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2

ENGINE ELECTRICAL

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DISTRIBUTOR IGNITION SYSTEM

➡For information on understanding electricity and troubleshooting electrical circuits, please refer to Section 6 of this manual.

General Information

The ignition system on the 1.5L, 1993–96 1.8L, 2.0L SOHC, 1994–98 2.4L SOHC, 3.0L SOHC, and 3.5L engines uses a pointless type distributor, whose advance mechanism is controlled by the Engine Control Unit (ECU). On the 1.5L, 1.8L, 2.4L and 3.5L engines, the distributor houses a built in ignition coil and ignition power transistor. The 2.0L SOHC and 3.0L SOHC engines utilize a separate coil and transistor assembly.

When the ignition switch is turned **ON**, battery voltage is applied to the ignition coil primary winding. As the shaft of the distributor rotates, signals are transmitted from the powertrain control module to the ignition power transistor. These signals activate the power transistor to cause ignition coil primary winding current flow from the ignition coil negative terminal through the power transistor to ground repeatedly. This interruption induces high voltage in the ignition coil secondary windings, which is diverted through the distributor, spark plug cable and spark plug to ground, thus causing ignition in each cylinder.

Diagnosis and Testing

SECONDARY SPARK TEST

➧ See Figures 1 thru 6

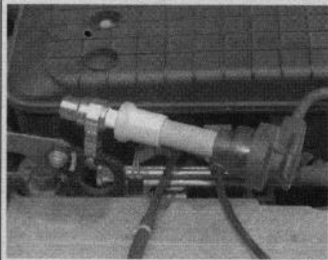
The best way to perform this procedure is to use a spark tester (available at most automotive parts stores). Three types of spark testers are commonly available. The Neon Bulb type is connected to the spark plug wire and flashes with each ignition pulse. The Air Gap type must be adjusted to the individual spark plug gap specified for the engine. The last type of spark plug tester looks like a spark plug with a grounding clip on the side, but there is no side electrode for the spark to jump to. The last two types of testers allows the user to not only detect the presence of spark, but also the intensity (orange/yellow is weak, blue is strong).

1. Disconnect a spark plug wire at the spark plug end.
2. Connect the plug wire to the spark tester and ground the tester to an appropriate location on the engine.
3. Crank the engine and check for spark at the tester.
4. If spark exists at the tester, the ignition system is functioning properly.
5. If spark does not exist at the spark plug wire, perform diagnosis of the ignition system using individual component diagnosis procedures.

CYLINDER DROP TEST

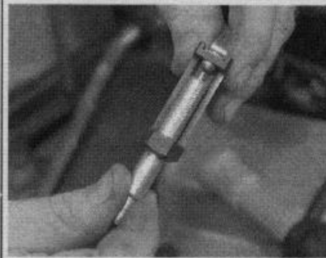
➧ See Figures 7, 8, and 9

The cylinder drop test is performed when an engine misfire is evident. This test helps determine which cylinder is not contributing the proper power. The easiest way to perform this test is to remove the plug wires one at a time from the cylinders with the engine running.



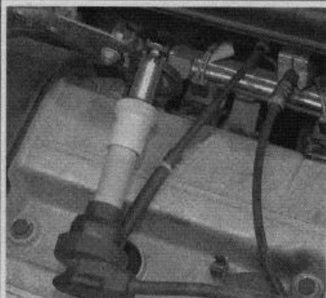
91052p10

Fig. 1 This spark tester looks just like a spark plug, attach the clip to ground and crank the engine to check for spark



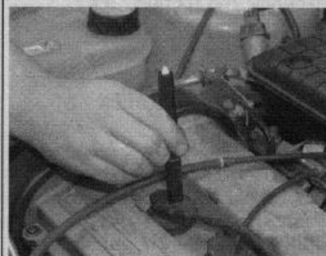
91052p11

Fig. 2 This spark tester has an adjustable air-gap for measuring spark strength and testing different voltage ignition systems



91052p12

Fig. 3 Attach the clip to ground and crank the engine to check for spark

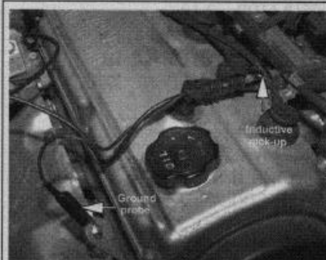


91052p13

Fig. 4 This spark tester is the easiest to use just place it on a plug wire and the spark voltage is detected and the bulb on the top will flash with each pulse

93152p28

Fig. 5 A tool used by many professionals to check the secondary ignition pattern is an oscilloscope, similar to this one from UEI



93152p27

Fig. 6 The setup of the oscilloscope is quite easy, just connect the ground lead and place the inductive pick-up on one of the plug wires

1. Place the transaxle in **P**, engage the emergency brake, and start the engine and let it idle.
2. Using a spark plug wire removing tool, preferably the plier type, carefully remove the boot from one of the cylinders.

WARNING

Make sure your body is free from touching any part of the car which is metal. The secondary voltage in the ignition system is high and although it cannot kill you, it will shock you and it does hurt.

3. The engine will sputter, run worse, and possibly nearly stall. If this happens reinstall the plug wire and move to the next cylinder. If the engine runs no differently, or the difference is minimal, shut the engine off and inspect the spark plug wire, spark plug, and if necessary, perform component diagnostics as covered in this section. Perform the test on all cylinders to verify the which cylinders are suspect.

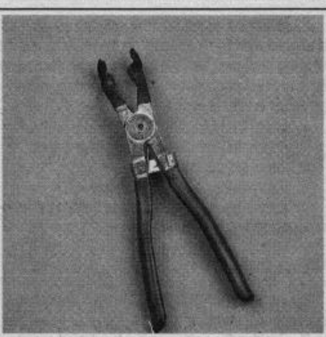

91052p14

Fig. 7 These pliers are insulated and help protect the user from shock as well as the plug wires from being damaged

Adjustments

There are no adjustments to the distributor ignition system other than the ignition timing adjustment. Refer to section 1 for ignition timing adjustment.

Ignition Coil

TESTING

1.5L, 1.8L, 2.4L, and 3.5L Engines

See Figures 10, 11, and 12

The ignition coil is an integral part of the distributor.

1. Measure the resistance of the primary ignition coil as follows:
   a. Unplug the electrical connector at the distributor. Using an ohmmeter, measure the resistance between the two terminals of the distributor, **NOT THE WIRE HARNESS**, except for the 3.5L engine, in which you test across terminals **1** and **2** of the distributor.
   b. Measure the resistance and compare to the desired specifications of:
   - 0.9–1.2 ohms on the 1.5L, 1.8L, and 2.4L engines
   - 0.5–0.7 ohms on the 3.5L engine

   c. If the actual reading differs from the desired specification, replace the ignition coil.
   d. If the measured value is within standard allowance, there are no broken wires or short circuits.


91052p15

Fig. 8 To perform the cylinder drop test, remove one wire at a time and . . .

2. Measure the resistance of the secondary ignition coil as follows:
   a. Insert one of the test leads into the secondary ignition coil terminal on top of the distributor cap.
   b. Touch the second test lead to terminal **1** or terminal **2** of the distributor connector.
   c. Measure the resistance and compare to the desired specifications of:
   - 20–29 kilo-ohms on the 1.5L, 1.8L, and 2.4L engines
   - 9–13 kilo-ohms on the 3.5L engine

   d. If the measured value is within standard allowance, there are no broken wires or short circuits.
   e. If the actual reading differs from the desired specification, replace the ignition coill.

2.0L SOHC and 3.0L SOHC Engines

See Figure 13

1. Measure the resistance of the primary ignition coil as follows:
   a. Unplug the electrical connector at the coil. Using an ohmmeter, measure the resistance between the two terminals of the coil, **NOT THE WIRE HARNESS**.
   b. Measure the resistance and compare to the desired specifications of:
   - 0.9–1.2 ohms on the 2.0L SOHC engine
   - 0.72–0.88 ohms on the 3.0L SOHC engine

   c. If the actual reading differs from the desired specification, replace the ignition coil.
   d. If the measured value is within standard allowance, there are no broken wires or short circuits.


91052p16

Fig. 9 . . . note the idle speed and idle characteristics of the engine. The cylinder(s) with the least drop is the non-contributing cylinder(s)

2. Measure the resistance of the secondary ignition coil as follows:
   a. Insert one of the test leads into the secondary ignition coil terminal on top of the distributor cap.
   b. Touch the second test lead to terminal **1** or terminal **2** of the distributor connector.
   c. Measure the resistance and compare to the desired specifications of:
   - 20–29 kilo-ohms on the 2.0L SOHC engine
   - 10.29–13.92 kilo-ohms on the 3.0L SOHC engine

   d. If the measured value is within standard allowance, there are no broken wires or short circuits.
   e. If the actual reading differs from the desired specification, replace the ignition coill.

REMOVAL & INSTALLATION

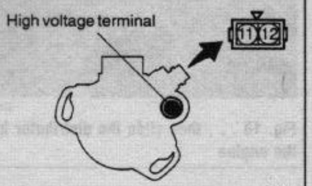
1.5L, 1.8L, 2.4L, and 3.5L Engines

The ignition coil is an integral part of the distributor.

2.0L SOHC and 3.0L SOHC Engines

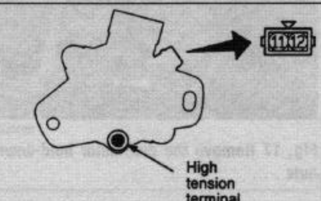
See Figure 14

1. Disconnect the negative battery cable.
2. Remove the coil wire from the ignition coil by gripping the boot and not the cable.
3. Detach the electrical connectors for the coil.



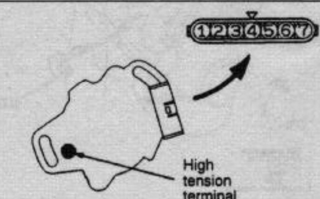
93152g01

Fig. 10 Distributor connector pins and location—1.5L and 1.8L engines



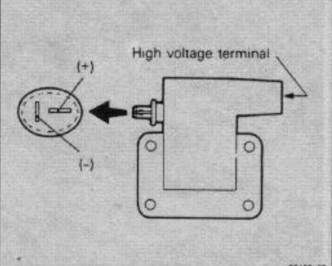
93152g02

Fig. 11 Distributor connector pins and location—2.4L SOHC engine



93152g04

Fig. 12 Distributor connector pins and location—3.5L engine



93152g03

Fig. 13 Distributor connector pins and location—3.0L SOHC engine

4. Remove the retaining screws and coil from engine.
5. Installation is the reverse of the removal procedure.

Power Transistor (Ignition Module)

REMOVAL & INSTALLATION

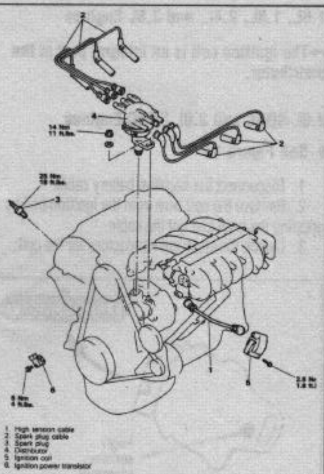
1.5L, 1.8L, 2.4L, and 3.5L Engines

The power transistor (ignition module) is an integral part of the distributor.

2.0L SOHC and 3.0L SOHC Engines

See Figure 14

1. Disconnect the negative battery cable.
2. Detach the electrical connectors for the power transistor.
3. Remove the retaining screws and power transistor from engine.
4. Installation is the reverse of the removal procedure.



93152g05

Fig. 14 Ignition system component locations—3.0L SOHC engine

Distributor

REMOVAL & INSTALLATION

See Figures 14, 15, 16, 17, and 18

Before removing the distributor, position No. 1 cylinder at Top Dead Center (TDC) on the compression stroke and align the timing marks.

1. Disconnect the negative battery cable.
2. Remove the ignition wire cover, if equipped.
3. Detach the distributor harness connector.
4. Remove the distributor cap with all ignition wires still connected. Remove the coil wire, if necessary.
5. Matchmark the rotor to the distributor housing and the distributor housing to the engine.
6. Remove the hold-down nut.
7. Carefully remove the distributor from the engine.

INSTALLATION

See Figures 19 and 20

Timing Not Disturbed

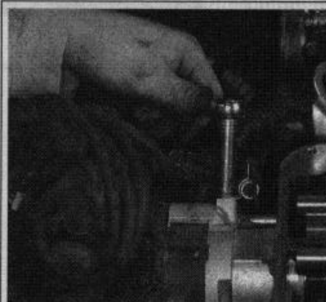
1. Install a new distributor housing O-ring and lubricate with clean oil.
2. Install the distributor in the engine so the rotor is aligned with the matchmark on the housing and the housing is aligned with the matchmark on the engine. Be sure the distributor is fully seated and the distributor shaft is fully engaged.
3. Install the hold-down nut.
4. Attach the distributor harness connectors.
5. Install the distributor cap.
6. Connect the negative battery cable.
7. Adjust the ignition timing and tighten the hold-down nut to 8 ft. lbs. (11 Nm).

Timing Disturbed

1. Install a new distributor housing O-ring and lubricate with clean oil.
2. Position the engine so the No. 1 piston is at Top Dead Center (TDC) of its compression stroke and the mark on the vibration damper is aligned with **0** on the timing indicator.
3. Align the distributor housing and gear mating marks. Install the distributor in the engine so the slot or groove of the distributor's installation flange aligns with the distributor installation stud in the engine block. Be sure the distributor is fully seated. Inspect alignment of the distributor rotor making sure the rotor is aligned with the position of the No. 1 ignition wire in the distributor cap.

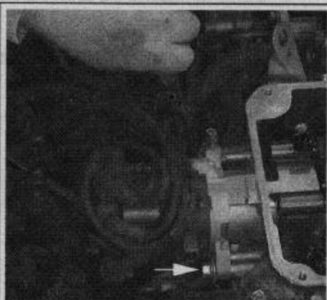
93152p21

Fig. 15 Detach the connectors from the distributor



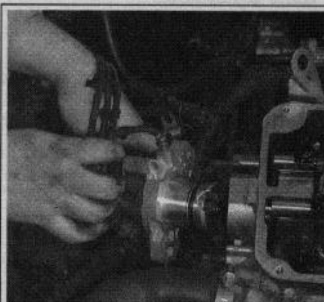
93152p22

Fig. 16 Remove the bolt holding the wire harness and capacitor, then move the harness and capacitor to the side



93152p23

Fig. 17 Remove the distributor hold-down nuts . . .



93152p24

Fig. 18 . . . then slide the distributor from the engine

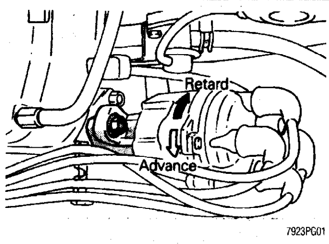


Fig. 19 Adjusting the distributor—1.5L engine shown, others similar

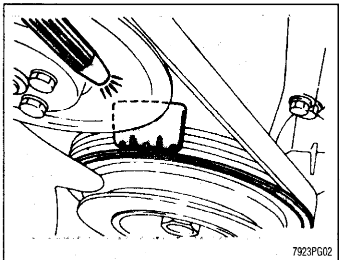


Fig. 20 Checking the ignition timing—1.5L engine, others similar

4. Install the hold-down nut.
5. Attach the distributor harness connectors.
6. Install the distributor cap.
7. Connect the negative battery cable.
8. Adjust the ignition timing and tighten the hold-down nut to 8 ft. lbs. (11 Nm).

Crankshaft and Camshaft Position Sensors

For procedures on the position sensors, please refer to Section 4 in this manual.

DISTRIBUTORLESS IGNITION SYSTEM

General Information

The ignition system found on the 1.6L, 1997–00 1.8L, 2.0L DOHC, 1999–00 2.4L SOHC, 2.4L DOHC, and 3.0L DOHC engines is a distributorless type. The advance of this system, like the distributor type ignition, is controlled by the Engine Control Unit (ECU) or Powertrain Control Module (PCM). The distributorless ignition system contains a crank angle/position sensor which detects the crank angle or position to each cylinder and converts this data into pulse signals. These signals are sent to the ECU/PCM, which calculates the engine rpm and regulates the fuel injection and ignition timing accordingly. The system also contains a top dead center sensor which detects the top dead center position of each cylinder and converts this data into pulse signals. These signals are then sent to the ECU/PCM, which calculates the sequence of fuel injection and engine rpm.

When the ignition switch is turned **ON**, battery voltage is applied to the ignition coil primary winding. As the crank angle sensor shaft rotates, ignition signals are transmitted from the multi port injection control unit to the power transistor. These signals activate the power transistor to cause ignition coil primary winding current to flow from the ignition coil negative terminal through the power transistor to ground or be interrupted, repeatedly. This action induces high voltage in the secondary winding of the ignition coil. From the ignition coil, the secondary winding current produced flows through the spark plug to ground, thus causing ignition in each cylinder.

Diagnosis and Testing

Refer to Diagnosis and Testing under Distributor Ignition in this section.

Adjustments

There are no adjustments to the distributorless ignition system other than the ignition timing adjustment. Refer to section 1 for ignition timing adjustment.

Ignition Coil(s)

TESTING

1.6L and 1990 2.0L DOHC Engines

See Figures 21 and 22

1. Disconnect the negative battery cable and ignition coil harness connector.
2. Measure the primary coil resistance as follows:
   a. Measure the resistance between terminals of the coil pack, **NOT THE WIRE HARNESS**, between **4** and **2** (coils at the No. 1 and No. 4 cylinder sides) of the ignition coil, and between terminals **4** and **1** (coils at the No. 2 and No. 3 cylinder sides).

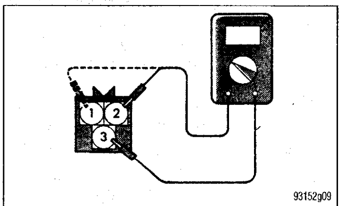


Fig. 21 Measuring ignition coil primary resistance—1.6L and 1990 2.0L DOHC engines

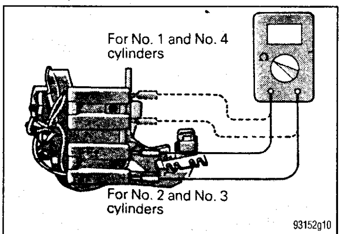


Fig. 22 Measuring ignition coil secondary resistance—1.6L and 1990 2.0L DOHC engines

   b. Compare reading to the desired primary coil resistance of 0.77–0.95 ohms.
3. Measure the coil secondary resistance as follows:
   c. Detach the connector from the ignition coil.
   d. Measure the resistance between the high-voltage terminals for the No. 1 and No. 4 cylinders, and between the high-voltage terminals for the No. 2 and No. 3 cylinders.
   e. Compare the measured resistance to the desired secondary coil resistance of 10.3–13.9 kilo-ohms.
4. If the readings are not within the specified value, replace the ignition coil.

1991–93 2.0L DOHC Engines

See Figures 23 and 24

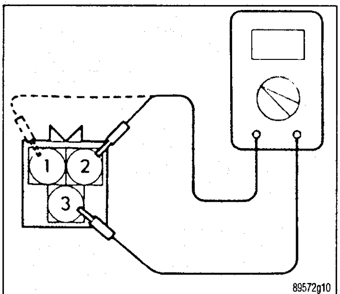


Fig. 23 Measuring the primary ignition coil resistance—1991–93 2.0L DOHC engines

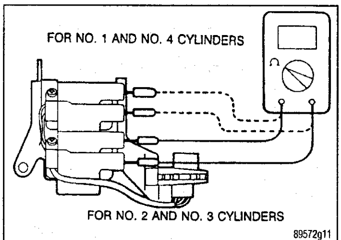


Fig. 24 Measuring ignition coil secondary resistance—1991–93 2.0L DOHC engines

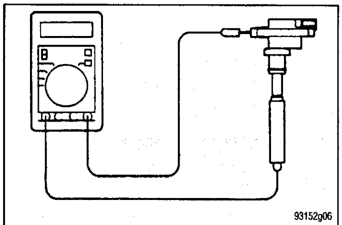


Fig. 25 Measuring ignition coil secondary resistance—1997–00 1.8L and 1999–00 2.4L SOHC engines

1. Disconnect the negative battery cable and ignition coil harness connector.
2. Measure the primary coil resistance as follows:
   a. Measure the resistance between terminals **3** and **2** (coils at the No. 1 and No. 4 cylinder sides) of the ignition coil, and between terminals **3** and **1** (coils at the No. 2 and No. 3 cylinder sides).
   b. Compare reading to the desired primary coil resistance of 0.70–0.86 ohms.
3. Measure the coil secondary resistance as follows:
   c. Detach the connector from the ignition coil.
   d. Measure the resistance between the high-voltage terminals for the No. 1 and No. 4 cylinders, and between the high-voltage terminals for the No. 2 and No. 3 cylinders.
   e. The desired secondary coil resistance is 11.3–15.3 kilo-ohms.
4. If the readings are not within the specified value, replace the ignition coil.

1997–00 1.8L and 1999–00 2.4L SOHC Engines

See Figure 25

1. Measure the resistance of the secondary ignition coil as follows:
   a. Insert one of the test leads into the secondary ignition coil terminal of the coil.
   b. Touch the second test lead to terminal **1** or terminal **2** of the coil connector.
   c. Measure the resistance and compare to the desired specifications of 9.4–12.8 kilo-ohms.
   d. If the measured value is within standard allowance, there are no broken wires or short circuits.
   e. If the actual reading differs from the desired specification, replace the ignition coil.

2.4L DOHC Engines

See Figures 26 and 27

1. Disconnect the negative battery cable.
2. To check the primary coil resistance, perform the following:
   a. Detach the electrical connector from the coil pack.
   b. Using an ohmmeter, measure the resistance between the two terminals of the coil, **NOT THE WIRE HARNESS**.
   c. If the resistance is not between 0.74–0.90 ohms, replace the ignition coil.

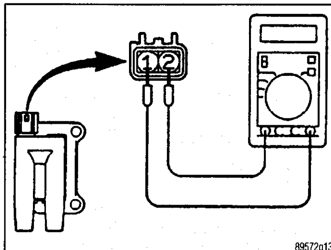


Fig. 26 Measure the primary coil resistance between the connector terminals—2.4L DOHC engine

3. To check the secondary coil resistance, perform the following:
   a. Tag and disconnect the spark plug wires from the ignition coil.
   b. Measure the secondary resistance of the coil between the towers of each individual coil.
   c. If the resistance is not between 20.1–27.3 kilo-ohms, replace the ignition coil.

3.0L DOHC Engine

See Figures 28 and 29

1. Measure the resistance of the primary ignition coil as follows:
   a. Unplug the electrical connector at the coil pack. Using an ohmmeter, measure the resistance between the terminals of the coil pack, **NOT THE WIRE HARNESS**. Measure the resistance between terminals:
      - **2–3** for Coil **A**
      - **1–3** for Coil **B**
      - **4–3** for Coil **C**
   b. Measure the resistance and compare to the desired specifications of 0.67–0.81 ohms.
   c. If the actual reading differs from the desired specification, replace the ignition coil.

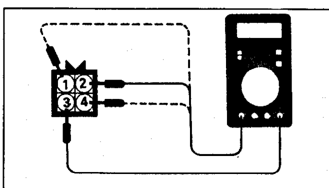


Fig. 28 Measuring ignition coil primary resistance—3.0L DOHC engine

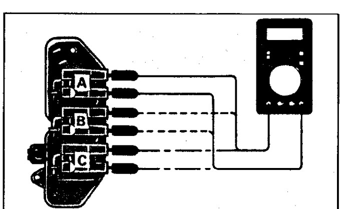


Fig. 29 Measuring ignition coil secondary resistance—3.0L DOHC engine

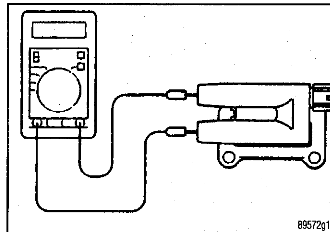


Fig. 27 Measure the secondary resistance between the towers of the coil—2.4L DOHC engine

   d. If the measured value is within standard allowance, there are no broken wires or short circuits.
2. Measure the resistance of the secondary ignition coil as follows:
3. Insert the lead of the ohmmeter between coil pack cylinder terminals:
   - Between coil terminals **1–4** for Coil **A**
   - Between coil terminals **2–5** for Coil **B**
   - Between coil terminals **3–6** for Coil **C**
   e. Measure the resistance and compare to the desired specifications of 11.3–15.3 kilo-ohms.
   f. If the measured value is within standard allowance, there are no broken wires or short circuits.
   g. If the actual reading differs from the desired specification, replace the ignition coil pack.

REMOVAL & INSTALLATION

1.6L, 2.0L DOHC, and 2.4L DOHC Engines

See Figure 30

1. Disconnect the negative battery cable.
2. Tag and remove the spark plug wires from the ignition coil by gripping the boot and not the cable.

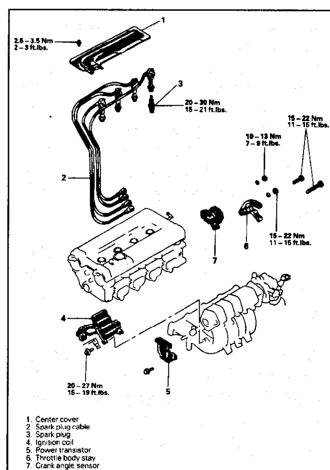


Fig. 30 Ignition system component locations—1.6L and 2.0L DOHC engines

3. Detach the electrical connectors for the coil.
4. Remove the retaining screws and coil from engine.
5. Installation is the reverse of the removal procedure.

1997–00 1.8L and 1999–00 2.4L Engines

See Figure 31

1. Disconnect the negative battery cable.
2. Detach the electrical connector(s) for the coil(s).
3. Remove the spark plug wire(s) to the companion cylinder(s).
4. Remove the coil retaining bolts and lift the coil from the cylinder head.
5. The installation is the reverse of the removal.

3.0L DOHC Engine

See Figure 32

1. Disconnect the negative battery cable.
2. Remove the intake manifold plenum (upper intake manifold). Refer to Section 3.
3. Tag and remove the spark plug wires from the ignition coil by gripping the boot and not the cable.
4. Detach the electrical connectors for the coil.
5. Remove the retaining screws and coil from engine.
6. Installation is the reverse of the removal procedure.

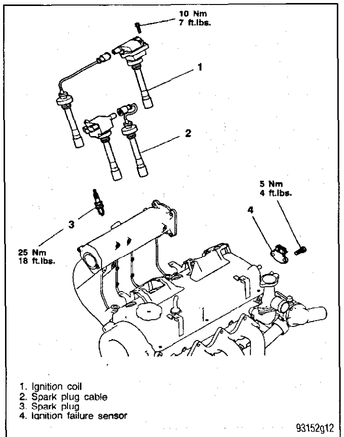


Fig. 31 Ignition system component locations—1997–00 1.8L engine shown, 1999–00 2.4L engine similar

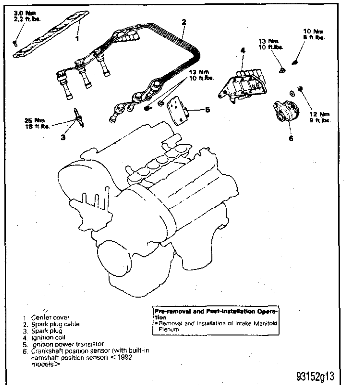


Fig. 32 Ignition system component locations—3.0L DOHC engine

Power Transistor (Ignition Module)

REMOVAL & INSTALLATION

1.6L, 2.0L DOHC, and 2.4L DOHC Engines

See Figure 30

1. Disconnect the negative battery cable.
2. Detach the electrical connectors for the transistor.
3. Remove the retaining screws and remove the transistor from engine.
4. Installation is the reverse of the removal procedure.

1.8L and 1999–00 2.4L Engines

The power transistor (ignition module) is an integral part of the powertrain control module.

3.0L DOHC Engine

See Figure 32

1. Disconnect the negative battery cable.
2. Remove the intake manifold plenum (upper intake manifold). Refer to Section 3.
3. Detach the electrical connectors for the transistor.
4. Remove the retaining screws and remove the transistor from engine.
5. Installation is the reverse of the removal procedure.

Crankshaft and Camshaft Position Sensors

For procedures on the position sensors, please refer to Section 4 in this manual.

FIRING ORDERS

See Figures 33 thru 40

➡To avoid confusion, remove and tag the spark plug wires one at a time, for replacement.

If a distributor is not keyed for installation with only one orientation, it could have been removed previously and rewired. The resultant wiring would hold the correct firing order, but could change the relative placement of the plug towers in relation to the engine. For this reason it is imperative that you label all wires before disconnecting any of them. Also, before removal, compare the current wiring with the accompanying illustrations. If the current wiring does not match, make notes in your book to reflect how your engine is wired.

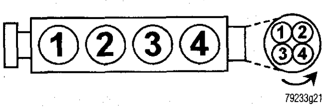


Fig. 33 1.5L (4G15) and 1993–96 1.8L (4G93) engines
Firing order: 1–3–4–2
Distributor rotation: Counterclockwise

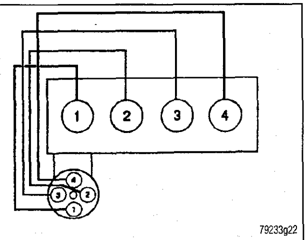


Fig. 34 2.0L (4G63) SOHC engine
Firing order: 1–3–4–2
Distributor rotation: Clockwise

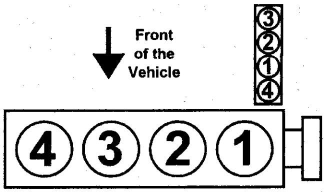


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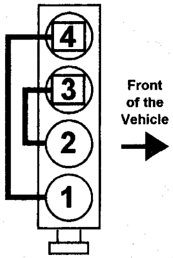
Fig. 35 1.6L (4G61) and 2.0L (4G63) DOHC engines
Firing order: 1–3–4–2
Distributorless ignition system



79233g71

Fig. 36 1997–00 1.8L (4G93) and 1999–00 2.4L (4G64) Engines with distributorless ignition
Firing order: 1–3–4–2
Distributorless ignition system

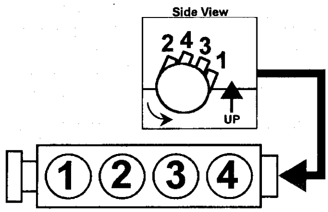


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Fig. 37 2.4L (4G64) engine with distributor ignition
Firing order: 1–3–4–2
Distributor rotation: Counterclockwise

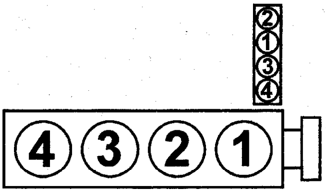

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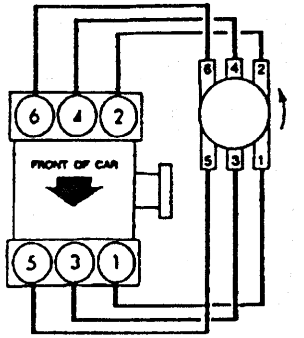
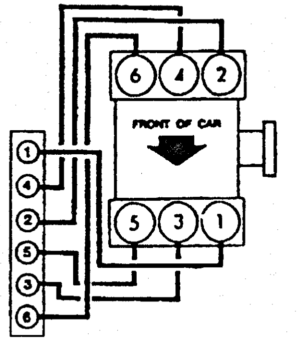
Fig. 38 2.4L (4G64) DOHC engine with distributorless ignition
Firing order: 1–3–4–2
Distributorless ignition system



79233g26

Fig. 39 3.0L (6G72) SOHC and 3.5L (6G74) engines
Firing order: 1–2–3–4–5–6
Distributor rotation: Counterclockwise



79233g25

Fig. 40 3.0L (6G72) DOHC engine
Firing order: 1–2–3–4–5–6
Distributorless ignition system

CHARGING SYSTEM

General Information

The automobile charging system provides electrical power for operation of the vehicle's ignition and starting systems and all the electrical accessories. The battery serves as an electrical surge or storage tank, storing (in chemical form) the energy originally produced by the engine driven alternator. The system also provides a means of regulating generator output to protect the battery from being overcharged and to avoid excessive voltage to the accessories.

The storage battery is a chemical device incorporating parallel lead plates in a tank containing a sulfuric acid/water solution. Adjacent plates are slightly dissimilar, and the chemical reaction of the 2 dissimilar plates produces electrical energy when the battery is connected to a load such as the starter motor. The chemical reaction is reversible, so that when the generator is producing a voltage (electrical pressure) greater than that produced by the battery, electricity is forced into the battery, and the battery is returned to its fully charged state.

The vehicle's alternator is driven mechanically, by a belt(s) that is driven by the engine crankshaft. In an alternator, the field rotates while all the current produced passes only through the stator winding. The brushes bear against continuous slip rings rather than a commutator. This causes the current produced to periodically reverse the direction of its flow creating alternating current (A/C). Diodes (electrical one-way switches) block the flow of current from traveling in the wrong direction. A series of diodes is wired together to permit the alternating flow of the stator to be converted to a pulsating, but unidirectional flow at the alternator output. The alternator's field is wired in series with the voltage regulator.

The regulator consists of several circuits. Each circuit has a core, or magnetic coil of wire, which operates a switch. Each switch is connected to ground through one or more resistors. The coil of wire responds directly to system voltage. When the voltage reaches the required level, the magnetic field created by the winding of wire closes the switch and inserts a resistance into the generator field circuit, thus reducing the output. The contacts of the switch cycle open and close many times each second to precisely control voltage.

Alternator Precautions

Several precautions must be observed when performing work on alternator equipment.

- If the battery is removed for any reason, make sure that it is reconnected with the correct polarity. Reversing the battery connections may result in damage to the one-way rectifiers.
- Never operate the alternator with the main circuit broken. Make sure that the battery, alternator, and regulator leads are not disconnected while the engine is running.
- Never attempt to polarize an alternator.
- When charging a battery that is installed in the vehicle, disconnect the negative battery cable.
- When utilizing a booster battery as a starting aid, always connect it in parallel; negative to negative, and positive to positive.
- When arc (electric) welding is to be performed on any part of the vehicle, disconnect the negative battery cable and alternator leads.
- Never unplug the PCM while the engine is running or with the ignition in the **ON** position. Severe and expensive damage may result within the solid state equipment.

Alternator

TESTING

Voltage Test

1. Make sure the engine is **OFF**, and turn the headlights on for 15–20 seconds to remove any surface charge from the battery.
2. Using a DVOM set to volts DC, probe across the battery terminals.
3. Measure the battery voltage.
4. Write down the voltage reading and proceed to the next test.

No-Load Test

1. Connect a tachometer to the engine.

CAUTION

Ensure that the transmission is in Park and the emergency brake is set. Blocking a wheel is optional and an added safety measure.

2. Turn off all electrical loads (radio, blower motor, wipers, etc.)
3. Start the engine and increase engine speed to approximately 1500 rpm.
4. Measure the voltage reading at the battery with the engine holding a steady 1500 rpm. Voltage should have raised at least 0.5 volts, but no more than 2.5 volts.
5. If the voltage does not go up more than 0.5 volts, the alternator is not charging. If the voltage goes up more than 2.5 volts, the alternator is overcharging.

➡Usually under and overcharging is caused by a defective alternator, or its related parts (regulator), and replacement will fix the problem; however, faulty wiring and other problems can cause the charging system to malfunction. Further testing, which is not covered by this book, will reveal the exact component failure. Many automotive parts stores have alternator bench testers available for use by customers. An alternator bench test is the most definitive way to determine the condition of your alternator.

6. If the voltage is within specifications, proceed to the next test.

Load Test

1. With the engine running, turn on the blower motor and the high beams (or other electrical accessories to place a load on the charging system).
2. Increase and hold engine speed to 2000 rpm.
3. Measure the voltage reading at the battery.
4. The voltage should increase at least 0.5 volts from the voltage test. If the voltage does not meet specifications, the charging system is malfunctioning.

➡Usually under and overcharging is caused by a defective alternator, or its related parts (regulator), and replacement will fix the problem; however, faulty wiring and other problems can cause the charging system to malfunction. Further testing, which is not covered by this book, will reveal the exact component failure. Many automotive parts stores have alternator bench testers available for use by customers. An alternator bench test is the most definitive way to determine the condition of your alternator.

REMOVAL & INSTALLATION

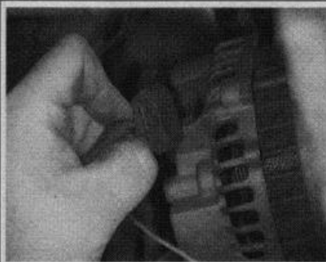
1.5L, 1.6L, 1.8L, 2.0L and 2.4L Engines

See Figures 41 thru 48

1. Disconnect the negative battery cable.
2. Remove the left side cover panel under the vehicle.
3. On turbocharged Galant models, remove the air intake hose.
4. Remove the drive belts.
5. Remove the water pump pulleys.
6. Remove the alternator upper bracket/brace.
7. On the 1.6L engine remove the battery, windshield washer reservoir and battery tray.
8. On the 1.6L engine, remove the attaching bolts at the top of the radiator and lift up the radiator. Do not disconnect the radiator hoses.
9. Detach the alternator wiring connectors.
10. Remove the alternator mounting bolts and remove the alternator.

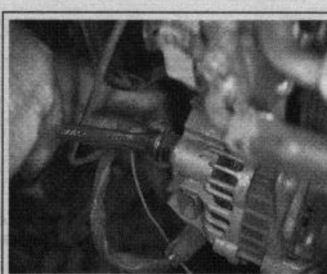
To install:

11. Position the alternator on the lower mounting fixture and install the lower mounting bolt and nut. Tighten nut just enough to allow for movement of the alternator.
12. On the 1.6L engine, lower the radiator and reinstall the upper attaching bolts.
13. On the 1.6L engine, install the battery, windshield washer reservoir and battery tray.



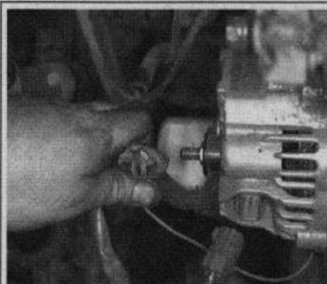
93152p10

Fig. 41 Detach the regulator connector from the alternator



93152p12

Fig. 42 Remove the nut retaining the battery cable to the alternator . . .



93152p13

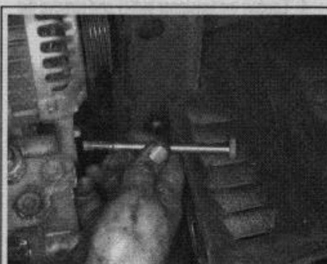
Fig. 43 . . . then remove the battery cable from the alternator

93152p14

Fig. 44 Remove the nut retaining the wire harness to the alternator, and remove the harness from the alternator

93152p16

Fig. 45 Remove the nut for the pivot bolt on the rear of the alternator . . .



93152p17

Fig. 46 . . . then remove the pivot bolt from the alternator

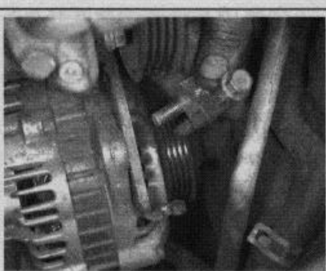

93152p15

Fig. 47 Remove the alternator adjusting bolt . . .

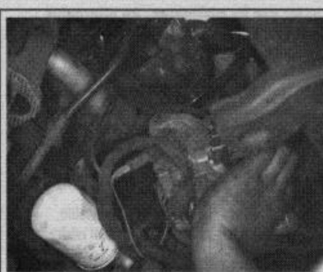

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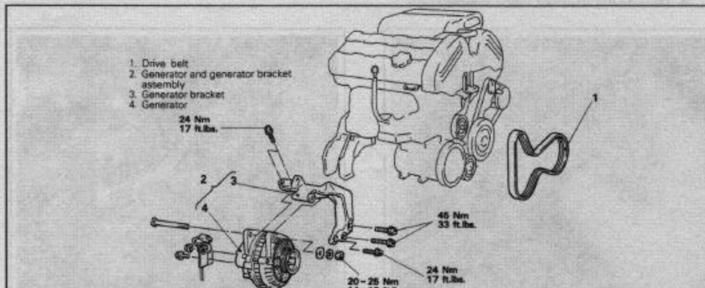
Fig. 48 . . . then remove the alternator from the vehicle



93152g15

Fig. 49 Alternator mounting—3.0L DOHC engine

14. Install the alternator upper bracket/brace and connect the alternator electrical harness.
15. Install the water pump pulleys.
16. Install the drive belts and adjust to the proper tension.
17. On turbocharged Galant models, install the air intake hose.
18. Install the left side cover panel under the vehicle as required.
19. Connect the negative battery cable and check for proper operation.

3.0L DOHC Engine

➧ **See Figure 49**

1. Disconnect the negative battery cable.
2. Remove the headlamp washer reservoir tank.
3. Remove the condenser fan and upper radiator insulator.
4. Loosen the tensioner pulley and remove the alternator drive belt.
5. Remove the alternator upper and lower mounting bolts.
6. Remove the alternator support bracket mounting bolts.
7. Remove the alternator support bracket from the vehicle.
8. Disconnect the alternator wiring harness.
9. Remove the alternator from the vehicle.

To install:

10. Install the alternator to the vehicle and connect the wiring harness.
11. Install the alternator support bracket to the vehicle and tighten the bracket mounting bolts to specifications.
12. Position the alternator on the mounting bracket. Install and tighten the mounting bolt and nut to 17 ft. lbs. (24 Nm).
13. Reinstall the drive belt and adjust the tensioner until the proper belt tension is achieved.
14. Install the upper radiator insulator and condenser fan.
15. Install the headlamp washer reservoir tank.
16. Connect the negative battery cable and check the charging system for proper operation.

3.0L SOHC and 3.5L Engines

➧ **See Figures 50 and 51**

1. Disconnect the negative battery cable.
2. Disconnect and remove the air intake hose.
3. Loosen the tensioner pulley and remove the alternator drive belt.
4. On California models, remove the rear bank converter assembly.
5. Remove the engine roll stopper stay bracket assembly.
6. On the 3.0L SOHC engine, disconnect the EGR temperature sensor wire and remove the EGR pipe assembly.
7. On the 3.0L SOHC engine, remove the intake plenum stay bracket assembly.
8. Detach the alternator wiring harness connectors.
9. Remove the alternator upper and lower mounting bolts.
10. From beneath the vehicle, remove the alternator.

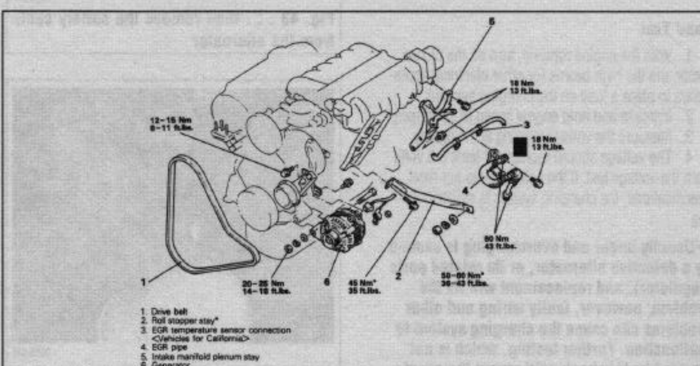
To install:

11. Position the alternator on the lower mounting fixture. Install and tighten the mounting bolt and nut to 14–18 ft. lbs. (20–25 Nm).
12. Connect the alternator wiring harness.
13. On the 3.0L SOHC engine, install the intake plenum stay bracket and tighten the mounting bolt to 13 ft. lbs. (18 Nm).
14. On the 3.0L SOHC engine, install the EGR pipe and tighten the fitting connections to 43 ft. lbs. (60 Nm).
15. On the 3.0L SOHC engine, connect the EGR temperature sensor wire.
16. Connect the engine roll stopper stay and tighten the mounting bolt to 35 ft. lbs. (45 Nm) and the nut to 36–43 ft. lbs. (50–60 Nm).
17. Install the rear converter assembly, if removed.
18. Reinstall the drive belt and adjust the tensioner until the proper belt tension is achieved.
19. Connect the air intake hose.
20. Connect the negative battery cable and check the charging system for proper operation.

Regulator

REMOVAL & INSTALLATION

The voltage regulator on models covered by this manual is an integral part of the alternator. If the regulator is defective, replace the alternator assembly.



93152g14

Fig. 50 Alternator mounting—3.0L SOHC engine

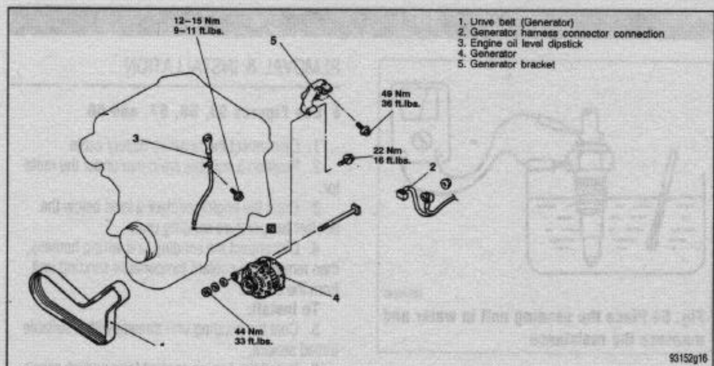


Fig. 51 Alternator mounting —3.5L engine

STARTING SYSTEM

General Information

The starting system includes the battery, starter motor, solenoid, ignition switch, circuit protection and wiring connecting the components. An inhibitor switch located in the park/neutral safety switch or Transmission Range (TR) sensor is included in the starting system to prevent the vehicle from being started with the vehicle in gear.

When the ignition key is turned to the **START** position, current flows and energizes the starter's solenoid coil. The solenoid plunger and clutch shift lever are activated and the clutch pinion engages the ring gear on the flywheel. The switch contacts close and the starter cranks the engine until it starts.

To prevent damage caused by excessive starter armature rotation when the engine starts, the starter incorporates an over-running clutch in the pinion gear.

Starter

TESTING

Voltage Drop Test

➡The battery must be in good condition and fully charged prior to performing this test.

1. Disable the ignition system by unplugging the coil pack. Verify that the vehicle will not start.
2. Connect a voltmeter between the positive terminal of the battery and the starter **B+** circuit.
3. Turn the ignition key to the **START** position and note the voltage on the meter.
4. If voltage reads 0.5 volts or more, there is high resistance in the starter cables or the cable ground, repair as necessary. If the voltage reading is ok proceed to the next step.
5. Connect a voltmeter between the positive terminal of the battery and the starter **M** circuit.
6. Turn the ignition key to the **START** position and note the voltage on the meter.
7. If voltage reads 0.5 volts or more, there is high resistance in the starter. Repair or replace the starter as necessary.

➡Many automotive parts stores have starter bench testers available for use by customers. A starter bench test is the most definitive way to determine the condition of your starter.

REMOVAL & INSTALLATION

▶ See Figures 52 and 53

1. Disconnect the negative battery cable.
2. Detach the air-flow sensor assembly connector and remove the breather hose.
3. Remove the resonator retaining nuts and remove the air intake hose and resonator assembly as required.

➡Use care when removing the air cleaner cover because the air-flow sensor is attached and is a sensitive component.

4. If equipped with Active-ECS suspension, remove the air compressor as follows:
   a. Detach the two electrical connectors, from the compressor.
   b. Disconnect the air line at the compressor.
   c. Remove the three mounting bolts, securing the compressor to the chassis.
5. Raise the vehicle and support safely.
6. Remove the engine undercover.
7. Remove the heat shield from beneath the intake manifold on the 1.5L engine.
8. If necessary, detach the speedometer cable connector at the transaxle end.
9. Detach the starter motor electrical connections.
10. Remove the starter motor mounting bolts and remove the starter.
11. The installation is the reverse of the removal procedure. Tighten the starter mounting bolts to 22 ft. lbs. (31 Nm).
12. Connect the negative battery cable and check the starter for proper operation.

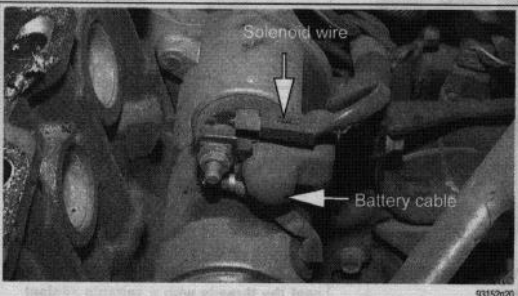


Fig. 52 Remove the starter electrical connections, noting their locations

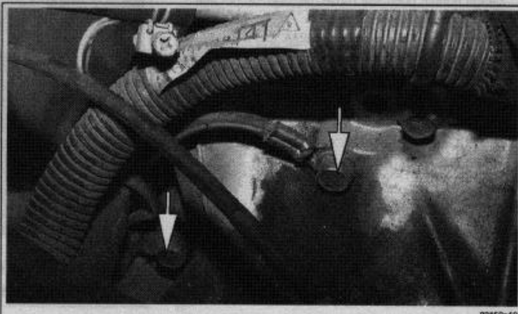


Fig. 53 Location of the two starter retaining bolts

SENDING UNITS

➡This section describes the operating principles of sending units, warning lights and gauges. Sensors which provide information to the Engine Control Unit (ECU) or Electronic or Powertrain Control Module (ECM/PCM) are covered in Section 4 of this manual.

Instrument panels contain a number of indicating devices (gauges and warning lights). These devices are composed of two separate components. One is the sending unit, mounted on the engine or other remote part of the vehicle, and the other is the actual gauge or light in the instrument panel.

Several types of sending units exist, however most can be characterized as being either a pressure type or a resistance type. Pressure type sending units convert liquid pressure into an electrical signal which is sent to the gauge. Resistance type sending units are most often used to measure temperature and use variable resistance to control the current flow back to the indicating device. Both types of sending units are connected in series by a wire to the battery (through the ignition switch). When the ignition is turned **ON**, current flows from the battery through the indicating device and on to the sending unit.

Engine Coolant Temperature Sending Unit

TESTING

The coolant temperature sending unit is used to operate the temperature gauge. Do not confuse this sending unit with the other switches or sensors used to signal the engine control unit or air conditioning regarding temperature of the coolant. Usually, these other units are mounted near the coolant temperature sensor used for engine control.

Gauge Check

1. Detach the engine coolant gauge sending unit electrical connector.
2. Connect a suitable test light (12V–3.4W) between the harness side connector and the ground.
3. Turn the ignition switch to the **ON** position.
4. Check the condition of the test light and gauge as follows:
   a. If all components are operating properly, the test light should illuminate and the gauge needle should move.
   b. If the test light is illuminated and the gauge needle does not move, replace the coolant temperature gauge.
   c. If the test light is illuminated and the gauge needle does not move, check the fuse for a broken wire, or resistance between the gauge terminals
   d. If the test light is not illuminated and the gauge is not moving, check, then replace the wiring harness, if necessarly.

Sender Check

♦ See Figure 54

1. Drain the engine coolant to a level below the coolant temperature sending unit.

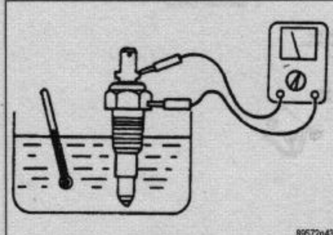

89572g43

Fig. 54 Place the sending unit in water and measure the resistance

2. Disconnect the sending unit wiring harness and remove the coolant temperature sending unit.
3. Place the sending unit tip in a pan of warm water. Use a thermometer to measure the water temperature.
4. Measure the resistance across the sending unit terminals while the sending unit is in the water.
5. Note the ohm reading and compare to the following specifications:
   - Water temperature of 68°F (20°C)—2.21–2.69 kilo-ohms resistance
   - Water temperature of 158°F (70°C)—90.5–117.5 ohms resistance
   - Water temperature of 176°F (80°C)—264–328 ohms resistance.

If the resistance is not approximately accurate for the temperature, the sending unit must be replaced.

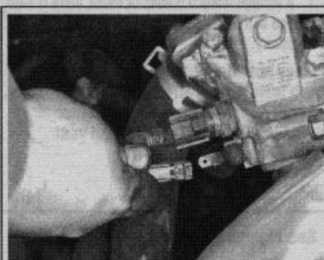

93152p08

Fig. 55 Detach the connector from the coolant temperature sending unit


93152p09

Fig. 57 . . . then remove the sending unit from the thermostat housing

REMOVAL & INSTALLATION

♦ See Figures 55, 56, 57, and 58

1. Disconnect the negative battery cable.
2. Position a suitable drain pan under the radiator.
3. Drain the engine coolant a level below the coolant temperature sending unit.
4. Disconnect the sending unit wiring harness, then remove the coolant temperature sending unit from the engine.

To install:

5. Coat the sending unit threads with a suitable thread sealant.
6. Install the engine coolant temperature gauge sending unit into the bore in the engine and tighten to 7–8 ft. lbs. (10–12 Nm).
7. Attach the electrical harness connector to the sending unit.
8. Fill the cooling system to the proper level. Connect the negative battery cable.

Oil Pressure Sending Unit

TESTING

Gauge Check

♦ See Figure 59


93152p07

Fig. 56 Using a suitable size socket and drive tool, loosen the sending unit . . .

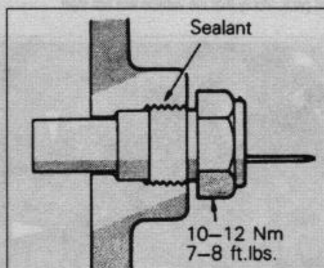


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Fig. 58 Before installing the sending unit, coat the threads with a suitable sealant

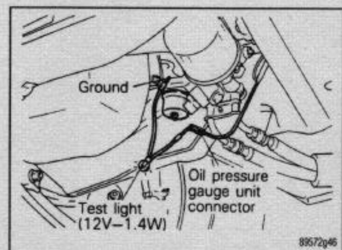

Fig. 59 Testing the oil pressure sending unit and gauge

1. Detach the oil pressure gauge unit electrical connector.
2. Use a suitable test light (12V–3.4W) to ground the harness side connector.
3. Turn the ignition to the **ON** position.
4. Check the condition of the test light and gauge as follows:
   a. If all components are operating properly, the test light will flash or light steadily and the oil pressure gauge needle will move.
   b. If the test light flashes or lights steadily but the gauge does not move, the gauge must be replaced.
   c. If neither the test light or the gauge operate, check the oil pressure gauge circuit and replace, if necessary.

Sending Unit Check

1. Remove the electrical harness connector from the sending unit and remove the sending unit from the oil filter head.
2. Connect an ohmmeter between the terminal and the sending unit body cavity and check for conductivity. If there is no conductivity, replace the sending unit.
3. Next, insert a very thin wedge through the oil hole in the end of the sending unit. Push the wedge in slightly and measure resistance. There should be no conductivity.
4. If there is conductivity, even when wedge is pushed, replace the sending unit.
5. If there is no conductivity when a 71 psi pressure is placed through the oil hole, the sending unit is operating properly.
6. Check to see that there is no air pressure leakage through the sending unit. If there is air pressure leakage, the diaphragm is broken and the sending unit will require replacement.

REMOVAL & INSTALLATION

See Figures 60 thru 65

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely.
3. Detach the electrical harness connector from the sending unit, then remove the unit from the oil filter head.

To install:

4. Apply a thin bead of sealant to the threaded portion of the oil pressure sending unit. Do not allow sealer to contact the end of the threaded portion of the sending unit.
5. Install the sending unit and tighten to 8 ft. lbs. (12 Nm). Do not overtighten the sending unit.
6. Attach the electrical harness connector to the sending unit.
7. Carefully lower the vehicle, then connect the negative battery cable.

Fig. 60 Detach the connector from the oil pressure sending unit

Fig. 61 The body of the sending unit has a unique shape . . .

Fig. 62 . . . and the use of an oil pressure sending unit socket greatly aids the removal and installation

Fig. 63 Using the socket and a suitable drive tool, loosen the sending unit . . .

Fig. 64 . . . then remove the sending unit from the oil filter head

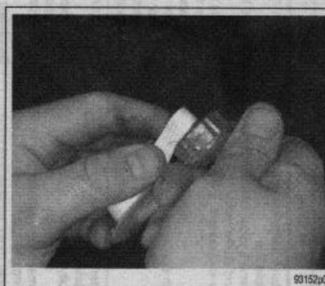

Fig. 65 Before installing the sending unit, it is a good idea to place Teflon® tape on the threads

Troubleshooting Basic Starting System Problems

Problem	Cause	Solution
Starter motor rotates engine slowly	• Battery charge low or battery defective • Defective circuit between battery and starter motor • Low load current • High load current	• Charge or replace battery • Clean and tighten, or replace cables • Bench-test starter motor. Inspect for worn brushes and weak brush springs. • Bench-test starter motor. Check engine for friction, drag or coolant in cylinders. Check ring gear-to-pinion gear clearance.
Starter motor will not rotate engine	• Battery charge low or battery defective • Faulty solenoid • Damaged drive pinion gear or ring gear • Starter motor engagement weak • Starter motor rotates slowly with high load current • Engine seized	• Charge or replace battery • Check solenoid ground. Repair or replace as necessary. • Replace damaged gear(s) • Bench-test starter motor • Inspect drive yoke pull-down and point gap, check for worn end bushings, check ring gear clearance • Repair engine
Starter motor drive will not engage (solenoid known to be good)	• Defective contact point assembly • Inadequate contact point assembly ground • Defective hold-in coil	• Repair or replace contact point assembly • Repair connection at ground screw • Replace field winding assembly
Starter motor drive will not disengage	• Starter motor loose on flywheel housing • Worn drive end busing • Damaged ring gear teeth • Drive yoke return spring broken or missing	• Tighten mounting bolts • Replace bushing • Replace ring gear or driveplate • Replace spring
Starter motor drive disengages prematurely	• Weak drive assembly thrust spring • Hold-in coil defective	• Replace drive mechanism • Replace field winding assembly
Low load current	• Worn brushes • Weak brush springs	• Replace brushes • Replace springs

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Troubleshooting Basic Charging System Problems

Problem	Cause	Solution
Noisy alternator	• Loose mountings • Loose drive pulley • Worn bearings • Brush noise • Internal circuits shorted (High pitched whine)	• Tighten mounting bolts • Tighten pulley • Replace alternator • Replace alternator • Replace alternator
Squeal when starting engine or accelerating	• Glazed or loose belt	• Replace or adjust belt
Indicator light remains on or ammeter indicates discharge (engine running)	• Broken belt • Broken or disconnected wires • Internal alternator problems • Defective voltage regulator	• Install belt • Repair or connect wiring • Replace alternator • Replace voltage regulator/alternator
Car light bulbs continually burn out—battery needs water continually	• Alternator/regulator overcharging	• Replace voltage regulator/alternator
Car lights flare on acceleration	• Battery low • Internal alternator/regulator problems	• Charge or replace battery • Replace alternator/regulator
Low voltage output (alternator light flickers continually or ammeter needle wanders)	• Loose or worn belt • Dirty or corroded connections • Internal alternator/regulator problems	• Replace or adjust belt • Clean or replace connections • Replace alternator/regulator

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