Declaration of Conformance—Cummins MerCruiser Diesel

This sterndrive or inboard engine when installed in accordance with Cummins MerCruiser Diesel instructions complies with the requirements of the following directives by meeting the associated standards, as amended:

Recreational Craft Directive 94/25/EC; 2003/44/EC

Applicable Requirement	Standards Applied
Handling characteristics (A.4)	ISO 8665
Inboard engine (A.5.1.1)	ISO 15584; ISO 10088; ISO 7840; ISO 10133
Steering system (A.5.4)	Applicable portions of: ISO 10592, ISO 8848 and ABYC P-17
Exhaust emission requirements (B.2)	ISO 8178
Owner's manual (B.4)	ISO 8665
Noise emission levels (C.1) (sterndrive CE marked products only)	ISO 14509

Cummins MerCruiser Diesel declares that our sterndrive or inboard engines without integral exhaust, when installed in a recreational craft in accordance with the manufacturer's supplied instructions will meet the exhaust emissions requirements of the directive mentioned above. This engine must not be put into service until the recreational craft in which it is to be installed has been declared in conformity, if so required, with the relevant provision of the directive.

Electromagnetic Compatibility Directive 89/336/EC, 92/31/EEC and 93/68/EEC

Generic emission standard	EN 50081-1
Generic immunity standard	EN 50082-1
Vehicles, boats and internal combustion engine driven devices—radio disturbance characteristics	SAE J551 (CISPR 12)
Electrostatic discharge testing	EN 61000-6-2; EN 61000-4-2; EN61000-4-3

For specific information regarding exhaust or noise emissions and power declaration, please refer to the Declaration of Conformity supplied with each Cummins MerCruiser Diesel engine.

This declaration is issued under the sole responsibility of Cummins MerCruiser Diesel.

Jim Kahlenbeck

Director of Engineering—Cummins MerCruiser Diesel, Charleston, South Carolina U.S.A.

Regulatory contact:
Engineering—Marine Emissions
Cummins MerCruiser Diesel
4500 Leeds Avenue
Charleston, South Carolina 29405
USA
(843) 745-1610

Identification Record

Please record the following information:

Engine Model and Horsepower		**Engine Serial Number**
Transom Assembly Serial Number (Sterndrive)	**Gear Ratio**	**Sterndrive Unit Serial Number**

Transmission Model (Inboard)	**Gear Ratio**	**Transmission Serial Number**
Propeller Number	**Pitch**	**Diameter**
Hull Identification Number (HIN)		**Purchase Date**
Boat Manufacturer	**Boat Model**	**Length**
Exhaust Gas Emissions Certification Number		

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

Descriptions and specifications contained herein were in effect at the time this guide was approved for printing. Cummins MerCruiser Diesel, whose policies are based on continuous improvement, reserves the right to discontinue models at any time or to change specifications or designs without notice and without incurring obligation.

Cummins MerCruiser Diesel, Charleston, South Carolina, 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

IMPORTANT: If you do not understand any portion of this manual, contact your dealer for a demonstration of actual starting and operating procedures.

Notice

Throughout this publication, and on your power package, dangers, warnings, cautions, and notices, accompanied by the International Hazard Symbol ⚠, may be used to alert the installer and 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.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

Indicates a situation which, if not avoided, could result in engine or major component failure.

IMPORTANT: Identifies information essential to the successful completion of the task.

NOTE: *Indicates information that helps in the understanding of a particular step or action.*

⚠ WARNING

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

⚠ WARNING

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

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Section 1 - Warranty

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Warranty Information

Warranty Registration—United States and Canada

1. 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.
2. It identifies the 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.
3. Upon receipt of the Warranty Registration Card at the factory, you will receive an owner resource guide that will include your warranty registration confirmation.
4. A temporary Owner Warranty Registration Card will be presented to you when you purchase the product.
5. Because of your selling dealer's continuing personal interest in your satisfaction, the product should be returned to him for warranty service.
6. If your owner resource guide is not received within 60 days from date of new product sale, please contact your selling dealer.
7. The product warranty is not effective until the product is registered at the factory.

   NOTE: *Registration lists must be maintained by the factory and dealer on marine products sold in the United States, should a safety recall notification under the Federal Boat Safety Act be required.*
8. 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.

United States customers or dealers may contact:
Mercury Marine
Attn: Warranty Registration Department
W6250 Pioneer Road
P.O. Box 1939
Fond du Lac, WI 54936-1939
920-929-5054
Fax 920-929-5893

Canadian customers or dealers may contact:
Mercury Marine Canada Limited
2395 Meadowpine Blvd.
Mississauga,
Canada, L5N 7W6
Fax 1-800-663-8334

Warranty Registration—Outside the United States and Canada

1. 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 and claim program for your area.
2. The Warranty Registration Card identifies your name and address, product model and serial numbers, date of sale, type of use and the selling distributor's and dealer's code number, name and address. The distributor or dealer also certifies that you are the original purchaser and user of the product.
3. 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 or 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 forms.
4. 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 or dealer. If you receive a plastic Warranty Registration Card, you may discard the Purchaser's Copy that you received from the distributor or dealer when you purchased the product. Ask your distributor or dealer if this plastic card program applies to you.
5. For further information concerning the Warranty Registration Card and its relationship to Warranty Claim processing, refer to the International Warranty. See 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 Cummins MerCruiser Diesel Distributor or Cummins MerCruiser Diesel Authorized Dealer fills out the warranty registration card immediately and sends the factory copy to the Marine Power International Service Center for your area.

Warranty Policy

High Output Recreational Use Worldwide Limited Warranty

Products Included in this Coverage

QSD 2.0L

QSD 2.8L

QSD 4.2L

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

Duration of Coverage

This Limited Warranty provides coverage for two (2) years from the date the product is first sold to a recreational use retail purchaser, the date on which the product is first put into service, or when the product has been operated for 50 hours, whichever occurs first. Commercial use of the product voids the warranty. Commercial use includes any work-related 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 term 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.

High Output Rating

A **High Output Rating** applies to variable load applications where full power is limited to one (1) hour out of every eight (8) hours of operation. Reduced power operation must be at or below cruise speed. Cruise speed (RPM) is dependant on the engine's maximum engine rated speed (RPM):

Rated Speed (RPM)	Cruise Speed (RPM) Reduction from Rated Speed (RPM)
2000–2800 RPM	200 RPM
2801–3500 RPM	300 RPM
3501–4500 RPM	400 RPM

This rating is for pleasure (non-revenue generating) applications that operate 500 hours or less per year.

Conditions That Must Be Met to Obtain Warranty Coverage

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

What Cummins MerCruiser Diesel Will Do

Cummins MerCruiser Diesel's sole and exclusive obligation under this warranty is limited to, at our option, repairing a defective part, replacing such part or parts with new or Mercury Marine certified re-manufactured parts, or refunding the purchase price of the Cummins MerCruiser Diesel product. Cummins MerCruiser Diesel reserves the right to improve or modify products from time to time without assuming an obligation to modify products previously manufactured.
Cummins MerCruiser Diesel will pay a service technician's reasonable travel expenses when on-site warranty repairs are necessary. Cummins MerCruiser Diesel will pay reasonable labor costs for the removal and reinstallation of the engine and drive when necessary to repair a Warrantable Failure.

How to Obtain Warranty Coverage

Warranty claims must be made through a Cummins MerCruiser Diesel Authorized Repair Facility. The customer must provide Cummins MerCruiser Diesel with a reasonable opportunity to repair and reasonable access to the product for warranty service. The purchaser shall not, unless requested by Cummins MerCruiser Diesel, ship the product or parts of the product directly to Cummins MerCruiser Diesel.
The warranty registration card is the only valid registration identification and must be presented to the dealer at the time warranty service is requested in order to obtain coverage.

What Is Not Covered

This limited warranty does not cover the following:

- Routine maintenance
- Minor adjustments or checks including cleaning fuel injectors, checking filters, adjusting belts or controls, lubrication, and fluid level checks made in connection with normal service
- Oils, lubricants, or fluids unless loss or contamination of the same is caused by a product failure that would be eligible for warranty consideration.
- Normal wear and tear
- Correction of an engine noise, unless diagnosis indicates the condition responsible for the noise is a serious internal engine condition that could result in a failure
- Valve or valve seat grinding because of wear
- Damage caused by abuse, abnormal use, neglect, accident, submersion, improper service, freezing temperatures, alteration, or removal of parts
- Damage caused by use of a propeller or gear ratio that does not allow the engine to run at its maximum rated RPM (see the Operation, Maintenance & Warranty Manual)
- Operation of the product in a manner inconsistent with the recommended operation and duty cycle section of the Operation, Maintenance & Warranty Manual
- Damage to the sterndrive lower unit or propeller caused by striking a marine hazard, such as a submerged object
- Improper installation (proper installation specifications and techniques are set forth in the installation instructions for the product)
- Additional service work requested by the customer other than that necessary to satisfy the warranty obligation
- Damage to the Cummins MerCruiser Diesel product caused by the use of an accessory or part that was not manufactured or sold by Cummins MerCruiser Diesel or Mercury Marine
- Jet pump impellers and liners
- Operation with fuels, oils, or lubricants that are not suitable for use with the product (see the Operation, Maintenance & Warranty Manual)
- Damage caused by water entering the engine through the air filter or exhaust system
- Damage as a result of water in the starter motor

- Starter motors, armatures, or field coil assemblies, that are burned, or where lead is thrown out of the commutator because of excessive cranking
- Damage to the product from insufficient cooling water caused by blockage of the cooling system or water inlets
- Damage caused by running the engine out of water
- Damage resulting from mounting the power package too high on the transom
- Damage as a result of operating the boat with the engine over trimmed
- Damage caused by engines that do not reach maximum rated RPM because of vessel overloading
- Labor not performed by a Cummins MerCruiser Diesel Authorized Repair Facility except when such a facility is not available to perform the work required and prior factory approval has been given to have the work performed at an alternate repair facility on an emergency basis
- Expenses related to haul-out, launch, or towing
- Removal or replacement of boat partitions or other material in order to gain access to the product
- Expenses related to delivering the product to a Cummins MerCruiser Diesel Authorized Dealer when reasonable access is not provided to the product for warranty service
- Expenses related to 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

Use of the product for racing or other competitive activity, or operating with a racing-type lower unit at any time, even by a previous owner of the product, voids the warranty.

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

DISCLAIMERS AND LIMITATIONS

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

Transfer of Warranty

The limited 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.

To transfer the warranty to the subsequent owner, send or fax a copy of the bill of sale or purchase agreement, new owner's name, address and engine serial number to Mercury Marine's warranty registration department. In the United States mail to:

Mercury Marine
Attn: Warranty Registration Department
W6250 W. Pioneer Road
P.O. Box 1939
Fond du Lac, WI 54936-1939
920-929-5054
Fax 920-929-5893

In Canada mail to:
Mercury Marine Canada Limited
2395 Meadowpine Blvd.
Mississauga,
Canada, L5N 7W6
Fax 1-800-663-8334

Upon processing the transfer of warranty, Mercury Marine will send registration verification to the new owner of the product by mail.

There is no charge for this service.

For products purchased outside the United States and Canada, contact the distributor in your country, or the Marine Power Service Center closest to you.

Section 2 - Getting to Know Your Power Package

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Identification

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

Serial Number Decal

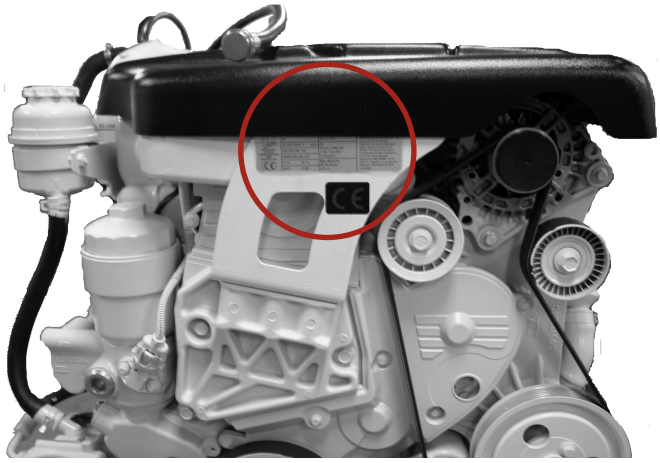
The serial number decal is located on the engine and indicates the engine's CMD serial number, transom serial number, drive serial number, and the fill cap color codes for engine fluids.

25986

Serial number decal

Data Plate Location

The engine data plate is on the front area of the engine as shown. The data plate lists important identification and emissions certification information.



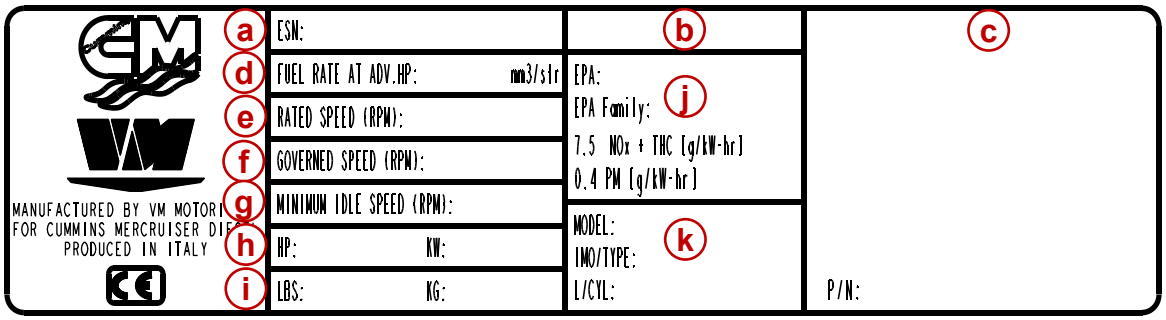
28074

Location of QSD 2.0 engine data plate

Engine Data Plate

A tamper-resistant engine data plate is affixed to the engine at the time of manufacture by Cummins MerCruiser Diesel. It contains important exhaust gas emissions information. Please note that the engine data plate will not affect the fit, function, or performance of the engine and neither boatbuilders nor dealers may remove the engine data plate or the engine component it is affixed to before sale. If modifications are necessary or the engine data plate is damaged contact Cummins MerCruiser Diesel for a replacement.

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



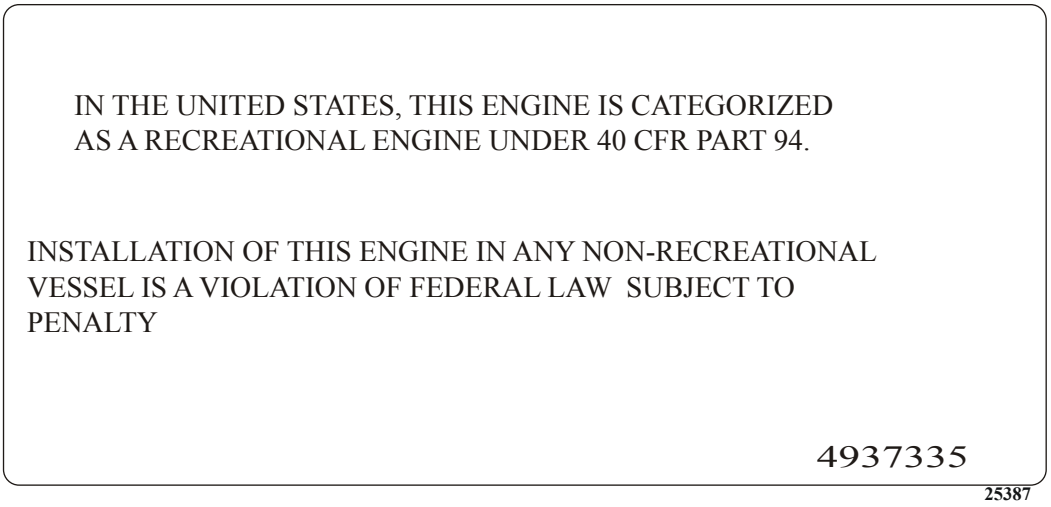
QSD engine data plate

- **a -** Engine serial number
- **b -** Cummins MerCruiser Diesel model information
- **c -** Emissions certification information
- **d -** Fuel rate
- **e -** Rated operation engine speed
- **f -** Governed engine speed
- **g -** Minimum idle speed
- **h -** Engine power rating
- **i -** Engine weight
- **j -** Emissions data
- **k -** Manufacturer model number, IMO type, liters per cylinder

Emissions Information

Exhaust Gas Emissions Certificate

A tamper-resistant exhaust gas emission label is affixed to the engine's integrated exhaust manifold and expansion tank assembly at the time of manufacture by Cummins MerCruiser Diesel. Please note that the exhaust gas emissions certification will not affect the fit, function, or performance of the engine. Neither boatbuilders nor dealers may remove the exhaust gas emission label or the part it is affixed to before sale. If modifications require the removal or cause damage to the exhaust gas emission label, contact Cummins MerCruiser Diesel about the availability of a replacement before proceeding.



Exhaust gas emission label

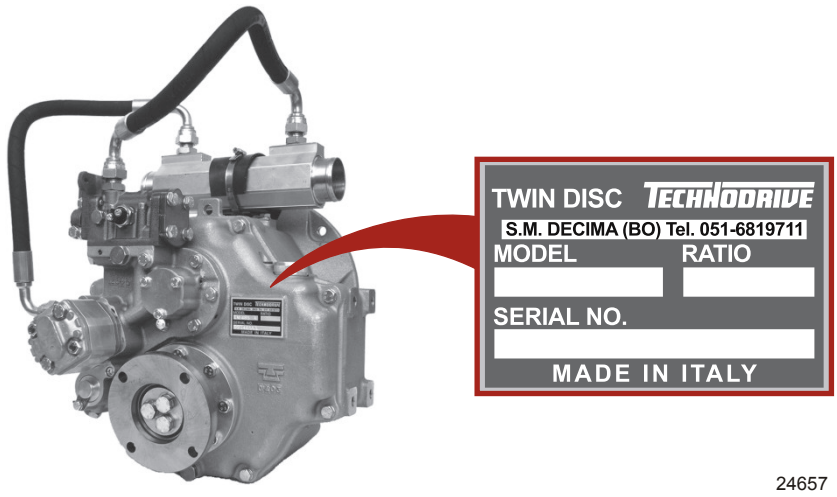
Owner Responsibility

Neither the owner nor operator is to modify the engine in any manner that would alter the horsepower or allow exhaust gas emission levels to exceed their predetermined factory specifications.

Technodrive Transmissions

The transmission identification plate indicates gear ratio, serial number, and model.

Technodrive TM 345 identification plate

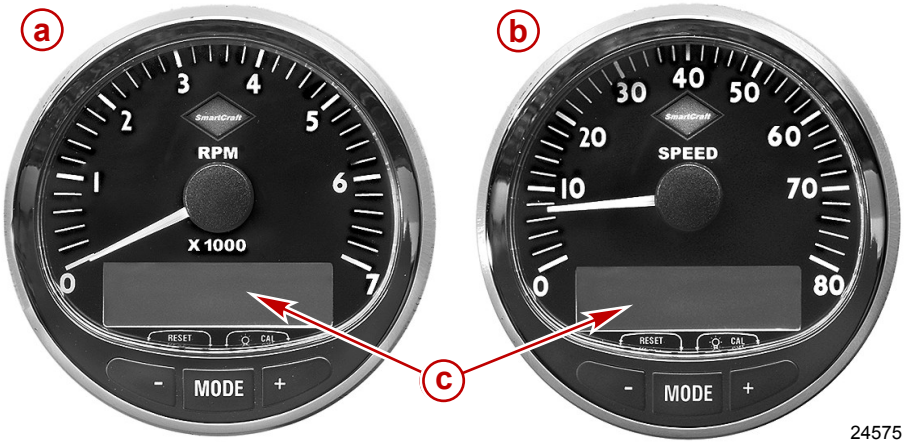


Technodrive TM 485-A identification plate

Instrumentation—QSD Sterndrive Models

Digital Gauges

A Cummins MerCruiser Diesel SmartCraft instrument package may be provided with this product. A few of the functions the instrument package will display are engine RPM, coolant temperature, oil pressure, battery voltage, fuel consumption, and engine operating hours.



Typical SmartCraft gauges

- a - Tachometer
- b - Speedometer
- c - LCD system view display

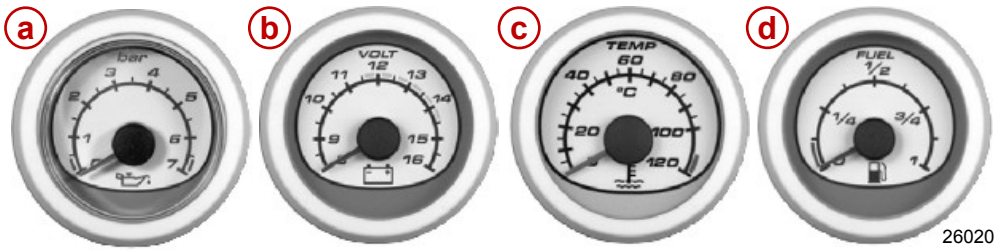
The SmartCraft instrument package will also aid in identifying the fault codes associated with the sounding of the engine audio warning system. The SmartCraft instrument package will display critical engine alarm data and relate other potential problem areas on its LCD display.

Refer to the manual with your gauge package for the warning functions monitored and basic operation of the SmartCraft Instrument package.

Instruments—Inboard Models

The following briefly explains the instrumentation typically found on some boats. The owner and operator should be familiar with all the instruments and their functions on the boat. Because of the large variety of instrumentation and manufacturers, have your boat dealer explain the gauges and normal readings that will appear on your boat.

The following types of gauges may be included with your power package.

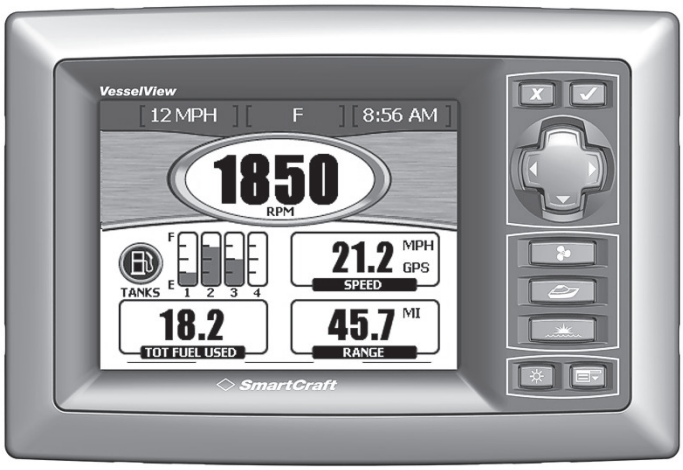


Typical gauges

Reference	Gauge	Function
a	Oil pressure gauge	Indicates engine oil pressure.
b	Battery meter	Indicates battery voltage.
c	Coolant temperature gauge	Indicates engine operating temperature.
d	Fuel gauge	Indicates quantity of fuel in tank.

VesselView (if equipped)

Your power package may be connected to a SmartCraft VesselView display. The interactive VesselView display continuously reports real-time information about speed and performance, engine fault codes, fuel status, water temperature and depth, and other operating data. When VesselView detects a problem with any connected system, it displays an alarm message to the boat operator.

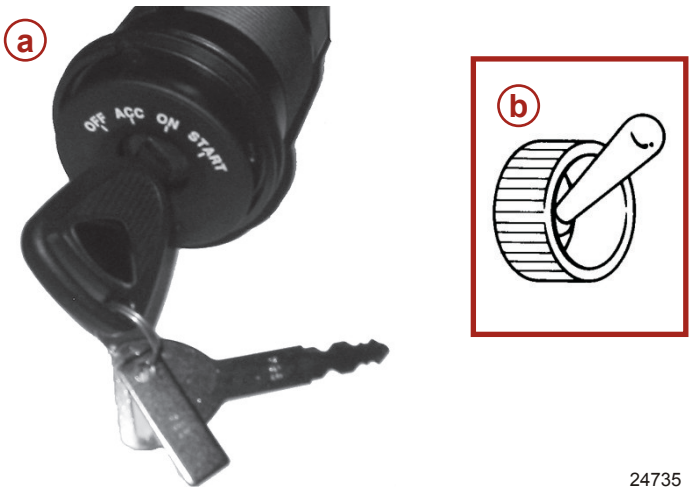


Typical VesselView display

VesselView may also be connected to other vessel systems such as GPS, generators, and cabin environmental controls. This vessel integration allows the operator to monitor and control a wide range of vessel systems from a single display.

Refer to your VesselView operations manual for detailed instructions on how to operate this display.

Switches



24735

a - Key switch
b - Bilge blower switch (if equipped)

Reference	Switch	Function
a	Key switch	Has four positions. 1. **"OFF."** In the "OFF" position, all electrical circuits are off and the engine cannot be started. The engine is stopped when the key switch is turned to the "OFF" position. 2. **"ACC."** In the "ACC" position, any accessory connections to the electrical circuits can be operated. The engine will not operate with the key switch in the "ACC" position. 3. **"ON."** In the "ON" position, all electrical circuits and instruments are operational. 4. **"START."** In the "START" position the engine can be started. ***NOTE:*** *The key can only be removed with the key switch in the "OFF" position.*
b	Bilge blower switch (if equipped)	Operates the bilge blower, if equipped

Start/Stop Panel

The start/stop panel allows the operator to start or stop an engine with the press of a single button. In dual engine applications, each engine is controlled independently. For the start/stop panel to function, the key switch must be in the "ON" position.

28082

Dual engine start/stop panel, single engine similar

In single helm applications, the start/stop panel is optional.

In dual helm applications, a start/stop panel is optional at the main station and required at secondary stations. The ignition key switch connector will be capped at helm 2.

We recommend instructing other occupants on proper starting and operating procedures should they need to operate the engine in an emergency.

Accidental or unintended activation of the switch can cause any or all of the following potentially hazardous situations:

- Sudden and unexpected loss of forward motion can throw or eject vessel occupants.
- The loss of power will effect directional control in heavy seas, strong current, or high winds.
- The operator can lose control of the vessel when docking.

Engine Monitoring Features

Audio Warning System

Your Cummins MerCruiser Diesel power package is equipped with an audio warning system. The audio warning system monitors critical components and informs the operator when a malfunction has occurred. The warning system is not capable of protecting the power package from damage caused by a malfunction.

When an electronic control system detects a recordable malfunction the audio warning system will sound to alert the operator. The duration and type of horn sound will be dependant upon the nature of the fault condition. In the case of any horn sounding, the user should refer to the helm displays to understand the specific situation.

For the operator to view the fault code of the malfunction indicated and any recommended actions, the power package must be equipped with a gauge package that supports the warning system and can display fault codes.

The following instruments have screens that display fault codes:

- VesselView
- SmartCraft System Tachometer
- SmartCraft System Speedometer

NOTICE

The sound from an audio warning horn indicates that a critical fault malfunction has occurred. Operating a power package with a critical fault can damage components. If the audio warning horn emits a sound, do not continue operations unless avoiding a hazardous situation.

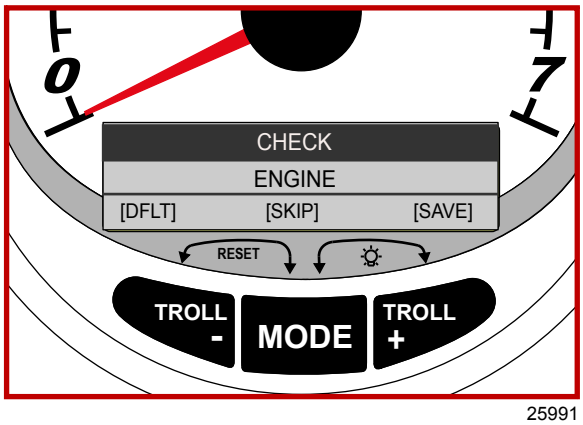
If the audio warning sounds, stop the engine immediately if you are not in a hazardous situation. Investigate the cause and correct it, if possible. If you cannot determine the cause, consult your Cummins MerCruiser Diesel Authorized Repair Facility.

VesselView

Refer to your VesselView operations manual for detailed engine monitoring information.

System Tachometer or Speedometer

The LCD on the system tachometer, if equipped, displays active fault codes. To indicate an active fault code is present the following screen appears on the tachometer display.



Typical system tachometer fault code display

After pressing "MODE," a blinking "AL" also appears in the upper right corner of each menu on the digital display screen to signify an active fault. A major fault is also accompanied by an audio warning.

To view the active faults, press "MODE" until you reach the total engine hours screen. In the event of an active fault code, total engine hours are displayed for 30 seconds after key-on. After 30 seconds, the digital display screen outputs the active fault codes in 3-second intervals.

The following is a list of faults displayed by the SmartTach that also activates an audio warning.

Smart Tach Display	Warning Indication
"LOW OIL PRESS"	The oil pressure has dropped below the critical engine protection limit.
"OVERHEAT"	The engine coolant temperature has risen above the engine protection limit.
"WATER IN FUEL"	The WIF sensor detects water in the fuel filter housing.
"FAULT THROTTLE"	The throttle sensor is registering a fault.
"FAULT BATTERY"	The ECM battery voltage is out of range.
"CHECK ENGINE"	The "CHECK ENGINE" code corresponds to a number of different engine related faults. Refer to your Cummins MerCruiser Diesel Authorized Repair Facility.

Features And Controls

Digital Throttle and Shift Applications

For digital throttle and shift (DTS) applications and electronic remote control (ERC) operation refer to the Cummins MerCruiser Diesel **SmartCraft Owner's Manual**.

Emergency Stop Switch, If Equipped

An emergency stop (E-stop) switch turns off the engines in an emergency situation, such as a person overboard or a tangled propeller. When activated, an E-stop switch interrupts the power supply to the engine and transmission. If the boat is equipped with an E-stop switch at the helm, the E-stop switch turns off all of the engines.

35308

Typical E-stop switch at the helm

Activation of an E-stop switch stops the engine, or engines, immediately, but the boat can continue to coast for some distance depending upon the velocity and degree of any turn at shutdown. 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 recommend instructing other occupants on proper starting and operating procedures should they need to operate the engine in an emergency.

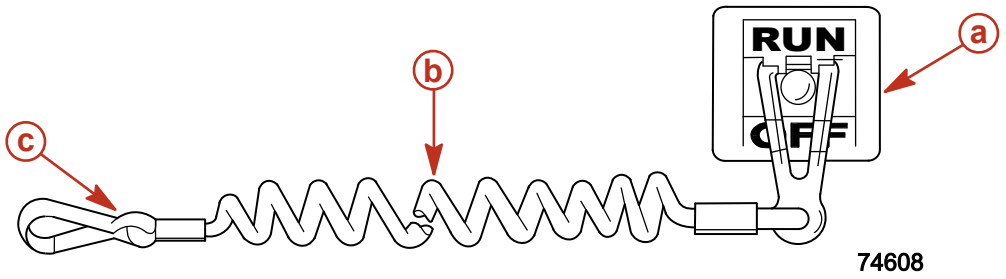
Accidental or unintended activation of the switch during normal operation is also possible, which can cause any or all of the following potentially hazardous situations:

- Occupants can be thrown forward due to unexpected loss of forward motion, and passengers in the front of the boat could be ejected over the bow and possibly struck by the propulsion or steering components.
- The operator can lose power and directional control in heavy seas, strong current, or high winds.
- The operator can lose control of the vessel when docking.

Restarting an engine using the key switch or start button after an E-stop shutdown without first turning the key switch to the off position for at least 30 seconds will restart the engine but cause fault codes to be set. Unless you are in a potentially hazardous situation, turn the key switch off and wait at least 30 seconds before restarting the engine or engines. If after restarting some fault codes are still being displayed, contact your Authorized Cummins MerCruiser Diesel Repair Facility.

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 one direction
- consuming alcohol or drugs
- high speed boating maneuvers

The lanyard is a cord usually between 122 and 152 cm (4 and 5 ft) in length when stretched out, with an element on one 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 its at-rest condition as short as possible to minimize the likelihood of lanyard entanglement with nearby objects. Its stretched-out length is made to minimize the likelihood of accidental activation should the operator choose to move around in an area close to the normal operator's position. If it is desired to have a shorter lanyard, wrap the lanyard 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

If the operator falls out of the boat, stop the engine immediately to reduce the possibility of serious injury or death from being struck by the boat. Always properly connect the operator to the stop switch using a lanyard.

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 propulsion or steering components.
- Loss of power and directional control in heavy seas, strong current or high winds.
- Loss of control when docking.

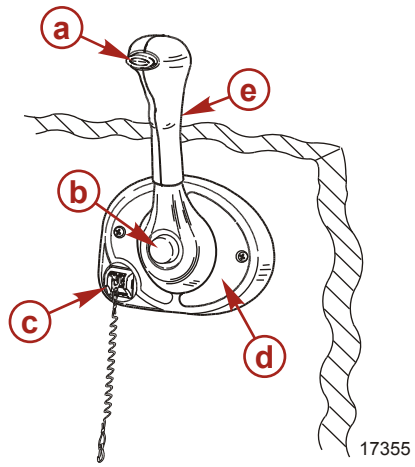
⚠ WARNING

Avoid serious injury or death from deceleration forces resulting from accidental or unintended stop switch activation. The boat operator should never leave the operator's station without first disconnecting the stop switch lanyard from the operator.

Remote Controls

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

Panel Mount Features



a - Neutral lock button
b - Throttle-only button
c - Lanyard stop switch
d - Control handle tension adjustment screw
e - Control handle

Neutral lock button. Prevents accidental shift and throttle engagement. The neutral lock button must be pushed in to move the control handle out of neutral.

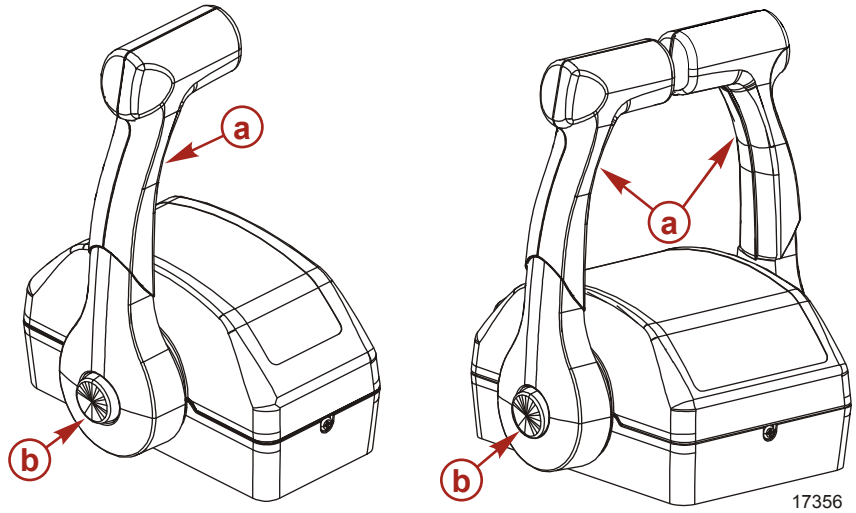
Throttle-only button. Allows engine throttle advancement without shifting the engine. This is done by disengaging the shift mechanism from the control handle. The throttle-only button can be depressed only when the remote control handle is in the neutral position, and should only be used to assist in 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. See **Lanyard Stop Switch** for information on the use of this switch.

Control handle. Operation of the shift and throttle is 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.

Control handle tension adjustment screw (not visible). This screw is used to adjust the effort required to move the remote control handle. Refer to the instructions provided with the remote control for complete adjustment instructions.

Console Mount Features



a - Control handle
b - Throttle-only button

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.

Control handles. Operation of the the shift and throttle is 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.

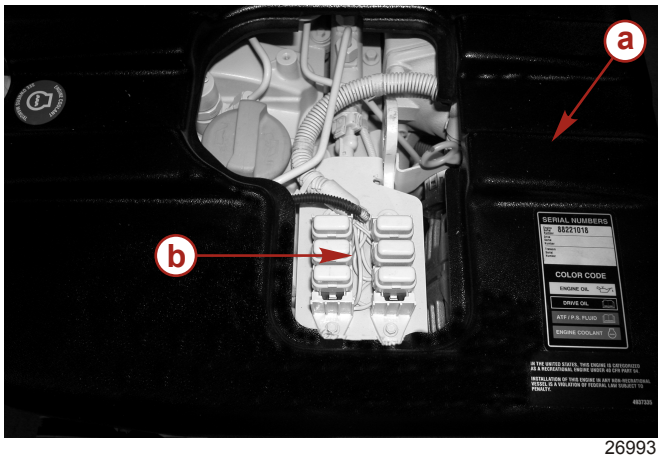
Control handle tension adjustment screw (not visible). This screw is used to adjust the effort required to move the remote control handle. Refer to the instructions provided with the remote control for complete adjustment instructions.

Engine Electrical System Overload Protection

If an electrical overload occurs, a fuse will burn out (blow). Find and correct the cause for the electrical overload before replacing the fuse.

NOTE: *In an emergency, when the engine must be operated and the cause for the electrical overload cannot be located and corrected, turn off or disconnect all the accessories connected to the engine and instrumentation wiring. Replace the blown fuse. If the replacement fuse also blows then the electrical overload has not been eliminated. Further checks must be made on the electrical system.* ***Do not circumvent the electrical overload protection provided on fused circuits by installing a higher amperage fuse or shorting across the fuse block terminals.*** *Contact your Cummins MerCruiser Diesel Authorized Repair Facility.*

Fuses provide protection for the engine electrical system as indicated. The fuse panel is located beneath an access panel in the front of the engine cover.

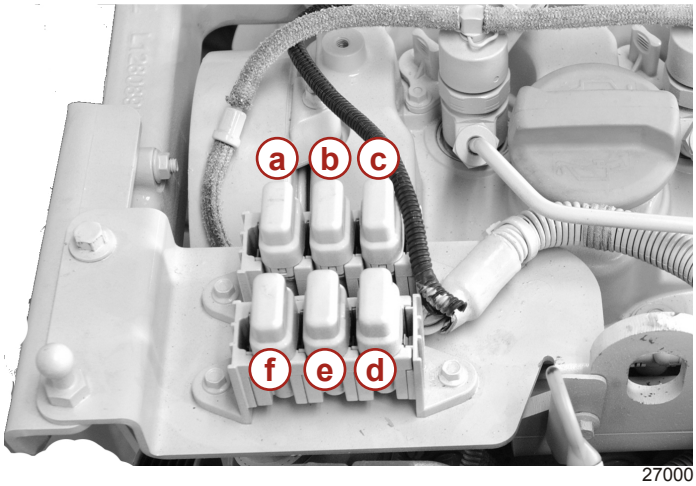


26993

2.0 engine cover with access panel

a - Engine cover access panel
b - Fuse panel

After finding and correcting the cause of the overload, replace any burned out (blown) fuses.



27000

2.0 fuse panel

Reference	Fuse	Protection	Location on fuse panel (From Front of Engine)
a	20-amp	Un-switched power to helm	Lower left
b	10-amp	Switched power to ECM	Middle left
c	10-amp	Keyed power to ECM	Upper left
d	5-amp	Power—diagnostic connector	Upper right
e	15-amp	ECM switched power to SIM	Middle right
f	15-amp	Switched power to ECM	Lower right

Vessel Integration Panel (VIP) Overload Protection

The Vessel Integration Panel (VIP) contains 2 circuit breakers that help protect the engine harness, vessel sensor harness, and helm harness.

27818

Vessel Integration Panel (VIP) circuit breakers

Reference	Circuit breaker rating	Protection	Location on fuse panel
a	5-amp	VIP Diagnostic	Left
b	10-amp	Helm	Right

Section 3 - On the Water

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3

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.

- **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
  - ☐ Transistor radio
  - ☐ Tools necessary for minor repairs
  - ☐ First aid kit and instructions
  - ☐ Anchor and extra anchor line
  - ☐ Waterproof 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
- **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 aboard, 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 one person aboard in the basics of starting and operating the engine and handling the boat 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).** Alcohol or drugs impairs 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 operator's view when operating the boat above idle or planing transition speed. Watch out for others, keep your eyes on the the water, and be aware of 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 five 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 US $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

Carbon monoxide poisoning can lead to unconsciousness, brain damage, or death. Keep the boat well ventilated while at rest or underway and avoid prolonged exposure to carbon monoxide.

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.

mc79553-1

Poor Ventilation

Under certain conditions, permanently enclosed or canvas enclosed cabins or cockpits with insufficient ventilation may draw in carbon monoxide. Install one 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.

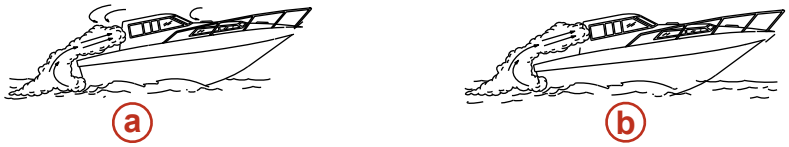
1. Examples of poor ventilation while a boat is stationary:

mc79554-1

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:



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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)

Important Operation Information

Launching

IMPORTANT: Install the bilge drain plug before launching the boat.

Duty Cycle Rating Requirements

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

Cummins MerCruiser Diesel engines must be used in applications that meet the operation specifications indicated by the appropriate Cummins MerCruiser Diesel application manual. The power package must be equipped with a gear ratio and propeller that allows the engine to operate at wide open throttle (WOT) at the engine's Rated Speed (RPM). Use of Cummins MerCruiser Diesel engines in applications that do not meet specified operational parameters is not approved.

High Output Rating

A **High Output Rating** applies to variable load applications where full power is limited to one (1) hour out of every eight (8) hours of operation. Reduced power operation must be at or below cruise speed (RPM). Cruise speed is dependant on the engine's maximum rated speed (RPM):

Reduced Power Operation	
Rated Speed (RPM)	**Cruise Speed (RPM) Reduction from Rated Speed (RPM)**
2000–2800 RPM	200 RPM
2801–3500 RPM	300 RPM
3501–4500 RPM	400 RPM

This rating is for pleasure (non-revenue generating) applications that operate 500 hours or less per year.

Operation Chart

Starting Procedure	After Starting	While Underway	Stopping and Shut Down
Open the engine hatch. Air out the bilge completely.	Observe all instrumentation to monitor the condition of the engine. If not normal, stop the engine.	Frequently review all instrumentation to monitor engine condition.	Shift the remote control lever to the neutral position.
Turn the battery switch on, if equipped.	Check for fuel, oil, water, fluid, and exhaust leaks, etc.	Listen for the audio alarm.	Run the engine at idle-RPM for several minutes to allow the turbocharger and engine to cool.
Turn on and run the engine compartment bilge blower, if equipped, for 5 minutes.	Check shift and throttle control operation.		Turn the key switch to "OFF" position.
Check for leaks: fuel, oil, water, fluid, etc.	Check steering operation.		Turn the battery switch off, if equipped.
Open the fuel shut-off valve, if equipped.			Close the fuel shut-off valve, if equipped.
Open the seacock, if equipped.			Close the seacock, if equipped.
Prime the fuel injection system, if necessary.			Flush the seawater cooling circuit, if operating in saltwater, brackish water, or polluted water.
Turn the key switch to "START" position. Release the key when the engine starts.			
Warm-up the engine at a fast idle-RPM for several minutes.			

Starting, Shifting, and Stopping

Important Information—SmartStart

IMPORTANT: This Cummins MerCruiser Diesel model is equipped with SmartStart. SmartStart performs all appropriate starting operations upon initial start switch actuation. To begin the Smartstart sequence, turn the ignition key switch to the "START" position and release, or turn the ignition key switch the run position and press and release the start/stop switch, if equipped.

Rather than holding the start button or key switch in position until the engine starts, SmartStart controls the starting process automatically. When the start switch is actuated the system signals the engine ECM to start the engine. The starter will receive power until the engine starts, the starting process times out after a few seconds, or when the engine reaches 400 RPM. Attempting to start the engine with the engine running will turn the engine off.

⚠ WARNING

Vapors can ignite and cause an explosion, resulting in engine damage or severe personal injury. Do not use volatile starting aids such as ether, propane, or gasoline in the engine air intake system.

⚠ WARNING

Fuel vapors trapped in the engine compartment may be an irritant, cause difficulty breathing, or may ignite resulting in a fire or explosion. Always ventilate the engine compartment before servicing the power package.

Before Starting the Engine

NOTICE

Without sufficient cooling water, the engine, the water pump, and other components will overheat and suffer damage. Provide a sufficient supply of water to the water inlets during operation.

IMPORTANT: Observe the following before starting the engine:

- Provide water to the seawater pickup pump.
- Ensure that the engine crankcase is filled to the correct level with the proper grade of oil for the prevailing temperature. Refer to **Section 4: Specifications** .
- Ensure that all electrical connections are secure.
- Check all applicable items in the maintenance schedules and operation chart.
- Perform any other necessary checks as indicated by your Cummins MerCruiser Diesel Authorized Repair Facility or specified in your boat owner's and operation manual.

Starting a Cold Engine

IMPORTANT: Check the fluid levels before starting the engine. Refer to the Maintenance Schedule in the Maintenance section.

1. Turn on and run the engine compartment bilge blower (if equipped) for 5 minutes. Or, open the engine hatch to air out the bilge before attempting to start the engine.
2. Place the remote control handle in neutral.
3. If the engine has not been run for a period of time and will not readily start with the standard starting procedure, use the hand pump and primer plunger located on the fuel filter header. Move the primer plunger up and down four or five strokes. Attempt to start the engine following the normal procedure.
4. Turn the ignition key switch to "RUN" position.
5. Turn the ignition key switch to "START" position and release, or press and release the start/stop switch, if equipped. **IMPORTANT: Engine oil pressure should exceed 69 kPa (10 psi) a few seconds after the engine starts. If oil pressure does build adequatly, stop the engine then locate and correct the problem. See your Cummins MerCruiser Diesel Authorized Repair Facility if you are unable to identify and correct the problem.**
6. Ensure that all instrumentation is functioning properly and indicating normal engine operation.

Engine Warm Up

NOTICE

Engine wear caused by increased friction and limited oil flow is greatest when an engine is cold. Decrease engine wear by allowing the engine coolant temperature to reach normal operating range before hard acceleration or applying full throttle.

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

2. Operate the engine at 1,000 to 1,200 RPM until the engine temperature is within the normal operating range. It is very important that any engine be warmed up 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 the vessel at a reduced engine speed. Begin normal vessel operation when systems reach operating temperatures.*

3. After the engine has reached operating temperature:
   a. The oil pressure should be within the range specified. See **Specifications—Engine Specifications**. Stop the engine if the oil pressure is not within the range specified.
   b. Check the fuel system for leakage from the injection pump, fuel pipes, fuel filter, or fuel lines.
   c. Check for oil leakage. Check the engine and the transmission for oil leakage. Especially check the oil filter, oil lines, oil line connectors, and oil pan.
   d. Check for coolant leaks. Check the coolant hoses and connection pipes of the heat exchanger, fluid coolers, aftercooler, water pump, and drain fittings.
4. Locate and correct any problems, or see your Cummins MerCruiser Diesel Authorized Repair Facility if you are unable to determine the problem.

Starting a Warm Engine

1. Turn on and run the engine compartment bilge blower (if equipped) for 5 minutes. Or, open the engine hatch and ventilate the bilge before starting the engine.
2. Place the remote control handle in neutral.
3. Turn the ignition key switch to "RUN" position.
4. Turn the ignition key switch to "START" position and release, or press and release the start/stop switch, if equipped.
5. Ensure that all instrumentation is functioning properly and indicating normal engine operation.

Shifting

NOTICE

Shifting into gear at engine speeds above idle will damage the gearcase. Shifting into gear when the engine is not running can cause misalign the clutch, preventing proper shifting. Always shift the gearcase into gear when the engine is operating at idle. If you must shift while the engine is not operating, rotate the propeller shaft in the appropriate direction during shifting.

To shift the unit, ensure that the remote control throttle lever is in "NEUTRAL". Move the remote control shift lever forward to shift into "FORWARD" gear or backward to shift into "REVERSE". After shifting the transmission, advance the throttle to the desired setting.

Engine oil pressure must meet specification once underway. Refer to **Section 4: Engine Specifications** 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 Cummins MerCruiser Diesel Authorized Repair Facility.

Engine Shut Down (Stopping)

1. Place the remote control lever in neutral.

NOTICE

Immediately stopping the engine after high load operation can damage the turbocharger bearings. Idle the engine for several minutes before shutdown.

2. Operate the engine at idle speed for several minutes to allow the turbocharger and engine to cool.
3. The engine can be stopped by any one of the following four methods:
   a. Move the ignition key switch to the "ACCESSORY" or "OFF" position. The engine will stop and the control system will be deactivated.
   b. Depress the start/stop button, if equipped. The engine will stop and the control system will remain active.
   c. Momentarily move the ignition key switch to the "START" position, then release immediately. The control system will recognize that the engine is running and will stop the engine. The control system will remain active. Moving the ignition key switch to the "START" position again will issue a start request to the control system and the control system will start the engine, if appropriate.
   d. Activate the lanyard stop switch, if equipped. The engine will stop, but the control system will remain active. The control system will not allow the engine to start if the lanyard stop switch is activated.

Freezing Temperature and Cold Weather Operation

IMPORTANT: If the boat is operated during periods of freezing temperature, take precautions to prevent freezing damage to the power package. Damage caused by freezing is not covered by Cummins MerCruiser Diesel Limited Warranty.

NOTICE

Water trapped in the seawater section of the cooling system can cause corrosion or freeze damage. Drain the seawater section of the cooling system immediately after operation or before any length of storage in freezing temperatures. If the boat is in the water, keep the seacock closed until restarting the engine to prevent water from flowing back into the cooling system. If the boat is not fitted with a seacock, leave the water inlet hose disconnected and plugged.

NOTE: *As a precautionary measure, attach a tag to the key switch or steering wheel of the boat reminding the operator to open the seacock or unplug and reconnect the water inlet hose before starting the engine.*

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

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

See **Section 6** for cold weather or extended storage related information.

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 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 or Cummins MerCruiser Diesel Limited Warranty.

Protecting People In The Water

While You Are Cruising

It is very difficult for a person in the water to take quick action to avoid a boat heading in their direction, even at slow speeds.

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 (even coasting) and the gear shift is in neutral, 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

A spinning propeller, a moving boat, or any solid device attached to the boat can cause serious injury or death to swimmers. Stop the engine immediately whenever anyone in the water is near your boat.

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

High-Speed and High-Performance

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 the **Hi-Performance Boat Operation** booklet (90-849250-R03) from your Cummins MerCruiser Diesel Authorized Repair Facility.

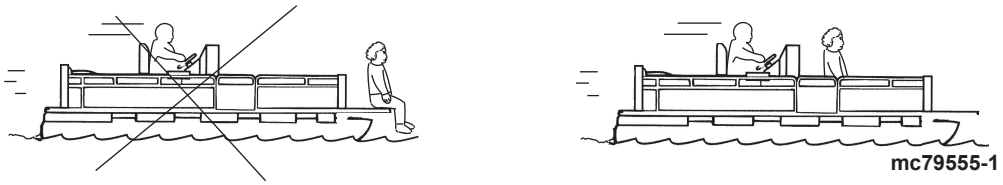
Passenger Safety In Pontoon Boats And Deck Boats

Whenever the boat is in motion, observe the location of all 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 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 two pontoons will position them to be run over.

Boats Having An Open Front Deck

No one should ever be on the deck in front of the rail while the boat is in motion. Keep all passengers behind the front rail or enclosure.

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.



⚠ WARNING

Sitting or standing in an area of the boat not designed for passengers at speeds above idle can cause serious injury or death. Stay back from the front end of deck boats or raised platforms and remain seated while the boat is in motion.

Boats With Front-Mounted, Raised Pedestal Fishing Seats

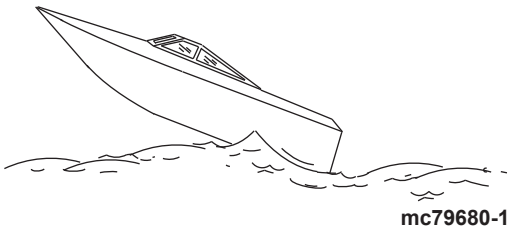
Elevated fishing seats are not intended for use when the boat is traveling faster than idle or trolling speed. Sit only in seats designated for traveling at faster speeds.

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

Wave and Wake Jumping

⚠ WARNING

Wave or wake jumping can cause serious injury or death from occupants being thrown within or out of the boat. Avoid wave or wake jumping whenever possible.

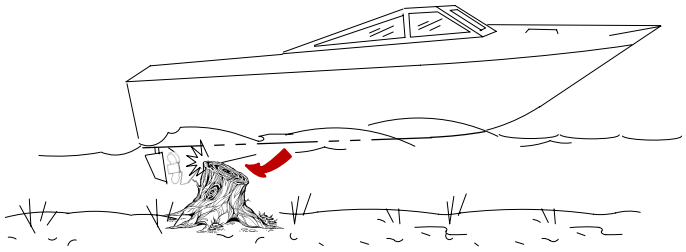


Operating recreational boats over waves and wakes is a natural part of boating. However, when this activity is done with enough speed to force the boat hull partially or completely out of the water, certain hazards arise, particularly when the boat re-enters the water.

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



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Reduce speed and proceed with caution whenever you're driving a boat in shallow water areas 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. 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 minimum planing speed of 24 to 40 km/h (15 to 25 MPH).

Striking a floating or 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 throw occupants out of their seats or out of the boat.
- A rapid reduction in speed. This will throw occupants forward, even out of the boat.
- Impact damage to the underwater drive components, rudder, 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, take the power package to an authorized dealer for a thorough inspection and necessary repair.

The boat should also be checked for any 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 running is necessary, do so at greatly reduced speeds.

⚠ WARNING

Operating a boat or engine with impact damage can result in product damage, serious injury, or death. If the vessel experiences any form of impact, have an authorized Mercury Marine dealer inspect and repair the vessel or power package.

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, ensure that the boat bottom is:

- Clean, free of barnacles and marine growth.
- Free of distortion, nearly flat where it contacts 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 water inlets and cause the engine to overheat.

Elevation and Climate

NOTE: *Engines equipped with an Engine Control Module (ECM) reduce the effects of changes in elevation and climate by automatically adjusting fuel flow for weather conditions and elevation. ECM controlled engines, however, do not compensate for increased loading or hull conditions.*

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

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

For optimum engine performance under changing weather conditions and high elevation, use a propeller that allows the engine to operate at rated RPM at wide open throttle (WOT) with a maximum boat load during your normal boating.

In most cases, the rated RPM at WOT can be achieved by changing to a lower pitch propeller.

Propeller Selection

NOTICE
Operating the engine with the wrong propeller installed can limit power, increase fuel consumption, overheat the engine, or cause internal powerhead damage. Choose a propeller that allows the engine to operate at the specified wide open throttle RPM.

The boat manufacturer and the selling dealer are responsible for equipping the power package with the correct propellers.

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

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

Select a propeller that will allow the engine power package to operate at the rated engine RPM with a maximum load.

If full throttle operation is below the engine rated RPM, the propeller must be changed to prevent loss of performance and possible engine damage. On the other hand, operating an engine above the rated engine RPM will cause higher than normal wear 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 these models).
- Operating in a higher elevation causes an RPM loss (not as significant on these 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

The following procedure is especially important 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: Cummins MerCruiser Diesel recommends 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 the engine does not start, wait 1 minute to allow the starter motor to cool; then, repeat starting procedure.

1. See the appropriate **Starting, Shifting, and Stopping** section and start the engine.
2. Operate the engine at a fast idle until it has reached normal operating temperature.
3. Operate the engine in gear for 3 minutes at each of the following RPM: 1200 RPM, 2400 RPM and 3000 RPM.
4. Operate the engine in gear for 3 minutes at each of the following RPM: 1500 RPM, 2800 RPM and 3400 RPM.
5. Operate the engine in gear for 3 minutes at each of the following RPM: 1800 RPM, 3000 RPM and maximum rated full throttle RPM.

Engine Break-In

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, observe the following rules:

- 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.
- Check engine oil level frequently. Add oil as needed. High oil consumption is normal during the break-in period.

After the 20-Hour Break-In Period

To help extend the life of your power package, Cummins MerCruiser Diesel recommends the following:

- Change the engine oil and filter at the interval indicated in the **Maintenance Schedule**. See **Specifications** and **Maintenance**.
- Use a propeller that allows the engine to operate at the rated engine RPM when at full throttle with a fully loaded boat. See **Specifications** and **Maintenance**.
- Operation at 3/4 throttle setting or lower is recommended. Refrain from prolonged operation at wide-open throttle RPM.

End of First Season Checkup

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

Notes:

Section 4 - Specifications

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4

Fuel Requirements

⚠ WARNING

Failure to comply with regulations can result in injury from fire or explosion. Electrical system components on this engine are not rated as external ignition–protected (EIP). Do not store or use gasoline on boats equipped with these engines, unless provisions have been made to exclude gasoline vapors from the engine compartment (REF: 33 CFR).

⚠ WARNING

Fuel leakage is a fire or explosion hazard, which can cause serious injury or death. Periodically inspect all fuel system components for leaks, softening, hardening, swelling, or corrosion, particularly after storage. Any sign of leakage or deterioration requires replacement before further engine operation.

⚠ WARNING

This engine requires diesel fuel. Mixing gasoline, gasohol, or alcohol and diesel fuel can cause serious injury or death due to fire or explosion. Never mix gasoline, gasohol, or alcohol with diesel fuel.

IMPORTANT: Use of improper or water-contaminated diesel fuel can seriously damage your engine. Use of improper fuel is considered misuse of the engine, and damage caused thereby will not be covered by the 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 fill-up, 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 engines that use high sulphur content diesel fuel, this will greatly increase:

- Corrosion on metal parts.
- Deterioration of elastomer and plastic parts.
- Excessive wear of internal engine parts, particularly bearings, and corrosion and extensive damage to other engine parts.
- Difficulty starting and operating the engine.

Recommended Fuels

NOTICE

The use of improper fuel can cause serious damage to the engine. Damage resulting from the use of improper fuel is considered engine misuse and is not covered under the limited warranty. Use only the recommended fuel in the engine.

Diesel Fuel/Applicable Standard	Recommendation
JIS (Japanese Industrial Standard)	No. 2
DIN (Deutsche Industrie Normen)	DIN 51601
SAE (Society Of Automotive Engineers) Based on SAE J-313C	No. 2-D
BS (British Standard) Based on BSEN 590-1197	A-1

Diesel Fuel in Cold Weather

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

Coolant (Antifreeze)

NOTICE

Using propylene glycol antifreeze in the closed cooling system can damage the cooling system or the engine. Fill the closed cooling system with an ethylene glycol antifreeze solution suitable to the lowest temperature to which the engine will be exposed.

Because diesel engines are high-compression engines, they operate at higher operating temperatures. Therefore the closed cooling system and engine, including related cooling passages, must remain as clean as possible to provide adequate engine cooling. To ensure proper cooling, we recommend filling the closed cooled section of the cooling system with a low silicate formula of ethylene glycol antifreeze in a solution with deionized water. A low silicate formula prevents the antifreeze from separating and forming a silicate gelatin. This gelatin can block passages in the engine and heat exchanger, causing the engine to overheat. Using deionized water instead of common tap water or softened water can prevent large mineral deposits from forming that restrict the cooling system efficiency.

Mix the coolant, if it is not premixed, before adding it to the closed cooling system. Additives and inhibitors introduced into acceptable coolant solutions will form a protective film on the internal passages and provide protection against internal cooling system erosion.

Keep the closed cooling section filled year-round with an acceptable coolant (antifreeze) solution. Do not drain the closed cooled section for storage as this will promote rust formation on the internal surfaces. If the engine will be exposed to freezing temperatures, ensure that the closed cooled section is filled with a properly mixed coolant (antifreeze) solution to protect the engine and closed cooling system to the lowest temperature to which they will be exposed.

NOTE: *Generally, we recommend using a 50/50 solution of coolant (antifreeze) and deionized, purified water. When operating where seawater temperatures are greater than 32 °C (90 °F), you can use a 25/75 solution of coolant (antifreeze) and deionized, purified water for improved cooling performance.*

IMPORTANT: The coolant (antifreeze) used in these marine engines must be a solution of 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 antifreeze and coolants are listed in the following table. See **Maintenance Schedules** for respective change intervals.

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

Engine Oil

NOTICE

Discharge of oil, coolant, or other engine/drive fluids into the environment is restricted by law. Use caution not to spill oil, coolant, or other fluids into the environment when using or servicing your boat. Be aware of the local restrictions governing the disposal or recycling of waste, and contain and dispose of fluids as required.

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 4- Cycle 15W40 Marine Engine Oil	Engine crankcase	92-877695K1

This oil is a specially blended 15W40 oil with marine additives for all–temperature operation. It exceeds requirements for API CF-2, CF-4, CG-4 and CH-4 oils.

Other recommended oils:

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

These oils are approved by Mercury Marine and Marine Power Europe. For all temperature operation use 15W40 oil.

Engine Specifications

Description	Specifications
	QSD 2.0
Engine type	In-line 4 cylinder diesel
Induction Type	Turbocharged and Aftercooled 16 Valve
Displacement	2.0 liter (122 cu. in.)
Firing order	1-3-4-2
Bore	83 mm (3.700 in.)
Stroke	92 mm (3.622 in.)
Rated engine RPM (see **Conditions Affecting Operation—Propeller Selection** for additional information).	Refer to CMD's Marine Performance Curves And Data Sheet (www.Cummins.com)
Idle RPM in neutral (engine at normal operating temperature).	700 RPM
Oil pressure at idle	2.4 bar [240 kPa] (35 PSI)
Oil pressure at 4000 RPM	6.6 bar [660 kPa] (95 PSI)
Thermostats (water)	83° C (181° F)
Thermostats (oil)	95° C (203° F)
Coolant temperature	80–85° C (176–185° F)
Electrical system	12-volt negative (–) ground
Alternator rating	14V, 110 A
Recommended battery rating	750 CCA, 950 MCA, or 180 Ahm

Fluid Specifications

IMPORTANT: All capacities are approximate fluid measures.

Engine

IMPORTANT: Fluid level indicators are calibrated to provide accurate readings with the engine level and installed according to manufacturer's instructions. Modifications may effect fluid level readings.

Always use the proper fluid level indicator to determine the exact quantity of oil or fluid required.

QSD 2.0

Engines with Closed Cooling System Oil Cooler			
QSD 2.0	**System Capacity Liters**	**Fluid Type**	**Part Number**
Engine oil (with filter)	5.85 liter (6.20 US qt)	15W40 4-cycle Diesel Engine Oil	92-877695K1
Closed cooling system	7.80 liter (8.25 US qt)	Marine Engine Coolant (Only available in Europe)	92-813054A2
		Fleetguard Compleat with DCA4 Fleetguard Part Number: CC2825 Container size: 3.75 liter (1.00 US gal)	Obtain locally

Engines with Seawater System Oil Cooler			
QSD 2.0	**System Capacity Liters**	**Fluid Type**	**Part Number**
Engine oil (with filter)	6.00 liter (6.30 US qt)	15W40 4-cycle Diesel Engine Oil	92-877695K1
Closed cooling system	7.50 liter (8.00 US qt)	Marine Engine Coolant (Only available in Europe)	92-813054A2
		Fleetguard Compleat with DCA4 Fleetguard Part Number: CC2825 Container size: 3.75 liter (1.00 US gal)	Obtain locally

Transmission

NOTE: *Capacities are for the transmission only and do not include the fluid cooler or fluid cooler hose capacities.*

Model	Capacity	Fluid type	Part Number
Technodrive TM 345	1.6 L (1.7 US qt)	Class CD SAE 20 or Class CD SAE 30 engine oil	Obtain locally
Technodrive TM 485-A	2.6 L (2.75 US qt)	SAE 20W - 40 or SAE 15W - 40 engine oil	Obtain locally

Approved Paints

Description	Part Number
Marine Cloud White (CMD part number: 4918660)	Obtain locally
Mercury Light Gray Primer	92-80287852
Mercury Phantom Black	92-802878Q1

Notes:

Section 5 - Maintenance

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Owner and 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 a Cummins MerCruiser Diesel Authorized Repair Facility for a periodic checkup.

Normal maintenance service and replacement parts are the responsibility of the owner or 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 Cummins MerCruiser Diesel Authorized Repair Facility for service aids.

Dealer Responsibilities

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

- Before delivery, making certain that the Cummins MerCruiser Diesel power package is in proper operating condition.
- Making all necessary adjustments for maximum efficiency.
- Explaining and demonstrating the operation of the power package and the boat.
- Providing a copy of the Predelivery Inspection Checklist.
- Filling out the Warranty Registration Card completely and mailing it to the factory immediately upon sale of the new product. All power packages must be registered for warranty purposes.

Maintenance

⚠ WARNING

Performing service or maintenance without first disconnecting the battery can cause product damage, personal injury, or death due to fire, explosion, electrical shock, or unexpected engine starting. Always disconnect the battery cables from the battery before maintaining, servicing, installing, or removing engine or drive components.

⚠ WARNING

Fuel vapors trapped in the engine compartment may be an irritant, cause difficulty breathing, or may ignite resulting in a fire or explosion. Always ventilate the engine compartment before servicing the power package.

IMPORTANT: See Maintenance Schedule for complete listing of all scheduled maintenance to be performed. Some listings can be done by the owner or operator, while others should be performed by an authorized Cummins MerCruiser Diesel repair facility. Before attempting maintenance or repair procedures not covered in this manual, we recommended that you purchase the appropriate Cummins MerCruiser Diesel or Mercury MerCruiser Service Manual and read thoroughly.

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

- Blue—Coolant
- Yellow—Engine Oil
- Orange—Fuel
- Brown—Transmission Fluid

Do-It-Yourself Maintenance Suggestions

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

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

- Do not attempt any repairs unless you are aware of the Cautions, Warnings, and procedures required. Your safety is our concern.
- If you attempt to service the product yourself, we suggest you order the service manual for that model. The service manual outlines the correct procedures to follow. It is written for the trained mechanic, so there may be procedures you do not 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 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 Cummins MerCruiser Diesel Authorized Repair Facility is there to service your power package. They have qualified factory-trained mechanics.

It is recommended you have the Cummins MerCruiser Diesel Authorized Repair Facility 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.

General Inspection

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

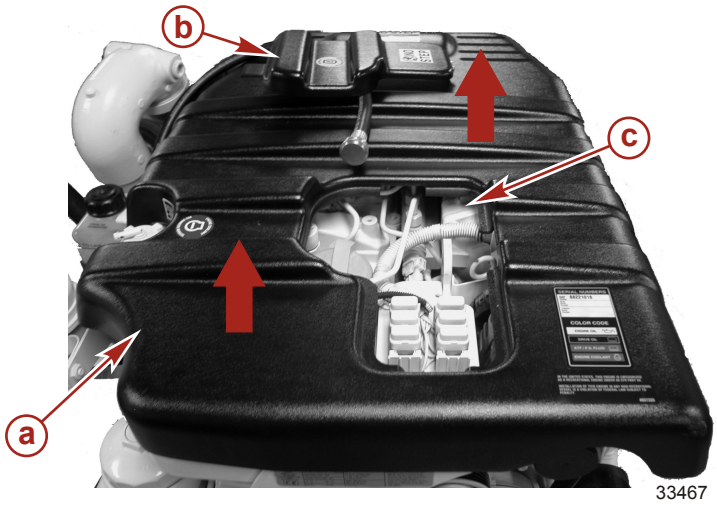
1. Check for loose, damaged, or missing parts, hoses and clamps; tighten or replace as necessary.
2. Check electrical connections and leads for damage or corrosion.
3. Remove and inspect the propeller. If badly nicked, bent, or cracked, contact your Cummins MerCruiser Diesel Authorized Repair Facility.
4. Repair nicks and corrosion damage on power package exterior finish. Contact your Cummins MerCruiser Diesel Authorized Repair Facility.

NOTE: *The engine cover contains an access panel allowing access to the engine fuse panel, the engine oil fill cap, and engine oil dipstick without removing the entire engine cover.*

Engine Cover

Removal

1. Remove the engine fuse panel cover.
2. Lift straight up and detach the engine cover from the ball stud mounts.



a - Engine cover
b - Fuse panel cover
c - Engine access

3. Replace the fuse panel cover during storage.

Cleaning

1. Clean the engine cover with warm soapy water.
2. Air dry the cover.

Inspection

1. Inspect the engine cover for cracks or deterioration.
2. Inspect the rubber grommets for deterioration.
3. Inspect the hardware used with each grommet.
4. Replace damaged parts.

Installation

1. Remove the fuse panel cover.
2. Set the engine cover over the ball stud mounts.

3. Press the engine cover down above each mount to reattach the engine cover.
4. Replace the fuse panel cover.

Maintenance Schedule

Routine Maintenance

NOTE: *Perform only the maintenance tasks that apply to your particular power package.*

Each day start	• Check the engine oil level. (This interval can be extended based on operator experience with the product.) • Check the engine coolant level. • Check the transmission oil level.
Each day end	• If operating in saltwater, brackish water, or polluted water, flush the seawater section of the cooling system after each use. • Drain any water from the primary fuel filter after each use. (Drain any water from both fuel filters if operating in freezing temperatures.)
Weekly	• Drain any water from the fuel filters. • Check the seawater inlets for debris or marine growth. • Check and clean the seawater strainer.
Every Two Months	• Check the battery connections and fluid level. • Treat the engine surfaces with Corrosion Guard if operating in saltwater, brackish water, or polluted waters. • Inspect the air filter. (Inspect every two months or every 50 hours, whichever occurs first.) • Inspect the engine anodes and replace if eroded by 50% or more. • Ensure that the gauges and all wiring connections are secure. • Clean the gauges. (If operating in saltwater reduce the interval to every 25 hours or 30 days, whichever occurs first.)

Scheduled Maintenance

NOTE: *Perform only the maintenance tasks that apply to your particular power package.*

After first 25 hours and not to exceed 30 hours	• Change the engine oil and filter.
After first 50 hours	• Clean the transmission oil filter and change the transmission oil.
Annually	• Touch up the power package with paint and spray with Corrosion Guard. • Clean the transmission oil filter and change the transmission oil.
Every 100 hours or annually (whichever occurs first)	• Change the engine oil and filter. • Replace the fuel filters. • Check the steering system and the remote control for loose, missing, or damaged parts. Lubricate the cables and linkages. • Check the engine alignment. • Torque the engine mounts. • Check the electrical system for loose, damaged, or corroded terminals. • Inspect the condition and tension of the engine accessory drive belts. • Inspect the cooling system and the exhaust system for damage or leaks. Check both systems hose clamps for tightness. • Disassemble and inspect the engine 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 eroded by 50% or more. • Replace the air filter. • Clean the transmission oil filter and change the transmission oil.
Every 2 years	• Replace the engine coolant.
Every 500 hours or 5 years (whichever occurs first)	• Clean the aftercooler core.
Every 1000 Hours or 4 years (whichever occurs first)	• Replace the engine timing belt.
Every 1000 hours or 5 years (whichever occurs first)	• Clean the fuel tank.
According to OEM Schedule	• Check the engine to propeller shaft alignment.

Maintenance Log

Record all maintenance performed on your power package here. Be sure to save all work orders and receipts.

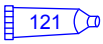
Date	Maintenance Performed	Engine Hours

Engine Oil

Specifications

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

Tube Ref No.	Description	Where Used	Part No.
	15W40 4-cycle Diesel Engine Oil	Engine crankcase	92-858042K01

Other recommended oils are listed in the following table. These oils are approved by Cummins MerCruiser Diesel and Marine Power Europe.

Shell Myrina	Texaco Ursa Super TD	Veedol Turbostar
Mopar	Wintershall Multi-Rekord	Wintershall Viva 1

For all-temperature operation use 15W-40 oil.

Oil Level—Overfilled

NOTICE

Discharge of oil, coolant, or other engine/drive fluids into the environment is restricted by law. Use caution not to spill oil, coolant, or other fluids into the environment when using or servicing your boat. Be aware of the local restrictions governing the disposal or recycling of waste, and contain and dispose of fluids as required.

An overfilled engine crankcase or block can cause a fluctuation or drop in oil pressure. The overfull condition results in the engine crankshaft splashing and agitating the oil, causing it to become aerated. The aerated oil causes a loss of engine performance and an increase in crankcase back pressure. An extreme overfill condition could result in large amounts of oil being drawn into the intake.

Checking engine oil level must be done carefully. The oil level must be maintained between the minimum and the maximum oil level mark on the dipstick. To ensure that you are not getting a false reading, observe the following before checking the oil level.

- If the boat is in the water, ensure that the boat is at rest.
- If the boat is on a trailer, raise or lower the bow until the boat is sitting as it does at rest in the water.
- Allow five minutes for the oil to drain into the oil pan if the engine has just been operated or oil has just been added.

Checking

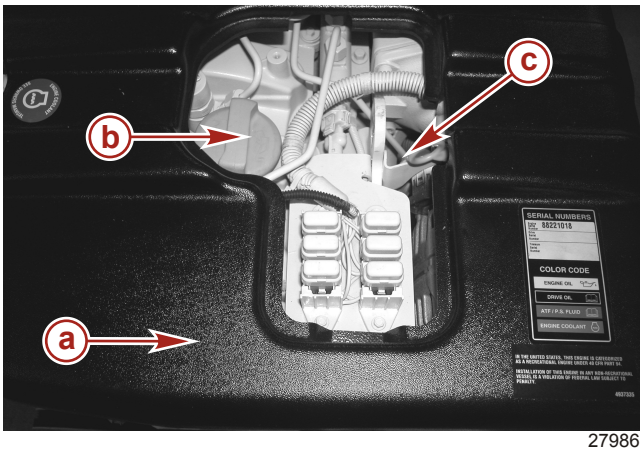
IMPORTANT: Engine crankcase oil must be checked at intervals specified in Maintenance Schedules. It is normal for an engine to use a certain amount of oil in the process of lubricating and cooling the engine. The amount of oil consumed depends greatly upon engine speed, with consumption being highest at wide open throttle and decreasing substantially as engine speed is reduced.

NOTICE

With the engine running, the crankshaft journals or rod journals may strike and break the dipstick, resulting in damage to internal engine components. Stop the engine completely before removing or inserting the dipstick.

1. To check the engine oil level during operation, stop the engine and allow five minutes for the oil to drain into the pan.

2. Remove the dipstick. Wipe clean and reinstall into the dipstick tube.

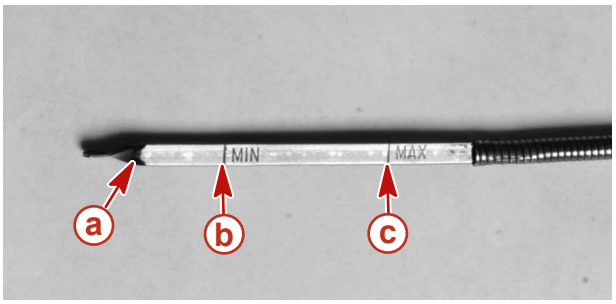


27986

QSD 2.0L engine oil service

- **a -** Engine cover with access panel removed
- **b -** Engine oil fill cap
- **c -** Engine oil dipstick

3. Remove the dipstick and observe the oil level. The oil level must be between the marks on the dipstick. If necessary, add oil. See **Filling**.



14624

Engine oil level markings

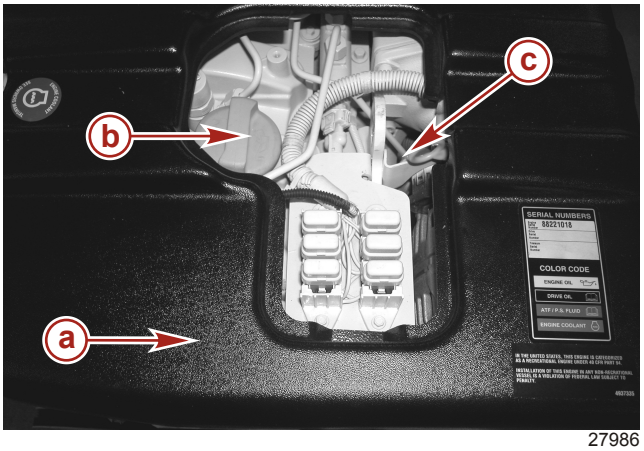
- **a -** Dipstick
- **b -** Minimum operating level
- **c -** Full mark and maximum operating level

4. Install engine oil dipstick

Filling

IMPORTANT: Do not overfill the engine with oil.

1. Remove the oil fill cap.

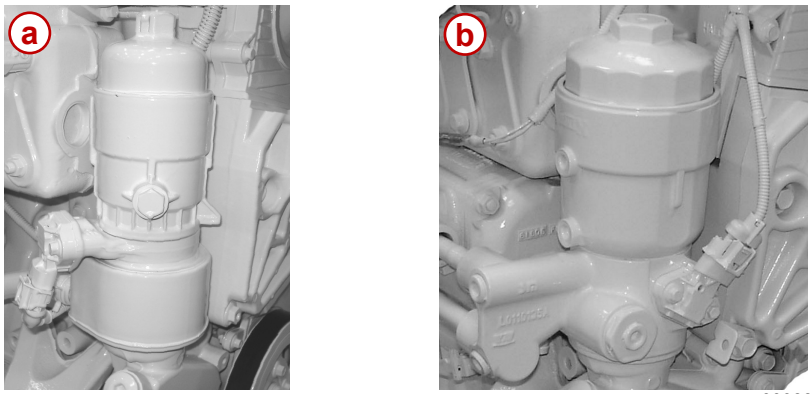


27986

QSD 2.0L engine oil service

- **a -** Engine cover with access panel removed
- **b -** Engine oil fill cap
- **c -** Engine oil dipstick

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



33988

a - Coolant oil cooler
b - Seawater oil cooler

Engine Coolant Oil Cooler			
QSD 2.0	**System Capacity**	**Fluid Type**	**Part Number**
Engine oil (with filter)	5.85 L (6.20 US qt)	15W40 4-cycle Diesel Engine Oil	92-877695K1

Engine Seawater Oil Cooler			
QSD 2.0	**System Capacity**	**Fluid Type**	**Part Number**
Engine oil (with filter)	6.00 L (6.30 US qt)	15W40 4-cycle Diesel Engine Oil	92-877695K1

IMPORTANT: When refilling the engine with oil always use the dipstick to confirm the oil level.

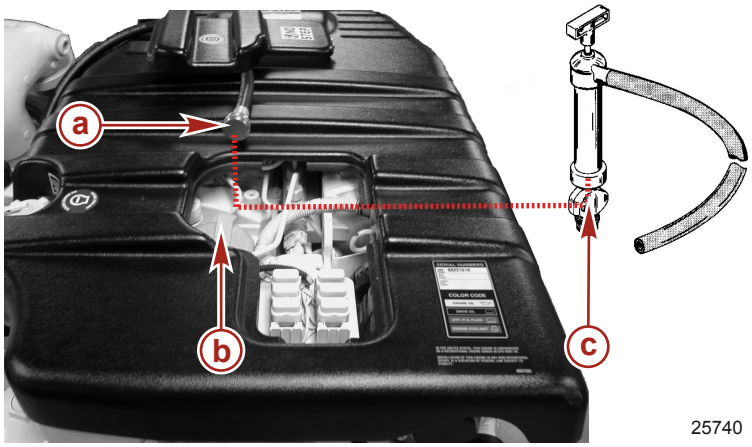
3. Install the oil fill cap.

Changing Oil and Filter

See the **Maintenance Schedule** for the change interval. You should change the engine oil before placing the boat in storage.

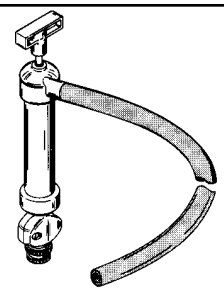
IMPORTANT: Change the engine oil when the engine is warm from operation. Warm oil flows more freely, carrying away more impurities. Use only recommended engine oil. See Specifications.

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

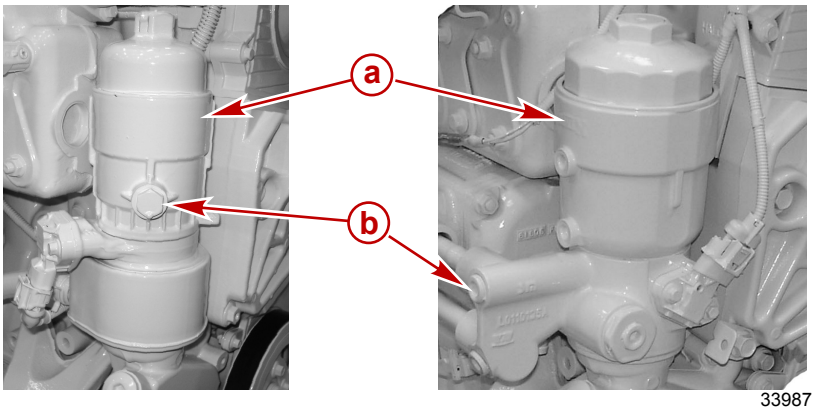


25740

Engine oil removal (Engine cover removed to provide access)
a - Engine oil drain hose
b - Engine oil cap
c - Crankcase oil pump

Crankcase oil pump	91-90265A 5
 11591	Aids in the removal of engine oil without draining the crankcase.

5. Pump the oil out of the crankcase into a drain pan.
6. Remove the oil filter housing drain plug and drain the oil into an appropriate container.

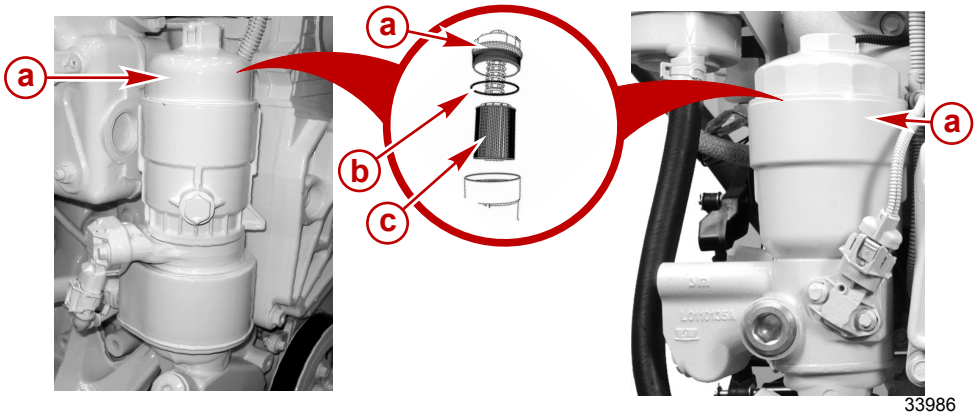


33987

Engine coolant oil cooler **Seawater oil cooler**

a - Oil filter housing
b - Drain plug

7. Contain and dispose of the waste oil and used filter element as directed by all applicable ordinances.
8. Remove the crankcase oil pump and install the crankcase oil drain hose fitting when the crankcase is empty. Tighten securely.
9. Install the oil dipstick.
10. Place a suitable container under the oil filter housing to contain any spilled oil. Use an appropriate socket to loosen the oil filter cover.
11. Remove the oil filter cover and cartridge type oil filter.
12. Remove and discard the old filter element. Discard the old cover O-ring.

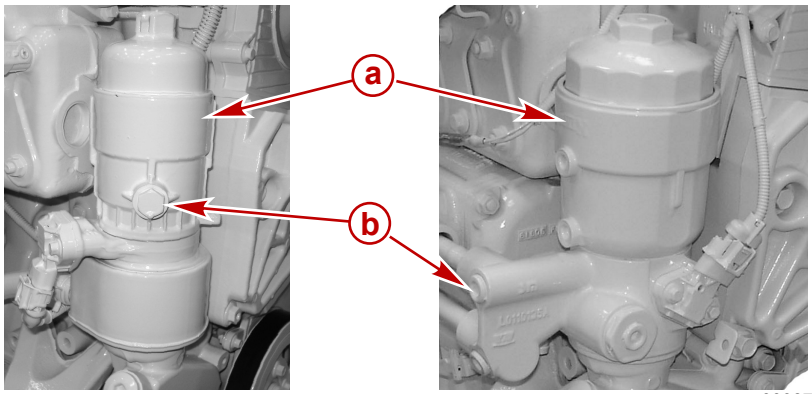


33986

Engine coolant oil cooler **Seawater oil cooler**

a - Oil filter cover
b - O-ring
c - Filter element

13. Apply sealant to the threads of the oil filter housing drain plug and install.



Engine coolant oil cooler **Seawater oil cooler**

a - Oil filter housing
b - Drain plug

Tube Ref No.	Description	Where Used	Part No.
9	Loctite 567 PST Pipe Sealant	Drain plug	92-809822

14. Tighten the oil filter housing drain plug to specification.

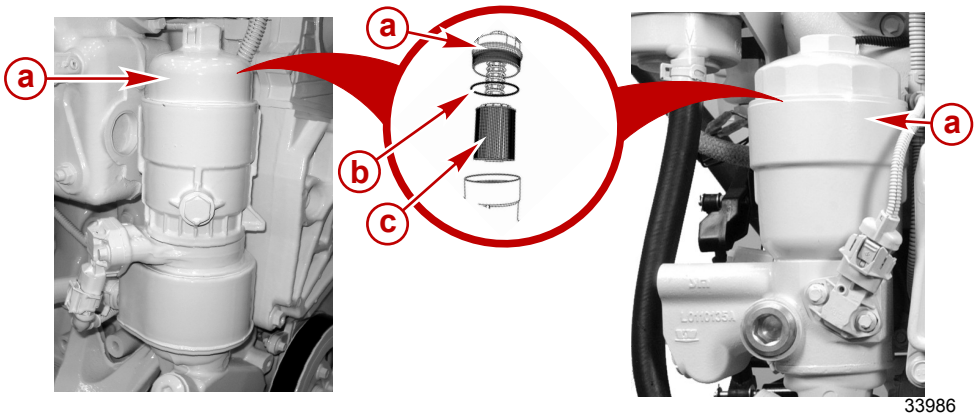
Engine Coolant Oil Cooler			
Description	**Nm**	**lb–in.**	**lb–ft**
Drain plug	19	168	–

Seawater Oil Cooler			
Description	**Nm**	**lb–in.**	**lb–ft**
Drain plug	19	168	–

15. Lubricate and install a new cover O-ring.

Tube Ref No.	Description	Where Used	Part No.
121	15W40 4-cycle Diesel Engine Oil	Oil filter O-rings	92-858042K01

16. Push the filter element into the cover until it is locked. Listen for a click.



Engine coolant oil cooler **Seawater oil cooler**

a - Oil filter cover
b - O-ring
c - Filter element

17. Install the cover with the new filter element into the oil filter housing. Turn the oil filter cover until the sealing surface contacts the housing.
18. Tighten the cover to specification.
    IMPORTANT: Overtightening the cover may cause an oil leak.

Engine Coolant Oil Cooler			
Description	**Nm**	**lb–in.**	**lb–ft**
Engine oil filter housing cover	25.0	–	18.0

Seawater Oil Cooler			
Description	**Nm**	**lb–in.**	**lb–ft**
Engine oil filter housing cover	22.5	–	16.0

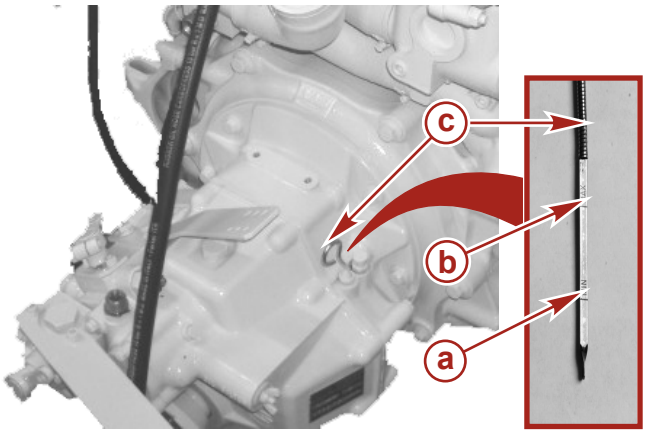
19. Remove the oil fill cap and refill the engine with new oil. See **Filling**.
    IMPORTANT: When refilling the engine with oil, always use the dipstick to determine how much oil is required.
20. Replace and secure the oil fill cap.
21. Start the engine and check for leaks.

TM 345 Technodrive Transmission Fluid

Checking

1. Remove the dipstick.
2. Perform a preliminary check the oil level as indicated on the dipstick with the dipstick fully inserted into the dipstick receptacle.
   NOTE: *The oil level may be somewhat over the maximum mark, as some of the oil from the transmission oil cooler and hoses may have drained back into the transmission.*

3. If the oil level is below the minimum mark on the dipstick, add transmission oil. See **Filling**.

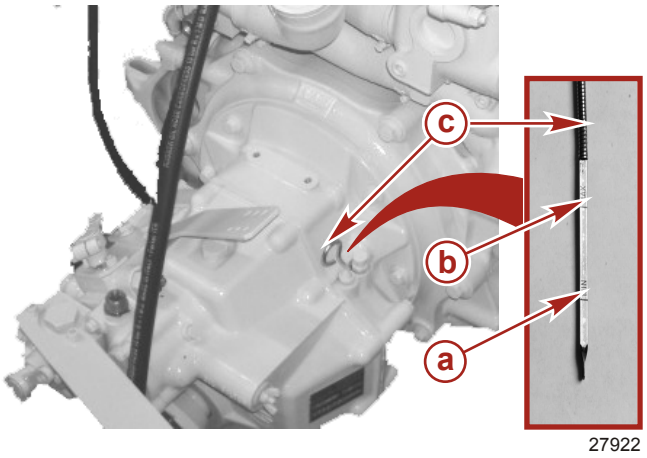


a - Minimum oil level
b - Maximum oil level
c - Dipstick

4. Clean and install the dipstick.
   IMPORTANT: To ensure an accurate indication of the oil level, operate the engine at 1500 RPM for 2 minutes immediately before checking the oil level.
5. Start the engine and operate at 1500 RPM for 2 minutes to reach operating temperature and fill all of the transmission's hydraulic circuits.
6. Stop the engine and quickly check the oil level with the dipstick.
7. If the oil level is low, add transmission oil to bring the level up to the maximum mark on the dipstick. See **Filling**.
   NOTE: *If the transmission oil level was extremely low, see your local Cummins MerCruiser Diesel Authorized Repair Facility.*
8. Clean and install the dipstick.

Filling

1. If necessary, add the specified transmission oil through the dipstick receptacle to bring the level up to the maximum mark on the dipstick.



a - Minimum oil level
b - Maximum oil level
c - Dipstick

NOTE: *Always use the dipstick to determine the quantity of oil required.*

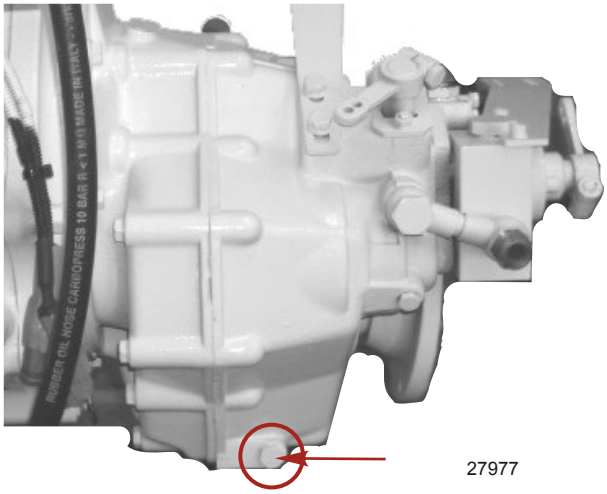
Model	Capacity	oil type	Part Number
Technodrive 345A	1.6 liters (2.7 qt.)	API Class CD SAE 20 or API Class CD SAE 30 engine oil	Obtain Locally

2. Clean and install the dipstick.
3. Check the oil level. See **Checking**.

Changing

1. Remove the dipstick.

2. Remove the transmission oil drain plug and drain the transmission into a suitable container.

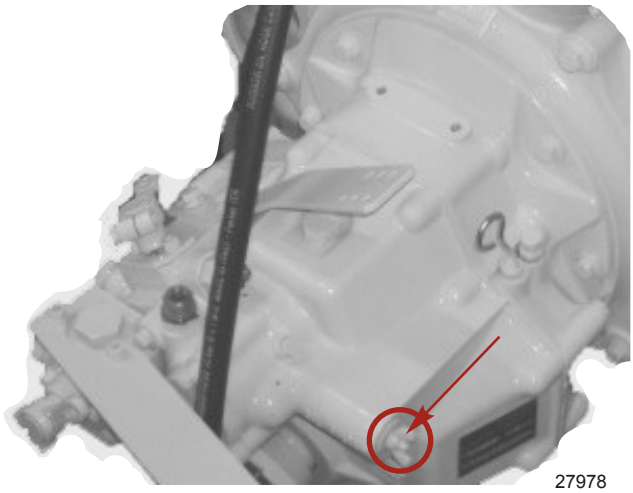


Transmission drain plug

3. Contain and dispose of the oil and oil waste according to applicable regulations.
4. Reinstall the transmission oil drain plug.
5. Torque the drain plug.

Description	Nm	lb. ft.
Transmission oil drain plug	17	12.5

6. Clean the exterior of the transmission around the oil filter assembly.
7. Loosen the retaining nut.



Transmission oil filter retaining nut

8. Remove the filter element.
9. Clean the oil filter element using the cleaning solvent.

Tube Ref No.	Description	Where Used	Part No.
	Cleaning solvent	Transmission filter element	Obtain Locally

10. Lubricate the oil filter O-rings.

Tube Ref No.	Description	Where Used	Part No.
80	SAE engine oil 30W	Transmission filter element O-ring	Obtain Locally

11. Reinstall the filter element.

NOTICE

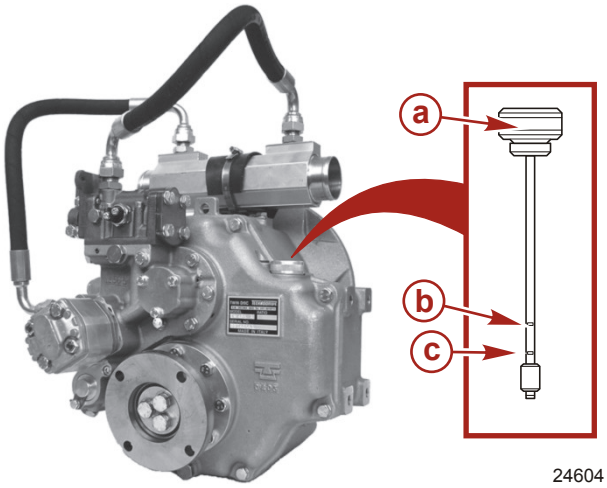
Improper installation of the transmission fluid filter assembly may cause the fluid to foam or leak out, resulting in decreased efficiency and damage to the transmission. Properly seat the transmission fluid filter during installation.

12. Tighten the retaining nut.
13. Fill the transmission to the proper level with the specified oil. See **Filling**.

TM 485-A Technodrive Transmission Fluid

Checking

1. Remove the dipstick.
   IMPORTANT: When checking the fluid level, rest the dipstick on top of the threaded housing hole. Do not screw the dipstick onto the threaded housing hole.
2. Check the fluid level as indicated on the dipstick with the dipstick resting on the top of the threaded hole.
   NOTE: *The fluid level may be somewhat over the maximum mark, as some of the fluid from the transmission fluid cooler and hoses may have drained back into the transmission.*
3. If the fluid level is below the minimum mark on the dipstick, add transmission fluid. See **Filling**.



24604

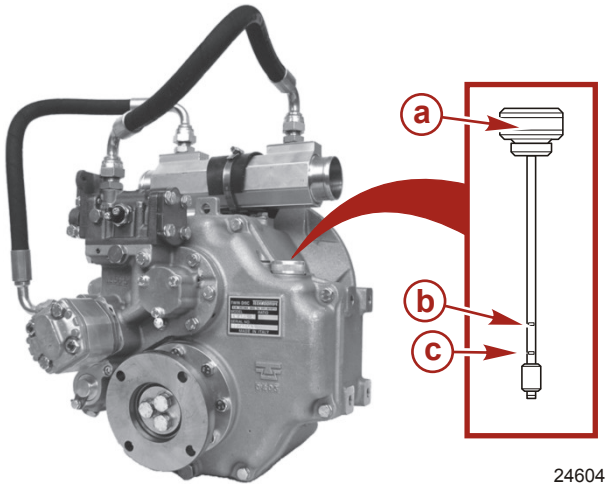
a - Dipstick
b - Maximum fluid level
c - Minimum fluid level

IMPORTANT: To accurately check the fluid level, operate the engine at 1500 RPM for 2 minutes immediately before checking the level.

4. Start the engine and operate at 1500 RPM for 2 minutes to fill all the hydraulic circuits.
5. Stop the engine and quickly check the fluid level with the dipstick resting on the top of the threaded hole.
6. If the fluid level is low, add transmission fluid to bring the level up to the maximum mark on the dipstick. See **Filling**.
   NOTE: *If the transmission fluid level was extremely low, see your local Cummins MerCruiser Diesel Authorized Repair Facility.*
7. Install the dipstick.

Filling

1. If necessary, add specified transmission fluid through the dipstick threaded hole to bring the level up to the maximum mark on the dipstick.



a - Dipstick
b - Maximum fluid level
c - Minimum fluid level

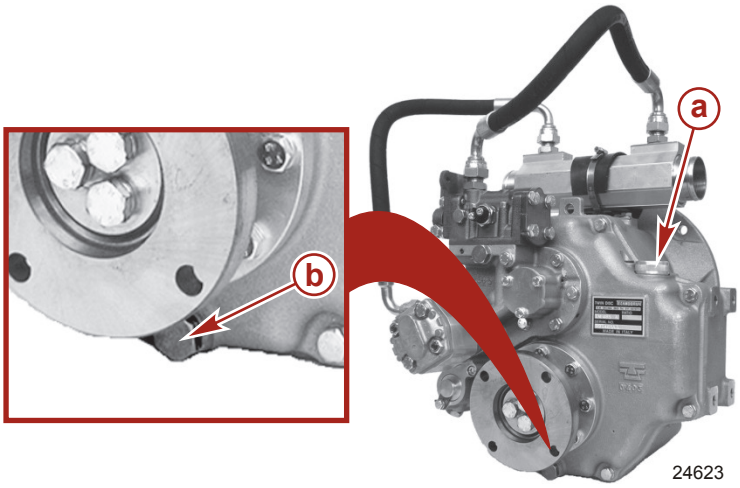
NOTE: *Always use the dipstick to determine the quantity of oil or fluid required.*

Model	Capacity	Fluid type	Part Number
Technodrive 485A	2.6 liters (2 ½ US qt)	SAE 20W - 40 or SAE 15W - 40 engine oil	Obtain Locally

2. Install the dipstick.
3. Check the fluid level. See **Checking**.

Changing

1. Remove the fill cap and dipstick.
2. Remove the transmission fluid drain plug and drain the transmission into a suitable container.



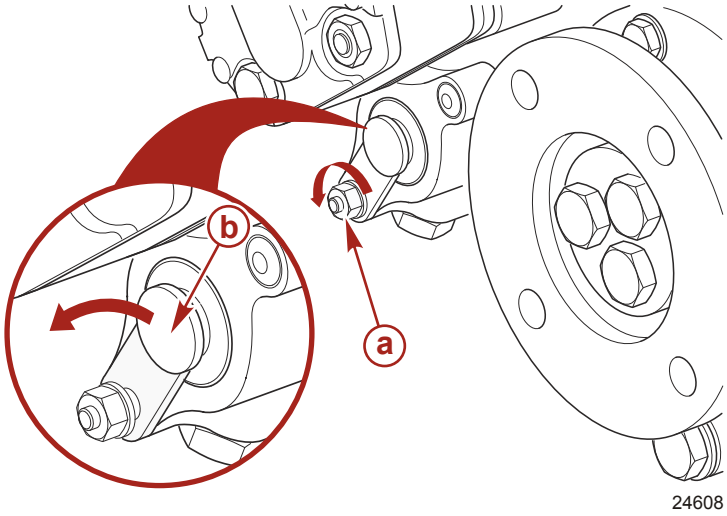
a - Fill cap and dipstick
b - Drain plug

3. Contain and dispose of the oil or oil waste as directed by local authorities.
4. Reinstall the transmission fluid drain plug.
5. Torque the drain plug.

Description	Nm	lb. in.	lb. ft.
Transmission fluid drain plug	17		12.5

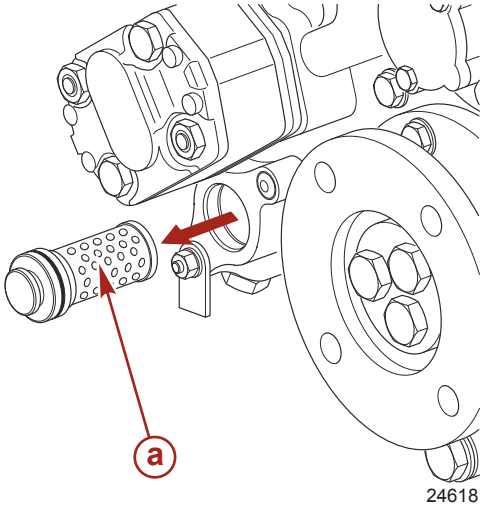
6. Clean the exterior of the transmission around the fluid filter assembly.

7. Loosen the assembly nut then rotate the securing tab in the direction shown.



a - Assembly nut
b - Securing tab

8. Remove the filter element.



a - Filter element

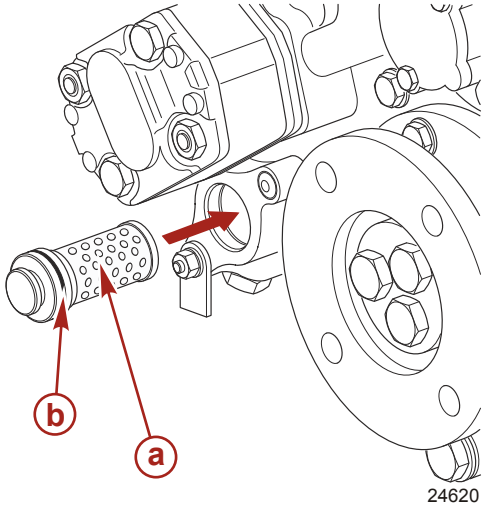
9. Clean the filter element using the cleaning solvent.

Tube Ref No.	Description	Where Used	Part No.
	Cleaning solvent	Transmission filter element	Obtain Locally

10. Lubricate the O-rings.

Tube Ref No.	Description	Where Used	Part No.
80	SAE Engine Oil 30W	Transmission filter element O-ring	Obtain Locally

11. Reinstall the filter element.

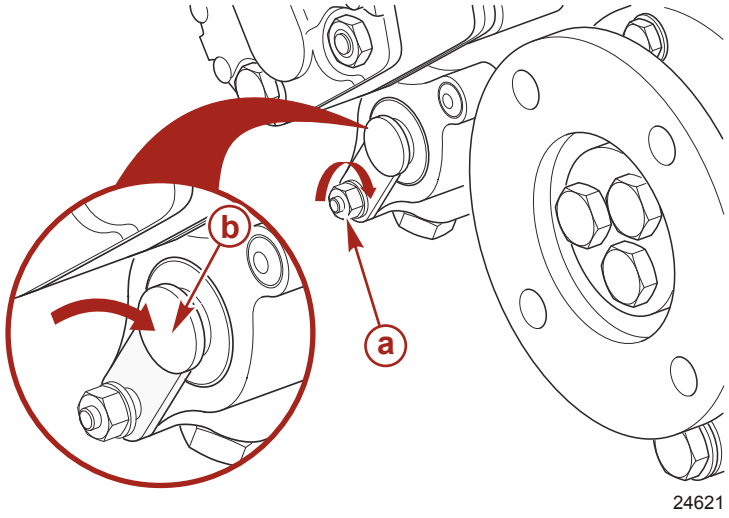


a - Filter element
b - O-ring

NOTICE

Improper installation of the transmission fluid filter assembly may cause the fluid to foam or leak out, resulting in decreased efficiency and damage to the transmission. Properly seat the transmission fluid filter during installation.

12. Replace the securing tab over the filter assembly by turning it clockwise.
13. Tighten the assembly nut. Torque the nut.



a - Assembly nut
b - Securing tab

Description	Nm	lb. in.	lb. ft.
Assembly nut	5-8	48-72	

14. Fill the transmission to the proper level with the specified fluid. See **Filling**.

Engine Coolant

⚠ CAUTION

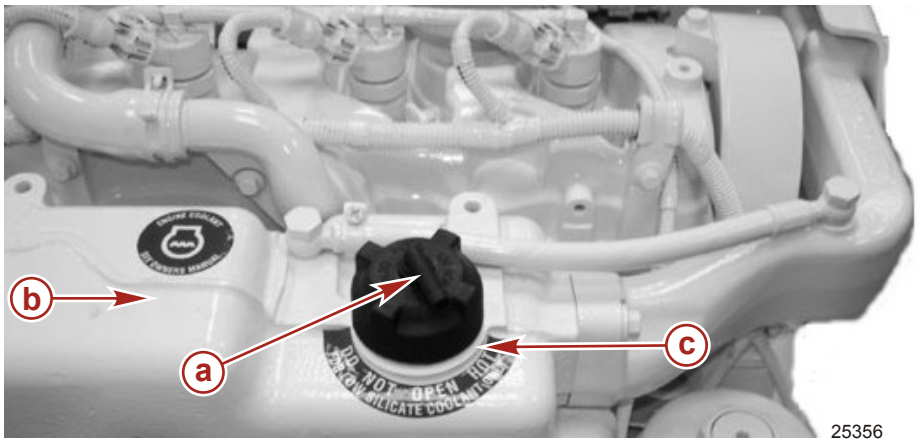
A sudden loss of pressure can cause hot coolant to boil and discharge violently resulting in serious injury from burns. Allow the engine to cool down before removing the coolant pressure cap.

Checking

IMPORTANT: Check the engine coolant before starting the engine.

1. Allow the engine to cool.
2. Remove the pressure cap from the coolant expansion tank.

3. The coolant level in the coolant expansion tank should be within 25 mm (1 in.) of the top of the fill neck.

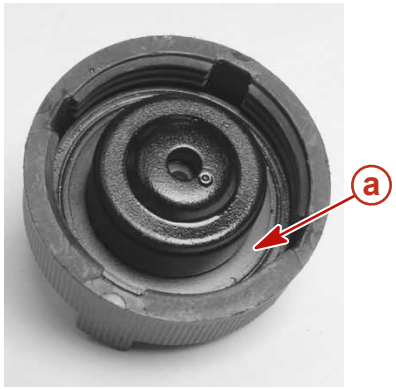


25356

Location of engine coolant cap (engine cover removed)

a - Pressure cap
b - Coolant expansion tank
c - Bottom of fill neck

4. If the coolant level is low:
   a. Inspect the coolant recovery system for leaks.
   b. Inspect the gasket in the pressure cap for damage and replace if necessary.



14142

a - Gasket

   c. The pressure cap maintains pressure on the cooling system and may not be holding pressure properly. To have the cap tested, contact your Cummins MerCruiser Diesel Authorized Repair Facility.
   d. Add the specified coolant as necessary. See **Filling**.

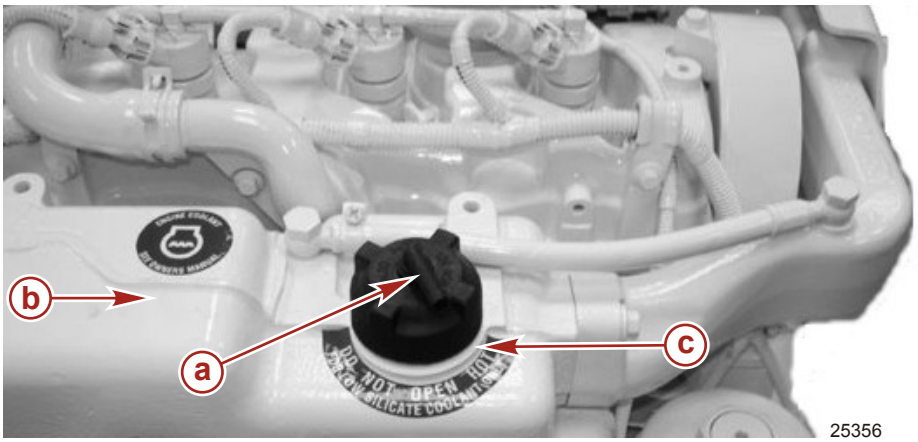
IMPORTANT: When installing the pressure cap, be sure to tighten it securely to prevent coolant loss.

5. If the coolant level is correct, install the pressure cap and tighten securely.
6. Recheck the coolant level after the first WOT boat test and add coolant, if necessary.

Filling

1. Allow the engine to cool.
2. Remove the pressure cap from the coolant expansion tank.

3. If the coolant is low in the coolant expansion tank, add the specified coolant as necessary to bring the level to within 25 mm (1 in.) of the bottom of the fill neck.



Engine coolant fill location (engine cover removed)
- **a -** Coolant cap
- **b -** Coolant expansion tank
- **c -** Bottom of fill neck

Description	Where Used	Part Number
Marine Engine Coolant	Closed cooling system	92-813054A2 Europe Only
Fleetguard Compleat with DCA4		Fleetguard Part Number: CC2825 Obtain Locally

IMPORTANT: When installing the pressure cap, be sure to tighten it securely to prevent coolant loss.

4. Install the pressure cap. Tighten securely.

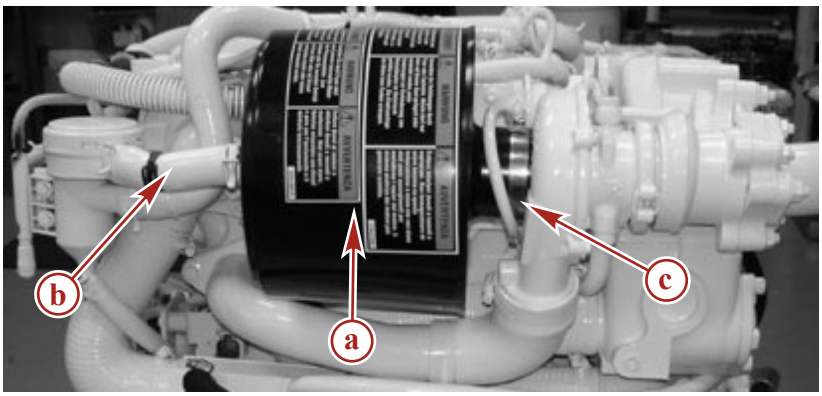
Changing

Change (replace) the engine coolant at the prescribed interval. See **Replacing the Engine Coolant in the Closed Cooling System**.

Air Filter

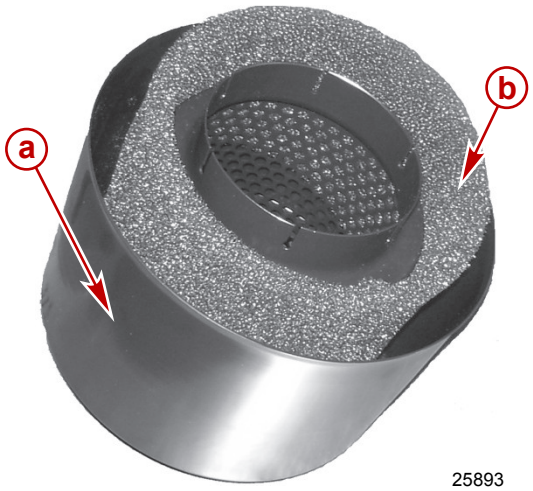
Removal

1. Loosen the clamp and remove the oil separator vent hose.
2. Loosen the clamp and remove the air filter housing from the turbocharger inlet.



Air filter housing installed on engine
- **a -** Air filter housing
- **b -** Oil separator vent hose
- **c -** Air intake retaining clamp

3. Remove the air filter element from the air filter housing



a - Air filter housing
b - Air filter element

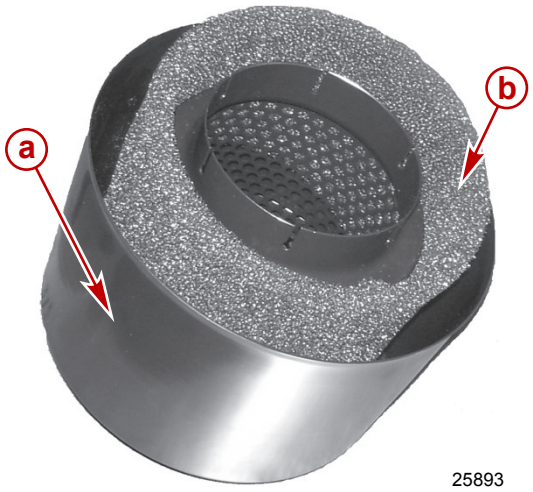
Inspection

1. The air filter cannot be cleaned. Replace the air filter if it is dirty or contaminated.
2. Replace the air filter if the foam element is deteriorated or torn.
3. Replace the air filter at the recommended interval. See **Maintenance Schedules** for the replacement interval under normal conditions.

Installation

IMPORTANT: The foam cover is an integral component of the air filter element and must be clean and dry for proper filtration and engine performance. Do not treat the foam filter cover with oil.

1. Slide the filter element into the air filter housing. Ensure that the element is seated fully into the air filter housing.



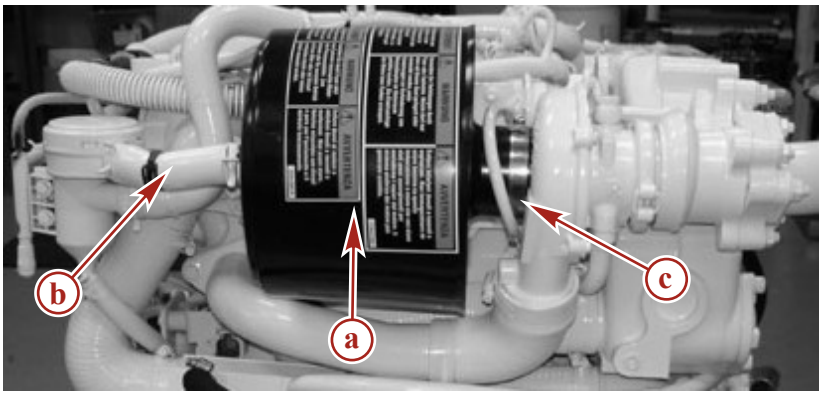
a - Air filter housing
b - Air filter element

NOTE: *The warning labels on the air filter housing must be visible after the air filter housing is installed.*

2. Install the air filter housing on to the turbocharger inlet.
3. Tighten the air filter housing clamp to specification.

Description	Nm	lb–in.	lb–ft
Air filter housing clamp	5.6	50	–

4. Install the oil separator vent hose. Tighten the oil separator vent hose clamp securely.



25357

Air filter housing

a - Air filter housing
b - Oil separator vent hose
c - Air filter retaining clamp

5. Tighten the oil separator vent hose clamp to specification.

Description	Nm	lb–in.	lb–ft
Oil separator vent hose clamp	5.6	50	–

Water-Separating Fuel Filter

⚠ WARNING

Fuel is flammable and explosive. Ensure that the key switch is off and the lanyard is positioned so that the engine cannot start. Do not smoke or allow sources of spark or open flame in the area while servicing. Keep the work area well ventilated and avoid prolonged exposure to vapors. Always check for leaks before attempting to start the engine, and wipe up any spilled fuel immediately.

NOTICE

Water entering the fuel injection system will cause corrosion and rusting of the injectors and other components, disabling the fuel injection system. Check daily for water in the water-separating fuel filter and have the engine inspected immediately if there is evidence of water in the fuel system.

IMPORTANT: Use a suitable container to collect fuel. Clean up any spills immediately and dispose of fuel in a safe manner in accordance with all local, federal, and international regulations.

The engine-mounted water-separating fuel filter is equipped with a water-in-fuel (WIF) sensor that should alert the operator when water is present in the filter. This fuel filter needs to be replaced at specified intervals or whenever water is detected in the fuel, whichever comes first.

The operator may be alerted that the WIF sensor has detected water in the fuel, depending upon the boat instrumentation package and if equipped:

- A fault code may be displayed on a system viewer.
- The audio warning system may sound.

See **Features and Controls**.

Drain or replace the remote mounted primary filter (such as a Racor® filter) at specified intervals, or whenever water is detected in the engine-mounted fuel filter.

Draining

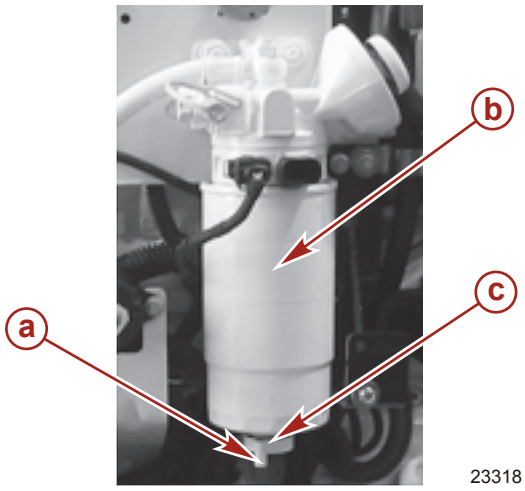
The engine-mounted water-separating fuel filter can be drained of water and small dirt particles by opening the drain cap on the bottom of the filter.

NOTE: *To ensure complete draining in warm weather, drain the filter 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 the fuel filter to catch contaminated fuel or water. Dispose of properly.*

1. Place a container under the drain cap on the filter.

2. 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 water-separating fuel filter
- **a -** WIF sensor wire connection
- **b -** Filter
- **c -** Drain cap

3. Drain until the fuel is clear in appearance.
4. Close the drain cap by turning clockwise. Tighten securely.
5. Fill the fuel filter. See **Filling**.

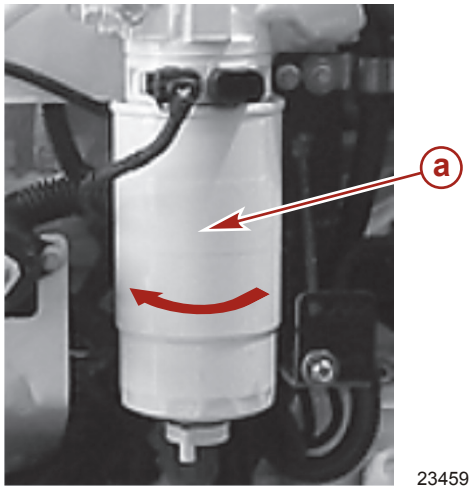
Replacing

⚠ WARNING

Performing service or maintenance without first disconnecting the battery can cause product damage, personal injury, or death due to fire, explosion, electrical shock, or unexpected engine starting. Always disconnect the battery cables from the battery before maintaining, servicing, installing, or removing engine or drive components.

IMPORTANT: The element cannot be cleaned and reused. It must be replaced.

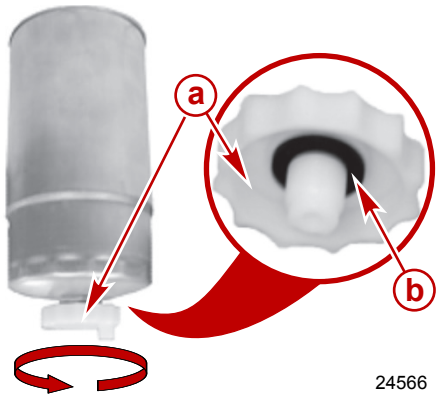
1. Disconnect both battery cables from the battery.
2. Disconnect the WIF sensor wires, if equipped.
3. Remove the water-separating fuel filter and sealing ring from the mounting bracket. Do not use a filter wrench.



Typical
- **a -** Water-separating fuel filter

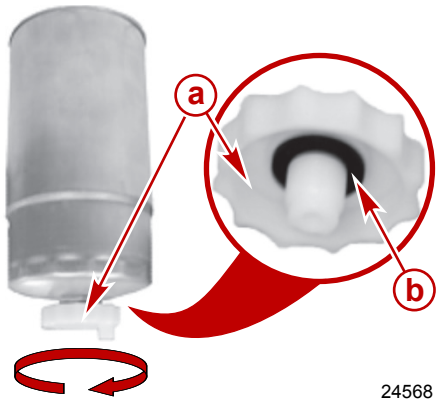
NOTE: *It may be necessary to keep the existing drain cap and use it on the new filter. Be sure to replace the O-ring on the drain cap.*

4. Remove the drain cap and O-ring seal from the bottom of the existing fuel filter. Note the position of the O-ring seal.



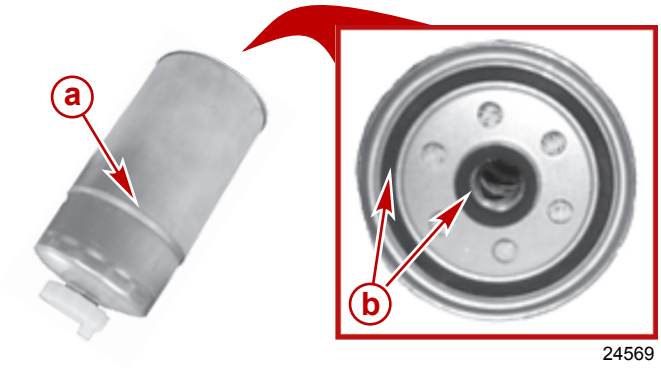
Typical
a - Drain cap
b - O-ring seal

5. Discard the used filter and O-ring seal as defined by local authorities.
6. Install the O-ring and drain cap on the new water-separating fuel filter.



Typical
a - Drain cap
b - O-ring seal

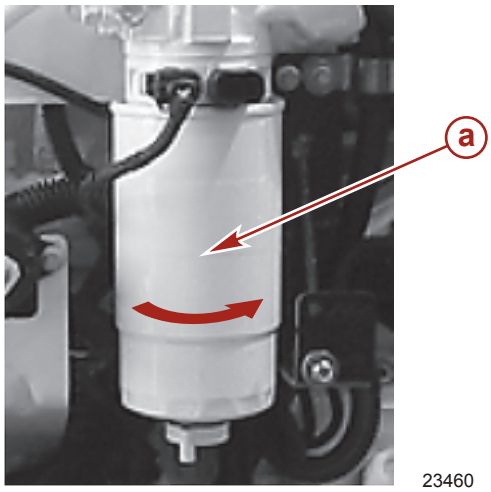
7. Lubricate the fuel filter seals.



Typical
a - Water-separating fuel filter
b - Seals

Tube Ref No.	Description	Where Used	Part No.
80	SAE Engine Oil 30W	Water-separating fuel filter sealing ring	Obtain Locally

8. Align the filter to the bracket. Twist the filter by hand to secure the filter to the bracket. Do not use a filter wrench.



23460

Typical
a - Water-separating fuel filter

9. Ensure that the drain cap is securely tightened.
10. Connect the WIF sensor wires, if equipped.
11. Fill the water-separating fuel filter with fuel. See **Filling**.
12. Check the filter and drain cap for fuel leaks.
13. Connect the battery cables.
14. Start and operate the engine. Check the filter connection for fuel leaks. If leaks exist, recheck filter installation. If leaks continue, stop the engine immediately and contact your Cummins MerCruiser Diesel Authorized Repair Facility.

Filling

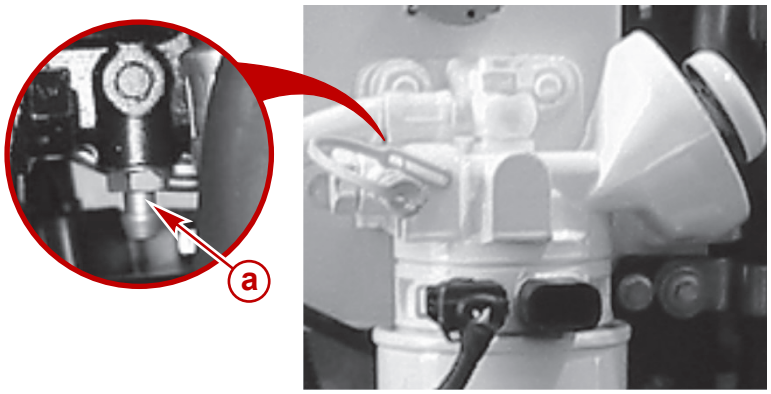
A type of hand pump and primer plunger is located on the fuel filter bracket and is used to

- Refill the fuel filter when draining or changing the filter.
- Refill the fuel system on the engine if the system was run dry.
- Prime the fuel system if the engine has not been run for an extended period.

IMPORTANT: Only fill the fuel filter with the hand pump and primer plunger to ensure that unfiltered fuel does not get into the fuel system.

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

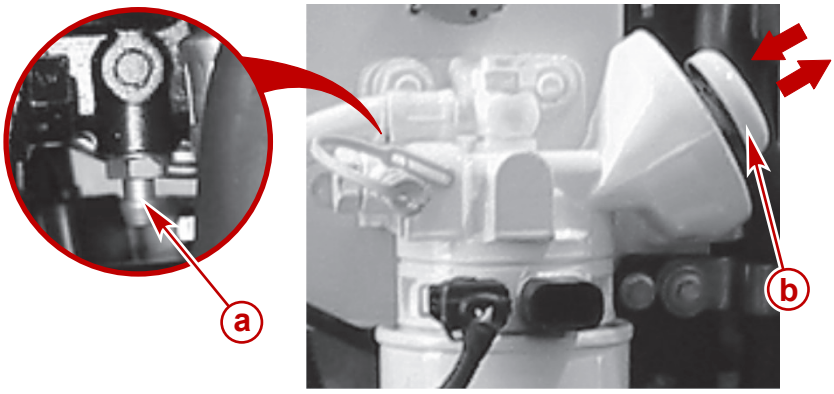
1. Loosen the air vent (bleed) screw on the fuel filter bracket.



23469

Typical
a - Air vent screw

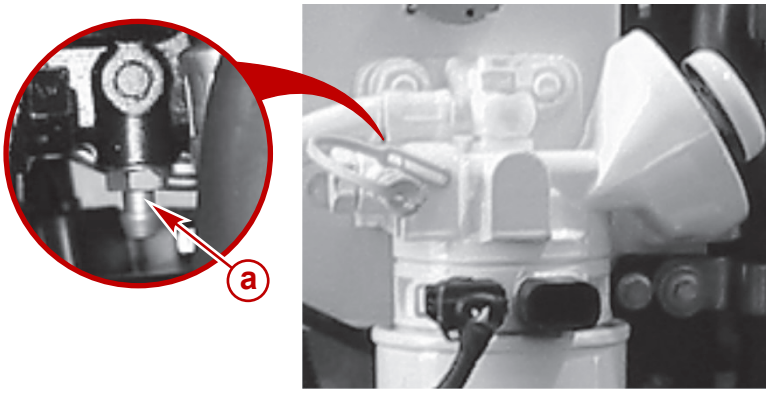
2. Move the primer plunger up and down repeatedly. The filter is full when an air-free stream of fuel flows from the air vent screw.



23468

Typical
a - Air vent screw
b - Primer plunger

3. Securely tighten the air vent screw.



23469

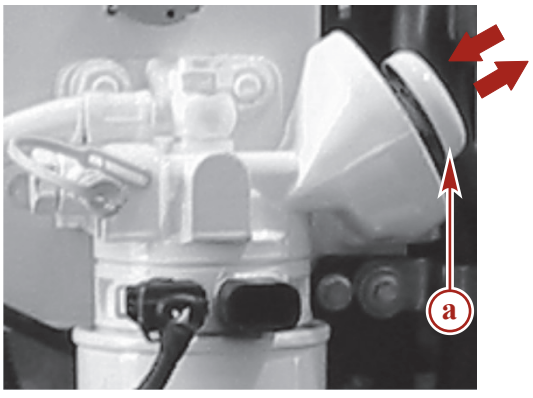
Typical
a - Air vent screw

Fuel System

Priming

Prime the engine if it has not been run for an extended period or if the engine will not start.

1. Move the primer plunger up and down repeatedly.



25985

a - Fuel priming pump

2. Attempt to start the engine.

Filling (Bleeding)

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

1. See **Water Separating Fuel Filter - Filling** and fill the fuel filter.
2. Check the filter and drain cap for fuel leaks. Ensure that the bleed screw on the fuel filter bracket is closed.

Fuel Tank Cleaning and Flushing

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

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

Seawater System

Draining the Seawater System

⚠ CAUTION

Water can enter the bilge when the drain system is open, damaging the engine or causing the boat to sink. Remove the boat from the water or close the seacock, disconnect and plug the seawater inlet hose, and ensure the bilge pump is operational before draining. Do not operate the engine with the drain system open.

IMPORTANT: The engine must be as level as possible to ensure complete draining of the seawater system.

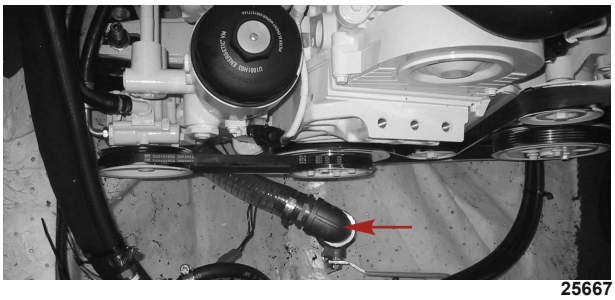
Drain the seawater system before flushing or prior to cold weather (freezing temperature), seasonal storage, or extended storage.

IMPORTANT: The engine must not be operating during this procedure.

⚠ CAUTION

Water can enter the bilge when the drain system is open, damaging the engine or causing the boat to sink. Remove the boat from the water or close the seacock, disconnect and plug the seawater inlet hose, and ensure the bilge pump is operational before draining. Do not operate the engine with the drain system open.

1. Remove the boat from the water if possible.
2. **If the boat is to remain in the water**, turn on the bilge pump, close the seacock (if equipped), or disconnect and plug the seawater inlet hose.

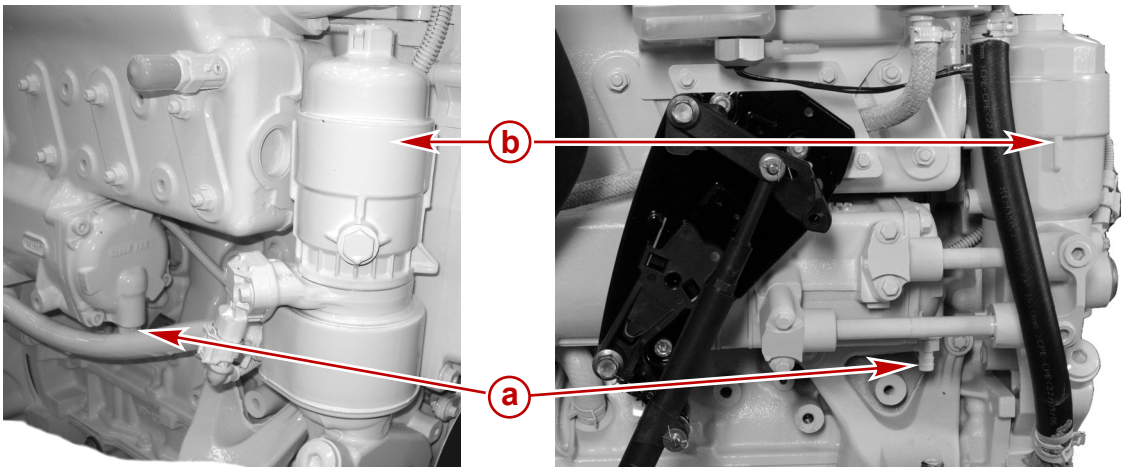


25667

Typical seacock installation

3. Make the engine as level as possible to ensure complete draining of the seawater system.

4. Attach a temporary drain hose to the barbed fitting of the seawater drain valve.

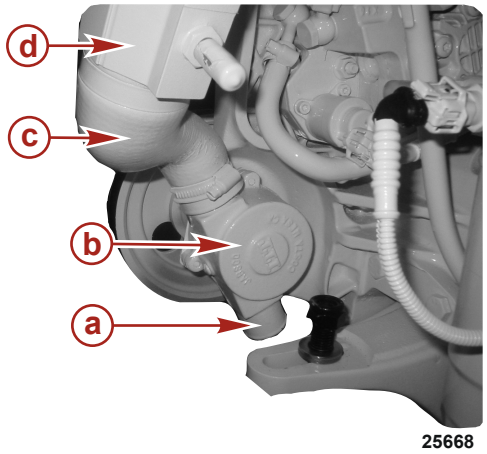


33990

Coolant oil cooler **Seawater oil cooler**

a - Seawater drain valve
b - Oil filter housing

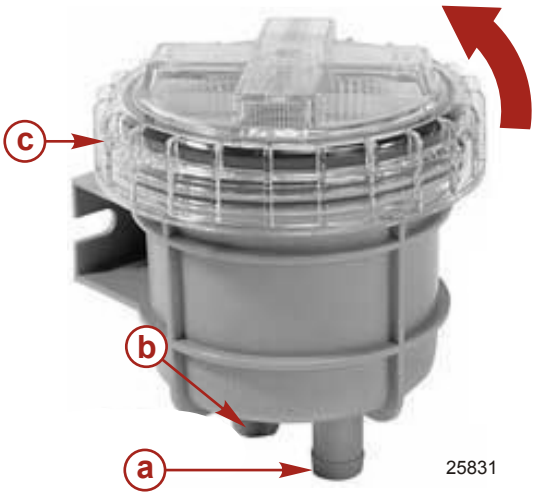
5. Open the seawater drain valve.
6. A small diameter wire bore brush or stiff piece of ware can be used to clear the seawater drain valve of any debris.
7. Disconnect the seawater inlet hose from the connector on the seawater pump.



25668

a - Seawater pump inlet
b - Seawater pump
c - Seawater pump outlet
d - Fuel cooler (if equipped)

8. **On models equipped with a seawater strainer**, remove the hoses at the seawater strainer and drain them completely. Drain and empty the seawater strainer. Reconnect the hoses and tighten the hose clamps securely.



25831

Typical

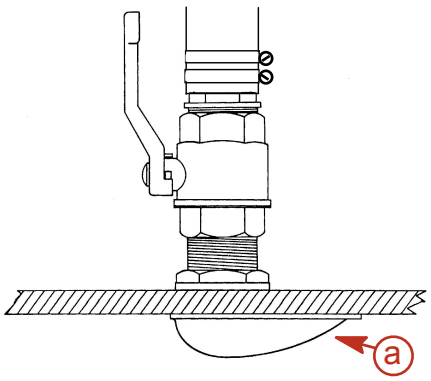
a - Seawater inlet
b - Seawater outlet
c - Seawater strainer cover

9. After the seawater has completely drained, remove the temporary drain hose and close the heat exchanger seawater drain valve.
10. Reconnect all seawater hoses.
11. Tighten all hose clamps to specification.

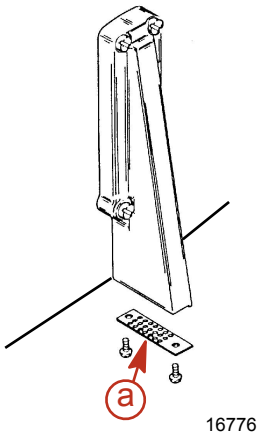
Description	Nm	lb–in.	lb–ft
Hose clamp	5.6	50	–

Checking the Seawater Pickups

1. Ensure that the water inlet holes for the seawater pickup are clean and not obstructed.



Typical through-hull seawater pickup



Typical through-transom seawater pickup

a - Water inlet holes

Cleaning the Seawater Strainer

NOTE: *Visually inspect the seawater strainer through its clear cover.*

NOTICE

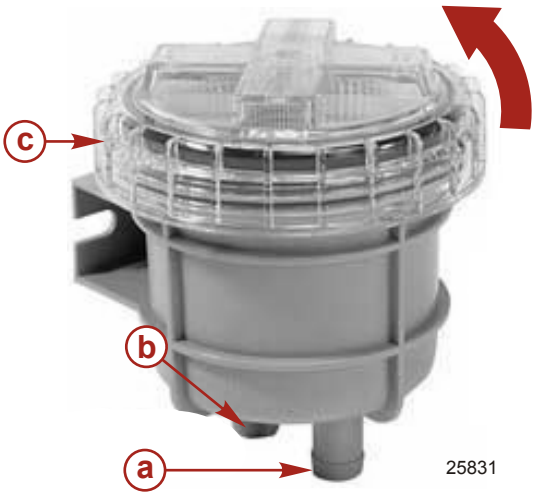
An open seawater strainer or seacock during some service or maintenance procedures can introduce water into the boat, causing damage or sinking the boat. Always close the water supply from the seawater pump, water inlet, or seacock when performing service or maintenance on the cooling system.

NOTICE

Disconnecting the seawater inlet hose will cause water to enter the bilge resulting in engine damage. Close the seacock before disconnecting the seawater inlet hose. Plug the seawater inlet hose immediately after disconnecting it.

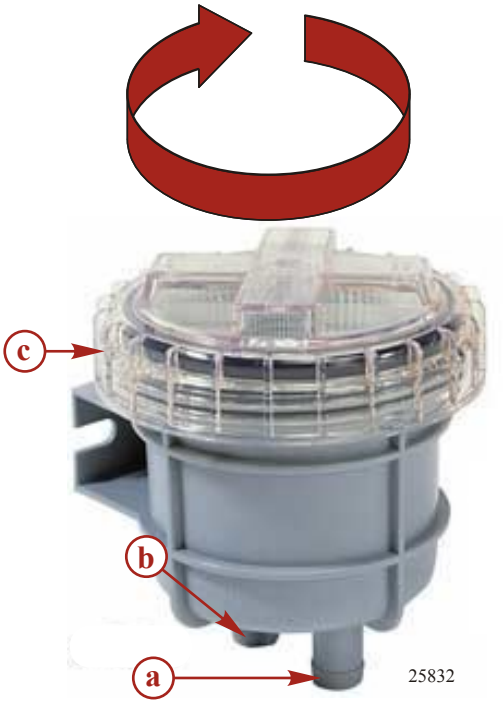
If the boat is in the water, ensure that the engine is off, close the seacock, if equipped, or remove and plug the seawater inlet hose.

2. Remove the the seawater strainer cover by turning it counterclockwise by hand.



a - Seawater inlet
b - Seawater outlet
c - Seawater strainer cover

3. Remove the strainer from the strainer housing and clean out any debris. Flush the strainer with clean water.
4. Clean out any debris from the strainer housing and flush with clean water.
5. Place the strainer back into strainer housing. Ensure that it is fully and evenly seated into the bottom of the strainer housing.
6. Inspect the strainer cover's O-ring seal and replace if damaged or leaking.
7. Install the strainer cover by turning it clockwise by hand. Ensure that the strainer cover O-ring is properly located and moderately compressed when the cover is installed. Do not overtighten.



a - Seawater inlet
b - Seawater outlet
c - Seawater strainer cover

8. If the boat is out of the water. Perform an operational inspection of the seawater cooling system after cleaning the seawater strainer.
   a. Cooling water must be supplied to the engine seawater pump. See **Flushing the Seawater System** regarding cooling water supply when this service is performed with the boat out of the water.
   b. Start the engine and allow the seawater system to fill and the engine to reach normal operating temperature.
   c. Run the engine at a fast idle between 600 to 1400 RPM. Monitor engine temperature to confirm proper operation of the cooling system.
   d. Inspect the seawater system for leaks maintaining a fast idle engine speed between 600 to 1400 RPM.
   e. Tag the keys, record the service in the maintenance log, or otherwise make note that a proper operational inspection of the seawater system must be performed before returning the boat to service.
9. If the boat is in the water, perform an operational inspection of the seawater cooling system.

a. Open the seacock, if equipped, or remove the plug and reconnect the seawater inlet hose.
b. Start the engine and allow the seawater system to be filled and the engine to reach normal operating temperature.
c. Check the seawater cooling system for leaks within an RPM range of 600 to 1400 RPM.
d. Carefully monitor the engine operating temperature to ensure that it remains in normal operational range and that the seawater cooling system is functioning properly.

Engine Seawater Pump Inspection

IMPORTANT: Cummins MerCruiser Diesel strongly recommends that this service be performed by a Cummins MerCruiser Diesel Authorized Repair Facility.

Remove and inspect the engine seawater pump at the interval specified in the **Maintenance Schedule**. See your Cummins MerCruiser Diesel Authorized Repair Facility.

Replacing the Engine Coolant

Draining the Closed Cooling System

IMPORTANT: Due to the complex nature of this service Cummins MerCruiser Diesel strongly recommends that this service be performed by a Cummins MerCruiser Diesel Authorized Repair Facility.

NOTICE

Discharge of oil, coolant, or other engine/drive fluids into the environment is restricted by law. Use caution not to spill oil, coolant, or other fluids into the environment when using or servicing your boat. Be aware of the local restrictions governing the disposal or recycling of waste, and contain and dispose of fluids as required.

NOTE: *For instructions on draining the seawater section, see* ***Draining the Seawater System*** *in this section.*

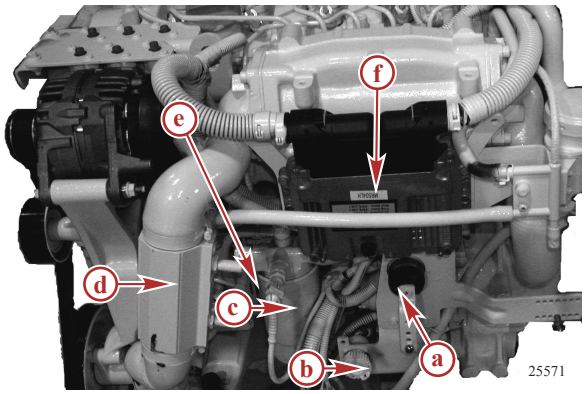
IMPORTANT: Observe the following points.

- **Ensure that the engine is as level as possible to promote complete draining of the cooling system.**
- **The closed cooling section must be filled year-round with the required coolant. If the engine will be exposed to freezing temperatures, ensure that the closed cooling section is filled with a solution of low silicate ethylene glycol antifreeze and deionized, purified water properly mixed to protect the engine to the lowest temperature to which it will be exposed.**
- **Do not use propylene glycol antifreeze in the closed cooling section of the engine.**

⚠ CAUTION

A sudden loss of pressure can cause hot coolant to boil and discharge violently resulting in serious injury from burns. Allow the engine to cool down before removing the coolant pressure cap.

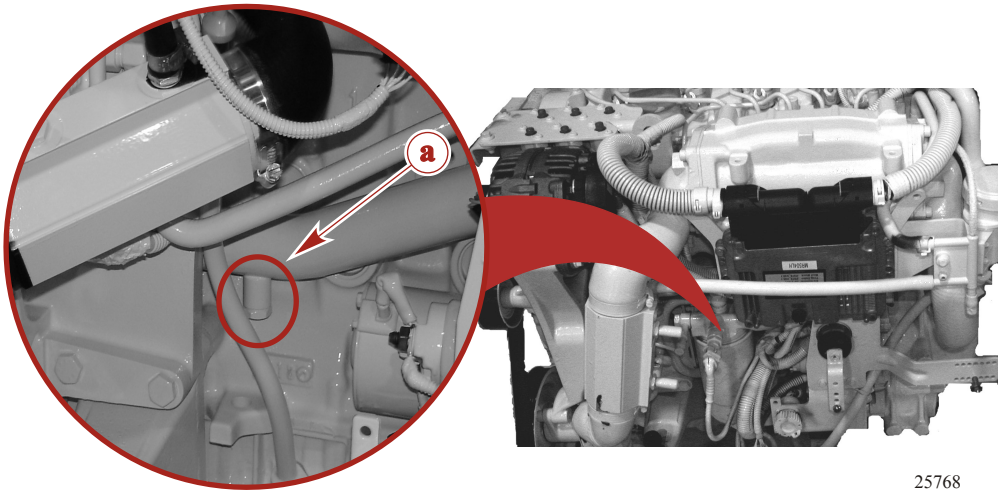
1. Allow the engine to cool.
2. Remove the pressure cap from the expansion tank and coolant reservoir.
3. Remove the fuel filter for access to the engine coolant drain plug. See **Water–Separating Fuel Filter**.
4. Move the fuel lines so they do not obstruct access to the engine coolant drain plug.



Port side of engine
a - Throttle cable bracket
b - 14–pin electrical connector
c - Water–separating fuel filter
d - Fuel cooler with fuel lines moved to provide access
e - General location of engine coolant drain plug
f - Engine control module

5. Remove the engine coolant drain plug and drain the coolant into a suitable container.
   NOTE: *Allow the engine coolant system to drain completely.*

NOTE: *Dispose of old coolant properly.*



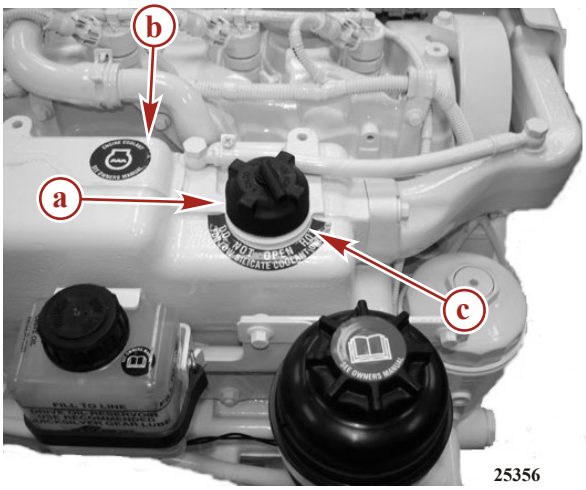
Port side of block with water–separating fuel filter removed for access

a - Engine coolant drain plug

6. Ensure that the coolant has drained completely.
7. If required, clean the closed cooling system. See your local Cummins MerCruiser Diesel Authorized Repair Facility.
8. Install and tighten the engine coolant drain plug.
9. Reinstall the water–separating fuel filter. See **Water–Separating Fuel Filter, Replacing.**
10. Fill the system with the specified coolant. See **Filling the Closed Cooling System**.

Filling the Closed Cooling System

1. Remove the pressure cap.



QSD 2.0L (engine cover removed)

a - Pressure cap
b - Coolant expansion tank
c - Coolant fill neck

IMPORTANT: Use only the specified coolant.

2. If the coolant is being replaced or the level is low, slowly add the specified coolant to the level indicated in the table.

Coolant level in expansion tank	
QSD 2.0L	Within 25 mm (1 in.) of the top of the filler neck

Tube Ref No.	Description	Where Used	Part No.
123	Marine engine coolant (only available in Europe)	Closed cooling system	92-813054A2
	Fleetguard Compleat with DCA4, Fleetguard part number CC2825	Closed cooling system	Obtain Locally

NOTICE
Without sufficient cooling water, the engine, the water pump, and other components will overheat and suffer damage. Provide a sufficient supply of water to the water inlets during operation.

3. If the boat is out of the water, the engine seawater pump must be supplied with cooling water. See the **Flushing the Seawater System** section of this manual.
4. Do not install the pressure cap. Start and operate the engine at fast idle speed between 600 and 1400 RPM. Add coolant as necessary to maintain the coolant at the level specified previously.
   IMPORTANT: When installing the pressure cap, be sure to tighten it securely to avoid coolant loss.
5. Install the pressure cap after the engine has reached normal operating temperature (with the thermostat fully open) and the coolant level remains constant.
6. Test the engine operation. Observe the temperature gauge and check the engine for coolant leaks. If the temperature gauge indicates high coolant temperature or coolant is leaking, stop the engine immediately and inspect for the cause.
7. After the first operation, allow the engine to cool.
8. Remove the pressure cap and add the specified coolant to the level indicated in the table.

Coolant level in expansion tank	
2.0	Within 25 mm (1 in.) of the top of the filler neck

9. Install and securely tighten the pressure cap.

Corrosion Protection

General Information

Whenever two or more dissimilar metals (such as those found on this power package) 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 erosion is known as *galvanic corrosion* and, if it is not controlled, it will eventually cause the need for replacement of power package components exposed to water.

To help control the effects of galvanic corrosion, Cummins MerCruiser Diesel power packages 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).

IMPORTANT: Replace sacrificial anodes if eroded 50% or more. Cummins MerCruiser Diesel strongly recommends avoiding the use of anodes from another manufacturer. Refer to your Cummins MerCruiser Diesel Authorized Repair Facility for additional information.

Engine Corrosion Protection Components

The engine is equipped with a sacrificial anode located in the end cover of the engine aftercooler to assist in protecting the engine and the seawater cooling system from corrosion.

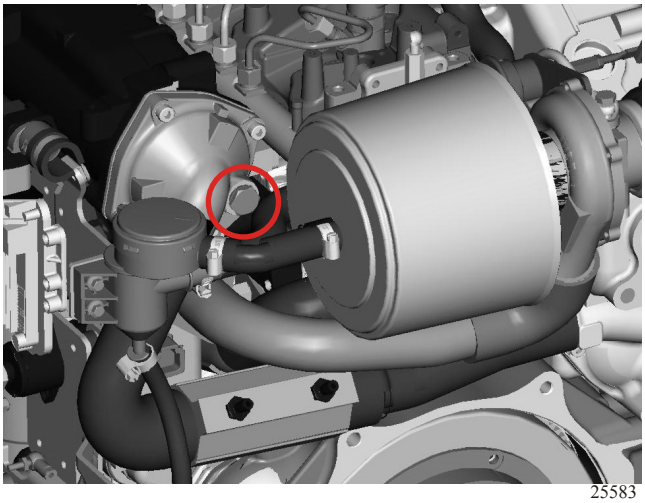
Removal

1. Allow the engine to cool.

NOTICE
Failure to close the seawater inlet or seacock when removing or replacing the anode plugs can lead to water damage. Close the seacock or remove and plug the seawater inlet hose to prevent water from entering the anode plug holes.

2. With the engine off, close the seacock, if equipped, or remove and plug the seawater inlet hose.
3. Drain the seawater system. See **Draining the Seawater System** .

4. Remove the anode assembly (anode plug, sealing washer, and the sacrificial anode) from the aftercooler end cover.



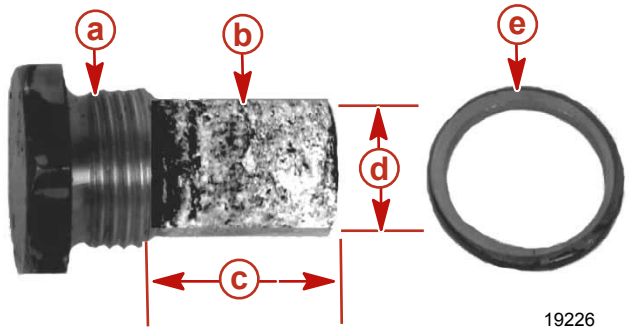
a - Sacrificial anode

Cleaning and Inspection

NOTE: *Using sandpaper, fiber brush, or cleaning pad, remove the deposits from the surface of the anode before trying to determine the amount of erosion. Do not use a mild steel brush which might leave deposits that could accelerate corrosion.*

1. Remove the deposits.
2. Inspect and measure the anode. Compare the measurements to the specifications for a new sacrificial anode and replace the anode assembly when deteriorated 50%.

   NOTE: *Sacrificial anodes are available only as an assembly. Replace both the plug and anode as a unit.*



Anode assembly

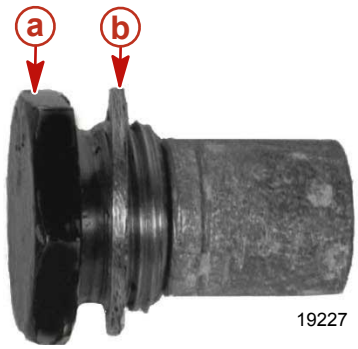
a - Anode plug
b - Sacrificial anode
c - Length
d - Diameter
e - Sealing washer

Sacrificial anode measurements (new)	
Length	19 mm (3/4 in.)
Diameter	16 mm (5/8 in.)

3. Discard the sealing washer.

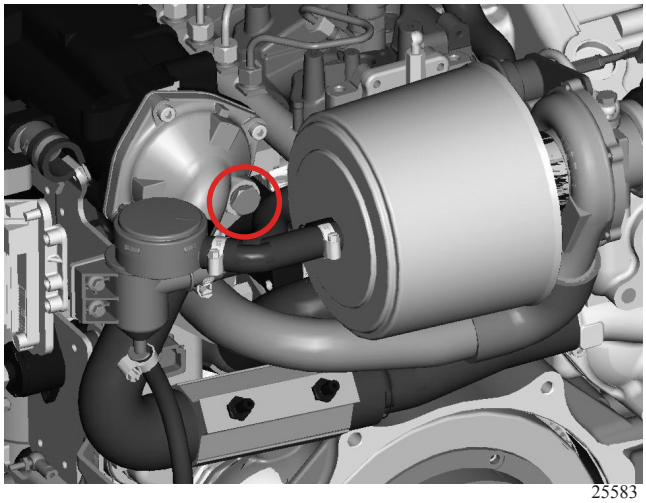
Installation

1. Install a new sealing washer on the anode assembly (anode plug with the sacrificial anode).



a - Anode assembly
b - Sealing washer

2. Install the anode assembly and washer into the aftercooler end cover. Tighten securely.



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a - Sacrificial anode

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

NOTICE

Without sufficient cooling water, the engine, the water pump, and other components will overheat and suffer damage. Provide a sufficient supply of water to the water inlets during operation.

4. Ensure that both the sterndrive and engine seawater pickup pumps are supplied cooling water.
5. Start the engine and check for leaks

Antifouling Paint

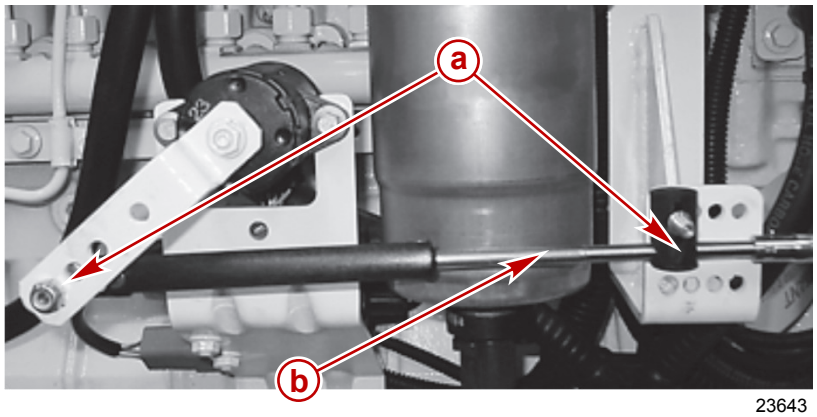
IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint is not covered by the limited warranty.

In some areas it may be advisable to paint the bottom of the boat to help prevent marine growth. Contact your Cummins MerCruiser Diesel Authorized Repair Facility for recommendations for your boat.

Lubrication

Throttle Cable

1. Lubricate the pivot points and guide contact surfaces.



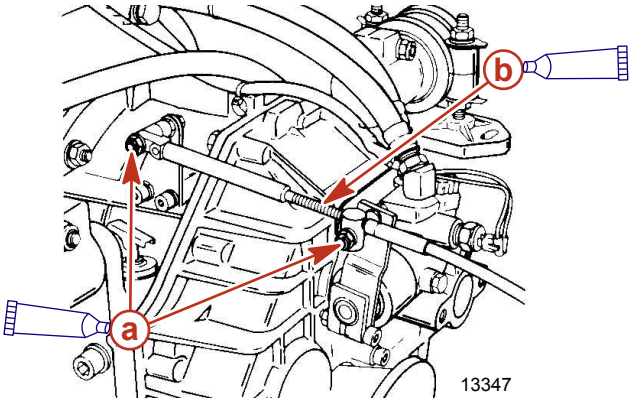
23643

a - Pivot points
b - Guide contact surfaces

Tube Ref No.	Description	Where Used	Part No.
80	SAE Engine Oil 30W	Throttle cable pivot points and guide contact surfaces	Obtain Locally

Shift Cable

1. Lubricate the pivot points and guide contact surfaces.



Typical inboard model shift cable and transmission linkage

a - Pivot points

b - Guide contact surface

Tube Ref No.	Description	Where Used	Part No.
80	SAE Engine Oil 30W	Shift cable pivot points and guide contact surfaces	Obtain Locally

Battery

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

⚠ WARNING

Recharging a weak battery in the boat, or using jumper cables and a booster battery to start the engine, can cause serious injury or product damage from fire or explosion. Remove the battery from the boat and recharge in a ventilated area away from sparks or flames.

⚠ WARNING

An operating or charging battery produces gas that can ignite and explode, spraying out sulfuric acid, which can cause severe burns. Ventilate the area around the battery and wear protective equipment when handling or servicing batteries.

Battery Precautions for Multiple Engines

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

Engine Control Module (ECM) and Vessel Integration Panel (VIP). The ECM and VIP require 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 drop below the ECM or VIP minimum voltage requirements. The alternator on the second engine may also start charging, causing 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. Intermittent or temporary VIP shutdown can cause a loss of instrumentation, engine misfire and can adversely effect power package performance and boat safety.

Batteries. Boats with multi-engine electronic control power packages require each engine be connected to its own battery, ensuring that the engine's ECM has a stable voltage source.

Battery Switches. Battery switches should always be positioned so that each engine is operating off of its own battery. Do not operate engines with switches in the **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. They 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.

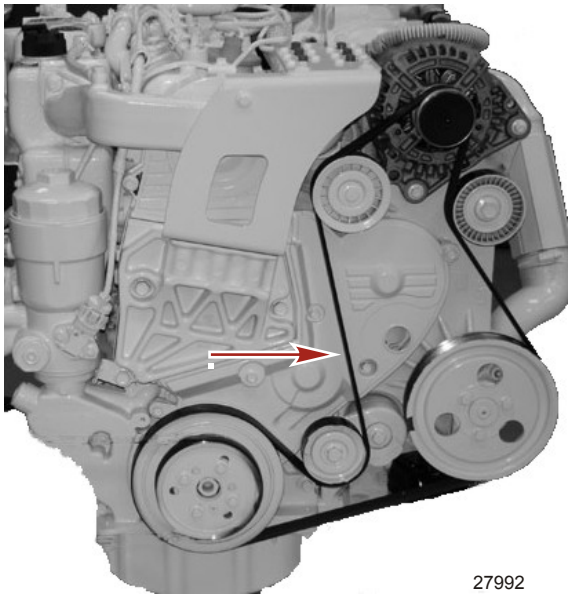
Generators. The generator's battery should be considered another engine's battery.

Serpentine Belt Inspection

⚠ WARNING

Inspecting the belts with the engine running may cause serious injury or death. Turn off the engine and remove the ignition key before adjusting tension or inspecting belts.

All drive belts must be periodically inspected for proper tension and condition. Belts that show signs of wear such as cracking, fraying, or glazing of the belt surface should be replaced.

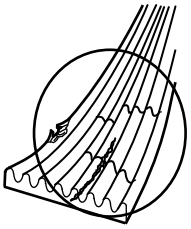


QSD 2.0 serpentine drive belt

If the serpentine belt needs to be replaced consult your Cummins MerCruiser Authorized Repair Facility.

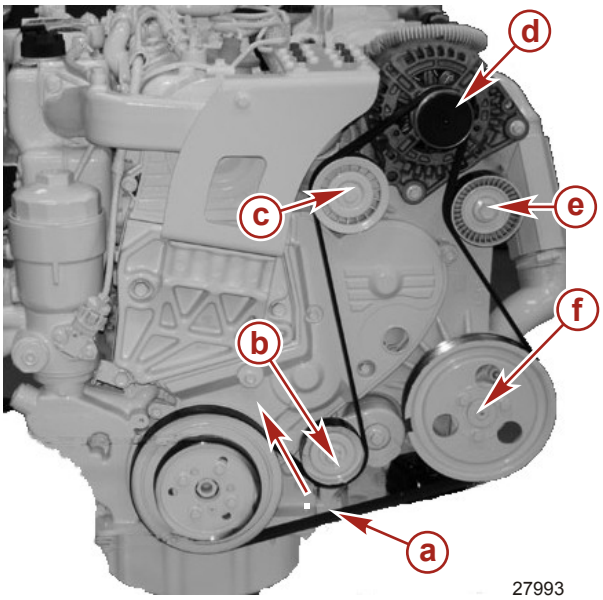
1. Inspect the belt for proper tension and for the following:
   - Excessive wear
   - Cracks

     NOTE: *Minor, transverse cracks (across the belt width) may be acceptable. Cracking that results in the loss of belt material or longitudinal cracks (in the direction of belt length) that join transverse cracks are not acceptable.*
   - Fraying
   - Glazed surfaces



2. Check the operation of the automatic tensioner and associated components.
   a. Position a suitable tool on the automatic tensioner pulley bolt.

b. Rotate the automatic tensioner clockwise.



a - Serpentine belt
b - Automatic tensioner
c - Idler pulley
d - Alternator
e - Idler pulley
f - Sea water pump pulley

c. Release the automatic tensioner allowing it to return to a load position on the serpentine belt.

d. The automatic tensioner must return to the initial position and hold tension on the serpentine belt. If the automatic tensioner does not operate smoothly or does not return to a loaded position providing tension on the belt, it must be replaced. See your Cummins MerCruiser Authorized Repair Facility for all of your repair needs.

3. There is no adjustment available for the serpentine belt. If the belt becomes loose or noisy it has worn out and must be replaced. See your Cummins MerCruiser Authorized Repair Facility.

4. If the serpentine belt needs to be replaced consult your Cummins MerCruiser Authorized Repair Facility.

Section 6 - Storage

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6

Cold Weather (Freezing Temperature), Seasonal Storage, and Extended Storage

IMPORTANT: Cummins MerCruiser Diesel strongly recommends that this service be performed by a Cummins MerCruiser Diesel Authorized Repair Facility. Damage caused by freezing IS NOT covered by the Cummins MerCruiser Diesel Limited Warranty.

NOTICE

Water trapped in the seawater section of the cooling system can cause corrosion or freeze damage. Drain the seawater section of the cooling system immediately after operation or before any length of storage in freezing temperatures. If the boat is in the water, keep the seacock closed until restarting the engine to prevent water from flowing back into the cooling system. If the boat is not fitted with a seacock, leave the water inlet hose disconnected and plugged.

NOTE: *As a precautionary measure, attach a tag to the key switch or steering wheel of the boat reminding the operator to open the seacock or unplug and reconnect the water inlet hose before starting the engine.*

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

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

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

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

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

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

See the specific procedures in this section related to the conditions and the length of storage for your application.

Cold Weather (Freezing Temperature) Storage

NOTICE

Water trapped in the seawater section of the cooling system can cause corrosion or freeze damage. Remove the boat from the water to drain the seawater section of the cooling system immediately after operation or before any length of storage in freezing temperatures.

NOTE: *As a precautionary measure, attach a tag to the key switch or steering wheel of the boat reminding the operator to open the seacock or unplug and reconnect the water inlet hose before starting the engine.*

1. Read all precautions and perform all procedures found in **Draining the Seawater System** and drain the seawater section of the cooling system.
2. Place a caution tag at the helm advising the operator to unplug and connect the water inlet hose or open the seacock, if equipped, before operating the boat.
3. For additional assurance against freezing and corrosion fill the seawater cooling system with a mixture of propylene glycol antifreeze and tap water. See **Seasonal Storage Instructions** in this section.

Preparing Your Power Package for Seasonal or Extended Storage

NOTICE

Without sufficient cooling water, the engine, the water pump, and other components will overheat and suffer damage. Provide a sufficient supply of water to the water inlets during operation.

IMPORTANT: If the boat has already been removed from the water, supply water to the water inlet holes before starting the engine. Follow all warnings and flushing attachment procedures stated in Flushing the Seawater System.

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

Seasonal Storage

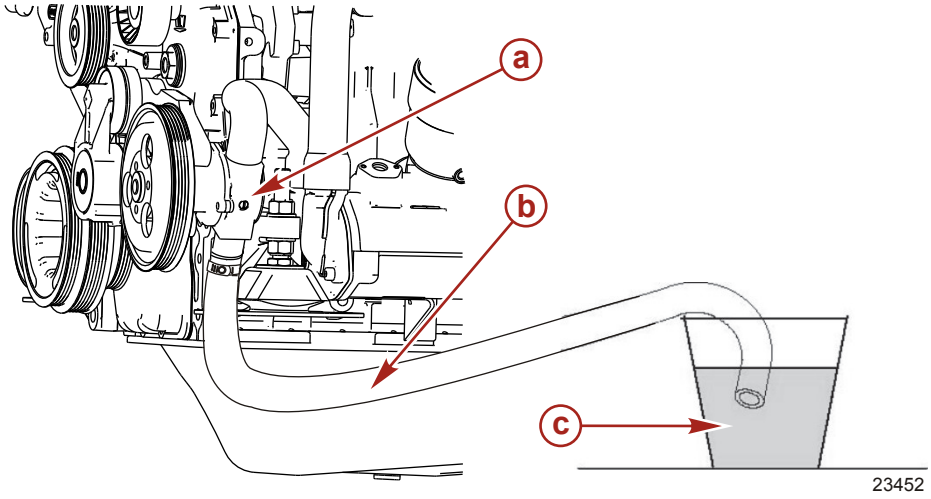
1. Read all precautions and perform all procedures found in **Preparing Your Power Package for Seasonal or Extended Storage**.
2. Read all precautions and perform all procedures found in **Draining the Seawater System** and drain the seawater section of the cooling system.

NOTICE

Water trapped in the seawater section of the cooling system can cause corrosion or freeze damage. Remove the boat from the water to drain the seawater section of the cooling system immediately after operation or before any length of storage in freezing temperatures.

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

3. Fill a container with approximately 5.6 liters (6 U.S. quarts) of propylene glycol antifreeze and tap water mixed to manufacturer's recommendation to protect the engine to the lowest temperature to which it will be exposed during cold weather or extended storage.
4. Disconnect the seawater inlet hose from the seawater pump. Using an adapter, if required, temporarily connect an appropriate length piece of hose to seawater pump and place the other end of the hose into the container of propylene glycol antifreeze and tap water.



Typical
- **a -** Seawater pump
- **b -** Temporary hose
- **c -** Container of propylene glycol antifreeze and tap water

NOTE: *Discharge of propylene glycol into the environment may be restricted by law. Dispose of propylene glycol in accordance with federal, state, and local requirements.*

5. Start the engine and operate at idle speed until the antifreeze mixture has been pumped into the engine seawater cooling system.
6. Stop the engine.
7. Remove the temporary hose from the seawater pump.
8. Clean the outside of the engine and repaint any areas required with primer and spray paint. After the paint has dried, coat the engine with the specified corrosion inhibiting oil or equivalent.

Description	Where Used	Part Number
Corrosion Guard	Outside of engine	92-802878-55
Light gray primer		92-802878-52
Marine Cloud White paint (CMD part number: 4918660)		Obtain locally
Mercury Phantom Black	Shift plate and air filter housing	92-802878Q1

9. Your Cummins MerCruiser Diesel Authorized Repair Facility should now perform all checks, inspections, lubrications, and fluid changes outlined in **Maintenance Schedules**.

NOTICE

The universal joint bellows may develop a set when stored in a raised or up position, causing the bellows to fail when returned to service and allowing water to enter the boat. Store the sterndrive in the full down position.

On Sterndrive models, place the sterndrive in the full down (in) position.

11. Follow the battery manufacturer's instructions for storage and store the battery.

Extended Storage Instructions

IMPORTANT: Cummins MerCruiser Diesel strongly recommends that this service be performed by a Cummins MerCruiser Diesel Authorized Repair Facility.

1. Read all precautions and perform all procedures found in **Preparing Your Power Package for Seasonal or Extended Storage**.
2. Read all precautions and perform all procedures found in **Draining the Seawater System**.
3. Read all precautions and perform all procedures found in **Seasonal Storage Instructions**.
   IMPORTANT: The seawater pump impeller material can be damaged by prolonged exposure to direct sunlight.
4. Remove the seawater pump impeller and store away from direct sunlight. Refer to a Cummins MerCruiser Diesel Authorized Repair Facility for additional information and service.
5. Place a caution tag at the instrument panel and in the engine compartment stating that the seawater pump is out and not to operate the engine.

Battery

Follow the battery manufacturer's instructions for storage.

Recommissioning

NOTE: *Discharge of propylene glycol into the environment may be restricted by law. Contain and dispose of propylene glycol in accordance with federal, state, and local laws and guidelines.*

1. On engines that were prepared for extended storage, refer to a Cummins MerCruiser Diesel Authorized Repair Facility and have the seawater pump impeller installed, if it was removed for storage.
2. On engines that were prepared for cold weather (freezing temperature), seasonal, or extended storage, see **Draining the Seawater System** and drain the propylene glycol into a suitable container. Dispose of the propylene glycol in accordance with federal, state, and local laws and guidelines.
3. Ensure that all cooling system hoses are in good condition, connected properly, and clamped tightly. Verify that all drain valves and drain plugs are installed and tight.
4. Inspect all drive belts.
5. Perform all lubrication and maintenance specified for completion according to **Annually** in **Maintenance Schedules**, except items that were performed at time of engine layup.
6. Fill the fuel tanks with fresh diesel fuel. Do not use old fuel. Check the general condition of the fuel lines and inspect the connections for leaks.
7. Replace the water-separating fuel filter or filters (some engines may have more than one).

⚠ CAUTION

Disconnecting or connecting the battery cables in the incorrect order can cause injury from electrical shock or can damage the electrical system. Always disconnect the negative (-) battery cable first and connect it last.

8. Install a fully charged battery. Clean the battery cable clamps and terminals. Reconnect the cables (see the 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 in the Starting Procedure column found in the **Operation Chart**. See the **On the Water** section.

NOTICE
Without sufficient cooling water, the engine, the water pump, and other components will overheat and suffer damage. Provide a sufficient supply of water to the water inlets during operation.

10. Supply cooling water to the water inlet openings.
11. Start the engine and closely observe instrumentation. Ensure that all systems are functioning correctly.
12. Carefully inspect the engine for fuel, oil, fluid, water, and exhaust leaks.
13. Check the steering system, shift, and throttle control for proper operation.

Notes:

Section 7 - Troubleshooting

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7

Diagnosing Electronically Controlled Fuel System Problems

Your Cummins MerCruiser Diesel Authorized Repair Facility has the proper service tools for diagnosing problems on electronically controlled fuel systems. The Engine 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.
Throttle not operating properly.	Check the throttle for freedom of movement.
Faulty electrical stop-circuit.	Have a Cummins MerCruiser Diesel Authorized Repair Facility service the electrical stop circuit.
Clogged fuel filters.	Replace fuel 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 the lines with compressed air to remove obstruction.
Air in fuel injection system.	Purge fuel injection system.
Faulty wire connections.	Check wire connections.
Electronic fuel system fault.	Have the electronic fuel system checked by a Cummins MerCruiser Diesel Authorized Repair Facility.

Engine Runs Rough, Misses, or Backfires

Possible Cause	Remedy
Throttle not operating properly.	Check the throttle for binding or an obstruction.
Idle speed too low.	Have idle speed checked and adjusted by a Cummins MerCruiser Diesel Authorized Repair Facility.
Clogged fuel or air filters.	Replace air 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.
Electronic fuel system faulty.	Have electronic system checked by a Cummins MerCruiser Diesel Authorized Repair Facility.

Poor Performance

Possible Cause	Remedy
Throttle not fully open.	Inspect throttle cable and linkages for proper operation.
Damaged or improper propeller.	Replace propeller. See a Cummins MerCruiser Diesel Authorized Repair Facility.
Excessive bilge water.	Drain and check for cause of entry.
Boat overloaded or improperly distributed.	Reduce load or redistribute more evenly.
Boat bottom fouled or damaged.	Clean or repair as necessary.
Electronic fuel system fault.	Have electronic fuel system checked by a Cummins MerCruiser Diesel Authorized Repair Facility.

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 a Cummins MerCruiser Diesel Authorized Repair Facility.
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 a Cummins MerCruiser Diesel Authorized Repair Facility.
Loss of pressure in closed cooling section.	Check for leaks. Clean, inspect, and test pressure cap. See a Cummins MerCruiser Diesel Authorized Repair Facility.
Faulty seawater pickup pump.	Repair. See a Cummins MerCruiser Diesel Authorized Repair Facility.
Seawater discharge restricted or plugged.	Clean exhaust elbows. See a Cummins MerCruiser Diesel Authorized Repair Facility.
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 a Cummins MerCruiser Diesel Authorized Repair Facility.

Low Engine Oil Pressure

Possible Cause	Remedy
Faulty senders.	Have system checked by a Cummins MerCruiser Diesel Authorized Repair Facility.
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.

Possible Cause	Remedy
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 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 the shift or throttle linkages.	Remove the obstruction.
Loose or missing shift and throttle linkages.	Check all throttle linkages. If any are loose or missing, see a Cummins MerCruiser Diesel Authorized Repair Facility immediately.
Shift or throttle cable kinked.	Straighten cable or have a Cummins MerCruiser Diesel Authorized Repair Facility replace cable if damaged beyond repair.
Improper shift cable adjustment.	Have adjustment checked by a Cummins MerCruiser Diesel Authorized Repair Facility.

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. Contact 1-800-DIESELS to locate your closest distributor.

Service Away From Home

If you are away from your local dealer and the need arises for service, contact the nearest Cummins MerCruiser Diesel authorized dealer. Refer to the Yellow Pages of the telephone directory or by using the service locator on the Cummins MerCruiser Diesel website (www.cmdmarine.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 and distributors in the recovery of stolen motors.

Attention Required After Submersion

1. Before recovery, contact an Cummins MerCruiser Diesel Authorized Repair Facility.
2. After recovery, immediate service by an Cummins MerCruiser Diesel Authorized Repair Facility is required to prevent serious damage to power package.

Replacement Service Parts

⚠ WARNING

Avoid fire or explosion hazard. Electrical, ignition, and fuel system components on Cummins MerCruiser Diesel products comply with U.S. Coast Guard rules to minimize risk of fire or explosion. Do not use replacement electrical or fuel system components that do not comply with these rules. When servicing the electrical and fuel systems, properly install and tighten all components.

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. Exercise care 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 if he does 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 Authorized Repair Facility. 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. If 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 service office will need the following information:

- Your name and address
- Daytime telephone number

- Model and serial numbers for your power package
- The name and address of your dealership
- The nature of the problem

To find the distributor for your area, use the service locator on the Cummins MerCruiser Diesel website (www.cmdmarine.com) or contact CMD sales or service listed in the yellow pages of the telephone directory. Contact 1-800-DIESELS to locate your closest distributor.

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.

Allej glþssej

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