

121 Battery, Starter, Alternator

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GENERAL

The charging system consists of a belt-driven alternator with integral voltage regulator and a battery.

Various alternators, voltage regulators, starters, and batteries are used in the E32 7 Series cars. It is important to replace components according to the original equipment specification. Check with an authorized BMW dealer for specific application and parts information.

WARNING—

- Wear goggles, rubber gloves, and a rubber apron when working around batteries and battery acid (electrolyte).
- Battery electrolyte contains sulfuric acid and can cause skin irritation and burning. If acid is spilled on your skin or clothing, flush the area at once with large quantities of water. If electrolyte gets into your eyes, flush them with large quantities of clean water for several minutes and call a physician.
- Batteries that are being charged or are fully charged give off explosive hydrogen gas. Keep sparks and open flames away. Do not smoke.

NOTE—

The battery is mounted beneath the rear seat. See 520 Seats.

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CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.
- Disconnecting the battery cables may erase fault codes stored in control unit memory.
- Always disconnect the negative (–) battery cable first and reconnect it last. Cover the battery post with an insulating material whenever the cable is removed.
- Never reverse the battery cables. Even a momentary wrong connection can damage the alternator or other electrical components.
- Battery cables may be the same color. Label cable before removing.

CHARGING SYSTEM TROUBLESHOOTING

Charging system diagnostics requires special test equipment. If the test equipment is not available, charging system fault diagnosis can be performed by an authorized BMW dealer or other qualified repair shop.

Charging system quick-check

As a quick-check, use a voltmeter to measure voltage across the battery terminals with the key off and then again with the engine running. The battery voltage should be about 12.6 volts with key off and approximately 14.0 volts with the engine running. If the voltage does not increase when the engine is running, there is a fault in the charging system.

NOTE—

The regulated voltage (engine running) should be between 13.8 and 14.8, depending on temperature and operating conditions. If the voltage is higher than 14.8 volts, the voltage regulator is most likely faulty.

Check for clean and tight battery cables. Check the ground cable running from the negative (–) battery terminal to the chassis and the ground cable running from the engine to the chassis. Check the alternator drive belt for looseness or wear.

Static current draw, checking

If the battery discharges over time, there may be a constant drain or current draw on the battery. A small static drain on the battery is normal, but a large drain will cause the battery to quickly discharge. Make a static current draw test as the first step when experiencing battery discharge.

- Make sure ignition and all electrical accessories are switched off.

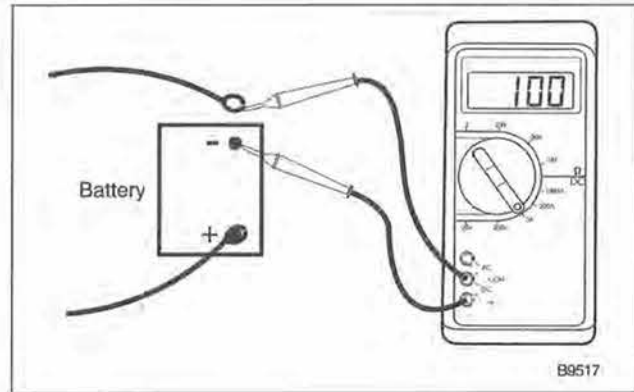
- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Connect a digital ammeter between battery negative post and negative battery cable to measure current.

A range of about 0 to 100 milliamps is normal, depending on the number of accessories that need constant power. A current of 500 milliamps (0.5 amp) or more may indicate a problem. To determine the circuit or component causing the problem, remove one fuse at a time until the current drops to a normal range.



Battery open-circuit voltage test

Before making the test, load the battery with 15 amps for one minute with a battery load-tester or turn on the headlights for about one minute without the engine running. Then disconnect the battery negative (–) cable and connect a digital voltmeter across the battery terminals. Open-circuit voltage levels are given in **Table a**.

If the open-circuit voltage is OK but the battery still lacks power for starting, make a load voltage test. If the open-circuit voltage is below 12.4 volts, recharge the battery and re-test.

Table a. Open-Circuit Voltage and Battery Charge

Open-circuit voltage	State of charge
12.6 V or more	Fully charged
12.4 V	75% charged
12.2 V	50% charged
12.0 V	25% charged
11.7 V or less	Fully discharged

Battery load voltage test

A battery load tester is required for a load voltage test. The test is made by applying a high resistive load to the battery terminals and then measuring battery voltage. The battery should be fully charged for the most accurate results. Disconnect the battery cables when making the test. If the voltage is below that listed in **Table b**, the battery should be replaced.

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WARNING—

Always wear protective goggles and clothing when performing a load test.

**Table b. Battery Load Test—Minimum Voltage
(apply 200 amp load for 15 seconds)**

Ambient temperature	Voltage
80°F (27°C)	9.6 V
60°F (16°C)	9.5 V
40°F (4°C)	9.3 V
20°F (-7°C)	8.9 V
0°F (-18°C)	8.5 V

Battery charging

Battery maintenance is covered in **020 Maintenance**.

Discharged batteries can be recharged using a battery charger. Prolonged charging causes gassing that will evaporate the electrolyte to a level that can damage the battery. It is best to use a low-current charger (6 amp or less) to prevent battery damage caused by overheating.

WARNING—

- *Battery acid is caustic and dangerous. Take care to keep it from contacting eyes, skin, or clothing. Wear eye protection. Extinguish all smoking materials and do not work near any open flames.*
- *Hydrogen gas given off by the battery during charging is explosive. Do not smoke. Keep open flames away from the top of the battery, and prevent electrical sparks by turning off the battery charger before connecting or disconnecting it.*

CAUTION—

- *Disconnecting the battery cables with the engine running, or reconnecting the cables to the incorrect posts will damage the electrical system.*
- *Be sure to have the radio code on hand before disconnecting battery.*
- *To avoid causing battery acid damage to the interior, remove battery from car before using a battery charger.*

ALTERNATOR SERVICE

Before checking the alternator and regulator, make sure the battery is fully charged and capable of holding a charge. Check that the battery terminals are clean and tight and the alternator drive belt is properly tensioned and not severely worn.

Charging system, checking

- Turn ignition key on. Check that charge warning lamp comes on.

NOTE—

If the warning light does not come on, repair any wiring or bulb faults before continuing to check the charging system.

- Remove terminal cover from rear of alternator.

- Check for battery voltage between ground and terminal **B+** at back of alternator. Then turn ignition on and check for battery voltage between terminal **D+** and ground. If voltage is not present at either point, check for wiring for faults.

NOTE—

Terminal B+ is supplied battery voltage directly from the battery. Terminal D+ is supplied battery voltage via the charge warning bulb when the key is on or the engine is running.

- If no faults are found up to this point, test alternator output.
- If a load tester is not available, a crude output test can be done by running engine at about 2000 rpm and turning on electrical loads (fans, lights and rear window defroster, wipers). When fully loaded, battery voltage should be at least 12.0 VDC.



Alternator removal and installation

Various alternators with different current ratings and from different manufacturers are installed on E32 7 Series cars. Replacement alternators should be of the same make and rating as originally installed. Alternator manufacturer and ampere rating are marked on the alternator housing.

Alternator removal and installation procedures in this section are organized according to engine code. If necessary, see **100 Engine-General** for engine code and application information.

Alternator, removing and installing (M30 engine)

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove alternator drive belt as described in **020 Maintenance**. If necessary, remove radiator cooling fan and fan shroud as described in **170 Radiator and Cooling System**.

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NOTE—

The radiator cooling fan nut (32 mm wrench) has left-hand threads.

- Working at rear of alternator, disconnect alternator cooling duct. Remove terminal cover and disconnect wiring from alternator.
- Remove upper adjustment mounting bolt and lower bolt(s) from alternator. Remove alternator.

CAUTION—

Protect radiator with heavy cardboard or sheet metal.

- Installation is reverse of removal.

Tightening Torques

- D+ wire to alternator 6 Nm (53 in-lb)
- B+ wire to alternator 14 Nm (10 ft-lb)
- Pulley to alternator 45 Nm (33 ft-lb)

Alternator, removing and installing (M60 engine)

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise car and support in a safe manner.

WARNING—

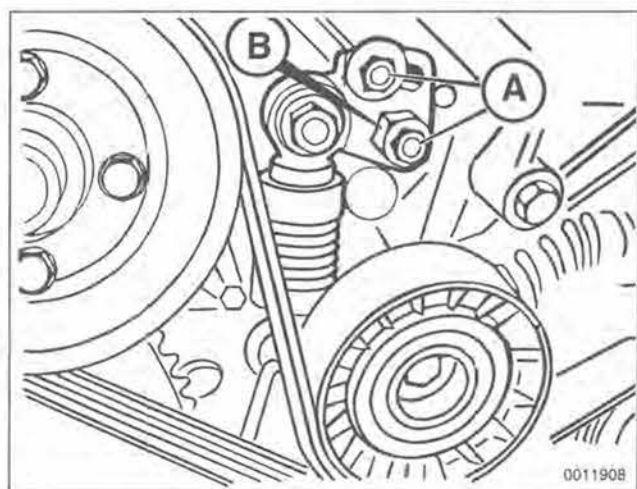
Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove engine splash shields from beneath car.
- Remove radiator cooling fan and fan shroud. See **170 Radiator and Cooling System**.

NOTE—

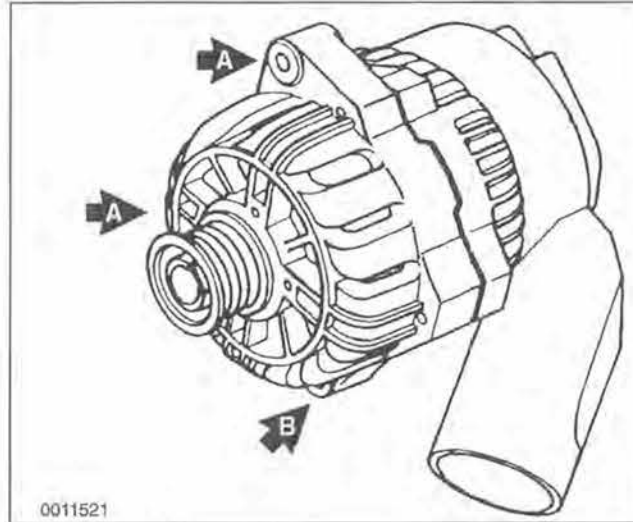
The radiator cooling fan nut (32 mm wrench) has left-hand threads.

- ◀ Loosen mounting nuts on belt tensioner (A). Use an open end wrench to rotate tensioner hex (B) counterclockwise and remove belt. Remove belt tensioner from engine.



ALTERNATOR SERVICE

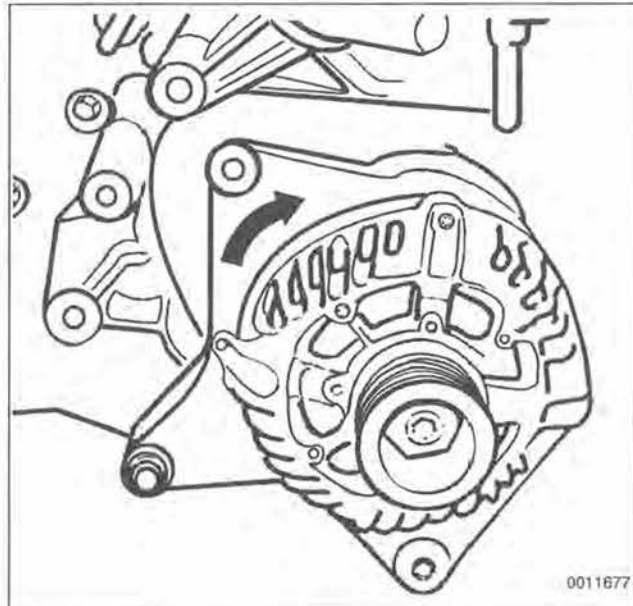
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- Remove oil filter housing mounting bolts at front of engine and set oil filter housing aside.
- Remove top two alternator mounting bolts (A).
 - Working underneath car at rear of alternator, disconnect alternator cooling duct.
 - Remove lower alternator mounting bolt (B).
- Pull alternator forward and remove electrical harness terminal cover. Detach wiring from alternator.

CAUTION—
Protect radiator with heavy cardboard or sheet metal.

NOTE—
During these next steps, unclamp and disengage coolant and vacuum hoses and electrical harness ducts as necessary.



- Pull oil filter housing forward while rotating upper alternator mounting clockwise (arrow) and under oil filter housing mounting.
- Rotate alternator forward and then up and out of engine compartment, using care not to damage radiator.
- Installation is reverse of removal.

Tightening Torques

- D+ wire to alternator 6 Nm (53 in-lb)
- B+ wire to alternator 14 Nm (10 ft-lb)
- Pulley to alternator 70 Nm (52 ft-lb)

Alternator, removing and installing (M70 engine)

- Disconnect negative (–) battery cable. See 020 Maintenance.

CAUTION—
Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise car and support in a safe manner.
- Remove engine splash shields from beneath car.

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WARNING—

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

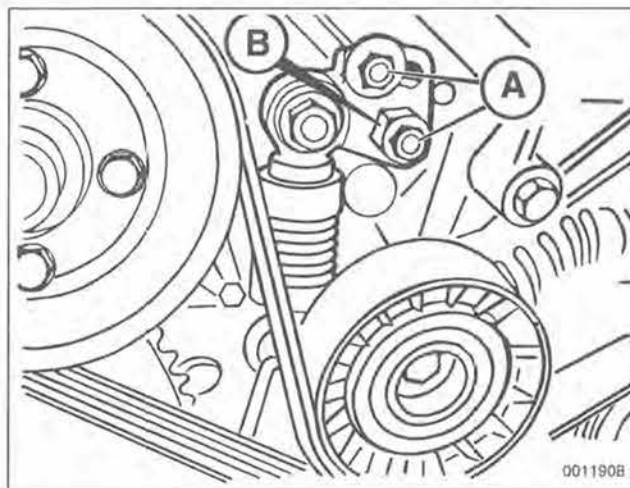
- Remove left air filter housing assembly, mass air flow sensor and associated ducting from engine compartment.
- Drain coolant, then remove radiator and radiator cooling fan. See **170 Radiator and Cooling System**.

WARNING—

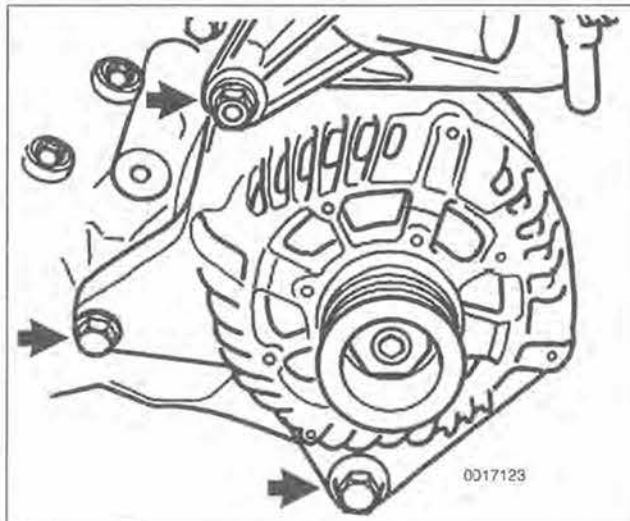
Due to risk of personal injury, be sure the engine is cold before beginning the radiator removal procedure.

NOTE—

The radiator cooling fan nut (32 mm wrench) has left-hand threads.



- ◀ Loosen mounting nuts on belt tensioner (A). Use an open end wrench to rotate tensioner hex (B) counterclockwise and remove belt. Remove belt tensioner from engine.



- Working underneath car, detach alternator cooling duct.
- ◀ Remove three mounting bolts (arrows) from alternator.
- Tilt alternator forward and remove electrical harness terminal cover. Detach wiring from alternator.
- Remove alternator by lifting up and out of engine compartment.
- Installation is reverse of removal.

Tightening Torques

- D+ wire to alternator 6 Nm (53 in-lb)
- B+ wire to alternator 14 Nm (10 ft-lb)
- Pulley to alternator 70 Nm (52 ft-lb)

Voltage regulator, removing and installing

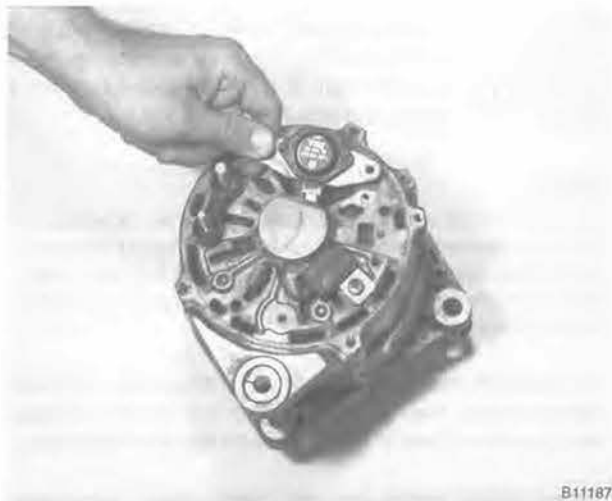
Different types of voltage regulators were installed on the E32 7 Series cars. Installation of the wrong type can damage the electrical system.

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- On models with M60/M70 engine: Remove alternator as described earlier.
- Remove wiring cover and cooling duct from rear of alternator
- Remove voltage regulator mounting screws and remove regulator from alternator.
- Installation is reverse of removal.
 - Clean brush contact surfaces in alternator and inspect brush protrusion.



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Brushes, inspecting and replacing

- Remove voltage regulator as described earlier.
- Clean brush contact surfaces and measure brush protrusion.

Voltage Regulator

- Brush protrusion (minimum) 5 mm (¼ in.)

- To replace brushes, carefully and as quickly as possible, unsolder brush lead from brush holder terminal, withdrawing brush from holder at same time.

CAUTION—

Regulator brushes are not available as replacements parts for all versions of regulators. Check with an authorized BMW dealer for the latest in parts information before unsoldering the brushes.



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- Remove any traces of solder from brush holder terminal.
- Fit spring into brush holder and insert new brush.
- Guide brush lead into terminal and solder into place. Check for free movement of brushes when solder cools.
- Check brush slip rings in alternator for wear. Lightly clean slip rings using fine abrasive cloth.
- Reinstall regulator and alternator.

STARTER SERVICE

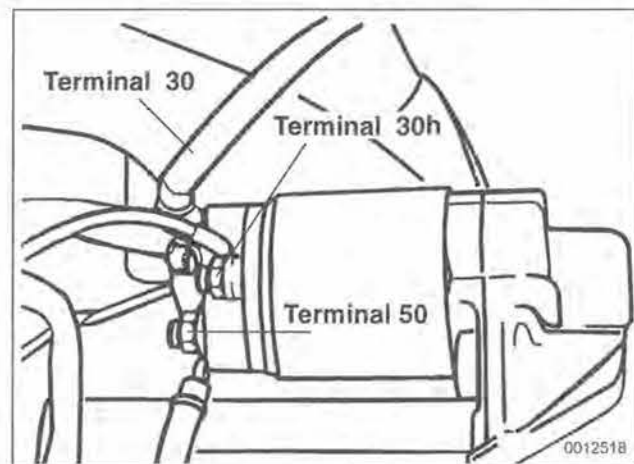
Starter troubleshooting

If the starter turns the engine slowly or fails to operate when the ignition is in the start position, check the battery first. Inspect the starter wires, terminals, and ground connections for good contact. In particular, make sure the ground connections between the battery, the body and the engine are completely clean and tight. If no faults can be found, the starter may be faulty and should be replaced.

NOTE—

On cars with automatic transmission, a starter relay and a neutral safety switch are used to prevent the engine from starting in gear positions other than park or neutral. If voltage is not present at terminal 50 with the key in the start position, check these components.

To make the most accurate check of the battery cables and starter wiring, make a voltage drop test on the cables and wiring as described in **600 Electrical System—General**.



Typical starter wiring terminal identification. Large wire at terminal 30 is direct battery voltage. Smaller wire at terminal 50 operates starter solenoid via ignition switch.

- Check for battery voltage at terminal 50 of the starter motor with the key in the start position.
- If voltage is not present, check the wiring between the ignition switch and the starter terminal.
- If voltage is present and no other visible wiring faults can be found, the problem is most likely internal in the starter motor.

NOTE—

On cars with automatic transmission, a starter relay and a neutral safety switch are used to prevent the engine from starting in gear positions other than park or neutral. If voltage is not present at terminal 50 with the key in the start position, check these components.

If the solenoid clicks but the motor does not turn, switch on the lights and turn the key to the start position. If the lights go out while attempting to start, the battery cable may be loose or the starter may have a short circuit. If the lights stay on, the solenoid is most likely at fault.

STARTER SERVICE

Starter removal and installation

Starter removal and installation procedures in this section are organized according to engine code. If necessary, see **100 Engine-General** for engine code and application information.

Starter, removing and installing (M30 engine)

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- With engine cold, remove coolant expansion tank.
- Disconnect wiring from starter.
- Loosen and remove starter mounting bolts and nuts. Remove starter.

NOTE—

A bent box wrench is helpful in removing the top bolt.

- Installation is reverse of removal.

Tightening Torques

- Starter to engine block 50 Nm (37 ft-lb)
- Wire to terminal 30h 5 Nm (44 in-lb)
- Wire to terminal 50 6 Nm (53 in-lb)
- Wire to terminal 30 12 Nm (9 ft-lb)

Starter, removing and installing (M60 engine)

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise car and support in a safe manner.

WARNING—

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Working underneath car, remove engine splash pans and heat shields from right side of engine.

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- Remove heat shield from front suspension crossmember and from rear of starter motor.
- Disconnect wiring from starter. Label as necessary.
- Loosen and remove starter bolts from transmission side. Remove starter.
- Installation is reverse of removal.

Tightening Torques

- Starter to engine block 50 Nm (37 ft-lb)
- Wire to terminal 30h 5 Nm (44 in-lb)
- Wire to terminal 50 6 Nm (53 in-lb)
- Wire to terminal 30 12 Nm (9 ft-lb)

Starter, removing and installing (M70 engine)

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise car and support in a safe manner.

WARNING—

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Working underneath car, remove engine splash pan.
- Drain windshield washer tank, then detach hose and electrical harness and remove tank.
- Working in right side of engine compartment, detach evaporative purge (carbon) canister and move aside without disconnecting ducts or hoses.
- Remove right side exhaust manifold heat shield. Detach right side front exhaust pipe from manifold and lower out of the way.
- Disconnect wiring from starter. Label as necessary.

NOTE—

It is helpful to turn the steering wheel fully to left lock.

- Remove starter motor bolts.

NOTE—

Remove upper starter bolt using a ground down 16 mm wrench.

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- Remove starter downward.
- Installation is reverse of removal.

Tightening Torques

- Starter to engine block 50 Nm (37 ft-lb)
- Wire to terminal 30h 5 Nm (44 in-lb)
- Wire to terminal 50 6 Nm (53 in-lb)
- Wire to terminal 30 12 Nm (9 ft-lb)

Solenoid switch, removing and installing

- Remove starter as described above.
- Remove cover from solenoid switch.
- Disconnect field winding strap between starter motor and solenoid switch.

NOTE—

The condition of the field winding strap is critical. If it is damaged, burned or partially melted through, a new or rebuilt starter motor is needed.

- Remove solenoid switch mounting screws (arrows), and separate solenoid from starter.

CAUTION—

When installing field winding strap to starter, position it so that it does not contact the starter body.

- Installation is reverse of removal. Lubricate solenoid piston with light grease.

Tightening Torque

- Field winding strap to starter (M8) 12 Nm (9 ft-lb)



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