

Fig. 78 Removing the spark plug

■ Remove the spark plugs when the engine is cold, if possible, to prevent damage to the threads. If plug removal is difficult, apply a few drops of penetrating oil to the area around the base of the plug and allow it a few minutes to work.

6. Using a spark plug socket that is equipped with a rubber insert to properly hold the plug, turn the spark plug counterclockwise to loosen and remove the spark plug from the bore.

**** WARNING**

Avoid the use of a flexible extension on the socket. Use of a flexible extension may allow a shear force to be applied to the plug. A shear force could break the plug off in the cylinder head, leading to costly and frustrating repairs. In addition, be sure to support the socket with your other hand—this will also help prevent the socket from slipping and breaking the plug.

7. Evaluate each cylinder's performance by comparing the spark plug condition. Check each spark plug to be sure they are of the same heat range, manufacturer and have the same heat range markings. Clean the threads in the spark plug opening of the block and clean the threads before installing the plug.

8. When purchasing new spark plugs, ask the dealer if there has been a spark plug change for the engine you are serviced. Many times manufacturers will update the spark plug used in an engine to offer better efficiency or performance.

9. Crank the engine through several revolutions to blow out any material that might have become lodged during cleaning. Always use a new gasket (if applicable), but never use gaskets on taper seat plugs. The gasket must be fully compressed on clean seats to complete the heat transfer process and to provide a gas tight seal in the cylinder.

10. Inspect the spark plug boot for tears or damage. If a damaged boot is found, the spark plug boot and possible the entire wire will need replacement.

11. Check the spark plug gap prior to installing the plug. Most spark plugs do not come gapped to the proper specification.

12. Apply a thin coating of anti-seize on the thread of the plug. This is extremely important on aluminum head engines.

13. Carefully thread the plug into the bore by hand. If resistance is felt before the plug completely bottomed, back the plug out and begin threading again.

**** WARNING**

Do not use the spark plug socket to thread the plugs. Always carefully thread the plug by hand or using an old plug wire to prevent the possibility of cross-threading and damaging the cylinder head bore.

14. Carefully tighten the spark plug. If the plug you are installing is equipped with a crush washer, tighten the plug until the washer seats, then turn it 1/4 turn to crush the washer. Whenever possible, spark plugs should be tightened to the factory torque specification:

- 1994-95 3.0L—22 ft. lbs. (30 Nm)
- 1996-03 3.0L—20 ft. lbs. (27 Nm)
- 1992-95 4.3L—22 ft. lbs. (30 Nm)
- 1996-03 4.3L—20 ft. lbs. (27 Nm)
- 1992-95 GM V8s—22 ft. lbs. (30 Nm)
- 1996-03 GM V8s—20 ft. lbs. (27 Nm)
- Ford V8s—5-10 ft. lbs. (6.7-13.5 Nm)

15. Apply a small amount of silicone dielectric grease to the end of the spark plug lead or inside the spark plug boot to prevent sticking, then install the boot to the spark plug and push until it clicks into place. The click may be felt or heard. Gently pull back on the boot to assure proper contact.

- 16. Connect the negative battery cable or turn the battery switch ON.
- 17. Start the engine and insure proper operation.

READING SPARK PLUGS



◆ See Figures 79, 80, 81, 82, 83, 84 and 85

Reading spark plugs can be a valuable tuning aid. By examining the insulator firing nose condition you can determine much about the engine's overall operating condition.

In general, a tan or gray color tells you that the spark plug is at the optimum temperature and that the engine is in good operating condition. Deposits, such as heavy black wet or dry deposits usually indicate a rich mixture. Heavy, dry deposits can indicate an overly rich condition, while a heat range spark plug, possible vacuum leak, low compression, or retarded timing or too large a plug gap.

If the deposits are wet, it can be an indication of a breached head or oil control from ring problems or an extremely rich condition, depending on what liquid is present at the firing tip.

Look for signs of detonation, such as silver specs, black specs or melting or breakage at the firing tip.

Compare your plugs to the illustrations shown to identify the most common plug conditions.

Fouled Spark Plugs

A spark plug is fouled when the insulator nose at the firing tip becomes coated with a foreign substance, such as fuel, oil or carbon. This coating makes it easier for the voltage to follow along the insulator nose and leach back down into the metal shell, grounding out, rather than bridging the gap normally.

Fuel, oil and carbon fouling can all be caused by different things but in any case, once a spark plug is fouled, it will not provide voltage to the firing tip and that cylinder will not fire properly. In many cases, the spark plug cannot be cleaned sufficiently to restore normal operation. It is therefore recommended that fouled plugs be replaced.

Signs of fouling or excessive heat must be traced quickly to prevent further deterioration of performance and to prevent possible engine damage.

Overheated Spark Plugs

When a spark plug tip shows signs of melting or is broken, it usually means that excessive heat and/or detonation was present in that particular combustion chamber or that the spark plug was suffering from thermal shock.

Since spark plugs do not create heat by themselves, one must use this visual clue to track down the root cause of the problem. In any case, damaged firing tips most often indicate that cylinder pressures or temperatures were too high. Left unresolved, this condition usually results in more serious engine damage.

Detonation refers to a type of abnormal combustion that is usually preceded by pre-ignition. It is most often caused by a hot spot formed in the combustion chamber.

As air and fuel is drawn into the combustion chamber during the intake stroke, this hot spot will "pre-ignite" the air fuel mixture without any spark from the spark plugs.

INSPECTION & GAPPING



◆ See Figures 86 and 87

A particular spark plug might fit hundreds of engines and although the factory will typically set the gap to a pre-selected setting, this gap may not be the right one for your particular engine.

Insufficient spark plug gap can cause pre-ignition, detonation, even engine damage. Too much gap can result in a higher rate of misfires, noticeable loss of power, plug fouling and poor economy.

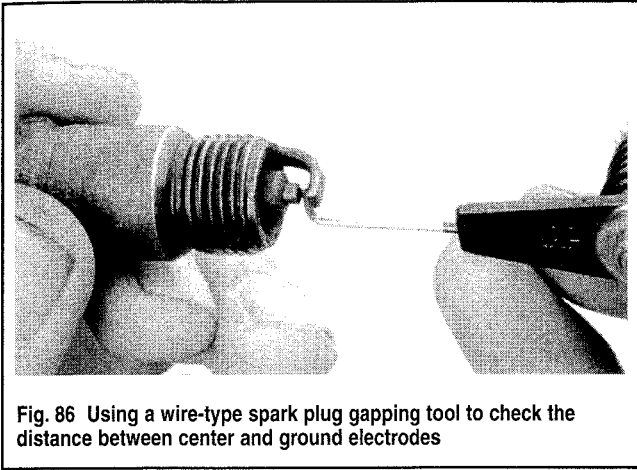


Fig. 86 Using a wire-type spark plug gapping tool to check the distance between center and ground electrodes

Check the spark plug gap before installation. The ground electrode (the L-shaped one connected to the body of the plug) must be parallel to the center electrode and the specified size wire gauge must pass between the electrodes with a slight drag.

Do not use a flat feeler gauge when measuring the gap on a spark plug because the reading may be inaccurate. A round wire-type gapping tool is the best way to check the gap. The correct gauge should pass between the electrode gap with a slight drag. If you're in doubt, try a wire gauge one size smaller or larger. The smaller gauge should go through easily while the larger one shouldn't go through at all.

Wire gapping tools usually have an adjusting tool attached. Use this tool to adjust the side electrode until the proper gap is obtained. Never attempt to bend the center electrode. Also, be careful not to bend the side electrode too far or too often as it may break. If the electrode breaks within the engine, requiring removal of the cylinder head to retrieve it.

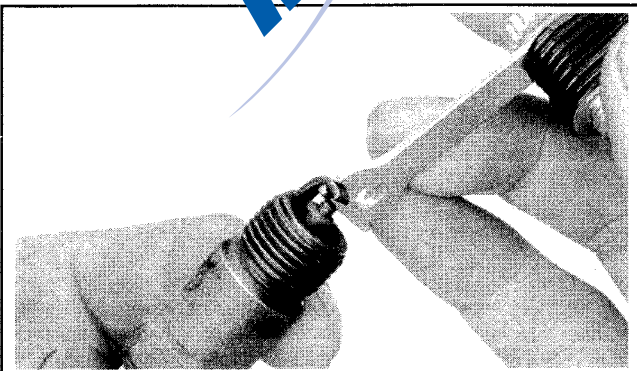
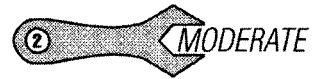


Fig. 87 Most spark plug gapping tools have an adjusting tool used to bend the ground electrode. **USE IT!** This tool greatly reduces the chance of breaking off the electrode and is much more accurate

Spark Plug Wires

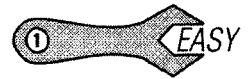


TESTING

Each time you remove the engine cover, visually inspect the spark plug wires for burns, cuts or breaks in the insulation. Check the boots on the coil and at the spark plug end. Replace any wire that is damaged.

Once a year, usually when you change your spark plugs, check the resistance of the spark plug wires with an ohmmeter. Wires with excessive resistance will cause misfiring and may make the engine difficult to start. In addition worn wires will allow arcing and misfiring in humid conditions.

Remove the spark plug wire from the engine. Test the wires by connecting one lead of an ohmmeter to the coil end of the wire and the other lead to the spark plug end of the wire. Resistance should measure approximately 3000-7000 ohms per foot of wire. If a spark plug wire is found to have excessive (high) resistance, the entire set should be replaced.



REMOVAL & INSTALLATION

When installing a new set of spark plug wires, replace the wires one at a time so there will be no confusion. Coat the inside of the boots with dielectric grease to prevent sticking. Install the boot firmly over the spark plug until it clicks in place. The click may be felt or heard. Gently pull back on the boot to assure proper contact. Repeat the process for each wire.

It is important to route the new spark plug wire the same as the old wire and install it in a similar manner on the engine. Improper routing of spark plug wires may cause engine performance problems.

Ignition Timing

As the engine must be running while performing this operation we recommend that it is undertaken with the boat in the water. If not, make certain that an engine flushing kit has been installed.

■ Ignition timing is not adjustable on 8.1L engines.



ADJUSTMENT

■ If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Applications chart.

■ Ignition timing is not adjustable on 8.1L engines.



Electronic Spark Timing (EST) Ignition Systems

■ If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart.

Carbureted Engines

◆ See Figures 88, 89 and 90

■ Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage.

1. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.

2. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.

3. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be:

- 430, 431, 570, 311, 572, 740: 8°
- 432: 0°
- 500, 501, 211, 231, 271: 6°
- 1994-97 3.0L: 0°
- 1998-03 3.0L: 2° ATDC
- 1994 4.3L: 0°
- 1995-96 4.3L: 0° w/89 AKI fuel; or 5° ATDC w/87 AKI fuel. On models with a ribbed aluminum oil pan, 6° BTDC w/89 AKI fuel or 1° BTDC w/87 AKI fuel
- 1997-03 4.3L: 6° BTDC w/89 AKI fuel or 1° BTDC w/86 AKI fuel

And also on the mark stamped into the pulley. Timing marks are generally shown in 2° increments from TDC.

■ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

4. Before moving forward, you must bypass the electronic spark advance function of the EST system. Disconnect the 4-wire connector on the side of the distributor and install Volvo Adaptor #885163-6 across the two white leads. Connect the bare wire to a 12-volt engine power source.

■ Not all models will have a harness connected to the 4-wire connector on the distributor. If there is nothing attached, simply remove the connector cover.

5. Start the engine and allow it to reach normal operating temperature at idle—the choke valve should be wide open.

6. Check that the idle speed is to specification (as per the Tune-Up Specifications chart) with the engine in gear and then shift it to Neutral.

7. While still idling, point the light at the timing marks. The objective is to make it appear that the mark on the tab and the mark on the pulley are still in alignment.

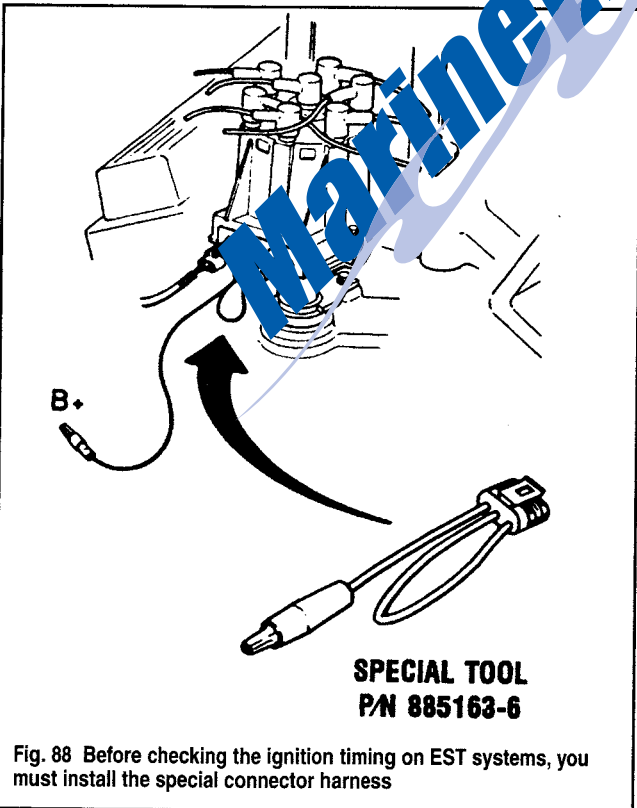


Fig. 88 Before checking the ignition timing on EST systems, you must install the special connector harness

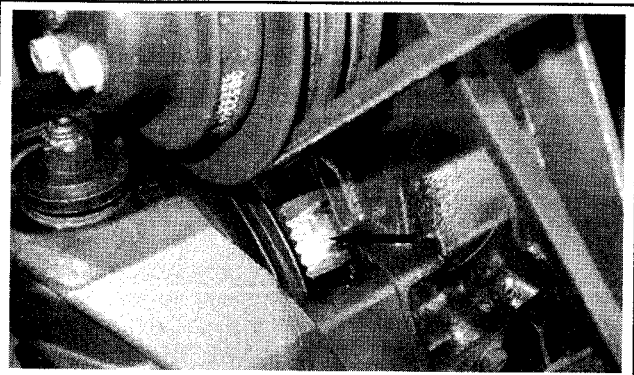


Fig. 89 Typical timing mark tab



Fig. 90 Always use a timing light to adjust the ignition timing

8. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor or sensor until the correct marks line up.

9. Tighten the clamp bolt to 20 ft. lbs. (27 Nm) and check the timing one last time.

10. Turn off the engine, remove the adaptor plug from the distributor and reconnect the 4-wire connector.

11. Restart the engine. With the timing light still connected and the engine running at 1000 rpm, check that the timing advanced to 15° BTDC (10° w/86 AKI fuel on the 4.3L) on all 1994-98 engines. 13° on 1999 and later 3.0L; and on 1999 and later 4.3L, 21° w/86 AKI fuel and 26° w/89 AKI fuel. Adjust as necessary by rotating the distributor.

■ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

12. Turn off the engine. Disconnect the timing light and the tachometer.

EFI Engines

◆ See Figures 89, 90 and 90a

Although ignition timing is adjustable on these models, it is generally controlled by the EFI electronic control module. In order to adjust the timing, the ECM must be forced to enter into its service mode by using a scan tool. This done, the ECM will stabilize the base timing to allow for adjustment by conventional means of rotating the distributor.

■ **The idle speed and dwell must be correctly adjusted and within specifications before performing this procedure.**

1. Open or remove the engine compartment hatch.
2. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
3. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel, as it will not provide the necessary accuracy.

4. Locate the timing marks on the engine timing cover (just above the crankshaft pulley/damper) and place a bit of white paint where the proper mark should be:

- 4.3L and 5.0L: 8° BTDC
- 1994-95 5.7L: 8° BTDC w/89 AKI fuel; or 3° BTDC w/87 AKI fuel
- 1996-03 5.7L: 8° BTDC
- 7.4L/8.2L: 10° BTDC

Also detailed in the Tune-Up Specifications chart. Timing marks are generally shown in 2° increments from TDC (0°).

5. Start the engine and allow it to reach normal operating temperature at idle.

6. Turn off the engine, locate the data link connector (DLC) on the EFI/MPI main harness (usually at the front of the engine on the upper starboard side) and plug in Volvo's Marine Diagnostic Trouble Code (MDTC) tool—please refer to the Fuel System section for further details on this. If an MDTC is not available, use a jumper wire and connect it between the white/black and black wire terminals on the DLC. The DLC should be at the front of the engine, starboard side.

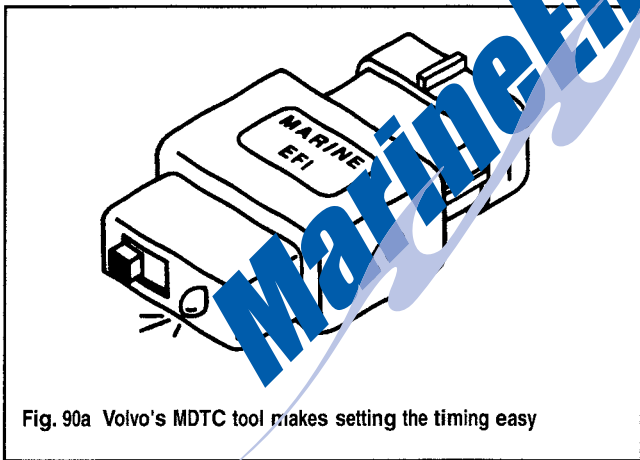


Fig. 90a Volvo's MDTC tool makes setting the timing easy

7. Restart the engine and allow the idle to stabilize, then adjust the throttle cable to reach 1000 rpm.
8. Set the MDTC to the Service Mode.
9. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the damper/pulley stand still in alignment.
10. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor until the correct marks line up.
11. Tighten the clamp bolt to 30 ft. lbs. (40 Nm) and then recheck the timing.
12. Set the scan tool to the Normal Mode. Disconnect the tool or the jumper wire. On engines where the throttle lever was adjusted up to 1000 rpm, adjust it back to the normal idle position.
13. Check the timing one last time. If still correct, disconnect the light and tachometer.



Breaker Point Ignition Systems

◆ See Figures 89 and 90

■ **If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart.**

■ **Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage.**

1. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.

2. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.

3. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be (6° BTDC).

And also on the mark stamped into the pulley. Timing marks are generally shown in 2° increments from TDC.

■ **Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the tune-up sticker.**

4. Start the engine and allow it to reach normal operating temperature at idle. The choke valve should be wide open.

5. Check that the idle speed is to specification (as per the Tune-Up Specifications chart) with the engine in gear and then shift it to Neutral.

6. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.

7. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor or sensor until the correct marks line up.

8. Tighten the clamp bolt to 20 ft. lbs. (27 Nm) and check the timing one last time.

9. Turn off the engine. Disconnect the timing light and the tachometer.



Breakerless Inductive Distributor (BID) Ignition Systems

◆ See Figures 91, 92 and 93

■ **If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart.**

■ **Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage.**

1. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.

2. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.

3. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be:

- 1994-02 5.7L/8.2L: 8° BTDC w/89 AKI fuel; or 3° BTDC w/87 AKI fuel.
- 1994-02 5.0L/5.8L: 10° BTDC w/86 AKI fuel
- 1994-96 7.4L: 10° BTDC w/89 AKI fuel; or 6° BTDC w/87 AKI fuel

And also on the mark stamped into the pulley. Timing marks are generally shown in 2° increments from TDC.



Fig. 91 Typical timing mark tab—GM engine

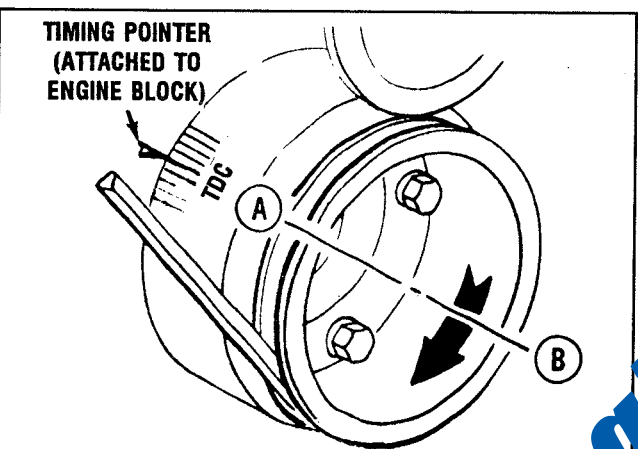


Fig. 92 Typical timing mark tab—Ford engine



Fig. 93 Always use a timing light to adjust the ignition timing

■ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

4. Start the engine and allow it to reach normal operating temperature at idle—the choke valve should be wide open.
5. Check that the idle speed is to specification (as per the Tune-Up Specifications chart) with the engine in gear and then shift it to Neutral.

■ Always ensure the air gap between the sensor and the trigger wheel is correct before checking ignition timing.

6. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.

7. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor or sensor until the correct marks line up.

8. Tighten the clamp bolt to 20 ft. lbs. (27 Nm) and check the timing one last time.

9. Restart the engine and check the idle speed and mixture. Adjust as necessary.

■ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.



For Film Integrated (TFI-IV) Ignition Systems

◆ See Figure 93

■ If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart.

■ Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage.

1. Position the shift lever in Neutral.
2. Connect a suitable variable advance, inductive timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
3. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.
4. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be—5° BTDC
And also on the mark stamped into the pulley. Timing marks are generally shown in 2° increments from TDC.

■ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

5. Start the engine and allow it to reach normal operating temperature at idle.
6. Locate the two-wire SPOUT connector (near the front of the engine) and carefully pull out the shorting bar.
7. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.

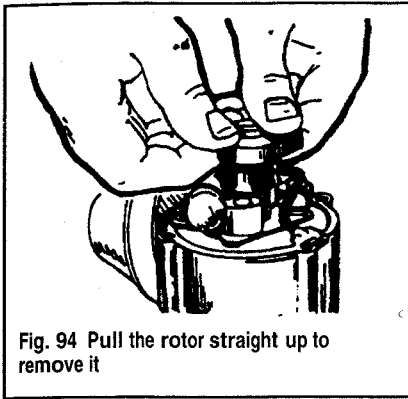


Fig. 94 Pull the rotor straight up to remove it

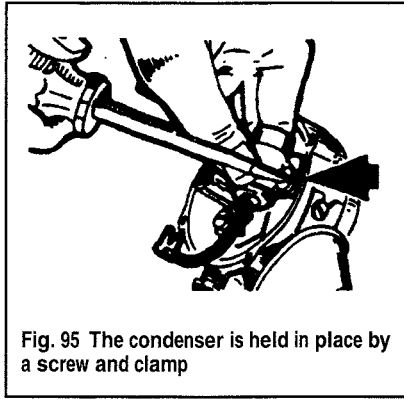


Fig. 95 The condenser is held in place by a screw and clamp

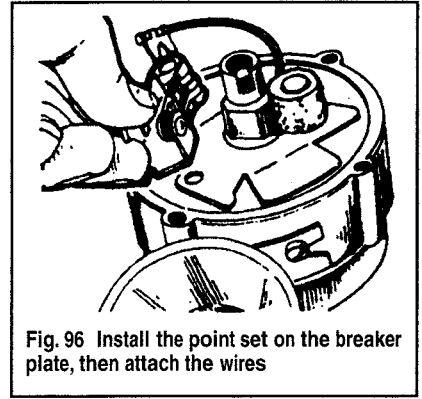


Fig. 96 Install the point set on the breaker plate, then attach the wires

8. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor until the correct marks line up.

9. Apply Electrical Terminal grease to the SPOUT connector terminals and then reinsert the shorting bar.

10. Check the timing advance to ensure it is advancing beyond the initial setting.

11. Disconnect the timing light and tachometer.

12. Tighten the distributor clamp bolt to 17-25 ft. lbs. (23-34 Nm).

13. Restart the engine and recheck the idle speed and mixture. Adjust as necessary.

■ Please refer to the Tune-Up Specifications chart for the correct specifications. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

Breaker Points and Condenser

A few early V8 models were equipped with a standard breaker points ignition system. There are two ways to check breaker point gap: with a feeler gauge or with a dwell meter. Either way you choose, you are measuring the amount of time (in degrees of distributor rotation) that the points remain open. If you adjust the points with a feeler gauge, you are measuring the maximum amount the points will open when the rubbing block is on one of the high points of the distributor cam. If you adjust the points with a dwell meter, you are measuring the number of degrees (of distributor cam rotation) that the points will remain closed before they start to open as a high point of the distributor cam reaches the rubbing block of the points.

Although using a feeler gauge is more accurate when setting new point sets, this method can be unreliable when checking used points due to the rough surface caused by the association with wear and tear. Adjusting the dwell should always be considered the more accurate method.

There are two rules that should always be followed when adjusting or replacing points:

- Points and condenser are a matched set; NEVER replace one without replacing the other.
- When you change the point gap or dwell of the engine, you also change the ignition timing. Always adjust the timing after a point or dwell adjustment.

■ Marine distributors have a corrosion-resistant coating applied to the return spring on top of the breaker plate and on the two small springs under the plate - NEVER use automotive parts as a replacement!

REMOVAL & INSTALLATION

◆ See Figures 94, 95 and 96

1. Remove or open the engine compartment hatch cover. Disconnect the negative battery cable or turn the battery switch to OFF.

2. Loosen the distributor cap retaining screws (two) and carefully lift off the cap. Although it is not necessary to remove the spark plug wires from the cap, we recommend that you first tag all the wires just to be safe.

3. Note the position of the rotor and pull the rotor straight up and remove it. Check the rotor carefully for a burned or corroded center contact, cracks or carbon tracks.

4. Loosen the primary terminal nut and then disconnect the lead wire. Do the same for the secondary lead wire.

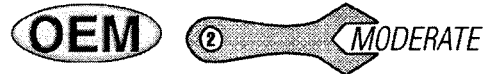
5. Loosen the condenser/breaker point mounting screws and then lift them up and out of the breaker plate. Clean any dirt or oil left on the plate.

6. Coat the distributor cam with a small amount of distributor Cam Lubricant (NEVER use grease or oil), wipe the new point set clean and position it on the breaker plate. Tighten the mounting screws, leaving the lock washers slightly loose.

7. Reconnect the lead wires for the condenser and primary.

8. Check that the points are in alignment. If not, carefully bend the stationary arm until they align properly. If you are still not satisfied, get a new set of points. Never adjust alignment on used points.

9. Adjust the point gap to 0.014-0.016 in. (0.36-0.46mm). Install the rotor in the same position as was removed. Install the cap, connect the battery cables and check for proper operation. Adjust the ignition timing.



ADJUSTMENT—FEELER GAUGE

◆ See Figures 97, 98 and 99

1. Perform the first three steps of the removal procedure above.
2. Connect a remote starter switch as detailed in the manufacturers' instructions. Have a friend bump the engine over until you see that the breaker point rubbing block is resting on the high point of the distributor cam—the points should open to their fullest extent.

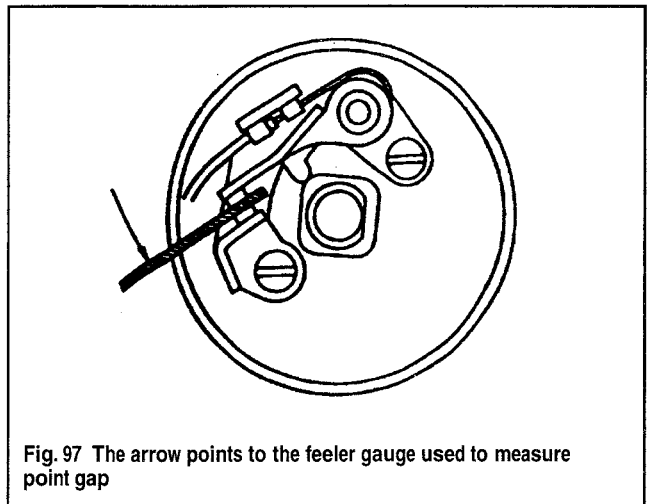


Fig. 97 The arrow points to the feeler gauge used to measure point gap

