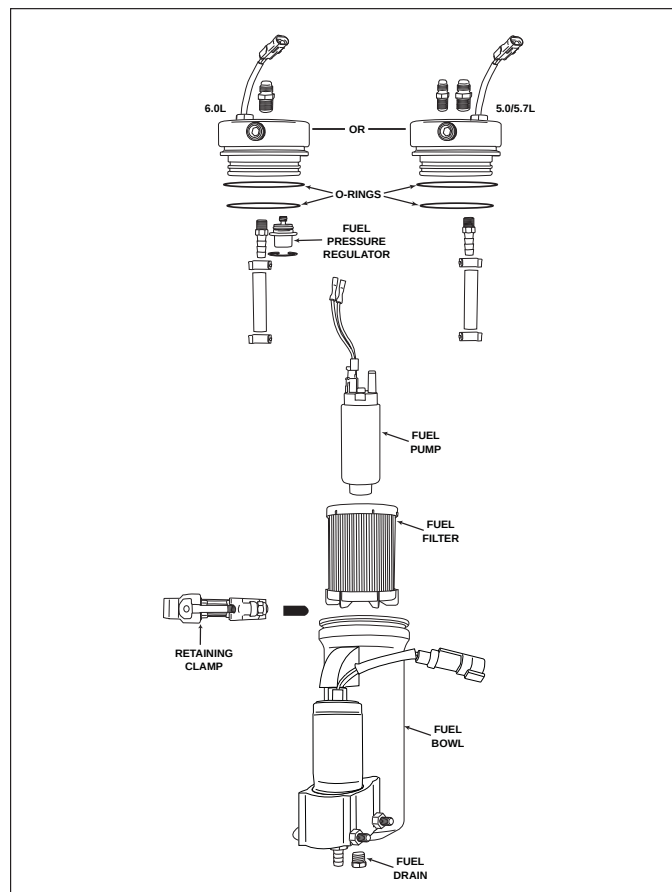
4. Remove the canister retaining clamp.
5. If equipped, remove water supply (bottom)

and discharge (top) hoses from the canister. Disconnect bonding wire attached to canister.

6. Slide the canister downward over the suspended filter element. It may be necessary to pull the unit to one side in order to remove.
7. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand, and pulling the filter element downward with the other hand.
8. Visually inspect all internal components, i.e. hoses, wires, etc.
9. Push on new filter element (part number RP080026) over the electric fuel pump.
10. Using a pick made of soft material, such as a toothpick, remove the old O-rings from the FCC head.

**CAUTION: The mounting head O-ring grooves may be damaged by using sharp steel tools to remove this O-ring.**

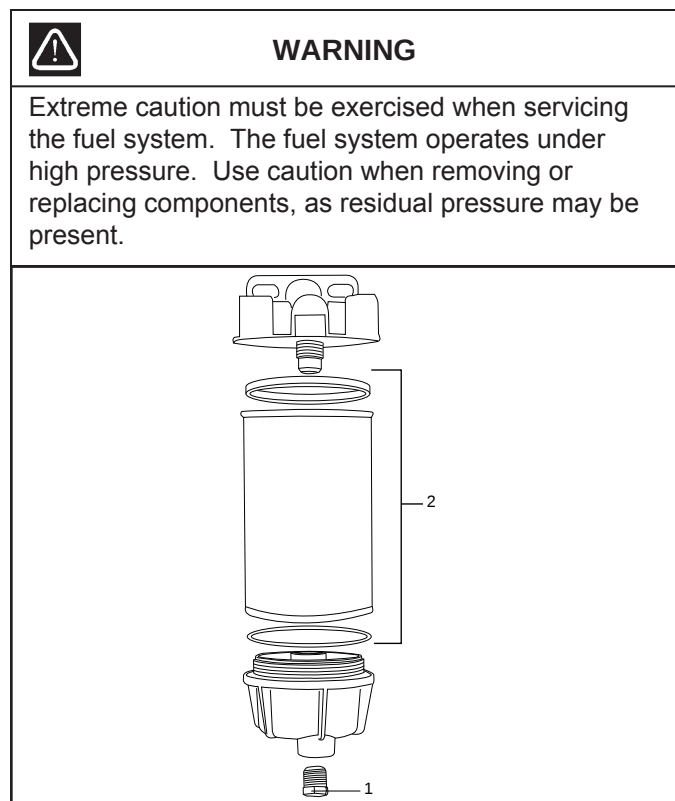
**CAUTION: Use only fuel approved O-rings (R047241) provided in RP080026 Kit. Use of non-approved O-rings may cause fuel to leak from the FCC.**



**Figure 11-7** Fuel Control Cell (FCC) - Clamp-on Canister (Typical)

11. Install the new O-rings in the same location. Lubricate the new O-rings with a fuel resistant O-ring lubricant.
12. Apply pipe sealant, suitable for use with gasoline, to the threads of the 7/16" plug.
12. Install and tighten the 7/16" plug into the canister.
13. Install the canister firmly back onto the FCC head.
14. Reinstall the retaining clamp and tighten securely.
15. Reconnect the fuel supply line to the LPFP.
- 16.. If equipped, re-install water supply (bottom) and discharge (top) hoses to the canister. Connect bonding wire to canister.
17. Reconnect the two-wire electrical connectors to the FCC and the LPFP.
18. Cycle the ignition key several times to run the electric fuel pumps and fill the FCC bowl with fuel. Inspect the drain plug area for leaks. Correct any leaks prior to operating the engine.
19. Start the engine and inspect for fuel leaks. Correct any leaks prior to operating the engine any further.

**DO NOT ATTEMPT TO SERVICE ANY OTHER PARTS ON THIS UNIT.**



**Figure 11-8** Primary Fuel Filter

## Primary Fuel Filter

**Primary Fuel Filter Element#: R080033**

### To Drain Contaminants:

Draining the collection bowl: water is heavier than fuel and will settle to the bottom of the bowl and appear different in color. In extremely humid conditions, take a fuel sample (in a clear container) frequently, daily, if needed and drain as required if water is present.

1. Place a suitable container below the unit to collect the contaminants.
2. Close the fuel tank valve (if applicable), then loosen/ remove the drain plug (1) at the bottom of the bowl. Figure 11-8 item 1.
3. Prime the fuel system following the instructions under Priming the Fuel System.

### To Replace the Element:

Element replacement frequency is determined by the contamination level in fuels. Fuel flow to the engine becomes restricted as the element slowly plugs with contaminants, resulting in noticeable power loss and/ or hard starting. Replace element annually, every 500 hours or when there is a noticeable power loss, whichever comes first. Change the element as soon as possible. *Always carry extra replacement elements as one tank full of excessively contaminated fuel can plug a fuel filter.*

Clean any debris or dirt away from the Crusader head/ filter joint prior to removal.

1. Place a suitable container below the unit to collect the contaminants.
2. Close the valve at the fuel tank (if applicable) and then remove the drain plug (1) to empty the filter of fuel.
3. Spin the Element and Bowl off together (use a strap wrench on the element), then remove the bowl from the element (2). Figure 11-8 item 2.
4. Clean the bowl O-ring gland and the sealing surface of the mounting head free of dirt, debris or gums.
5. Apply clean motor oil to the new seal and to the bowl O-ring supplied with the new element.
6. Place the new seal onto the top of the new element and the O-ring into the bowl gland.
7. Spin the bowl onto the element, and then fill the element and bowl assembly with clean fuel.
8. Spin the bowl and element onto the head. Tighten snugly by hand - *do not use tools*.
9. Prime the fuel system following the instructions under Priming the Fuel System.

# ENGINE MAINTENANCE - 11



## WARNING

Make sure there are no fuel leaks before closing the engine hatch.

### Priming Fuel System

To prime the fuel system, cycle the ignition key 3 times using the following procedures:

1. Turn ignition key to ON position for 5 seconds.
2. Turn ignition key OFF.
3. Pause for 10 seconds.
4. Repeat steps 1-3 three times.

Crank the engine until it starts or 30 seconds elapse. If the engine does not start, repeat the priming procedures.



## WARNING

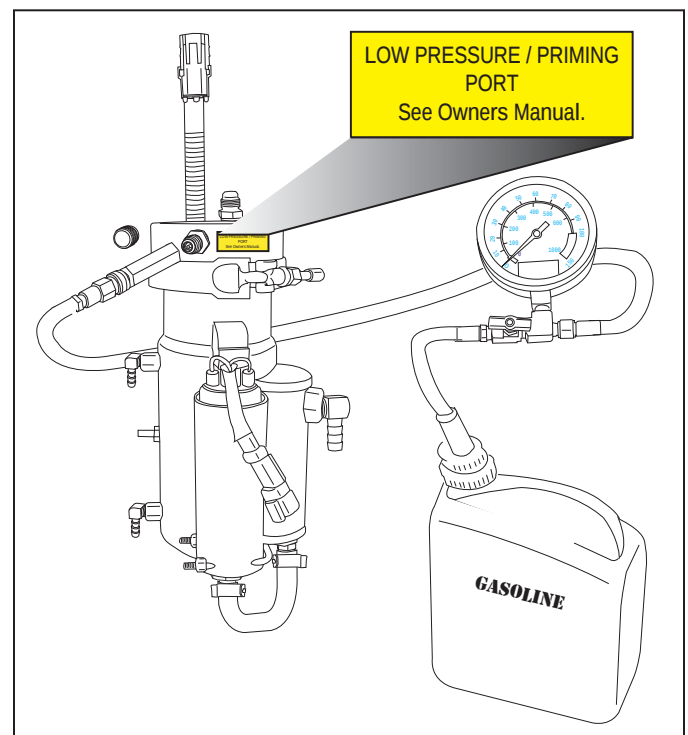
Make sure there are no fuel leaks before closing the engine hatch.

### Priming Returnless Fuel System

Refer to Figure 11-9.

Priming the Returnless Fuel System for use after the fuel tanks have been run dry may require the use of the following procedure.

1. Ensure Primary Fuel Filter is filled with fresh fuel. Refer to Primary Fuel Filter procedure on page 55.
2. Connect a Fuel Pressure Gauge to the Low Pressure/Priming Port on the FCC.
3. Place the Fuel Pressure Gauge pressure relief hose into an approved container. Open the Fuel Pressure Gauge Pressure Relief Valve.
4. Cycle the ignition key to the ON position for 5 seconds then OFF for 10 seconds. Repeat this sequence until fuel flows through the Fuel Pressure Gauge into the approved container.
5. Close the Pressure Relief Valve on the Fuel Pressure Gauge. Disconnect the Fuel Pressure Gauge and properly dispose of the recovered fuel.
6. Refer to the engine starting procedure, page 21.

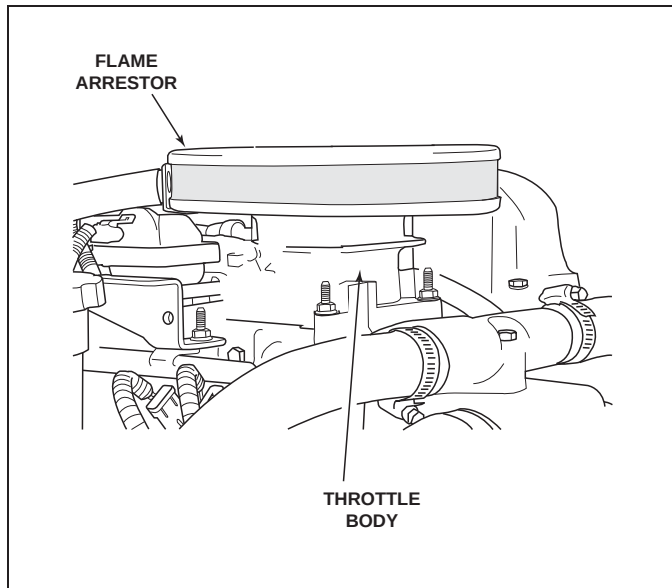


**Figure 11-9** Priming Port

## FLAME ARRESTOR

At specified intervals, the flame arrestor should be checked for blockage caused by dirt or other foreign material.

Loosen the fastener securing the flame arrestor to the air intake throttle body. Remove the flame arrestor. Clean the flame arrestor with solvent and dry with compressed air. Reinstall the flame arrestor and tighten the fastener securely.



**Figure 11-10** Flame Arrestor - 5.7L (Typical)

## CHANGING ENGINE OIL



### WARNING

**IMPORTANT:** The Federal Water Pollution Control Act prohibits the discharge of oil or oily waste into or upon the navigable waters and continuous zone of the United States, if such discharge causes a film or sheen upon, or discoloration of the surface of the water, or causes sludge or emulsion beneath the surface of the water. Violators are subject to a penalty of \$5,000.00.

Refer to the MAINTENANCE SCHEDULE for oil change intervals. The engine oil should be changed prior to placing the boat into storage.

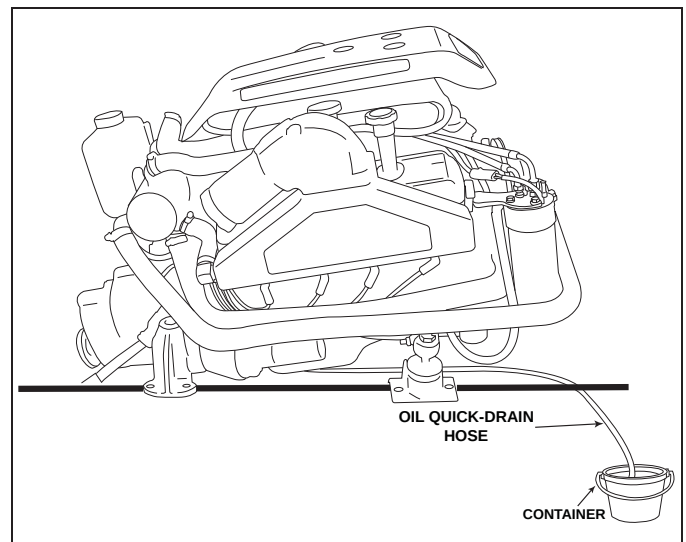
**IMPORTANT:** Change the engine oil when the engine is warm from operation. Warm oil flows more freely, and allows more foreign material and impurities to be removed.



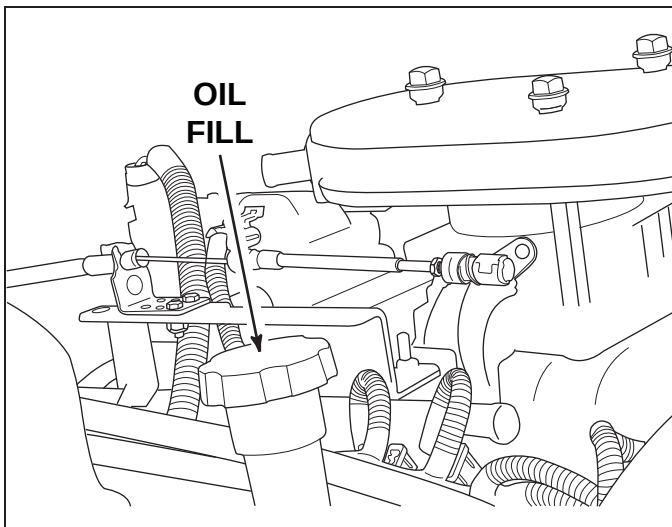
### CAUTION

**DO NOT OVERFILL ENGINE CRANKCASE WITH OIL.** Excessive oil can lead to premature engine component failure and/or loss of performance.

1. With the engine at normal operating temperature, locate the oil pan quick drain hose and thread the hose through the boat's drain plug hole. (Figure 11-11). Remove the cap from the end of the quick-drain hose and insert the discharge hose into a suitable container. Allow the oil from the engine to drain until the crankcase is empty. Reinstall the cap onto the quick-drain hose and pull the hose back through the drain and secure the hose at the engine.
2. Remove the oil filter by turning it counterclockwise, using an oil filter wrench if necessary. Discard the old filter and sealing ring.
3. Coat the sealing ring, on the new filter, with a light coating of clean engine oil. Install the oil filter securely by hand. DO NOT overtighten.
4. Fill the engine with the recommended oil and quantity, through the oil fill location on the valve cover (Figure 11-12). See **OIL REQUIREMENTS** page 30 and **ENGINE FLUID CAPACITIES** page 44, respectively.



**Figure 11-11** Engine Oil Removal



**Figure 11-12** Engine Oil Fill (5.7L)

5. Start the engine and operate for 5 minutes to circulate the oil throughout the engine. Check entire system for leaks, especially around the oil filter.
6. Stop the engine and wait 5 minutes to allow the oil to completely drain down. Check the oil level. Add or remove oil, as needed, to bring the engine oil to the proper level. See **CHECKING FLUID LEVELS** page 31 for Important Notes and Cautions to observe when checking the engine crankcase oil level.

**IF YOU ARE UNSURE OF THE CORRECT AMOUNT OF OIL TO USE DURING A SERVICE INTERVAL, PERFORM THE FOLLOWING PROCEDURE:**

- (1) Drain the oil and change the oil filter.
- (2) Add four (4) quarts of new oil.
- (3) Start and run the engine allowing sufficient time for the new oil to circulate and fill the new oil filter.
- (4) Shut the engine off. Wait 5 minutes to allow the oil to completely drain back to the pan. Check the oil level with the dipstick and add the correct amount of oil to fill to the "FULL" mark on the oil level dipstick.

## ENGINE MAINTENANCE - 11

[illegible]

# ENGINE MAINTENANCE - 11

## 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 - Drive Unit                                                                                                                 | 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           |                               |                             |                              |                |
| Cooling System - Check condition and tightness of all hose clamps                                                                            |             | X                             |                             | X <sup>1</sup>               | X              |
| Cooling System - Inspect/Replace raw water pump impeller (if applicable)                                                                     |             |                               | X                           |                              | X              |
| Drive Belt - Inspect condition and check tension                                                                                             |             | X                             |                             | X                            | X              |
| Exhaust System - Check condition and tightness of all hose clamps                                                                            |             | X                             |                             | X <sup>1</sup>               | X              |
| 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 CAM Retard (B)                                                                                              |             |                               |                             |                              |                |
| 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 <sup>2</sup>              |                              | X              |
| Flame Arrestor and Crankcase Ventilation System - Clean and inspect                                                                          |             |                               |                             | X                            | X              |

# ENGINE MAINTENANCE - 11

## 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 <sup>1</sup>               | X              |
| Fuel Filters - Service or replace                                                            |             | O                             |                             | O                            | O              |

### Notes:

(X) Denotes service to be performed by the owner/operator

(O) Denotes service to be performed by an authorized Crusader Engines Premier dealer

(A) Use SAE 30 engine oil

(B) Requires a Diagnostic Scan Tool in order to set.

<sup>1</sup> 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).

<sup>2</sup> 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).

<sup>3</sup> Requires more frequent inspection if used in extremely salty, polluted or mineral-laden waters.

<sup>4</sup> See COOLANT SPECIFICATIONS.

Crusader Engines recommends that all periodical and annual service be performed by your local, authorized Crusader Engines Premier dealer.

# ENGINE MAINTENANCE - 11

## 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.

Touch up scratches, nicks and corrosion damage to the exterior finish of the engine. Spray paint may be obtained from your local Crusader Engines dealer.

Protect engine finish from corrosion by periodically spraying the engine exterior finish with a rust preventative oil (such as WD-40).

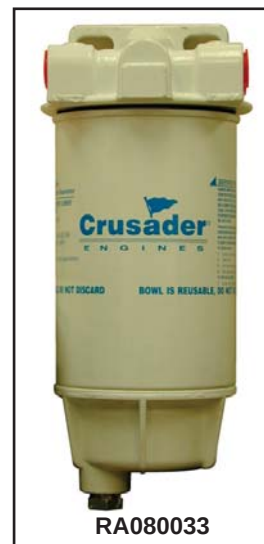
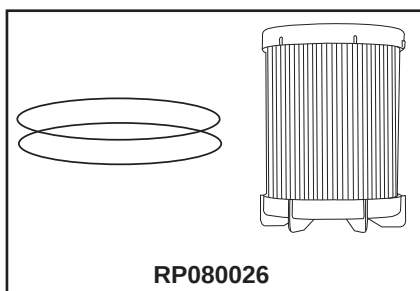
## ENGINE FLUID CAPACITIES

| Model                                    | MP 5.7L                          |
|------------------------------------------|----------------------------------|
| Crankcase Oil Capacity<br>W / NEW FILTER | 4.75 Quarts (4.5 L) <sup>1</sup> |

1 - **Engine Fluid Capacities are dependent on installation angle.** DO NOT overfill the crankcase. Remove excess fluid above the “FULL” mark on the dipstick. Check oil with the boat at its normal, level, at rest position on the water. Ensure that ballast systems (if equipped) and excess water in the bilge have been purged. If the boat is on a trailer, the trailer must be level and adjusted to represent the boat’s normal resting state on the water. Oil capacities are approximate, and may not include capacity needed for cooler and oil lines. Refer to the **Checking Fluid Levels** instructions page 31 and **Changing Oils** instructions page 39, of this manual, for complete instructions, important notes and Cautions for checking engine oil levels. Always use the dipstick to determine the exact quantity of oil required. Add the correct amount of oil to fill to the “FULL” mark on the oil level dipstick.

## FILTER REQUIREMENTS

| Description                                 | Part No. |
|---------------------------------------------|----------|
| Oil Filter                                  | R077002  |
| Primary Water Separator/Fuel Filter Element | R080033  |
| Fuel Control Cell (FCC) Fuel Filter Element | RP080026 |



## Crusader SYNC/RUISE SPEED CONTROL SYSTEM

| Description                             | Part No. |
|-----------------------------------------|----------|
| Crusader Sync/Cruise Control Panel      | RA152007 |
| Speed Control Interface Harness - 25 Ft | RA121091 |

# ENGINE SPECIFICATIONS - 12

## Crusader MASTER ENGINE SPECIFICATIONS - 2013

|                                                |                                      |
|------------------------------------------------|--------------------------------------|
| <b>MODEL<br/>(Horsepower)</b>                  | <b>MP 5.7L<br/>(343 HP)</b>          |
| <b>Displacement</b>                            | 5.7L (350 CID)                       |
| <b>Bore</b>                                    | 4.0 in. (101.6 mm)                   |
| <b>Stroke</b>                                  | 3.48 in. (88.3 mm)                   |
| <b>Compression Ratio</b>                       | 9.4:1                                |
| <b>Compression Pressure</b>                    | 130 - 215 psi                        |
| <b>WOT Operating RPM<br/>Preferred WOT RPM</b> | 4800 - 5200 (**5300)<br><b>5000</b>  |
| <b>Cruising RPM (Max)</b>                      | 4000                                 |
| <b>Idle RPM (In Gear)</b>                      | 650 (Not Adjustable)                 |
| <b>Oil Pressure @<br/>2000 RPM</b>             | 25 - 60 psi<br>(172 - 414 kPa)       |
| <b>Minimum Oil Pressure</b>                    | 5 psi (69 kPa)<br>at Idle            |
| <b>Spark Plug P/N<br/>Spark Plug Gap</b>       | R030010<br>0.060 in.                 |
| <b>Firing Order</b>                            | 1-8-4-3-6-5-7-2                      |
| <b>Thermostat</b>                              | RWC 160°F (61.7°C)                   |
| <b>Over- Temperature</b>                       | 210° F (98.9° C)                     |
| <b>Electrical System</b>                       | 12 Volt Negative (-)<br>Ground       |
| <b>Alternator Rating</b>                       | N/A                                  |
| <b>Ignition Timing<br/>CAM Retard ***</b>      | Not Adjustable<br>15 + / - 2 degrees |
| <b>Battery Rating</b>                          | 650 CCA (Minimum)<br>120 Ah          |

\*\*\* Checking/Setting CAM Retard requires the use of a Diagnostic Scan Tool.

## Crusader MASTER FUEL PRESSURE SPECIFICATIONS - 2013

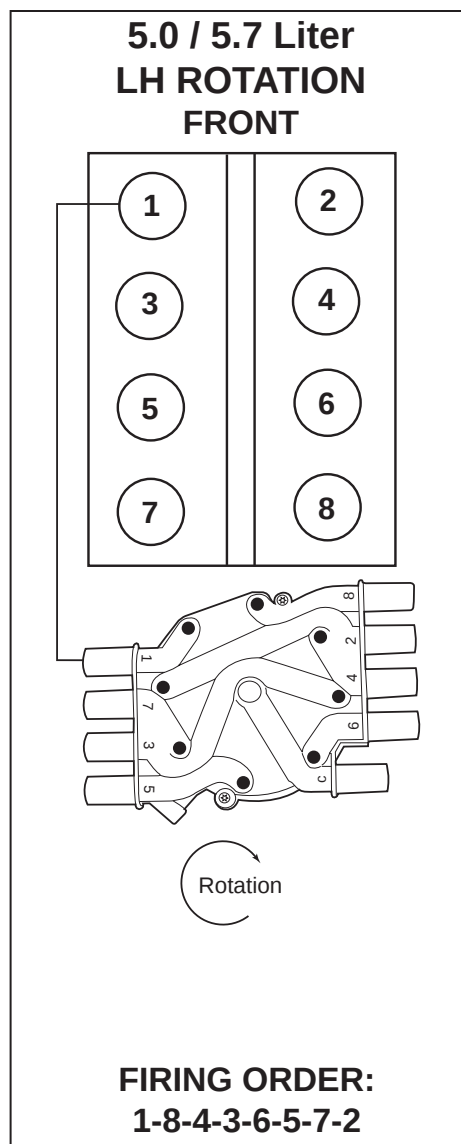
| MODEL                               | ALL<br>5.7L        |
|-------------------------------------|--------------------|
| Fuel Pressure                       | 57-62 psi @ WOT    |
| Fuel Pressure - LPFP<br>ALL ENGINES | 7 - 9 psi<br>(WOT) |

**IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD.**

## Crusader MASTER WARNING/ALARM SPECIFICATIONS - 2013

| MODEL                                 | MP 5.7L                                                                                                                                                                                                                           |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coolant<br>Over-Temperature<br>Sensor | <p>&gt; 200° F (93.3° C) Stage 1 Over-Temp, Sets - DTC 116,<br/>Lights MIL, Engine Derates and sounds Buzzer</p> <p>&gt; 215° F (98.9° C) Stage 2 Over-Temp, Sets - DTC 217,<br/>Lights MIL, Engine Derates and sounds Buzzer</p> |
| Low Oil<br>Pressure Sensor            | <p>&lt; 5 psi @ Idle RPM or &lt; 24 psi @ 4000 RPM,<br/>Sets - DTC 524,<br/>Lights MIL Lamp and sounds Buzzer</p>                                                                                                                 |

## ENGINE SPECIFICATIONS - 12



*Figure 12-1* V-8 Firing Orders

### TUNE-UP SPECIFICATIONS

| Model                            | MP 5.7L                                    |
|----------------------------------|--------------------------------------------|
| Spark Plug Type                  | R030010                                    |
| Spark Plug Gap                   | 0.060 in.<br>(1.52 mm)                     |
| Ignition Timing<br>CAM Retard*** | Fixed,<br>Not Adjustable<br>15 ± 2 degrees |
| Firing Order                     | 1-8-4-3-6-5-7-2                            |

\*\*\* Checking/Setting CAM Retard requires the use of a Diagnostic Scan Tool.

## ENGINE STORAGE

**IMPORTANT:** *This service should be performed by an Authorized Crusader Premier dealer.*



### CAUTION

**Refer to FLUSHING COOLING SYSTEM before proceeding.**

1. Fill the fuel tanks with gasoline and add a sufficient amount of gasoline stabilizer, such as STA-BIL™ fuel 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.**

2. Remove, empty and clean the fuel filter assembly. Reinstall with a new fuel filter and gasket / seals. Refer to Engine Maintenance for filter replacement procedures.

**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 (See ENGINE MAINTENANCE).
4. Flush the cooling system if operating in salt water or brackish water areas. (See ENGINE MAINTENANCE).



### 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.

5. Restart the engine and allow it to idle for 5 minutes.
6. Turn off the ignition and remove the spark plugs. Use an aerosol-type fogging solution and spray a sufficient amount of oil into each cylinder. (Follow the instructions for the storage oil used.) Turn the crankshaft several revolutions by hand to spread the oil evenly throughout the cylinders.



### CAUTION

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

7. Install the spark plugs and connect the spark plug wires.
8. 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.
9. Close the fuel shut-off valve (if equipped).

# OUT-OF-SEASON STORAGE - 13

## DRAINING INSTRUCTIONS

**IMPORTANT:** These services should be performed by an Authorized Crusader Premier 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.

## RAW-WATER COOLED MODELS

1. Remove all the drain plugs from the following locations:
  - Cylinder Block - one on each side (5.0/5.7L engines, remove the knock sensor on the port and starboard sides). When installing the knock sensor, torque to 20 N·m (15 lb ft).
  - Exhaust Manifolds - remove hoses and/or drain plugs, one on each side.
  - Transmission Cooler - one drain plug (if applicable).
2. Remove the hose from the inlet side of the sea-water pump (if equipped).
3. Remove the large hose from the engine circulating pump, or drain plug (if equipped).
4. Returnless Fuel Control Cell Canister - remove the lower water hose

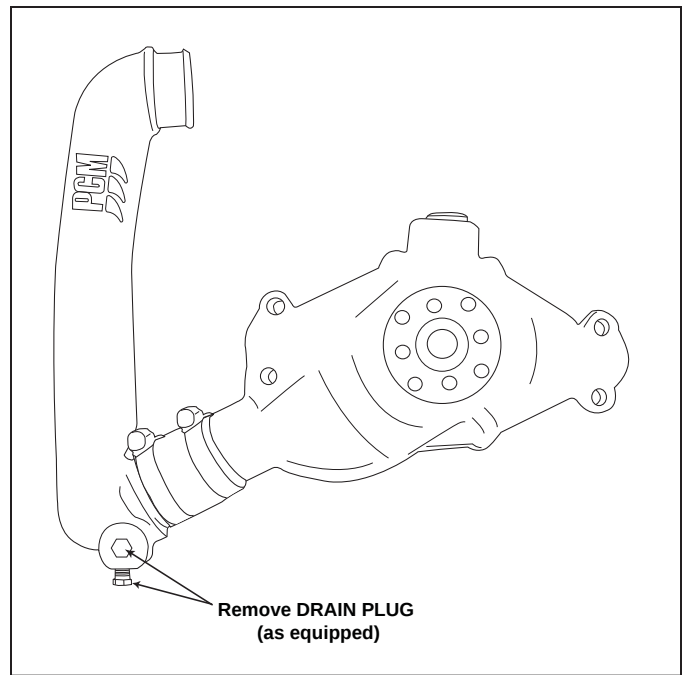
**NOTICE:** It may be necessary to bend or lift the hoses to allow water to drain completely.

5. Remove the raw water pump impeller (if equipped). 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".

6. After the water has completely drained, coat the threads of the drain plugs with PerfectSeal (or equivalent), and reinstall in the proper locations. Reinstall all the hoses and tighten the clamps securely.
7. Loosen the engine alternator and raw water pump drive belt(s).

**NOTICE:** For additional protection against freezing and



**Figure 13-1** Draining Engine Circulating Pump (5.0/5.7L)

corrosion, you may wish to fill the engine with antifreeze. If ethylene glycol based antifreeze is used, check with local environmental agencies about the proper disposal of antifreeze. It may be necessary to drain the system prior to re-commissioning the boat.

8. Remove the hoses which connect to the exhaust manifolds from the thermostat housing.
9. Remove the large circulating pump hose from the thermostat housing. Pour the mixture of antifreeze and water, properly mixed to protect the engine to the lowest temperatures that it will be exposed to, into the circulating pump hose and fill the engine block. Pour additional antifreeze solution into the hoses connected to the exhaust manifolds.
10. Reinstall the hoses into the thermostat housing and tighten the hose 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.

## RECOMMISSIONING AFTER STORAGE

**IMPORTANT:** *These services should be performed by an Authorized Crusader Premier 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.



### 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. Readjust alternator and water pump 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. Refer to the Engine Maintenance section and perform the Priming the Fuel System instructions.



### CAUTION

If the engine(s) is (are) to be started prior to launching, use the procedure FLUSHING COOLING SYSTEM before proceeding to start the engine(s).

11. Open the seacock before starting the engine.
12. 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.
13. Check the steering, shift and throttle controls for proper operation.

# TROUBLESHOOTING - 14

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 Crusader Engines Servicing Dealer for assistance.

| Malfunction                                                                                                                                                                                                                      | Possible Cause                                                                                                                                                                                                                                        | Corrective Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Engine will not crank with the starter motor, or cranks slowly.</b></p> <p><b>NOTICE:</b> Battery voltage must be AT or ABOVE 10 volts while the engine is cranking or the engine management system will not function.</p> | <p>Problem with the engine management system.</p> <p>Battery switch turned OFF (if equipped)</p> <p>Remote control not in Neutral position.</p> <p>Blown ignition/starter fuse.</p> <p>Loose and/or dirty wiring connections.</p> <p>Dead Battery</p> | <p>Contact Crusader Engines Dealer.</p> <p>Turn the battery switch ON.</p> <p>Position the remote control exactly in Neutral.</p> <p>Replace the fuse</p> <p>Check the battery cables and starter circuit wiring. Clean and tighten all connections. Repair or replace the damaged wiring.</p> <p>Recharge, test and replace as necessary.</p>                                                                                                                                                                                                                                                       |
| <p><b>Engine Cranks - will not start or is hard starting.</b></p> <p><b>NOTICE:</b> Battery voltage must be AT or ABOVE 10 volts while the engine is cranking or the engine management system will not function.</p>             | <p>Improper starting procedure.</p> <p>No fuel - empty fuel tank</p> <p>No fuel to the throttle body (TBI) or the injectors (MPI)</p> <p>Engine flooded</p> <p>Ignition system malfunction</p> <p>Contaminated fuel</p>                               | <p>Refer to "STARTING ENGINE" in the OPERATING INSTRUCTIONS section.</p> <p>Check the fuel tank level - fill tank(s). Open shut-off valve(s).</p> <p>Plugged fuel filters.<br/>Plugged or kinked fuel lines or plugged fuel-tank vent.<br/>Faulty fuel pump - check electrical connections.<br/>Faulty anti-siphon valve.</p> <p>Open the throttle 100% and crank the engine. When the engine starts, immediately return the throttle to 1000 RPM.</p> <p>Contact Crusader Engines Dealer.</p> <p>Check fuel for water or other contamination. If contaminated, drain and clean the fuel system.</p> |

| <b>Malfunction</b>                                                                                                                                      | <b>Possible Cause</b>                                              | <b>Corrective Action</b>                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>Engine Overheats</b><br><br><br><br><br><br><br><br><br><br><i>The following applies to engines equipped with Fresh-Water Cooling (FWC) systems.</i> | Loose or worn drive belt(s)                                        | Adjust or replace the belts as necessary.                                                                             |
|                                                                                                                                                         | Collapsed, kinked or leaking hoses.                                | Replace the hoses.                                                                                                    |
|                                                                                                                                                         | Transmission/engine oil cooler plugged                             | Remove the water hoses and flush in opposite direction of the normal flow.                                            |
|                                                                                                                                                         | Faulty thermostat                                                  | Replace the thermostat.                                                                                               |
|                                                                                                                                                         | Sea-water intake valve partially/fully closed.                     | Open the valve completely.                                                                                            |
|                                                                                                                                                         | Restricted sea-water pickup                                        | Remove restriction.                                                                                                   |
|                                                                                                                                                         | Faulty temperature sending unit or gauge                           | Test and replace as necessary.                                                                                        |
|                                                                                                                                                         | Sea-water pump impeller worn or damaged                            | Replace the impeller.                                                                                                 |
|                                                                                                                                                         | Coolant level low in the fresh-water section of the cooling system | Check the cooling system for leaks. Refill the system. See Warning before removing the fill cap.                      |
| <b>Insufficient engine temperature</b>                                                                                                                  | Heat exchanger passages plugged with scales and debris             | Clean and flush the exchanger.                                                                                        |
|                                                                                                                                                         | Improper coolant mixture                                           | Install the proper coolant mixture (50% antifreeze - 50% water).                                                      |
| <b>Engine oil pressure low</b>                                                                                                                          | Faulty thermostat                                                  | Replace the thermostat.                                                                                               |
|                                                                                                                                                         | Faulty temperature sender                                          | Replace the temperature sender.                                                                                       |
|                                                                                                                                                         | Faulty oil pressure sending unit or gauge                          | Test and replace as necessary.                                                                                        |
|                                                                                                                                                         | Oil level low                                                      | Add specified oil. Check the engine for leaks.                                                                        |
|                                                                                                                                                         | 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 - 14

| Malfunction                                       | Possible Cause                                 | Corrective Action                                                                                        |
|---------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>Transmission slipping - erratic operation</b>  | Low oil level                                  | Add specified oil. Check the transmission for leaks.                                                     |
|                                                   | Transmission overfilled causing oil aeration   | Drain required amount of oil.                                                                            |
|                                                   | Transmission shift lever not fully engaged     | Adjust the shift linkage and remote control. Check the shift cables for freedom of movement and binding. |
|                                                   | Contaminated fluid                             | Determine and correct the contamination source and change the fluid.                                     |
| <b>Engine misses, runs rough and/or backfires</b> | Ignition system malfunction                    | Contact Crusader Engines Dealer.                                                                         |
|                                                   | Plugged fuel filters                           | Replace the fuel filters.                                                                                |
|                                                   | Faulty fuel pump.                              | Have fuel pump replaced by a Crusader Engines Dealer/                                                    |
|                                                   | Plugged or kinked fuel lines or fuel tank vent | Repair or replace the fuel lines. Remove obstruction.                                                    |
|                                                   | Anti-siphon valve faulty                       | Clean or replace as necessary.                                                                           |
|                                                   | Flame arrestor dirty                           | Clean the flame arrestor.                                                                                |
| <b>Poor engine or boat performance</b>            | Ignition malfunction                           | Contact Crusader Engines Dealer.                                                                         |
|                                                   | Throttle not fully open                        | Check the remote control and throttle body linkage for freedom of movement and proper adjustment.        |
|                                                   | Damaged or improper propeller                  | Repair or replace as necessary.                                                                          |
|                                                   | Excessive water in the bilge                   | Pump the water out and investigate source of entry.                                                      |
|                                                   | Excessive growth on the boat bottom            | Clean the bottom and paint with an anti-fouling paint.                                                   |
|                                                   | Boat overloaded                                | Reduce and/or redistribute the load.                                                                     |
|                                                   | Dirty flame arrestor                           | Clean the flame arrestor.                                                                                |
|                                                   | Engine overheating                             | Repair the cooling system (See "Engine Overheats").                                                      |

# INSTRUMENTATION WIRING DIAGRAMS - 15

NOTE: ENGINE HARNESS WIRED FOR PANELS USING VOLTMETERS ONLY.

NOTE (A): POWER FOR A FUSED ACCESSORY PANEL MAY BE TAKEN FROM THIS LOCATION. LOAD CANNOT EXCEED 30 AMPS.

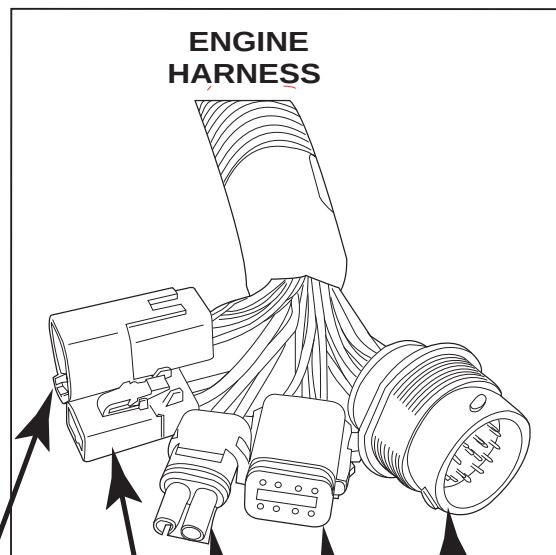
## 2-PIN WIRE HARNESS COLOR CHART

| CIRCUIT NUMBER | CIRCUIT NAME | ENGINE HARNESS WIRE COLOR |
|----------------|--------------|---------------------------|
| (A) 1.         | VBAT         | RED/PURPLE                |
| 2.             | GROUND       | BLACK                     |

## 8-PIN WIRE HARNESS COLOR CHART

| CIRCUIT NUMBER | CIRCUIT NAME       | ENGINE HARNESS WIRE COLOR |
|----------------|--------------------|---------------------------|
| *1.            | *CHECK GAUGES LAMP | GRAY/BLACK*               |
| 2.             | TACHOMETER         | GRAY                      |
| 3.             | COOLANT TEMP       | TAN                       |
| 4.             | BUZZER             | TAN/BLACK                 |
| 5.             | IGNITION           | PURPLE                    |
| 6.             | MIL                | GREEN/YELLOW              |
| 7.             | STARTER            | YELLOW/RED                |
| 8.             | OIL PRESSURE       | DARK BLUE                 |

\*CES ENGINES ONLY



TWIN ENGINE  
MASTER/SLAVE  
CONNECTOR

2-PIN BOAT  
HARNESS  
CONNECTOR

FUEL TANK  
SOLENOID  
CONNECTOR

8-PIN BOAT  
HARNESS  
CONNECTOR

SPEED CONTROL/  
CAN BUS  
CONNECTOR

NOTE: The 'MIL' or Malfunction Indicator Lamp may be labeled the "Check Engine Lamp" on the instrument panel. Check the boat owners manual for exact labelling.

**Figure 15-1** Typical Instrumentation Wiring

**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.

|  |  |
|--|--|
|  |  |
|--|--|

[illegible]