General Motors Corp. - Starter

STARTER IDENTIFICATION

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Model	Engine	Starter
"Y" Body	5.7L	N/A

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 dissembled for any reason. They are serviceable only by complete replacement.

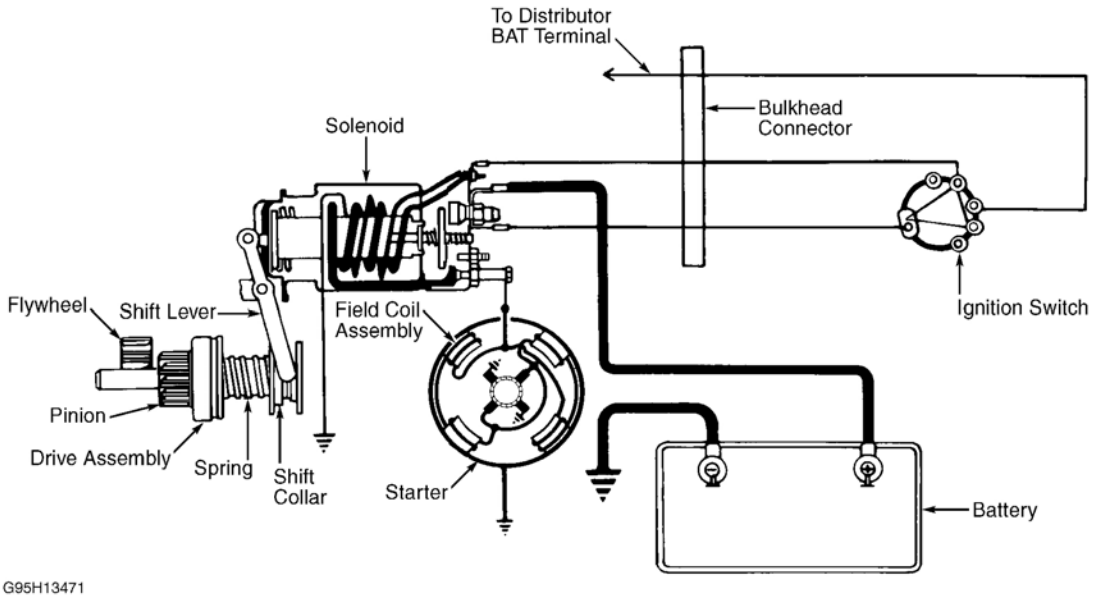

Fig. 1: Illustrating Typical Cranking Circuit
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATIONS

COMPONENT LOCATIONS

Component	Location
Clutch Pedal Position/Cruise Switch	Behind Clutch Pedal
Ignition & Start Switch	Left Side Of Instrument Panel, Next To Radio
Instrument Panel Junction Block	Below Instrument Panel, At Top Of Footwell Behind Carpet
Park/Neutral Position & Back-Up Switch	Left Side Of Transmission
Powertrain Control Module (PCM)	Right Side Of Engine Bay Between Wheelhouse & Dash Panel, Above Battery
Theft Deterrent Relay	In Instrument Panel Junction Block
Underhood Junction Block	Right Side Of Engine Bay, Between Wheelhouse & Dash Panel

TROUBLE SHOOTING

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

TROUBLE SHOOTING HINTS

On all models, note condition of SECURITY indicator light. If indicator stays on or flashes continuously, see **ANTI-THEFT SYSTEM** 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 **TESTS W/CODES** article in ENGINE PERFORMANCE.

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. On

3.0L engines, ensure starter-to-engine bolts are tightened correctly. See **TORQUE SPECIFICATIONS** . 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 then 2 shims. If using .015 In (.38 mm) double shims, do not install more then 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** .

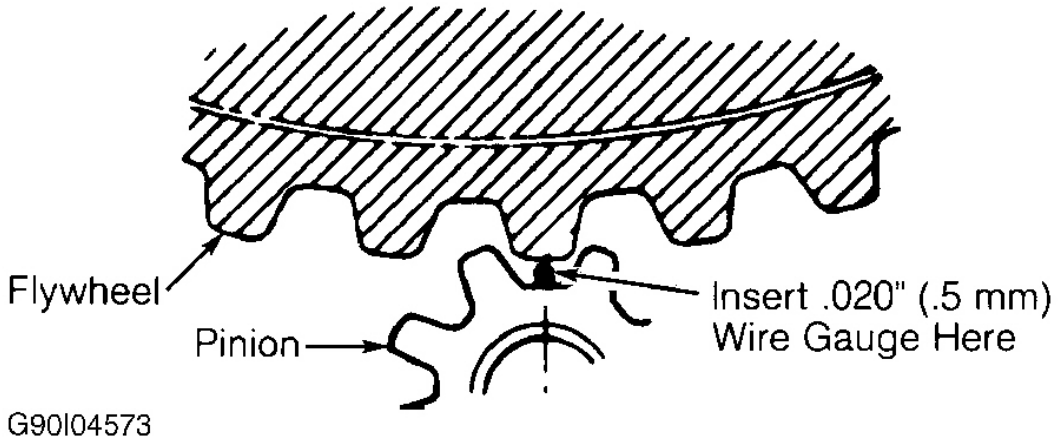

Fig. 2: Measuring Pinion-To-Flywheel Clearance
Courtesy of GENERAL MOTORS CORP.

ON-VEHICLE TESTING

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 the 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 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. Remove theft deterrent relay from instrument panel electrical center. Connect a test light between theft deterrent relay connector terminal A1 and battery voltage. See **COMPONENT LOCATIONS** . Turn ignition switch to START position and observe test light. If test light illuminates, go to next step. If test light does not illuminate, diagnose and repair anti-theft system. See **ANTI-THEFT SYSTEM** article in ACCESSORIES & EQUIPMENT. Also see **BODY CONTROL MODULE** article in ACCESSORIES & EQUIPMENT.
2. Connect a test light between theft deterrent relay connector terminal C1 and ground. If test light illuminates, go to next step. If test light does not illuminate, go to step 9).
3. Connect test light between theft deterrent relay connector terminal C2 and ground. On vehicles with manual transmission, depress clutch. On vehicles with automatic transmission, put shifter in PARK. Turn ignition switch to START position and observe test light. If test light illuminates, go to step 5). If test light does not illuminate, go to next step.
4. On vehicles with automatic transmission, go to step 6). On vehicles with manual transmission, go to step 7).
5. Check for open in Purple wire between theft deterrent relay connector terminal A2 and underhood electrical center connector C2, terminal A10. Check for an open in underhood electrical center between connector C1, terminal F10 and connector C2, terminal A10, and in Purple wire between underhood electrical center connector C1, terminal F10 and starter solenoid terminal "S". Check starter solenoid terminal "S" connection. Repair as needed.
6. Check for an open in Yellow wire between theft deterrent relay connector terminal C2 and park/neutral switch connector C1, terminal "G". Check park/neutral switch. Check for an open in Purple wire between park/neutral switch connector C1, terminal "E" and instrument panel electrical center connector C2, terminal C5. Check 10-amp CRK mini-fuse No. 14 in instrument panel fuse block. Repair as necessary. If problem is still not resolved, go to step 8).
7. Check for an open in Yellow wire between theft deterrent relay connector terminal C2 and Clutch Pedal Position (CPP) switch terminal "B". Check CPP switch. Check for an open in Purple wire between CPP switch terminal "A" and instrument panel electrical center connector C2, terminal C5. Check 10-amp CRK mini-fuse No. 14 in instrument panel fuse block. Repair as necessary and recheck symptom. If problem is still not resolved, go to next step.
8. Check for open circuit between ignition switch C1 terminal B and instrument panel connector C2 terminal E5 (Yellow wire), between ignition switch connector C2 terminal "A" and instrument panel junction block connector C6 terminal "B" (Red wire) or 60-amp IGN2 maxi-fuse. Check for open or poor connections in Red wire between positive battery terminal and instrument panel electrical center. Repair as necessary and recheck symptom.
9. Check STARTER maxi-fuse. Check for open in Red wire between instrument panel connector C8 terminal "A" and theft deterrent relay connector A2. Repair as needed. Recheck system.

TESTING

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 witch 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. 3** . 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.

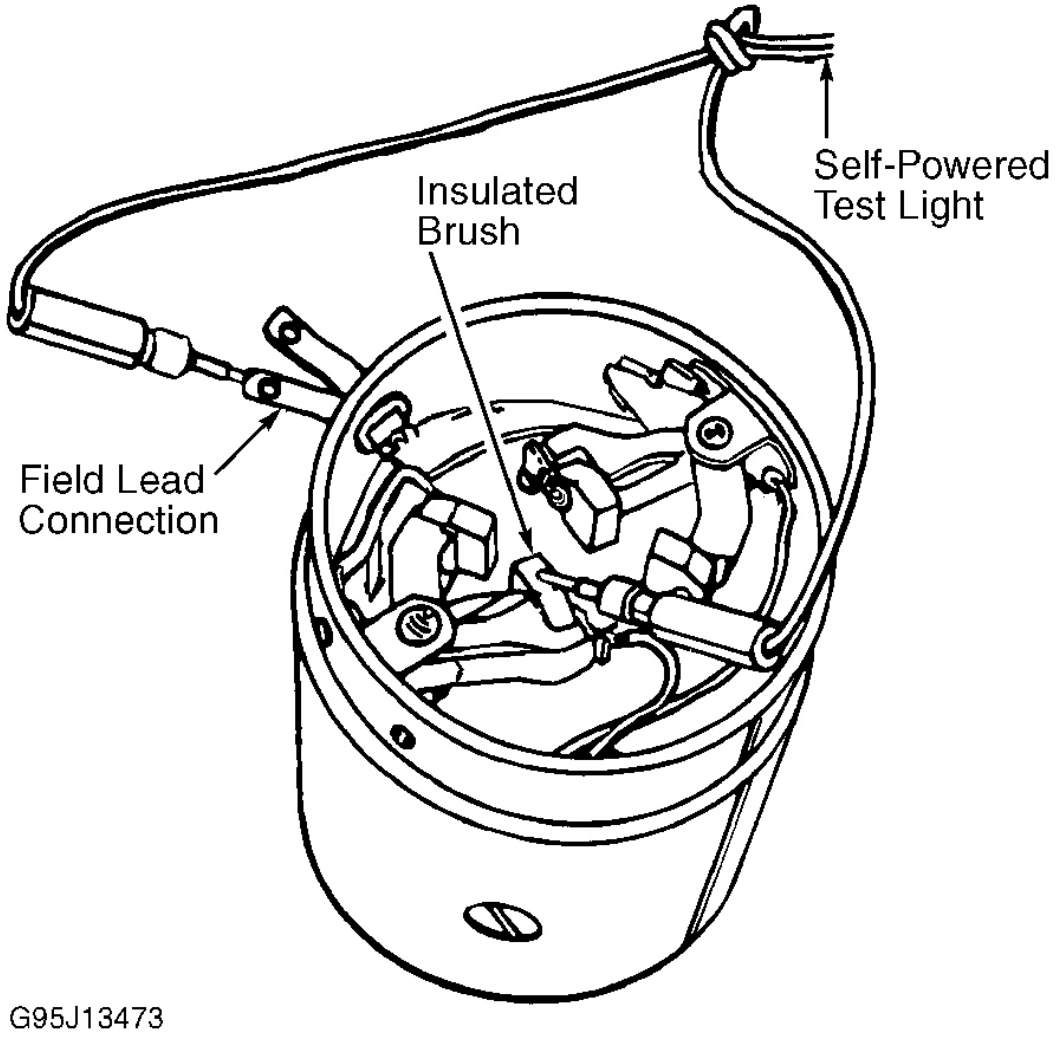

Fig. 3: Testing Field Coil For Open
Courtesy of GENERAL MOTORS CORP.

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. 4** . 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.

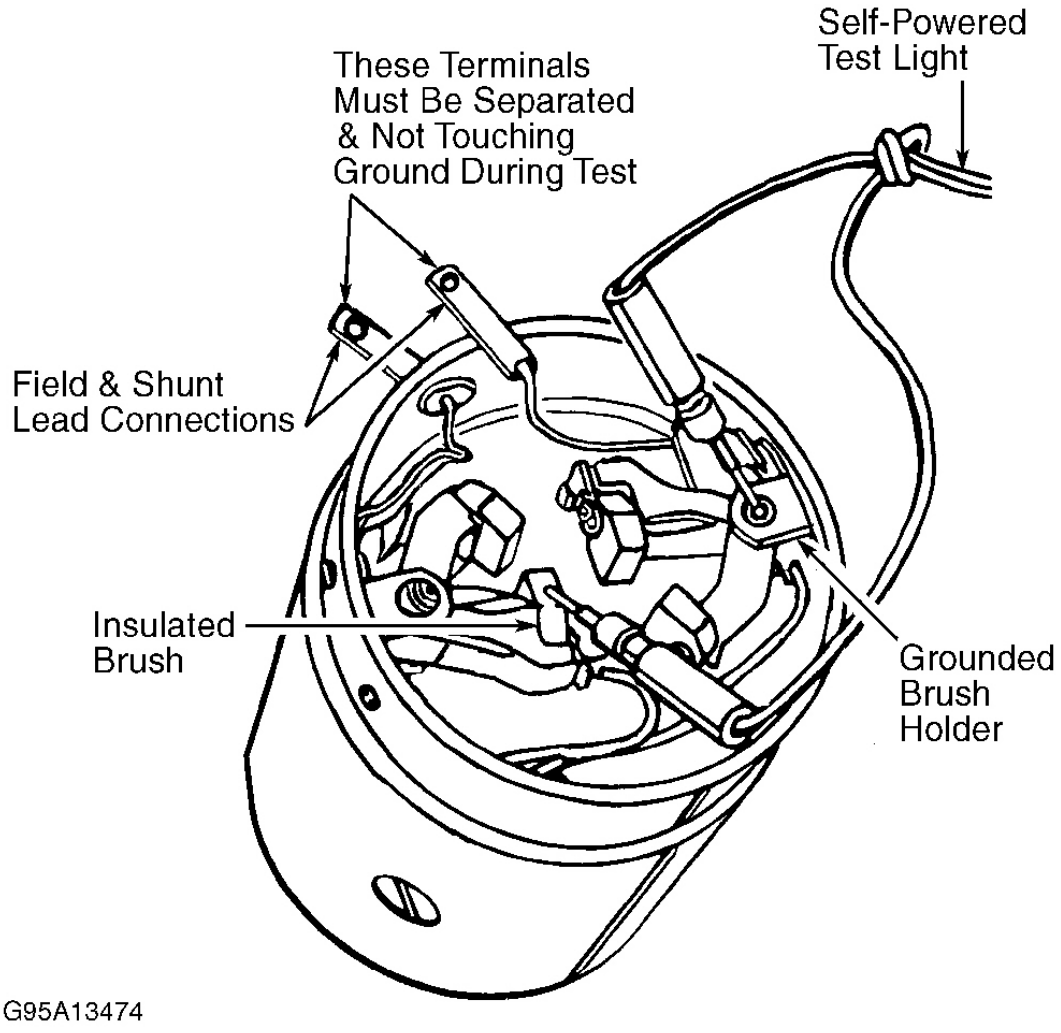

Fig. 4: Testing Field Coil For Ground
Courtesy of GENERAL MOTORS CORP.

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. 5** .
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. 6** .

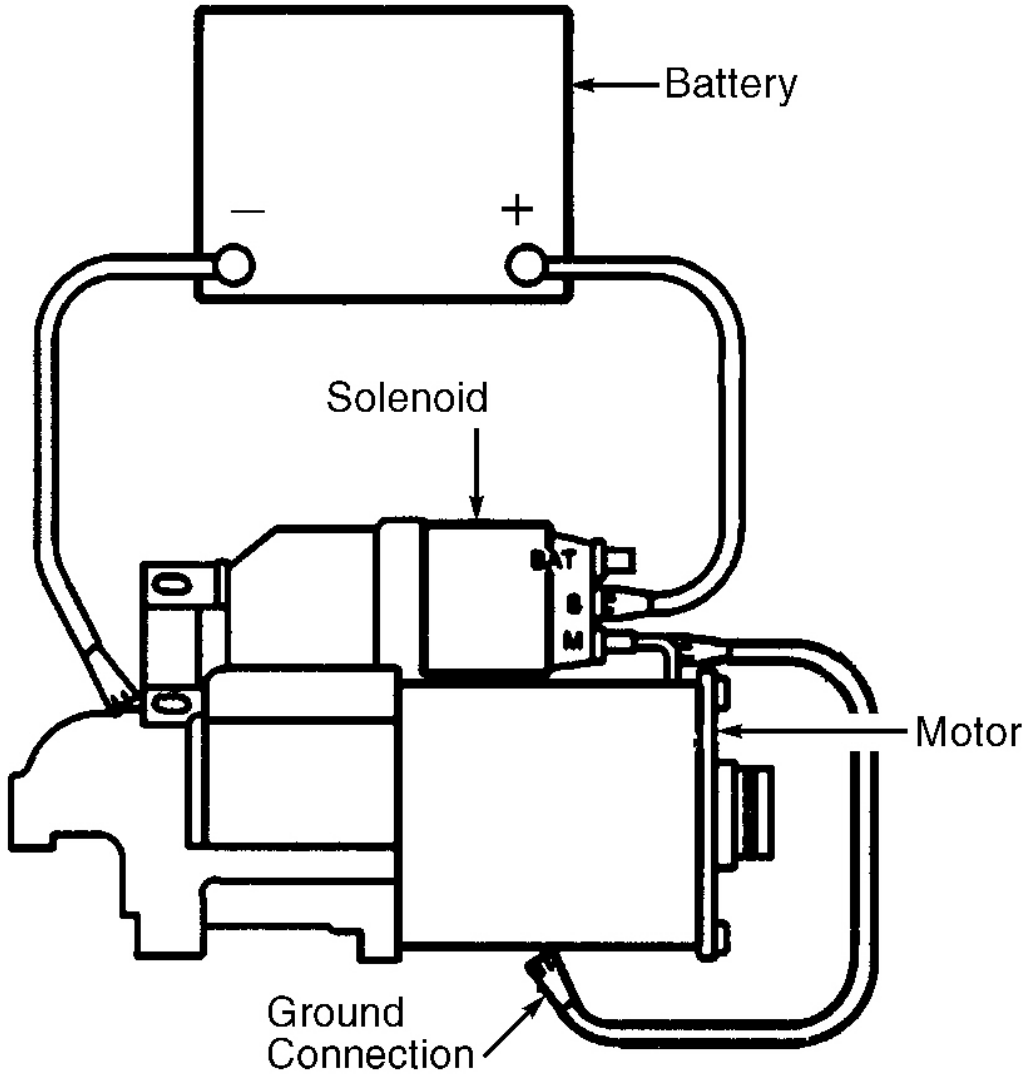

Fig. 5: Pinion Clearance Connections
Courtesy of GENERAL MOTORS CORP.

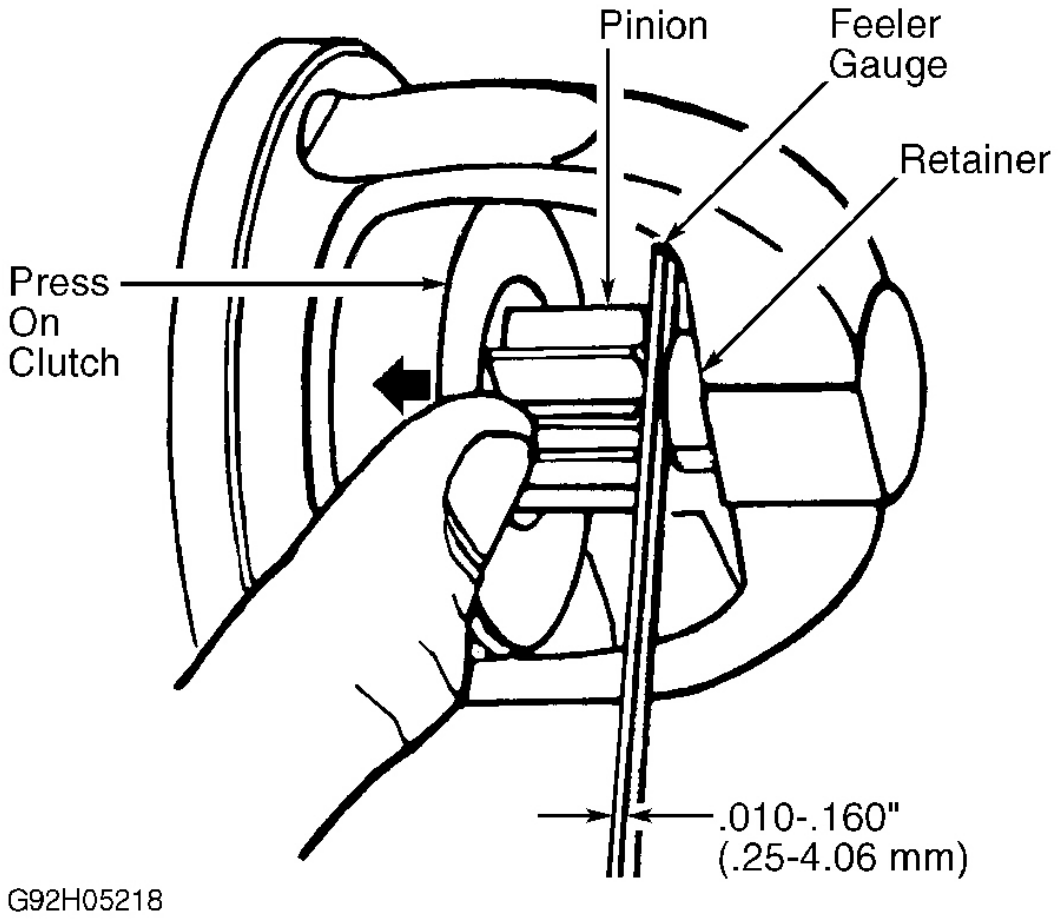

Fig. 6: Checking Pinion Clearance
Courtesy of GENERAL MOTORS CORP.

REMOVAL & INSTALLATION

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 exhaust pipe located directly before catalytic converter, catalytic converter, and exhaust pipe located directly after catalytic converter. 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.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Starter Mounting Bolts	35 (47)

WIRING DIAGRAMS

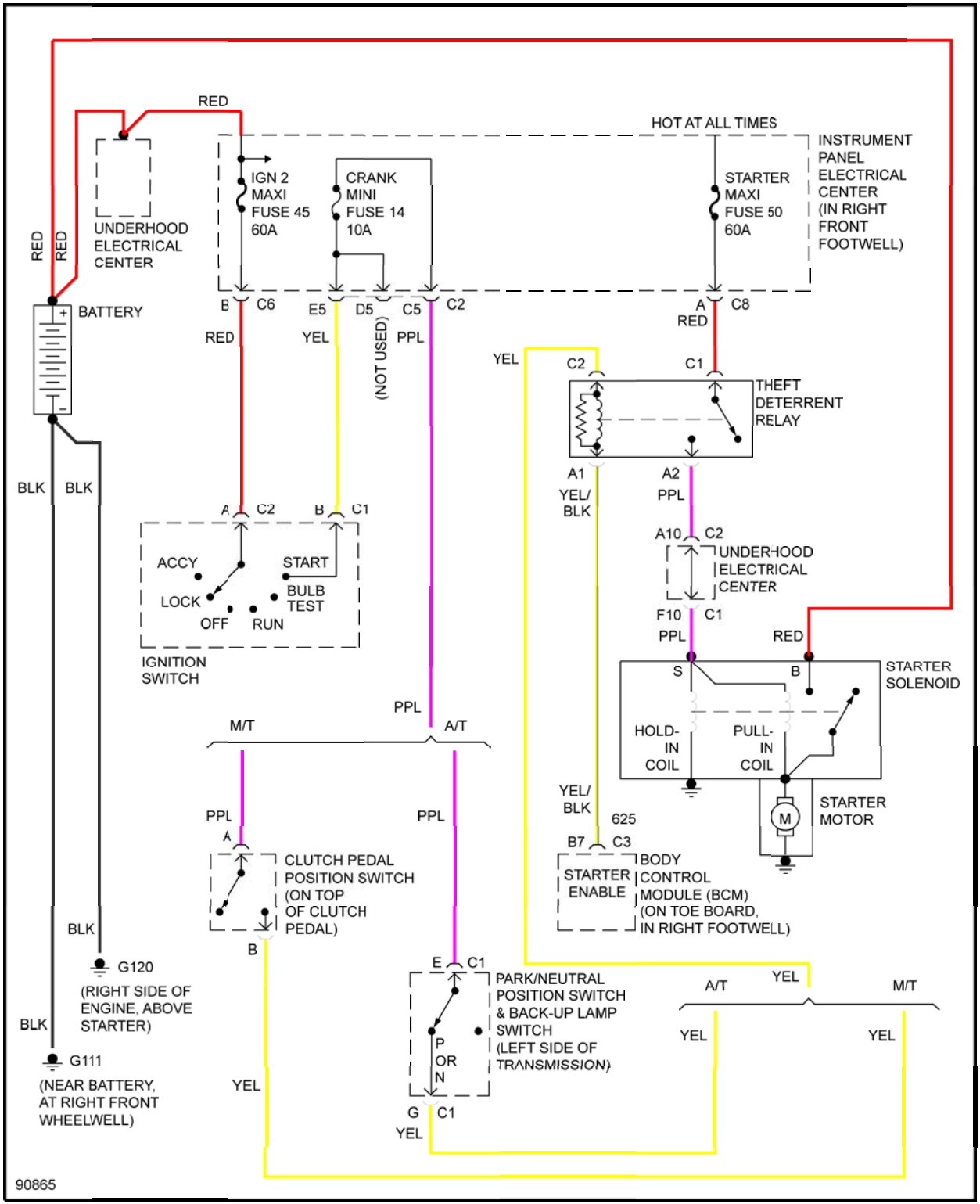
RED
HOT AT ALL TIMES
INSTRUMENT PANEL ELECTRICAL CENTER (IN RIGHT FRONT FOOTWELL)
IGN 2 MAXI FUSE 45 60A
CRANK MINI FUSE 14 10A
STARTER MAXI FUSE 50 60A
UNDERHOOD ELECTRICAL CENTER
RED
RED
BATTERY
B C6
E5 D5 C5 C2
A C8
RED
YEL
PPL
(NOT USED)
YEL
C2 C1
THEFT DETERRENT RELAY
A1
A2
YEL/ BLK
PPL
BLK
BLK
A C2
B C1
ACCY
START
LOCK
BULB TEST
OFF
RUN
IGNITION SWITCH
A10 C2
UNDERHOOD ELECTRICAL CENTER
F10 C1
PPL
RED
S
B
STARTER SOLENOID
HOLD-IN COIL
PULL-IN COIL
STARTER MOTOR
M
PPL
M/T
A/T
YEL/ BLK
625
B7 C3
STARTER ENABLE
BODY CONTROL MODULE (BCM) (ON TOE BOARD, IN RIGHT FOOTWELL)
PPL
PPL
A
CLUTCH PEDAL POSITION SWITCH (ON TOP OF CLUTCH PEDAL)
B
BLK
G120
(RIGHT SIDE OF ENGINE, ABOVE STARTER)
BLK
G111
(NEAR BATTERY, AT RIGHT FRONT WHEELWELL)
E C1
PARK/NEUTRAL POSITION SWITCH & BACK-UP LAMP SWITCH (LEFT SIDE OF TRANSMISSION)
P OR N
G C1
YEL
YEL
A/T
YEL
M/T
YEL
YEL
90865

Fig. 7: Starting System Wiring Diagram