

# STARTER

1998 Pontiac Bonneville

1998 ELECTRICAL  
General Motors Corp. - Starter

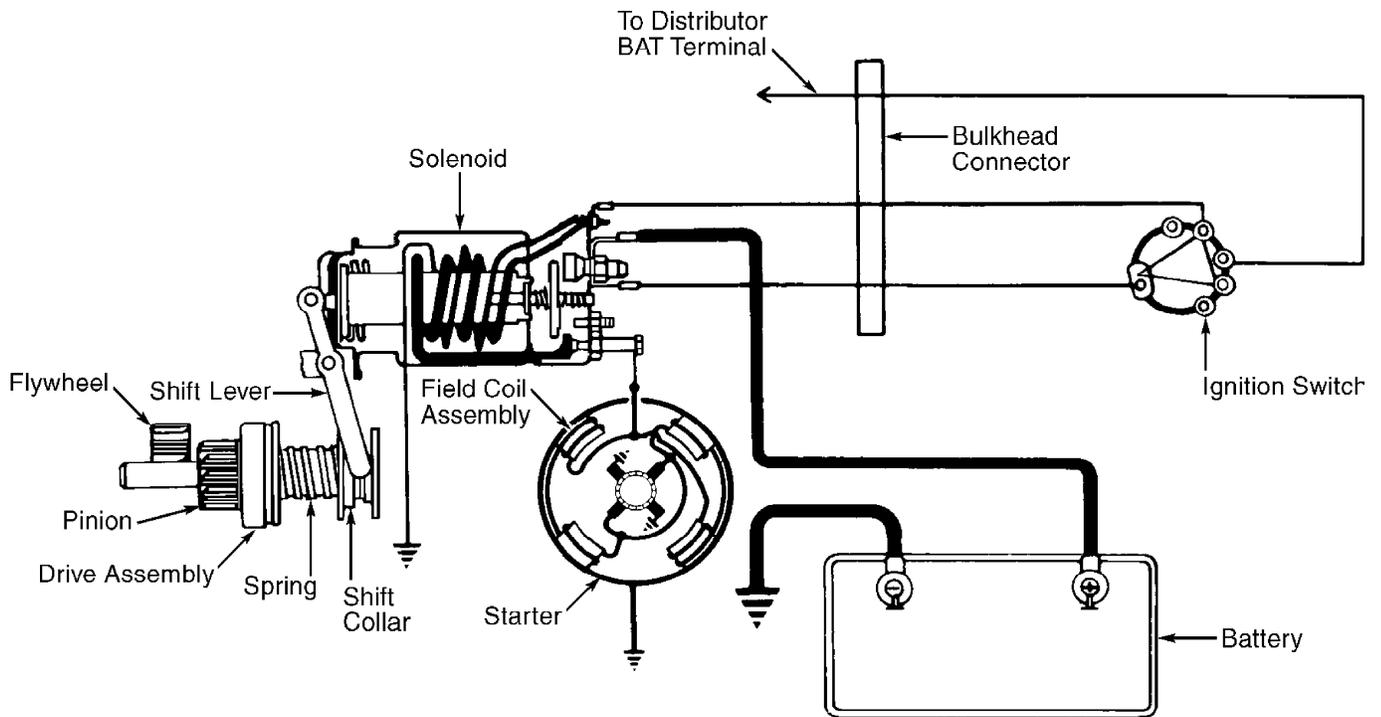
Buick; LeSabre  
Oldsmobile; Eighty Eight, LSS & Regency  
Pontiac; Bonneville

## DESCRIPTION & OPERATION

All models are equipped with Delco-Remy starters. When the ignition switch is turned to the START position, the Delco-Remy 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 motor. See Fig. 1.

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.

Starters with the PG designation have a pinion that is driven by a gear reduction system. These starters are easily identified by 3 Torx bolts that retain the solenoid and should not be disassembled for any reason. They are serviceable only by complete replacement.



95H13471

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

## STARTER IDENTIFICATION

STARTER IDENTIFICATION TABLE

Model	Engine	Starter
"H" Body .....	3.8L .....	SD255

## COMPONENT LOCATIONS

COMPONENT LOCATIONS TABLE

Component	Location
Instrument Panel Fuse Block .....	Lower Left Side Of Instrument Panel, Behind Trim Panel
Park/Neutral Position Switch .....	Top Of Left Side Of Transaxle
Pass-Key(R) II Decoder Module .....	Behind Right Side Of Instrument Panel
Powertrain Control Module (PCM) .....	Left Front Of Engine Compartment, In Air Cleaner Assembly
Right Maxi-Fuse Block .....	Right Rear Of Engine Compartment
Sensing & Diagnostic Module .....	Below Right Front Seat, Under Carpet
Starter Enable Relay .....	Behind Left Side Of Instrument Panel Above Fuse Block

## TROUBLE SHOOTING

NOTE: For information not covered in this article, see TROUBLE SHOOTING - BASIC PROCEDURES article in GENERAL TROUBLE SHOOTING section.

### TROUBLE SHOOTING HINTS

On all models, note condition of SECURITY indicator light. If indicator stays on or flashes continuously, see ANTI-THEFT SYSTEMS article in ACCESSORIES & EQUIPMENT. Check starter solenoid terminals and battery grounds. Check for proper installation of aftermarket electronic equipment. Perform self-diagnostic system test, to be certain no trouble codes are stored in PCM memory which may lead to misdiagnosis. See G - TESTS W/CODES article in ENGINE PERFORMANCE.

Check 60-amp IGN SW fuse in right maxi-fuse block. Check 10-amp AIR BAG/VATS fuse in instrument panel fuse block. See COMPONENT LOCATIONS table.

### STARTER NOISE

CAUTION: Never operate starter for periods of more than 15 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

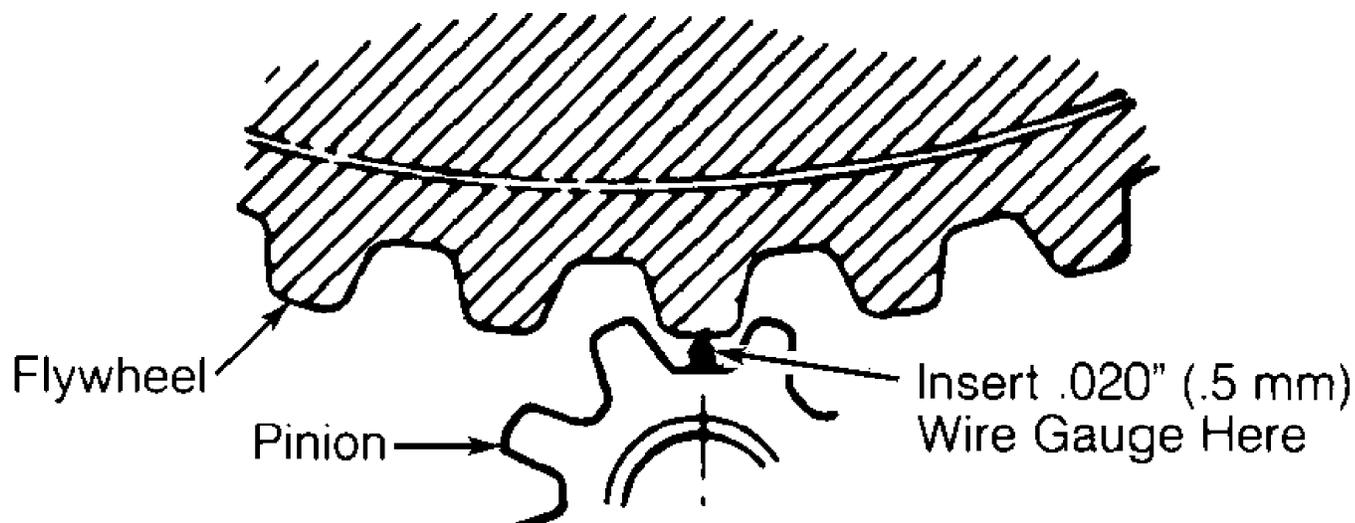
small. Pinion-to-flywheel clearance should be .020 In (0.5 mm). See Fig. 2.

2) If loud, siren-like "whoop" sound is heard after the engine starts, drive assembly is likely defective. If "rumble", "growl" or "knock" exists 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. If using .039 In (1.0 mm) double shims, do not install more than 2 shims. If using .015 In (.38 mm) double shims, do not install more than 3 shims. If condition is not corrected, and pinion-to-flywheel clearance has been reached, single shims may be added to outer side of starter motor bolt using .015 In (.38 mm) shims. See STARTER under REMOVAL & INSTALLATION.



90104573

Fig. 2: Measuring Pinion-To-Flywheel Clearance  
Courtesy of General Motors Corp.

## ON-VEHICLE TESTING

\* PLEASE READ THIS FIRST \*

WARNING: Vehicles are equipped with air bag supplemental restraint system. Before attempting ANY repairs involving steering column, instrument panel or related components, see SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM in AIR BAG RESTRAINT SYSTEM article.

NOTE: The following tests assume that engine and battery are operating normally and are at operating temperature, battery is charged, there are no engine problems that would cause a no-start condition, and no diagnostic trouble codes are present.

SLOW OR NO CRANK ONLY AFTER EXTENDED PERIODS OF VEHICLE

## NON-USE

There may be a parasitic load on electrical system. See PARASITIC LOAD EXPLANATION & TEST PROCEDURES article in GENERAL INFORMATION.

## ENGINE DOES NOT CRANK, STARTER SOLENOID DOES NOT CLICK

1) Place gear selector in Park. Turn ignition switch to START position and observe SECURITY indicator on instrument cluster. SECURITY indicator should illuminate for 5 seconds, then go out.

2) If SECURITY indicator does not remain illuminated as specified or does not flash continuously, go to next step. If SECURITY indicator remains illuminated as specified or flashes continuously, problem exists within anti-theft system. See ANTI-THEFT SYSTEM article in ACCESSORIES & EQUIPMENT.

3) 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 10-amp INJECTOR fuse No. 7. Turn ignition switch to START position. Using DVOM, measure voltage between starter solenoid terminal "S" (Purple wire) and ground. See WIRING DIAGRAMS. If voltage is 8 volts or greater, check starter solenoid terminal "S" for poor connection. Also, check for dirty or poor ground between starter and engine block. If connection and ground are okay, repair or replace starter. If voltage is less than 8 volts, go to next step.

5) Turn ignition switch to START position. Locate Black 66-pin C101 connector in right rear of engine compartment near A/C accumulator. Using DVOM, backprobe Black 66-pin C101 connector terminal F1 (Purple wire). See Fig. 3. Disconnect Purple wire from starter solenoid terminal "S". Measure voltage from female side of Black 66-pin C101 connector terminal F1 (Purple wire) and ground. If voltage is less than 8 volts, go to next step. If voltage is 8 volts or greater, check Black 66-pin C101 connector terminals for poor connections. Also, check for open circuit in Purple wire between starter solenoid terminal "S" and Black 66-pin C101 connector terminal F1. If connections and Purple wire are okay, replace starter solenoid.

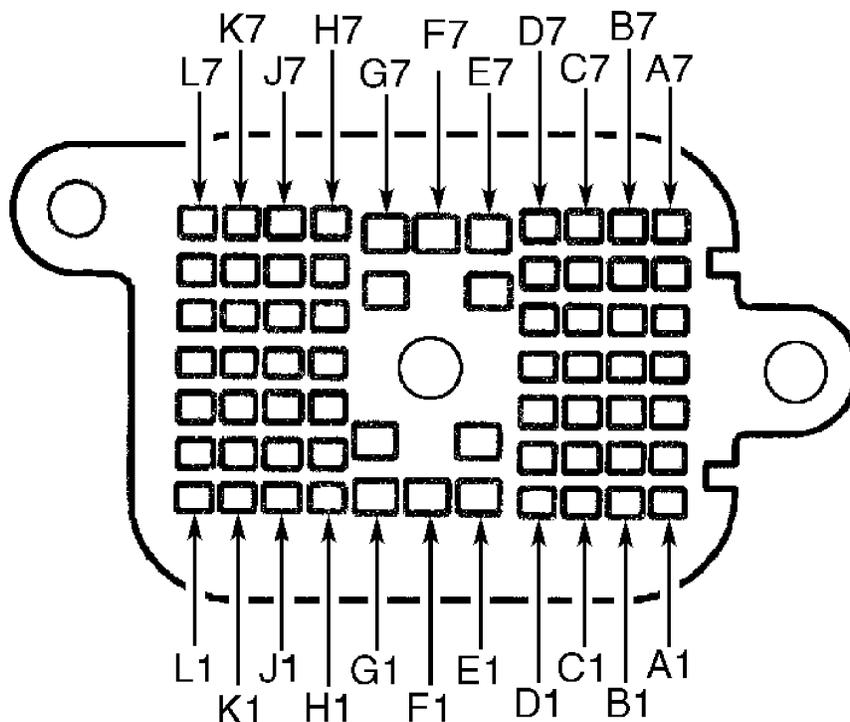
6) Reconnect Purple wire to starter solenoid terminal "S". Disconnect park/neutral position switch connector C1 located at left rear of engine, on transaxle. Connect test light between park/neutral position switch connector C1, terminal "G" (Yellow wire) and ground. Turn ignition switch to START position. If test light does not illuminate, go to next step. If test light illuminates, check anti-theft system for proper operation. See ANTI-THEFT SYSTEM article in ACCESSORIES & EQUIPMENT. Also check for open circuit in Yellow/Black wire between park/neutral position switch connector C1, terminal "E" and Pass-Key II decoder module connector terminal A4, and park/neutral position switch connector terminals for poor contact or damage.

7) Reconnect park/neutral position switch connector C1. Remove 10-amp AIRBAG/VATS fuse 2E located in instrument panel fuse block. Connect test light between 10-amp AIRBAG/VATS fuse 2E connector terminal B1 (Yellow wire) and ground. Turn ignition switch to START position. If test light does not illuminate, go to next step. If test light illuminates, check for open in Purple wire between AIRBAG/VATS fuse 2E connector terminal B2 and starter enable relay connector terminal C2. Check for open in Yellow wire between starter enable relay connector terminal A1 and park/neutral position switch connector C1, terminal "G". Also, check for open or high resistance in starter enable relay connector terminals C1 (Yellow wire) and A2 (Purple wire). If harness connector wires and terminals okay, replace starter enable relay.

8) Locate Natural 48-pin C202 connector behind dash, at base of steering column. Using DVOM, backprobe Natural 48-pin C202 connector terminal D5 (Red wire). See Fig. 4. Measure voltage between Natural 48-pin C202 connector terminal D5 (Red wire) and ground. If voltage is 8 volts or greater, go to next step. If voltage is less than 8 volts, check for open circuit or short to ground in Red wire between ignition switch and 60-amp IGN SW fuse connector terminal A2 located in right maxi-fuse block. If necessary, replace 60-amp IGN SW fuse.

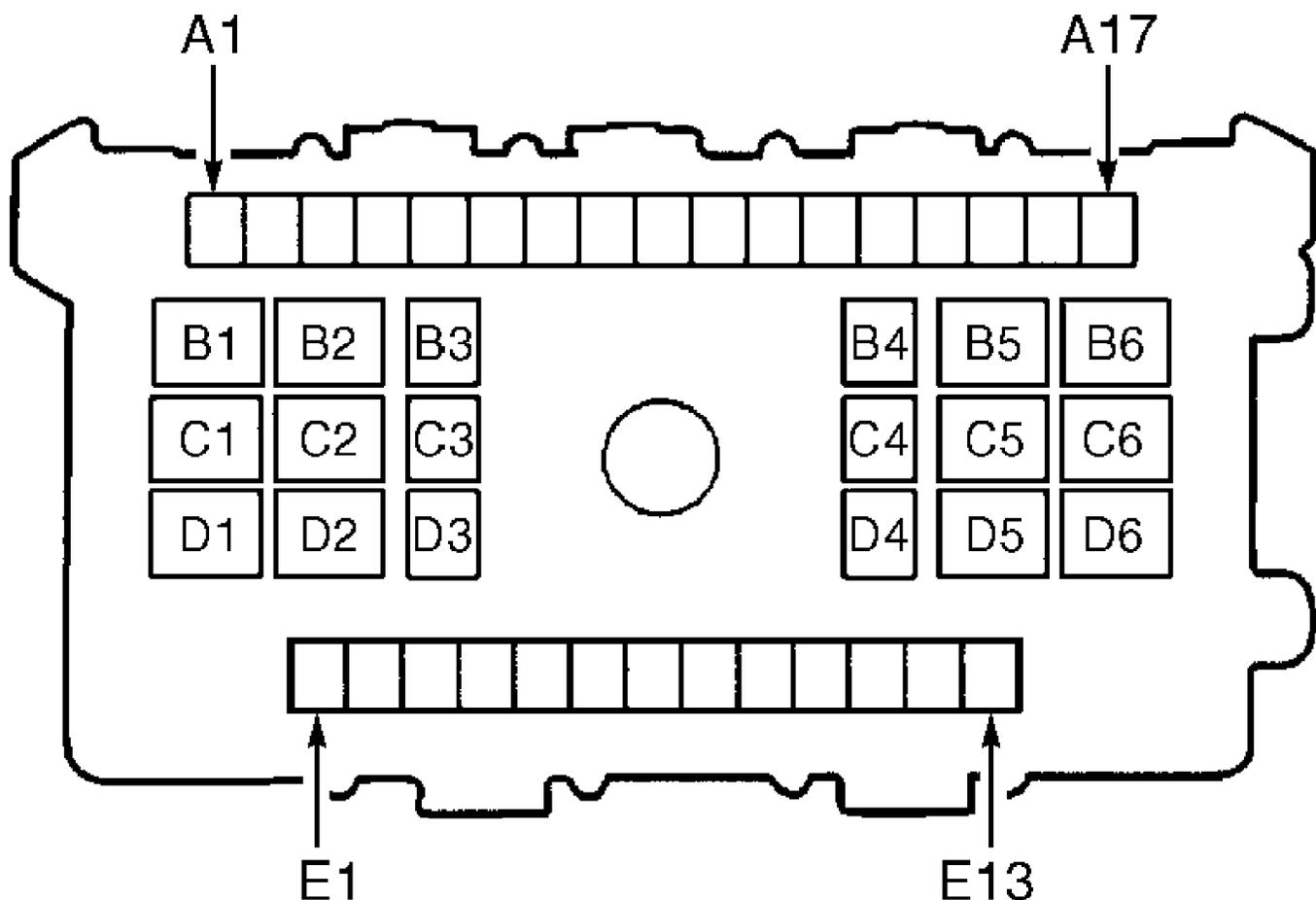
9) Turn ignition switch to START position and hold. Using DVOM, backprobe Natural 48-pin C202 connector terminal B6 (Yellow wire). Measure voltage between Natural 48-pin C202 connector terminal B6 (Yellow wire) and ground. If voltage is less than 8 volts, go to next step. If voltage is 8 volts or greater, check for open circuit in Yellow wire between ignition switch, 10-amp AIRBAG/VATS fuse 2E connector terminal B1 and starter enable relay connector terminal C1, and in Purple wire between starter enable relay connector terminal A2 and connector C101, terminal F1. Also, check starter enable relay. Repair or replace as necessary.

10) Check Natural 48-pin C202 connector terminals B6 and D5 for poor contact. Check for open or short to ground in Yellow wire between ignition switch, 10-amp AIRBAG/VATS fuse 2E connector terminal B1 and starter enable relay connector terminal C1. Check ignition switch for damage. Check for open circuit in Red wire between ignition switch and 60-amp IGN SW fuse connector terminal A2 located in right maxi-fuse block. Also, check for open circuit in steering column wiring harness. Repair or replace as necessary. See procedures in STEERING COLUMN SWITCHES article under ACCESSORIES & EQUIPMENT.



97F28451

Fig. 3: Identifying Connector C101  
 Courtesy of General Motors Corp.



### 97C28037

Fig. 4: Identifying Connector C202  
 Courtesy of General Motors Corp.

#### ENGINE DOES NOT CRANK, SOLENOID CLICKS

1) Remove F/P INJ fuse No. 7. F/P INJ fuse is located in relay center. INJ fuses are located in instrument panel fuse block. Turn ignition switch to START position. Using a DVOM, measure voltage between battery positive and negative terminals. Crank engine for at least 15 seconds. If voltage is more than 8 volts, go to step 3). If voltage is 8 volts or less, go to next step.

2) Load test battery. If load test is not okay, replace battery. If load test is okay, check battery and starter terminals for corrosion or poor contact. If terminals are okay, repair or replace starter motor.

3) Using DVOM, measure voltage between battery negative terminal and engine block while cranking engine for 15 seconds. If voltage is less than 0.5 volt, go to next step. If voltage is 0.5 volt or more, clean negative battery cable connections and retest. If voltage is still 0.5 volt or more, replace battery negative cable.

4) Using DVOM, measure voltage between battery positive terminal and starter solenoid terminal "B" (Black wire) while cranking engine for 15 seconds. If voltage is less than 0.5 volt, repair or replace starter motor assembly. If voltage is 0.5 volt or more, clean positive battery cable connections and retest. If voltage is still 0.5 volt or more, replace battery positive cable.

## 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.

### SOLENOID WINDINGS TESTS

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

NOTE: Current flow 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 and switch in series with 12-volt battery and starter solenoid terminal "S" as illustrated. See Fig. 5. Connect a voltmeter between solenoid terminal "S" and ground. Connect a carbon pile across battery.

2) Turn switch on and quickly adjust carbon pile load until voltage reads as specified. See HOLD-IN WINDINGS SPECIFICATIONS table. Check ammeter reading. Turn off carbon pile and open switch. See HOLD-IN WINDINGS SPECIFICATIONS table. If amperage reading is not as specified, replace starter solenoid.

#### Pull-In Windings Test

Connect test equipment as in hold-in windings test. See HOLD-IN WINDINGS TEST. See Fig. 5. Ground starter solenoid terminal "M". Turn switch on and quickly adjust carbon pile load until voltage reads as specified. See PULL-IN WINDINGS SPECIFICATIONS table. Check ammeter reading. Turn off carbon pile and open switch. See PULL-IN WINDINGS SPECIFICATIONS table. If ammeter reading is not as specified, replace starter solenoid.

#### HOLD-IN WINDINGS SPECIFICATIONS TABLE

---

Engine	Starter Motor	Amps
3.8L .....	SD255 .....	(1) 10-20

(1) - At 10 volts.

---

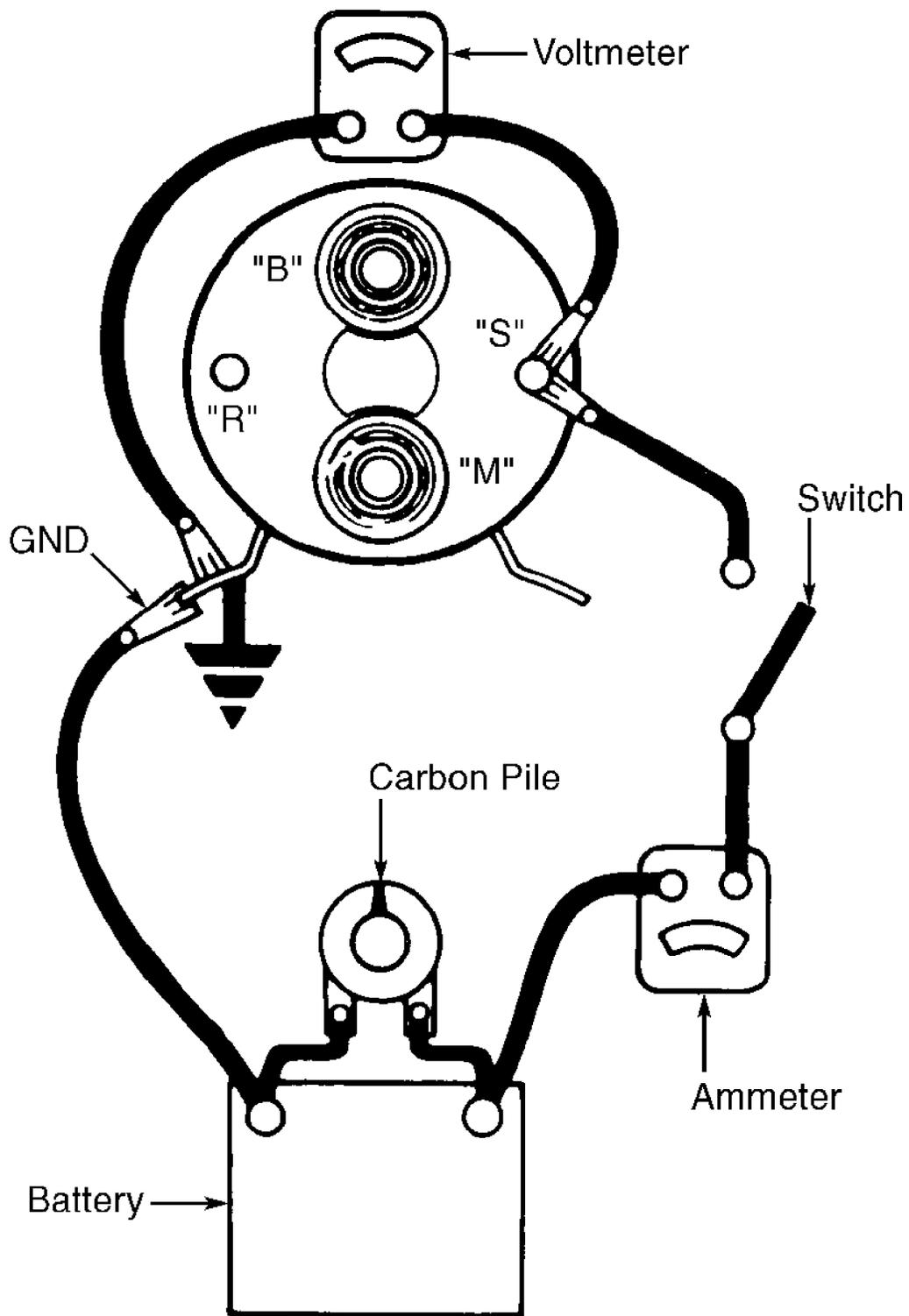
#### PULL-IN WINDINGS SPECIFICATIONS TABLE

---

Engine	Starter Motor	Amps
3.8L .....	SD255 .....	(1) 60-85

(1) - At 10 volts.

---



95G13470

Fig. 5: 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 as illustrated. See Fig. 6. Turn switch on and adjust carbon pile until voltage reads as specified. See STARTER NO-LOAD TEST SPECIFICATIONS table. 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.

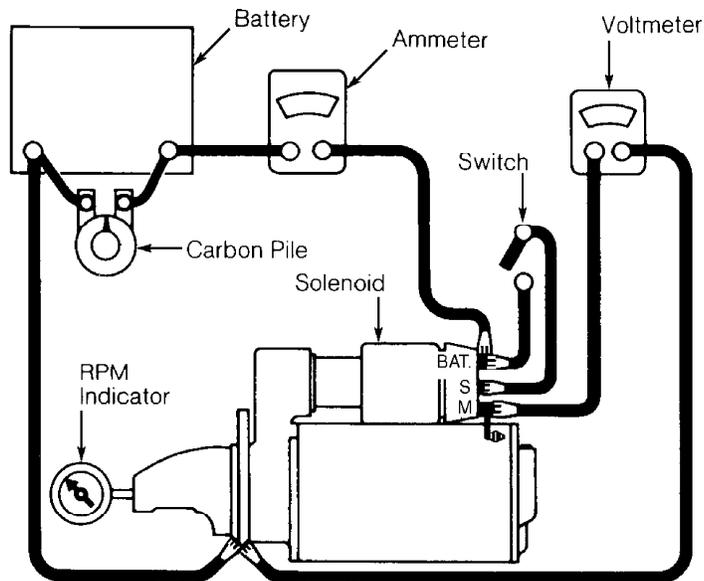
CAUTION: DO NOT apply more voltage than specified. Excessive voltage may cause armature to throw windings due to excessive speed.

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, bent armature shaft, 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 a normal current reading indicates plunger is unable to move into solenoid or drive is unable to move on armature shaft. No pinion movement and very low or no current draw indicates an open or ground in solenoid windings.

4) Pinion moving into cranking position but not turning 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. If starter vibrates or is noisy, armature may be rubbing against inside of frame and field.



95113472

Fig. 6: Starter No-Load Test Connections  
 Courtesy of General Motors Corp.

STARTER NO-LOAD TEST SPECIFICATIONS TABLE

Application	Starter	Amps	RPM
3.8L .....	SD255 ....	(2) 45-75 .....	8600-13,000

(2) - At 11.5 volts.

---

## ARMATURE TEST

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

**NOTE:** Any ball bearings that are removed from armature must be replaced with new bearings.

1) Inspect solder joints between armature windings and commutator bars. If any have come loose, replace armature. Replace armature assembly if commutator outer diameter is less than 1.378 in (36 mm) or if undercut depth is less than .008 in (.2 mm). Do not undercut insulation. 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.

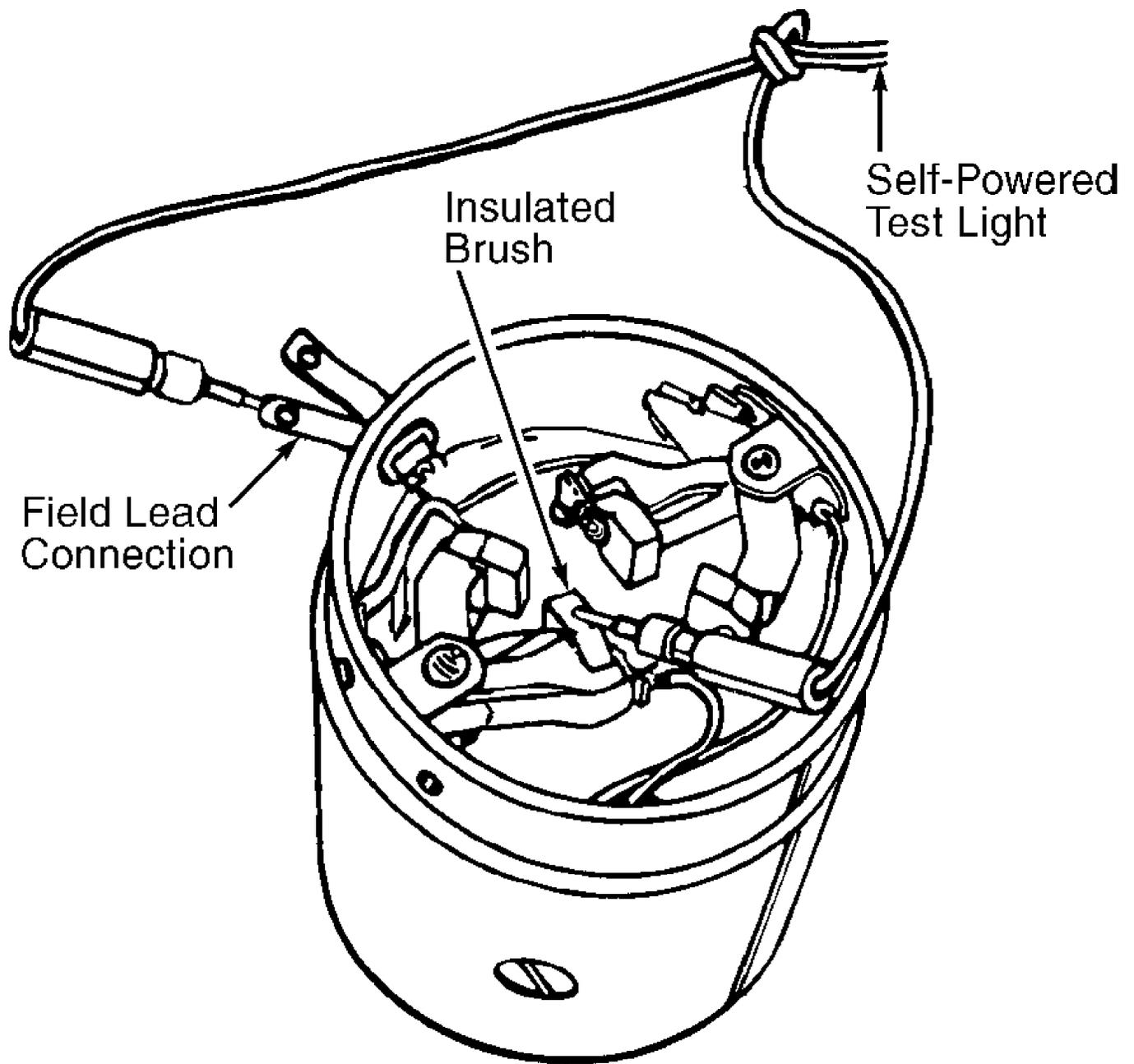
2) Using growler, check armature for shorts. Hold a flat steel strip on armature parallel to armature core or shaft. Rotate armature in growler. Steel strip will vibrate on area of short circuit.

3) Using self-powered test light, 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.

4) 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.

## 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. 7. 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.

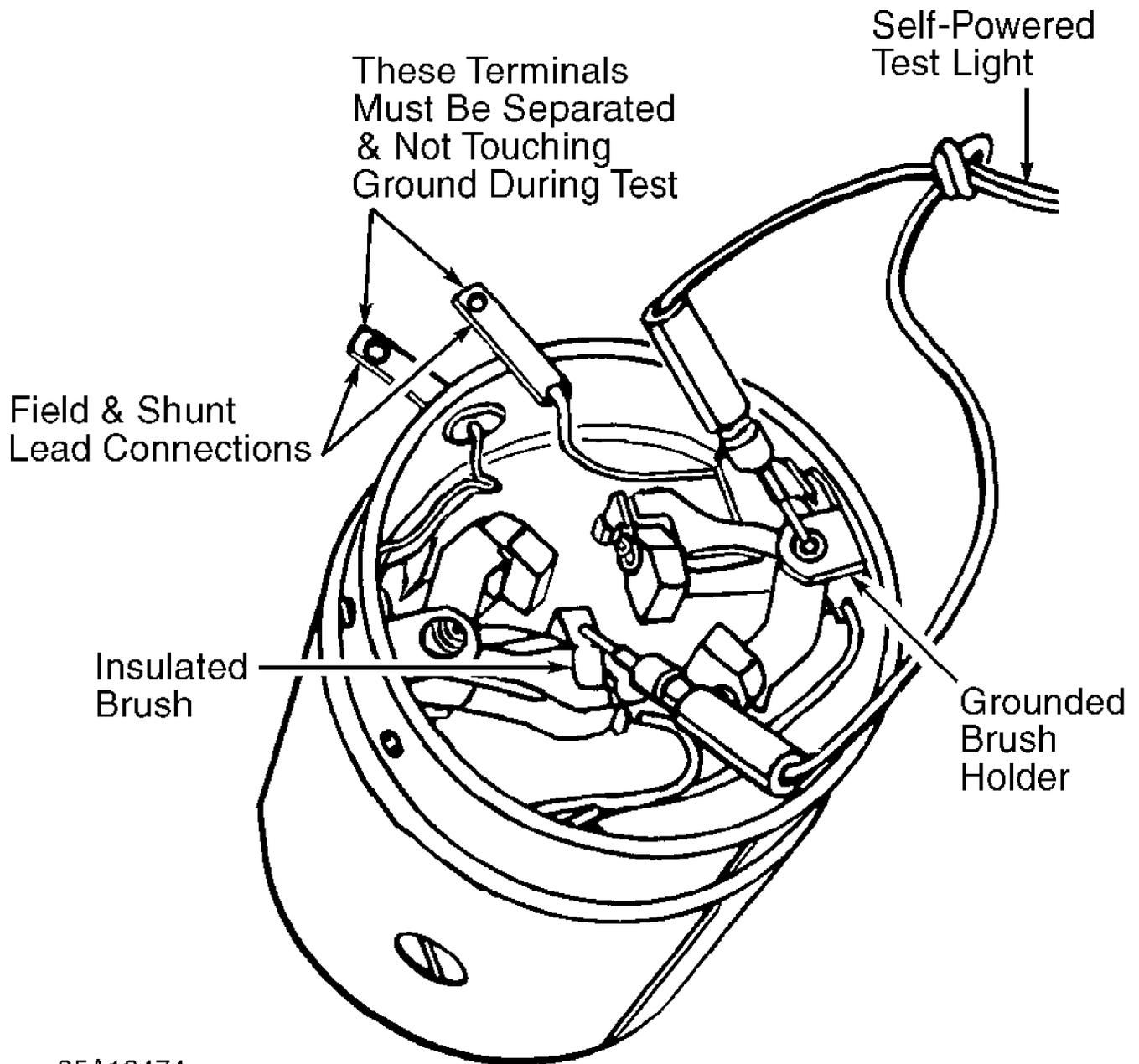


95J13473

Fig. 7: 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. 8. 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. 8: Testing Field Coil For Ground  
 Courtesy of General Motors Corp.

### BRUSHES, SPRINGS & HOLDERS CHECK

If any brushes are damaged (oil-soaked or pitted) or worn more than 90 percent, replace frame and fields. If brushes are not damaged and still have more than 50 percent, use a soft cloth to clean contact face of brushes. 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.

## COMMUTATOR END FRAME & BEARING

Ensure commutator end bearing has not spun in frame. If bearing has spun, replace frame and bearing. Do not lubricate bearing. If bearing is dry or damaged, replace bearing. Measure original bearing depth and install new bearing to same depth.

## DRIVE END HOUSING & BEARING

Ensure drive end bearing has not spun in housing. If bearing has spun, replace housing and bearing. Do not lubricate bearing. If bearing is dry or damaged, replace bearing. Measure original bearing depth and install new bearing to same depth.

## 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.

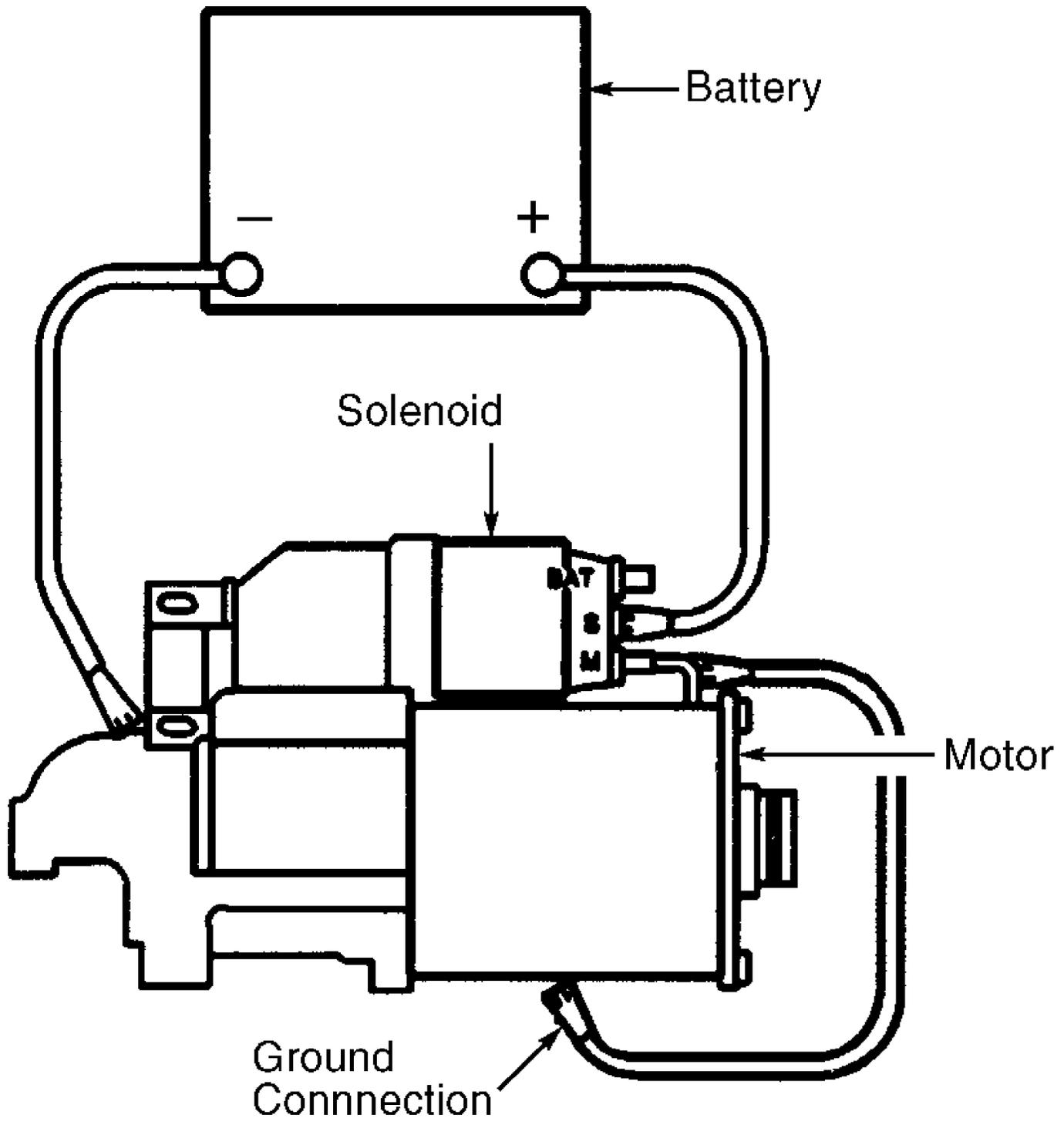
3) Using a 12-point socket and a torque wrench, turn pinion clockwise. Pinion should turn freely in overrunning direction (clockwise) only. If pinion does not turn freely in clockwise direction, replace drive assembly.

## PINION CLEARANCE CHECK

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

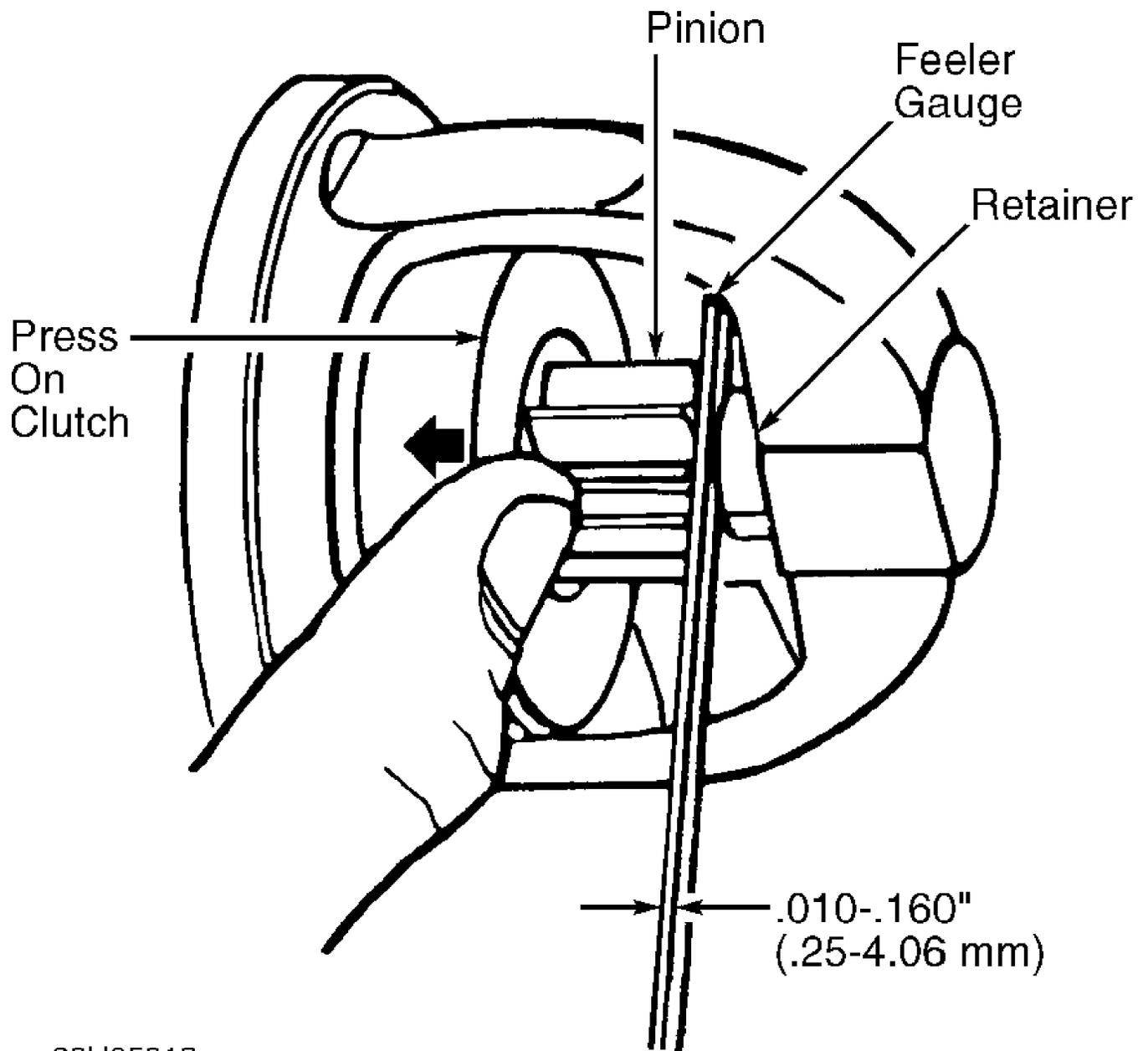
1) Secure starter motor in vise with opening in housing accessible for measurement. Disconnect field lead at solenoid terminal "M" and insulate from solenoid field terminal "M". Connect battery negative terminal lead to starter frame. Connect 12 volts to starter solenoid terminal "S". Momentarily touch jumper lead from starter solenoid terminal "M" to starter frame, shifting pinion into cranking position. See Fig. 9.

2) Push pinion as far as possible away from retainer. Using a feeler gauge, ensure there is .010-.160 in (.25-4.06 mm) clearance between pinion and retainer. See Fig. 10.



97H28040

Fig. 9: Pinion Clearance Connections  
Courtesy of General Motors Corp.



92H05218

Fig. 10: Checking Pinion Clearance  
 Courtesy of General Motors Corp.

**REMOVAL & INSTALLATION**

\* PLEASE READ THIS FIRST \*

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 COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION section before disconnecting battery.

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.

## STARTER

### Removal

Raise and support vehicle. Remove splash shield and flywheel inspection cover. Remove starter solenoid terminal "S" nut and battery cable nut. Separate wiring from starter. Remove starter mounting bolts. Remove shims and note arrangement for reassembly. 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. Install starter and wiring. Ensure shims are installed in original location. Tighten starter mounting bolts to specification. See TORQUE SPECIFICATIONS.

CAUTION: Ensure engine and intake manifold are cool before tightening intake manifold bolts.

## OVERHAUL

### STARTER & SOLENOID

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.

NOTE: When reassembling starter and solenoid, use grease (10477431 or 1960954) for lubrication. Use of other greases may cause starter failure.

NOTE: For exploded view of starter, refer to illustrations. See Fig. 11.

### Disassembly

Remove solenoid by turning 90 degrees while pulling solenoid out of starter. If shift lever shaft needs to be drilled out, a new shaft and retaining ring will be needed for reassembly. Check starter drive for slippage before removing from armature shaft.

### Assembly

Apply a small amount of lubricant to armature shaft and to starter drive contact points. Use 2 sets of pliers to snap pinion stop collar over retainer ring. Pinion stop color ring is not re-used.

Lubricate solenoid core with grease. Apply grease evenly around inside edge of solenoid core. Apply thickly to first .5" (13 mm) inside edge of core. Plunger movement will distribute grease properly. Soak new drive end bushing in oil (for at least 30 minutes) before installation.

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS TABLE

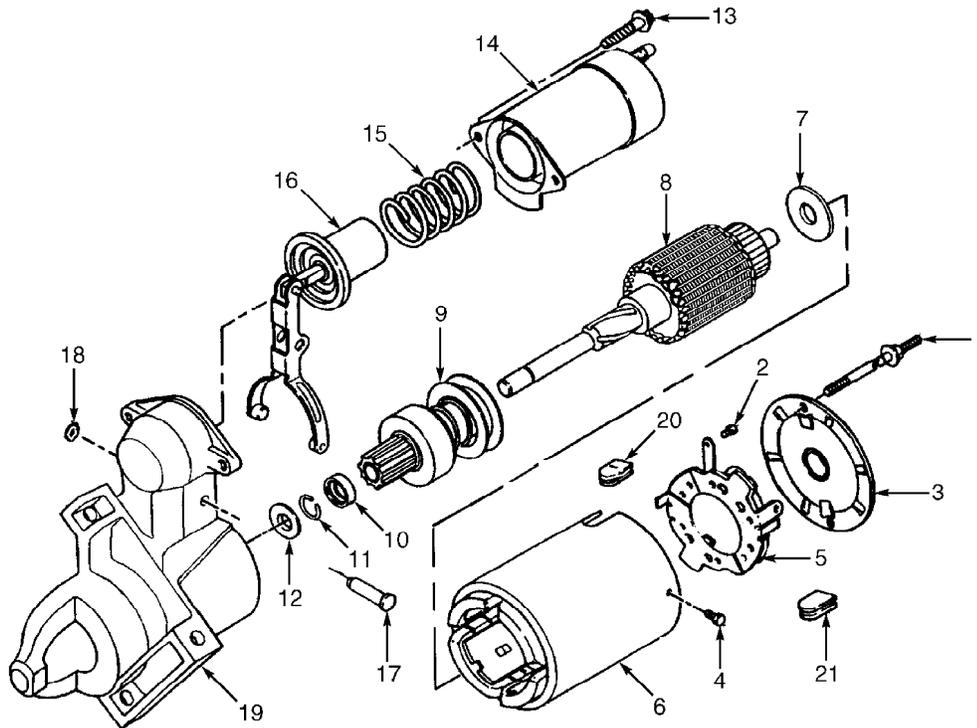
---

Application

Ft. Lbs. (N.m)

EGR Pipe Bolts .....	21 (28)
Starter Mounting Bolts .....	32 (43)

---



1. Starter Motor Through-Bolt
2. Brush Attaching Screw
3. Commutator End Frame
4. Brush Attaching Screw
5. Brush & Holder Package
6. Frame & Field Housing
7. Brake Washer
8. Armature
9. Starter Drive
10. Pinion Stop Collar
11. Pinion Stop Retaining Ring
12. Thrust Collar
13. Solenoid Switch Screw
14. Solenoid Switch
15. Plunger Return Spring
16. Plunger Shift Lever
17. Shift Lever Shaft
18. Lever Shaft Retaining Ring
19. Drive End Housing
20. Grommet
21. Grommet

95C35164  
 Fig. 11: Exploded View Of Delco-Remy Starter Motor (SD205 & SD255)  
 Courtesy of General Motors Corp.

## WIRING DIAGRAMS

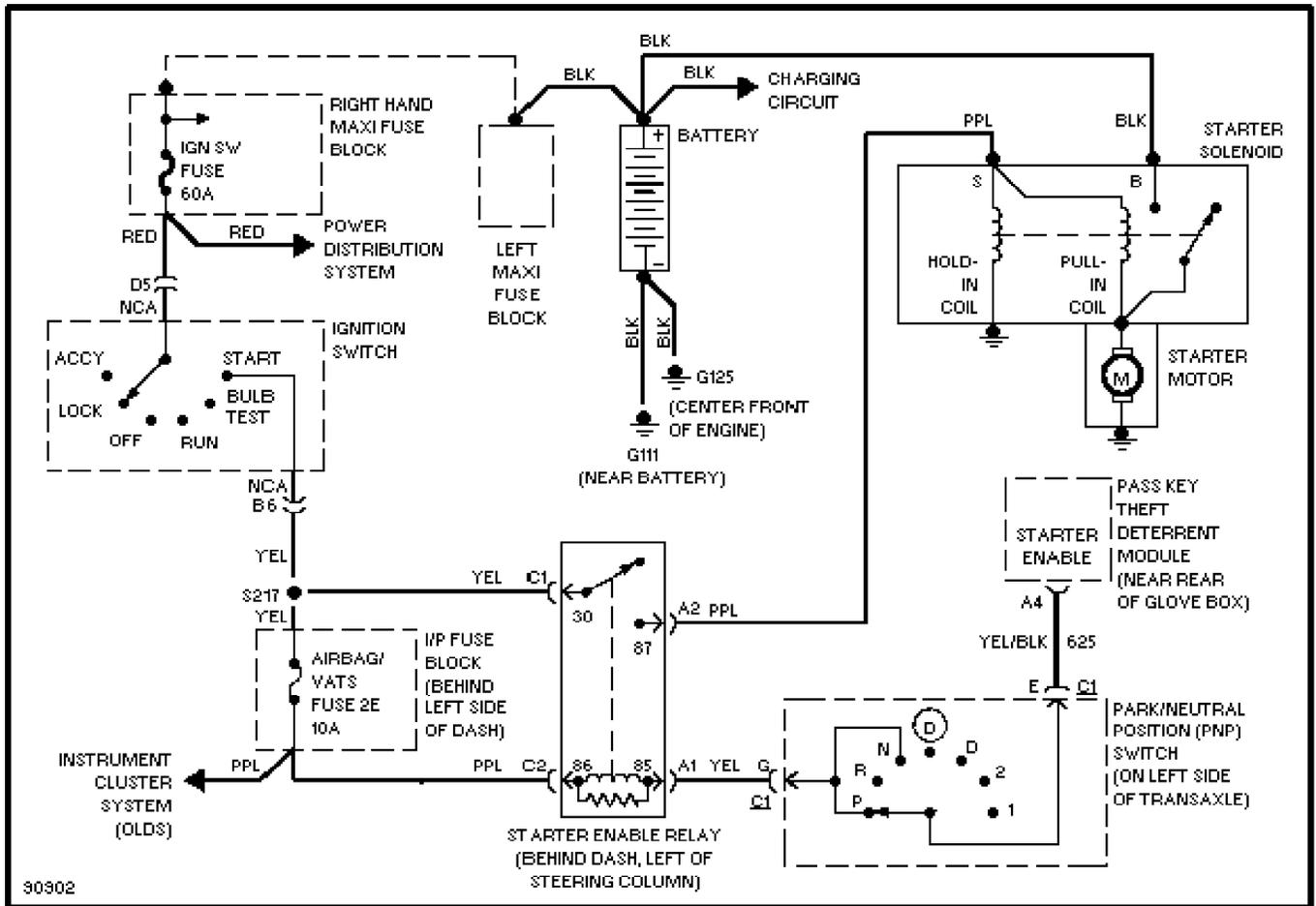


Fig. 12: Starting System Wiring Diagram