5

ENGINE ELECTRICAL SYSTEMS

Section

1 General information and precautions
2 Battery - emergency jump starting
3 Battery - check and replacement
4 Battery cables - replacement
5 Ignition system - general information
6 Ignition system - check
7 Ignition coil and ignition control module (V6 models) - removal and installation
8 Ignition coils (V8 models) - removal and installation
9 Distributor (V6 models) - removal and installation
10 Charging system - general information and precautions
11 Charging system - check
12 Alternator - removal and installation
13 Starting system - general information and precautions
14 Starter motor and circuit - check
15 Starter motor - removal and installation

Reference to other Chapters

Battery check, maintenance and charging - See Chapter 1
Drivebelt check, adjustment and replacement - See Chapter 1
SERVICE ENGINE SOON light - See Chapter 6
Spark plug replacement - See Chapter 1

1 General information and precautions

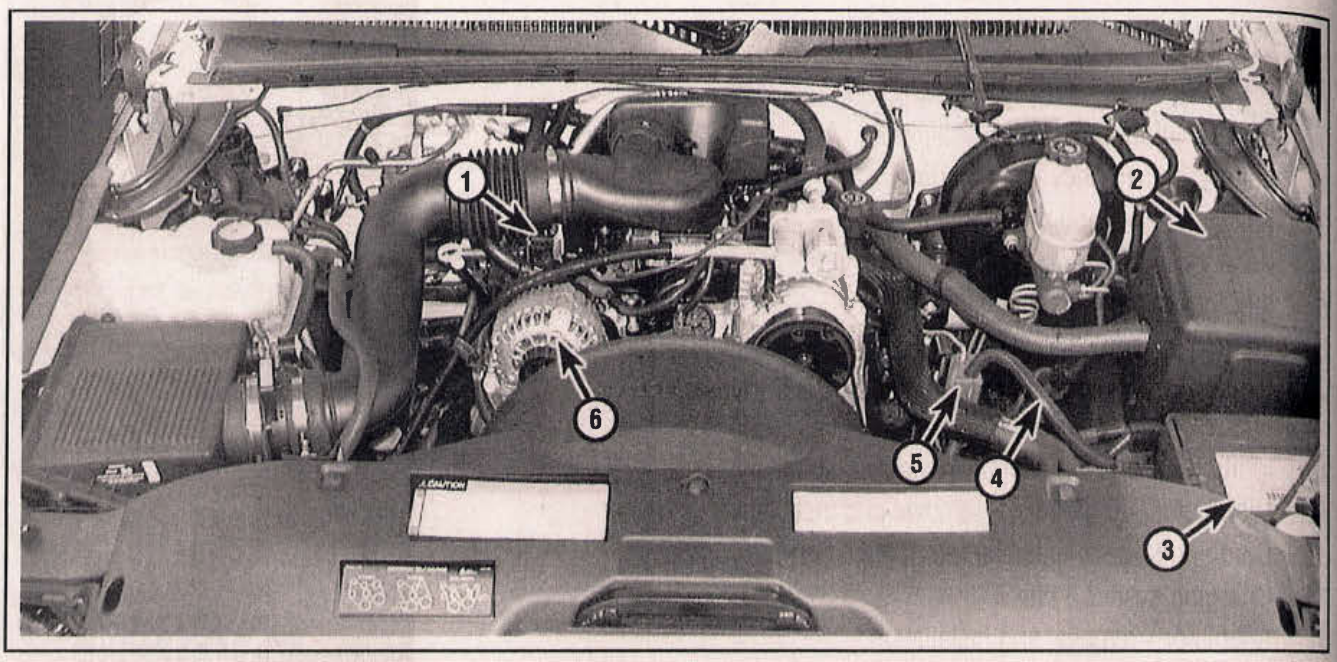
GENERAL INFORMATION

Refer to illustrations 1.1a and 1.1b

The engine electrical systems include all ignition, charging and starting components (see illustrations). Because of their engine-related functions, these components are discussed separately from body electrical devices such as the lights, instruments, etc. (which are included in Chapter 12).

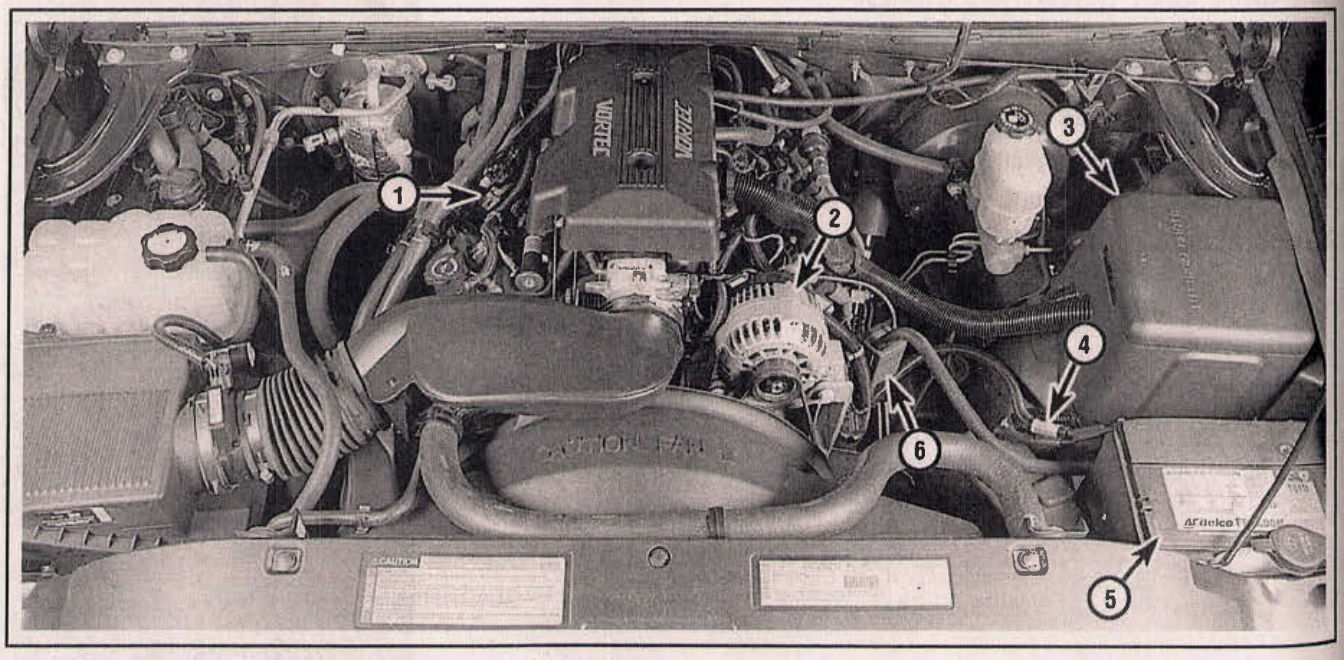
PRECAUTIONS

Always observe the following precautions when working on the



1.1a Typical engine electrical system components - V6 engine

1 *Ignition coil and ignition control module*
2 *Underhood Electrical Center*
3 *Battery*
4 *Battery cable*
5 *Remote positive jumper terminal*
6 *Alternator*



1.1b Typical engine electrical system components - V8 engines

1 *Ignition coil (1 of 8)*
2 *Alternator*
3 *Underhood electrical center*
4 *Battery cable*
5 *Battery*
6 *Remote positive jumper terminal*

electrical system:

a) *Be extremely careful when servicing engine electrical components. They are easily damaged if checked, connected or handled improperly.*
b) *Never leave the ignition switched on for long periods of time when the engine is not running.*
c) *Never disconnect the battery cables while the engine is running.*
d) *Maintain correct polarity when connecting battery cables from another vehicle during jump starting - see the "Booster battery (jump) starting" section at the front of this manual.*
e) *Always disconnect the negative battery cable before working on the electrical system.*

It's also a good idea to review the safety-related information regarding the engine electrical systems located in the "Safety first!" section at the front of this manual, before beginning any operation included in this Chapter.

BATTERY DISCONNECTION

WARNING:

On 2006 and later models with OnStar, make absolutely sure the ignition key is in the Off position and Retained Accessory Power (RAP) has been depleted before disconnecting the cable from the negative battery terminal. Also, never remove the OnStar fuse with the ignition key in any position other than Off. If these precautions are not taken, the OnStar system's back-up battery will be activated, and remain activated, until it goes dead. If this happens, the OnStar system will not function as it should in the event that the main vehicle battery power is cut off (as might happen during a collision).

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

Several systems on the vehicle require battery power to be available at all times, either to ensure their continued operation (such as the clock) or to maintain control unit memories (such as that in the engine management system's Powertrain Control Module) which would be wiped out if the battery were to be disconnected. Therefore, whenever the battery is to be disconnected, first note the following to ensure that there are no unforeseen consequences of this action:

a) *First, on any vehicle with power door locks, it is a wise precaution to remove the key from the ignition and to keep it with you, so that it does not get locked inside if the power door locks should engage accidentally when the battery is reconnected!*
b) *The engine management system's PCM will lose the information stored in its memory when the battery is disconnected. This includes idling and operating values, and any fault codes detected (see Chapter 6). Whenever the battery is disconnected, the information relating to idle speed control and other operating values will have to be re-programmed into the unit's memory. The PCM does this by itself, but until then, there may be surging, hesitation, erratic idle and a generally inferior level of performance. To allow the PCM to relearn these values, start the engine and run it as close to idle speed as possible until it reaches its normal operating temperature, then run it for approximately two minutes at 1200 rpm. Next, drive the vehicle as far as necessary - approximately 5 miles of varied driving conditions is usually sufficient - to complete the relearning process.*

Devices known as "memory-savers" can be used to avoid some of the above problems. Precise details vary according to the device used. Typically, it is plugged into the cigarette lighter, and is connected by its own wires to a spare battery; the vehicle's own battery is then disconnected from the electrical system, leaving the "memory-saver" to pass sufficient current to maintain audio unit security codes and PCM memory values, and also to run permanently live circuits such as the clock, all the while isolating the battery in the event of a short-circuit occurring while work is carried out.

WARNING:

Some of these devices allow a considerable amount of current to pass, which can mean that many of the vehicle's systems are still operational when the main battery is disconnected. If a "memory-saver" is used, ensure that the circuit concerned is actually "dead" before carrying out any work on it!

To disconnect the battery for service procedures requiring power to be cut from the vehicle, first open the driver's door to disable Retained Accessory Power (RAP), then loosen the cable end bolt and disconnect the cable from the negative battery terminal. Isolate the cable end to prevent it from coming into accidental contact with the battery terminal.

2 Battery - emergency jump starting

Refer to the *Booster battery (jump) starting* procedure at the front of this manual.

3 Battery - check and replacement

WARNING:

Hydrogen gas is produced by the battery, so keep open flames and lighted cigarettes away from it at all times. Always wear eye protection when working around a battery. Rinse off spilled electrolyte immediately with large amounts of water.

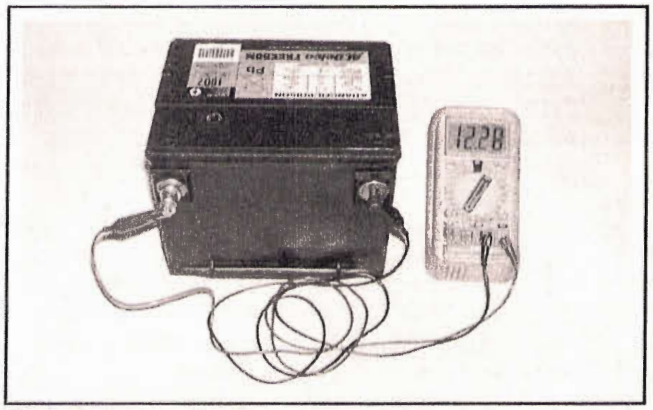
CHECK

Refer to illustrations 3.2 and 3.3

1 The battery's surface charge must be removed before accurate voltage measurements can be made. Turn On the high beams for ten

seconds, then turn them Off, let the vehicle stand for two minutes. Remove the battery from the vehicle (see Steps 4 through 10).

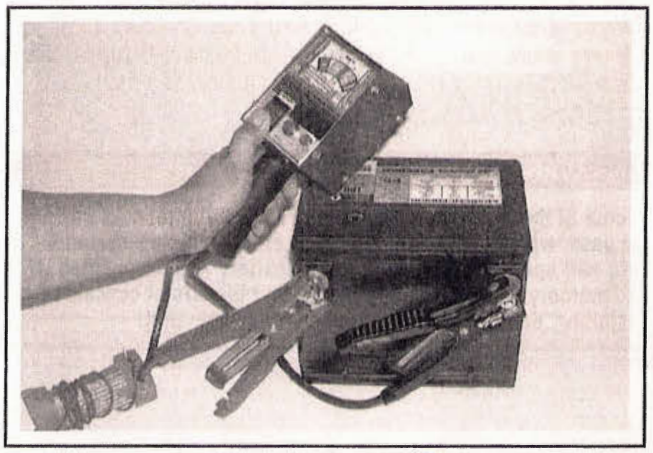
2 Check the battery state of charge. Visually inspect the indicator eye on the top of the battery, if the indicator eye is clear, charge the battery as described in Chapter 1. Next perform an open voltage circuit test using a digital voltmeter (see illustration). With the engine and all accessories Off, connect the negative probe of the voltmeter to the negative terminal of the battery and the positive probe to the positive. terminal of the battery. The battery voltage should be 12.4 volts or more. If the battery is less than the specified voltage, charge the battery before proceeding to the next test. Do not proceed with the battery load test unless the battery charge is correct.



3.2 To test the open circuit voltage of the battery, connect a voltmeter to the battery - a fully charged battery should measure at least 12.4 volts (depending on outside air temperature)

3 Perform a battery load test. An accurate check of the battery condition can only be performed with a load tester (available at most auto parts stores). This test evaluates the ability of the battery to operate the starter and other accessories during periods of heavy amperage draw (load). Install a special battery load testing tool onto the terminals (see illustration). Load test the battery according to the tool manufacturer's instructions. This tool utilizes a carbon pile to increase the load demand (amperage draw) on the battery. Maintain the load on the battery for 15 seconds or less and observe that the battery voltage does not drop below 9.6 volts. If the battery condition is weak or defective, the tool will indicate this condition immediately.

➡Note: Cold temperatures will cause the minimum voltage requirements to drop slightly. Follow the chart given in the tool manufacturer's instructions to compensate for cold climates. Minimum load voltage for freezing temperatures (32 degrees F) should be approximately 9.1 volts.



3.3 Connect a battery load tester to the battery and check the battery condition under load following the tool manufacturers instructions

REPLACEMENT

▸ Refer to illustrations 3.6 and 3.8

WARNING:

Refer to the Warning and Caution in Chapter 5, Section 1 under "Battery disconnection" before proceeding with the following Steps.

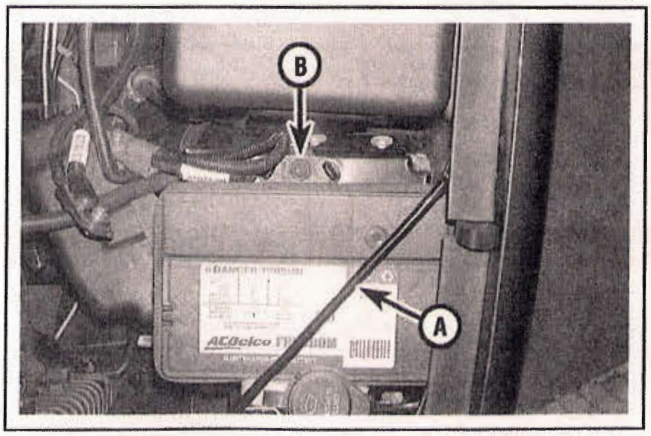
CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

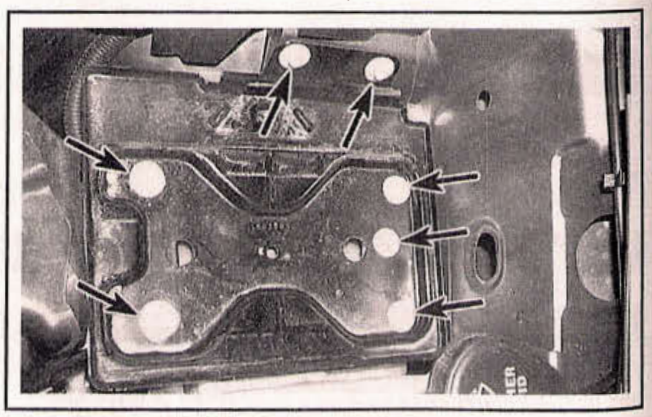
4 Disconnect the cable from the negative battery terminal.

5 Disconnect the positive battery cable.

6 Remove the fender brace. Remove the battery retainer bolt and retainer (see illustration).



3.6 Before removing the battery, remove the fender brace (A), then remove the battery retainer (B) and lift out the battery



3.8 Inspect the tray, retainer brackets and related fasteners for corrosion or damage - if necessary, remove the bolts (arrows) and the battery tray

7 Remove the battery and place it on a workbench. Remove the battery insulator.

➡Note: Battery handling tools are available at most auto parts stores for a reasonable price. They make it easier to remove and carry the battery.

8 While the battery is removed, inspect the tray, retainer brackets and related fasteners for corrosion or damage (see illustration).

9 If corrosion is evident, remove the battery tray and use a baking soda/water solution to clean the corroded area to prevent further oxidation. Repaint the area as necessary using rust resistant paint.

10 Clean and service the battery and cables (see Chapter 1).

11 If you are replacing the battery, make sure you purchase one that is identical to yours, with the same dimensions, amperage rating, cold cranking amps rating, etc. Make sure it is fully charged prior to installation in the vehicle.

12 Installation is the reverse of removal. Connect the positive cable first and the negative cable last.

13 After connecting the cables to the battery, apply a light coating of petroleum jelly or grease to the connections to help prevent corrosion.

4 Battery cables - replacement

▸ Refer to illustrations 4.4a, 4.4b, 4.4c, 4.4d and 4.4e

WARNING:

Refer to the Warning and Caution in Chapter 5, Section 1 under "Battery disconnection" before proceeding with the following Steps.

CAUTION:

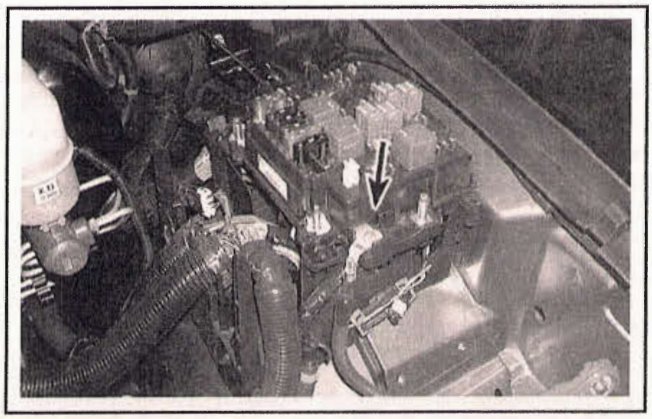
On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

1 Periodically inspect the entire length of each battery cable for damage, cracked or burned insulation and corrosion. Poor battery cable connections can cause starting problems and decreased engine performance.

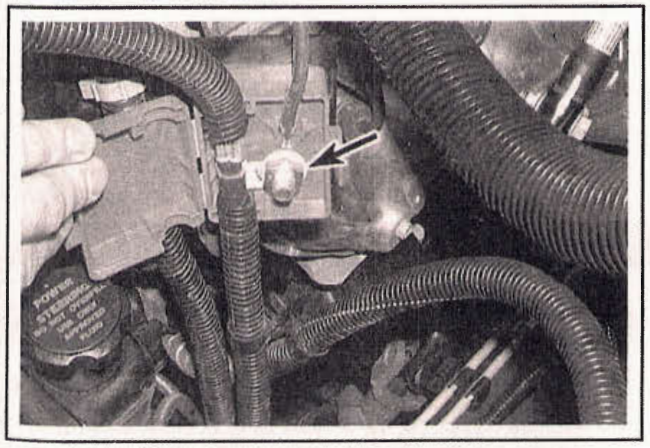
2 Check the cable-to-terminal connections at the ends of the cables for cracks, loose wire strands and corrosion. The presence of white, fluffy deposits under the insulation at the cable terminal connection is a sign that the cable is corroded and should be replaced. Check the terminals for distortion, missing mounting bolts and corrosion.

3 When removing the cables, always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool used to loosen the cable clamps. Even if only the positive cable is being replaced, be sure to disconnect the negative cable first (see Chapter 1 for further information regarding battery cable maintenance).

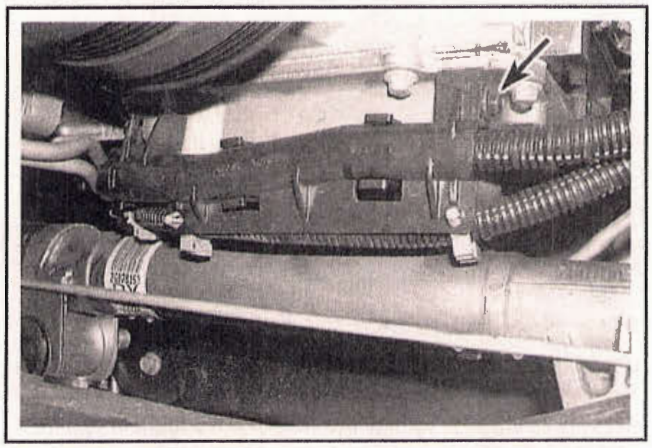
4 Disconnect the old cables from the battery, then disconnect them at the opposite end. Detach the cables from the starter solenoid, underhood electrical center and ground terminals, as necessary (see



4.4a One branch of the positive cable is connected to the underhood electrical center

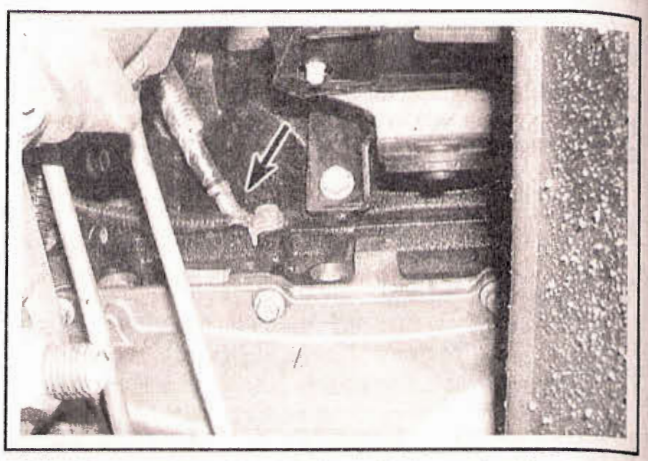


4.4b Remove the nut (arrow) and disconnect the positive cable from the remote positive jumper terminal (do this only after disconnecting the cable from the negative terminal of the battery)



4.4c On V8 models, remove the bolt (arrow) and slide the positive cable retainer toward the drivers side of the vehicle to detach the retainer from the engine - release the clips and detach the wiring harness from the retainer

4.4d Release the clip and detach the positive cable from the retainer - this type retainer can be found at various points along the entire length of the cable



4.4e The negative cable is fastened to the engine block

illustrations). Note the routing of each cable to ensure correct installation. The positive cable is retained by clips and/or tape to the main wiring harness, the oil pan and the power steering pump. It is easiest to access these areas by first raising the vehicle and placing it securely on jackstands.

5 If you are replacing either or both of the battery cables, take them with you when buying new cables. It is vitally important that you replace the cables with identical parts. Cables have characteristics that make them easy to identify: positive cables are usually red and larger in cross-section; ground cables are usually black and smaller in cross-section.

6 Clean the threads of the starter solenoid or ground connection with a wire brush to remove rust and corrosion. Apply a light coat of battery terminal corrosion inhibitor or petroleum jelly to the threads to prevent future corrosion.

7 Attach the cable to the terminal and tighten the mounting nut/bolt securely.

8 Before connecting a new cable to the battery, make sure that it reaches the battery without having to be stretched.

5 Ignition system - general information

V6 models are equipped with a distributor-type electronic ignition system. The ignition system consists of the battery, distributor, ignition coil, ignition control module, spark plug wires, spark plugs, camshaft position sensor, crankshaft position sensor and the Powertrain Control Module (PCM).

V8 models are equipped with a distributorless ignition system. The ignition system consists of the battery, eight ignition coils (one per cylinder), spark plug wires, spark plugs, camshaft position sensor, crankshaft position sensor and the Powertrain Control Module (PCM).

On all models, the PCM controls the ignition timing and spark advance characteristics for the engine. The ignition timing is not adjustable.

The crankshaft position sensor produces a signal voltage to indicate crankshaft position and crankshaft speed. This signal is used by the Powertrain Control Module (PCM) to control the ignition system and ignition timing.

The camshaft position sensor operation is similar to a crankshaft position sensor, but produces only one pulse per camshaft revolution. The camshaft position sensor signal is not essential to engine operation. The PCM uses the camshaft position sensor signal for fuel synchronization and misfire detection.

The ignition system is also equipped with a knock sensor to detect detonation, or spark knock (usually caused by the use of sub-standard fuel). The system uses a knock sensor in conjunction with the Powertrain Control Module (PCM) to control spark timing. If a knock signal is received, the PCM will retard the timing until the knock is eliminated. The knock sensor system allows the engine to use maximum spark advance without spark knock, which improves driveability and fuel economy.

6 Ignition system - check

Refer to illustrations 6.4, 6.10a, 6.10b, 6.11, 6.14 and 6.15

WARNING 1:

Because of the high voltage generated by the ignition system, extreme care should be taken whenever an operation is performed involving ignition components. This not only includes the ignition coil, but related components and test equipment.

WARNING 2:

The following procedure requires the engine to be cranked during testing, make sure the meter leads, loose clothing, long hair, etc. are away from the moving parts of the engine (drive-belt, cooling fan, etc.) before cranking the engine.

1 Before proceeding with the ignition system, check the following items:

a) Make sure the battery cable clamps, where they connect to the battery, are clean and tight.
b) Test the condition of the battery (see Section 3). If it does not pass all the tests, replace it with a new battery.
c) Check the ignition coil and ignition control module external wiring and connections.
d) Check the related fuses inside the underhood electrical center (see Chapter 12). If they're burned, determine the cause and repair the circuit.

2 If the engine turns over but won't start or has a severe misfire, make sure there is sufficient secondary ignition voltage to fire the spark plugs.

3 Disable the fuel system by removing the fuel pump relay from the underhood electrical center (see Chapter 12).

4 Disconnect a spark plug wire from one of the spark plugs and attach a calibrated ignition system tester (available at most auto parts stores) to the spark plug boot. Connect the clip on the tester to a bolt or metal bracket on the engine (see illustration). Crank the engine and watch the end of the tester to see if bright blue, well-defined sparks occur (weak spark or intermittent spark is the same as no spark).

5 If spark occurs, sufficient voltage is reaching the plug to fire it. Repeat the check at the remaining spark plug wires to verify that the distributor cap, rotor, spark plug wires, ignition coil(s) and control systems are functioning properly. If the ignition system is operating properly the problem lies elsewhere; i.e. a mechanical or fuel system problem. However, the spark plugs may be fouled, so remove and check them as described in Chapter 1.

6 If no spark occurs at one or more wires, remove the suspected spark plug wire from the ignition coil and check the terminals at both ends for damage. Connect an ohmmeter to the ends of the spark plug wire and check the wire for an open or high resistance. If the spark plug wire resistance is greater than 30 K-ohms, replace the wire.

7 If the engine won't start due to no spark or misfires severely, proceed with the ignition system check according to engine type as follows:

WARNING:

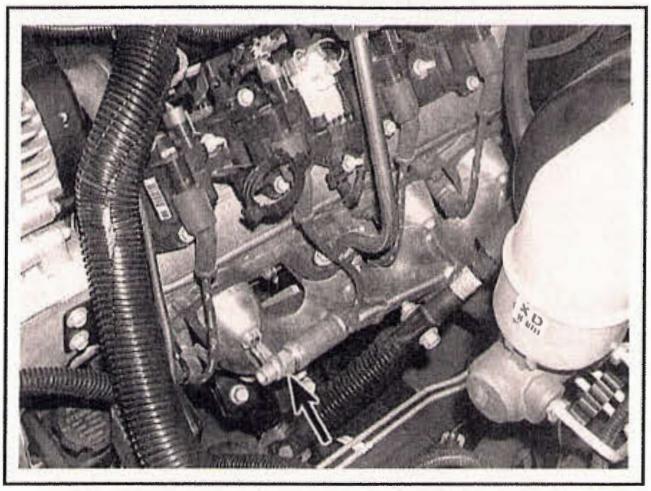
The following tests require the engine to be cranked. Keep all loose clothing, hair, etc. away from the drivebelt and engine cooling fan as the starter is operated or seriously injury may result.

V6 MODELS

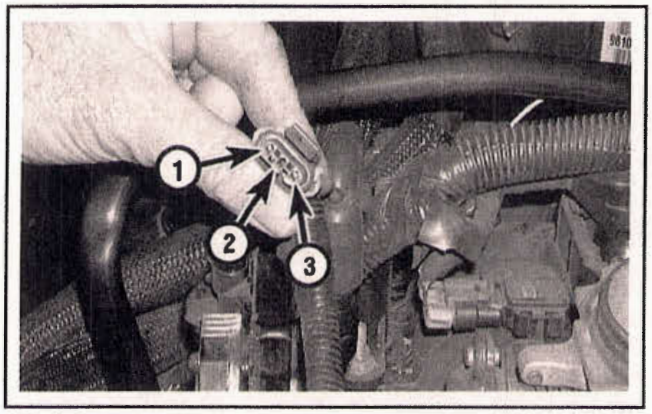
8 Disconnect the ignition coil wire from the distributor cap, connect the calibrated ignition tester to the coil wire, crank the engine and check for spark (see illustration 6.4). If adequate sparks occur at the coil wire, remove the distributor cap and check the distributor cap and rotor as described in Chapter 1. Replace the defective parts as necessary. Crank the engine while watching the distributor rotor. If the rotor does not turn, the distributor gear is stripped or the distributor shaft, timing chain/gears or camshaft are broken or damaged.

9 If no spark occurs at the coil wire, use an ohmmeter to check the resistance of the coil wire. Coil wire resistance should be approximately 1000 ohms per inch. Replace the coil wire if defective.

10 Disconnect the electrical connector from the ignition coil and from the ignition control module. Turn the ignition key On and check for battery voltage at the pink wire terminal of each harness connector (see illustrations). Also check for continuity to battery ground at the black

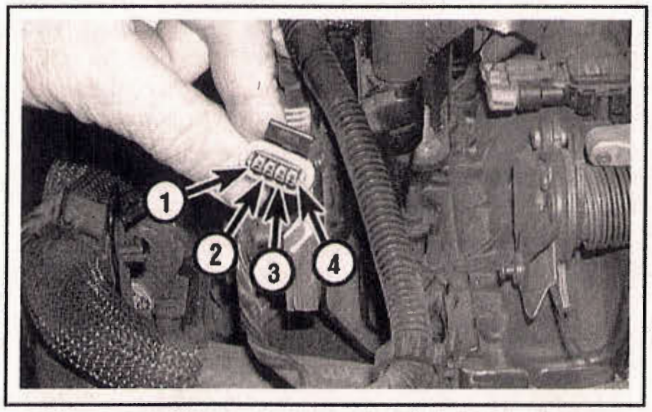


6.4 To use a calibrated ignition tester; disconnect a spark plug wire, connect the tester to the spark plug boot and clip the tester (arrow) to a convenient ground - crank the engine over, if there's enough power to fire the plug, bright blue sparks will be visible between the electrode tip and the tester body (weak spark or intermittent spark are the same as no spark)



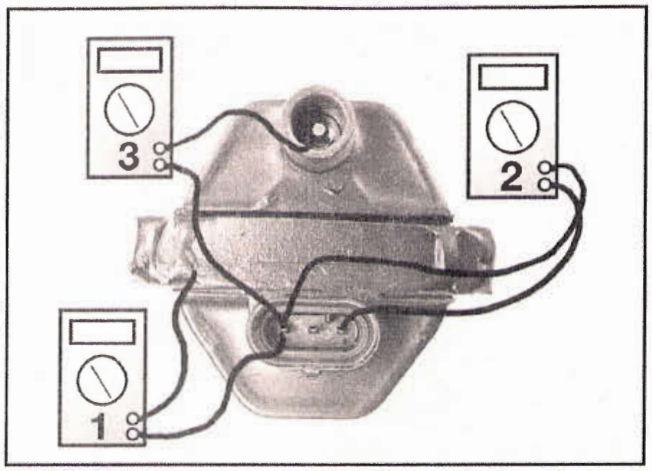
6.10a Ignition coil harness connector terminal identification

1 12-volt supply
2 Not used
3 Coil driver (from ignition control module)



6.10b Ignition control module harness connector terminal identification

1 Ignition coil driver
2 Ground
3 Ignition timing control (from PCM)
4 12-volt supply



6.11 To check the primary and secondary resistance of the V6 ignition coil, perform the three tests as shown - replace the ignition coil if your measurements are not as specified

1 *The ohmmeter should read infinite resistance between the primary terminals and the core*
2 *The primary resistance should be approximately 0.1 ohm*
3 *The secondary resistance should be between 5,000 to 25,000 ohms*

wire terminal of the ignition module harness connector. If battery voltage is not available at the ignition coil and/or ignition module, check the circuits from the underhood electrical center to the coil or module (don't forget to check the fuses first).

11 Using an ohmmeter, check the primary and secondary resistance of the ignition coil (see illustration). Replace the ignition coil if defective.

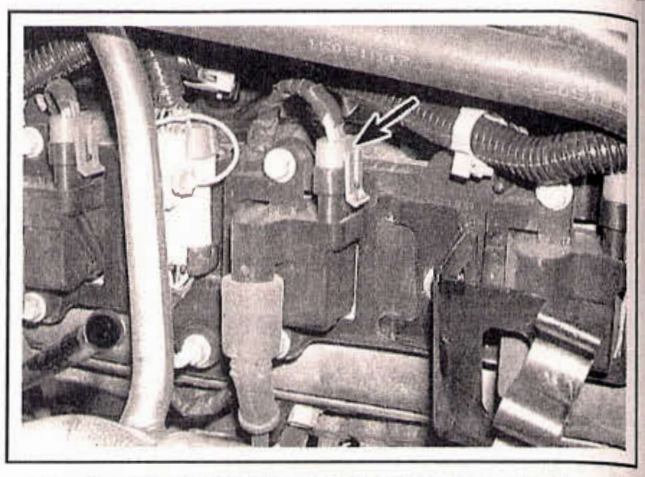
12 If the previous checks are correct, check the trigger signal from the ignition control module. Reconnect the electrical connector to the ignition control module. Attach the lead of a test light to the positive battery terminal and touch the probe of the test light to the white/black wire terminal at the ignition coil connector. Crank the engine. The test light should blink with the engine cranking if a trigger signal is present. If a trigger signal is not present, disconnect the electrical connector from the ignition control module and connect the positive probe of a voltmeter to the white wire terminal of the harness connector. Connect the negative lead to a good engine ground point and set the meter on the AC volts scale. Crank the engine. Approximately 1.0 to 4.0 volts should be indicated, if not, check the crankshaft position sensor (see Chapter 6). If the crankshaft position sensor is good, check the related circuits for continuity. If the circuits are good, have the PCM checked by a dealer service department or other qualified repair shop.

➡Note: Refer to the wiring diagrams at the end of Chapter 12 for wire color identification for testing and additional information on the circuits.

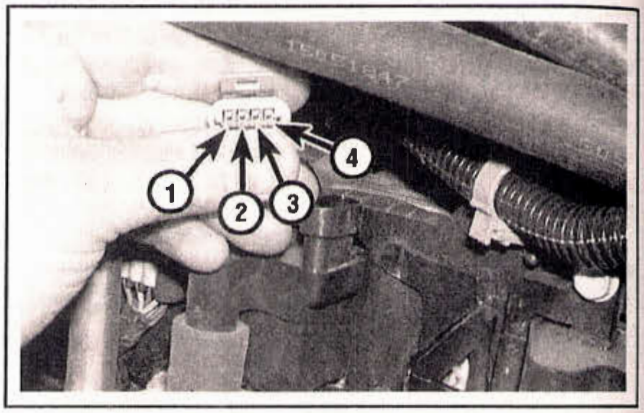
13 If the 1.0 to 4.0 volts ignition control signal was present at the ignition control module connector, but no trigger signal was present at the ignition coil connector, check the white/black wire for continuity between the ignition module connector and the ignition coil connector. If the circuit is good, replace the ignition control module.

V8 MODELS

14 Check for battery voltage to the ignition coils from the ignition switch. Attach a 12 volt test light to the battery negative (-) terminal or other good ground. Disconnect the electrical connector from one of the ignition coils and check for power at the pink wire terminal (see illustration). Battery voltage should be available with the ignition key On. If there is no battery voltage present, check the wiring and/or circuit between the underhood electrical center and ignition coil connector (don't forget to check the fuses). Also check the black wire terminal for continuity to battery ground. If there is battery voltage at the coil, but there is no spark from the coil, the coil, crankshaft position sensor, PCM or wiring are likely culprits.



6.14 Disconnect an ignition coil electrical connector (arrow) and check for battery power at the pink wire terminal of the connector



6.15 Using a test light connected to the positive battery terminal, check for a trigger signal at the ignition control terminal (1999 and 2000 models)

1 *12-volt supply*
2 *Ignition control (from PCM)*
3 *Reference low*
4 *Ground*

15 On 1999 and 2000 models, check for a trigger signal from the PCM. Attach the lead of a test light to the positive battery terminal and touch the probe of the test light to the ignition control circuit terminal (see illustration). Crank the engine. The test light should blink with the engine cranking if a trigger signal is present. Check each coil, if necessary. If a trigger signal is present at the coil, the power and ground circuits are good and there is no spark, replace the ignition coil. If a trigger signal is not present, check the crankshaft position sensor (see Chapter 6). If the crankshaft position sensor is good, check the circuits from the coil to the PCM. If the circuits are good, have the PCM checked by a dealer service department or other qualified repair shop.

➡Note: Refer to the wiring diagrams at the end of Chapter 12 for wire color identification for testing and additional information on the circuits.

7 Ignition coil and ignition control module (V6 models) - removal and installation

1 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Remove the air intake duct and resonator from the throttle body (see Chapter 4).

IGNITION COIL

Refer to illustration 7.4

3 Disconnect the electrical connectors from the ignition coil and ignition control module. Detach the coil wire from the ignition coil high-tension terminal.

4 Remove the ignition coil/module bracket mounting bolts and remove the assembly from the engine (see illustration). Remove the ignition control module from the bracket.

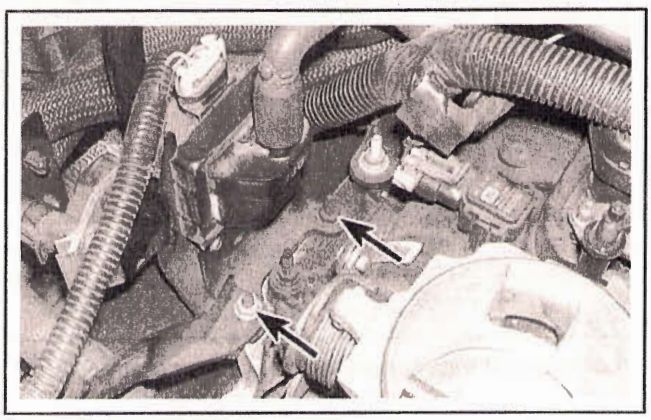
5 Place the assembly on a workbench. Using the appropriate size drill, drill out the center of the rivets retaining the coil to the bracket. Use a drift punch to punch out the rivets and remove the coil from the bracket.

6 Attach the ignition coil to the bracket using new screws.

Note: Screws are provided with a new ignition coil.

Attach the ignition module to the bracket.

7 Install the assembly on the engine and connect the electrical connectors and coil wire.

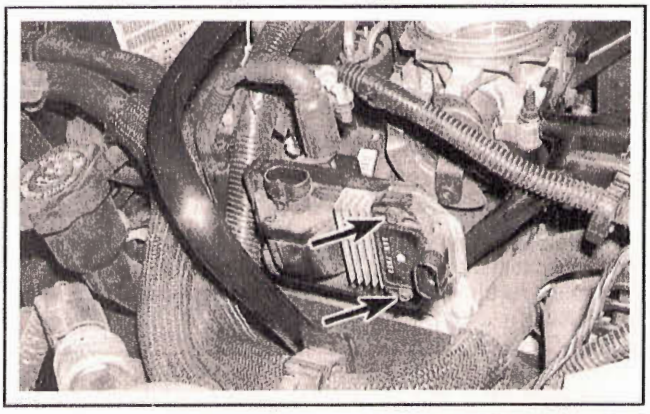


7.4 Remove the ignition coil/module bracket mounting bolts (arrows)

IGNITION CONTROL MODULE

Refer to illustration 7.10

8 The ignition control module can be removed without removing the coil bracket from the engine.



7.10 Ignition control module mounting screws (arrows)

9 Disconnect the electrical connector from the ignition control module.

10 Remove the mounting screws and remove the ignition control module from the bracket (see illustration).

11 Installation is the reverse of removal.

8 Ignition coils (V8 models) - removal and installation

Refer to illustrations 8.3 and 8.4

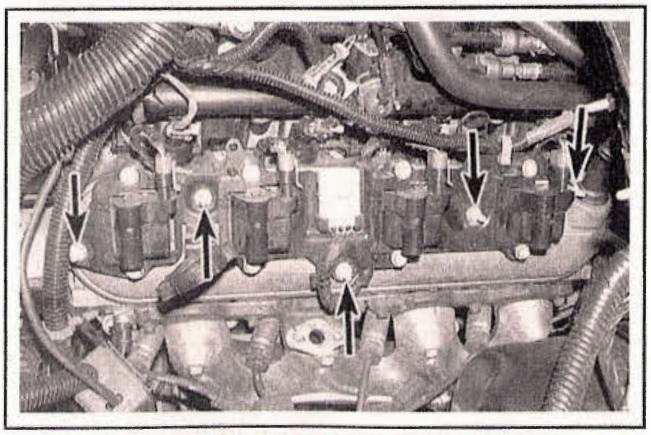
1 Disconnect the cable from the negative battery terminal.

CAUTION:

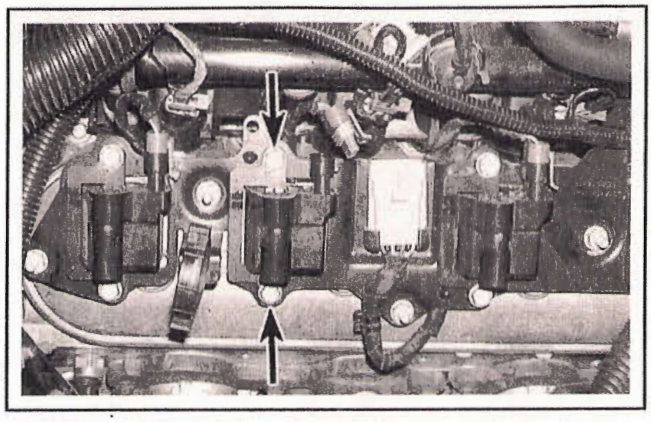
On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 The ignition coils may be removed from each cylinder bank as a complete assembly or removed from the mounting bracket individually.

3 If removing the complete assembly, disconnect the ignition coils main electrical connector. Disconnect the spark plug wires from the spark plugs. Remove the ignition coil bracket mounting nuts/bolts and remove the assembly from the engine (see illustration).



8.3 Remove the ignition coil bracket bolts (arrows)



8.4 Remove the ignition coil mounting screws (arrows)

4 If removing an individual coil, disconnect the spark plug wire from the coil. Remove the ignition coil mounting screws and remove the ignition coil from the bracket (see illustration).

5 Installation is the reverse of removal.

➡Note: There are two different coil manufacturers, and the coils, plug wires and coil mounting brackets are not interchangeable. If you are replacing one or more coils, take the old coil with you for identification at the auto parts store.

9 Distributor (V6 models) - removal and installation

REMOVAL

◗ Refer to illustrations 9.6 and 9.7

1 Disconnect the cable from the negative battery terminal.

✻✻✻ CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Remove the air intake duct and resonator assembly from the throttle body (see Chapter 4).

3 Position the engine with the number one cylinder at TDC on the compression stroke (see Chapter 2A).

4 Disconnect the electrical connector from the distributor.

5 Disconnect the coil wire from the distributor cap. Label and detach the spark plug wires from the spark plugs. Detach the spark plug wire retainers from the studs and brackets. Loosen the distributor cap mounting screws, remove the cap from the distributor and position the cap (with the spark plug wires attached) aside.

6 The distributor rotor should be pointing at the alignment mark; if necessary apply a paint mark on the edge of the distributor body directly below the rotor tip and in line with it (see illustration).

7 Mark the position of the distributor base to the engine to ensure the distributor can be re-installed in exactly the same position as originally installed (see illustration).

8 Remove the distributor hold-down bolt and pull out the distributor. Remove and discard the O-ring.

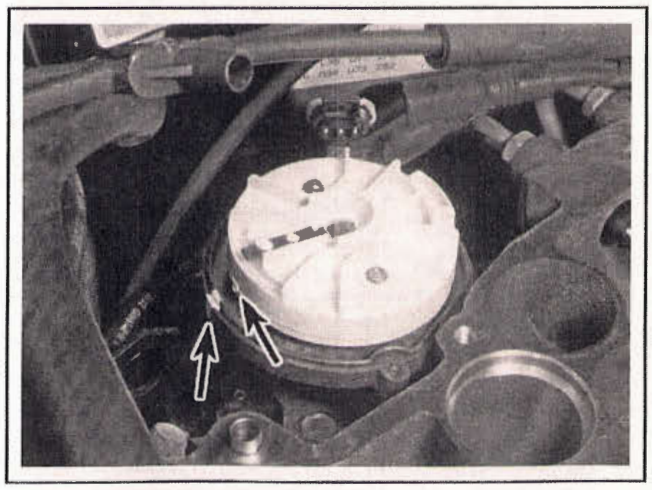
INSTALLATION

9 If the crankshaft has been moved while the distributor is out, the number one piston must be repositioned at TDC. This can be done by feeling for compression pressure at the number one spark plug hole as the crankshaft is rotated. Once compression is felt, continue rotating the crankshaft until the mark on the crankshaft damper is aligned with the TDC mark on the timing indicator (see Chapter 2A).

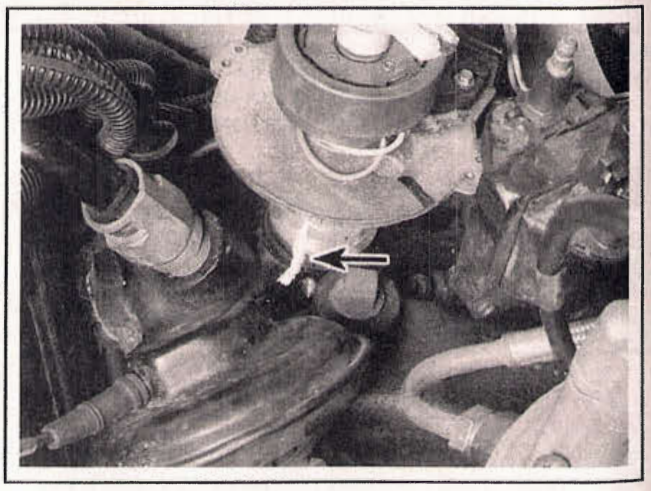
10 Install a new O-ring on the distributor housing.

11 Turn the rotor until it points approximately 42-degrees counterclockwise from the mark made in Step 6.

➡Note: Make sure the oil pump drive gear is properly aligned with the tab on the distributor shaft. If necessary use a long screwdriver to turn the oil pump drive shaft.



9.6 Apply a paint mark on the edge of the distributor body directly below the rotor tip and in line with it



9.7 Mark the position of the distributor base to the engine

12 Insert the distributor into the engine block. As the distributor gear engages the camshaft the rotor will rotate clockwise and when fully seated, the rotor must align with the mark made in Step 6. Rotate the distributor base until the marks made in Step 7 align.

CAUTION:

The distributor must be installed the same position as originally installed. Make sure the spark plug wire terminals are perpendicular to the engine centerline and the rotor remains aligned with the alignment mark. If the distributor is installed incorrectly, the engine will run poorly, the SERVICE ENGINE SOON light will illuminate and a diagnostic trouble code will set (see Chapter 6).

13 Install the distributor hold-down clamp and tighten the bolt to the torque listed in this Chapter's Specifications.

14 The remainder of installation is the reverse of removal.

10 Charging system - general information and precautions

The main components of the charging system are an alternator (with an integral voltage regulator), the battery and the wiring connecting the components. The components work together to supply electrical power for the electrical system and maintain the battery in a charged condition. The alternator is driven by the drivebelt at the front of the engine.

All models are equipped with either a model AD-230 or AD-244 alternator. AD type alternators should be considered non-serviceable and, if defective, exchanged as cores for new or rebuilt units. An identification number and amperage rating is stamped on the alternator housing. Refer to these numbers to obtain the correct replacement alternator, if necessary.

The purpose of the voltage regulator is to limit the alternator voltage output to a preset value. This prevents power surges and circuit overloads during peak voltage output. On all models with which this manual is concerned, the voltage regulator is integral with the alternator.

The charging system doesn't ordinarily require periodic maintenance. However, the drivebelt, battery and wires and connections should be inspected at the intervals outlined in Chapter 1.

The instrument panel warning light should come on when the ignition key is turned to START, then go off immediately after the engine has started. If the warning light stays on or comes on when the engine is running, a charging system problem has occurred (see Section 9).

Be very careful when making electrical circuit connections to a vehicle equipped with an alternator and note the following:

a) When reconnecting wires to the alternator from the battery, be sure to note the polarity.

b) Before using arc welding equipment to repair any part of the vehicle, disconnect the wires from the alternator and the battery terminals.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

c) Never start the engine with a battery charger connected.

d) Always disconnect both battery leads before using a battery charger.

e) The alternator is turned by an engine drivebelt which could cause serious injury if your hands, hair or clothes become entangled in it with the engine running.

f) Because the alternator is connected directly to the battery, it could arc or cause a fire if overloaded or shorted out.

g) Wrap a plastic bag over the alternator and secure it with rubber bands before steam cleaning the engine.

11 Charging system - check

Refer to illustration 11.2

Note: These vehicles are equipped with an On-Board Diagnostic (OBD) system that is useful for detecting charging system problems. Refer to Chapter 6 for the list of diagnostic codes and procedures for obtaining the codes.

1 If a malfunction occurs in the charging circuit, do not immediately assume that the alternator is causing the problem. First check the following items:

a) The battery cables where they connect to the battery. Make sure the connections are clean and tight.

b) The battery electrolyte specific gravity (by observing the charge indicator on the battery). If it is low, charge the battery.

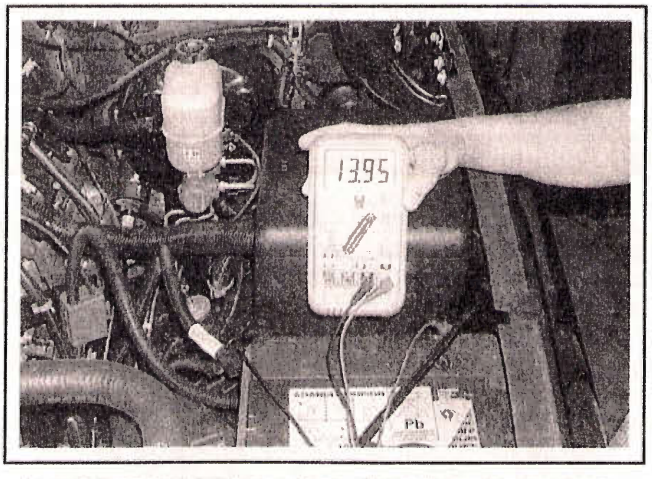
c) Check the external alternator wiring and connections.

d) Check the drivebelt condition and tension (see Chapter 1).

e) Check the alternator mounting bolts for tightness.

f) Run the engine and check the alternator for abnormal noise.

2 Connect a voltmeter to the positive and negative battery terminals (see illustration). Check the battery voltage with the engine off.



11.2 To measure battery voltage, attach the voltmeter leads to the battery terminals (engine OFF) - to measure charging voltage, start the engine

It should be approximately 12.4 to 12.6 volts, if the battery is fully charged.

3 Start the engine and check the battery voltage again. It should now be greater than the voltage recorded in Step 2, but not more than 14.7 volts.

4 If the indicated voltage reading is less or more than the specified charging voltage, have the charging system checked at a dealer service department or other properly equipped repair facility.

➡Note: Many auto parts stores will bench test an alternator off the vehicle. Refer to your local auto parts store regarding their policy, many will perform this service free of charge.

12 Alternator - removal and installation

Refer to illustrations 12.3, 12.4a and 12.4b

1 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Remove the drivebelt (see Chapter 1).

3 Disconnect the output wire and the electrical connector from the alternator (see illustration).

4 Remove the mounting bolts and remove the alternator from the engine (see illustrations).

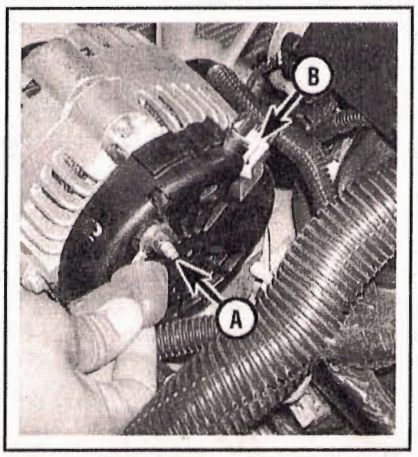
5 If you are replacing the alternator, take the old one with you when purchasing a replacement unit. Make sure the new/rebuilt unit looks identical to the old alternator. Look at the terminals - they should be the same in number, size and location as the terminals on the old alternator. Finally, look at the identification numbers - they will be stamped into the housing. Make sure the numbers are the same on both alternators.

6 Many new/rebuilt alternators do not have a pulley installed, so you may have to switch the pulley from the old unit to the new/rebuilt one. When buying an alternator, find out the shop's policy regarding pulleys; some shops will perform this service free of charge.

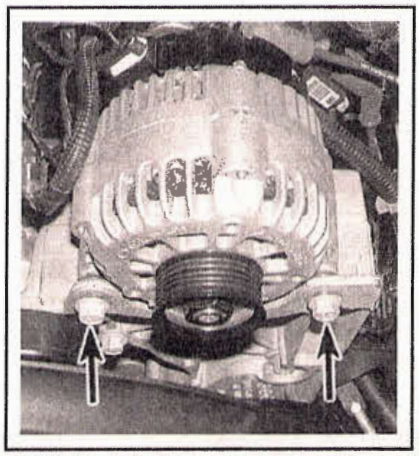
7 Installation is the reverse of removal. Tighten the mounting bolts to the torque listed in this Chapter's Specifications.

8 Install the drivebelt (see Chapter 1).

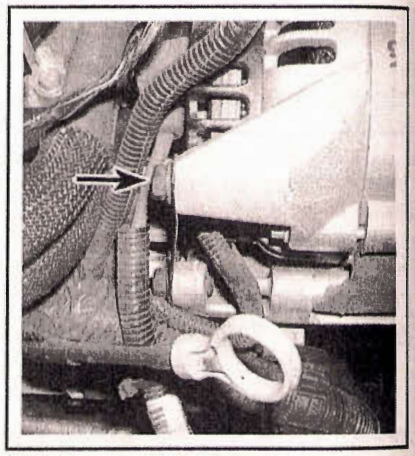
9 Check the charging voltage to verify proper operation of the alternator (see Section 11).



12.3 Remove the nut and wire terminal from the output terminal (A) and disconnect the alternator electrical connector (B)



12.4a Remove the alternator mounting bolts (arrows)



12.4b On V6 models, also remove the bracket bolt (if equipped) at the rear of the alternator (arrow)

13 Starting system - general information and precautions

The starter motor assembly is a permanent magnet, planetary gear drive starter motor. The starter motor assembly is serviced as a complete unit. If any component of the starter motor fails, including the solenoid, the entire assembly must be replaced.

The sole function of the starting system is to turn over the engine quickly enough to allow it to start. The starting system consists of the battery, starter motor assembly and the wiring connecting the components.

When the ignition key is turned to the START position, the starter solenoid is actuated through the starter control circuit. The starter solenoid then connects the battery to the starter motor. The battery supplies the electrical energy to the starter motor, which does the actual work of cranking the engine.

Always observe the following precautions when working on the starting system:

a) Excessive cranking of the starter motor can overheat it and cause serious damage. Never operate the starter motor for more than 15 seconds at a time without pausing to allow it to cool for at least two minutes.

b) The starter is connected directly to the battery and could arc or cause a fire if mishandled, overloaded or shorted.

c) Always detach the cable from the negative terminal of the battery before working on the starting system.

14 Starter motor and circuit - check

Refer to illustration 14.4

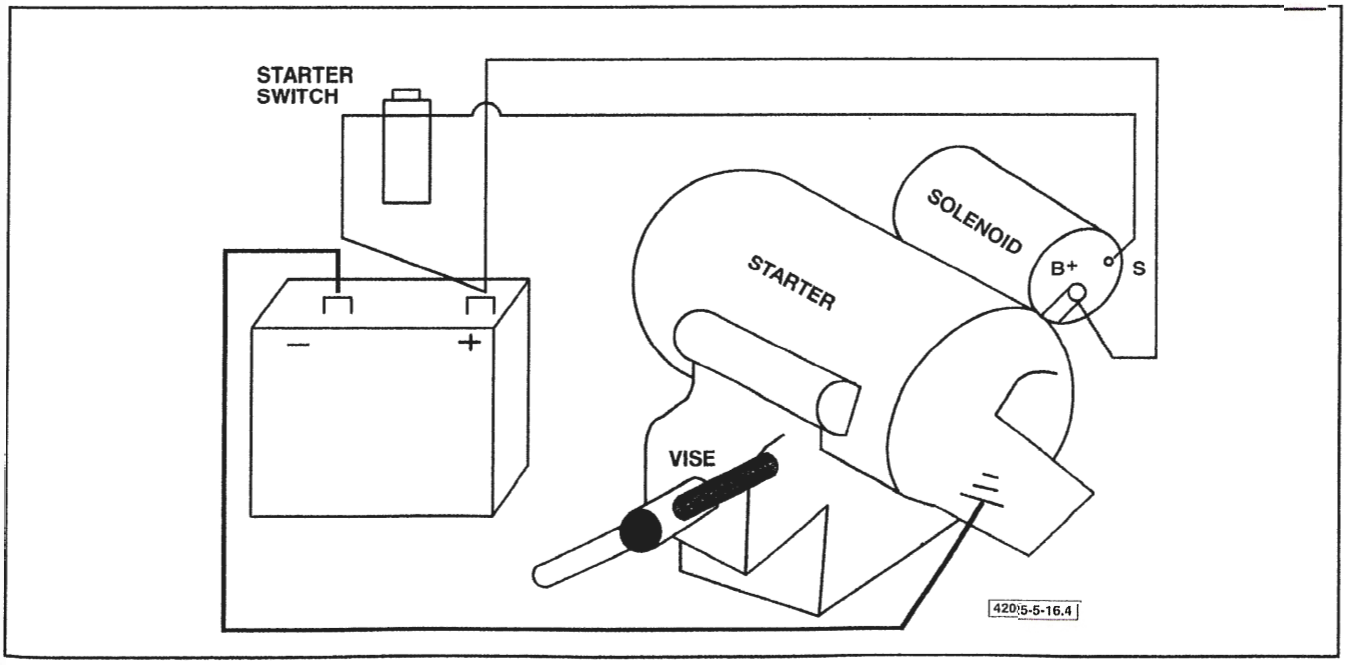
1 If a malfunction occurs in the starting circuit, do not immediately assume that the starter is causing the problem. First, check the following items:

a) Make sure the battery cable clamps, where they connect to the battery, are clean and tight.
b) Check the condition of the battery cables (see Section 4). Replace any defective battery cables with new parts.
c) Test the condition of the battery (see Section 3). If it does not pass all the tests, replace it with a new battery.
d) Check the starter motor wiring and connections.
e) Check the starter motor mounting bolts for tightness.
f) Check the related fuses in the engine compartment fuse box (see Chapter 12). If they're blown, determine the cause and repair the circuit.
g) Check the ignition switch circuit for correct operation (see Chapter 12).
h) Check the starter relay (located in the underhood electrical center) for proper operation (see Chapter 12).
i) Check the operation of the clutch start switch (manual transmission) or the Park/Neutral position switch (automatic transmission) (see Chapter 8 or 7B). These systems must operate correctly to provide battery voltage to the starter relay.

2 If the starter does not activate when the ignition switch is turned to the start position, check for battery voltage to the starter solenoid. This will determine if the solenoid is receiving the correct voltage from the starter relay. Install a 12-volt test light or a voltmeter to the starter solenoid terminal (purple wire). While an assistant turns the ignition switch to the start position, observe the test light or voltmeter. The test light should shine brightly or battery voltage should be indicated on the voltmeter. If voltage is not available to the starter solenoid, refer to the wiring diagrams in Chapter 12 and check the fuses, ignition switch, starter relay and related wiring in series with the starting system. If voltage is available but there is no movement from the starter motor, remove the starter from the engine (see Section 15) and bench test the starter (see Step 4).

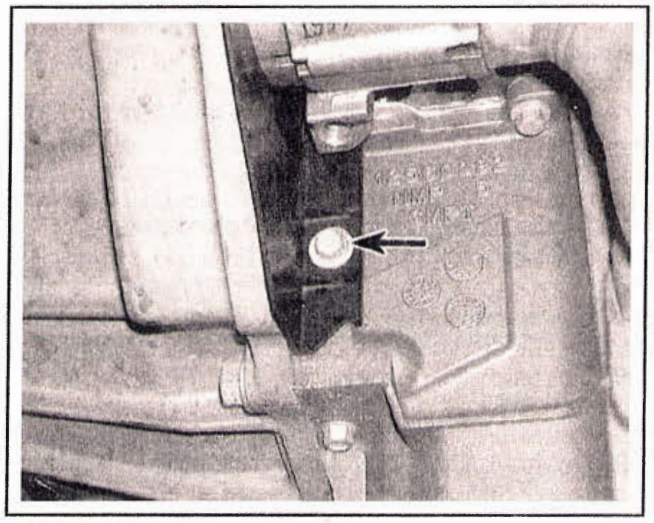
3 If the starter turns over slowly, check the starter cranking voltage and the current draw from the battery. This test must be performed with the starter assembly on the engine. Crank the engine over (for 10 seconds or less) and observe the battery voltage. It should not drop below 8.5 volts. Also, observe the current draw using an amp meter. Typically a starter amperage draw should not exceed 350 amps. If the starter motor amperage draw is excessive, have it tested by a dealer service department or other qualified repair shop. There are several conditions that may affect the starter cranking potential. The battery must be in good condition and the battery cold-cranking rating must not be under-rated for the particular application. Be sure to check the battery specifications carefully. The battery terminals and cables must be clean and not corroded. Also, in cases of extreme cold temperatures, make sure the battery and/or engine block is warmed before performing the tests.

4 If the starter is receiving voltage but does not activate, remove and check the starter motor assembly on the bench. Most likely the starter motor or solenoid is defective. In some rare cases, the engine may be seized so be sure to try and rotate the crankshaft pulley (see Chapter 2A or 2B) before proceeding. With the starter assembly mounted in a vise on the bench, install one jumper cable from the positive terminal of a test battery to the B+ terminal on the starter. Install another jumper cable from the negative terminal of the battery to the body of the starter (see illustration). Install a starter switch and apply battery voltage to the solenoid S terminal (for 10 seconds or less) and observe the solenoid plunger, shift lever and overrunning clutch extend and rotate the pinion drive. If the pinion drive extends but does not rotate, the solenoid is operating but the starter motor is defective. If there is no movement but the solenoid clicks, the solenoid and/or the starter motor is defective. If the solenoid plunger extends and rotates the pinion drive, the starter assembly is operating properly.

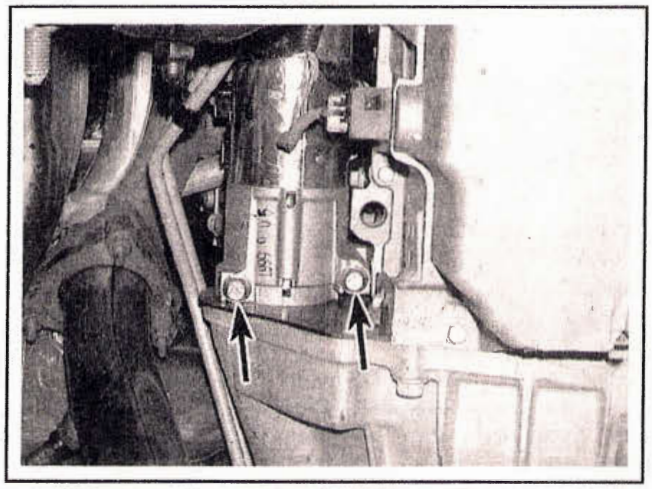


14.4 Starter motor bench testing details

15 Starter motor - removal and installation



15.4 On V8 models, remove the transmission bellhousing cover bolt (arrow)



15.5 Remove the starter mounting bolts (arrows)

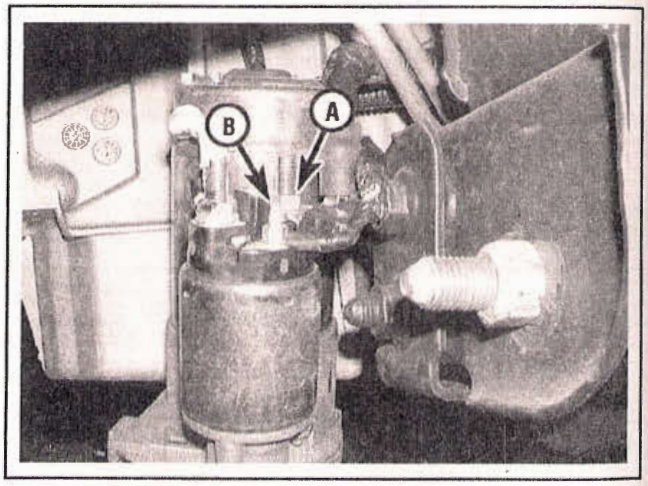
Refer to illustrations 15.4, 15.5 and 15.8

1 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Raise the vehicle and support it securely on jackstands.
3 Remove the splash shield, if equipped.
4 On V8 models, remove the starter solenoid shield and the transmission bellhousing cover bolt (see illustration). Disconnect the oil level sensor electrical connector.
5 Remove the starter mounting bolts (see illustration).
6 On V8 models, move the starter forward and remove the transmission bellhousing cover.
7 Carefully lower the starter. If necessary, detach the transmission cooler lines from the retainers at the oil pan and carefully position the lines aside - do not bend or kink the lines.
8 Disconnect the wires from the terminals on the starter motor solenoid (see illustration) and remove the starter from the vehicle.
9 Installation is the reverse of removal.



15.8 Remove the nuts and disconnect the battery cable (A) and the solenoid terminal (B) from the starter motor

Specifications

General

Battery voltage	
Engine off	12.0 to 12.6 volts
Engine running	13.5 to 14.7 volts

Torque specifications

	Ft-lbs (unless otherwise indicated)
Alternator mounting bolts	
V6 engine	
Front mounting bolts	37
Rear bracket bolt	
Through 2001	18
2002	30
V8 engines	37
Distributor hold-down bolt (V6)	18
Starter mounting bolts	
V6 engine	32
V8 engines	37