

Electrical System

Section 4B - Charging System

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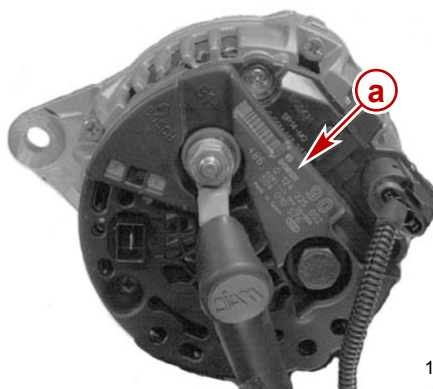
Alternator Specifications

Alternator - Bosch			
Identification number		0 124 325 052	
Current output (alternator RPM)	1800 RPM	50 amperes	
	6000 RPM	90 amperes	
Voltage set point		14 volts	
Drive belt tension		Automatic tensioning	

Lubricant, Sealant, Adhesives

Tube Ref No.	Description	Where Used	Part No.
 25	Liquid Neoprene	Exposed electrical terminals and connections	92- 25711 3
 95	2-4-C with Teflon	Battery terminal bolts	92-802859A 1

Alternator Identification



a - Identification number location on alternator

⚠ 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).

Wire Color Code Abbreviations

Wire Color Abbreviations				
BLK	Black		BLU	Blue
BRN	Brown		GRY	Gray
GRN	Green		ORN or ORG	Orange
PNK	Pink		PPL or PUR	Purple
RED	Red		TAN	Tan
WHT	White		YEL	Yellow
LT or LIT	Light		DK or DRK	Dark

Battery Precautions

WARNING

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

When charging batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through holes in vent plugs and may form an explosive atmosphere around battery if ventilation is poor. This explosive gas may remain in or around battery for several hours after it has been charged. Sparks or flames can ignite this gas and cause an internal explosion which may shatter the battery.

The following precautions should be observed to prevent an explosion:

1. Do not smoke near batteries being charged or which have been charged very recently.
2. Do not break live circuits at terminals of batteries because a spark usually occurs at the point where a live circuit is broken. Always be careful when connecting or disconnecting cable clamps on chargers. Poor connections are a common cause of electrical arcs which cause explosions.
3. Do not reverse polarity of battery terminal to cable connections.

Charging a Discharged Battery

WARNING

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

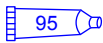
The following basic rules apply to any battery charging situation:

1. Any battery may be charged at any rate (in amperes) or as long as spewing of electrolyte (from violent gassing) does not occur and for as long as electrolyte temperature does not exceed 52 °C (125 °F). If spewing of electrolyte occurs, or if electrolyte temperature exceeds 52 °C (125 °F), charging rate (in amperes) must be reduced or temporarily halted to avoid damage to the battery.
2. Battery is fully charged when, over a 2 hour period at a low charging rate (in amperes), all cells are gassing freely (not spewing liquid electrolyte), and no change in specific gravity occurs. Full charge specific gravity is 1.260 - 1.275, corrected for electrolyte temperature with electrolyte level at 4.8 mm (3/16 in.) over plate, unless electrolyte loss has occurred (from age or overfilling) in which case specific gravity reading will be lower. For most satisfactory charging, lower charging rates in amperes are recommended.
3. If, after prolonged charging, specific gravity of at least 1.230 on all cells cannot be reached, battery is not in optimum condition and will not provide optimum performance; however, it may continue to provide additional service, if it has performed satisfactorily in the past.
4. To check battery voltage while cranking engine with electric starting motor at ambient air temperature of 23.8 °C (75 °F), place red (+) lead of tester on positive (+) battery terminal and black (–) lead of tester on negative (–) battery terminal. If the voltage drops below 10-1/2 volts while cranking, the battery is weak and should be recharged or replaced.

Winter Storage of Batteries

Battery companies are not responsible for battery damage either in winter storage or in dealer stock if the following instructions are not observed:

1. Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface by running water over top of battery. Be sure, however, that vent caps are tight beforehand and blow off all excess water thoroughly with compressed air. Check water level, making sure that plates are covered.
2. When adding distilled water to battery, be extremely careful not to fill more than 4.8 mm (3/16 in.) above perforated baffles inside battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling battery will cause electrolyte to overflow (if filled beyond 4.8 mm [3/16 in.] above baffles).
3. Grease terminal bolts well with 2-4-C with Teflon and store battery in a cool-dry place. Remove battery from storage every 30 - 45 days, check water level and put on charge for 5 or 6 amperes. Do not fast charge.

Tube Ref No.	Description	Where Used	Part No.
 95	2-4-C with Teflon	Battery terminal bolts	92-802859A 1

4. If specific gravity drops below 1.240, check battery for reason and recharge. When gravity reaches 1.260, discontinue charging. To check specific gravity, use a hydrometer, which can be purchased locally.
5. Repeat preceding charging procedure every 30 - 45 days, as long as battery is in storage, for best possible maintenance during inactive periods to ensure a good serviceable battery in spring. When ready to place battery back in service, remove excess grease from terminals (a small amount is desirable on terminals at all times), recharge again as necessary and reinstall battery.

Charging System Precautions

The following precautions must be observed when working on the charging system. Failure to observe these precautions may result in serious damage to the alternator or charging system.

1. Do not attempt to polarize the alternator.
2. Do not short across or ground any of the terminals on the alternator, except as specifically instructed in the **Troubleshooting Tests**.
3. Never disconnect the alternator output lead or battery cables when the alternator is operating.
4. Never disconnect the regulator lead from the alternator regulator terminal when the alternator is operating.
5. Always remove the negative (-) battery cable from the battery before working on the charging system.
6. When installing the battery, be sure to connect the positive (+) battery cable to the positive (+) battery terminal and the negative (-) (grounded) battery cable to the negative (-) battery terminal.
7. If a charger or booster battery is to be used, be sure to connect it in parallel with the existing battery (positive to positive; negative to negative).

Battery Isolators

⚠ WARNING

Improper design and installation of the electrical system can result in serious injury or death. Adhere to all applicable marine regulations (United States Coast Guard [USCG], European Union–Recreational Craft Directive [EU-RCD], etc.) and the standards they reference (American Boat and Yacht Council [ABYC], Society of Automotive Engineers [SAE], International Standards Organization [ISO], etc.) for the market in which the boat will be sold.

A battery isolator can be installed to allow the charging of an auxiliary battery for use in operating accessories. The battery isolator will allow the alternator to charge both the cranking battery and auxiliary battery at the same time, while preventing accessories connected to the auxiliary battery from discharging the cranking battery.

The alternators used on Cummins MerCruiser Diesel products are equipped with a special external sensing circuit to ensure optimum charging performance in these types of applications by compensating for the voltage drop across the isolator. The manufacturer's instructions should be carefully followed when making the installation.

IMPORTANT: Cummins MerCruiser Diesel cannot be responsible for problems resulting from the installation of the isolator. The installer and the isolator manufacturer must ensure that the installation and any modifications to the Cummins MerCruiser Diesel product comply with all applicable standards/regulations, including (but not limited to) wire size, type, routing, terminals, overcurrent protection).

A special isolator is required for multiple-engine installations where the cranking batteries are to be charged from a common source.

Refer to the appropriate Cummins MerCruiser Diesel Product Applications Manual.

Alternator Description

The alternator employs a rotor that is supported in two end frames by ball bearings, and is belt-driven by the engine. The rotor contains a field winding enclosed between two multiple-finger pole pieces. The ends of the field winding are connected to two brushes which make continuous sliding contact with the slip rings. The current flowing through the field winding creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

The 3-phase stator is mounted directly over the rotor pole pieces and between the two end frames. It consists of three windings wound 120° electrically out of phase on the inside of a laminated core.

The rectifier bridge contains six diodes, allowing current to flow from ground through the stator and to the output terminal, but not in the opposite direction.

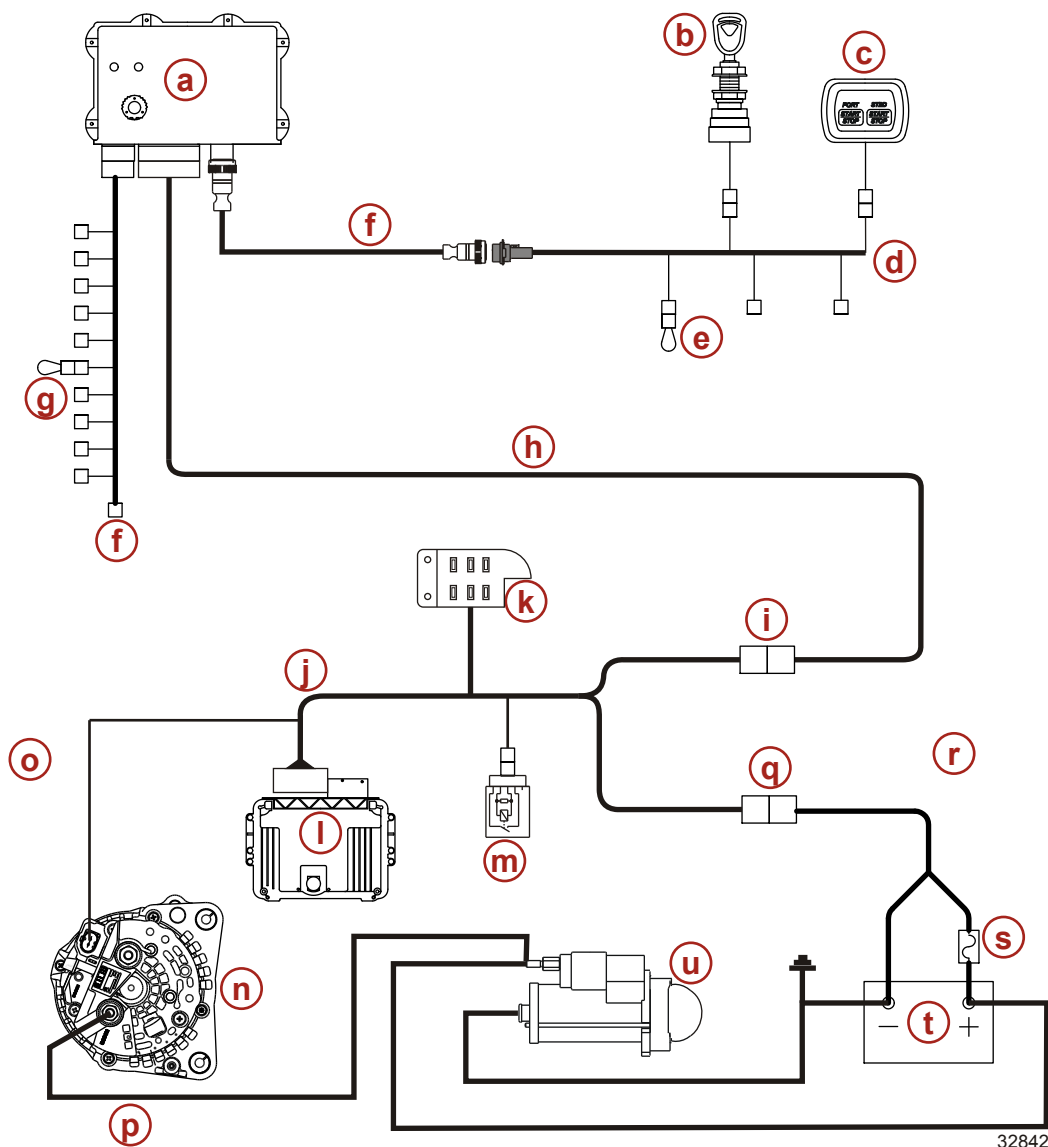
When current is supplied to the rotor field winding and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge changes this alternating current to direct current, which appears at the output terminal. The diode trio is connected to the stator windings to supply current to the regulator and the rotor field during operation.

Voltage output of the alternator is controlled by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is limited by the design of the alternator. When the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator is not required, because the rectifier diodes prevent the battery from discharging back through the stator.

A small amount of current is supplied by the excitation circuit in the regulator to the rotor field to start the alternator charging. After the alternator has begun to produce output, field current is supplied solely by the diode trio.

The alternator is equipped with two fans that induce air flow through the alternator to remove heat created by the rectifier and stator.

Alternator System Components



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- | | |
|--|---|
| a - Vessel interface panel (VIP) | l - ECM |
| b - Key switch | m - Main relay |
| c - Start stop button panel | n - Alternator |
| d - Main station helm harness | o - Alternator excitation wire |
| e - Halon breakout | p - Alternator output cable |
| f - Helm extension harness | q - Engine power harness connector |
| g - Vessel sensor harness | r - Power harness |
| h - Engine to VIP harness | s - 30-amp fuse |
| i - Engine to VIP harness engine connection | t - Battery |
| j - Engine interface harness "K" | u - Starter |
| k - Circuit breaker panel | |

IMPORTANT: The key switch that powers the alternator excitation circuit depends on the halon breakout connections. If a halon breakout connection is broken the alternator excitation circuit will not function.

Periodic Maintenance

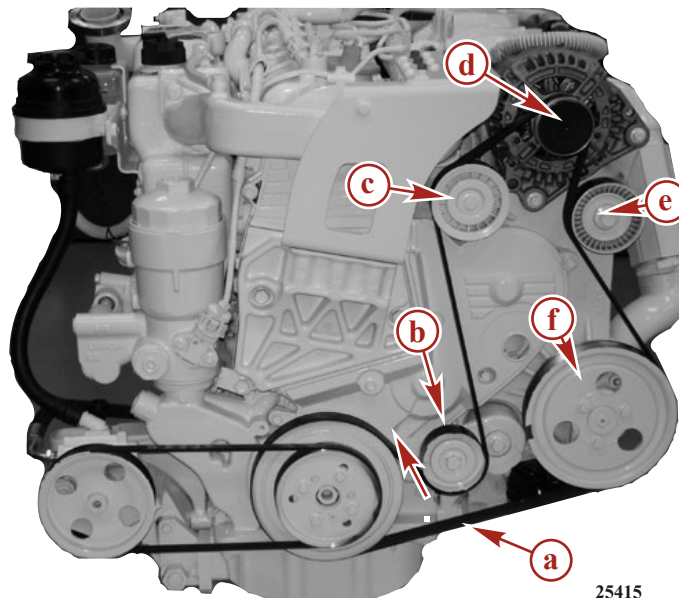
⚠ WARNING

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.

1. Disconnect both battery cables.
2. Inspect the entire alternator system for corroded or loose connectors.
3. Check the wiring for frayed or worn insulation.
4. Check the alternator drive belt for excessive wear, cracks, fraying and glazed surfaces.
5. Check the drive belt tension and adjust, if necessary.
6. Check the alternator mounting bolts for adequate torque.

Drive Belt Tension Adjustment

- An automatic tensioner maintains proper belt tension.



a - Serpentine belt
b - Automatic tensioner
c - Idler pulley

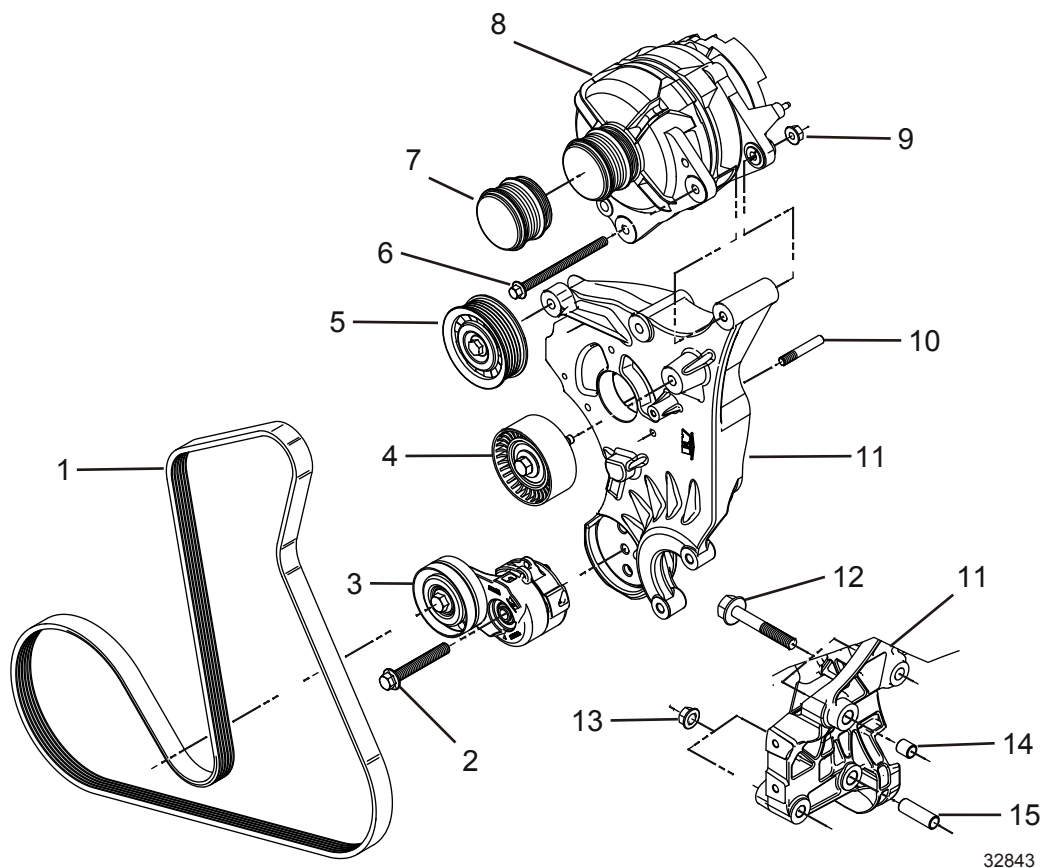
d - Alternator
e - Idler pulley
f - Sea water pump pulley

Troubleshooting

For additional diagnostic procedures see **Section 1C: Troubleshooting**.

Notes:

Exploded View, Alternator



Exploded View, Alternator

Ref. No.	Qty.	Description	Torque		
			Nm	lb-in.	lb-ft
1	1	Serpentine belt			
2	1	Belt tensioner screw	47.1	–	35
3	1	Belt tensioner			
4	1	Idler pulley assembly (smooth)	47.1	–	35
5	1	Idler pulley assembly (grooved)	47.1	–	35
6	2	Alternator mounting bolt			
7	1	Alternator pulley			
8	1	Alternator			
9	2	Alternator mounting bolt nut	24.5	–	18
10	3	Stud	24.5	–	18
11	1	Alternator bracket			
12	2	Alternator bracket screws	47.1	–	35
13	2	Alternator bracket nut	47.1	–	35
14	1	Pin, taper			
15	1	Pin, taper			

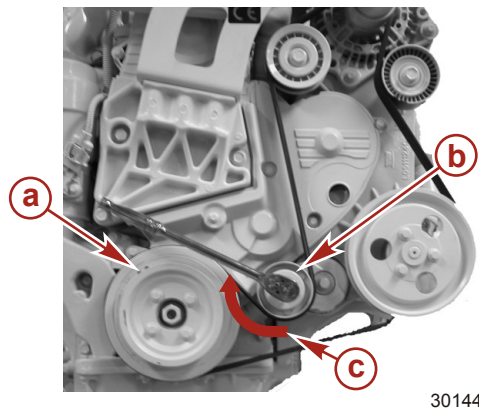
Alternator Removal

⚠ 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.

NOTE: The alternator mounting hardware and electrical connections can be difficult to access. Remove the seawater hose between the oil and fuel coolers if necessary to gain access to the mounting hardware and electrical connections. Refer to **Section 6A** for information on removing the seawater hose.

1. Disconnect both battery cables from the battery.
2. Position a suitable tool in the tensioner release slot and rotate the tensioner pulley to relieve serpentine belt tension. Refer to **Section 1B: Serpentine Belt Removal**.

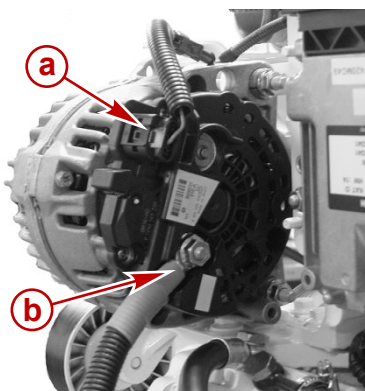


Tensioner rotation

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

3. Remove the serpentine belt.
4. Slowly release the tensioner returning it to the original position.
5. Remove the protective rubber boot, if equipped, from the alternator output lead.
6. Disconnect the output lead.

7. Disconnect the excitation circuit 2-pin connector.

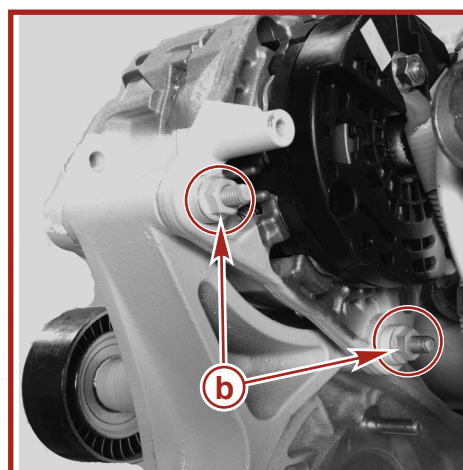
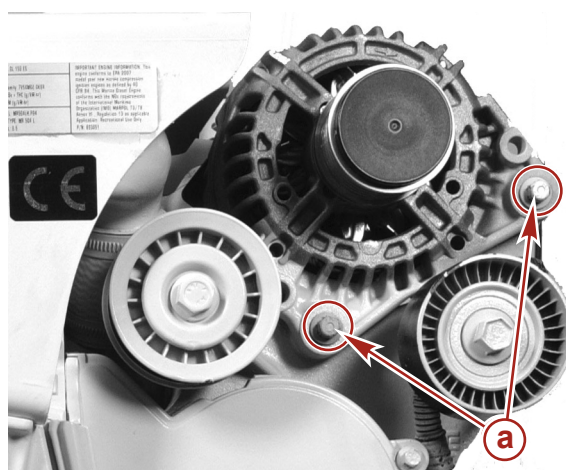


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Seawater hose removed for visual clarity

- a** - 2-pin connector
- b** - Output lead

8. Remove the upper and lower alternator mounting bolts, flange nuts, and washers.



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Seawater hose removed for visual clarity

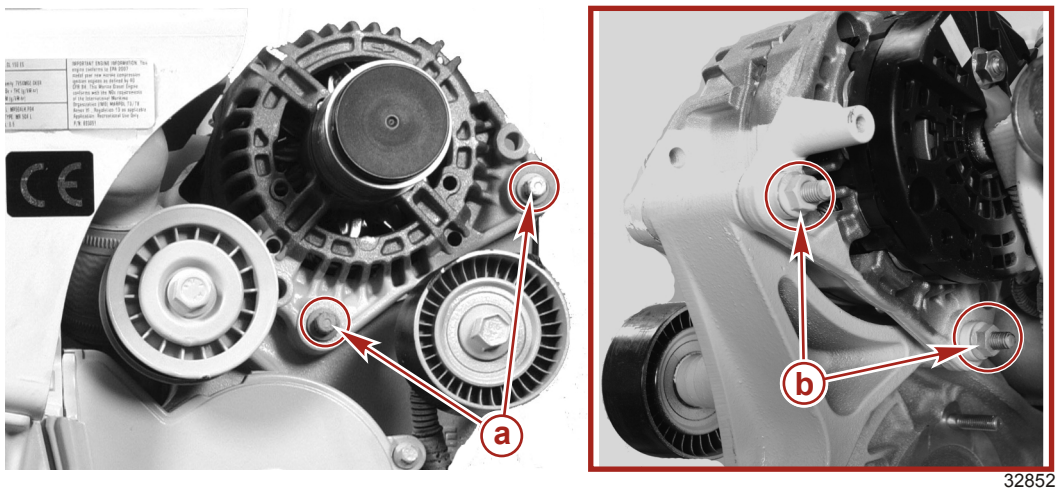
- a** - Mounting bolt
- b** - Flange nut and washer

9. Remove the alternator.

Alternator Installation

1. Position the alternator in the mounting bracket.

2. Install and tighten the alternator mounting bolts, washers and flange nuts.



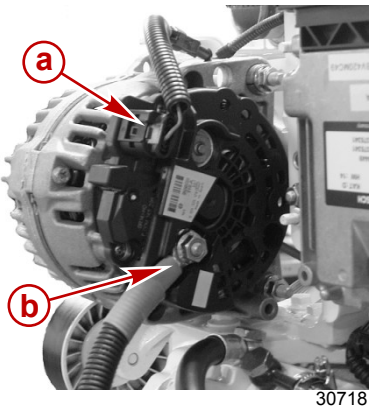
Seawater hose removed for visual clarity

- a - Mounting bolt
- b - Flange nut and washer

3. Tighten the alternator mounting bolts to the specification.

Description	Nm	lb-in.	lb-ft
Alternator mounting bolt	47.1	–	35

4. Connect the output lead. Ensure the output lead (positive [+] cable) is positioned as shown.



Seawater hose removed for visual clarity

- a - 2-pin connector
- b - Output lead

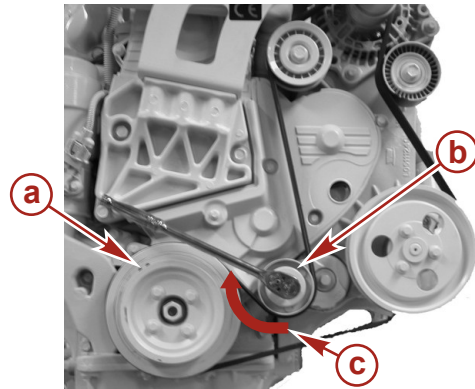
5. Connect the excitation circuit 2-pin connector to the alternator.
6. Tighten the output lead nut to specification.

Description	Nm	lb-in.	lb-ft
Output lead nut	15	132	–

7. Apply sealant to any exposed electrical terminals and connections.

Tube Ref No.	Description	Where Used	Part No.
 25	Liquid Neoprene	Exposed electrical terminals and connections	92- 25711 3

8. When the sealant is dry, install the protective rubber boot, if equipped, over the output lead.
9. Position a suitable tool in the tensioner release slot and rotate the tensioner pulley in the direction of the arrow.



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Tensioner rotation

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

10. Install the serpentine belt. Refer to **Section 1B—Serpentine Belt Installation**.
11. Slowly release the tensioner returning it to the original position.
12. Connect the battery cables.

Notes: