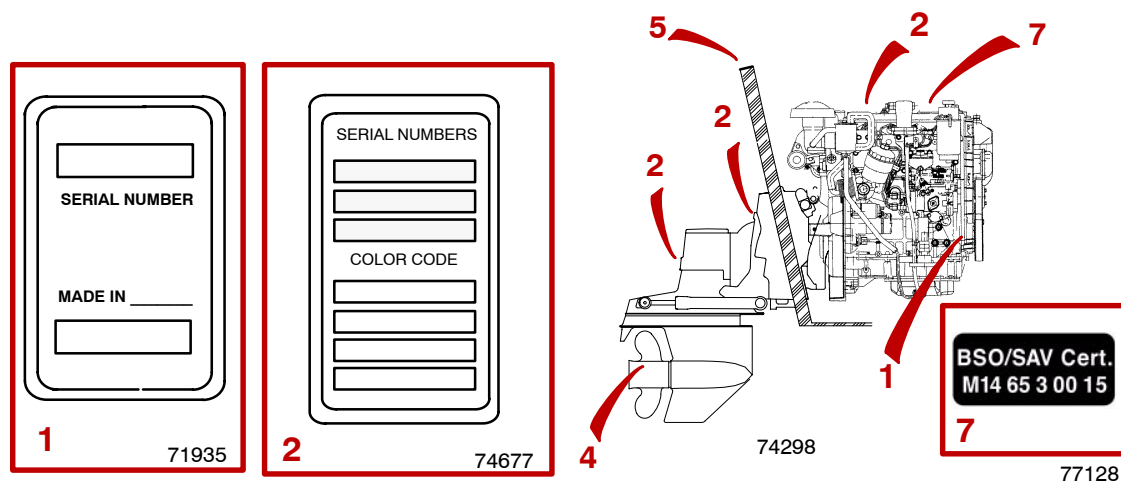


1.7 Diesel Sterndrive Models

Identification Record

The serial numbers are the manufacturer's keys to numerous engineering details which apply to your Cummins MerCruiser Diesel® power package. When contacting Cummins MerCruiser Diesel (CMD®) about service, **always specify model and serial numbers.**



Please record the following information:

1.

Engine Model and Horsepower

Engine Serial Number

2.

Transom Assembly Serial Number
(Sterndrive)

Gear
Ratio

Sterndrive Unit Serial
Number

3.

Transmission Model (Inboard)

Gear
Ratio

Transmission Serial
Number

4.

Propeller Number

Pitch

Diameter

5.

Hull Identification Number (HIN)

Purchase Date

6.

Boat Manufacturer

Boat
Model

Length

7.

Exhaust Gas Emissions Certificate Number (Europe Only)

The description and specifications contained herein were in effect at the time this guide was approved for printing. Cummins MerCruiser Diesel, whose policy is one of continuous improvement, reserves the right to discontinue models at any time, or to change specifications or designs, without notice and without incurring obligation.

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Mercury Marine, Fond du Lac, Wisconsin, U.S.A.

Printed in U.S.A.

WELCOME!

You have selected one of the finest marine power packages available. It incorporates numerous design features to assure operating ease and durability.

With proper care and maintenance, you will thoroughly enjoy using this product for many boating seasons. To ensure maximum performance and carefree use, we ask that you thoroughly read this manual.

The Operation, Maintenance and Warranty Manual contains specific instructions for using and maintaining your product. We suggest that this manual remain with the product for ready reference whenever you are on the water.

Thank you for purchasing one of our Cummins MerCruiser Diesel products. We sincerely hope your boating will be pleasant!

Cummins MerCruiser Diesel


Warranty Message

The product you have purchased comes with a **limited warranty** from Cummins MerCruiser Diesel; the terms of the warranty are set forth in the **Warranty Sections** of this manual. The warranty statement contains a description of what is covered, what is not covered, the duration of coverage, how to best obtain warranty coverage, **important disclaimers and limitations of damages** and other related information. Please review this important information.

Read This Manual Thoroughly

IF YOU DON'T UNDERSTAND ANY PORTION, CONTACT YOUR DEALER FOR A DEMONSTRATION OF ACTUAL STARTING AND OPERATING PROCEDURES.

NOTICE

Throughout this publication, and on your power package, **WARNINGS** and **CAUTIONS**, accompanied by the International Hazard Symbol , may be used to alert the installer/user 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 with these special instructions while performing the service, plus common sense operation, are major accident prevention measures.

WARNING

WARNING - Hazards or unsafe practices which could result in severe personal injury or death.

CAUTION

CAUTION - 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 operation and/or maintenance.

WARNING

The operator (driver) is responsible for the correct and safe operation of the boat, the equipment aboard and the safety of all occupants aboard. We strongly recommend that the operator read this Operation, Maintenance and Warranty Manual and thoroughly understand the operational instructions for the power package and all related accessories before the boat is used.

WARNING

California Proposition 65 Warning

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

WARNING

Electrical system components on this engine are not external ignition protected. **DO NOT STORE OR UTILIZE GASOLINE ON BOATS EQUIPPED WITH THESE ENGINES, UNLESS PROVISIONS HAVE BEEN MADE TO EXCLUDE GASOLINE VAPORS FROM ENGINE COMPARTMENT (REF: 33 CFR).** Failure to comply could result in fire, explosion and/or severe personal injury.

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Warranty Information

Owner Warranty Registration

UNITED STATES AND CANADA ONLY

- It is important that your selling dealer fills out the Warranty Registration Card completely and mails it to the factory immediately upon sale of the new product.
- It identifies name and address of the original purchaser, product model and serial number(s), date of sale, type of use and selling dealer's code, name and address. The dealer also certifies that you are the original purchaser and user of the product.
- Upon receipt of the Warranty Registration Card at the factory, you will be issued a plastic Owner Warranty Registration Card which is your only valid registration identification. It must be presented to the servicing dealer should warranty service be required. Warranty claims will not be accepted without presentation of this card.
- A temporary Owner Warranty Registration Card will be presented to you when you purchase the product. It is valid only for 30 days from date of sale while your plastic Owner Warranty Registration Card is being processed. Should your product need service during this period, present the temporary registration card to the dealer. He will attach it to your warranty claim form.
- Because of your selling dealer's continuing personal interest in your satisfaction, the product should be returned to him for warranty service.
- If your plastic card is not received within 30 days from date of new product sale, please contact your selling dealer.
- The product warranty is not effective until the product is registered at the factory.
- NOTICE: Registration lists must be maintained by factory and dealer on marine products sold in the United States, should notification under the Federal Boat Safety Act be required.
- You may change your address at any time, including at time of warranty claim, by calling Mercury MerCruiser or sending a letter or fax with you name, old address, new address, and engine serial number to Mercury MerCruiser's warranty registration department. Your dealer can also process this change of information.

Mercury Marine
Attn: Warranty Registration Department
W6250 Pioneer Road
P.O. Box 1939
Fond du Lac, WI 54935-1939
Phone: 920-929-5054
Fax: 920-929-5893

International Owner Registration

OUTSIDE THE UNITED STATES AND CANADA

- It is important that your selling dealer fills out the Warranty Registration Card completely and mails it to the distributor or Marine Power Service Center responsible for administering the warranty registration/claim program for your area.
- The Warranty Registration Card identifies your name and address, product model and serial number(s), date of sale, type of use and the selling distributor's/dealer's code number, name and address. The distributor/dealer also certifies that you are the original purchaser and user of the product.
- A copy of the Warranty Registration Card, designated as the "Purchaser's Copy", MUST be given to you immediately after the card has been completely filled out by the selling distributor/dealer. This card represents your factory registration identification, and should be retained by you for future use when required. Should you ever require warranty service on this product, your dealer may ask you for the Warranty Registration Card to verify date of purchase and to use the information on the card to prepare the warranty claim form(s).
- In some countries, the Marine Power Service Center will issue you a permanent (plastic) Warranty Registration Card within 30 days after receiving the "Factory Copy" of the Warranty Registration Card from your distributor / dealer. If you receive a plastic Warranty Registration Card, you may discard the "Purchaser's Copy" that you received from the distributor / dealer when you purchased the product. Ask your distributor / dealer if this plastic card program applies to you.
- For further information concerning the Warranty Registration Card and its relationship to Warranty Claim processing, refer to the "International Warranty." Refer to "Table of Contents."

IMPORTANT: Registration lists must be maintained by the factory and dealer in some countries by law. It is our desire to have ALL products registered at the factory should it ever be necessary to contact you. Make sure your dealer / distributor fills out the warranty registration card immediately and sends the factory copy to the Marine Power International Service Center for your area.

Warranty Policies

Recreational Use Diesel Limited Warranty

WHAT IS COVERED

Cummins MerCruiser Diesel warrants its new products to be free of defects in material and workmanship during the period described below.

DURATION OF COVERAGE

This Limited Warranty provides coverage for one (1) year from the date the product is first sold to a recreational use retail purchaser, or the date on which the product is first put into service, whichever occurs first. Commercial use of the product voids the warranty. Commercial use is defined as any work or employment related use of the product, or any use of the product which generates income, for any part of the warranty period, even if the product is only occasionally used for such purposes. The repair or replacement of parts, or the performance of service under this warranty, does not extend the life of this warranty beyond its original expiration date. Unexpired warranty coverage can be transferred from one recreational use customer to a subsequent recreational use customer upon proper re-registration of the product. Unexpired warranty coverage cannot be transferred either to or from a commercial use customer.

CONDITIONS THAT MUST BE MET IN ORDER TO OBTAIN WARRANTY COVERAGE

Warranty coverage is available only to retail customers that purchase from a Dealer authorized by Cummins MerCruiser Diesel to distribute the product in the country in which the sale occurred, and then only after the Cummins MerCruiser Diesel specified pre-delivery inspection process is completed and documented. Warranty coverage becomes available upon proper registration of the product by the authorized dealer. Inaccurate warranty registration information regarding recreational use, or subsequent change of use from recreational to commercial (unless properly re-registered) may void the warranty at the sole discretion of Cummins MerCruiser Diesel. Routine maintenance outlined in the Operation, Maintenance, and Warranty Manual must be timely performed in order to obtain warranty coverage. Cummins MerCruiser Diesel reserves the right to make any warranty coverage contingent upon proof of proper maintenance.

WHAT CUMMINS MERCUISER DIESEL WILL DO

Cummins MerCruiser Diesel's sole and exclusive obligation under this warranty is limited to, at our option, repairing a defective part, replacing such part or parts with new or Mercury Marine certified re-manufactured parts, or refunding the purchase price of the Cummins MerCruiser Diesel product. Mercury reserves the right to improve or modify products from time to time without assuming an obligation to modify products previously manufactured.

HOW TO OBTAIN WARRANTY COVERAGE

The customer must provide Cummins MerCruiser Diesel with a reasonable opportunity to repair, and reasonable access to the product for warranty service. Warranty claims shall be made by delivering the product for inspection to a Cummins MerCruiser Diesel dealer / distributor authorized to service the product. If purchaser cannot deliver the product to such a dealer, written notice must be given to Cummins MerCruiser Diesel. We will then arrange for the inspection and any covered repair. Purchaser in that case shall pay for all related transportation charges and/or travel time. If the service provided is not covered by this warranty, purchaser shall pay for all related labor and material, and any other expenses associated with that service. Purchaser shall not, unless requested by Cummins MerCruiser Diesel, ship the product or parts of the product directly to Cummins MerCruiser Diesel. The warranty registration card is the only valid registration identification and must be presented to the dealer at the time warranty service is requested in order to obtain coverage.

WHAT IS NOT COVERED

This limited warranty does not cover routine maintenance items, tune ups, adjustments, normal wear and tear, damage caused by abuse, abnormal use, use of a propeller or gear ratio that does not allow the engine to operate at the recommended Engine Rated rpm, operation of the product in a manner inconsistent with the recommended operation / duty cycle section of the Operation, Maintenance, And Warranty Manual, neglect, accident, submersion, improper installation (proper installation specifications and techniques are set forth in the installation instructions for the product), improper service, use of an accessory or part which damages the Cummins MerCruiser Diesel product and was not manufactured or sold by us, jet pump impellers and liners, operation with fuels, oils or lubricants which are not suitable for use with the product (see the Operation, Maintenance, And Warranty Manual), alteration or removal of parts, water entering the engine through the fuel intake, air intake or exhaust system or damage to the product from insufficient cooling water caused by blockage of the cooling system by a foreign body, running the engine out of water, mounting the engine too high on the transom, or running the boat with the engine trimmed out too far. Use of the product for racing or other competitive activity, or operating with a racing type lower unit, at any point, even by a prior owner of the product, voids the warranty.

Expenses related to haul-out, launch, towing, storage, telephone, rental, inconvenience, slip fees, insurance coverage, loan payments, loss of time, loss of income, or any other type of incidental or consequential damages are not covered by this warranty. Also, expenses associated with the removal and/or replacement of boat partitions or material caused by boat design for access to the product are not covered by this warranty.

No individual or entity, including Cummins MerCruiser Diesel authorized dealers, has been given authority by Cummins MerCruiser Diesel to make any affirmation, representation or warranty regarding the product, other than those contained in this limited warranty, and if made, shall not be enforceable against Cummins MerCruiser Diesel.

DISCLAIMERS AND LIMITATIONS

THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED. TO THE EXTENT THAT THEY CANNOT BE DISCLAIMED, THE IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE LIFE OF THE EXPRESS WARRANTY. INCIDENTAL AND CONSEQUENTIAL DAMAGES ARE EXCLUDED FROM COVERAGE UNDER THIS WARRANTY. SOME STATES/COUNTRIES DO NOT ALLOW FOR THE DISCLAIMERS, LIMITATIONS AND EXCLUSIONS IDENTIFIED ABOVE. AS A RESULT, THEY MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER LEGAL RIGHTS WHICH VARY FROM STATE TO STATE AND COUNTRY TO COUNTRY.

Warranty Coverage and Exclusion

Keep in mind that warranty covers repairs that are needed within the warranty period because of defects in material and workmanship. Installation errors, accidents, normal wear, and a variety of other causes that affect the product are not covered.

Warranty is limited to defects in material or workmanship, but only when the consumer sale is made in the country to which distribution is authorized by us.

Should you have any questions concerning warranty coverage contact your authorized dealer. They will be pleased to answer any questions that you may have.

WARRANTY DOES NOT APPLY TO THE FOLLOWING:

- Minor adjustments or checks, including checking fuel injection pump timing, cleaning fuel injectors, filters, or adjusting belts, controls, and checking lubrication made in connection with normal services.
- Damage caused by neglect, lack of maintenance, accident, abnormal operation, improper installation or service, or freezing temperatures.
- Haul-out, launch, towing charges; removal and/or replacement of boat partitions or material because of boat design for necessary access to the product; all related transportation charges and/or travel time, etc. Reasonable access must be provided to the product for warranty service. Customer must deliver product to an Authorized Dealer.
- Additional service work requested by customer other than that necessary to satisfy the warranty obligation.
- Labor performed by other than an Authorized Dealer may be covered only under following circumstances: When performed on emergency basis (providing there are no Authorized Dealers in area who can perform the work required or have no facilities to haul out, etc., and prior factory approval has been given to have the work performed at this facility).
- All incidental and/or consequential damages (storage charges, telephone or rental charges of any type, inconvenience or loss of time or income) are the owner's responsibility.

- Use of other than Quicksilver replacement parts when making warranty repairs.
- Oils, lubricants or fluids changed as a matter of normal maintenance is customer's responsibility unless loss or contamination of same is caused by product failure that would be eligible for warranty consideration.
- Participating in or preparing for racing or other competitive activity.
- Engine noise does not necessarily indicate a serious engine problem. If diagnosis indicates a serious internal engine condition which could result in a failure, condition responsible for noise should be corrected under the warranty.
- Lower unit and/or propeller damage caused by striking a submerged object is considered a marine hazard.
- Water entering the engine via the air filter or exhaust system or submersion. Also, water in the starter motor.
- Starter motors and/or armatures or field coil assembly, which are burned, or where lead is thrown out of commutator because of excess cranking.
- Valve or valve seat grinding required because wear.
- Failure of any parts caused by lack of cooling water, which results from starting power package out of water, foreign material blocking inlets or power package being mounted too high.
- Use of fuels and lubricants that are not suitable for use with or on the product. Refer to your Operation, Maintenance, And Warranty Manual.
- Our limited warranty does not apply to any damage to our products caused by the installation or use of parts and accessories that are not manufactured or sold by us. Failures that are not related to the use of those parts or accessories, are covered under warranty, if they otherwise meet the terms of the limited warranty for that product.

Transferable Warranty

The product warranty is transferable to a subsequent purchaser, but only for the remainder of the unused portion of the limited warranty. This will not apply to products used for commercial applications.

Direct Sale By Owner

- The second owner can be registered as the new owner and retain the unused portion of the limited warranty by sending the former owner's plastic Owner Warranty Registration Card and a copy of the bill of sale to show proof of ownership. In the United States and Canada, mail to:

Mercury Marine
Attn: Warranty Registration Department
W6250 Pioneer Road
P.O. Box 1939
Fond du Lac, WI 54935-1939

- A new Owner Warranty Registration Card will be issued with the new owner's name and address. Registration records will be changed on the factory computer registration file.
- There is no charge for this service.

Outside the United States and Canada, please contact the distributor in your country, or the Marine Power International Service Center closest to you, for the transferable warranty procedure that would apply to you.

SECTION 2 - GETTING TO KNOW YOUR POWER PACKAGE

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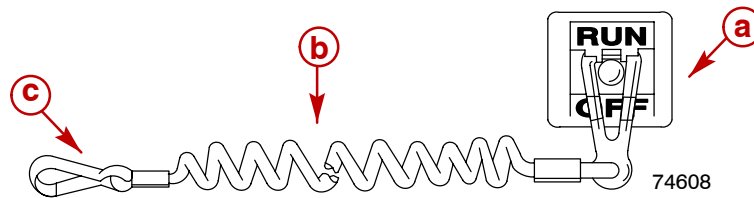
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Features And Controls

Lanyard Stop Switch

The purpose of a lanyard stop switch is to turn off the engine when the operator moves outside the operator's position (as in accidental ejection from the operator's position).



- a** - Stop switch
- b** - Lanyard
- c** - Clips to the operator

Accidental ejections, such as falling overboard, are more likely to occur in:

- low sided sport boats
- bass boats
- high performance boats

Accidental ejections can also occur from:

- poor operating practices
- sitting on the seat or gunwale at planing speeds
- standing at planing speeds
- operating at planing speeds in shallow or obstacle infested waters
- releasing your grip on the steering wheel that is pulling in 1 direction
- consuming alcohol or drugs
- high speed boating maneuvers

Some remote control units are equipped with a lanyard stop switch, if your remote control is not equipped with a lanyard stop switch one can be installed on the dashboard or side adjacent to the operator's position. The lanyard is a cord usually 4 - 5 ft (1.2 - 1.5 m) long when stretched out with an element on 1 end made to be inserted into the switch and a snap on the other end for attaching to the operator. The lanyard is coiled to make it as short as possible to minimize the likelihood of entanglement with nearby objects. It stretches to minimize the likelihood of accidental activation should the operator choose to move around in an area close to the normal operator's position. To shorten the lanyard, wrap it around the operator's wrist or leg, or tie a knot in the lanyard.

Activation of the lanyard stop switch will stop the engine immediately, but the boat will continue to coast for some distance depending upon the velocity and degree of any turn at shut down. However, the boat will not complete a full circle. While the boat is coasting, it can cause injury to anyone in the boat's path as seriously as the boat would when under power.

We strongly recommend that other occupants be instructed on proper starting and operating procedures should they be required to operate the engine in an emergency (e.g. if the operator is accidentally ejected).

⚠ WARNING

Avoid contact with the boat hull and propeller from accidental ejection. Personal injury or death could occur. Always properly connect both ends of the lanyard stop switch.

Accidental or unintended activation of the switch during normal operation is also a possibility. This could cause any, or all, of the following potentially hazardous situations:

- Occupants could be thrown forward due to unexpected loss of forward motion, a particular concern for passengers in the front of the boat who could be ejected over the bow and possibly struck by the gear case or propeller.
- Loss of power and directional control in heavy seas, strong current or high winds.
- Loss of control when docking.

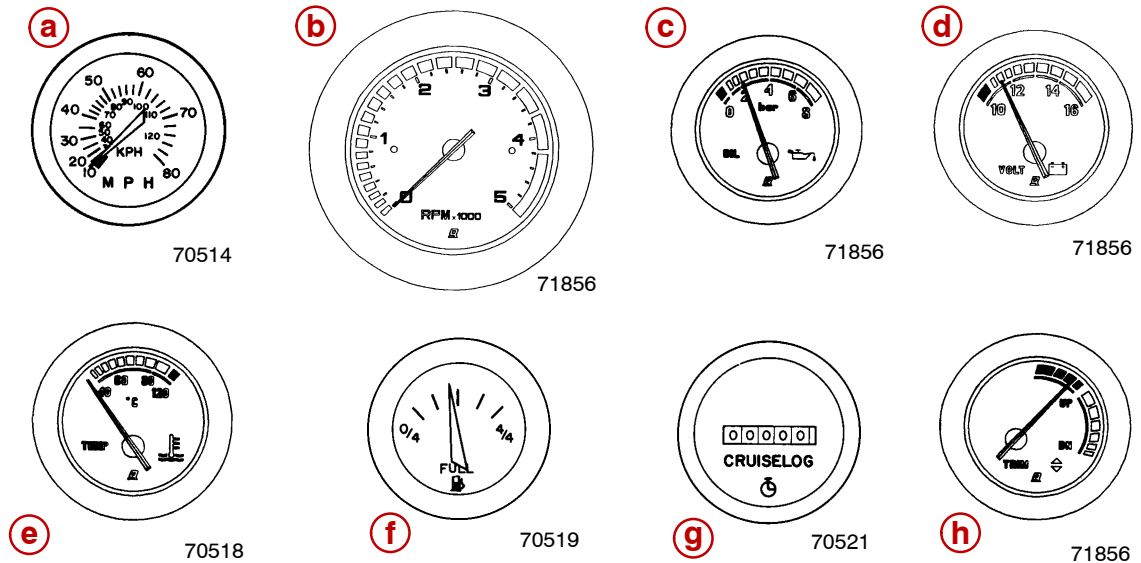
⚠ WARNING

Avoid abrupt deceleration of the boat from lanyard stop switch activation. Boat damage and personal injury or death could occur. NEVER leave the operator's station with the engine operating and in gear.

Instrumentation

INSTRUMENTS

The following is a brief explanation of instrumentation typically found on some boats. The owner/operator should be familiar with all instruments and their functions on the boat. Because of the large variety of instrumentation and manufacturers, you should have your boat dealer explain the particular gauges and normal readings that will appear on your style gauges.



Typical

- | | |
|-------------------------------|--------------------------------------|
| a - Speedometer | e - Coolant temperature gauge |
| b - Tachometer | f - Fuel gauge |
| c - Oil pressure gauge | g - Hour meter |
| d - Battery meter | h - Power trim gauge |

Speedometer: Indicates boat speed.

Tachometer: Indicates engine rpm.

Oil Pressure Gauge: Indicates engine oil pressure.

Battery Meter: Indicates battery voltage.

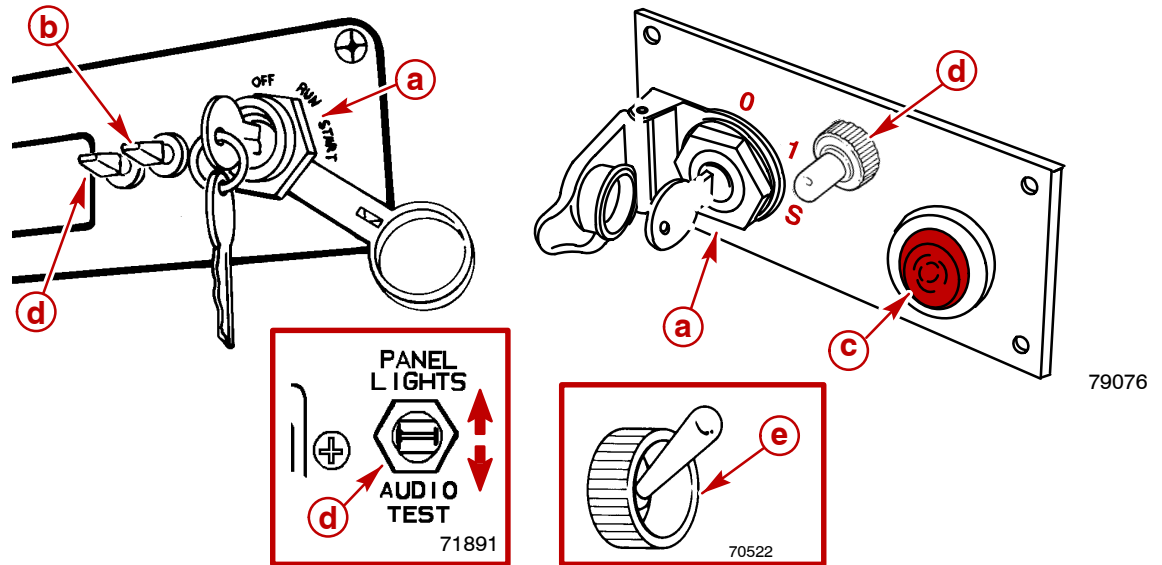
Coolant Temperature Gauge: Indicates engine operating temperature.

Fuel Gauge: Indicates quantity of fuel in tank.

Hour Meter: Records engine operating time.

Power Trim Gauge: Indicates sterndrive unit angle (trim up/out and down/in). Sterndrive Models only.

SWITCHES

**Typical switches**

- a** - Key switch
- b** - Engine stop switch - toggle
- c** - Engine stop switch - push button
- d** - Panel lights / audio test switch
- e** - Bilge blower switch

Key Switch - has three positions.

1. **OFF** - In the OFF position, all electrical circuits are off and engine cannot be started. If the engine is operating the Key Switch CANNOT be used to stop the engine. The engine can only be stopped by using the engine Stop Switch, while the Key Switch is in the RUN position. No electrical circuit is operational when the Key Switch is turned to the OFF position.
2. **RUN** - In the RUN position, all electrical circuits, indicator lamps, automatic preheating (if equipped) and all instruments are operational.
3. **START** - In the START position the engine can be started.

NOTE: Key can only be removed in the OFF position.

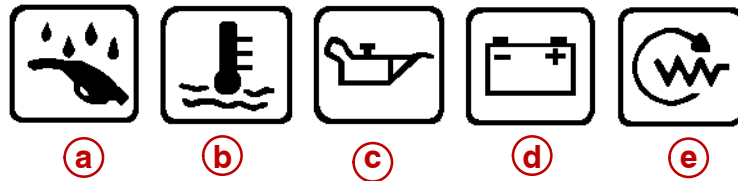
Engine Stop Switch - is used to stop the engine. This is done by electrically shutting off the fuel delivery system. The switch, toggle or push-button, is either toggled DOWN or pressed IN. Engage and hold the stop switch until the engine stops completely. Then, turn the key switch to the OFF position.

1. Toggle Switch
2. Push-Button Switch

Panel Lights / Audio Test Switch - has three positions; in the NORMAL position all electrical circuits operate in a standard fashion (as described above). With switch toggled UP the instrumentation lights are all illuminated. When the switch is toggled DOWN the audio warning horn will sound allowing the operator to perform a test of the audio warning horn.

Bilge Blower Switch: Operates bilge blower, if equipped.

ENGINE MONITORING FEATURES



77359

- a** - Water-in-fuel warning lamp
- b** - Coolant temperature warning lamp
- c** - Oil pressure warning lamp
- d** - Charge indicator lamp
- e** - Preheat indicator lamp

The appropriate light functions as follows:

Water-In-Fuel Warning Lamp - indicates water is present in fuel filter and that fuel filter requires service.

Coolant Temperature Warning Lamp - indicates excessive engine coolant temperature if lamp illuminates while engine is running.

Oil Pressure Warning Lamp - indicates low engine oil pressure if lamp illuminates while engine is running, or low oil level in the gear lube monitor bottle. (See the following note).

NOTE: The oil pressure warning lamp is wired in a parallel circuit with the gear lube monitor bottle switch. If lamp illuminates while engine is running and oil pressure and oil level are normal, this may be an indication of low oil level in the gear lube monitor bottle. The cause should be determined and corrected.

Charge Indicator Lamp - indicates a problem with charging system if lamp illuminates while engine is operating. Lamp will be on when key switch is in RUN and engine is not operating. When engine starts, light should go off.

Preheat Indicator Lamp - indicates when the glow plugs, if equipped, are preheating the combustion chambers. When the engine is cold the timed preheat period begins when the key switch is turned to RUN. The light stays on until the preheat period is complete. The engine can be started only after the light goes out.

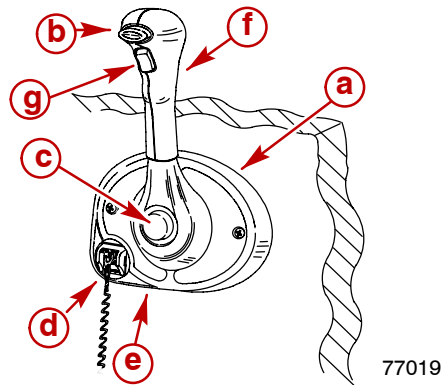
Remote Controls

Your boat may be equipped with a Mercury Precision Parts or Quicksilver remote controls. All controls may not have all features shown. Consult your dealer for a description and/or demonstration of your remote control.

CAUTION

Avoid possible boat and power package damage. Never shift unit into or out of gear unless throttle lever is at idle rpm.

PANEL MOUNTED



- | | |
|--|---|
| a - Neutral Safety Switch circuit | e - Control handle throttle friction screw |
| b - Neutral lock button | f - Control handle |
| c - Throttle only button | g - Trim / tilt button |
| d - Lanyard stop switch | |

Neutral Safety Switch Circuit - Special electrical circuitry that allows starter engagement only when the remote control handle is in the NEUTRAL position.

Neutral Lock Button - Prevents accidental shift and throttle engagement. Neutral lock button must be pushed IN to move the control handle out of NEUTRAL.

Throttle Only Button - Allows engine throttle advancement without shifting the engine. This is done by disengaging the shift mechanism from the control handle. The throttle only button can be depressed only when the remote control handle is in the NEUTRAL position, and should only be used to assist in starting the engine.

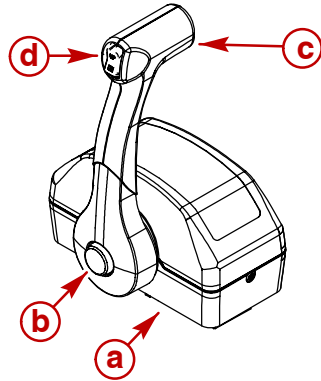
Lanyard Stop Switch - Turns the ignition OFF whenever the operator (when attached to the lanyard) moves far enough away from the operator's position to activate the switch. Refer to Lanyard Stop Switch for information on the use of this switch.

Control Handle Throttle Friction Screw - This screw (located behind the bezel cover) can be adjusted to increase or decrease the tension on the control handle. This will help prevent slipping of the remote control handle. Turn screw clockwise to increase tension and counterclockwise to decrease tension. Adjust to tension desired.

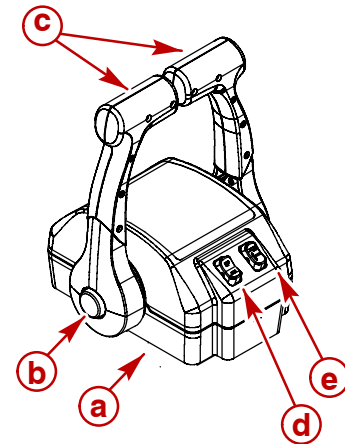
Control Handle - Operation of the shift and throttle are controlled by the movement of the control handle. Push the control handle forward from NEUTRAL with a quick firm motion to the first detent for FORWARD gear. Continue pushing forward to increase speed. Pull the control handle back from NEUTRAL with a quick firm motion to the first detent for REVERSE gear and continue pushing back to increase speed.

Trim/Tilt Button - Refer to Power Trim.

CONSOLE MOUNTED



mc79503



79690

- a** - Neutral Safety Switch circuit
- b** - Throttle only button
- c** - Control handles
- d** - Power Trim switch
- e** - Trailer switch

Neutral Safety Switch Circuit - Special electrical circuitry that allows starter engagement only when the remote control handle is in the NEUTRAL position.

Throttle Only Button - Allows engine throttle advancement without shifting the engine. This is done by disengaging the shift mechanism from the control handle. The throttle only button can be depressed only when the remote control handle is in the NEUTRAL position, and should only be used to assist in starting the engine.

Control Handle Tension Adjustment Screw - This screw can be adjusted to increase or decrease the tension on the control handle (cover must be removed to adjust). This will help prevent slipping of the remote control handle. Turn screw clockwise to increase tension and counterclockwise to decrease tension. Adjust to tension desired.

Control Handles - Operation of the the shift and throttle are controlled by the movement of the control handle. Push the control handle forward from NEUTRAL with a quick firm motion to the first detent for FORWARD gear and continue pushing forward to increase speed. Pull the control handle back from NEUTRAL with a quick firm motion to the first detent for REVERSE gear and continue pushing back to increase speed.

Power Trim Switch - See Power Trim section for detailed power trim operating procedures.

Trailer Switch - Used to raise drive unit for trailering, launching, beaching or shallow water operation. On the single remote control handle units, the trailering mode begins with the second click or when the Power Trim/ Trailer Switch is pressed all the way UP. See Power Trim for detailed trailer switch operation.

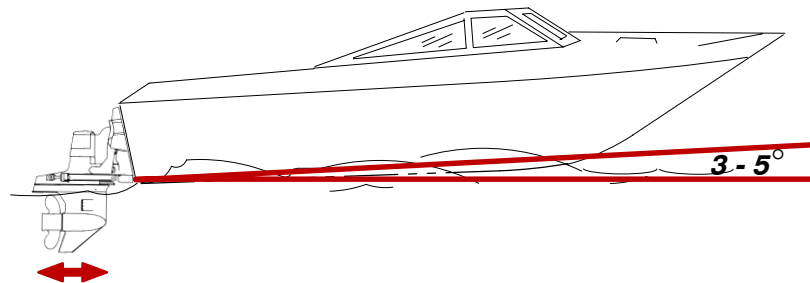
Power Trim

Power Trim allows the operator to adjust the sterndrive angle while underway, to provide the ideal boat angle for varying load and water conditions. Also, the Power Trim system Trailing feature allows the operator to raise and lower the sterndrive unit for trailering, beaching, launching and low speed (below 1200 rpm engine speed), shallow water operation.

⚠ CAUTION

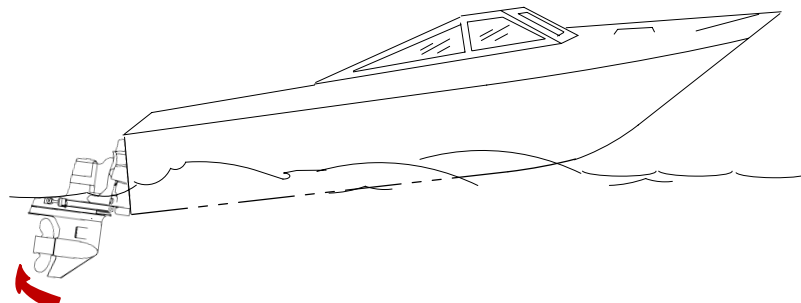
Never trim the sterndrive unit UP/OUT using TRAILER switch while boat is underway at engine speeds above 1200 rpm. Use extreme caution when operating with sterndrive unit raised. Severe damage to the sterndrive unit may result if unit is raised beyond the gimbal ring support flanges at engine speeds above 1200 rpm.

For best performance trim the sterndrive unit so that the boat bottom is at a 3-5 degree angle to the water.



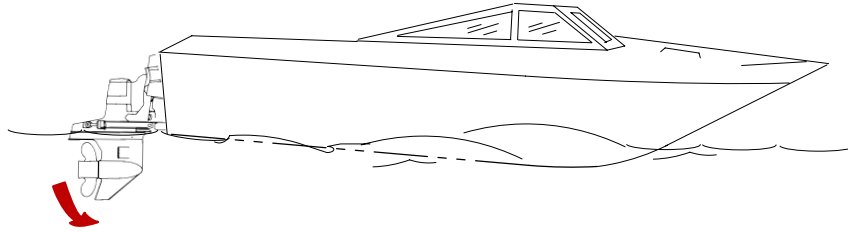
Trimming sterndrive unit UP/OUT can:

- Generally increase top speed
- Increase clearance over submerged objects or a shallow bottom
- Cause boat to accelerate and plane off slower
- In excess, cause boat porpoising (bouncing) or propeller ventilation
- Cause engine overheating if trimmed UP/OUT to a point where any cooling water intake holes are above the water line



Trimming sterndrive unit DOWN/IN can:

- Help the boat accelerate and plane off quicker
- Generally improve the ride in choppy water
- In most cases, reduce boat speed
- If in excess, lower the bow of some boats to a point at which they begin to plow with their bow in the water while on plane. This can result in an unexpected turn in either direction called bow steering or over steering if any turn is attempted or if a significant wave is encountered.



SINGLE ENGINE TRIM/TRAILER

Single engine applications will have a button that can be pressed to trim the sterndrive unit up or down.

To raise the sterndrive unit for trailering, beaching, launching and low speed (below 1200 rpm), shallow water operation push the trim button to raise the sterndrive unit to the full UP/OUT position.

Some controls also have a trailer button that trims the sterndrive to a position suitable for trailer purposes only.

DUAL ENGINE TRIM/TRAILER

⚠ CAUTION

Avoid twisting or binding dual engine tie bars. Damage to the tie bar and sterndrives could occur. ALWAYS raise or lower the sterndrive units evenly.

Dual engine applications may have a single integral button to operate both sterndrive units simultaneously or may have separate buttons for each sterndrive unit.

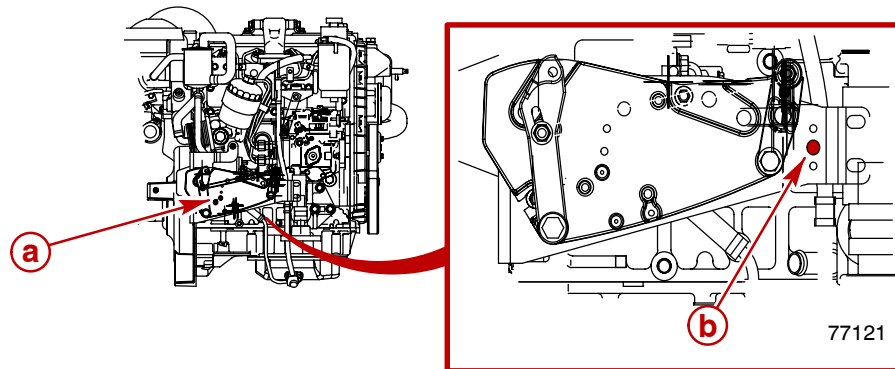
Some controls also have a trailer button that trims the drives to a position suitable for trailer purposes only.

Electrical System Overload Protection

If an electrical overload occurs, a fuse will blow or the circuit breaker will trip open. The cause must be found and corrected before replacing the fuse or resetting the circuit breaker.

NOTE: In an emergency, when the engine must be operated and the cause for the high current draw cannot be located and corrected, turn OFF or disconnect all accessories connected to the engine and instrumentation wiring. Reset the circuit breaker. If the breaker remains open, the electrical overload has not been eliminated. Further checks must be made on the electrical system. Contact your authorized Cummins MerCruiser Diesel dealer / distributor.

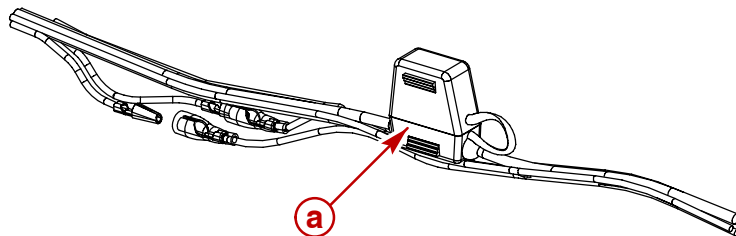
1. One 50 amp circuit breaker provide protection for engine wiring harness and instrumentation power lead. Reset by pushing RESET button IN.



74703

- a** - Electircal bracket
- b** - Circuit breaker

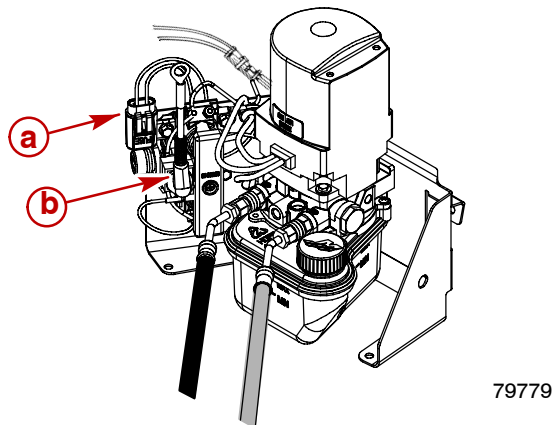
2. A 20 amp fuse located in-line on key switch power supply wire and protects the instrumentation and wiring should an electrical overload occur. If an overload occurs, the fuse will burn out. Check blown (burned) fuse if key is turned to RUN or START and instruments do not work and/or if switches do not function (and a circuit breaker is not tripped).



77421

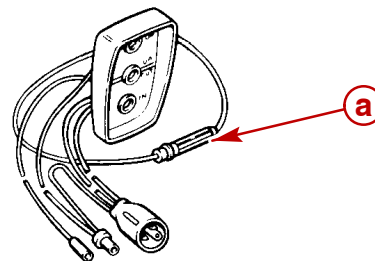
- a** - 20 amp. fuse holder

3. The Power Trim System is protected from overload by a 110 amp fuse and a 20 amp in-line fuse on the power trim pump.



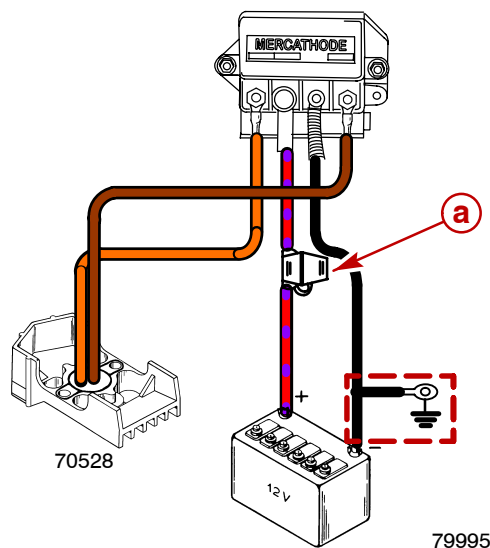
- a** - 20 amp. fuse holder
b - 110 amp. fuse

4. The Quicksilver Three-Button Power Trim Control Panel is further protected by a 20 amp in-line fuse.



- a** - 20 amp. fuse holder

5. The Quicksilver MerCathode System, if equipped, has a 20 amp in-line fuse in the wire which connects to the positive (+) terminal on the controller. If the fuse is blown (burned), the system will not operate resulting in a loss of corrosion protection.



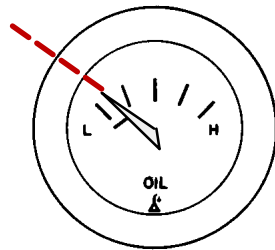
- a** - 20 amp. fuse holder

Audio Warning System

Your Cummins MerCruiser Diesel power package may be equipped with an Audio Warning System. The Audio Warning System will not protect the engine from damage. It is designed to warn the operator that a problem has occurred.

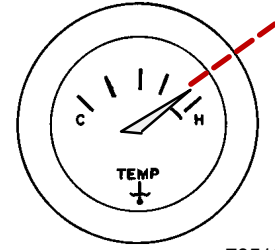
The audio warning system will sound with a continuous horn if one of the following occurs:

- Engine oil pressure too low
- Coolant temperature too hot
- Sterndrive oil level too low



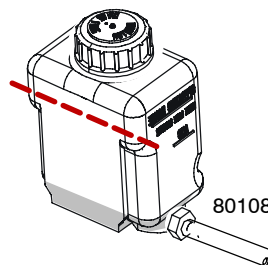
70516

Typical oil pressure gauge



70518

Typical engine temperature gauge



80108

Typical sterndrive oil reservoir

CAUTION

Operation of the engine after the audio warning system alarm has sounded could result in damage to the power package. Do NOT operate engine once the alarm has sounded EXCEPT TO AVOID A HAZARDOUS SITUATION.

If the alarm sounds, stop the engine immediately. Investigate the cause and correct it, if possible. If the cause cannot be determined, consult your authorized Cummins MerCruiser Diesel dealer / distributor.

TESTING THE AUDIO WARNING SYSTEM

1. Turn the ignition switch to the ON position without cranking the engine.
2. Engage the audio test switch and hold.
3. Listen for the alarm to sound indicating that the system is functioning correctly.

NOTES:

SECTION 3 - ON THE WATER

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Safe Boating Suggestions

In order to safely enjoy the waterways, familiarize yourself with local and all other governmental boating regulations and restrictions and also consider the following suggestions.

- **Know and obey all nautical rules and laws of the waterways.**

Mercury MerCruiser strongly recommends that all powerboat operators complete a boating safety course. Courses are offered in the U.S.A. by: The U.S. Coast Guard Auxiliary, The Power Squadron, The Red Cross and your state or provincial boating law enforcement agency. Inquiries may be made to the Boating Hotline at 1-800-368-5647 or the Boat U.S. Foundation at 1-800-336-BOAT.

You should also review the NMMA Sources of Waterway Information booklet. It lists regional sources of safety, cruising and local navigation and is available at no charge by writing to:

Sources of Waterway Information
National Marine Manufacturers Association
410 N. Michigan Avenue
Chicago, IL 60611 U.S.A.

- **Perform safety checks and required maintenance.** Follow a regular schedule and ensure that all repairs are properly made.
- **Check safety equipment on board.** Here are some suggestions of the types of safety equipment to carry when boating:

Approved fire extinguishers	Paddle or oar
Signal devices: flashlight, rockets or flares, flag and whistle or horn	Spare propeller, thrust hubs, and an appropriate wrench
Tools necessary for minor repairs	First aid kit and instructions
Anchor and extra anchor line	Water-proof storage containers
Manual bilge pump and extra drain plugs	Spare operating equipment, batteries, bulbs and fuses
Drinking water	Compass and map or chart of the area
Transistor radio	

- **Watch for signs of weather change and avoid foul weather and rough-sea boating.**
- **Tell someone where you are going and when you expect to return.**
- **Passenger boarding.** Stop the engine whenever passengers are boarding, unloading or are near the back (stern) of the boat. Shifting the drive unit into neutral is not sufficient.
- **Use personal flotation devices.** Federal Law requires that there be a U. S. Coast Guard approved, wearable-type life jacket (personal flotation device), correctly sized and readily accessible for every person on board, plus a throwable cushion or ring. We strongly advise that everyone wear a life jacket at all times while in the boat.
- **Prepare other boat operators.** Instruct at least 1 person on board in the basics of starting and operating the engine and boat handling in case the driver becomes disabled or falls overboard.
- **Do not overload your boat.** Most boats are rated and certified for maximum load (weight) capacities (refer to your boat capacity plate). Know your boat's operating and loading limitations. Know if your boat will float if full of water. When in doubt, contact your authorized Mercury MerCruiser dealer or the boat manufacturer.
- **Ensure that everyone in the boat is properly seated.** Do NOT allow anyone to sit or ride on any part of the boat that was not intended for such use. This includes the backs of seats, gunwales, transom, bow, decks, raised fishing seats and any rotating fishing seat; anywhere that sudden unexpected acceleration, sudden stopping, unexpected loss of boat control or sudden boat movement could cause a person to be thrown overboard or into the boat. Ensure that all passengers have a proper seat and are in it before any boat movement.
- **Never be under the influence of alcohol or drugs while boating (it is the law).** They impair your judgment and greatly reduce your ability to react quickly.

- **Know your boating area and avoid hazardous locations.**
- **Be alert.** The operator of the boat is responsible by law to “maintain a proper lookout by sight and hearing.” The operator must have an unobstructed view particularly to the front. No passengers, load or fishing seats should block the operators view when operating the boat above idle or planing transition speed. Watch out for others, the water and your wake.
- **Never drive your boat directly behind a water skier in case the skier falls.** As an example, your boat traveling at 25 MPH (40 km/h) will overtake a fallen skier who was 61 m (200 ft) in front of you in 5 seconds.
- **Watch fallen skiers.** When using your boat for water skiing or similar activities, always keep a fallen or down skier on the operator’s side of the boat while returning to attend to the skier. The operator should always have the down skier in sight and never back up to the skier or anyone in the water.
- **Report accidents.** Boat operators are required by law to file a Boating Accident Report with their state boating law enforcement agency when their boat is involved in certain boating accidents. A boating accident must be reported if (1) there is loss of life or probable loss of life, (2) there is personal injury requiring medical treatment beyond first aid, (3) there is damage to boats or other property where the damage value exceeds \$500.00 or (4) there is complete loss of the boat. Seek further assistance from local law enforcement.

Be Alert To Carbon Monoxide Poisoning

Carbon monoxide is present in the exhaust fumes of all internal combustion engines including the outboards, sterndrives and inboard engines that propel boats, as well as the generators that power various boat accessories. Carbon monoxide is a deadly gas that is odorless, colorless and tasteless.

Early symptoms of carbon monoxide poisoning, which should not be confused with seasickness or intoxication, include headache, dizziness, drowsiness and nausea.

WARNING

Avoid prolonged exposure to carbon monoxide. Carbon monoxide poisoning can lead to unconsciousness, brain damage or death. Ensure that the boat, while at rest or underway, is well ventilated.

GOOD VENTILATION

Ventilate the passenger area, open the side curtains or forward hatches to remove fumes.

1. Example of desired air flow through the boat.



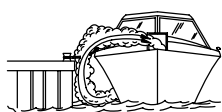
Courtesy of ABYC

POOR VENTILATION

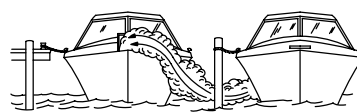
Under certain conditions, permanently enclosed or canvas enclosed cabins or cockpits with insufficient ventilation may draw in carbon monoxide. Install 1 or more carbon monoxide detectors in your boat.

Although the occurrence is rare, on a very calm day, swimmers and passengers in an open area of a stationary boat that contains or is near an operating engine may be exposed to a hazardous level of carbon monoxide.

1. Examples of poor ventilation while a boat is stationary:



a



b

Courtesy of ABYC

- a** - Operating the engine when the boat is moored in a confined space
- b** - Mooring close to another boat with its engine operating

2. Examples of poor ventilation while a boat is moving:



a



b

Courtesy of ABYC

- a** - Operating the boat with the trim angle of the bow too high
- b** - Operating the boat with no forward hatches open (station wagon effect)

Basic Boat Operation

Launching And Boat Operation Care

CAUTION

To avoid possible ingestion of water that can damage engine components:

- Do NOT turn the ignition key off when the engine is above idle speed.
- When launching your boat from a steep ramp, enter the water slowly.
- Do NOT use the lanyard stop switch to shut off the engine above idle speed.
- When coming off plane, if a large following wave may roll over the boat's transom, apply a short, light burst of throttle to minimize the wave action against the stern of the boat.
- Do NOT come off plane quickly, shift into reverse and shut off engine.

IMPORTANT: Install bilge drain plug prior to launching boat.

Duty Cycle Rating

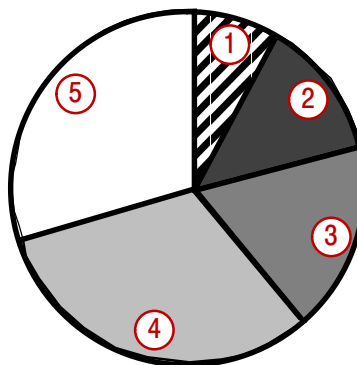
IMPORTANT: Damage caused by improper application or failure to operate the power package within the specified operating parameters, will not be covered by the Mercury MerCruiser Diesel Limited Warranty.

It is the responsibility of the boat manufacturer and/or the installing dealer to ensure that the power package is properly applied. In all cases, the power package must be equipped with a propeller that will allow the engine to operate at wide open throttle (WOT) at the Rated Engine rpm. The drive unit must also be applied in accordance with recommendations indicated in the Diesel Applications Manual. Use of Cummins MerCruiser Diesels in other than the applications indicated by the following information and in the Diesel Applications Manual requires written approval from an authorized Cummins MerCruiser Application Engineer.

PLEASURE DUTY RATING

The **Pleasure Duty Rating** applies to recreational planing craft used exclusively for pleasure and recreation. Typical applications include pleasure craft such as sailboats, ski boats, runabouts, speedboats, and other planing hulls. Application must conform to the Pleasure Craft / Recreational duty cycle shown (EPA Mode Number Cycle 5 / ICOMIA 83-28 Duty Cycle).

EPA Mode Number Cycle 5 / ICOMIA 83-28 DUTY CYCLE	Modes				
	1	2	3	4	5
Engine Speed (Percent of WOT)	100	91	80	63	Idle
Engine Power (Percent of Total)	100	75	50	25	0
Time At Given Mode (Percent Of Total Operating Time)	8	13	17	32	30



79175

Chart showing full power operation is limited to a maximum of 1 of 12 hours

- 1** - Mode 1: 1.0 hour (8 percent)
- 2** - Mode 2: 1.5 hours (13 percent)
- 3** - Mode 3: 2.0 hours (17 percent)
- 4** - Mode 4: 4.0 hours (32 percent)
- 5** - Mode 5: 3.5 hours (30 percent)

Operation Chart

STARTING PROCEDURE	AFTER STARTING	WHILE UNDERWAY	STOPPING & SHUT DOWN
Open engine hatch. Air out bilge completely.	Observe all gauges and warning lights to check condition of engine. If not normal, stop engine.	Frequently observe all gauges and indicator lights to monitor engine condition.	Shift remote control lever to neutral position.
Turn battery switch ON, if so equipped.	Check for fuel, oil, water, fluid, and exhaust leaks, etc.		Run engine at idle speed several minutes to allow the turbocharger and engine to cool.
Turn on and run engine compartment bilge blower, if so equipped, for five minutes.	Check shift and throttle control operation.		Engage STOP switch and hold, until engine completely stops.
Check for leaks - fuel, oil, water, fluid, etc.	Check steering operation.		Turn key switch to OFF position.
Open fuel shut-off valve, if so equipped.			Turn battery switch OFF, if so equipped.
Open seacock, if so equipped.			Close fuel shut-off valve, if so equipped.
Check that mechanical engine-stop lever is <i>not</i> engaged.			Close seacock, if so equipped.
Prime fuel injection system, if necessary.			Flush seawater cooling circuit, if operating in saltwater area.
Pre-lubricate turbocharger and engine, if necessary.			
Turn key switch to "RUN" and check that lights and indicator lamps come on.			
Turn key switch to START, <i>after</i> the indicator lamp for glow plugs (if so equipped) ceases. Release key when engine starts.			
Check that charge indicator and oil pressure indicator lamps cease AFTER engine starts.			
Warm-up engine at idle rpm for several minutes.			

Starting, Shifting and Stopping

WARNING

Do not use volatile starting aids, such as Ether, Propane, or Gasoline in the engine air intake system. Explosion hazard resulting from ignition of vapors by glow plugs could cause severe personal injury and engine damage.

CAUTION

It is good practice to ventilate the engine compartment prior to servicing any engine components to remove any fuel vapors which may cause difficulty breathing or be an irritant.

A Mechanical Engine Stop Lever is located on the injection pump. It is used to manually shut off the engine by mechanically cutting off the fuel supply. It can be engaged by moving the lever in the direction shown by the arrow.

BEFORE STARTING THE ENGINE

CAUTION

Do not operate the engine without water flowing through the seawater pickup pump, as the pickup pump impeller may be damaged and subsequent overheating damage to engine or drive unit may result.

CAUTION

Avoid starter motor damage. Prolonged or repeated operation of the starter motor could cause overheating resulting in starter motor damage. Allow the starter motor to cool before prolonged or repeated operation.

IMPORTANT: Observe the following before starting:

- Provide water to the seawater pickup pump.
 - Never operate the starter motor longer than 15 seconds at a time, to avoid overheating the starter motor. If the engine does not readily start, wait 1 minute to allow the starter motor to cool; then, repeat the starting procedure.
 - Ensure the engine crankcase is filled to correct level with the proper grade of oil for the prevailing temperature. Refer to Section 4 -Specifications.
 - Ensure that all electrical connections are secure.
1. Check all items listed in the **Maintenance Schedules** and **Operation Chart**.
 2. Perform any other necessary checks, as indicated by your dealer, or specified in your boat owner's manual.

STARTING A COLD ENGINE

IMPORTANT: Always check fluid levels before starting the engine. Refer to Section 5 - Maintenance Schedule.

1. Turn on and run the engine compartment bilge blower (if equipped) for five minutes. Or, open the engine hatch to air out the bilge before attempting to start the engine.
2. Place the drive unit in full DOWN/IN position.
3. Place the control handle in NEUTRAL.
4. If the engine has not been run for a period of time and will not readily start with the standard starting procedure, there is a hand pump/primer located on the engine to improve initial fuel supply. Refer to **Section 5 - Fuel System, Priming** and follow the instructions given.

NOTE: If equipped, the preheat devices (glow plugs) should operate at temperatures lower than -0 degrees C (32 degrees F). An engine coolant temperature sensor will automatically control activation and duration of preheat cycle. The preheat cycle usually lasts 10 to 15 seconds.

5. Turn key switch to RUN position to activate the glow plugs, if equipped. Observe the indicator lamp, if equipped, for the glow plugs. When cylinder temperature is great enough to sustain combustion, the indicator lamp will go off. The engine should be started only after the preheat indicator lamp goes off.

CAUTION

Do not attempt to engage the starter while the engine is running as this will lead to starter pinion and ring gear damage.

6. Turn key switch to START position. Release the key and allow the switch to return to RUN position when the engine starts.

IMPORTANT: Operate the engine with the key switch in the RUN position only. If the key switch is in the OFF position and the engine is operating, the battery will not be charged, audio warning alarms will not be operational in the event of trouble, and accessories may not operate.

7. Operate the engine with the switch in the RUN position. Before returning the key switch to the OFF position, first shut down (stop) the engine using the engine stop switch.
8. After starting, ensure that the charge indicator and the oil pressure warning lamps are off.

CAUTION

Do not increase the engine speed until the oil pressure gauge indicates normal. Shut the engine down if oil pressure does not register on the gauge within 20 to 30 seconds after start.

IMPORTANT: If oil pressure is not within the specified range within 20 to 30 seconds after start (refer to Section 5 - Specifications), stop the engine, locate and correct the problem. If you are unable to determine the problem, see your authorized Cummins MerCruiser Diesel dealer / distributor.

9. Observe the oil pressure gauge immediately after the engine starts.
10. Ensure that all instrumentation is functioning properly and indicating normal readings.

ENGINE WARM UP

CAUTION

Improper or no warm-up of engine can seriously impair the life of your diesel engine.

1. After starting, ensure all instrumentation is functioning properly.

NOTE: *It is very important that any engine be warmed up before applying full load.*

2. Operate engine for 1 or 2 minutes at fast IDLE (1000-1500 rpm) or until engine temperature reaches operating temperature before applying full load. The warm-up period provides time for the lubricating oil to establish a film between moving parts.

NOTE: *Engine warm-up time during cold weather can be reduced by operating vessel at reduced engine speed. Commence normal vessel operation when systems reach operating temperatures.*

3. After the engine has reached operating temperature:
 - a. Oil pressure should be within range listed in the engine specifications chart. Stop the engine if oil pressure is not within this range.
 - b. Check the fuel system for leakage from the injection pump, fuel pipes, fuel filter and fuel lines.
 - c. Check for oil leakage. Check the engine and sterndrive unit for oil leakage. Especially check the oil filter, oil lines, oil line connectors, and oil pan.
 - d. Check for coolant leaks. Check coolant hoses and connection pipes of heat exchanger, fluid coolers, intercooler, water pump and drain fittings.
4. Locate and correct any problems, or see your Cummins MerCruiser Diesel dealer / distributor if you are unable to determine the problem.

STARTING A WARM ENGINE

1. Turn on and run the engine compartment bilge blower, if equipped, for five minutes. Or, open the engine hatch to air out bilge before attempting to start engine.
2. Place the remote control handle in NEUTRAL.
3. Turn the key switch to the RUN position.
4. Turn key switch to START position. Release the key and allow the switch to return to RUN position when the engine starts.
5. After starting, ensure that the charge indicator and the oil pressure warning lamps are off.
6. Ensure that all instrumentation is functioning properly and indicating normal readings.

SHIFTING

CAUTION

Avoid damage to the sterndrive unit. Shifting the sterndrive unit at rpms greater than idle rpm may cause internal damage to the sterndrive unit. Shift the sterndrive unit only when the engine is at idle rpm.

1. Ensure the remote control / shift lever is in NEUTRAL.
2. To shift the sterndrive unit, move the remote control / shift lever with a firm, quick motion forward to shift to FORWARD gear, or backward to shift to REVERSE.
3. After shifting drive unit, advance throttle to desired setting.

IMPORTANT: Avoid stopping the engine if the sterndrive unit is in gear. If the engine does stop with the sterndrive unit in gear, refer to the following procedure:

4. Push and pull repeatedly on the remote control handle until handle returns to the neutral detent position. This may take several tries if the power package was operating above idle rpm when the engine stopped.
5. After handle returns to the neutral detent position, resume normal starting procedures.

ENGINE SHUT-DOWN (STOPPING)

1. Place remote control lever in NEUTRAL.

CAUTION

Avoid damaging the turbocharger and engine. Immediate engine shutdown (stopping) after high load operation may result in permanent turbocharger bearing damage. Operate the engine at IDLE for several minutes before shut-down.

2. Operate the engine at idle speed for several minutes to allow the turbocharger and engine to cool.
3. Engage the STOP switch and hold, until engine stops completely.
4. Turn key switch to the OFF position.

Starting The Engine After Stopped While In Gear

IMPORTANT: Avoid stopping the engine if the sterndrive unit is in gear. If the engine does stop, refer to the following procedure:

1. Push and pull repeatedly on the remote control handle until handle returns to the NEUTRAL/IDLE position. This may take several tries if the power package was operating above idle rpm when the engine stopped.
2. After the handle returns to the NEUTRAL/IDLE position, resume normal starting procedures.

Trailing The Boat

Your boat can be trailered with the sterndrive unit in the UP or DOWN position. Adequate clearance is required between the road and sterndrive when transporting.

If adequate road clearance is a problem, place the sterndrive unit in full trailer position and support it with an optional trailer kit which is available from your authorized Cummins MerCruiser Diesel dealer / distributor.

Freezing Temperature And Cold Weather Operation

IMPORTANT: If boat is operated during periods of freezing temperature, precautions must be taken to prevent freezing damage to power package. Damage caused by freezing **IS NOT** covered by Cummins MerCruiser Diesel Limited Warranty.

CAUTION

Seawater (raw water) section of cooling system MUST BE COMPLETELY drained for winter storage or immediately after cold weather use, if the possibility of freezing temperatures exist. Failure to comply may result in trapped water causing freeze and/or corrosion damage to engine.

In order to operate the engine in temperatures of 0 degrees C (32 degrees F) or lower, observe the following instructions:

- At the end of each daily operation, COMPLETELY drain seawater section of cooling system to protect against damage by freezing.
- At the end of each daily operation, drain water from water separator, if equipped. Fill fuel tank at end of daily operation to prevent condensation.
- Use required permanent-type antifreeze solution to protect components against damage by freezing.
- Be sure to use proper cold weather lubrication oil, and be sure the crankcase contains a sufficient amount.
- Make certain that the battery is of sufficient size and is fully charged. Check that all other electrical equipment is in optimum condition.
- At temperatures of – 20 degrees C (–4 degrees F) and below, it is recommended that you use a coolant heater to improve cold starting.
- If operating in arctic temperatures of – 29 degrees C (–20 degrees F) or lower, consult your Cummins MerCruiser Diesel dealer / distributor for information about special cold weather equipment and precautions.

Refer to **Section 6** for Cold Weather (Freezing Temperatures), Seasonal or Extended Storage related information and draining instructions.

Drain Plug and Bilge Pump

The engine compartment in your boat is a natural place for water to collect. For this reason, boats are normally equipped with a drain plug and/or a bilge pump. It is very important to check these items on a regular basis to ensure that the water level does not come into contact with your power package. Components on your engine will be damaged if submerged. Damage caused by submersion is not covered by the Mercury MerCruiser Limited Warranty.

Protecting People In The Water

While You Are Cruising

It is very difficult for a person standing or floating in the water to take quick action to avoid a boat heading in his/her direction even at slow speed.

Always slow down and exercise extreme caution any time you are boating in an area where there might be people in the water.

Whenever a boat is moving (coasting) in NEUTRAL/IDLE, there is sufficient force by the water on the propeller to cause the propeller to rotate. This neutral propeller rotation can cause serious injury.

While Boat Is Stationary

WARNING

Stop your engine immediately whenever anyone in the water is near your boat. Serious injury to the person in the water is likely if contacted by a rotating propeller, a moving boat, a gear case or any solid device rigidly attached to a moving boat or gear case.

Shift into the NEUTRAL/IDLE position and shut off the engine before allowing people to swim or be in the water near your boat.

High-Speed And High-Performance Boat Operation

If your boat is considered a high-speed or high-performance boat with which you are unfamiliar, we recommend that you never operate it at its high speed capability without first requesting an initial orientation and demonstration ride with your dealer or an operator experienced with your boat. For additional information, refer to **Hi-Performance Boat Operation** booklet (90-849250-R2) from your authorized Cummins MerCruiser Diesel dealer / distributor.

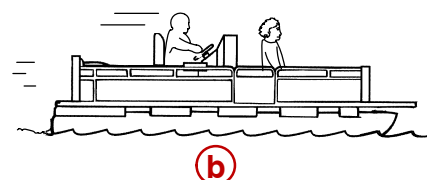
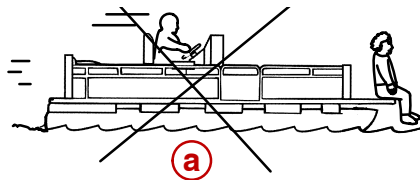
Passenger Safety Message - Pontoon And Deck Boats

WARNING

Avoid serious injury or death from falling over the front end of a pontoon or deck boat and coming in contact with the boat hull or propeller. Stay back from the front end of the deck and remain seated while the boat is in motion.

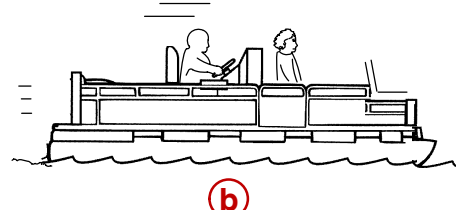
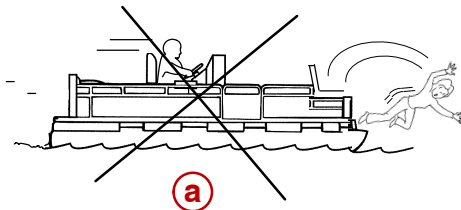
Whenever the boat is in motion, observe the location of all the passengers. Do not allow any passengers to stand or use seats other than those designated for traveling faster than idle speed. A sudden reduction in boat speed, such as the result of plunging into a large wave or wake, a sudden throttle reduction or a sharp change of boat direction, could throw them over the front of boat. Falling over the front of the boat between the 2 pontoons will position them to come into contact with the drive unit.

1. Boats having an open front deck:



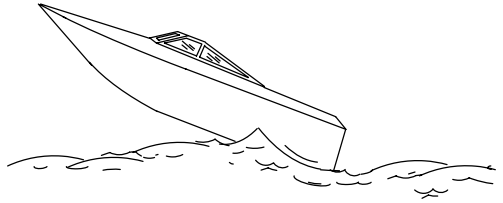
- a. No one should ever be on the deck in front of the fence while the boat is in motion. Keep all passengers behind the front fence or enclosure.
- b. Persons on the front deck could easily be thrown overboard or persons dangling their feet over the front edge could get their legs caught by a wave and pulled into the water.

2. Boats with front-mounted, raised pedestal fishing seats:



- a. These elevated fishing seats are not intended for use when the boat is traveling faster than idle or trolling speed. Sit only in seats designated for traveling at faster speeds.
- b. Any unexpected sudden reduction in boat speed could result in the elevated passenger falling over the front of the boat.

Wave And Wake Jumping



WARNING

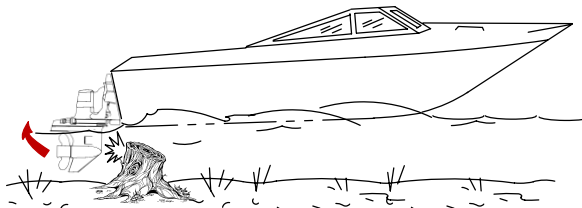
Avoid serious injury or death from being thrown within or out of a boat when it lands after jumping a wave or wake. Avoid wave or wake jumping whenever possible. Instruct all occupants that if a wake or wave jump occurs, get low and hang on to a boat hand hold.

Operating recreational boats over waves and wakes is a natural part of boating. However, when this activity is done with enough speed to force the boat hull partially or completely out of the water, certain hazards arise, particularly when the boat re-enters the water.

The primary concern is the boat changing direction while in the midst of the jump. In such cases the landing may cause the boat to violently veer in a new direction. Such a sharp change in direction or turn can cause occupants to be thrown out of their seats or out of the boat.

There is another less common hazardous result from allowing your boat to launch off of a wave or wake. If the bow of your boat pitches down far enough while airborne, upon water contact it may penetrate under the water surface and submarine for an instant. This will bring the boat nearly to a stop in an instant and can send the occupants flying forward. The boat may also veer sharply to one side.

Impact With Underwater Hazards



Reduce speed and proceed with caution whenever you're driving a boat in shallow water or in areas where the waters are suspected of having underwater obstacles that could be struck by the underwater drive components, rudder or the boat bottom.

IMPORTANT: The most important thing you can do to help reduce injury or impact damage from striking a floating or underwater object is control the boat speed. Under these conditions, boat speed should be kept to a maximum speed of 24 to 40 km/h (15 to 25 MPH).

Striking a floating/underwater object may result in an infinite number of situations. Some of these situations could result in the following:

- The boat could move suddenly in a new direction. Such a sharp change in direction or turn can cause occupants to be thrown out of their seats or out of the boat.
- A rapid reduction in speed. This will cause occupants to be thrown forward, even out of the boat.
- Impact damage to the underwater drive components, rudder and/or boat.

Keep in mind, one of the most important things you can do to help reduce injury or impact damage in these situations is control the boat speed. Boat speed should be kept to a minimum planing speed when driving in waters known to have underwater obstacles.

After striking a submerged object, stop the engine as soon as possible and inspect the drive system for any broken or loose parts. If damage is present or suspected, the power package should be taken to an authorized Cummins MerCruiser Diesel dealer / distributor for a thorough inspection and necessary repair.

The boat should be checked for hull fractures, transom fractures and water leaks.

Operating with damaged underwater drive components, rudder or boat bottom could cause additional damage to other parts of the power package, or could affect control of the boat. If continued operation is necessary, do so at greatly reduced speeds.

WARNING

Avoid serious injury or death from loss of boat control. Continued boating with major impact damage can result in sudden component failure with or without subsequent impacts. Have the power package thoroughly inspected and any necessary repairs made.

Drive Unit Impact Protection

The power trim hydraulic system is designed to provide impact protection for the sterndrive unit. If a submerged object is struck while the boat is moving forward, the hydraulic system will cushion the pickup of the sterndrive unit as it clears the object, reducing damage to the unit. After the sterndrive unit has cleared the object, the hydraulic system allows the sterndrive unit to return to its original operating position, preventing loss of steering control and engine overspeed.

Use extreme caution when operating in shallow water or where underwater objects are known to be present. No impact protection is provided in REVERSE, use extreme care to prevent striking submerged objects while operating in REVERSE.

IMPORTANT: Impact protection system cannot be designed to ensure total protection from impact damage under all conditions.

Conditions Affecting Operation

Weight Distribution (Passengers And Gear) Inside The Boat

Shifting weight to rear (stern):

- Generally increases speed and engine rpm
- Causes bow to bounce in choppy water
- Increases danger of following wave splashing into the boat when coming off plane
- At extremes, can cause the boat to porpoise

Shifting weight to front (bow):

- Improves ease of planing
- Improves rough water ride
- At extremes, can cause the boat to veer back and forth (bow steer)

Bottom Of Boat

To maintain maximum speed, the boat bottom should be:

- Clean, free of barnacles and marine growth
- Free of distortion; nearly flat where it contacts the water
- Straight and smooth, fore and aft

Marine vegetation may accumulate when the boat is docked. This growth must be removed before operation; it may clog the water inlets and cause the engine to overheat.

Cavitation

Cavitation occurs when water flow cannot follow the contour of a fast-moving underwater object, such as a gear housing or a propeller. Cavitation permits the propeller to speed up, but the boat speed to reduce. Cavitation can seriously erode the surface of the gear housing or the propeller. Common causes of cavitation are:

- Weeds or other debris snagged on the propeller
- Bent propeller blade
- Raised burrs or sharp edges on the propeller

Ventilation

Ventilation is caused by surface air or exhaust gases that are introduced around the propeller resulting in propeller speedup and a reduction in boat speed. Excessive ventilation is annoying and usually caused by:

- Drive unit trimmed out too far
- A missing propeller diffuser ring
- A damaged propeller or gear housing, which allows exhaust gases to escape between propeller and gear housing
- Drive unit installed too high on transom

Elevation And Climate

Elevation and climate changes will affect the performance of your power package. Loss of performance can be caused by:

- Higher elevations
- Higher temperatures
- Low barometric pressures
- High humidity

For you to have optimum engine performance under changing weather conditions, it is essential that the engine be propped to allow the engine to operate at or near the Engine Rated rpm with a normal boat load during your normal boating weather conditions.

In most cases, performance can be regained by changing to a lower pitch propeller.

Propeller Selection

CAUTION

The installed propeller must allow the engine to run at the Rated Engine rpm at WOT to avoid engine damage. Using a propeller that causes the engine to operate below the Rated Engine rpm can cause piston and/or valve damage (even if the engine is not operated at WOT). Conversely, using a propeller that allows engine to operate above the specified Rated Engine rpm can increase fuel consumption and wear and will not allow engine to produce its rated horsepower.

It is the responsibility of the boat manufacturer and/or the selling dealer to equip the power package with the correct propellers.

IMPORTANT: The engines covered in this manual are equipped with a governor device that limits engine rpm. Be sure that propeller being used does not allow engine to run excessively against the governor, as a significant loss in performance will result.

NOTE: Use an accurate service tachometer to verify rpm.

Select a propeller that will allow the engine power package to operate at the Rated Engine rpm with a full load.

If full throttle operation is below the Engine Rated rpm, the propeller must be changed to prevent loss of performance and possible engine damage. On the other hand, operating an engine above the Rated Engine rpm will cause higher than normal wear and/or damage.

After initial propeller selection, the following common problems may require that the propeller be changed to a lower pitch:

- Warmer weather and greater humidity cause an rpm loss.
- Operating in a higher elevation causes an rpm loss.
- Operating with a damaged propeller or dirty boat bottom causes an rpm loss.
- Operating with increased load (additional passengers, pulling skiers).

Getting Started

Engine Break-In

INITIAL BREAK-IN PROCEDURE

It is especially important that the following procedure be used on new diesel engines. This break-in procedure allows the proper seating of the pistons and rings, which greatly reduces the likelihood of problems.

IMPORTANT: It is recommended that the boat not be accelerated hard until this procedure has been completed.

IMPORTANT: Never operate the starter motor longer than 15 seconds at a time, to avoid overheating the starter motor. If engine does not start, wait 1 minute to allow the starter motor to cool; then, repeat starting procedure.

- 1.. Refer to appropriate Starting, Shifting and Stopping section and start engine. Allow engine to idle until it has reached normal operating temperature.
- 2.. Run engine in gear for 3 minutes at each of the following rpms: 1400 rpm, 2800 rpm and 3500 rpm.
- 3.. Run engine in gear for 3 minutes at each of the following rpms: 1700 rpm, 3500 rpm and 4000 rpm.
- 4.. Run engine in gear for 3 minutes at each of the following rpms: 2100 rpm, 3500 rpm and Maximum Rated Full Throttle rpm.

Sterndrive Unit 10-Hour Break-In Period

It is especially important that the following procedure be used on new sterndrive units. This break-in procedure allows the proper seating of drive unit gears and related components, which greatly reduces the likelihood of problems.

1. Avoid full throttle starts.
2. Do not operate at any one constant speed for extended periods of time.
3. Do not exceed 75 percent of full throttle during the first 5 hours. During the next 5 hours, operate at intermittent full throttle.
4. Drive unit should be shifted into forward gear a minimum of 10 times during break-in, with run-in time at moderate rpm after each shift.

20-Hour Break-In Period

IMPORTANT: The first 20 hours of operation is the engine break-in period. Correct break-in is essential to obtain minimum oil consumption and maximum engine performance. During this break-in period, the following rules must be observed:

- Do not operate below 1500 rpm for extended periods of time for the first 10 hours. Shift into gear as soon as possible after starting and advance the throttle above 1500 rpm **if conditions permit safe operation.**
- Do not operate at one speed consistently for extended periods.
- Do not exceed 3/4 throttle during the first 10 hours. During the next 10 hours, occasional operation at full throttle is permissible (5 minutes at a time maximum).
- Avoid full throttle acceleration from IDLE speed.
- Do not operate at full throttle until the engine reaches normal operating temperature.
- Frequently check engine oil level. Add oil as needed. It is normal for oil consumption to be high during the break-in period.
- At end of 20-Hour Break-in Period, remove break-in oil and replace oil filter. Fill crankcase with correct grade and viscosity oil.

After Break-In Period

To help extend the life of your Cummins MerCruiser Diesel power package, the following recommendations should be considered;

- Ensure that propeller allows the engine to operate at or near the top of the specified Engine Rated rpms (refer to Specifications and Maintenance) when at full throttle with a normal boat load.
- Operation at 3/4 throttle setting or lower is recommended. Refrain from prolonged operation at WOT rpm.
- Change the oil and oil filter. Refer to Specifications and Maintenance.

End of First Season Checkup

At the end of the first season of operation, contact an authorized Cummins MerCruiser Diesel dealer / distributor to discuss and/or perform scheduled maintenance items. If you are in an area where the product is operated continuously, year-round, you should contact your dealer at the end of the first 100 hours of operation or once yearly, whichever occurs first.

NOTES:

SECTION 4 - SPECIFICATIONS

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Fuel Requirements

WARNING

Electrical system components on this engine are not external ignition protected. **DO NOT STORE OR UTILIZE GASOLINE ON BOATS EQUIPPED WITH THESE ENGINES, UNLESS PROVISIONS HAVE BEEN MADE TO EXCLUDE GASOLINE VAPORS FROM ENGINE COMPARTMENT (REF: 33 CFR).** Failure to comply could result in fire, explosion and/or severe personal injury.

WARNING

FIRE HAZARD: Fuel leakage from any part of the fuel system can be a fire hazard which can cause serious bodily injury or death. Careful periodic inspection of entire fuel system is mandatory, particularly after storage. All fuel components including fuel tanks, whether plastic, metal or fiberglass, fuel lines, primers, fittings, and fuel filters should be inspected for leakage, soften, hardening, swelling or corrosion. Any sign of leakage or deterioration requires replacement before further engine operation.

WARNING

Under *no circumstances* should gasoline, gasohol and/or alcohol be mixed with diesel fuel for any reason. This mixture of gasoline, gasohol and/or alcohol with diesel fuel is highly flammable and produces a significant risk to the user.

IMPORTANT: Use of improper or water contaminated diesel fuel can damage your engine seriously. Use of improper fuel is considered misuse of engine, and damage caused thereby will not be covered by warranty.

Grade 2-D diesel fuel is required, meeting ASTM Standards D975 (or fuel rated Diesel DIN 51601), and having a minimum cetane rating of 45.

The Cetane number is a measure of the ignition quality of diesel fuel. Increasing the cetane number will not improve overall engine performance, but it may be necessary to raise the cetane rating for low temperature, or high altitude use. A lower cetane number could cause hard starting and slower warm-up, and could increase engine noise and exhaust emissions.

NOTE: *If your engine suddenly becomes noisy after a fuel fill, you possibly received substandard fuel with a low cetane rating.*

Sulphur content of the above fuel is rated at 0.50% by weight, maximum (ASTM). Limits may vary in countries outside of the United States.

On intermittent use engines, high sulphur content diesel fuel will greatly increase:

- Corrosion on metal parts.
- Deterioration of elastomer and plastic parts.
- Corrosion and extensive damage, and excessive wear of internal engine parts, particularly bearings.
- Starting and operating difficulties.

Recommended Fuels

CAUTION

Avoid fuel system damage. Use of fuels not recommended by Cummins MerCruiser Diesel may cause hard-starting and other various troubles such as premature wear of the injection pump plungers and injection nozzles resulting from the deposit of carbon residue and other contaminants.

Diesel Fuel/Applicable Standard	Recommendation
JIS (JAPANESE INDUSTRIAL STANDARD)	No.2
DIN (DEUTSCHE INDUSTRIE NORMEN)	DIN 51601
SAE (SOCIETY OF AUTOMOTIVE ENGINEERS)Based on SAE J-313C	No.2-D
BS (BRITISH STANDARD) Based on BSEN 590-1197	A-1

Diesel Fuel In Cold Weather

Unaltered diesel fuels thicken and gel in cold temperatures, unless treated. Virtually all diesel fuels are climatized to allow their use in the particular region for that time of the year. If it becomes necessary to further treat diesel fuel, it is the owner/operator's responsibility to add a commercial standard brand, anti-gel diesel fuel additive, following that product's directions.

Anti-Freeze/Coolant

CAUTION

Alcohol or Methanol base antifreeze or plain water are not recommended for use in closed cooling section of cooling system at any time.

Because diesel engines are high compression engines and related higher engine operating temperatures are created, the closed cooling system and engine, including related cooling passages must remain as clean as possible to provide adequate engine cooling. This can only be assured by using the proper anti-freeze, water, additives and inhibitors. It is recommended that the closed cooled section of the cooling system be filled with a low silicate formula of ethylene glycol antifreeze in solution with deionized water. A low silicate formula prevents antifreeze separation which causes a silicate gelatin to form. This gelatin will block engine and heat exchanger passages causing engine overheating.

The coolant, if not premixed, should be mixed before being added to the closed cooling system using a proper anti-freeze together with deionized water. Common tap water or softened water contains unwanted minerals which can leave large deposits in the system that restrict the cooling system efficiency. In addition, additives and inhibitors introduced into acceptable coolant solutions will form a protective film on internal passages and provide protection against internal cooling system erosion.

The closed cooling section should be kept filled year-round with an acceptable anti/freeze/coolant solution. Do not drain closed cooled section for storage, as this will promote rusting of internal surfaces. If engine will be exposed to freezing temperatures, make sure that closed cooled section is filled with a properly mixed antifreeze/coolant solution, to protect engine and closed cooling system to lowest temperature to which they will be exposed.

NOTE: A 50/50 antifreeze/coolant solution should be used except when operating where seawater temperatures are greater than 32 degrees C (90 degrees F), then a 25 / 75 (antifreeze / water) solution can be used for improved cooling performance.

IMPORTANT: The anti-freeze/coolant used in these marine engines must be a low silicate ethylene glycol, containing special additives, and deionized, purified water. Using other types of engine coolant may cause fouling of the heat exchangers, and overheating of the engine. Do not combine different types of coolants without knowing that they are compatible. Refer to the coolant manufacturer's instructions.

Some acceptable types of anti-freeze/coolants are listed in the following table. Refer to Maintenance Schedules for respective change intervals.

Description	Part Number
Marine Engine Coolant	92-813054A2
Fleetguard Compleat with DCA4 Fleetguard Part Number: CC2825 Quantity: 3-3/4 liters, 1 U.S. Gallon	Obtain Locally

Engine Oil

CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do NOT spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

To help obtain optimum engine performance and to provide maximum protection, the engine requires engine oil with a rating of HD-SAE-API CG-4 and CH-4.

We strongly recommend the use of:

Description	Where Used	Part Number
15W40 4-cycle Diesel Engine Oil	Engine crankcase	92-877695K1

This oil is a specially blended 15W-40 oil with Marine Additives, for all temperature operation. It exceeds requirements for API CF-2, CF-4, CG-4 and CH-4 oils.

Other recommended oils:

Description	Where Used	Part Number
Shell Myrina	Engine crankcase	Obtain Locally
Mopar		
Texaco Ursa Super TD		
Wintershall Multi-Rekord		
Veedol Turbostar		
Wintershall Vliva 1		

These oils are approved by Mercury Marine and Marine Power Europe. For all temperature operation use 15W-40 oil.

Engine Specifications

1.7 MS

Description	Specification - Sterndrive
	1.7 MS
Engine Type	4 Stroke, 4 Cylinder, Vertical In-Line, 4 Valves Per Cylinder, Dual Overhead Camshaft, Direct Injection, Turbocharged, Aftercooled
Displacement	1.686 cubic liters (103 cid)
Engine Weight	225 kg (495 lb)
Firing Order	1 - 3 - 4 - 2
Bore	79 mm (3.11 in.)
Stroke	86 mm (3.39 in.)
Thermostat	82-95 (180-203) ¹
Coolant Temperature (Peak)	90 - 104 (194 - 219) ¹
Electrical System	12-volt Negative (-) Ground
Recommended Battery Rating	515 cca, 652 mca, or 65 Ah

¹ Unit of measure shown in degrees C (degrees F).

Fluid Specifications

IMPORTANT: All capacities are approximate fluid measures.

ENGINE

IMPORTANT: It may be necessary to adjust oil levels depending on installation angle and cooling systems (heat exchanger and fluid lines).

1.7 MS 120	Capacity Liters (U.S. qts)	Fluid type	Part Number
Total Engine Oil (With Filter) ¹	6-1/2 (6-3/4)	15W40 4-cycle Diesel Engine Oil	92-877695K1
Closed Cooling System	8-3/4 (9-1/4)	Marine Engine Coolant	92-813054A2
		Fleetguard Compleat with DCA4 Fleetguard Part Number: CC2825	Obtain Locally

¹ Always use the dipstick to determine the exact quantity of oil or fluid required.

STERNDRIVES

NOTE: Oil capacity includes drive lube monitor.

Model	Capacity ml (oz)	Fluid Type	Part Number
Alpha	1892 (64)	High Performance Gear Lube	92-802854A1

NOTES:

SECTION 5 - MAINTENANCE

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Owner/Operator Responsibilities

It is the operator's responsibility to perform all safety checks, to ensure that all lubrication and maintenance instructions are complied with for safe operation and to return the unit to an authorized Cummins MerCruiser Diesel for a periodic checkup.

Normal maintenance service and replacement parts are the responsibility of the owner/operator and as such, are not considered defects in workmanship or material within the terms of the warranty. Individual operating habits and usage contribute to the need for maintenance service.

Proper maintenance and care of your power package will ensure optimum performance and dependability and will keep your overall operating expenses at a minimum. See your authorized Cummins MerCruiser Diesel dealer / distributor for service aids.

Dealer Responsibilities

In general, a dealer's responsibilities to the customer include predelivery inspection and preparation such as:

- Ensure that the boat is properly equipped.
- Prior to delivery, make certain that the Cummins MerCruiser Diesel dealer / distributor power package and other equipment are in proper operating condition.
- Make all necessary adjustments for maximum efficiency.
- Familiarize the customer with the on-board equipment.
- Explain and demonstrate the operation of the power package and boat.
- Provide you with a copy of a Predelivery Inspection Checklist.
- Your selling dealer should fill out the Warranty Registration Card completely and mail it to the factory immediately upon sale of the new product.

Maintenance



WARNING

Avoid injury or death and power package damage from an electrical shock, fire or explosion. Always disconnect both battery cables from the battery before servicing the power package.



CAUTION

It is good practice to ventilate the engine compartment prior to servicing any engine components to remove any fuel vapors which may cause difficulty breathing or be an irritant.

IMPORTANT: Refer to Maintenance Chart for complete listing of all scheduled maintenance to be performed. Some listings can be done by owner/operator, while others should be performed by an authorized Cummins MerCruiser Diesel dealer / distributor. Before attempting maintenance or repair procedures not covered in this manual, it is recommended that the appropriate Cummins MerCruiser Diesel or Mercury MerCruiser Service Manual be purchased and read thoroughly.

NOTE: Maintenance points are color coded for ease of identification. See the decal on engine for identification.

- Blue-Coolant
- Yellow-Engine Oil
- Orange-Fuel
- Black-Gear Lube Oil

Do-It-Yourself Maintenance Suggestions

Present-day marine equipment, such as your Cummins MerCruiser Diesel power package, are highly technical pieces of machinery. Special fuel delivery systems provide greater fuel economies, but also are more complex for the untrained mechanic.

If you are one of those persons who likes to do-it-yourself, here are some suggestions for you.

- Do not attempt any repairs unless you are aware of the Cautions, Warnings and procedures required. Your safety is our concern.
- If you attempt to service the product yourself, we suggest you order the service manual for that model. The service manual outlines the correct procedures to follow. It is written for the trained mechanic, so there may be procedures you don't understand. Do not attempt repairs if you do not understand the procedures.
- There are special tools and equipment that are required to perform some repairs. Do not attempt these repairs unless you have these special tools and/or equipment. You can cause damage to the product in excess of the cost a dealer would charge you.

- Also, if you partially disassemble an engine or drive assembly and are unable to repair it, the dealer's mechanic must reassemble the components and test to determine the problem. This will cost you more than taking it to the dealer immediately upon having a problem. It may be a very simple adjustment to correct the problem.
- Do not telephone the dealer, service office or the factory to attempt for them to diagnose a problem or to request the repair procedure. It is difficult for them to diagnose a problem over the telephone.

Your local dealer / distributor of Cummins MerCruiser Diesel products is there to service your power package. They have qualified factory-trained mechanics.

It is recommended you have the dealer do periodic maintenance checks on your power package. Have them winterize it in the fall and service it before the boating season. This will reduce the possibility of any problems occurring during your boating season when you want trouble-free boating pleasure.

Inspection

Inspect your power package often, and at regular intervals, to help maintain its top operating performance and correct potential problems before they occur. The entire power package should be checked carefully, including all accessible engine parts.

Check for loose, damaged or missing parts, hoses and clamps; tighten or replace as necessary.

Check electrical connections and leads for damage.

Remove and inspect the propeller. If badly nicked, bent or cracked, contact your authorized Cummins MerCruiser Diesel dealer / distributor.

Repair nicks and corrosion damage on power package exterior finish. Contact your authorized Cummins MerCruiser Diesel dealer / distributor.

Maintenance Schedules

Routine Maintenance				
	Each Day Start	Each Day End	Weekly	Every Two Months
Check the engine oil level (interval can be extended based on experience).	•			
Check the coolant level.	•			
If equipped with power steering, check the fluid level.	•			
Check the sterndrive unit oil level in the gear lube monitor.	•			
Check the trim pump oil level.	•			
If operating in salt, brackish or polluted waters, flush the cooling system after each use.		•		
Drain any water from the fuel filter ⁴			•	
Check the seawater pickups for debris or marine growth. Check the seawater strainer and clean, if equipped.			•	
Inspect the sterndrive unit anodes and replace if 50 percent eroded.			•	
Check the battery connections and fluid level.				•
Inspect the air cleaner. ¹				•
Lubricate the propeller shaft and torque the nut. ³				•
Operating in saltwater only: treat the engine surface with corrosion guard.				•
Ensure the gauges and the wiring connections are secure. Clean the gauges. ²				•

¹ Or every 50 hours, whichever occurs first.

² Or every 50 hours, whichever occurs first. If operating in saltwater, interval is reduced to every 25 hours or 30 days whichever occurs first

³ If operating in only freshwater, this maintenance may be extended to every four months.

⁴ If operating in cold weather (freezing temperatures), drain any water from the fuel filter after each use.

Maintenance Schedules (Continued)

Scheduled Maintenance			
	After first 50 hours	Every 100 hours or Annually ◆	Every 200 hours or Annually ◆
Change the engine oil and filter.	•	•	
Retorque the exhaust riser clamp.	•		•
Change the drive unit oil and retorque the gimbal ring to steering shaft connection.		•	
Replace the fuel filter(s).			•
Check the steering system and the remote control for loose, missing or damaged parts. Lubricate the cables and linkages.		•	
Inspect the U-joints, splines, and bellows. Check the clamps. Check the engine alignment. Lubricate the splines.		•	
Lubricate the hinge pins, gimbal bearing and engine coupler ⁸		•	
Check the continuity circuit for loose or damaged connections. Test the MerCathode® unit output, if equipped.		•	
Drain the condensation from aftercooler.			•
Lubricate the driveshaft U-joints and tailstock input and output bearings (on driveshaft extension models).		•	
Touch-up paint the power package and spray with corrosion guard.		•	

◆ Whichever Occurs First

⁸ Lubricate engine coupler every 50 hours if operated at idle for prolonged periods of time.

Maintenance Schedules (Continued)

Scheduled Maintenance (Continued)					
	Every 200 hours or Annually ◆	Every 200 hours or 2 years ◆	Every 300 hours or 3 years ◆	Every 500 hours or 5 years ◆	Every 1000 hours or 5 years ◆
Retorque the engine mounts.			•		
Check the electrical system for loose, damaged or corroded fasteners.			•		
Inspect the condition and tension of belts.	•				
Check the cooling system and exhaust system hose clamps for tightness. Inspect both systems for damage or leaks.	•				
Disassemble and inspect the seawater pump and replace worn components.			•		
Clean the seawater section of the closed cooling system. Clean, inspect and test the pressure cap. Check the anodes.	•				
Replace the coolant.		•			
Clean the aftercooler core.				•	
Inspect the timing belt and pulleys.			•		
Replace the timing belt.					•
Check the valve clearance.					•
Clean the fuel tank.					•

◆ Whichever Occurs First

[illegible]

Engine Oil

⚠ CAUTION

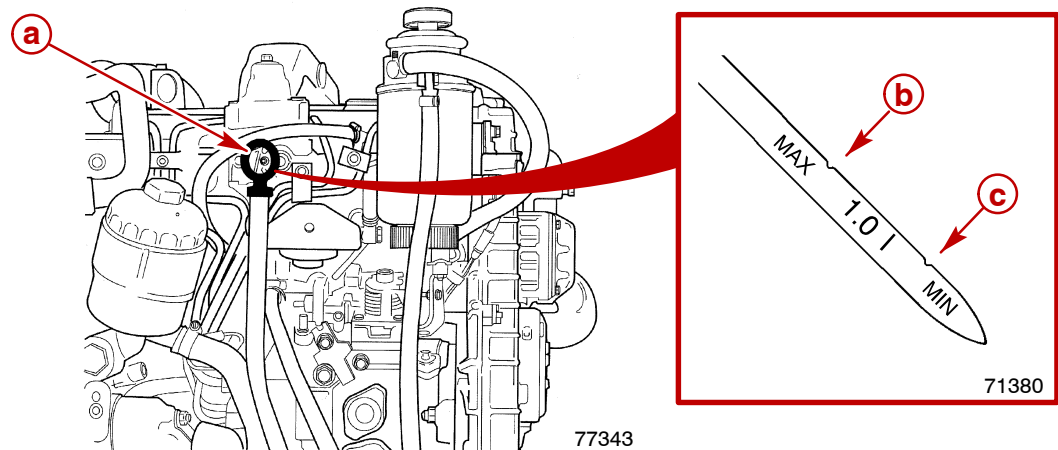
ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do NOT spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

Checking

If it becomes necessary to check the engine oil level during operation, stop the engine and allow 5 minutes for oil to drain into pan.

1. Remove the dipstick. Wipe clean and reinstall into dipstick tube.
2. Remove the dipstick and observe the oil level. Oil must be between the marks on the dipstick. If necessary, add oil. Refer to **Filling**.

NOTE: Distance between marks is equivalent to approximately 1.0 liter (1 US quart).

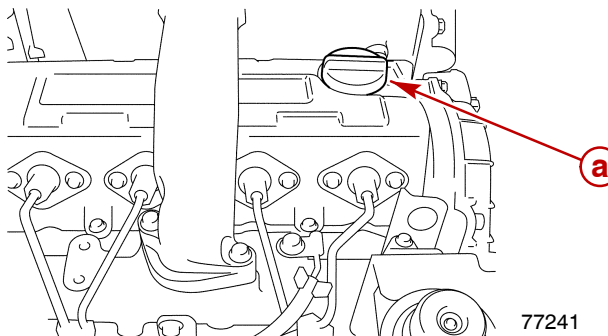


- a** - Dipstick
- b** - Maximum mark
- c** - Minimum mark

Filling

IMPORTANT: Do not overfill the engine with oil.

1. Remove the oil filler cap.



a - Oil filler cap

2. Add specified oil to bring the oil level up to, but not over, the MAX mark on the dipstick.

1.7 MS 120	Capacity Liters (U.S. qts)	Fluid type	Part Number
Total Engine Oil (With Filter) ¹	6-1/2 (6-3/4)	15W40 4-cycle Diesel Engine Oil	92-877695K1

¹ Always use the dipstick to determine the exact quantity of oil or fluid required.

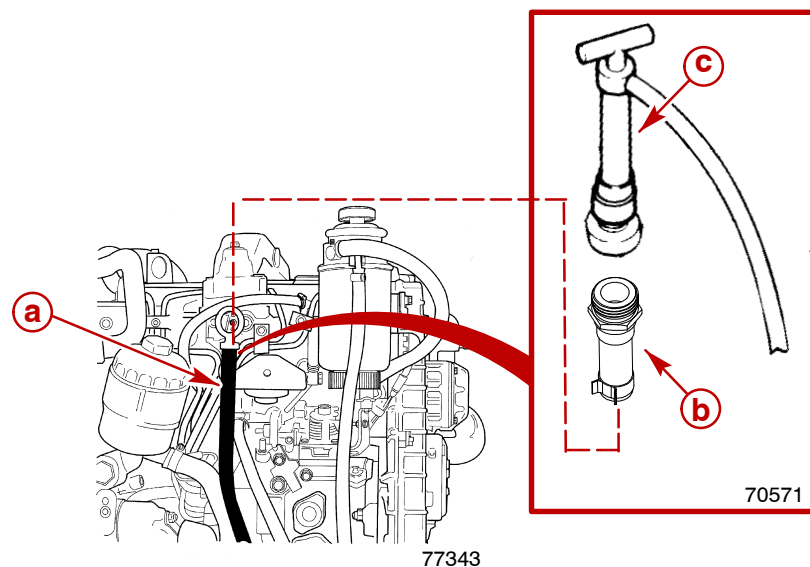
3. Install the oil filler cap.

Changing Oil and Filter

Refer to the Maintenance schedule for the change interval. Engine oil should be changed before placing the boat in storage.

IMPORTANT: Change engine oil when the engine is warm from operation. Warm oil flows more freely, carrying away more impurities. Use only recommended engine oil. Refer to Specifications.

1. Start the engine and allow it to warm up to normal operating temperature.
2. Stop the engine and allow some time for oil to drain into oil pan (approximately 10 minutes).
3. Remove the dipstick.
4. Push the oil pump adapter onto the dipstick tube.
5. Attach the crankcase oil pump onto the oil pump adapter.



- a** - Dipstick tube
- b** - Quicksilver Hose / Oil Pump Adapter (Quicksilver P/N 32-863642)
- c** - Quicksilver Crankcase Oil Pump (Quicksilver P/N 802889A1)

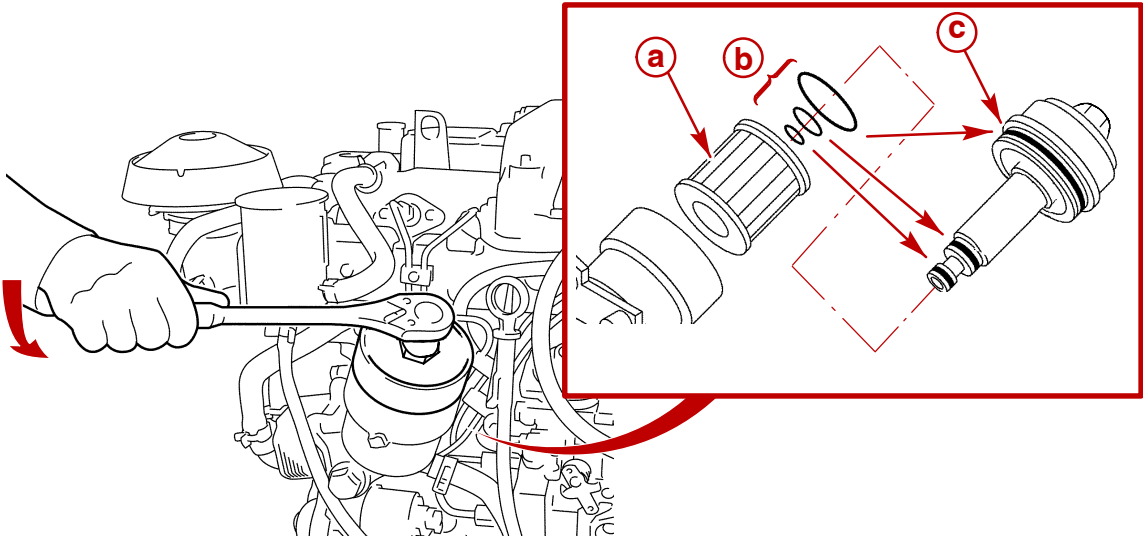
6. Pump the oil out of the crankcase into drain pan.
7. When the crankcase is empty, remove the pump and adapter.
8. Install the oil dipstick.

CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

9. Contain and dispose of oil or oil waste as defined by local authorities.

10. Use a filter wrench or appropriate socket to remove the cartridge type oil filter.
11. Discard the old filter element. Discard the old O-rings from the top piece.



79740

- a - Filter element
- b - O-rings
- c - Top piece

12. Install the three O-rings. Apply lubricant to the O-rings. Install the element on the top piece.

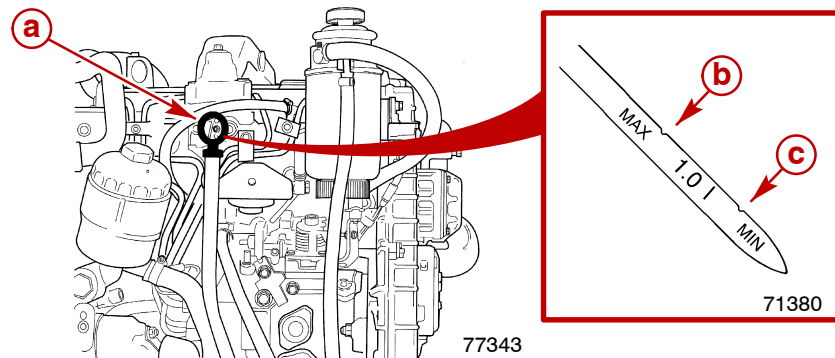
Description	Where Used	Part Number
Engine oil	Oil filter O-rings	Obtain Locally

13. Install the top piece with the new element into the oil filter housing.
14. Turn the top piece until the sealing face is fitted against the gasket using the filter wrench or a socket. Torque the top piece.

Description	Nm	lb-in.	lb-ft
Oil filter top piece	25		18

IMPORTANT: Over tightening the top piece will cause deformation resulting in oil leakage.

15. Remove the oil fill cap and refill the engine with new oil. Refer to specifications for quantity and grade of oil.
16. Add the specified oil to bring the oil level up to, but not over, the maximum oil level mark - "MAX" - on dipstick.



- a** - Dipstick
- b** - Maximum mark
- c** - Minimum mark

17. Install the oil filler cap.

CAUTION

Avoid starter motor damage. Prolonged or repeated operation of the starter motor could cause overheating resulting in starter motor damage. Allow the starter motor to cool before prolonged or repeated operation.

18. Pre-lubricate the turbocharger and engine.
 - a. Hold the stop switch engaged while you simultaneously turn the key switch to the START position for 15 seconds. Doing this together turns the engine without starting it.

IMPORTANT: Never operate the starter motor longer than 15 seconds at a time, to avoid overheating the starter motor. If the engine does not readily start, wait 1 minute to allow the starter motor to cool; then, repeat the starting procedure.

- b. Allow the starter motor to cool and repeat step a. as needed. Pre-lubrication is complete when oil pressure is shown by the instruments.

19. Start and operate the engine for a few minutes. Stop the engine and wait for about ten minutes.

20. Remove the oil dipstick. Wipe clean and install into the dipstick tube.

21. Remove the dipstick and observe the oil level. If necessary, add oil to bring level up to but not over the MAX mark or between MIN and MAX marks on dipstick.

IMPORTANT: When refilling engine with oil always use dipstick to determine how much oil is required.

CAUTION

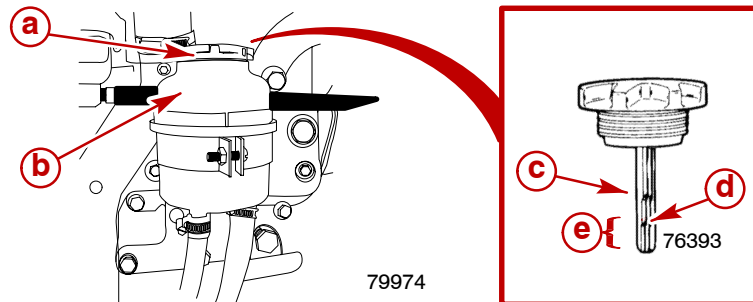
Do not overfill the engine with oil. Too much engine oil will cause excessive oil consumption and higher oil temperature.

22. Install the oil filler cap.
23. Start the engine and check for leaks.

Power Steering Pump Fluid

Checking

1. Stop the engine and center the sterndrive unit.
2. Remove the dipstick and observe the fluid level.
 - a. Proper fluid level with engine at normal operating temperature should be between the full hot mark and the full cold mark on dipstick.
 - b. Proper fluid level with the engine cold should be between the full cold mark and the end of the dipstick.



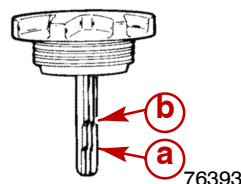
Typical

- | | |
|----------------------------|--|
| a - Dipstick | d - Full cold mark |
| b - Fluid reservoir | e - Proper fluid level with the engine cold |
| c - Full hot mark | |

IMPORTANT: If fluid is not visible in the pump, contact your authorized Cummins MerCruiser Diesel dealer/distributor.

Filling

1. Remove the dipstick and observe the level.
2. Add fluid, if necessary. The fluid level should be between the full cold mark and the full hot mark.



- | | |
|---------------------------|--------------------------|
| a - Full cold mark | b - Full hot mark |
|---------------------------|--------------------------|

Description	Where Used	Part Number
Quicksilver Power Trim And Steering Fluid	Steering system	92-802880A1
Transmission Fluid Dexron III (or Equivalent)	Steering system	Obtain Locally

3. Install the dipstick. Tighten securely.

Changing

Power Steering fluid does not require changing.

Engine Coolant

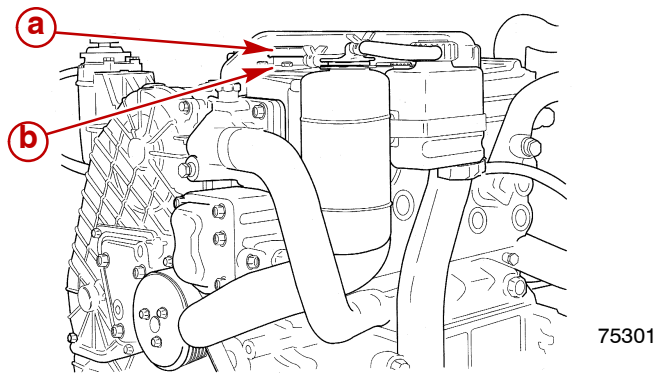
Checking

⚠ CAUTION

Allow the engine to cool before removing the pressure cap. A sudden loss of pressure could cause hot coolant to boil and discharge violently. After the engine has cooled, turn the cap 1/4 turn to allow any pressure to escape slowly, then push down and turn the cap all the way off.

1. Allow the engine to cool.
2. Remove the pressure cap from the heat exchanger and observe the coolant level.
3. The coolant level in the heat exchanger should be at the bottom of the filler neck. If coolant is low refer to Filling.

NOTE: If no coolant is visible in the heat exchanger or operating temperatures are excessive, air may have become trapped in the cooling system. See your authorized Cummins MerCruiser Diesel dealer / distributor.



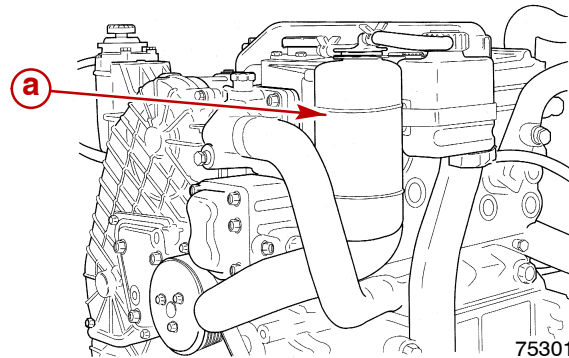
Typical

- a** - Pressure cap
- b** - Filler neck

IMPORTANT: When installing the pressure cap, be sure to tighten until it contacts locking tabs on the filler neck.

4. Install the pressure cap. Tighten until it contacts locking tabs on the filler neck.

5. With the engine at normal operating temperature, check the coolant level in the coolant recovery bottle.
6. The coolant level should be between the ADD and FULL marks.

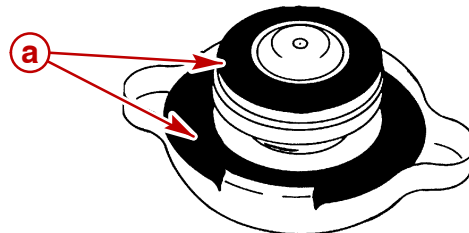


a - Coolant recovery bottle

7. Add the specified coolant as necessary.

Description	Where Used	Part Number
Marine Engine Coolant	Closed cooling system	92-813054A2
Fleetguard Compleat with DCA4		Obtain Locally
Fleetguard Part Number: CC2825 Quantity: 3-3/4 liters, 1 U.S. Gallon		

8. If coolant level in coolant recovery bottle was low:
 - Inspect coolant recovery system for leaks.
 - Inspect pressure cap gaskets for damage and replace if necessary.



a - Gaskets

Also, the pressure cap maintains pressure on the coolant tank. It may not be holding pressure properly. Contact your authorized Cummins MerCruiser Diesel dealer / distributor to have the cap tested.

Filling

NOTE: If no coolant is visible in the heat exchanger or operating temperatures are excessive, air may have become trapped in the cooling system. See your authorized Cummins MerCruiser Diesel dealer / distributor.

1. If coolant is low in the heat exchanger, add specified coolant as necessary to bring the level up to the bottom of the fill neck.

IMPORTANT: The pressure cap is correctly installed if it contacts locking tabs on the fill neck when tightened.

2. Install the pressure cap. Tighten until it contacts locking tabs on the fill neck.
3. Remove the fill cap from the coolant recovery bottle.
4. Fill to the FULL line with the specified coolant.

Description	Where Used	Part Number
Marine Engine Coolant	Closed cooling system	92-813054A2
Fleetguard Compleat with DCA4 Fleetguard Part Number: CC2825 Quantity: 3-3/4 liters, 1 U.S. Gallon		Obtain Locally

5. Install the fill cap onto the coolant recovery bottle.

Changing

Contact your authorized Cummins MerCruiser Diesel dealer/distributor.

Sterndrive Unit Oil

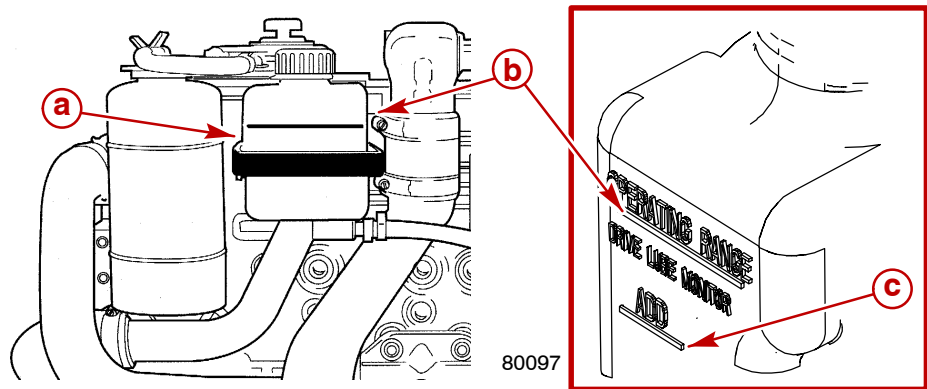
⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

Checking

NOTE: Oil level will rise and fall during sterndrive operation. Oil level should be checked with the engine cold, before starting.

1. Check the gear lube oil level. Keep the oil level at or near “OPERATING RANGE” (full) line on the gear lube monitor.
2. The oil level is low if it is below the “ADD” line on the gear lube monitor. Fill as necessary with the specified fluid. Refer to **Filling**.



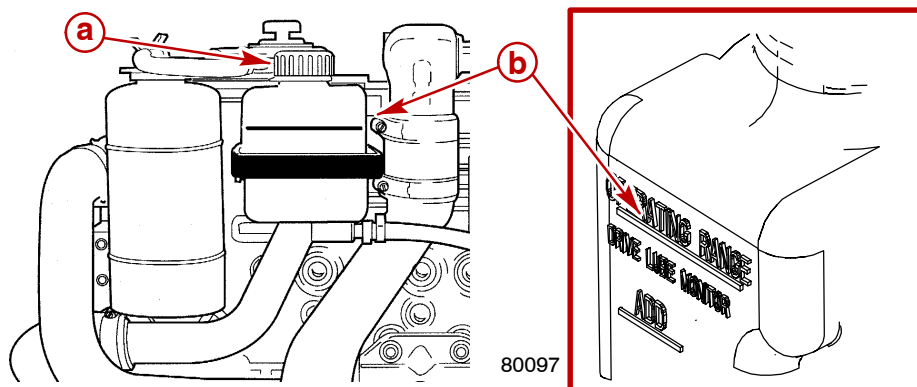
- a** - Gear lube monitor
- b** - “OPERATING RANGE” line
- c** - “ADD” line

IMPORTANT: If any water is visible at the bottom of the monitor or appears at the oil fill/drain plug and/or if oil appears discolored, contact your authorized Cummins MerCruiser Diesel dealer / distributor immediately. Both conditions may indicate a water leak somewhere in the sterndrive unit.

Filling

IMPORTANT: If more than 59 ml (2 fl. oz.) of Quicksilver High Performance Gear Lube is required to fill the monitor, a seal may be leaking. Damage to the sterndrive unit may occur due to lack of lubrication. Contact your authorized Cummins MerCruiser Diesel dealer/distributor.

1. Remove the gear lube monitor cap.
2. Fill the gear lube monitor to the “OPERATING RANGE” (full) line with specified fluid. Do not overfill.



- a** - Gear lube monitor cap
b - “OPERATING RANGE” line

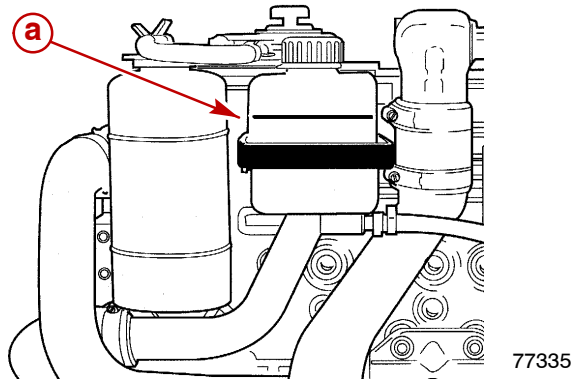
Description	Where Used	Part Number
High Performance Gear Lube	Gear lube monitor	92-802854A1

3. Ensure that the rubber gasket is inside the gear lube monitor cap and install the cap. Do not overtighten.

NOTE: When filling the entire sterndrive unit refer to **Changing** instructions.

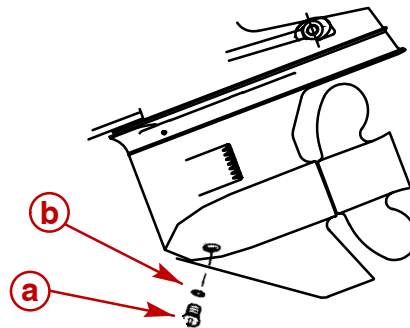
Changing

1. Remove the gear lube monitor from the bracket.



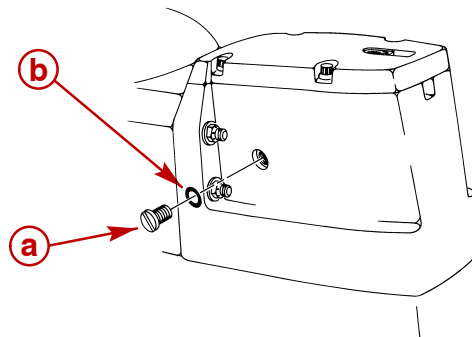
a - Gear lube monitor

2. Empty the contents into a suitable container.
3. Install the gear lube monitor in the bracket.
4. Place the sterndrive unit in full trim limit OUT position, remove the oil fill/drain screw and sealing washer. Drain the oil.



a - Oil fill/drain screw
b - Sealing washer

5. Remove the oil vent screw and sealing washer. Allow the oil to drain completely.



a - Oil vent screw
b - Sealing washer

IMPORTANT: If any water drained from the oil fill/drain hole, or if the oil appears milky, the sterndrive unit is leaking and should be checked immediately by your authorized Cummins MerCruiser Diesel dealer / distributor.

6. Lower the sterndrive unit so that the propeller shaft is level. Fill the sterndrive unit, through the oil fill/drain hole, with specified gear lube until an air-free stream of lubricant flows from oil vent hole.

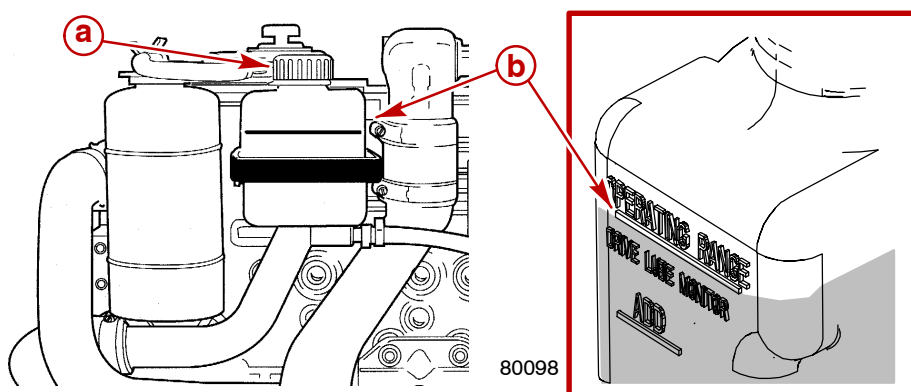
Description	Where Used	Part Number
High Performance Gear Lube	Gear lube monitor	92-802854A1

IMPORTANT: Use only Quicksilver High Performance Gear Lube in sterndrive unit.

7. Install the oil vent screw and sealing washer. Torque the oil vent screw.

Description	Nm	lb-in.	lb-ft
Oil vent screw	6.8	60	

8. Continue to pump gear lube into the gear lube monitor circuit until the gear lube appears in the gear lube monitor.
9. Fill the gear lube monitor to the “OPERATING RANGE” (full) line with specified fluid. Do not overfill.



- a** - Gear lube monitor cap
b - “OPERATING RANGE” line

Description	Where Used	Part Number
High Performance Gear Lube	Gear lube monitor	92-802854A1

10. Ensure that the rubber gasket is inside the gear lube monitor cap and install the cap. Do not overtighten.
11. Remove the pump from the oil fill/drain hole. Quickly install the sealing washer and oil fill/drain screw. Torque the oil fill/drain screw.

Description	Nm	lb-in.	lb-ft
Oil fill/drain screw	6.8	60	

12. Check the oil level in the gear lube monitor after the first use.

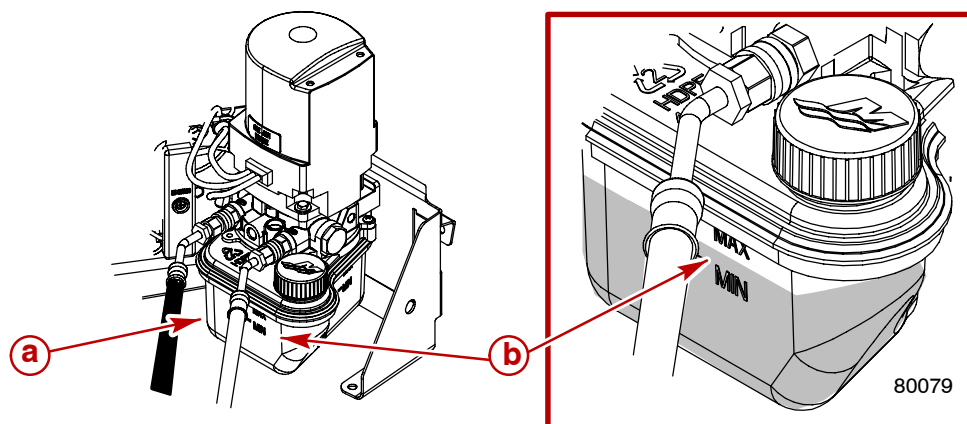
IMPORTANT: Oil level in the gear lube monitor will rise and fall during sterndrive operation; always check the oil level when the sterndrive is cool and the engine is shut down.

Power Trim Pump Fluid

Checking

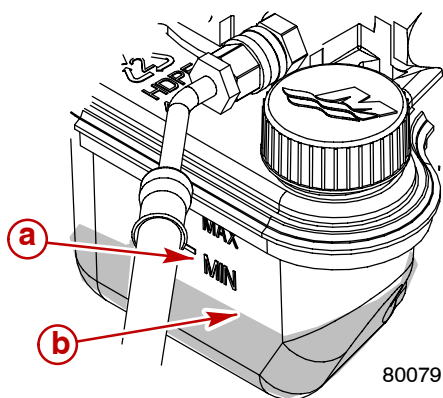
IMPORTANT: Check the oil level with sterndrive unit in the full DOWN/IN position only.

1. Place the sterndrive unit in full DOWN/IN position.
2. Observe the oil level in the reservoir. The oil level should be maintained within the “MIN” and “MAX” lines on the reservoir.



- a** - Reservoir
b - “MIN” and “MAX” lines

3. The oil level is low if it is below the “MIN” line on the reservoir. Fill as necessary with the specified fluid. Refer to **Filling**.

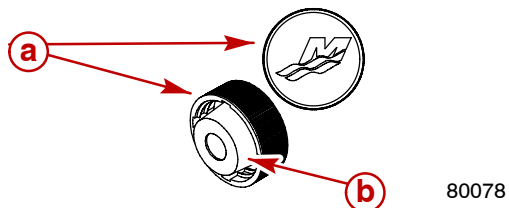


- a** - “MIN” line
b - Low oil level

Filling

1. Place the sterndrive unit in full DOWN/IN position.
2. Unscrew and remove the fill cap assembly from the reservoir.

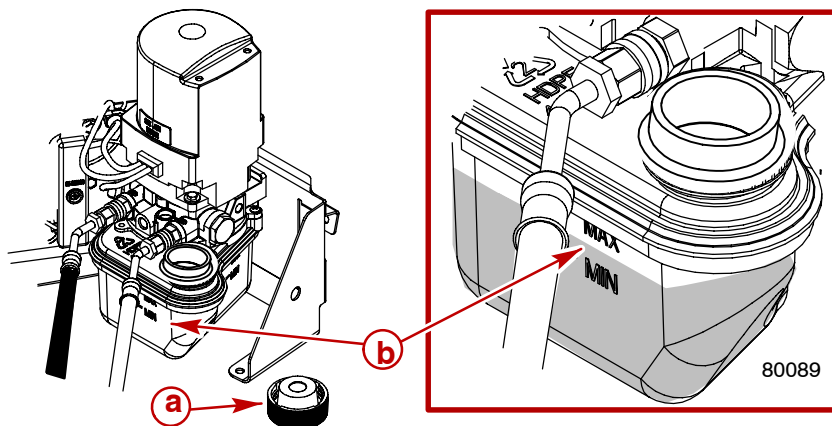
NOTE: The cap plug and fill cap are an assembled piece and should not be separated; do not remove or discard the cap plug.



- a** - Fill cap assembly
b - Cap plug

IMPORTANT: Use only the specified lubricant.

3. Add lubricant to bring the oil level to within the “MIN” and “MAX” lines on the reservoir.



Typical

- a** - Fill cap assembly
b - “MIN” and “MAX” lines

Description	Where Used	Part Number
Power Trim And Steering Fluid	Power trim pump	92-802880A1

4. Install the fill cap assembly.

Changing

Power Trim fluid does not require changing unless it becomes contaminated with water or debris. Contact your authorized Cummins MerCruiser Diesel dealer/distributor.

Battery

Refer to specific instructions and warnings accompanying your battery. If this information is not available, observe the following precautions when handling a battery.

WARNING

Avoid serious injury from fire or explosion. Do NOT use jumper cables and a booster battery to start engine. Do NOT recharge a weak battery in the boat. Remove battery and recharge in a ventilated area away from fuel vapors, sparks or flames.

WARNING

Batteries contain acid which can cause severe burns. Avoid contact with skin, eyes and clothing. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible.

Safety glasses and rubber gloves are recommended when handling batteries or filling with electrolyte.

Battery Precautions For Multiple Engines

Alternators: Alternators are designed to charge a single battery that supplies electrical power to the individual engine that the alternator is mounted on. connect only one battery to one alternator. Do not connect two batteries to the same alternator unless a battery isolator is used.

Batteries: Boats with multi-engine power packages require each engine be connected to its own battery. This ensures that the engine has a stable voltage source.

Battery Switches: Battery switches should always be positioned so each engine is running off its own battery. Do not operate engines with switches in BOTH or ALL position. In an emergency, another engine's battery can be used to start an engine with a dead battery.

Battery Isolators: Isolators can be used to charge an auxiliary battery used for powering accessories in the boat. Isolators should not be used to charge the battery of another engine in the boat unless the type of isolator is specifically designed for this purpose.

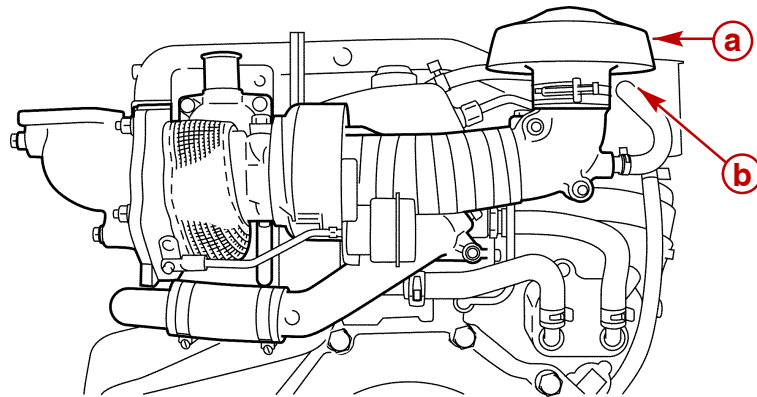
Generators: The generator's battery should be considered in the same manner as another engine's battery.

Air Cleaner

The air cleaner is used to prevent the entry of rain water, seawater, and debris. No maintenance is required and there are no serviceable parts to the air cleaner.

Cleaning

1. Remove any debris present at openings.
2. Ensure that the air cleaner is mounted (clamped) securely at all times.



77132

- a** - Air cleaner
b - Openings

Replacement

Replace the assembly if is cracked or damaged.

Water Separating Fuel Filter

⚠ WARNING

Be careful when draining water separating fuel filter. Diesel fuel is flammable. Be sure ignition key is OFF. Do not allow fuel to contact any hot surfaces which may cause it to ignite. Do not allow sources of open flame in the area. Wipe up any spilled fuel immediately. Dispose of fuel soaked rags, paper, etc. in an appropriate air tight, fire retardant container. Fuel soaked items may spontaneously ignite and result in a fire hazard which could cause serious bodily injury or death.

⚠ CAUTION

Any water entering the fuel injection system will disable the system. Check for water in water separating fuel filter before starting, daily.

⚠ CAUTION

If water should enter the fuel injection system, take unit to an authorized Cummins MerCruiser Diesel dealer / distributor IMMEDIATELY, so that corrosion and rusting of the injectors and other components can be avoided.

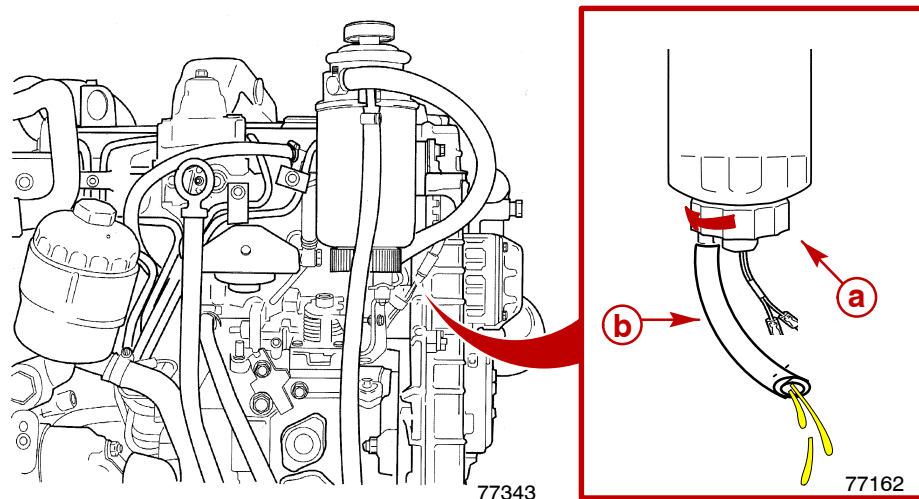
Draining

The filter can be drained of water and small dirt particles by opening the drain cap on the bottom of the filter.

NOTE: To ensure complete draining, in warm weather open the drain cap before starting daily operations. In cold weather, where there is a possibility that the condensed water will freeze, drain the filter shortly after the end of daily operations.

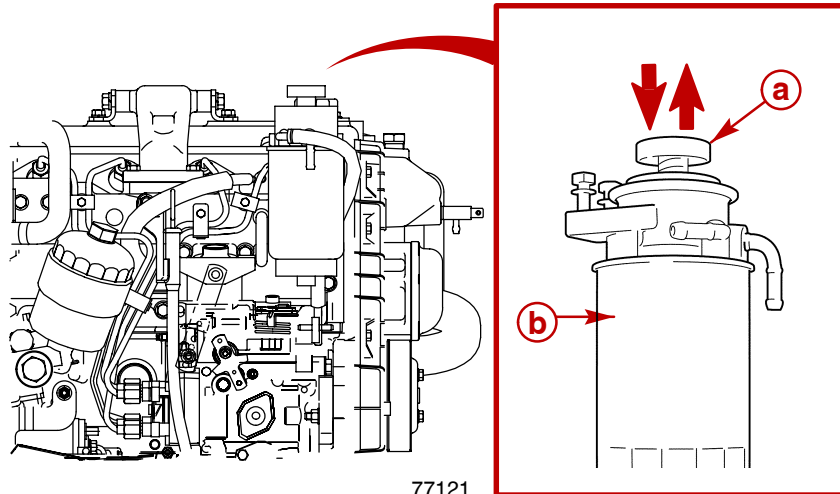
NOTE: Place a suitable container under fuel filter to catch contaminated fuel and/or water. Dispose of properly.

1. Place a small container at the end of a drain hose beneath the drain cap on the filter.
2. Open by turning the drain cap counterclockwise (as viewed from the bottom of the filter) approximately 5 turns.



- a** - Drain cap
b - Drain hose

3. Operate the priming pump up and down about 10 times until approximately 4 ml. (2 fl oz.) is drained. or until fuel is clear in appearance.



a - Priming pump

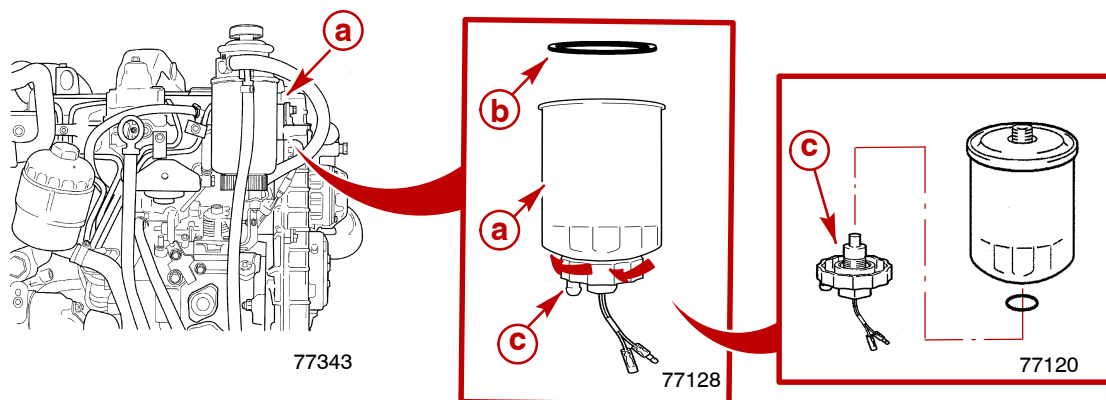
4. Close drain cap by turning clockwise. Tighten securely.
5. Fill the fuel filter. Refer to Filling The Fuel Filter.
6. After starting the engine, check to see that there is no fuel leak from the drain cap.

IMPORTANT: If fuel filter requires frequent draining, have the fuel tank drained to remove the water.

Replacing

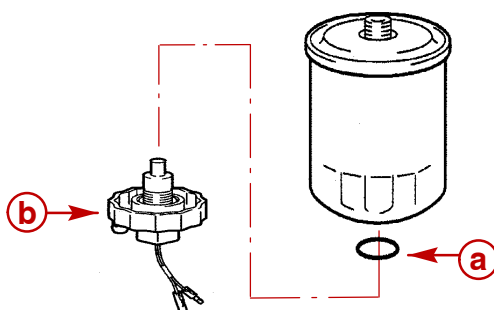
IMPORTANT: Element cannot be cleaned and reused. It must be replaced.

1. Remove water separating fuel filter and sealing ring from fuel filter bracket.
2. Remove the drain cap from the filter by turning it counterclockwise. Discard the used filter.



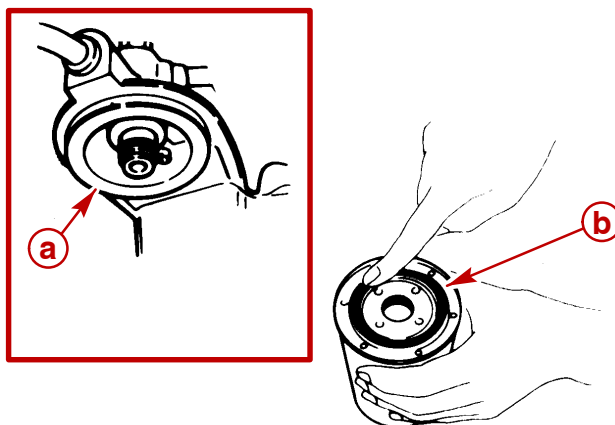
- a** - Water separating fuel filter
- b** - Sealing ring
- c** - Drain cap

3. Install the O-ring and drain cap on the new fuel filter. Tighten **the** drain cap.



- a** - O-ring
- b** - Drain cap

4. Clean filter sealing surface on mounting bracket.
5. Coat sealing ring on new filter with clean motor oil.



77296

Typical mounting bracket and filter

- a** - Filter sealing surface
- b** - Sealing ring

Description	Where Used	Part Number
Engine oil	Oil filter O-rings	Obtain Locally

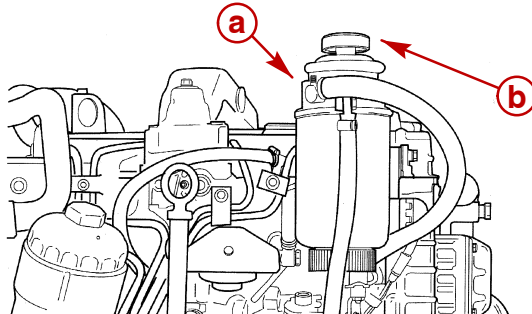
6. Thread filter onto bracket until the sealing ring contacts bracket.
7. Tighten the fuel filter an additional 2/3 of a turn with a filter wrench.
8. Ensure bottom drain cap is securely tightened.
9. Fill the fuel filter. Refer to Filling.
10. Check filter and drain cap for fuel leaks.
11. Start and operate the engine. Check filter connection for fuel leaks. If leaks exist, recheck filter installation. If leaks continue, stop engine immediately and contact your authorized Cummins MerCruiser dealer / distributor.

Filling

A plunger-type of hand pump/primer is located on the fuel filter bracket and is used to:

- Refill fuel filter when changing filter
- Refill fuel system if system was run dry
- To prime the fuel system if engine has not been run for a while.

To operate the hand pump/primer, move the plunger (upper portion) up and down as needed.

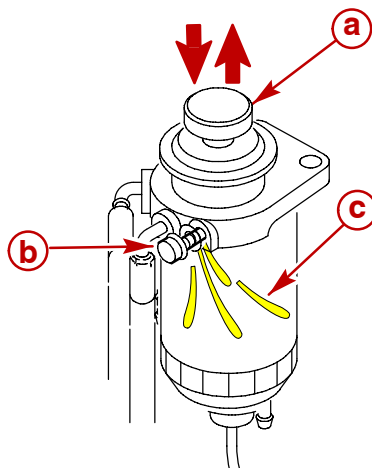


77343

- a** - Fuel filter bracket
b - Hand pump / primer

NOTE: Follow this procedure after installing new filter or if fuel has been drained from filter checking for water.

1. Loosen the bleed screw on fuel filter bracket.
2. Move the plunger on the hand pump/primer up and down repeatedly, until an air free stream of fuel flows from the bleed screw. Filter is full when this occurs.



77381

- a** - Bleed screw
a - Plunger
b - Fuel from bleed screw

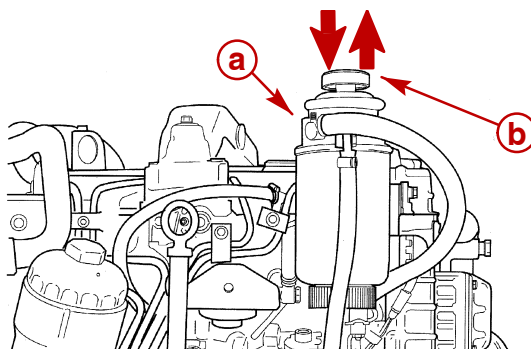
3. Tighten the bleed screw

Fuel System

Priming

Prime engine if it has not been run for a while or if engine will not start.

1. Move the hand pump/primer plunger up and down several times.



77343

- a** - Fuel filter bracket
b - Hand pump / primer

CAUTION

Avoid starter motor damage. Prolonged or repeated operation of the starter motor could cause overheating resulting in starter motor damage. Allow the starter motor to cool before prolonged or repeated operation.

2. Attempt to start the engine. Never operate the starter motor longer than 15 seconds at a time, to avoid overheating the starter motor. If the engine does not readily start, wait 1 minute to allow the starter motor to cool; then, repeat the starting procedure.

Purging Air

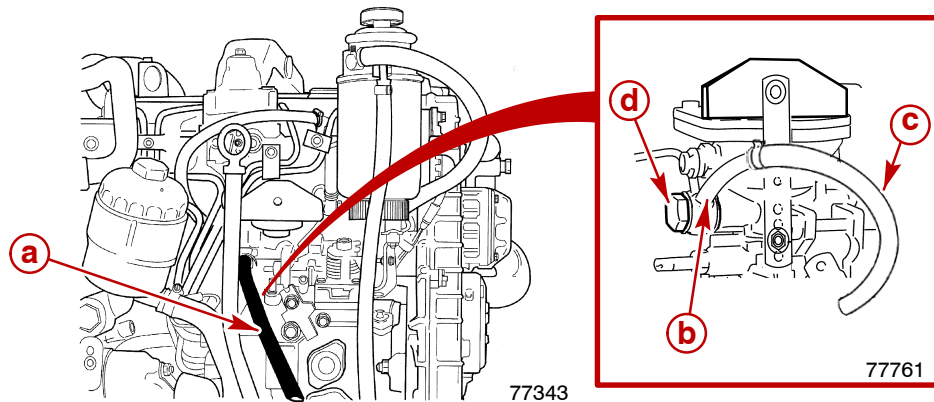
NOTE: Follow this procedure if fuel system was run dry or if part of fuel system was drained for a service function.

1. Fill the fuel filter. Refer to Filling.
2. Check filter and drain cap for fuel leaks. Ensure that bleed screw on fuel filter bracket is closed.
3. Place a suitable container under fuel injection pump to catch fuel.
4. Remove and plug boat fuel return hose from injection pump return fuel fitting.

⚠ CAUTION

Avoid the risks of fuel leaking. The injection pump fuel return valve, a special hollow bolt, uses sealing washers to prevent fuel from leaking. Replace the sealing washers if leaking.

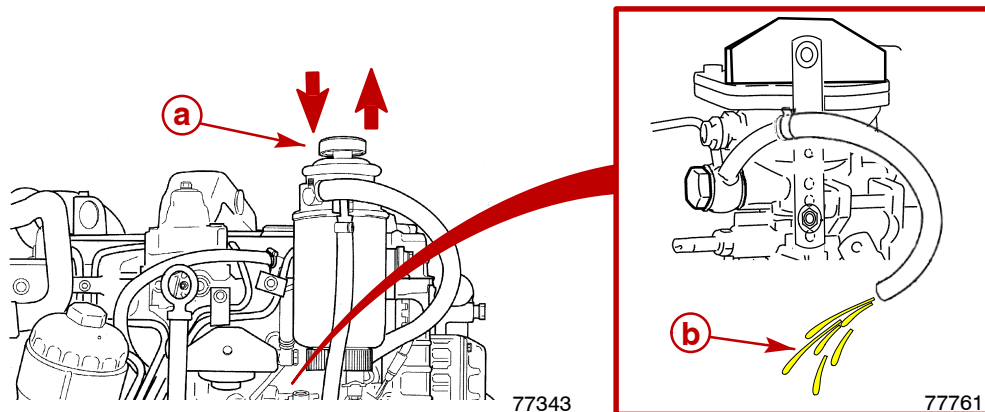
5. Temporarily install a length of fuel hose on fuel return fitting. Avoid disturbing special hollow bolt and sealing washers.



a - Fuel return hose
b - Fuel return fitting

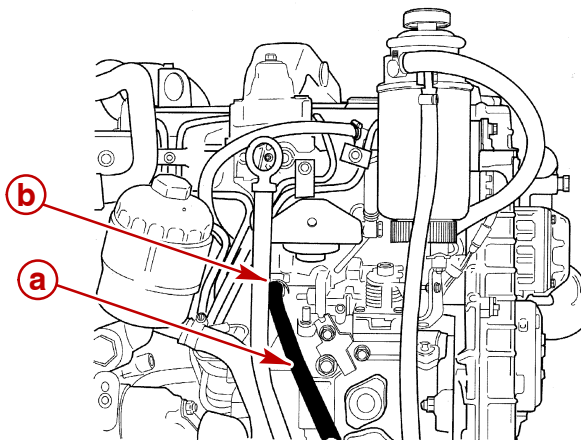
c - Temporary hose
d - Hollow bolt and sealing washers

6. Move plunger on hand pump/primer up and down repeatedly, until an air free stream of fuel flows from temporary hose.



a - Plunger
b - Fuel from temporary hose

7. Remove temporary hose. Unplug and install boat fuel return hose on fitting. Securely tighten the hose clamp.



77343

- a** - Fuel return hose
- b** - Hose clamp

8. Move plunger knob up and down several times until some added resistance is noticed when knob is moved.
9. Check for fuel leaks.
10. Dispose of waste fuel as defined by local authorities.

CAUTION

Avoid starter motor damage. Prolonged or repeated operation of the starter motor could cause overheating resulting in starter motor damage. Allow the starter motor to cool before prolonged or repeated operation.

11. Start the engine. Never operate the starter motor longer than 15 seconds at a time, to avoid overheating the starter motor. If the engine does not readily start, wait 1 minute to allow the starter motor to cool; then, repeat the starting procedure.
12. Check for fuel leaks. If leaks exist stop the engine immediately. Recheck installation.

NOTE: In some circumstances, it may be necessary to bleed (purge air) from the injectors if the engine does not readily start. Refer to an authorized Cummins MerCruiser Diesel dealer / distributor.

Fuel Tank Cleaning And Flushing

IMPORTANT: Diesel fuel should not be left in tank during winter storage, as an accumulation of rust, sludge and wax residue will form.

Refer to boat manufacturer’s instructions and clean fuel tank at specified intervals. Unless specified otherwise, flush and clean diesel fuel tank every 1000 hours or 5 years, whichever occurs first.

Lubrication

Steering System

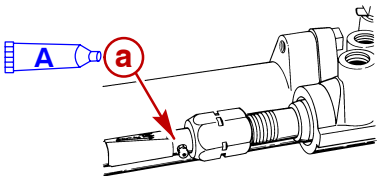


WARNING

Do not grease steering cable while extended. Hydraulic lock could occur and cause loss of steering control.

1. **If Steering Cable Has Grease Fittings:** Turn steering wheel until steering cable is fully retracted into cable housing. Apply approximately 3 pumps of grease from a typical hand-operated grease gun.

NOTE: *If steering cable does not have grease fitting, inner wire of cable cannot be greased.*

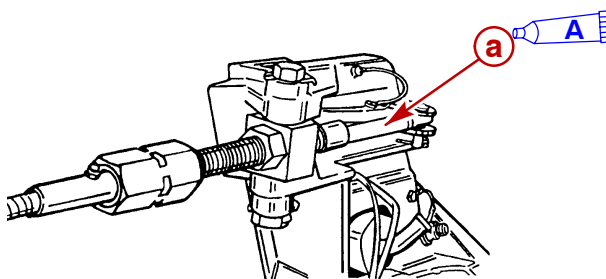


71903

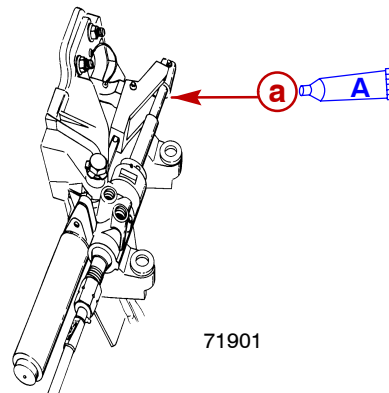
a - Steering cable grease fitting

Description		Where Used	Part Number
A	2-4-C with Teflon	Steering cable	92-802859A1

2. Turn steering wheel until steering cable fully extended. Lightly lubricate the exposed part of cable.



70373

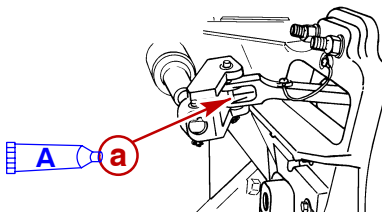
Without power steering**a** - Extended steering cable

71901

With power steering

Description	Where Used	Part Number
A Special Lubricant 101	Steering cable	92-802865A1

3. Lubricate the steering system pivot points.



71904

a - Steering system pivot points

Description	Where Used	Part Number
A SAE 30W Engine Oil	Pivot points	Obtain Locally

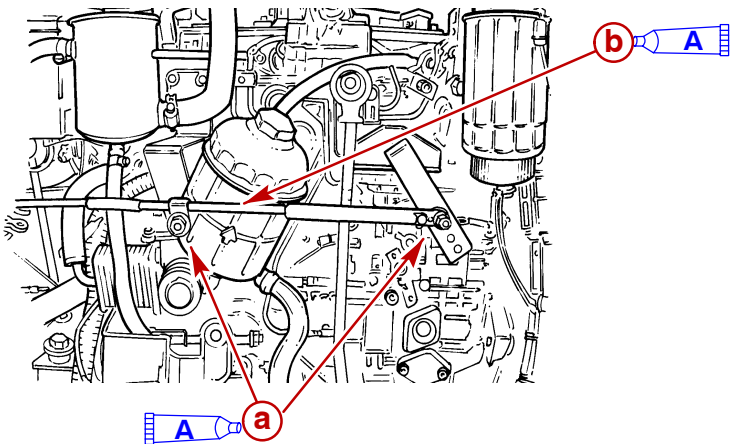
4. On dual engine boats: Lubricate the tie bar pivot points.

Description	Where Used	Part Number
SAE 30W Engine Oil	Pivot points	Obtain Locally

5. Upon first starting engine, turn steering wheel several times to starboard and then port to ensure that the steering system operates properly before getting underway.

Throttle Cable

1. Lubricate the pivot points and the guide contact surfaces.



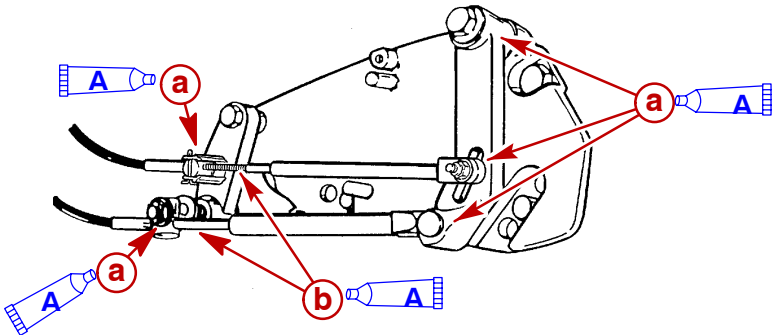
77312

- a - Pivot points
b - Guide contact surfaces

Description		Where Used	Part Number
A	SAE 30W Engine Oil	Pivot points, guide contact surfaces	Obtain Locally

Shift Cable

1. Lubricate the pivot points and the guide contact surfaces.



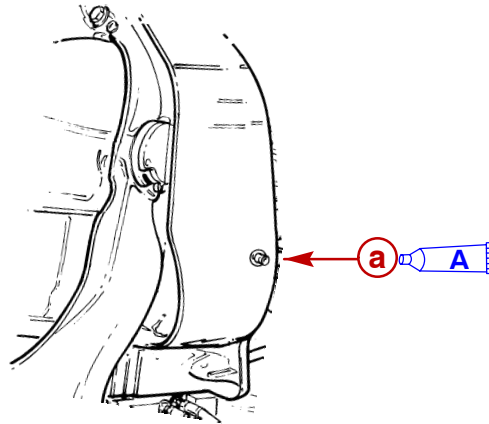
22245

- Typical
a - Pivot points
b - Guide contact surfaces

Description		Where Used	Part Number
A	SAE 30W Engine Oil	Pivot points, guide contact surfaces	Obtain Locally

Sterndrive Unit and Transom Assembly

1. Lubricate gimbal bearing through grease fitting by applying approximately 8-10 pumps of grease from a typical hand-operated grease gun.



77068

a - Gimbal bearing grease fitting

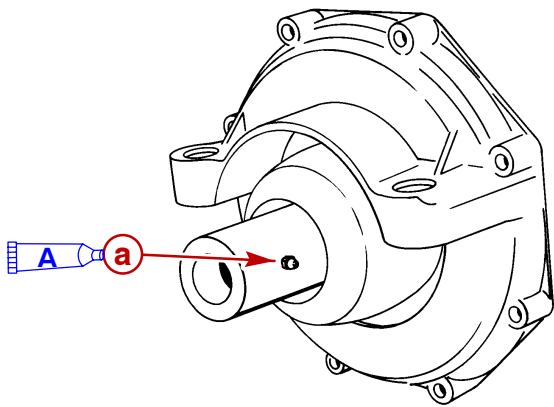
Description		Where Used	Part Number
A	U-joint And Gimbal Bearing Grease	Gimbal bearing	92-802870A1

2. For propeller shaft lubrication, refer to **Propeller**.

Engine Coupler

- 1. Lubricate engine coupler splines through grease fittings on coupler by applying approximately 8-10 pumps of grease from a typical hand-operated grease gun.

NOTE: If the boat is operated at idle for prolonged periods of time, coupler should be lubricated every 50 hours.



71569

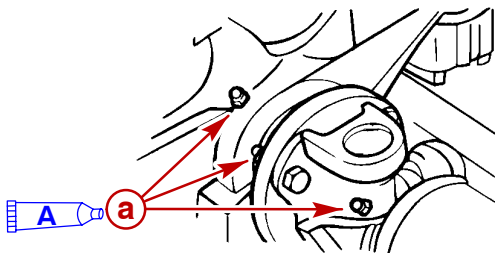
a - Engine coupler grease fitting

Description		Where Used	Part Number
A	Engine Coupler Spline Grease	Coupler	92-802869A1

NOTE: Alpha Models - Your power package is equipped with a sealed engine coupler and Perm-a-Lube U-joints. The sealed coupler and shaft splines can be lubricated without removing the sterndrive unit. The Perm-a-Lube U-joints do not require lubrication.

Drive Shaft Extension Models

1. Lubricate drive shaft grease fittings, at transom end, by applying approximately 10 - 12 pumps of grease from a typical hand-operated grease gun.

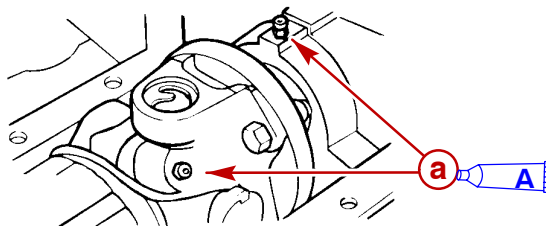


71346

a - Grease fitting locations

Description	Where Used	Part Number
A U-joint and Gimbal Bearing Grease	Drive shaft U-joints	92-802870A1

2. Lubricate drive shaft grease fittings, at engine end, by applying approximately 3 - 4 pumps of grease from a typical hand-operated grease gun.



71347

a - Grease fitting locations

Description	Where Used	Part Number
A U-joint and Gimbal Bearing Grease	Drive shaft U-joints	92-802870A1

Propellers

Alpha

⚠ WARNING

Avoid Injury: Remote Control must be in NEUTRAL and ignition key removed from switch before removing and/or installing propeller.

⚠ WARNING

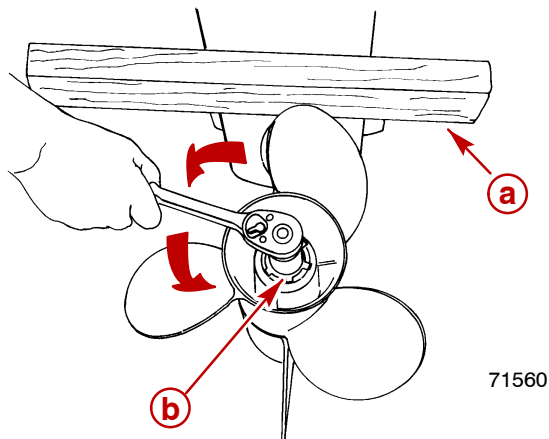
Avoid Injury: Place a block of wood between anti-ventilation plate and propeller to protect hands from propeller blades and to prevent propeller from rotating when removing propeller nut.

⚠ CAUTION

Avoid Injury: Periodically check propeller nut for tightness during boating season. A minimum of 55 lb-ft (75 Nm) torque is required.

REMOVAL

1. Place wood block between propeller blade and anti-ventilation plate to prevent rotation.
2. Straighten bent tabs on tab washer.
3. Turn propeller shaft nut counterclockwise to remove nut.



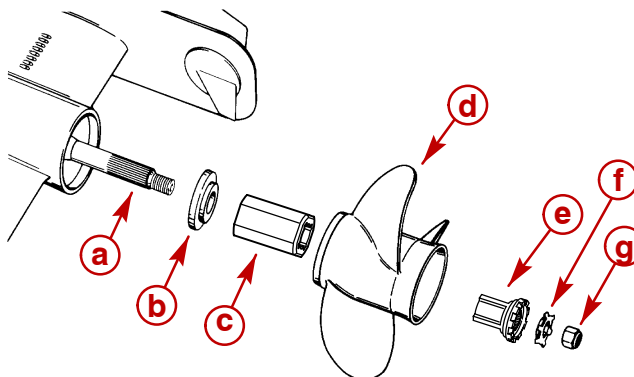
- a** - Wood block
b - Tab washer

4. Slide tab washer, drive sleeve, propeller and thrust hub off propeller shaft.

REPAIR

Some damaged propellers can be repaired. Contact your authorized Cummins MerCruiser Diesel dealer / distributor.

INSTALLATION



76910

- a** - Propeller shaft
- b** - Thrust hub
- c** - Flo-Torque II drive hub
- d** - Propeller
- e** - Drive sleeve
- f** - Locking tab washer
- g** - Propeller nut

IMPORTANT: If reusing tab washer, carefully inspect tabs for cracks or other damage. Replace tab washer if condition is questionable.

1. Apply a liberal coat of one of the following lubricants to the propeller shaft.

Description	Where used	Part number
Anti-Corrosion Grease	Propeller shaft	92-802867A1
Special Lubricant 101		92-802865A1
2-4-C with Teflon		92-802859A1

2. Slide thrust hub onto propeller shaft, with stepped side toward propeller hub.
3. Install Flo-Torque II Drive Hub into propeller.

NOTE: The drive sleeve is tapered and will slide fully into the propeller as the nut is tightened and properly torqued.

4. Align splines and place propeller on propeller shaft.
5. Install drive sleeve and locking tab washer.
6. Install and torque the propeller nut.

Description	Nm	lb-in.	lb-ft
Propeller Nut ¹	75		55

¹ The propeller torque stated is a minimum value and is required.

7. Bend three tabs on the tab washer down into the grooves in spline washer. After the first use, bend the three tabs straight and retorqued the propeller nut. Bend tabs back down into spline washer. Check propeller at least after 20 hours of operation. Do not operate with loose propeller.

Drive Belts

All drive belts must be periodically inspected for tension and condition (excessive wear, cracks, fraying, or glazed surfaces).

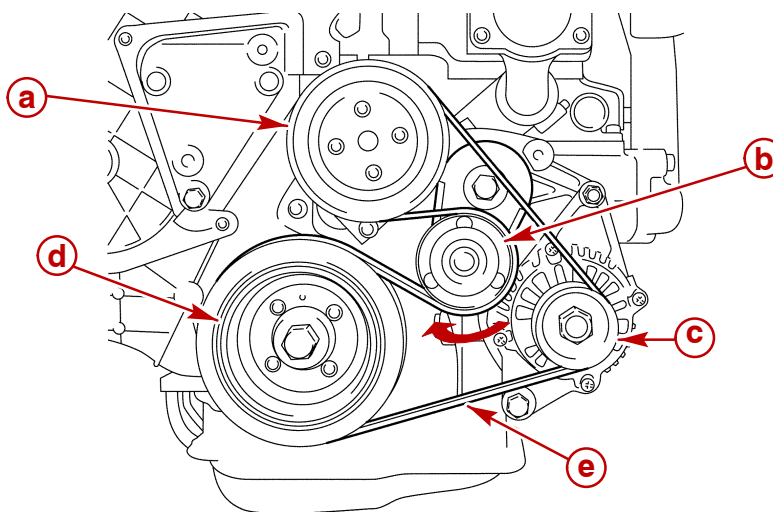
If any drive belts need replacement or tension needs adjustment, see your authorized Cummins MerCruiser Diesel dealer / distributor.

WARNING

Avoid possible serious injury. Make sure engine is shut off and ignition key is removed before inspecting belts.

Checking Serpentine Belt

1. The various components are:



77139

Typical

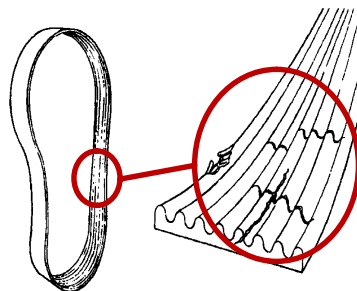
- a** - Water circulating pump pulley
- b** - Automatic tensioner pulley
- c** - Alternator pulley
- d** - Crankshaft pulley
- e** - Serpentine belt

2. Inspect serpentine belt for proper tension and for the following:

- Excessive wear
- Cracks

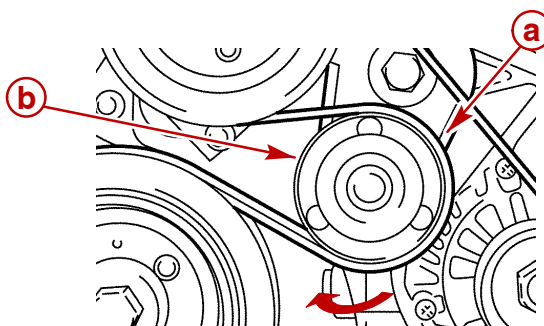
NOTE: Minor, transverse cracks (across the belt width) may be acceptable. Longitudinal cracks (in direction of belt length) that join transverse cracks are NOT acceptable.

- Fraying
- Glazed surfaces
- Proper tension



75130

3. Check operation of the automatic tensioner and associated components. Move tensioner pulley in direction of arrow (position a suitable tool on pulley fastener and rotate). Release and allow to glide back slowly. Tensioner must return to its initial position.

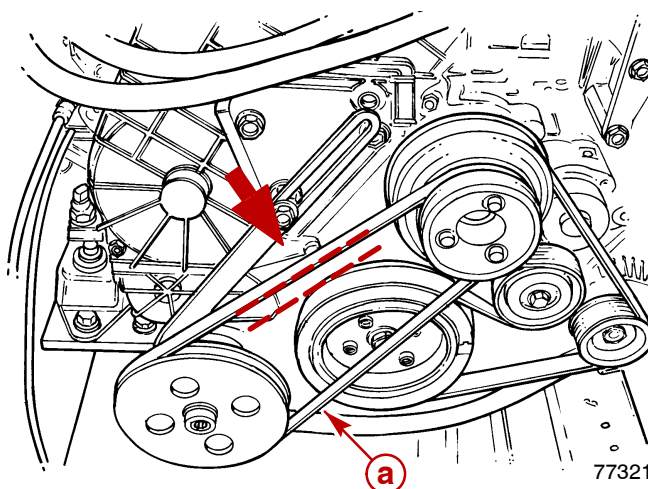


77139

- a** - Serpentine belt
b - Automatic tensioner

Checking Power Steering Pump Belt

1. Inspect power steering belt for proper tension and for the following:
 - Excessive wear
 - Cracks
 - Fraying
 - Glazed surfaces
 - Proper tension
2. Check tension by depressing upper strand of power steering belt, with light thumb pressure (approximately 5 kgf [11 lbf]), at point shown. Belt should move no more than 5 mm (3/16 in.) either way.

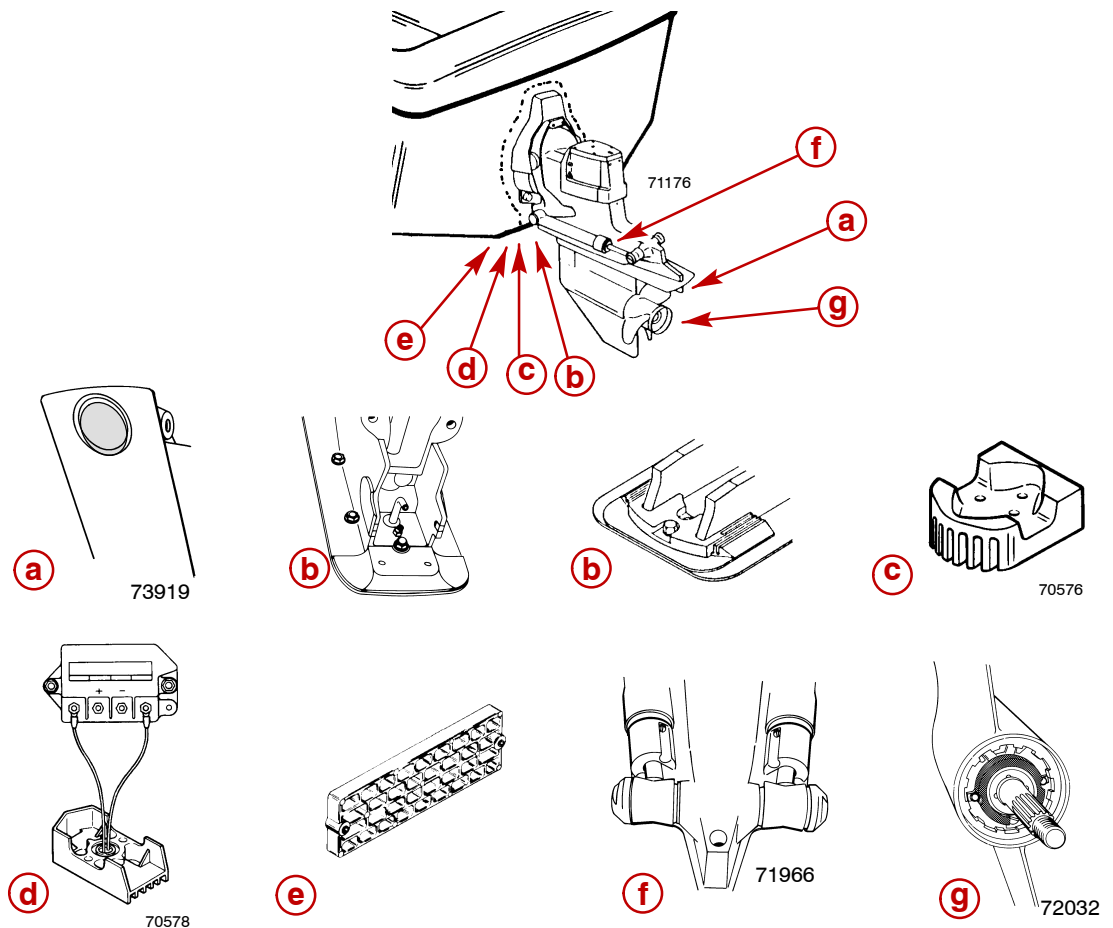


a - Power steering pump belt

Corrosion Protection

External Components

Whenever 2 or more dissimilar metals (like those found on the sterndrive) are submerged in a conductive solution, such as saltwater, polluted water or water with a high mineral content, a chemical reaction takes place causing electrical current to flow between metals. The electrical current flow causes the metal that is most chemically active, or anodic, to erode. This is known as galvanic corrosion and, if not controlled, it will in time cause the need for replacement of power package components exposed to water. Refer to the **Marine Corrosion Protection Guide** (90-88181301).



- a** - Universal anodic plate
- b** - Anodic plate
- c** - Block
- d** - MerCathode system

- e** - Anode kit
- f** - Trim cylinder anodes
- g** - Bearing carrier anode

IMPORTANT: Replace sacrificial anodes if eroded 50 percent or more.

Universal Anodic Plate - serves as a sacrificial anode.

Anodic Plate - serves as a sacrificial anode.

Block (if equipped) - Is mounted to underside of gimbal housing and serves as a sacrificial anode.

MerCathode System (if equipped) - Electrode assembly replaces Anodic block. System should be tested to ensure adequate output. The test should be performed where boat is moored, using Quicksilver Reference Electrode and Test Meter. Contact your authorized Cummins MerCruiser Diesel dealer / distributor.

Anode Kit (if equipped) - Mounted to boat transom. Acts as a sacrificial anode.

Trim Cylinder Anodes - are mounted on each trim cylinder.

Bearing Carrier Anode - is located in front of the propeller, between the front side of the propeller and the gear housing.

In addition to the corrosion protection devices, the following steps should be taken to inhibit corrosion:

1. Paint your power package, refer to **Painting Your Power Package**.
2. Spray power package components on inside of boat annually with Corrosion Guard to protect finish from dulling and corrosion. External power package components may also be sprayed.
3. All lubrication points, especially steering system, shift and throttle linkages, should be kept well lubricated.
4. Flush cooling system periodically, preferably after each use.

Internal Components

There are anodes as part of the aftercooler and heat exchanger systems, which serve as sacrificial anodes.

These sacrificial anodes are installed in the seawater circuit to help avoid electrolytic corrosion caused by seawater.

Sacrificial anode locations:

- Front and rear of the heat exchanger.
- Two on the aftercooler.

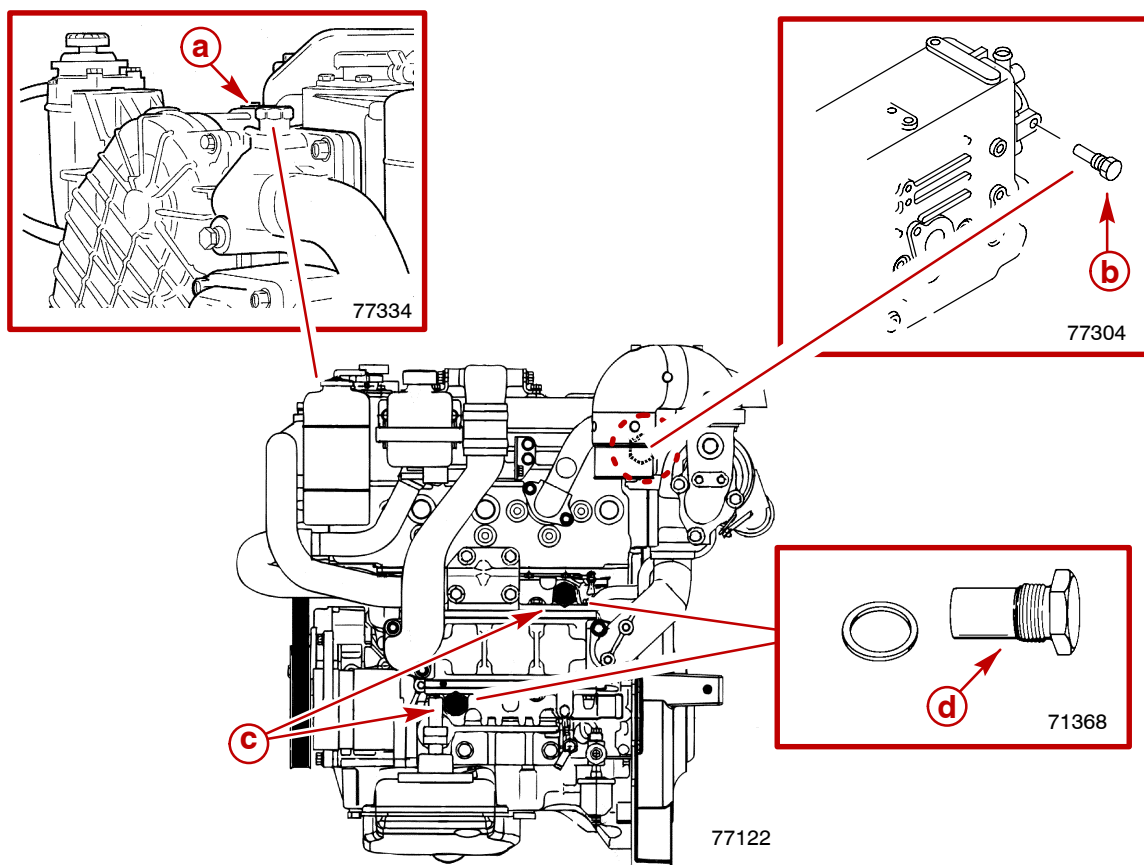
REMOVAL

1. Allow the engine to cool.

CAUTION

When removing anode plugs, close seacock, if equipped. If boat is not equipped with a seacock, remove and plug seawater inlet hose to prevent a siphoning action that may occur, allowing seawater to flow from the anode plug holes .

2. With engine off, close seacock (if equipped) or remove and plug seawater inlet hose if no seacock exists.
3. Remove anode plugs and sacrificial anodes.



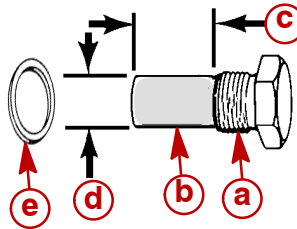
- a** - Front heat exchanger anode
- b** - Rear heat exchanger anode
- c** - Aftercooler anodes
- d** - Anode Plug And Sacrificial Anode

INSPECTION

Inspection and replacement interval will vary depending on the condition of seawater and mode of engine operation.

NOTE: Remove deposits from surface of anode before trying to determine amount of erosion.

1. Replace anode assembly when deteriorated 50%.
 - Length When New - 32 mm (1-1/4 in.)
 - Diameter When New - 15 mm (5/8 in.)
2. Discard sealing washer.



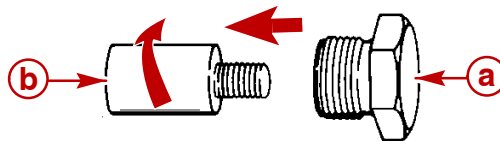
71368

- a** - Anode plug
- b** - Sacrificial anode
- c** - Length
- d** - Diameter
- e** - Sealing washer

REPAIR

NOTE: Sacrificial anodes are available as an assembly. Replace both the plug and anode, if so desired.

1. Unscrew sacrificial anode from anode plug by holding plug hex head and turning anode.

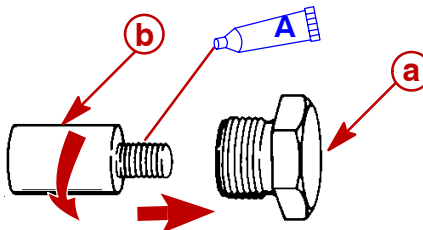


71367

- a** - Plug
- b** - Anode

2. Clean interior threads of anode plug.

3. Apply sealant to threads of new sacrificial anode and install into anode plug. Tighten securely.



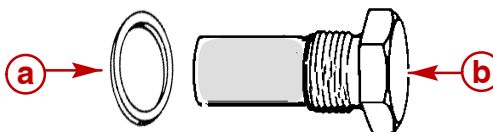
71367

- a** - Plug
b - Anode

Description	Where Used	Part Number
A Loctite 567 PST Pipe Sealant	Threads of anode plug	92-809822

INSTALLATION

1. Install new sealing washer.
2. Install anode plug with sacrificial anode.



71368

- a** - Sealing washer
b - Anode plug

3. Unplug and connect seawater inlet hose, or open seacock if equipped.

CAUTION

Avoid seawater pump impeller damage. Do not operate the engine without cooling water being supplied to the seawater pickup pump.

4. Ensure that the seawater pickup pump is supplied cooling water.
5. Start the engine and check for leaks.

Painting Your Power Package

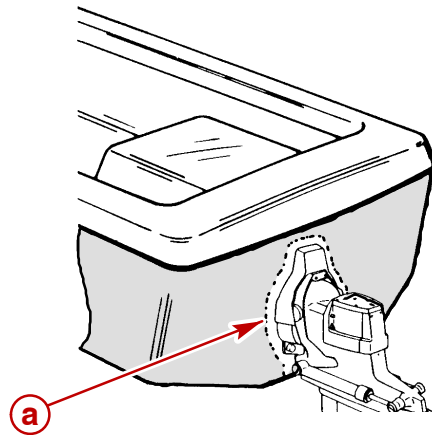
IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint will not be covered by the limited warranty.

1. **Painting Boat Hull or Boat Transom:** Anti-fouling paint may be applied to boat hull and boat transom but you must observe the following:

IMPORTANT: Do not paint anodes or MerCathode System reference electrode and anode, as this will render them ineffective as galvanic corrosion inhibitors.

IMPORTANT: If anti-fouling protection is required for boat hull or boat transom, copper or tin base paints, if not prohibited by law, can be used. If using copper or tin based anti-fouling paints, observe the following:

- Avoid any electrical interconnection between the Cummins MerCruiser Diesel Product, Anodic Blocks, or MerCathode System and the paint by allowing a minimum of 40 mm (1-1/2 in.) unpainted area on transom of the boat around these items.



71176

a - Unpainted area on transom

2. **Painting Sterndrive Unit or Transom Assembly:** Sterndrive unit and transom assembly should be painted with a good quality marine paint or an anti-fouling paint that does not contain copper, or any other material that could conduct electrical current. Do not paint drain holes, anodes, MerCathode system, and items specified by boat manufacturer.

Seawater System

Draining Instructions

⚠ CAUTION

Ensure that the boat is out of the water or seacock is closed and bilge pump is operating before beginning procedure. Excess water in bilge can damage engine or cause boat to sink.

⚠ CAUTION

Do not operate engine with drain system open. Excess water in bilge can damage engine or cause boat to sink.

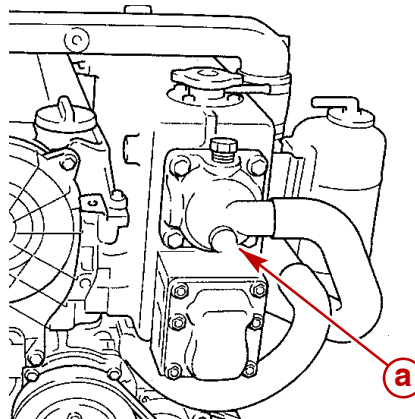
IMPORTANT: Boat must be as level as possible to ensure complete draining of cooling system.

1. Ensure engine is as level as possible to ensure complete draining of seawater cooling system.
2. Close seacock, if equipped, or disconnect and plug seawater inlet hose, if boat is to remain in the water.

⚠ CAUTION

Avoid damage to heat exchanger and subsequent possible engine damage. Remove all water from heat exchanger sections. Failure to do so could cause corrosion or freeze damage to heat exchanger water passage tubes.

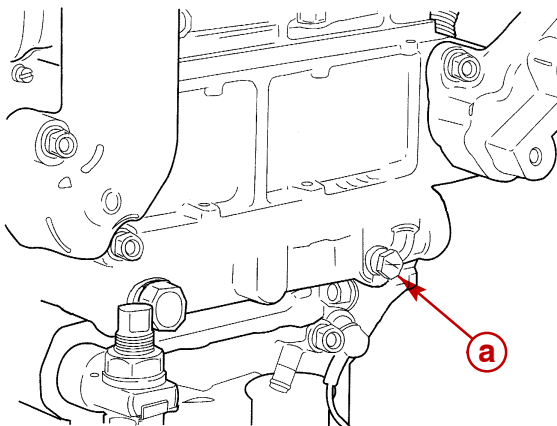
3. Remove drain plug from front cover of heat exchanger.



a - Drain plug

77144

4. Remove drain plug from lower part of aftercooler.



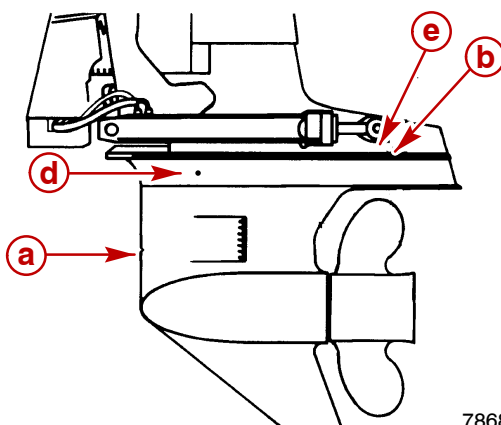
77338

a - Drain plug

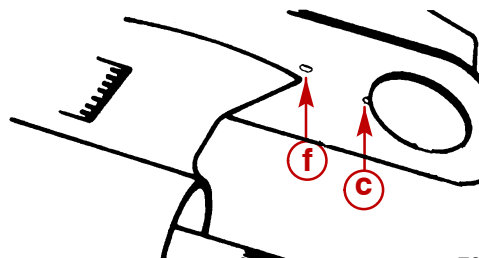
5. Repeatedly clean out drain holes using a stiff piece of wire. Do this until the entire seawater system is drained.
6. After seawater section of cooling system has been drained completely, coat threads of drain plugs with sealant and reinstall. Tighten securely.

Description	Where Used	Part Number
Perfect Seal	Drain plugs	92-34227-1

7. Using a piece of wire, check water drain holes in sterndrive unit to ensure that they are open.



78680



70134

Sterndrive unit water drain holes

- a** - Speedometer pitot tube
- b** - Trim tab cavity vent hole
- c** - Trim tab cavity drain passage
- d** - Gear housing water drain hole (1 each - port and starboard)
- e** - Gear housing cavity vent hole
- f** - Gear housing cavity drain hole

Flushing The Seawater System

To prevent silt and/or salt buildup in the cooling system, flush with freshwater after each use and prior to storage.

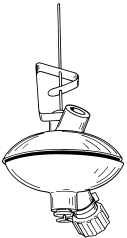
1. If flushing the cooling system with the boat in the water, raise the sterndrive unit to TRAILER position, install the flushing attachment and lower the sterndrive unit to full DOWN/IN position.

⚠ WARNING

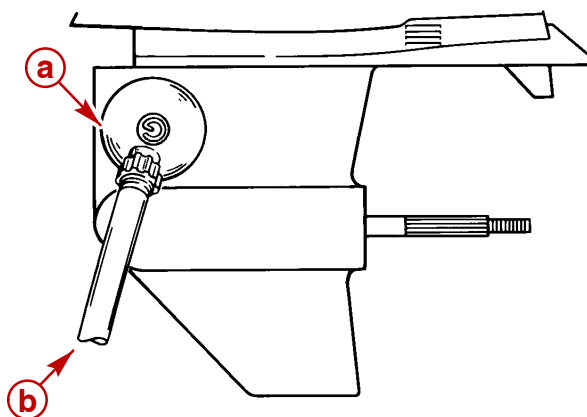
When flushing, be certain the area around propeller is clear, and no person (or animal) is standing nearby. To avoid possible injury, remove the propeller.

2. If flushing the cooling system with the boat out of the water, ensure the area around the propeller is clear and no one is standing nearby. To avoid possible injury, remove the propeller.
3. Install the Quicksilver flushing device, or equivalent, over the water intake openings in the gear housing.

Flushing Device

 <p>73440</p>	<p>Attaches to the drive unit water intakes, provides a fresh water connection when flushing the cooling system or operating the engine.</p>	<p>91-44357Q2</p>
---	--	-------------------

4. Connect a hose between the flushing device and the water source valve.



70564

- a** - Flushing device
b - Hose to water source valve

5. Lower the sterndrive unit to the full DOWN/IN position.
6. Partially open the water tap (approximately 1/2 maximum capacity). Do not use full water pressure.

⚠ CAUTION

Do not operate the engine above 1500 rpm when flushing. Suction created by the seawater pickup pump may collapse the flushing hose, causing the engine to overheat.

7. Place the drive in NEUTRAL, IDLE speed position and start the engine.

⚠ CAUTION

Watch temperature gauge on dash to ensure that engine does not overheat.

8. Operate the engine with drive in NEUTRAL, IDLE speed position, for about 10 minutes or until the discharge water is clear.
9. Slowly return the throttle to IDLE speed position.
10. Stop the engine
11. Shut off the water tap.
12. If boat is in the water, raise the sterndrive unit to the TRAILER position.
13. Remove the hose and flushing device.
14. Place the sterndrive unit in the full DOWN / IN position.

SECTION 6 - STORAGE

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Preparing Your Power Package For Seasonal or Extended Storage	111	Battery	113
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Cold Weather (Freezing Temperature), Seasonal, And Extended Storage

IMPORTANT: Cummins MerCruiser Diesel strongly recommends that this service should be performed by an authorized Cummins MerCruiser Diesel dealer / distributor. Damage caused by freezing IS NOT covered by the Cummins MerCruiser Diesel Limited Warranty.

CAUTION

Avoid cooling system and engine damage. Water trapped in the seawater section of the cooling system can cause corrosion damage, can freeze causing freeze damage, or may result in both types of damage. Ensure that the seawater section of the cooling system is drained immediately after operation or before any length of storage in cold weather if the possibility of freezing temperatures exists.

Consider a boat is in storage whenever it is not in operation. The amount of time that the power package is not operated may be for a brief period, such as during a day, overnight, for a season, or for an extended period of time. Certain precautions and procedures must be observed to protect the power package from freeze damage, corrosion damage, or both types of damage during storage.

Freeze damage can be caused when water trapped in the seawater cooling system is frozen. For example, after operating the boat, exposure to freezing temperatures for even a brief period of time could result in freeze damage.

Corrosion damage is the result of saltwater, polluted water, or water with a high mineral content trapped in the seawater cooling system. Saltwater should not stay in an engine's cooling system for even a brief storage time; drain and flush the seawater cooling system after each outing.

Cold weather operation refers to operating the boat whenever the possibility of freezing temperatures exists. Likewise, cold weather (freezing temperature) storage refers to whenever the boat is not being operated and the possibility of freezing temperatures exists. In such cases, the seawater section of the cooling system must be completely drained immediately after operation.

Seasonal storage refers to when the boat is not being operated for 1 month or more. The length of time varies depending on the geographic location of the boat in storage. Seasonal storage precautions and procedures include all of the steps for cold weather (freezing temperature) storage and some additional steps that must be taken when storage will last longer than the short time of cold weather (freezing temperature) storage.

Extended storage means storage for a period of time that may last for several seasons or longer. Extended storage precautions and procedures include all of the steps for cold weather (freezing temperature) storage and seasonal storage plus some additional steps.

Refer to the specific procedures in this **Section 6** related to the conditions and the length of storage for your application.

Cold Weather (Freezing Temperature) Storage

1. Read all precautions and perform all procedures found in **Section 5 - Draining The Seawater System** and drain the seawater section of the cooling system.

CAUTION

If boat is in the water, the seacock must remain closed until the engine is to be re-started to prevent water from flowing back into the cooling system, boat, or both. If the boat is not fitted with a seacock, the water inlet hose must remain disconnected and plugged to prevent water from flowing back into the cooling system, boat, or both.

2. Place a caution tag at the helm advising the operator to unplug and connect the water inlet hose or open the seacock, if equipped, before operating the boat.
3. For additional assurance against freezing and corrosion fill the seawater cooling system with a mixture of propylene glycol antifreeze and tap water. Refer to Seasonal Storage Instructions in this section.

Preparing Your Power Package For Seasonal or Extended Storage

CAUTION

Overheating from insufficient cooling water will cause engine and drive damage. Ensure that there is sufficient water always available at the water inlet holes during operation.

IMPORTANT: If boat has already been removed from the water, before starting the engine a source of water must be supplied to the water inlet holes. Follow all warnings and flushing attachment procedures stated in **Section 5 - Flushing The Seawater System**.

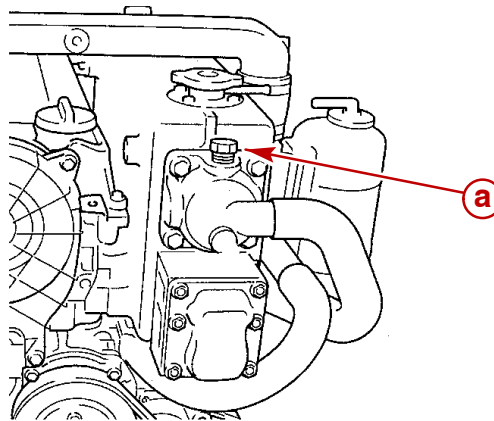
1. Supply cooling water to the water inlet holes or seawater pump inlet.
2. Start the engine and operate until it reaches normal operating temperature.
3. Stop the engine.
4. Change the engine oil and filter.
5. Start the engine and run for about 15 minutes. Check for oil leaks.
6. Flush the seawater cooling system. Refer to **Section 5 - Flushing The Seawater System**.

Seasonal Storage Instructions

1. Read all precautions and perform all procedures found in Preparing Your Power Package For Seasonal or Extended Storage.
2. Read all precautions and perform all procedures found in **Section 5 - Draining The Seawater System** and drain the seawater section of the cooling system.

IMPORTANT: Cummins MerCruiser Diesel recommends that propylene glycol antifreeze be used in seawater section of the cooling system for cold weather (freezing temperature), seasonal storage, or extended storage. Make sure that the propylene glycol antifreeze contains a rust inhibitor and is recommended for use in marine engines. Be certain to follow the propylene glycol manufacturer's recommendations.

3. Fill a container with approximately 5.6 liter (6 U.S. quarts) of propylene glycol antifreeze and tap water mixed to manufacturer's recommendation to protect engine to the lowest temperature to which it will be exposed during cold weather or extended storage.
4. Remove the anode plug from front cover of heat exchanger.



77144

a - Anode plug

NOTE: Some propylene glycol may leak from the sterndrive unit during storage. Catch the solution and dispose of properly.

5. Using a suitable funnel, slowly pour the propylene glycol antifreeze mixture through the anode plug opening and into the seawater system until system is full.
6. Install the anode plug. Tighten securely.

NOTE: Discharge of propylene glycol into the environment may be restricted by law. Dispose of propylene glycol in accordance with Federal, State, and local laws and guidelines.

7. Clean the outside of the engine and repaint any areas required with Primer and Spray Paint. After the paint has dried, coat the engine with specified corrosion inhibiting oil or equivalent.

Description	Where Used	Part Number
Corrosion Guard	Outside of engine	92-802878-55
Light gray primer		92-802878-52
Phantom Black paint		92-802878-1

8. Your Cummins MerCruiser Diesel dealer / distributor should now perform all checks, inspections, lubrication and fluid changes outlined in **Section 5 - Maintenance Schedules**.
9. Follow the battery manufacturer's instructions for storage and store the battery.

Extended Storage Instructions

IMPORTANT: Cummins MerCruiser Diesel strongly recommends that this service should be performed by an authorized Cummins MerCruiser Diesel dealer / distributor.

1. Read all precautions and perform all procedures found in Preparing Your Power Package For Seasonal Or Extended Storage.
2. Read all precautions and perform all procedures found in **Section 5 - Draining The Seawater System** and drain the seawater section of the cooling system.
3. Read all precautions and perform all procedures found in Seasonal Storage Instructions.

IMPORTANT: The seawater pump impeller material can be damaged by prolonged exposure to direct sunlight.

4. Remove the seawater pump impeller and store away from direct sunlight. Refer to an authorized Cummins MerCruiser Diesel dealer / distributor for additional information and service.
5. Place a CAUTION TAG at instrument panel and in engine compartment stating that the seawater pump impeller has been removed and to not operate the engine.

BATTERY

Follow the battery manufacturer's instructions for storage.

Power Package Recommissioning

NOTICE

Refer to Cold Weather Or Extended Storage precautions, BEFORE proceeding.

1. Ensure that all cooling system hoses are in good condition, connected properly, and hose clamps are tight.
2. Verify that all drain valves and drain plugs are installed and tight.
3. Inspect all drive belts.
4. Perform all lubrication and maintenance specified for completion Annually in Maintenance Schedule, except items that were performed at time of engine layup.
5. Fill fuel tanks with fresh diesel fuel. Old fuel should not be used. Check fuel lines and connections for leaks and general condition.
6. Replace fuel filter.
7. For sterndrive unit, refer to appropriate Mercury MerCruiser Sterndrive Service Manual.

⚠ CAUTION

When installing battery, connect POSITIVE (+) battery cable to POSITIVE (+) battery terminal FIRST, and NEGATIVE (–) battery cable to NEGATIVE (–) battery terminal LAST. If battery cables are reversed, or connection order is reversed, electrical system damage will result.

8. Install a fully charged battery. Clean the battery cable clamps and terminals. Reconnect the cables (see CAUTION listed above). Secure each cable clamp when connecting.
9. Coat terminals with a battery terminal anti-corrosion spray to help retard corrosion.

10. Perform all checks on the Operation Chart in the Starting Procedure column. Refer to **SECTION 3**.

⚠ CAUTION

Overheating from insufficient cooling water will cause engine and drive system damage. Ensure that there is sufficient water always available at water inlet openings during operation.

11. Supply cooling water to the water inlet openings.

IMPORTANT: After not having been operated for two months or longer, it is necessary to pre-lubricate the engine and turbocharger. To do this, hold the stop switch engaged while you simultaneously turn the key switch to START position for 15 seconds. This will rotate the starter motor and engine/oil pump. During this process the engine will not run because no fuel is injected. Allow the starter motor to cool down for one minute and repeat the above described process. To avoid overheating the starter motor, do not engage starter motor for more than 15 seconds each time.

12. Pre-lubricate the engine and turbocharger, if necessary. Refer to above Important information.
13. Start the engine and closely observe instrumentation. Ensure that all systems are functioning correctly.
14. Carefully inspect the engine for fuel, oil, fluid, water and exhaust leaks.
15. Inspect the steering system, shift and throttle control for proper operation.

NOTES:

SECTION 7 - TROUBLESHOOTING

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Troubleshooting Charts

Starter Motor Will Not Crank Engine, Or Cranks Slow

Possible Cause	Remedy
Battery switch turned off.	Turn switch on.
Remote control not in neutral position.	Position control lever in neutral.
Open circuit breaker or blown fuse.	Check and reset circuit breaker or replace fuse.
Loose or dirty electrical connections or damaged wiring.	Check all electrical connections and wires (especially battery cables). Clean and tighten faulty connection.
Bad battery.	Test and replace if bad.

Engine Will Not Start, Or Is Hard To Start

Possible Cause	Remedy
Lanyard stop switch activated.	Check lanyard stop switch.
Improper starting procedure.	Read starting procedure.
Empty fuel tank or fuel shut off valve closed.	Fill tank or open valve.
Throttle not operating properly.	Check throttle for freedom of movement.
Faulty electrical stop-circuit.	Have an authorized Cummins MerCruiser Diesel dealer / distributor service the electrical stop circuit.
Clogged fuel filters.	Replace filters.
Stale or contaminated fuel.	Drain tank. Fill with fresh fuel.
Fuel line or tank vent line kinked or clogged.	Replace kinked lines or blow out lines with compressed air to remove obstruction.
Air in fuel injection system	Purge fuel injection system
Faulty wire connections.	Check wire connections.
Glow-plugs or glow-plug system inoperative, if so equipped	Test, and repair or replace components
Injector / injector nozzle malfunction	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Incorrect injection timing	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.

Engine Runs Rough, Misses And/Or Backfires

Possible Cause	Remedy
Throttle not operating properly.	Check throttle linkages for binding or an obstruction. Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Idle speed too low.	Check idle speed and adjust, if necessary.
Clogged fuel or air filters.	Replace filters.
Stale or contaminated fuel.	If contaminated, drain tank. Fill with fresh fuel.
Kinked or clogged fuel line or fuel tank vent line.	Replace kinked lines or blow out lines with compressed air to remove obstruction.
Air in fuel injection system.	Purge fuel injection system.
Injector / injector nozzle malfunction	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Injection pump governor malfunction	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.

Poor Performance

Possible Cause	Remedy
Throttle not fully open	Inspect throttle cable and linkages for operation.
Damaged or improper propeller	Replace.
Excessive bilge water	Drain and check for cause of entry.
Boat overloaded or load improperly distributed	Reduce load or redistribute load more evenly.
Boat bottom fouled or damaged	Clean or repair as necessary.
Air in fuel injection system	Purge fuel injection system.
Clogged fuel or air filters	Replace filters.
Fuel leakage from overflow valve	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Incorrect valve clearance adjustment.	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Deteriorated injection pump governor spring	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Uneven fuel injection amount between cylinders.	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.
Cylinder compression pressure leakage	Have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.

Excessive Engine Temperature

Possible Cause	Remedy
Water inlet or seacock closed.	Open.
Drive belt loose or in poor condition.	Replace or adjust belt.
Seawater pickups or sea strainer obstructed.	Remove obstruction.
Faulty thermostat.	Have inspected by an authorized Cummins MerCruiser Diesel dealer / distributor.
Coolant level low in closed cooling section.	Check for cause of low coolant level and repair. Fill system with proper coolant solution.
Heat exchanger cores plugged with foreign material	Have inspected by an authorized Cummins MerCruiser Diesel dealer / distributor.
Loss of pressure in closed cooling section.	Check for leaks. Clean, inspect and test pressure cap.
Faulty seawater pickup pump.	Have inspected by an authorized Cummins MerCruiser Diesel dealer / distributor.
Seawater discharge restricted or plugged.	Have inspected by an authorized Cummins MerCruiser Diesel dealer / distributor.
Seawater inlet hose kinked (restricted)	Position hose to prevent kinking (restriction).
Use of improperly designed hose on inlet side of seawater pump allowing it to collapse.	Replace hose with wire reinforced design.

Insufficient Engine Temperature

Possible Cause	Remedy
Faulty thermostat.	Have inspected by an authorized Cummins MerCruiser Diesel dealer / distributor.

Turbocharger - Noisy Or Rough Operation

Possible Cause	Remedy
Poor lubrication / low oil pressure at turbocharger	Have inspected by an authorized Cummins MerCruiser Diesel dealer / distributor.
Entry of foreign materials from intake or exhaust side	
Rubbing of compressor or turbine impellers against housing	
Bearing failure	

Turbocharger - White Smoke

Possible Cause	Remedy
Thermal blanket at turbocharger getting hot, resulting in white smoke and burning smell from turbocharger area	This is usually normal and occurs mostly during the first hour of engine operation. If the problem persists, have inspected by an authorized Cummins MerCruiser Diesel dealer/distributor.

Low Engine Oil Pressure

Possible Cause	Remedy
Faulty senders.	Have system checked by an authorized Cummins MerCruiser Diesel dealer / distributor.
Insufficient oil in crankcase.	Check and add oil.
Excessive oil in crankcase (causing it to become aerated).	Check and remove required amount of oil. Check for cause of excessive oil (improper filling).
Diluted or improper viscosity oil.	Change oil and oil filter, using correct grade and viscosity oil. Determine cause for dilution (excessive idling).

Battery Will Not Charge

Possible Cause	Remedy
Excessive current draw from battery.	Turn off non-essential accessories.
Loose or dirty electrical connections or damaged wiring.	Check all associated electrical connections and wires (especially battery cables). Clean and tighten faulty connections. Repair or replace damaged wiring.
Alternator drive belt loose or in poor condition.	Replace serpentine belt and/or check automatic tensioner.
Unacceptable battery condition.	Test battery.

Remote Control Operates Hard, Binds, Has Excessive Free-play Or Makes Unusual Sounds

Possible Cause	Remedy
Insufficient lubrication on shift and throttle linkage fasteners.	Lubricate.
Obstruction in shift or throttle linkages.	Remove obstruction.
Loose or missing shift and throttle linkages.	Check all throttle linkages. If any are loose or missing, see an authorized Cummins MerCruiser Diesel dealer / distributor immediately.
Shift or throttle cable kinked.	Straighten cable or have an authorized Cummins MerCruiser Diesel dealer / distributor replace cable if damaged beyond repair.
Improper shift cable adjustment.	Have adjustment checked by an authorized Cummins MerCruiser Diesel dealer / distributor.

Steering Wheel Turns Hard Or Jerky

Possible Cause	Remedy
Low power steering pump fluid level.	Check for leak. Refill system with fluid.
Drive belt loose or in poor condition.	Replace and/or adjust.
Insufficient lubrication on steering components.	Lubricate.
Loose or missing steering fasteners or parts.	Check all parts and fasteners if any are loose or missing, see an authorized Cummins MerCruiser Diesel dealer / distributor.
Contaminated power steering fluid.	See an authorized Cummins MerCruiser Diesel dealer / distributor.

Power Trim Does Not Operate (Motor Does Not Operate)

Possible Cause	Remedy
Blown fuse.	Replace fuse.
Loose or dirty electrical connections or damaged wiring.	Check all associated electrical connections and wires (especially battery cables). Clean and tighten faulty connection. Repair or replace wiring.

Power Trim Does Not Operate (Motor Operates But Sterndrive Unit Does Not Move)

Possible Cause	Remedy
Trim pump oil level low.	Fill pump with oil.
Drive unit binding in gimbal ring.	Check for obstruction.

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Owner Service Assistance

Local Repair Service

Always return your Cummins MerCruiser Diesel powered boat to your authorized dealer / distributor should the need for service arise. Only the dealer / distributor has the factory trained mechanics, knowledge, special tools and equipment and the genuine Quicksilver parts and accessories* to properly service your engine should the need occur. The dealer / distributor knows your engine best.

* Quicksilver parts and accessories are engineered and built specifically for Cummins MerCruiser Diesel sterndrives and inboards.

Service Away From Home

If you are away from your local dealer and the need arises for service, contact the nearest authorized Cummins MerCruiser Diesel dealer / distributor. Refer to the yellow pages of the telephone directory or by using the service locator on the Cummins website (www.Cummins.com). If, for any reason, you cannot obtain service, contact the nearest Regional Service Center. Outside the United States and Canada, contact the nearest Marine Power International Service Center.

Stolen Power Package

If your power package is stolen, immediately advise the local authorities and Cummins MerCruiser Diesel of the model and serial numbers and to whom the recovery is to be reported. This information is placed into a file at Cummins MerCruiser Diesel to aid authorities and dealers in recovery of stolen power packages.

Attention Required After Submersion

1. Before recovery, contact an authorized Cummins MerCruiser Diesel dealer / distributor.
2. After recovery, immediate service by an authorized Cummins MerCruiser Diesel dealer / distributor is required to prevent serious damage to power package.

Replacement Service Parts

WARNING

Electrical, ignition and fuel system components on Cummins MerCruiser Diesel Engines and Sterndrives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

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

Marine engines are expected to operate at or near full throttle for most of their life. They are also expected to operate in both fresh and saltwater environments. These conditions require numerous special parts. Care should be exercised when replacing marine engine parts as specifications are quite different from those of the standard automotive engine.

Since marine engines must be capable of running at or near maximum rpm much of the time, special pistons, camshafts and other heavy-duty moving parts are required for long life and peak performance.

These are but a few of the many special modifications that are required in Cummins MerCruiser Diesel marine engines to provide long life and dependable performance.

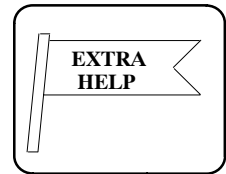
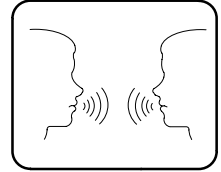
PARTS AND ACCESSORIES INQUIRIES

All inquiries concerning Quicksilver replacement parts and accessories should be directed to your local authorized dealer. The dealer has the necessary information to order parts and accessories for you should he not have them in stock. Only authorized dealers can purchase genuine Quicksilver parts and accessories from the factory. Cummins MerCruiser Diesel does not sell to unauthorized dealers or retail customers. When inquiring on parts and accessories, the dealer requires the **engine model** and **serial numbers** to order the correct parts.

Resolving A Problem

Satisfaction with your Cummins MerCruiser Diesel product is very important to your dealer and to us. If you ever have a problem, question or concern about your power package, contact your authorized Cummins MerCruiser Diesel dealer / distributor. If additional assistance is required, take these steps:

1. Talk with the dealership's sales manager or service manager. If this has already been done, then contact the owner of the dealership.
2. Should you have a question, concern or problem that cannot be resolved by your dealership, please contact your local distributor of Cummins MerCruiser Diesel products for assistance. The distributor will work with you and your dealership to resolve all problems.



The following information will be needed by the service office:

- Your name and address
- Daytime telephone number
- Model and serial numbers for your power package
- The name and address of your dealership
- Nature of problem

The distributor for your area can be found by using the service locator on the Cummins website (www.Cummins.com) or by contacting CMD sales or service listed in the yellow pages of the telephone directory.

Customer Service Literature

English Language

English language publications are available from:

Mercury Marine
Attn: Publications Department
W6250 West Pioneer Road
P.O. Box 1939
Fond du Lac, WI 54935-1939

Outside the United States and Canada, contact the nearest Mercury Marine or Marine Power International Service Center for further information.

When ordering be sure to:

- List your product, model, year and serial numbers.
- Check the literature and quantities you want.
- Enclose full remittance in check or money order (NO COD).

Other Languages

To obtain an Operation, Maintenance and Warranty Manual in another language, contact the nearest Mercury Marine or Marine Power International Service Center for information. A list of part numbers for other languages is provided with your power package.

Andre sprog

Kontakt det nærmeste Mercury Marine eller Marine Power International servicecenter for oplysninger om hvordan du kan anskaffe en Betjenings- og vedligeholdelsesmanual på et andet sprog. En liste med reservedelsnumre for andre sprog leveres sammen med din power-pakke.

Andere talen

Voor het verkrijgen van een Handleiding voor gebruik en onderhoud in andere talen dient u contact op te nemen met het dichtstbijzijnde internationale servicecentrum van Mercury Marine of Marine Power voor informatie hierover. Een lijst met onderdeelnummers voor andere talen wordt bij uw motorinstallatie geleverd.

Muut kiolet

Saadaksesi Käyttö- ja huolto-ohjekirjoja muilla kielillä, ota yhteys lähimpään Mercury Marine tai Marine Power International huoltokeskukseen, josta saat lähempiä tietoja. Moottorisi mukana seuraa monikielinen varaosanumeroluettelo.

Autres langues

Pour obtenir un Manuel d'utilisation et d'entretien dans une autre langue, contactez le centre de service après-vente international Mercury Marine ou Marine Power le plus proche pour toute information. Une liste des numéros de pièces en d'autres langues accompagne votre bloc-moteur.

Andere Sprachen

Um eine Betriebs– und Wartungsanleitung in einer anderen Sprache zu erhalten, wenden Sie sich an das nächste Mercury Marine oder Marine Power International Service Center. Eine Liste mit Teilenummern für Fremdsprachen ist im Lieferumfang Ihres Motors enthalten.

Altre lingue

Per ottenere il manuale di funzionamento e manutenzione in altra lingua, contattate il centro assistenza internazionale Mercury Marine o Marine Power più vicino. In dotazione con il gruppo motore, viene fornito l'elenco dei codici prodotto dei componenti venduti all'estero.

Andre språk

Ytterligere informasjon om bruks– og vedlikeholdshåndbok på andre språk kan fås ved henvendelse til nærmeste internasjonale servicecenter for Mercury Marine eller Marine Power. En liste over delenumre for andre språk følger med aggregatet.

Outros Idiomas

Para obter um Manual de Operação e Manutenção em outro idioma, contate o Centro de Serviço Internacional de “Marine Power” (Potência Marinha) ou a Mercury Marine mais próxima para obter informações. Uma lista de números de referência para outros idiomas é fornecida com o seu pacote de propulsão.

Otros idiomas

Para obtener un Manual de operación y mantenimiento en otro idioma, póngase en contacto con el centro de servicio más cercano de Mercury Marine o Marine Power International para recibir información. Con su conjunto motriz se entrega una lista de los números de pieza para los otros idiomas.

Andra språk

För att få Instruktions– och underhållsböcker på andra språk, kontakta närmaste Mercury Marine eller Marine Power International servicecenter, som kan ge ytterligare information. En förteckning över artikelnummer på andra språk medföljer ditt kraftpaket.

Άλλες γλώσσες

Για να αποκτήσετε ένα Εγχειρίδιο Λειτουργίας και Συντήρησης σε άλλη γλώσσα, επικοινωνήστε με το πλησιέστερο Διεθνές Κέντρο Σέρβις της Mercury Marine ή της Marine Power για πληροφορίες. Το πακέτο ισχύος σας συνοδεύεται από έναν κατάλογο αριθμών παραγγελίας για άλλες γλώσσες.

Ordering Literature




Before ordering literature, please have the following information about your power package available:

Model _____ Horsepower _____
Serial Number _____ Year _____

United States and Canada

For information on additional literature that is available for your particular Cummins MerCruiser Diesel power package and how to order that literature contact your nearest Cummins MerCruiser Diesel dealer / distributor or contact:

Mercury Marine

Telephone 	Fax 	Mail 
(920) 929-5110	(920) 929-4894	Mercury Marine Attn: Publications Department P.O. Box 1939 Fond du Lac, WI 54935-1939

Outside The United States and Canada

Contact your nearest authorized Cummins MerCruiser Diesel dealer / distributor or Marine Power Service Center for information on additional literature that is available for your particular Cummins MerCruiser Diesel power package and how to order that literature.

NOTES: