

Important Information

Section 1B - Maintenance

**1
B**

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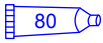
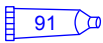
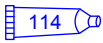


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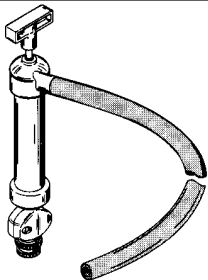
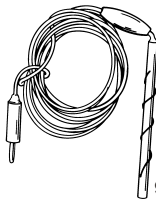
Engine Specifications

Description	Specifications
	QSD 2.0
Engine type	In-line 4-cylinder diesel
Induction Type	Turbocharged and aftercooled 16-Valve
Displacement	2.0 L (122 c.i.d.)
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.cmdmarine.com)
Idle RPM in neutral (engine at normal operating temperature).	700 RPM
Oil pressure at idle	240kPa, (2.4 bar), (35 psi)
Oil pressure at 4000 RPM	660kPa, (6.6 bar), (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	14#, 110 A
Recommended battery rating	750 CCA, 950 MCA, or 180 Ah

Lubricant, Sealant, Adhesives

Tube Ref No.	Description	Where Used	Part No.
	Cleaning solvent	Transmission filter element	Obtain Locally
		Closed cooling system	
		Gray sterndrive U-joint cross bearings on Bravo X Sterndrive units	
	Dexron III Automatic Transmission Fluid	Power-assisted steering system	Obtain Locally
	Special Lubricant 101	Steering cable grease fitting	92-802865Q02
		Steering cable	
	U-joint and Gimbal Bearing Grease	Gimbal bearing grease insert	92-802870A1
		Transom end grease fitting, engine end grease fitting, driveshaft grease fittings	
	SAE engine oil 30W	Transmission filter element O-ring	Obtain Locally
		Water-separating fuel filter sealing ring	
		Throttle cable pivot points and guide contact surfaces	
		Shift cable pivot points and guide contact surfaces	
	Engine Coupler Spline Grease	Coupler	92-802869A 1
		Driveshaft splines	
	Power Trim and Steering Fluid	Power-assisted steering pump	92-858074K01
	15W40 4-cycle Diesel Engine Oil	Engine crankcase	92-858042K01
		Oil filter O-rings	
	Marine Engine Coolant (Only available in Europe)	Closed cooling system	92-813054A2

Special Tools

Flushing Device	91-44357Q 2
 <p>9192</p>	Attaches to the water intakes; provides a fresh water connection when flushing the cooling system or operating the engine.
Dual Water Pick-up Flush Gearcase Seal Kit	91-881150K 1
 <p>9194</p>	Blocks off the front water inlet holes on the dual water inlet gearcases.
Crankcase oil pump	91-90265A 5
 <p>11591</p>	Aids in the removal of engine oil without draining the crankcase.
Reference Electrode	91-76675T 1
 <p>9188</p>	Senses and electrical current in the water when testing the MerCathode system. Use to check hull potential.

Maintenance Tools

Description	Part Number
Water supply hose adapter (to Water Inlet Fitting)	Obtain Locally
Hand-operated grease gun	
Flushing Device	91-44357Q 2
Dual Water Pick-up Flush Gearcase Seal Kit	91-881150K 1

Capacities

Fluid Specifications

IMPORTANT: All capacities are approximate fluid measures.

Engine

IMPORTANT: If necessary, adjust fluid levels depending on installation angle, heat exchanger, and fluid lines used.

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

QSD 2.0

All Models	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
Closed cooling system	7.50 L (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 gal.)	Obtain locally

Alpha Sterndrive Fluid Specifications

NOTE: Oil capacity includes gear lube monitor.

Model	Capacity	Fluid Type
Alpha One	1892 ml (64 oz)	High Performance Gear Lubricant

Bravo Serial Numbers Below 0W240000

NOTE: Oil capacity includes gear lube monitor.

Models	Capacity	Fluid Type
Bravo One	2602 ml (88 fl oz)	High performance gear lubricant
Bravo Two	3076 ml (104 fl oz)	
Bravo Three	2839 ml (96 fl oz)	

Bravo Serial Numbers Above 0W240000

NOTE: Oil capacity includes gear lube monitor.

Models	Capacity	Fluid Type
Bravo One	2736 ml (92.5 fl oz)	High performance gear lubricant
Bravo Two	3209 ml (108.5 fl oz)	
Bravo Three	Side water pick-up	
	Dual water pick-up	
	2972 ml (100.5 fl oz)	
	2736 ml (92.5 oz)	

Power-Assisted Steering and Power Trim Fluids

APPROVED POWER-ASSISTED STEERING FLUIDS

Description	Part Number
Power Trim and Steering Fluid	92-858074K01

APPROVED POWER TRIM FLUIDS

Description	Part Number
Power Trim and Steering Fluid	92-858074K01

Description	Part Number
SAE Engine Oil 10W-30	Obtain locally
SAE Engine Oil 10W-40	

TM345 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 TM345	1.6 liters (2.7 qt.)	Class CD SAE 20 or Class CD SAE 30 engine oil	Obtain Locally

Maintenance Intervals

NOTE: Refer to appropriate Mercury MerCruiser Sterndrive Service Manual for information and procedures on Sterndrive 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.

Maintenance intervals and the corresponding tasks, as shown in this schedule or found in a previous schedule, are based on an average boating application and environment. However, factors such as individual operating habits and personal maintenance preferences can impact the suggested intervals. In consideration of these factors, Cummins MerCruiser Diesel has adjusted some maintenance intervals and corresponding tasks. In some cases, more tasks are scheduled to be performed in a single visit to the servicing facility. Therefore, the boat owner and servicing dealer should discuss the current Maintenance Schedule and develop appropriate maintenance intervals to coincide with individual operating habits, operating environments, and maintenance requirements.

Always disconnect battery cables from the battery before working around electrical system components to prevent injury to yourself and damage to the electrical system should a wire be accidentally shorted.

Maintenance Schedule—Sterndrive Models

Routine Maintenance

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

Task Interval	Maintenance to Be Performed
Each day start	<ul style="list-style-type: none"> Check the engine oil level. (You may extend this interval based on operator experience with the product.) Check the engine coolant level. Check the power-assisted steering fluid level. Check the sterndrive gear lube level in the gear lube monitor.
Each day end	<ul style="list-style-type: none"> 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 all water from both fuel filters if operating in freezing temperatures.)

Task Interval	Maintenance to Be Performed
Weekly	<ul style="list-style-type: none"> • Drain any water from the fuel filters. • Check the trim pump fluid level. • Check the seawater inlets for debris or marine growth. • Check and clean the seawater strainer. • Inspect the sterndrive anodes and replace if eroded 50% or more.
Every two months	<ul style="list-style-type: none"> • Check the battery connections and fluid level. • Lubricate the propeller shaft and torque the propeller nut (If operating only in freshwater, you may extend this maintenance to every four months). • Treat the engine surfaces with Corrosion Guard if operating in saltwater, brackish water, or polluted waters. • Inspect the air filter. (Every two months or every 50 hours, whichever occurs first.) • Inspect the engine anodes and replace if eroded 50% or more. • Ensure that the gauges and the wiring connections are secure and clean the gauges. (Every two months or every 50 hours, whichever occurs first. 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.

Task Interval	Maintenance to Be Performed
After the first 25 hours but before 30 hours	<ul style="list-style-type: none"> • Change the engine oil and filter.
Annually	<ul style="list-style-type: none"> • Touch up the power package with paint and spray with Corrosion Guard.
Every 100 hours or annually (whichever occurs first)	<ul style="list-style-type: none"> • Change the engine oil and filter. • Change the sterndrive gear lube. • Torque the gimbal ring U-bolt locknuts. • Replace the fuel filters. • Check the steering system and the remote control for loose, missing, or damaged parts. Lubricate the cables and linkages. • Inspect and lubricate the sterndrive U-joint splines. Inspect the bellows, the exhaust tube, and check the clamps. • Lubricate the gimbal bearing and engine coupler (Lubricate the engine coupler every 50 hours if operated at idle for prolonged periods of time). • Check the continuity circuit for loose or damaged connections. If equipped with MerCathode, test the unit output. • Check the engine alignment. • Torque the engine mounts. • Check the electrical system for loose, damaged, or corroded fasteners. • On driveshaft extension models, lubricate the drive shaft U-joints, transom end (tailstock) bearings, and engine end (output) bearings. • Inspect the condition and tension of the belts. • Inspect the cooling system and the exhaust system for damage or leaks. Check the hose clamps for tightness. • Disassemble and inspect the seawater pump and replace worn components. • Clean the seawater section of the closed cooling system. Clean, inspect, and test the pressure cap. Check the anodes and replace if eroded 50% or more. • Replace the air filter.
Every 2 years	<ul style="list-style-type: none"> • Replace the engine coolant.

Task Interval	Maintenance to Be Performed
Every 300 hours or 3 years (whichever occurs first)	<ul style="list-style-type: none"> Disassemble and inspect the Alpha drive seawater pump. Replace any worn components. (Alpha Sterndrives only)
Every 500 hours or 5 years (whichever occurs first)	<ul style="list-style-type: none"> Clean the aftercooler core.
Every 700 Hours or 3 years (Whichever Occurs First)	<ul style="list-style-type: none"> Replace the power assisted steering pump drive belt.
Every 1000 Hours or 4 years (Whichever Occurs First)	<ul style="list-style-type: none"> Replace the engine timing belt.
Every 1000 hours or 5 years (whichever occurs first)	<ul style="list-style-type: none"> Clean the fuel tank.

Maintenance Schedule—Inboard Models

Routine Maintenance

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

Each day start	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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.)

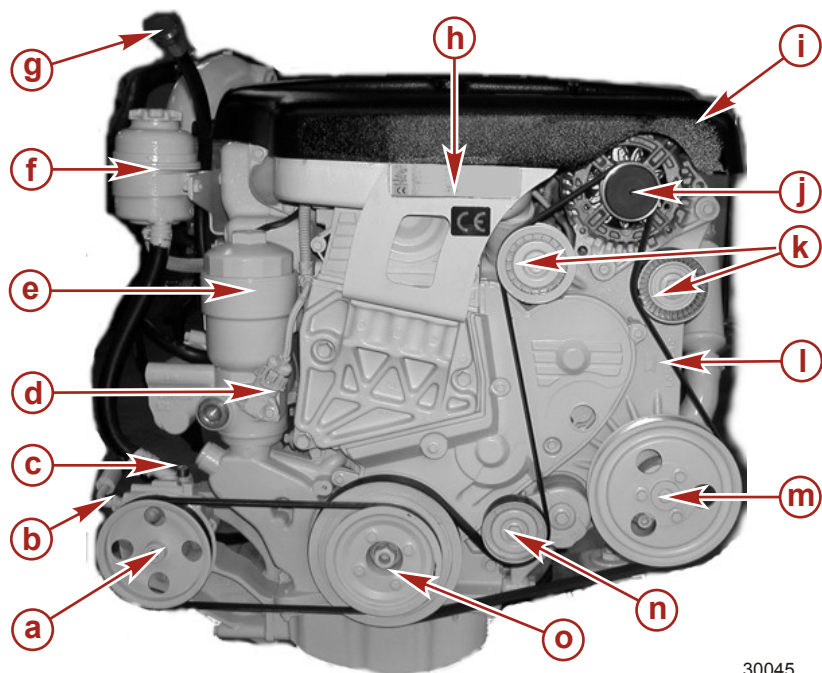
Scheduled Maintenance

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

After first 25 hours and not to exceed 30 hours	<ul style="list-style-type: none"> • Change the engine oil and filter.
After first 50 hours	<ul style="list-style-type: none"> • Clean the transmission oil filter and change the transmission oil.
Annually	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Replace the engine coolant.
Every 500 hours or 5 years (whichever occurs first)	<ul style="list-style-type: none"> • Clean the aftercooler core.
Every 1000 Hours or 4 years (whichever occurs first)	<ul style="list-style-type: none"> • Replace the engine timing belt.
Every 1000 hours or 5 years (whichever occurs first)	<ul style="list-style-type: none"> • Clean the fuel tank.
According to OEM Schedule	<ul style="list-style-type: none"> • Check the engine to propeller shaft alignment.

QSD 2.0 External Engine Views

Front View

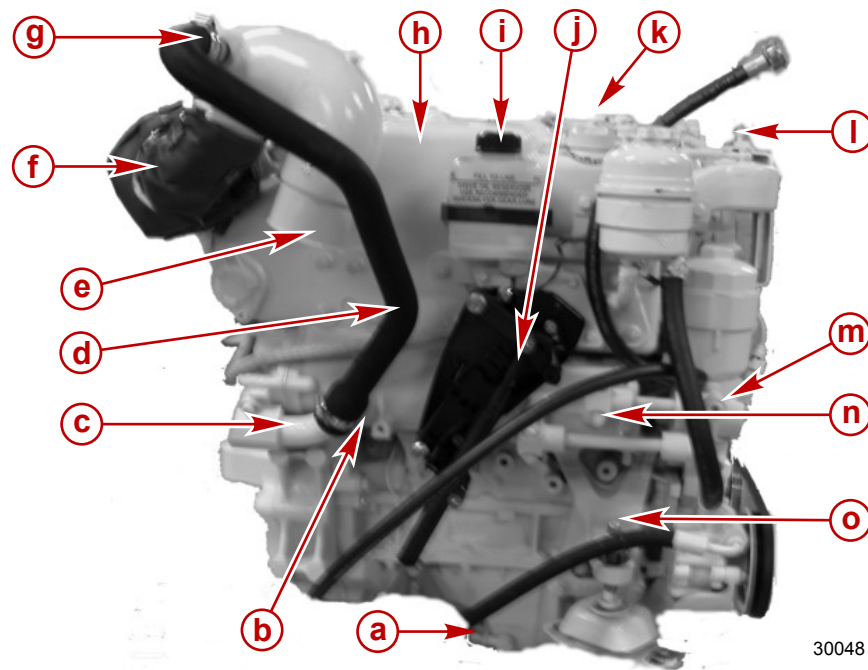


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- a** - Power-assisted steering pump (sterndrive only)
- b** - High pressure hose
- c** - Return hose
- d** - Oil pressure and temperature sensor
- e** - Oil filter housing
- f** - Power-assisted steering fluid reservoir (sterndrive only)
- g** - Remote oil drain (reference only)
- h** - Engine data plate

- i** - Engine cover
- j** - Alternator
- k** - Idler pulleys
- l** - Serpentine belt
- m** - Injection pump pulley
- n** - Tensioner pulley
- o** - Crankcase pulley

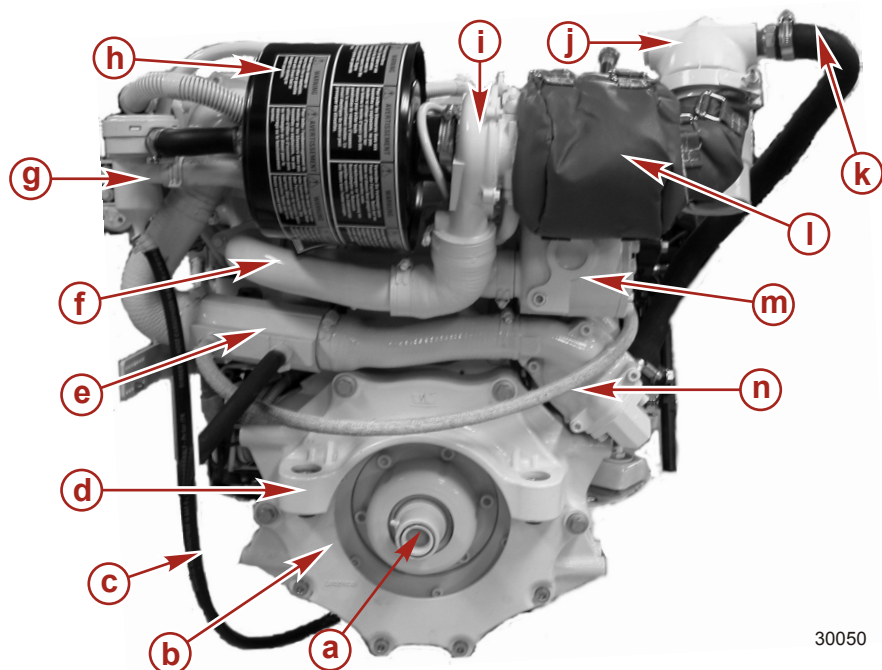
Starboard Side View



Engine cover removed

- | | |
|---|--|
| a - Remote oil drain hose connection | i - Gear lube reservoir (sterndrive only) |
| b - Crankshaft position sensor | j - Shift plate |
| c - Engine seawater outlet | k - Coolant cap |
| d - Seawater hose | l - Engine cover stud |
| e - Exhaust elbow | m - Engine oil cooler (later models) |
| f - Turbocharger heat shield | n - Seawater oil cooler (early models) |
| g - Seawater to exhaust elbow outlet | o - Engine mount, front |
| h - Heat exchanger and exhaust manifold assembly | |

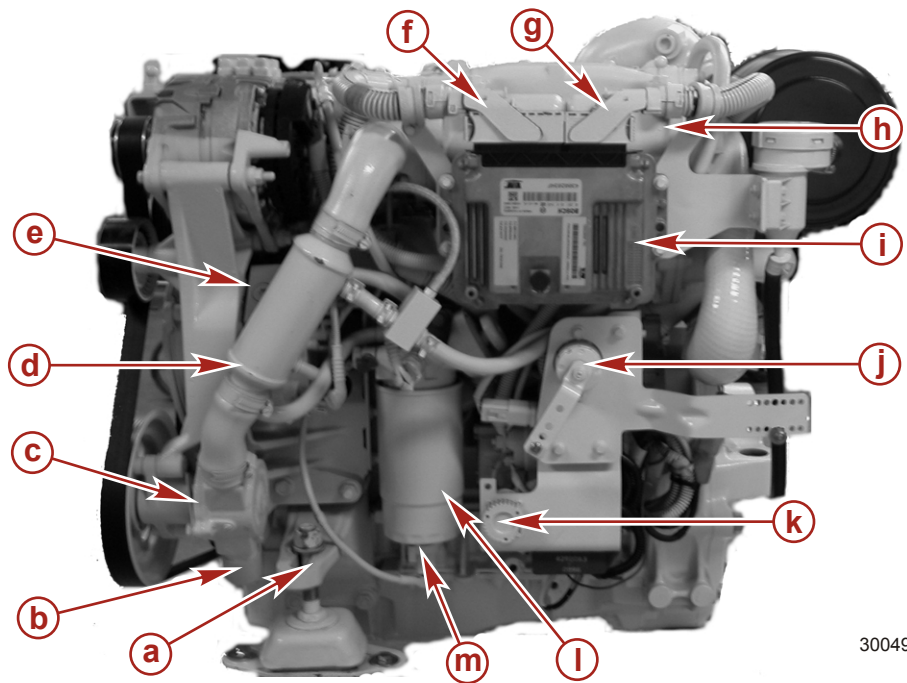
Rear View



Engine cover removed

- | | |
|---|---|
| a - Coupler (sterndrive) or driven plate (inboard) | h - Air filter |
| b - Flywheel housing | i - Turbocharger |
| c - Oil separator drain hose | j - Exhaust elbow |
| d - Rear engine mount (sterndrive engines only) | k - Seawater return hose |
| e - Fluid cooler | l - Turbocharger heat shield |
| f - Air intake pipe | m - Expansion tank and exhaust manifold assembly |
| g - Oil separator | n - Heat exchanger |

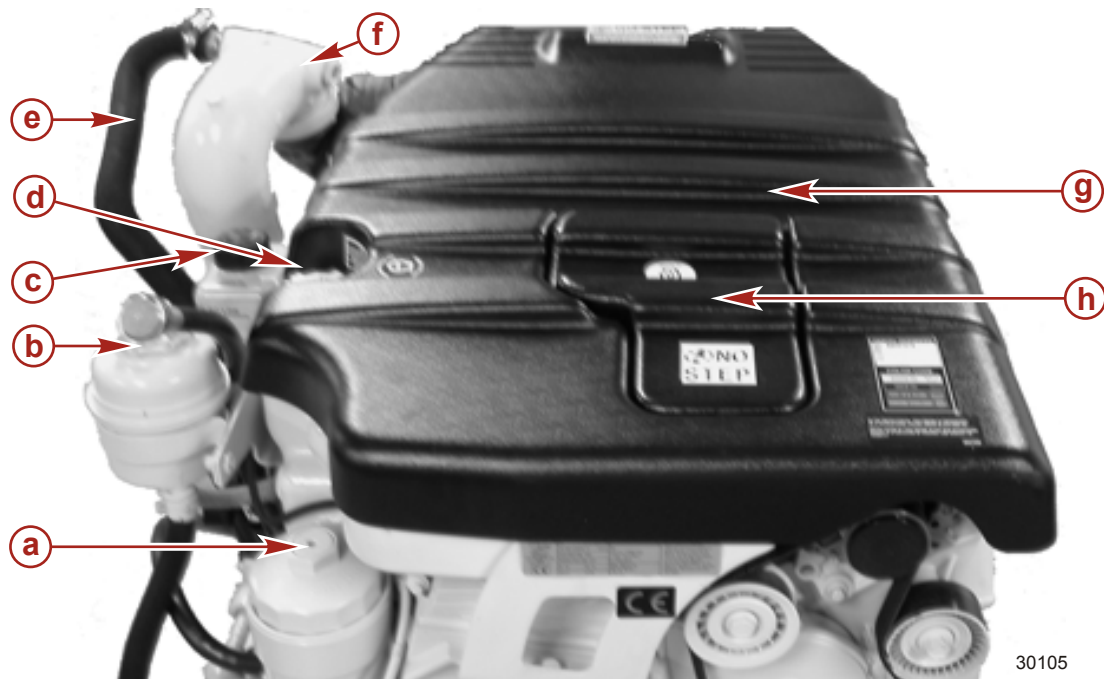
Port Side View



Engine cover removed

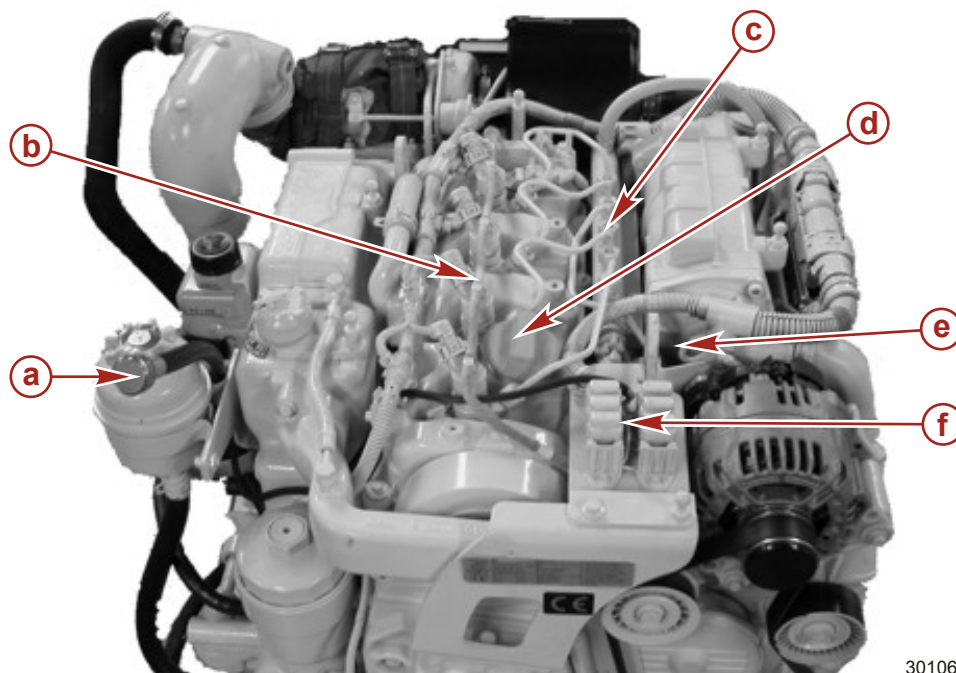
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|---------------------------------------|---|
| a - Engine mount | h - Aftercooler sacrificial anode |
| b - Seawater inlet | i - Engine Control Module (ECM) |
| c - Seawater pump | j - Throttle position sensor (TPS) |
| d - Fuel cooler (early models) | k - DLC port |
| e - Injection pump | l - Water-separating fuel filter |
| f - ECM 94-pin connector "K" | m - Water in fuel sensor (WIF) |
| g - ECM 60-pin connector "A" | |

Top View



With cover

- | | |
|--|---------------------------------|
| a - Oil filter housing | e - Seawater outlet hose |
| b - Power-assisted steering fluid reservoir (sterndrive models) | f - Exhaust elbow |
| c - Gear lube monitor (sterndrive models) | g - Engine cover |
| d - Coolant cap | h - Access panel |



Cover removed

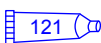
a - Remote oil drain hose**b** - Fuel Injectors (4)**c** - Fuel rail**d** - Oil fill cap**e** - Oil dipstick**f** - Fuse panel

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.
 121	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

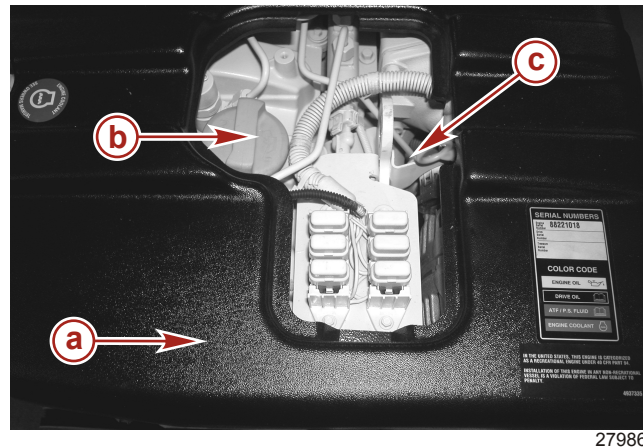
IMPORTANT: Engine crankcase oil must be checked at intervals specified in Maintenance Schedules. It is normal for an engine to use a certain amount of oil in the process of lubricating and cooling the engine. The amount of oil consumed depends greatly upon engine speed, with consumption being highest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

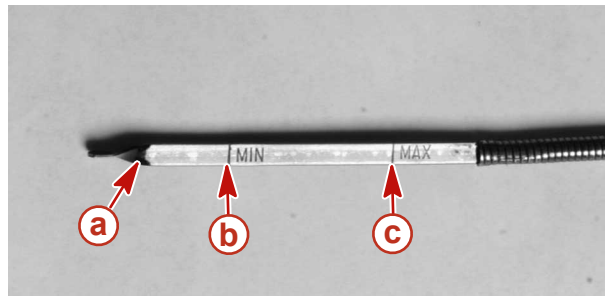
2. Remove the dipstick. Wipe clean and reinstall into the dipstick tube.



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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**.



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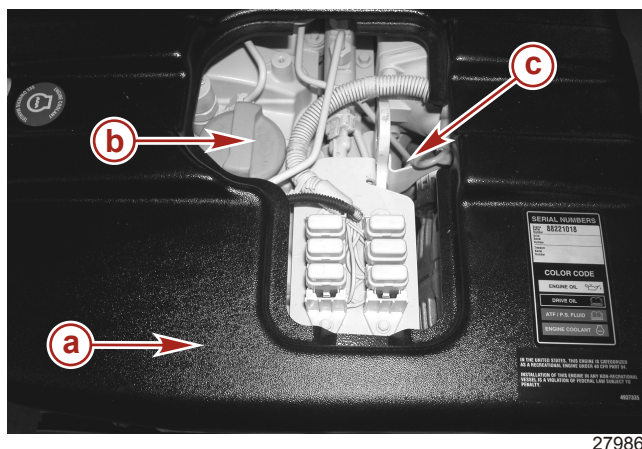
Engine oil level markings

- 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.



QSD 2.0L engine oil service

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

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

QSD 2.0L	Capacity Liters (U.S. qts)	Fluid Type
Engine oil (with filter)	6.0 liter (6.3 U.S. qts)	4-Cycle 15W40 marine engine oil

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

3. Install the oil fill cap.

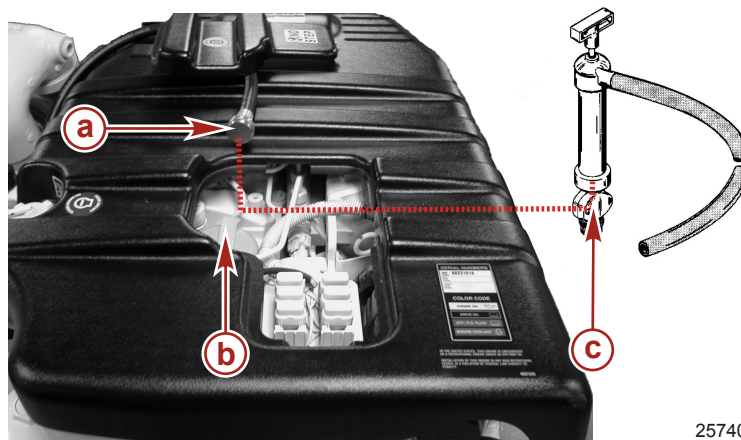
Changing Oil and Filter

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 oil dipstick tube.



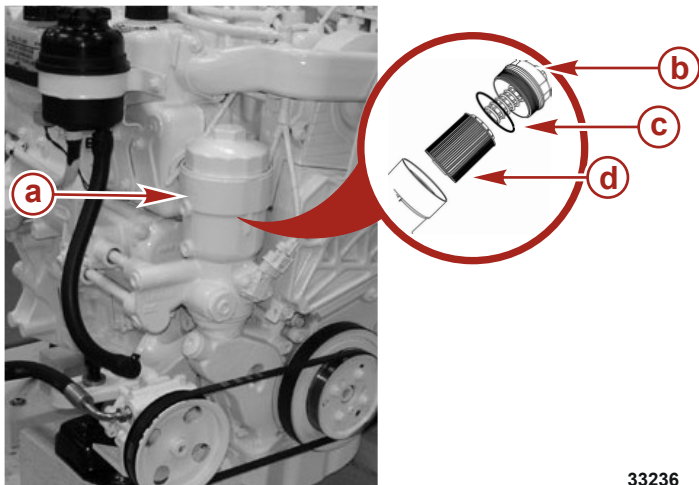
Engine oil removal (Engine cover removed to provide access)

- a** - Engine oil drain hose
b - Engine oil cap
c - Crankcase oil pump

Crankcase oil pump	91-90265A 5
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5. Pump the oil out of the crankcase into the drain pan.
6. Contain and dispose of the oil or oil waste as directed by local authorities.
7. Remove the crankcase oil pump and install the crankcase oil drain hose fitting when the crankcase is empty. Tighten securely.
8. Install the oil dipstick.
9. Place a suitable container under the oil filter housing to contain any oil leakage that may occur. Use an appropriate socket to loosen the oil filter cover.
10. Remove the top piece and cartridge type oil filter.

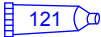
11. Disconnect and discard the old filter element. Discard the old O-ring from the cover.



2.0 oil filter

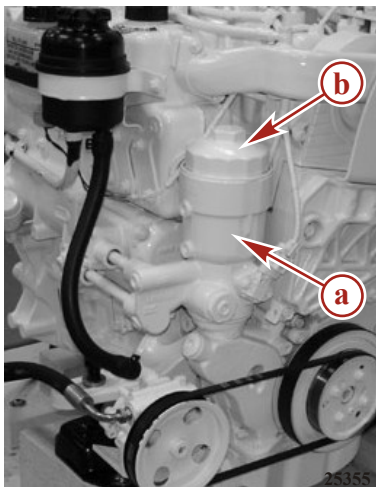
- a - Oil filter housing
- b - Cover
- c - O-ring
- d - Filter element

12. Install the new O-ring. Apply lubricant to the O-ring.

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

13. Push the filter element into the cover until it is locked. Listen for a click.
14. Install the cover with the new filter element into the oil filter housing.
15. Turn the oil filter cover until the sealing surface contacts the housing. Torque the cover using an appropriate socket.

IMPORTANT: Overtightening the cover may cause an oil leak.



2.0L Oil filter housing location

- a - Oil filter housing
- b - Cover

Description	Nm	lb-in.	lb-ft
Engine oil filter housing cover	25.0	—	18.0

16. 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.

17. Start the engine and check for leaks.

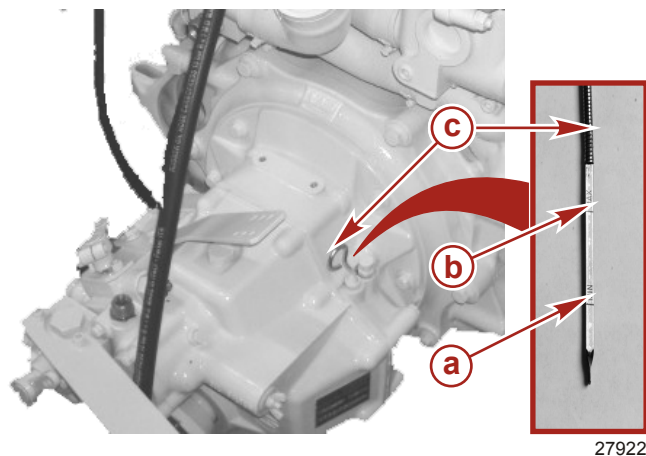
Technodrive Transmission Fluid

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 mark
- b** - Maximum oil level mark
- 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.

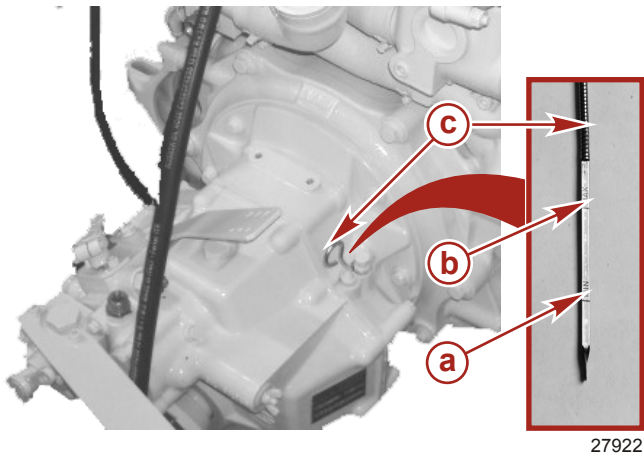
5. Start the engine and operate at 1500 RPM for 2 minutes to reach operating temperature and fill all of the transmission's hydraulic circuits.
6. Stop the engine and quickly check the oil level with the dipstick.
7. If the oil level is low, add transmission oil to bring the level up to the maximum mark 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 mark
- b - Maximum oil level mark
- c - Dipstick

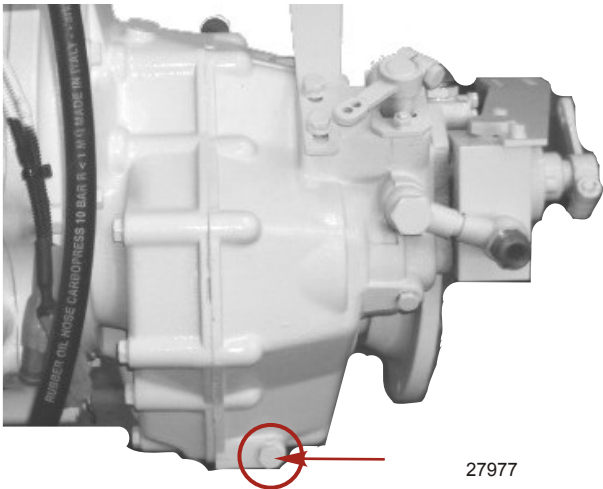
NOTE: Always use the dipstick to determine the quantity of oil required.

Model	Capacity	oil type	Part Number
Technodrive 345A	1.6 liters (2.7 US 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.



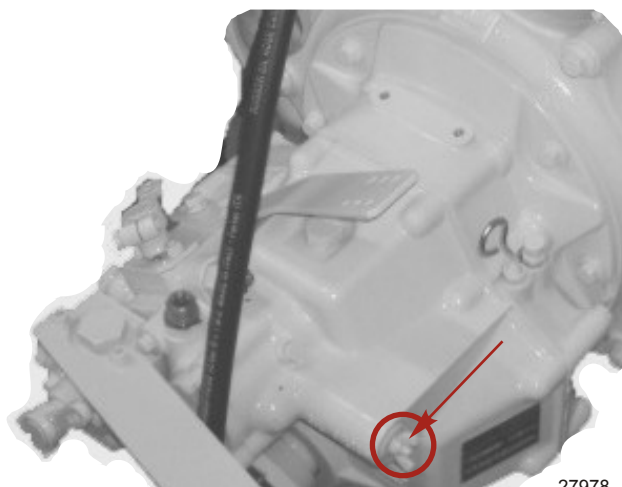
Transmission drain plug

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

- Torque the drain plug.


Description	Nm	lb-ft
Transmission oil drain plug	17	12.5

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




Transmission oil filter retaining nut

- Remove the filter element.
- Clean the oil filter element using the cleaning solvent.

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

- Lubricate the oil filter O-rings.

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

- 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.

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

Power-Assisted Steering Fluid

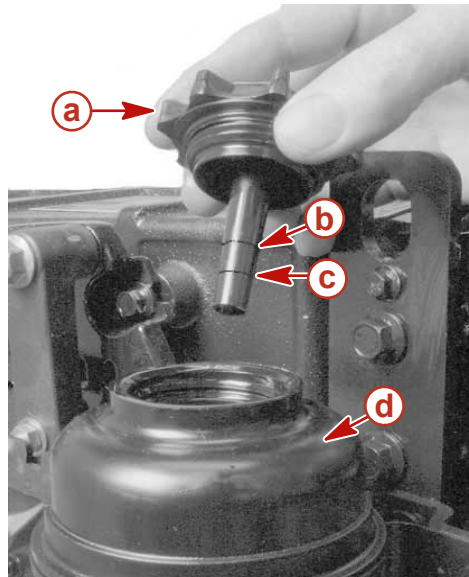
IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid or Dexron III automatic transmission fluid (ATF) in the power-assisted steering system.

IMPORTANT: Running the pump dry will damage the pump. Always check steering fluid levels before operating the boat.

Checking

- Center the sterndrive and stop the engine.
- Remove the fill cap and dipstick from the fluid reservoir and observe the level.

- a. The proper fluid level with the engine cold should be between the full cold mark and the end of the dipstick.
- b. With the engine at normal operating temperature the fluid level should be between the full hot and full cold marks.




13064


- a - Fill cap and dipstick
- b - Full hot mark
- c - Full cold mark
- d - Fluid reservoir

IMPORTANT: If fluid is not visible in the fluid reservoir, determine the cause and correct.

Filling

1. Remove the fill cap and dipstick and observe the fluid level.
2. Add the specified fluid to bring the fluid level up to the proper level.

Tube Ref No.	Description	Where Used	Part No.
 114	Power Trim and Steering Fluid	Power-assisted steering pump	92-858074K01

Tube Ref No.	Description	Where Used	Part No.
 28	Dexron III Automatic Transmission Fluid	Power-assisted steering system	Obtain Locally

3. Install the fill cap and dipstick.

Changing

The power-assisted steering fluid does not require changing as part of regularly scheduled maintenance. If the power-assisted steering fluid becomes contaminated see **Section 9: Power-Assisted Steering System** of this manual for fluid changing and system bleeding instructions.

Closed-Cooling System

Engine Coolant

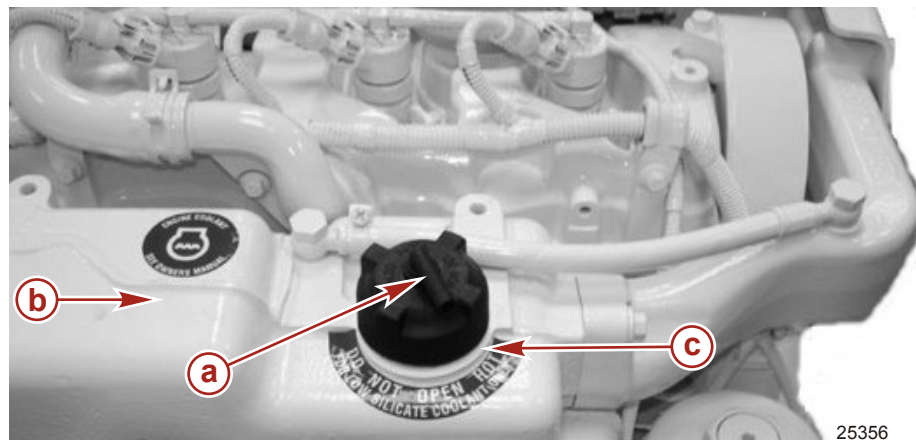
⚠ CAUTION

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.



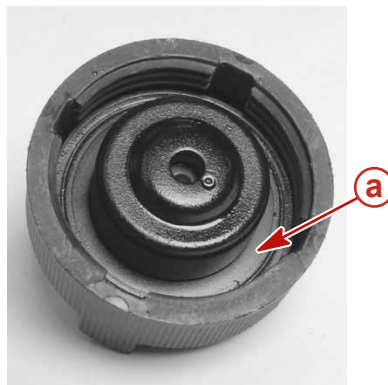
Location of engine coolant cap (engine cover removed)

a - Pressure cap

c - Bottom of fill neck

b - Coolant expansion tank

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.



a - Gasket

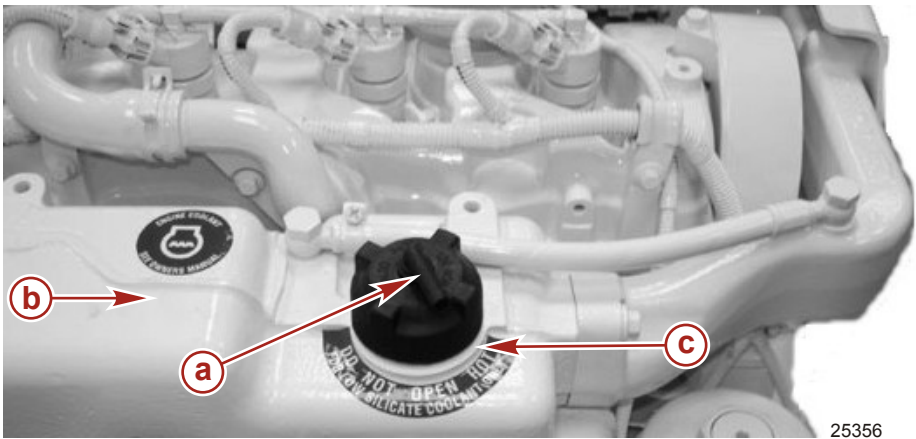
- c. The pressure cap maintains pressure on the cooling system and may not be holding pressure properly. To have the cap tested, contact your Cummins MerCruiser Diesel Authorized Repair Facility.
- d. Add the specified coolant as necessary. See **Filling**.

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**.

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.

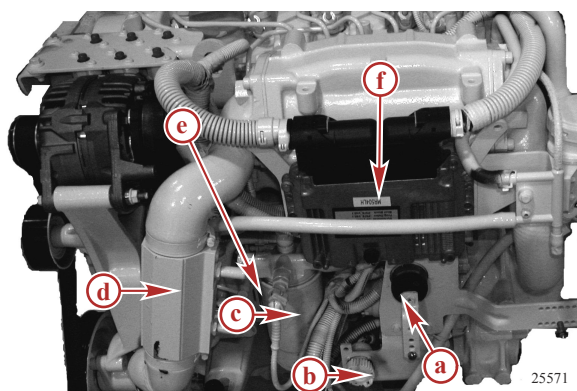
IMPORTANT: Observe the following points.

- 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

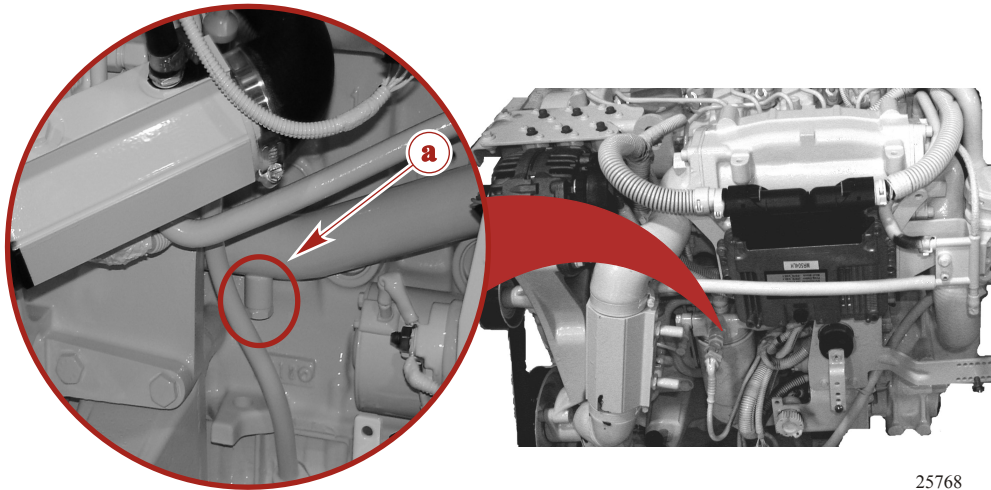
- a** - Throttle cable bracket
- b** - 14-pin electrical connector
- c** - Water-separating fuel filter

- d** - Fuel cooler with fuel lines moved to provide access (early models only)
- 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.*



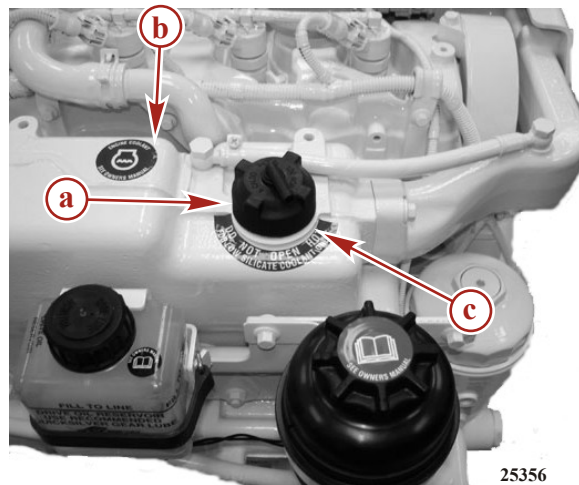
Port side of block with water-separating fuel filter removed for access

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.

- If the boat is out of the water, both the engine and sterndrive must be supplied with cooling water. See the **Flushing the Seawater System** section of this manual.
- 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.

- Install the pressure cap after the engine has reached normal operating temperature (with the thermostat fully open) and the coolant level remains constant.
- Test the engine operation. Observe the temperature gauge and check the engine for coolant leaks. If the temperature gauge indicates the presence of excessive temperature or coolant is leaking, stop the engine immediately and inspect for the cause.
- After the first operation, allow the engine to cool.
- Remove the pressure cap and 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

- Install and securely tighten the pressure cap.

Battery

NOTE: Refer to the manufacturer's instructions.

- Ensure that the battery connections are secure.
- Check the fluid level.

Fuel System

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

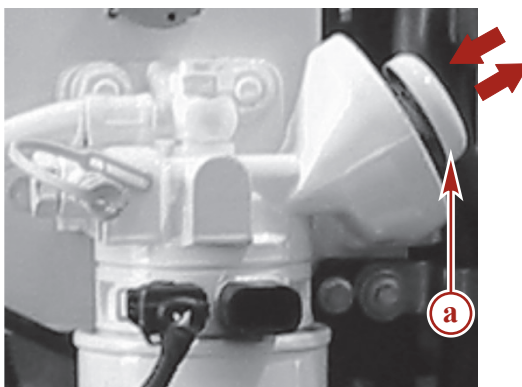
Diesel Fuel In Cold Weather

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.

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.

Water-Separating Fuel Filter

⚠ WARNING

Fuel is flammable and explosive. Ensure 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

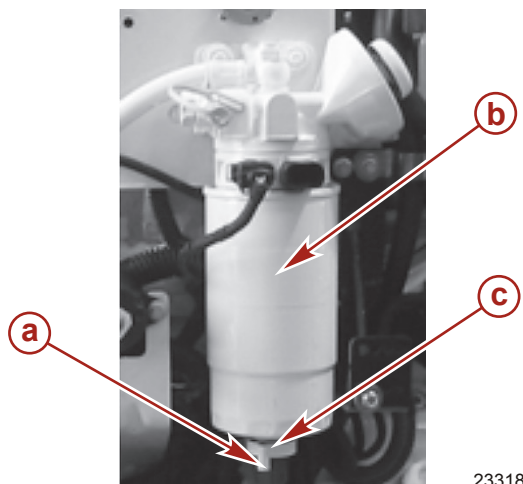
The engine-mounted water-separating fuel filter can be drained of water and small dirt particles by opening the drain cap on the bottom of the filter.

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, if equipped
- 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

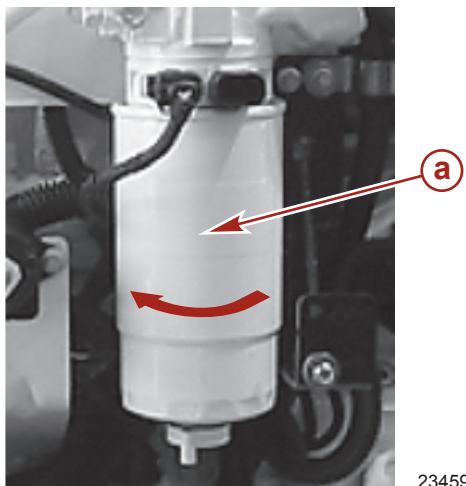
⚠ WARNING

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.

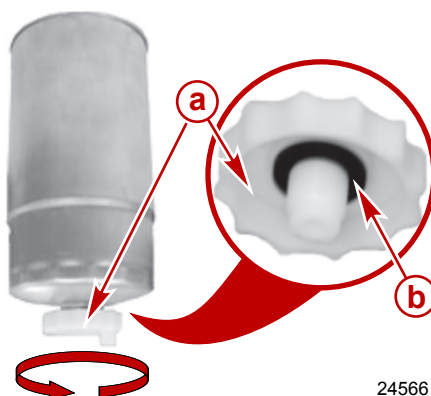


Typical

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.



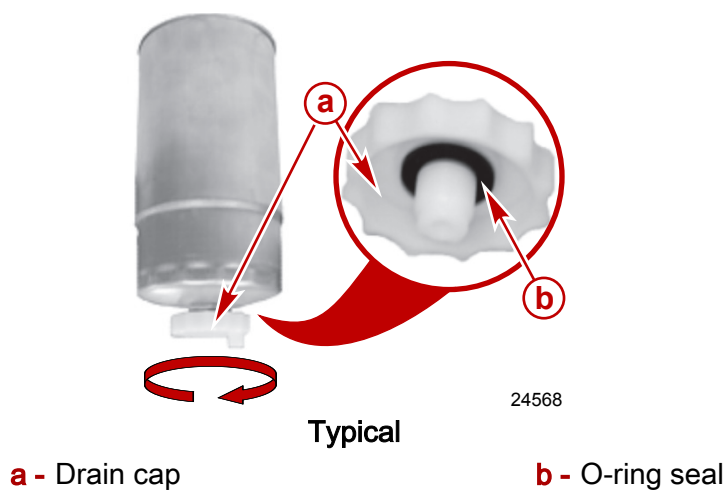
Typical

a - Drain cap

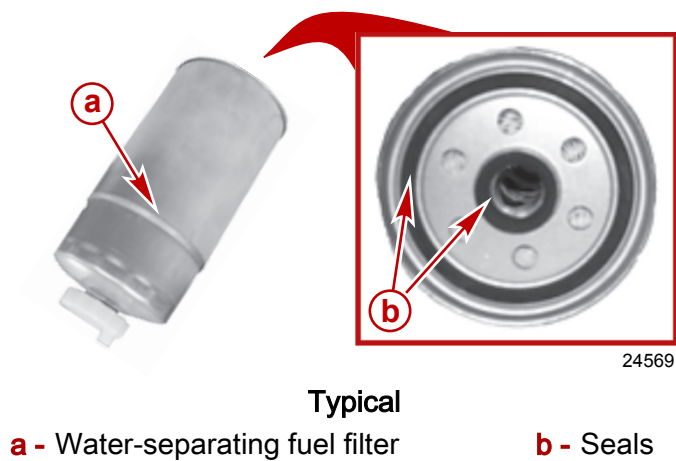
b - O-ring seal

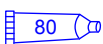
5. Discard the used filter and O-ring seal as defined by local authorities.

6. Install the O-ring and drain cap on the new water-separating fuel filter.

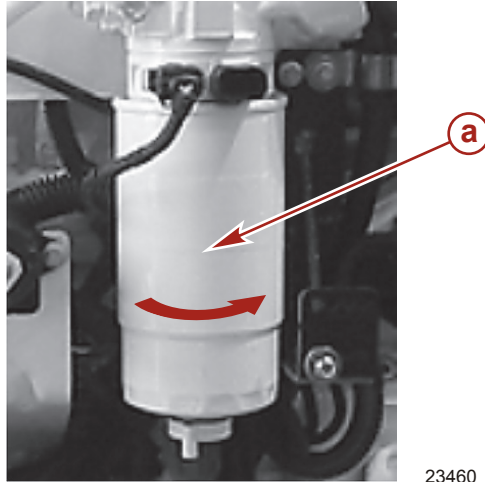


7. Lubricate the fuel filter seals.



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

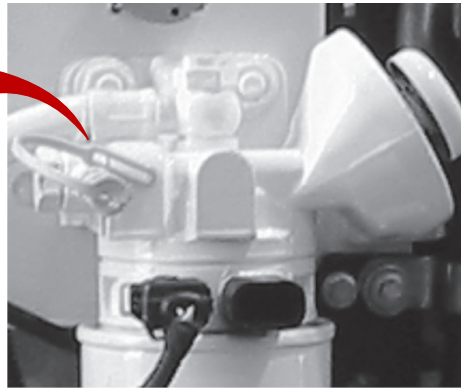
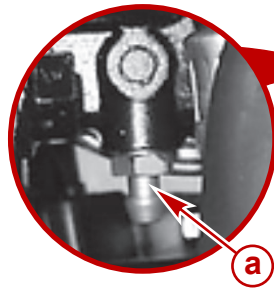
A type of hand pump and primer plunger is located on the fuel filter bracket and is used to

- 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.

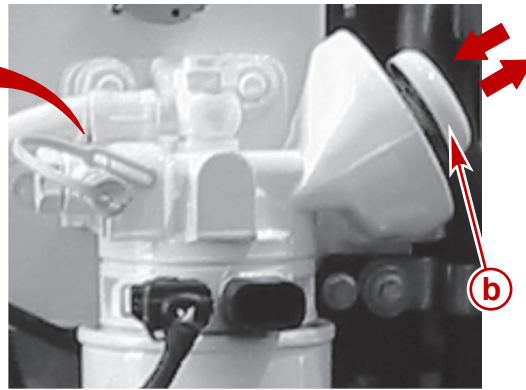
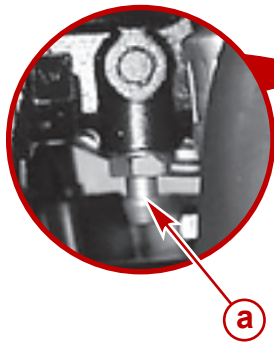
1. Loosen the air vent (bleed) screw on the fuel filter bracket.



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.

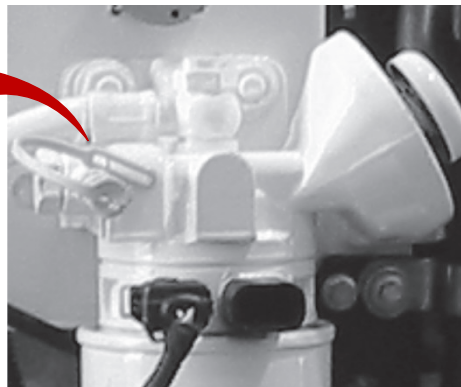
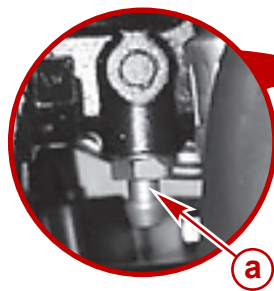


Typical

a - Air vent screw

b - Primer plunger

3. Securely tighten the air vent screw.



Typical

a - Air vent screw

-

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

-
- Figure 1 shows a 3D perspective view of the experimental setup. It consists of a cylindrical container filled with a granular material. A central cylindrical component with a perforated top is positioned inside. Red arrows labeled 'a' and 'b' point to the outer wall and the central component, respectively.

a - Air filter housing **b** - Air filter element

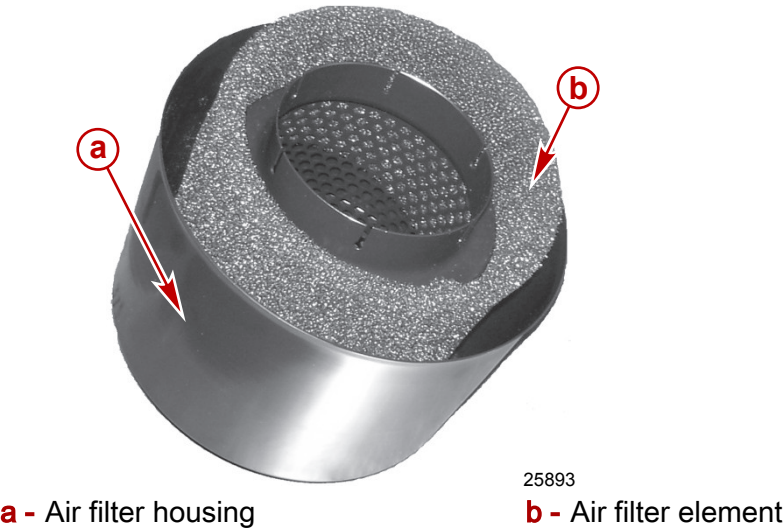
Inspection

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. The foam cover 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.

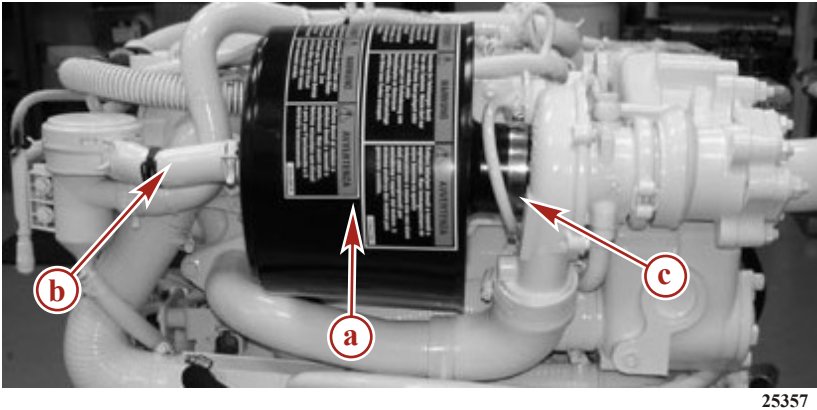


NOTE: The warning labels on the air filter housing must be visible after the air filter housing is installed.

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

Description	Nm	lb. in.	lb. ft.
Air filter housing clamp			

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



a - Air filter housing **c** - Air filter retaining clamp

b - Oil separator vent hose

Seawater Pump Inspection

Alpha Sterndrive Block-off Plate

With Alpha sterndrive models, the seawater cooling system is isolated from the engine seawater system by a water block-off plate. The engine is supplied with seawater through an engine mounted seawater pump and a through-hull or through-transom water inlet.

IMPORTANT: Both seawater systems must be serviced and maintained. Both seawater systems require that an adequate supply of cooling water be available during engine operation.

Sterndrive Seawater Pump Inspection

For sterndrive seawater pump inspection and maintenance refer to the appropriate MerCruiser sterndrive service manual.

Remove and inspect the sterndrive seawater pump at the interval specified in the **Maintenance Schedule**.

Engine Seawater Pump Inspection

For engine seawater pump inspection and maintenance refer to **Section 6—Cooling System**.

Remove and inspect the engine seawater pump at the interval specified in the **Maintenance Schedule**.

Seawater System

Alpha Sterndrive Block-off Plate

With Alpha sterndrive models, the seawater cooling system is isolated from the engine seawater system by a water block-off plate. The engine is supplied with seawater through an engine mounted seawater pump and a through-hull or through-transom water inlet.

IMPORTANT: Both seawater systems must be serviced and maintained. Both seawater systems require that an adequate supply of cooling water be available during engine operation.

Bravo Sterndrive Block-off Plate

With Bravo sterndrive models, the seawater cooling system is isolated from the engine seawater system by a water block-off at the gimble housing. The engine is supplied with seawater through an engine mounted seawater pump and a through-hull or through-transom water inlet.

IMPORTANT: Both seawater systems must be serviced and maintained. Both seawater systems require that an adequate supply of cooling water be available during engine operation.

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 cooling system.

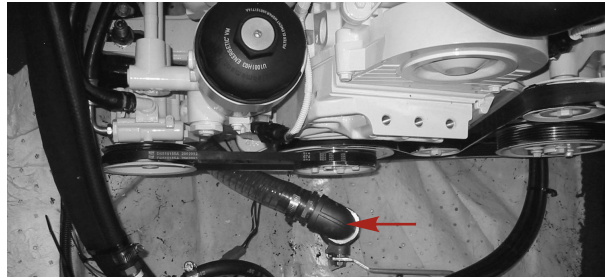
Drain the seawater system of the power package before flushing or prior to cold weather (freezing temperature), seasonal storage, or extended storage.

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

⚠ CAUTION

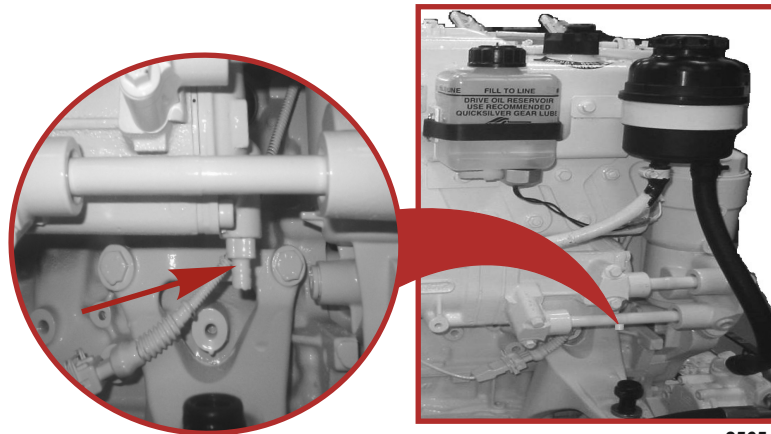
Water can enter the bilge when the drain system is open, damaging the engine or causing the boat to sink. Remove the boat from the water or close the seacock, disconnect and plug the seawater inlet hose, and ensure the bilge pump is operational before draining. Do not operate the engine with the drain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



Typical seacock installation

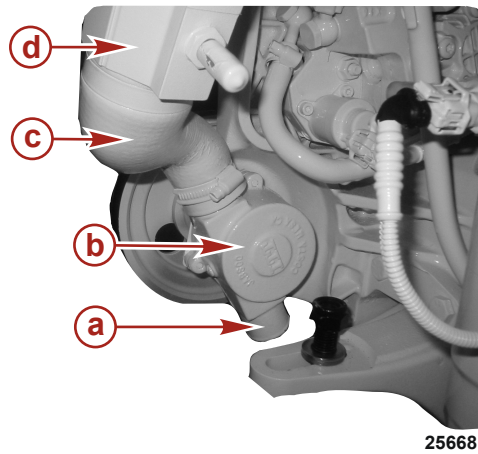
3. Make the engine as level as possible to ensure complete draining of the seawater system.
4. Attach a temporary drain hose to the barbed fitting of the seawater drain valve.



a - Seawater drain valve

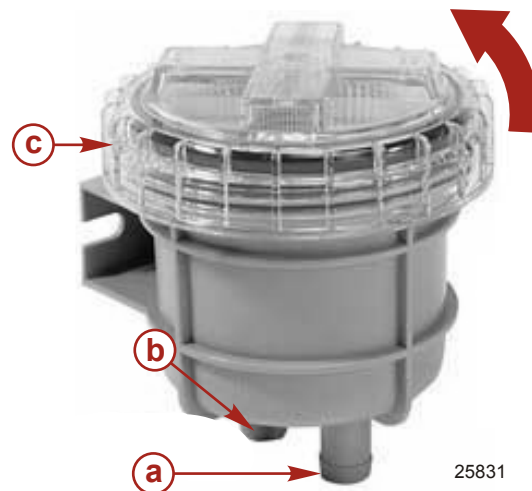
5. Open the seawater drain valve.
6. A small diameter wire bore brush or stiff piece of wire can be used to clear the seawater drain of any debris.

7. Disconnect the seawater inlet hose from the connector on the seawater pump.



- a** - Seawater pump inlet
- b** - Seawater pump
- c** - Seawater pump outlet
- d** - Fuel cooler

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.



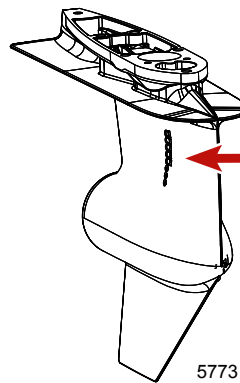
- a** - Seawater inlet
- b** - Seawater outlet
- c** - Seawater strainer cover

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. Tighten the hose clamps securely.

Alpha Sterndrive Water Inlets Check

1. Obtain a piece of wire the appropriate size to insert into the water inlets holes.
2. Insert the wire in and out of the sterndrive water inlets to ensure that they are open and to remove debris or marine growth. Do not scrape the sterndrive paint.

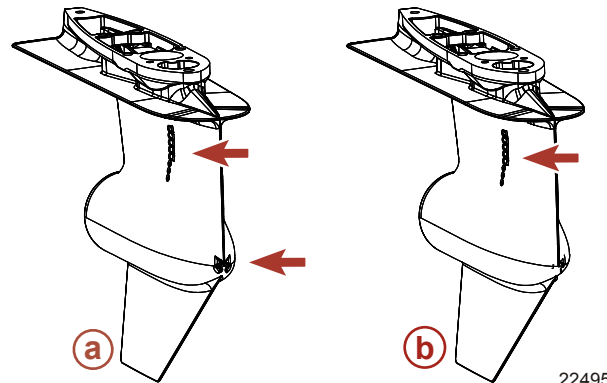
3. Remove the wire from the sterndrive and retain for periodic water inlet checks.



Side pickup water inlets

Bravo Sterndrive Water Inlets Check

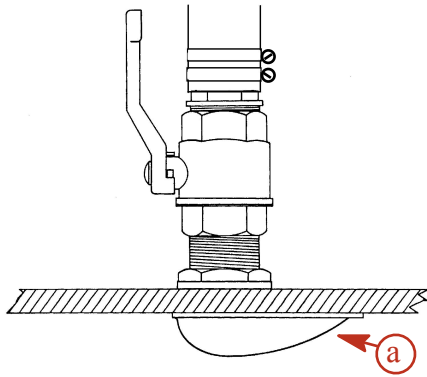
1. Obtain a piece of wire the appropriate size to insert into the water inlets holes.
2. Insert the wire in and out of the sterndrive water inlets to ensure that they are open and to remove debris or marine growth. Do not scrape the sterndrive paint.
3. Remove the wire from the sterndrive and retain for periodic water inlet checks.



- a** - Dual water pickup water inlets
b - Side pickup water inlets

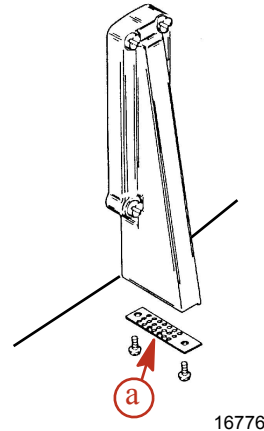
Checking the Seawater Pickups

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



Typical through-hull seawater pickup

a - Water inlet holes



Typical through-transom seawater pickup

Cleaning the Seawater Strainer

NOTE: The seawater strainer can be visually inspected through its clear cover without requiring any seawater system disassembly.

NOTICE

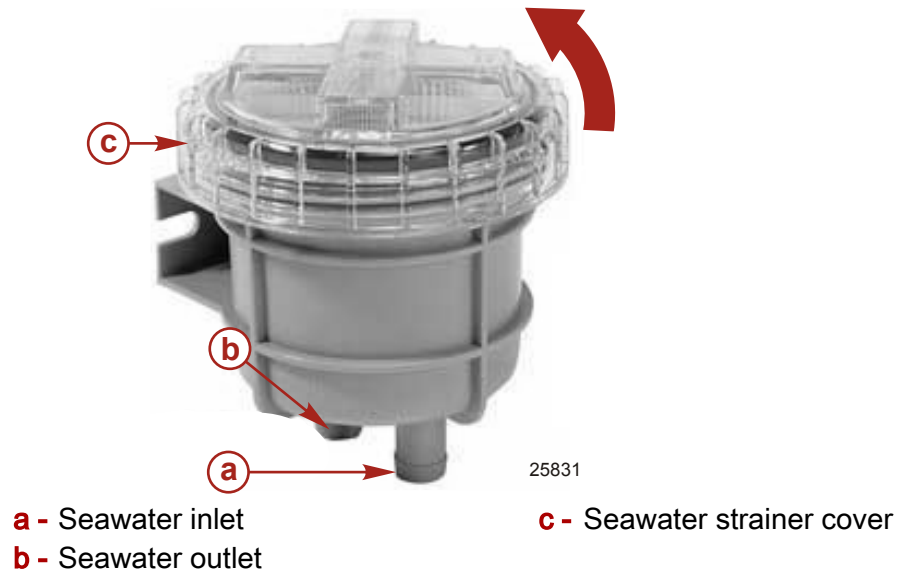
An open seawater strainer or seacock during some service or maintenance procedures can introduce water into the boat, causing damage or sinking the boat. Always close the water supply from the seawater pump, water inlet, or seacock when performing service or maintenance on the cooling system.

NOTICE

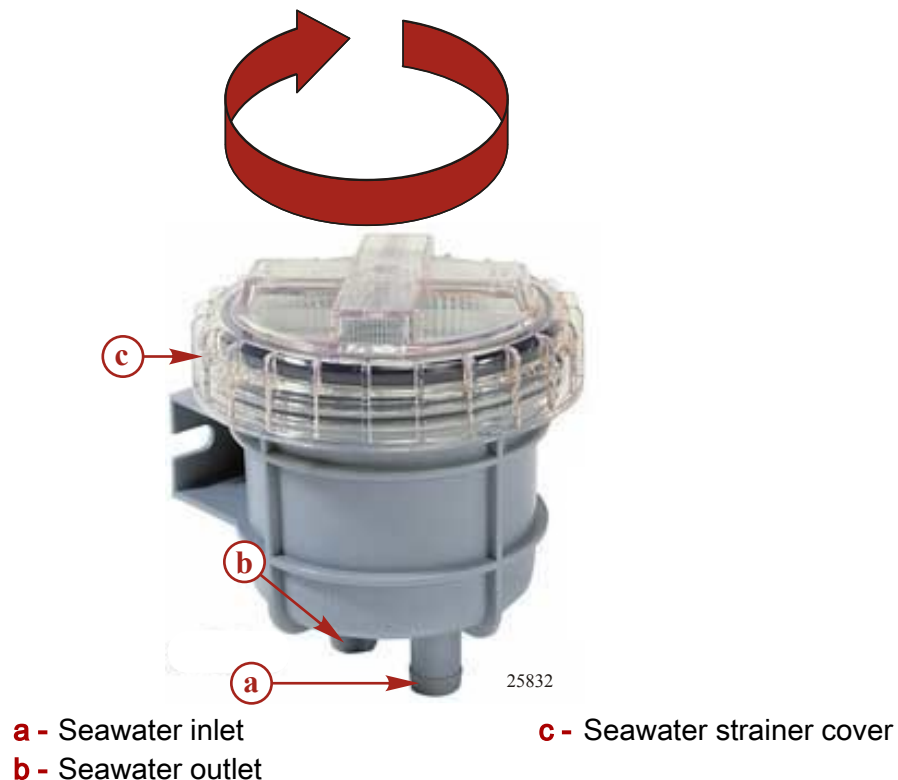
Disconnecting the seawater inlet hose will cause water to enter the bilge resulting in engine damage. Close the seacock before disconnecting the seawater inlet hose. Plug the seawater inlet hose immediately after disconnecting it.

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.



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.



8. If the boat is out of the water, tag the boats 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 use on the water.
9. Boat 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 both the engine and the sterndrive. 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.
10. 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's operating temperature to ensure that it remains in normal operational range and that the seawater cooling system is functioning properly.

Flushing the Seawater System—Alpha Models

IMPORTANT: Because the sterndrive-to-engine seawater supply port is blocked at the gimbal housing, the CMD Alpha sterndrive power package uses an alternative seawater inlet to supply the engine with cooling water. When flushing the seawater system, a supply of cooling water must be provided to both the sterndrive and the engine.

For applications operating in saltwater, brackish water, polluted water, or water with a high mineral content, flush the seawater system with fresh water periodically to avoid salt or sile buildup. For best results under these conditions, we recommend flushing the seawater system after each outing. The seawater cooling system must be flushed after each operation in saltwater and before placing the boat in storage following operation under any conditions. See **Routine and Schedule Maintenance** sections of this manual.

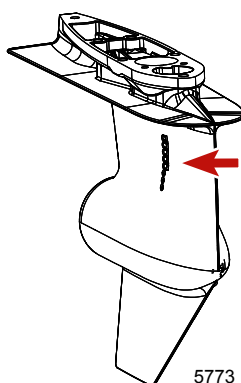
FLUSHING ATTACHMENTS

Your boat comes equipped with sterndrive water pickups. Flushing the sterndrive requires the appropriate flushing attachment device. See **Sterndrive Water Pickups** for the flushing procedure or consult your Cummins MerCruiser Diesel Authorized Repair Facility for service and further explanation.

Flushing Device	91-44357Q 2
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STERNDRIVE WATER PICKUPS

This Cummins MerCruiser Diesel sterndrive is equipped with side water pickups. Side pickups require the use of a flushing attachment (44357Q 2).



Side Pickup

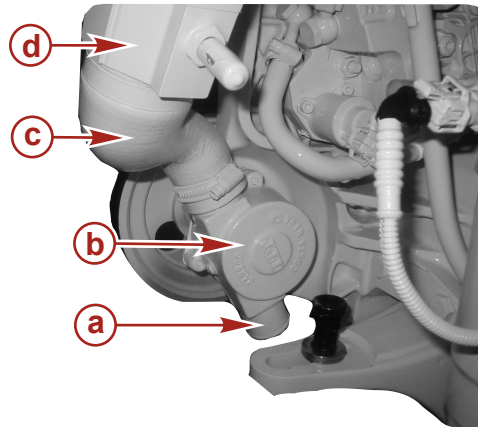
1. Drain the seawater section of the cooling system.
2. **If flushing the cooling system with the boat in the water:**
 - a. Raise the sterndrive to trailer position.
 - b. Install the appropriate flushing attachment over the water inlet holes in the gear housing.
 - c. Lower the sterndrive to full down (in) position.
3. **If flushing the cooling system with the boat out of the water:**
 - a. Lower sterndrive to full down (in) position.

WARNING

Rotating propellers can cause serious injury or death. Never operate the boat out of the water with a propeller installed. Before installing or removing a propeller, place the drive unit in neutral and engage the lanyard stop switch to prevent the engine from starting. Place a block of wood between the propeller blade and the anti-ventilation plate.

- b. Remove the propeller.
 - c. Install the appropriate flushing attachment over the water inlet holes in the gear housing.
4. Connect a hose between the flushing attachment and a water source.
5. **On Alpha engines with the sterndrive water inlet blocked off at the gimbal housing and using a through-hull water inlet**, ensure that there is an adequate supply of cooling water to both the sterndrive and the engine during operation.

6. Connect a second flushing hose from a water tap to the seawater inlet hose connector or to the seawater pump inlet using an appropriate adapter.



a - Seawater pump inlet
b - Seawater pump

c - Seawater pump outlet
d - Fuel cooler

7. With the sterndrive in the normal operating position, partially open the water source (about 1/2 maximum flow).
8. Place the remote control in the neutral, idle speed position and start the engine.

NOTICE

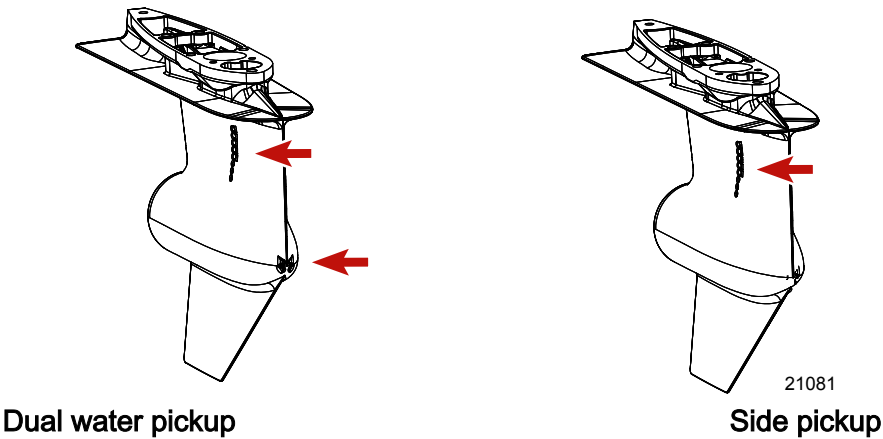
Operating the engine out of the water at high speeds creates suction, which can collapse the water supply hose and overheat the engine. Do not operate the engine above 1400 RPM out of the water and without sufficient cooling water supply.

9. Operate the engine with the sterndrive in neutral at a fast idle between 600 to 1400 RPM for about 10 minutes or until discharge water is clear.
10. Observe the water temperature gauge to ensure that the engine is operating in the normal range.
11. Slowly return the throttle to the idle speed position.
12. Stop the engine.
13. Shut off the water and remove the flushing attachment.
14. Remove any adaptors used and reconnect all of the seawater hoses.

Flushing the Seawater System—Bravo Models

Flushing the sterndrive out of the water requires the use of the appropriate flushing attachment.

1. Bravo Sterndrive:



Flushing Device	91-44357Q 2
Dual Water Pick-up Flush Gearcase Seal Kit	91-881150K 1

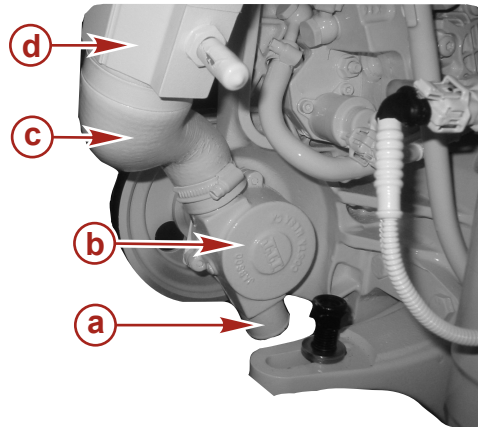
1. Drain the seawater section of the cooling system.
2. **If flushing the cooling system with the boat in the water:**
 - a. Raise the sterndrive to trailer position.
 - b. Install the appropriate flushing attachment over the water inlet holes in the gear housing.
 - c. Lower the sterndrive to full down (in) position.
3. **If flushing the cooling system with the boat out of the water:**
 - a. Lower sterndrive to full down (in) position.

⚠ WARNING

Rotating propellers can cause serious injury or death. Never operate the boat out of the water with a propeller installed. Before installing or removing a propeller, place the drive unit in neutral and engage the lanyard stop switch to prevent the engine from starting. Place a block of wood between the propeller blade and the anti-ventilation plate.

- b. Remove the propeller.
 - c. Install the appropriate flushing attachment over the water inlet holes in the gear housing.
4. Connect a hose between the flushing attachment and a water source.
5. **On engines with the sterndrive water inlet blocked off at the gimbal housing and using a through-hull water inlet**, ensure that there is an adequate supply of cooling water to both the sterndrive and the engine during operation.

6. Connect a second flushing hose from a water tap to the seawater inlet hose connector or to the seawater pump inlet using an appropriate adapter.



a - Seawater pump inlet
b - Seawater pump

c - Seawater pump outlet
d - Fuel cooler

7. With the sterndrive in the normal operating position, partially open the water source (about 1/2 maximum flow).
8. Place the remote control in the neutral, idle speed position and start the engine.

NOTICE

Operating the engine out of the water at high speeds creates suction, which can collapse the water supply hose and overheat the engine. Do not operate the engine above 1400 RPM out of the water and without sufficient cooling water supply.

9. Operate the engine with the sterndrive in neutral at a fast idle between 600 to 1400 RPM for about 10 minutes or until discharge water is clear.
10. Observe the water temperature gauge to ensure that the engine is operating in the normal range.
11. Slowly return the throttle to the idle speed position.
12. Stop the engine.
13. Shut off the water and remove the flushing attachment.
14. Remove any adaptors used and reconnect all of the seawater hoses.

Corrosion Protection–General

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.

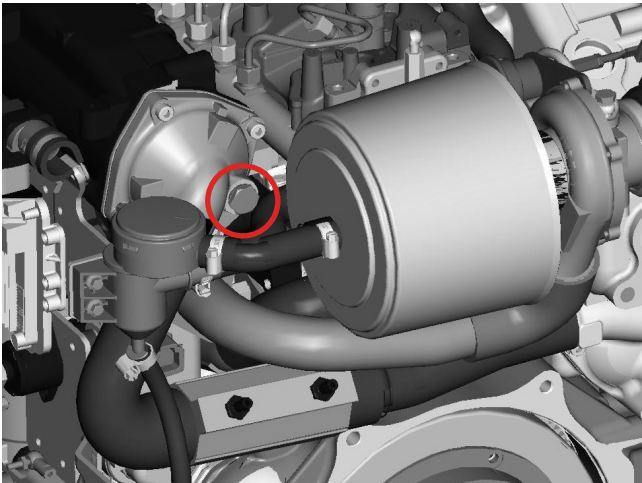
REMOVAL

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.



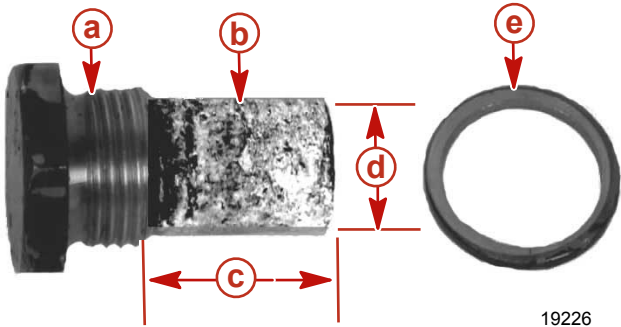
a - Sacrificial anode

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

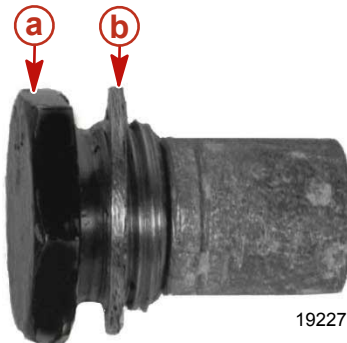
- a** - Anode plug
- b** - Sacrificial anode
- c** - Length
- d** - Diameter
- e** - Sealing washer

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

- 3. Discard the sealing washer.

INSTALLATION

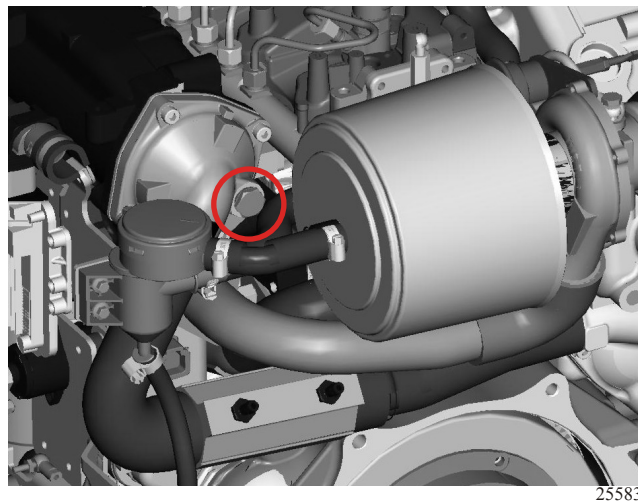
1. Install a new sealing washer on the anode assembly (anode plug with the sacrificial anode).



a - Anode assembly

b - Sealing washer

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



a - Sacrificial anode

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

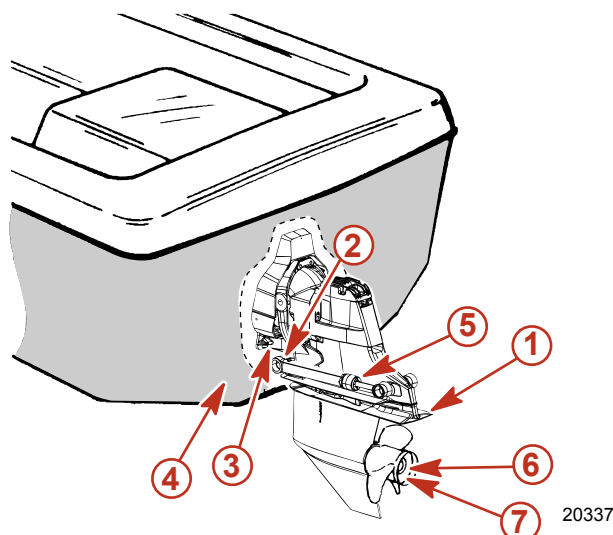
NOTICE

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

Sterndrive Corrosion Protection Components

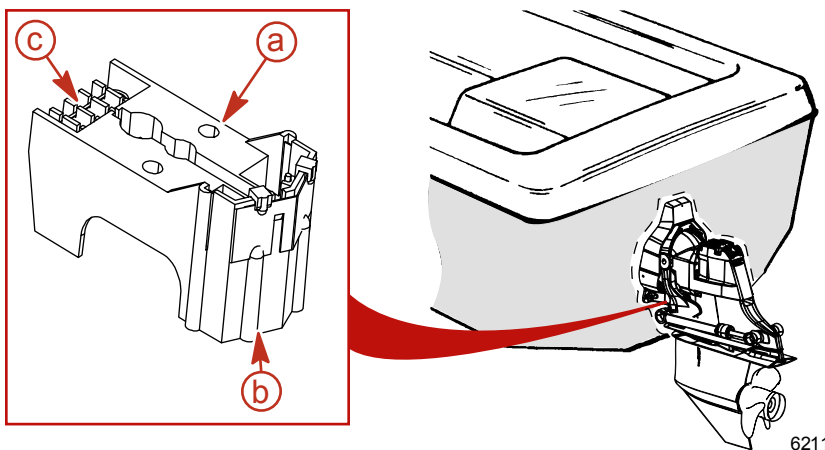
To help control the effects of galvanic corrosion, Cummins MerCruiser Diesel sterndrives come with several sacrificial anodes and other corrosion protection devices. For a more comprehensive explanation of corrosion and corrosion protection refer to the **Marine Corrosion Protection Guide**.



- | | |
|-----------------------------|--|
| 1 - Gearcase anodic plate | 5 - Trim cylinder anodes |
| 2 - Ventilation plate anode | 6 - Bearing carrier anodes |
| 3 - MerCathode System | 7 - Propshaft Anode (Bravo III standard) |
| 4 - Anode kit | |

NOTICE

Washing the MerCathode assembly can damage components and lead to rapid corrosion. Do not use any cleaning equipment such as brushes or high-pressure washers to clean the MerCathode assembly.

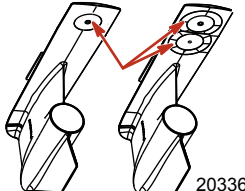
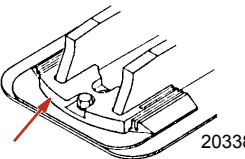
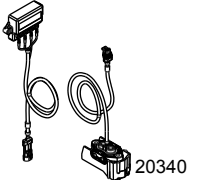
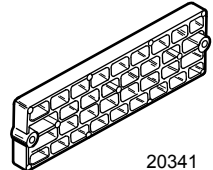
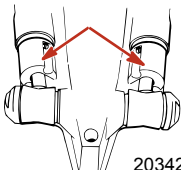
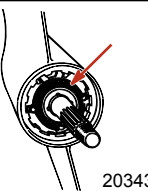
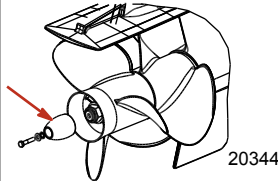


- | | |
|------------------------------------|--------------------------|
| a - MerCathode reference electrode | c - Do not pressure wash |
| b - Do not paint | |

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

The following sacrificial anodes are installed at different locations on your power package. These anodes help protect against galvanic corrosion by sacrificing its metal to be slowly eroded instead of the metal components on the power package.

MerCathode System - Electrode assembly replaces Anodic block. System should be tested to ensure adequate output. The test should be performed where boat is moored, using Quicksilver Reference Electrode and Test Meter. Contact your authorized Mercury MerCruiser dealer.

Description	Location	Figure
Gearcase anodic plate	Mounted on the underside of the lower gearcase.	 20336
Ventilation plate anode	Mounted on the front of the gearcase.	 20338
MerCathode System	The MerCathode electrode is mounted to the underside of the gimbal housing. The MerCathode controller is mounted on the engine or on the boat transom. The controller harness connects to the electrode harness.	 20340
Anode kit (if equipped)	Mounted to the boat transom.	 20341
Trim cylinder anodes	Mounted on each of the trim cylinders.	 20342
Bearing carrier anode (Bravo One)	Located in front of the propeller, between the front side of the propeller and the gear housing.	 20343
Propshaft anode (Bravo Three)	Located behind the aft propeller.	 20344

In addition to the corrosion protection devices, take the following steps to inhibit corrosion.

1. Paint the power package. See **Painting Your Power Package**.
2. Annually spray the power package components on the inside of the boat with Corrosion Guard to protect the finish from dulling and corrosion. You may also spray external power package components.

3. Keep all lubrication points, especially the steering system, shift and throttle linkages, well lubricated.
4. Flush the cooling system periodically, preferably after each use.

MerCathode

If the boat is equipped with a Quicksilver MerCathode system, the system should be tested to ensure that it is providing adequate output to protect the underwater metal parts on the boat. The test should be made where the boat is moored, using a Quicksilver Reference Electrode and Test Meter.

Reference Electrode	91-76675T 1
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Refer to the appropriate Mercury MerCruiser Sterndrive Service Manual for testing procedures.

Painting Your Power Package

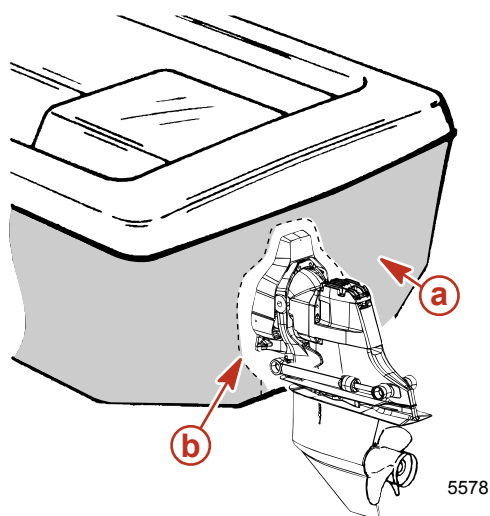
IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint will not be covered by the limited warranty.

1. **Painting the boat hull or transom:** you may apply anti-fouling paint to the boat hull and transom. However, observe the following:

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

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

- Avoid any electrical interconnection between the paint and the Mercury MerCruiser product, anodic blocks, or MerCathode system by allowing a minimum of 40 mm (1-1/2 in.) unpainted area on the transom of the boat around these items.



a - Painted boat transom

b - Unpainted Area on Transom

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

Corrosion Protection, Alpha Sterndrive

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.

Alpha Sterndrive Continuity Circuit Inspection

The transom assembly and sterndrive unit are equipped with ground-circuit wires to ensure good electrical continuity between the engine, transom assembly, and sterndrive components. Good continuity to a ground is essential for the anode and MerCathode system to function most effectively.

1. Inspect the steering lever ground wire for loose connections, broken connectors, or frayed wiring.
2. Inspect the inner transom plate ground wire for loose connections, broken connectors, or frayed wiring.
3. Inspect the gimbal housing ground wires for loose connections, broken connectors, or frayed wiring.
4. Inspect the flywheel housing grounding stud, ground wire, and the inner transom plate grounding screw for loose connections, broken connectors, or frayed wiring.

Corrosion Protection, Bravo Sterndrive

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 require the replacement of power package components exposed to water.

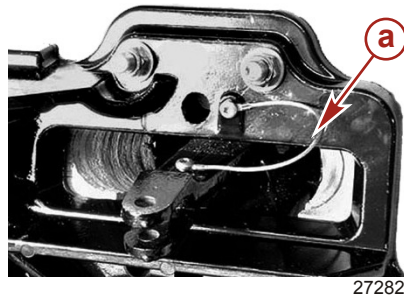
To help control the effects of galvanic corrosion, Cummins MerCruiser Diesel power packages come with several sacrificial anodes and other corrosion protection devices. For a more comprehensive explanation of corrosion and corrosion protection refer to the **Marine Corrosion Protection Guide**.

IMPORTANT: Replace sacrificial anodes if they are eroded 50% or more. Avoid the use of anodes from another manufacturer.

Continuity Circuit—Bravo Sterndrive

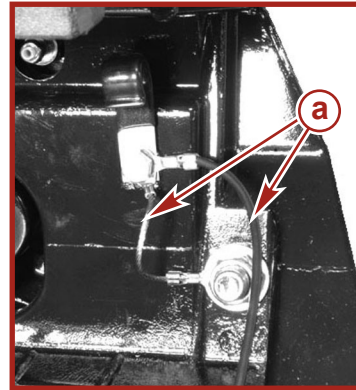
The transom assembly and sterndrive have ground-circuit wires to ensure good electrical continuity between the engine, transom assembly, and sterndrive components. Good continuity to a ground is essential for the anode and MerCathode system to function effectively.

1. Inspect the steering lever ground wire for loose connections, broken connectors, or frayed wiring.
2. Inspect the inner transom plate ground wire for loose connections, broken connectors, or frayed wiring.



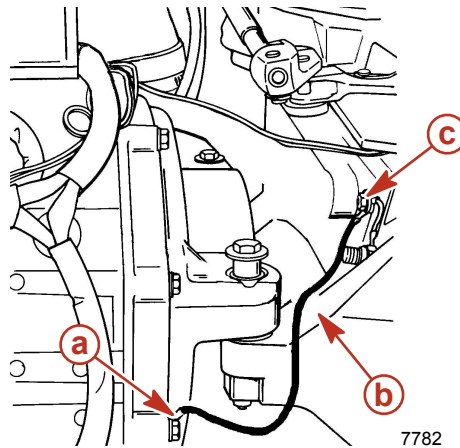
Steering lever continuity wire

a - Continuity wire



Transom plate continuity wires

3. Inspect the flywheel housing grounding stud and ground wire, and the inner transom plate grounding screw for loose connections, broken connectors, or frayed wiring.



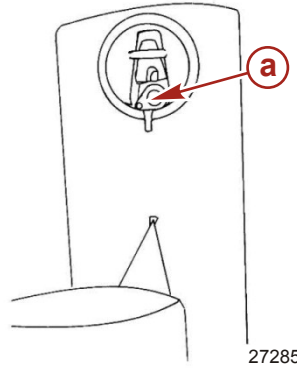
Typical

a - Flywheel housing screw or grounding stud

b - Continuity circuit (ground) wire

c - Inner transom plate grounding screw

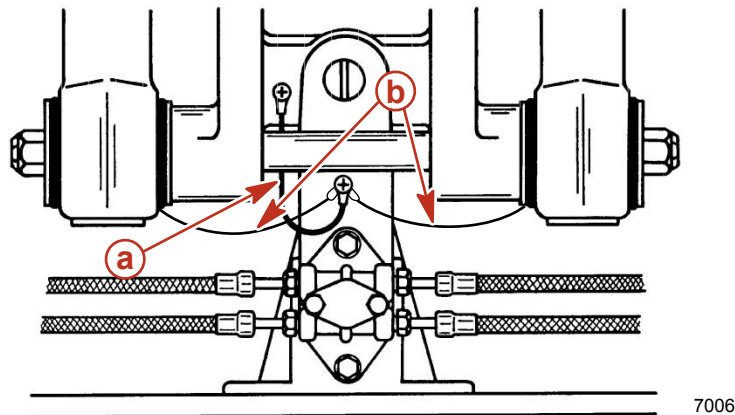
4. Inspect the driveshaft housing-to-gear housing ground plate inside the anode cavity for a loose or faulty connection.



Sterndrive anodic plate cavity

a - Ground plate (inside anode cavity)

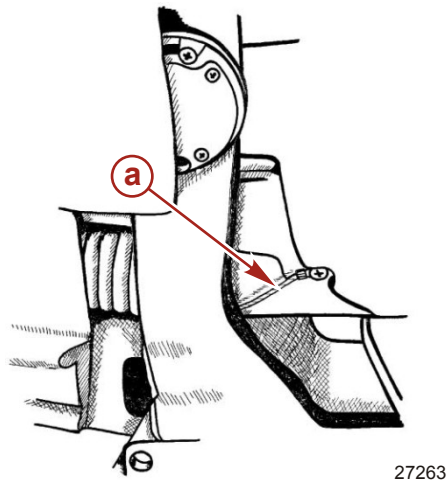
5. Inspect the gimbal housing ground wires for loose connections, broken connectors, or frayed wiring.



a - Gimbal housing-to-gimbal ring ground wire

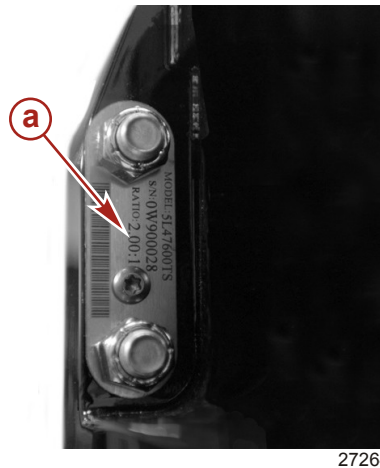
b - Gimbal housing-to-trim cylinder ground wires

6. Inspect the gimbal ring ground wire for loose connections, broken connectors, or frayed wiring.



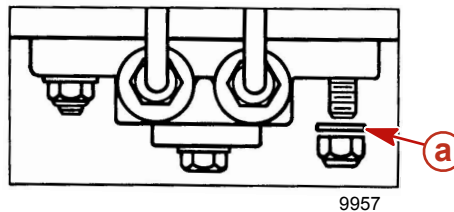
a - Gimbal ring-to-bell housing ground wire

7. Inspect the sterndrive ground plate for loose or broken connections.



a - Sterndrive-to-bell housing ground plate

8. Inspect the continuity washers under the hydraulic manifold block fasteners for a loose or faulty connection .



a - Continuity washers

9. Inspect the sterndrive U-joint bellows ground clips and exhaust tube ground clip for loose or faulty connections.



Exhaust tube ground clip shown, U-joint bellows ground clips similar

a - Exhaust tube ground clip

Lubrication

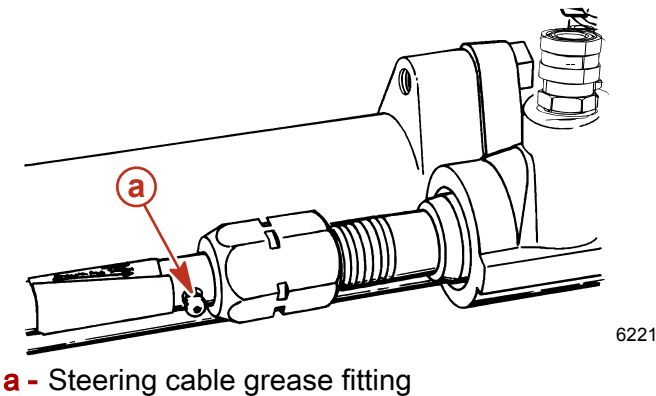
Steering System


⚠ WARNING

Incorrect cable lubrication can cause hydraulic lock, leading to serious injury or death from loss of boat control. Completely retract the end of the steering cable before applying lubricant.

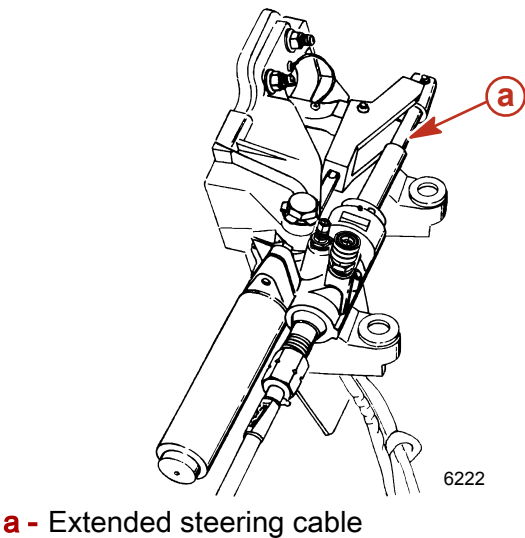
NOTE: If the steering cable does not have a grease fitting, the inner wire of the cable cannot be greased.


1. If the steering cable has grease fittings, turn the steering wheel until the steering cable is fully retracted into the cable housing. Apply approximately three pumps of grease from a typical hand-operated grease gun.



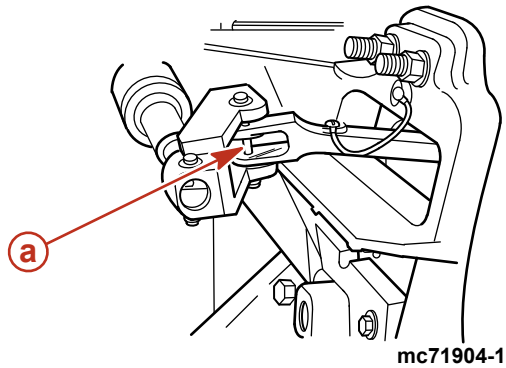
Tube Ref No.	Description	Where Used	Part No.
 34	Special Lubricant 101	Steering cable grease fitting	92-802865Q02

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




Tube Ref No.	Description	Where Used	Part No.
 34	Special Lubricant 101	Steering cable	92-802865Q02


3. Lubricate the steering pin.



a - Steering pin

Tube Ref. No.	Description	Where Used	Part No.
	Synthetic Blend MerCruiser Engine Oil SAE25W-40	Steering pin	92-883725K01

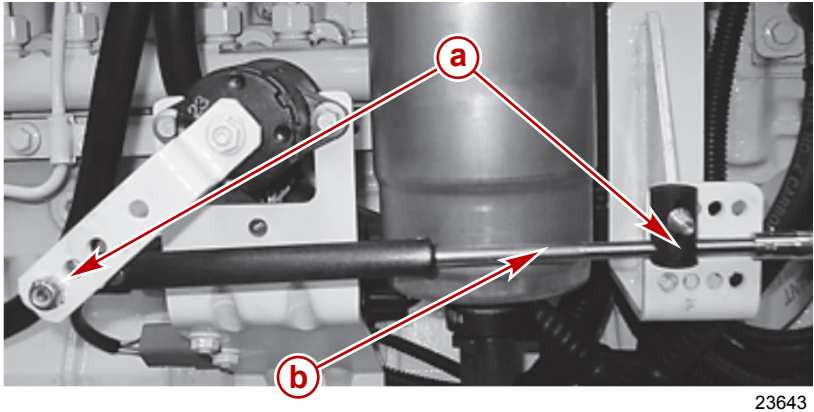
4. On dual engine boats: Lubricate the tie bar pivot points.

Tube Ref. No.	Description	Where Used	Part No.
	Synthetic Blend MerCruiser Engine Oil SAE25W-40	Tie bar pivot points	92-883725K01

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

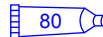
Throttle Cable

1. Lubricate the pivot points and guide contact surfaces.




a - Pivot points

b - Guide contact surfaces

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

-


b - Guide contact surface

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

Transom Assembly

-
- 19979

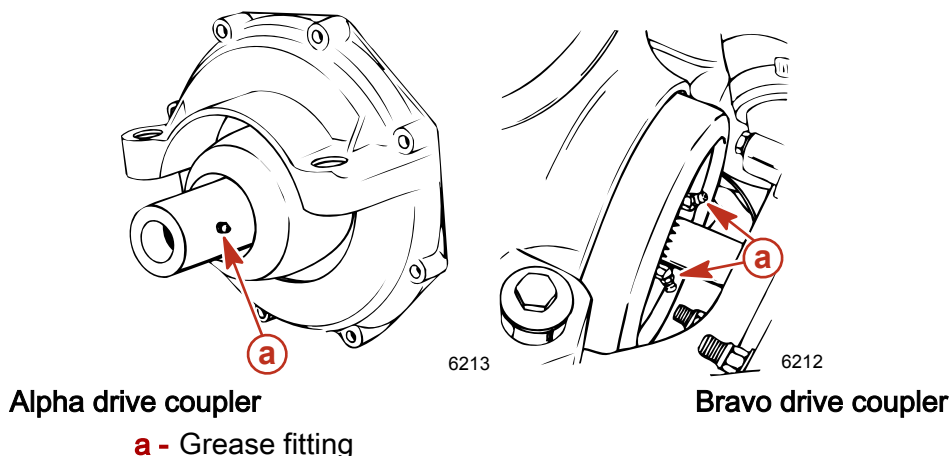
a - Gimbal bearing grease insert

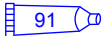
Tube Ref No.	Description	Where Used	Part No.
 42	U-joint and Gimbal Bearing Grease	Gimbal bearing grease insert	92-802870A1

Engine Coupler

- 90-866942 JANUARY 2008

NOTE: If the boat is operated at idle for prolonged periods of time, coupler should be lubricated **Bravo Models** - every 50 hours; **Alpha Models** - every 150 hours.



Tube Ref No.	Description	Where Used	Part No.
 91	Engine Coupler Spline Grease	Coupler	92-802869A 1

NOTE: Alpha Models - Your power package is equipped with a sealed engine coupler and Perm-a-Lube U-joints. The sealed coupler and shaft splines can be lubricated without removing the sterndrive unit.

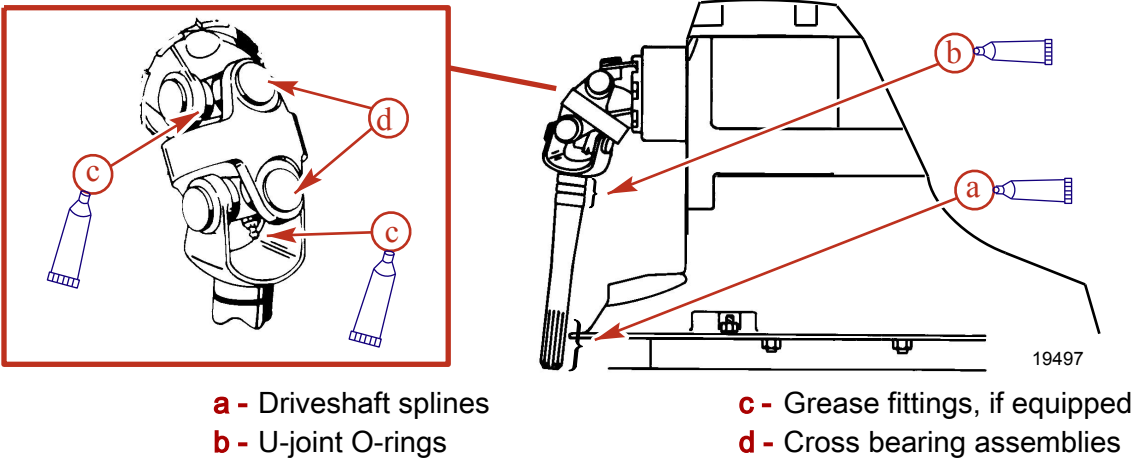
NOTE: Bravo Models - The coupler and shaft splines can be lubricated without removing the sterndrive unit. Apply lubricant from a typical hand-operated grease gun until a small amount of grease begins to push out.

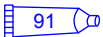
Sterndrive U-joint Cross Bearings and Shaft Splines (Sterndrive Unit Removed)


NOTE: Gray sterndrive U-joint cross bearings have grease fittings and require lubrication at specified intervals. Black sterndrive U-joint cross bearings do not have grease fittings and do not require additional lubrication. The sterndrive must be removed to lubricate the gray U-joints.

1. Remove the sterndrive unit; refer to the appropriate Mercury MerCruiser Sterndrive Service Manual for sterndrive unit removal and installation.
2. Lubricate the sterndrive U-joint cross bearings through the grease fittings, if equipped, by applying approximately 3-6 pumps of grease from a typical hand-operated grease gun.

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



Tube Ref No.	Description	Where Used	Part No.
 91	Engine Coupler Spline Grease	Driveshaft splines	92-802869A 1

Tube Ref No.	Description	Where Used	Part No.
	Exxon Unirex EP2 Grease	Gray sterndrive U-joint cross bearings on Bravo X Sterndrive units	Obtain Locally

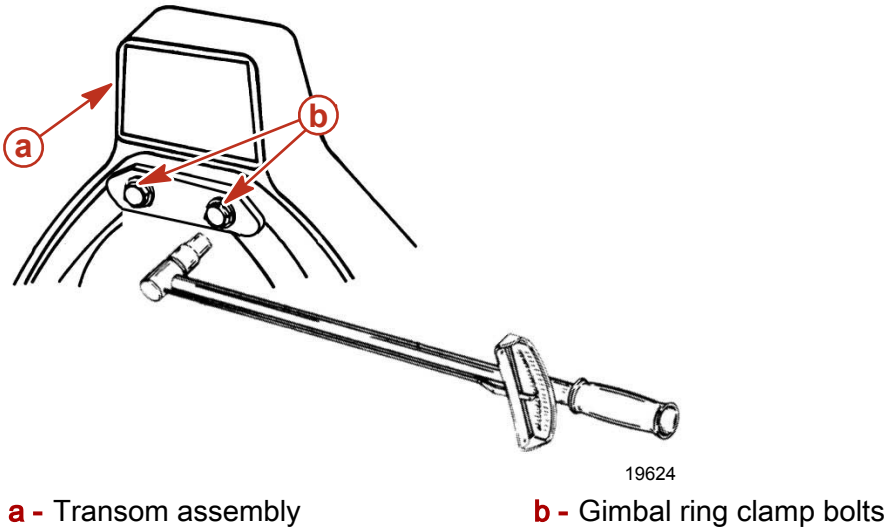
Propeller Shaft

For propeller shaft lubrication, refer to the appropriate Mercury MerCruiser Sterndrive Service Manual.

Maintaining Torques

Transom Gimbal Ring Clamp Bolt

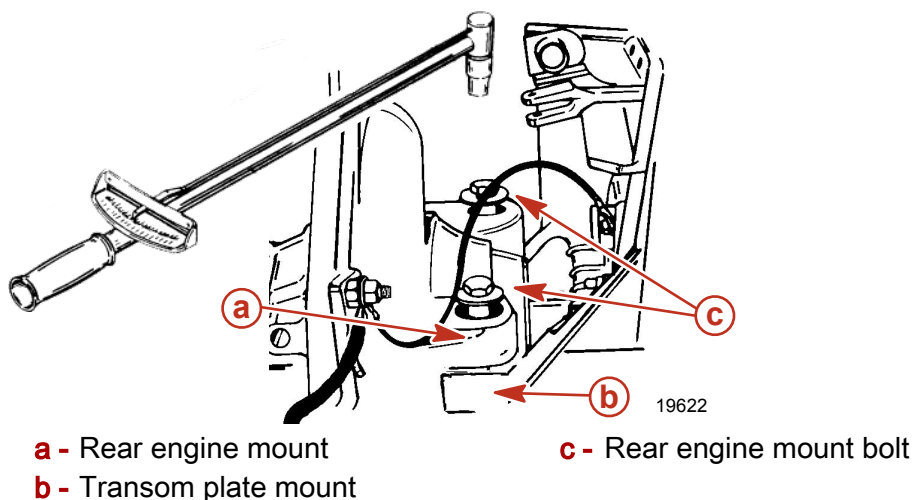
NOTE: The gimbal ring is a component of the transom assembly.
Tighten the gimbal ring clamp bolts to the specified torque.



Description	Nm	lb-in.	lb-ft
Alpha gimbal ring clamp bolts	74	—	55
Bravo gimbal ring clamp bolts for 3/8 in. U-bolt	72	—	53
Bravo gimbal ring clamp bolts for 7/16 in. U-bolt	95	—	70

Engine Mounts

Loosen the rear engine mount bolts 1 to 1-1/2 turns. Retorque the rear engine mount bolts.



Description	Nm	lb. in.	lb. ft.
Rear engine mounts	51		38

Electrical System

NOTE: Refer to **Section 4** for specific procedures.

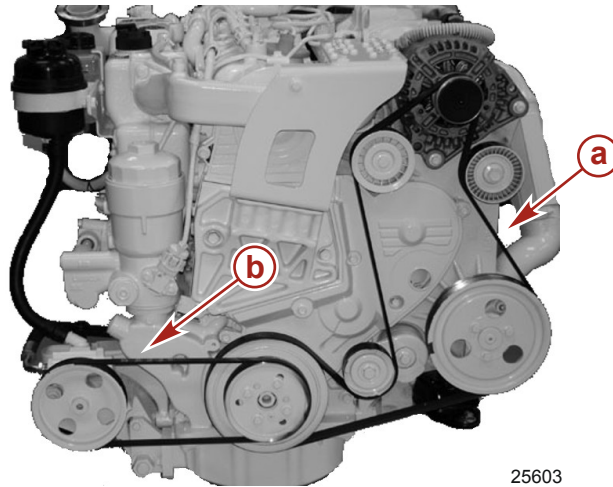
Inspect the entire electrical system for loose, damaged, or corroded fasteners and connectors.

QSD 2.0 Drive Belts

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

⚠ 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.



25603

QSD 2.0L front cover removed

- a** - Serpentine belt
b - Power assisted steering belt (sterndrive models)

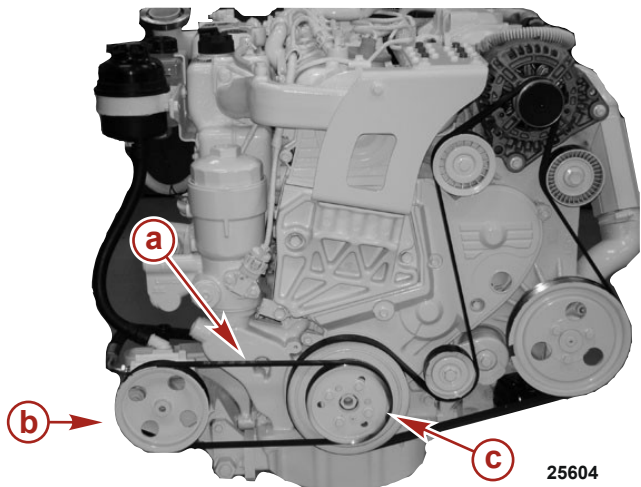
Power Assisted Steering Pump Belt–Sterndrive Only

Inspection

The 2.0 diesel engine with a sterndrive is equipped with a stretch-belt that is used to drive the power-assisted steering pump. The stretch-belt has a specific level of elasticity, and self-tensioning and vibration-damping characteristics not found in standard belts. It cannot be reused. Replace the power-assisted steering pump stretch-belt if you remove it for any reason.

1. Inspect the power-assisted steering stretch-belt for the following:
 - Excessive wear
 - Cracks
 - Fiber fraying
 - Glazed surfaces

2. Replace the belt if it appears worn or damaged.

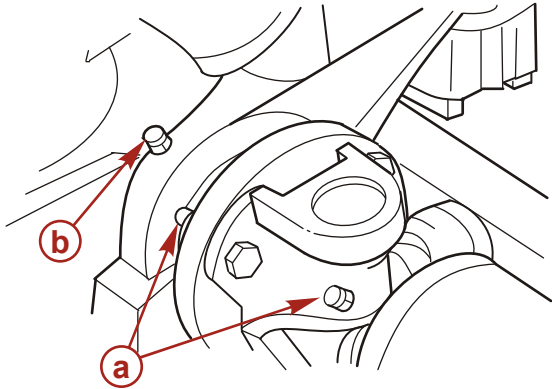


- a** - Power-assisted steering stretch belt
b - Power-assisted steering pump pulley
c - Crankshaft pulley

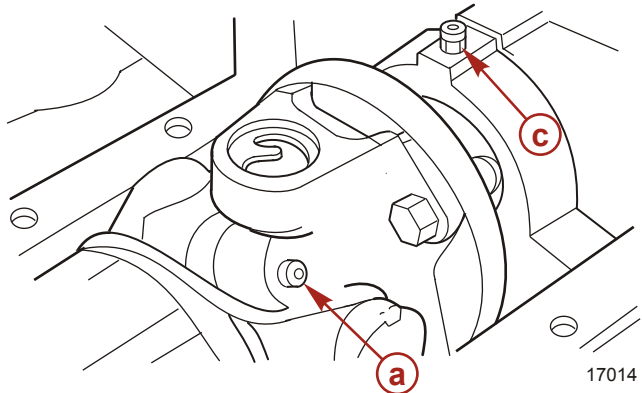
3. Replace the power-assisted steering stretch-belt at the recommended service interval as indicated by the appropriate maintenance schedule.

Driveshaft Extension Models


1. Lubricate the transom end grease fitting and engine end grease fitting by applying approximately 10 - 12 pumps of grease from a typical hand-operated grease gun.
2. Lubricate the driveshaft grease fittings by applying approximately 3 - 4 pumps of grease from a typical hand-operated grease gun.



- a** - Driveshaft grease fittings
b - Transom end grease fitting



- c** - Engine end grease fitting

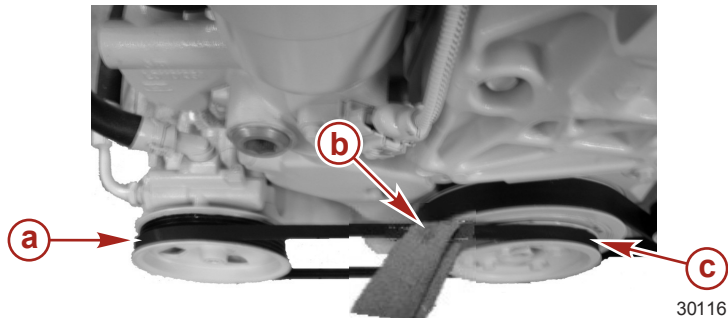
Tube Ref No.	Description	Where Used	Part No.
 42	U-joint and Gimbal Bearing Grease	Transom end grease fitting, engine end grease fitting, driveshaft grease fittings	92-802870A1

Adjustment

The power-assisted steering pump stretch-belt cannot be adjusted. Loose or noisy belts must be replaced. The stretch-belt has a specific level of elasticity, and self- tensioning and vibration-damping characteristics not found in standard belts. **Replace the power-assisted steering pump stretch-belt if you remove it for any reason.**

Removal

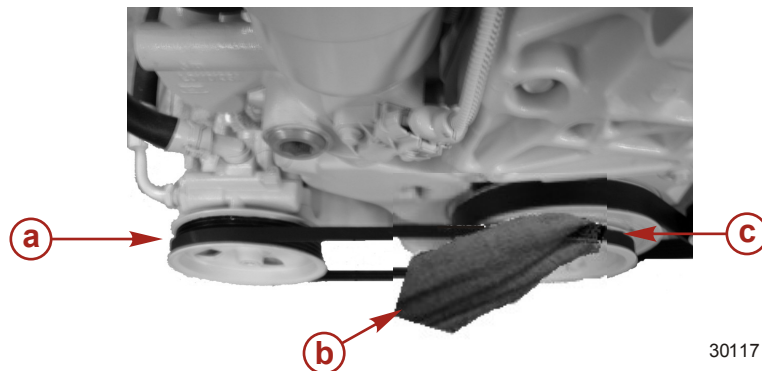
1. Disconnect both battery cables.
2. Position a suitable tool on the crankshaft pulley nut.
IMPORTANT: Do not rotate the crankshaft in a counterclockwise direction. Counterclockwise engine rotation will damage the seawater pump impeller and could affect crankshaft pulley torque.
3. Loop a light weight shop towel around the power-assisted steering stretch belt so that the loose ends are even and on the outside of the belt.



Tool and shop towel positioning

- a** - Power-assisted steering pump
- b** - Shop towel
- c** - Belt around crankshaft pulley

4. While rotating the engine in a clockwise direction, pull out the stretch-belt with the shop towel. Continue the clockwise rotation of the engine while working the stretch-belt off of the front of the crankshaft pulley with the shop towel.



Crankshaft rotation

- a** - Power-assisted steering pump
- b** - Shop towel
- c** - Belt working off of the crankshaft pulley

5. Remove the stretch-belt from the engine and discard.
IMPORTANT: The power-assisted steering pump stretch-belt is not reusable and must be replaced once removed.

Installation

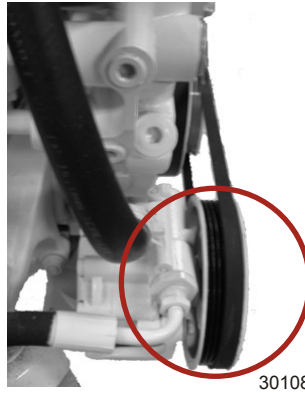
The replacement power-assisted steering pump belt is supplied with an installation tool.

1. Attach a suitable tool to the crankshaft pulley bolt.

IMPORTANT: Do not rotate the crankshaft in a counterclockwise direction. Counterclockwise engine rotation will damage the seawater pump impeller and could affect crankshaft pulley torque.

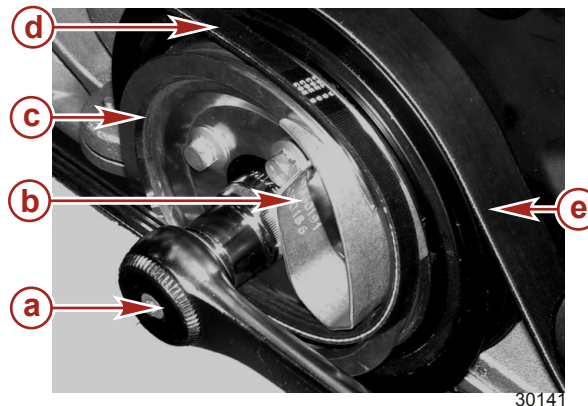
2. Position the new stretch-belt onto the power-assisted steering pump pulley so that it is aligned in the first three grooves of the pulley.

NOTE: The three rear grooves of the power-assisted steering pump pulley should be exposed. Failure to properly align the belt during installation will result in premature belt wear and failure.



Belt alignment

3. Position the stretch-belt installation tool on the top of the crankshaft pulley.
4. Place the belt over the stretch-belt installation tool.



Belt and tool position

- a** - Drive and socket
- b** - Stretch-belt installation tool
- c** - Crankshaft pulley
- d** - Stretch-belt
- e** - Serpentine drive belt

5. Rotate the tool clockwise 360°, allowing the tool to guide the belt on to the pulley.
6. Confirm that the belt is aligned in all of the grooves of the crankshaft pulley and the first three grooves of the power-assisted steering pump pulley.
7. If necessary, continue to rotate the crankshaft pulley in a clockwise direction while providing hand pressure to guide the belt.
8. Reconnect the battery cables.

Serpentine Belt

Inspection

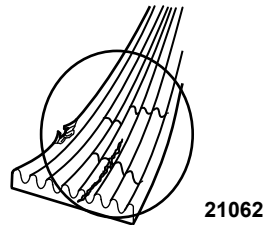
NOTE: The 2.0 diesel engine with a sterndrive is equipped with a stretch-belt that is used to drive the power-assisted steering pump. This belt must be removed to service the serpentine belt. Stretch-belt service and maintenance procedures differ significantly from those that apply to standard accessory drive belts. Refer to **Power-Assisted Steering Pump Belt**.

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

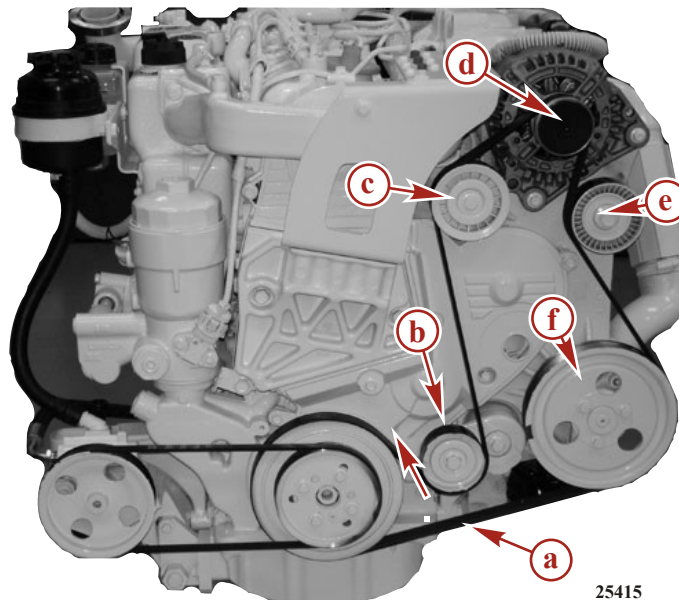
- Excessive wear
- Cracks

NOTE: Minor, transverse cracks (across the belt width) may be acceptable. Longitudinal cracks (in 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 | d - Alternator |
| b - Automatic tensioner | e - Idler pulley |
| c - 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 Diesel Authorized Repair Facility for all of your repair needs.

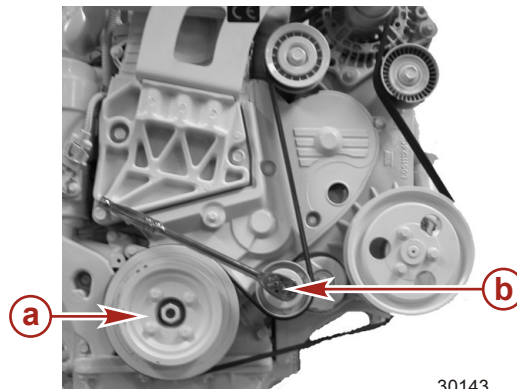
Adjustment

The serpentine belt cannot be adjusted. The automatic tensioner pulley maintains belt tension. Automatic tensioner failure may cause noisy operation and premature serpentine belt wear. If the belt becomes loose, worn, or noisy and the automatic tensioner is functioning properly then the belt must be replaced.

Removal

IMPORTANT: Do not turn the seawater pump pulley counterclockwise while performing this service. Reverse rotation of the seawater pump may damage the pump's impeller.

1. Disconnect both battery cables.
2. Remove the power-assisted steering pump belt. See **Power-Assisted Steering Pump Belt—Removal**.
3. Position a suitable tool on the automatic tensioner pulley bolt.



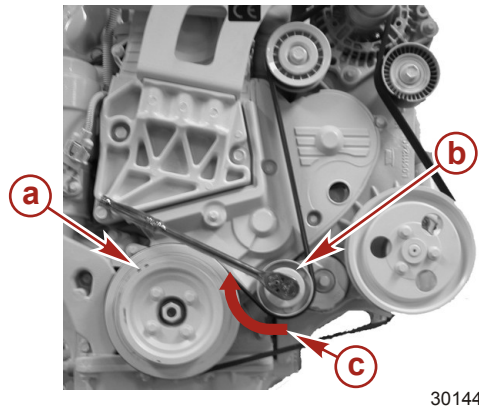
Drive and socket positioned on tensioner pulley bolt

a - Crankshaft pulley

b - Socket on tensioner pulley bolt

NOTE: If the serpentine belt will be reused note the direction of rotation and mark the belt so that it can be reinstalled in its original orientation.

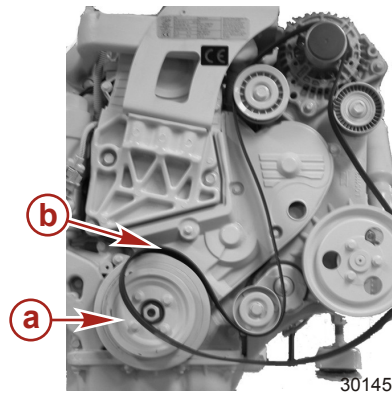
4. Rotate the automatic tensioner clockwise removing tension from the serpentine belt.



Tensioner rotation

- a** - Crankshaft pulley
- b** - Tensioner pulley
- c** - Tensioner rotation

5. Remove the serpentine belt from the crankshaft pulley.



Serpentine belt removal

- a** - Crankshaft pulley
- b** - Loose belt

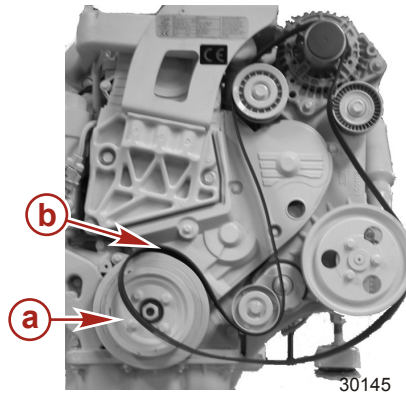
6. Release the tensioner and remove the drive and socket from the tensioner pulley bolt.
7. Remove the serpentine belt from the remainder of the accessory drive pulleys.
8. Inspect the serpentine belt for damage or wear and replace if necessary.

Installation

NOTE: Reinstall the serpentine belt in its original orientation, so that it rotates in the same direction as when previously installed.

1. Working in a clockwise direction, route the serpentine belt over the grooved idler pulley, the alternator pulley, and the inside of the smooth idler pulley. Pull the belt through enough to remove any slack between the top three accessory drive pulleys.
2. Route the belt around the outside of the seawater pump pulley.

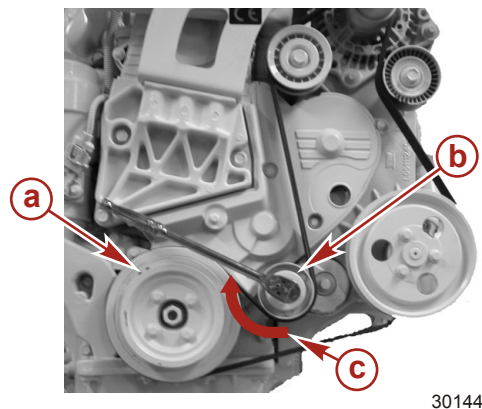
3. Route the middle portion of the belt beneath the smooth pulley of the automatic tensioner.



Serpentine belt installation

- a** - Crankshaft pulley
- b** - Loose belt

4. Position a suitable tool on the automatic tensioner pulley bolt.
5. Rotate the automatic tensioner clockwise

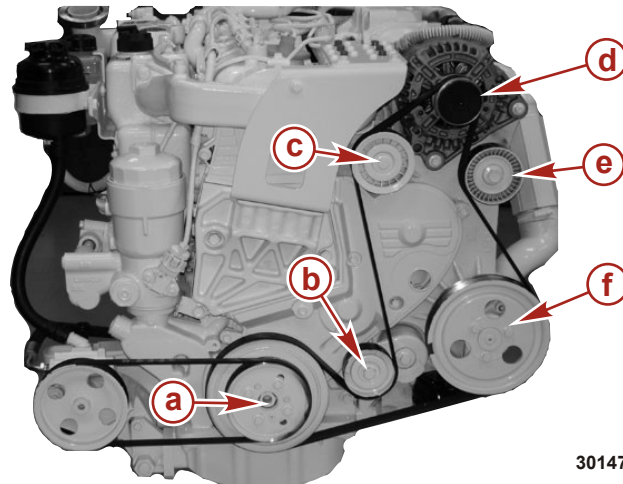


Tensioner rotation

- a** - Crankshaft pulley
- b** - Tensioner pulley
- c** - Tensioner rotation

6. Route the belt around the crankshaft pulley starting at the top and working around to the bottom.
7. Release the automatic tensioner.

8. Inspect the belt installation to confirm that the belt is properly aligned with all grooves and pulleys.



Serpentine belt routing

- | | |
|--------------------------------|----------------------------------|
| a - Crankshaft pulley | d - Alternator |
| b - Automatic tensioner | e - Idler pulley |
| c - Idler pulley | f - Sea water pump pulley |

9. Install a new power-assisted steering pump belt. See **Power-Assisted Steering Pump Belt—Installation**.

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 cold weather. 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 cold weather.

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 Instructions

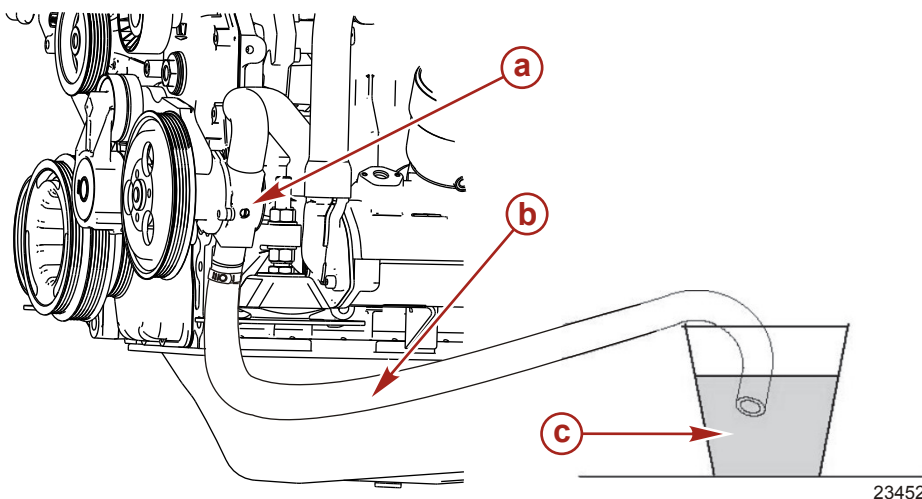
1. Observe all precautions and perform all procedures found in **Preparing Your Power Package for Seasonal or Extended Storage**.
2. Observe all precautions and perform all procedures found in **Draining the Seawater System** and drain the seawater section of the cooling system.

NOTICE

Water trapped in the seawater section of the cooling system can cause corrosion or freeze damage. Drain the seawater section of the cooling system immediately after operation or before any length of storage in cold weather. 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.

IMPORTANT: Cummins MerCruiser Diesel recommends 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 necessary, temporarily connect a hose of appropriate length to the 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 laws and guidelines.

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 required areas 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.

10. **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.