

# PRODUCT INSTALLATION MANUAL



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Welcome to the growing family of Crusader Marine Engines owners. We are delighted you have chosen Crusader power for your boat and wish you many years of enjoyment.

When you chose Crusader, you selected the utmost in premium power for your boating application. Pleasurecraft 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. No matter which Crusader 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 you begin the installation of your new Crusader engine, **READ THIS MANUAL CAREFULLY AND COMPLETELY**. There are many new and exciting features available with your new Crusader that you may wish to take advantage of and plan for as you begin the installation of your new Crusader engine.

**Crusader Sync-N-Cruz** - Every new fuel injected Crusader engine is capable of twin engine synchronization and cruise control with the addition of the Crusader Sync-N-Cruz Kit RF152007. This kit includes a harness and control panel which provides for a very simple installation for plug and play operation. For twin engine applications, the Master/Slave engine harness is required.

**Crusader Engines** has worked closely with **FW Murphy** who makes available multifunction digital displays, such as PowerView and HelmView, plus a complete line of CAN Bus Instrumentation that are completely compatible with your new Crusader engine. The Crusader Engines' ECM-07 engine management system outputs J1939 and NEMA 2000 protocol messages that may be compatible with other manufacturers' multifunction display equipment. Check with the manufacturer of the display and / or instrument you are considering, prior to purchase, for compatibility with the Crusader ECM-07 system.

**Crusader Engines** has taken care to develop a complete line of adapters and boat harnesses to make your new installation as seamless as possible. Items available include adapters for engine to existing boat harness, twin engine Master/Slave harness, engine alarm kit, electric fuel solenoid valves, and water separating fuel filters.

Please read this manual carefully and plan ahead. There may be additional items that you may wish to replace or upgrade as you install your new Crusader engine. If you do not understand any portion of the manual or require additional supplies or accessories, contact your Distributor/Dealer for clarification or assistance.

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

This manual will cover the following Crusader engines:

Year	Model
2007	5.0L MPI
2007	5.7L MPI
2007	6.0L MPI
2007	8.1L MPI
2007	8.1L MPI (HO)
2007	Classic 5.7L Carburetor



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## GENERAL INFORMATION

### Notice to Installer

Throughout this manual, "Warnings" and "Cautions" (accompanied by the International Hazard Symbol) are used to alert the installer to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. Observe them carefully!

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus "common-sense" operation, are major accident prevention measures.

	<b>WARNING</b>
Hazards or unsafe practices which could result in severe personal injury or death.	

	<b>CAUTION</b>
Hazards or unsafe practices which could result in minor personal injury or product or property damage.	

**IMPORTANT:** Indicates information or instructions that are necessary for proper installation and/or operation.

Experience gained over the past several years has shown that marine engines fitted with electronic fuel injection (EFI) require carefully integrated fuel delivery systems. More specifically, the fuel tank, fuel supply and return lines, fuel filters and all their associated valves and fittings must be considered an integral part of any fuel injection engine package. This may require changes in both fuel system components and/or layout to assure compatibility and 100% customer satisfaction with the latest EFI engines.

Any new or re-power application involving the replacement of a non-EFI engine with an EFI engine may require a new or modified fuel delivery system, from the tank to the engine, for proper operation. This installation manual has been published by Crusader Engines to aid installers when installing the products described herein.

It is assumed that these personnel are familiar with the installation procedures of similar products manufactured and marketed by Crusader Engines. That they have been trained in the recommended installation procedures of these products which includes the use of mechanics' common hand tools and any recommended tools from other manufacturers.

We could not possibly know of and advise the marine trade of all conceivable procedures by which an installation might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses an installation procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product's safety will be endangered by the installation procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication.

## ENGINE MODELS

This manual gives installation guidelines for the following engine models.

**MP 5.0L / MP 5.7L**

**MP 6.0L**

**MP 8.1L STD**

**MP 8.1L HO**

**Carb. 5.7L**

## CRUSADER ACCESSORIES

Instrument panels, wiring harnesses, propeller shaft couplers, etc. are available for this product. Contact your Crusader Engines Distributor or Crusader Engines Sales Department for a listing of these options. A list of Distributors is provided at the end of this manual.

## ENGINE INSTALLATION ACCESSORIES

Electric Fuel Solenoid Valve	P/N 23532
Solenoid Valve Power Harness	P/N 98452
Water Separating Fuel Filter Kit	P/N RK080033
Check Engine Lamp / Alarm Kit	P/N RK179008
Crusader Sync-N-Cruz Kit	P/N RF152007
Master / Slave Wire Harness:	P/N RA121072C
Adapter - Engine to Boat Harness	<b>see page 20</b>
Boat to Engine Harness	<b>see page 21</b>

## INSTALLATION SUPPLIES

Marine Lubricant

Liquid Neoprene

Perfect Seal or equivalent

Loctite PST Pipe Sealant or equivalent

Mount Adjustment Tool - P/N 22165

## INSTALLATION DRAWINGS

Installation drawings are at the back of this manual. These and archive installation drawings, are also available at [crusaderengines.com](http://crusaderengines.com)

## ENGINE AND TRANSMISSION COMBINATIONS

### Engine Rotation:

Engine rotation is indicated by the model number on the engine serial number plate. Engine rotation is described by flywheel rotation viewing from the rear of the engine (transmission end) looking forward to the water pump end. Refer to the Crusader Model Identification/Advisory information below.

### CRUSADER MODEL IDENTIFICATION / ADVISORY

MODEL 23 - 6 0 0 V - 0 1 SERIAL 670000

1<sup>st</sup> - 2<sup>nd</sup> Space: **MANUFACTURING CODE**

3<sup>rd</sup> - 5<sup>th</sup> Space: **ENGINE CODE**

<b>810</b>	= 8.1L (496 CID LH MPI)	(GM)
<b>811</b>	= 8.1L (496 CID LH H.O. MPI)	(GM)
<b>600</b>	= 6.0L (364 CID LH MPI)	(GM)
<b>570</b>	= 5.7L (350 CID LH MPI)	(GM)
<b>571</b>	= 5.7L (350 CID RH MPI)	(GM)
<b>572</b>	= 5.7L (350 CID LH Carburetor)	(GM)
<b>573</b>	= 5.7L (350 CID RH Carburetor)	(GM)
<b>500</b>	= 5.0L (305 CID LH MPI)	(GM)
<b>501</b>	= 5.0L (305 CID RH MPI)	(GM)
<b>502</b>	= 5.0L (305 CID LH Carburetor)	(GM)
<b>503</b>	= 5.0L (305 CID RH Carburetor)	(GM)

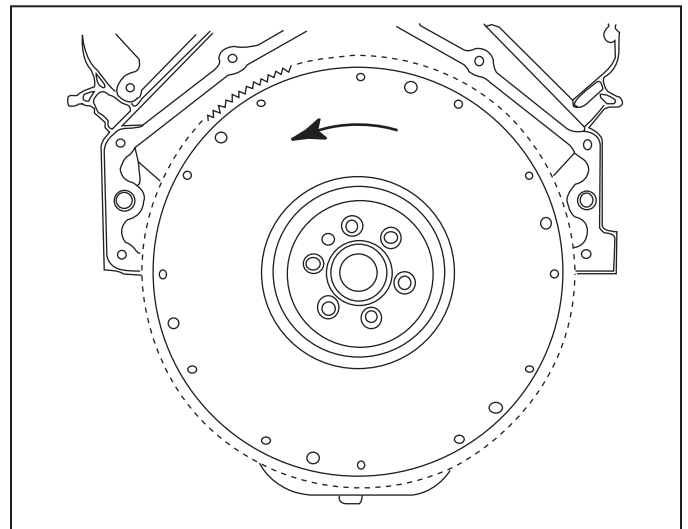
6<sup>th</sup> Space: **DRIVE CONFIGURATION**

blank - Direct Drive  
**V** - V-Drive

7<sup>th</sup> - 8<sup>th</sup> Space: **SPECIFICATION CODE**

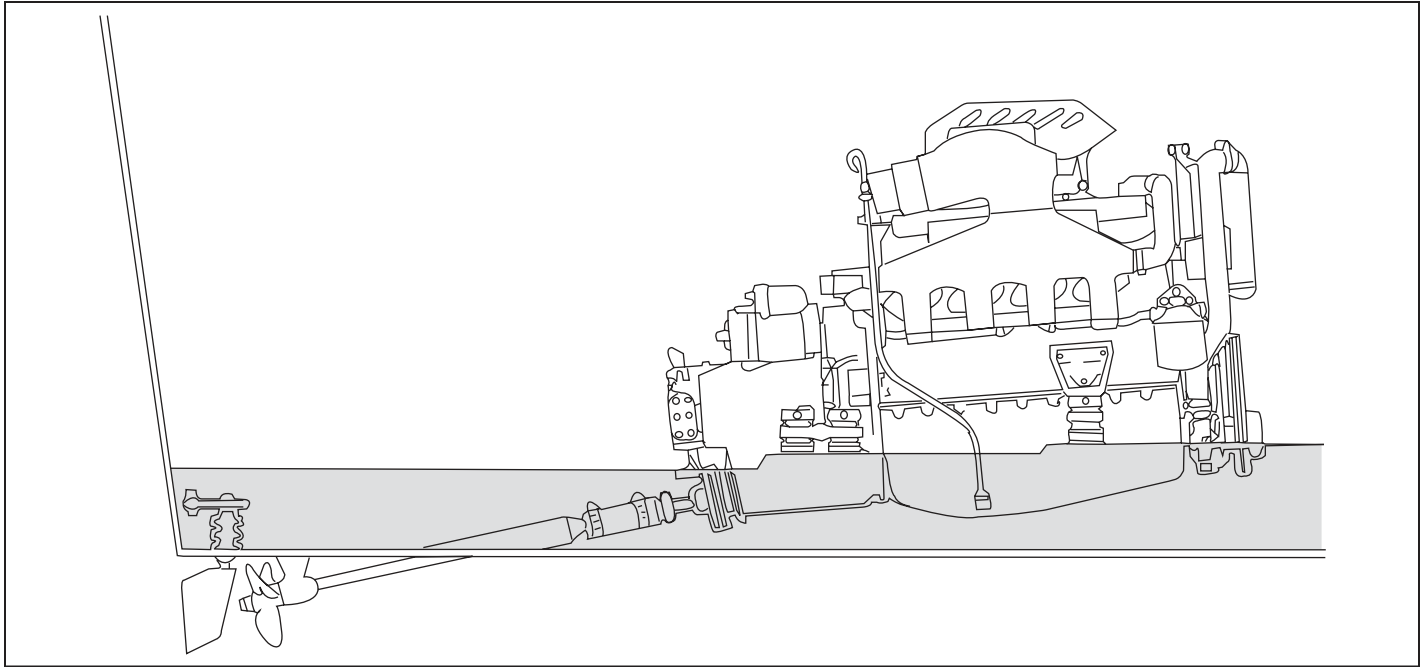
#### **\*SERIAL NUMBER I.D.\***

1<sup>st</sup> DIGIT INDICATES DECADE ENGINE WAS MANUFACTURED ( 5 = 1990, 6 = 2000, 7 = 2010 )  
 2<sup>nd</sup> DIGIT INDICATES YEAR ENGINE WAS MANUFACTURED.

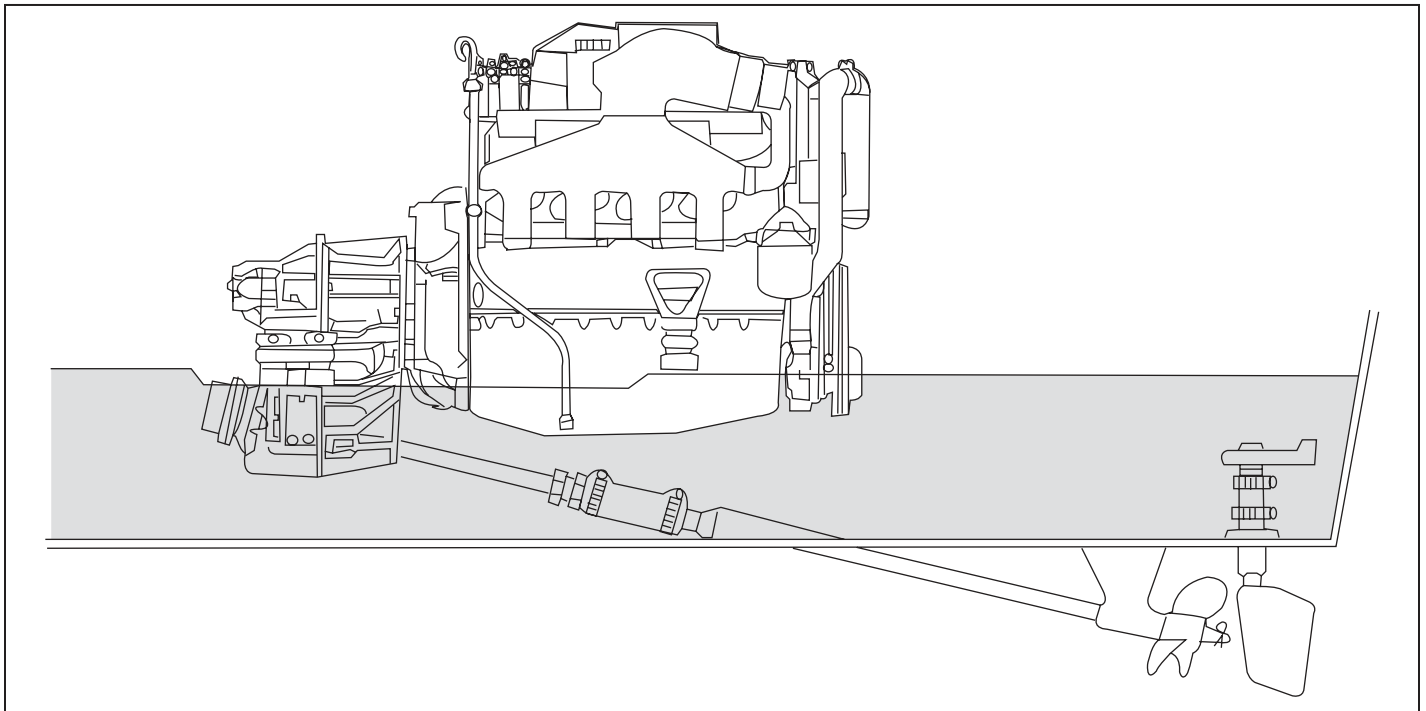


**Figure 1** Flywheel Showing LH Rotation

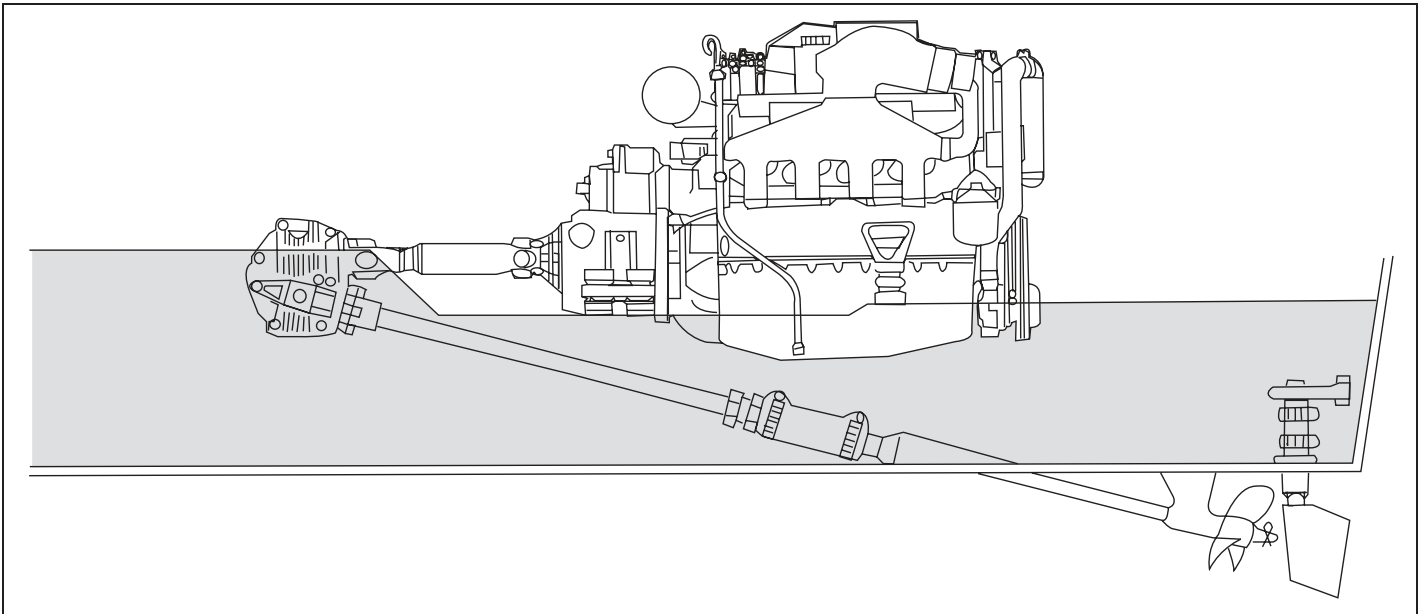




**Figure 2** Engine Applications - Typical 8 Degree Down Angle Transmission



**Figure 3** Engine Applications - Typical V-Drive Transmission



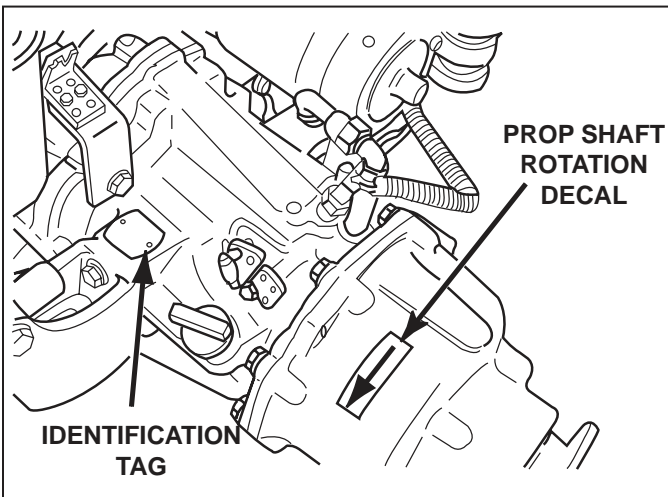
**Figure 4** Engine Applications - Typical Remote V-Drive Transmission

## TRANSMISSION ROTATION

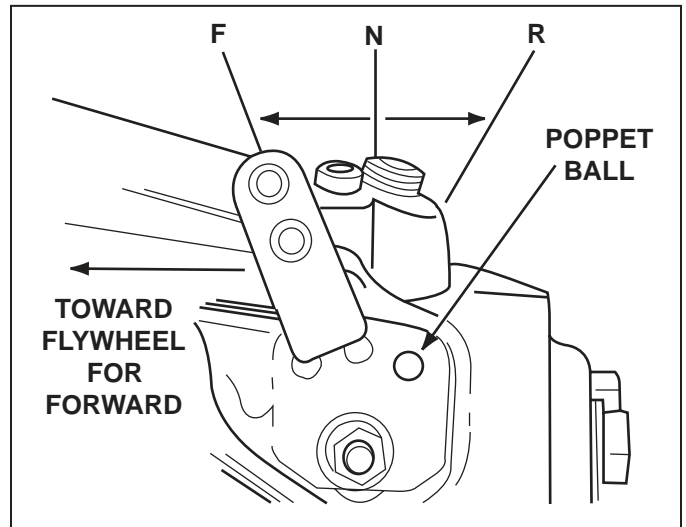
### Velvet Drive In-Line and V-Drive

Transmission gear ratio (in forward gear) is marked on the transmission identification plate. Transmission output shaft rotation is indicated on a decal on the transmission case.

**IMPORTANT:** Use of proper rotation propeller, indicated by the output flange rotation decal, is critical as operating the transmission in Reverse to move the boat forward **WILL CAUSE** transmission failure. The transmission **MUST BE** operated in forward gear only to propel the boat forward.



**Figure 5** Standard Velvet Drive Identification Plate and Propshaft Rotation



**Figure 6** Shift Lever Positions - Standard Velvet Drive

## Velvet Drive 5000 Series and Hurth Transmissions

These transmissions are “Full Reversing” with an 8-degree, down-angle output flange. This allows a standard (LH or CCW) rotation engine to be used for both propeller shaft rotations. Shaft rotation is determined by shift cable installation at the remote control (Figures 7 and 8). Transmission gear ratio and serial number is marked on the transmission identification plate.

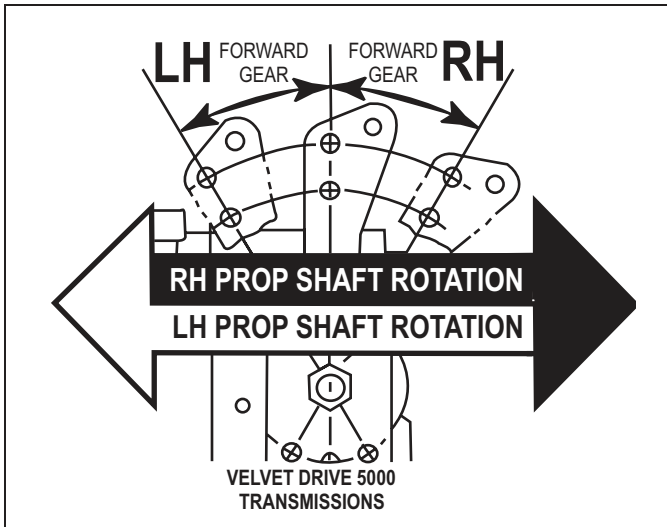


Figure 7 Shift Lever Positions - Velvet Drive 5000

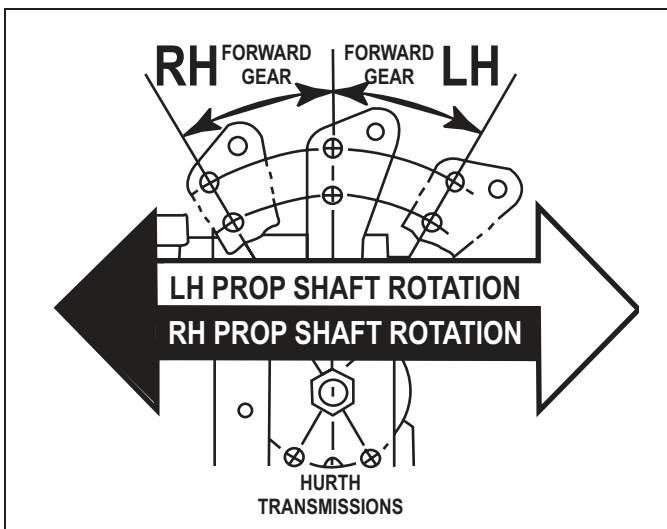


Figure 8 Shift Lever Positions - Hurth

## GEAR RATIO SELECTION

The propeller shaft speed is determined by engine speed and transmission gear ratio. Fast boats operate best with direct drive or small reductions. Heavier boats respond best with larger ratios of gear reduction.

If shaft speeds are too high, a smaller than normal propeller must be used resulting in poor performance. Conversely, if shaft speeds are too low, a larger than normal propeller must be used, again resulting in poor performance.

## PROPELLER SHAFT / COUPLING

Installed angle of the engine should not exceed maximum of 16 degrees from water line.

Propeller shaft diameter should be sufficient size for the type of application.

Coupling must be keyed to the propeller shaft. The key should be a close fit with keyway sides, but should not touch the top of the keyway in the coupling hub. The coupling should be a light press fit on the shaft.

## TRANSMISSION AND PROPELLER ROTATION

For best all-around performance, it is recommended that the engines be installed so that the propellers turn outboard in dual engine applications.

**NOTICE:** Propeller rotation is not necessarily the same as engine rotation.

## PROPELLER SELECTION

**IMPORTANT:** Installed propeller must allow the engine to run at its specified, Preferred, wide-open-throttle RPM.

It is the responsibility of the boat manufacturer and/or selling dealer to equip the boat with the correct propeller. Specified engine WOT RPM is listed in the "Master Engine Specifications" found within this manual.

Because of many variables of boat designs, only testing will determine the best propeller for a particular application. A propeller should be selected that will allow the engine to operate at or near the recommended WOT operating range with a normal load. Refer to the engine RPM chart, right, or the Master Engine Specifications found in this manual.

In general, a 1 inch change in propeller pitch will result in a 100 to 200 RPM change in engine speed.

### ENGINE RPM CHART

Model	Minimum Full Load	Maximum	Preferred
MP 5.0L	4600	5000	4800
MP 5.7L	4800	5200	5000
MP 6.0L	4800	5300	5200
MP 8.1L STD	4400	4800	4600
MP 8.1L HO	4800	5200	5000

**IMPORTANT NOTICE:** Engines equipped with the ECM-07 engine management system incorporate an RPM "MAX Governor" in order to prevent the engine from over-revving. Engine operation above the Maximum RPM listed will appear normal, but will not exceed the "MAX Governor" RPM (100 RPM above the Maximum RPM specified for an engine model). Operation above the maximum RPM specified for your engine model is not recommended. If the engine is operating above the maximum RPM, a higher pitched propeller would be required to lower the engine maximum RPM to the Preferred RPM specified for your engine model.

Model	Minimum Full Load	Maximum	Preferred
Carb. 5.7L	4800	5200	5000

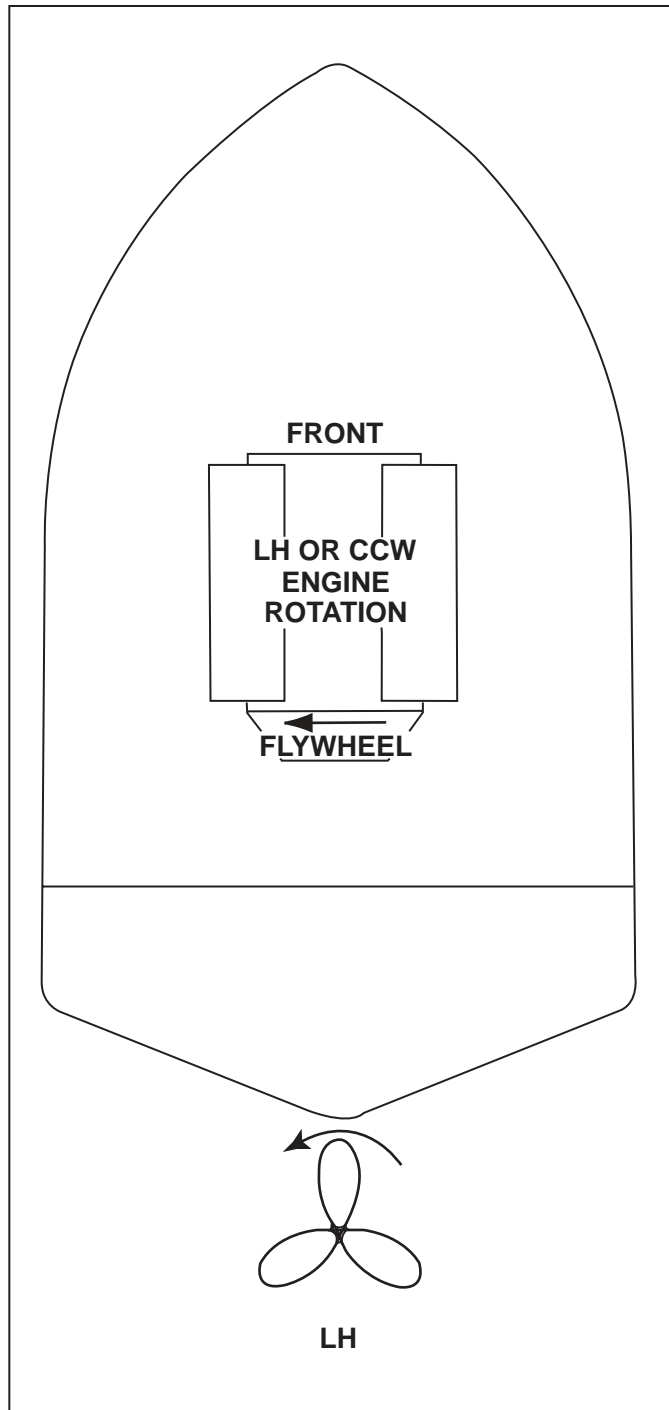


### CAUTION

Prolonged WOT operation will shorten the life of your engine and could cause premature engine failure. See **Cruising RPM (Max)** in the Master Engine Specifications. Problems caused by WOT operation are considered abuse and are not covered under the Crusader Warranty.

**Single Engine Velvet Drive In-Line Installation  
- (1:1, 1.52:1, 2.57:1 or 2.91:1 Ratio)**

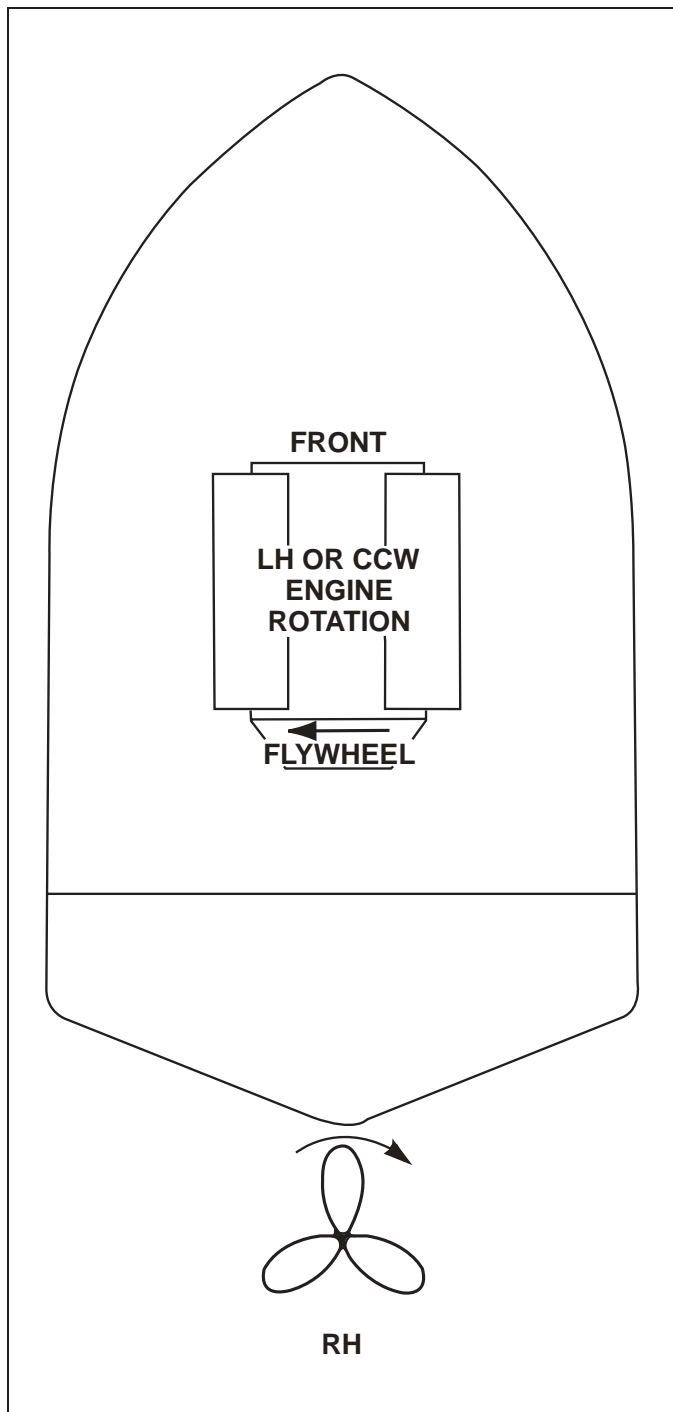
The transmission output shaft rotation is the same as the engine rotation. A LH (CCW) rotation engine requires a LH propeller.



**Figure 9** Single Engine Velvet Drive in-Line Installation  
- 1:1, 1.52:1, 2.57:1 or 2.91:1 Ratio

## Single Engine Velvet Drive In-Line Installation - (1.90:1 Ratio)

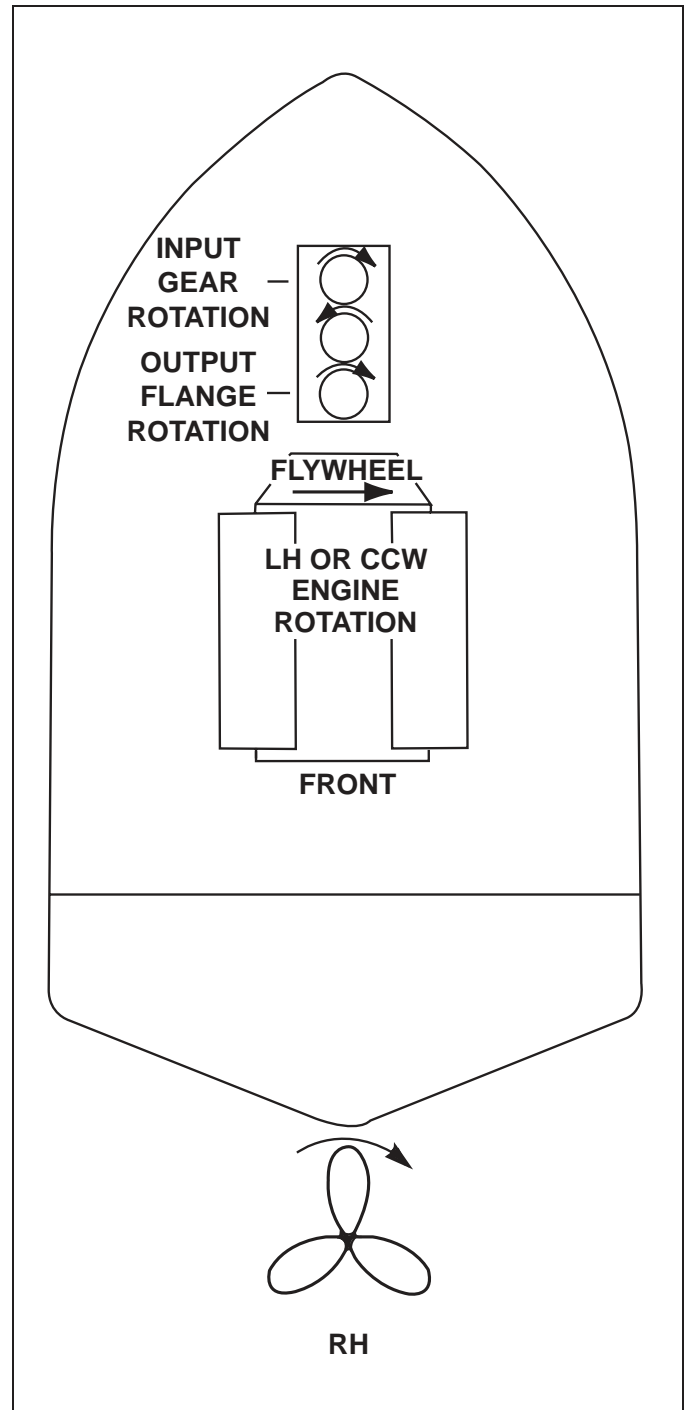
The transmission output shaft rotation is the opposite of the engine rotation. A LH (CCW) rotation engine requires a RH propeller.



**Figure 10** Single Engine Velvet Drive in-Line Installation  
- 1.90:1 Ratio

## Single Engine V-Drive Installation

The transmission output shaft rotation is the opposite of the engine rotation. A LH (CCW) rotation engine requires a RH propeller.



**Figure 11** Single Engine V-Drive Installation

## Dual Engine Velvet Drive 5000 and Hurth 630A Installation

These "Full-Reversing" transmissions rotate equally in either direction depending upon shift lever position and desired propeller rotation.

Velvet Drive 5000 gear ratios include: 1.50:1, 2.00:1, 2.45:1 or 2.80:1.

Hurth 630A gear ratios include: 1.50:1, 2.00:1, 2.50:1 or 2.70:1.

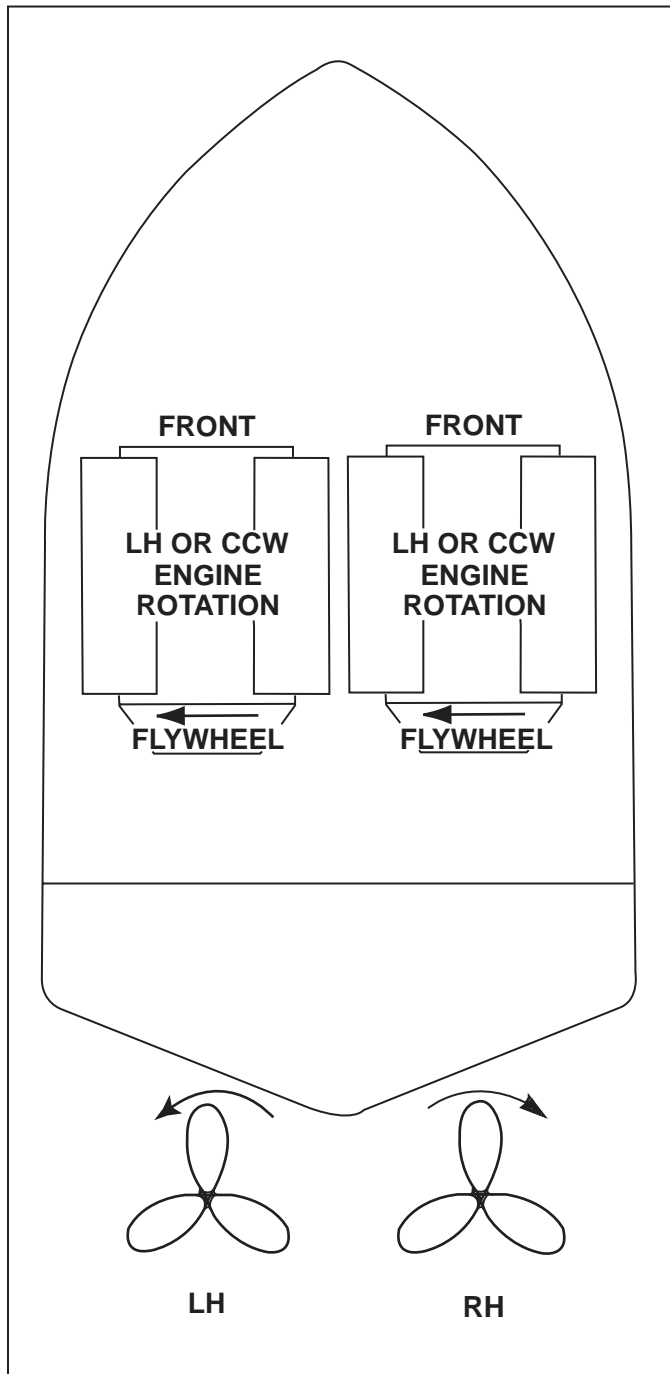


Figure 12 Dual Engine Velvet Drive 5000 and Hurth 630H Installation

## Dual Engine Velvet Drive 5000 and Hurth 630V V-Drive Installation

These "Full-Reversing" V-Drive transmissions rotate equally in either direction depending upon shift lever position and desired propeller rotation.

Velvet Drive 5000 V-Drive gear ratios include: 1.21:1, 1.51:1, 1.99:1 or 2.50:1.

Hurth 630V gear ratios include: 1.30:1, 1.55:1, 2.00:1 or 2.50:1.

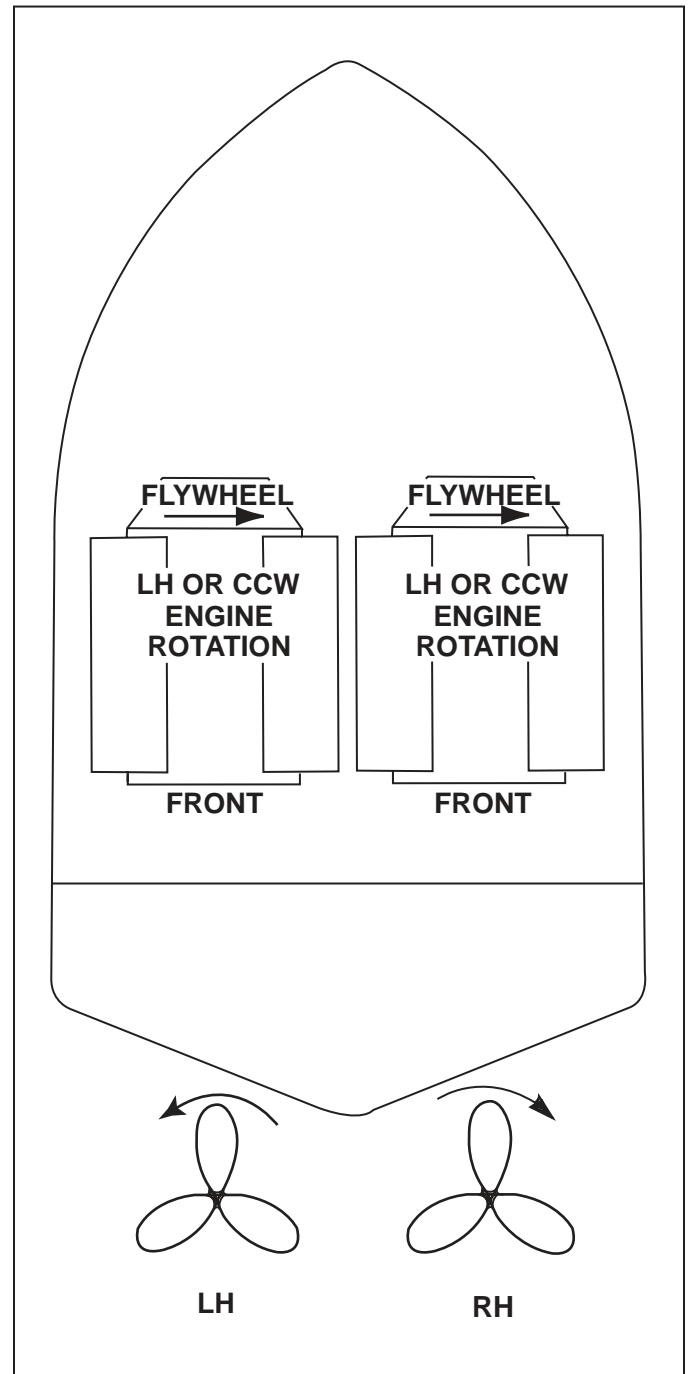


Figure 13 Dual Engine Velvet Drive 5000 and Hurth 630V V-Drive Installation

## BOAT CONSTRUCTION

### Engine Bed

The engine bed should be a horizontal type and rigid enough to maintain engine alignment at all times. Distance between the starboard and port engine mounts is 22 1/2 in. (57.15 cm). The engine bed should support the four (4) engine mounts in such a manner so that a minimum of 1/4 in. (0.64 cm) up and down adjustment still exists on all the mounts after the final engine alignment has been performed. This is necessary to allow for realigning the engine in the future.

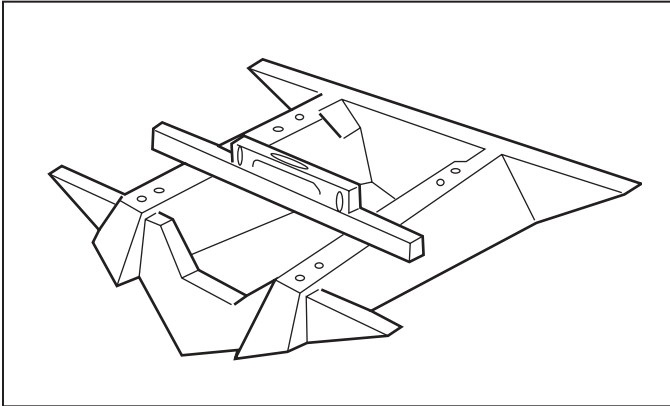


Figure 14 Engine Bed

Use adequately sized bolts to attach the engine to the stringers or mounting plates. It must be remembered that all the force used to drive the boat through the water is transferred to the hull through the engine bed. Make sure there is adequate clearance between the underside of the engine and the hull.

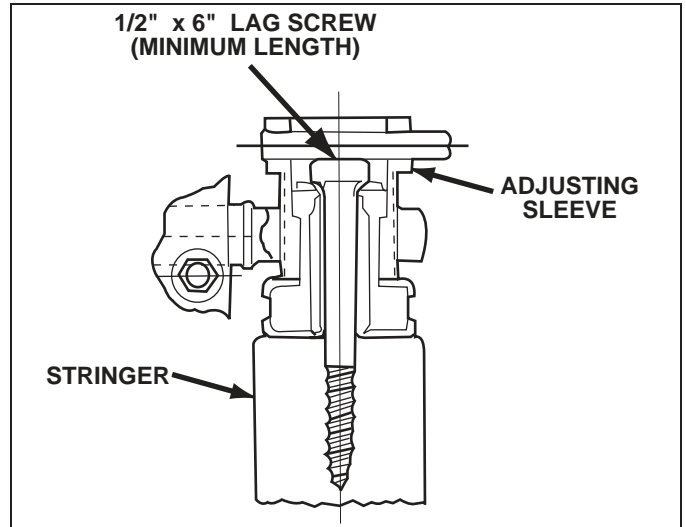


Figure 15 Engine Mount Attachment

## INSTALLATION REQUIREMENTS

### Battery/Battery Cables

**IMPORTANT:** Boating industry standards (BIA, ABYC, etc.), Federal standards and Coast Guard regulations must be adhered to when installing the battery. Be sure the battery cable installation meets the pull test requirements and that the positive battery terminal is properly insulated in accordance with the regulations.

**IMPORTANT:** Engine electrical system is negative (-) ground. It is recommended (required in some states) that the battery be installed in an enclosed case. Refer to the regulations in your area.

1. Select a battery that meets all of the following specifications:
  - A. 12-volt marine type
  - B. Tapered post connections
  - C. Reserve capacity rating of at least 100 minutes

#### MINIMUM 12-VOLT BATTERY SIZE

All Engines	650 CCA	120 Ah
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2. Select the proper size positive (+) and negative (-) battery cables using the chart. Battery should be located as close to the engine as possible.
3. In twin engine applications, it is recommended that both engines be grounded together using a cable of adequate gauge.



**IMPORTANT: Terminals must be soldered to the cable ends to ensure good electrical contact. Use electrical grade (resin flux) solder only. Do not use acid flux solder as it may cause corrosion and a subsequent failure.**

BATTERY CABLES	
Cable Length	Cable Gauge
Up to 3-1/2 ft. (1.1 m)	4 (19 mm <sup>2</sup> )
3-1/2 - 6 ft. (1.1 - 1.8 m)	2 (32 mm <sup>2</sup> )
6 - 7-1/2 ft. (1.8 - 2.3 m)	1 (40 mm <sup>2</sup> )
7-1/2 - 9-1/2 ft. (2.3 - 2.9 m)	0 (50 mm <sup>2</sup> )
9-1/2 - 12 ft. (2.9 - 3.7 m)	00 (62 mm <sup>2</sup> )
12 - 15 ft. (3.7 - 4.6 m)	000 (81 mm <sup>2</sup> )
15 - 19 ft. (4.6 - 5.8 m)	0000 (103 mm <sup>2</sup> )

## INSTRUMENTATION

	<b>CAUTION</b>
<p>If a Crusader wiring harness is used, and a fused accessory panel is to be installed (30 amp current draw maximum), be sure to connect it as shown in wiring diagram. Do not connect accessory panel at any other location, as wires in wiring harness may not be of sufficient size to handle current load.</p>	

For ECM-07 equipped engines, instrumentation at the dash is no longer driven by separate senders on the engine. Instrumentation is now driven by the engine control module (ECM-07) and is just another function of the engine management system. As such, programming or calibration of the ECM is critical for proper instrumentation operation.

The 4 basic gauges which must be used with the engine are:

- Tachometer
- Oil Pressure
- Water Temperature
- Voltmeter

If you experience erroneous instrumentation readings, the most common reasons for this condition are:

- (1) The boat is equipped with dual helm instrumentation. Verify through your selling distributor/dealer that the calibration in the ECM is for dual helm instrumentation.
- (2) Some instruments may still require instrument specific senders to be installed on the engine. Contact your selling distributor/dealer with your

instrument manufacturer's name. You may need to install an oil pressure and water temperature sender on your engine and use a different engine to boat harness adapter.

- (3) Faulty wire connections at the instrument panel and/or the old instruments are defective and need to be replaced.

Refer to pages 20 and 25, for replacement boat harnesses, adapter harnesses, and Sync-N-Cruz Speed Control Harness + FWMurphy Instrument interface.

Crusader Engines are equipped with the ECM-07 engine management system. This system outputs J1939 and NEMA 2000 protocol messages that may be utilized by various manufacturers of multifunction displays; such as, FWMurphy's CAN Bus instruments and PowerView and HelmView, which provide expanded display capabilities.

**Always check with the manufacturer of the instrument you are considering, prior to purchase, for compatibility.** These multifunction digital displays not only display typical engine data, such as oil pressure, water temperature, tach, etc., but also provide expanded displays for fuel consumption, ECM-07 diagnostic code display, and much more.

When replacing or installing the main boat harness, route the instrumentation wiring harness back to the engine, making sure that the harness does not rub or get pinched. If an extension harness is required, be sure to secure the connection properly. Fasten harness to the boat at least every 18 in. (45.72 cm) using appropriate fasteners.

## TWIN ENGINE SYNCHRONIZATION AND SPEED CONTROL (OPTIONAL)

MY 2007 and newer multi-port fuel injected engines are equipped with the ECM-07 engine management system. This new system has allowed more features to be available than ever before. One of significance is the ability to provide twin engine synchronization and speed control without having to add expensive aftermarket equipment. This feature is available on all ECM-07 multi-port fuel injected engine models. Refer to the diagram on page 23 for the accessory harnesses and keypad required to enable this feature.

REQUIREMENTS:

- **Master/Slave Harness - RA121072C**
- **Sync-N-Cruz Kit - RF152007**

NOTE: The Sync-N-Cruz Control Panel and harnesses are available as separate items for unique installation requirements. Refer to page 23 for harness options.

**IMPORTANT:** Sync-N-Cruz harness must be connected to the Master engine.

**Refer to the Crusader Owners Manual for operating instructions for the Sync-N-Cruz system.**

When installing the Sync-N-Cruz harness, route the harness back to the Master engine, making sure that the harness does not rub or get pinched. If an extension harness is required, be sure to secure the connection properly. Fasten harness to the boat at least every 18 in. (45.72 cm) using appropriate fasteners.

## MASTER/SLAVE WIRING CONNECTION

This connection allows the CAN Bus data lines to be joined together for dual engine applications.

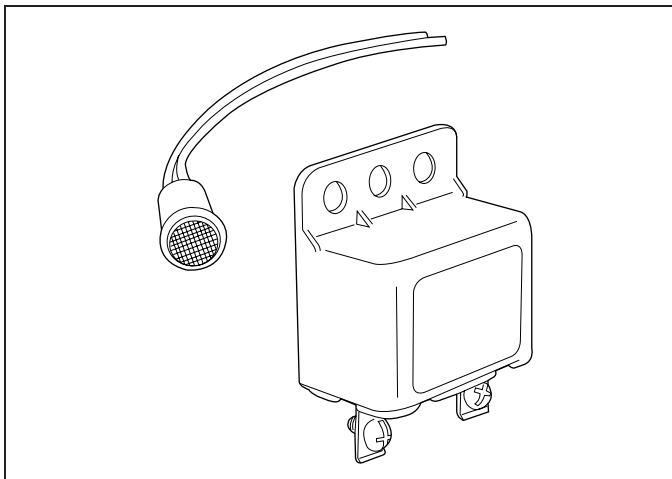
The benefits of a Master/Slave connection are:

- Allows for twin engine Sync-N-Cruz operation.
- Electronic Engine Monitor systems installed at the helm area may display engine data for both engines.

**IMPORTANT:** In dual engine applications, the master/slave wiring harness is used to connect the engines together. One end of this harness has one more wire in it than the other end. The end with the extra wire is plugged into the Slave engine harness. This extra wire is then attached to the ground stud on the Slave engine.

## ENGINE WARNING KIT (OPTIONAL)

An engine warning kit, RK179008, is available. This kit contains a Check Engine Lamp and Warning Buzzer. It is recommended that the boat be equipped with a Check Engine Lamp (Malfunction Indicator Lamp - MIL) and buzzer. These devices warn the boat operator of potential engine problems.



**Figure 16** Optional Warning Light / Alarm - Crusader Part No. RK179008

Some boat wiring may already support these devices and/or they may already be installed at the helm. Ensure that the new connections match up to the existing boat wiring and warning devices.

Ensure the light and buzzer wires are in the existing boat harness, otherwise new wires will have to be run from the helm to the engine. Use 18 ga minimum wire size,

making sure that the wires do not rub or get pinched. Fasten wire(s) to the boat at least every 18 in. (45.72 cm) using appropriate fasteners.

- **Using existing Round 10-pin BOAT harness connector**

Pin-4 = Buzzer

Pin-9 - MIL or Check Engine Lamp

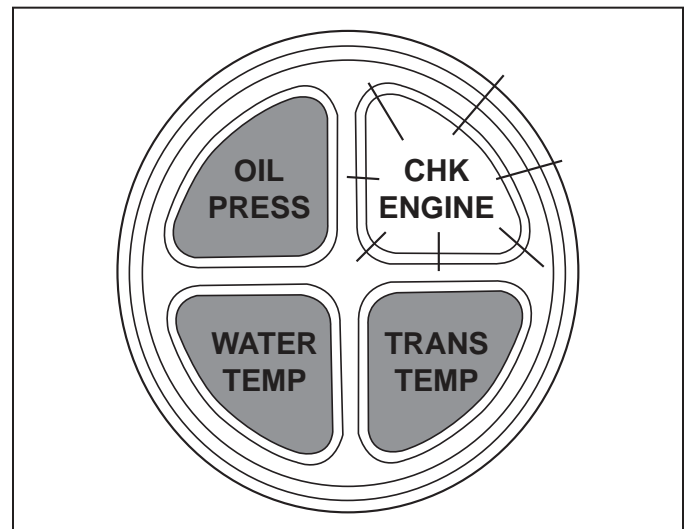
Verify that connections exist at the helm. If not, two new wires will be required between the helm and pins 4 (MIL) and 6 (Buzzer) of the Engine harness 8-pin Deutsch connector.

- **Using existing Rectangular 8-pin BOAT harness connector**

\* Requires two additional wires for the MIL and Buzzer. The MIL is connected to pin-6 and the Buzzer is connected to pin-4 of the Engine harness, 8-Pin, Deutsch connector.

- **Using the Crusader boat harness (P/N RA121092/RA121092A),** the MIL is wired at the helm to the Green/Yellow wire and the Buzzer is wired to the Tan/Black wire.

- **If previously equipped with the Optional Crusader Warning Light Cluster P/N 23505:**

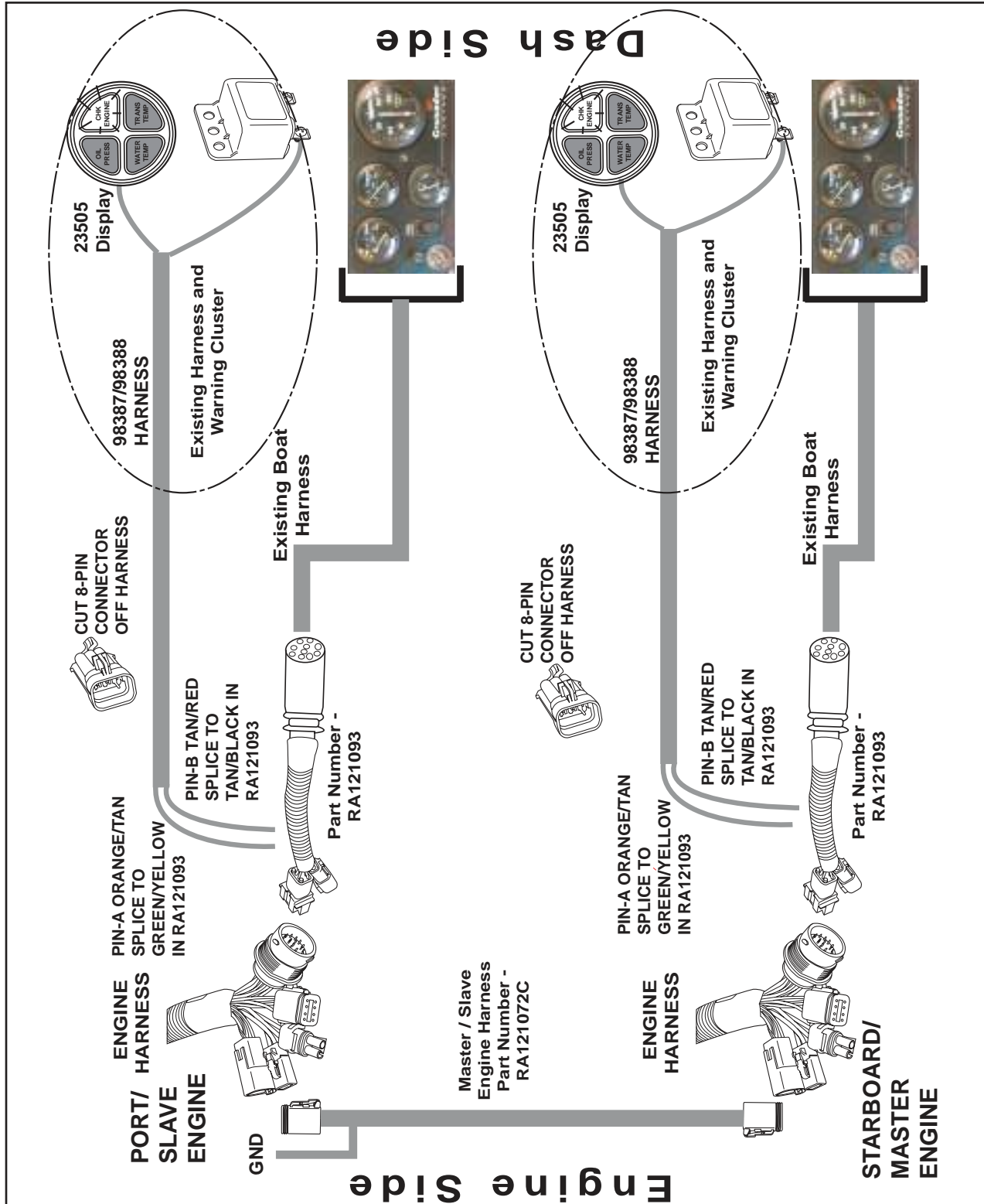


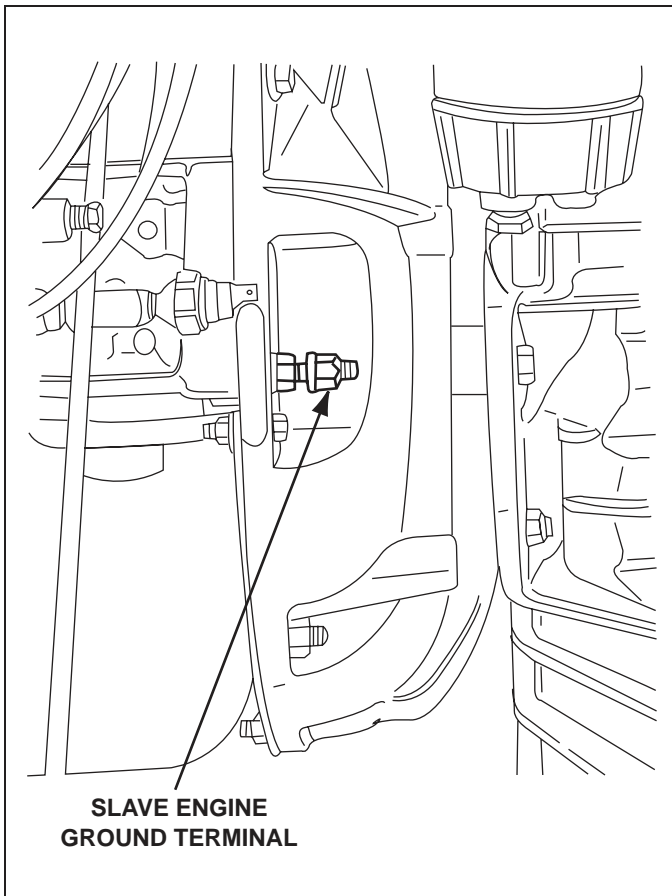
**Figure 17** Optional Warning Light Cluster - Crusader Part No. 23505

The Check Engine lamp, of the cluster, and the existing Buzzer may be used with ECM-07 engine models.

(1) At each engine, locate the Warning Cluster Harness, 8-pin connector. The wires at Pin-A (Orange/Tan wire, Check Engine Lamp) and Pin-B (Tan/Red wire, Buzzer) will be the only wires used. Cut the 8-Pin connector off of the harness and tape back the wires not used.

(2) Splice pin-A (Orange/Tan) to pin-6 of the respective engine 8-pin Deutsch connector and pin-B (Tan/Red) to pin-4 of the engine 8-pin connector. **Only**, the Check Engine Lamp and alarm buzzer of the warning cluster will be functional. **Refer to the wiring diagram below for connection/splice options for the MIL and Buzzer.**



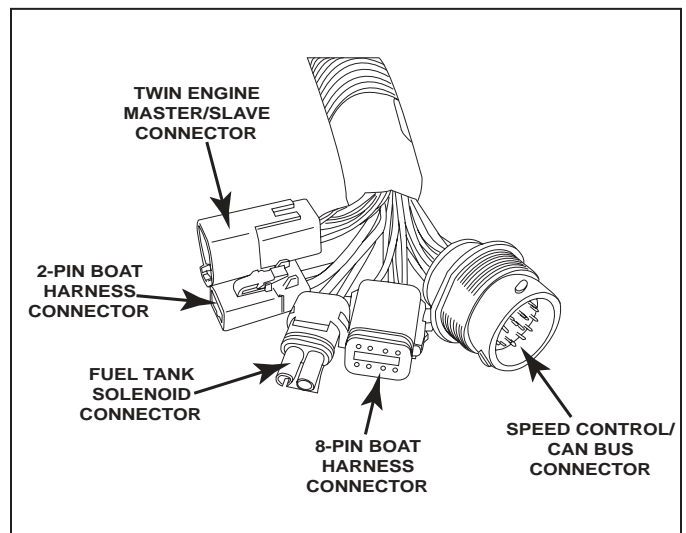


**Figure 18** ECM Slave Ground Terminal

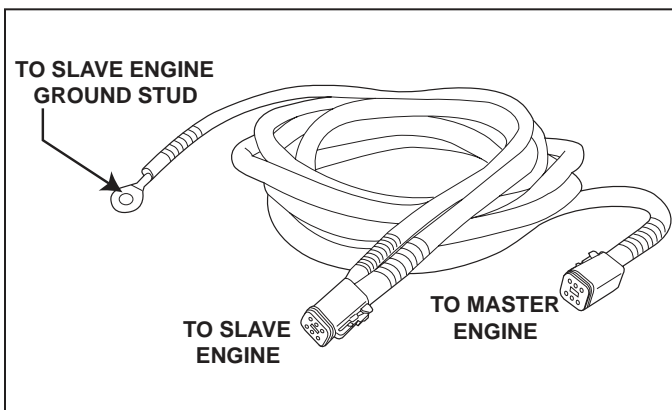
## ELECTRICAL SYSTEM PRECAUTIONS

To avoid damage to the electronic fuel injection (EFI) system, the following precautions must be observed when adding additional electric accessories.

- DO NOT reverse battery leads.
- DO NOT splice wires into engine electrical harness.
- DO NOT puncture engine wires for testing (probing).
- DO NOT attempt engine diagnostics without the proper service tools.
- DO NOT attach any accessory wiring to the ECM ground location.



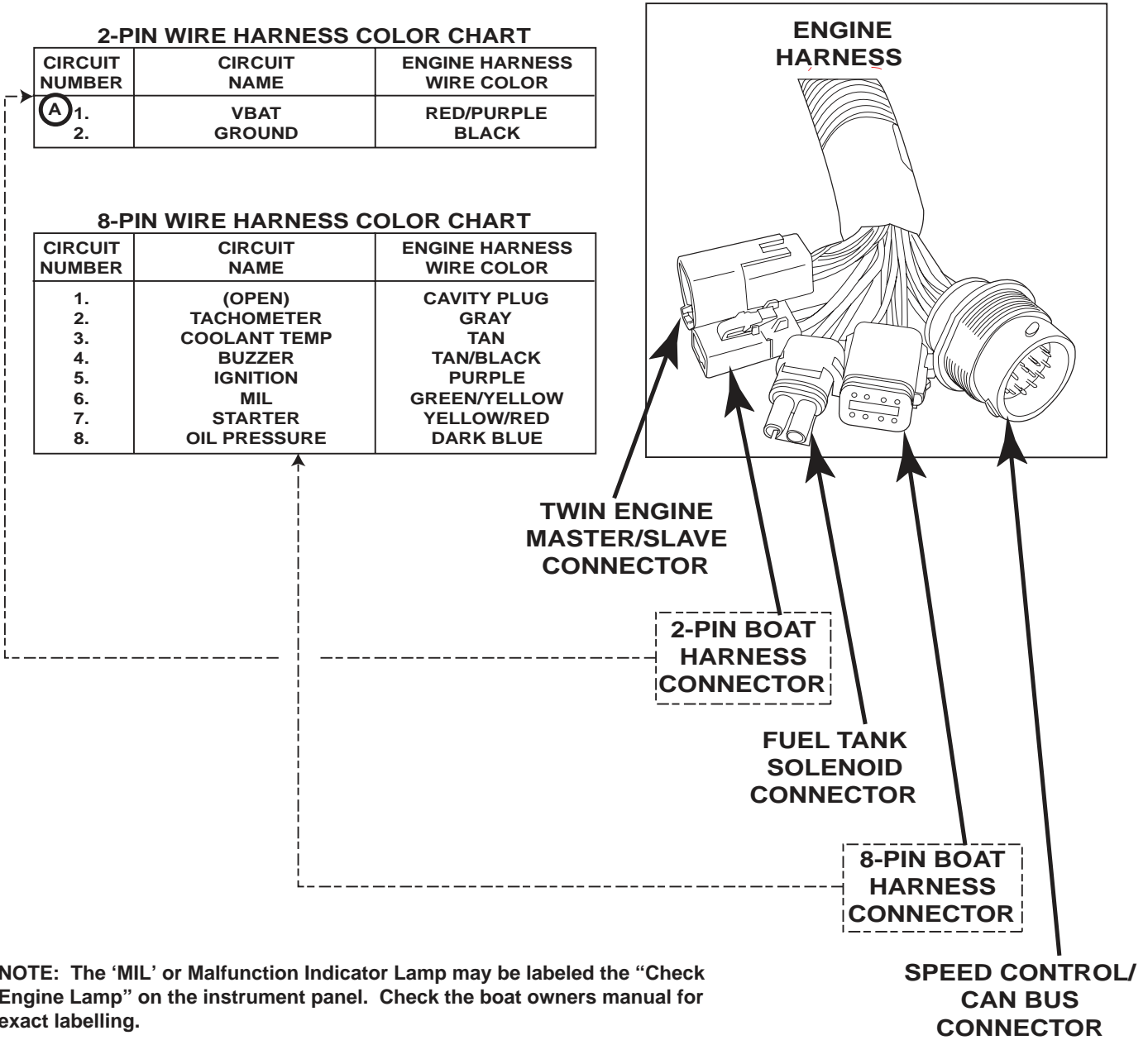
**Figure 20** Electrical System Connectors



**Figure 19** Master / Slave Wire Harness

**INSTALLATION NOTE:** When installing the Optional Crusader Sync-N-Cruz system, the speed control harness (RA121091/RA121091A) **MUST** be connected to the **Master** engine, 20-Pin Speed Control/ CAN Bus Connector and the master/slave harness (RA121072C) must connect the Master and Slave engines together. Ensure that the Slave side of the harness is grounded to the Slave engine.

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.



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 20A - Electrical System Connectors

**INSTALLATION NOTE:** When installing the Optional Crusader Sync-N-Cruz system, the speed control harness (RA121091/RA121091A) MUST be connected to the **Master** engine, 20-Pin Speed Control/CAN Bus Connector **and** the Master/Slave harness (RA121072C) must connect the Master and Slave engines together. Ensure that the Slave side of the harness is grounded to the Slave engine.

## CRUSADER CLASSIC 5.7L CARBURETOR - ELECTRICAL SYSTEM PRECAUTIONS

To avoid damage to the electrical system, the following precautions must be observed when adding additional electric accessories.

- DO NOT reverse battery leads.
- DO NOT splice wires into engine electrical harness.
- DO NOT puncture engine wires for testing (probing).
- DO NOT attempt engine diagnostics without the proper service tools.
- DO NOT attach any accessory wiring to the ECM ground location.

## CRUSADER CLASSIC ACCESSORIES

Instrument panels, wiring harnesses, propeller shaft couplers, etc. are available for this product. Contact your Crusader Engines Distributor or Crusader Engines Sales Department for a listing of these options. A list of Distributors is provided at the end of this manual.

## ENGINE INSTALLATION ACCESSORIES

Electric Fuel Solenoid Valve	P/N 23532
Solenoid Valve Power Harness	P/N 98452
Water Separating Fuel Filter Kit	P/N RK080033
Adapter - Engine to Boat Harness 10-Pin to 8-Pin Male	98218
Adapter - Engine to Boat Harness 10-Pin to 8-Pin Female	R121073

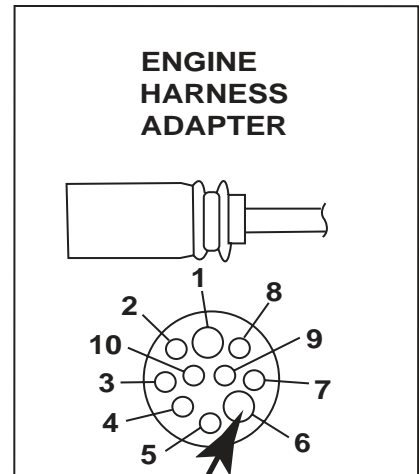
**NOTE:** *Twin engine Sync-N-Cruz, multifunction displays, and CAN-Bus instrumentation options are not available with the Crusader Classic series engines.*

### WIRE HARNESS COLOR CHART

CIRCUIT NUMBER	CIRCUIT NAME	ENGINE HARNESS WIRE COLOR
1.	GROUND	BLACK
2.	TACHOMETER	GRAY
3.	WATER TEMPERATURE	TAN
4.		N/C
5.	IGNITION	PURPLE
6.	BATTERY	RED
7.	STARTER	YELLOW/RED
8.	OIL PRESSURE	LT. BLUE
9.		N/C
10.		N/C

**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.



**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 how 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.

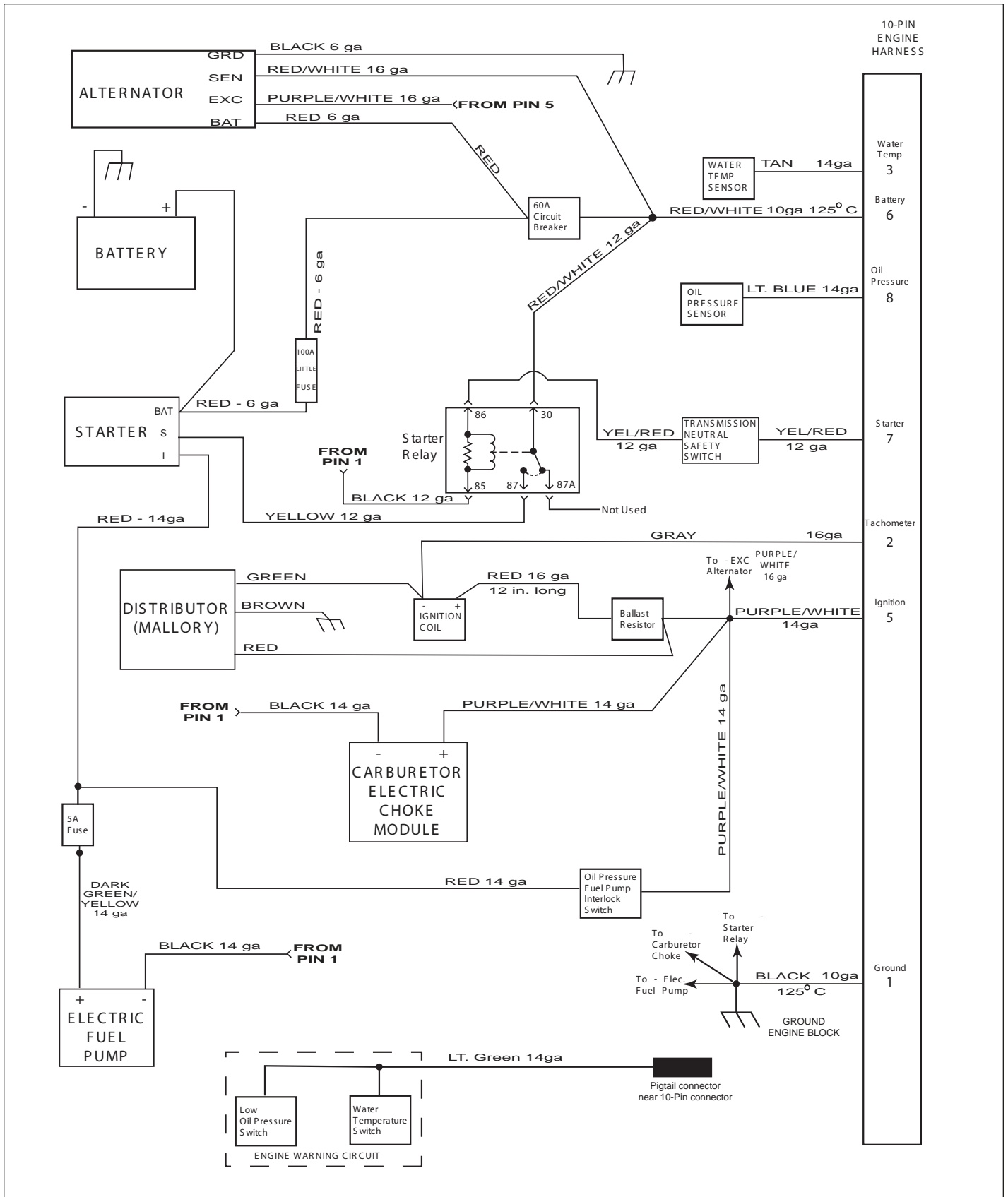
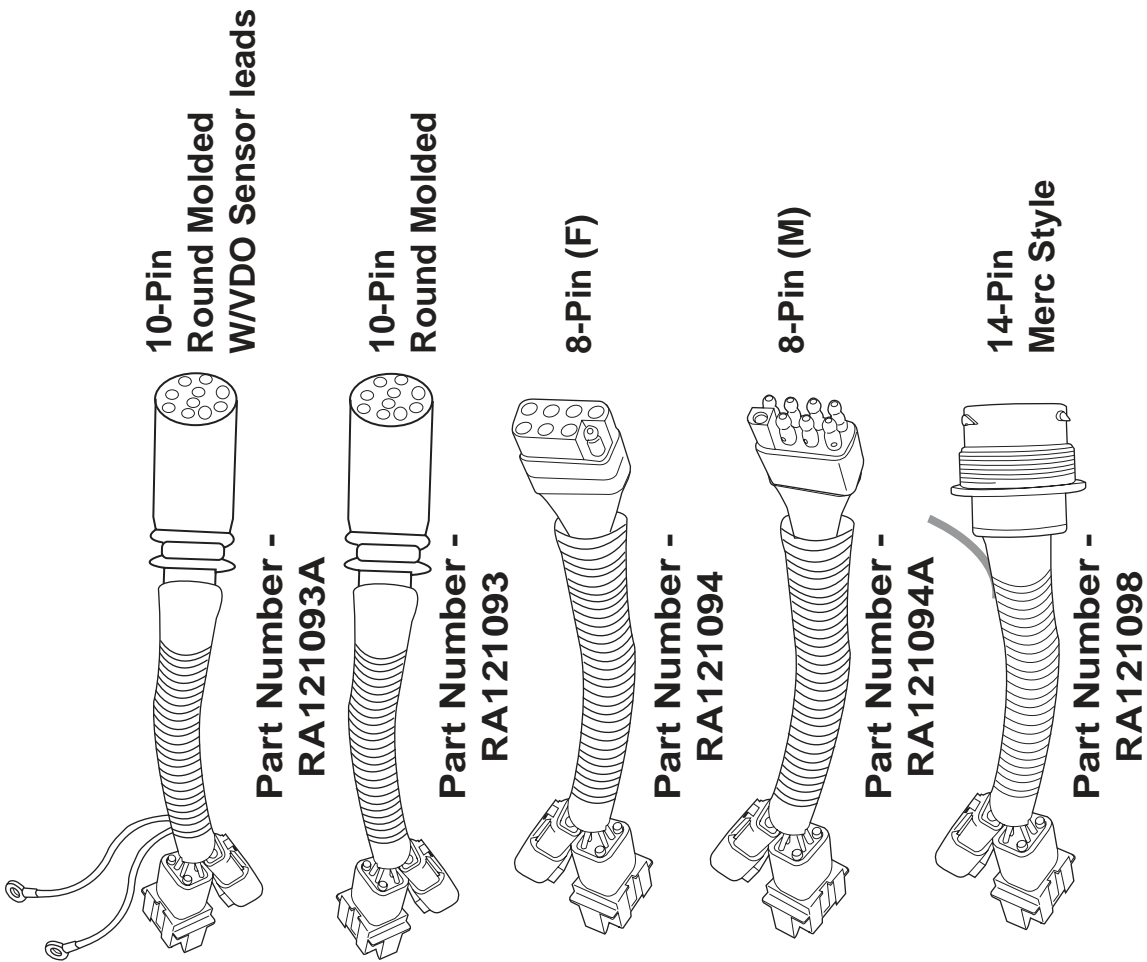


Figure 20B Typical Engine Wiring w/Mallory Ignition - Crusader Classic 5.7L Carburetor

# Boat Adapter Harnesses

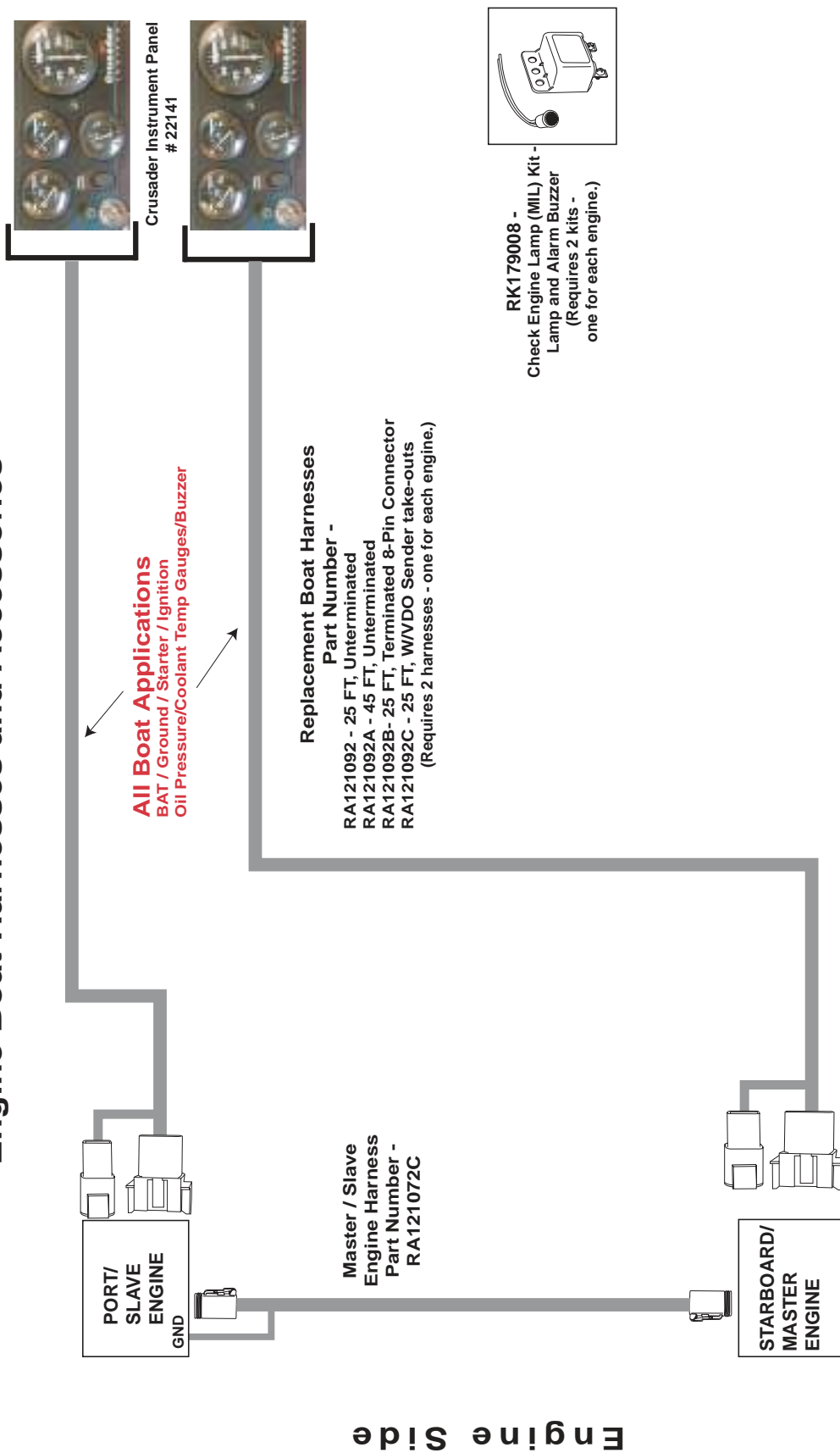
Engine Side

Dash Side





# Engine Boat Harnesses and Accessories



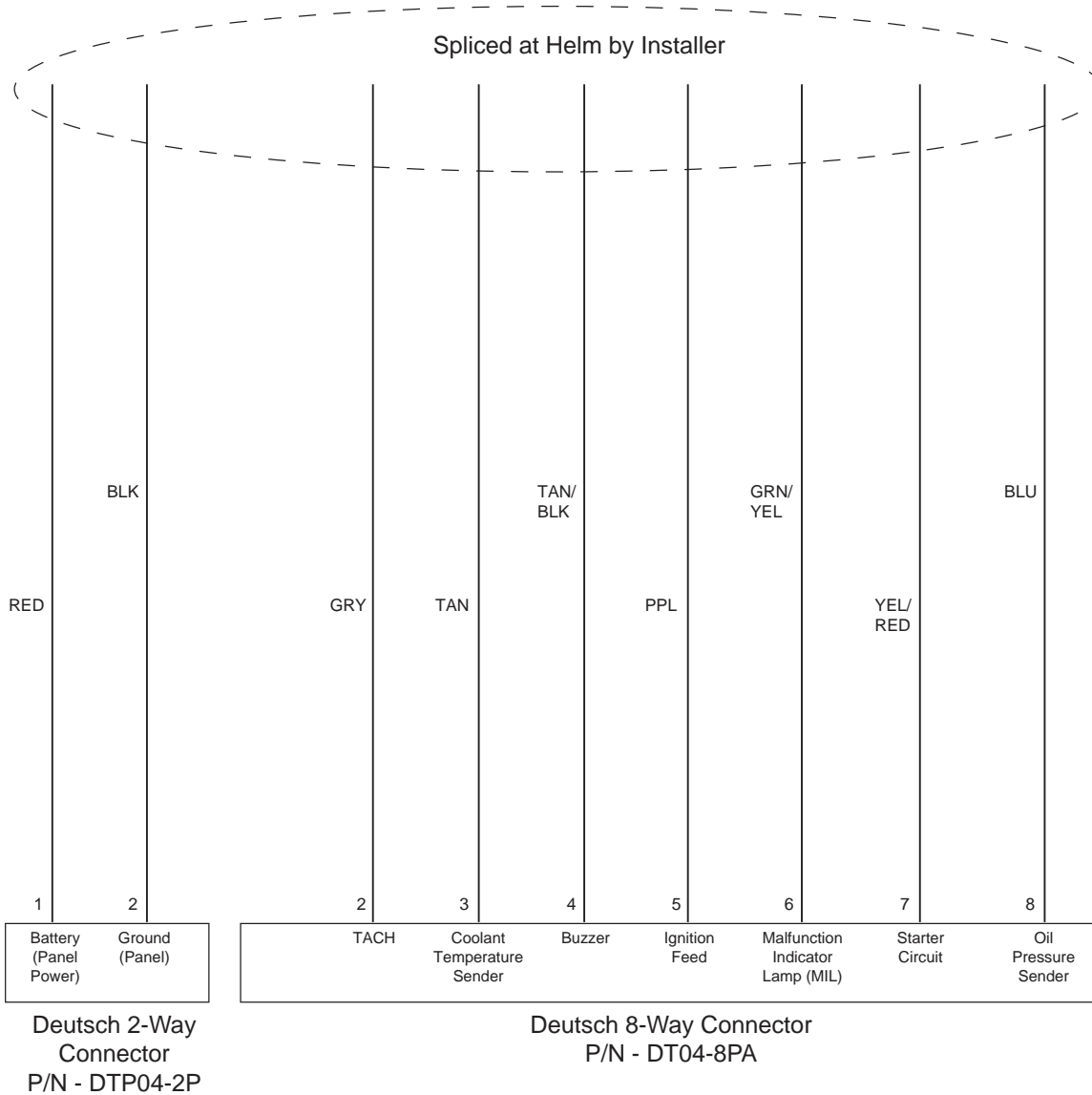
NOTE: The above illustration represents a typical twin engine installation using Crusader harnesses and accessories.

Crusader supplied Boat Extension Harnesses

RA121092 = 25 ft

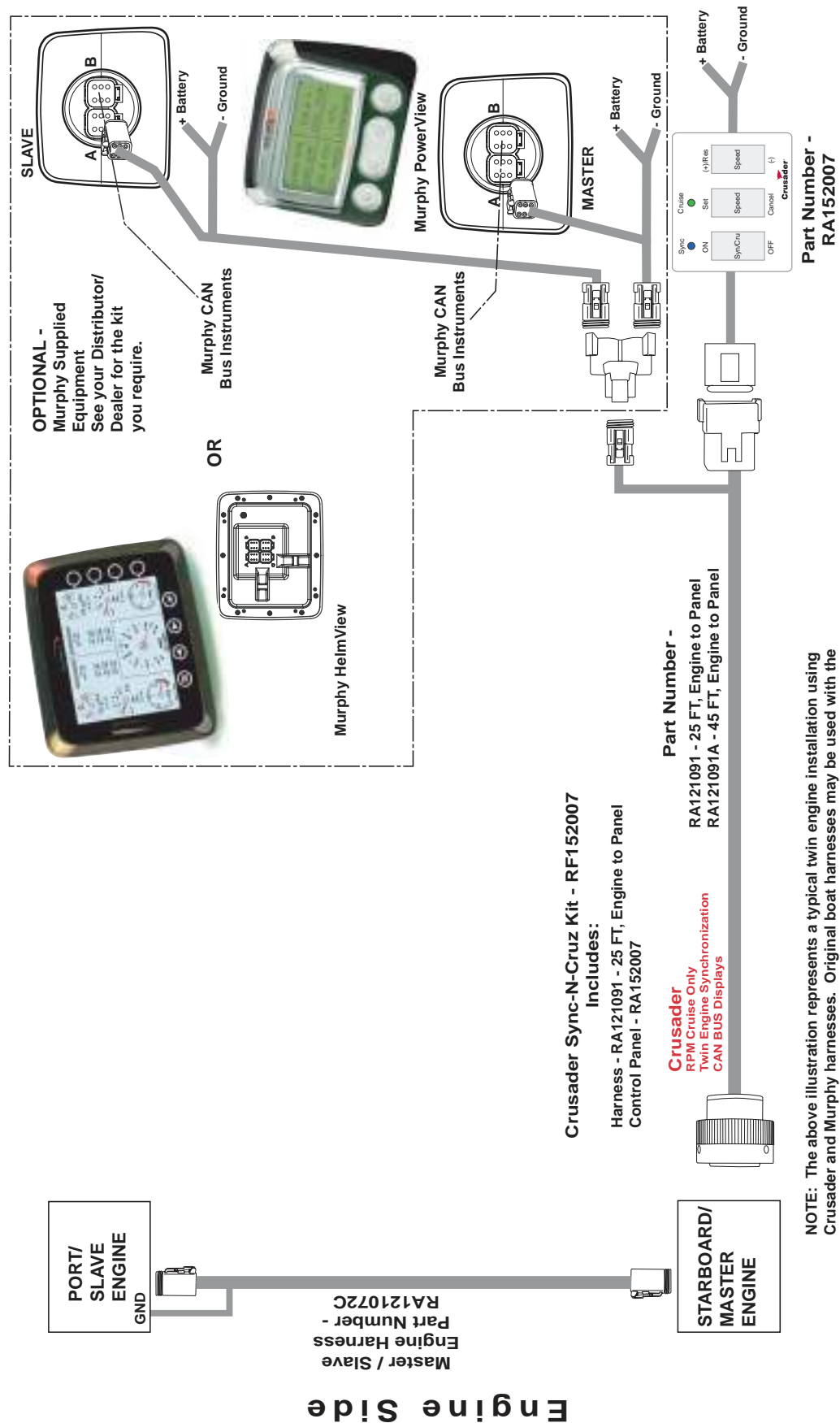
RA121092A = 45 ft

\*\*\*Extension harnesses are used to connect engine wiring to the helm.

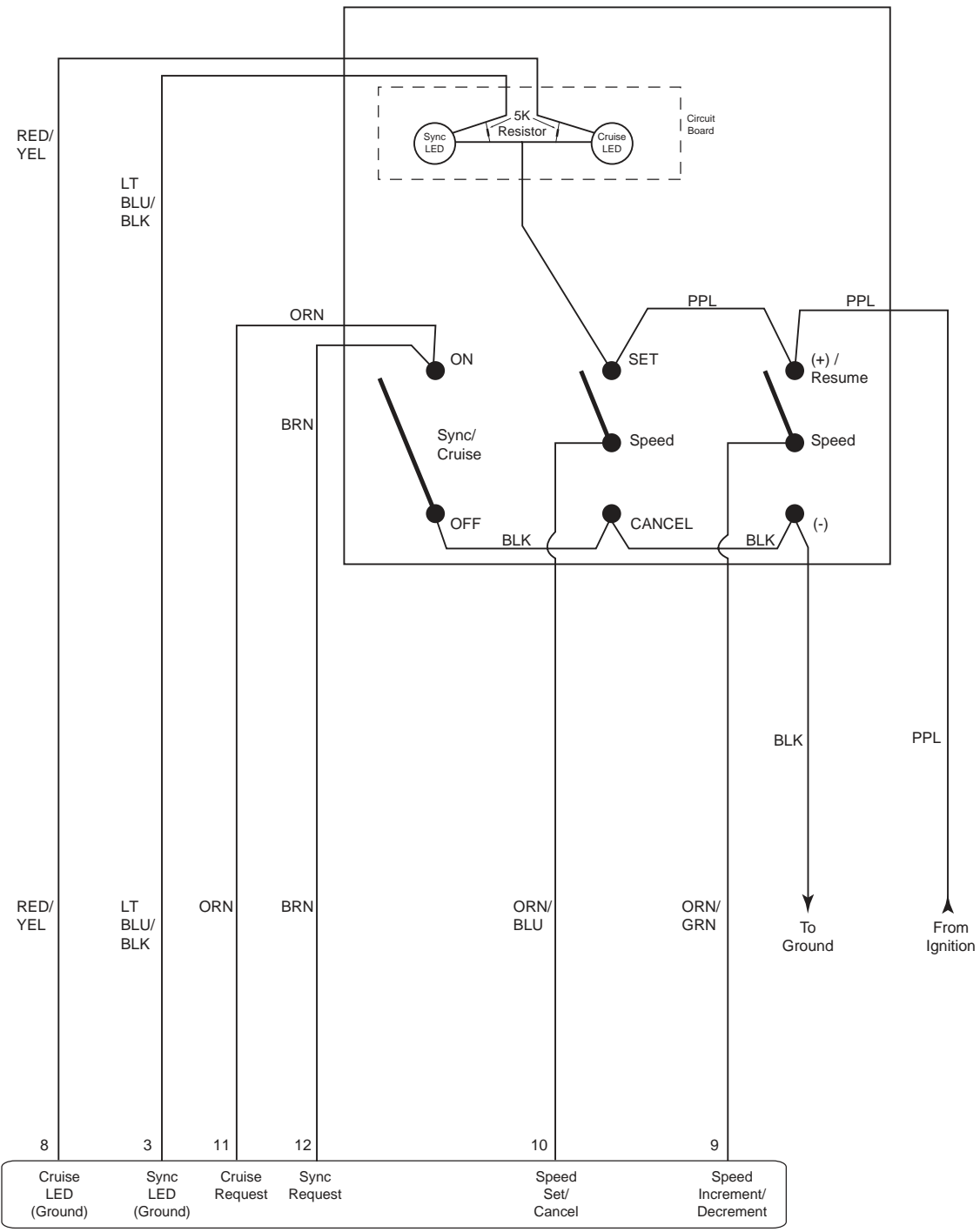


RA121092\_092A  
9-28-06

# Engine Speed Control / CAN-Bus Harnesses



Sync/Cruise Switch Panel (RA152007)



Deutsch 12-Way Connector  
P/N - DT06-12S

**Note:** Panel 12-Way connector plugs directly into the following Crusader supplied Boat Speed Control Harnesses:  
RA121091  
RA121091A

\*\*\*See the following pages for schematics of these harnesses.

RA152007  
9-28-06

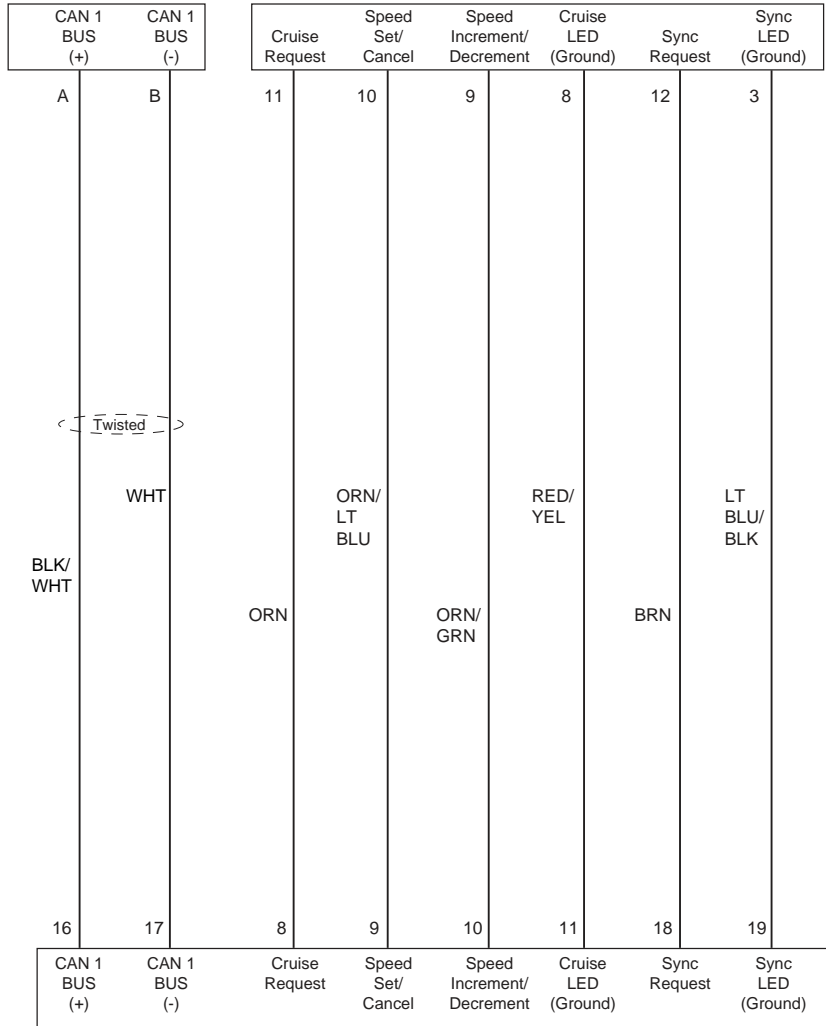
Crusader supplied Boat Speed Control Harnesses

RA121091 = 25 ft

RA121091A = 45 ft

Deutsch 3-Way  
Connector  
P/N - DT06-3S

Deutsch 12-Way  
Connector  
P/N - DT04-12PA



Deutsch 20-Way Connector  
P/N - HDP26-18-20SN

RA121091\_091A  
9-28-06

## ENGINE COMPARTMENT VENTILATION

### USCG & ABYC Standards

United States Coast Guard regulations (33 CFR Section 183, subpart J & K) must be adhered to in any fuel and ventilation system installation. In addition, we strongly suggest that ABYC's recommendations regarding fuel systems and engine room ventilation be followed.

Care must be exercised in the design and construction of the engine compartment. Hatch openings must be located so that any rain water, which may leak through the seams, is directed away from the engine. If water enters the flame arrestor, it can enter the engine and cause serious damage to internal engine parts.

**IMPORTANT: Crusader Engines will not honor any warranty claim for engine damage as a result of water entry.**

Over the past several years, engine compartments have been made smaller and insulated to be quieter. This trend, while resulting in quieter boats, has resulted in higher engine compartment temperatures. It is important that attention be given to the air temperatures inside the engine compartment while running and for a period of time after the engine is shut off. This period of time after shutting off the engines is critical as temperatures normally rise (heat soak) and can lead to fuel vapor lock causing the engine startability problems.

Engine compartment must be designed to provide a sufficient volume of air for engine breathing, and must vent off any fumes in engine compartment. It should also be designed to allow heated air to escape and maintain low temperatures during engine operation. Cool air should enter the engine compartment as low as possible and heated air should be vented from as high a point as possible.

**IMPORTANT: The size of ventilation opening must be increased if any auxiliary equipment, such as generators, is located in the engine compartment.**

ENGINE AIR REQUIREMENTS AT WIDE-OPEN-THROTTLE	
Model	Volume
MP 5.0L	670 ft <sup>3</sup> /min (0.320 m <sup>3</sup> /sec)
MP 5.7L	670 ft <sup>3</sup> /min (0.320 m <sup>3</sup> /sec)
MP 6.0L	670 ft <sup>3</sup> /min (0.320 m <sup>3</sup> /sec)
MP 8.1L STD	697 ft <sup>3</sup> /min (0.329 m <sup>3</sup> /sec)
MP 8.1L HO	697 ft <sup>3</sup> /min (0.329 m <sup>3</sup> /sec)

**Air requirements listed are for single engine and must be doubled for dual engine installations.**

The pressure differential (outside engine compartment versus inside engine compartment) should not exceed 2 in. (51 mm) of water (measured with a manometer) at wide open throttle.

Engine Compartment & Fuel Temperature Testing capable of operation throughout an ambient (air temperature) range from 20° to 150°F (-7° to 65°C) without failure. Crusader EFI and associated components meet this standard.

Because electronic fuel injection systems require higher fuel delivery pressures and higher volumes, fuel temperatures become an issue. Engine compartment temperatures have been measured in excess of 200°F (82°C). High fuel temperatures may lead to excessive vapor in the fuel line, particularly when gasoline containing alcohol and the newer "reformulated" blends are used. A maximum fuel temperature at the fuel pump inlet of 105°F (40°C) and an ambient engine room temperature of 150°F (65°C) must be adhered to.

To test for ambient air and fuel inlet temperature compliance, proceed as follows:

The boat being tested should be a standard production boat. The temperature meter used must be of a type which can be read with the engine compartment closed. The engine compartment is to remain closed and no air is to be forced into the engine compartment during the test. The bilge blower should not be running.

- Install thermal couples 1 in. (25 mm) above each flame arrestor for air temperature measurement.
- Tee another thermal couple into the fuel line(s) at the fuel pump inlet for measuring fuel temperature.
- Operate the engine(s) until engine and bilge temperatures are stabilized. This usually occurs when operating the engine under cruise conditions for a minimum of one hour.
- Shut engine(s) off and monitor temperatures for an additional hour. Air temperature should not exceed 150°F (65°C) and fuel temperature should not exceed 105°F (40°C) at any time, either during engine operation or engine off (hot soak).
- After the one hour hot soak test, start the engine and let it idle (in neutral) for 20 minutes. Continue to record temperatures for another 20 minutes.

If temperature limits are exceeded at any time during this test, it is necessary to reevaluate the fuel system and/or bilge ventilation and take appropriate measures to maintain temperatures at or below the specified limits at all times.

## FUEL SUPPLY AND RETURN CONNECTIONS

### USCG & ABYC Standards

United States Coast Guard regulations (33 CFR Section 183, subpart J & K) must be adhered to in any fuel and ventilation system installation. In addition, we strongly suggest that ABYC's recommendations regarding fuel systems and engine room ventilation be followed.



#### CAUTION

Using Loctite Pipe Sealant with Teflon, lightly coat all threads of the fuel fittings used at the tank, fuel filter, fuel pumps, etc. DO NOT use Teflon tape.

A flexible fuel line must be used to connect fuel line to and from the engine to absorb deflection when the engine is running. The accompanying drawing illustrates the typical location on the engine for connection of fuel supply and return lines. Remove shipping plugs and connect fuel lines to the locations shown.

1. Fuel pickup should be at least 1 in. (25 mm) from the bottom of the fuel tank to prevent picking up impurities.

2. Dual installations; it is best to use a fuel pickup and supply line for each engine. If a single pickup and line is used, **fittings and line must not be smaller than 1/2 in. (13 mm) I.D.**
3. Fuel tanks must have at least **1/2 in. (13 mm)** shut-off valves and fittings on the fuel supply line and **3/8 in. (10 mm)** shut-off valves and fittings on the fuel return line.
4. There must be free flow into the top of the tank for the return fuel line. There must not be a "dip tube" extending into the tank.
5. On installations requiring long lines or numerous fittings, larger size lines (than previously specified) should be used.
6. Fuel line should be installed free of stress, and firmly secured to prevent vibration and/or chafing.
7. Sharp bends in fuel lines should be avoided.
8. A flexible fuel line must be used to connect fuel line to the engine fuel pump to absorb deflection when engine is running.
9. Route all fuel lines as low in the bilge as possible to take advantage of the cooler ambient temperatures found there.

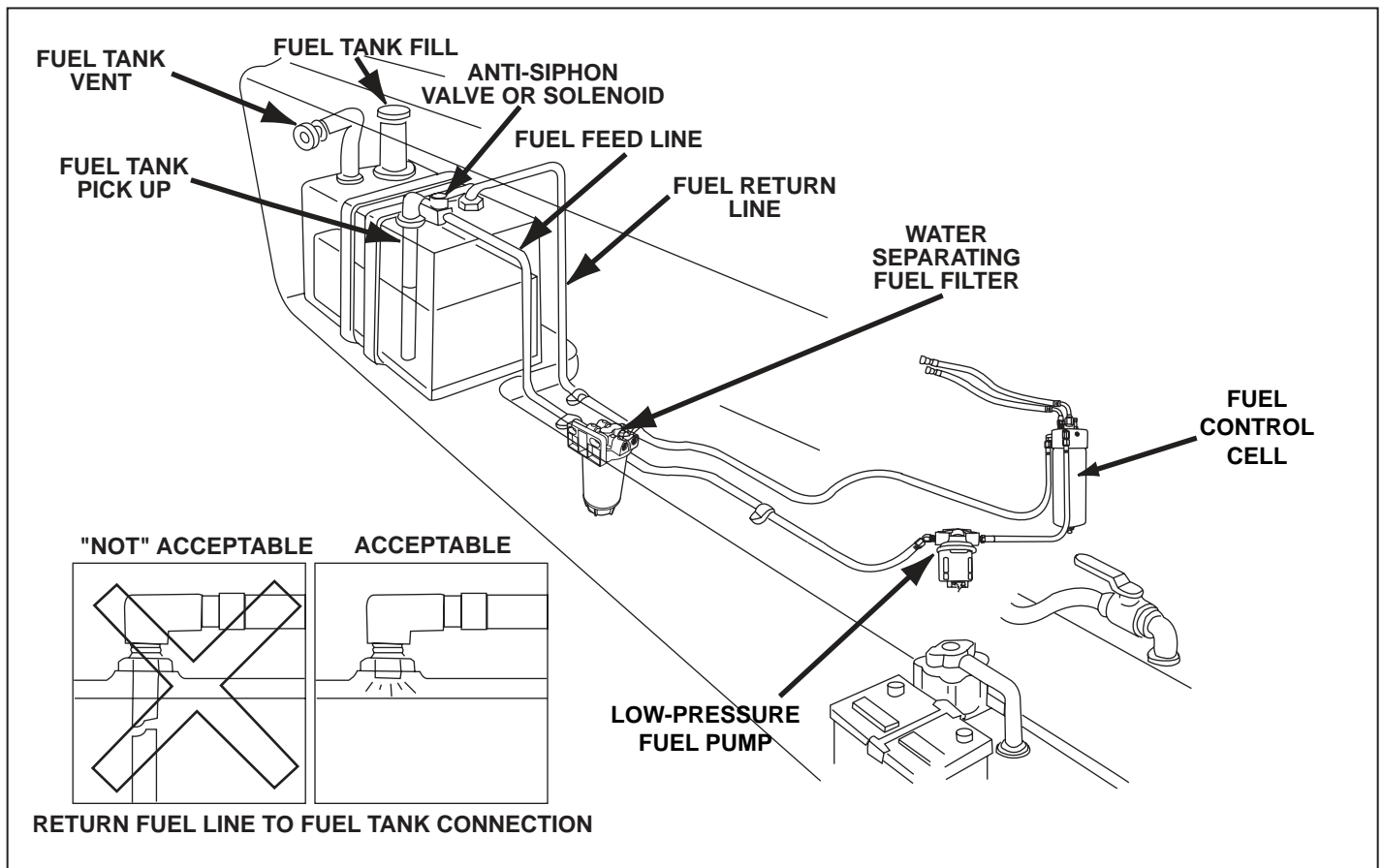


Figure 21 Engine and Fuel Line Installation

## FUEL INLET RESTRICTION

The maximum allowable inlet restriction at the electric fuel pump inlet is 2 in. Hg (6.75 kPa) at 40 GPH (151 LPH) flow (typical idle flow rate). To test this, tee a digital vacuum gauge into the fuel supply line at the inlet to the low pressure fuel pump and read the gauge at engine idle. If fuel inlet restriction exceeds the maximum, the following is recommended:

- A. Use supply side fuel lines including valves and fittings with at least 1/2 in. (13 mm) I.D.
- B. DO NOT install any additional fuel filters between the fuel tank and the fuel pump inlet.
- C. Avoid using crossover valves unless absolutely necessary.
- D. If an anti-siphon valve(s) is required, it is recommended to use an electric solenoid shut-off valve.

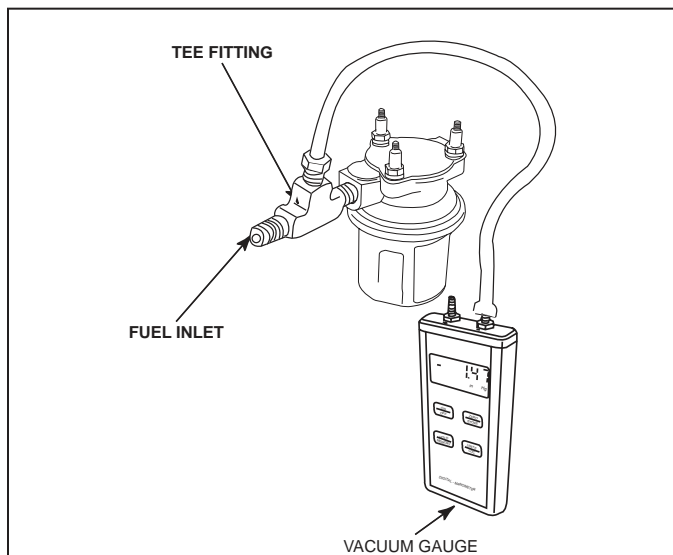


Figure 22 Checking Fuel Inlet Restriction

## FUEL LINES

**IMPORTANT:** Current or proposed legislation may require the use of low permeation fuel lines when re-powering. This type fuel line will be marked with the 'Type A1-15' designation. Check your local and state regulations regarding the required use of this type of fuel line.

**IMPORTANT:** Return fuel must flow back to the tank from which it was drawn to prevent over-filling and fuel spills through the vent system.

**IMPORTANT:** Prior to engine installation, fuel lines should be inspected for compatibility with ethanol blended fuel.

Replacement fuel line should be USCG Approved, Marine Grade fuel line for use with ethanol blended fuels.

Recommended minimum size fuel line:

- 1/2" (13 mm) I.D. supply side
- 3/8" (10 mm) I.D. return side. (If required.)

Fuel lines should be secured per ABYC recommendations. In addition, the following steps should be followed to minimize fuel temperature:

- A. Route all fuel lines as low in the bilge as possible to take advantage of the cooler ambient temperatures found there.
- B. Keep the use of brass fuel elbows and fittings to an absolute minimum. Brass is a good conductor of heat. Tests have shown that fuel may begin to vaporize when passing through a 90 degree brass elbow at only 85°F (29°C) ambient temperature.
- C. Maintain adequate engine compartment ventilation.

**IMPORTANT:** The electric fuel pump on the engine has been designed to function with a fuel/water separator, with 10 micron filter capability and a minimum of 90 gallons per hour flow rate, between the pump and fuel source. Crusader DOES NOT recommend the use of any additional filters installed by the OEM or boat dealer. The use of additional filters which do not meet the requirements stated above, can cause one or more of the following:

- Fuel Vapor Locking
- Difficult Warm-Starting
- Poor Drivability
- Piston Detonation Due to Lean Fuel Mixture

## FUEL SYSTEM PRESSURE CHECK

Connect a fuel pressure tester to the test valve on the fuel rail. Start and run the engine at idle and note the fuel pressure reading. Verify reading meets or exceeds minimum pressure (if shown) listed in the following chart.

Engine	Minimum Pressure	WOT Pressure
MP 5.0L	Master Specs.	Master Specs.
MP 5.7L	Master Specs.	Master Specs.
MP 6.0L	Master Specs.	Master Specs.
MP 8.1L STD	Master Specs.	Master Specs.
MP 8.1L HO	Master Specs.	Master Specs.
Carb. 5.7L	Master Specs.	Master Specs.

**IMPORTANT:** Fuel pressure MUST be taken at wide-open-throttle conditions in order to ensure that the correct fuel pressure is present at all times.

See MASTER SPECIFICATIONS at the end of this manual for specifications not shown on the chart.



## 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 octane specification.

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

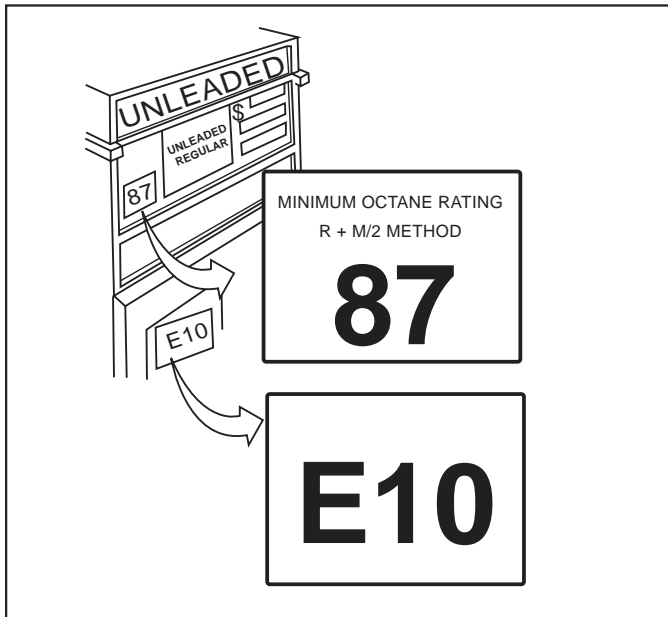


Figure 23 Fuel Requirements

**NOTICE:** Most Crusader Fuel Injected engines are calibrated to operate on 87 octane fuel and maximum performance is obtained when using this fuel. Some applications may require a higher octane fuel. These particular applications will be noted.

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 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 when storing ethanol-blended fuel for more than **2 weeks**.

## FUEL FILTER RECOMMENDATIONS FOR ETHANOL BLEND FUEL

Because ethanol will act as a solvent and will attract and hold moisture, Crusader Engines has removed the Primary Fuel Filter or Fuel Pre-Filter and in its place a fitting will be provided for connection to a spin-on type fuel/water separator.

A spin-on type fuel/water separator filter, of 10 micron filtering capability with a minimum rating of 90 gallons per hour is required between the low pressure fuel pump and the fuel source. Crusader Engines recommends the use of Crusader part number RA080033. This is a 3-piece, RACOR, fuel/water separator. This unit allows for the easy draining of water and contaminant inspection between service intervals, without the need to replace the filter element during an inspection.

Crusader Engines recommends that the fuel/water separator be mounted as low as possible, relative to the fuel source, away from heat, such as exhaust runs, and in an easily accessed and serviceable area.

Upon initial installation or service of the fuel/water separator, the filter element should be pre-filled with fresh fuel prior to mounting the element to the head. Pre-filling the filter element, with fresh fuel, will reduce the time required to prime/re-prime the fuel system after a service interval.

Refer to the diagram below for height, width, depth, and the minimum under bowl clearance for service dimensions for the RA080033 fuel/water separator.

### RA080033 - Fuel / Water Separator Assembly

### R080033 - Fuel / Water Separator Replacement Element

### RK080033 - Fuel / Water Separator Kit, Includes RA080033 Assembly plus 1/2" hose barb fittings for Low Pressure Fuel Pump and Separator Assembly.

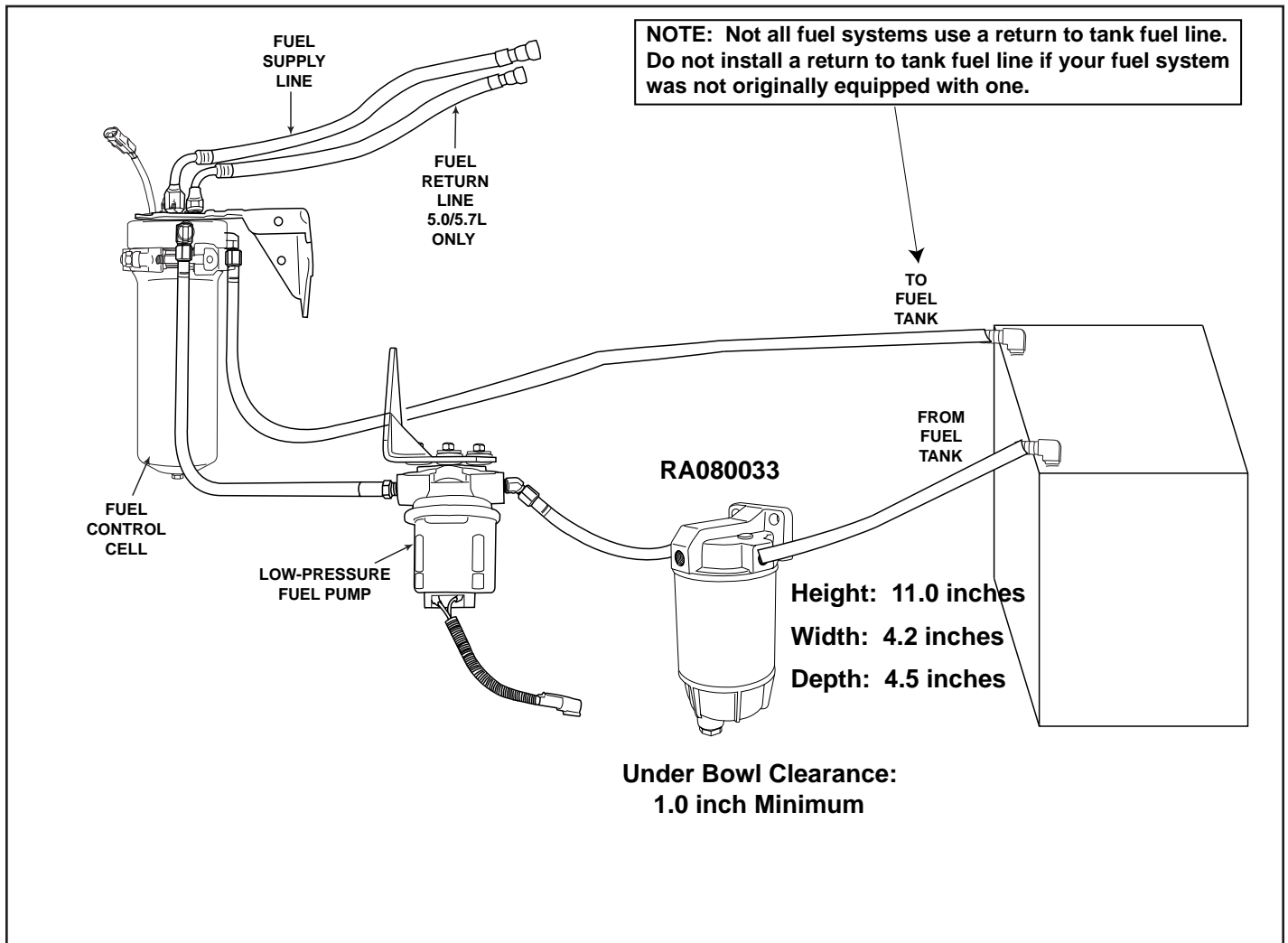


Figure 24 Fuel / Water Separator Installation

## EXHAUST SYSTEM

**IMPORTANT:** It is the responsibility of the boat manufacturer, or the installing dealer, to properly locate the engine and install the exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers, and severely damage the engine.

Damage caused by water entering the engine through the exhaust system WILL NOT be covered by Crusader Engines Warranty, unless the damage is the result of defective part(s).

When designing and installing the exhaust system, it is very important that the following points be taken into consideration.

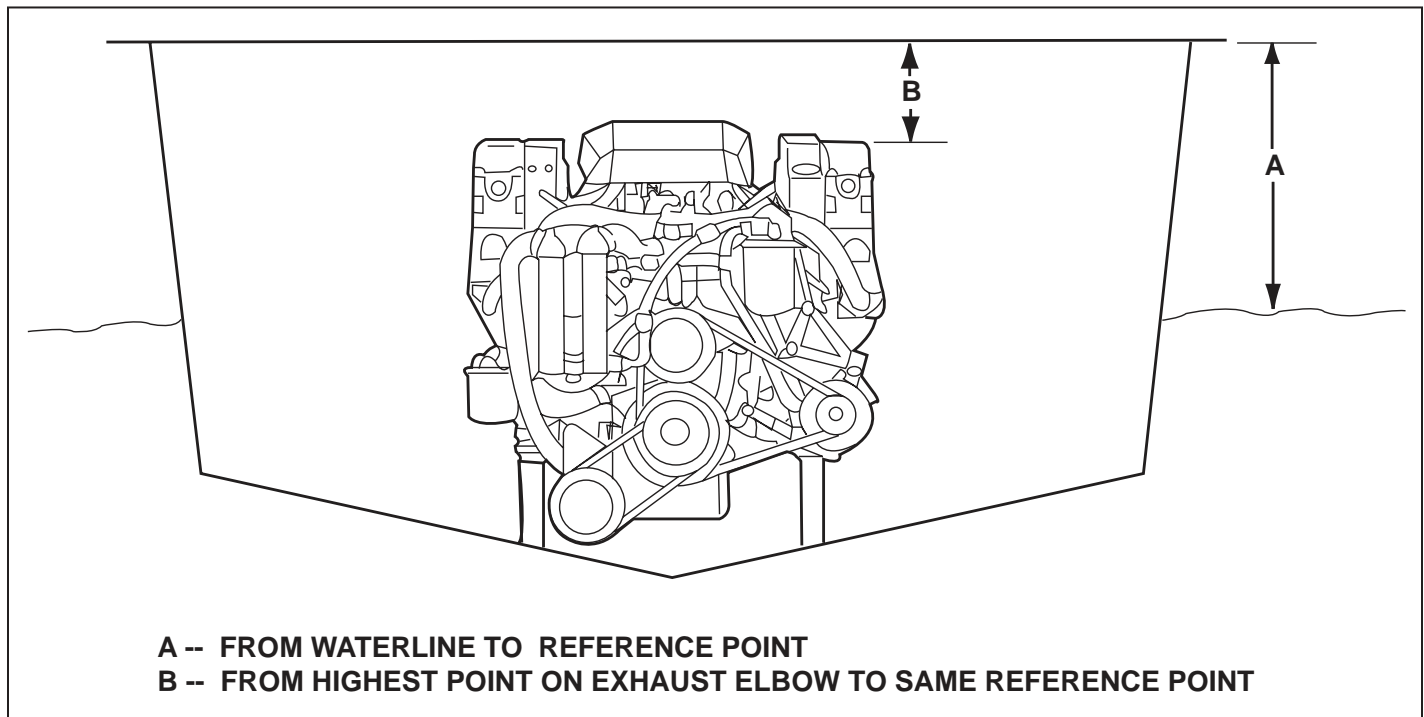
1. **A water lift muffler, or collector, mounted close to the exhaust outlets** - These components hold hot water. Once the engine is shut off, this sets up a "sauna" effect. Condensation will form and enter the exhaust manifolds and run into the cylinders in some cases. Always try to install these components as far away from the exhaust outlets as possible.
2. **Not enough drop in the exhaust hose** - The most aggressive drop between the exhaust outlet and the muffler, or collector, will aid in preventing condensation from forming and working its way back into the exhaust manifold(s) and elbow(s).

3. **Engine Operation** - You should never start the engine just for the sake of warming it when not being used. This does not get the manifolds up to temperatures needed to burn off condensation. This will get worse with colder inlet water temperatures.

## EXHAUST RISERS

To determine if exhaust risers are required, make the following measurements. With the boat in the water and maximum load onboard, make measurements "A" and "B" (Figure 22). Subtract measurement "B" from "A." If the difference between the two measurements is less than specified on the drawing and chart below, it will be necessary to add exhaust risers as required to correctly position the exhaust elbow.

Engine Models	"A" minus "B" must be this distance or more
All Engines	12 in. (304.80 mm)



*Figure 25* Proper Exhaust Elbow Location

## Exhaust Systems without Water-Lift Mufflers

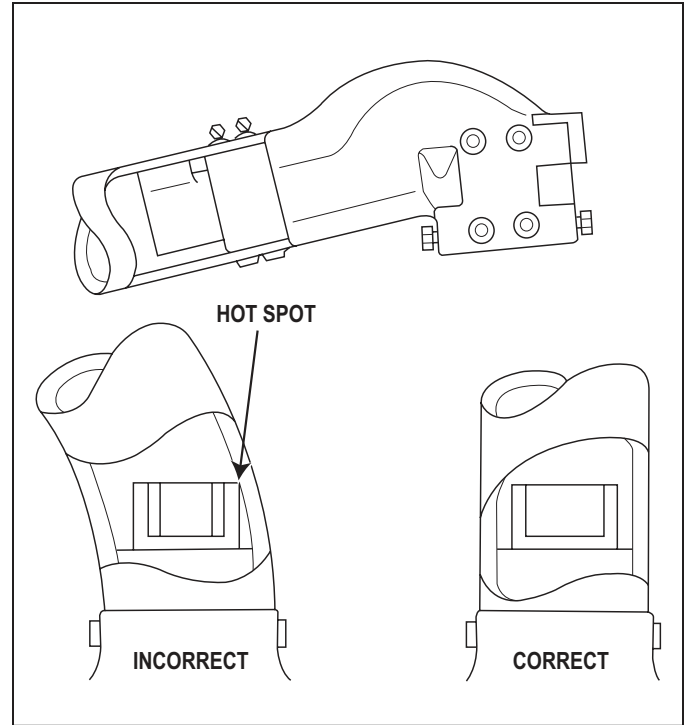


### WARNING

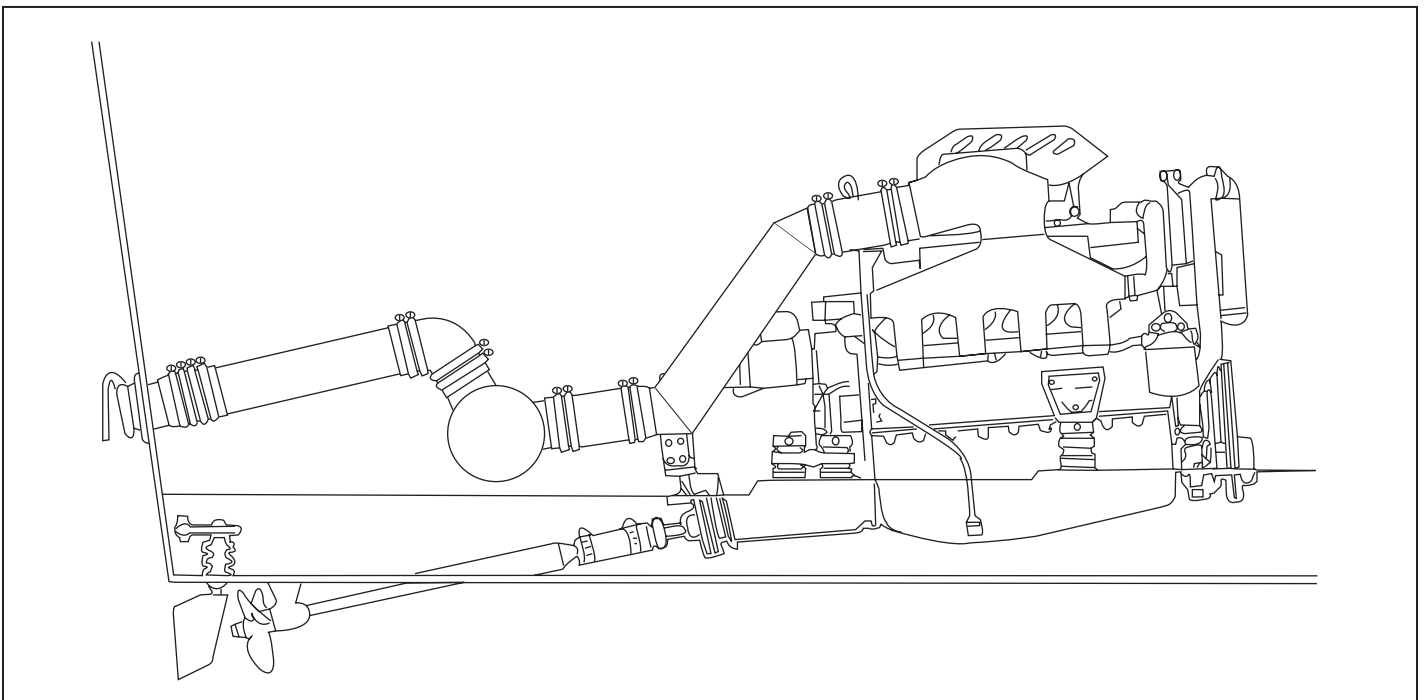
Boating industry standards (BIA, ABYC, etc.), Federal standards, and Coast Guard regulations must be adhered to when designing and installing exhaust systems.

1. System layout and construction must prevent cooling system discharge water from flowing back into the engine, and also must prevent seawater from entering the engine via the exhaust system.
2. The exhaust hoses and pipes must not be higher than the exhaust elbow outlets at any point.
3. The exhaust system (for routing exhaust to outside of boat) must be located so that a minimum of 1 in. per foot (83.31 mm per meter) downward pitch exists in the exhaust hose or pipe from the engine exhaust elbow to the outlet, with a minimum drop of 4 in. (100 mm) overall (this is an ABYC recommendation). The drop must be constant so that a low spot does not exist at any point in the exhaust hose or pipe.

4. Exhaust outlet(s) should be slightly above the water line with the boat at rest in the water, and a full load onboard. Exhaust outlet(s) must be equipped with an internal shutter and/or exhaust flapper to prevent seawater from running back into the exhaust system.



**Figure 26** Exhaust Hose Connections



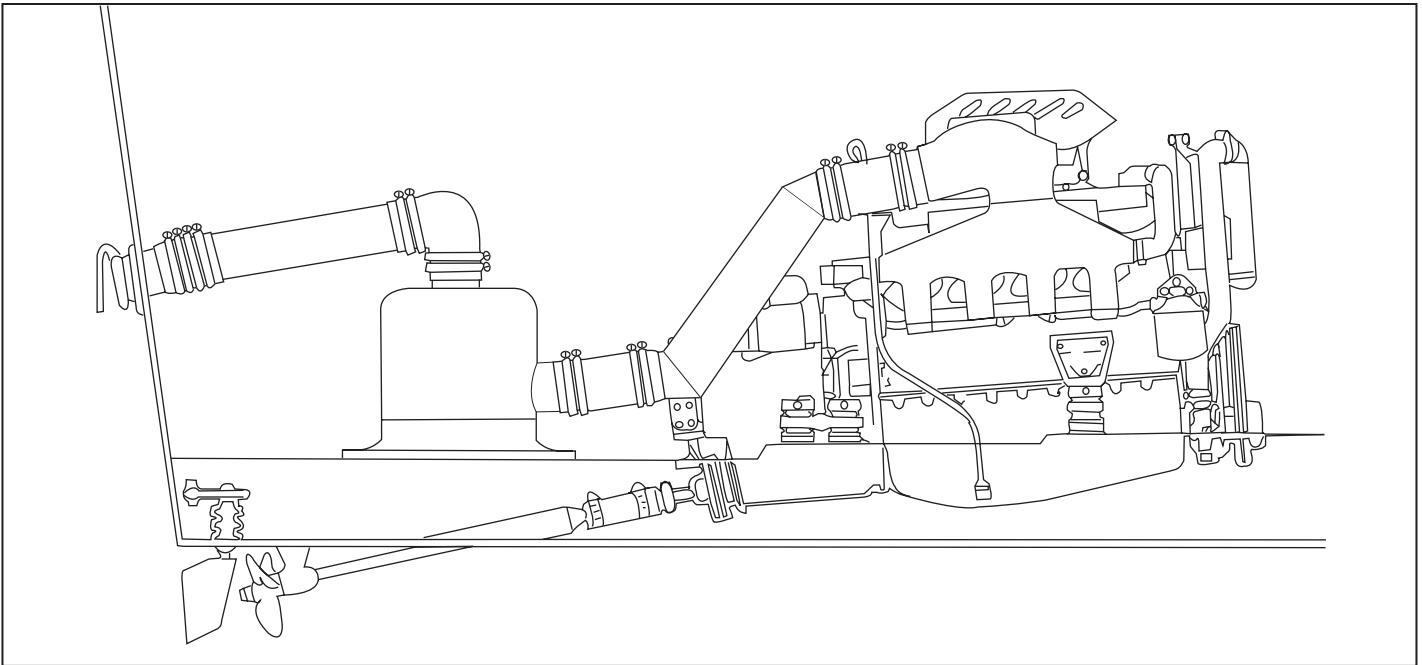
**Figure 27** Typical Inline Muffler Exhaust Layout

5. System must not cause excessive back pressure. Back pressure **MUST NOT** exceed 4 in. (10.16 cm) of mercury when measured with a mercury manometer at the exhaust elbow outlets. **Minimum** exhaust hose sizes are given in the chart below.

6. Exhaust hoses must be connected to the engine exhaust elbows so that they do not restrict the flow of discharge water from the elbow.

If hoses are connected incorrectly, a hot spot in the hose can occur, and eventually burn through.

<b>MINIMUM EXHAUST HOSE SIZE</b>		
<b>Engine</b>	<b>Single</b>	<b>Dual</b>
<b>MP 5.0L</b>	<b>4 in. (102 mm)</b>	<b>3 in. (76 mm)</b>
<b>MP 5.7L</b>	<b>4 in. (102 mm)</b>	<b>4 in. (102 mm)</b>
<b>MP 6.0L</b>	<b>4 in. (102 mm)</b>	<b>4 in. (102 mm)</b>
<b>MP 8.1L STD</b>	<b>4 in. (102 mm)</b>	<b>4 in. (102 mm)</b>
<b>MP 8.1L HO</b>	<b>4 in. (102 mm)</b>	<b>4 in. (102 mm)</b>
<b>Carb. 5.7L</b>	<b>4 in. (102 mm)</b>	<b>4 in. (102 mm)</b>



**Figure 28** Typical Water-Lift Muffler Exhaust Layout

### Exhaust Systems with Water-Lift Mufflers



#### WARNING

Boating industry standards (BIA, ABYC, etc.), Federal standards, and Coast Guard regulations must be adhered to when designing and installing exhaust systems.

1. System layout and construction must prevent cooling system discharge water from flowing back into the engine, and also must prevent seawater from entering the engine via the exhaust system.
2. The exhaust hoses and pipes must not be higher than the exhaust elbow outlets at any point.
3. The exhaust system (for routing exhaust to outside of boat) must be located so that a minimum of 1 in. per foot (83.31 mm per meter) downward pitch exists in the exhaust hose or pipe from the engine exhaust elbow to the muffler inlet, and from the muffler outlet to the exhaust outlet, with a minimum drop of 4 in. (100 mm) overall (this is an ABYC recommendation). The drop must be constant so that a low spot does not exist at any point in the exhaust hose or pipe.
4. Exhaust outlet(s) should be slightly above the water line with the boat at rest in the water, and a full load onboard. Exhaust outlet(s) must be equipped with an internal shutter and/or exhaust

flapper to prevent seawater from running back into the exhaust system.

5. System must not cause excessive back pressure. Back pressure **MUST NOT** exceed 4 in. (10.16 cm) of mercury when measured with a mercury manometer at the exhaust elbow outlets. Minimum exhaust hose sizes are given in the chart on page 26.
6. Exhaust hoses must be connected to the engine exhaust elbows so that they do not restrict the flow of discharge water from the elbow.

**NOTICE:** There have been instances where the use of water-lift mufflers, installed close to the engine, have caused water to be drawn back into the engine under certain operating conditions. Crusader has in-line damper valve assemblies available to help prevent water ingestion problems.

In-Line Exhaust Damper Valve Kit	P/N RK012023
LH Damper Tee Assembly (4X4X5 in.)	P/N 22920
RH Damper Tee Assembly (4X4X5 in.)	P/N 22921

If you have questions regarding the use of water-lift mufflers, contact Crusader Engines for clarification.

## THROTTLE/SHIFT REMOTE CONTROL AND CABLES

Shift control and shift cable MUST position transmission shift lever EXACTLY as stated in this manual or transmission failure may occur. Damage caused to transmission as a result of improper shift lever positioning WILL NOT be covered by transmission manufacturer's warranty.

**IMPORTANT:** To ensure proper shift and throttle operation, control must provide a shift cable travel of 2-3/4 in. (6.99 cm).

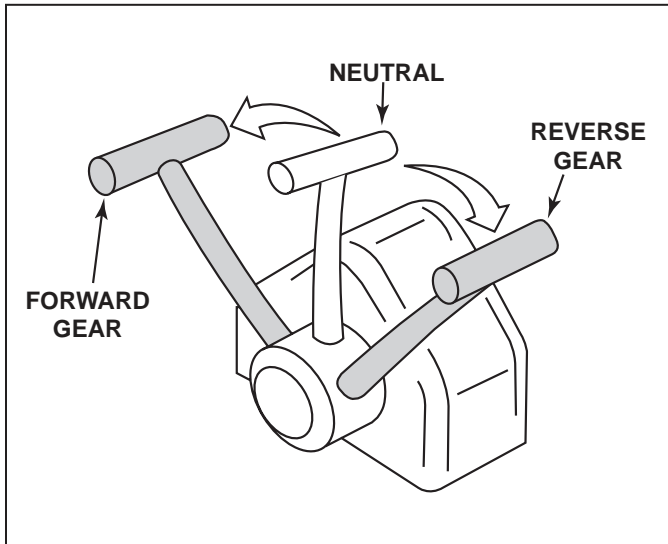


Figure 29 Shift Control

## SEAWATER PICKUP CONNECTION

### Seawater Pickup and Hose

Water pickup must be large enough to permit sufficient water flow to the engine seawater pickup pump for adequate engine cooling [30 gallons per minute (114 liters per minute) minimum]. Pickup must supply a positive head while underway. Water pickup should be located as close to the seawater pickup pump inlet as possible and in an area where an uninterrupted, solid stream of water will flow past, when the boat is underway.

Connect the water pickup to the seawater pickup pump inlet with 1-1/4 in. (3.17 cm) I.D. wire reinforced hose of adequate wall thickness to prevent it from collapsing from the pump suction. Be sure to secure the hose connections with hose clamps.

**IMPORTANT:** DO NOT install the water pickup directly in line with the propeller, as the pickup may create turbulence and allow air to flow into the "propeller slipstream." This will cause propeller ventilation and will adversely affect boat performance.

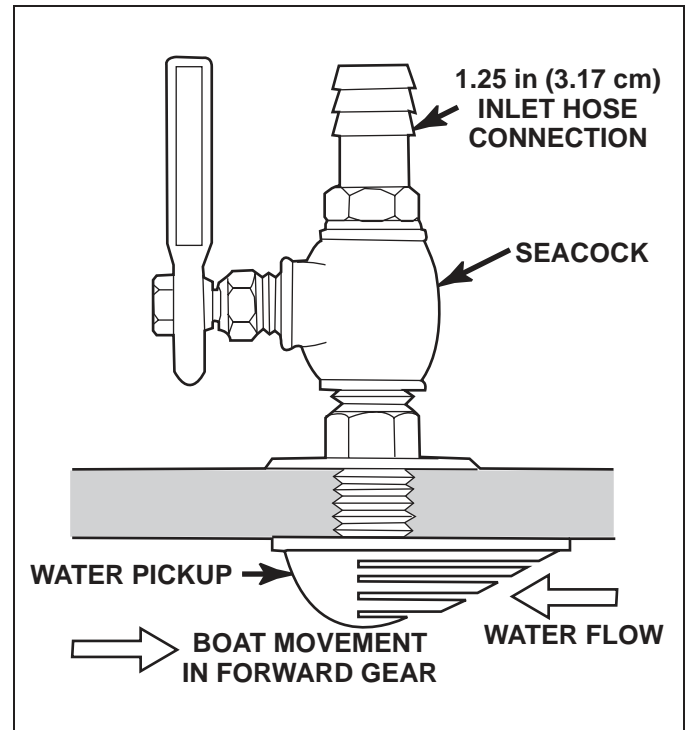


Figure 30 Water Pickup and Seacock

## SEACOCK SIZE RECOMMENDATION

Seacock used must have an internal cross-sectional area equal to, or greater than, the hose to prevent restricting water flow. Install the valve in an area where it will be easily accessible and supported adequately to prevent hose fatigue. A minimum 1-1/4 in. (3.17 cm) brass ball or gate valve is recommended.

## SEA STRAINER RECOMMENDATION

Strainer used must be of sufficient size to ensure that an adequate supply of water will be maintained for cooling the engine. A minimum of 30 gallons per minute (114 liters per minute) flow rate is required.

## CRANKCASE OIL DIPSTICK RELOCATION

### All Transmissions Except Hurth and Velvet Drive 5000 Series

Engine crankcase oil dipstick and tube can be located on either the starboard or port side of the engine to suit installation requirements. To move the dipstick and tube to the opposite side of the engine, if necessary, do the following:

1. Lift the engine with a suitable sling and loosen the dipstick fitting on the oil pan. Drain the oil into a clean, approved container for reuse.

2. Remove the bolt retaining the dipstick mounting clamp. Then, remove the dipstick fitting at the oil pan. Loosen the center bolt and rotate the oil pan fitting.
3. Put sealer on the dipstick fitting threads and reinstall into the oil pan fitting. Mount and attach the dipstick in the same manner as it was removed from the other side.
4. Fill the engine with oil.

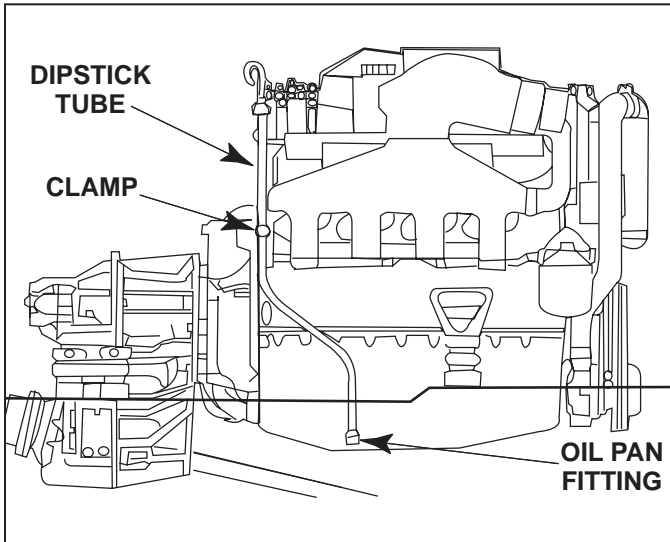


Figure 31 Oil Pan and Dipstick Fittings

### Engines Equipped with Hurth and Velvet Drive 5000 Series Transmissions

Engine crankcase oil dipstick can be located either port or starboard side of the engine, depending on installation requirements. To move the dipstick, reverse the dipstick and rubber caps on the dipstick tubes.

### ENGINE INSTALLATION

**NOTICE TO INSTALLER BEFORE STARTING INSTALLATION:** Read “General Information” and “Installation Requirements” completely.

### TORQUE SPECIFICATIONS

**NOTICE:** Tighten ALL fasteners (not listed) securely.

Engine Mount Attaching Bolts	45 lb-ft (61 N·m)
Fuel Line Inlet Fitting	Securely
Trunnion Clamping Bolt and Nut	45 lb-ft (61 N·m)
Propeller Shaft Coupling Bolt and Nut	50 lb-ft (68 N·m)
Exhaust Manifold Bolt	20 lb-ft (27 N·m)

### PRELIMINARY ENGINE ALIGNMENT

(Mount Adjustment Tool - P/N 22165)

1. Remove the lag screws holding the engine to the shipping pallet. Attach a suitable sling to the lifting eyes on the engine. Lift the engine from the pallet with an overhead hoist.
2. Check the tightness of the engine mounts and re-torque the mount attaching bolts to 45-50 lb-ft (61-68 N·m), if necessary.

**IMPORTANT: Engine mounts must be adjusted as explained in Steps 3 and 4 to center mount adjustment and establish a uniform height on all mounts.**

3. Check all four (4) engine mounts to ensure that the distance from the bottom of the mount to the bottom of the trunnion is as shown. If not, turn the nylon adjusting sleeve in the direction required to obtain the proper dimension.
4. Loosen the trunnion clamping bolt and nut on all four (4) engine mount brackets to ensure the following:
  - a. Large diameter of the mount trunnion is extended as shown.
  - b. Each mount base is downward. Tighten the trunnion clamping bolts and nuts slightly to prevent moving in or out. Mounts must be free to pivot when installing the engine.

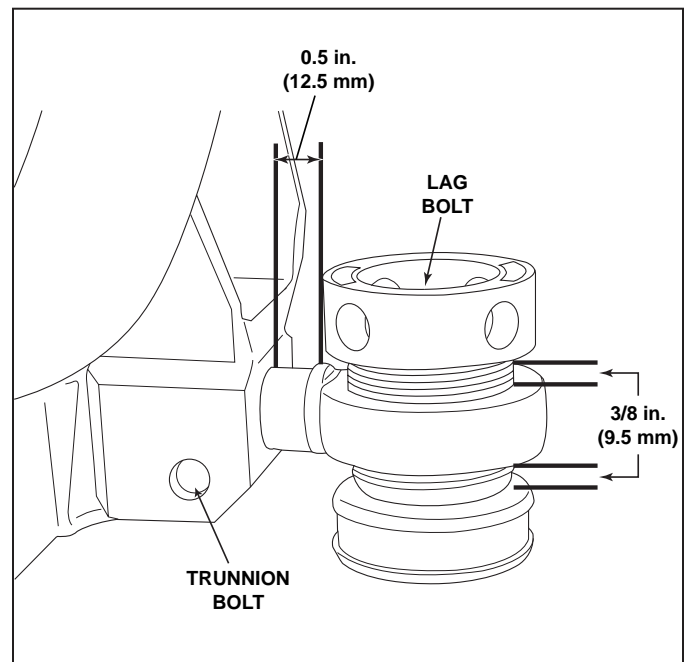


Figure 32 Preliminary Engine Mount Extension



## Velvet Drive and Hurth 8 Degree Down Angle Transmissions

5. Lift the engine into the boat and position it on the engine bed so that the transmission and propeller shaft couplings are visibly aligned (no gap can be seen between the coupling faces when butted together). Adjust the engine bed height, if necessary, to obtain proper alignment. **DO NOT** use mount adjustments to adjust engine position at this time.

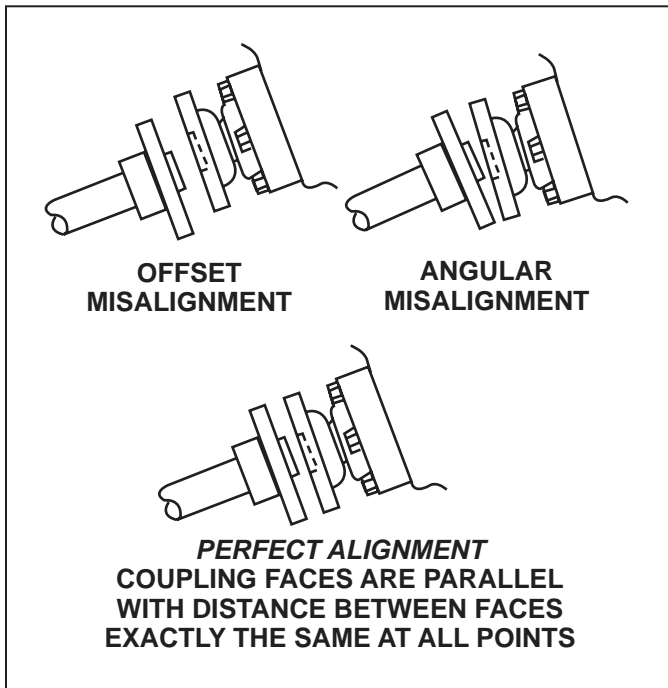


Figure 33 Coupling Flange Alignment

## Velvet Drive and Hurth V-Drive Transmissions

5. Lift the engine into the boat and position it on the engine bed so that the propeller shaft protrudes through the transmission output flange coupling. Install the propeller shaft coupling and then position the engine so that the couplings are visibly aligned (no gap can be seen between the coupling faces when butted together). Adjust the engine bed height, if necessary, to obtain proper alignment. **DO NOT** use mount adjustments to adjust engine position at this time.

## All Transmissions

**IMPORTANT:** The engine bed must position the engine so that a minimum of 1/4 in. (6 mm) up-and-down adjustment still exists on all four (4) mounts after performing final adjustment. This is necessary to allow for realigning the engine in the future.

6. Check all four (4) mounts to ensure that they are still positioned properly, then fasten the mounts to the engine bed with 1/2 in. (1.27 cm) diameter lag bolts (of sufficient length). Tighten the lag bolts securely.
7. Disconnect the overhead hoist and remove the sling.

## FINAL ENGINE ALIGNMENT

**IMPORTANT:** Engine alignment **MUST BE RECHECKED** with the boat in the water, fuel tanks filled, and with normal load onboard.

You **MUST** allow 24 hours from the time the boat is launched until the final engine alignment is checked. This allows the boat hull to settle into the position that the engines will run in.

Engine must be aligned so that the transmission and propeller shaft coupling center lines are aligned and coupling faces are parallel within 0.003 in. (0.07 mm). This applies to installations with solid couplings, as well as flexible couplings.

1. Check the mating faces on the transmission and propeller shaft couplings to make sure they are clean and flat.

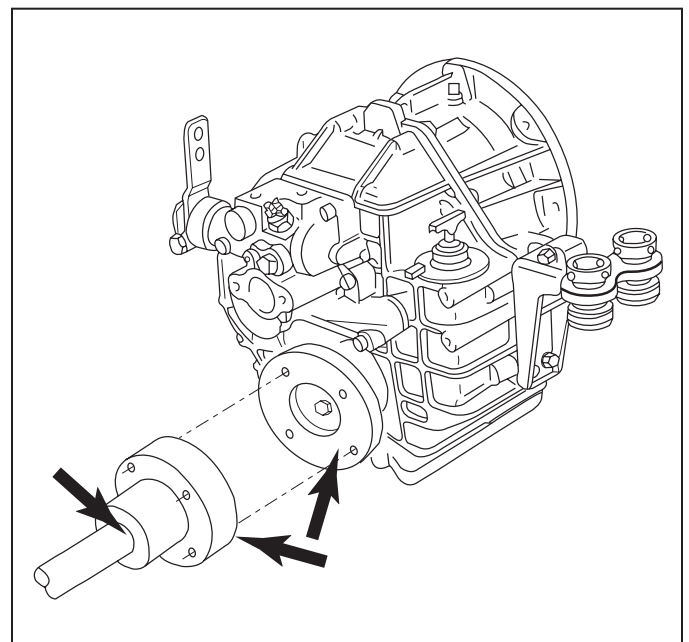
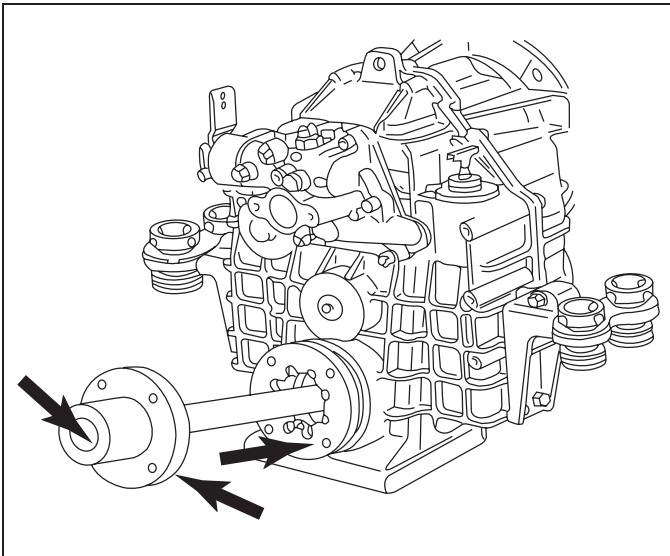
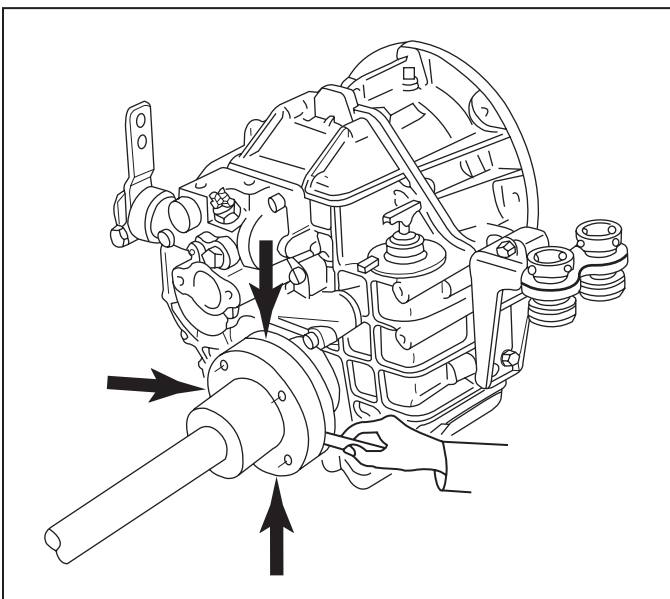


Figure 34 Shaft Mating Surface Check - 8 Degree Down Angle

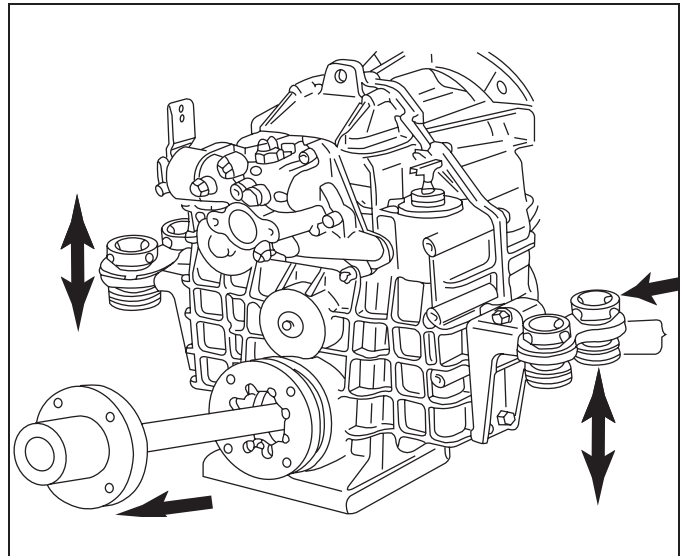


**Figure 35** Shaft Mating Surface Check - V-Drives

2. Center the propeller shaft in the shaft log as follows:
  - A. Push down and then lift the propeller shaft as far as it will move, then place the shaft in the middle of the movement.
  - B. Move the shaft to the port and then to the starboard as far as the shaft will move, then place the shaft in the middle of the movement.
  - C. With the propeller shaft in the middle of the shaft log, align the engine to the shaft.



**Figure 36** Centering Propeller Shaft - 8 Degree Down Angle

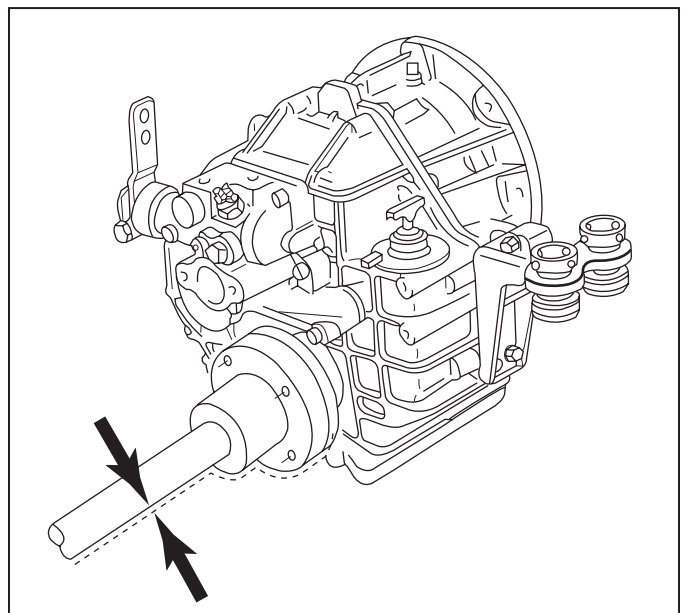


**Figure 37** Centering Propeller Shaft - V-Drives

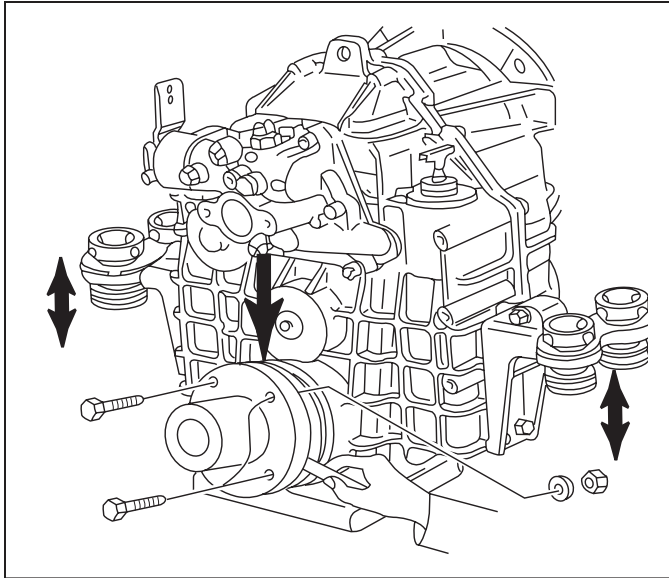
3. Check that the coupling center lines align by butting the propeller shaft coupling against the transmission coupling. The shoulder on the propeller shaft coupling face should engage recessed on the transmission coupling face, with no resistance.

**NOTICE:** Some propeller shaft couplings may not have a shoulder on the mating surface. On these installations, use a straight edge to check the centerline alignment.

4. Check for any angular misalignment. Hold coupling faces tightly together and check for a gap between the coupling faces, with a 0.003 in. (0.07 mm) feeler gauge, at 90-degree intervals.



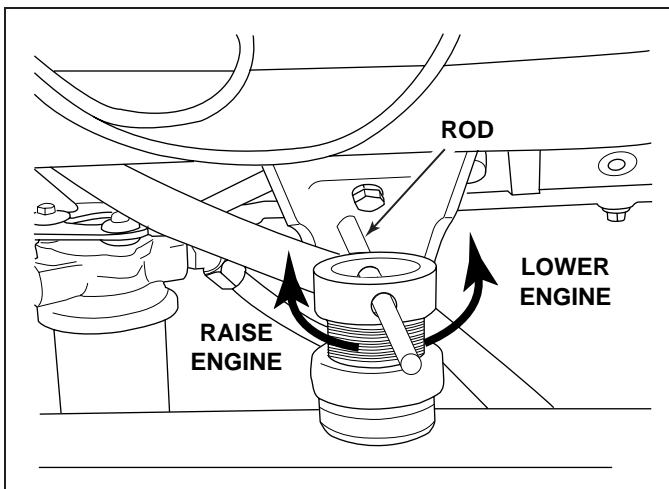
**Figure 38** Angular Alignment - 8 Degree Down Angle



**Figure 39** Angular Alignment - V-Drives

5. If the coupling center lines are not aligned, or if the coupling faces are more than 0.003 in. (0.07 mm) out of parallel, adjust the engine mounts as follows:

A. UP or DOWN ADJUSTMENT: Loosen the lag bolt 1/4 turn. Use the mount adjusting tool or a 3/8 in. (0.95 cm) or 1/2 (1.27 cm) diameter rod through both sides of the adjusting sleeve to turn. Turn the adjusting sleeve in the direction required to raise or lower the engine. After the adjustment is complete, tighten the lag bolt.

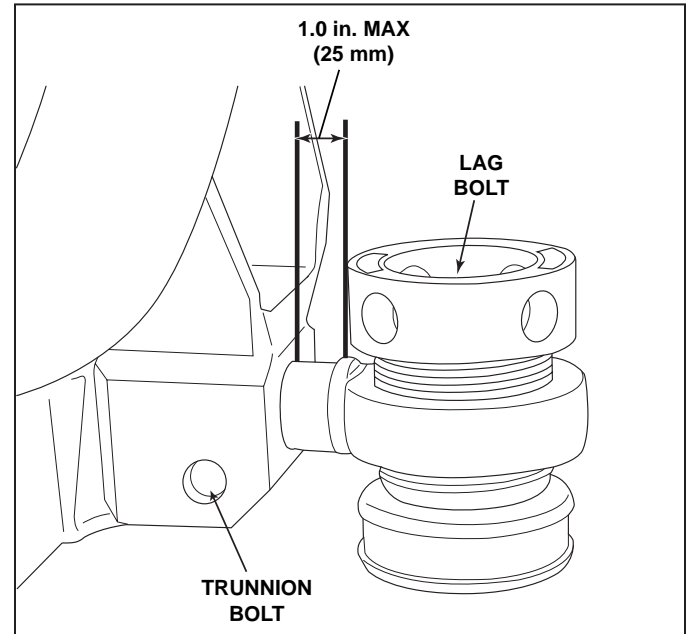


**Figure 40** Engine Mount Adjustment

**IMPORTANT:** Both the front mount (or rear mount) adjusting sleeves must be turned equally to keep the engine level from side to side.

B. LEFT or RIGHT ADJUSTMENT: Loosen the trunnion clamping bolt and the nut on all four mounting brackets. Move the engine to the left or right, as necessary, to obtain the proper alignment.

**IMPORTANT:** The large diameter of the mount trunnion **MUST NOT** extend over 1.0 in. (25.4 mm) from the mounting brackets on any of the mounts.



**Figure 41** Engine Extension

6. After the engine has been properly aligned, secure the engine mounts.
7. Connect the propeller shaft coupling to the transmission coupling. Tighten the coupling attaching bolts and nuts to the correct specifications.

## THROTTLE/SHIFT CABLES

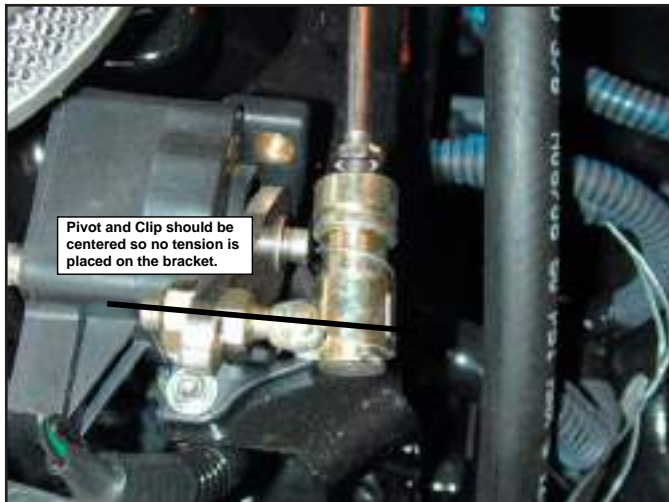
Lubricate the cable ends, then attach to the engine and transmission.

### Attaching/Adjusting Throttle Cable

Your new engine is equipped with an electronic sensor, the Throttle Control Position sensor, which is used to command the throttle plate to the desired throttle position. The TCP sensor is a spring loaded device, when the throttle cable is disconnected the TCP will return to its Idle or zero position at rest on the TCP bracket idle stop. There are two critical positions that need to be checked when ensuring proper throttle cable adjustment.

1. Place the remote control throttle lever in the idle position.

2. Install the throttle cable hub into the throttle cable retaining clip and secure with the cable clip.
3. Thread the ball joint clevis onto the throttle cable as far as necessary to line up the ball joint stud mounted on the TCP throttle arm. The TCP arm should be on the idle stop by its own return spring pressure with no additional pressure supplied by the throttle cable. Tighten the clevis jam nut when positioned correctly.



4. Retract the spring lock on the clevis pin and attach the throttle cable to the ball joint stud.
5. Place the remote control throttle lever in the full throttle position. The TCP arm should be near or just touch the **WOT** stop of the TCP bracket. **IMPORTANT:** It *is not* necessary for the arm to touch the bracket stop to achieve 100% throttle. Check the throttle cable and TCP linkage for any binding. Return the throttle lever to the neutral or idle position.

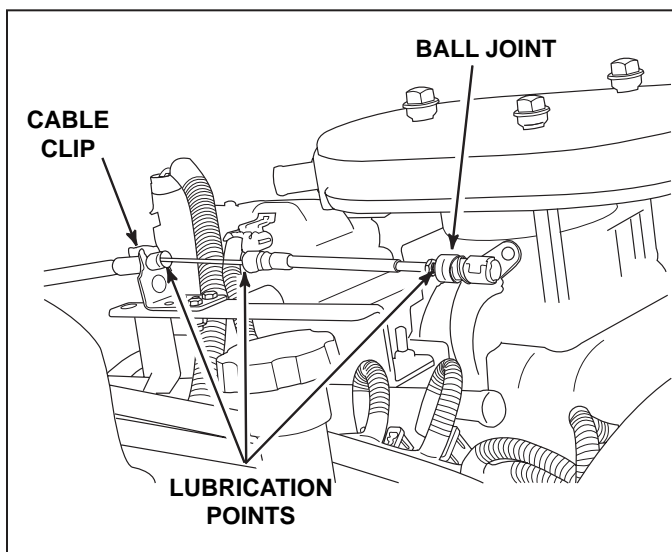


Figure 42 Typical Throttle Cable Installation

## Attaching/Adjusting Shift Cable - Velvet Drive In-Line and V-Drive Models

**IMPORTANT:** Velvet Drive Transmission Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, if the shift lever is repositioned or changed in any manner or if the linkage between the remote control and the transmission shift lever does not have sufficient travel in both directions.

1. Place the remote control shift lever and transmission shift lever in neutral position.
2. Install the shift cable hub onto the shift cable retaining bracket and lock the cable clip.
3. Thread the clevis pin onto the shift cable until the clevis lines up with the stud attached on the transmission shift lever.
4. Retract the spring lock on the clevis pin and attach the shift cable to the ball joint stud.
5. Place the remote control lever in the forward gear position and check the transmission shift lever position. Lever must be positioned as shown for full engagement.

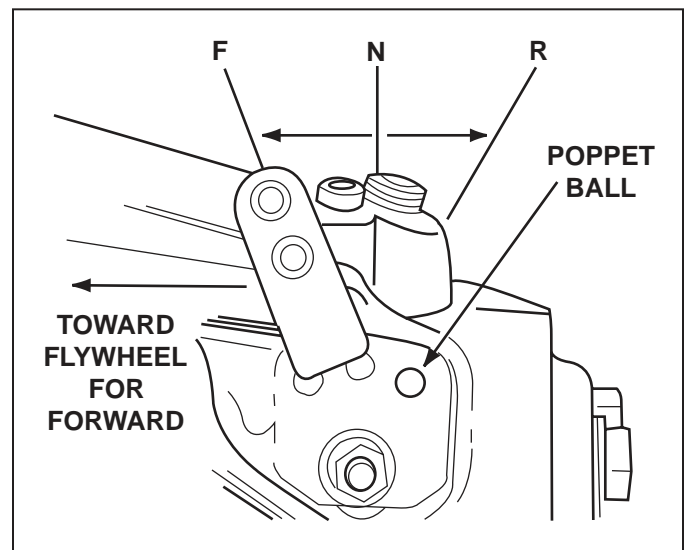
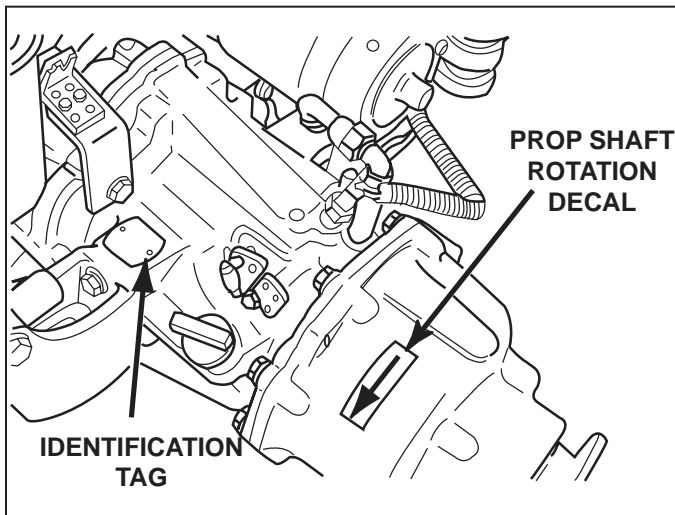


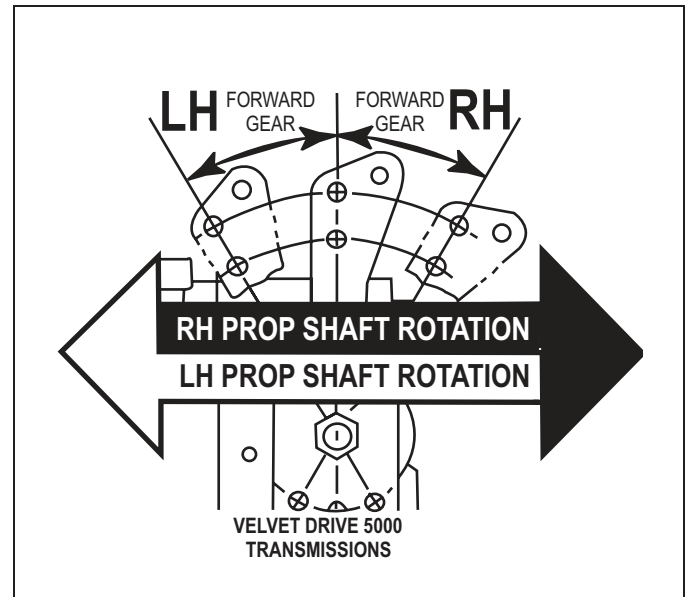
Figure 43 Shift Lever Positions - Standard Velvet Drive

6. Place the remote control lever in the reverse gear position and check transmission shift lever position. The lever must be positioned as shown for full engagement.
7. If the transmission shift lever is positioned properly in one gear but not the other, recheck the shift cable adjustment. If the transmission shift lever is not properly positioned in either gear, readjust the shift cable and recheck for correct shift engagement. If correct positioning is still not achieved, the remote control does not provide sufficient shift travel and must be replaced.

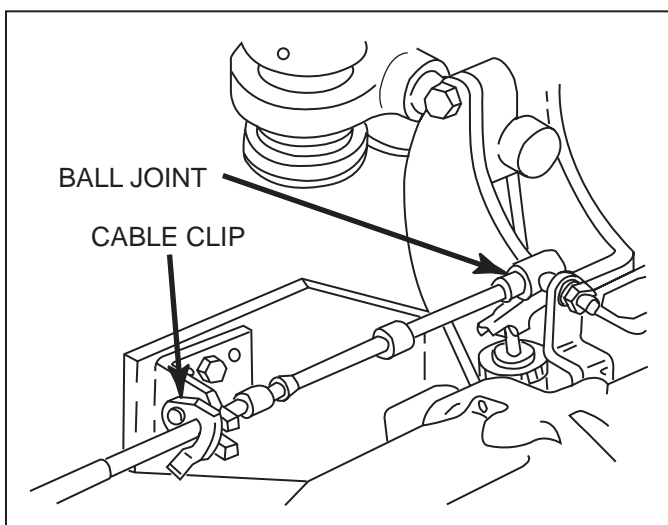
- Shift remote control lever from forward to reverse and make sure cable moves freely and no binding occurs.



**Figure 44** Forward Gear Prop Shaft Rotation - Standard Velvet Drive



**Figure 46** Velvet Drive 5000 Shift Lever Movement vs. Output Flange Rotation



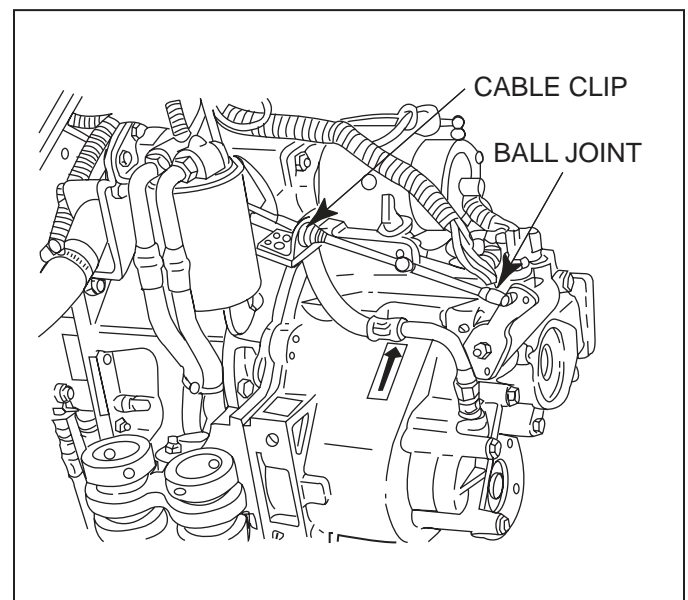
**Figure 45** Typical Shift Cable Installation

### Attaching/Adjusting Shift Cable - Velvet Drive 5000 Series Transmissions

These model transmissions are full reversing transmissions. Rotation of the output flange and propeller shaft is determined by the hookup of the shift cable at the remote control before starting the installation and adjustment procedures.

For left-hand (LH) shaft rotation - the transmission shift lever must move TOWARD the engine (flywheel) when the remote control shift handle is placed in the forward position.

For right-hand (RH) shaft rotation - the transmission shift lever must move AWAY from the engine (flywheel) when the remote control shift handle is placed in the forward position.



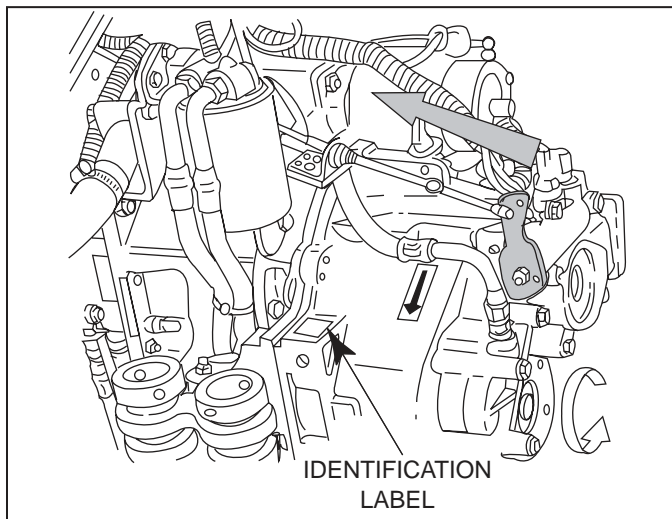
**Figure 47** Shift Cable Installation - Velvet Drive 5000

- Place the remote control shift lever and transmission shift lever in neutral position.
- Install the shift cable hub into the shift cable retaining bracket and lock the cable clip.
- Thread the clevis pin onto the shift cable until the clevis lines up with the stud attached to the transmission shift lever.
- Retract the spring lock on the clevis pin and attach the shift cable to the ball joint stud.

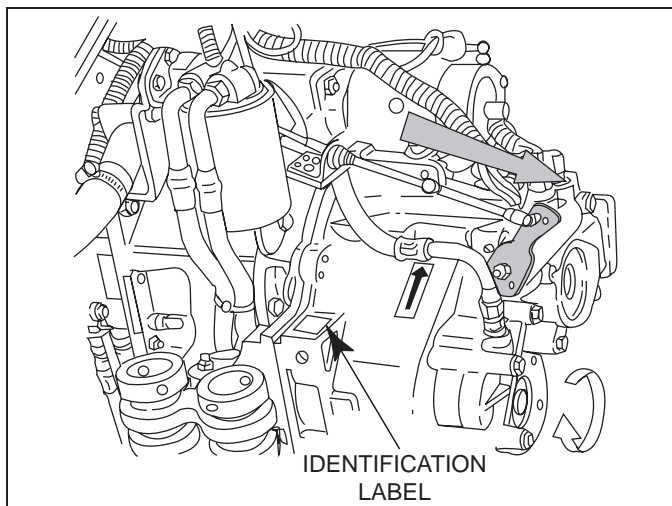
5. Place the remote control shift lever in the forward gear position and check the transmission shift lever position. Lever must be positioned as shown for full engagement.
6. Place the remote control shift lever in the reverse gear position and check the transmission shift lever position. Lever must be positioned as shown for full engagement.
7. If the transmission shift lever is positioned properly in one gear, but not the other, recheck the shift cable adjustment. Readjust the shift cable and recheck for correct shift engagement.

**NOTICE:** If correct positioning is still not achieved, the remote control does not provide sufficient shift travel and must be replaced.

8. Shift the remote control lever from forward to reverse and make sure cable moves freely and no binding occurs.



**Figure 48** Forward Gear - LH Prop Shaft Rotation - Velvet Drive 5000



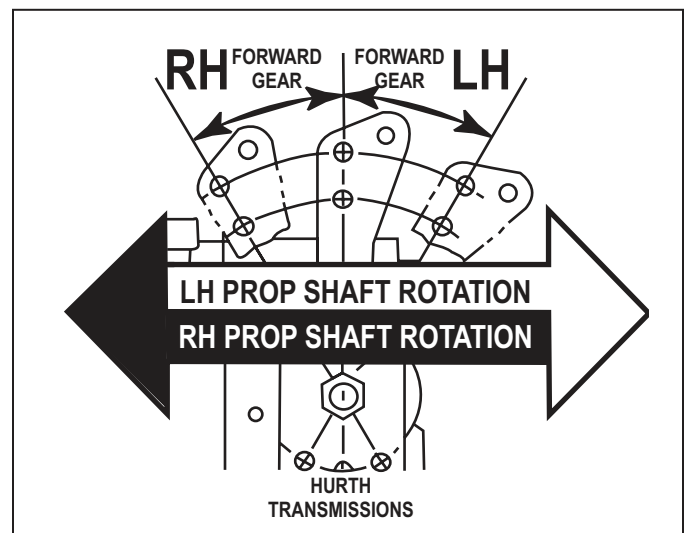
**Figure 49** Forward Gear - RH Prop Shaft Rotation - Velvet Drive 5000

### Attaching/Adjusting Shift Cable - Hurth 630 Series Transmissions

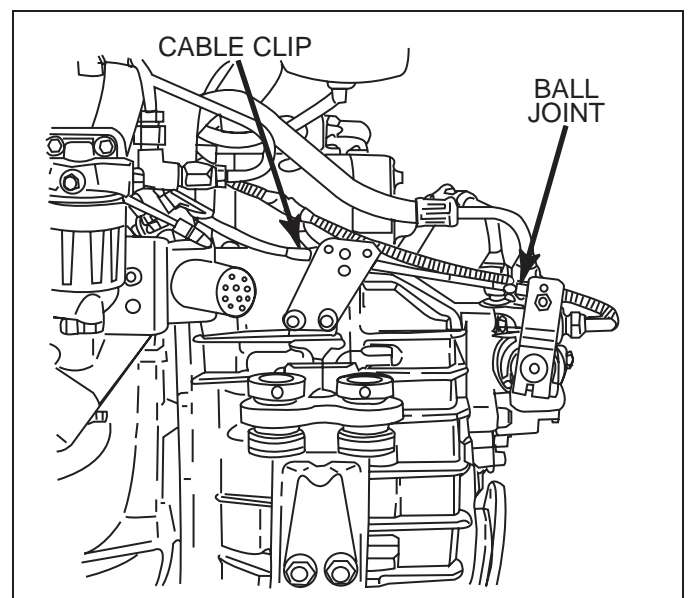
These model transmissions are full reversing transmissions. Rotation of the output flange and propeller shaft is determined by the hookup of the shift cable at the remote control before starting the installation and adjustment procedures.

For left-hand (LH) shaft rotation - the transmission shift lever must move AWAY the engine (flywheel) when the remote control shift handle is placed in the forward position.

For right-hand (RH) shaft rotation - the transmission shift lever must move TOWARD from the engine (flywheel) when the remote control shift handle is placed in the forward position.



**Figure 50** Hurth Shift Lever Movement vs. Output Flange Rotation

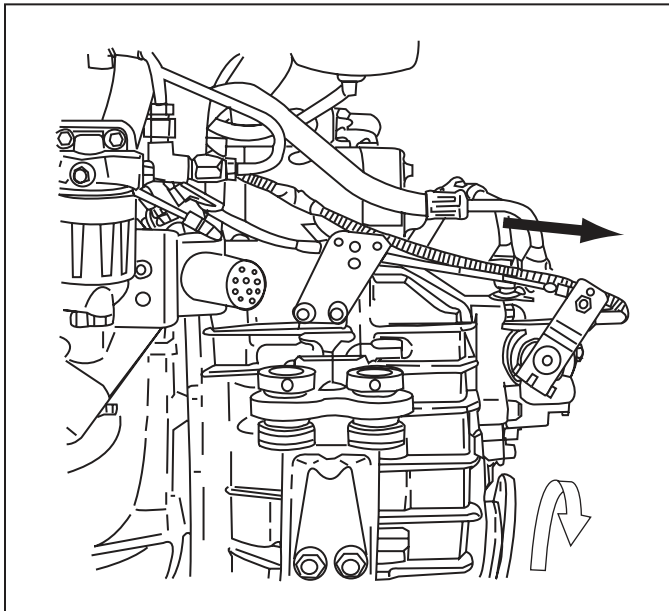


**Figure 51** Shift Cable Installation - Hurth

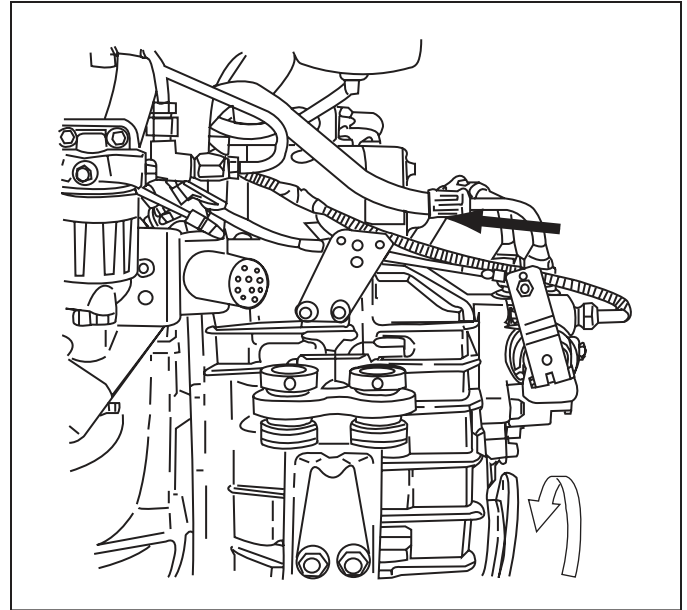
1. Place the remote control shift lever and transmission shift lever in neutral position.
2. Install the shift cable hub into the shift cable retaining bracket and lock the cable clip.
3. Thread the clevis pin onto the shift cable until the clevis lines up with the stud attached to the transmission shift lever.
4. Retract the spring lock on the clevis pin and attach the shift cable to the ball joint stud.
5. Place the remote control shift lever in the forward gear position and check the transmission shift lever position. Lever must be positioned as shown for full engagement.
6. Place the remote control shift lever in the reverse gear position and check the transmission shift lever position. Lever must be positioned as shown for full engagement.
7. If the transmission shift lever is positioned properly in one gear, but not the other, recheck the shift cable adjustment. Readjust the shift cable and recheck for correct shift engagement.

**NOTICE:** If correct positioning is still not achieved, the remote control does not provide sufficient shift travel and must be replaced.

8. Shift the remote control lever from forward to reverse and make sure cable moves freely and no binding occurs.



**Figure 52** Forward Gear - LH Prop Shaft Rotation  
- Hurth



**Figure 53** Forward Gear - RH Prop Shaft Rotation  
- Hurth

## AUDIO ALARM SYSTEM



### WARNING

The buzzer is not external-ignition protected. Therefore, **DO NOT** mount buzzer in the engine or fuel compartments.

1. Select a location for the audio warning buzzer which meets all of the following requirements:
  - a. A location where the buzzer can be easily heard, yet is out of sight
  - b. A location which is easily accessible for installation and maintenance.
  - c. A location where the buzzer will not get wet.
2. Mount the buzzer in desired location.
3. Attach the buzzer to any 12-volt source on switched side of the ignition switch. **TERMINAL TO WHICH WIRE IS ATTACHED MUST HAVE NO VOLTAGE WHEN THE IGNITION SWITCH IS IN THE "OFF" POSITION.** Tighten the connection securely, and coat with liquid neoprene.
4. Connect tan/blue wire in the instrumentation wiring harness to the buzzer.

## EXHAUST SYSTEM CONNECTION

1. Exhaust hoses must be connected to the exhaust elbows so that they do not restrict the flow of discharge water from the elbow. If the hoses are connected incorrectly, a hot spot in the hose can occur, and can eventually burn through.
2. Exhaust hoses should be secured at each connection with at least two (2) adequate hose clamps.

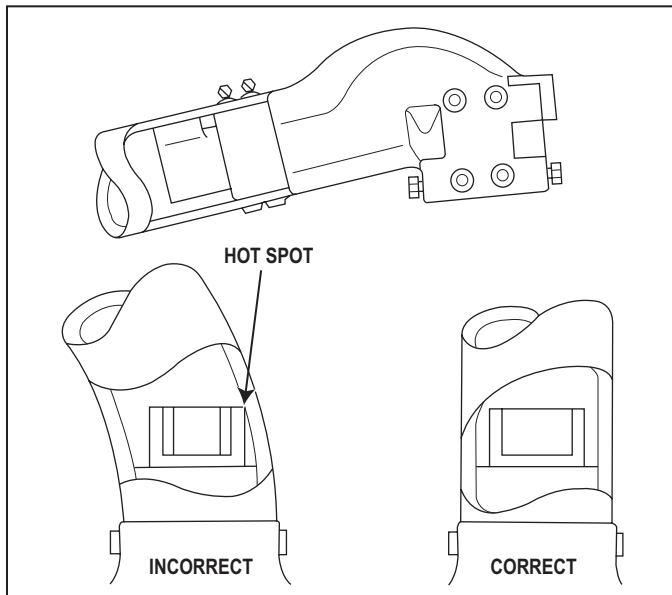


Figure 54 Exhaust Hose Connections

## ENGINE HARNESS CONNECTION

Install the main engine electrical harness at the 2-Pin and 8-Pin Deutsch connectors.

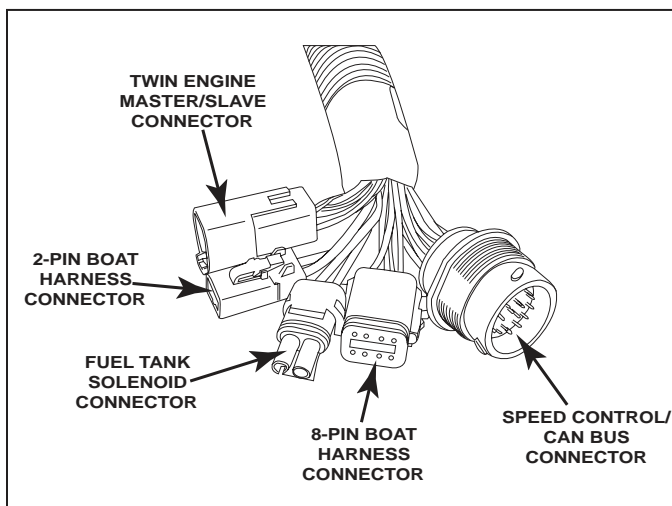
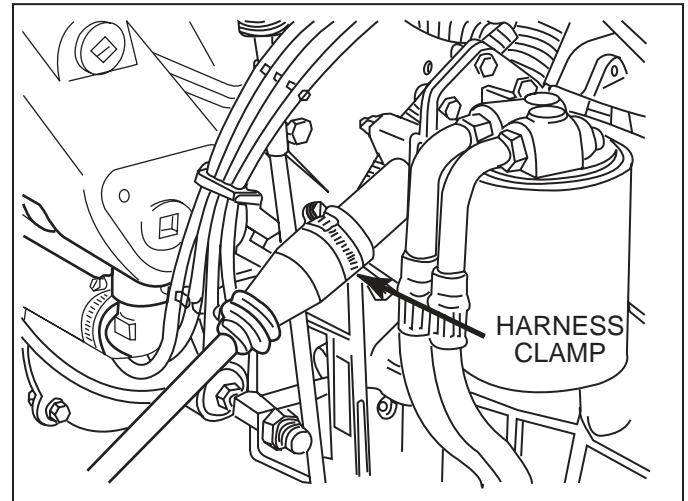


Figure 55 Typical Main Engine Electrical Harness Connection

**NOTE:** Refer to page 20 for Adapters to mate to existing boat harnesses.

## CLASSIC 5.7L CARBURETOR - ENGINE HARNESS CONNECTION

Install the main engine electrical harness plug and clamp as shown. Tighten the clamp securely.



## BATTERY CONNECTION

**IMPORTANT:** Engine electrical system is negative (-) ground.

1. Connect the engine positive (+) battery cable (usually red) to the positive (+) battery terminal.
2. Connect the engine negative (-) battery cable (usually black) to the negative (-) battery terminal.
3. Make sure that all the battery terminal connections are tight. Then, coat the connections and terminals with a battery terminal anti-corrosion spray to help retard corrosion.

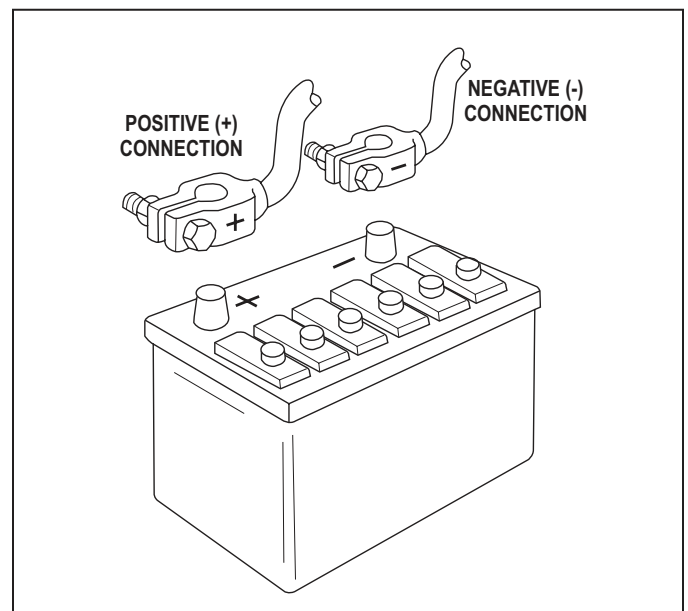


Figure 56 Battery Terminal Connections



**CRUSADER MASTER ENGINE SPECIFICATIONS - 2007**

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)	Carb 5.7L (300 HP)
<b>Displacement</b>	5.0L (305 CID) 3.75 in. (95.0 mm)	5.7L (350 CID) 4.0 in. (101.6 mm)	8.1L (496 CID) 4.25 in. (107.95 mm)	8.1L (496 CID) 4.25 in. (107.95 mm)	6.0L (364 CID) 4.0007 in. (101.618 mm)	5.7L (350 CID) 4.0 in. (101.6 mm)
<b>Bore</b>	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	4.370 in. (111.0 mm)	4.370 in. (111.0 mm)	3.622 in. (92.0 mm)	3.48 in. (88.3 mm)
<b>Stroke</b>	9.4:1	9.4:1	9.1:1	9.1:1	9.4:1	9.4:1
<b>Compression Ratio</b>	130 - 215 psi	130 - 215 psi	130 - 175 psi	130 - 175 psi	130 - 215 psi	130 - 215 psi
<b>WOT Operating RPM Preferred WOT RPM</b>	4600-5000 (**5100) 4800	4800 - 5200 (**5300) 5000	4400 - 4800 (**4900) 4600	4800 - 5200 (**5300) 5000	4800 - 5300 (**5400) 5200	4800 - 5200 5000
<b>Cruising RPM (Max)</b>	3800	4000	3800	4000	4000	4000
<b>Idle RPM (In Gear)</b>	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)	700 (Not Adjustable)	650 (Not Adjustable)	750
<b>Oil Pressure @ 2000 RPM</b>	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)	25 - 60 psi (172 - 414 kPa)
<b>Minimum Oil Pressure</b>	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
<b>Spark Plug P/N Spark Plug Gap</b>	R030010 0.060 in.	R030010 0.060 in.	R030009 0.060 in.	R030009 0.060 in.	R030011 0.060 in.	R030010 0.060 in.
<b>Firing Order</b>	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)
<b>Thermostat</b>	FWC 170° F (76.7° C)	FWC 170° F (76.7° C)	FWC 170° F (76.7° C)	FWC 170° F (76.7° C)	FWC 170° F (76.7° C)	FWC 170° F (76.7° C)
<b>Over-Temperature</b>	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)	210° F (100° C)
<b>Electrical System</b>	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
<b>Alternator Rating</b>	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps
<b>Ignition Timing</b>	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable	26° @ 4000 RPM
<b>CAM Retard</b>	0-4 degrees	0-4 degrees	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable
<b>Battery Rating</b>	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

**CRUSADER MASTER FUEL PRESSURE SPECIFICATIONS - 2007**

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)	Carb 5.7L (300 HP)
Fuel Pressure FCC	57-62 psi @ WOT	57-62 psi @ WOT	57-62 psi @ WOT	57-62 psi @ WOT	59-62 psi @ WOT	
Fuel Pressure - FCC Returnless Fuel System w/mounted LPFP	57-62 psi @ WOT	57-62 psi @ WOT	66-69 psi @ WOT	66-69 psi @ WOT	66-69 psi @ WOT	
Fuel Pressure mounted LPFP	7 - 9 psi (WOT)	7 - 9 psi (WOT)	7 - 9 psi (WOT)	7 - 9 psi (WOT)	7 - 9 psi (WOT)	
Fuel Pressure - FCC Returnless Fuel System w/Remote mount LPFP	57-62 psi @ WOT	57-62 psi @ WOT	63-68 psi @ WOT	63-68 psi @ WOT	63-68 psi @ WOT	
Fuel Pressure remote LPFP	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

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

**CRUSADER MASTER WARNING/ALARM SPECIFICATIONS - 2007**

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)	Carb 5.7L (300 HP)
Coolant Over-Temperature Sensor	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	210° F (100° C) Check Gauges Lamp and/or Buzzer
Transmission Over-Temperature Switch	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F Check Gauges Lamp and/or Buzzer
Exhaust Over-Temperature Switch	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	N/A
Low Oil Pressure Sensor or (Switch-5.7L carb only)	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi Check Gauges Lamp and/or Buzzer

**\*\*IMPORTANT NOTICE:** Crusader engines incorporate an RPM "MAX GOVERNOR" in order to prevent the engine from over-revving. Engine operation above the Maximum RPM listed will appear normal, but will not exceed the (\*\*MAX Governor) RPM listed. This is not recommended. If the engine is operating above the maximum RPM listed, a higher pitched propeller would be required to lower the engine maximum RPM to the Preferred RPM listed in the chart above.

**NOTE: FOR NEW BOAT PROPPING, IT IS RECOMMENDED THAT OEMS PROP TO THE MAXIMUM RPM LISTED.**

**CRUSADER MASTER ENGINE SPECIFICATIONS - 2007 - SN 671344 and higher**

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)	Carb 5.7L (300 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	8.1L (496 CID)	8.1L (496 CID)	6.0L (364 CID)	5.7L (350 CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.25 in. (107.95 mm)	4.25 in. (107.95 mm)	4.0007 in. (101.618 mm)	4.0 in. (101.6 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	4.370 in. (111.0 mm)	4.370 in. (111.0 mm)	3.622 in. (92.0 mm)	3.48 in. (88.3 mm)
Compression Ratio	9.4:1	9.4:1	9.1:1	9.1:1	9.4:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 175 psi	130 - 175 psi	130 - 215 psi	130 - 215 psi
WOT Operating RPM Preferred WOT RPM	4600-5000 (**5100) <b>4800</b>	4800 - 5200 (**5300) <b>5000</b>	4400 - 4800 (**4900) <b>4600</b>	4800 - 5200 (**5300) <b>5000</b>	4800 - 5300 (**5400) <b>5200</b>	4800 - 5200 <b>5000</b>
Cruising RPM (Max)	3800	4000	3800	4000	4000	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)	700 (Not Adjustable)	650 (Not Adjustable)	750
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)	25 - 60 psi (172 - 414 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N Spark Plug Gap	R030010 0.060 in.	R030010 0.060 in.	R030009 0.060 in.	R030009 0.060 in.	R030011 0.060 in.	R030010 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)
Thermostat	FWC 170°F (76.7°C)	FWC 170°F (76.7°C)	FWC 170°F (76.7°C)	FWC 170°F (76.7°C)	FWC 170°F (76.7°C)	FWC 170°F (76.7°C)
Over-Temperature	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)	210° F (100° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable	26° @ 4000 RPM
CAM Retard	0-4 degrees	0-4 degrees	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

**CRUSADER MASTER FUEL PRESSURE SPECIFICATIONS - 2007 - SN 671344 and higher**

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)	Carb 5.7L (300 HP)
Fuel Pressure FCC	57-62 psi @ WOT	57-62 psi @ WOT	57-62 psi @ WOT	57-62 psi @ WOT	59-62 psi @ WOT	
Fuel Pressure - FCC Returnless Fuel System w/mounted LPFP	57-62 psi @ WOT	57-62 psi @ WOT	66-69 psi @ WOT	66-69 psi @ WOT	66-69 psi @ WOT	
Fuel Pressure mounted LPFP	7 - 9 psi (WOT)	7 - 9 psi (WOT)	7 - 9 psi (WOT)	7 - 9 psi (WOT)	7 - 9 psi (WOT)	
Fuel Pressure - FCC Returnless Fuel System w/Remote mount LPFP	57-62 psi @ WOT	57-62 psi @ WOT	63-68 psi @ WOT	63-68 psi @ WOT	63-68 psi @ WOT	
Fuel Pressure remote LPFP	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

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

**CRUSADER MASTER WARNING/ALARM SPECIFICATIONS - 2007 - SN 671344 and higher**

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)	Carb 5.7L (300 HP)
Coolant Over-Temperature Sensor	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	220° F (104.8° C) M.I.L. - DTC 116 Check Engine Lamp and/or Buzzer	210° F (100° C) Check Gauges Lamp and/or Buzzer
Transmission Over-Temperature Switch	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F M.I.L. - DTC 1542 Check Engine Lamp	235° F ± 10° F Check Gauges Lamp and/or Buzzer
Exhaust Over-Temperature Switch	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	248° F ± 5° F M.I.L. - DTC 2428 Check Engine Lamp and/or Buzzer	N/A
Low Oil Pressure Sensor or (Switch-5.7L carb only)	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi M.I.L. - DTC 524 Check Engine Lamp and/or Buzzer	< 10 psi Check Gauges Lamp and/or Buzzer

**\*\*IMPORTANT NOTICE:** Crusader engines incorporate an RPM "MAX GOVERNOR" in order to prevent the engine from over-revving. Engine operation above the Maximum RPM listed will appear normal, but will not exceed the (\*\*MAX Governor) RPM listed. This is not recommended. If the engine is operating above the maximum RPM listed, a higher pitched propeller would be required to lower the engine maximum RPM to the Preferred RPM listed in the chart above.

**NOTE: FOR NEW BOAT PROPPING, IT IS RECOMMENDED THAT OEMS PROP TO THE MAXIMUM RPM LISTED.**

Engine Specs  
07/07

## DELIVERY PREPARATION

**NOTICE:** Before starting the pre-delivery, read “General Information” and “Installation Requirements” completely.

### Test Running the Engine

**IMPORTANT:** If the engine is to be tested on land, water must be supplied to the seawater pickup pump. **DO NOT** run engine above 1500 RPM.



#### WARNING

If the engine is to be tested on land, propeller must be removed.

## Pre-Delivery Checklist

- |   |   |
|---|---|
| <input type="checkbox"/> Check for Bulletins  | <input type="checkbox"/> Belt and Pulley: Inspect for Damage              |
| <input type="checkbox"/> Engine Oil: Check  | <input type="checkbox"/> All Drain Plugs: Confirm Proper Installation     |
| <input type="checkbox"/> Drive Lube: Check  | <input type="checkbox"/> All Fuel Lines: Confirm No Leaks                 |
| <input type="checkbox"/> Battery Rating, Charge, and Level: Check   | <input type="checkbox"/> All Oil Lines: Confirm No Leaks                  |
| <input type="checkbox"/> Control Adjustments: Confirm Proper Operation  | <input type="checkbox"/> All Water Lines: Confirm No Leaks                |
| <input type="checkbox"/> Gauges: Check for Proper Operation   | <input type="checkbox"/> Electrical Wiring: Check for Proper Installation |
| <input type="checkbox"/> Record Propeller Size, Rotation and WOT - <b>Port</b><br>WOT RPM _____ Diameter _____ Pitch _____ Rotation _____ |   |
| <input type="checkbox"/> Record Propeller Size, Rotation and WOT - <b>Stbd</b><br>WOT RPM _____ Diameter _____ Pitch _____ Rotation _____ |   |
| <input type="checkbox"/> Port - Record Fuel Pressure, WOT _____   | <input type="checkbox"/> Starboard - Record Fuel Pressure, WOT _____      |
| <input type="checkbox"/> Dealer Reviewed Warranty with Owner  | <input type="checkbox"/> Trouble Codes Checked<br>Trouble Codes Cleared   |

**NOTICE:** The following pages contain detailed steps in order to successfully perform the “Crusader Pre-Delivery Inspection Procedure.” These steps should be read carefully and completely prior to performing the inspection.

# Pre-Delivery Inspection

- REFERENCES:**
- **Crusader Owner's Operation and Maintenance Manual**
  - **Crusader Master Engine Specifications Sheet**
  - **Boat Owner's Manual**

The Pre-Delivery Inspection ensures the safety and reliability of the Crusader product. It is necessary that the inspection procedures be performed in the order given. Crusader recommends that the inspection be accomplished in a timely manner, allowing time for repairs that may be necessary, prior to the boats delivery to the customer.

The inspection is laid out in two (2) stages. Stage One is a static, pre-operational inspection. Stage Two is an operational/sea-trial inspection. After completion of the Pre-Delivery Inspection you will have the information necessary to accurately and completely fill out the Pre-Delivery Checklist portion of the Warranty Registration Form.

## Stage 1 - Static Pre-Operational Inspection

### 1. Engine and Transmission Identification.

*(Refer to the Crusader Owner's Operation and Maintenance Manual for Engine and Transmission Identification location.)*

Locate the engine identification tag and record the model and serial number in the space provide. The Crusader model identification provides you with valuable information concerning the engine you are working on. Information includes raw/fresh water cooling, engine rotation, engine type, drive type and function, propeller shaft rotation, gear ratio, and ignition and fuel type. Also the engine serial number. This information will be needed for the next step in this procedure so you can narrow your search for Service Updates to only those associated with the engine you are preparing to put into service.

**ENGINE MODEL NO.**

**ENGINE SERIAL NO.**

Locate the transmission identification tag and record the model and serial number in the space provide on the inspection procedure.

**TRANS. MODEL NO.**

**TRANS. SERIAL NO.**

**PORT**

**STBD**

_____	_____
_____	_____
_____	_____
_____	_____

### 2. Service Update Check

Once you have located the Engine and Transmission Model and Serial numbers you need to review the Service Updates for any which may apply to the engine(s) you are preparing for delivery.

Check Crusader Service Updates for USCG Safety Recall and product enhancement bulletins. Correct any condition that may be discovered, before proceeding with the Pre-Delivery Inspection Procedure. Note Service Update number(s) in the space provided and check the compliance box.

**SERVICE UPDATE #**

_____	_____
_____	_____
_____	_____

**SERVICE UPDATE(S) INSTALLED:**

### 3. Propeller Identification and Inspection

(Refer to the Crusader Owner's Operation and Maintenance Manual and the Crusader Master Engine Specification Sheet for operational parameters based on propeller selection.)

- Proper boat performance is dependent upon boat design, engine power and a properly sized propeller. The size markings will be needed if a performance issue is raised.
- Prior to installation of the propellers, locate the size and rotation markings on the propeller(s).
- Record the markings, Diameter, Pitch, and Rotation in the space provided and compare to known standards. If you are unsure of the proper propeller size, contact the boat manufacturer for the information necessary to determine the proper size for the boat. Correct any deficiency.

	<u>PORT</u>	<u>STBD</u>
Diameter:	_____	_____
Pitch:	_____	_____
Rotation:	_____	_____

**NOTICE:** The boat manufacturer and/or the dealer selects and installs the propeller(s). Problems that are associated with the propeller(s) or its installation should be corrected at the direction of the boat manufacturer and/or installer and are not a Crusader Warranty item.

### 4. Static Leak Check of Fuel and Oil Lines

Check all fuel and oil lines for leaks. Using your hand check each and every fuel line and oil line to and on the engine for leaks. Note the location of any leaks found. Correct any deficiency. Check the compliance box.

<u>PORT</u>	<u>STBD</u>
<input type="checkbox"/>	<input type="checkbox"/>

**NOTICE:** The boat manufacturer and/or the dealer selects and installs the fuel lines from the fuel tank to the engine. Problems associated with this fuel line or its installation should be corrected at the direction of the boat manufacturer and/or installer and are not a Crusader Warranty item.

### 5. Engine Wiring Inspection

Do a visual inspection to insure that all plug-in connectors of the engine wiring harness are plugged into their proper devices. Check to insure that the boat harness is plugged completely and correctly into the engine harness. Correct any deficiencies found and check the compliance box.

<u>PORT</u>	<u>STBD</u>
<input type="checkbox"/>	<input type="checkbox"/>

### 6. Static, Prelaunch Fluids Check

- Engine and transmission oil levels must be verified prior to engine operation. These levels will again be checked after operation. Normal levels for both the engine and transmission should be between the Low and Full marks on the dipstick. **Oil levels must be at least to the low oil level mark at this time.**
- With the boat resting close to its in-the-water position, remove the engine(s) dipstick(s) and wipe the dipstick(s) clean of oil and insert the dipstick into the dipstick tube. Be sure that the dipstick bottoms out in the tube.
- Remove the dipstick and note the oil level. Correct any deficiency for each engine.
- Remove the dipstick from each transmission, wipe the dipstick clean of oil and insert the dipstick into the dipstick opening. Be sure that the dipstick bottoms out on case (Velvet Drive) or to the threads (Hurth - Note: do not screw the dipstick in when checking fluid levels.).
- Remove the dipstick from the transmission and note the oil level. Correct any deficiency. **NOTE: Oil levels slightly above the full mark, at this time, would be normal. Do Not remove fluid at this time.**

<u>PORT</u>	<u>STBD</u>
<input type="checkbox"/>	<input type="checkbox"/>

## 7. Check Water & Exhaust Hoses for Proper Connection

PORT

STBD

- Attach hoses removed for winterization.
- Inspect each hose for leaks, routing, rubbing and cuts or abrasions. Correct any deficiency.
- If equipped, check to insure that the strainer is not damaged and seal is secure. Correct any deficiency.
- If equipped, check to insure that the hull inlet valve is turned to its OPEN position.
- Check Fresh Water Cooling to insure that the coolant level is proper. Coolant level in the Degas Bottle should be at the 'MAX' line on the bottle.

**IMPORTANT:** *The addition of accessories, either by the Dealer or Boat Manufacturer, i.e. a hot water heater or heater, to the engine's freshwater coolant system, increases the volume of the engine's coolant system and will require additional coolant to be added. Be sure to use Dex-Cool™ extended life coolant when topping off the Fresh Water Cooling System.*

**NOTICE:** *The boat manufacturer/dealer selects and installs the water/exhaust hoses and accessories to the engine. Problems associated with these hoses, accessories, or their installation should be corrected at the direction of the boat manufacturer and/or installer and are not a Crusader Warranty item.*

## 8. Install and Tighten all Drain Plugs

PORT

STBD

- The drain plugs have been removed for shipping or winterization. Before the engine may be safely started the drain plugs must be installed.
- Insert a plug of the proper size coated with PST (Pipe Sealant with Teflon by Loctite or equivalent) into each drain location.
- Tighten each drain plug securely. *Caution ! Do Not Over Tighten Or Damage Could Occur.*
- Check the compliance box on the procedure.

## 9. Visual Check of Belt And Pulley Alignment

PORT

STBD

**NOTE:** *All Crusader engines currently use a serpentine belt at the front of the engine. This belt has a self-tensioning system which is non-adjustable.*

- Check belt for cuts or other damage. Correct any deficiency.
- Check the pulleys for damage. Correct any deficiency.
- Visually inspect for pulley and belt alignment. Correct any deficiency.



### 10. Check Battery Installation And Charge Level

PORT

STBD

- Check battery(s) cold cranking amps against the minimum recommended Cold Cranking Amps listed on the *Master Engine Specification Sheet*. Correct any deficiency.
- Check for a properly connected power cable(s) (Red) and ground cable(s) (Black), **at the engine, terminal block/isolator, charger, house battery, and battery switch(s)**. Correct any deficiency.
- Check the electrolyte level (as required) and battery(s) charge. Correct any deficiency.
- **Always connect the positive (+) cable to the battery(s) first** and tighten securely.
- Connect the negative (-) cable to the battery(s) and tighten securely.
- After following boat manufacturer's pre-start procedures, turn the Ignition Switch(s) to the ON position and verify battery voltage on the instrument panel and remaining gauge cluster reads normal for Key On Engine Off. Turn the Ignition Switch(s) to the OFF position. **DO NOT START THE ENGINE AT THIS TIME.**
- Check the compliance box on the procedure.

**NOTICE: Problems that are associated with the battery(s) or installation should be corrected at the direction of the supplier and/or installer and are not a Crusader Warranty item.**

### 11. Check Control Adjustment, Direction and Travel

PORT

STBD

The boat manufacturer and/or the dealer selects and installs the control cables and control head. Check both the throttle and shift cable in accordance with the boat manufacturers and/or installers instructions.

A minimum inspection of the control cables would include the following: (1) Throttle and shift in neutral, (2) Shift in forward, throttle in neutral or idle position, (3) Shift in reverse, throttle in neutral or idle position, and (4) Throttle at the wide-open-throttle (WOT) position.

When the control is in the neutral position, inspect that the throttle linkage is at its zero or detent position, with no additional pressure supplied by the throttle cable to the TCP sensor (SUC-1006-01). Verify that the transmission shift arm is in its neutral position. With the control moved to its in gear and zero throttle position, the transmission shift arm should be to its **full** in gear position (both forward and reverse positions need to be checked) and the throttle linkage should still be at its zero throttle position or detent position.

With the throttle at its WOT position the verify the TCP arm is near or just touches the WOT detent. Adjustments should be made as necessary and in accordance with the boat manufacturer's / installer's instructions and SUC-1006-01.

Check the compliance box on the procedure.

**NOTICE: Improper adjustment of the control cables can cause engine and/or transmission damage. Control cables, their adjustment, or engine/transmission damage resulting from improper adjustment are not a Crusader Warranty item.**

## Stage 2 - Operational / Sea-Trial Inspection

### Boat-in-the-Water Tests

**IMPORTANT:** Engine alignment **MUST BE CHECKED** at this time, with the boat in the water, fuel tanks filled, and with a normal load onboard.

PORT

STBD



#### WARNING

DO NOT leave the helm unattended while performing any tests.

### 1. Test Equipment Connection

- With the boat in the water and secured in her slip, locate the Data Link Connector (DLC) on the engine and connect the Diacom cable from your computer to the engine.

**Note:** *On twin engine applications, Diacom can only read the engine data from the engine it is connected to. You must disconnect from the current engine and reconnect to the other engine when you are instructed.*

**Verify that the Master/Slave Wiring Harness is installed between engine #1 and engine #2's Engine Wiring Harnesses.**

- Install the fuel pressure gauge onto the fuel rail or FCC fuel pressure fitting. (NOTE: For twin engine applications, you will be instructed on when to connect the fuel pressure gauge to the second engine.) Readings should be made with the gauge positioned at the same height as the fitting to which it is attached. Consult the *Master Engine Specification Sheet* for the proper pressures for the engine being tested.

Check the compliance box.

### 2. Priming the Fuel System and Check for Fuel Leaks

- Turn the Ignition Switch to the ON position (for the engine that the fuel pressure gauge is currently connected to.) to allow the fuel pumps to run until they shut off, then turn the Ignition Switch to the OFF position (Ignition switch must remain in the OFF position for a minimum of 5 seconds in order to reset the engine's ECM and allow another pump cycle to occur.) This procedure may have to be repeated 1-3 times to prime the fuel system. Repeat as necessary to build fuel pressure to the specification of this engine. Check for fuel leaks at the fuel pressure gauge connection and all fuel fittings. Correct any leaks before proceeding.
- When the fuel pressure is at the specified level, stop cycling the pumps and allow the engine to sit for one minute while observing the fuel pressure reading on fuel gauge. Pressure must remain constant when the fuel pumps are not operating.

**NOTE:** While the pumps are operating fuel pressure should be within the *Master Engine Specification* range for WOT pressure; after the pumps cut off pressure will drop slightly but remain constant. If proper pressure is not displayed or does not remain constant, correct this condition before proceeding.

- Check for signs of fuel in the engine compartment and all fuel lines for leaks before starting the engine. Correct any deficiency prior to proceeding.
- **For twin engine applications: Relieve the fuel pressure and disconnect the fuel gauge from engine #1, connect the fuel gauge to engine #2 and repeat the priming and fuel leak check for engine #2.**

Check the compliance box.

PORT

STBD

### 3. Engine at Idle Check

PORT

STBD

Follow boat manufacturer's starting procedures regarding the blower, etc. Start the engine.

**WARNING! If fuel and/or oil leaks are present shut off the engine(s) immediately.**

- Check to insure that the raw water pump is pumping water( both engines) then allow the engine(s) to idle for approximately one minute. Shut the engine(s) off. Check each fuel line and fitting for leaks by running your clean, dry hand along and under every fuel line and fitting. Correct any deficiency prior to proceeding.
- With clean dry hands, check each oil line and fitting for leaks by running your clean, dry hand along and under every oil line and fitting. Correct any deficiency prior to proceeding.
- With clean dry hands, check each water hose and fitting for leaks by running your hand along and under every water hose and fitting. Correct any deficiency prior to proceeding.
- Start the engine(s), then check each exhaust hose and fitting for leaks by running your hand along and under every engine exhaust outlet hose and fitting. Correct any deficiency prior to proceeding.
- Check each engine's pulleys for wobble. Correct any deficiency.
- Cycle each transmission, at idle RPM, from Neutral-Forward-Neutral-Reverse-Neutral.
- Shut the engine(s) off and leave the test equipment attached to the engine.













**NOTE: Immediately proceed to the Transmission Fluid check after shutting the engines off. False fluid readings can be obtained as the fluid returns to the transmission from the oil cooler and its lines.**

Check the compliance box.

PORT

STBD

### 4. Engine and Transmission Fluid Check

#### Transmission:

- On each transmission, wipe the dipstick clean of oil and insert the dipstick into the dipstick opening. Be sure that the dipstick is fully inserted into the case (Velvet Drive) or inserted to the threads, but not screwed in (Hurth).
- Remove the dipstick from the transmission and note the oil level. Correct any deficiency.
- Correct any low oil deficiency by adding the proper amount of oil, that meets the specification stated on the engine specification decal, to bring the oil to the full mark. Correct an over-filled condition by removing oil until the level reading on the dipstick is at the full mark.



PORT

STBD

#### Engine:

- On each engine remove the dipstick and wipe the dipstick clean of oil, then insert the dipstick into the dipstick tube. Be sure that the dipstick bottoms out in the tube.
- Remove the dipstick and note the oil level. Correct any deficiency.
- Correct a low oil level condition by adding the proper amount of oil, that meets the specification stated on the engine specification decal, to bring the oil to the full mark. Correct an over-filled condition by removing oil until the level reading on the dipstick is at the full mark.



Check the compliance box.

## 5. ECM-07 System Check

A check of the engine management system is done to insure that the EFI system has not been damaged or modified since shipment from Crusader.

- With the Diacom loaded and set to Crusader's standardized screen, turn the ignition switch(s) to the 'ON' position (Do Not start the engine(s)) and check the engine(s) for codes. If codes are present, make a note of them, in the space provided on the Pre-Delivery Inspection Procedure, and then erase the codes using the 'Pencil with Eraser' icon button on the Diacom screen.
- If any code returns after the erase procedure is performed, the problem is still in the circuit indicated by the code and must be corrected by the technician before proceeding.

PORT

STBD

NOTES: \_\_\_\_\_ CODES: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- When the system tests code-free, you may proceed to start the engine(s).

NO CODES:

- **\*\*ECM-07 Engines: After starting the engine(s), for 5.0L and 5.7L engines only, CAM Retard must be checked, using Diacom, and verified to be between 0 to 4 degrees. If CAM Retard is not between 0 to 4 degrees it must be set to the proper specification. Consult Crusader Service Update # SUC-0706-01 for the procedure to be used to correct CAM Retard.**

For Twin Engine Applications, disconnect Diacom from the current engine and connect Diacom to the other engine. Repeat the CAM Retard check/adjustment for the other engine.

CAM RETARD:

Check the compliance box.

## 6. Instrumentation Check

- The gauges on the boat's instrument panel are the operator's insight into the engine's vital signs. Constant monitoring of the gauges is necessary to insure that abnormal conditions are recognized as soon as possible to prevent engine damage and/or dangerous conditions from occurring.
- Allow the engine(s) to come up to normal operating temperature.
- Verify coolant flow and level at the Degas Bottle on the engine(s). Correct any deficiency. **Caution! The Degas Bottle operates under pressure. Allow the engine to cool sufficiently before removing the Degas Bottle Cap to add fluid.**
- Check and verify proper operation of all gauges. Correct any deficiency.

**NOTICE: The boat manufacturer and/or the dealer selects and installs the instrument panel and gauges. Problems associated with the instrument panel and gauges or their installation should be corrected at the direction of the boat manufacturer and/or installer and are not a Crusader Warranty item.**

Check the compliance box.

PORT

STBD

**7. Engine Performance Test**

- All gauges and test equipment should be observed as frequently as possible to allow the operator to react quickly to any discrepancy displayed. The operator must also listen for unusual sounds, feel for unusual vibrations, smell for signs of fuel, smoke, etc. and look for any sign of abnormal operational characteristics.
- Verify normal operation and readings on all gauges.
- When conditions permit, accelerate to bring the boat on plane and to a cruising speed of 3600 RPM. While frequently observing the gauges, operate the boat at this speed for five minutes.
- After five minutes at 3600 RPM, move the throttle to wide-open-throttle (WOT) and run at this speed (not to exceed 30 seconds) until the RPMs have stopped increasing. Note and record the WOT RPM and fuel pressure at WOT. Reduce the throttle to 3600 RPM.
- Operate the engine(s) at 3600 RPM for an additional 10 minutes while frequently observing the gauges.
- Return to idle.
- **For twin engine applications: Shut off both engines, then relieve the fuel pressure and disconnect the fuel gauge from engine #1, connect the fuel gauge to engine #2, re-start the engines, then as conditions permit, accelerate to bring the boat on plane and to a cruising speed of 3600 RPM. Operate the boat at this speed for approximately one minute, then move the throttle to wide-open-throttle (WOT) and run at this speed (not to exceed 30 seconds) until the RPMs have stopped increasing. Note and record the fuel pressure at WOT for engine #2.**
- Return to idle.

**PORT                      STBD**

WOT RPM: \_\_\_\_\_

FUEL PRESSURE - WOT: \_\_\_\_\_

**8. Diacom Record of Engine Performance (Optional)**

- Record the following water test for your records, using the Diacom 'Record' feature. *This recording is to be made after all defects, if any are found, have been corrected.* The record time for this procedure will easily fit on a 3 1/2" floppy disk making it easily accessible for future retrieval, reference and storage.

**PORT                      STBD**



**NOTE: 2007 Engines: For Twin engine applications, Diacom will have to be connected to the other engine and the procedure repeated so you will have a recording of both engine's parameters.**

1. Start the Diacom record function.
2. Idle for 10 seconds.
3. Run at 1,000, 2,000, 3,000, and 4,000 RPMs for 10 seconds each.
4. Return to idle for 10 seconds.
5. Accelerate to 3600 RPM and run @ 3600 RPM for 30 seconds.
6. Accelerate to WOT and run at WOT until the RPM's stop increasing (not to exceed 30 seconds).
7. Return the throttle(s) quickly to idle and allow the engine(s) to idle for 10 seconds, then stop the recording.
8. Save the recording, using the engine(s) serial number as the *file name*.
  - Return to the dock, check the engine(s) for leaks (water, oil and fuel) and correct any leaks noted. Turn off the engine(s), recheck the fluid levels in the transmission(s) and engine(s) and correct as necessary.
  - Review the test data and compare the results to the *Master Engine Specification Sheet*. If defects were noted, correct all, then retest the boat.
  - Disconnect the test equipment and prepare the boat for customer delivery. Check the compliance box.

## 9. Lay-Up Engine (OPTIONAL)



### CAUTION

If the engine will not be used for an extended period of time, or will be exposed to freezing temperatures, drain the water from the cooling system, as explained in the "Owner's Operation and Maintenance Manual." Water **MUST BE** drained to prevent corrosion and freeze damage to the engine.



### CAUTION

If the new engine is test run and actual customer usage is not anticipated with a seven-day period, the engine must be put back into a preserved state by fogging the cylinders with rust-preventive oil. See the "Owner's Operation and Maintenance Manual."

Check the compliance box.

**PORT**

**STBD**

## 10. Complete the Pre-Delivery Checklist

Obtain the Crusader Warranty Registration Form that came with the engine. Using the data obtained and recorded on the Pre-Delivery Inspection Procedure complete the following blocks on the Warranty Registration Form:

Complete the *Pre-Delivery Checklist* by checking each box and filing in the required data to signal compliance.

**Engine Model No. (Port and Starboard)**

**Engine Serial No. (Port and Starboard)**

**Transmission Serial No. (Port and Starboard)**

**Check for Bulletins**

**Engine Oil: Check**

**Drive Lube: Check**

**Battery Rating, Charge, and Level: Check**

**Control Adjustments: Confirm Proper Operation**

**Gauges: Check for Proper Operation**

**Record Propeller Size, Rotation, and WOT:**

**Port: WOT RPM \_\_\_\_\_ Diameter \_\_\_\_ Pitch \_\_\_\_ Rotation \_\_\_\_**

**Stbd: WOT RPM \_\_\_\_\_ Diameter \_\_\_\_ Pitch \_\_\_\_ Rotation \_\_\_\_**

**Record Fuel Pressure:**

**Port: WOT \_\_\_\_\_**

**Stbd: WOT \_\_\_\_\_**

**Belt and Pulley: Inspect for Damage**

**All Drain Plugs: Confirm Proper Installation**

**All Fuel Lines: Confirm No Leaks**

**All Oil Lines: Confirm No Leaks**

**All Water Lines: Confirm No Leaks**

**Electrical Wiring: Check for Proper Installation**

**Trouble Codes Checked / Trouble Codes Cleared**

*Your Diacom recording and these Pre-Delivery procedure sheets can be archived either by engine serial number, owner's name, or both for future reference by the technician.*

### 11. Register the Engine with Crusader

PORT

STBD

When the boat is sold, you will complete the remaining blocks of the Warranty Registration Form. **Completely fill in the required information.**

**Owner's Name**

**Date of Sale**

**Address**

**Selling Dealer**

**City, State, Zip**

**Address**

**Boat Make, Length, Type**

You should review the Crusader 2 Year Transferable Limited Warranty with the new owner. Upon completion of the warranty review, you will complete the remaining dealer portion of the Crusader Warranty Registration form by filling in the following blocks.

**Dealer Reviewed Warranty with Owner** (the last block of the Pre-Delivery Checklist)

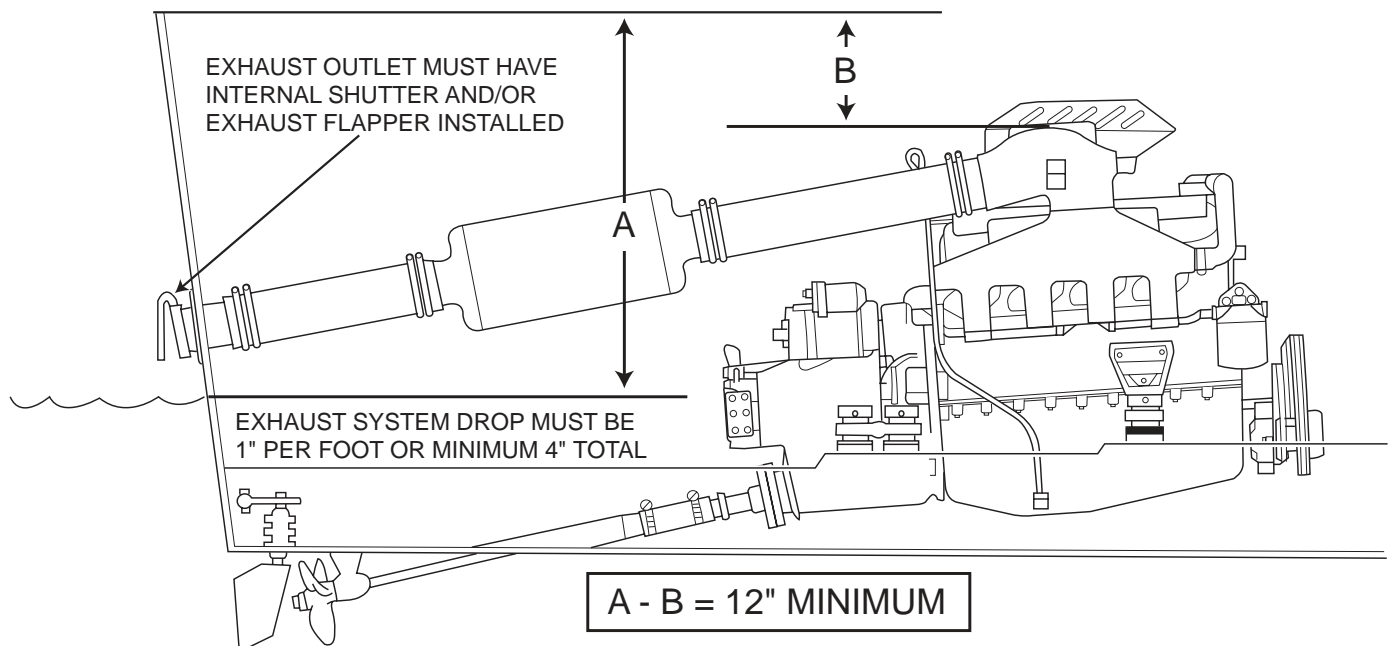
**Dealer Signature:** (By signing this form, the dealer certifies that he has checked the installation and operation of the engine(s) and finds them to be performing properly.)

**Owner's Signature and Date**

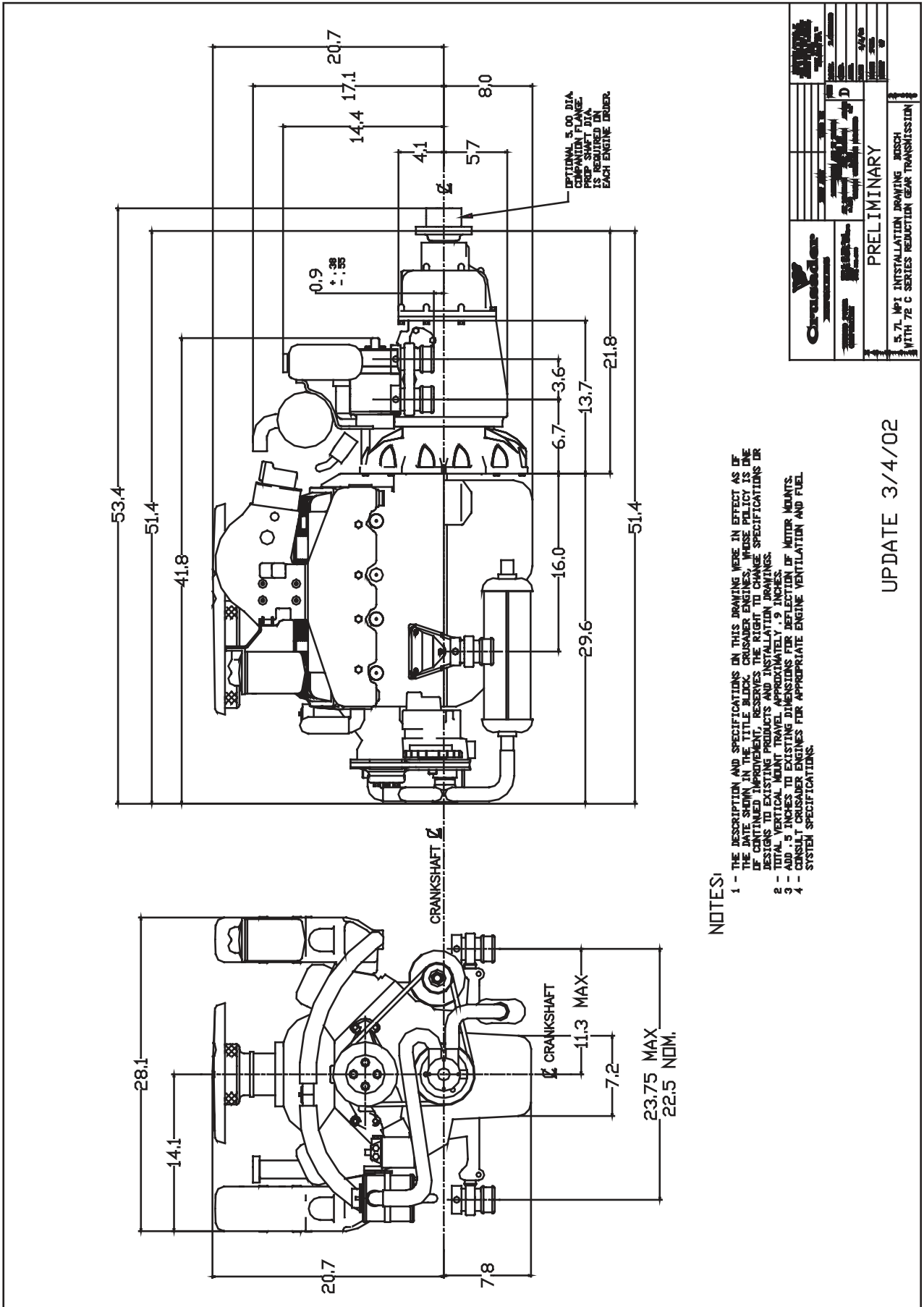
Give the customer their copy of the completed Crusader Warranty Registration form along with the copy of the Warranty Statement. Affix proper postage and send the pre-addressed card to Crusader. This completes the registration of a new Crusader engine.

# EXHAUST INSTALLATION GUIDELINES

The top of the exhaust riser must be a minimum of 12 inches above the water line with the boat at rest and a full load aboard. It is recommended by the ABYC, and a Pleasurecraft Engine Group requirement, that there be a drop in the exhaust run between the engine and exhaust outlet of a minimum of 1 inch per foot of run, with a minimum of four (4) inches drop overall. The drop must be constant so that no low spots exist at any point in the exhaust hose. The above are minimum guidelines for installation, however, meeting the minimum guidelines will not necessarily insure no water intrusion under all operating conditions. It is the responsibility of the boat builder to confirm, for each model, that under any and all running angles and other conditions of operation, no water ingestion will occur.









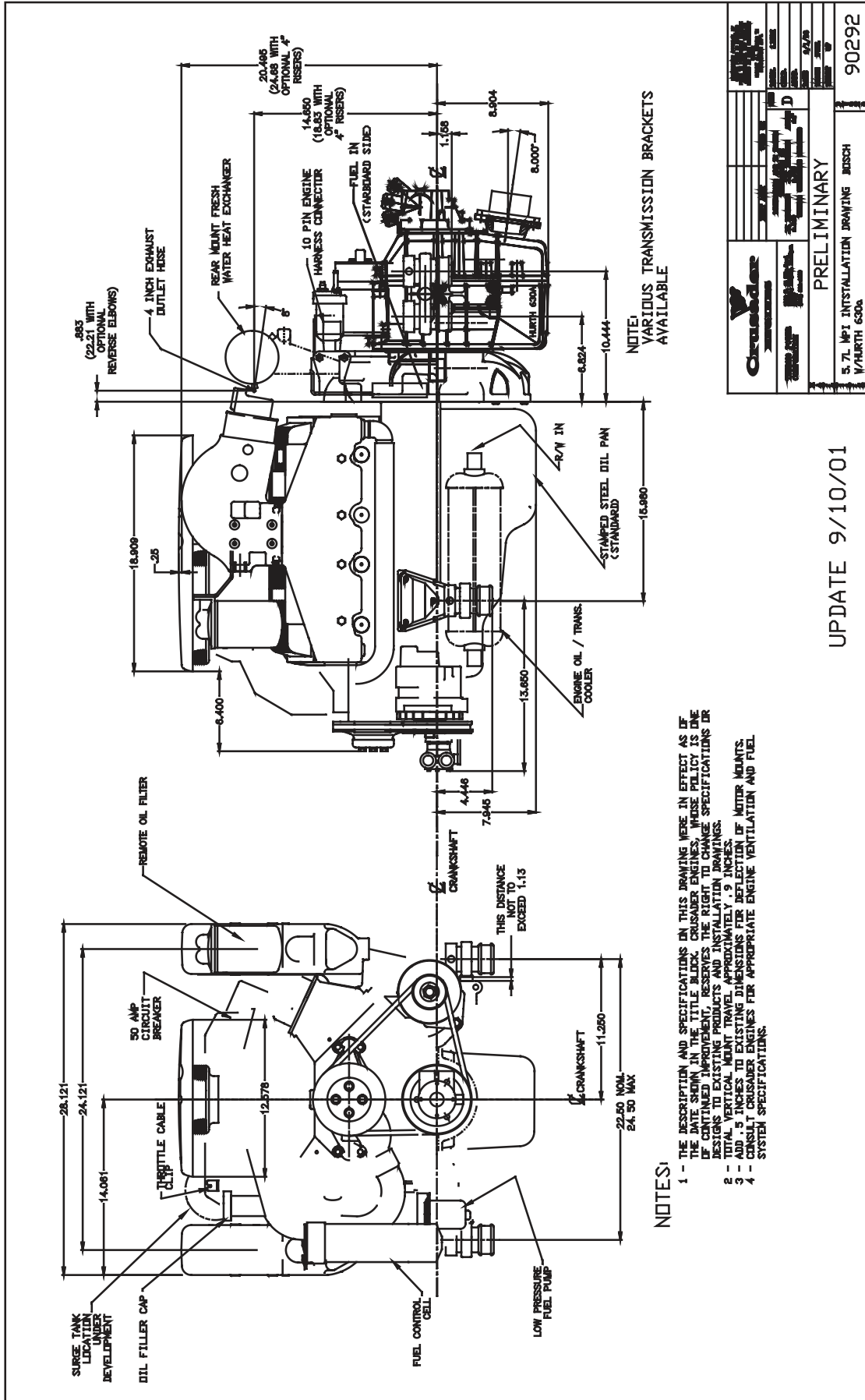


NOTES:





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- 2 - TOTAL VERTICAL MOUNT TRAVEL APPROXIMATELY .9 INCHES.
- 3 - ADD .5 INCHES TO EXISTING DIMENSIONS FOR DEFLECTION OF MOTOR MOUNTS.
- 4 - CONSULT CRUSAHER ENGINES FOR APPROPRIATE ENGINE VENTILATION AND FUEL SYSTEM SPECIFICATIONS.

			
PRELIMINARY	PRELIMINARY	PRELIMINARY	PRELIMINARY
5.7L MPI INSTALLATION DRAWING	5.7L MPI INSTALLATION DRAWING	5.7L MPI INSTALLATION DRAWING	5.7L MPI INSTALLATION DRAWING
WITH 72 C SERIES REDUCTION GEAR TRANSMISSION	WITH 72 C SERIES REDUCTION GEAR TRANSMISSION	WITH 72 C SERIES REDUCTION GEAR TRANSMISSION	WITH 72 C SERIES REDUCTION GEAR TRANSMISSION

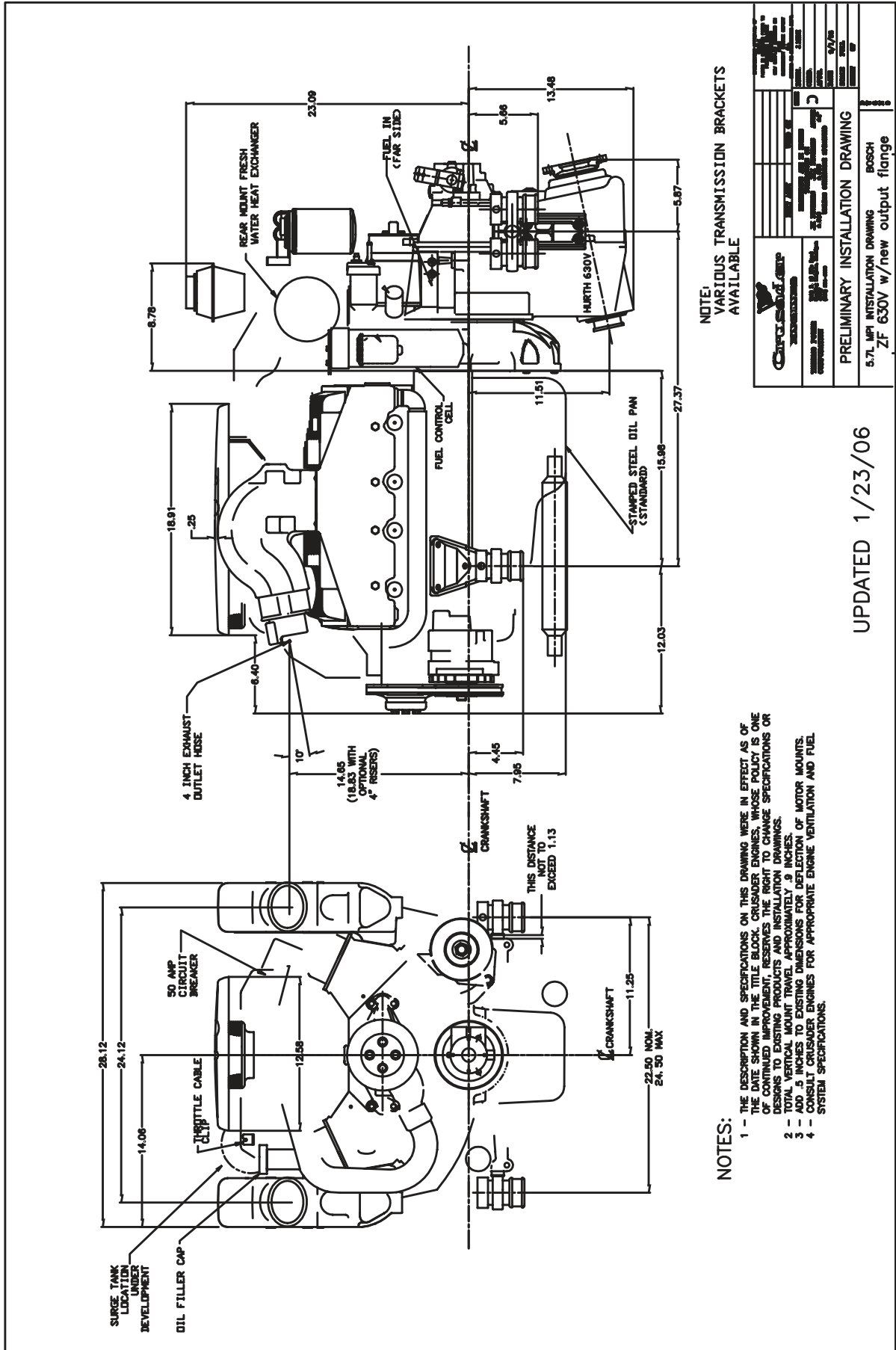
UPDATE 3/4/02



- NOTES:**
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<b>PRELIMINARY</b>			
5.7L MPI INSTALLATION DRAWING BOSCH W/HEARTH 650A			
			90292

UPDATE 9/10/01

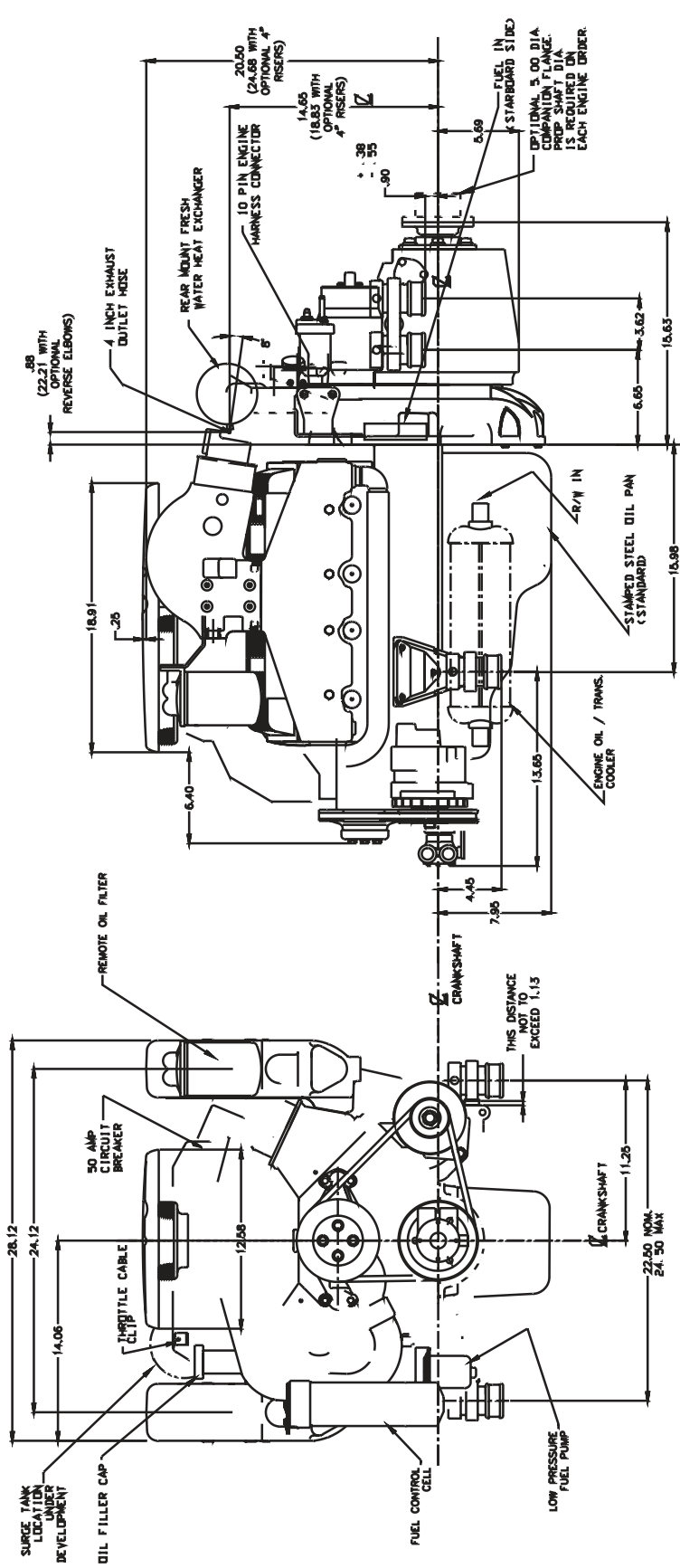


NOTE:  
VARIOUS TRANSMISSION BRACKETS  
AVAILABLE

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PRELIMINARY INSTALLATION DRAWING	5.7L MPI INSTALLATION DRAWING
5.7L MPI INSTALLATION DRAWING	ZF 630V w/new output flange
DATE	DATE
BY	BY
CHECKED	CHECKED
APPROVED	APPROVED

UPDATED 1/23/06



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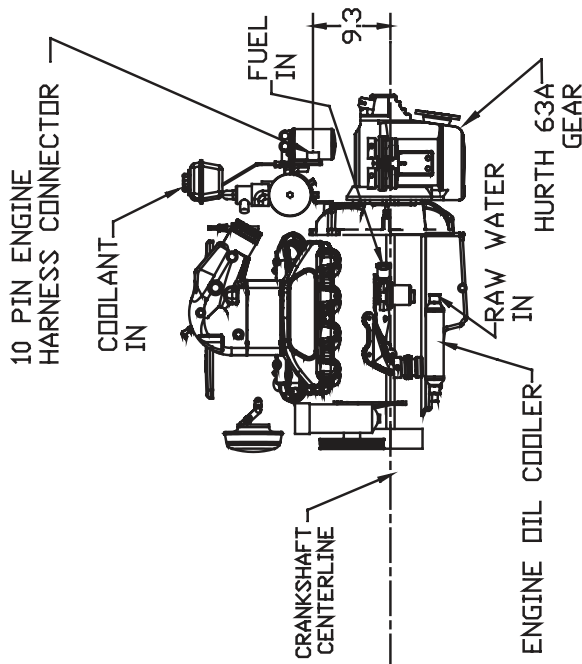
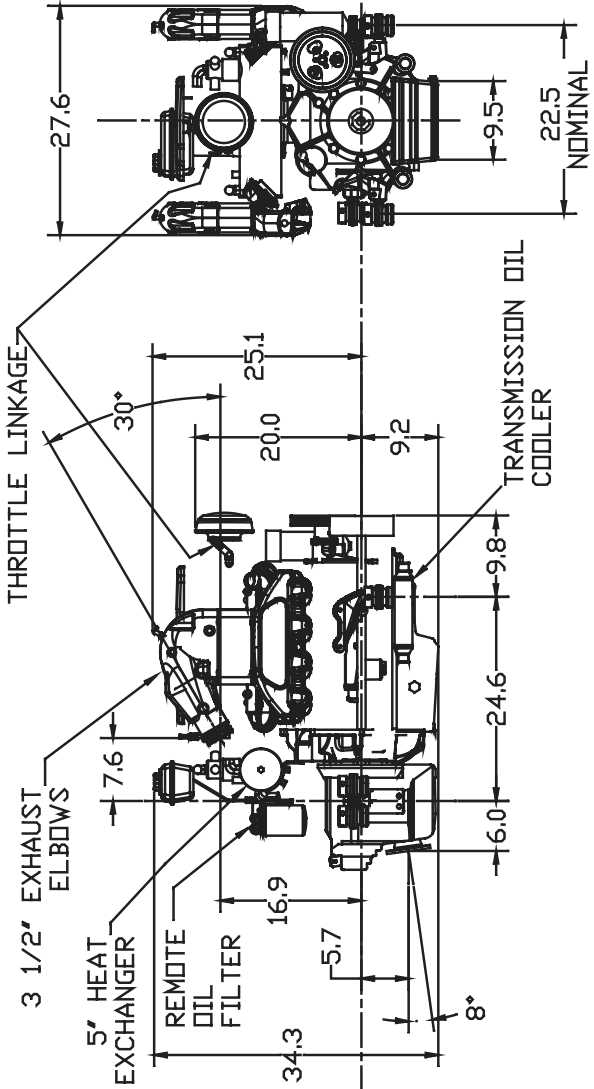
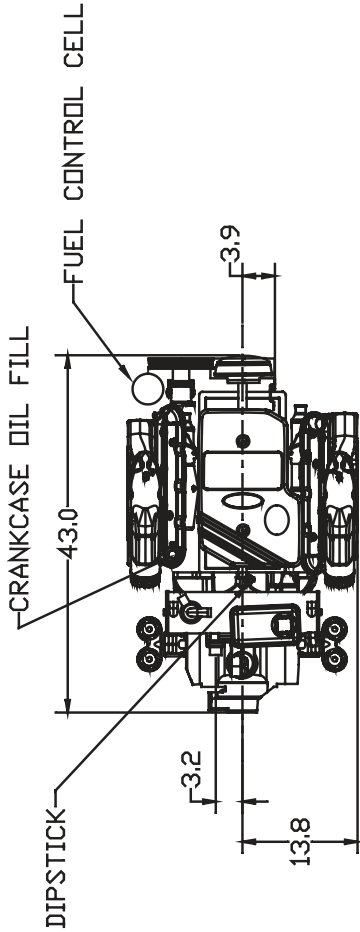
<b>Crusader</b>	<b>PRELIMINARY</b>
<small>                 5.7L MPI INSTALLATION DRAWING                  WITH 72 C SERIES TRANSMISSION             </small>	<small>                 DATE: 3/4/02                  DRAWN BY: [Signature]                  CHECKED BY: [Signature]                  SCALE: 1:1                  SHEET NO. 1 OF 1             </small>

UPDATE 3/4/02

REV	DATE	BY	CHKD

NOTES:

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- 4 - CONSULT CRUISER ENGINES FOR APPROPRIATE ENGINE VENTILATION AND FUEL SYSTEM SPECIFICATIONS.

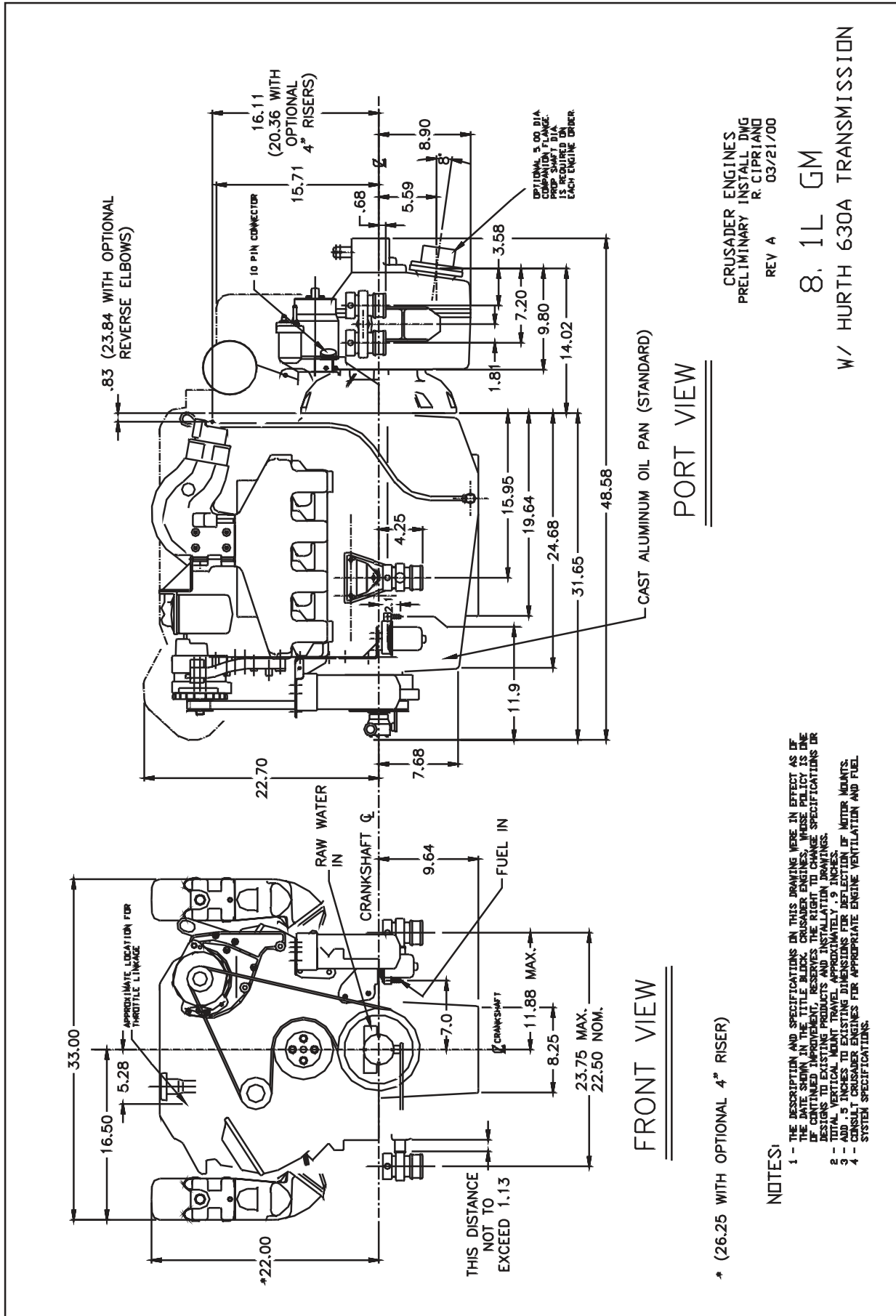


PRELIMINARY DRAWING

REV	DATE	BY	CHKD

PLEASURECRAFT  
 60 LITER CRUISER  
 WITH 4 IN EXHAUST  
 V/ HURTH 63A GEAR

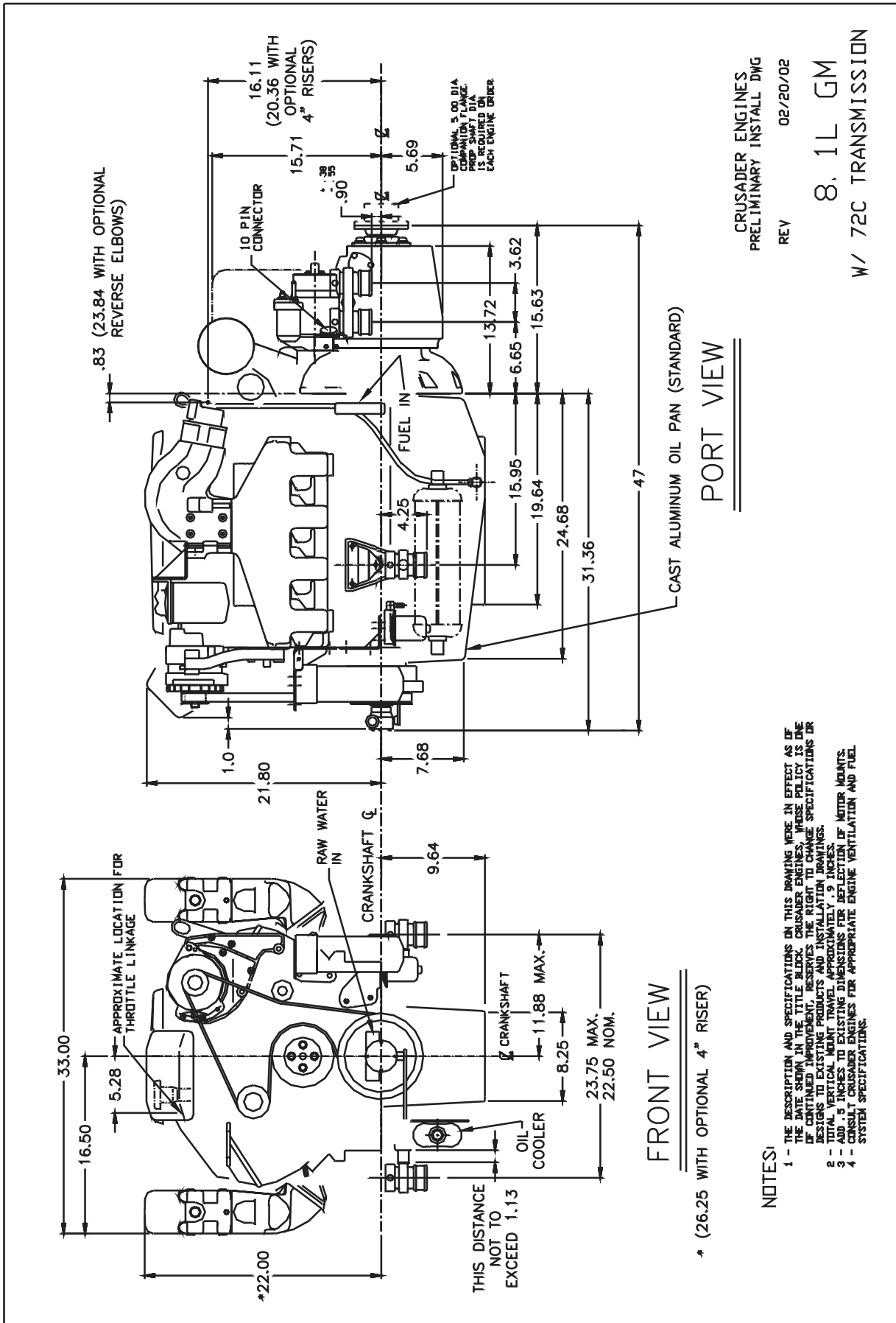
DATE: 10/10/07  
 DRAWN BY: J. B. BROWN  
 CHECKED BY: J. B. BROWN  
 SCALE: 1/4" = 1"



\* (26.25 WITH OPTIONAL 4" RISER)

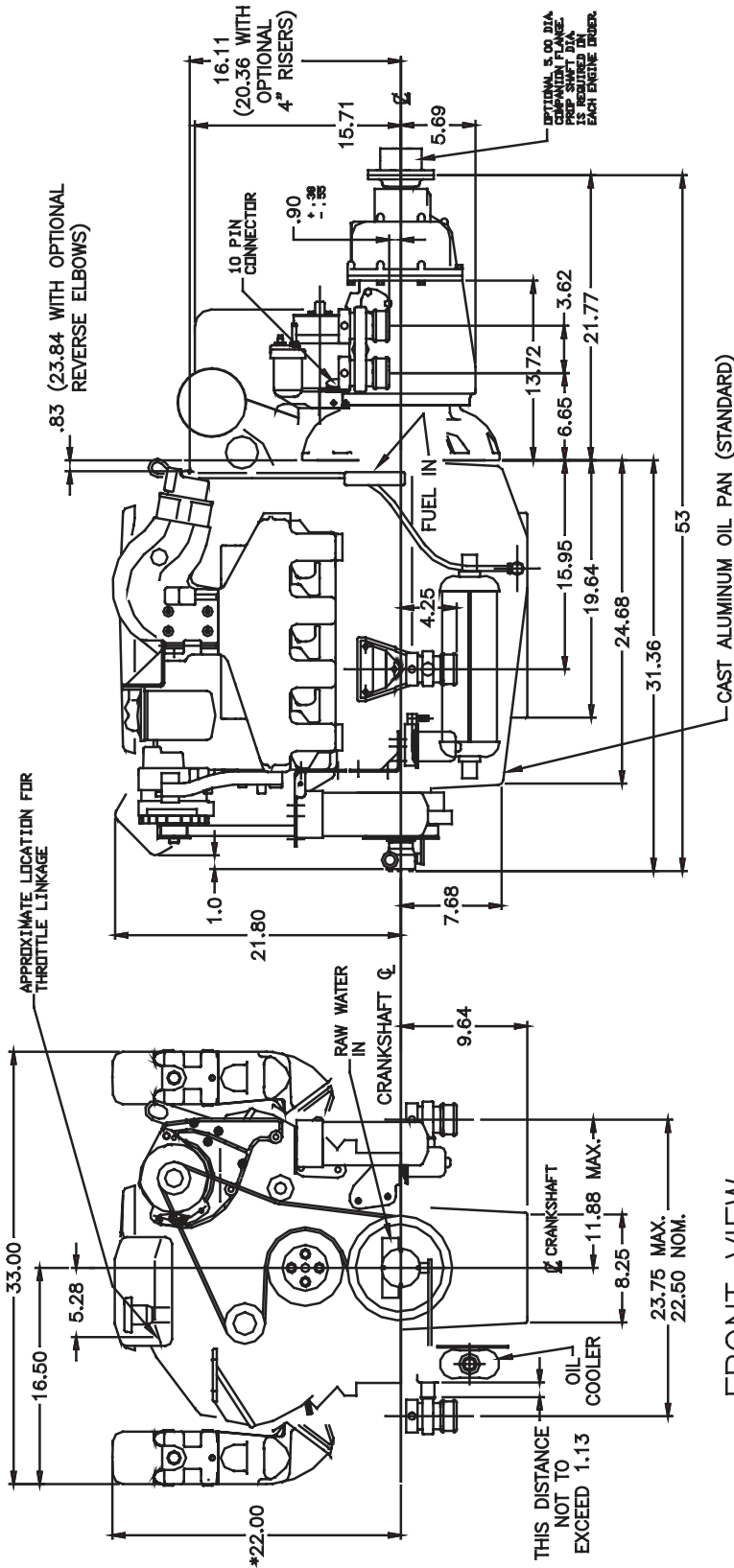
NOTES:

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CRUSADER ENGINES  
 PRELIMINARY INSTALL DWG  
 REV 02/20/02  
 8.1L GM  
 W/ 72C TRANSMISSION

- NOTES:
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**FRONT VIEW**  
 \* (26.25 WITH OPTIONAL 4" RISER)

**PORT VIEW**

CRUSADER ENGINES  
 PRELIMINARY INSTALL DWG

REV 3/6/02 HP

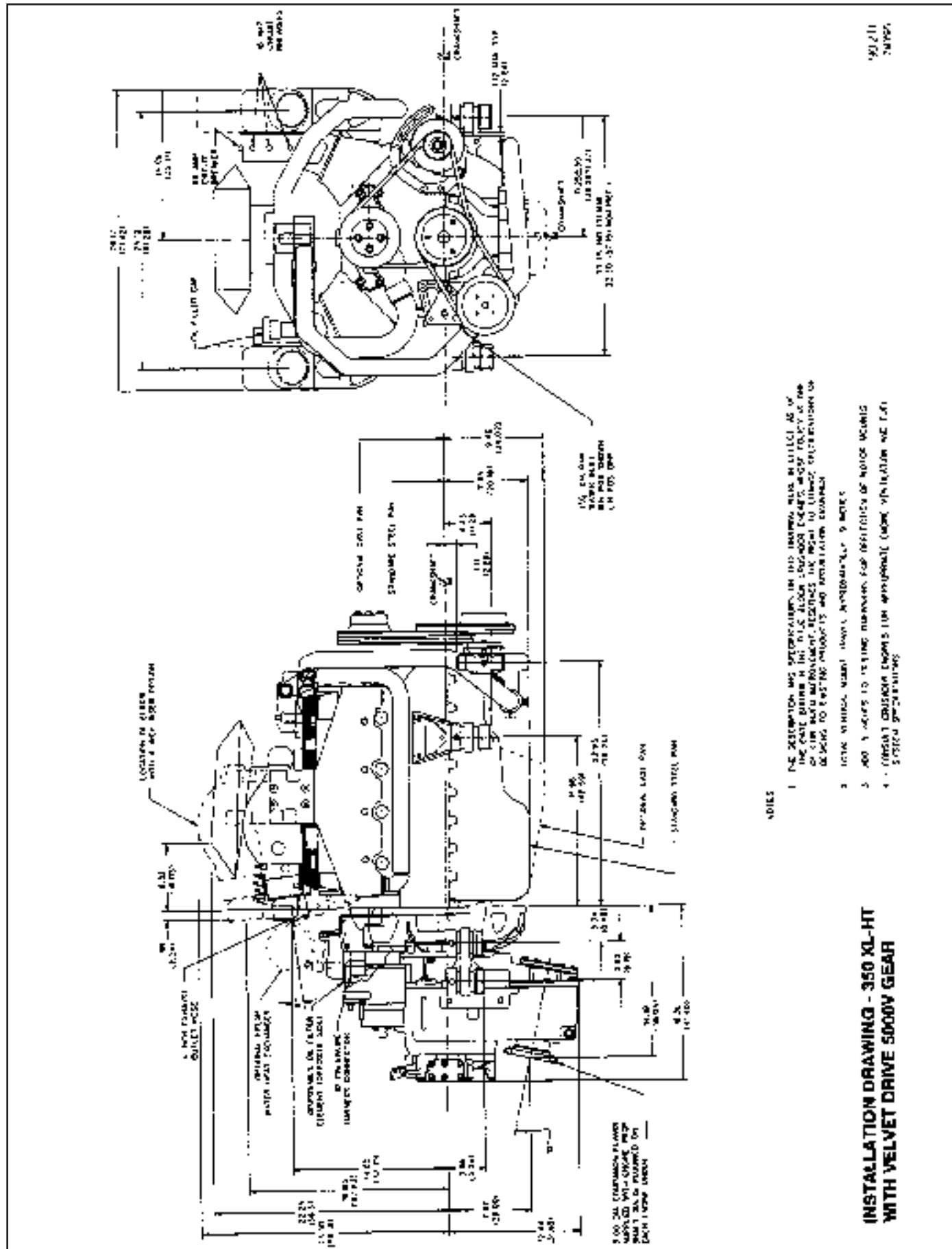
8.1L GM

W/ 72C REDUCTION GEAR TRANSMISSION

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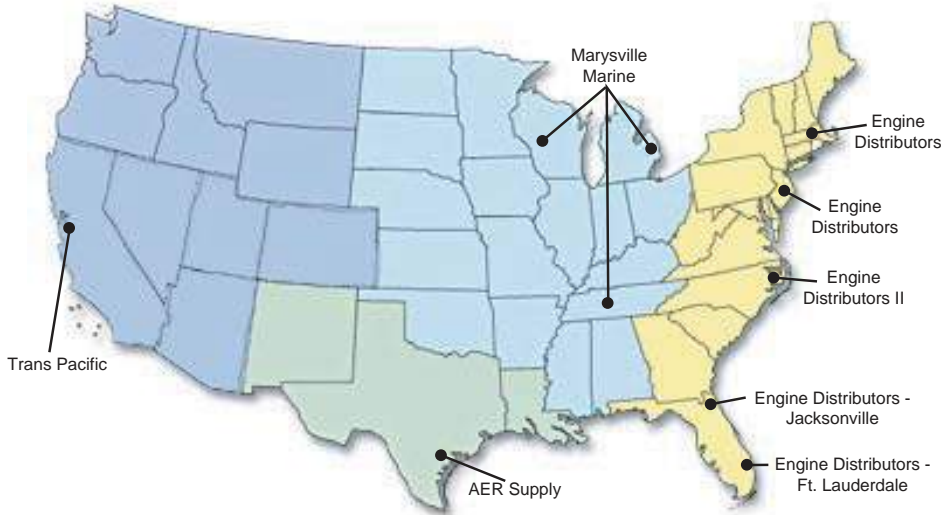








# CRUSADER MARINE ENGINES DISTRIBUTORS



- Marysville Marine Distributors
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- AER Supply
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**Engine Distributors Inc.**  
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 Blackwood, NJ 08012  
 Jaime Cummins  
 Phone: 800-220-2700  
 Fax: 856-228-5657 - Parts  
 Fax: 856-228-5531 - Sales  
[jcummins@edi-dist.com](mailto:jcummins@edi-dist.com)

**Engine Distributors Inc.**  
 41 Pope Road  
 Holliston, MA 01746  
 Jaime Cummins  
 Phone: 800-220-2700  
 Fax: 856-228-5657 - Parts  
 Fax: 856-228-5531 - Sales  
[jcummins@edi-dist.com](mailto:jcummins@edi-dist.com)

**Engine Distributors Inc. II**  
 303 Interstate Dr.  
 Archdale, NC 27263-3148  
 Jaime Cummins  
 Phone: 800-220-2700  
 Fax: 856-228-5657 - Parts  
 Fax: 856-228-5531 - Sales  
[jcummins@edi-dist.com](mailto:jcummins@edi-dist.com)

**Trans Pacific Distributors**  
 1941 Walters Court  
 Fairfield, CA 94533  
 Henry Bramhall - Owner  
 Arley Harty  
 Phone: 800-688-6208  
 Fax: 707-426-0206  
[sales@marinegate.com](mailto:sales@marinegate.com)

**Marysville Marine Distributors**  
 282 Progress Way  
 Sun Prairie, WI 53590  
 Brian Hunter  
 Phone: 608-825-3878  
 Fax: 608-825-2790  
[marysvillemarine.com](http://marysvillemarine.com)

**Marysville Marine Distributors**  
 1551 Michigan Avenue  
 Marysville, MI 48060  
 Steve Riehl  
 Phone: 810-364-7653  
 Fax: 810-364-4112  
[marysvillemarine.com](http://marysvillemarine.com)

**Engine Distributors - Jacksonville**  
 259 Ellis Road South  
 Jacksonville, FL 32254  
 Jaime Cummins  
 Phone: 800-220-2700  
 Fax: 856-228-5657 - Parts  
 Fax: 856-228-5531 - Sales  
[jcummins@edi-dist.com](mailto:jcummins@edi-dist.com)

**AER Supply**  
 2301 NASA Road One  
 PO Box 349  
 Seabrook, TX 77586  
 Richard Miller  
 Phone: 800-767-7606  
 Fax: 281-474-2714  
[aersupply.com](http://aersupply.com)

**Marysville Marine Distributors**  
 127 Industrial Dr.  
 White House, TN 37188  
 Randy Hall  
 Phone: 615-672-1142  
 Fax: 615-672-8084  
[marysvillemarine.com](http://marysvillemarine.com)

**Engine Distributors - Ft. Lauderdale**  
 2917 SW 2nd Avenue  
 Ft. Lauderdale, FL 33315  
 Jaime Cummins  
 Phone: 800-220-2700  
 Fax: 856-228-5657 - Parts  
 Fax: 856-228-5531 - Sales  
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