Chapter Thirteen

Electrical Systems

This chapter provides service procedures for the battery, charging system, starting system, ignition system and switches. Wiring diagrams are included at the end of the book. **Tables 1-4** are at the end of the chapter.

BATTERY

Since batteries used in marine applications endure far more rigorous treatment than those used in an automotive charging system, they are constructed differently. Marine batteries have a thicker exterior case to cushion the plates inside during tight turns and rough weather. Thicker plates are also used, with each one individually fastened within the case to prevent premature failure. Spill-proof caps on the battery cells prevent electrolyte from spilling into the bilges. Automotive batteries should *only* be used in an emergency situation when a suitable marine battery is not available.

To assure sufficient cranking power, Mercury Marine recommends the use of a 12-volt marine battery with a minimum cold cranking amperage of:

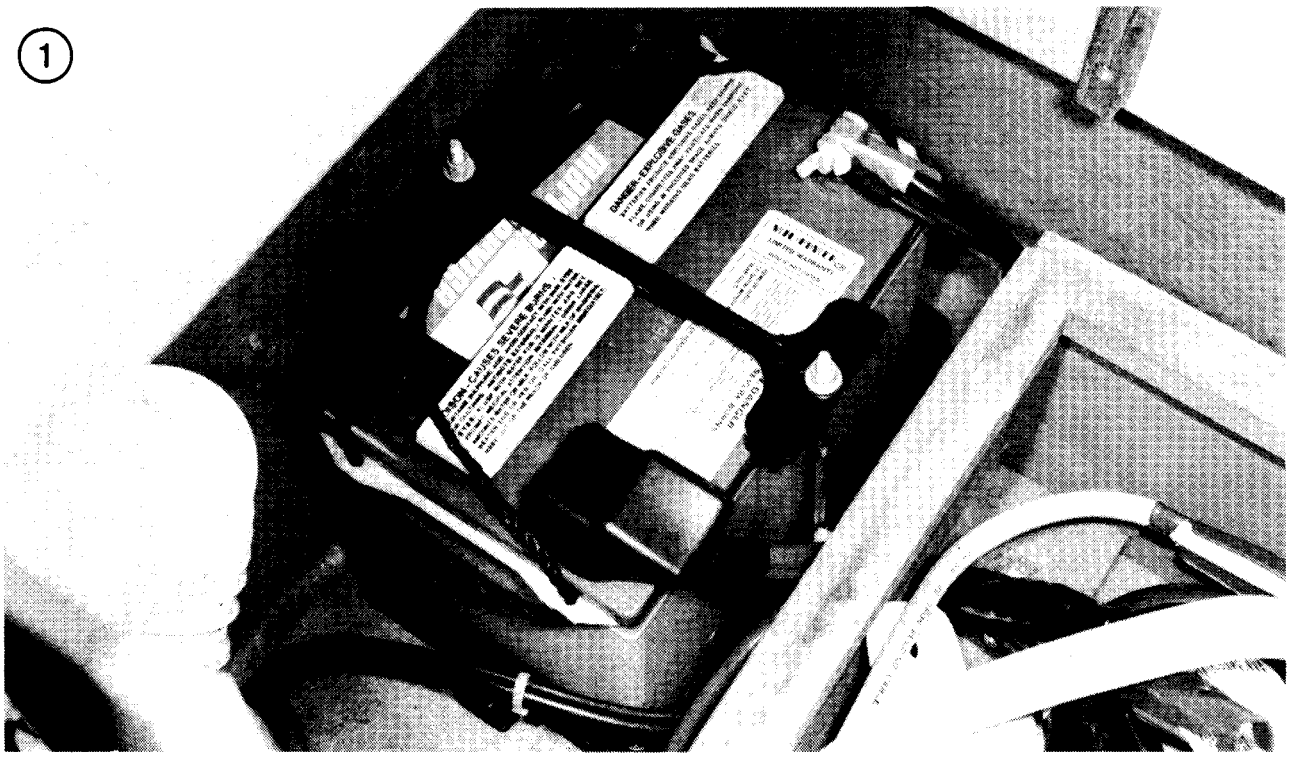
a. 2 amps per cu. in. displacement for 4-cylinder engines.
b. 1 1/2 amps per cu. in. displacement for 6-cylinder engines.
c. 1 amp per cu. in. displacement for 8-cylinder engines.

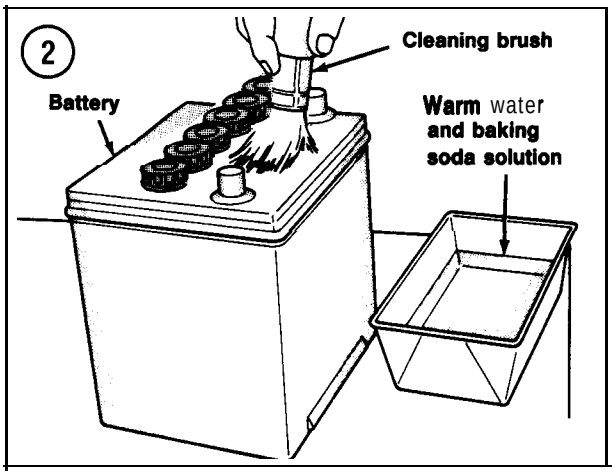
The battery used should also have a reserve capacity rating of at least 100 minutes. **Table 1** provides the suggested cold cranking amperage for current MerCruiser engines. For engines not included in **Table 1,** refer to the recommended specifications provided above to calculate the minimum cold cranking amperage requirement.

NOTE

A "Deep Cycle" battery may not be suitable for use with MerCruiser engines. Such batteries are designed to charge and discharge at moderate current levels. If the battery does not have a cold cranking amperage rating, it should not be used.

A good state of charge should be maintained in the battery. Any battery that cannot deliver at least 9.6 volts under a starting load should be recharged. If recharging does not bring it up to strength or if it does not hold the charge, replace the battery.





Care and Inspection

1. Disconnect both battery cables and remove the battery hold-down clamp. **See Figure 1** for a typical installation.

NOTE

Some batteries have a carry strap built-in for use in Step 2.

2. Attach a battery carry strap to the terminal posts. Remove the battery from the battery tray.

3. Check the entire battery case for cracks.

4. Inspect the battery tray or container for corrosion and clean if necessary with a solution of baking soda and water.

NOTE

Keep cleaning solution out of the battery cells in Step 5 or the electrolyte will be seriously weakened.

5. Clean the top of the battery with a stiff bristle brush using the baking soda and water solution **(Figure 2).** Rinse the battery case with clear water and wipe dry with a clean cloth or paper towel.

6. Position the battery on the battery tray and install the hold-down clamp. Tighten the clamp bolt snugly.

7. Clean the battery cable clamps with a stiff wire brush or one of the many tools made for this purpose **(Figure 3).** The same tool is used for cleaning the battery posts. See **Figure 4.**

8. Reconnect the positive battery cable, then the negative cable.

CA UTION

Be sure the battery cables are connected to their proper terminals. Connecting the battery backwards will reverse the polarity and damage the alternator.

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9. Tighten the battery connections and coat with a petroleum jelly such as Vaseline or a light mineral grease.

NOTE

Do not overfill the battery cells in Step 10. The electrolyte expands due to heat from charging and will overflow if the level is more than 3/16 in. above the battery plates.

10. Remove the filler caps and check the electrolyte level. Add distilled water, if necessary, to bring the level up to 3/16 in. above the plates in the battery case.

Testing

Hydrometer testing is the best way to check battery condition. Use a hydrometer with numbered graduations from 1.100 to 1.300 rather than one with just color-coded bands. To use the hydrometer, squeeze the rubber ball, insert the tip in a cell and release the ball **(Figure 5).**

NOTE

Do not attempt to test a battery with a hydrometer immediately after adding water to the cells. Run the engine or charge the batteryfor 15-20 minutes to allow the water and electrolyte to mix thoroughly.

Draw enough electrolyte to float the weighted float inside the hydrometer. Note the number in line with the surface of the electrolyte. This is the specific gravity for the cell. Return the electrolyte to the cell from which it came.

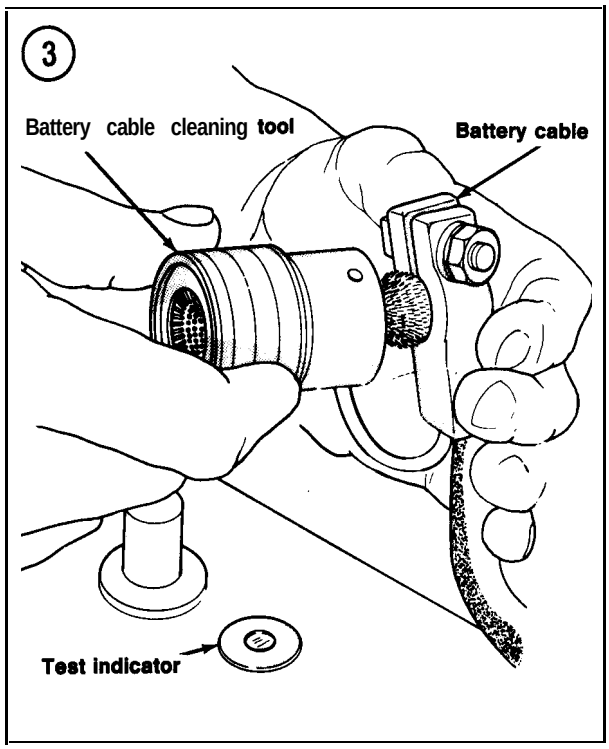
The specific gravity of the electrolyte in each battery cell is an excellent indicator of that cell's condition. A fully charged cell will read 1.275 or more at 68" F (20' C). A cell in good condition may read from 1.250-1.280 while one in fair condition reads from 1.225-1.250. If the cell tests below 1.225, the battery must be recharged. Charging is also necessary if the specific gravity varies more than 0.050 from cell to cell.

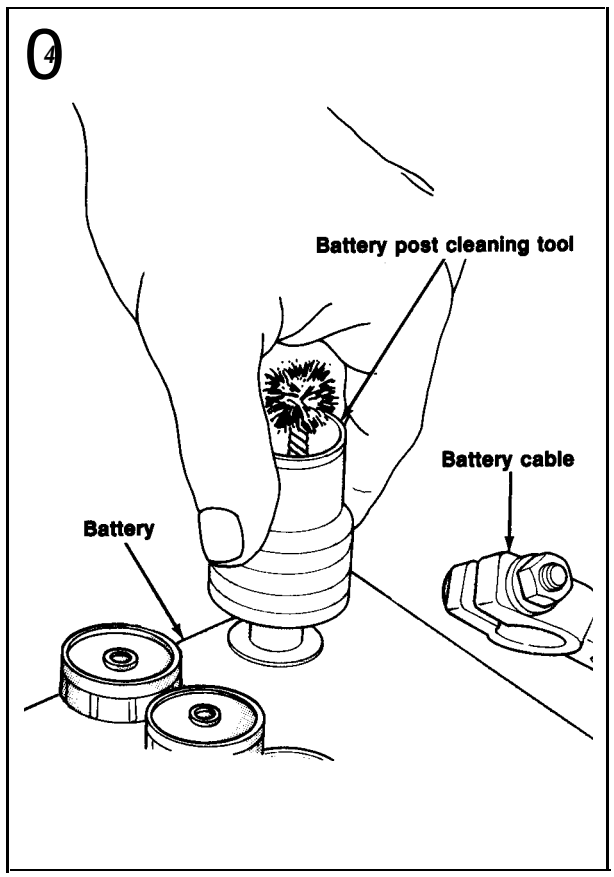
NOTE

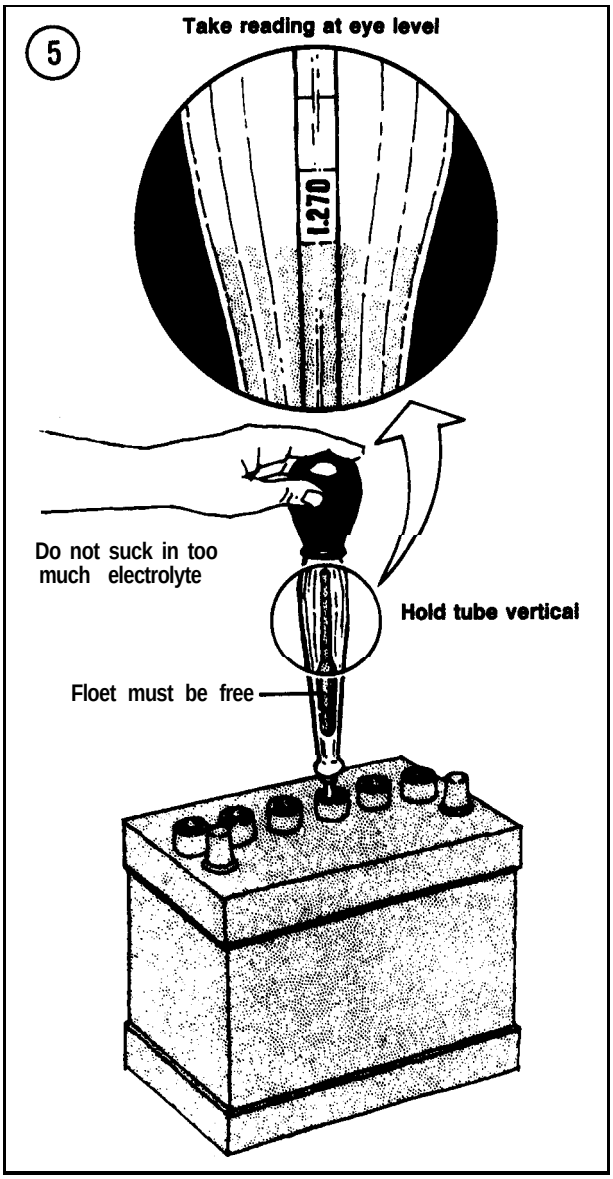
If a temperature-compensated hydrometer is not used, add 0.004 to the specific gravity reading for every 10° above 80' F (25' C). For every 10° below 80' F (25' C), subtract 0.004.

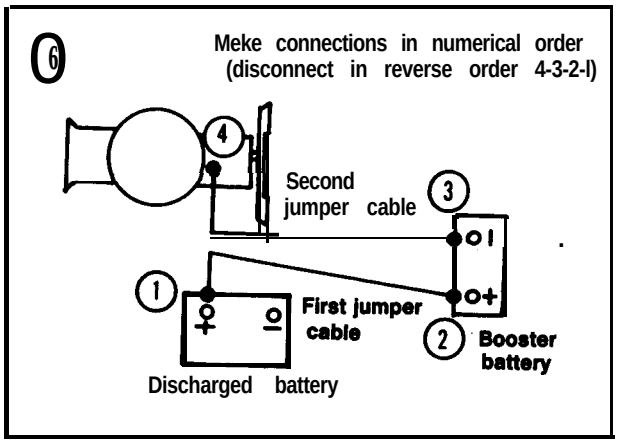
Charging

The battery does not have to be removed from the boat for charging, but it is a recommended









procedure. In many boats, the area around the battery is not well ventilated. Since a charging battery gives off highly explosive hydrogen gas, sparks or flames occurring near the battery can cause it to explode, spraying battery acid over a wide area.

Disconnect the negative battery cable first, then the positive cable. Make sure the electrolyte is fully topped up.

Connect the charger to the battery-negative to negative, positive to positive. If the charger output is variable, select a 4 amp setting. Set the voltage regulator to 12 volts and plug the charger in. If the battery is severely discharged, allow it to charge for at least 8 hours. Batteries that are not as badly discharged require less charging time. **Table 2** gives approximate charge rates. Check charging progress with the hydrometer.

Jump Starting

If the battery becomes severely discharged, it is possible to start and run an engine by jump starting it from another battery. If the proper procedure is not followed, however, jump starting can be dangerous. Check the electrolyte level before jump starting any battery. If it is not visible or if the electrolyte appears to be frozen, do not attempt to jump start the battery.

WARNING

Use extreme caution when connecting a booster battery to one that is discharged to avoid personal injury or damage to the system.

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1. Connect the jumper cables in the order and sequence shown in **Figure 6.**

WARNING

An electrical arc may occur when the final connection is made. This could cause an explosion if it occurs near the battery. For this reason, the final connection should be made to the alternator mounting bracket and not to the battery itself.

2. Check that all jumper cables are out of the way of moving engine parts.

3. Start the engine. Once it starts, run it at a moderate speed.

CAUTION

Racing the engine may cause damage to the electrical system.

4. Remove the jumper cables in the exact reverse order shown in **Figure** 6. Remove the cable at point 4, then 3, 2 and 1.

CHARGING SYSTEM

The charging system consists of the battery, alternator, voltage regulator, charge indicator light or gauge and wiring. A variety of systems have been used on MerCruiser installations during the years covered by this manual.

This section includes in-boat testing and replacement of the alternator and regulator. Complete alternator overhaul is not practical for the amateur mechanic. Rebuilt alternators can be purchased quite inexpensively compared to the time and effort involved in disassembly, testing, repair and assembly. In some cases, such overhaul is not even possible since components are not available.

DIRECT DRIVE ALTERNATOR CHARGING SYSTEM

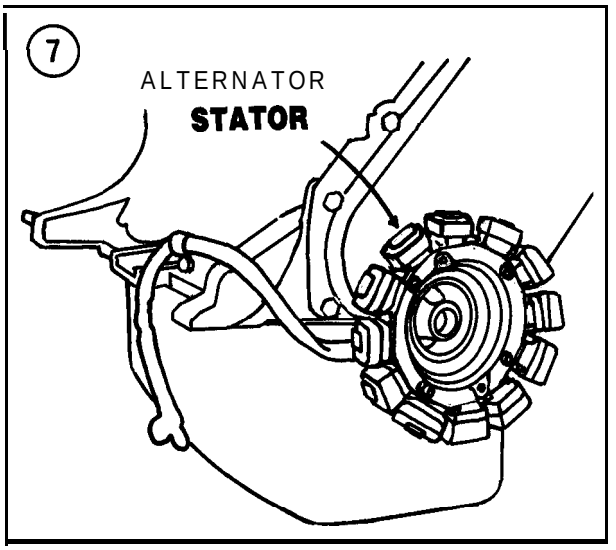
The direct drive alternator charging system is used on the MerCruiser 60, 80, 90, 470, 485 and 488 models. This system is nearly maintenance-free, since it has no brushes, pulleys, belts or bearings. The stator windings are installed on a laminated core attached to a flywheel cover/housing (Model 80, 90,470, 485 and 488) or alternator flywheel (Model **60). Figure 7** shows the Model 60. Permanent magnets installed in the flywheel rotate around the stationary stator to produce alternating current. A remote diode rectifier changes the alternating current to direct current.

To prevent voltage regulator damage from excessive resistance, the ammeter circuit has been eliminated from the wiring harness on MerCruiser 470 and 485 engines. All engines with serial No. 5847335 and above (470) or serial No. 5813434 and above (485) now use a voltmeter circuit. Earlier 470 and 485 engines experiencing premature regulator failure can be converted from an ammeter to a voltmeter circuit with a voltage regulator kit (part No. 99502A8).

System Output Test (Models 60, 80 and 90)

Model 60

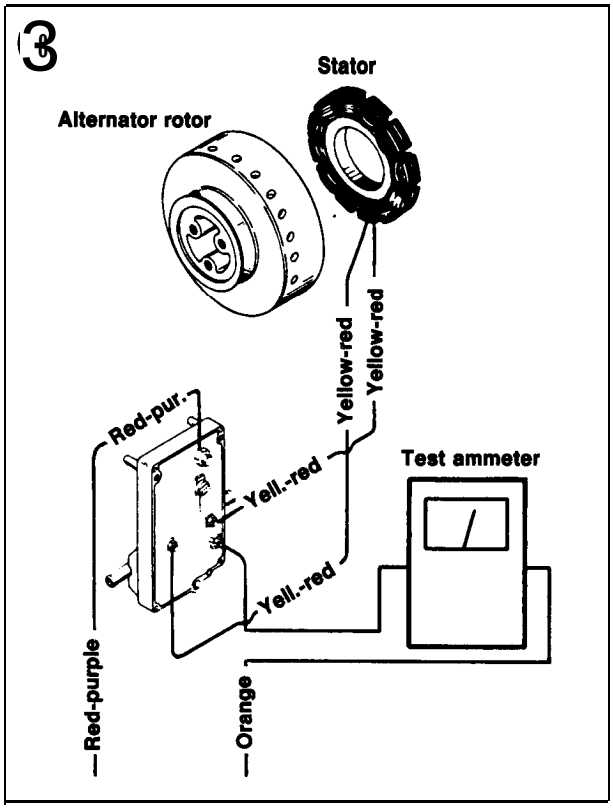
1. Disconnect the coil secondary lead from the center tower of the distributor cap. Ground the lead to the engine block with a jumper wire.

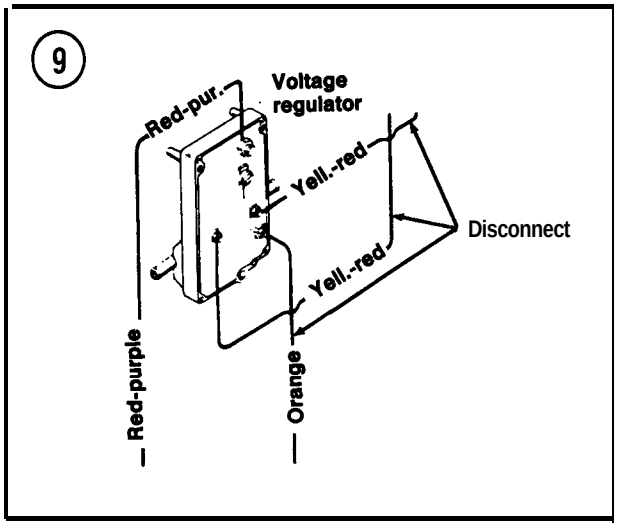


2. Disconnect the red wire at the rectifier and connect an ammeter in series with the red wire and its rectifier terminal.
3. Crank the engine for 10- 15 seconds to remove any surface charge on the battery.
4. Reconnect the coil secondary lead to the distributor cap tower.
5. Connect a tachometer to the engine according to manufacturer's instructions.
6. Start the engine and run at part throttle (3,000 rpm). Ammeter scale should read 11 amps or more.
7. If ammeter reading is less than 11 amps, have the system components tested by a dealer to determine which one is defective.

Models 80 and 90

1. Disconnect the blue stator wire from the blue voltage regulator lead.
2. Remove the red/white wire at the rectifier and connect an ammeter between the wire and rectifier terminal.
3. Connect a tachometer to the engine according to manufacturer's instructions.
4. Start engine and run at part throttle (3,000 rpm). Ammeter scale should read 18-25 amps.
5. If ammeter reading is within specifications but an undercharged battery is the symptom, check regulator wiring. If wiring is satisfactory, replace the regulator.
6. If ammeter reading is not within specifications, test rectifier as described in this chapter. If rectifier is good, have the stator resistance checked by a dealer.





MERCRUISER 470 ALTERNATOR CHARGING SYSTEM (AIR-COOLED REGULATOR)

1. Disconnect the negative battery cable, then the positive battery cable.
2. Disconnect the stator wires at the rectifier and terminal block.
3. Connect an ohmmeter between the 2 yellow/red stator wires. The ohmmeter should read about 1/4 ohm.

4A. 3-stator wire system-Connect the ohmmeter between the white/black wire and either yellow/red wire. The ohmmeter should read about 2.6 ohms.

4B. 4-stator wire system-Connect the ohmmeter between the 2 white/black wires. Meter should read 2-6 ohms.

5. Check for continuity between the stator wires and ground. If there is continuity, replace the stator. See Chapter Ten.

NOTE

The regulator is an enclosed unit and can only be tested for continuity as described in Step 6. If all other testing does not locate the source of the problem, replace the regulator.

6. Disconnect regulator leads. Check for continuity between the leads and between each lead and the regulator base with an ohmmeter. Replace the regulator if continuity is found.

MERCRUISER 470, 485 AND 488 (WATER-COOLED REGULATOR)

Constant High Output Test

1. Disconnect the negative battery cable.
2. Connect a tachometer to the engine according to manufacturer's instructions.
3. Disconnect the orange wire at the regulator and connect an ammeter between the wire and its terminal. **See Figure** 8. Reconnect the negative battery cable.
4. Disconnect one of the yellow/red wires at the regulator and tape it out of the way where it will not contact any metal.
5. Start the engine and run at 1,000 rpm. The ammeter should show no current output. If it does, there is a stator short to ground.
6. Reconnect the yellow/red wire to the regulator. Disconnect the other yellow/red wire and repeat Step 4. If there is no current output, replace the regulator.

No Output Test

1. Disconnect both yellow/red leads and the orange lead at the regulator. See **Figure 9.** Check resistance between regulator case and yellow/red wire studs with an ohmmeter. Replace the regulator if a reading near zero is obtained.

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2. Check both yellow/red stator leads with the ohmmeter. Replace the stator if resistance exceeds 1 ohm with either lead.
3. Reconnect all regulator leads and disconnect the red/purple sensing lead. Connect an ammeter between the red/purple lead and regulator terminal. Start the engine and run at 1,000 rpm. If any charging current is indicated, replace the regulator.
4. If there is no output in Step 3, reconnect the red/purple lead. Connect the ammeter as shown in **Figure** 8. Connect one yellow/red wire terminal to ground with a jumper lead. Run engine at 1,000 rpm and note ammeter reading. Ground the other yellow/red terminal and note the reading. If output is less than 10 amps at either terminal stud, replace the regulator.

RECTIFIER TEST

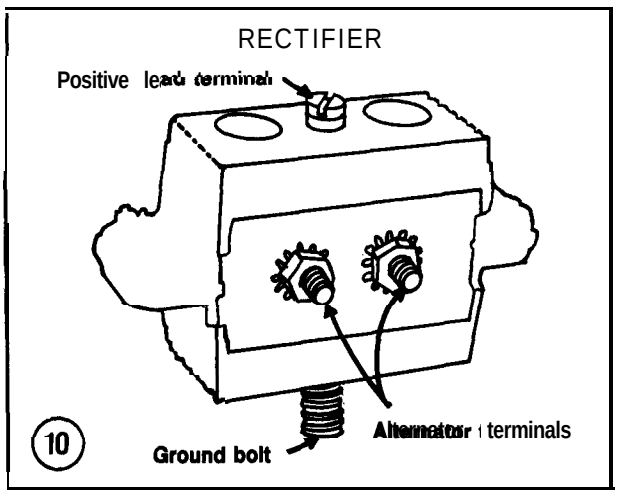
A Magneto Analyzer (part No, C-91-3 1800) is recommended for this test. If not available, the test can be performed with either an ohmmeter or self-powered test lamp.

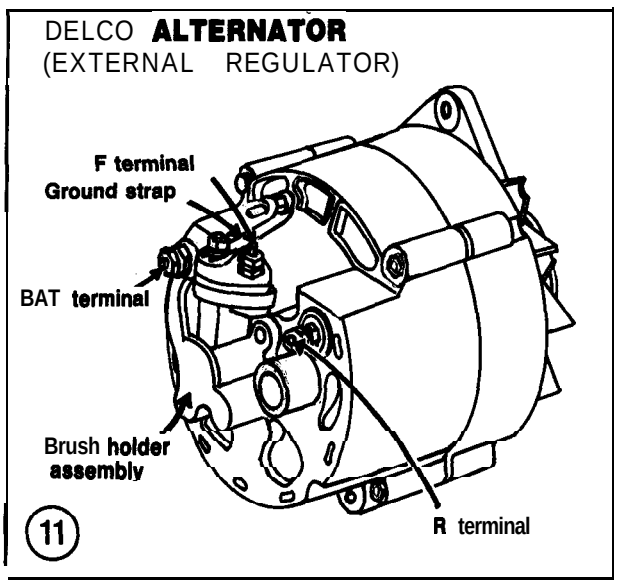
1. Calibrate the magneto analyzer by setting the selector switch to the No. 3 position and connecting the small red/black test leads together. Turn adjustment knob to align needle with "set" position on scale. After meter is calibrated, , disconnect red/black leads.

NOTE

If *an ohmmeter is used in Steps 2-7, it should show continuity in only one direction when testing positive or negative diodes. A self-powered test lamp will light in one direction and not in the other if the diodes are good.*

2. Connect small red tester lead to either alternator terminal on rectifier. Connect small black tester lead to positive rectifier terminal. **See Figure 10.** Meter needle should move to right of scale No. 3.
3. Reverse position of tester leads on rectifier terminals. Meter needle should move to left of scale No. 3.
4. Repeat Step 2 and Step 3 with the other rectifier alternator terminal. If the meter needle does not react as specified, one or more of the positive diodes is bad.
5. Connect small red tester lead to either alternator terminal on rectifier. Connect small black tester lead to rectifer ground bolt. **See Figure 10.** Meter needle should move to left of scale No. 3.
6. Reverse position of tester leads on rectifier terminals. Meter needle should move to right of scale No. 3.





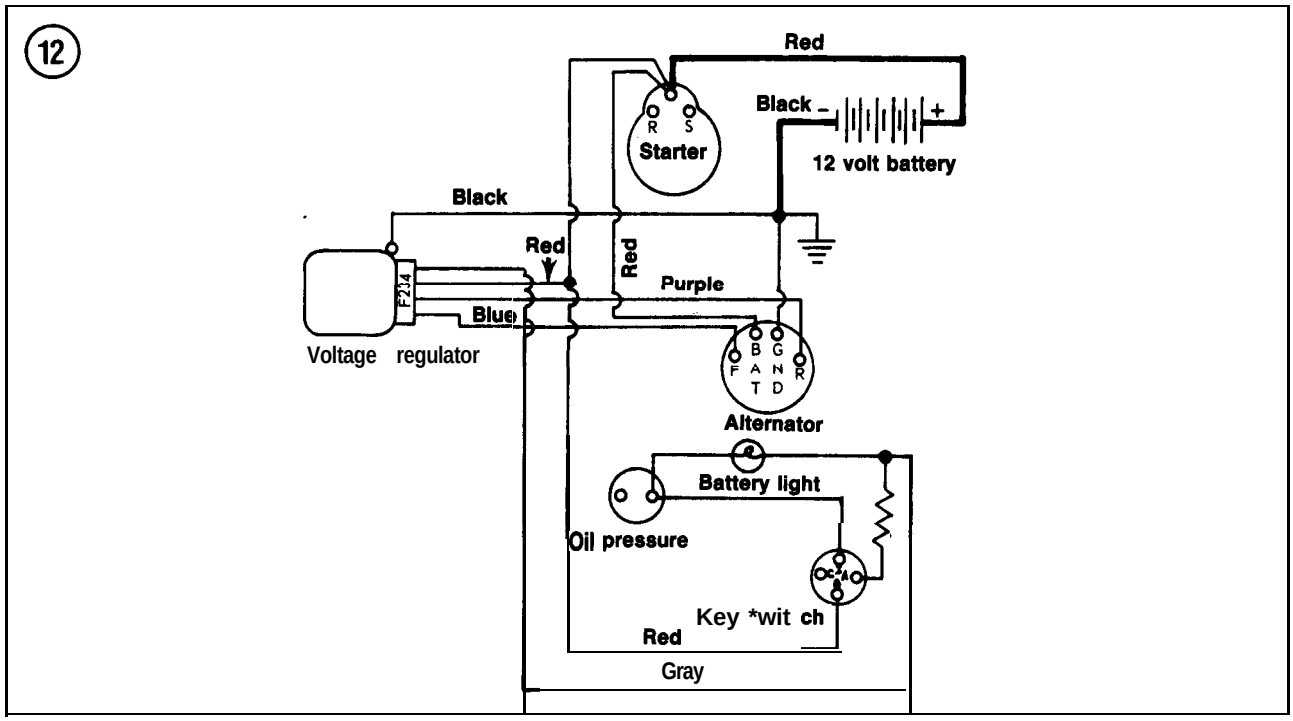
7. Repeat Step 5 and Step 6 with the other rectifer alternator terminal. If the meter needle does not react as specified, one or more of the negative diodes is bad.

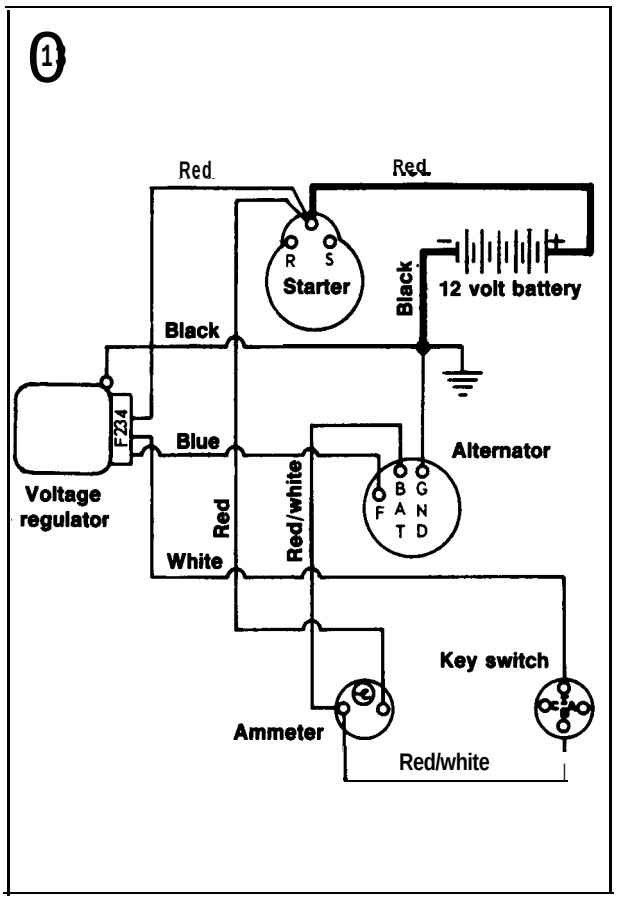
Rectifier Replacement

1. Disconnect the rectifier terminal leads.
2. Remove the hex head mounting bolt.
3. Remove the rectifier.
4. Installation is the reverse of removal.

DELCO-REMY EXTERNAL REGULATOR SYSTEM

Early MerCruiser engines (except Models 60, 80 and 90) are equipped with a Delco-Remy alternator





(Figure 11) and external voltage regulator. Three different regulator circuits are used: the indicator light circuit with regulator **506 (Figure 12)**, ammeter circuit with regulator **507 (Figure 13)** and transistorized regulator/ammeter circuit with regulator B-37707 **(Figure 14).** Regulators are non-adjustable and are serviced by replacement only.

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Undercharged Battery

Short/resistance test

A Magneto Analyzer (part No. C-91-31800) and volt-ohm-amp (VOA) tester are required for this procedure.

1. Disconnect the wiring harness from the system components. Set the magneto analyzer on scale No. 3 (or use an ohmmeter) and check harness wires for continuity. If continuity exists, repair or replace the harness.

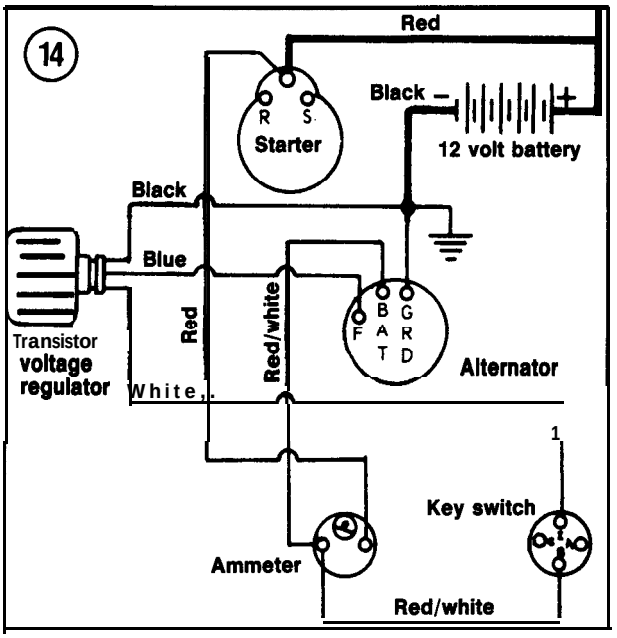
2. Set the magneto analyzer to scale No. 2 and calibrate the unit. Clip the small red/black tester leads together and turn No. 2 scale adjustment knob until meter needle is aligned with "set" position. Unclip the leads.

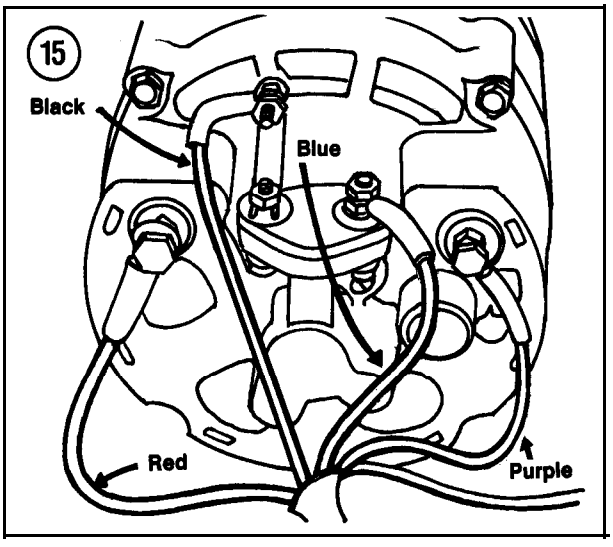
3. Refer to appropriate wiring diagram **(Figures 12-14)** and check each wire for resistance between terminal ends and harness connections.

4. Repair or replace harness if any wire in the harness shows resistance.
5. Repeat Step 3 and check the instrument panel wiring harness. Repair or replace harness as required.
6. Check all connections. They should be tight and free of corrosion. Clean or tighten as required.
7. Set the VOA tester on the O-80 scale and connect it between the alternator BAT terminal and ground. If the meter needle reads zero, there is an open in the circuit between the alternator BAT terminal and battery.
8. If the problem has not been isolated, proceed with the output test as described in this chapter.

Current *output test*

1. Disconnect the coil secondary lead from the center tower of the distributor cap. Ground the lead to the engine block with a jumper wire.
2. Set the VOA tester on the O-20 volt scale and connect it across the battery terminals.
3. Disconnect BAT lead at alternator. Connect an ammeter in series with the lead and alternator terminal.
4. Crank the engine for 10-l 5 seconds to remove any surface charge on the battery.
5. Reconnect the coil secondary lead to the distributor cap tower.
6. Connect a tachometer to the engine according to manufacturer's instructions.
7. Start the engine and run at part throttle (3,000 rpm). Ammeter scale should read as follows:
   a. 42 amp alternator—30-45 amps decreasing to 15 amps within a few seconds.
   b. 32 amp alternator-minimum 25 amps decreasing to 15 amps within a few seconds.
8. Once ammeter scale reaches its lowest reading in Step 7, note the VOA scale. It should read as follows:
   a. Standard voltage regulator-14- 15 volts.
   b. Transistorized regulator-13.5- 14.5 volts.
9. If ampere output in Step 7 is less than specified, shut the engine off. Disconnect the blue wire at the alternator field terminal. Start engine and run at 3,000 rpm. Connect a jumper lead to the alternator BAT terminal and quickly touch it to the alternator field terminal. The ammeter scale should show the initial reading specified in Step 7. If it does not, remove the alternator and have it bench-tested by a dealer or qualified electrical shop.



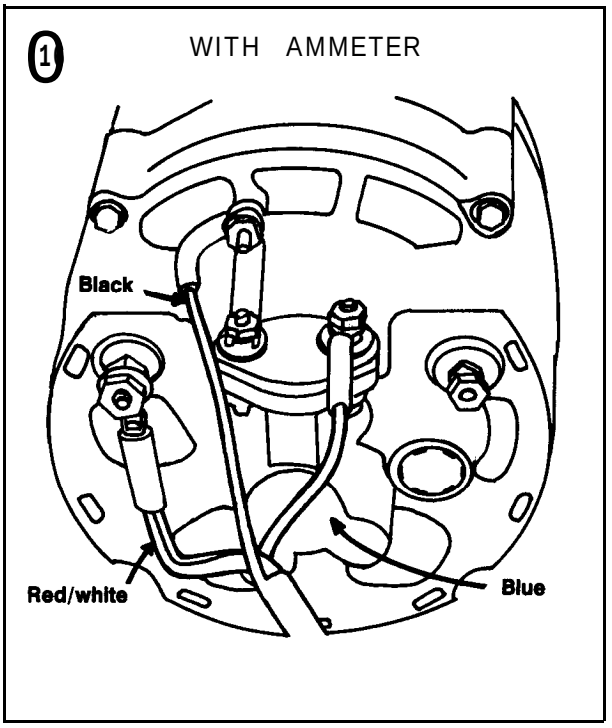


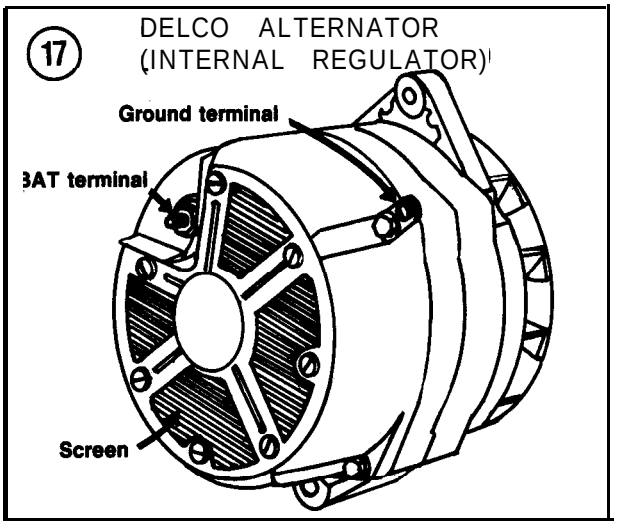
Overcharged Battery

If the battery consistently requires the addition of water, check to see if it is overheated due to location. An overheated battery will overcharge even if the alternator system is functioning properly. If this is not the problem, replace the regulator.

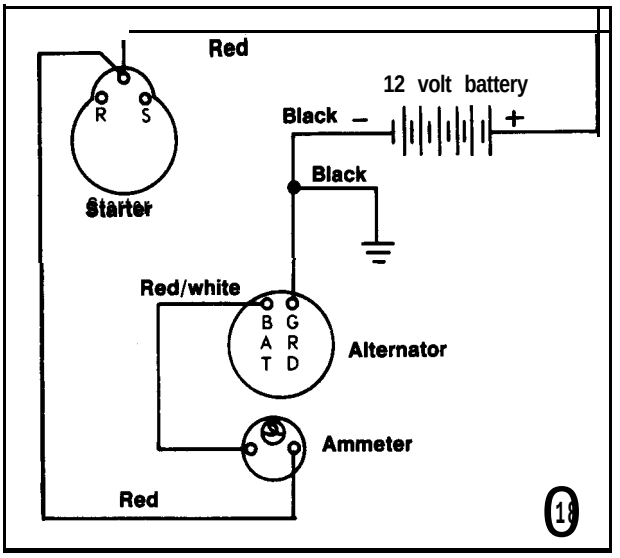
Alternator Removal/Installation

1. Disconnect the wiring harness leads at the back of the alternator. **See Figure 15** (indicator light) or **Figure 16** (ammeter) as appropriate.





2. Loosen alternator mounting and support bracket bolts. Swivel alternator toward engine and remove drive belt from the pulley.
3. Remove the mounting and support bracket fasteners. Remove the alternator.
4. Installation is the reverse of removal. Spacer should be installed on support bracket bolt. Adjust drive belt tension to 45 lb. or 1/2 in. deflection as described in this chapter. Tighten fasteners securely.



Regulator Replacement

1. Depress latch holding wiring harness connector to regulator unit. Disconnect wiring harness connector from regulator.
2. Remove screws holding regulator to mounting bracket. Remove regulator.

NOTE

Early MerCruiser engines were not equipped with a voltage regulator vibration dampening mounting bracket. On installations lacking this bracket, install bracket part No. B-33614AI when replacing the regulator.

3. Match harness connector and terminal leads, then plug connector into the regulator housing.
4. Install regulator (and vibration dampening bracket, if necessary) to transom. Make sure wire harness leads have some slack. If they do not, reposition the regulator.

EARLY MODEL DELCO-REMY INTEGRAL REGULATOR SYSTEM

A Delco-Remy alternator containing a solid-state voltage regulator is used instead of the external regulator system on later MerCruiser installations. This regulator can be easily identified by the use of an explosion-resistant or flame arrestor screen on the rear end frame (Figure 17).

Early integral regulator systems are wired according to the schematics shown in Figure 18 (wiring harness length less than 20 feet) or Figure 19 (wiring harness length greater than 20 feet).

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Current Output Test

Refer to **Figure 18** or **Figure 19** for this procedure.

1. Perform *Short/Resistance Test* as described for external regulator systems in this chapter.
2. Disconnect negative battery cable.
3. Disconnect the alternator lead at the BAT terminal. Connect an ammeter between the lead and the terminal. **See Figure 20.**
4. Connect a carbon pile across the battery terminals **(Figure 20).**
5. Reconnect the negative battery cable. Turn all accessories on.
6. Connect a tachometer to the engine according to manufacturer's instructions.

NOTE

Since initial voltage build-up is dependent upon residual magnetism in the rotor, increase engine speed as necessary to obtain the maximum current output in Step 7.

7. Start engine and run at moderate speed (2,000 rpm). Adjust carbon pile to obtain the maximum current output.
8. Note the ammeter reading. If within 10 percent of the rated output stamped on the alternator end frame, the system is satisfactory.

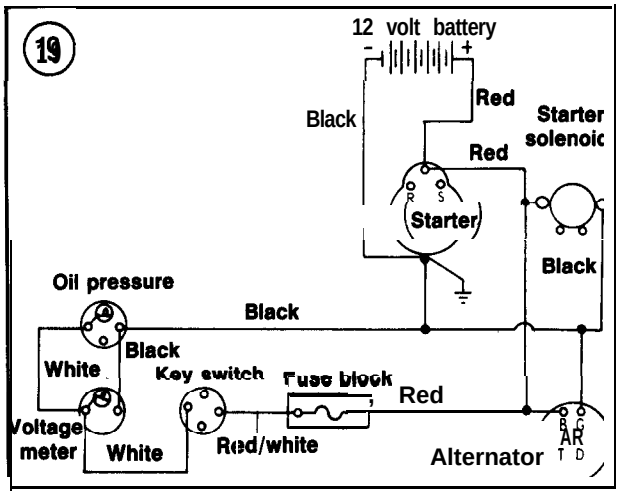
CAUTION

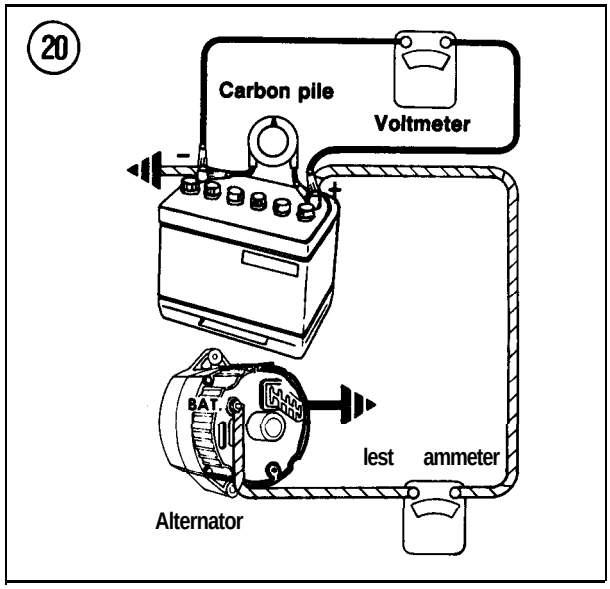
Be careful when inserting a screwdriver in the test hole in Step 9. The ground tab is located about 3/4 in. inside the end frame. If the screwdriver is inserted too far, it can contact the rotor and cause alternator damage.

9. If ammeter reading is not within 10 percent of the rated output, record the maximum amperes that can be obtained. Remove the flame arrestor screen from the rear of the alternator as described in this chapter. Insert a thin screwdriver blade inside the test hole in the end frame **(Figure 21)** and repeat Step 7.
10. Note the ammeter reading. If within 10 percent of the rated output, replace the regulator. If not within 10 percent of the rated output, remove the alternator and have it bench tested by a dealer or qualified electrical shop.

LATE MODEL DELCO-REMY INTEGRAL REGULATOR SYSTEM

Late model Delco-Remy integral regulator systems incorporate a single-wire alternator **(Figure**

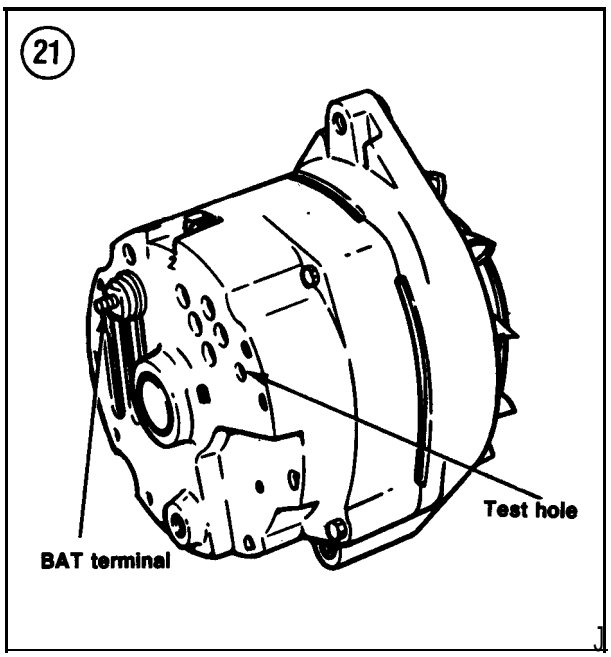




22) or a 3-wire alternator **(Figure 23).** The flame arrestor screen **(Figure 17)** is externally mounted on single-wire alternators. On 3-wire alternators, the alternator through bolts and ground clip must be removed to remove the flame arrestor screen.

The 3-wire alternator differs from the single-wire model in the type of regulator it contains. The single-wire alternator regulator can only sense internally (inside the alternator). The 3-wire alternator regulator contains an external sensing circuit, that is, the regulator can also sense resistance *outside* the alternator.

The regulator also contains an excitation circuit connected to the ignition switch. This circuit sends a small amount of current to the alternator rotor field winding, initiating output during starting. As a

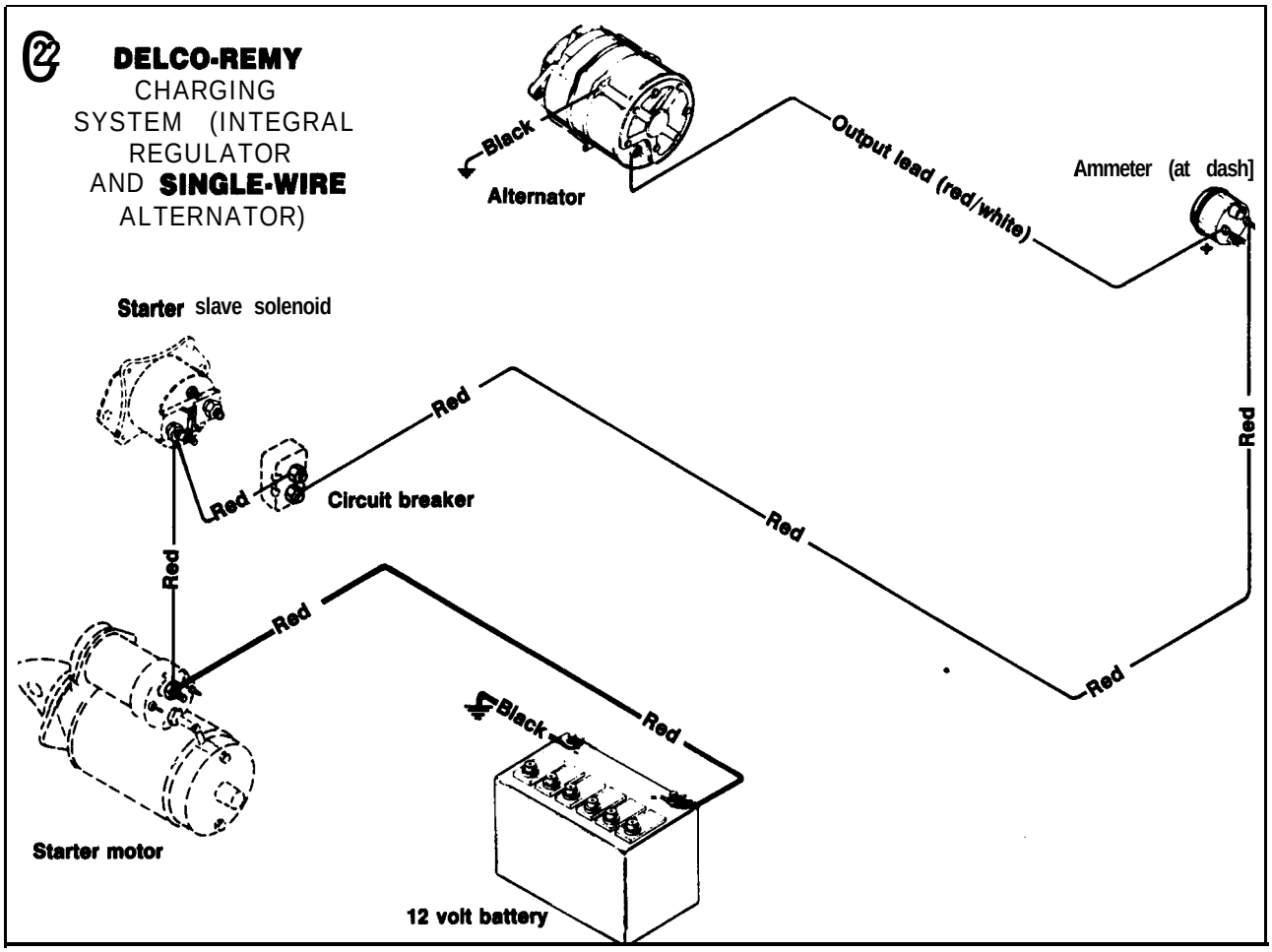


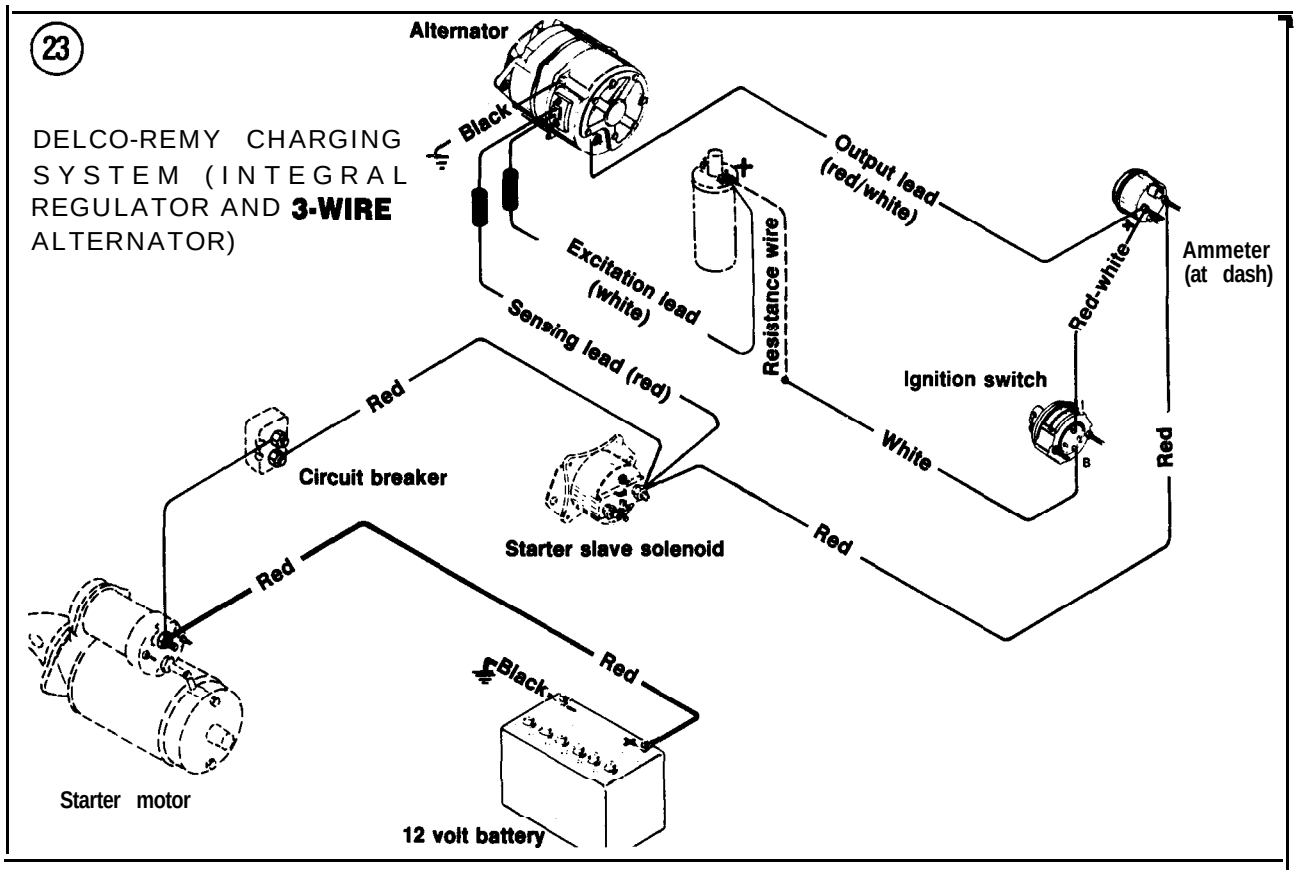
result, the 3-wire alternator builds voltage more quickly than the single-wire model, which relies on residual magnetism during initial start-up.

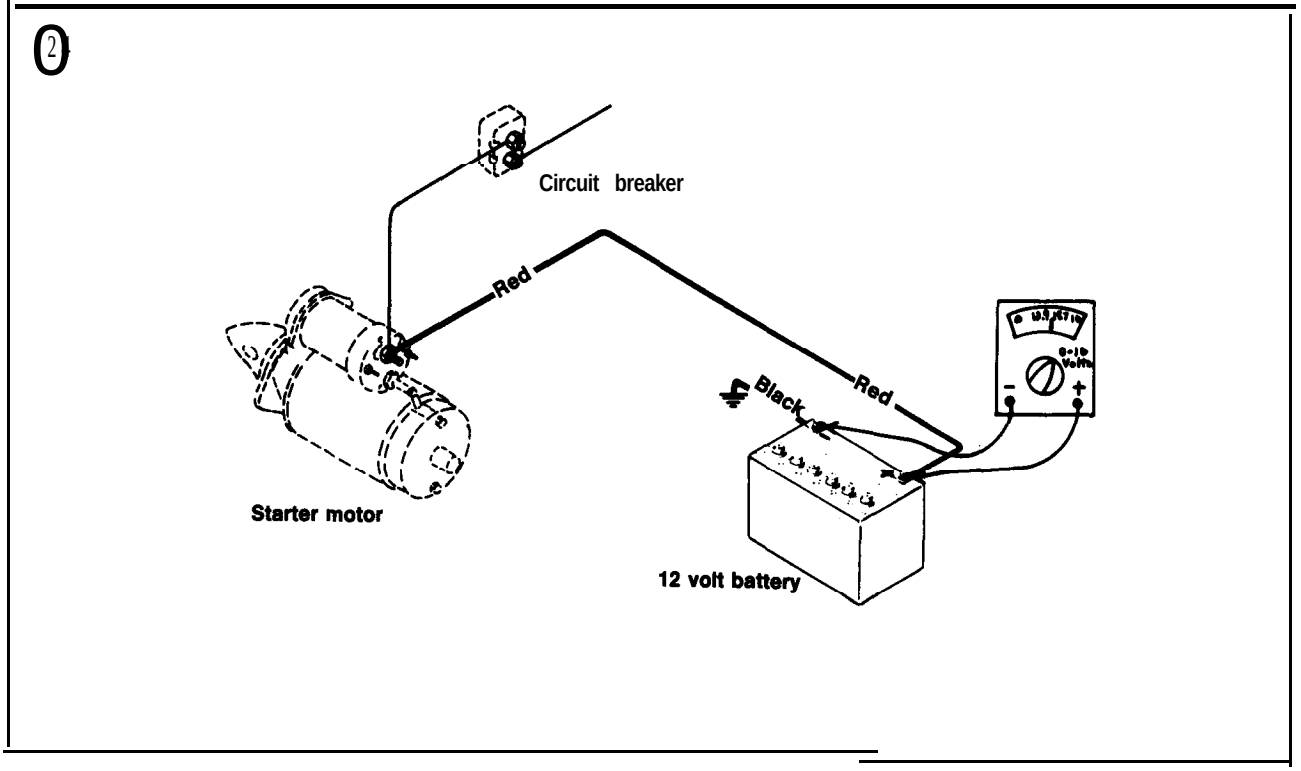
Voltage Regulator Test

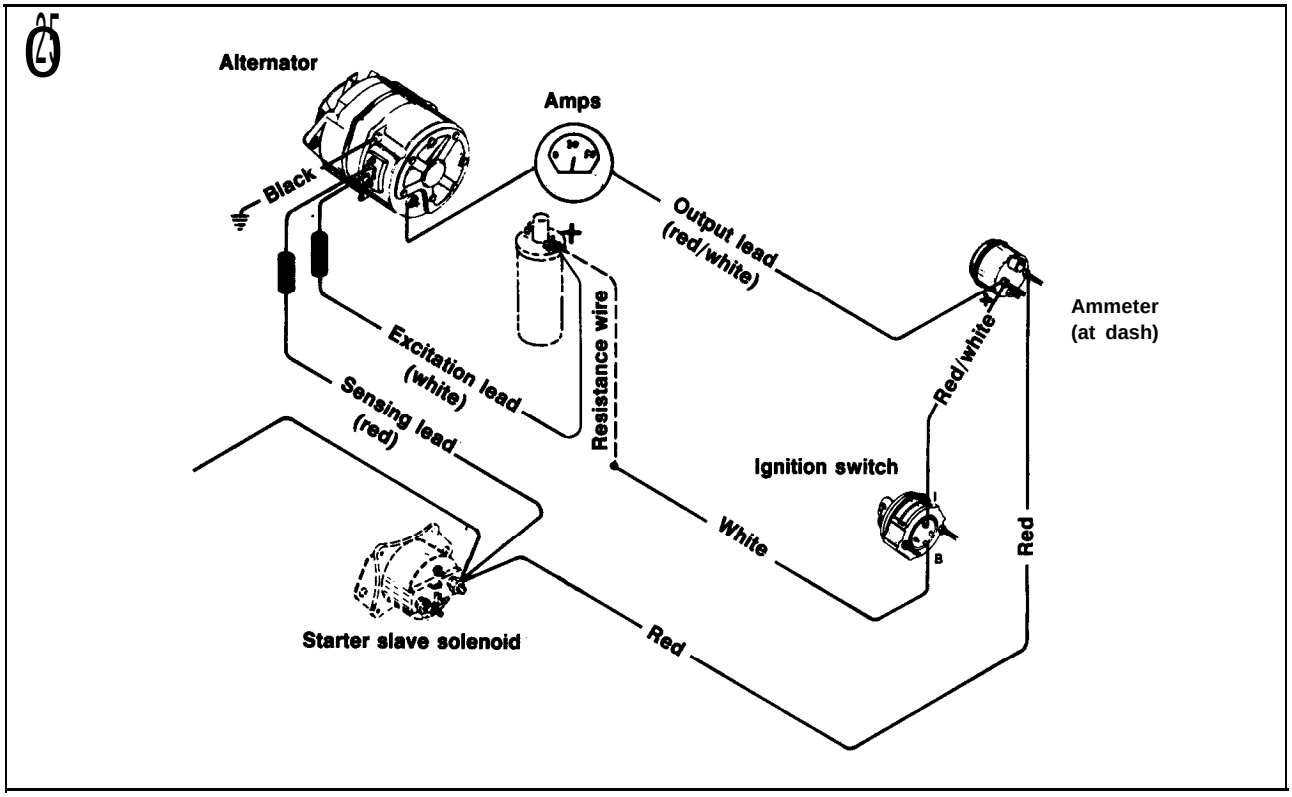
Make sure the battery is fully charged and that all accessories are off before performing this test. Refer to **Figure** 24 for this procedure.

1. Set the voltmeter on the O-20 volt scale. Connect the positive voltmeter lead to the positive battery terminal. Connect the negative voltmeter lead to the negative battery terminal.
2. Connect a tachometer to the engine according to manufacturer's instructions.
3. Start the engine and run at 3,000 rpm until engine reaches normal operating temperature (thermostat housing hoses hot).
4. Bring engine speed down to 1,500-2,000 rpm and note voltmeter reading. If voltage regulator is working correctly, the reading should be between 13.9-14.7 volts.




23
DELCO-REMY CHARGING SYSTEM (INTEGRAL REGULATOR AND 3-WIRE ALTERNATOR)
Alternator
Black
Output lead (red/white)
Excitation lead (white)
Resistance wire
Sensing lead (red)
Red-white
Ammeter (at dash)
Ignition switch
Red
White
Red
Circuit breaker
Starter slave solenoid
Red
Red
Black
Red
Starter motor
12 volt battery


Circuit breaker
Red
Red
Black
Starter motor
12 volt battery



NOTE

If voltmeter reading is normal on a 3-wire alternator but the dash light requires frequent replacement, perform System Circuitry Test in this chapter to check for excessive resistance. If voltmeter reading is high, perform the Sensing Circuit Test in this chapter.

5. If voltmeter reading is low, stop the engine and perform the *Current Output Test* in this chapter.

Current Output Test

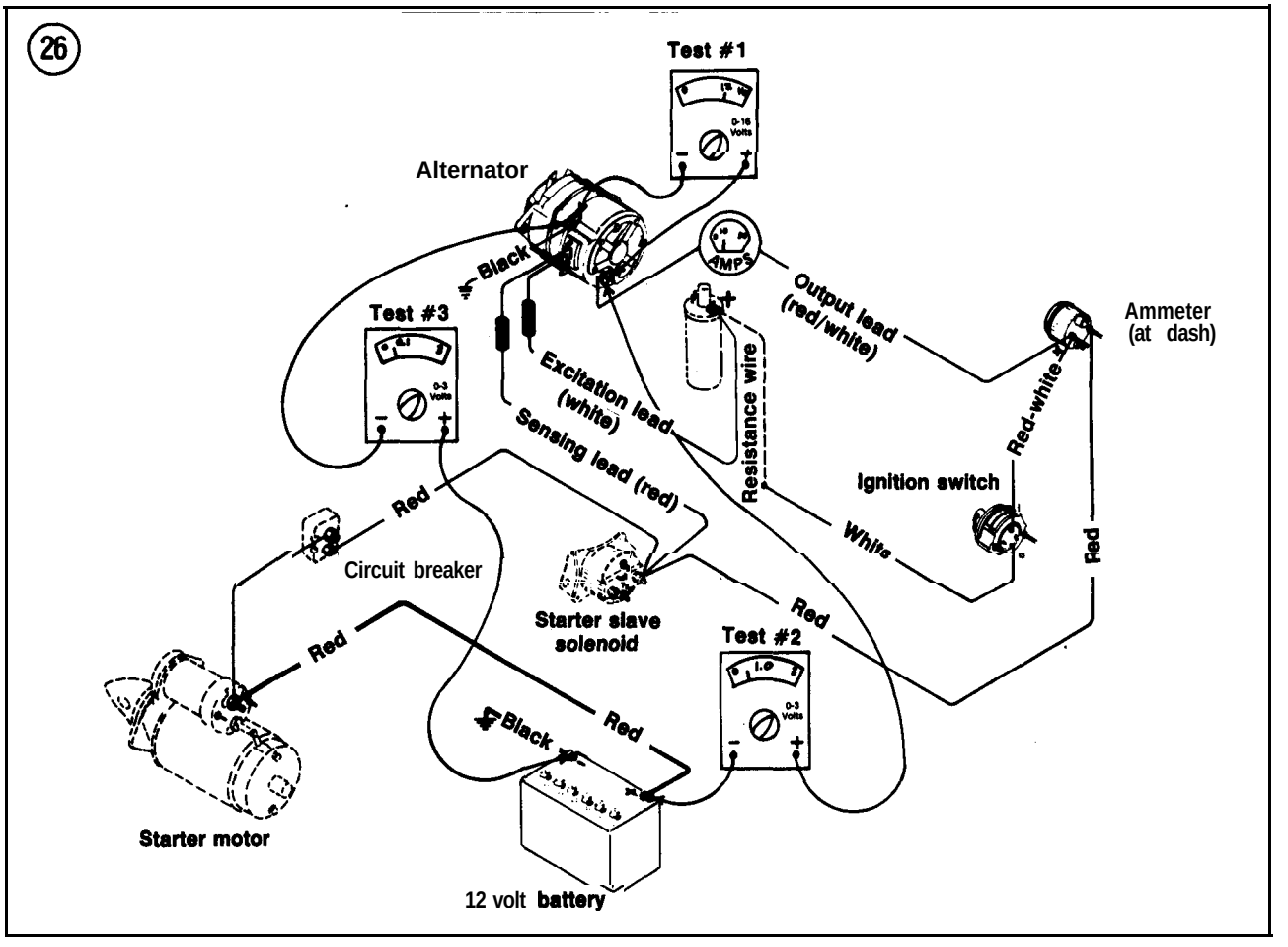
Refer to **Figure** 25 for this procedure.

1. Disconnect the negative battery cable, then the positive battery cable.
2. Disconnect the red/white wire at the alternator BAT terminal. Connect the negative lead of a DC ammeter to the alternator BAT terminal and the positive lead to the disconnected wire.
3. Reconnect the positive battery cable, then the negative battery cable.
4. Disconnect the coil secondary lead from the distributor center tower and ground it to the engine block with a jumper lead.
5. Turn all accessories on and crank engine over 15-20 seconds to remove any surface charge from the battery.
6. Turn all accessories off and reconnect the coil lead to the distributor cap.
7. Connect a tachometer to the engine according to manufacturer's instructions.
8. Start the engine, quickly bring engine speed to 1,500-2,000 rpm and note ammeter reading. It should be a minimum of 25 amps for single-wire alternators or 30 amps for 3-wire alternators.
9. If a low or no output reading is obtained, stop the engine. Perform the *System Circuitry Test* in this chapter. On 3-wire alternators, also perform the *Excitation Circuit Test* in this chapter.
10. If the output reading obtained is within specifications in Step 8, remove the flame arrestor from the rear of the alternator as described in this chapter.

CAUTION

Be careful when inserting a screwdriver in the test hole in Step 11. The ground tab is located about 3/4 in. inside the end frame. If the screwdriver is inserted too far, it can contact the rotor and cause alternator damage.

11. Repeat Steps 4-8. Watch ammeter and insert a thin screwdriver blade inside the test hole in the end frame **(Figure 21).**



12. If the reading specified in Step 7 is obtained, replace the regulator. A low output requires further bench testing of the alternator by a dealer or qualified electrical shop.

System Circuitry Test

NOTE

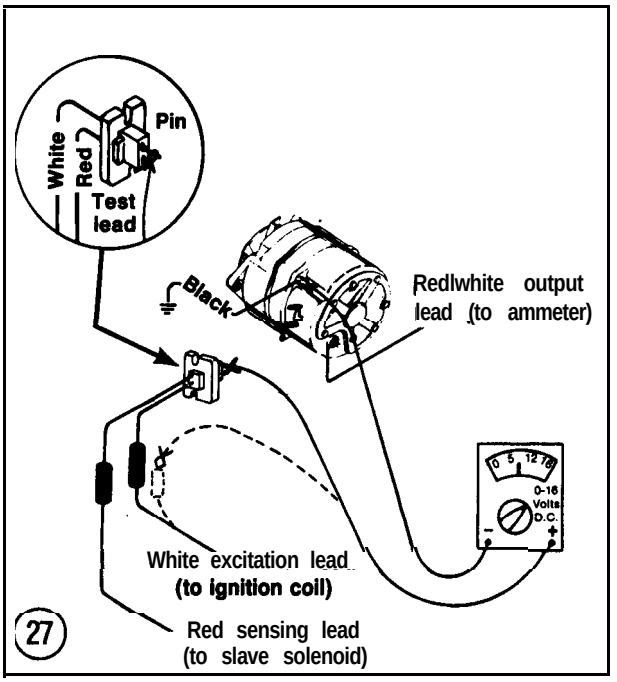
If the boat is equipped with battery isolators, the following procedure cannot be used.

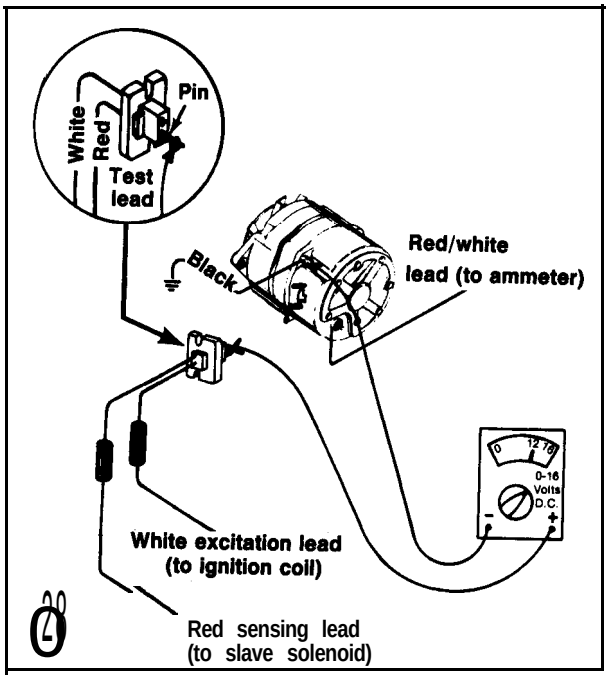
Refer to **Figure** 26 for this procedure.

1. Disconnect the negative battery cable, then the positive battery cable.
2. Disconnect the red/white wire at the alternator BAT terminal. Connect the negative lead of a DC ammeter to the alternator BAT terminal and the positive lead to the disconnected wire.
3. Reconnect the positive battery cable, then the negative battery cable.
4. Connect the positive voltmeter lead to the alternator BAT terminal and the negative voltmeter lead to the alternator ground terminal. **See** Test **No.** 1, **Figure 26.**
5. Watch voltmeter needle and move wiring harness back and forth. The meter should show a steady battery voltage reading (approximately 12 volts). If reading varies or no reading is obtained, check output circuit for poor connections or damaged wiring. Correct as necessary.
6. Disconnect negative voltmeter lead from alternator ground terminal. Connect it to the positive battery terminal. Set voltmeter on O-3 volt scale. See Test **No. 2, Figure 26.**
7. Connect a tachometer to the engine according to manufacturer's instructions.
8. Start engine and bring speed to 1,500-2,000 rpm. Turn on enough accessories to obtain a 10 amp reading on the ammeter scale.

NOTE

If wiring harness is 40 feet or longer, a slightly higher reading may be obtained than specified in Step 9. This is normal.





9. Note voltmeter reading. If greater than 1 volt, there is excessive resistance in the output circuit.
10. Connect the positive voltmeter lead to the negative battery terminal. Connect the negative voltmeter lead to the alternator ground terminal. See Test No. 3, **Figure 26.**
11. Repeat Step 8. If the voltmeter reading exceeds 0.01 volt, stop the engine. Disconnect, clean and reconnect all ground circuit connections.
12. Disconnect the negative battery cable, then the positive battery cable. Remove all test equipment from the circuit and reconnect the red/white lead to the alternator. Reconnect the positive battery cable, then the negative cable.

Excitation Circuit Test (3-wire Alternators Only)

Refer to **Figure** 27 for this procedure.
1. Remove flame arrestor screen as described in this chapter.
2. Remove regulator terminal nuts and bracket from rear of alternator. Remove regulator terminal.
3. Insert a pin or paper clip in the white wire terminal of the connector and attach the positive voltmeter lead to the pin or clip.
4. Connect the negative voltmeter lead to me alternator ground terminal.
5. Turn the ignition switch ON.
6. Move the excitation lead back and forth and note voltmeter reading. It should show a steady 5 volts.

CAUTION

Do not let white engine wire touch engine or other ground in Step 7 or an electrical short may damage system wiring/components.

7. If reading varies or no reading is obtained, turn ignition OFF. Disconnect the white engine wire from the regulator terminal at the bullet connector.
8. Disconnect positive voltmeter lead from regulator terminal connector. Reconnect voltmeter lead to excitation lead. See dotted line connection in **Figure 27.**
9. Turn ignition switch ON and repeat Step 5. If the voltmeter reading is now within specifications, replace the regulator terminal connector. If reading still varies or no reading is obtained, check wiring harness white lead for poor connections or damaged wiring. Correct as necessary.
10. Remove pin or paper clip from regulator terminal connector and reinstall connector to alternator. Insulate the bullet connection with heat shrink tubing or 4 layers of electrical tape.

Sensing Circuit Test

Refer to **Figure** 28 for this procedure.
1. Remove flame arrestor screen as described in this chapter.

2. Remove regulator terminal nuts and bracket from rear of alternator. Remove regulator terminal.
3. Insert a pin or paper clip into the red wire terminal of the connector and attach the positive voltmeter lead to the pin or clip.
4. Connect the negative voltmeter lead to the alternator ground terminal. .
5. Make sure the ignition switch is OFF.
6. Move the sensing lead back and forth and note voltmeter reading. It should show a steady 12 volts.
7. If reading varies or no reading is obtained, check red sensing lead for poor connections or damaged wiring. Correct as necessary.
8. Disconnect meter and reinstall regulator terminal connector to alternator.

Flame Arrestor Removal/Installation (Removable Slip Ring End Frame Arrestor)

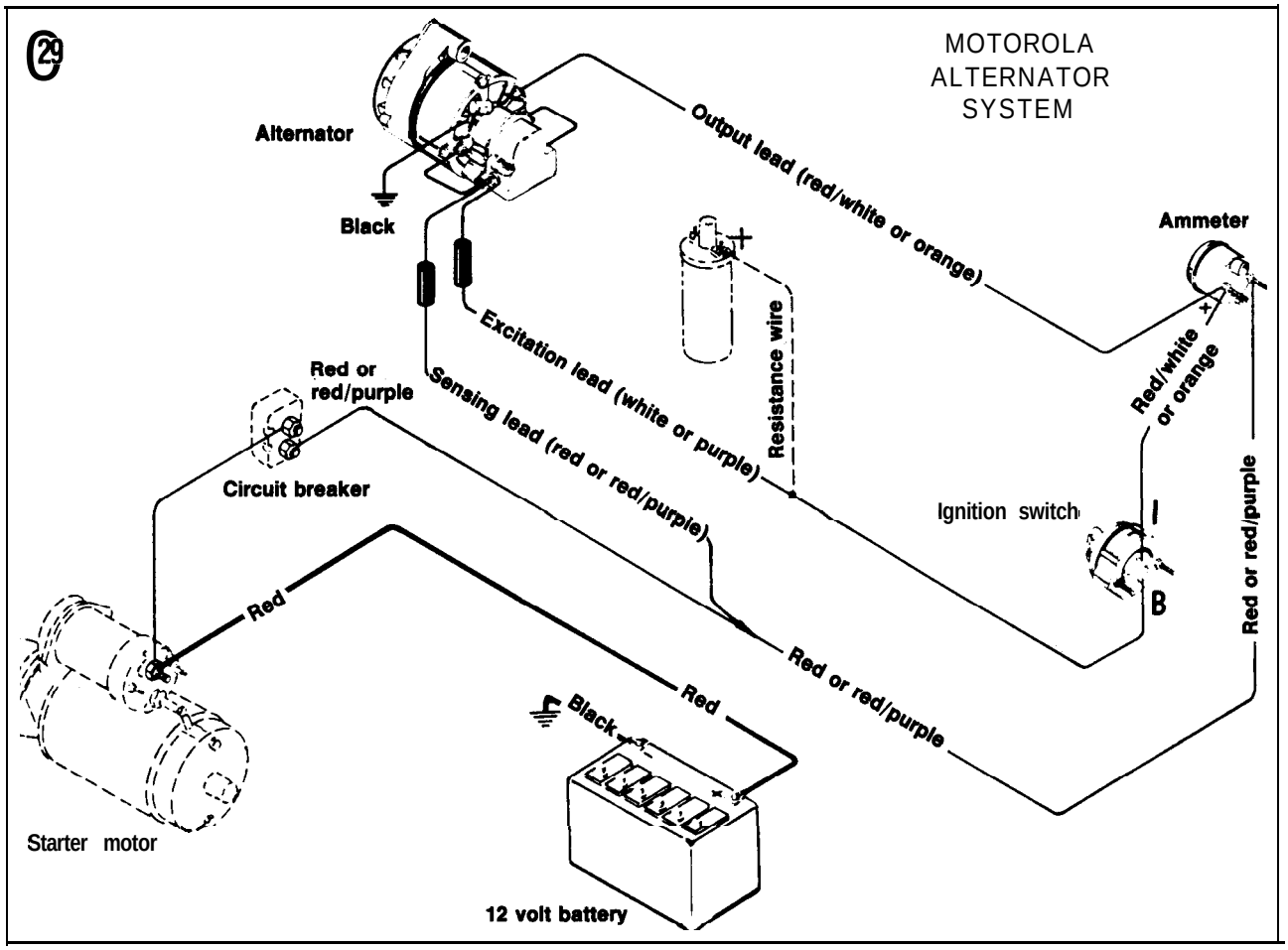
1. Remove attaching screws and lockwashers. Remove the screen.
2. Installation is the reverse of removal.

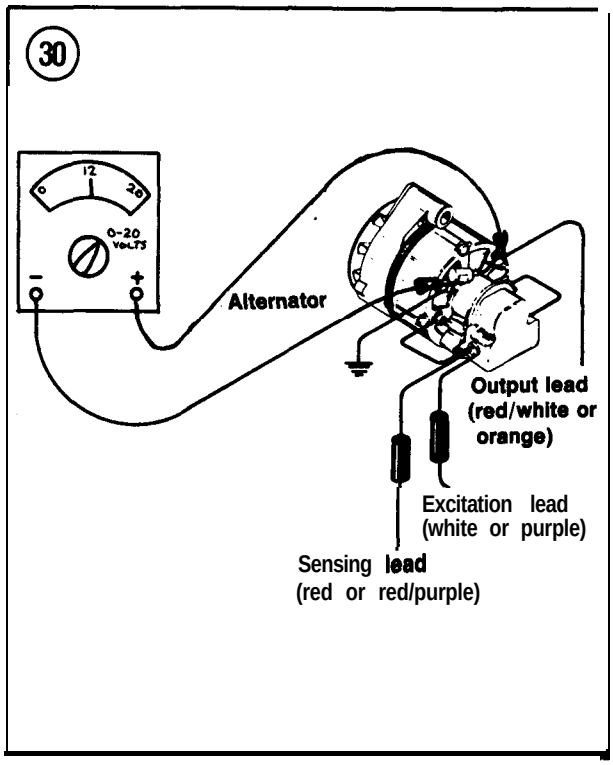
Flame Arrestor Removal/Installation (Non-removable Slip Ring End Frame Arrestor)

1. Disconnect the negative battery cable, then the positive battery cable.
2. Disconnect any test equipment attached to alternator BAT terminal.
3. On 3-wire alternators, remove nuts and bracket holding regulator terminal connector to alternator.
4. Remove alternator through bolts and ground clip lead.
5. Hold slip ring end frame in position and remove flame arrestor.
6. Install through bolts and ground clip lead. Tighten through bolts securely.
7. Reverse Steps l-3 to complete installation.

MOTOROLA ALTERNATOR SYSTEM

Some MerCruiser engines use a Motorola alternator system. A transistorized voltage



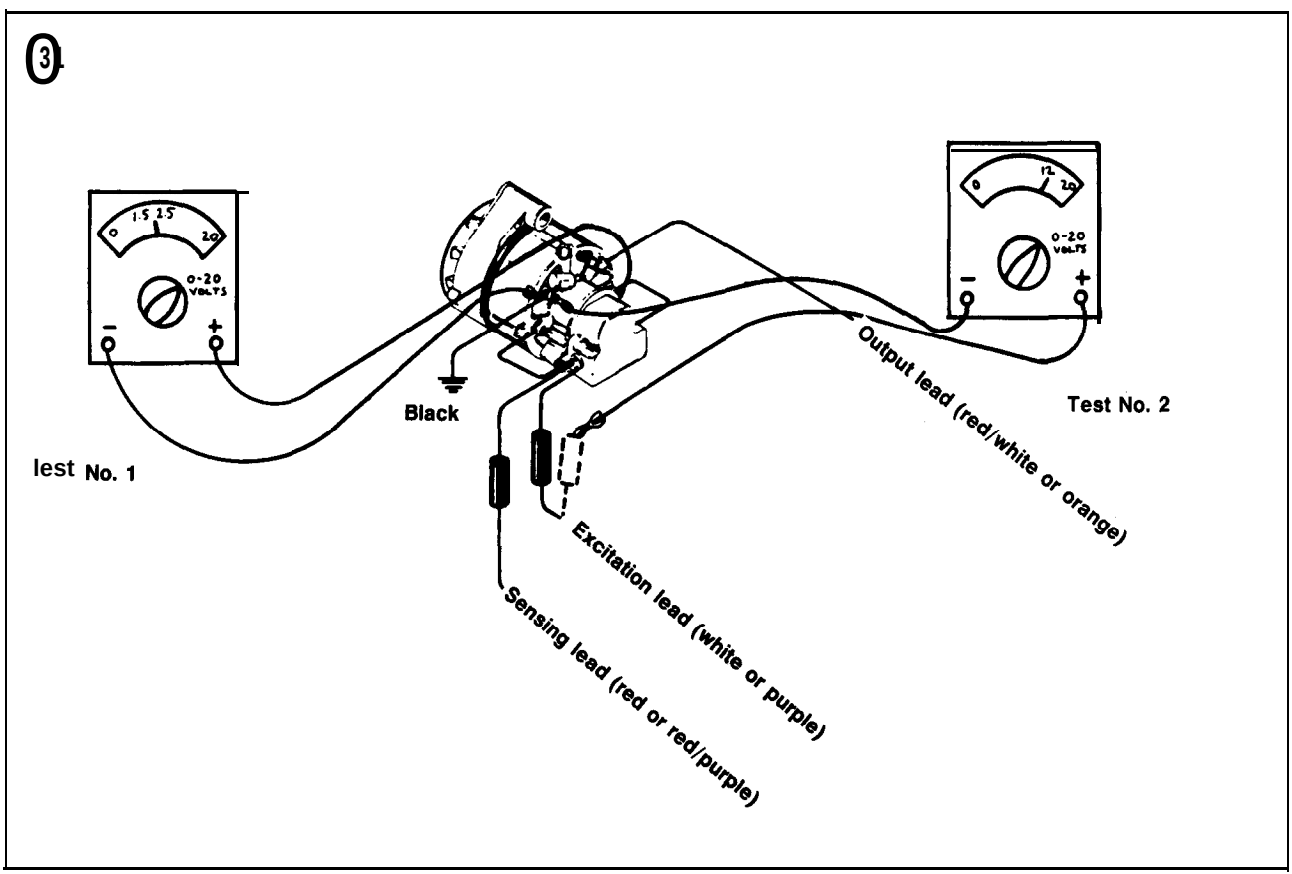


regulator is attached to the rear of the alternator. The transistorized regulator contains excitation and sensing circuits that perform the same tasks as the 3-wire Delco-Remy alternator regulator. **Figure** 29 shows the Motorola circuit schematic.

System Circuitry Test

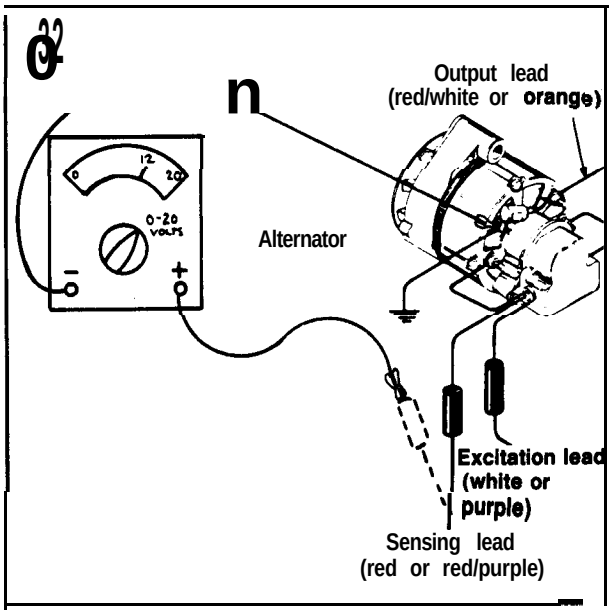
This test checks the output, excitation and sensing circuits.

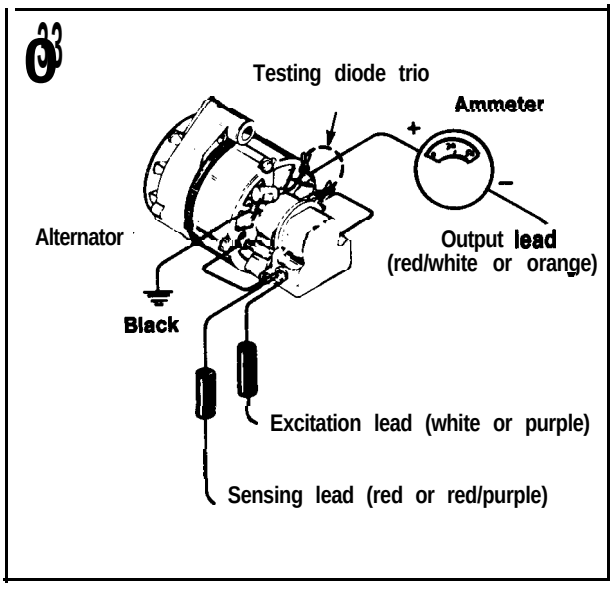
1. Connect the positive voltmeter lead to the alternator output terminal. Connect the negative voltmeter lead to the alternator ground terminal. **See Figure 30.**
2. Move engine wire harness back and forth while observing the voltmeter scale. The meter should indicate a steady battery voltage reading (approximately 12 volts). If reading varies or no reading is obtained, check for poor connections or damaged wiring. Correct as necessary.
3. Connect the positive voltmeter lead to the alternator regulator terminal. Connect the negative voltmeter lead to the alternator ground terminal. **See** Test **No. 1, Figure 31.**



13

4. Turn ignition switch ON. Voltmeter should read 1.5-2.5 volts. If voltmeter reading is not within specifications, remove the alternator and have it bench tested by a dealer or qualified electrical shop.
5. If no reading is obtained, unplug the white or purple lead at the regulator. Connect the positive voltmeter lead to the disconnected wire. Connect the negative voltmeter lead to a good ground. See Test **No. 2, Figure 31.**
6. If voltmeter reads battery voltage (approximately 12 volts) in Step 5, replace the voltage regulator. If there is still no voltage reading, check excitation circuit for poor connections or damaged wiring. Correct as necessary.
7. Unplug the red or red/purple voltage regulator lead. Connect a voltmeter between the regulator lead and the alternator ground terminal. **See Figure** 32.
8. If voltmeter does not indicate battery voltage (approximately 12 volts) in Step 7, check the red or red/purple wire for poor connections or damaged wiring. Correct as necessary.



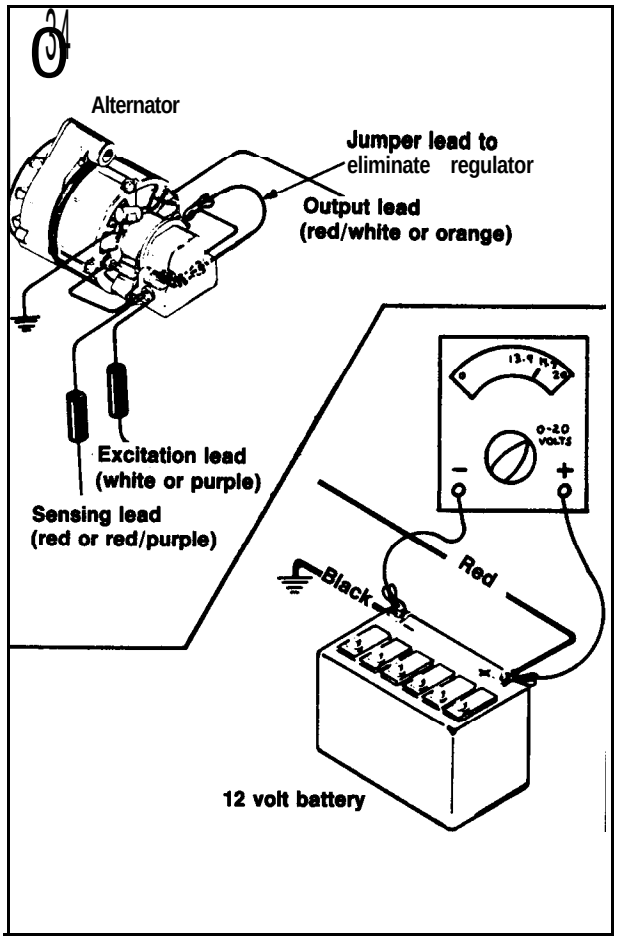


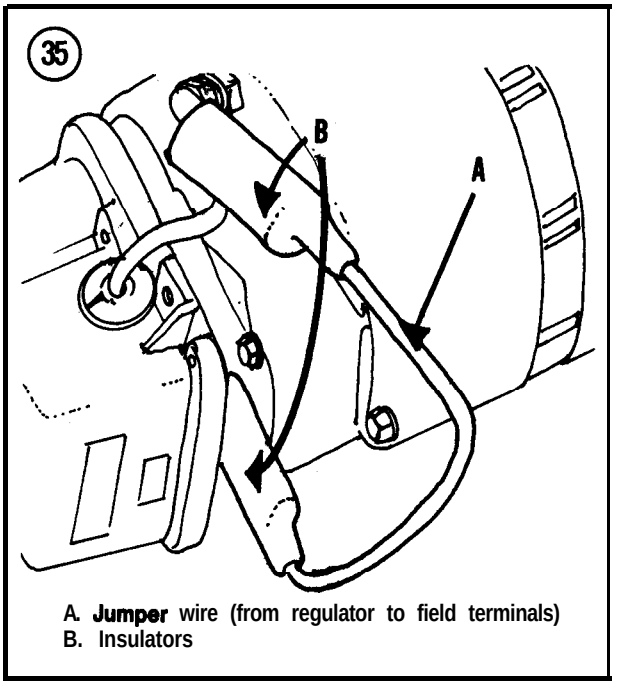
Current Output Test

Refer to **Figure 33** for this procedure.
1. Disconnect the negative battery cable.
2. Disconnect the red/white or orange lead at the alternator output terminal. Connect the positive lead of a O-50 amp DC ammeter to the output terminal and the negative lead to the disconnected wire.
3. Reconnect the negative battery cable.
4. Disconnect the coil secondary lead at the distributor center tower and ground it to the engine with a jumper wire.
5. Turn all accessories on and crank engine over 15-20 seconds to remove any surface charge from the battery.
6. Turn all accessories off and reconnect the coil lead to the distributor cap.
7. Connect a tachometer to the engine according to manufacturer's instructions.
8. Start the engine, quickly bring engine speed to 1,500-2,000 rpm. Ammeter should read a minimum of 30 amps.
9. If a low output reading is obtained, stop the engine. Connect a jumper lead between the alternator output and regulator terminals. Repeat Steps 4-8.
10. If ammeter reading is now within specifications, remove the alternator and have the diode trio replaced by a dealer or qualified electrical shop. If the low reading remains, perform the *Voltage Regulator Test* in this chapter.

Voltage Regulator Test

Refer to **Figure** 34 for this procedure.
1. Connect the positive voltmeter lead to the positive battery terminal. Connect the negative voltmeter lead to the negative battery terminal.





A. **Jumper** wire (from regulator to field terminals)
B. Insulators

2. Connect a tachometer to the engine according to manufacturer's specifications.
3. Start the engine and run at 3,000 rpm until it reaches normal operating temperature (thermostat housing hoses hot).
4. Bring engine speed down to 1,500-2,000 rpm and note voltmeter reading. If voltage regulator is working correctly, the reading should be between 13.9-14.7 volts.
5. If reading is above 14.7 volts, check for a poor connection or damaged wiring. Correct as necessary. If connection and wiring are good, perform Step 7 and Step *8* of ***System Circuitry Test*** in this chapter. If the sensing circuitry is good, replace the regulator as described in this chapter.

CA UTION

Jumper lead must not touch alternator end frame in Step 6 or the diode trio and regulator will be damaged.

6. If reading is less than 13.9 volts, stop the engine. Remove the 4 regulator attaching screws and pull regulator far enough from alternator end frame to connect a jumper lead between the field and regulator terminals. **See Figure 35.**
7. Start engine, watch the voltmeter and gradually increase speed to 1,500 rpm. Do not let voltage exceed 16 volts.
8. If voltmeter reads 14.5 volts or more in Step 7, replace the voltage regulator as described in this chapter. If voltmeter reading is less than 14.5 volts, remove the alternator and have it bench-tested by a dealer or qualified electrical shop.

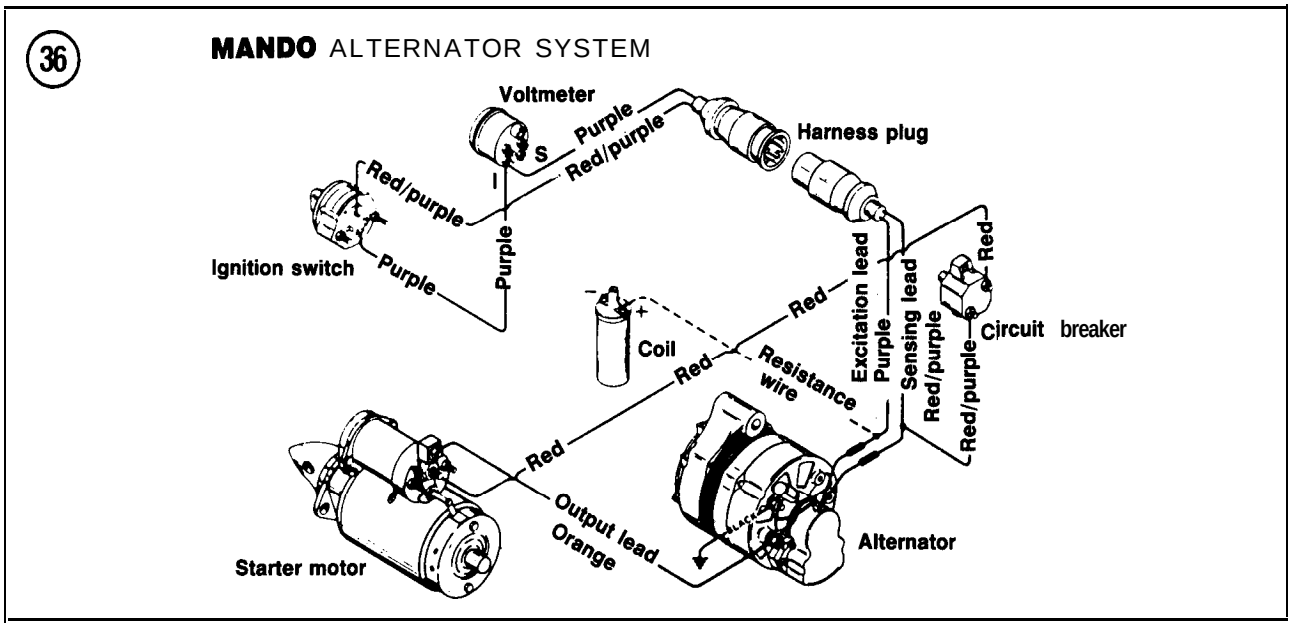
13

Regulator Replacement

1. Remove alternator from engine as described in this chapter.
2. Disconnect regulator leads from the end frame terminals.
3. Remove regulator attaching screws. Pull regulator away from end frame and disconnect the regulator field lead from the alternator.
4. Remove regulator and end seal.
5. Installation is the reverse of removal. Tighten attaching screws to 40-45 in.-lb. and regulator terminal nuts to 20-30 in.-lb.

Alternator Removal/Installation

1. Disconnect negative battery cable.
2. Disconnect all wiring harnesses and leads at the rear of the alternator.



3. Loosen the alternator bracket and pivot bolts.
4. Swivel alternator toward engine and remove drive belt.
5. Remove alternator bracket and pivot bolts, noting the position of any washers or spacers used.
6. Installation is the reverse of removal. Adjust drive belt as described in this chapter before reconnecting wiring harnesses and leads to rear of alternator.

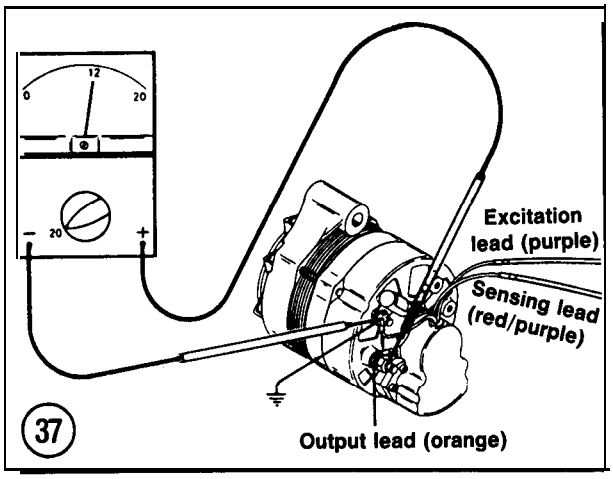
MANDO ALTERNATOR SYSTEM

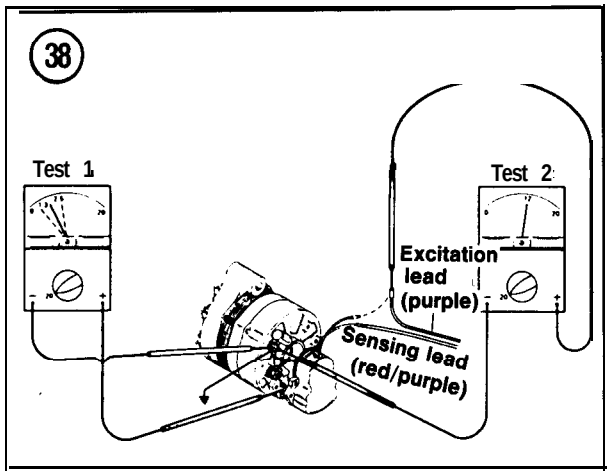
All 1984 and later V6 and V8 MerCruiser engines use a 55 amp Mando (Korean) alternator system. A transistorized voltage regulator is attached to the rear of the alternator. The Mando alternator system contains excitation and sensing circuits similar to those used with the Motorola alternator system. **Figure 36** shows the Mando circuit schematic.

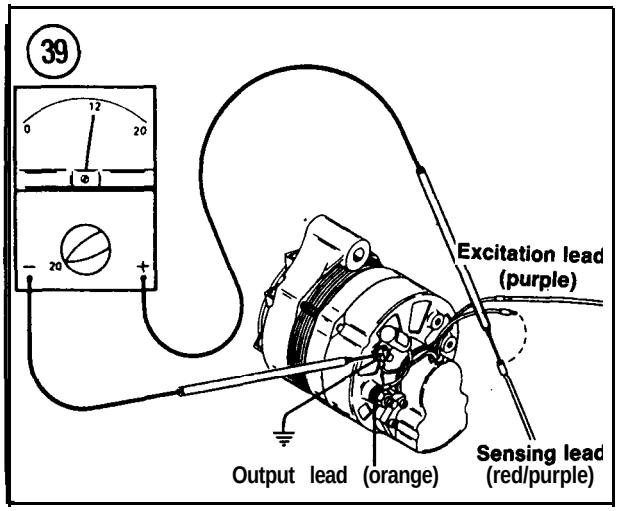
System Circuitry Test

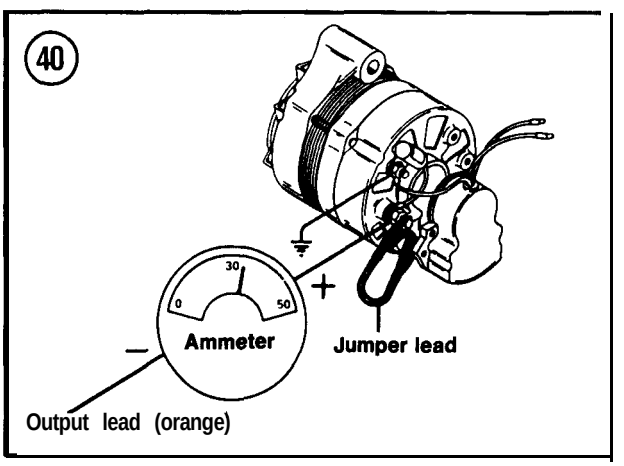
This test checks the output, excitation and sensing circuits.

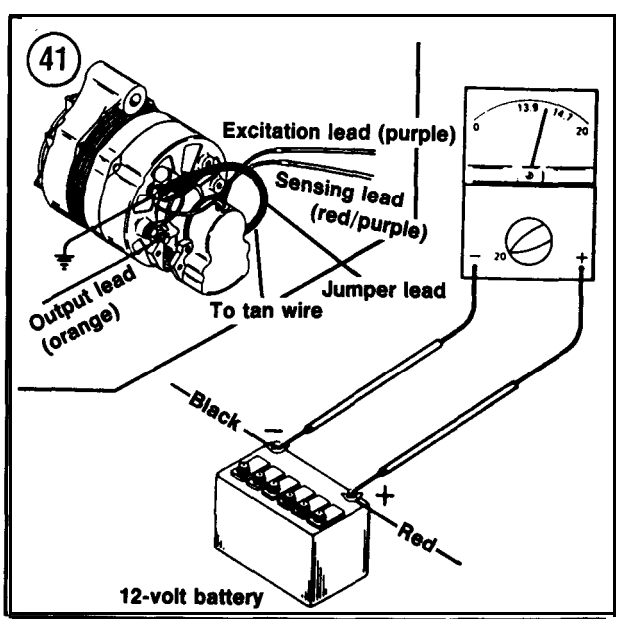
1. Connect the positive voltmeter lead to the alternator output terminal. Connect the negative voltmeter lead to the alternator ground terminal. **See Figure 37.**
2. Move the engine wire harness back and forth while observing the voltmeter scale. The meter should indicate a steady battery voltage reading











(approximately 12 volts). If reading varies or no reading is obtained, check for poor connections or damaged wiring and correct as required.

3. Connect the positive voltmeter lead to the alternator regulator terminal. Connect the negative voltmeter lead to the alternator ground terminal. See Test No. 1, Figure 38.

4. Turn ignition switch to ON. Voltmeter should read 1.3-2.5 vols. If voltmeter reading is not within specifications, remove the alternator and have it bench tested by a dealer or qualified electrical shop.

5. If no reading is obtained, unplug the purple excitation lead and connect it to the positive voltmeter lead. **See** Test No. 2, **Figure 38.**

6. If the voltmeter reads battery voltage (approximately 12 volts) in Step 5, replace the voltage regulator. If there is still no voltage reading, check excitation circuit for poor connections or damaged wiring and correct as required.

7. Disconnect the red/purple sensing lead and connect it to the positive voltmeter lead. See **Figure 39.**

8. If voltmeter does not indicate battery voltage (approximately 12 volts) in Step 7, check the red/purple sensing lead for poor connections or damaged wiring and correct as required.

Current Output Test

The procedure and specifications are the same as given under *Motorola Alternator System Current Output Test* in this chapter. Refer to **Figure 40** for test connections.

Voltage Regulator Test

The procedure and specifications are the same as given under *Motorola Alternator System Voltage Regulator Test* in this chapter. Refer to **Figure 41** for test connections.

DRIVE BELT ADJUSTMENT/REPLACEMENT

Drive belt tension can be checked according to belt deflection, but Mercury recommends the use of a belt tension gauge. If the deflection method is used, press downward firmly on the belt at a point midway between the pulleys. **See** B, **Figure 42.** The belt should deflect approximately 1/2 in. If it does not, perform Steps 2-4 of the procedure below.

Adjustment

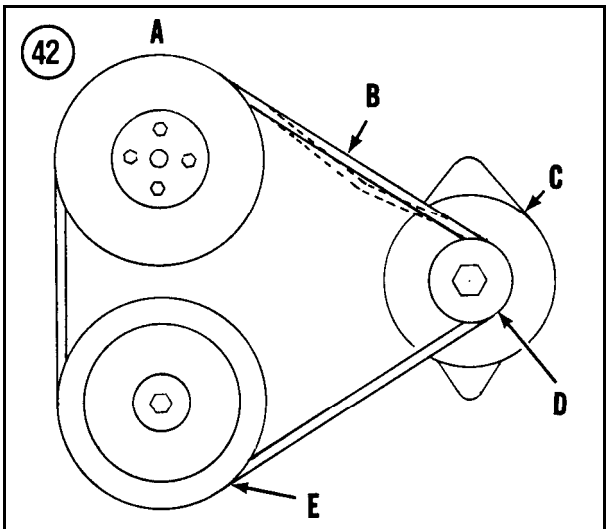
Adjust drive belt tension with a tension gauge as follows:

1. Install the belt tension gauge and take a reading. Tension should be 45 lb. for Delco-Remy external regulator systems and 65-95 lb. for all others.
2. Loosen the alternator bracket and pivot bolts.
3. Move the alternator toward the engine to loosen the belt or away from the engine to tighten the belt as required.
4. Tighten the bracket bolt, then tighten the pivot bolt.
5. Recheck belt tension. If necessary, repeat the procedure to obtain the correct tension.

Replacement

Replace the drive belt as follows:

1. Loosen the alternator bracket and pivot bolts.
2. Move the alternator toward the engine and slip the belt off the crankshaft and alternator pulleys.
3. Install a new belt over the pulleys and move the alternator away from the engine until the correct deflection or tension is obtained.
4. Tighten the bracket and pivot bolts securely.

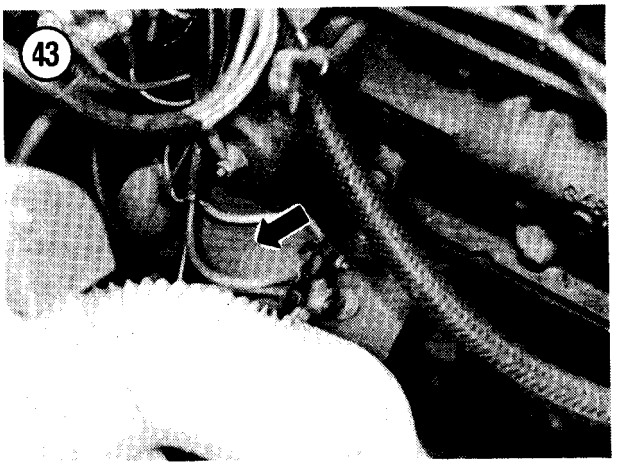


A. Circulating pump pulley
B. Check point
C. Alternator
D. Alternator pulley
E. Crankshaft pulley

STARTING SYSTEM

The starting system consists of the starter motor, starter relay or solenoid, ignition switch, neutral safety or cut-out switch, battery and connecting wiring. The neutral safety or cut-out switch is located inside the shift box and allows starter operation only when the shift selector lever is in NEUTRAL.

MerCruiser installations may be equipped with an Autolite, Delco-Remy or Prestolite starter motor. The Delco-Remy starter solenoid is enclosed in the drive housing to protect it from exposure to dirt and adverse weather conditions. **See Figure 43.**

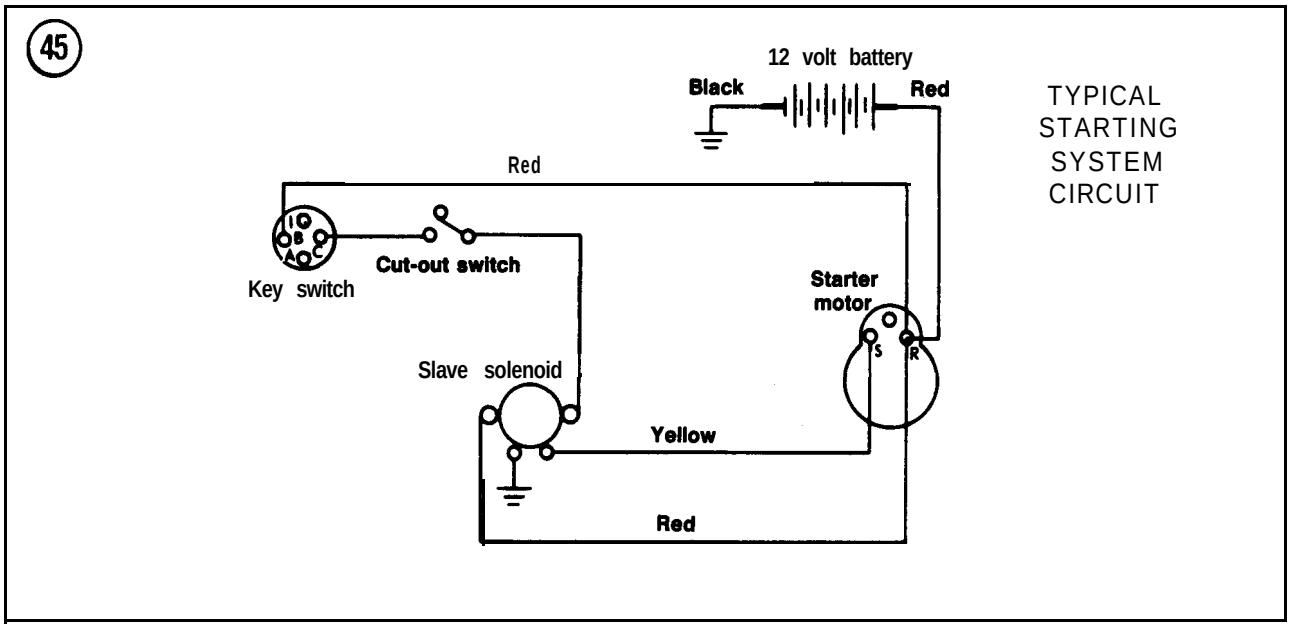


NOTE

Delco-Remy starters used after October 1981 use a shorter solenoid which has metric fasteners on the BAT, S and I terminals. The S and I terminals on these solenoids may be identified by paint marks instead of embossed letters on the end cover. Yellow marks the S terminal and purple identifies the I terminal.

Autolite and Prestolite starters use a remote mounted starter relay **(Figure 44). Figure 45** shows a typical starting system circuit.

This section includes on-boat testing of the starter and replacement of the starter, solenoid and brushes. Complete starter overhaul is not practical for the amateur mechanic. Starter brushes, however, can be replaced.



TYPICAL STARTING SYSTEM CIRCUIT

On-boat Testing

Two of these procedures require a fully charged 12 volt battery to be used as a booster and a pair of jumper cables. Use the jumper cables as outlined in *Jump Starting* in this chapter, following all of the precautions noted. Disconnect the wiring harness and leads at the rear of the alternator before connecting a booster battery for these tests. This will protect the alternator diodes from possible damage.

Slow cranking starter

1. Connect the 12 volt booster battery to the engine's battery with the jumper cables. Listen to the starter cranking speed as the engine is started. If the cranking speed sounds normal, check the battery for loose or corroded connections or a low charge. Clean and tighten the connections as required. Recharge the battery if necessary.
2. If cranking speed does not sound normal, clean and tighten all starter solenoid or relay connections and the battery ground on the engine.
3. Repeat Step 1. If the cranking speed is still too slow, replace the starter.

Starter solenoid or relay clicks, starter does not start

1. Clean and tighten all starter and solenoid/relay connections. Make sure the terminal eyelets are securely fastened to the wire strands and are not corroded.
2. Connect the 12 volt booster battery directly to the engine's battery with the jumper cables. Replace the starter if it still does not crank.

Starter solenoid or relay chatters (no click), starter does not crank

1. Check the S terminal wire on the solenoid or relay. Clean and tighten if necessary.
2. Remove the S terminal wire at the solenoid or relay. Connect a jumper lead between this terminal and the positive battery post.
3. Try starting the engine. If it starts, check the ignition switch, neutral safety (cut-out) switch or starting circuit wiring for loose connections. If the engine still does not start, replace the solenoid or relay.

Starter spins but does not crank

Remove the starter. Check the armature shaft for corrosion. If there is none, the starter drive mechanism is slipping. Replace the starter with a new or rebuilt unit.

Solenoid Removal/Installation

1. Disconnect the negative battery cable.
2. Remove the wires from the solenoid terminals.
3. Disconnect the field strap from the solenoid motor terminal.

4. Remove the solenoid-to-drive housing screws and the motor terminal bolt.
5. Rotate the solenoid 90° and remove from the drive housing with the plunger return spring.
6. Installation is the reverse of removal.

Relay Removal/Installation .

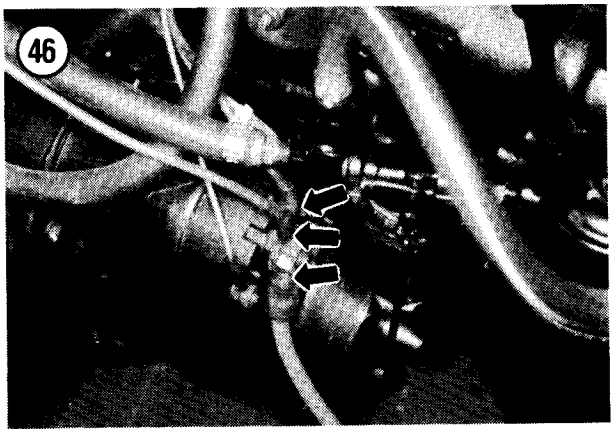
1. Disconnect the negative battery cable.
2. Disconnect the ignition switch and coil wires from the relay terminals.
3. Remove the nuts holding the starter and battery cables to the relay. Disconnect the cables.
4. Remove the relay attaching screws. Remove the relay.
5. Installation is the reverse of removal.

Starter Removal/Installation

1. Disconnect the negative battery cable.
2A. Delco-Remy starter-Disconnect the solenoid terminal wires. **See Figure 46.**
2B. Autolite or Prestolite starter-Disconnect the yellow starter cable at the starter terminal. See **Figure 47.**
3. Remove the starter mounting bolts. Autolite starters will have a battery ground strap and/or hose clamp attached to one of the mounting bolts.
4. Pull the starter motor away from the flywheel and remove it from the engine.
5. Installation is the reverse of removal. On Delco-Remy starters, install any shims that were removed to assure proper pinion-to-flywheel mesh.

Brush Replacement (Autolite Starter)

Brush replacement requires partial disassembly of the starter. Refer to **Figure** 48 (typical) for this procedure.
1. Remove the cover screw, cover and through bolts.
2. Remove the brush end plate, bushing and insulator plate..
3. Note position of brushes in the brush holder. Pull back and hold the brush retaining clip with a wire hook, then remove the brush. Repeat this step to remove remaining brushes.
4. Note location of the brush holder with respect to the end terminal and remove the brush holder.
5. Inspect the brushes. Replace all brushes if any are worn to 1/4 in. or less.
6. Check the brush holder for cracks or broken mounting pads.



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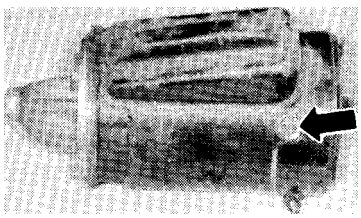


7. To replace ground brushes, remove the brush lead attaching screws from the starter frame. Take out the brushes and install new ones.
8. To replace field coil brushes, cut the insulated brush leads as close as possible to the field coils. Attach new brush leads with the clips provided in the brush replacement kit. Solder the connections together with rosin core solder and a 300-watt soldering iron.

NOTE

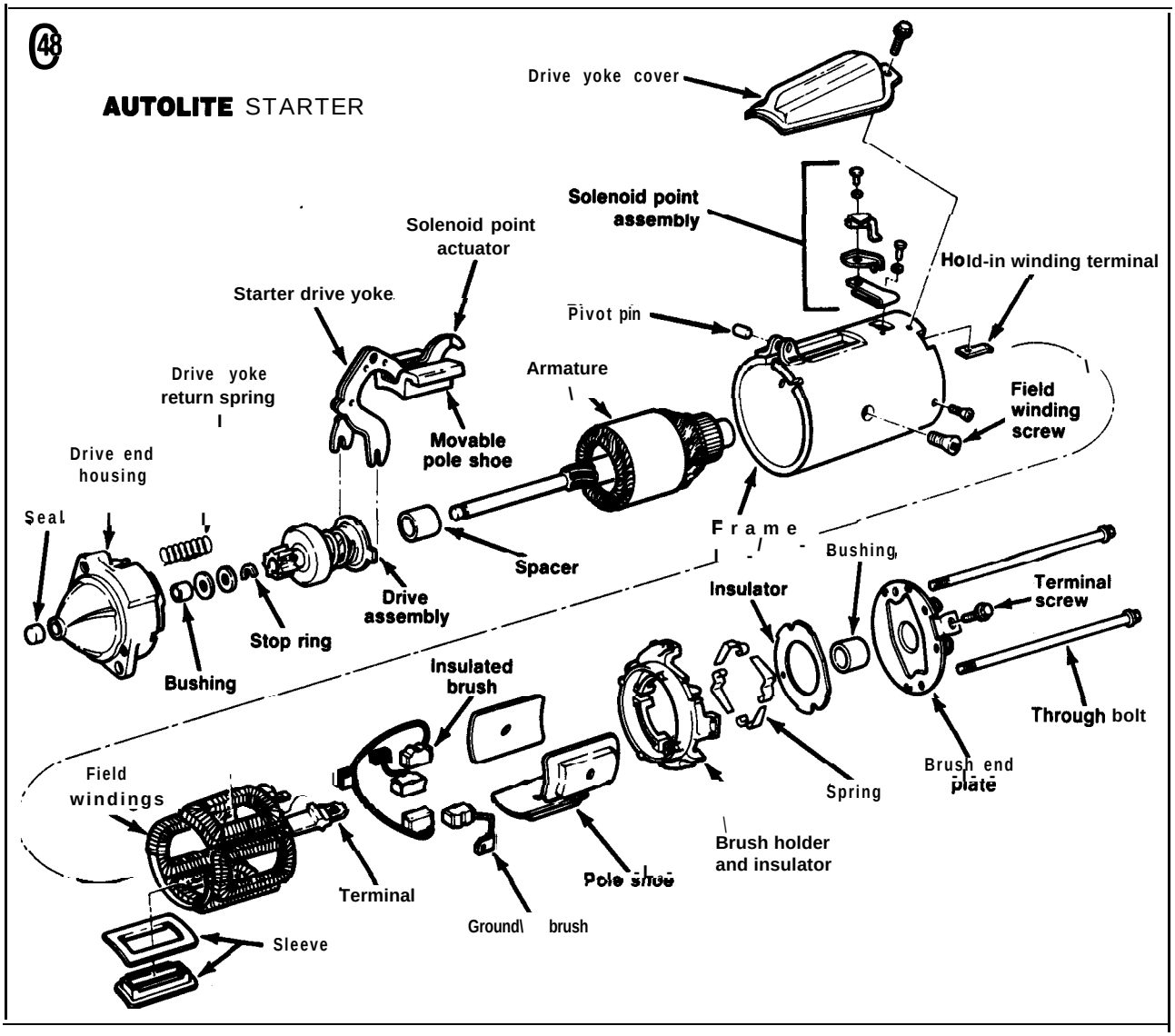
Always replace brushes in complete sets.

9. Install the brush holder. Insert brushes in the holder and install the brush springs.

NOTE

Position brush leads in their correct brush hole slots to prevent a potential ground.

10. Install brush insulator, bushing and end plate.
11. Install and tighten through bolts.
12. Install cover and tighten retaining screw.



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Brush Replacement (Delco-Remy Starter)

Refer to **Figure** 49 (typical) for this procedure.

1. Remove the terminal nut and disconnect the field lead from the solenoid terminal.
2. Remove the 2 through bolts. Separate end frame and field frame assembly from solenoid and drive assembly.
3. Remove the brush holder pivot pins. Remove the 2 brush holder/spring assemblies from the field housing.
4. Remove the brush and lead attaching screws.
5. Inspect the brushes. Replace all brushes if any are oil-soaked or worn to 1/4 in. or less in length.

NOTE

Always replace brushes in complete sets.

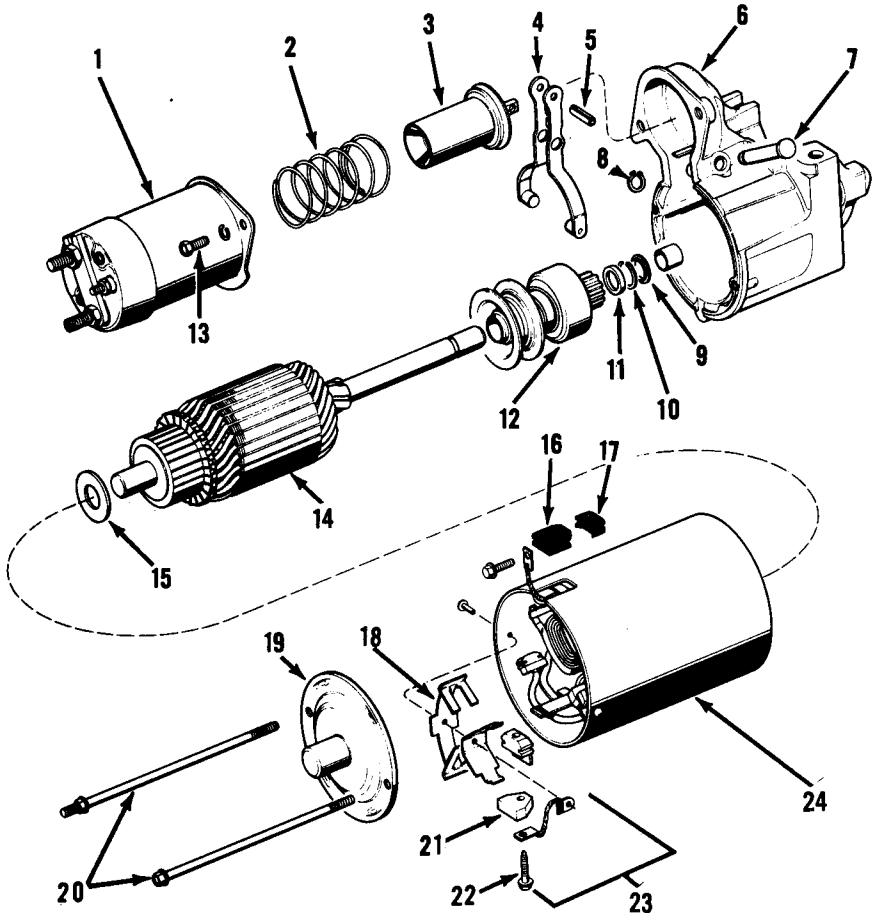
6. Secure new brushes to the leads with the attaching screws.
7. Reverse Steps 1-3 to complete brush installation.

Brush Replacement (Prestolite Starter)

Refer to **Figure** 50 (typical) for this procedure.

1. Remove the 2 through bolts. Remove the end plate, plug and thrust washer.
2. Pry the retaining springs back and slide the brushes from their holder.

49

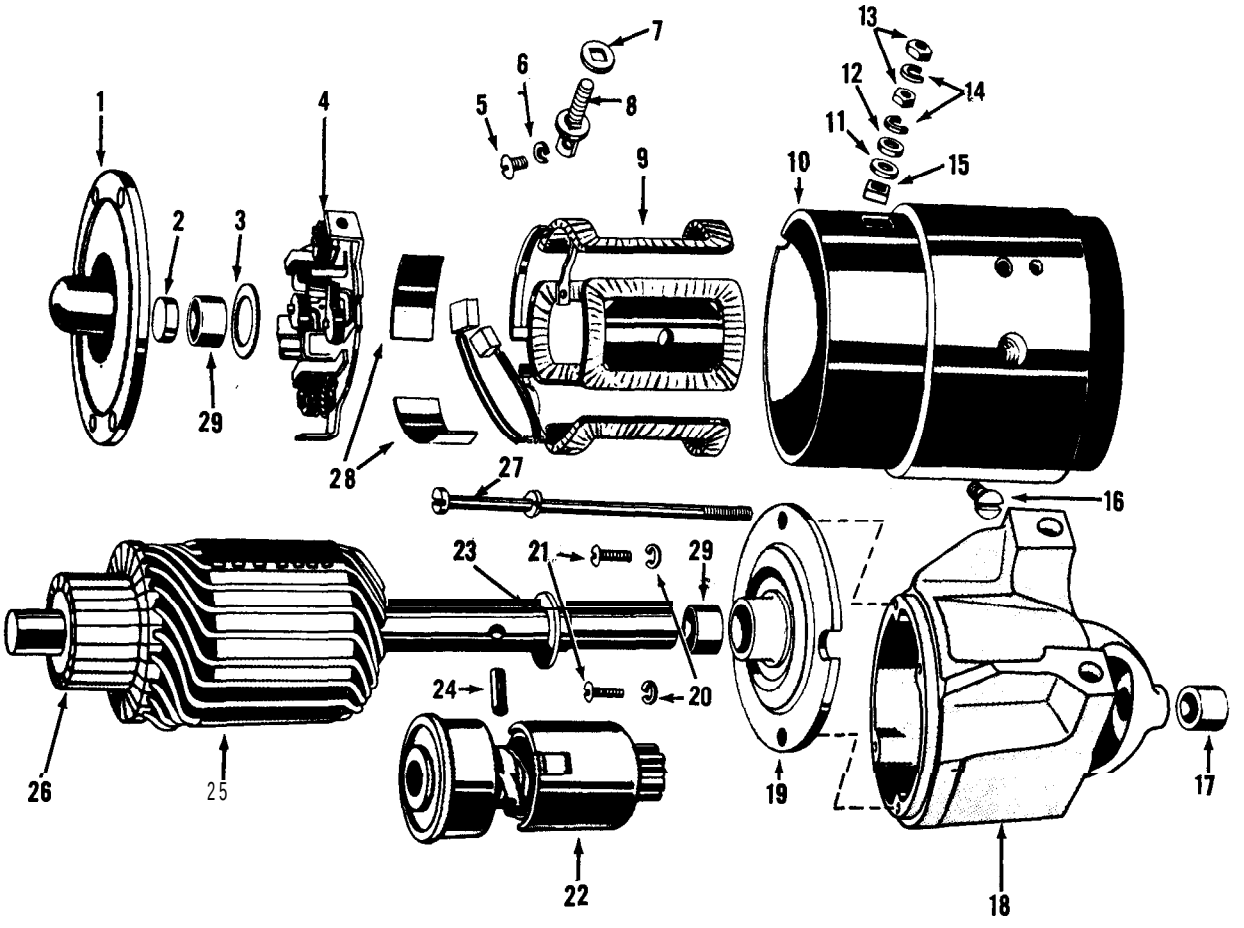


DELCO STARTER

1. Solenoid switch
2. Plunger return spring
3. Plunger
4. **Shift** lever
5. Plunger pin
6. Drive end housing
7. **Shift** lever **shaft** housing
8. Lever shaft retaining ring
9. Thrust collar
10. Pinion stop retainer ring
11. Pinion stop collar
12. **Drive**
13. Screw
14. Armature
15. Washer
16. Grommet
17. Grommet
18. Brush holder
19. Commutator end frame
20. Through bolt
21. Brush
22. Screw
23. Brush and holder assembly
24. Frame and field winding

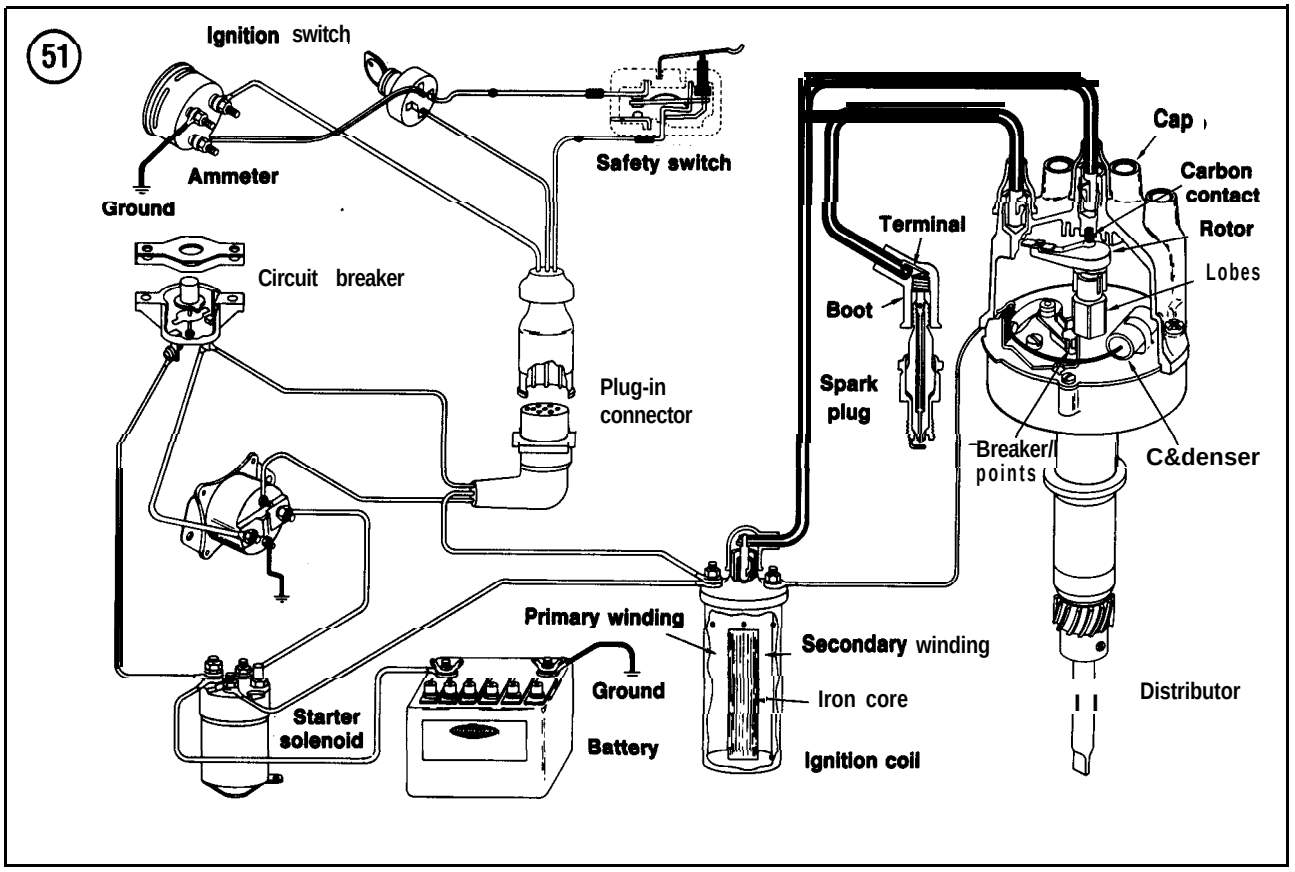
(50)

PRESTOLITE STARTER



1. End plate
2. Oiling pad
3. Thrust washer
4. Brush plate assembly
5. screw
6. Lockwasher
7. insulating washer
8. Terminal
0. Field coil and pole shoe
10. Frame
11. insulating washer
12. Washer
13. Nut
14. Lockwasher
15. insulating bushing
16. Pole shoe screw
17. Outer bearing
18. Drive end frame pinion housing
19. intermediate bearing housing
20. Lockwasher
21. Screw
22. Bendix drive
23. Thrust washer
24. Pin
25. Armature
26. Commutator
27. Through bolt
23. insulator
29. intermediate bearing

13



3. Remove the brush holder from the frame.
4. Inspect the brushes. Replace all brushes if any are oil-soaked or worn to 1/4 in. or less.
5. Ground brushes are replaced by installing a new brush plate. To replace field brushes, cut the insulated brush leads as close as possible to the field coils. Attach new brush leads and solder the connections with rosin core solder and a 300-watt soldering iron.

NOTE

Always replace brushes in complete sets.

6. Install the brush holder. Pry the retaining springs open and insert the field brushes in their respective holders.
7. Install the thrust washer, plug and end plate. Install the 2 through bolts.

IGNITION SYSTEM

MerCruiser engines are equipped with either a breaker point ignition or a Thunderbolt (breakerless) ignition system.

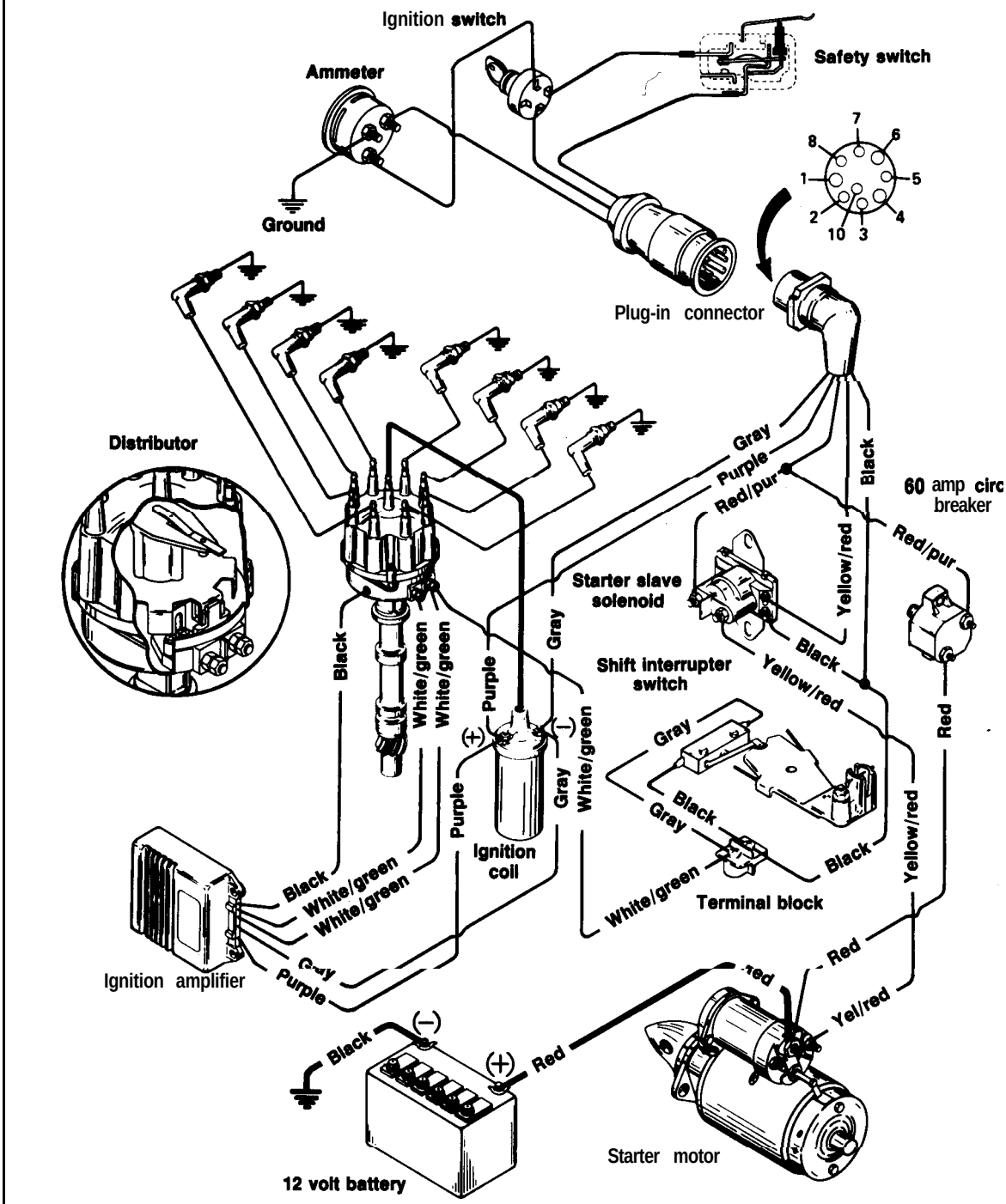
The breaker point system consists of a distributor (with breaker points and condenser), ignition coil, ignition switch, battery, spark plugs and connecting wiring. See **Figure 51.**

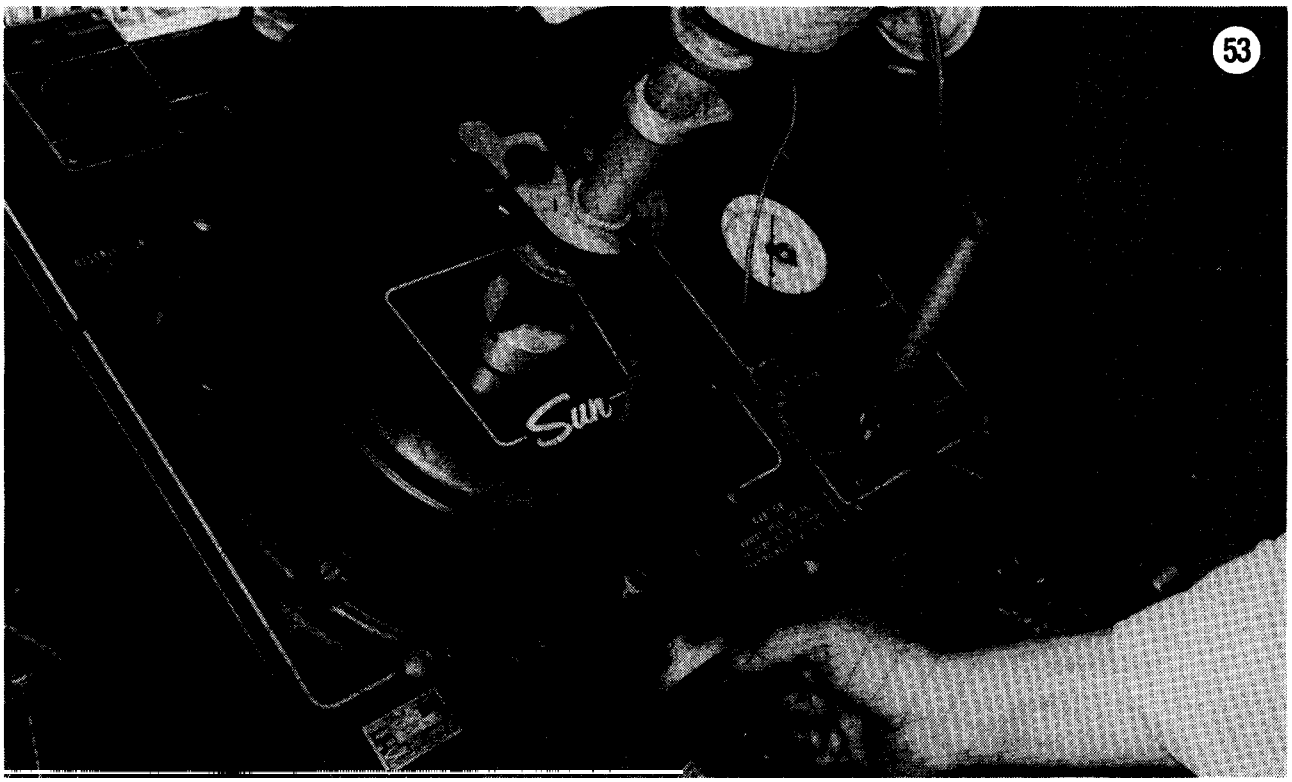
The Thunderbolt ignition consists of a distributor (with trigger or sensor assembly), ignition coil, switch box assembly, ignition switch, battery, spark plugs and connecting wiring. See **Figure 52.**

BREAKER POINT DISTRIBUTOR

Servicing

Marine distributors are heavy-duty units designed to withstand climatic and environmental abuse to which the typical automotive distributor is not subjected. For this reason, periodic care, cleaning and lubrication of the breaker point distributor is recommended for long service life. The following procedure can be adapted for use with any marine distributor used with MerCruiser engines.


Ignition switch
Ammeter
Safety switch
Ground
Plug-in connector
Distributor
Gray
Purple
Red/pur
Black
60 amp circ breaker
Red/pur
Starter slave solenoid
Yellow/red
Black
Shift interrupter switch
Yellow/red
Red
Gray
Black
White/green
White/green
Purple
Gray
White/green
Purple
Ignition coil
Gray
Black
Gray
Black
White/green
Terminal block
Yellow/red
Black
White/green
White/green
Ignition amplifier
Gray
Purple
Red
Red
Yel/red
Black
Red
12 volt battery
Starter motor



1. Remove the distributor as described in this chapter.
2. Clean the outside of the distributor with solvent and a brush to remove all dirt, grease and other contamination.
3. Remove the distributor cap and rotor. Inspect both as described in Chapter Four.
4. Have a dealer or qualified electrical shop test distributor operation on a synchroscope or distributor test machine **(Figure 53).** Have worn parts replaced as necessary.
5. Remove breaker point and condenser assembly. See Chapter Four.

NOTE

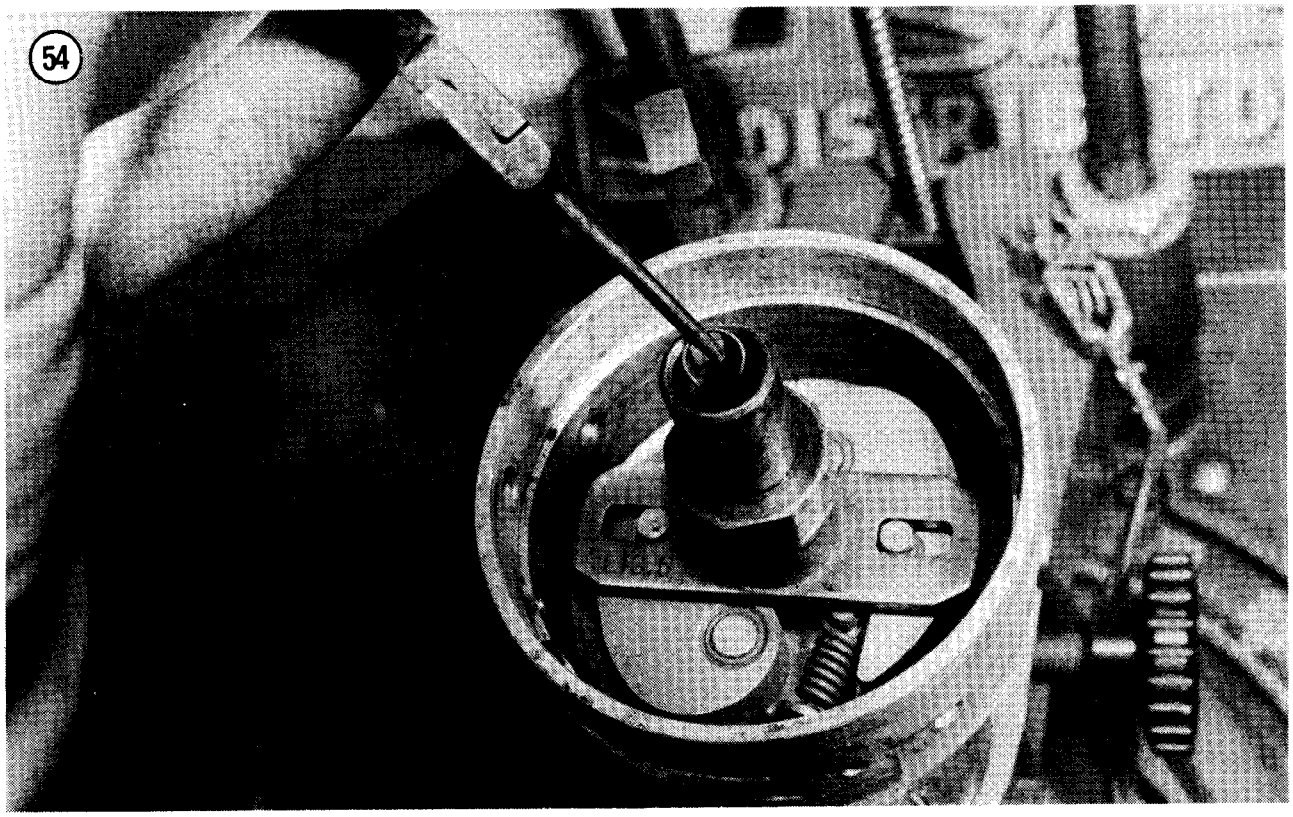
Steps 6-11 are not required on Delco-Remy &cylinder distributors that have the mechanical advance mechanism placed above the breaker point assembly.

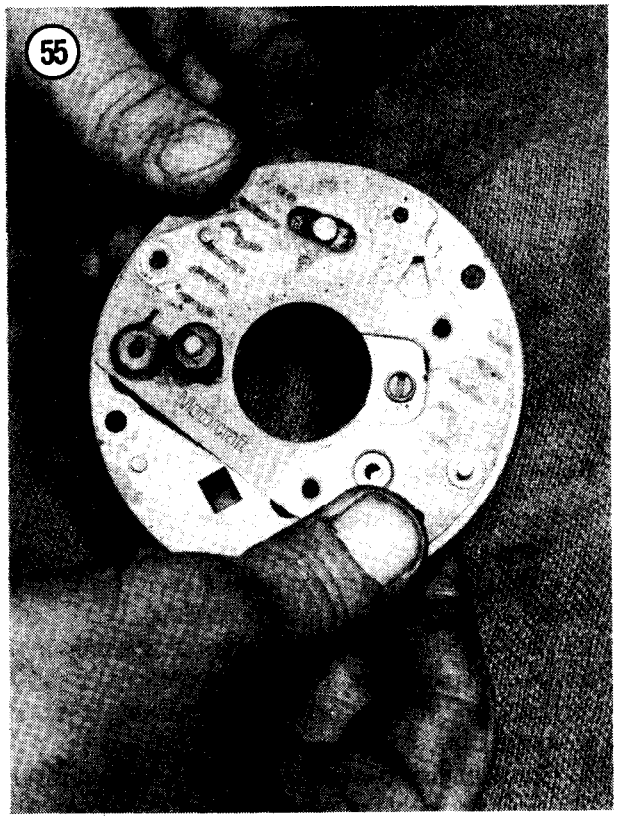
6. Remove breaker plate attaching screws. Lift or carefully pry on breaker plate and remove from distributor bowl.
7. Remove the felt lube washer (if so equipped) from the center of the cam assembly. Some distributors use a tiny wire retaining clip inside the cam assembly that must be removed after removing the felt lube washer. **See Figure 54.**
8. Remove the cam assembly from the distributor shaft.
9. Wipe inside of distributor bowl with a clean dry cloth. If more than a slight film of oil or crankcase vapors is present, wash inside of distributor bowl in cleaning solvent. If necessary, clean with a brush. When bowl and advance mechanism are clean, rinse in solvent and blow dry with compressed air.
10. Lightly lubricate distributor shaft with cam grease, then install the cam assembly. Install the retaining clip, if used, and the felt washer. Place a drop or two of engine oil on the washer.
11. Wipe the breaker plate with a clean dry cloth. Inspect plate for wear at pivot points. **See Figure** 55. Lubricate pivot points with cam grease. Reinstall breaker plate in distributor bowl.

NOTE

Some distributors use a felt lubricating wick mounted on the breaker plate. Always replace this wick with a new one when servicing the distributor.

12. Install breaker point and condenser assembly. See Chapter Four.
13. Install distributor in engine as described in this chapter.





Removal

1. Unsnap distributor cap retaining clips or remove retaining screws, as required. On Delco-Remy 8-cylinder distributor, depress each retaining latch with a stubby screwdriver and rotate 90".
2. Remove distributor cap with spark plug wires attached and place out of the way.
3. Disconnect the vacuum line from distributor vacuum advance unit, if so equipped.
4. Disconnect the distributor wiring harness. Scribe a mark on the distributor housing in line with the rotor tip. **See Figure** 56. Scribe a corresponding mark on the engine.
5. Remove the distributor hold-down bolt and clamp. Remove the distributor from the engine.

Installation
(Engine Not Rotated After Distributor Removal)

1. Install a new distributor mounting gasket (if used) in counterbore of engine block. Make sure the area is clean.

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2. Align the rotor tip with the mark scribed on the distributor housing during removal. Turn rotor about 1/8 turn counterclockwise past scribed mark. Position distributor to align housing mark with mark scribed on engine prior to removal. Slide distributor down into the engine.

NOTE

The rotor and shaft might have to be moved slightly to engage the distributor and camshaft gears and oil pump drive tang. However, the rotor should align with the scribed mark when the distributor is in its final position.

3. Install the distributor hold-down clamp and bolt. Do not tighten the bolt.
4. Install the distributor cap on the housing. Be sure the tang on the housing aligns with the cap slot and that the cap fits snugly on the housing.
5. Connect the distributor lead and set ignition timing. See Chapter Four. When timing is correctly adjusted, tighten distributor hold-down bolt snugly.

Installation
(Engine Rotated After Distributor Removal)

1. Remove the No. 1 spark plug. Hold a finger over the plug hole and crank the engine over or rotate the crankshaft pulley until compression pressure is felt. Continue to rotate engine slowly until the timing mark on the crankshaft pulley aligns with the TDC (zero) mark on the timing scale.

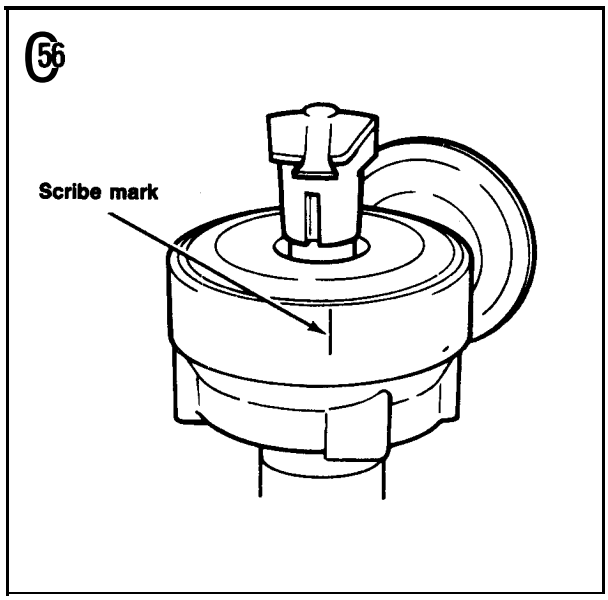
NOTE

Always rotate the engine in the direction of normal rotation. Do not back up engine to align timing marks,

2. Install a new distributor mounting gasket (if used) in the engine block counterbore. Make sure the area is clean.
3. Turn distributor shaft until the rotor tip points in the direction of the No. 1 terminal in the distributor cap. Turn the rotor 1/8 turn counterclockwise past the No. 1 terminal position. Slide the distributor into the engine.

NOTE

The rotor and shaft may have to be moved slightly to engage the distributor and camshaft gears and oil pump drive tang. However, the rotor should align with the No. I terminal when the distributor is in place.



4. Install the distributor hold-down clamp and bolt. Do not tighten bolt at this time.
5. Install the distributor cap on the housing. Be sure the tang in the housing aligns with the cap slot and that the cap fits down snugly on the housing.
6. Connect the distributor lead and set ignition timing. See Chapter Four. When timing is correctly adjusted, tighten the distributor hold-down bolt snugly.

THUNDERBOLT DISTRIBUTOR

The Thunderbolt distributor contains a trigger or sensor device which acts like a switch to make or break current flow when subjected to a magnetic field. Sensor switching is comparable to the points in a breaker point distributor. The amplifier provides ignition advance by controlling coil primary current. Distributor service should be performed by a dealer or qualified electrical shop.

Removal/Installation

1. Disconnect the negative battery cable.
2. Remove the switch box cover.
3. Disconnect the trigger leads (black, brown and white) from the switch box terminals.
4. Scribe a mark on the distributor housing under the No. 1 spark plug terminal in the cap.
5. Loosen distributor cap retaining screws. Remove cap.
6. Crank engine over or rotate crankshaft until the rotor aligns with the mark scribed in Step 4. Thr

timing mark on the torsional damper should align with the TDC (zero) mark on the timing scale.

NOTE

Always rotate the engine in the direction of normal rotation. Do not back up engine to align timing marks.

7. Remove the distributor ground wire screw at the intake manifold.
8. Remove distributor hold-down screw and clamp. Remove distributor from the engine. Remove and discard the distributor-to-intake manifold gasket.
9. Installation is the reverse of removal. If the crankshaft is rotated while the distributor is out of the engine, perform Step 1 of *Breaker Point Distributor Installation (Engine Rotated After Distributor Removal)* in this chapter to set the No. 1 piston at TDC on its compression stroke.

IGNITION COIL

The breaker point and Thunderbolt ignition coils are oil-filled, sealed units of standard size and shape. The Thunderbolt coil contains a special winding and core. A standard coil should not be used with a Thunderbolt ignition as its low output will cause it to overheat.

Whenever the coil secondary lead is removed from the coil tower, pack about 1/2 ounce of Quicksilver Insulating Compound (part No. 92-41669-1) into the secondary lead nipple before reinstalling it to the coil tower. Wipe off excess compound after wire is fully seated. This helps to make the coil connection waterproof.

Coils used with a breaker point ignition can be tested for resistance with any marine or automotive coil tester. Follow the manufacturer's instructions provided with the tester. See **Table 3** for specifications.

Coils used with a Thunderbolt ignition must be tested with the Thunderbolt ignition analyzer (part No. C-91-62563A1). Specifications for Thunderbolt coils are included in the analyzer test manual (part No. C-90-62900).

Removal/Installation

Breaker point ignition and Thunderbolt coils are serviced by disconnecting the electrical connections at the coil, removing the coil clamp bracket screw and lifting the coil from the bracket. Installation is the reverse of removal.

IGNITION RESISTANCE WIRE

A replacement ignition resistance wire (part No. 84-94227A2) is available and should be installed according to the instructions accompanying it if the old wire proves faulty. The test procedure used depends upon whether or not the engine is equipped with an electric choke heater element.

Testing (With Choke Heater Element)

1. Disconnect the positive coil lead at the coil.
2. Unplug the electric choke heater element connector at the carburetor.
3. Connect ohmmeter leads to the 2 disconnected choke heater wires. If reading is not within 1.8-2.0 ohms, replace the resistance wire.

Resistance Wire Test (Without Choke Heater Element)

1. Disconnect the positive coil lead at the coil.
2. Unplug the engine and instrumentation harness connectors.
3. Connect one ohmmeter lead to the disconnected coil lead.
4. Connect the other ohmmeter lead to the No. 5 terminal pin hole in the engine harness. If ohmmeter reading is not within 1.8-2.0 ohms, replace the resistance wire.

SWITCHES

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Switches can be tested with an ohmmeter or a self-powered test lamp. Continuity diagrams are provided where available for the switches discussed in this section. The continuity diagram shows which terminals should have continuity when the switch is in a given position. If a continuity diagram is not provided, refer to the wiring diagrams at the end of the book. If a switch does not perform properly, replace it.

Ignition Switch

Disconnect the negative battery cable when testing the ignition switch in the boat. Refer to **Figure** 57 and **Figure** 58 for this procedure.

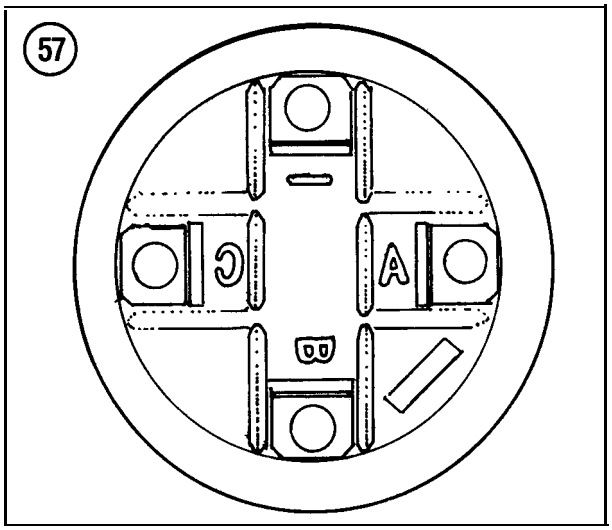
1. Test all switch terminals **(Figure** 57) with an ohmmeter or self-powered test lamp and the ignition key in the OFF position. There should be no continuity between the switch terminals.

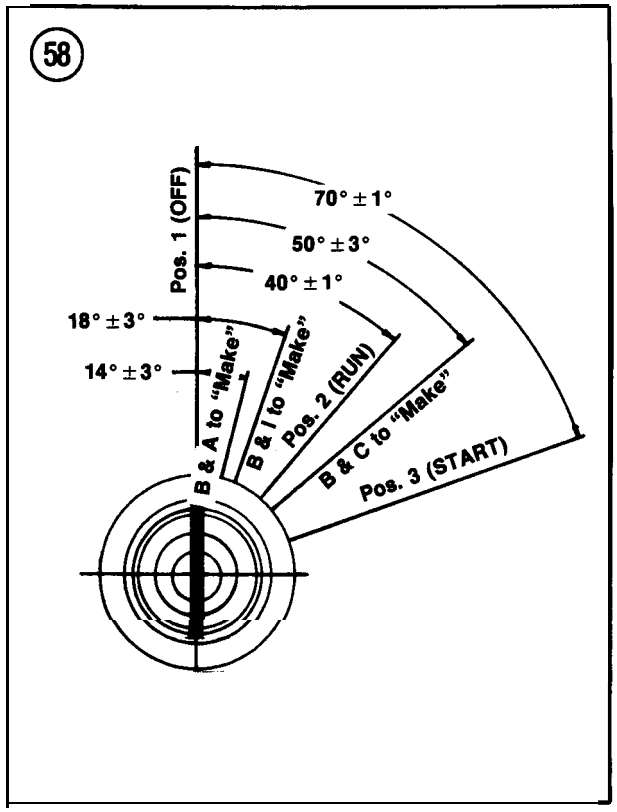
2. Turn the switch to the RUN position (No. 2) and test terminals. There should be continuity between terminals B and A and between B and I. There should be no continuity 'between the C terminal and any of the other terminals.
3. Turn the switch to the START position (No. 3) and test terminals. There should be continuity between terminals B and A, B and I and B and C.
4. Make sure terminals make contact at the angles shown in **Figure** 58. They must remain in contact as the switch is rotated to the START position.
5. If any switch position does not check out as described, unsolder the wires and remove the switch. Repeat Steps l-3 with the switch out of the dash. If the switch now performs as specified, the problem is in the wiring. If the switch still fails the continuity check, replace it.

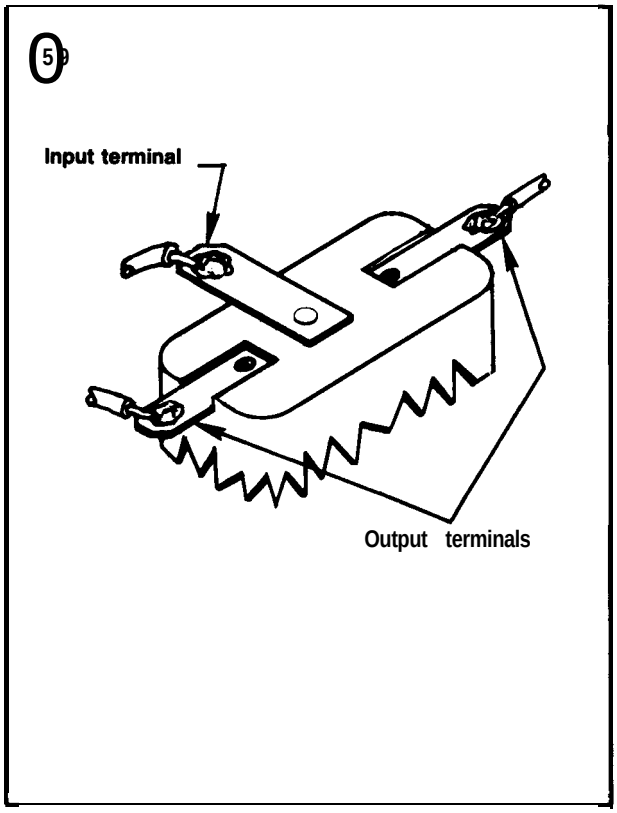
Two Station Tachometer Switch

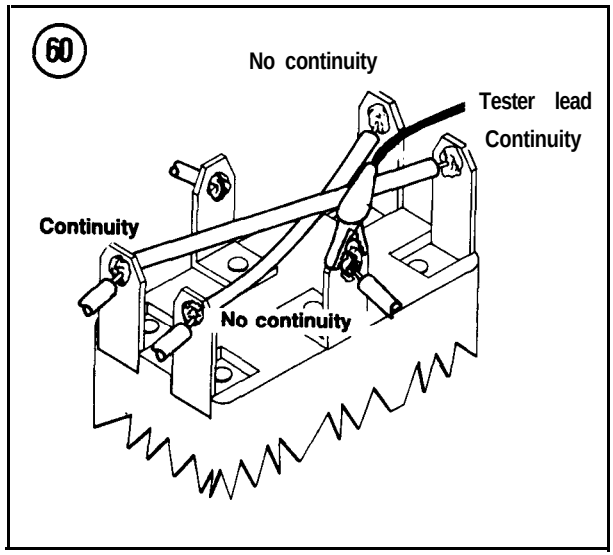
Single pole switch

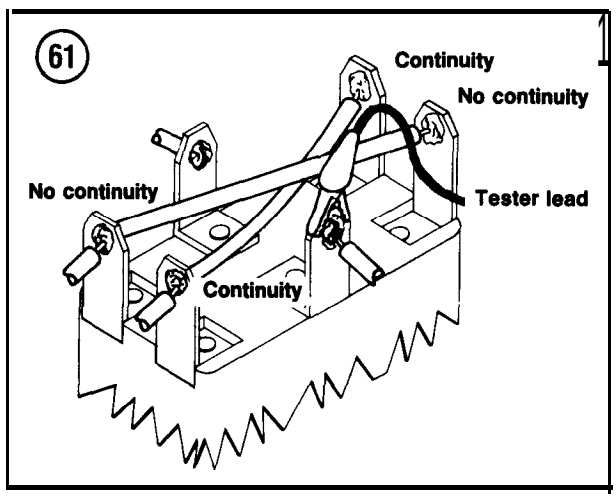
Refer to **Figure** 59 for this procedure.
1. Connect one ohmmeter lead to the input terminal and the other lead to one output terminal.
2. Note meter reading and operate switch. The meter should indicate continuity in one switch position and not continuity in the other.
3. Disconnect the ohmmeter lead at the switch output terminal and connect it to the other output terminal.
4. Repeat Step 2.
5. If the switch does not perform as described in Step 2 or Step 4, replace it.

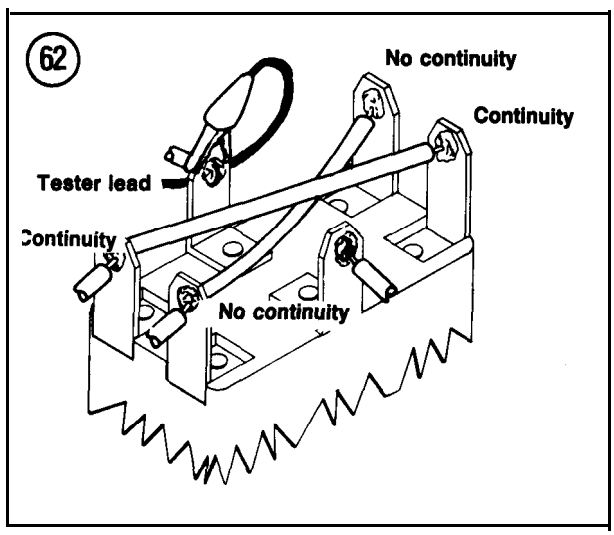








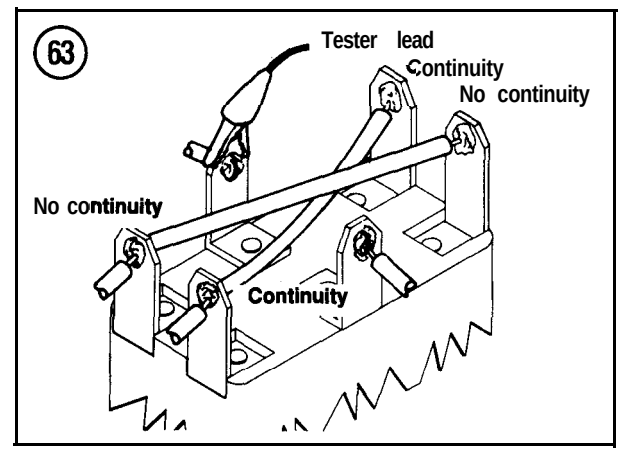


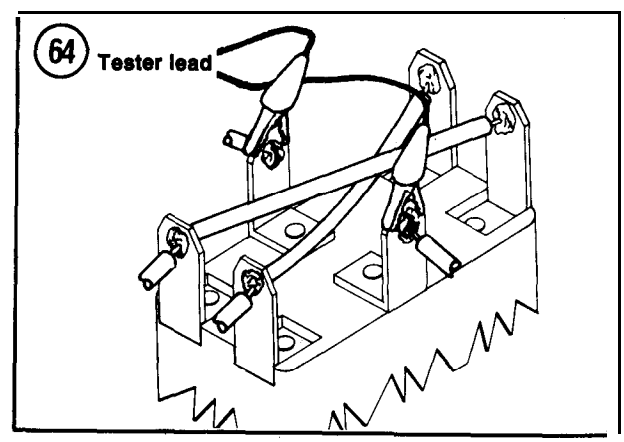


Double pole switch

Refer to **Figures 60-64** for this procedure.

1. Connect an ohmmeter lead to one center pole on either side of the switch **(Figure 60).**
2. Briefly touch the other ohmmeter lead to the switch end terminals in an "X" pattern while watching the meter scale. There should be continuity at one pair of switch terminals and no continuity at the other pair. **See Figure 60.**
3. Move switch to its other position and repeat Step 2. The continuity/no continuity pattern should reverse itself. **See Figure 61.**
4. Move the ohmmeter lead to the other center pole **(Figure 62).**
5. Repeat Step 2 and Step 3. The results should be the same. **See Figure** 63 and **Figure 64.**
6. Connect each ohmmeter lead to a center pole **(Figure 64).** There should be no continuity regardless of switch position.
7. If the switch fails any part of the continuity test, replace it.





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Switch Panel Test

Two-terminal switch

Refer to **Figure** 65 for this procedure.

1. Disconnect the switch panel harness from the battery.
2. Connect an ohmmeter between the red wire terminal and the wire leading to the fuse block.
3. Operate the switch. There should be continuity in one position and no continuity in the other. If not, replace the switch.

Six-terminal switch

NOTE

If switch is wired on one side only, perform only Steps 1-3.

Refer to **Figure** 65 for this procedure.

1. Disconnect the switch panel harness from the battery.
2. Connect one' ohmmeter lead to the red wire terminal. Move the switch to its center position. Touch the white wire terminal on each end of the switch with the other ohmmeter lead. There should be no continuity.
3. Move the switch to its ON position (either side of center). Touch the white wire terminal on each end of the switch with the other ohmmeter lead. This time, there should be continuity.
4. Repeat Step 3 with the switch in its other ON position. There should be continuity.
5. If the switch does not perform as described, replace it.

Switch removal installation

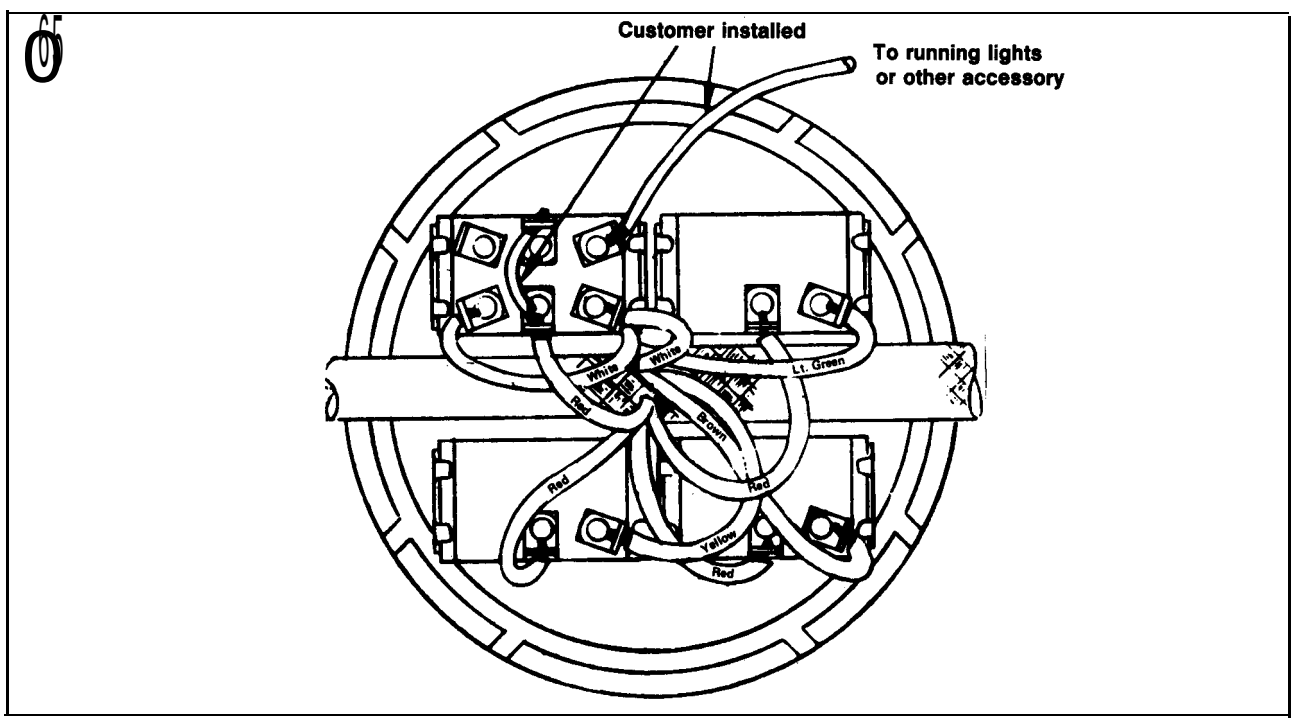
1. Disconnect switch panel wiring harness from the battery.
2. Remove the nut holding the switch to the panel. Remove switch from panel.
3. Unsolder the wire connections to the old switch. Solder the wires to the new switch terminals as shown in **Figure 65.**
4. Coat terminals with liquid neoprene (part No. C-92-2571 1).
5. Position the switch on the panel, install and tighten the nut. Connect wiring harness.

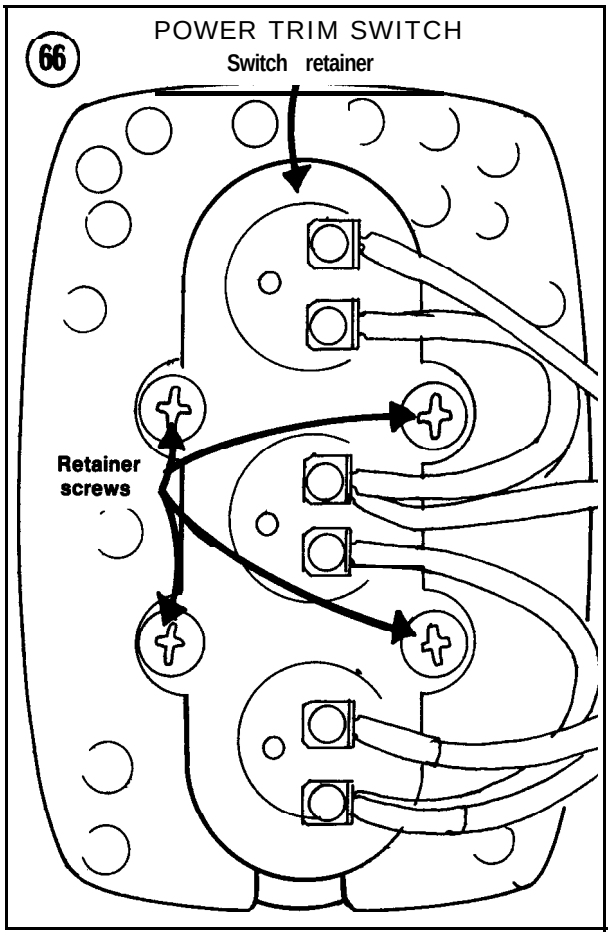
Power Trim Control Panel Switch

Three-button switch testing

Refer to **Figure** 66 for this procedure.

1. Disconnect trim pump wire harness.
2. Place one button in its free position and connect an ohmmeter between the corresponding terminals on the rear of the switch. There should be no continuity.





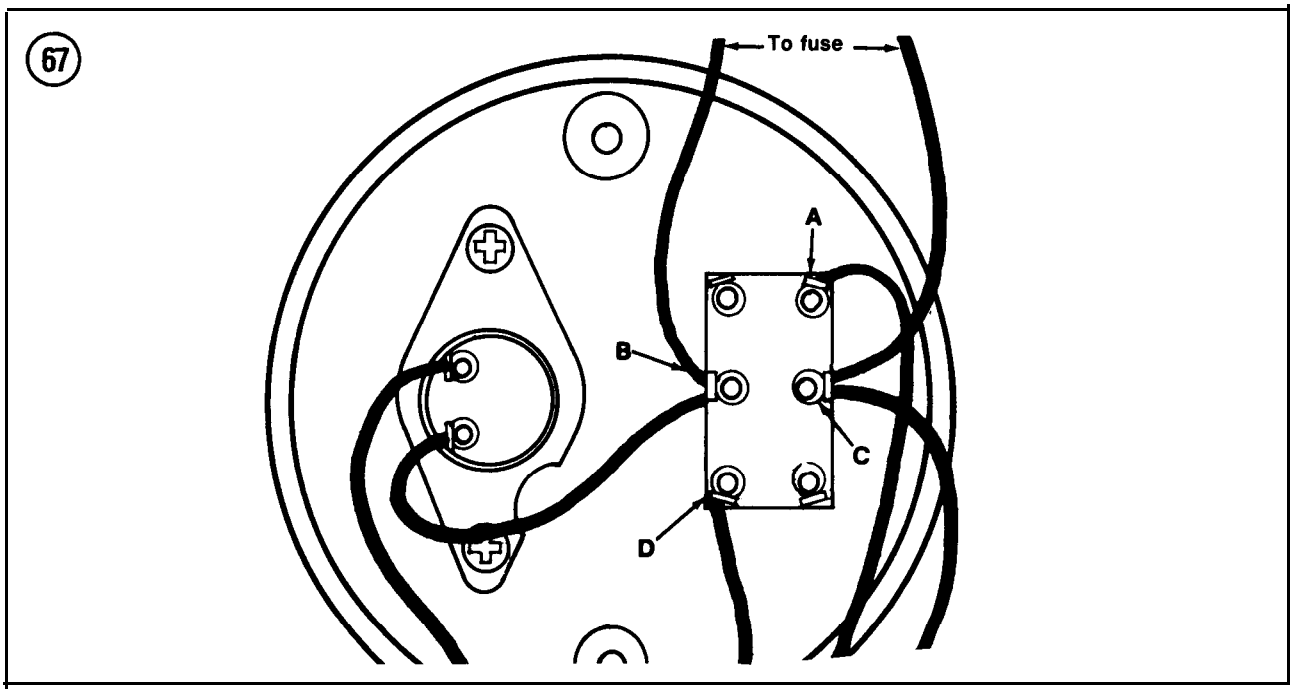
3. Depress button to set it in "ON" position and repeat Step 2. There should be continuity between terminals.
4. Repeat Step 2 and Step 3 for each remaining button.

Three-button switch removal/installation

1. Disconnect the power trim pump harness.
2. Remove control panel from its mounting hole.
3. Remove the retainer screws from the rear of the switch. Remove retainer and switch from control panel.
4. Unsolder the wire connections from the old switch. Solder the wires to the new switch terminals as shown in **Figure 66.**
5. Coat the wire terminals with liquid neoprene (part No. C-92-257 11).
6. Reverse Steps l-3 to install the switch.

Toggle switch testing

Refer to **Figure** 67 for this procedure.
1. Disconnect the power trim pump harness.
2. Connect ohmmeter leads between the 2 TRAILER button terminals. There should be no continuity with the button in its free position; there should be continuity with the button depressed.
3. Connect ohmmeter leads between B and C terminals. There should be continuity. If not, check



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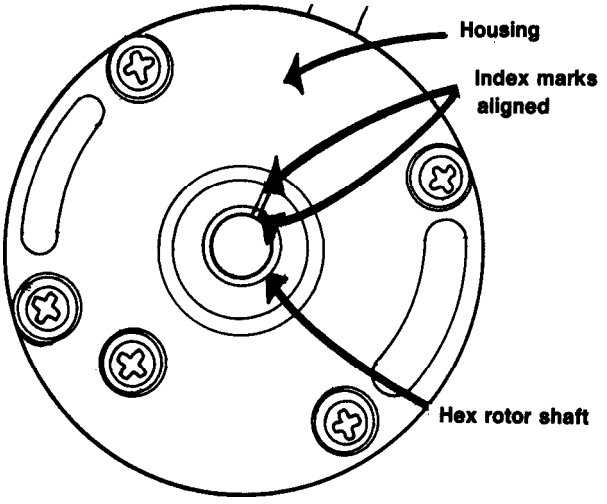
68 POWER TRIM ROTARY SENDER



the fuse at the fuse block. If the fuse is good, replace the switch.
4. Center toggle switch and connect ohmmeter leads between A and C terminals. There should be no continuity with the button in its free position, there should be continuity with the button depressed.
5. Repeat Step 4 with terminals B and D. The results should be the same.
6. If continuity does not exist as described, replace the switch.

Toggle switch removal installation

1. Disconnect the power trim pump harness.
2. Remove control panel from its mounting hole.
3. Remove the hex nut from the front of the switch. Remove switch from control panel.
4. Unsolder wire connections from the old switch. Solder the wires to the new switch terminal as shown in **Figure** 67. Coat the wire terminals with liquid neoprene (part No. C-92-2571 1).
5. Reverse Steps 1-3 to install the switch.

Power Trim Indicator Sender

Linear sender test

1. Remove sender unit and connect an ohmmeter to the sender leads.
2. Depress the sender plunger with a pencil. Sender resistance should be O-l 60 ohms (single installations) or O-80 ohms (dual installations).
3. If the meter needle does not move or if its movement is erratic, replace the sender.

Rotary sender switch

Refer to **Figure 68** for this procedure.
1. Remove sender unit and connect an ohmmeter to the sender leads.
2. Align sender housing and rotor shaft index marks. Sender resistance should be O-l 60 ohms (single installations) or O-80 ohms (dual installations).
3. If the meter needle does not move or if its movement is erratic, replace the sender.

Neutral Safety Switch

1. Disconnect switch leads from starter solenoid or relay and terminal block on flywheel.
2. Connect an ohmmeter between the switch leads. Shift the remote control into NEUTRAL, FORWARD and REVERSE. The ohmmeter should indicate continuity only as the remote control is shifted into NEUTRAL.
3. If continuity is shown in FORWARD or REVERSE, or if there is no continuity in NEUTRAL, replace the switch.

Table 1 **MERCRUISER** BATTERY REQUIREMENTS

Engine	Cold cranking amperage
120	305
140	375
165	375
165	350
226	305
260	350
330,370	450
485, 488, 470	450
696	305

Table 2 BATTERY CHARGING GUIDE (6- AND 12-VOLT BATTERIES)

	Recommended rate* and time for fully discharged condition					
Twenty hour rating	5 amps	10 amps	20 amps	30 amps	40 amps	50 amps
50 amp-hrs. or less	10 hrs.	5 hrs.	2 1/2 hrs.	2 hrs.		
Above 50 to 75 amp-hrs.	15 hrs.	7 1/2 hrs.	3 1/4 hrs.	2 1/2 hrs.	2 hrs.	1 1/2 hrs.
Above 75 to 100 amp-hrs.	20 hrs.	10 hrs.	5 hrs.	3 hrs.	2 1/2 hrs.	2 hrs.
Above 100 to 150 amp-hrs.	30 hrs.	15 hrs.	7 1/2 hrs.	5 hrs.	3 1/2 hrs.	3 hrs.
Above 150 amp-hrs.		20 hrs.	10 hrs.	6 1/2 hrs.	5 hrs.	4 hrs.

* Initial rate for constant voltage taper rate charger
To avoid damage, charging rate must be reduced or temporarily halted if:
1. Electrolyte temperature exceeds 125°F (52°C).
2. Violent gassing or spewing of electrolyte occurs.
Battery is fully charged when, over a two hour period @ a low charging rate in amps, all cells are gassing freely and no change in specific gravity occurs. For the most satisfactory charging, the lower charging rates in amps are recommended.
Full charge specific gravity is 1.260-1.280, corrected for temperature with electrolyte level @ split ring.

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Table 3 COIL SPECIFICATIONS

	Prestollte	Delco-Remy
Primary resistance		
Minimum	1.1 ohms	0.9 ohms
Maximum	1.5 ohms	1.2 ohms
Secondary resistance	9,500-15,000 ohms	7,500-10,500 ohms

Table 4 **MERCRUISER** WIRING COLOR **CROSS-REFERENCE**

Old color	BIA (new) color	**Application**
Black	Black	All grounds
Black	Brown	**MerCathode** reference electrode
Black	Orange	**MerCathode** anode electrode
Blue	Lt. blue/white	Trim up switch
Brown	Gray	Tachometer signal
Green	Green/white	Trim down switch
Green	Tan	Water temperature sender to gauge
Orange	Lt. blue	Oil pressure sender to gauge
Pink	Pink	Fuel gauge sender to gauge
Purple	Brown/white	Trim sender to trim gauge
Purple	Purple/white	Trim trailer switch
Red	Red	Unfused wires from battery
Red	Red/purple	Fused wires from battery
Red	Red/purple	Fused wires to trim panel
Red/white	Orange	Alternator output to ammeter
Tan	Purple/yellow	Ballast bypass
White	Purple	Ignition switch
Yellow	Yellow	Starter solenoid to starter motor (Model 470)
Yellow	Yellow/red	Starter switch to starter solenoid to neutral start switch