

ELECTRICAL SYSTEMS

Section 4B - Thunderbolt V Ignition System

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Replacement Parts Warning

WARNING

Electrical, ignition and fuel system components on your MerCruiser power package are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components that do not comply with these rules and regulations could result in a fire or explosion hazard and should be avoided.

General Precautions

CAUTION

Avoid personal injury and/or property damage. Listed below are some of the precautions, along with others listed throughout this manual, that you should observe to help ensure an accident-free maintenance experience:

- Always disconnect battery cables from battery BEFORE working on electrical system to prevent injury to yourself or damage to electrical system.
- Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of fire.
- Be sure to keep hands, feet and clothing clear of moving parts.
- DO NOT touch or disconnect any ignition system parts while engine is running.
- DO NOT reverse battery cable connections. System is negative (–) ground.
- DO NOT disconnect battery cables while engine is running.
- When working on engine, spark plug holes and carburetor throat should be kept covered to prevent foreign objects from entering combustion chamber.
- Replace a component if there is any doubt as to the condition of the component.

WARNING

When performing the following procedure, be sure to observe the following:

- Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of fire.
- Be sure to keep hands, feet and clothing clear of moving parts.
- DO NOT touch or disconnect any ignition system parts while engine is running.
- DO NOT reverse battery cable connections. System is negative (–) ground.
- DO NOT disconnect battery cables while engine is running.

EFI System Maintenance Precautions

WARNING

Avoid Injury or Electrical System Damage: Always disconnect battery cables from battery before working around electrical system components. See CAUTION following:

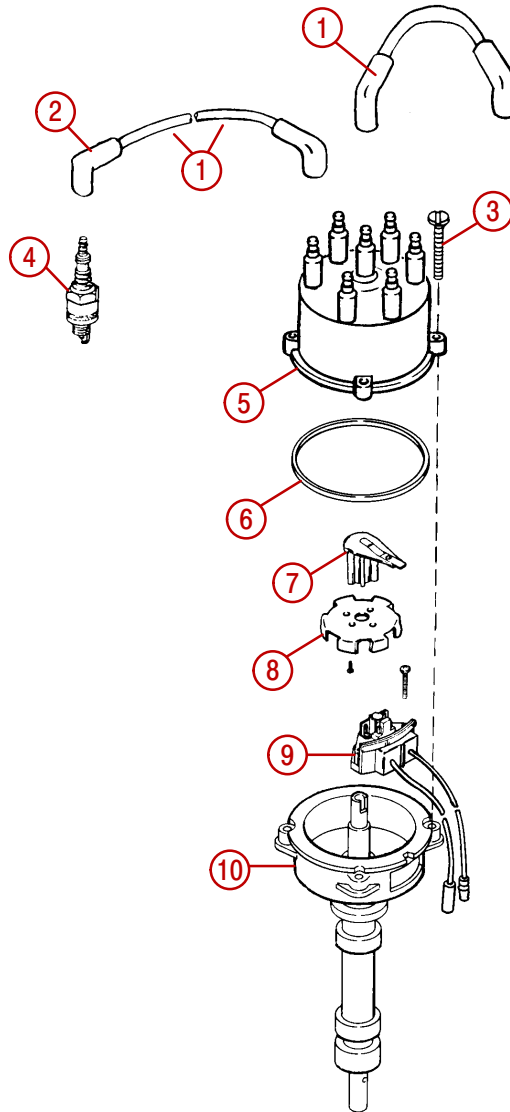
CAUTION

Avoid damage to the EFI electrical system components: Refer to the following precautions when working on or around the EFI electrical harness, or when adding other electrical accessories:

- DO NOT tap accessories into engine harness.
- DO NOT puncture wires for testing (Probing).
- DO NOT reverse battery leads.
- DO NOT splice wires into harness.
- DO NOT attempt diagnostics without proper, approved Service Tools.

Thunderbolt V Ignition System

Identification



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- 1 - Cable Kit - Ignition (Spark Plug and Coil)
- 2 - Boot
- 3 - Screw
- 4 - Spark Plug
- 5 - Cap
- 6 - Gasket
- 7 - Rotor
- 8 - Sensor Wheel
- 9 - Sensor Assembly
- 10 - Housing

Timing and Idle Adjustment Procedures

Setting Base Ignition Timing

1. Connect timing light (91-99379 or similar) to No. 1 spark plug wire. Connect power supply leads, if applicable, on light to 12 volt battery.
2. Connect a shop tachometer to engine.
3. Using a jumper wire, connect the ignition system timing lead (PUR/WHT wire) to a good engine ground (-). This locks the ignition module into the Base Timing Mode.

NOTE: Before starting engine make sure the timing tab and marks on damper are clean. Chalk or white paint on timing marks may help visibility.

4. Start engine and run at normal idle speed. Allow engine to reach normal operating temperature.
5. Aim timing light at timing tab, located on the timing gear cover and crankshaft torsional damper.
6. If adjustment is required, adjust timing by loosening distributor clamp and rotating distributor body as required until timing mark on damper or pulley lines up with the mark on tab specified in "Specifications." Tighten clamp and recheck location of timing mark.
7. Make sure that the distributor has been tightened. Remove the jumper wire from the timing terminal.
8. Remove jumper wire between the timing lead (PUR/WHT wire) and ground (-).

IMPORTANT: Be sure to disconnect the jumper wire from between the ignition system timing lead and ground (-) before attempting to resume normal operations. If the jumper wire is left in place, the ignition module will operate in the Base Timing Mode. This means that the additional timing advance features would not function.

9. Stop engine and remove timing light.

Adjusting Idle Mixture

The procedure for adjusting carburetor idle mixture can be found in the appropriate engine service manual. This procedure also requires that the ignition module be locked in the "Base Timing Mode."

IMPORTANT: In order to properly set idle mixture, the ignition module **MUST BE locked in the Base Timing Mode.** This is necessary because of the Idle Speed Control feature that exists in the ignition module. See information on the previous pages about this feature.

To adjust the idle mixture screw correctly, the throttle plates must be nearly closed. Please do the following:

1. Disconnect throttle cable.
2. Set idle speed (rpm) screw so engine idles at 550-600 rpm in neutral gear.
3. Adjust idle mixture screw.
4. Reset the idle speed screw until engine idles at its recommended rpm.
5. Adjust and connect throttle cable.

Spark Plugs

Specifications

Model	4.3L / 4.3LH	4.3L EFI
Spark Plug Gap	.045 in. (1.1 mm)	
Spark Plug Type	AC-MR43LTS NGK-BPR6EFS Champion RS12YC	

Removal

1. Disconnect spark plug wires (high tension leads) from spark plugs.

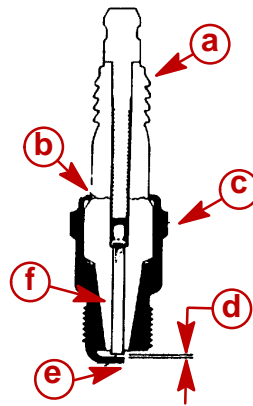
NOTE: Use care when removing spark plug wires and boots from spark plugs. Twist the boot 1/2 turn before removing. Firmly grasp and pull on the **boot** to remove the wire end.

2. Remove spark plugs.

NOTE: A "thin-walled" spark plug socket may be required.

Inspection

1. Inspect each spark plug for manufacturer and spark plug number. All plugs must be from the same manufacturer and have the same spark plug number. Refer to SECTION 1B. - "Specifications" for spark plug numbers.
2. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelain and replace where necessary.

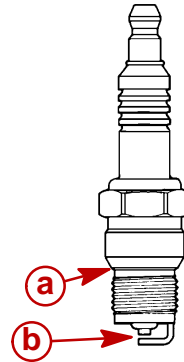


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- a** - Porcelain Insulator
- b** - Insulator - Cracks Often Occur at This Point
- c** - Shell
- d** - Proper Gap
- e** - Side Electrode
- f** - Center Electrode (When Adjusting Gap - DO NOT Bend)

Replacing

1. Clean the plug seating area on the cylinder heads.
2. Adjust spark plug gap with a round feeler gauge. Bend side electrode to adjust gap. Refer to SECTION 1B – “Specifications” for correct spark plug gap.



- a** - Seating Area
b - Gap

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IMPORTANT: It is recommended that spark plugs be torqued to the amount specified. In the absence of a torque wrench or access problems to the plugs, the spark plugs should be hand tightened until the plug seats on the cylinder head. Then, securely tighten with appropriate wrench and socket.

3. Install spark plugs and torque to specifications. Refer to “Torque Specifications” in this section.
4. Install spark plug wires in proper order. Refer to “Engine Rotation and Firing Order” and/or “Spark Plug Wires,” following.

Description

The Thunderbolt V ignition system has several spark control features that will be described following:

- Idle Speed Spark Control
- Acceleration Spark Advance
- Mean-Best-Timing Spark Advance
- Over-Speed Control (Rev-Limiter)
- Knock Retard Spark Control

Idle Speed Spark Control

The ignition module will control ignition timing to maintain a calibrated idle speed. This is accomplished by making small spark advance adjustments. This feature is only active within a certain rpm range. This range may be slightly different from one engine model to another. The approximate range is 400-700 rpm.

Acceleration Spark Advance

This feature is active during acceleration only. When accelerating, the ignition module may add more spark advance to the “Base Spark Timing Curve”. The amount of spark advance added, is totally dependant on how fast rpm increases (how fast the throttle is moved). This feature is also active within a certain rpm range. This range may be slightly different from one engine model to another. The approximate rpm range for this feature is 1200-4000 rpm. Within this range, the module can add approximately 10 degrees of spark advance to the base spark timing curve.

Mean-Best-Timing (MBT) Spark Advance

During light load cruising, the ignition module searches for the optimal ignition timing. This is also accomplished by small changes to the spark advance. At a given rpm, the module will try to add a small amount of advance and wait to see if there is an rpm change. If rpm increases, it will try to increase timing more. The module will continue to advance timing until it no longer gets an increase in rpm. Conversely, if it senses an rpm drop, it will start to retard some of the spark timing. The approximate rpm range for this feature is 1200-4000 rpm. Within this range, the ignition module can add approximately 10-15 degrees of spark advance to the base spark timing curve.

NOTE: *The Audio Warning System is also connected into the ignition module circuit. If the audio warning system becomes activated by the closing of one of the audio warning system switches, the MBT feature is deactivated.*

Over-Speed Control

The ignition module will prevent the engine speed from exceeding a preset limit by stopping the spark. This feature has an rpm range that varies from model to model. The over-speed limit for a particular engine is set slightly higher than the top end of the rpm range for that model. For example, if the recommended range is 4600-5000 rpm, the over-speed limit would be set at 5100 rpm. When rpm reaches this limit, spark is turned-off until engine rpm drops down to a “Reset rpm”, which would be approximately 4750 rpm for this example. At this point, spark comes back on.

Knock Retard Spark Control

The knock control feature helps provide protection from harmful detonation. Knock control is handled by the Knock Control Module. This module receives a signal from a sensor that is mounted on the engine block. The knock control module works in conjunction with the ignition module to retard the timing if spark knock is present.

Spark Plug Wires

1. Inspect spark plugs for damage.
2. Check spark plugs for continuity using Multi-Meter / DVA (91-99750) or similar.
3. Replace any wires that are cracked, cut, or have damaged spark plug boots.
4. Replace any wires that do not show continuity from end to end.
5. Reinstall wires in proper order. Observe the following:

IMPORTANT: Proper positioning in spark plug wire supports is important to prevent cross-firing.

IMPORTANT: Before installing coil wire to coil, apply approximately 1/2 oz of insulating compound around top of coil lead tower. Force nipple into coil and wipe off excess. Make sure boot does not hydraulically remove from the distributor cap terminal.

Adjusting Engine Idle Speed

This procedure should be done with boat in the water, drive unit in neutral and engine at normal operating temperature. Refer to the SECTION 1B - "Specifications" for the correct idle speed.

1. Disconnect the throttle cable from carburetor.

IMPORTANT: In order to properly set idle speed, the ignition module MUST BE locked in the Base Timing Mode. This is necessary because of the Idle Speed Control feature that exists in the ignition module. See information on the previous pages about this feature.

2. Connect a shop tachometer to engine.
3. Using a jumper wire, connect the ignition system timing lead 13 (PUR/WHT wire) to a good engine ground (-). This locks the ignition module into the Base Timing Mode.
4. Start engine and allow it to reach normal operating temperature.
5. Adjust idle speed to recommended rpm.
6. Stop engine. Readjust cable barrel and reinstall the throttle.

IMPORTANT: Be sure to disconnect the jumper wire from the ignition system test terminal before attempting to resume normal operations. If the jumper wire is left in place, the ignition module will operate in the Base Timing Mode. This means that the additional timing advance features would not be functioning.

7. Remove the jumper wire from the timing terminal.

Circuit Description

Refer to the circuit wiring diagram on the following page for reference to this circuit description.

Ignition Control Module

- The ignition module receives its power (+) thru the PUR wire “9”.
- Ignition module ground (–) is accomplished thru the BLK wire “10”.
- There is also a Case Ground (–) wire “12” that is connected to one of the ignition module attaching screws.
- The 12 volt signal from the ignition module to the distributor is carried through the WHT/RED wire “8”, to the distributor sensor and back to the ignition module through the WHT/GRN wire “7”.
- The tachometer signal is carried to the instrument panel thru the GRY wire “11”.
- The PUR/WHT wire “3” carries the signal from the knock control module to the ignition control module.
- There are two BLK wires “5” that have bullet connectors. This circuit is reserved for future options. On current models, the two BLK wires must be connected for the system to function properly.
- The TAN/BLU wire “6” carries a signal from the audio warning circuit to the ignition module.

Knock Control Module

- The knock control module receives its power (+) from the PUR wire “4”.
- Knock module ground (–) is accomplished thru the BLK wire “2”.
- The PUR/WHT wire “3” carries the signal from the knock control module to the ignition control module.
- The BLU wire “1” carries the signal from the knock sensor to the knock module.

Ignition Control System Timing Lead

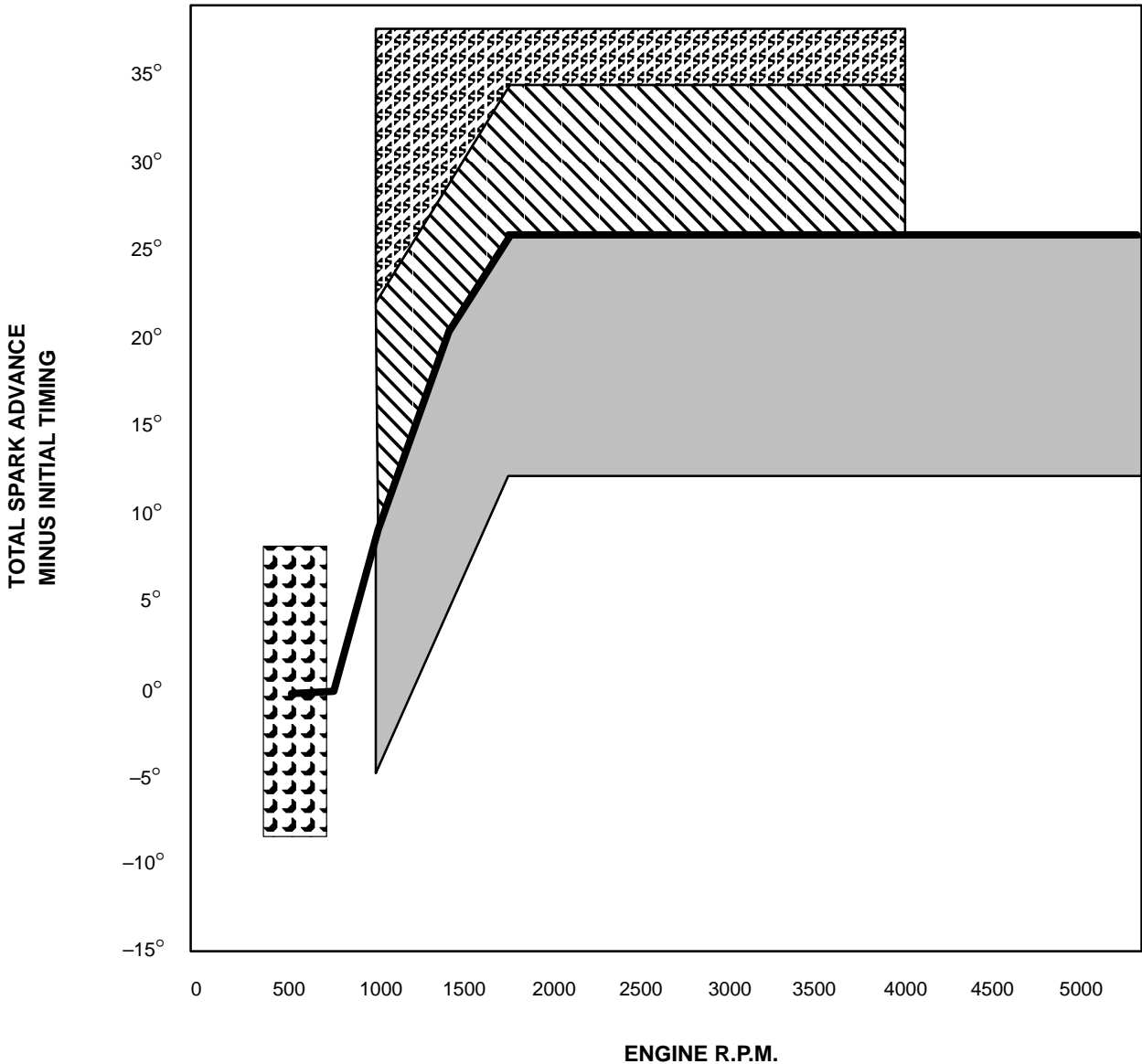
The ignition control system has a lead with bullet connector “11” that is connected into the PUR/WHT wire “3”. This lead is used for performing the following tests and procedures:





- Setting Base Ignition Timing
- Setting Engine Idle Speed
- Setting Idle Mixture
- Testing Knock Control Circuit

This lead, when connected to an engine ground (–), locks the ignition control module into the Base Timing mode.

Thunderbolt V Spark Control Graph

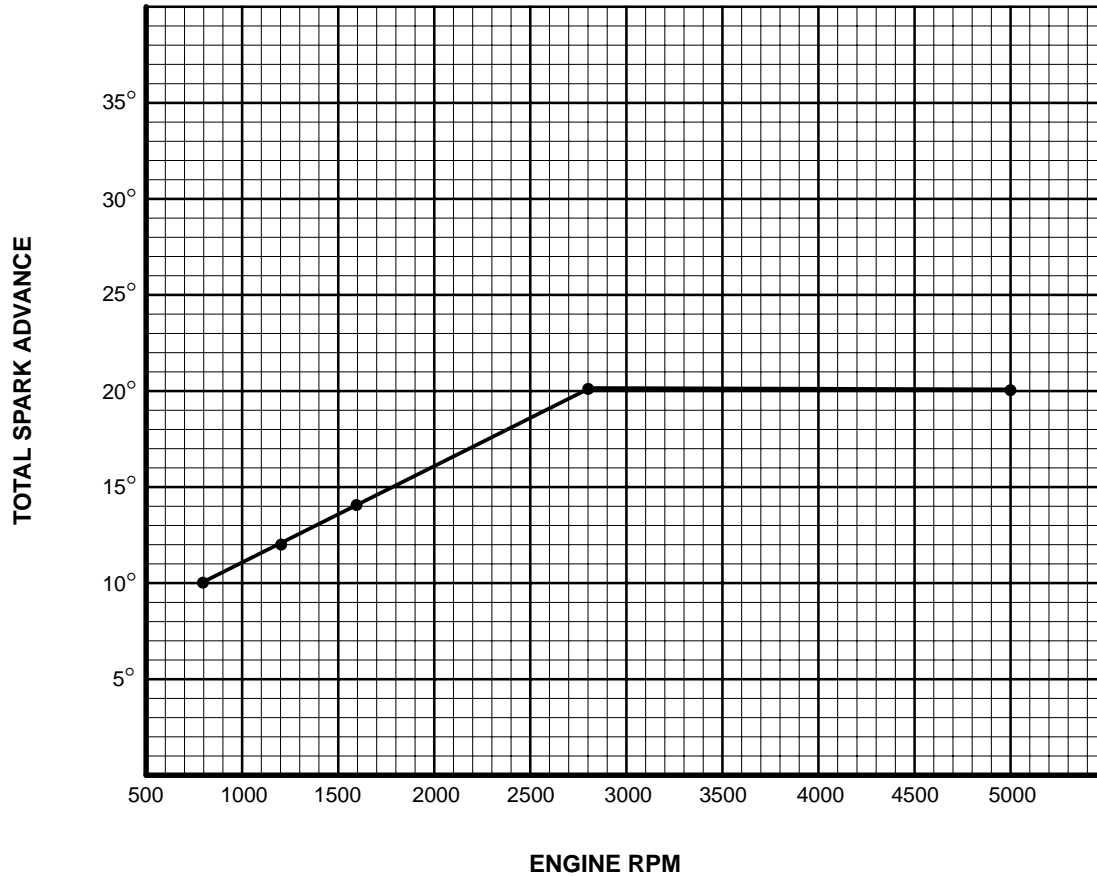
IMPORTANT: The graph below shows the typical advance ranges for a Thunderbolt V ignition control module. The numbers plotted on the graph are not representative of any particular model. It is only presented to provide an understanding of how the system functions.



- = Base Timing Advance Curve
-  = Idle Speed Advance Range
-  = Knock Retard Range
-  = Acceleration Advance Range
-  = MBT Advance Range

Distributor Advance Curves

1. Distributor advance curve charts do not include the initial engine timing. Basic initial timing must be added to chart for total advance curve.
2. The spark advance is controlled by the ignition module.



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Distributor

Removal

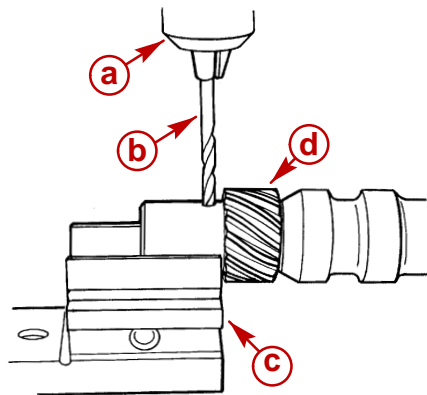
1. Unplug wiring harness from ignition amplifier on distributor housing.
2. Remove distributor cap. Do not remove high tension leads unless necessary.
3. Crank engine over until timing marks line up and rotor is pointing toward No. 1 cylinder on distributor cap.
4. Mark distributor housing in reference to engine block.
5. Remove bolt and hold-down clamp and remove distributor.
6. To simplify distributor installation, do not turn crankshaft when distributor is removed from engine.

Disassembly

1. Remove rotor, sensor wheel and sensor.
2. Remove roll pin, washer and driven gear from distributor shaft.
3. Check for side play between shaft and distributor housing bushings. Maximum side play is .002 in. (0.05 mm).
4. Remove shaft from housing and check shaft for being bent with a dial indicator and V-blocks. Maximum runout is .002 in. (0.5 mm).

Reassembly

1. Lubricate shaft with engine oil. Install E-clip (if removed) on shaft in housing.
2. Install washer on shaft. Install original gear; slide onto shaft and install roll pin.
3. Hole may be offset and gear will only fit in one direction.
4. If installing a new gear, the gear will come drilled on one side. Slide gear onto shaft; align hole in gear with hole in shaft. Using these holes as guides, drill through other side of gear with a 3/16 in. carbide tipped drill.
5. If a new gear has only a dimple, you will have to drill through one side of the gear before you slide gear onto shaft. In most cases it is recommended to have a machine shop complete the drilling operation for new gear installation.



- a** - Drill Press
- b** - 3/16 In. Carbide Tip Drill
- c** - V - Block
- d** - New Gear

6. Install sensor, sensor wheel and rotor.
7. Install distributor.

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Installation - Engine Not Disturbed

1. Install new gasket on distributor housing.
2. Turn rotor approximately 1/8-turn in a counterclockwise direction past mark previously scratched on distributor housing.
3. Work distributor down into position in engine block with distributor positioned as noted during removal.
4. It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place. Distributor shaft must enter oil pump shaft for complete installation.
5. Replace and tighten distributor hold-down bolt and clamp. Connect leads. Also install spark plug and coil secondary wires, if removed.
6. Install cap. Refer to "Spark Plug Wires" and install wires.
7. Plug wiring harness into ignition amplifier on distributor housing.
8. Time ignition as outlined under "Ignition Timing."

Installation - Engine Disturbed

CAUTION

If timing chain has been aligned as outlined in Section 3A - "Timing Chain and Sprocket," the No. 4 cylinder is on compression (TDC) and the distributor MUST BE installed with the rotor positioned at the No. 4 post on the distributor cap.

Electrical timing on No. 1 spark plug remains the same as outlined following.

1. Locate No. 1 piston in firing position by either of two methods described below.
 - a. Remove No. 1 spark plug and, with finger on plug hole, crank engine until compression is felt in No. 1 cylinder. Continue cranking until pointer lines up with timing mark on crankshaft pulley, or
 - b. Remove rocker cover and crank engine until No. 1 intake valve closes, continuing to crank slowly until pointer lines up with timing mark on crankshaft pulley.
2. Position distributor to opening in block in normal installed attitude.
3. Position rotor to point toward No. 1 cylinder on cap (with distributor housing held in installed attitude), then turn rotor counterclockwise approximately 1/8-turn more and push distributor down to engage camshaft. It may be necessary to rotate rotor slightly until camshaft engagement is felt.
4. While pressing down firmly on distributor housing, engage starter a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and snug up bolt.
5. Place distributor cap in position and check that rotor lines up with terminal for No. 1 spark plug. Install cap.
6. Refer to "High Tension Leads" and install wires. Refer to "Specifications" for firing order.
7. Time ignition as outlined under "Ignition Timing."

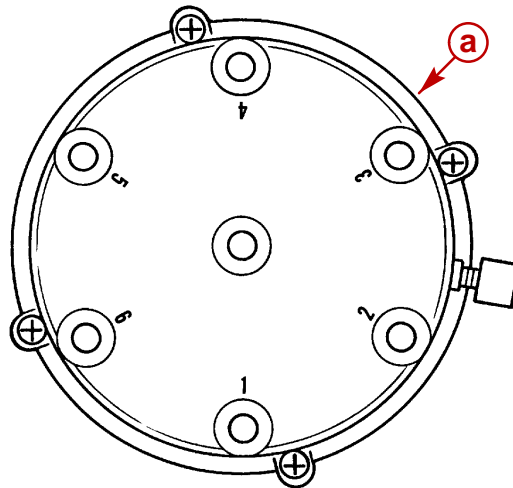
Distributor Cap

Removal

1. Loosen four distributor cap retaining screws.
2. Remove distributor cap.

Inspection

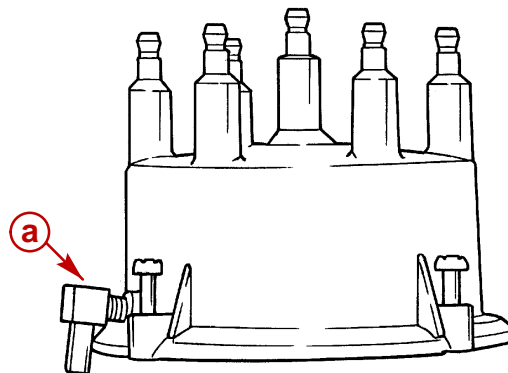
1. Clean cap with warm soap and water and blow off with compressed air.
2. Check cap contact for excessive burning or corrosion. Check center contact for deterioration.
3. Check cap for cracks or carbon tracks using magneto analyzer.
4. Check condition of distributor cap gasket. Replace gasket if damaged or missing.
5. If high tension leads are removed from cap refer to "Spark Plug Wires" in this section and the following illustrations for installation.



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Wiring

a - Alignment Notch



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a - Vent

Rotor/Sensor Wheel

Removal

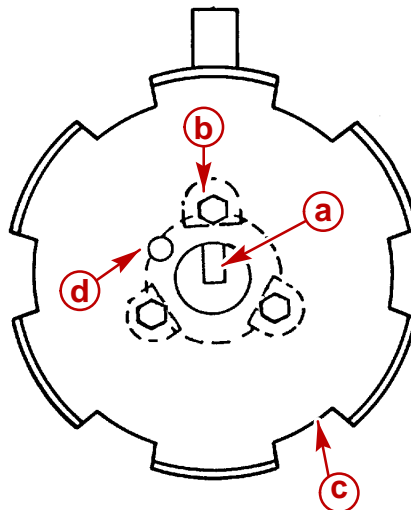
1. Remove distributor rotor/sensor wheel assembly from distributor shaft. Rotor and sensor wheel are secured to the shaft with Loctite. Use two flat blade screwdrivers. The screwdrivers are positioned opposite each other with the blade tips on the underside of the rotor and sensor wheel assembly. Make sure blade tips are toward distributor shaft until they come in contact with shaft. A downward push on both screwdriver handles at the same time will pry off rotor/sensor wheel assembly. The use of torch lamp will also aid in the removal of the rotor/sensor wheel assembly.

⚠ WARNING

Wear protective gloves when handling heated rotor/sensor wheel assembly to avoid severe burns.

Inspection

1. With the rotor/sensor wheel assembly removed, inspect the locating key inside the rotor.
2. The locating key will appear as a clean edged, 1/8 in. (3 mm) wide, sloped ramp at the bottom of the splined hole.

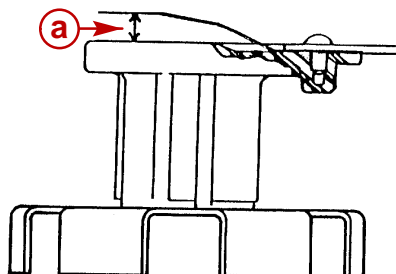


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- a** - Locating Key
- b** - Screws (Hex Head)
- c** - Sensor Wheel
- d** - Locating Pin

3. If there is any doubt if sensor wheel is located properly, lay sensor wheel on top of the figure above with sensor fingers facing up (toward you). Line up three screw holes and locating pin hole on sensor wheel with the figure. If wheel is indexed properly all the fingers on wheel will line up with those in the figure.
4. If there are pieces of material shaved off the key or if it appears to have been damaged by being forced down while misaligned with slot in distributor shaft, the rotor must be replaced.
5. Check rotor for burned or corroded center contact.
6. Check rotor for cracks and carbon tracks using magneto analyzer and instructions supplied with analyzer.

7. If rotor is damaged, replace rotor by removing three hex bolts and separating sensor wheel from rotor. Reinstall sensor wheel to new rotor making sure locating pin on rotor is installed in locating hole in sensor wheel. Tighten three hex bolts securely.
8. Bend carbon brush tang upward slightly until a distance of 1/4 in. (6.4 mm) is obtained between rotor and tang.



a - 1/4 in. (6.5 mm)

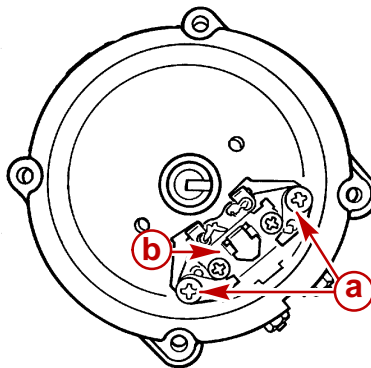
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Installation

1. Put 2 drops of Loctite 27131 into the rotor so it lands on the locating key.
2. Put 2 drops of Loctite 27131 in keyway on upper portion of distributor shaft.
3. Immediately install rotor assembly onto distributor shaft. Make sure rotor locating key is aligned with keyway in distributor shaft before pressing rotor all the way down on the shaft, until it stops, with the palm of your hand. Let Loctite cure overnight with distributor in inverted position.
4. The rotor should fit very tight. It may be necessary to heat rotor with torch lamp to properly install. It is important not to let any Loctite run down distributor shaft. Loctite could get into top distributor housing bushing.
5. Reinstall distributor cap on distributor.
6. Install spark plug wires (if removed). Refer to "Spark Plug Wires" in this section.

Sensor Removal

1. Remove rotor and sensor wheel.
2. Remove two screws that hold sensor into distributor housing.
3. Remove sensor from housing.

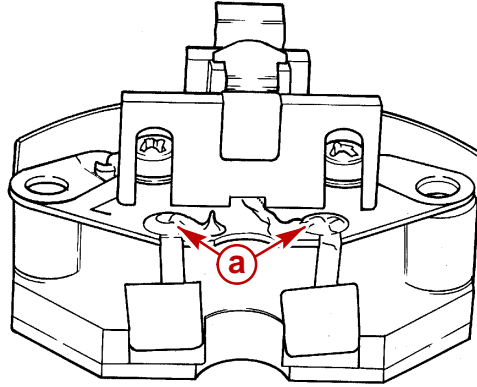


a - Mounting Screws
b - Sensor Assembly

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Inspection

1. Use a magnifying glass and light to inspect the two metal "jumper leads" for cracks. If a crack is found in either metal "jumper lead," install a new sensor.



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a - Jumper Leads

⚠ CAUTION

Do not use any type of silicone sealer on the inside of the distributor. Most silicone sealers give off an acidic vapor during the curing stage of the sealer. This acid can cause corrosion on the ignition components.

Installation

1. Install sensor into housing and install two retaining screws.
2. Install sensor wheel, rotor and distributor cap.

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