

# STARTER

## Article Text

1995 Cadillac Concours  
For Ace Mechanics 123 Main Street San Diego Ca 92126  
Copyright © 1997 Mitchell International  
Friday, November 28, 2003 07:33PM

### ARTICLE BEGINNING

#### 1995 STARTING & CHARGING SYSTEMS General Motors Corp. - Starters

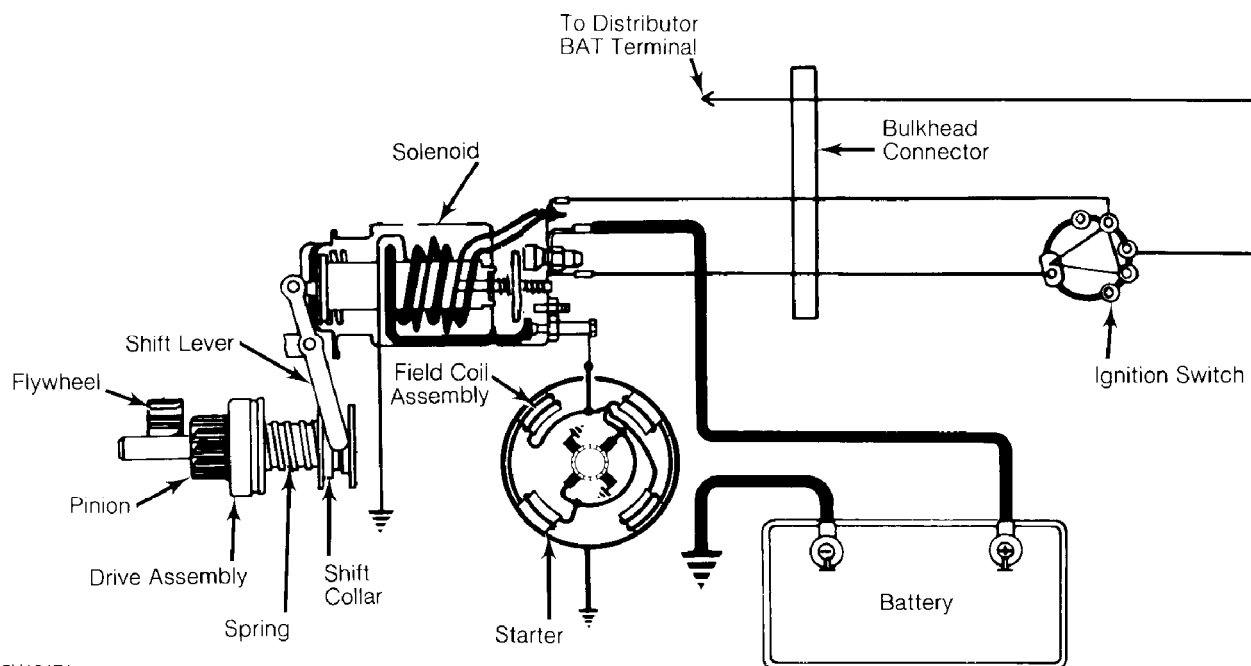
"E" & "K" Bodies

Cadillac: Concours, Eldorado, DeVille, Seville

### DESCRIPTION

The Delco-Remy starter is part of the cranking circuit, which also consists of the battery, ignition switch and related wiring. See Fig. 1. When the ignition switch is turned to the START position, the starter solenoid windings are energized. This causes the solenoid plunger to move the shift lever, which engages the pinion with the engine flywheel ring gear. The movement of the plunger also closes the main solenoid contacts, applying battery voltage to the starter.

When the engine starts, the pinion will overrun, protecting the armature from excessive speed and the flywheel from damage. When the ignition switch is released, the plunger return spring disengages the pinion.



95H13471  
Fig. 1: Typical Cranking Circuit  
Courtesy of General Motors Corp.

### TROUBLE SHOOTING

#### STARTER NOISE

**CAUTION:** Never operate starter for periods of more than 30 seconds. Excessive cranking can cause starter to overheat. Allow starter to cool for at least 2 minutes after each time operated.

1) A high-pitched whine, heard while cranking (before engine starts), indicates excessive distance between starter pinion and flywheel. If high-pitched whine is heard after engine starts and key is released, distance between starter pinion and flywheel is too small.

2) If loud, siren-like "whoop" sound is heard after the engine starts, drive assembly is likely defective. If "rumble", "growl" or "knock" is present as starter is coasting to a stop after starting engine, starter armature is bent or unbalanced.

**NOTE:** Check flywheel ring gear for damage.

3) If diagnosis indicates pinion should be closer to flywheel, ensure proper starter motor was installed. During initial starter motor installation, shim(s) are not used. If shim(s) are present, remove as necessary.

4) If diagnosis indicates pinion should be moved away from flywheel, add one shim. Consult manufacturer for required shim size. If condition is not corrected, another shim may be added. See STARTER under REMOVAL & INSTALLATION.

## ON-VEHICLE TESTING

### CRANKING TEST

**NOTE:** The following tests assume that engine and battery are operating normally and that there are no engine problems that would cause a no start condition.

**NOTE:** Anti-Theft and PASS-Key II systems interact with cranking system through a starter enable relay or theft deterrent relay. On models with Anti-Theft and/or PASS-Key II system, ensure both systems and related controls are operating properly. See the ANTI-THEFT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section. On models with Anti-Theft system, an unauthorized entry will cancel starter enable operation. On all models, ensure no diagnostic trouble codes are present.

Slower Or No Crank Only After Extended Periods Of Vehicle Non-Use

There may be a parasitic load on electrical system. See the

GENERAL INFORMATION section.

Engine Does Not Crank, Starter Solenoid Does Not Click

1) Place gear selector in Park position. Turn ignition switch to START position and observe SECURITY indicator on instrument cluster. SECURITY indicator should illuminate for 5 seconds then go out. STARTING DISABLED DUE TO THEFT SYSTEM, REMOVE IGNITION KEY message should not appear on Driver Information Center (DIC).

2) If SECURITY indicator does not remain illuminated or does not flash continuously, and STARTING DISABLED DUE TO THEFT SYSTEM, REMOVE IGNITION KEY message is not displayed on DIC, go to next step. If SECURITY indicator remains illuminated or flashes continuously, and STARTING DISABLED DUE TO THEFT SYSTEM, REMOVE IGNITION KEY message is displayed on DIC, problem exists within anti-theft system. See the ANTI-THEFT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section.

3) Check 10-amp CRANK fuse A13 located in trunk compartment fuse block. Load test battery. Replace battery if it fails load test. Check battery cables and battery cable connections. If battery cables and connections are okay, go to next step. If battery cables and connections are faulty, repair or replace battery cables and connections as necessary.

4) Remove INJ fuses A5 and A7 (if equipped) located in engine compartment fuse block to prevent engine from starting. Turn ignition switch to START position. Using DVOM, measure voltage between starter solenoid terminal "S" (Purple wire) and ground. See Fig. 2. See WIRING DIAGRAM. If voltage is greater than 9.5 volts, go to next step. If voltage is less than 9.5 volts, go to step 6).

5) Check starter solenoid terminal "S" for a poor connection. Check between starter and engine block for dirty or poor ground. If connection and ground are okay, repair or replace starter.

6) On 4.6L models, disconnect C131 connector (Purple wire) located on right rear of engine, near valve cover. Turn ignition switch to START position. Using DVOM, measure voltage between female side of C131 connector (Purple wire) and ground. If voltage is greater than 9.5 volts, go to next step. If voltage is less than 9.5 volts, go to step 8).

7) Check C131 connector for a poor connection. Check Purple wire circuit between C131 connector and starter solenoid terminal "S" (Purple wire) for an open. If connection and Purple wire circuit are okay, replace starter solenoid.

8) Reconnect C131 connector. On all models, disconnect PASS-Key II decoder module connector. Connect a fused jumper wire between PASS-Key II decoder module connector terminal A4 (Yellow/Black wire) and ground. Try to crank engine. If engine does not crank, go to next step. If engine cranks, problem exists within anti-theft system. See the ANTI-THEFT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section.

9) Leaving fused jumper install, disconnect starter. **STARTER Article Text (p**

relay connector. Turn ignition switch to START position. Using DVOM, measure voltage between starter enable relay connector terminals C1 (Yellow wire) and C2 (Yellow wire), and ground. If voltage is greater than 9.5 volts at both terminals, go to step 12). If voltage is less than 9.5 volts at both terminals, check ignition switch. Check Yellow wire circuit between ignition switch and starter enable relay for an open, high resistance or short to ground.

10) If voltage is greater than 9.5 volts at terminal C2 only, go to next step. If voltage is less than 9.5 volts at terminal C2 only, remove 10-amp CRANK fuse A13 located in trunk compartment fuse block. Turn ignition switch to START position. Using DVOM, measure voltage between CRANK fuse A13 connector Yellow wire terminal and ground. If voltage is greater than 9.5 volts, go to next step. If voltage is less than 9.5 volts, repair open or high resistance in Yellow wire circuit between CRANK fuse A13 and ignition switch.

11) Repair open, high resistance or short to ground in Purple wire circuit between CRANK fuse A13 and park/neutral position switch, or in Yellow wire circuit between park/neutral position switch and starter enable relay.

12) If voltage is greater than 9.5 volts at terminal C1 only, go to next step. If voltage is less than 9.5 volts at terminal C1 only, repair open or high resistance in Yellow wire circuit between ignition switch and starter enable relay.

13) Voltage is greater than 9.5 volts at both starter enable relay connector terminals C1 (Yellow wire) and C2 (Yellow wire). Turn ignition switch to START position. Using DVOM, measure voltage between starter enable relay connector terminals C2 (Yellow wire) and A1 (Yellow/Black wire). If voltage is less than 9.5 volts, go to next step. If voltage is greater than 9.5 volts, go to step 15).

14) Check that fused jumper wire connected between PASS-Key II decoder module connector terminal A4 (Yellow/Black wire) and ground is still connected. If fused jumper wire is still connected, repair open or high resistance in Yellow/Black wire circuit between starter enable relay and PASS-Key II decoder module.

15) Connect a 30-amp fused jumper wire between starter enable relay connector terminals C1 (Yellow wire) and A2 (Purple wire). Try to crank engine. If engine does not crank, repair open or high resistance in Purple wire circuit between starter enable relay and starter solenoid terminal "S". If engine cranks, check starter enable relay connector terminal connections. If connections are okay, replace starter enable relay.

#### Solenoid Clicks, Engine Does Not Crank

1) Ensure battery is fully charged. Remove INJ fuses A5 and A7 (if equipped) located in engine compartment fuse block to prevent engine from starting.

NOTE: A break in step numbering sequence occurs at this point. STARTERAr1

Procedure skips from step 1) to step 3). No test procedures have been omitted.

3) Turn ignition switch to START position. Using DVOM, measure voltage between battery positive terminal and battery negative terminal while cranking engine for at least 15 seconds. If voltage is greater than 9.5 volts, go to step 5). If voltage is less than 9.5 volts, go to next step.

4) Load test battery. If load test is okay, check battery and starter terminals for corrosion or poor connections. Repair or replace as necessary. If load test is not okay, replace battery.

5) Locate battery negative terminal ground. Using DVOM, measure voltage between battery negative terminal and battery negative terminal ground connection while cranking engine for at least 15 seconds. If voltage is less than 0.5 volt, go to next step. If voltage is greater than 0.5 volt, clean connections and retest. If voltage is still not as specified, replace battery negative cable.

6) Using DVOM, measure voltage between battery positive terminal and starter solenoid terminal "B", while cranking engine for at least 15 seconds. If voltage is less than 0.5 volt, repair or replace starter solenoid. If voltage is greater than 0.5 volt, clean connections and retest. If voltage is still not as specified, replace battery positive cable.

#### SOLENOID WINDINGS TESTS

NOTE: To prevent overheating, DO NOT allow solenoid pull-in current to flow for more than 15 seconds.

NOTE: Current will decrease as windings heat up.

##### Hold-In Windings Test

1) If solenoid is not removed from starter motor assembly, disconnect field lead from terminal "M" on solenoid and insulate field lead from solenoid motor terminal. Connect an ammeter in series with 12-volt battery and starter solenoid terminal "S". See Fig. 2. Connect a voltmeter between solenoid terminal "S" and ground. Connect a carbon pile across battery.

2) Turn switch on and adjust carbon pile load until voltage reads 10 volts (11.5 volts on PG260). Check ammeter reading. Turn off carbon pile and open switch. If amperage reading is not between 10-20 amps (5-15 amps on 4.6L PG260), replace starter solenoid.

##### Pull-In Windings Test

Connect test equipment as in hold-in windings test. See HOLD-IN WINDINGS TEST. See Fig. 2. Ground starter solenoid terminal "M". Turn switch on and adjust carbon pile load until voltage reads 10 volts (11.5 volts on 4.6L PG260). Check ammeter reading. Turn off STARTER Article

carbon pile and open switch. See PULL-IN WINDINGS SPECIFICATIONS table. If ammeter reading is not as specified, replace starter solenoid.

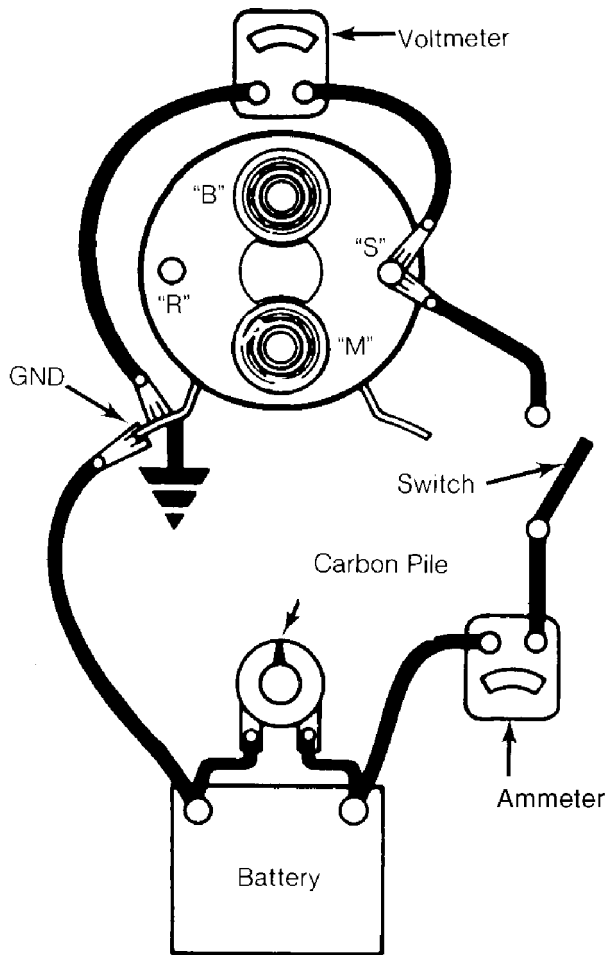
**PULL-IN WINDINGS SPECIFICATIONS TABLE**

AA

Engine	Starter Motor	Amps
4.6L		
Early Production .....	PG250 .....	(1) 60-85
Later Production .....	PG260 .....	(2) 30-50
4.6L .....	SD250 .....	(1) 60-85
4.9L .....	SD250 .....	(1) 60-85

(1) - At 10 volts.  
 (2) - At 11.5 volts.

AA



95G13470  
**Fig. 2: Solenoid Winding Test Connections**  
 Courtesy of General Motors Corp.

## STARTER NO-LOAD TEST

1) Secure starter in vise. Turn carbon pile off and open switch. Connect test equipment to starter. See Fig. 3. Turn switch on and adjust carbon pile until voltage reads 10 volts. Check ammeter reading and pinion speed on RPM indicator. Turn off carbon pile and open switch. Compare RPM and amperage readings with specifications. See STARTER NO-LOAD TEST SPECIFICATIONS table.

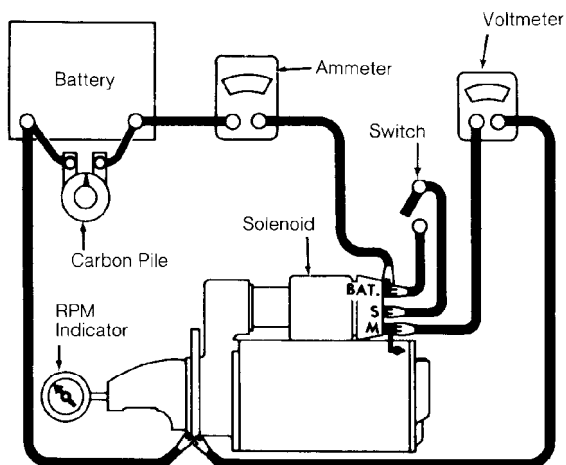
**CAUTION:** DO NOT apply more voltage than specified. Excessive voltage may cause armature to throw windings due to excessive speed.

2) If amperage and RPM readings are as specified, starter motor is okay. If test indicates low free speed and/or high current draw, unit may have tight, dirty or worn bearings or bushings, shorted or grounded armature, or a grounded field.

3) High current draw with pinion moving into cranking position but no pinion rotation indicates a direct ground in field, or frozen bearings or bushings. No pinion movement and very low or no current draw indicates an open or ground in solenoid windings.

4) Pinion moves into cranking position but does not turn and very low current draw indicates an open in field circuit or armature windings, or no current flow between solenoid battery and motor field terminals while motor is engaged. Connect a jumper wire between solenoid battery and motor field terminal "M". If motor now turns at specified RPM, replace solenoid.

5) Low no-load and low current draw indicates high internal resistance due to poor brush lead connections; a dirty commutator; an open in armature windings; broken, worn or weak brush springs; or worn, damaged or dirty brushes. High no-load speed and high current draw indicates shorted field coils or shorted armature windings.



95113472

Fig. 3: Starter No-Load Test Connections

Courtesy of General Motors Corp.

STARTER Article Text (p. 7) 1995 Cadillac Concours For Ace Mechanics 123 Main Street San Diego Ca 92126 Copyright © 1995

**STARTER NO-LOAD TEST SPECIFICATIONS TABLE**

AA

Application	Starter	(1) Amps	RPM
4.6L .....	PG250 ....	(1) 55-90 .....	2600-3200
4.6L .....	PG260 ....	(2) 60-120 .....	2900-3400
4.9L .....	SD250 ....	(1) 55-90 .....	2600-3200

- (1) - At 10 volts.
- (2) - At 11.5 volts.

AA

**BENCH TESTING**

**PRELIMINARY TESTS**

Remove starter from vehicle. See STARTER under REMOVAL & INSTALLATION. Check starter for damage such as broken or stripped electrical terminals, broken or cracked drive end housing, etc. If no obvious damage is found, perform starter no-load test and pinion clearance check before disassembling starter motor.

**ARMATURE TEST**

1) Inspect solder joints between armature windings and commutator bars. If any have come loose, replace armature. If commutator is rough or damaged, replace armature. DO NOT turn commutator in lathe or undercut spaces between bars. If commutator is dirty, clean with 400 grit emery cloth and blow away any copper dust.

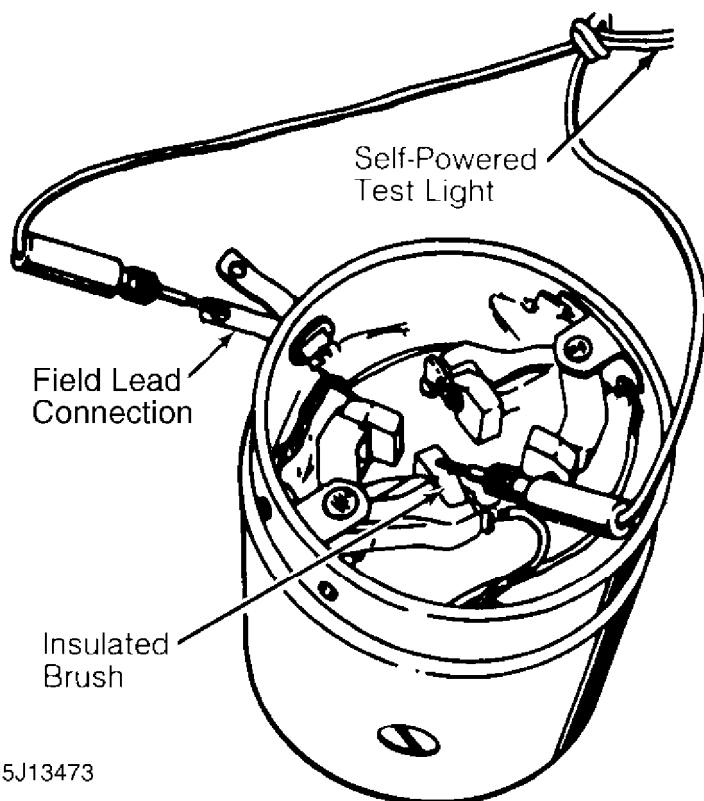
2) Using growler, check armature for shorts. Using self-powered test light, check for a ground between commutator bars and armature shaft. Place one lead on armature shaft and other lead on commutator. Test light should not illuminate. If test light illuminates, armature is shorted or grounded and must be replaced.

3) If no-load test indicated armature may be rubbing against inside of frame and field assembly, inspect outside of armature for signs of rubbing. If armature is scored only on one side of laminations, armature shaft may be bent and armature should be replaced. If scoring is all around armature laminations, check frame and field assembly for an out-of-position pole or for a foreign object lodged inside. Repair or replace frame and field assembly.

**CAUTION:** Some starters have a molded-type commutator. DO NOT undercut insulation as it may cause serious damage to commutator.

**FIELD COIL OPEN TEST**

Remove armature from frame and field assembly. Using self-powered test light, place one lead on field lead connection and other lead on one insulated brush. See Fig. 4. Test light should illuminate. If test light does not illuminate, field coil is open. Repair or replace field and frame assembly. Repeat test for each insulated brush.

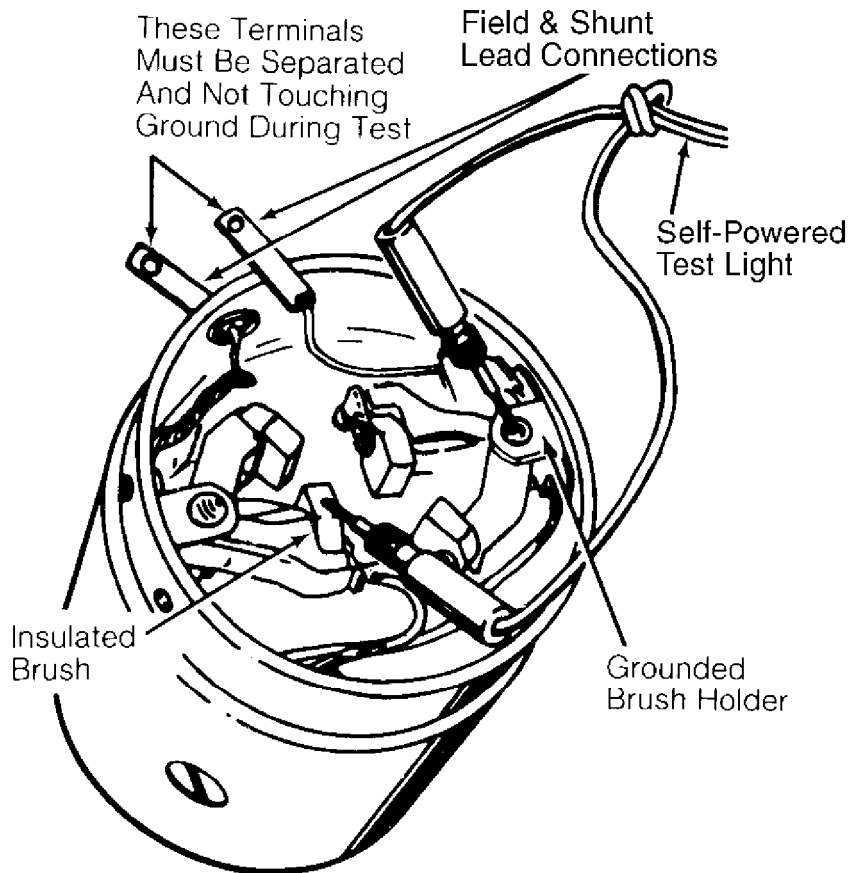


95J13473

Fig. 4: Testing Field Coil For Open  
Courtesy of General Motors Corp.

#### FIELD COIL GROUND TEST

Remove armature from field and frame assembly. On starters with shunt lead, separate field and shunt lead connections during test. Ensure field lead connection is NOT touching ground during test. Using self-powered test light, place one lead on grounded brush holder and other lead on one insulated brush. See Fig. 5. Test light should not illuminate. If test light illuminates, field coil is grounded. Repair or replace field and frame assembly. Repeat test for each insulated brush.



95A13474

**Fig. 5: Testing Field Coil For Ground**  
 Courtesy of General Motors Corp.

#### BRUSHES, SPRINGS & HOLDERS CHECK

Replace brushes if worn to 1/2 of original length, oil-soaked or pitted. Check brush spring tension and replace springs if weak, discolored or distorted. Ensure brush holders are clean and brushes are not binding in holders. Ensure full surface of brush contacts commutator for proper performance.

#### DRIVE ASSEMBLY CHECK

1) Check pinion teeth for chips, cracks or excessive wear. If pinion teeth are damaged, replace drive assembly. Also check flywheel for damage. Check drive assembly for slipping before disassembly from armature. With drive assembly attached to armature, cover armature with shop towels and secure in a vise.

2) Using a 12-point socket and a torque wrench, turn pinion counterclockwise. Pinion should lock and withstand a torque of 50 ft. lbs. (68 N.m) without slipping. If pinion slips before 50 ft. lbs. (68 N.m) is reached, replace drive assembly.

3) Using a 12-point socket and a torque wrench, turn pinion

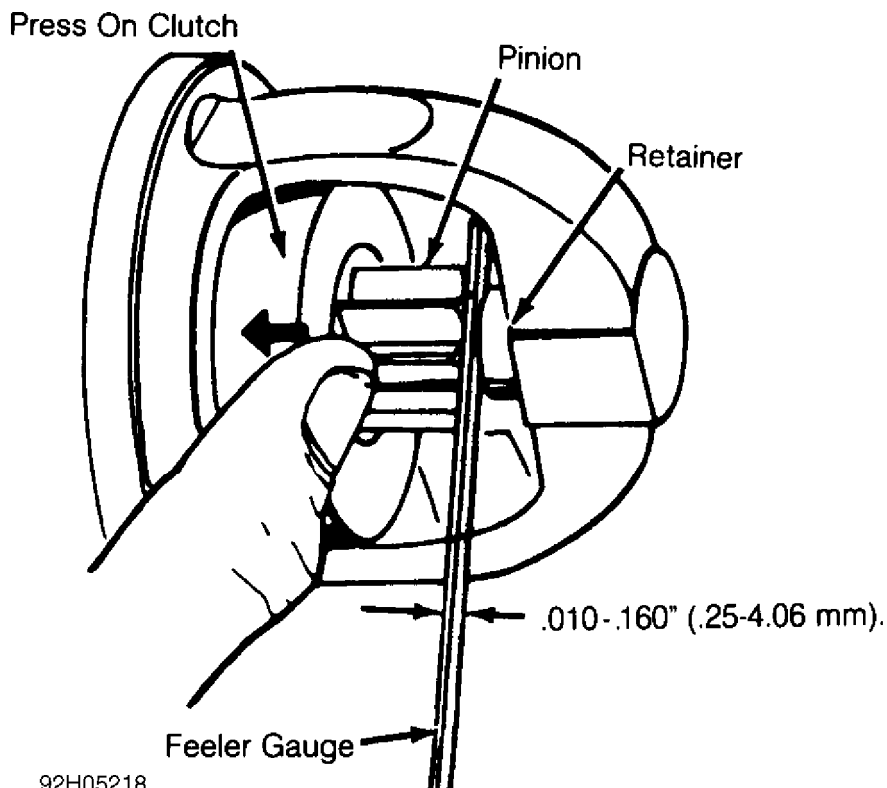
clockwise. Pinion should turn freely in overrunning direction (clockwise) only. If pinion does not turn freely in clockwise direction, replace drive assembly.

#### PINION CLEARANCE CHECK

1) Secure starter motor in vise with opening in housing accessible for measurement. Disconnect field lead at solenoid terminal "M" and insulate from solenoid field terminal "M". Connect battery negative terminal lead to starter frame. Connect 12 volts to starter solenoid terminal "S". Momentarily touch jumper lead from starter solenoid terminal "M" to starter frame, shifting pinion into cranking position.

2) Push pinion as far as possible away from retainer. Using a feeler gauge, ensure there is .010-.160" (.25-4.06 mm) clearance between pinion and retainer. See Fig. 6.

**NOTE:** Pinion clearance is not adjustable. If clearance is not within specification, disassemble and check starter motor for worn or damaged components.



92H05218

Fig. 6: Checking Pinion Clearance  
Courtesy of General Motors Corp.

**CAUTION:** When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See the COMPUTER RELEARN PROCEDURES article in the GENERAL INFORMATION section before disconnecting battery.

## STARTER

**NOTE:** Vehicles are designed for starter mounting without shims. A single shim or double shims may have been added to correct a noise or engagement condition. When installing starter any previously installed shims should be replaced in original location to ensure proper pinion to flywheel clearance.

### Removal (4.9L)

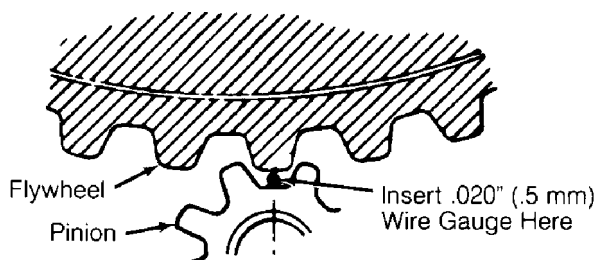
1) Disconnect negative battery cable. Raise and support vehicle. As required, remove nuts from A/C compressor, exhaust system and/or engine braces, adjacent to starter. On M/T models, remove bending brace from around starter (if equipped). On all models, remove other items that may interfere with removal of starter.

2) If necessary, remove nut from engine cross brace. Using pry bar between upper engine mount and engine, pry rearward and support engine.

3) If necessary, remove oil filter, air induction tube and cooling fan. Remove flywheel inspection cover (if equipped). Remove starter solenoid terminal "S" nut and battery cable nut. Separate wiring from starter. Remove starter mounting bolts and any shims. Remove starter.

### Installation

Before installing starter onto engine, tighten inner solenoid terminal nuts to ensure they are secure in cap. Starter failure may occur due to terminal or cap damage. Ensure pinion-to-flywheel clearance is .020" (0.5 mm). See Fig. 7. Add or subtract shims as necessary. To complete installation, reverse removal procedure. Tighten starter mounting bolts to specification. See TORQUE SPECIFICATIONS.



90104573

**Fig. 7: Measuring Pinion-To-Flywheel Clearance**

Courtesy of General Motors Corp.

**STARTER** Article Text (p. 12) 1995 Cadillac Concours For Ace Mechanics 123 Main Street San Diego Ca 92126 Copyright ©

### Removal (4.6L)

1) Disconnect negative battery cable, then positive battery cable. Remove intake manifold cover. Loosen fuel filler cap to relieve tank vapor pressure. Connect fuel pressure gauge (J-34730-1) to fuel pressure connection. Place fuel pressure gauge bleed hose in a container and open gauge bleed valve to relieve fuel system pressure.

2) Disconnect Intake Air Temperature (IAT) sensor electrical connector. Disconnect crankcase vent pipe at air intake duct. Remove air intake duct and air cleaner housing. Disconnect transaxle vent hose and vacuum lines at Idle Speed Control (ISC) actuator bracket. Disconnect vacuum manifold at throttle body. Disconnect Throttle Position (TP) sensor and ISC actuator electrical connectors. Disconnect cruise control servo vacuum hoses and electrical connector. Disconnect cruise control cable at throttle body. Remove cruise control servo and bracket.

3) Disconnect accelerator cable at throttle body and ISC actuator bracket. Disconnect front bank spark plug wires and position aside. Disconnect throttle body coolant hoses at throttle body and surge tank pipe. Disconnect Exhaust Gas Recirculation (EGR) pipe at throttle body spacer. Disconnect brake booster vacuum hose at intake manifold vacuum fitting. Disconnect fuel rail ground wire at rear cylinder head.

4) Disconnect quick-connect fittings at fuel rail. Remove fuel rail bracket at EGR valve. Disconnect Positive Crankcase Ventilation (PCV) hose at intake manifold. Disconnect injector harness main connector. Remove 6 bolts and 4 studs securing intake manifold, and remove intake manifold.

5) Remove starter solenoid terminal "S" nut and battery cable nut. Separate wiring from starter. Remove starter mounting bolts and any shims. Remove starter.

### Installation

1) Before installing starter onto engine, tighten inner solenoid terminal nuts to ensure they are secure in cap. Starter failure may occur due to terminal or cap damage. Install starter and wiring. Tighten starter mounting bolts to specification. See TORQUE SPECIFICATIONS.

2) Install intake manifold with throttle body attached. Tighten 6 intake manifold bolts and 4 intake manifold studs to 89 INCH lbs. (10 N.m). To complete installation, reverse removal procedure.

## OVERHAUL

### STARTER

**CAUTION:** DO NOT clean starter in degreasing tank or with grease dissolving solvents. This will remove lubricant from clutch mechanism, and damage insulation on armature and field coil.

Starter motors do not require lubrication, except during overhaul. Roll-type overrunning clutch requires no lubrication. Drive assembly, however, should be wiped clean and lubricated with silicon grease on shaft, underneath overrunning clutch assembly. See Figs. 8, 9 and 10.

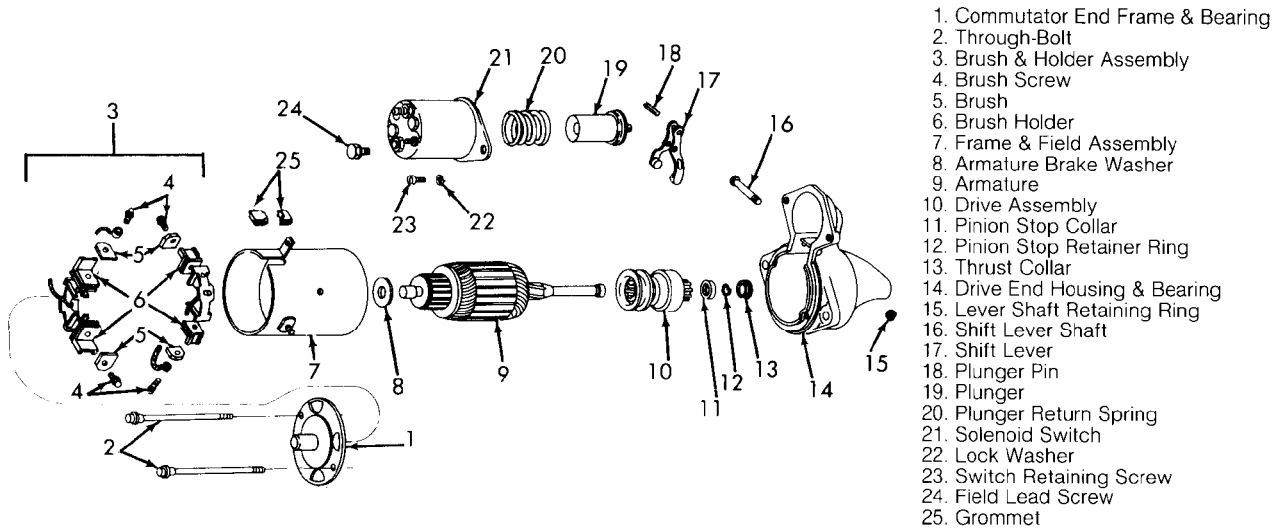
**TORQUE SPECIFICATIONS**

**TORQUE SPECIFICATIONS TABLE**

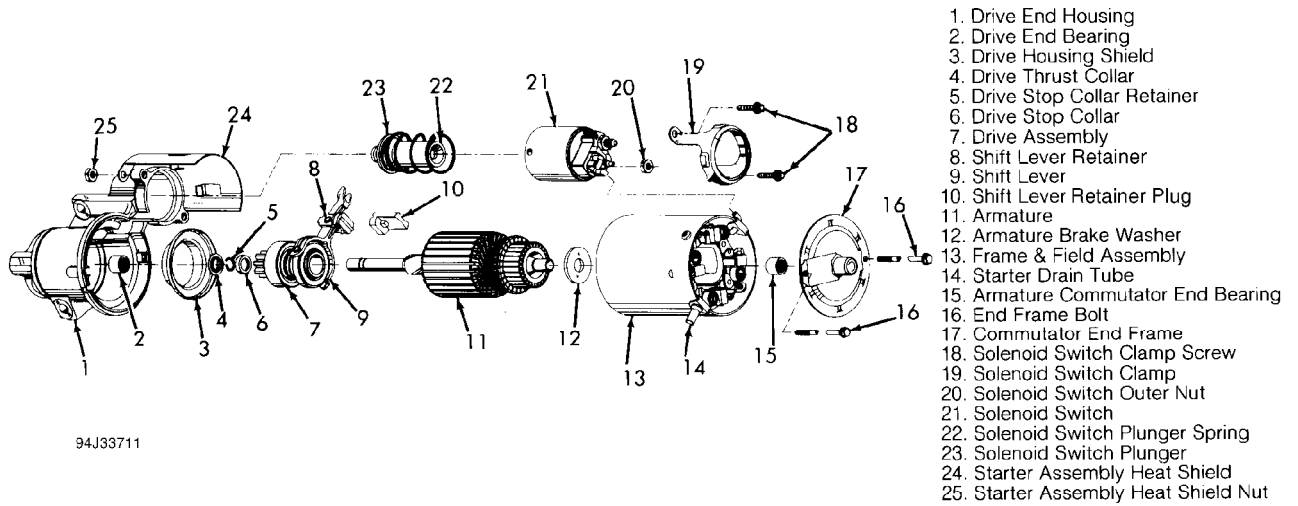
AA

Application	Ft. Lbs. (N.m)
Starter Mounting Bolts	
4.6L .....	22 (30)
4.9L .....	35 (47)

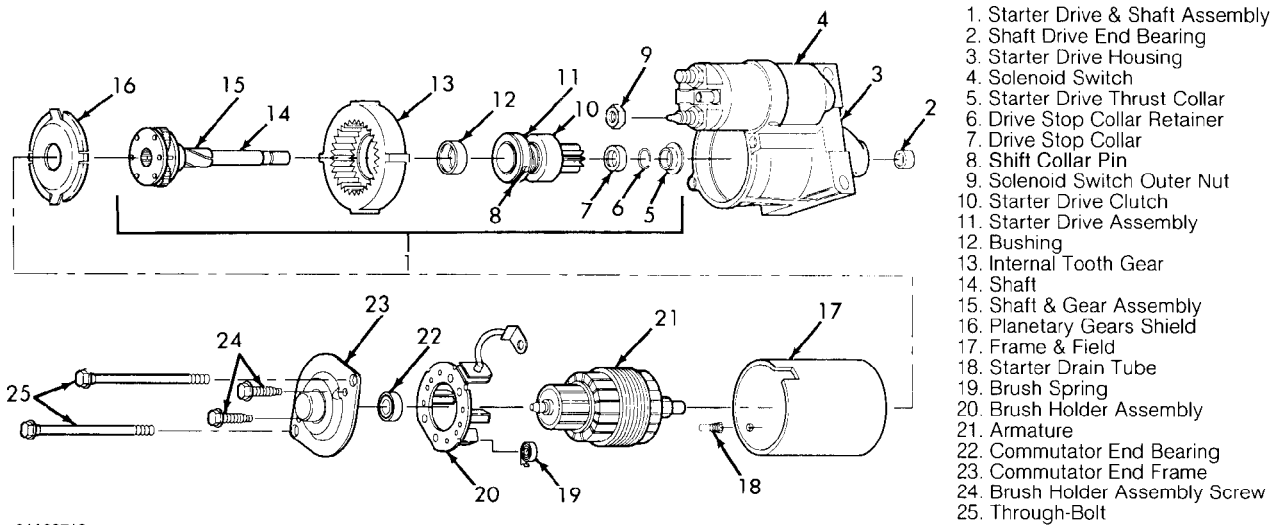
AA



94133710  
**Fig. 8: Exploded View Of Delco-Remy Starter Motor (SD250)**  
 Courtesy of General Motors Corp.



**Fig. 9: Exploded View Of Delco-Remy Starter Motor (SD260)**  
 Courtesy of General Motors Corp.



**Fig. 10: Exploded View Of Delco-Remy Starter Motor (PG250)**  
 Courtesy of General Motors Corp.

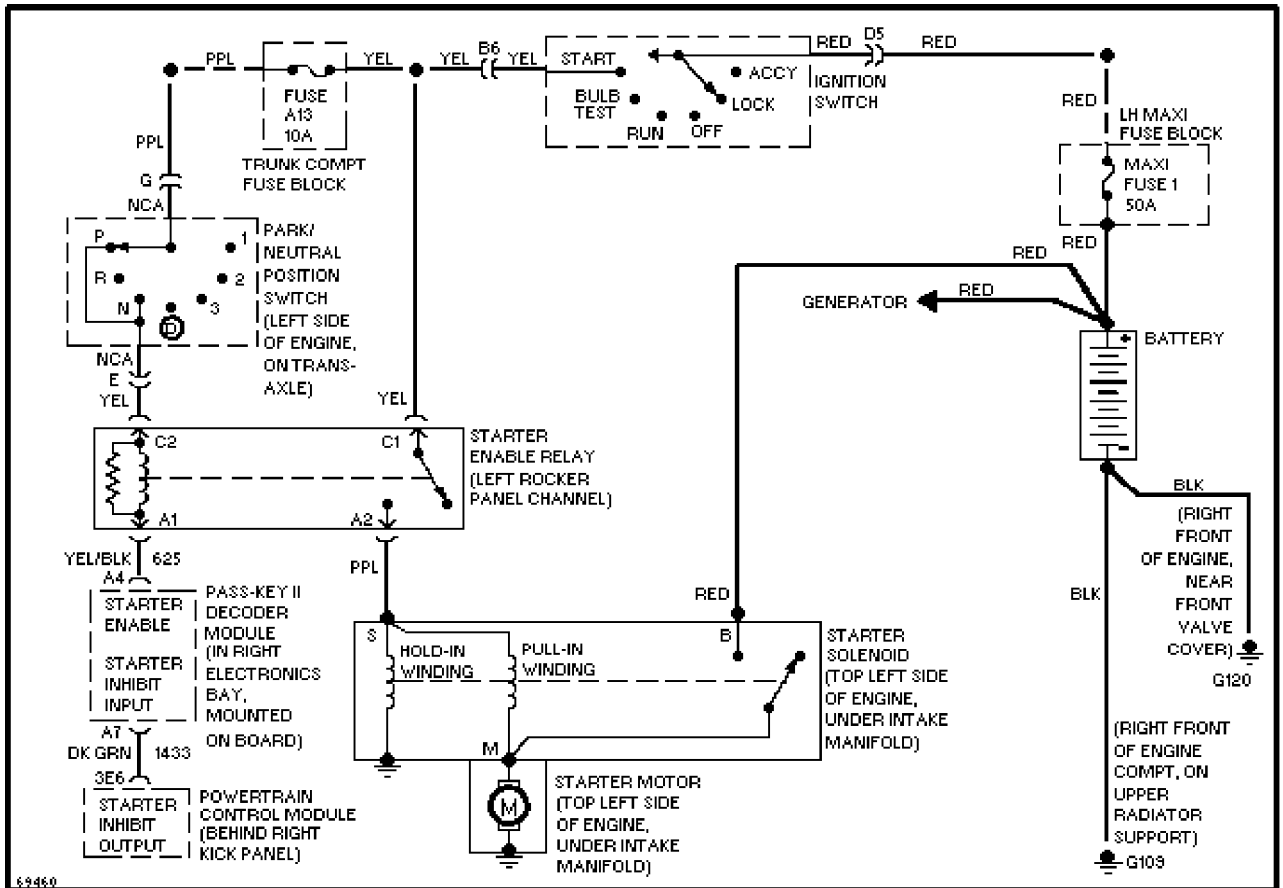


Fig. 11: Starting System Wiring Diagram (4.6L)

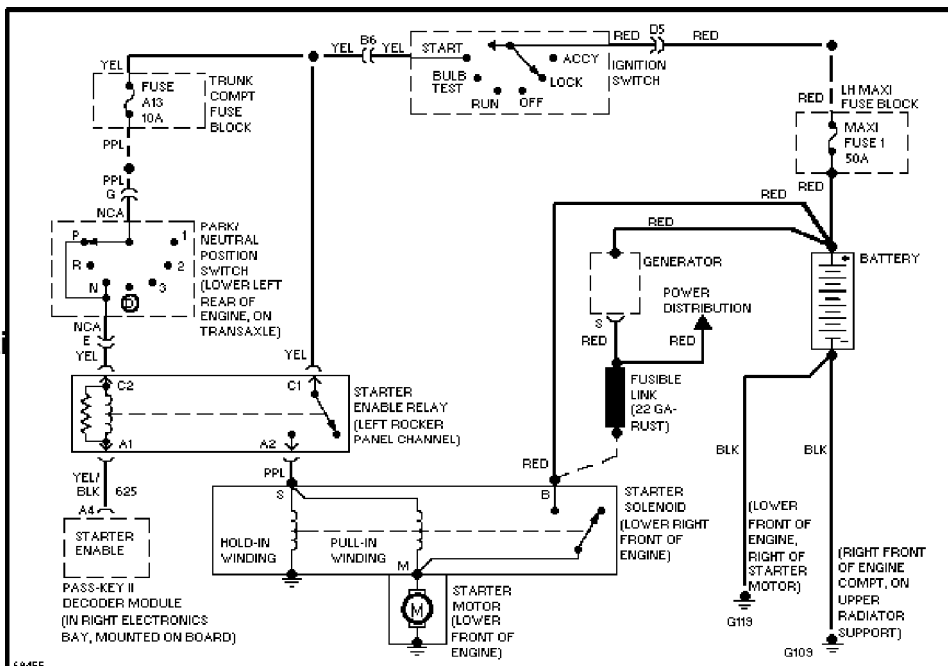


Fig. 12: Starting System Wiring Diagram (4.9L)

**END OF ARTICLE**