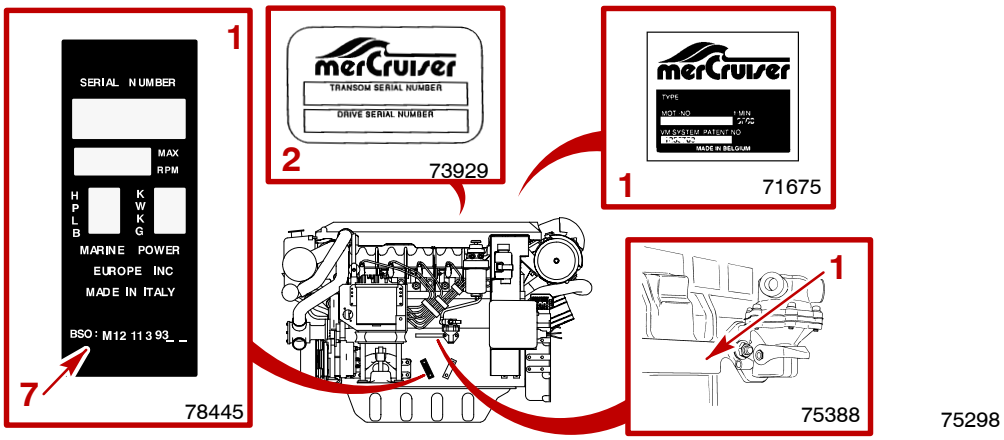
2.8 And 4.2 Diesel Sterndrive Models

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.

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.

We strongly recommend that other occupants be instructed on proper starting and operation procedures so they will be prepared should they be required to operate the power package and boat in an emergency.

⚠ 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.

SECTION 1 - WARRANTY

SECTION 2 - GETTING TO KNOW YOUR POWER PACKAGE

SECTION 3 - ON THE WATER

SECTION 4 - SPECIFICATIONS

SECTION 5 - MAINTENANCE

SECTION 6 - STORAGE

SECTION 7 - TROUBLESHOOTING

SECTION 8 - CUSTOMER ASSISTANCE INFORMATION

SECTION 1 - WARRANTY

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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

Mercury Marine 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 Mercury Marine to distribute the product in the country in which the sale occurred, and then only after the Mercury Marine 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 Mercury Marine. Routine maintenance outlined in the Operation, Maintenance and Warranty Manual must be timely performed in order to obtain warranty coverage. Mercury Marine reserves the right to make any warranty coverage contingent upon proof of proper maintenance.

WHAT MERCURY WILL DO

Mercury'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 Mercury 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 Mercury 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 Mercury dealer authorized to service the product. If purchaser cannot deliver the product to such a dealer, written notice must be given to Mercury. 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 Mercury, ship the product or parts of the product directly to Mercury. 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 run in its recommended RPM range (see the Operation, Maintenance And Warranty Manual), 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 Mercury 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 Mercury Marine authorized dealers, has been given authority by Mercury Marine 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 Mercury Marine.

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.

Light Duty Commercial Use Diesel Limited Warranty

WHAT IS COVERED

Mercury Marine warrants its new products to be free of defects in material and workmanship during the period described below

DURATION / DESCRIPTION OF COVERAGE

This Limited Warranty provides coverage from the date the product is first sold to a retail customer, or the date on which the product is first put into service, whichever occurs first. The warranty provides coverage for a period of one year, or the accumulation of 500 hours of operation, whichever occurs first. 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. Light duty commercial use is defined as annual operation not to exceed 500 hours, operation of the product at full rated power at maximum rated rpm for less than 10% of total operation time, and continuous cruising rpm is limited to no greater than 90% of wide open throttle rpm (see the Operation, Maintenance and Warranty Manual for further discussion and examples, incorporated by reference into this limited warranty statement, of light duty commercial operation). Operation of the product in excess of the light duty commercial specifications will void the warranty. 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 to a subsequent purchaser upon proper re-registration of the product.

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 Mercury Marine to distribute the product in the country in which the sale occurred, and then only after the Mercury Marine 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 Mercury Marine. Routine maintenance outlined in the Operation, Maintenance and Warranty Manual must be timely performed in order to obtain warranty coverage. If this maintenance is performed by the retail customer Mercury Marine reserves the right to make future warranty coverage contingent on proof of proper maintenance.

WHAT MERCURY WILL DO

Mercury'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 Mercury 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 Mercury 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 Mercury dealer authorized to service the product. If purchaser cannot deliver the product to such a dealer, written notice must be given to Mercury. 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 Mercury, ship the product or parts of the product directly to Mercury. 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 run in its recommended RPM range (see the Operation, Maintenance, And Warranty Manual), 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 Mercury 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 Mercury Marine authorized dealers, has been given authority by Mercury Marine 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 Mercury Marine.

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 which 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 which are not manufactured or sold by us. Failures which 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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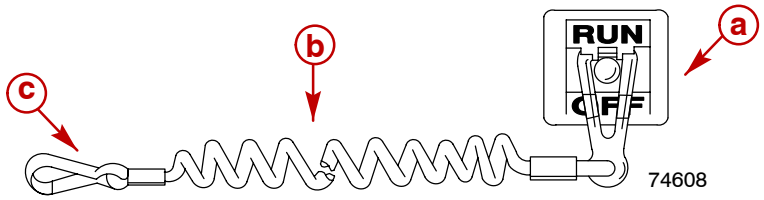
Features And Controls

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 1.2 - 1.5 m (4 - 5 ft) 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.

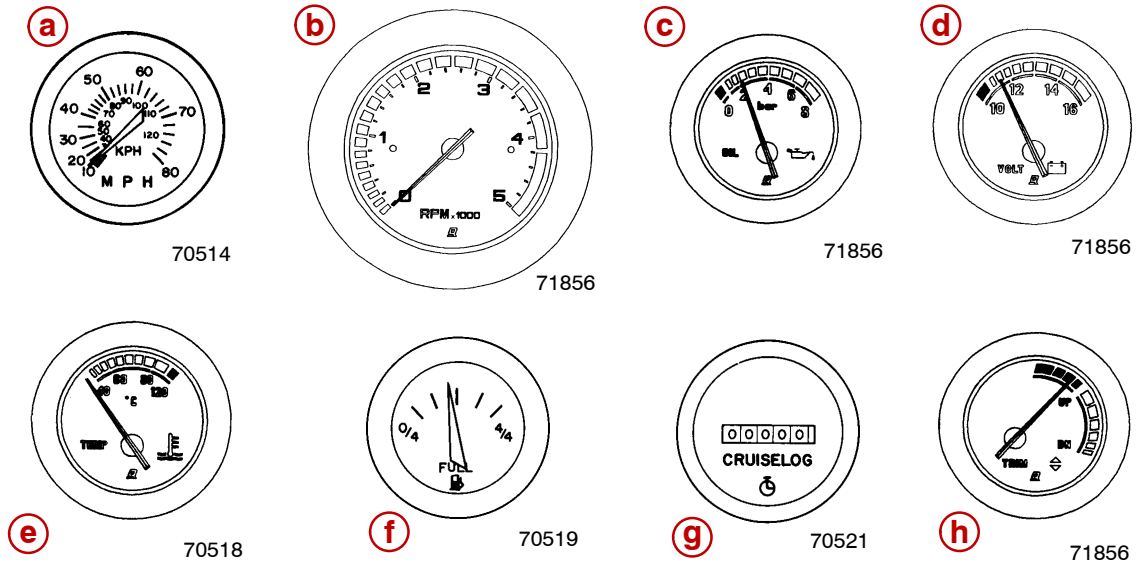
⚠ WARNING

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.



a - Speedometer
b - Tachometer
c - Oil pressure gauge
d - Battery meter
e - Coolant temperature gauge
f - Fuel gauge
g - Hour 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.

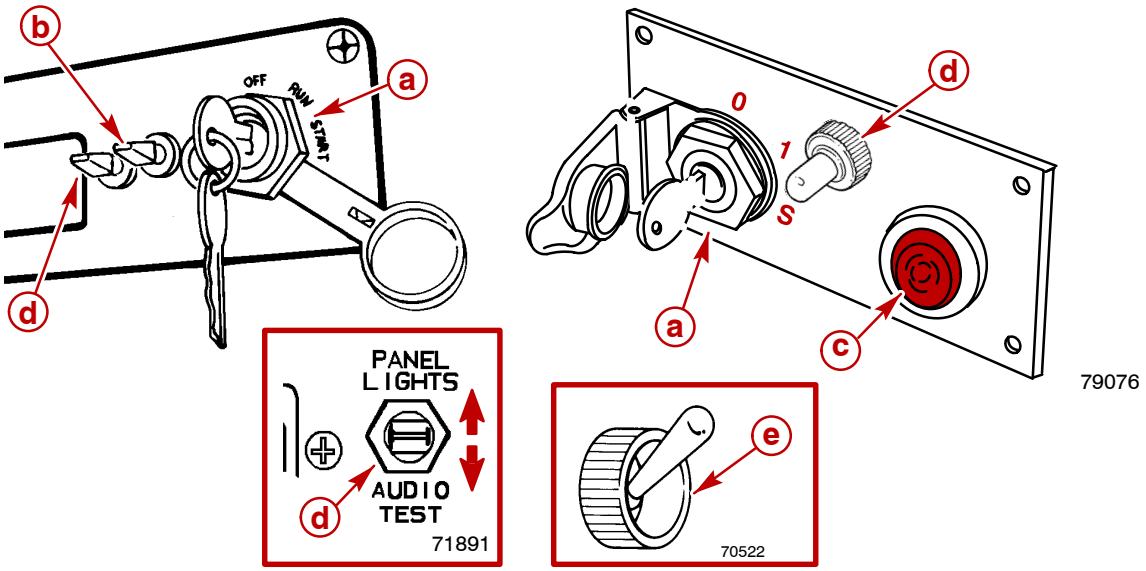
Coolant Temperature Gauge: Indicates engine operating temperature.

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, if equipped
- **c** - Engine stop switch - push button, if equipped
- **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, except on D-Tronic engines. On all engines except D-Tronic engines, 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.*

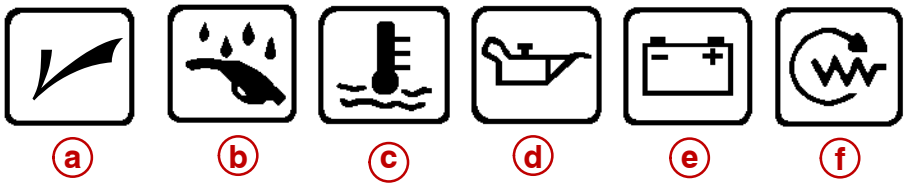
Engine Stop Switch (not present on D-Tronic engines) - is used to stop the engine. This is done by electrically shutting off the fuel delivery system. The switch, toggle or push-button, is either toggled DOWN or pressed IN. Engage and hold the stop switch until the engine stops completely. Then, turn 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.

ENGINE MONITORING FEATURES



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a - Malfunction indicator lamp (D-Tronic engines)
b - Water-in-fuel warning lamp
c - Coolant temperature warning lamp
d - Oil pressure warning lamp
e - Charge indicator lamp
f - Preheat indicator lamp

The appropriate light functions as follows:

Malfunction Indicator Lamp (MIL), D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300 Only - additional lamp indicates when a problem exists, or a malfunction has occurred, that requires service.

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.*

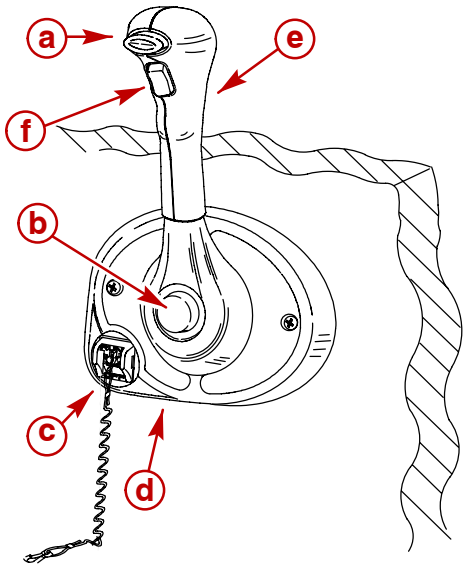
Charge Indicator Lamp - indicates a problem with charging system if lamp illuminates while engine is operating. Lamp will be on when key switch is in RUN and engine is not operating. When engine starts, light should go off.

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.

PANEL MOUNTED



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

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.

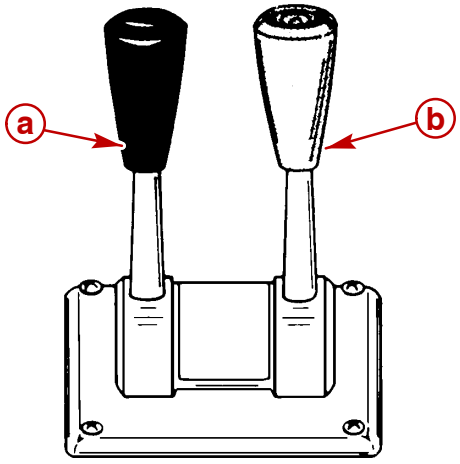
Trim/Tilt Button - Refer to Power Trim.

CONSOLE MOUNTED

⚠ CAUTION

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

IMPORTANT: Boats equipped with dual power packages may have both shift levers on 1 control and both throttle levers on the other control.



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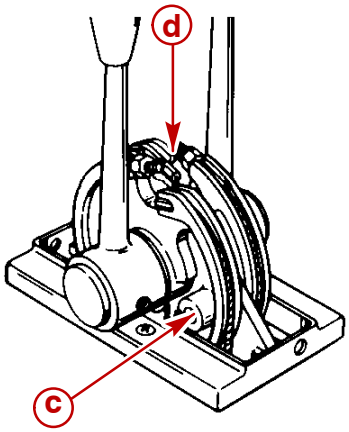

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a - Shift lever
b - Throttle lever
c - Friction screw
d - Detent screw

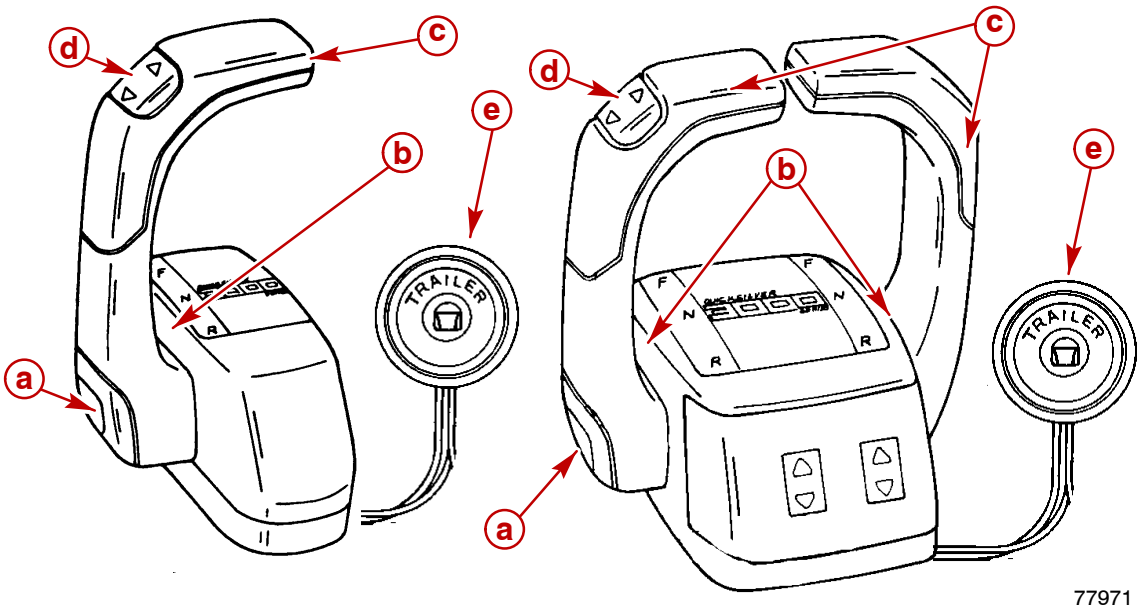
Shift Lever - shifts unit into gear with full lever movement. Move lever forward to shift to FORWARD gear. Move lever backward to shift to REVERSE gear. Lever in full vertical position shifts to NEUTRAL.

Throttle Lever - allows engine rpm to be increased or decreased.

Friction Screw - adjusts control handle friction so motor speed can be set and driver does not have to hold handle. Turn screw clockwise to increase friction. Do NOT thread screw all the way out.

Detent Screw - controls the effort needed to move control handle out of NEUTRAL. To increase tension, turn screw clockwise; to decrease, turn screw counterclockwise. Do NOT thread screw all the way out.

CONSOLE MOUNTED



a - Throttle only button
b - Control handle tension adjustment screw
c - Control handles
d - Power Trim switch
e - Trailer switch

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. See Power Trim for detailed trailer switch operation.

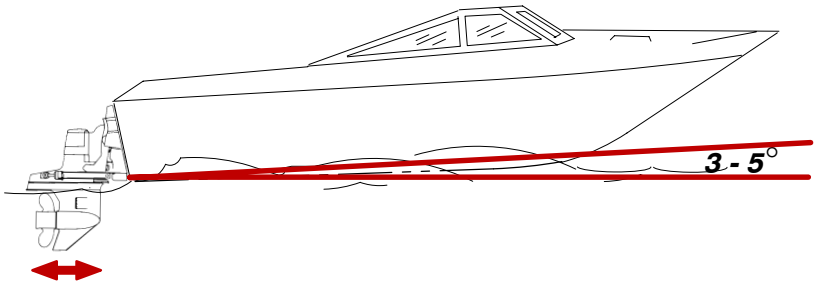
Power Trim

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 Trailering 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

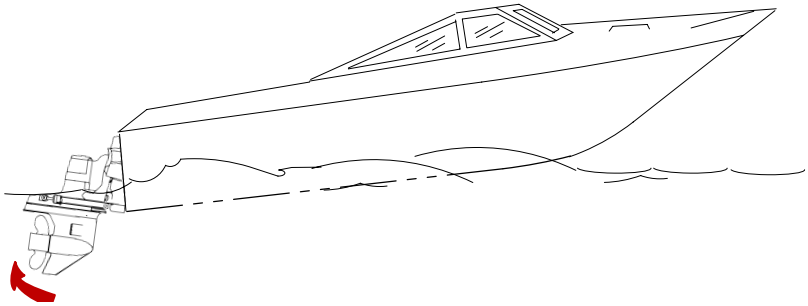
Never trim the sterndrive unit UP/OUT using TRAILER switch while boat is underway at engine speeds above 1200 rpm. Use extreme caution when operating with sterndrive unit raised. Severe damage to the sterndrive unit may result if unit is raised beyond the gimbal ring support flanges at engine speeds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



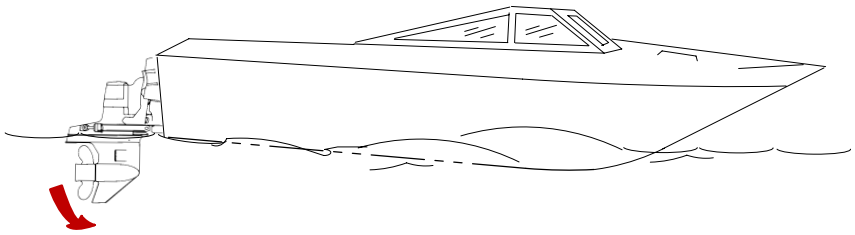
Trimming sterndrive unit UP/OUT can:

- 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.

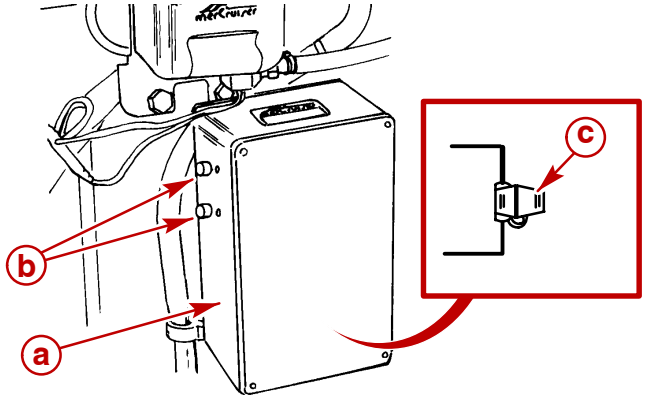
Some controls also have a trailer button that trims the drives to a position suitable for trailer purposes only.

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. Two 60 amp circuit breakers provide protection for engine wiring harness and instrumentation power lead. Reset by pushing RESET button IN (on outside of electrical box).
2. **On D-Tronic engines only:** The Engine Control Module (ECM) is protected from overload by a 5 amp in-line fuse inside the electrical box. Additional fuses are located inside the electrical box.



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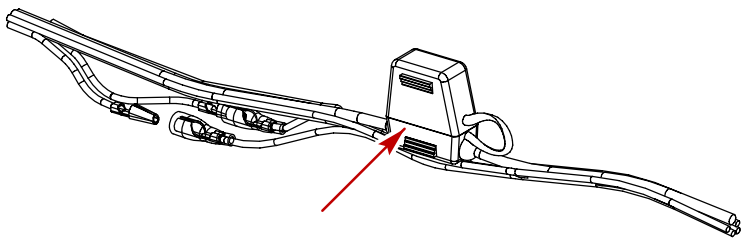
a - Electrical box
b - Circuit breaker
c - ECM fuse (D-Tronic only)

3. 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).



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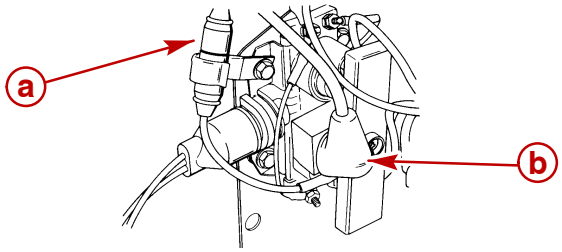
4. The Power Trim System is protected from overload by a 110 amp fuse and a 20 amp in-line fuse on the power trim pump.



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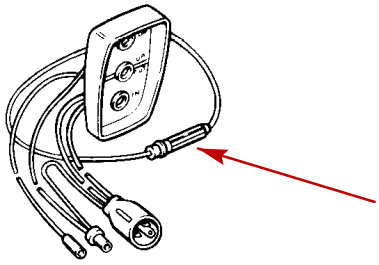
a - 20 amp fuse
b - 110 amp fuse

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



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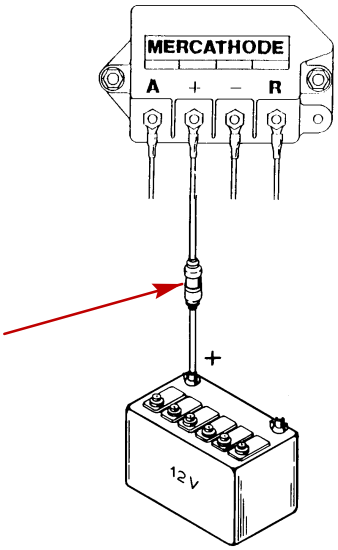
6. The Quicksilver MerCathode System has a 20 amp in-line fuse in the wire which connects to the positive (+) terminal on controller. If the fuse is blown, the system will not operate resulting in a loss of corrosion protection.



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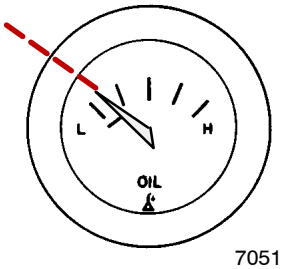
Audio Warning System

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



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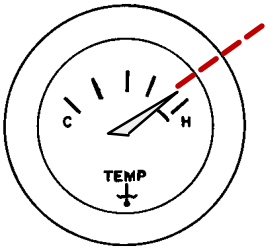
Typical oil pressure gauge



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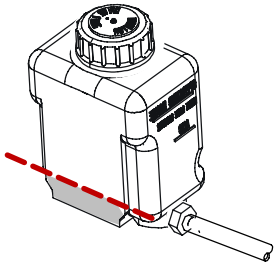
Typical engine temperature gauge



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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.

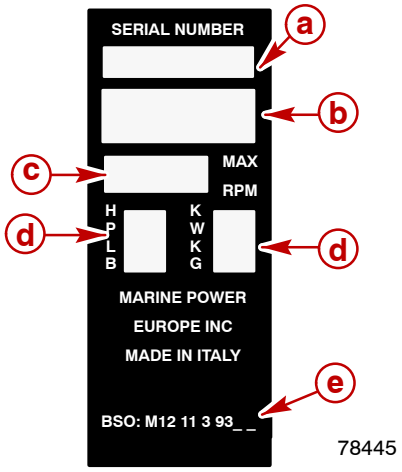
TESTING THE AUDIO WARNING SYSTEM

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 audio alarm. The alarm will sound if the system is functioning correctly.

Emissions Information

Exhaust Gas Emissions Certificate (Europe Only)

A tamper-resistant label is affixed to the engine at time of manufacture by Cummins MerCruiser Diesel. In addition to the required exhaust gas emissions certificate number, the label lists the engine serial number, engine family, maximum rpm, engine power, and weight. Please note that the exhaust gas emissions certification will not affect the fit, function, or performance of the engines. Boatbuilders and Dealers may not remove the label or the part it is affixed to before sale. If modifications are necessary, contact Cummins MerCruiser Diesel about the availability of replacement decals before proceeding.



a - Engine serial number
b - Engine family
c - Maximum rpm
d - Power and weight
e - “BSO” - Exhaust Gas Emissions Certificate Number

Owner Responsibility

The owner/operator is not to modify the engine in any matter that would alter the horsepower or allow exhaust gas emission levels to exceed their predetermined factory specifications.

NOTES:

SECTION 3 - ON THE WATER

Table of Contents

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.**

Cummins MerCruiser Diesel 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 Cummins MerCruiser Diesel dealer / distributor 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 40 km/h (25 mph) 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.

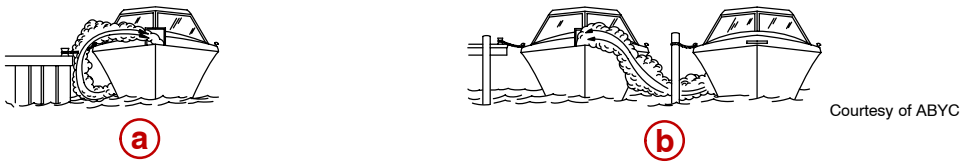
Courtesy of ABYC

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:



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:

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

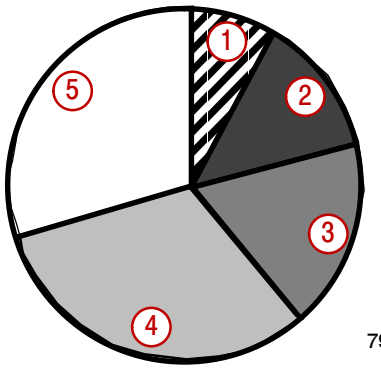


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Chart showing full power operation is limited to a maximum of 1 of 12 hours

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)

LIGHT DUTY RATING

It is the operator's responsibility to operate within the following specified operational capability, or duty cycle, as applicable to the engine and installation:

Description	D4.2L LD
Rated Engine RPM	3600
Wide Open Throttle (WOT) Operation	Limited to less that 10% of total operating time.
Continuous cruising rpm	Limited to no greater than 90% of WOT rpm.
Annual operating time	Not to exceed 500 hours.

NOTE: *Light duty rating applies to planing boats where the use of full rated power at maximum rated rpm is limited (as stated above). Examples of Light Duty applications include, but are not limited to: search and rescue craft, fast patrol boats, fire boats, dive boats and limited season fishing boats such as sport-fish charter boats. Application to common commercial crafts having full-displacement or semi-displacement hulls exceeds the recommended operational capability or duty cycle.*

Operation Chart - D4.2L, D4.2L LD, and D4.2L 230

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 *not* 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, *after* 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 - D4.2L, D4.2L LD and D4.2L 230

NOTE: *Does not include engines equipped with D-Tronic fuel injection.*

⚠ WARNING

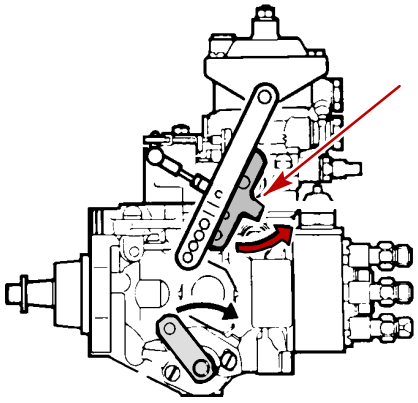
Do not use volatile starting aids, such as Ether, Propane, or Gasoline in the engine air intake system. Explosion hazard resulting from ignition of vapors by glow plugs could cause severe personal injury and engine damage.

⚠ 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.

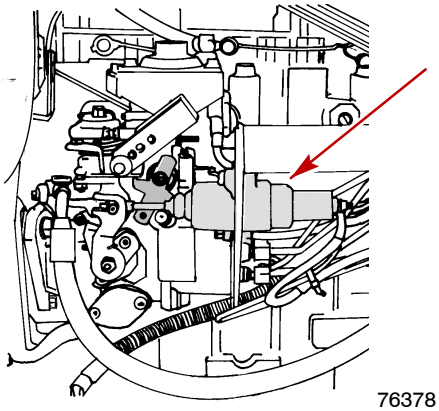
GENERAL INFORMATION

On D4.2L models, a Cold Start Lever located on the injection pump is used to aid in starting when the temperature is below 10 degrees C (50 degrees F).



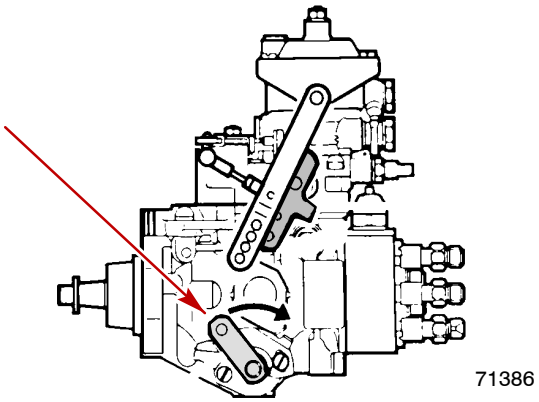
71386

On D4.2L LD and D4.2L 230 models, a Cold Start Device (electric solenoid) located on the injection pump is used to aid in starting when the temperature is below 10 degrees C (50 degrees F).

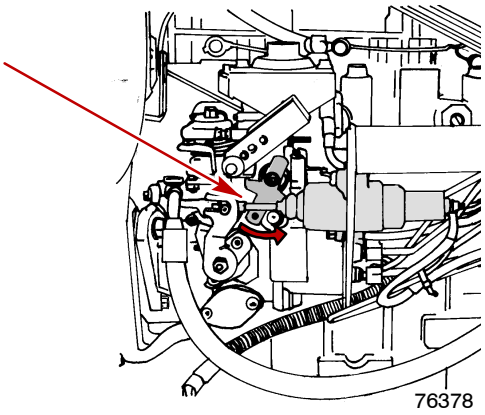


76378

Mechanical Engine Stop Lever - located on the injection pump of all engines except D-Tronic Engines. It is used to manually shut off engine by cutting off the fuel supply. It can be engaged by moving the lever in the direction shown.



D4.2L Models



D4.2L LD and D4.2L 230 Models

BEFORE STARTING THE ENGINE

⚠ CAUTION

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

IMPORTANT: Observe the following before starting:

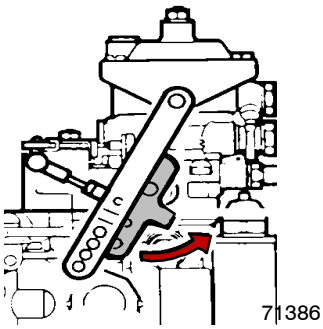
- **Provide water to the seawater pickup pump.**
- **Never operate the starter motor longer than 15 seconds at a time, to avoid overheating the starter motor. If engine does not start, wait 1 minute to allow the starter motor to cool; then, repeat starting procedure.**
- **Be sure engine crankcase is filled to correct level with the proper grade of oil for the prevailing temperature. Refer to Fluid Capacities - Engine Oil.**
- **Be sure that all electrical connections are secure.**
- **Check the air cleaner for proper installation of filter element.**

3. Check all items listed in the **Maintenance Schedules** and **Operation Chart - D4.2L, D4.2L LD, and D4.2L 230.** Refer to the Table Of Contents.
4. 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 all fluid levels before starting engine. Refer to Maintenance Chart.

1. Turn on and run engine compartment bilge blower (if equipped) for five minutes. Or, open engine hatch to air out bilge before attempting to start engine(s).
2. **On D4.2L only:** set cold start lever if temperature is less than 10 degrees C (50 degrees F). Move lever in direction shown. Lever should be reset as soon as engine starts and idles smoothly.



3. After a lengthy layup (several months or more) pre-lubricate the turbocharger and engine. 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. Proceed to next step after a slight increase in oil pressure is observed.
4. If 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 knob located on the fuel filter header. Move knob up and down four or five strokes.
5. Turn key switch to the RUN position. Observe indicator lamp for glow plugs. When cylinder temperature is great enough to sustain combustion, the indicator lamp will go off and the engine can be started.
6. Turn key switch to START position. Release the key and allow the switch to return to RUN position when the engine starts.

IMPORTANT: Within seconds after starting the engine, the oil pressure should exceed 10 psi (69 kPa) minimum. If the oil pressure does not meet these minimum limits, stop the engine, locate and correct the problem, or see your authorized Cummins MerCruiser Diesel dealer / distributor if you are unable to determine the problem.

7. Ensure charge indicator and 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.

8. **On D4.2L only:** reset Cold Start Lever when engine idles smoothly.

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. Inspect the power package for fuel, oil, water and exhaust leaks.
4. After the engine has reached operating temperature, oil pressure should be within range listed in the engine specifications chart. Stop the engine if oil pressure is not within this range. Locate and correct the problem, or see your authorized Cummins MerCruiser Diesel dealer / distributor if you are unable to determine the problem.

STARTING A WARM ENGINE

1. Turn on and run engine compartment bilge blower for five minutes (if so equipped). Or, open engine hatch to air out bilge before attempting to start engine(s).
2. Turn key switch to the RUN position.
3. Turn key switch to START position. Release the key and allow the switch to return to RUN position when the engine starts.
4. Ensure charge indicator and oil pressure warning lamps are off.
5. Ensure all instrumentation is functioning properly and indicating normal readings.

SHIFTING

⚠ CAUTION

Never attempt to shift unit unless engine is at idle rpm. Damage to drive unit could occur.

1. To shift unit, be sure remote control/throttle lever is in NEUTRAL. Move control/shift lever with a firm, quick motion forward to shift to FORWARD gear, or backward to shift to REVERSE. After shifting drive unit, advance throttle to desired setting.
2. Once underway, engine oil pressure should be within the range listed in the engine specifications chart at maximum rpm, or Wide-Open-Throttle. Stop the engine if oil pressure is not within this range. Locate and correct the problem, or see your authorized Cummins MerCruiser Diesel dealer / distributor if you are unable to determine the problem.

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

3. Push and pull repeatedly on 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.
4. 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. Toggle STOP switch DOWN and hold, until engine stops completely.
4. Turn key switch to the OFF position.

Operation Chart - D2.8L D-Tronic, D4.2L D-Tronic and D4.2L

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.		Operate 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.		Turn key switch to OFF position.
Check for leaks - fuel, oil, water, fluid, etc.	Check steering operation.		Turn battery switch, if so equipped, to OFF.
Open fuel shutoff valve, if so equipped.			Close fuel shutoff valve, if so equipped.
Open seacock, if so equipped.			Close seacock, if so equipped.
Prime fuel injection system, if necessary.			Flush seawater cooling circuit, if operating in saltwater area.
Turn key switch to RUN and check that lights and indicator lamps come on.			
Turn key switch to START, *after* 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 - D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300

⚠ 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.

BEFORE STARTING THE ENGINE

⚠ CAUTION

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

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 engine does not start, wait 1 minute to allow the starter motor to cool; then, repeat starting procedure.**
- **Ensure engine crankcase is filled to correct level with the proper grade of oil for the prevailing temperature. Refer to Specifications - Engine Oil.**
- **Ensure all electrical connections are secure.**
- **Check the air cleaner for proper installation of filter element.**

1. Check all items listed in the Maintenance Schedules and Operation Chart - D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300. Refer to Table Of Contents.
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 Maintenance Chart.

1. Turn on and run engine compartment bilge blower (if so equipped) for five minutes. Or, open engine hatch to air out bilge before attempting to start engine(s).
2. If 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 knob located on the fuel filter header. Move knob up and down four or five strokes. Attempt to start engine following normal procedure.
3. Turn key switch to the RUN position. Observe indicator lamp for glow plugs, if so equipped. When cylinder temperature is great enough to sustain combustion, the indicator lamp will go off and the engine can be started.
4. Turn key switch to START position. Release the key and allow the switch to return to RUN position when the engine starts.

IMPORTANT: Within seconds after starting the engine, the oil pressure should exceed 10 psi (69 kPa) minimum. If the oil pressure does not meet these minimum limits, stop the engine, locate and correct the problem, or see your authorized Cummins MerCruiser Diesel dealer or distributor if you are unable to determine the problem.

5. Ensure charge indicator and 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.

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. Inspect the power package for fuel, oil, water and exhaust leaks.
4. After the engine has reached operating temperature, oil pressure should be within range listed in the engine specifications chart. Stop the engine if oil pressure is not within this range. Locate and correct the problem, or see your authorized Cummins MerCruiser Diesel dealer or distributor if you are unable to determine the problem.

STARTING A WARM ENGINE

1. Turn on and run engine compartment bilge blower for five minutes (if so equipped). Or, open engine hatch to air out bilge before attempting to start engine(s).
2. Turn key switch to the RUN position.
3. Ensure charge indicator and oil pressure warning lamps are off.
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 all instrumentation is functioning properly.

SHIFTING

⚠ CAUTION

Never attempt to shift unit unless engine is at idle rpm. Damage to drive unit could occur.

1. To shift unit, be sure remote control/throttle lever is in NEUTRAL. Move control/shift lever with a firm, quick motion forward to shift to FORWARD gear, or backward to shift to REVERSE. After shifting drive unit, advance throttle to desired setting.
2. Once underway, engine oil pressure should be within the range listed in the engine specifications chart at maximum rpm, or Wide-Open-Throttle. Stop the engine if oil pressure is not within this range. Locate and correct the problem, or see your authorized Cummins MerCruiser Diesel dealer or distributor if you are unable to determine the problem.

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

3. Push and pull repeatedly on 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.
4. 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. Turn key switch to the OFF position.

Starting 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.

Trailering 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 Mercury MerCruiser dealer.

Freezing Temperature Operation

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

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 or distributor.

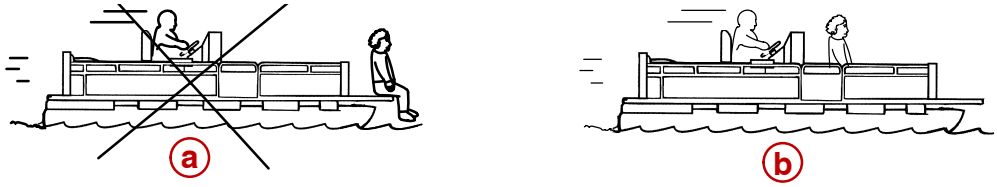
Passenger Safety Message - Pontoon And Deck Boats

⚠ 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. 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.

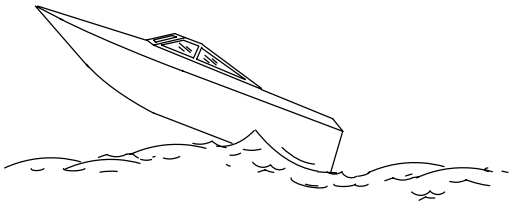
   b. Keep all passengers behind the front fence or enclosure.

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. Any unexpected sudden reduction in boat speed could result in the elevated passenger falling over the front of the boat.

   b. Sit only in seats designated for traveling at faster speeds.

Wave And Wake Jumping



⚠ WARNING

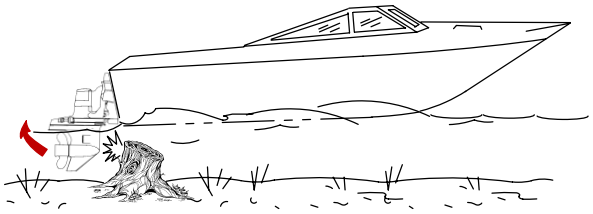
Avoid serious injury or death from being thrown within or out of a boat when it lands after jumping a wave or wake. Avoid wave or wake jumping whenever possible. Instruct all occupants that if a wake or wave jump occurs, get low and hang on to a boat hand hold.

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 kickup 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

NOTE: *Engines equipped with EDI (D-Tronic engines) reduce the effects of changes in elevation and climate by automatically adjusting fuel flow for weather conditions and elevation. EDI engines however, do not compensate for increased loading or hull conditions.*

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 top end of the Rated Engine 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, depending upon the model, are equipped with either a governor or a device that limits engine rpm. Be sure that propeller being used does not allow engine to run against the governor or limiter, as a significant loss in performance will result.

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

NOTE: *Use an accurate service tachometer to verify rpm.*

Description		Rated Engine rpm	Engine rpm Limiter Setting (Begins At:)
Sterndrive Models	D4.2L	3600	3630 ± 20
	D4.2L LD	3600	3650 ± 50
	D4.2L 230	3800	3875 ± 50
	D2.8L D-Tronic	3800	3875 ± 50
	D4.2L D-Tronic	3800	3875 ± 50
	D4.2L 300	3900	3950 ± 50

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 (not as significant on EDI models).
- Operating in a higher elevation causes an rpm loss (not as significant on EDI models).
- Operating with a damaged propeller or dirty boat bottom causes an rpm loss.
- Operating with increased load (additional passengers, pulling skiers).

For better acceleration, such as is needed for water skiing, use the next lower pitch propeller. Do not operate at full throttle when using the lower pitch propeller but not pulling skiers.

Getting Started

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. **On all EDI (D-Tronic) models:** Proceed to Step 3.
2. **On all engines except EDI (D-Tronic) models:** After a lengthy layup (several months or more) pre-lubricate the turbocharger and engine. To do this, engage the STOP switch and hold 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. Proceed to Step 3. after a slight increase in oil pressure is observed.
3. Refer to the appropriate Starting, Shifting and Stopping section and start the engine. Allow the engine to idle until it has reached normal operating temperature.
4. Operate the engine in gear for 3 minutes at each of the following rpms: 1200 rpm, 2400 rpm and 3000 rpm.
5. Operate the engine in gear for 3 minutes at each of the following rpms: 1500 rpm, 2800 rpm and 3400 rpm.
6. Operate the engine in gear for 3 minutes at each of the following rpms: 1800 rpm, 3000 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 the engine with the 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:

- Use a propeller that allows the engine to operate at the Rated Engine rpm at WOT when at full throttle with a normal boat load. Refer to Specifications and Maintenance.
- Operation at 3/4 throttle setting or lower is recommended. Refrain from prolonged operation at WOT rpm.

End of First Season Checkup

At the end of the first season of operation, contact an authorized Cumins 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.

SECTION 4 - SPECIFICATIONS

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4

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.

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.

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 **SECTION 5 - Maintenance Schedules** for respective change intervals.

Description	Part Number
Marine Engine Coolant	92-813054A2
Fleetguard Compleat (Product 91-50663 With DCA4 Additive)	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
Mercury 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 VIiva 1		

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

Engine Specifications

D4.2L

Description		Specification - Sterndrive
		D4.2L
Crankshaft Horsepower (Kilowatts) [1]		220 (164)
Propeller Shaft Horsepower (Kilowatts) [1]		200 (149)
Engine Type		In-Line 6 Cylinder Diesel
Displacement		254 cu. in. (4.2 L)
Firing Order		1 - 5 - 3 - 6 - 2 - 4
Bore		3.700 in. (94 mm)
Stroke		3.937 in. (100 mm)
Compression Ratio		21.5:1
Valve Clearance - Intake / Exhaust		Hydraulic
Maximum Pressure Difference Between Cylinders		72 psi (500 kPa)
Maximum High Idle No Load rpm		4200 ± 50
Governed rpm Setting (Begins At:)		3630 ± 20
Rated rpm At Wide-Open-Throttle [2]		3600
Idle rpm in Forward Gear		700
Oil Pressure:	750 rpm	22-36 psi (1.5 - 2.5 bar [152-248 kPa])
	3600 - 3800 rpm	50-58 psi (3.5 - 4 bar [345-400 kPa])
Oil Temperature		212 - 230 F (100 - 110 C) Degrees
Thermostats:	Water: (2 total)1 at:	160 F (70 C) Degrees
	1 at:	180 F (82 C) Degrees
	Oil:	203 F (95 C) Degrees
Coolant Temperature		176 - 185 F (80 - 85 C) Degrees
Electrical System		12-volt Negative (–) Ground
Alternator Rating		949W, 14.6v, 65A
Recommended Battery Rating		750 cca, 950 mca, or 180 Ah
Starter		12v, 2.7 kW

[1] Power rated in accordance with NMMA Procedure - ISO 3046 (Technically Identical to ICOMIA 28-83).

[2] Refer to Conditions Affecting Operation - Propeller Selection for additional information.

D4.2L LD And D4.2L 230

Description		Specification - Sterndrive	
		D4.2L LD	D4.2L 230
Crankshaft Kilowatts (Horsepower) [1]		149 (200)	171 (230)
Propeller Shaft Kilowatts (Horsepower) [1]		134 (180)	154 (207)
Engine Type		In-Line 6 Cylinder Diesel	
Displacement		4.2 L (254 cu. in.)	
Firing Order		1 - 5 - 3 - 6 - 2 - 4	
Bore		94 mm (3.700 in.)	
Stroke		100 mm (3.937 in.)	
Compression Ratio		16.5:1	
Valve Clearance - Intake / Exhaust		Hydraulic	
Maximum Pressure Difference Between Cyl.		500 kPa (72 psi)	
Maximum High Idle No Load rpm		4000 ± 50	4250 ± 50
Governed rpm Setting (Begins At:)		3650 ± 50	3850 ± 50
Rated rpm at Wide-Open-Throttle 2		3600	3800
Idle rpm in Forward Gear		600	600
Oil Pressure:	600 rpm	130-149 kPa (1.3 - 1.5 bar [19-22 psi])	
	3600 rpm 3	345-400 kPa (3.5 - 4 bar [50-58 psi])	
	3800 rpm 4	345-400 kPa5 (3.5 - 4 bar [0-58 psi])	
Oil Temperature		100 - 110 C (212 - 230 F) Degrees	
Thermostats:	Water: (2 total) 1 at:	70 C (160 F) Degrees	
	1 at:	82 C (180 F) Degrees	
	Oil:	95 C (203 F) Degrees	
Coolant Temperature		80 - 85 C (176 - 185 F) Degrees	
Electrical System		12-volt Negative (–) Ground	
Alternator Rating		980W, 14.6v, 70A	980W, 14.6V, 65A
Recommended Battery Rating		750 cca, 950 mca, or 180 Ah	
Starter		2.7 kW, 12v	

[1] Power rated in accordance with NMMA Procedure - ISO 3046 (Technically Identical to ICOMIA 28-83).

[2] Refer to Conditions Affecting Operation - Propeller Selection for additional information.

[3] D4.2L LD

[4] D4.2L 230

D2.8L D-Tronic and D4.2L D-Tronic

Description		Specification - Sterndrive	
		D2.8L D-Tronic	D4.2L D-Tronic
Crankshaft Horsepower (Kilowatts) [1]		165 (123)	250 (186)
Propeller Shaft Horsepower (Kilowatts) [1]		150 (112)	225 (168)
Engine Type		In-Line 4 Cylinder Diesel	In-Line 6 Cylinder Diesel
Displacement		169 cu. in. (2.8 L)	254 cu. in. (4.2 L)
Firing Order		1 - 3 - 4 - 2	1 - 5 - 3 - 6 - 2 - 4
Bore		3.700 in. (94 mm)	
Stroke		3.937 in. (100 mm)	
Compression Ratio		16.5:1	
Valve Clearance - Intake / Exhaust		Hydraulic	
Maximum Pressure Difference Between Cylinders		72 psi (500 kPa)	
Maximum High Idle No Load rpm		4200 ± 50	
Governed rpm Setting (Begins At:)		3850 ± 50	
Rated rpm at Wide-Open-Throttle [2]		3800	
Low Idle rpm		700 [3]	
		600 [4]	
Oil Pressure:	750 rpm	22-45 psi (1.5 - 3.1 bar [152-310 kPa])	
	3800 rpm	50-80 psi (3.5 - 5.6 bar [345-556 kPa])	
Oil Temperature		212 - 230 F (100 - 110 C) Degrees	
Thermostats:	Water: (2 total) 1 at:	160 F (70 C) Degrees	
	1 at:	180 F (82 C) Degrees	
	Oil:	203 F (95 C) Degrees	
Coolant Temperature		176 - 185 F (80 - 85 C) Degrees	
Electrical System		12-volt Negative (–) Ground	
Alternator Rating		949W, 14.6v, 65A	
Recommended Battery Rating		750 cca, 950 mca, or 180 Ah	
Starter		12v, 2.7 kW	

[1] Power rated in accordance with NMMA Procedure - ISO 3046 (Technically Identical to ICOMIA 28-83).

[2] Refer to Conditions Affecting Operation - Propeller Selection for additional information.

[3] Mercury Serial Number 0L343084 and Below on D2.8L D-Tronic Engines. Mercury Serial Number 0L343703 and Below on D4.2L D-Tronic Engines.

[4] Mercury Serial Number 0L343085 and Above on D2.8L D-Tronic Engines. Mercury Serial Number 0L343704 and Above on D4.2L D-Tronic Engines.

D4.2L 300

Description		Specification - Sterndrive
		D4.2L 300
Crankshaft Horsepower (Kilowatts) [1]		300 (224)
Propeller Shaft Horsepower (Kilowatts) [1]		270 (202)
Engine Type		In-Line 6 Cylinder Diesel
Displacement		254 cu. in. (4.2 L)
Firing Order		1 - 5 - 3 - 6 - 2 - 4
Bore		3.705 in. (94.1 mm)
Stroke		3.941 in. (100.1 mm)
Compression Ratio		17.0:1
Valve Clearance - Intake / Exhaust		Hydraulic
Maximum Pressure Difference Between Cylinders		72 psi (500 kPa)
Maximum High Idle No Load rpm		4200 ± 50
Governed rpm Setting (Begins At:)		3875 ± 50
Rated rpm at Wide-Open-Throttle [2]		3800
Low Idle rpm		600
Oil Pressure:	750 rpm	22-45 psi (1.5 - 3.1 bar [152-310 kPa])
	3800 rpm	50-80 psi (3.5 - 5.6 bar [345-556 kPa])
Oil Temperature		212 - 230 F (100 - 110 C) Degrees
Thermostats:	Water: (2 total) 1 at:	160 F (70 C) Degrees
	1 at::	180 F (82 C) Degrees
	Oil:	203 F (95 C) Degrees
Coolant Temperature		176 - 185 F (80 - 85 C) Degrees
Electrical System		12-volt Negative (–) Ground
Alternator Rating		949W, 14.6v, 65A
Recommended Battery Rating		750 cca, 950 mca, or 180 Ah
Starter		12v, 3.0 kW

[1] Power rated in accordance with NMMA Procedure - ISO 3046 (Technically Identical to ICOMIA 28-83).

[2] Refer to Conditions Affecting Operation - Propeller Selection for additional information.

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).

D2.8L D-Tronic	Capacity Liters (U.S. qts)	Fluid type
Total Engine Oil (With Filter) [1]	10 (8-1/2)	Mercury Diesel Engine Oil
Oil pan	8 (6-1/2)	
Oil filter	1 (1)	
Oil cooler	1 (1)	
Closed Cooling System	11 (11-2/3)	Marine Engine Coolant

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

D4.2L D4.2L LD D4.2L 230 D4.2L D-Tronic D4.2L 300	Capacity Liters (U.S. qts)	Fluid type
Engine Oil (With Filter) [1]	12 (12-3/4)	Mercury Diesel Engine Oil
Oil pan	10 (10-3/4)	
Oil filter	1 (1)	
Oil cooler	1 (1)	
Closed Cooling System	13 (13-3/4)	Marine Engine Coolant

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

Sterndrives

NOTE: *Oil capacity includes Drive Lube Monitor.*

Model	ml (oz)	Fluid Type
Bravo One	2603 (88)	High Performance Gear Lube
Bravo Two	3076 (104)	
Bravo Three	2839 (96)	

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 dealer / distributor 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 Schedules 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 Service Manual be purchased and read thoroughly.

IMPORTANT:

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. Electronic ignition and 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 plug leads and electrical 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.	•			
Check the power steering fluid level.	•			
Check the drive unit oil level in the gear lube monitor.	•			
If operating in salt, brackish or polluted waters, flush the cooling system after each use.		•		
Drain any water from the fuel filter after each use (If operating in freezing temperatures).			•	
Check the trim pump oil level.			•	
Check the water inlets for debris or marine growth. Check the seawater strainer and clean.			•	
Inspect the drive unit anodes and replace if 50 percent eroded.			•	
Check the battery connections and fluid level.				•
Lubricate the propeller shaft and retorque the nut.[3]				•
Operating in Saltwater Only: treat the engine surface with corrosion guard.				•
Clean the air filter. [1]				•
Ensure that the gauges and the wiring connections are secure. Clean the gauges. [2]				•

***** Only perform maintenance which applies to your particular power package.

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.

Maintenance Schedules (Continued)

Scheduled Maintenance *	After First 20 hours	Annually	Every 100 hours or Annually ◆
Change the engine oil and filter.	●		●
Touch-up paint the power package and spray with corrosion guard.		●	
Change the drive unit oil. 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 and lubricat the U-joints and splines.[2] Inspect the bellows and clamps. Check the engine alignment.			●
Lubricate the gimbal bearing and engine coupler [1]			●
Check continuity circuit for loose or damaged connections. Test MerCathode® unit output on Bravo Models.			●
Retorque the engine mounts.			●
Check the electrical system for loose, damaged or corroded fasteners.			●
Lubricate the drive shaft U-joints and tailstock input and output bearings.			●
Inspect the condition and tension of the belts.			●
Check the cooling system and the 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 and replace if 50 percent eroded.			●
Replace the air filter.			●

***** Only perform maintenance which applies to your particular power package.

◆ Whichever occurs first

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

[2] The U-joints on Bravo X sterndrive unit serial numbers 0M750000-0M752024 do not have grease fittings and require no additional lubrication.

Maintenance Schedules (Continued)

Scheduled Maintenance * (Continued)	Every 2 years	Every 500 hours or 5 years ◆	Every 1000 hours or 5 years ◆
Replace the coolant.	●		
Clean the aftercooler core.		●	
Clean the fuel tank.			●

***** Only perform maintenance which applies to your particular power package.

◆ Whichever occurs first

Maintenance Record

Date	Hour Meter Reading	Serviced By	Maintenance Performed

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.

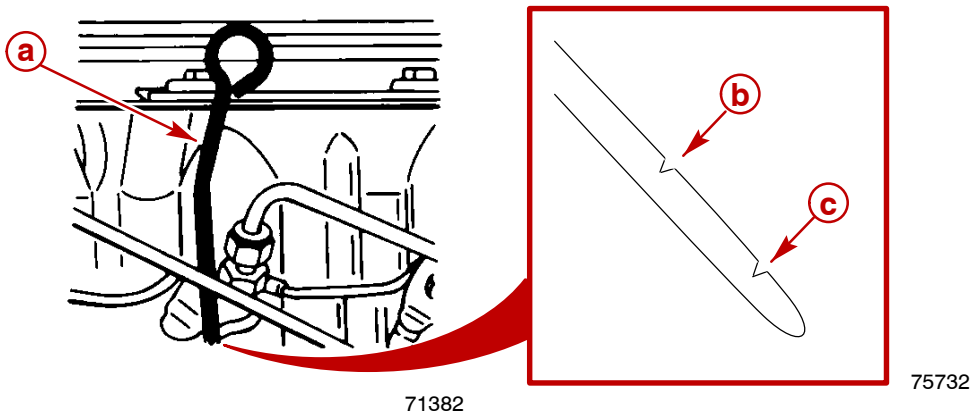
Checking

⚠ CAUTION

Avoid possible injury or damage to oil dipstick and internal engine components. Do not remove crankcase oil dipstick when engine is running. Stop the engine completely before removing or inserting dipstick.

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 dipstick. Wipe clean and reinstall into dipstick tube.
2. Remove dipstick and observe oil level. Oil must be between marks on dipstick. If necessary, add oil as follows.



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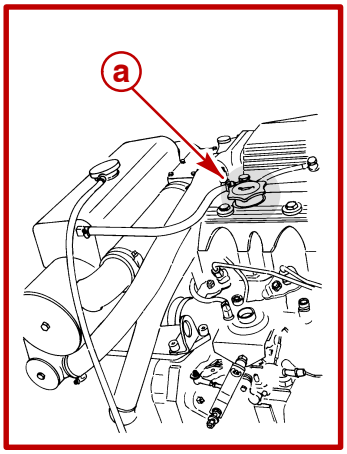
a - Dipstick
b - Maximum Mark
c - Minimum Mark

Filling

IMPORTANT: Do not overfill the engine with oil.

1. Remove oil filler cap.



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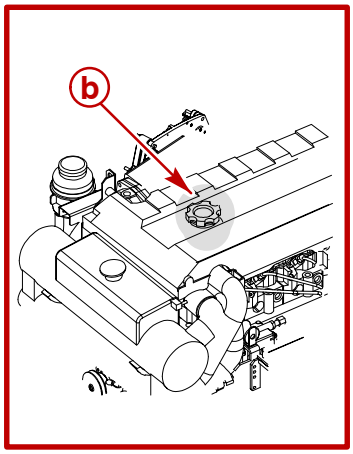

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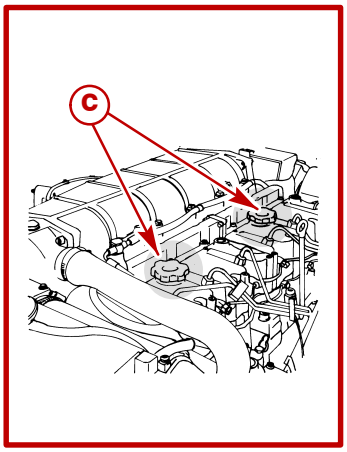

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a - D4.2L
b - D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300
c - D4.2L LD and D4.2L 230

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

D2.8L D-Tronic	Capacity Liters (U.S. qts)	Fluid Type
Engine Oil (With Filter) [1]	8 (8-1/2)	4-Cycle 25W-40 Marine Engine Oil

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

D4.2L, D4.2L LD, D4.2L 230 D4.2L D-Tronic, D4.2L 300	Capacity Liters (U.S. qts)	Fluid Type
Engine Oil (With Filter) [1]	12 (12-3/4)	4-Cycle 25W-40 Marine Engine Oil

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

3. Reinstall the filler cap.

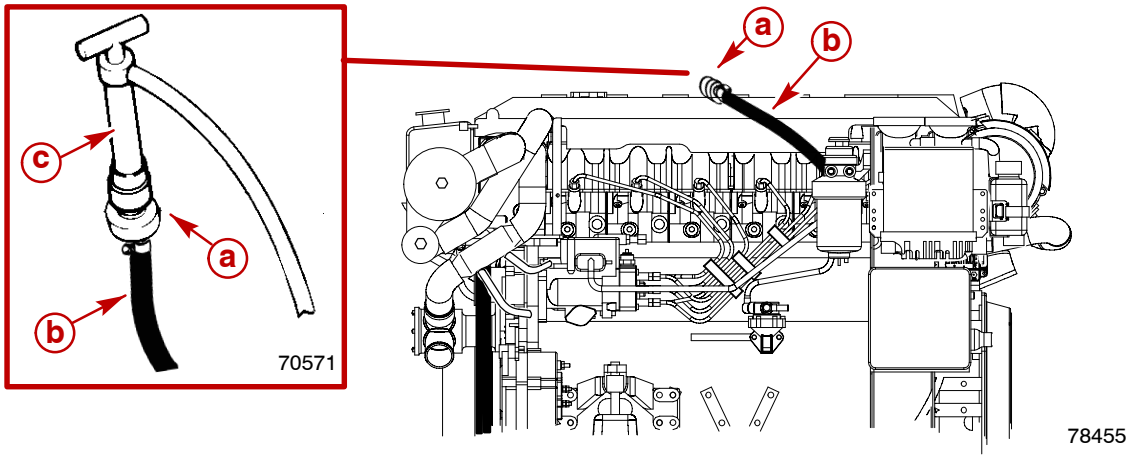
Changing Oil and Filter

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).

D4.2L, D4.2L 230, D2.8L D-TRONIC, D4.2L D-TRONIC AND D4.2L300

1. Start engine and allow it to warm up to normal operating temperature.
2. Stop engine and allow some time for oil to drain into oil pan (approximately 5 minutes).
3. Remove fitting from end of crankcase oil drain hose laying on top of engine.
4. Install crankcase oil pump onto threaded fitting of oil drain hose.

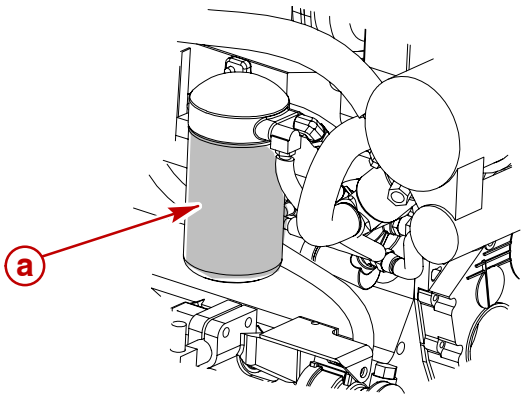


Typical engine and oil drain hose, all similar

a - Threaded fitting
b - Oil drain hose
c - Crankcase oil pump (Quicksilver Part Number 802889Q1)

5. Pump oil out of crankcase into drain pan. When crankcase is empty, remove pump and reinstall crankcase oil drain hose fitting. Tighten securely.

6. Remove and discard oil filter and sealing ring.
7. Coat sealing ring on new filter with oil and install filter. Hand tighten only, do not use a filter wrench.



74725

Typical engine and oil filter, all similar

a - Oil filter

8. Remove oil fill cap and refill engine with new oil. Refer to Filling.

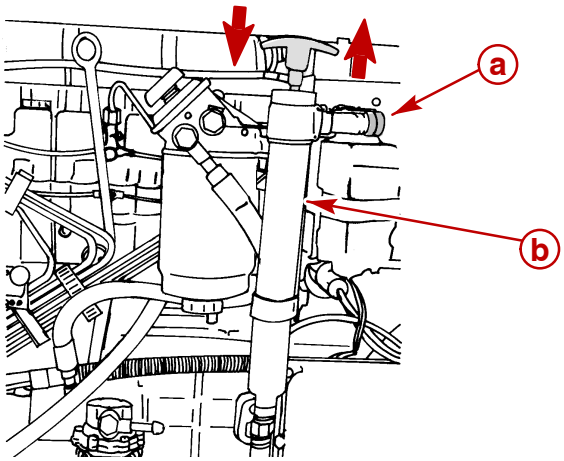
IMPORTANT: When refilling engine with oil always use dipstick to determine how much oil is required.

IMPORTANT: On all engines except EDI (D-Tronic) models: After oil change, pre-lubricate turbocharger and engine. To do this, engage the stop switch and hold while you turn the key switch to START position. Doing this TOGETHER turns the engine without starting it. Do not engage starter for more than 15 seconds; allow at least one minute cool down time before re-engaging starter for another 15 seconds. Ensure that the starter does not overheat.

9. Start the engine and check for leaks.

D4.2L LD

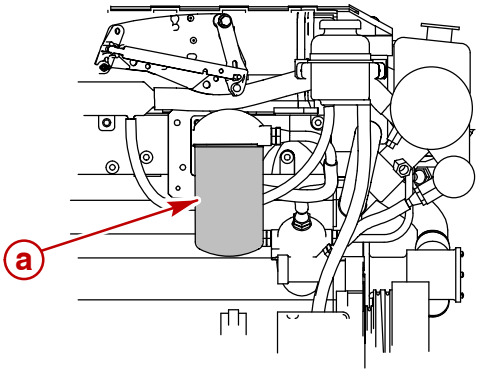
1. Start engine and allow it to warm up to normal operating temperature.
2. Stop engine and allow some time for oil to drain into oil pan (approximately 5 minutes).
3. Remove fitting from end of crankcase oil pump. Attach a suitable hose for draining.
4. Pump oil out of crankcase into drain pan. When crankcase is empty, remove hose and reinstall crankcase oil pump fitting. Tighten securely.



76379

a - Threaded fitting
b - Crankcase oil pump

5. Remove and discard oil filter and sealing ring. Coat sealing ring on new filter with oil and install filter. Hand tighten only, do not use a filter wrench.



75297

a - Oil filter

6. Remove oil fill cap and refill engine with new oil. Refer to Filling.

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

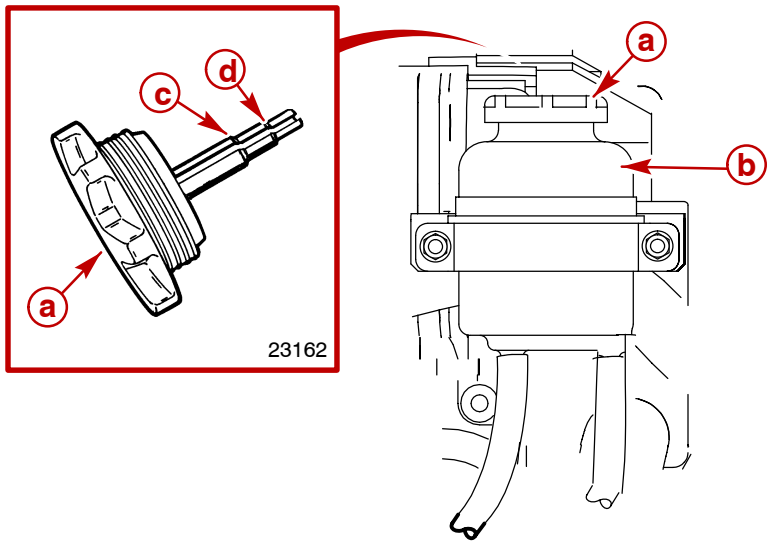
IMPORTANT: On all engines except EDI (D-Tronic) models: After oil change, pre-lubricate turbocharger and engine. To do this, engage the stop switch and hold while you turn the key switch to START position. Doing this TOGETHER turns the engine without starting it. Do not engage starter for more than 15 seconds; allow at least one minute cool down time before re-engaging starter for another 15 seconds. Ensure that the starter does not overheat.

7. Start the engine and check for leaks.

Power Steering Pump Fluid

Checking

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



Typical

a - Fillcap/dipstick
b - Fluid reservoir
c - Full hot mark
d - Full cold mark

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

Filling

1. Remove the fill cap/dipstick and observe the level.
2. Add Quicksilver Power Trim and Steering Fluid or Dexron III Automatic Transmission Fluid (ATF) to bring the fluid level up to the proper level.
3. Reinstall the fill cap/dipstick.

Changing

Power Steering fluid does not require changing.

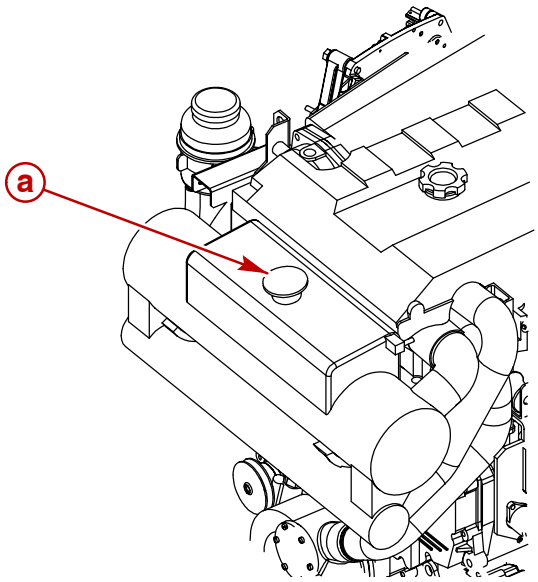
Engine Coolant - Closed Cooled Models Only

Checking

⚠ CAUTION

Allow the engine to cool down 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. Remove the pressure cap from the heat exchanger and observe the coolant level.



75301

Typical

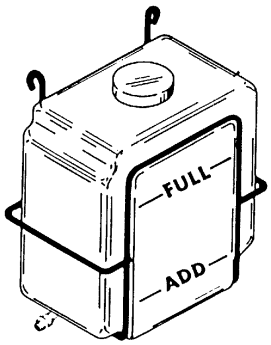
a - Pressure cap

2. The coolant level in the heat exchanger should be at the bottom of the filler neck. If coolant is low refer to Filling.

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

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

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



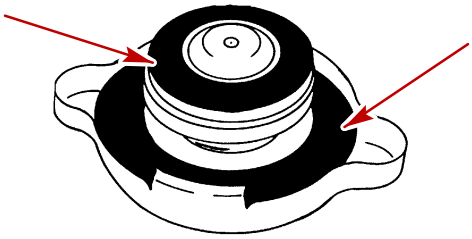
72520

6. Add the specified coolant as necessary.

Description	Where Used	Part Number
Marine Engine Coolant	Closed cooling system	92-813054A2
Fleetguard Compleat (Product 91-50663 with DCA4 Additive)		Obtain Locally

7. 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.



72714

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

Filling

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

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

2. Install the pressure cap. Tighten until it contacts locking tabs on the filler 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 (Product 91-50663 with DCA4 Additive)		Obtain Locally

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

Changing

Contact your authorized Cummins MerCruiser Diesel dealer/distributor.

Drive Unit Oil

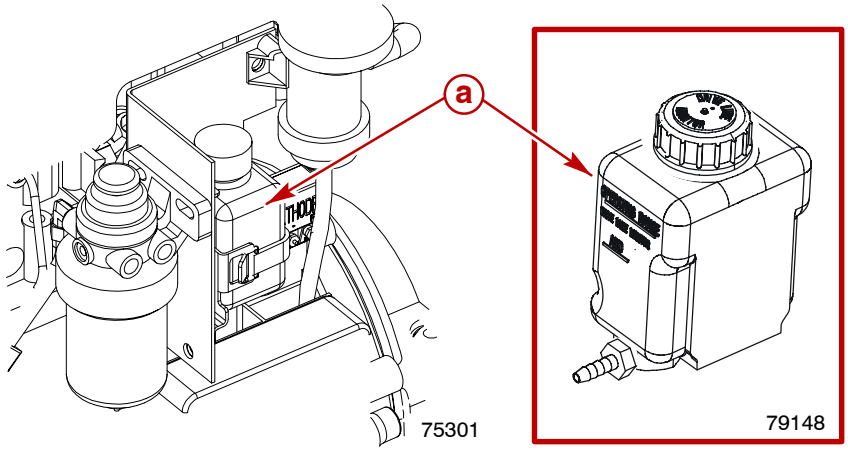
⚠ CAUTION

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 fluctuate during 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 FULL line in the drive lube monitor. 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.



Typical gear lube monitor location

a - Gear lube monitor

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

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 to full line with specified fluid.

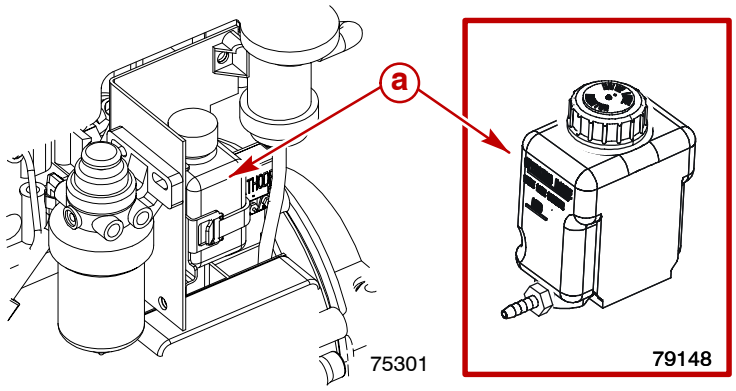
Description	Where Used	Part Number
High Performance Gear Lube	Gear lube monitor	92-802854A1

3. Replace the cap.

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

Changing

1. Remove the gear lube monitor from the bracket.

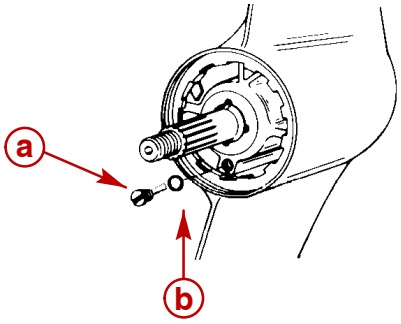


Typical gear lube monitor location

a - Gear lube monitor

2. Empty the contents into a suitable container.
3. Install the monitor in the bracket.

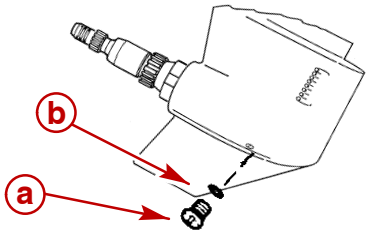
4. **Bravo One Models:** Remove the propeller, place the sterndrive unit in full trim limit IN position, remove the oil fill/drain screw and sealing washer and drain the oil.



70568

a - Oil fill/drain
b - Sealing washer

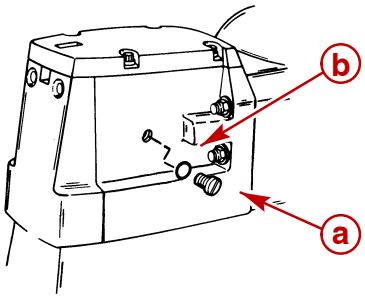
5. **All Other Models:** Place the sterndrive unit in full trim limit OUT position, remove the oil fill/drain screw and sealing washer and drain the oil.



72522

a - Oil fill/drain
b - Sealing washer

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



77106

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.

7. 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.

8. Install the oil vent screw and sealing washer.
9. Continue to pump gear lube into the gear lube monitor circuit until the gear lube appears in the gear lube monitor.
10. Fill the monitor so that the oil level is in the operating range. Do not overfill. Ensure that the rubber gasket is inside the cap and install. Do not overtighten.

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

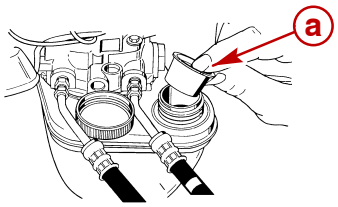
11. Remove the pump from the oil fill/drain hole. Quickly install the sealing washer and oil fill/drain screw. Tighten securely.
12. Reinstall the propeller, if removed. Refer to Propellers.
13. Recheck the oil level after the first use.

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

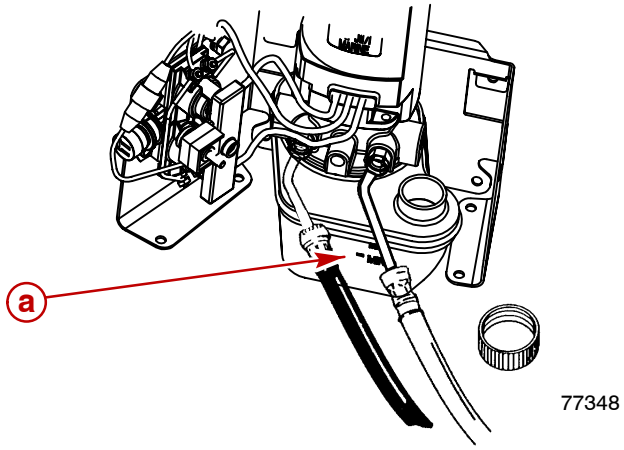
1. Place the sterndrive unit in full DOWN/IN position.
2. Remove the fill cap from the reservoir and verify that the cap plug has been removed. If not, remove and discard the cap plug.



70979

a - Cap plug

3. Observe the oil level. Oil level should be maintained within the ADD and FILL or MINIMUM and MAXIMUM lines on the reservoir.



77348

a - Oil level marks

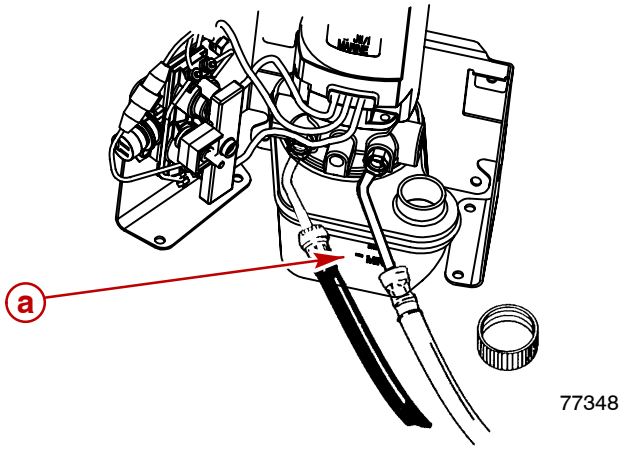
NOTE: *Fill cap is vented.*

4. Fill as necessary with the specified fluid.

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

Filling

1. Remove the fill cap from the reservoir.
2. Add lubricant to bring level to within the ADD and FILL or MINIMUM and MAXIMUM lines on the reservoir.



a - Oil level marks

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

3. Install the cap.

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.

Multiple EDI Engine Battery Precautions

SITUATION

Alternators: Alternators are designed to charge the battery that supplies electrical power to the engine that the alternator is mounted on. When batteries for two different engines are connected, one alternator will supply all of the charging current for both batteries. Normally, the other engine's alternator will not be required to supply any charging current.

EDI Electronic Control Module (ECM): The ECM requires a stable voltage source. During multiple engine operation, an onboard electrical device may cause a sudden drain of voltage at the engine's battery. The voltage may go below the ECM's minimum required voltage. Also, the alternator on the other engine may now start charging. This could cause a voltage spike in the engine's electrical system.

In either case, the ECM could shut off. When the voltage returns to the range that the ECM requires, the ECM will reset itself. The engine will now run normally. This ECM shut down usually happens so fast that the engine just appears to have an ignition miss.

RECOMMENDATIONS

Batteries: Boats with multi-engine EDI power packages require each engine be connected to its own battery. This ensures that the engine's Electronic Control Module (ECM) 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 Filter

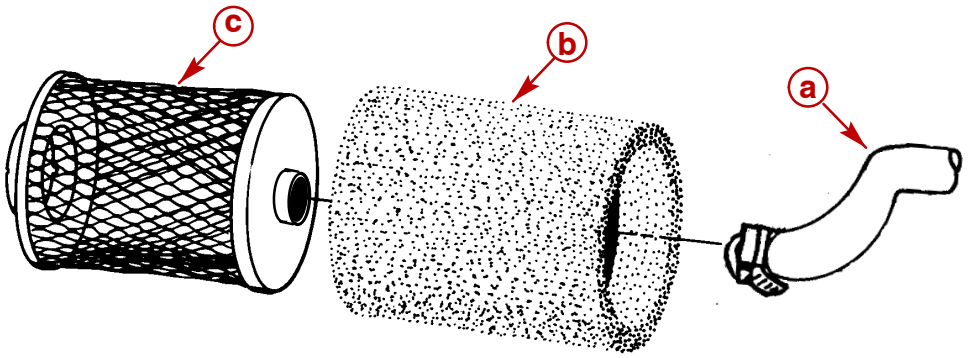
Cleaning

1. Disconnect crankcase vent hose from end of air cleaner.
2. Carefully remove air cleaner foam element from around air intake screen housing mounted on turbocharger inlet.

⚠ CAUTION

Avoid potential fire hazards and injury, or damage to polyester foam element. Do not clean foam element in petroleum based solvents or cleaners.

3. Wash foam element in warm water and detergent until clean.



71267

a - Crankcase Vent Hose
b - Foam Element
c - Intake Screen Housing

IMPORTANT: No treatment (such as partial oil saturation) is required or recommended on air cleaner foam element prior to use. Use element clean and dry for proper filtration.

4. Allow element to completely dry before use and install around air intake screen

IMPORTANT: To prevent unfiltered air from entering the engine be certain that all of the air intake screen is covered by the foam element when installed.

Replacement

Replace the foam element if it is deteriorated or torn. Refer to Maintenance Schedules for replacement interval under normal conditions.

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.

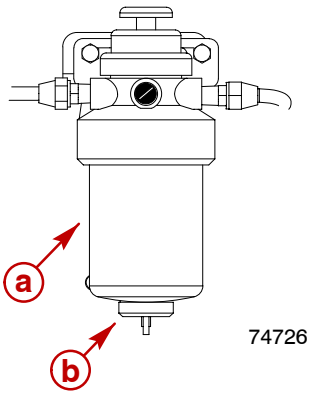
Draining

The filter can be drained of water and small dirt particles by opening drain cap on bottom of 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. Open the drain by turning the drain cap counterclockwise *(as viewed from the bottom of the filter)* until fuel starts draining. Do not remove the drain cap.



Typical

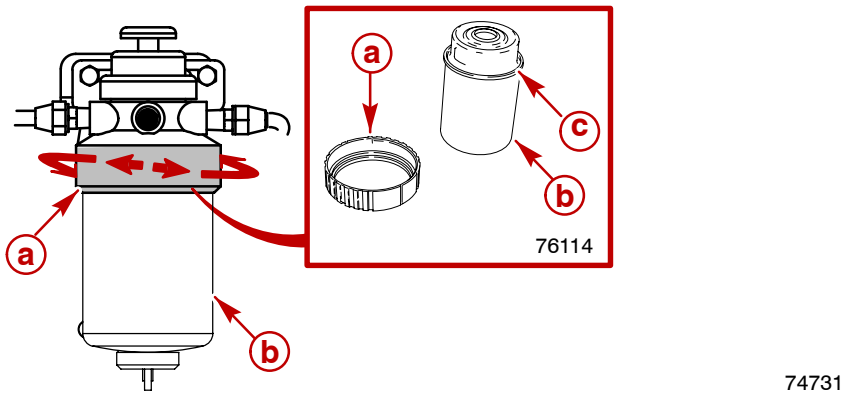
a - Filter
b - Drain Cap

2. Drain until fuel is clear in appearance. Close the drain cap by turning clockwise. Tighten securely.
3. Refer to **Filling** and fill the fuel filter.

Replacing

1. **On D4.2L, D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300 Models:**

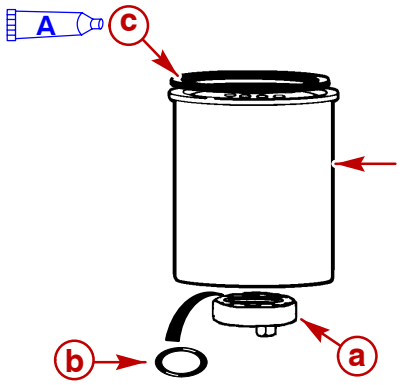
   a. Twist locking ring by hand. Remove water separating fuel filter and sealing ring from mounting bracket. Do not use a filter wrench.



   a - Locking ring
   b - Water separating fuel filter
   c - Sealing ring

   b. Remove the drain cap and O-ring from bottom of the existing filter. Install on new filter.

   c. Lubricate sealing ring on new filter.



   a - Drain cap
   b - O-ring
   c - Sealing ring

Description		Where Used	Part Number
A	SAE 30W engine oil	Water separating fuel filter sealing ring	Obtain locally

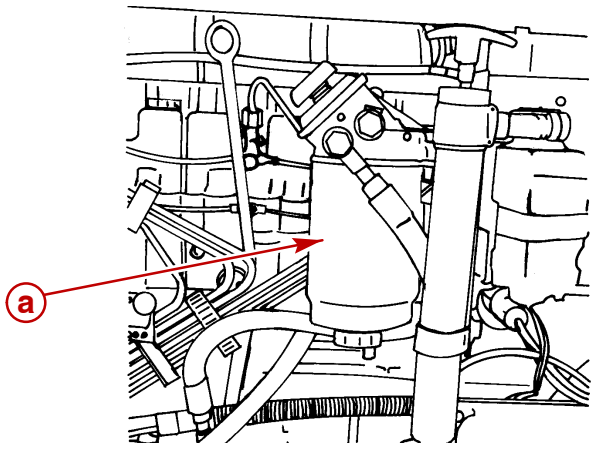
   d. Align filter to bracket. Twist locking ring by hand to secure filter to bracket. Do not use a filter wrench.

   e. Ensure bottom drain cap is securely tightened.

   f. Refer to Filling The Fuel Filter and fill the fuel filter. Check filter and drain cap for fuel leaks.

2. **On D4.2L LD and D4.2L 230 Models:**

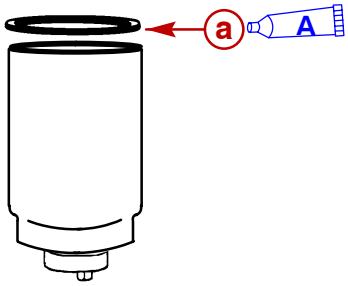
   a. Remove and discard water separating fuel filter and sealing ring from mounting bracket.



76379

a - Filter

   b. Coat sealing ring on new filter with clean motor oil.



76379

a - Sealing ring

Description		Where Used	Part Number
A	SAE 30W engine oil	Water separating fuel filter sealing ring	Obtain locally

   c. Thread filter onto bracket and tighten securely by hand. Do not use a filter wrench.

   d. Ensure bottom drain cap is securely tightened.

   e. Refer to **Filling** and fill the fuel filter. Check filter and drain cap for fuel leaks.

3. **On All Models:**

   a. Supply cooling water to water inlets.

   b. Start and operate the engine.

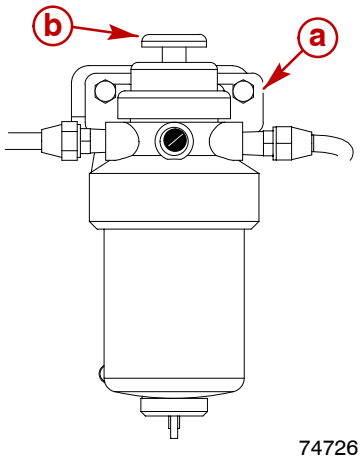
   c. Check filter connection for fuel leaks. If leaks exist, recheck filter installation.

   d. If leaks continue, stop engine immediately and contact your authorized Cummins MerCruiser Diesel dealer/distributor.

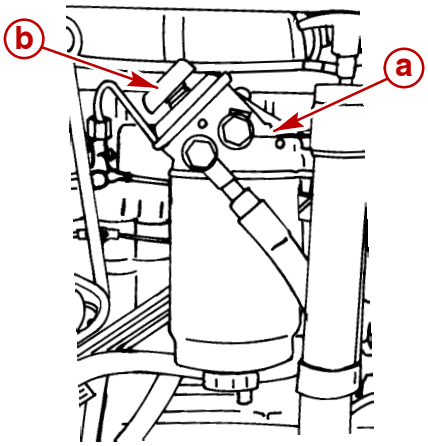
Filling

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.



D4.2L, D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300

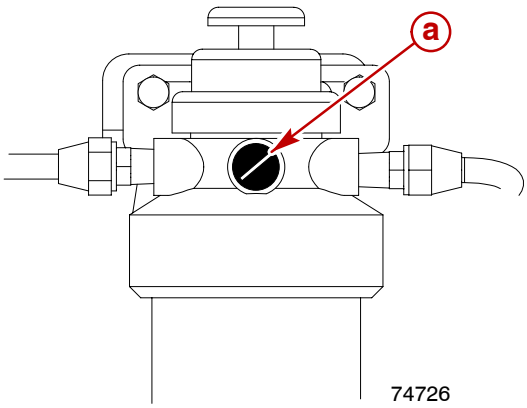


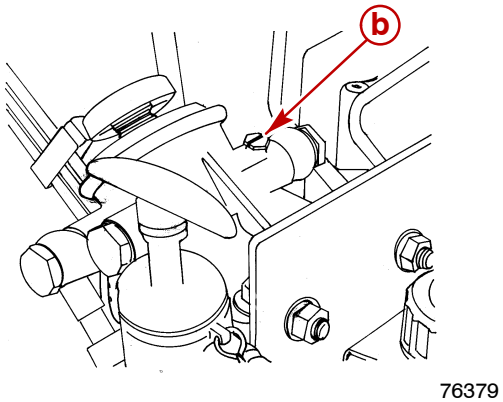
D4.2L LD and D4.2L 230

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.*

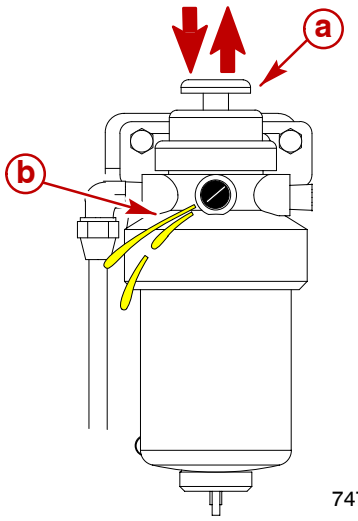
1. Loosen the bleed screw on fuel filter bracket.



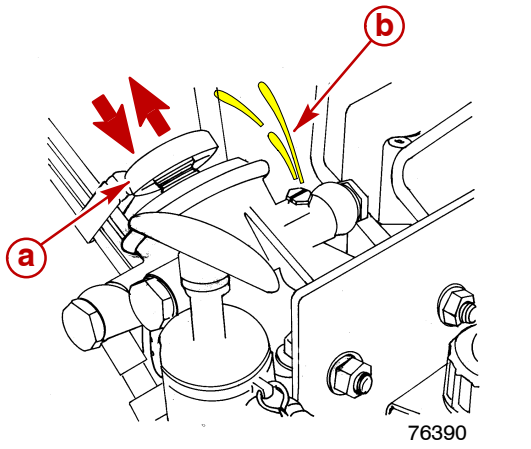


a - Bleed screw
b - Bleed screw

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.



D4.2L, D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300



D4.2L LD and D4.2L 230

a - Plunger
b - Fuel from bleed screw

3. Tighten the bleed screw.

Fuel System

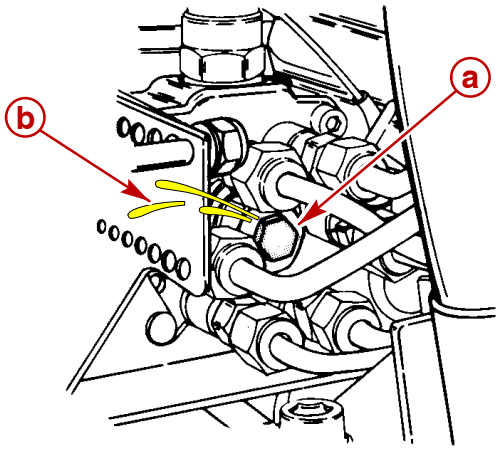
Priming

Prime engine if it has not been run for a while or if engine will not start. Move the hand pump/primer plunger up and down several times as previously outlined. Attempt to start engine.

Filling (Bleeding)

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

1. Refer to **Water Separating Fuel Filter - Filling** and fill the fuel filter.
2. Check filter and drain cap for fuel leaks. Ensure that bleed screw on fuel filter bracket is closed.
3. **D4.2L, D4.2L LD and D4.2L 230 only:**
   a. Loosen, do not remove, bleed screw on fuel injection pump (located between fuel line connection fittings on injection pump).



71371

a - Injection pump bleed screw
b - Fuel from bleed screw

   b. Continue to repeatedly move plunger on hand pump/primer, until an air-free stream of fuel flows from injection pump bleed screw.
   c. Tighten bleed screw.

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

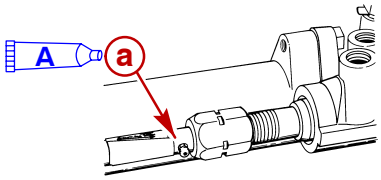
Steering System

⚠ 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.*

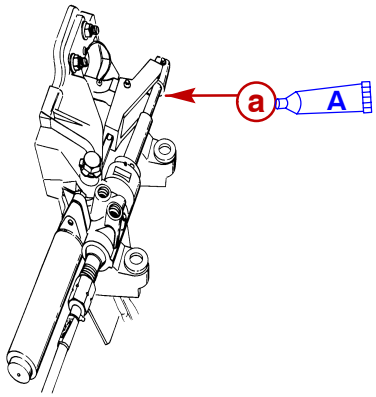


71903

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.

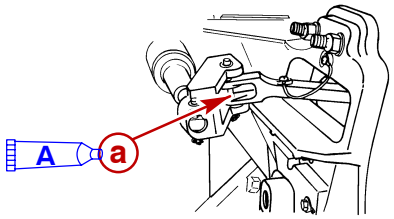


71901

a - Extended steering cable

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

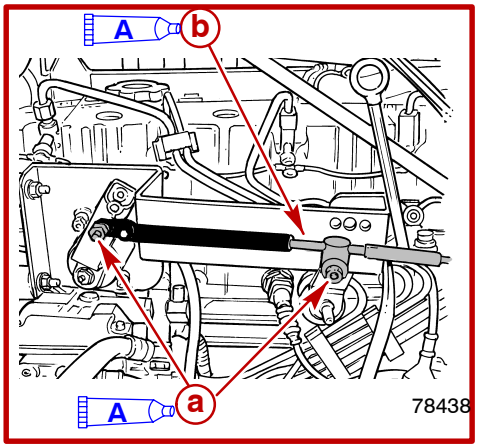
4. **On dual engine boats:** Lubricate the tie bar pivot points.

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

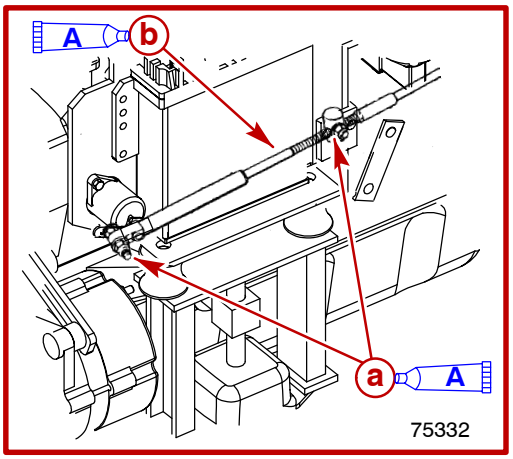
5. Upon first starting engine, turn steering wheel several times to starboard and then port to ensure that the steering system operates properly before getting underway.

Throttle Cable

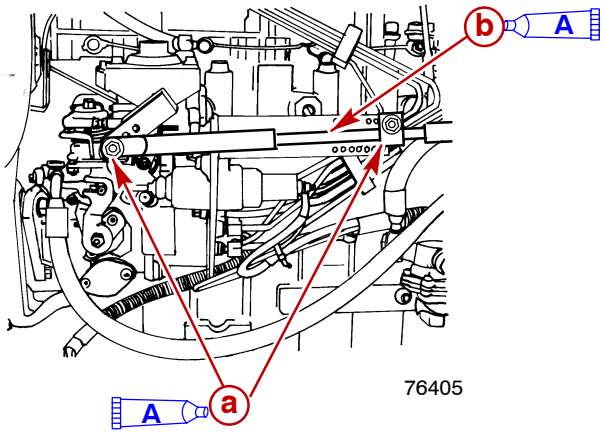
1. Lubricate the pivot points and the guide contact surfaces.



D4.2L 300 With Rear Mounted ECM



D2.8L D-Tronic, D4.2L D-Tronic and D4.2L 300 With Front Mounted ECM



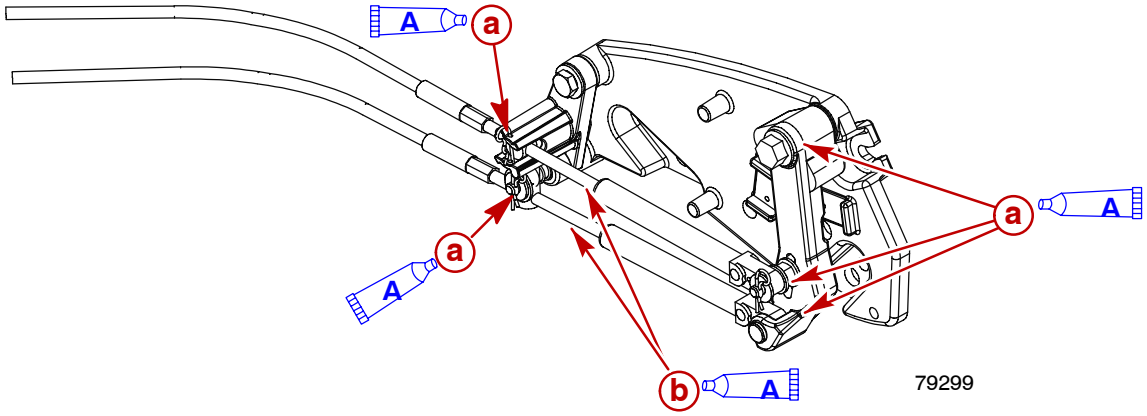
D4.2L, D4.2L LD and D4.2L 230

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.



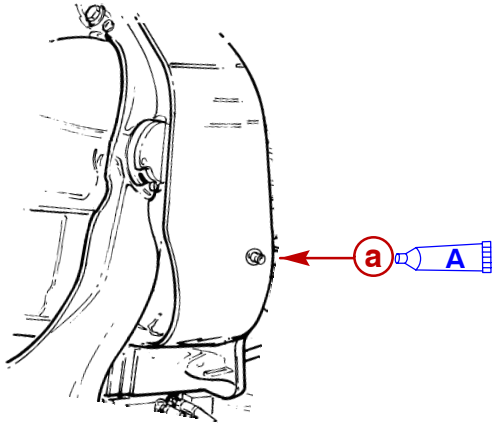
Typical

a - Pivot points
b - Guide contact surfaces

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

Sterndrive Unit and Transom Assembly

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



77068

a - Gimbal bearing grease fitting

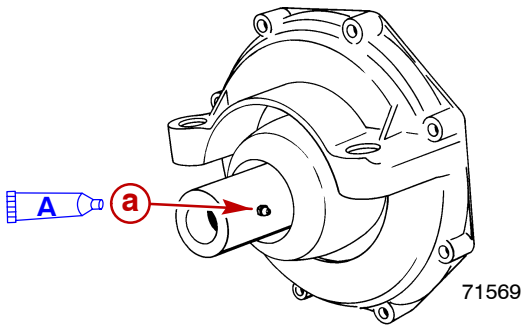
Description		Where Used	Part Number
A	U-joint And Gimbal Bearing Grease	Gimbal bearing	92-802870A1

2. For propeller shaft lubrication, refer to Propeller.

Engine Coupler

1. Lubricate the engine coupler splines through the grease fittings on the 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

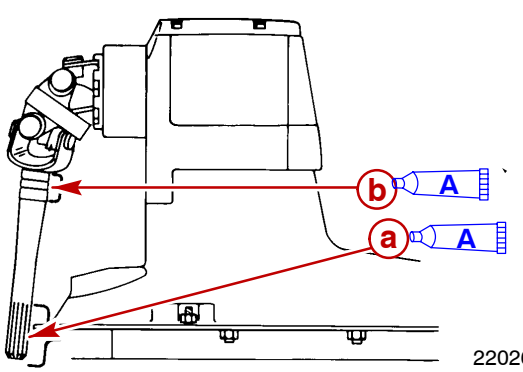
a - Engine coupler grease fitting

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

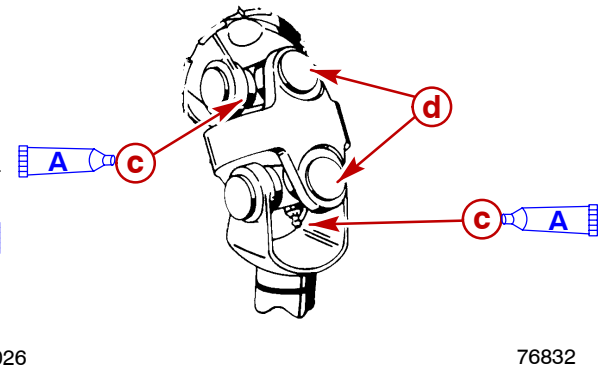
Sterndrive U-joint Cross Bearings And Shaft Splines (Sterndrive Unit Removed)

1. Lubricate the sterndrive U-joint cross bearings through the grease fittings by applying approximately 3-6 pumps of grease from a typical hand-operated grease gun.

2. Lubricate the U-joint shaft splines and the O-rings.



22026



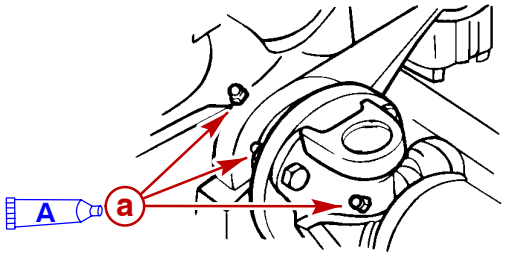
76832

a - U-joint shaft splines
b - U-joint shaft O-rings
c - Grease fittings
d - Cross bearing assemblies

Description		Where Used	Part Number
A	Engine Coupler Spline Grease	U-joint shaft splines and O-rings	92-802869A1
		Cross bearings grease insert	

Drive Shaft Extension Models

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

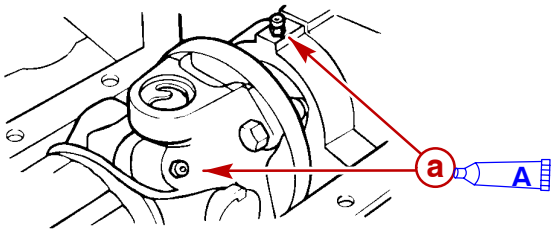


71346

a - Grease fittings

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

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



71347

a - Grease fittings

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

Propellers

Bravo One and Two

REMOVAL

⚠ WARNING

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

⚠ WARNING

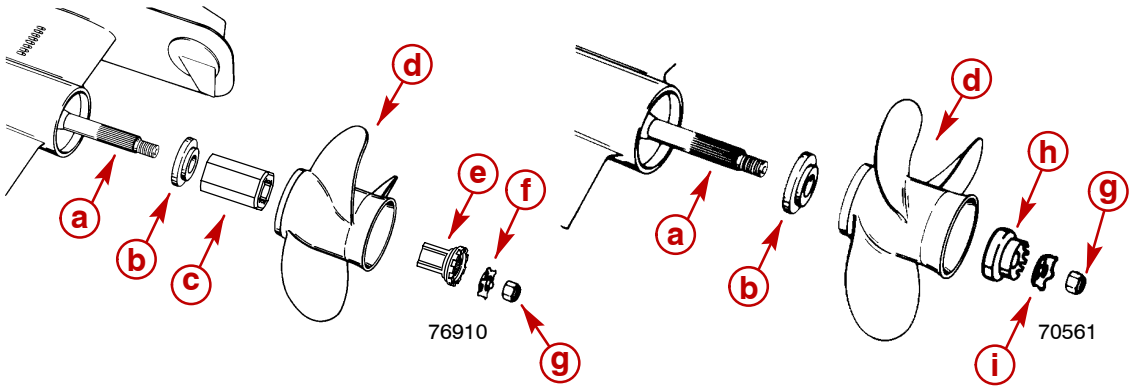
Avoid Injury: Place a block of wood between anti-ventilation plate and propeller to protect hands from propeller blades and to prevent propeller from rotating when removing propeller nut.

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

REPAIR

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

INSTALLATION



Bravo One

- **a** - Propeller shaft
- **b** - Thrust hub
- **c** - Flo-Torque II drive hub
- **d** - Propeller
- **e** - Drive sleeve

Bravo Two

- **f** - Locking tab washer
- **g** - Propeller nut
- **h** - Spline washer
- **i** - Tab washer

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 into propeller hub with stepped side toward propeller hub.
3. **Bravo One:** 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 final attaching hardware.
   a. **Bravo One:** Install drive sleeve adapter and locking tab washer.
   b. **Bravo Two:** Install spline washer and tab washer.

⚠ CAUTION

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

6. Install and torque the propeller nut.

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

[1] The propeller torque stated is the minimum torque value.

7. Bend 3 tabs on the tab washer down into the grooves in spline washer. After the first use, bend the 3 tabs straight and retorque 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.

Bravo Three

REMOVAL

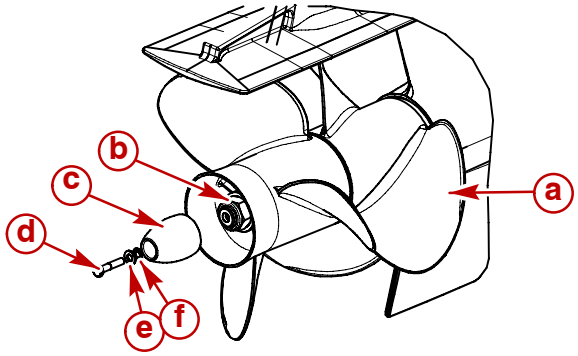
⚠ WARNING

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.

1. Place wood block between propeller blades and anti-ventilation plate to prevent rotation.
2. Remove the bolt and washers securing the propeller nut anode.
3. Remove the propeller nut anode.



79161

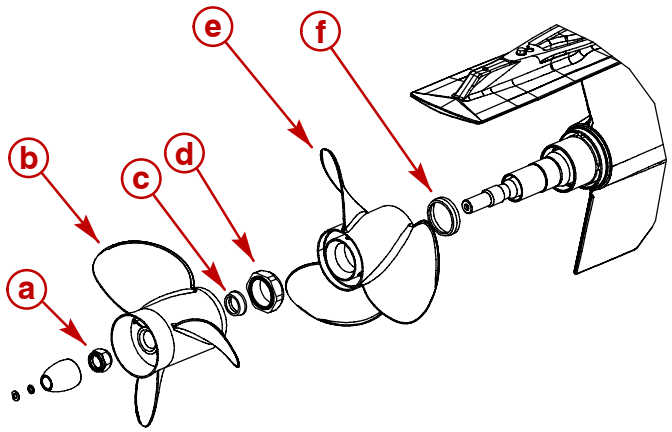
a - Propeller
b - Propeller shaft nut
c - Propeller shaft anode
d - Propeller shaft anode screw
e - Flat washer
f - Star washer

4. Turn aft propeller shaft nut (1-7/16 in. or 37 mm) counterclockwise to remove nut.
5. Slide propeller and thrust hub off propeller shaft.
6. Turn front propeller shaft nut (2-3/4 in. or 70 mm) counterclockwise to remove nut.
7. Slide propeller and thrust hub off propeller shaft.

REPAIR

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

INSTALLATION



77107

a - Rear propeller nut
b - Rear propeller
c - Rear propeller thrust hub
d - Front propeller nut
e - Front propeller
f - Front propeller thrust hub

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 forward thrust hub onto propeller shaft with tapered side toward propeller hub (toward end of shaft).
3. Align splines and place propeller on propeller shaft.
4. Install and torque the propeller nut. Check propeller at least every 20 hours of operation and retorque as needed.

Description	Nm	lb-in.	lb-ft
Forward Propeller Nut[1]	136		100

[1] The propeller torque stated is the minimum torque value.

5. Slide aft thrust hub onto propeller shaft, with tapered side toward propeller hub (toward end of shaft).
6. Align splines and place propeller on propeller shaft.

⚠ CAUTION

Avoid Injury: Periodically check propeller nut for tightness during boating season. A minimum of 60 lb-ft (81 Nm) torque is required.

7. Install and torque the propeller nut. Check propeller at least every 20 hours of operation and retorque as needed.

Description	Nm	lb-in.	lb-ft
Aft Propeller Nut[1]	81		60

[1] The propeller torque stated is the minimum torque value.

8. Install the propeller shaft anode over the propeller shaft nut.
9. Place the flat washer onto the propeller shaft anode screw.
10. Place the star washer onto the propeller shaft anode screw.

NOTE: *If the propeller shaft anode is removed after initial installation and is to be reinstalled, it will be necessary to apply Loctite Thread Locker 271 to the threads of the propeller shaft anode screw.*

11. Secure the propeller shaft anode to the propeller shaft using the propeller shaft anode screw and washers. Torque the screw.

Description	Nm	lb-in.	lb-ft
Propeller shaft anode screw 0.3125-18 x 1.5 in. (38 mm) long	27		20

Drive Belts - All Engines

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.

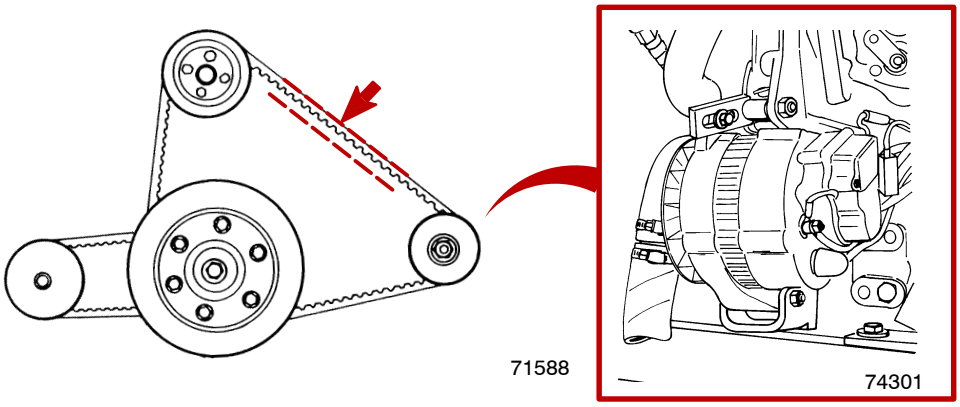
IMPORTANT: On models with dual-row pulleys and dual belts always inspect both belts. Never renew just one of the two belts driving the alternator and engine water circulating pump. Always replace both belts as a pair, preferably as a matched pair.

⚠ WARNING

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

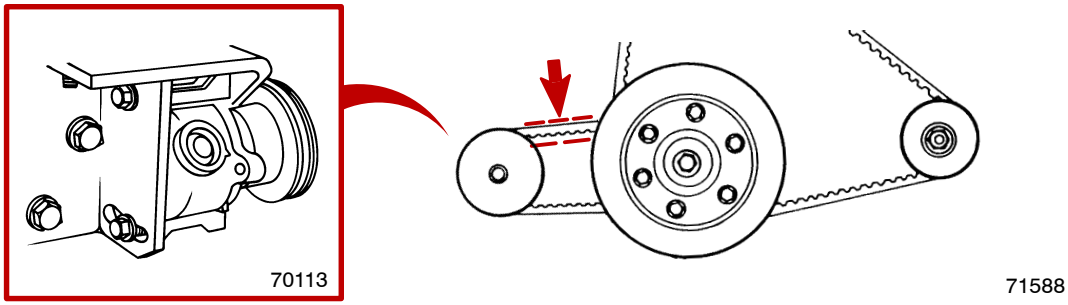
Alternator Drive Belt and Engine Water Circulating Pump Belt, or Belts

1. Inspect drive belt, or belts, for excessive wear or damage.
2. Check belt tension by depressing upper strand of belt, with moderate hand pressure, at point shown. Belt should move no more than 5 mm (3/16 in.) either way.



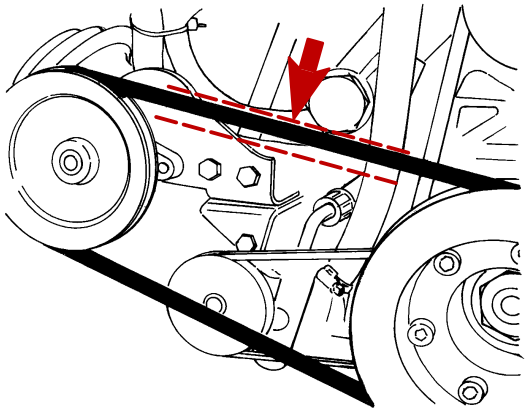
Power Steering Pump Belt

1. Inspect drive belt for excessive wear or damage.
2. Check belt tension by depressing upper strand of belt, with moderate hand pressure, at point shown. Belt should move no more than 5 mm (3/16 in.) either way.



Vacuum Pump Belt (If Equipped)

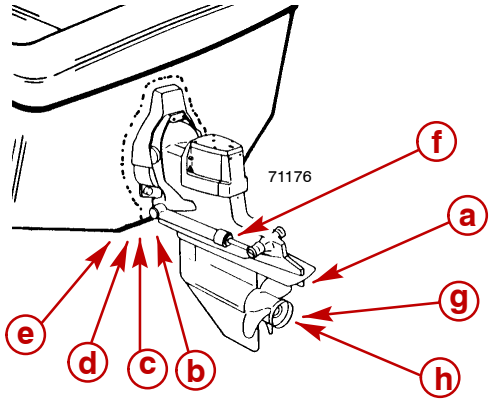
1. Inspect drive belt for excessive wear or damage.
2. Check belt tension by depressing upper strand of belt, with moderate hand pressure, at point shown. Belt should move no more than 5 mm (3/16 in.) either way.



Corrosion Protection

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.

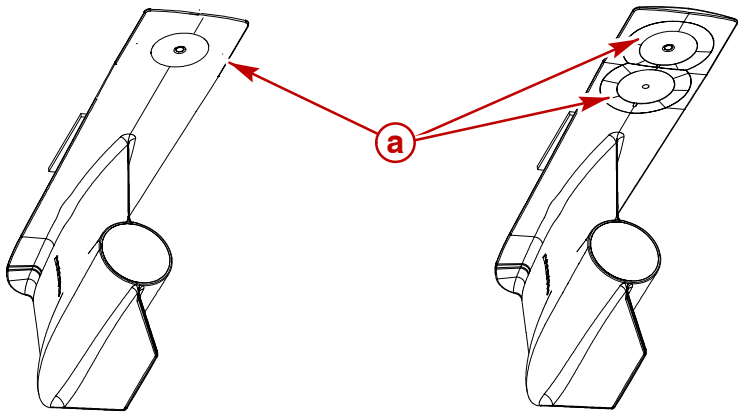
To help control the effects of galvanic corrosion, Cummins MerCruiser Diesel sterndrive units come with several sacrificial anodes and other corrosion protection devices. For a more comprehensive explanation of corrosion and corrosion protection refer to the ***Marine Corrosion Protection Guide*** (90-88181301).



a - Gearcase anodic plate
b - Ventilation Plate Anode
c - Drive mounted anodic block
d - MerCathode system
e - Anode kit
f - Trim cylinder anodes
g - Bearing carrier anode
h - Propshaft anode

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

Gearcase Anodic Plate - Is mounted on the underside of the lower gearcase and serves as a sacrificial anode.

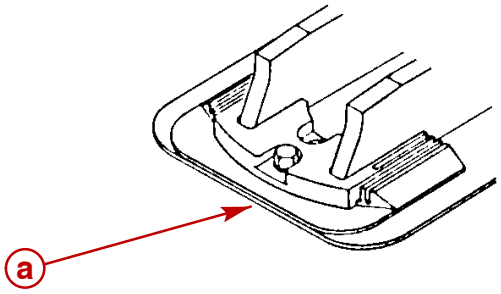


Alpha, Bravo One and Bravo Two Models

Bravo Three Models

a - Anode

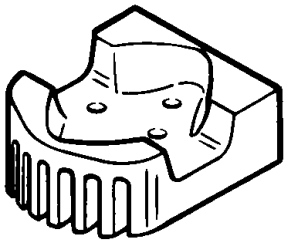
Ventilation Plate Anode - Is mounted on the front of the gearcase and serves as a sacrificial anode.



All Bravo Models

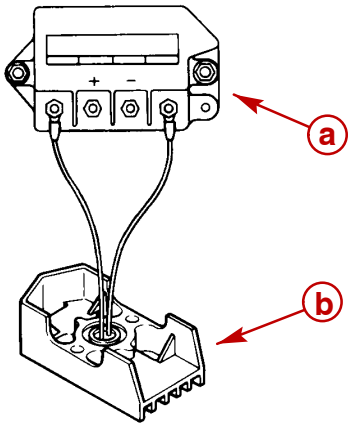
a - Anode

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



70576

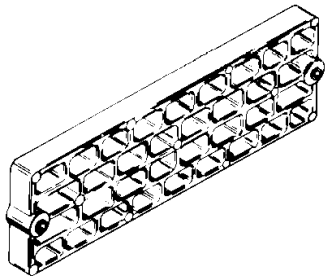
MerCathode System (if equipped) - Electrode assembly replaces Anodic Block. System should be tested to ensure adequate output. The test should be performed where boat is moored, using Quicksilver Reference Electrode and Test Meter. Contact your authorized Cummins MerCruiser Diesel dealer / distributor.



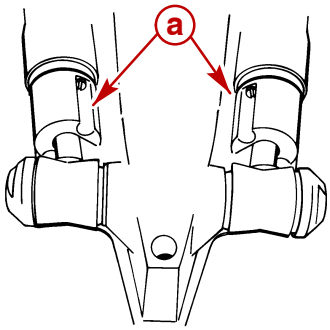
70578

a - MerCathode controller
b - Anodic block

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



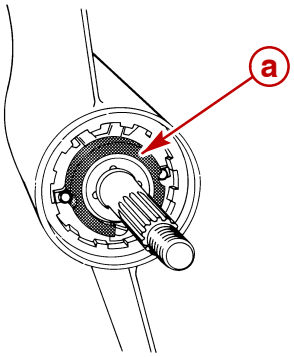
Trim Cylinder Anodes - are mounted on each trim cylinder.



71966

a - Trim cylinder anodes

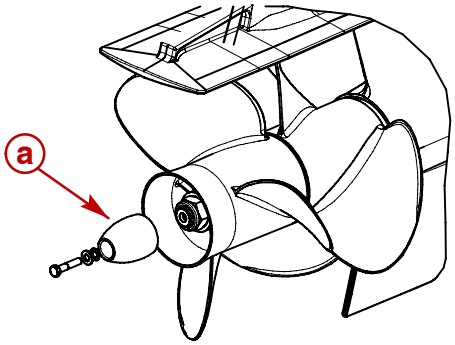
Bearing Carrier Anode (Bravo One Models) - is located in front of the propeller, between the front side of the propeller and the gear housing.



72032

a - Bearing carrier anode

Propshaft Anode (Bravo Three Only) - is located in front of the propeller, between the front side of the propeller and the gear housing.



79161

a - Propshaft anode

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.

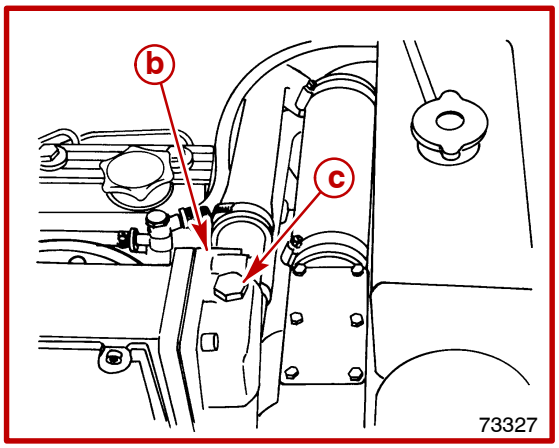
Internal Components

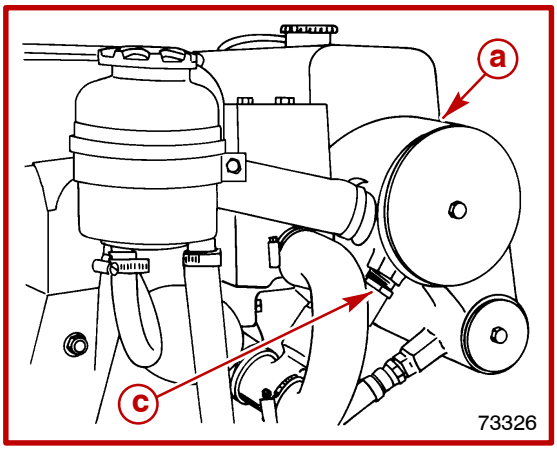
Sacrificial anode locations:

- Starboard, aft-side of the heat exchanger.
- Top of the intercooler end cover.

REMOVAL

1. Allow the engine to cool.
2. Remove anode plugs and sacrificial anodes.





a - Heat Exchanger
b - Intercooler End Cover
c - Anode Plug And Sacrificial Anode

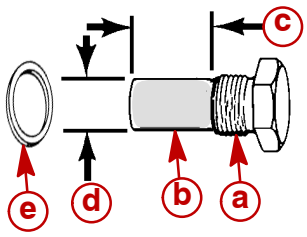
INSPECTION

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

1. Replace anode assembly when deteriorated 50%.

- Length When New - 19 mm (3/4 in.)
- Diameter When New - 16 mm (5/8 in.)

2. Discard sealing washer.



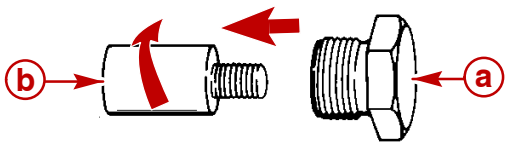
71368

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.

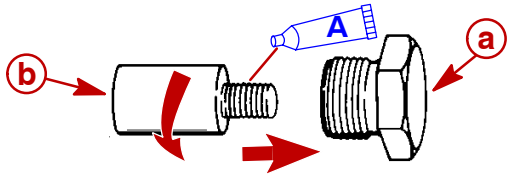


71367

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.



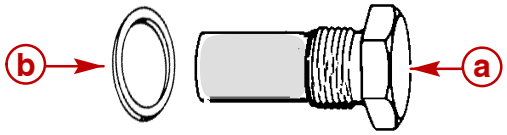
71367

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 and washer into heat exchanger or intercooler end cover. Tighten securely.



71368

a - Plug And Anode
b - Sealing Washer

⚠ CAUTION

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

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

Painting Your Power Package

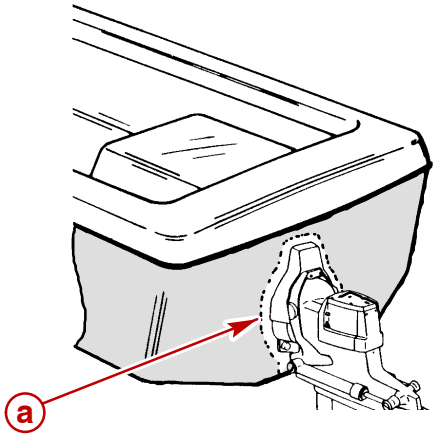
IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint will not be covered by the limited warranty.

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.

Cleaning The Seawater Strainer

1. Visually inspect seawater strainer through glass top.

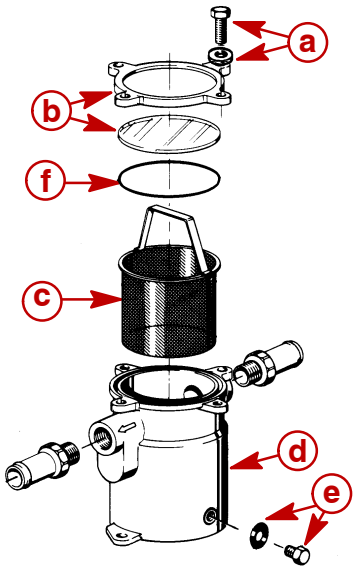
⚠ CAUTION

When cleaning seawater strainer, 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 drain holes or removed hoses.

⚠ CAUTION

Do not overtighten cover screws or cover will warp and leak.

2. With engine off, close seacock (if equipped) or remove and plug seawater inlet hose if no seacock exists.
3. Remove screws, washers, and cover.
4. Remove strainer, drain plug and washer.
5. Clean all debris from strainer housing; flush both strainer and housing with clean water.
6. Check gasket and replace when necessary (if it leaks).
7. Reinstall strainer, drain plug and washer.
8. Reattach cover with screws and washers.
9. Open the seacock (if equipped) or remove the plug and reconnect the seawater inlet hose.
10. After starting engine, check for leaks and/or air in system, which would indicate an external leak.



78157

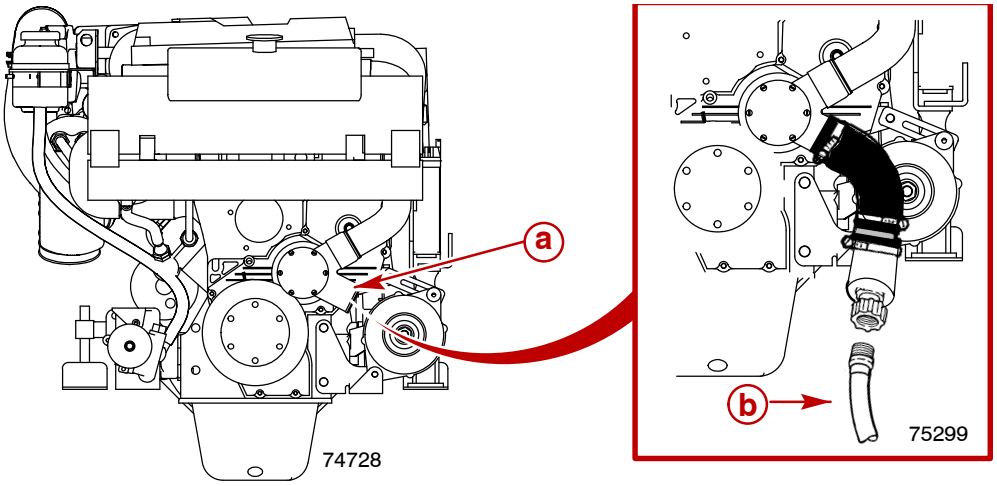
a - Screws and Washers
b - Cover, with glass
c - Strainer
d - Housing
e - Drain Plug and Sealing Washer Gasket

Flushing The Seawater System

Seawater section must be flushed after each operation in saltwater.

IMPORTANT: Engines with the sterndrive water inlet blocked off at the gimbal housing and using a through the hull water inlet, need a supply of cooling water available to both the sterndrive unit and to the engine during operation.

On Engines With Through The Hull Water Inlet: Supply sufficient cooling water to the seawater pump. Attach a hose between the sea pump and a water source.



a - Seawater pump
b - Hose

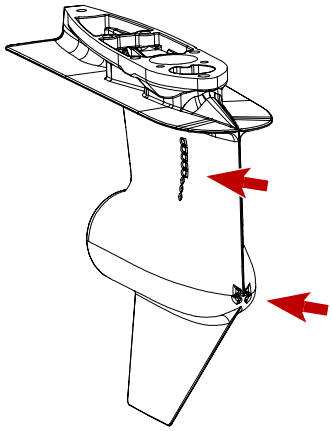
⚠ WARNING

When flushing, ensure the area around propeller is clear and no one is standing nearby. To avoid possible injury, remove propeller.

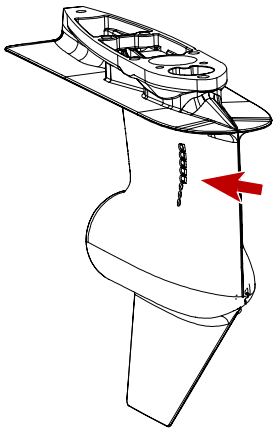
1. Ensure the area around propeller is clear and no one is standing nearby. To avoid possible injury, remove the propeller.
2. Install Flushing Attachment (or equivalent) over water pickup openings in gear housing.

⚠ CAUTION

<u>If using flush test device (attachment),</u> install over water intake holes and connect a water hose. Do not use full water tap pressure. Also, do not operate engine above 1500 rpm, as suction created could cause water hose to collapse causing water supply to be cut off.

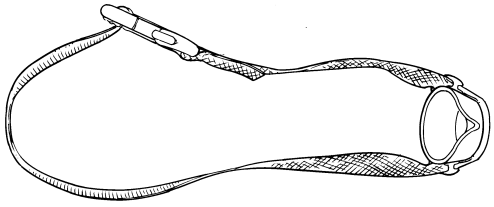


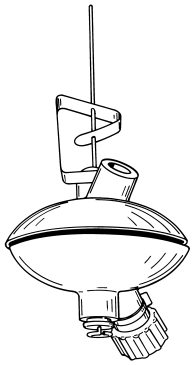
Dual water pickup



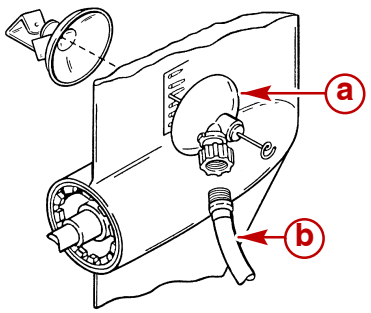
77899

Side pickup

Dual Water Pick-Up Flush Gear Case Seal Kit	**91-881150Q1**
Description: Use to block-off the front water inlet holes on the dual water inlet gear cases.	 77977

Flushing Device	**91-44357Q2**
Description: Attaches to the drive unit water intakes, provides a fresh water connection when flushing the cooling system or operating the engine.	 73440

3. Attach a hose between the flushing attachment and a water source.



72012

Typical

a - Flushing Attachment
b - Hose

4. Lower sterndrive unit to full DOWN/IN position.
5. Partially open water tap (approximately 1/2 maximum capacity). Do not use full water pressure.
6. Place remote control in NEUTRAL, IDLE speed position and start engine.

⚠ CAUTION

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

7. Operate engine at IDLE speed in NEUTRAL for 10 minutes, then stop engine.
8. Shut off water tap.
9. If boat is in the water, raise sterndrive unit to TRAILER position.
10. Remove hose and flushing attachment.

SECTION 6 - STORAGE

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Cold Weather Or 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 Mercury MerCruiser Limited Warranty.

⚠ CAUTION

Seawater 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. Damage caused by freezing is NOT covered by the Mercury MerCruiser Limited Warranty.

IMPORTANT: Cummins MerCruiser Diesel recommends that propylene glycol antifreeze (a nontoxic and environmentally safe) antifreeze be used in the seawater section of the cooling system for cold weather 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.

Preparing Your Power Package For Storage

⚠ CAUTION

The engine must be prepared for long storage periods to prevent internal corrosion and severe damage.

IMPORTANT: If boat has already been removed from water, before starting engine a source of water must be supplied to water intake (inlet) openings. Follow all warnings and flushing attachment procedures stated in "FLUSHING COOLING SYSTEM".

⚠ CAUTION

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

1. Start the engine and operate until it reaches normal operating temperature.
2. Stop the engine. Change the oil and filter.
3. Start the engine and run for about 15 minutes. Check for oil leaks.
4. Flush the seawater cooling system. Refer to SECTION 5 - Flushing The Seawater System.

Draining Instructions

IMPORTANT: Observe the following information to ensure complete draining of cooling system:

- **Engine must be as level as possible.**
- **A wire should be repeatedly inserted into all drain holes to ensure there are no obstructions in passages.**

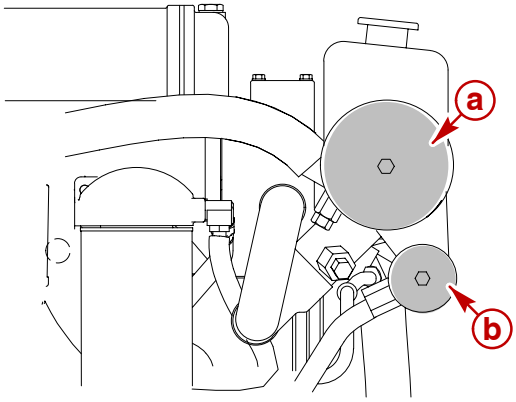
IMPORTANT: Drain seawater section of closed cooling system only.

1. Close seacock, if equipped, or disconnect and plug seawater inlet hose, if boat is to remain in the water.

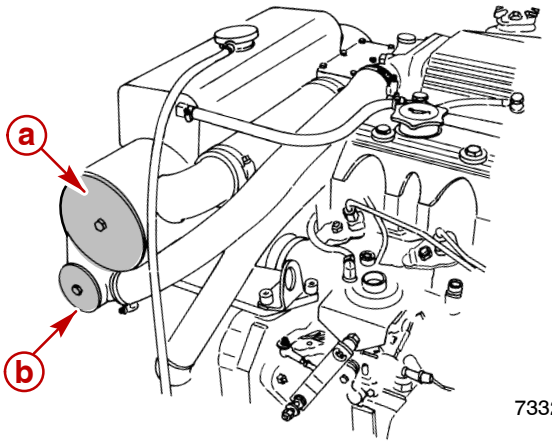
⚠ CAUTION

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.

2. Remove the end covers from BOTH port and starboard ends of upper and lower sections of heat exchanger tank.
3. Drain tank completely.
4. Use compressed air, sponge-out or soak-up any water that remains in the bottom part of each section, until all water passage tubes are completely free of standing water.



74732

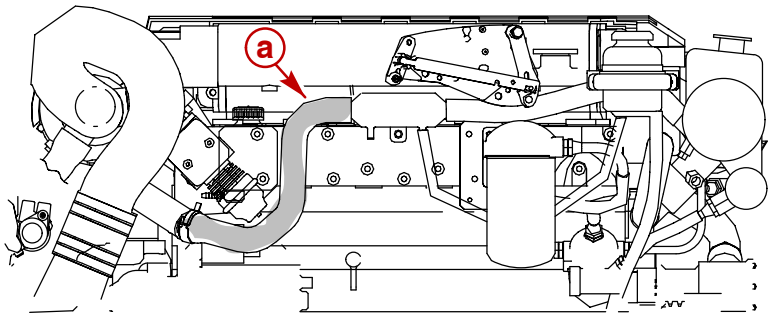


73322

a - Upper end cover
b - Lower end cover

NOTE: *In the following steps, it may be necessary to lower or bend the hoses to allow water to drain completely.*

5. Disconnect seawater outlet hose at aft end of power steering cooler. Lower hose and drain completely.

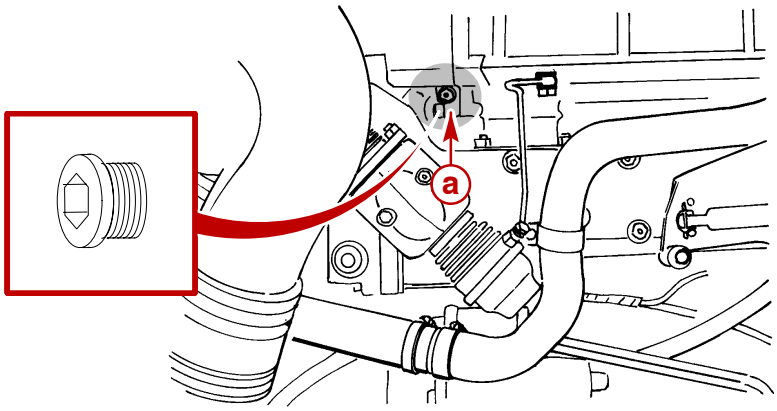


861076

Typical

a - Seawater outlet hose

6. Remove the drain plug from the aft end cover of the intercooler.

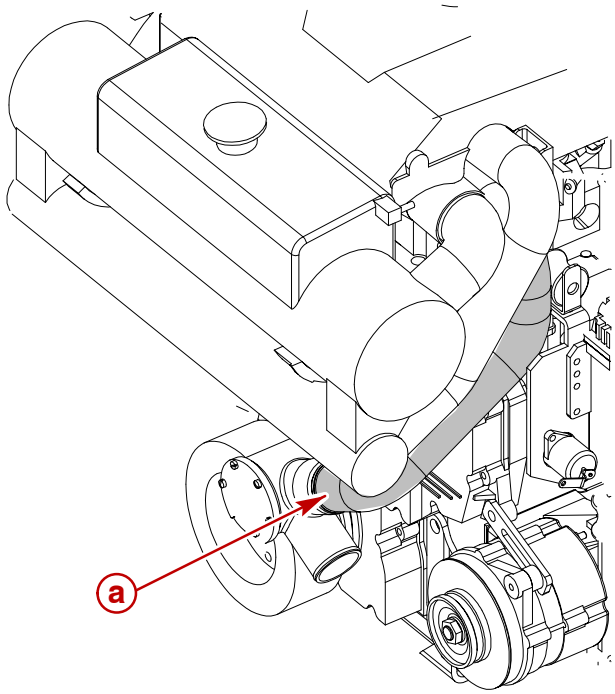


74303

Typical

a - Drain plug

7. Remove the seawater pump outlet hose from top of seawater pump. Drain the hose.



75301

D4.2L D-Tronic Engine (All Similar)

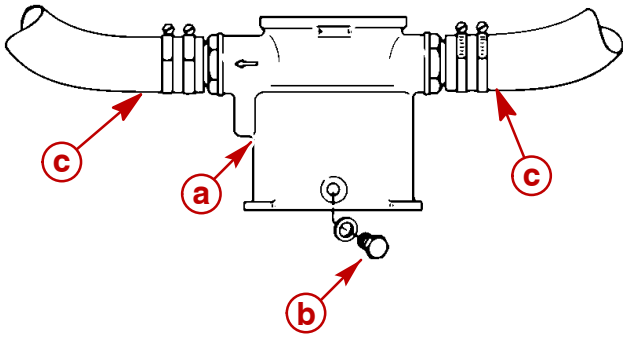
a - Seawater pump outlet hose

8. Repeatedly clean out drain holes using a stiff piece of wire. Do this until entire system is drained.

⚠ CAUTION

Avoid water entering boat. Do not unplug seawater inlet hose unless a seacock is present and it is closed.

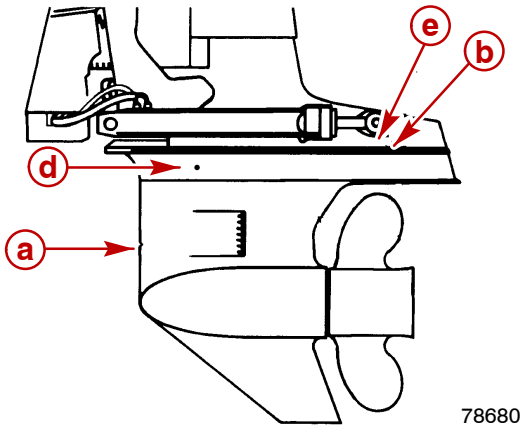
9. Remove hose at seawater strainer and drain hose completely. Drain and empty seawater strainer. Reconnect hose and tighten hose clamps securely. Install washer and drain plug.



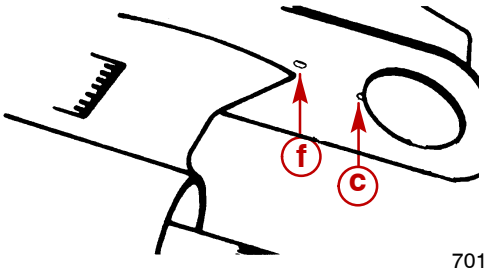
71362

a - Seawater strainer
b - Drain plug and washer
c - Hose

10. 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

11. After seawater section of cooling system has been drained completely, coat threads of intercooler drain plug with sealant and install. Tighten plug securely.

Description	Where Used	Part Number
Perfect Seal	Intercooler drain plug threads	92-34227-1

12. Reconnect hoses. Tighten hose clamps securely.
13. Replace end cover gaskets and seals if worn or deteriorated. Install all four end cover assemblies on the heat exchanger.
14. Torque the end covers on the upper and lower heat exchanger sections.

Description	Nm	lb-in.	lb-ft
Upper heater exchanger end covers	14-15	120-132	
Lower heat exchanger end covers	11-14	108-120	

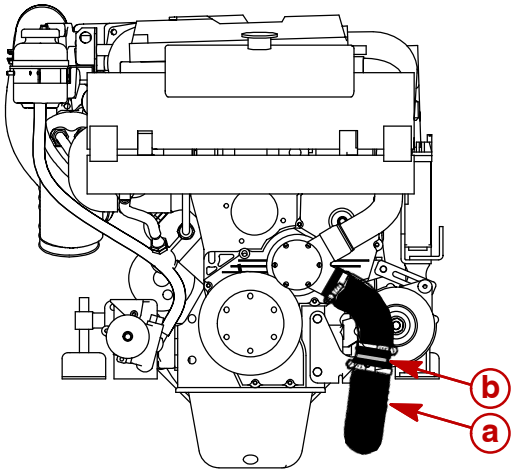
⚠ CAUTION

Sterndrive unit should be stored in full DOWN / IN position. Universal joint bellows may develop a set if unit is stored in the raised position and may fail when unit is returned to service.

15. Store boat with sterndrive unit in full DOWN / IN position.

IMPORTANT: Cummins MerCruiser Diesel recommends that propylene glycol antifreeze (nontoxic and biodegradable, which makes it friendly to lakes and rivers) be used in seawater section of the cooling system for cold weather 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.

16. 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.
17. Disconnect hose from seawater pump connector fitting. Using an adaptor, temporarily connect an appropriate length piece of hose to seawater pump and place the other end of the hose into container of coolant.



75299

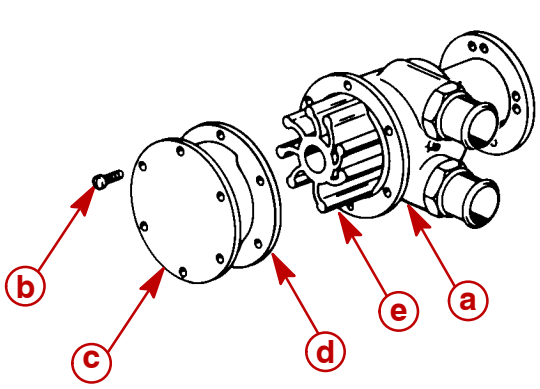
Typical

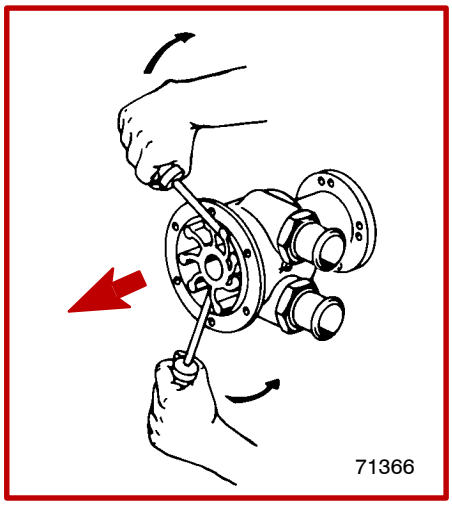
a - Inlet Hose
b - Connector Fitting

18. Start the engine and operate, at IDLE speed, until antifreeze mixture has been pumped into engine seawater cooling system.
19. Stop the engine.
20. Clean the engine.
21. Coat the engine with Quicksilver Corrosion Guard or equivalent corrosion inhibiting oil.
22. Lubricate all items outlined in Maintenance - Lubrication.
23. Perform all checks, inspections, lubrication and fluid changes outlined in the Maintenance Schedules.

24. Remove the seawater pump impeller for storage:
    a. Remove the seawater pump cover mounting screws, and remove the cover and gasket.
    b. Ease the impeller off the pump shaft with two screwdrivers.
    c. Reinstall the cover for storage.

NOTE: *Pump shown removed for visual clarity only.*





Typical

- **a** - Seawater Pump Housing
- **b** - Cover Screws
- **c** - Cover
- **d** - Gasket
- **e** - Impeller

IMPORTANT: It is recommended that others be informed to NOT operate the engine.

25. Place a CAUTION TAG at instrument panel and in engine compartment stating that the seawater pump is out - Do NOT operate engine.

⚠ CAUTION

Sterndrive unit should be stored in full DOWN / IN position. Universal Joint bellows may develop a set if unit is stored in raised position and may fail when unit is returned to service.

26. Place sterndrive unit in the full DOWN / IN position.

Battery

Follow the battery manufacturer's instructions for storage.

Recommissioning

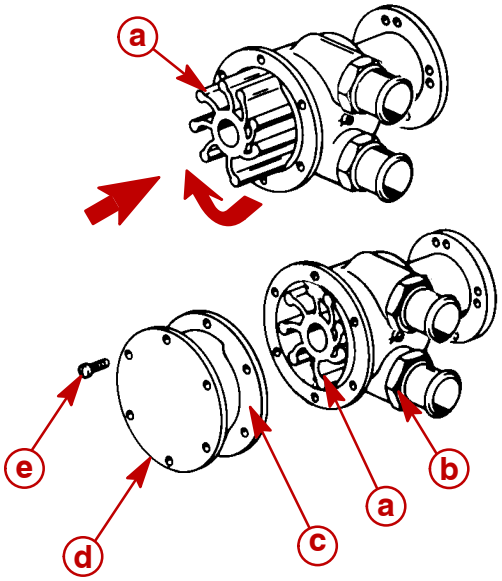
NOTICE
Refer to Cold Weather Extended Storage - Precautions, BEFORE proceeding.

1. Reinstall seawater pump components as follows:
   a. Place impeller in pump housing, turning clockwise while simultaneously pushing firmly inward onto pump shaft.

NOTE: *Use new gasket. Install in correct position - wide surface on side of cam.*

   b. Install pump cover with new gasket in noted position.
   c. Install the seawater pump cover mounting screws. Tighten securely.

NOTE: *Pump shown removed for visual clarity only.*



71366

a - Impeller
b - Seawater Pump Housing
c - Gasket (Wide Surface On Cam Side)
d - Cover
e - Cover Screws

2. Ensure that all cooling system hoses are in good condition, connected properly, and hose clamps are tight. 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 drive 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. Coat terminals with a battery terminal anti-corrosion spray to help retard corrosion.
9. Perform all checks on OPERATION CHART in the STARTING PROCEDURE column found in the Operation, Maintenance and Warranty Manual provided with the product.

⚠ CAUTION

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

10. Supply cooling water to the water inlet openings.

IMPORTANT: On all models except EDI (D-Tronic) models: 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.

11. **On all models except EDI (D-Tronic) models:** Pre-lubricate the engine and turbocharger, if necessary. Refer to above Important information.
12. Start the engine and closely observe instrumentation. Ensure that all systems are functioning correctly.
13. Carefully inspect the engine for fuel, oil, fluid, water and exhaust leaks.
14. Check the steering system, shift and throttle control for proper operation.

SECTION 7 - TROUBLESHOOTING

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7

Diagnosing EDI Problems

Your authorized Cummins MerCruiser Diesel dealer / distributor has the proper service tools for diagnosing problems on Electronic Diesel Injection (EDI) systems. The Electronic Control Module (ECM) on these engines has the ability to detect some problems with the system when they occur, and store a Trouble Code in the ECM's memory. This code can then be read later by a service technician using a special diagnostic tool.

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.
Faulty mechanical fuel delivery pump.	Have pump replaced by an authorized Cummins MerCruiser Diesel dealer / distributor, if fuel is present.
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	Have an authorized Cummins MerCruiser Diesel dealer / distributor service the glow plug system.
EDI System fault.	Have EDI System checked 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.
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 system.	Purge fuel injection system.
EDI System fault.	Have EDI System checked by an authorized Cummins MerCruiser Diesel dealer / distributor.

Poor Performance

Possible Cause	Remedy
Throttle not fully open.	Inspect throttle cable and linkages for proper operation.
Damaged or improper propeller.	Replace propeller. See an authorized Cummins MerCruiser Diesel dealer / distributor.
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.
EDI System fault.	Have EDI System checked 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.	Replace. See 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	Clean heat exchanger. See an authorized Cummins MerCruiser Diesel dealer / distributor.
Loss of pressure in closed cooling section.	Check for leaks. Clean, inspect and test pressure cap. See an authorized Cummins MerCruiser Diesel dealer / distributor.
Faulty seawater pickup pump.	Repair. See an authorized Cummins MerCruiser Diesel dealer / distributor.
Seawater discharge restricted or plugged.	Clean exhaust elbows. See 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 thermostats.	Replace. See 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 and/or adjust.
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 authorized Cummins MerCruiser Diesel dealer / distributor immediately.
Shift or throttle cable kinked.	Straighten cable or have 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.
Vacuum leak at shift cylinder, hose or fittings of Power Shift Assembly, if so equipped	Repair cut, pinched, or kinked hose or faulty shift cylinder.

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 Doesn’t 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. See an authorized Cummins MerCruiser Diesel dealer / distributor.
Drive unit binding in gimbal ring.	Check for obstruction. See an authorized Cummins MerCruiser Diesel dealer / distributor.

NOTES:

SECTION 8 - CUSTOMER ASSISTANCE INFORMATION

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8

Owner Service Assistance

Local Repair Service

Always return your Cummins MerCruiser Diesel (CMD®) powered boat to your authorized dealer should the need for service arise. Only he 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. He knows your engine best.

* Quicksilver parts and accessories are engineered and built especially 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 dealer. 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 number(s) and to whom the recovery is to be reported. This information about the stolen motor is placed into a file at Cummins MerCruiser Diesel to aid authorities and dealers / distributors in recovery of stolen motors.

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.

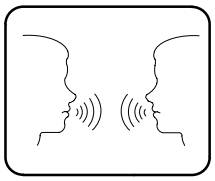
These are but a few of the many special modifications that are required in Cummins MerCruiser Diesel marine engines to provide long life and dependable performance.

Parts And Accessories Inquiries

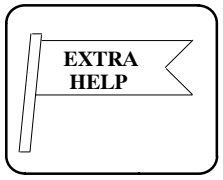
All inquiries concerning Quicksilver replacement parts and accessories should be directed to your local authorized dealer. The dealer has the necessary information to order parts and accessories for you should he not have them in stock. Only authorized dealers can purchase genuine Quicksilver parts and 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 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 kielet

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.

Αλλες 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.