

GROUP

STARTING SYSTEM

28

(11000)

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SECTION 28-01 Starting System—Service

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VEHICLE APPLICATION
Capri.

DESCRIPTION AND OPERATION

<p>The function of the starting system is to crank the engine at a speed fast enough to permit the engine to start. The starting system consists of a starting motor and a solenoid switch (attached to the starter motor housing), a storage battery, the ignition switch, a neutral switch (automatic transaxle) or clutch switch (manual transaxle) and the necessary cables and wiring.</p>	<p>Heavy duty cables are used in the starting system because of the amount of current required by the starter while it is cranking the engine. The amount of resistance in the starting circuit must be kept to a minimum to provide maximum current for starter operation. Loose or corroded connections, solenoid contacts, or partially broken cables will result in slower-than-normal cranking speeds and may prevent the starter from cranking the engine. For a description of the starter circuits, refer to Section 28-02.</p> <p>NOTE: Engine oil viscosity can affect engine cranking speed.</p> <p>If the starter motor or circuit is suspected of causing a no-start condition, use the diagnostic chart and the appropriate tests to isolate the problem.</p>
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DIAGNOSIS AND TESTING

On-Vehicle Inspection

Before this inspection, the battery should be tested to determine its state of charge. A load test should be performed using Rotunda Starting and Charging Tester 078-00005 or equivalent, to determine if the battery is serviceable. Refer to Section 31-02.

If the starter will not crank, check for voltage at the "S" terminal on the solenoid.

If the voltage at the "S" terminal is 8 volts or more, there is a starter malfunction.

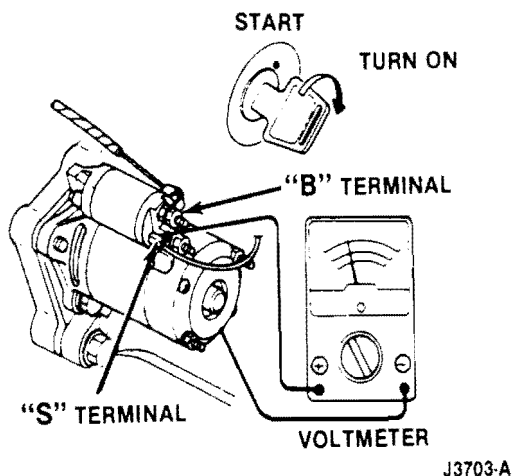
If there is no voltage (with a fully-charged battery), there is a malfunction in the circuit to the "S" terminal.

NOTE: If the solenoid is extremely hot, it may not function even though voltage at the "S" terminal is 8 volts or more. Allow the vehicle to cool and test again.

To find the problem in the "S" circuit, check the following components.

STARTER MOTOR TROUBLESHOOTING CHART

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> Engine Cranks Slowly 	<ul style="list-style-type: none"> Undercharged battery. Loose connections or corroded battery cables. Starter motor. 	<ul style="list-style-type: none"> Check battery. Charge or replace. Refer to Section 31-01. Clean and tighten cable connections. Perform voltage drop tests as outlined in this section. Remove starter for service. Refer to Section 28-02.
<ul style="list-style-type: none"> Engine Will Not Crank 	<ul style="list-style-type: none"> Undercharged battery. Loose cable connections at starter. Starter motor. 	<ul style="list-style-type: none"> Check battery. Charge or replace. Refer to Section 31-01. Clean and tighten cable connections. Check wire strands in eyelets. Refer to the voltage drop tests in this Section. Service or replace as required. Refer to Section 28-02.
<ul style="list-style-type: none"> Engine Will Not Crank—Starter Spins 	<ul style="list-style-type: none"> Starter motor. Flywheel ring gear. 	<ul style="list-style-type: none"> Remove starter and inspect drive. Replace as required. Refer to Section 28-02. Remove starter and inspect ring gear teeth (also starter drive pinion). Replace as required. Refer to Section 28-02.



Ignition Switch

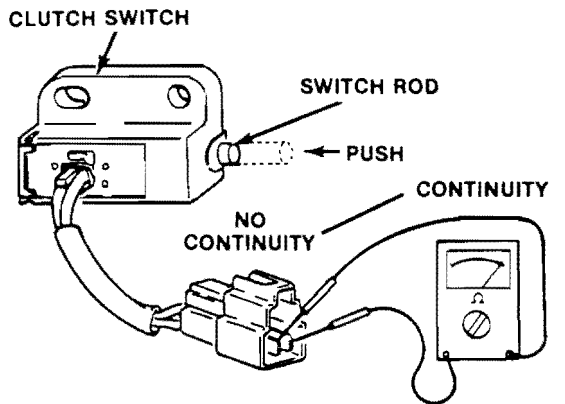
1. Refer to Section 31-20 for instructions on gaining access to the ignition switch connector.
2. Using a twelve volt test lamp or Dwell-Tach-Volts-Ohms Tester 059-00010 or equivalent, determine that there is power at the ignition switch connector on the black with a yellow stripe wire when the ignition switch is turned to the RUN position. This will verify that the ignition switch is operating properly.

NOTE: The ignition switch connector must remain connected during this test.

3. If there is no power on this wire, the problem is either the ignition switch or between the battery and the ignition switch.

DIAGNOSIS AND TESTING (Continued)**Clutch Switch****Manual Transaxle**

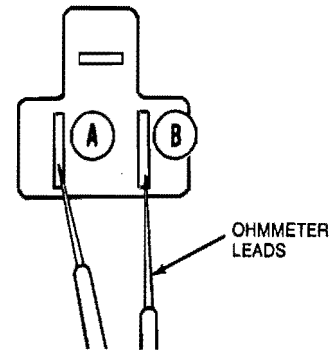
1. Unplug the clutch switch connector from the main wiring harness. With Rotunda Dwell-Tach-Volts-Ohms Tester 059-000 10 or equivalent connected to the two terminals in the switch connector, the ohmmeter should show no continuity when the switch rod is pushed into the switch. The ohmmeter should show continuity with the switch rod released.



2. Replace the clutch switch if it fails this test.

Neutral Safety Switch**Automatic Transaxle**

1. Unplug the neutral safety switch connector from the main wiring harness. Connect an ohmmeter such as Rotunda Dwell-Tach-Volts-Ohms Tester 059-000 10 or equivalent between terminals "A" and "B". With the transmission shift selector lever in the PARK and NEUTRAL positions there should be continuity between terminals "A" and "B".



2. Replace the switch as outlined, if it fails this test.
3. Check voltage at "S" terminal on starter solenoid. If the voltage is less than 8 volts, check the battery state of charge. If the battery has been tested and found to be good, perform a voltage drop test as outlined on the cables in the starter motor circuit.

Voltage Drop Tests

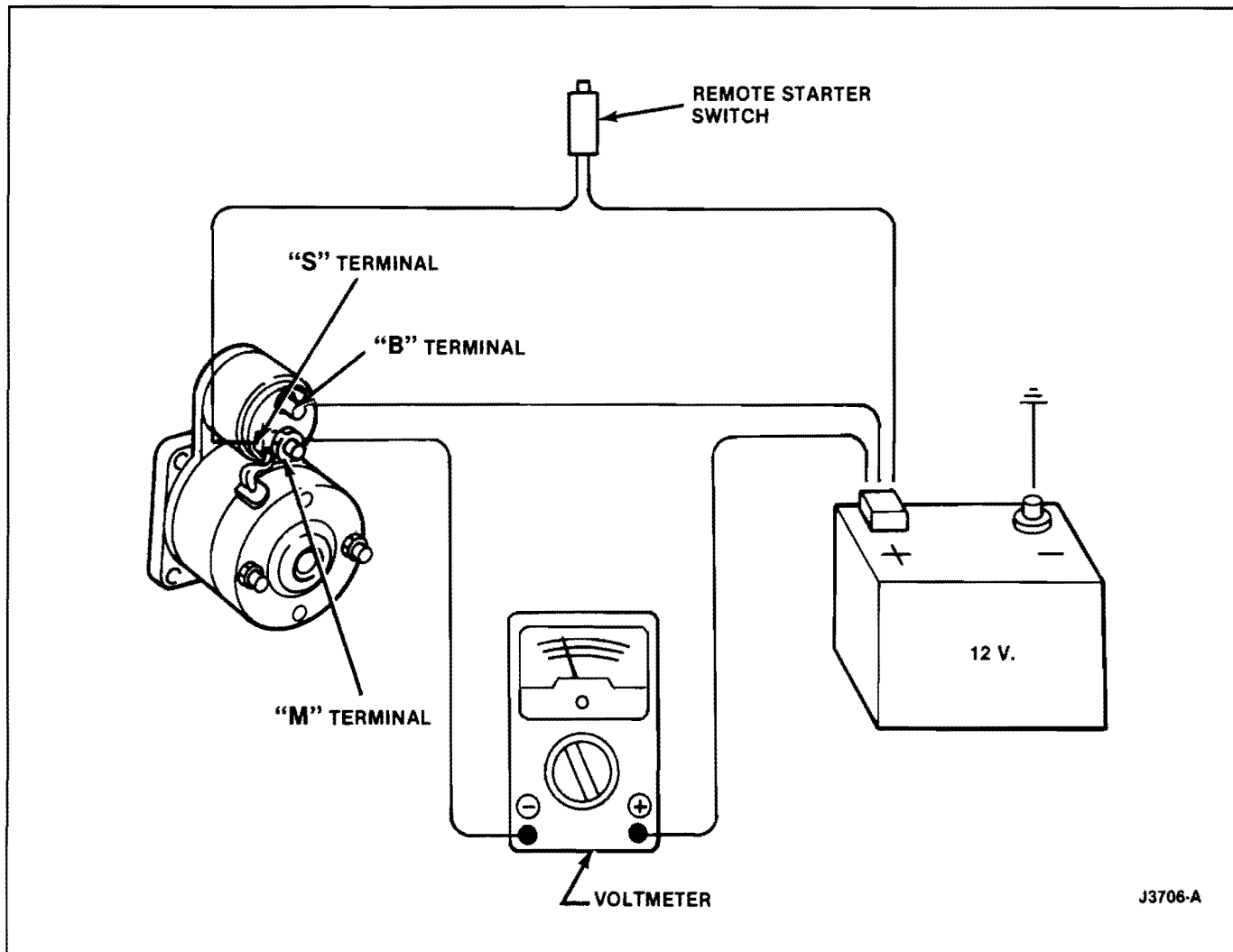
If the starter cranks slowly, and the battery is good, the problem may be the starter, or in the cranking circuit wiring. To determine if the problem is in the wiring, a voltage drop test must be performed.

These tests are performed to determine if there is excessive resistance in the starter motor circuit. Always make the voltmeter connections at the component wiring terminal rather than the cable or wiring terminal. Making a connection at the wiring terminal could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

Test 1—Starter Motor Feed Circuit

1. Disable the engine from starting by disconnecting and grounding the ignition coil secondary wire that runs from the coil output tower to the center distributor cap terminal. Remove the wire from the distributor cap terminal and attach to a good ground.
2. Connect a remote starter switch between the starter solenoid "S" terminal and the battery positive (+) terminal.
3. Connect a positive voltmeter such as Rotunda Dwell-Tach-Volts-Ohms Tester 059-000 10 or equivalent, lead to the battery positive (+) post. Connect the voltmeter negative lead to the solenoid "M" terminal.
4. Engage the remote starter switch. Read and record the voltage on the lowest voltmeter scale. The voltmeter reading should be 0.5 volts or less.

DIAGNOSIS AND TESTING (Continued)



J3706-A

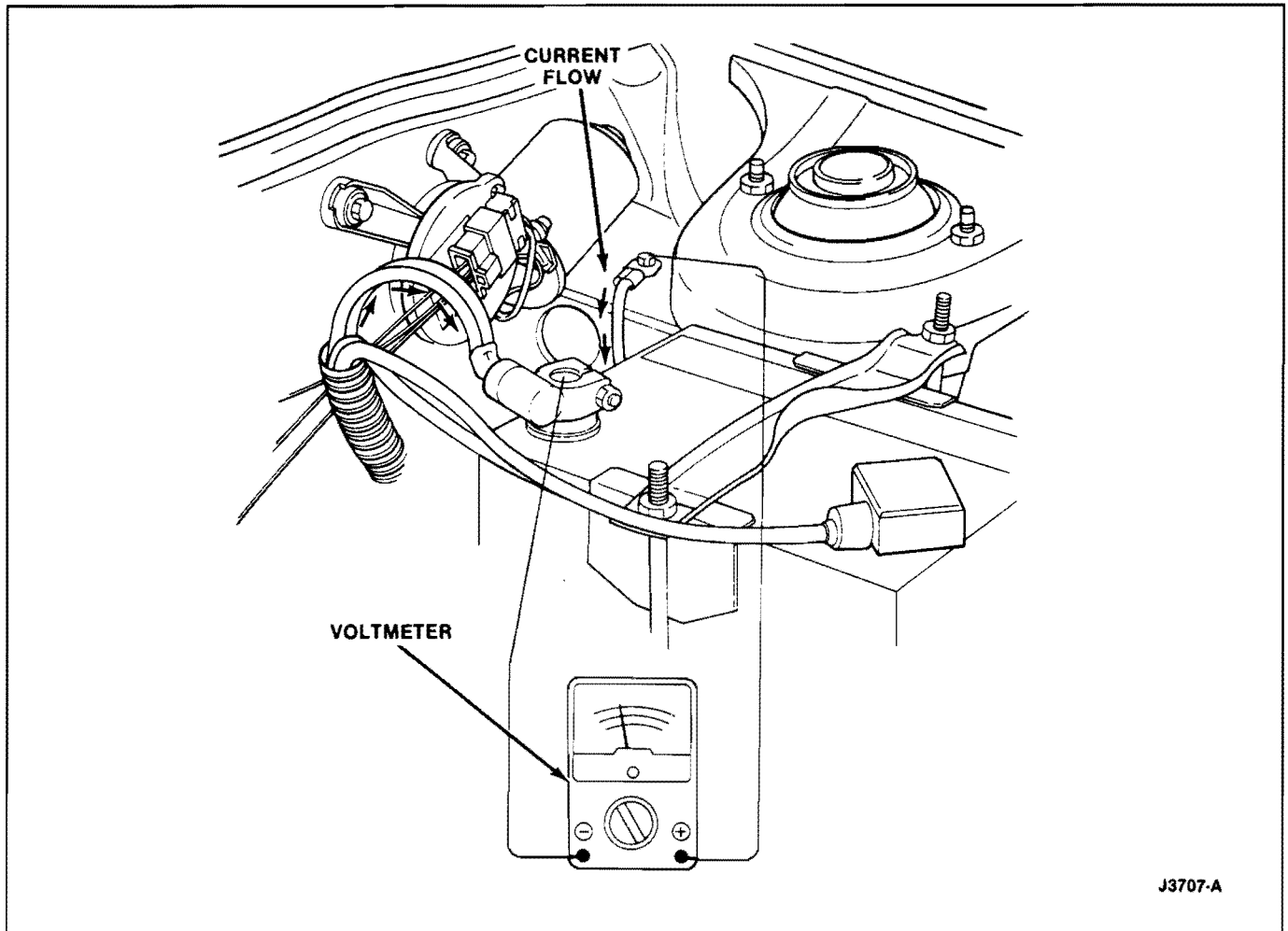
5. If the voltage reading is higher than this, indicating excessive resistance, move the voltmeter negative lead to the starter solenoid "B" terminal and repeat the test. If the voltage reading at the "B" terminal is less than 0.5 volts, the problem is either in the connections at the solenoid, or in the solenoid contacts.
6. Remove the wires at the solenoid "B", "S" and "M" terminals. Clean the cables and connections and reinstall the cables to the proper terminals. Repeat Steps 1 through 5. If the voltage drop reading is still higher than 0.5 volts at the "M" terminal, and 0.5 volts or lower when checked at the "B" terminal, the problem is in the solenoid contacts. Remove the starter for service.

7. If the voltage reading taken at the solenoid "B" terminal is still more than 0.5 volts after cleaning the cables and connections at the solenoid, the problem is either in the positive (+) battery cable connection, or in the positive battery cable itself.
8. By moving the voltmeter negative lead toward the battery, and checking each mechanical connection point, the excessive voltage drop can be located. When the high reading disappears, the last mechanical connection point that was checked is the problem.

Test 2 — Individual Cable

The resistance of any cable can be checked in the same manner using a voltmeter such as Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010 or equivalent.

DIAGNOSIS AND TESTING (Continued)



J3707-A

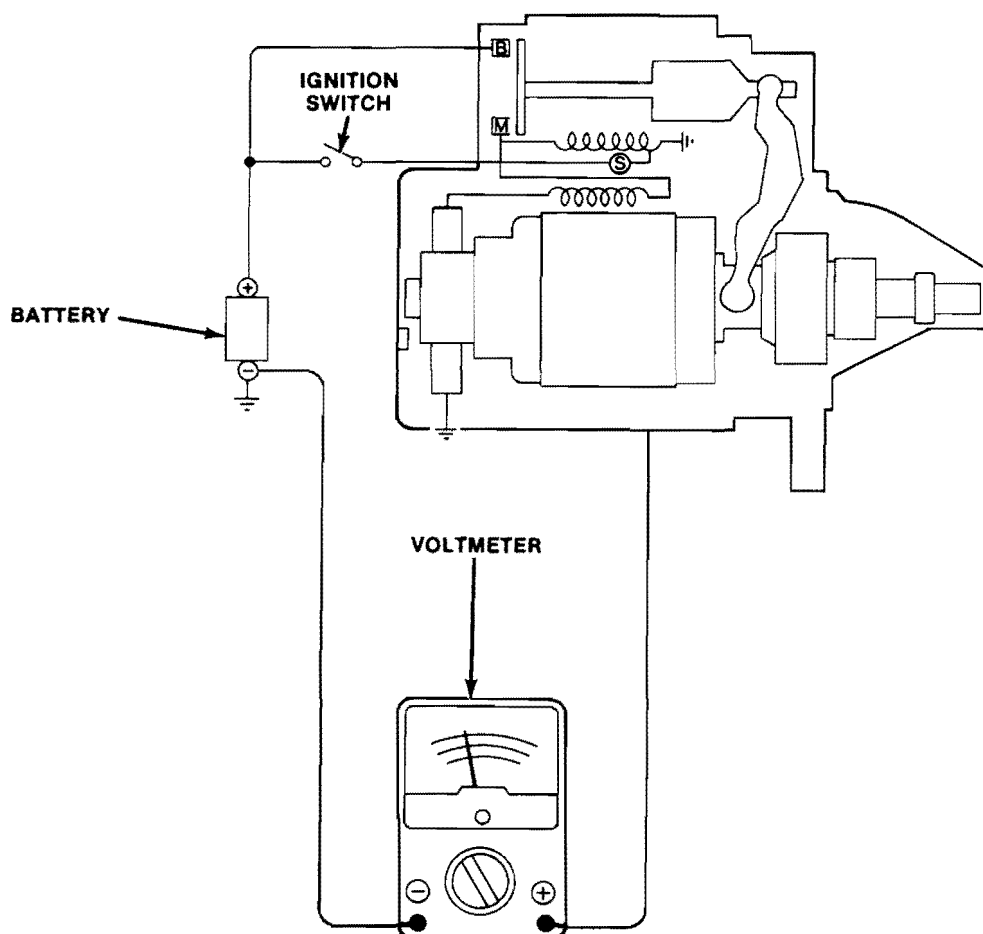
1. Determine which way the current is flowing in the cable. Connect the voltmeter positive lead to the end of the cable closest to the beginning of the current flow.
2. Connect the voltmeter negative lead to the terminal at the other end of the cable.
3. Crank the engine and observe the voltmeter. The voltmeter reading should be 0.2 volts or less. If the voltage drop is too high, clean the terminal ends. Retest and, if still high, replace the cable.

Test 3—Starter Motor Ground Circuit

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Disable the engine from starting by disconnecting the ignition coil secondary wire at the center distributor cap terminal and grounding it.
2. Connect a remote starter switch between the starter solenoid "S" terminal and the battery positive (+) terminal.

DIAGNOSIS AND TESTING (Continued)



J3708-A

3. Connect a voltmeter positive lead to the starter motor housing (connection must be clean and free of rust or grease). Connect the negative voltmeter lead to the negative (-) battery terminal.
4. Engage the remote starter switch and crank the engine. Read and record the voltmeter reading. The reading should be 0.2 volts or less.
5. If the voltage drop is more than 0.2 volts, clean the negative cable connections at the battery and body connections, and retest. If the voltage drop is still too high, perform the following test.

Test 4—Engine Ground Cable

1. Connect a voltmeter with the positive lead to the cylinder head lift bracket bolt. Connect the negative lead to the bolt at the other end of the cable where it attaches to the body.
2. Connect a remote starter switch to the solenoid "S" terminal and the battery positive (+) terminal as outlined in Test 3.

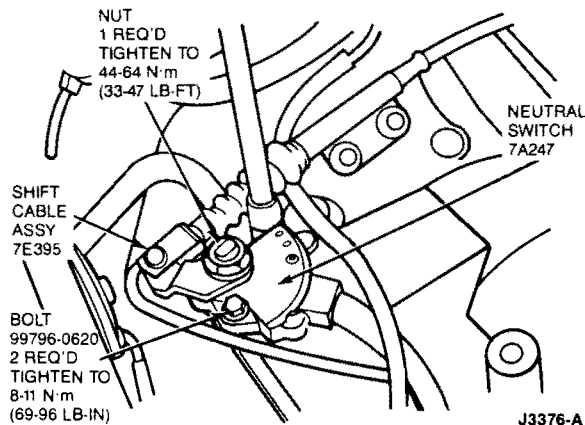
3. With the engine disabled from starting, engage the remote starter switch to crank the engine. Read and record the voltage reading.
4. If the reading is more than 0.2 volts, remove the cable and clean the connections at both ends. Install the cable, and retest. If the voltage drop is still excessive, service or replace the battery ground cable and/or the engine ground cable as necessary to bring the total circuit voltage drop reading below 0.2 volts.
5. Always repeat the voltage drop check after service to make sure the problem has been corrected.
6. If the battery and cables test good, and the starter motor still cranks slowly or not at all, remove the starter for service. Refer to Section 28-02.

REMOVAL AND INSTALLATION

Neutral Safety Switch

Removal

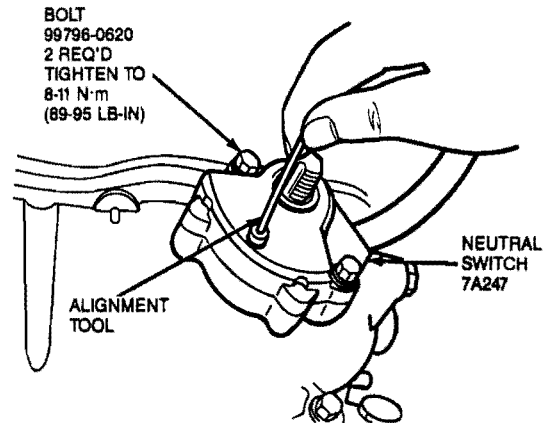
1. Disconnect negative battery terminal.
2. Place shift selector in the NEUTRAL position.
3. Remove air cleaner assembly. Refer to Section 24-41.
4. Remove shift cable retaining nut. Disconnect cable.
5. Remove neutral switch harness from metal retainers, cut tapes and separate harness from sheathing.
6. Disconnect electrical connectors.
7. Remove switch retaining bolts and remove switch.



Installation

1. Make sure switch and shaft are in the NEUTRAL position. Install switch.
2. Loosely install retaining bolts. Remove cover, screw and align internal hole with cover screw hole.
3. Hold this alignment by inserting a 2mm (0.079 inch) pin through the holes.

4. Tighten switch retaining screws to 8-11 N·m (69-95 lb-in).



J3444-A

5. Remove pin. Install screw and tighten to 0.4-0.7 N·m (3-6 lb-in).
6. Route harness into sheathing. Secure in metal retainers.
7. Connect electrical connectors.
8. Install shift cable. Tighten retaining nut to 44-64 N·m (33-47 lb-ft).
9. Install air cleaner assembly. Refer to Section 24-41.
10. Connect negative battery terminal.
11. Check for proper operation.

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT

Model	Description
059-00010	Inductive Dwell-Tach-Volts Ohms Tester
078-00005	Starting and Charging Tester

SECTION 28-02 Starter, Positive Engagement

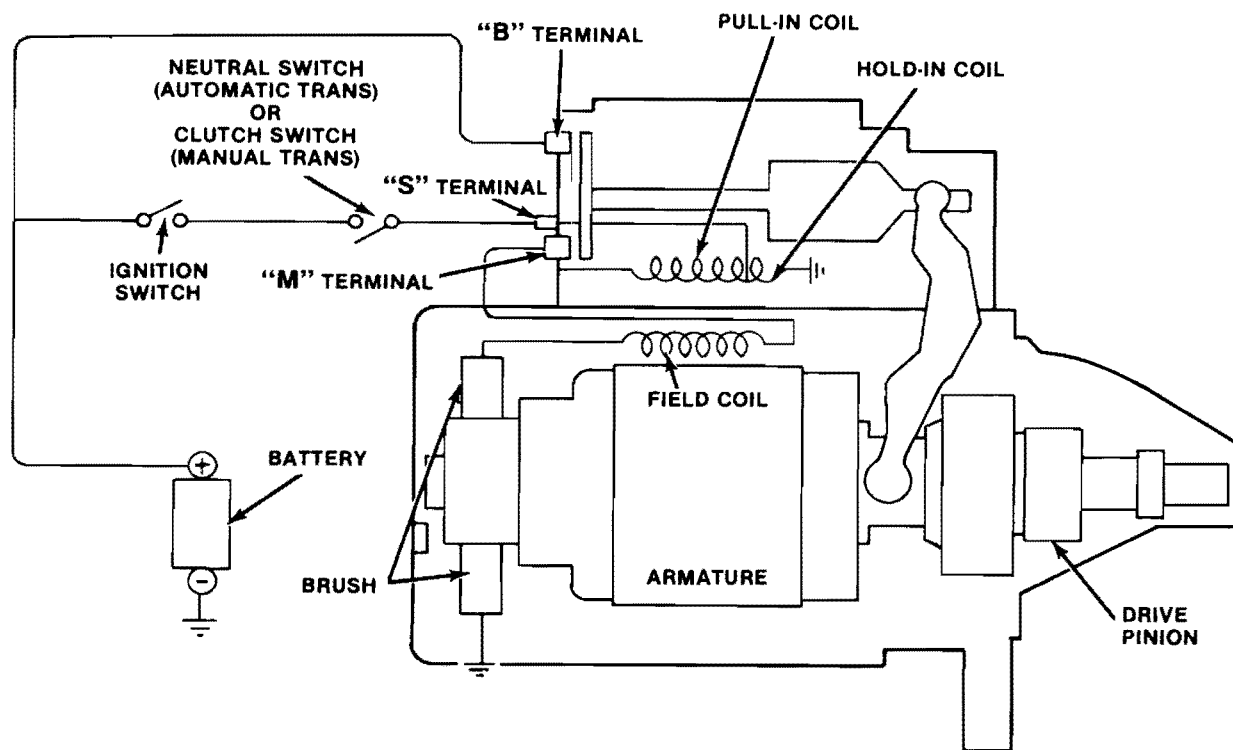
SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	28-02-1	REMOVAL AND INSTALLATION	
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Starter Motor	28-02-5	SPECIAL SERVICE TOOLS	28-02-13
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VEHICLE APPLICATION

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DESCRIPTION

The starter system has two electrical circuits: a low-current and a high-current circuit.



J3701-A

DESCRIPTION (Continued)

The low-current circuit is the control circuit. It includes the ignition switch, starter solenoid, neutral safety switch (automatic transaxle) or clutch switch (manual transaxle) and the necessary wiring.

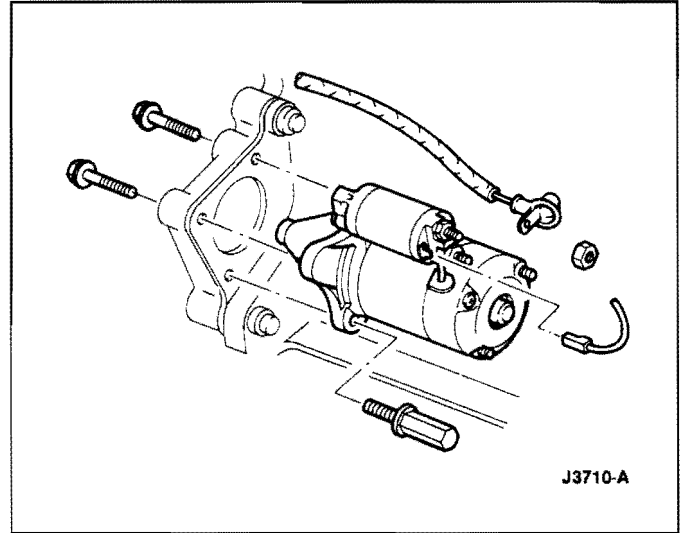
The high current circuit connects the starter to the battery positive terminal. This circuit uses heavy gauge cables because of the high-current flow required to operate the starter motor.

The starter motor low-current circuit is controlled by the ignition switch. When the ignition switch is turned to the START position, battery current will be applied to the "S" terminal on the starter motor solenoid, if the neutral safety switch (automatic transaxle) or clutch switch (manual transaxle) contacts are closed. With an automatic transaxle, the gear selector lever must be in the PARK or NEUTRAL position to close the neutral safety switch contacts. On a manual transaxle, the contacts will only close when the clutch pedal is fully depressed. The neutral safety switch is mounted on the LH side of the automatic transaxle and is operated by internal linkage. The clutch switch is mounted on the clutch pedal bracket and is operated by the clutch pedal.

Battery current at the "S" terminal of the starter solenoid flows through the pull-in coil to ground. Energizing the pull-in coil produces a magnetic field which pulls the relay armature and contact disc into the closed position, making contact between the starter "B" or battery terminal, and the "M" or motor terminal. Full battery voltage is then applied to the field coils and brushes within the starter, causing rotation. This is the high-current circuit.

The relay armature is connected through a yoke to the starter drive gear. As the relay armature moves forward from the magnetic field of the pull-in coil, the starter drive gear is moved toward the ring gear on the flywheel. At the end of its travel, the starter drive gear engages with the ring gear. Once the starter drive gear and flywheel ring gear are fully engaged, the contact disc completes the circuit between "B" and "M" and the starter armature rotates. A hold-in coil is energized by the "S" terminal, to supply the additional magnetic force required to keep the contact disc engaged as the starter draws current and the system voltage drops.

The starter motor is mounted on the lower dash panel side of the engine.

**TESTING****Jump Starting**

WARNING: TO AVOID ANY POSSIBILITY OF INJURY, EXTREME CARE SHOULD BE EXERCISED WHEN CONNECTING JUMPER CABLES TO A DISCHARGED BATTERY.

When the starter will not crank the engine or cranks the engine very slowly, connect a 12 volt booster battery following these instructions and precautions:

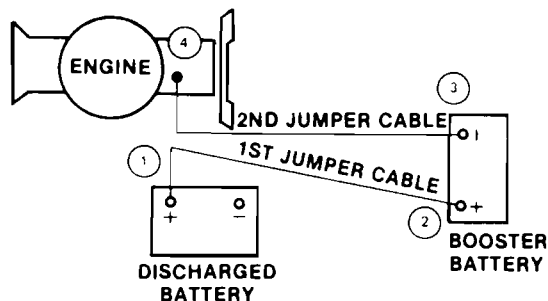
WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS OR LIGHTED TOBACCO ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED SPACE (TO INCLUDE THE VEHICLE ENGINE COMPARTMENT) ALWAYS PROVIDE VENTILATION AND SHIELD YOUR EYES.

WARNING: KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF 15 MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

TESTING (Continued)

CAUTION: Do not disconnect the battery of the vehicle to be started. Disconnecting the battery could damage the vehicle's electronic system.

MAKE CONNECTIONS IN NUMERICAL ORDER (DISCONNECT IN REVERSE ORDER 4, 3, 2, 1).



MAKE SURE VEHICLES DO NOT TOUCH

J3712-A

1. Position the vehicles so jumper cables will reach, being careful that vehicles **do not touch**.
 2. Make sure that all unnecessary electrical accessories on the disabled vehicle are turned off while jump starting.
 3. Turn on the heater blower motor of the booster vehicle, to remove surface charge voltage.
 4. Shield eyes, using safety goggles or similar eye protection.
 5. Make the jumper cable connections as follows:
 - a. Connect one end of the first jumper cable to the positive (+) terminal of the discharged battery and the other end to the positive (+) terminal of the booster battery.
 - b. Connect one end of the second jumper cable to the negative (-) terminal of the booster battery. Connect the other end to a good metallic contact spot on the engine of the disabled vehicle, **not to the negative (-) battery terminal**.
- WARNING: MAKING THE FINAL CABLE CONNECTION COULD CAUSE AN ELECTRICAL ARC WHICH, IF MADE AT OR NEAR THE BATTERY COULD CAUSE AN EXPLOSION. REFER TO THE WARNING AT THE BEGINNING OF THE JUMP STARTING PROCEDURE.**
- c. Make sure the jumper cables are not in the way of moving engine parts.
 - d. Start the engine of the vehicle with the good battery. Run the engine at a moderate speed.
 - e. Start the engine of the vehicle with the discharged battery.

- f. Turn off all electrical components and reduce engine speed to idle on both vehicles to prevent possible damage to the vehicle electrical system.

6. Remove the jumper cables in the exact **reverse** sequence they were connected in. Begin by removing the cable from the engine of the vehicle that had the discharged battery. With the jumper cables disconnected, the vehicle electrical accessories can be used.

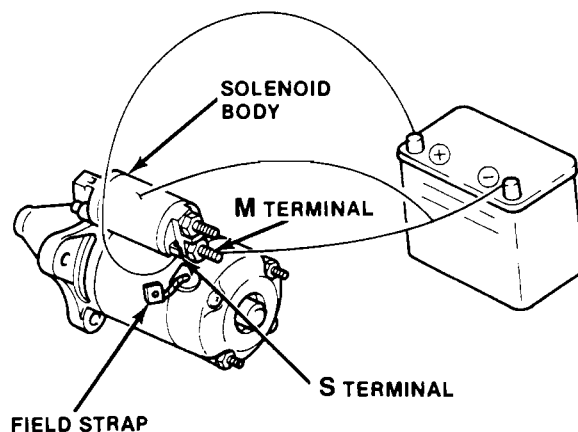
NOTE: If the starter does not crank the engine sufficiently with the booster battery attached, further diagnosis of the engine and starting system will be required. Refer to Section 28-01.

Pinion Depth Adjustment

Measure and adjust the pinion depth as necessary using the following instructions:

1. Connect a 12 volt battery to the starter as shown.

NOTE: The field strap must be disconnected from the "M" terminal during this test, to prevent the starter from turning.

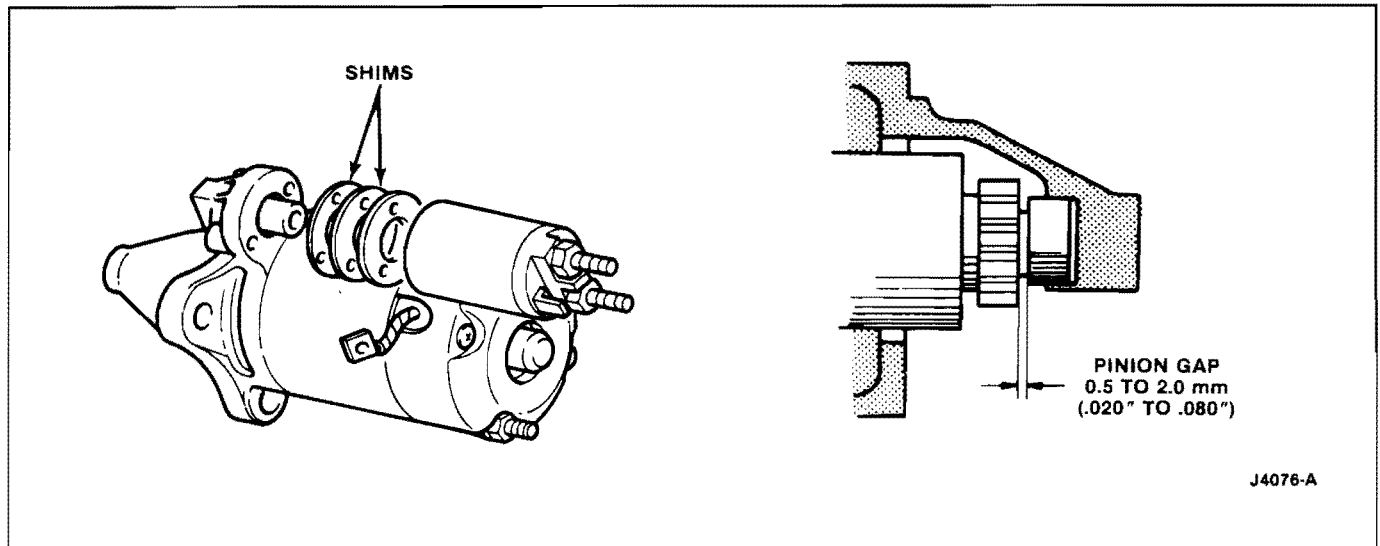


J3735-A

2. When the battery is connected as shown, the solenoid should activate and kick out the pinion gear. With the pinion extended, measure the gap between the pinion gear and the collar. This is the pinion depth adjustment, and the gap should be 0.5-2.0mm (0.020-0.080 inch).

NOTE: Do not engage the solenoid for more than 20 seconds at a time. If this test must be repeated, wait at least three minutes between attempts to allow the solenoid to cool.
3. Add or subtract shims between the solenoid and the drive end housing as necessary to achieve the proper pinion gap.
4. Install the field strap to the "M" terminal of the solenoid. Install the nut and tighten to 8-12 N·m (71-106 lb-in).

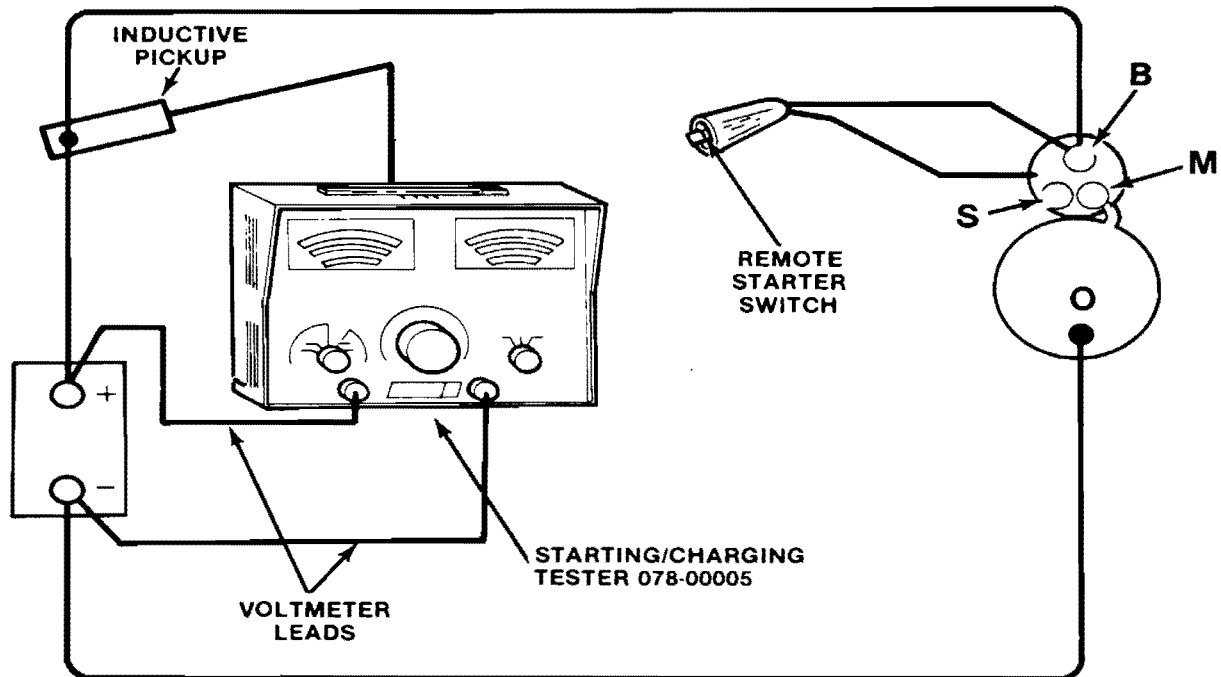
TESTING (Continued)



J4076-A

Starter Motor No-Load Test

1. Connect a battery, voltmeter, ammeter Starting / Charging Tester such as Rotunda 078-00005 or equivalent, and a remote starter switch to the starter motor as shown.



J4077 A

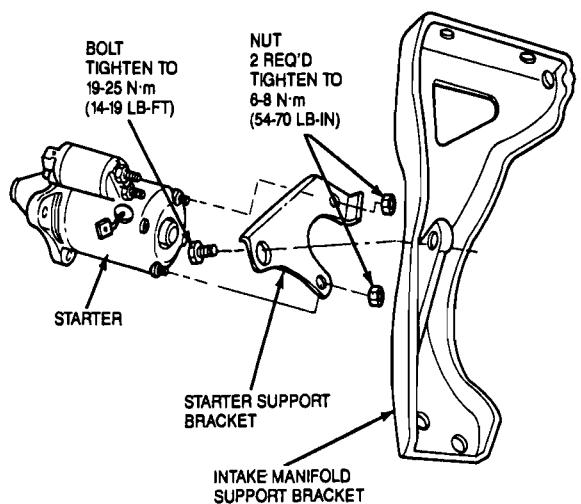
2. When the remote starter switch is engaged, the starter should turn smoothly. The voltmeter should read no less than 11.5 volts. The ammeter should read no more than 60 amps.
3. If the voltage is lower or the amperage is higher than the specification with a known good battery, disassemble the starter to determine the cause.

REMOVAL AND INSTALLATION

Starter Motor

Removal

1. Disconnect negative battery terminal.
2. Disconnect starter wires.
3. Remove starter upper retaining bolts.
4. Remove intake manifold support bracket upper retaining bolts.
5. Raise vehicle.
6. Remove starter support bracket to intake manifold support bracket retaining bolt.
7. Remove intake manifold support bracket lower retaining bolts.
8. Remove starter lower retaining bolt.
NOTE: Loosen rubber exhaust hangers, if required.
9. Remove starter.
10. Remove support bracket from starter, if required.



Installation

1. Install support bracket to starter, if removed. Tighten retaining nuts to 6-8 N·m (54-70 lb-in).
2. Position starter and loosely install lower retaining bolt.
3. Position intake manifold support bracket and loosely install lower retaining bolts.
4. Install starter support bracket to manifold support bracket retaining bolt. Tighten to 19-25 N·m (14-19 lb-ft).
5. Tighten lower starter bolt to 31-41 N·m (23-30 lb-ft).
6. Lower vehicle.
7. Install starter upper retaining bolts. Tighten to 31-41 N·m (23-30 lb-ft). Ensure starter wire support bracket is secured with rear upper starter bolt.
8. Install intake manifold support bracket upper retaining bolts. Tighten to 31-46 N·m (22-34 lb-ft). Tighten lower bolts to 31-46 N·m (22-34 lb-ft).
9. Connect starter wires. Tighten "B" terminal retaining nut to 8-12 N·m (7 1-106 lb-in).
10. Connect negative battery terminal.

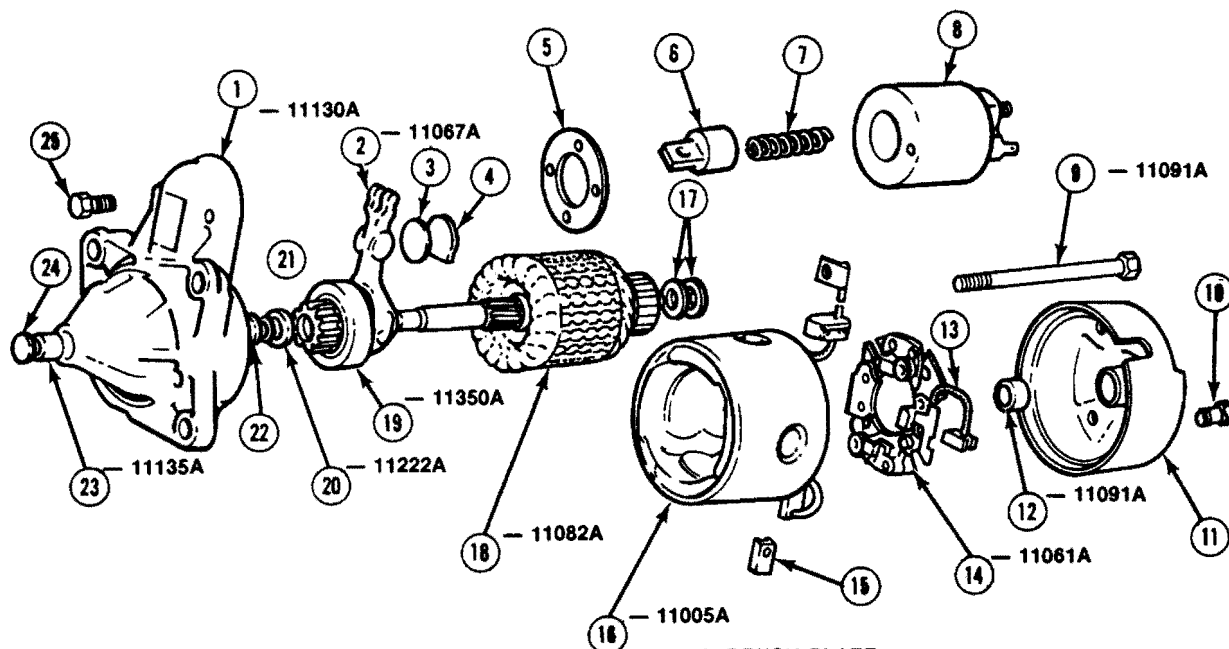
DISASSEMBLY AND ASSEMBLY

Starter Motor

Refer to the illustration for a disassembled view of the starter.

DISASSEMBLY AND ASSEMBLY (Continued)

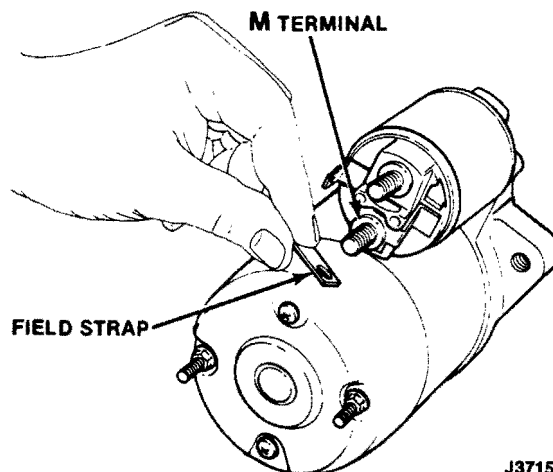
Disassembly



- | | |
|-------------------------------|--------------------------------|
| 1. HOUSING, DRIVE END | 14. BRUSH PLATE |
| 2. DRIVE YOKE | 15. BRUSH, POSITIVE (2) |
| 3. SEAL, SOLENOID COVER PLATE | 16. HOUSING, FIELD FRAME |
| 4. COVER PLATE, SOLENOID | 17. WASHERS, ARMATURE |
| 5. GASKET, SOLENOID | 18. ARMATURE |
| 6. PLUNGER, SOLENOID | 19. DRIVE |
| 7. SPRING, SOLENOID PLUNGER | 20. COLLAR |
| 8. SOLENOID HOUSING | 21. SNAP RING |
| 9. THROUGH-BOLT (2) | 22. WASHER, DRIVE |
| 10. SCREW, COVER (2) | 23. BUSHING, DRIVE END HOUSING |
| 11. COVER, END | 24. PLUG, DRIVE END HOUSING |
| 12. BUSHING, END COVER | 25. SCREW, SOLENOID (2) |
| 13. BRUSH, NEGATIVE (1) | |

J3714-A

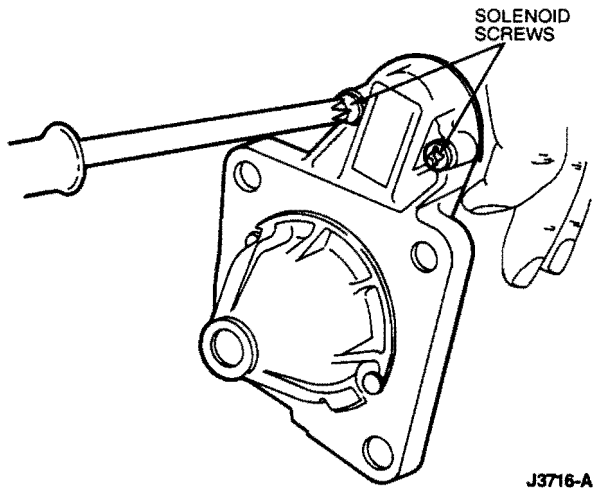
1. Clamp the starter motor in a soft-jawed vise. Remove the nut from the "M" terminal. Remove the field strap lead from the "M" terminal of the solenoid.



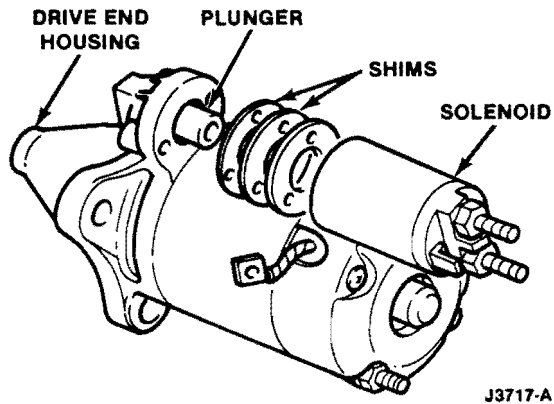
J3715-A

DISASSEMBLY AND ASSEMBLY (Continued)

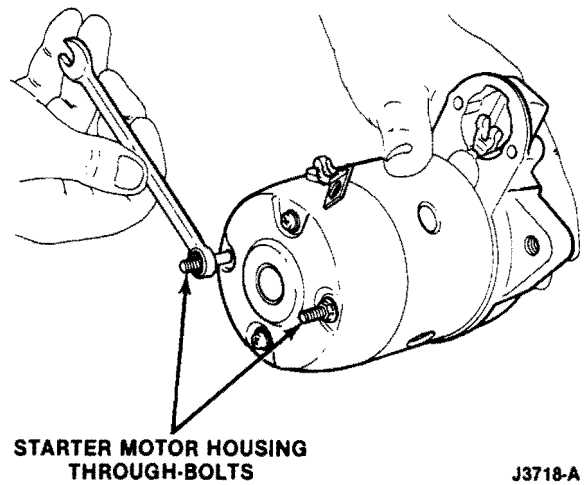
2. Remove two screws that retain the solenoid to the housing.



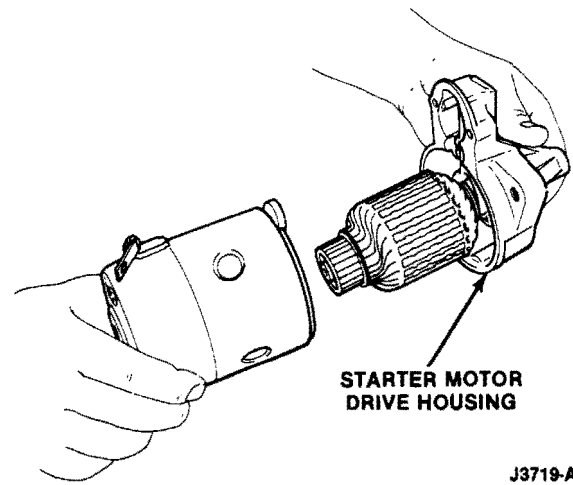
3. Remove the solenoid from the starter motor by guiding the solenoid body away from the drive end housing and plunger. Disconnect the plunger from the drive yoke. If there are shims between the solenoid and the starter, save them for possible reinstallation. These shims are used to determine starter motor pinion depth clearance.



4. Remove the two starter motor housing through-bolts.

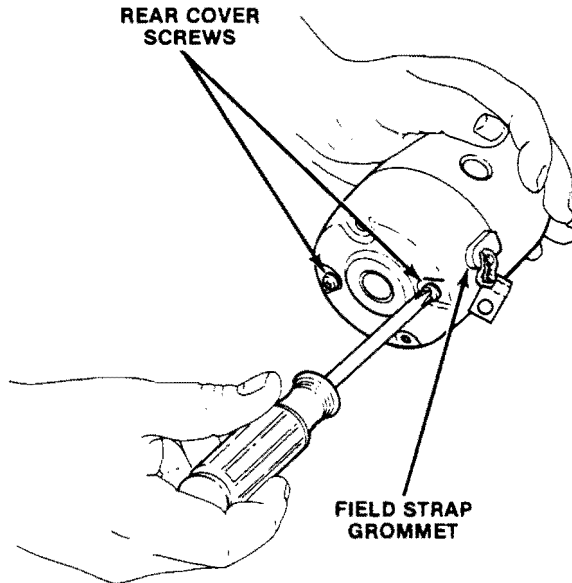


5. Separate the starter motor drive housing from the starter.



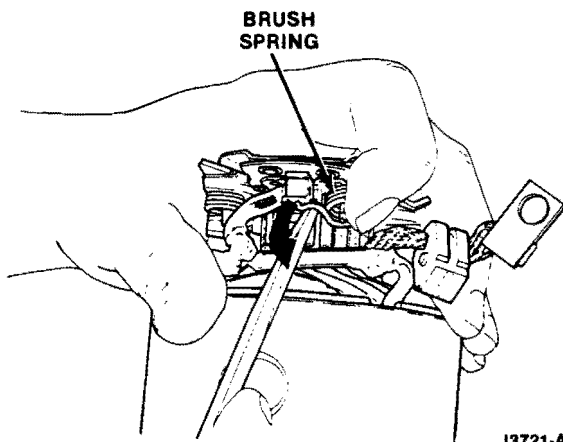
DISASSEMBLY AND ASSEMBLY (Continued)

6. Remove the two screws that retain the rear cover to the field frame. Disengage the field strap grommet from the rear cover. Remove the rear cover.



J3720-A

7. Remove the brushes from the brush plate assembly by carefully prying the brush retaining / tensioning springs clear and sliding the brushes from their channels.

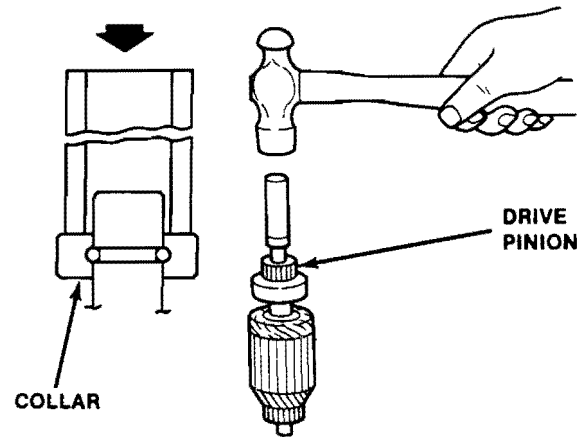


J3721-A

NOTE: The brushes should be released before attempting to remove the brush plate. This will prevent accidental damage to the brushes.

8. Disassemble the drive housing by disengaging the yoke from the drive pinion. Remove the armature and drive pinion. Note the position of the yoke at this time so that it may be reinstalled in the same position.

9. Remove the yoke and seal from the drive housing.
10. Remove the washer from the drive end of the armature. Remove the drive pinion from the armature by using a deep socket to drive the collar down toward the drive pinion.



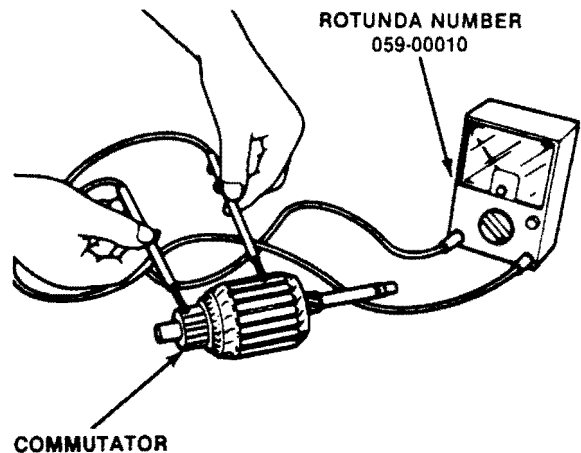
J3722-A

11. Remove the snap ring from its groove in the armature shaft. Slide the drive pinion off the end of the armature.

NOTE: Do not clamp the drive in a vise as it may damage the internal components.

Armature Coil**Inspection**

1. Check for a grounded armature by checking for continuity between the commutator and the core using an ohmmeter as shown.

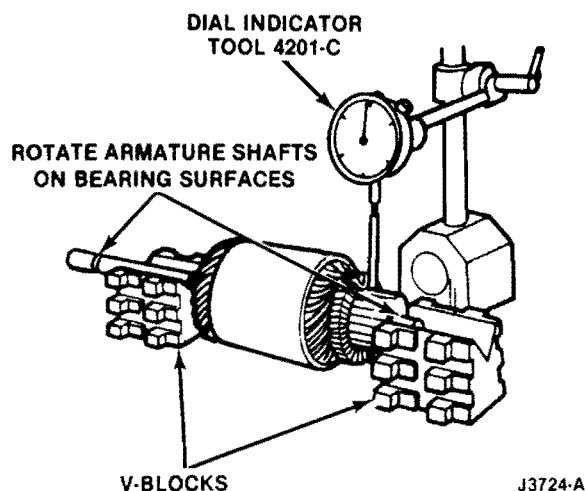


J3723-A

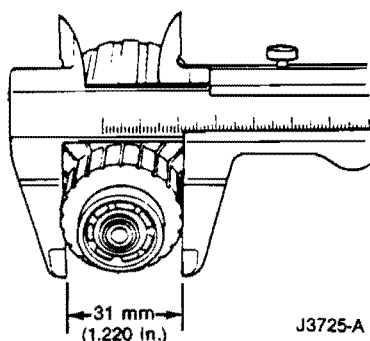
2. Replace the armature if there is continuity between the commutator and the core.

DISASSEMBLY AND ASSEMBLY (Continued)

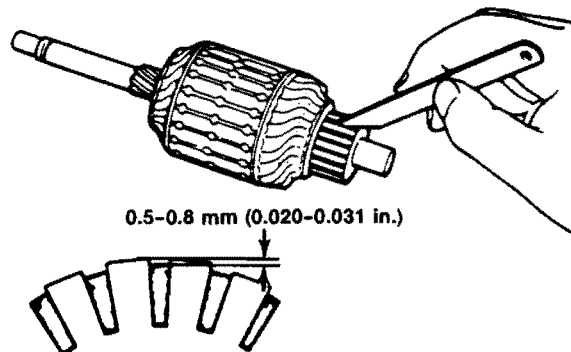
3. Check the commutator of the armature for runout by placing the armature on V-blocks, and measuring the runout using Dial Indicator TOOL-4201-C or equivalent. If the runout is 0.05mm (0.002 inch) or more, repair it using a lathe, or replace the armature.



4. Replace the armature if the outer diameter of the commutator is 31mm (1.220 inch) or less.



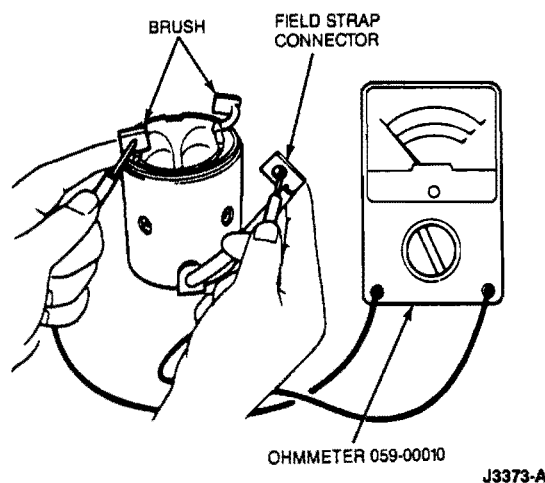
5. The commutator face of the armature should be clean and free of burnt spots. If dirty, wipe it with a cloth.
6. If the commutator face is excessively scored, use a lathe to refinish. If not excessively scored, remove burnt spots or refinish the commutator face with fine crocus cloth.
- NOTE:** Do not use emery cloth on the commutator face.
7. If the depth of the insulating material between commutator segments is 0.2mm (0.008 inch) or less, undercut using a hacksaw blade that has been cut to a sharp point. Undercut the insulating material to a depth of 0.5-0.8mm (0.020-0.031 inch) as shown.



8. If the armature laminations show signs of having contacted the field coil pole pieces, the armature bushings are probably worn excessively. First, check that the pole-pieces are tight in the field frame housing. Check the armature for excessive runout (bent shaft).

Field Coil**Inspection**

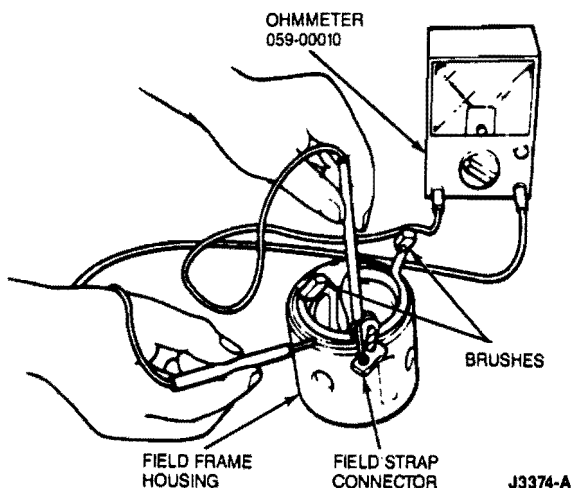
1. Inspect the field coil windings for corrosion, burnt or bare spots in the insulation, or insulation deterioration. Replace the field coils if any of these are evident. The field coils, pole pieces and the field coil housing are serviced as an assembly.
2. Also check field coils by performing a continuity check between the connector and positive brushes as shown. Replace the field coil housing assembly if there is NO continuity between the field strap connector and either brush.



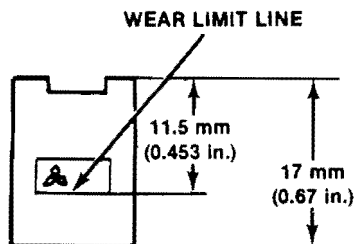
DISASSEMBLY AND ASSEMBLY (Continued)

3. Check for a grounded field coil using Rotunda Inductive Dwell-Tach-Volts-Ohms Tester 059-00010 or equivalent. Check for continuity between the field strap connector and the field frame. Replace the field coil housing assembly if there is continuity, indicating a short to ground.

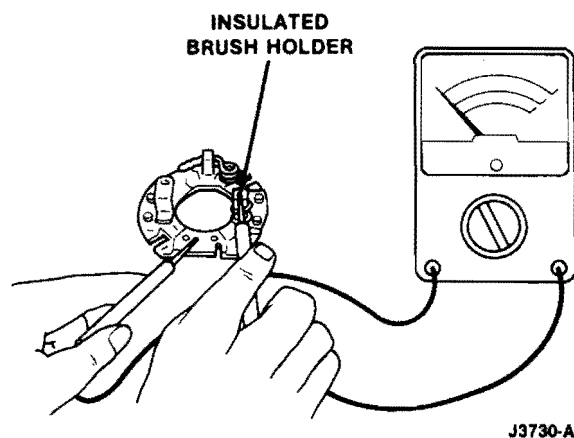
NOTE: Make sure that the brushes and brush wires do not contact the field frame housing during this test.

**Brush and Brush Holder****Inspection**

1. Check the brushes for wear by measuring the amount of useable brush remaining. If the brushes are near the wear limit or beyond, replace the brushes.

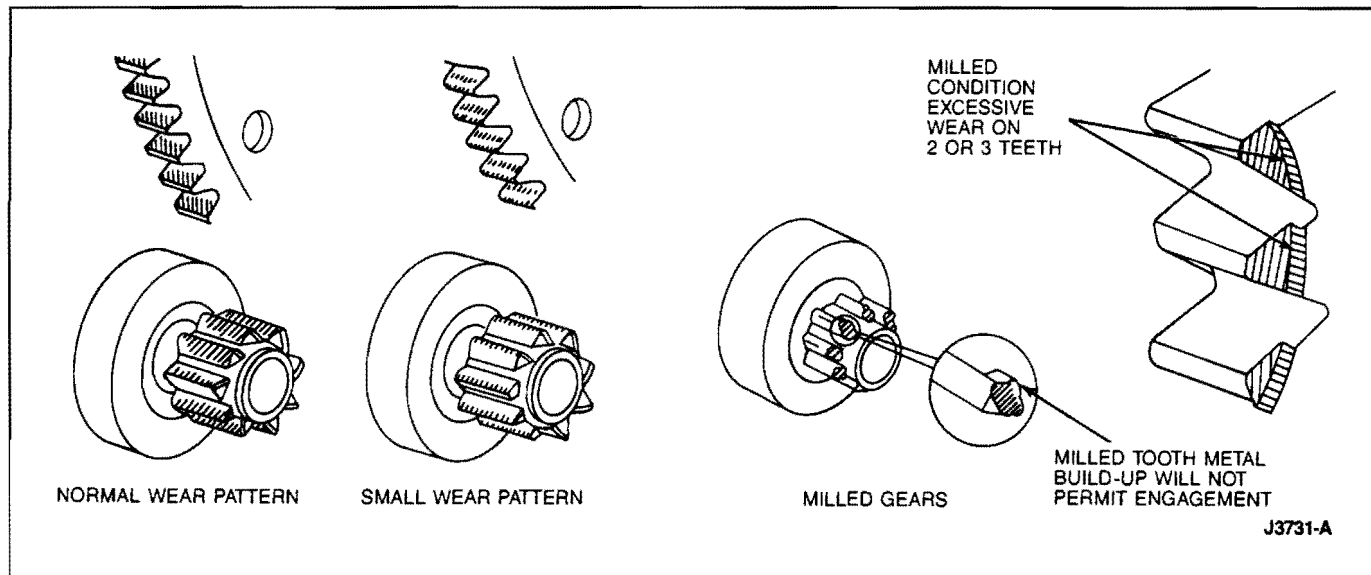


2. The positive brushes are an integral part of the field coils. To replace worn positive brushes, replace the field coil housing assembly.
3. The negative brush is permanently attached to the brush plate. To replace the negative brush, replace the brush plate assembly.
4. Check for continuity between the insulated brush holders and the brush plate using an ohmmeter as shown.
5. Service or replace the brush plate if continuity exists. Also check that the brushes slide smoothly inside the brush holder. If necessary, clean the brush channels if the brush plate is reused.

**Drive Pinion****Inspection**

1. Inspect the wear pattern on the pinion drive gear and the flywheel ring gear.

DISASSEMBLY AND ASSEMBLY (Continued)



2. Inspect the entire circumference of the ring gear for damage if the pinion drive gear teeth are damaged. The flywheel ring gear pattern will usually be found in two places around the ring gear. If the drive gear or ring gear show signs of excessive wear or milling, they must be replaced.

NOTE: If the ring gear is damaged, the flex plate (automatic transaxle) or flywheel (manual transaxle) must be replaced to prevent continued pinion gear damage. Refer to the appropriate section in Group 16 (manual transaxles) or Group 17 (automatic transaxles) for replacement information.

3. Check the one-way clutch action of the pinion drive gear assembly by grasping the drive and attempting to turn the pinion gear in both directions. The gear should turn freely in one direction, and lock up in the opposite direction. If the gear does not turn freely, or turns in both directions, replace the drive pinion assembly.

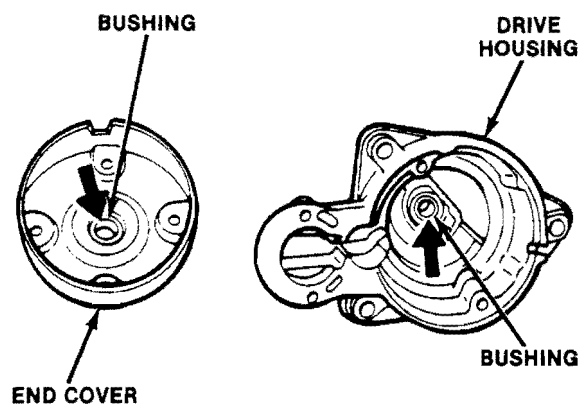
Bushings

Inspection

1. Inspect the self-lubricating bronze / iron armature bushings in the drive housing and end cover as follows:
 - a. Replace the bushings whenever excessive armature shaft side-play is evident (maximum allowable 0.2mm (0.008 inch)).
 - b. Check for evidence of the armature laminations contacting the field coil pole pieces.

2. Replace the bushings if they are worn or scored. Check the armature shaft for wear if the bushings are excessively scored or worn. Service or replace the armature as necessary.
3. The bushings can be pressed or tapped out of their housing using a driver of the appropriate size. Be sure the housing is well supported.
4. Immerse new bushings in engine oil (SAE 30 or 40) for at least 20 minutes before installation.
5. Press or tap the new bushing into position using a driver.

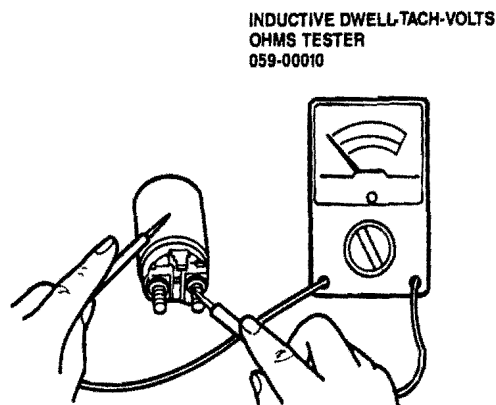
NOTE: Do not ream the bushings after installation since the self-lubricating qualities of the bushing may be damaged.



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DISASSEMBLY AND ASSEMBLY (Continued)**Solenoid**

1. Check the solenoid winding using Rotunda Inductive Dwell-Tach-Volts Ohms Tester 059-00010 or equivalent as shown.



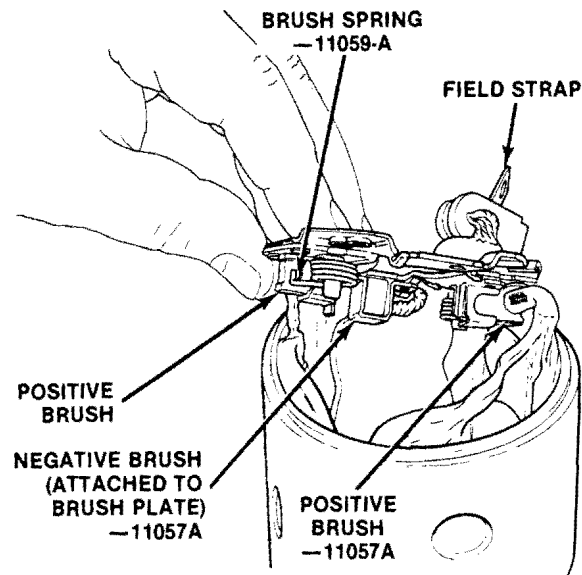
J4380-A

2. Check for continuity between the "M" terminal and the body of the solenoid. Replace the solenoid if there is no continuity.

Starter Motor**Assembly**

1. Lubricate the splines of the armature shaft with a light coat of Lubriplate 777 or equivalent.
2. Slide the drive assembly down onto the armature shaft. Install the collar down over the armature shaft.
3. Install the snap ring to its groove in the armature. Pull the collar up over the snap ring. Install the thrust washer over the end of the armature and down onto the collar.
4. Lubricate the shift fork where it mates with the drive end housing with a light coat of Lubriplate 777 or equivalent. Install the shift fork to the drive end housing.
5. Slide the armature assembly into the drive end housing, coupling the shift fork onto the drive pinion flange. Insert the armature shaft into the bushing in the drive end housing.
6. Mount the drive end housing and armature in a vise equipped with soft jaws, nose down. Install the plug and seal to the recess in the drive end housing.
7. Install the field frame housing to the drive end housing, by lowering it over the armature and down onto the drive end housing. Make sure the field strap coming out of the field frame housing is on the solenoid side.

8. Install the washers to the armature in the order they were removed.
9. Load the brushes into their holders as shown.



J3734-A

10. Position the brush springs on the sides of the brushes as shown, with the brushes pulled back in their holders.
11. Install the brush plate over the commutator of the armature. Push the brushes forward in their holders until the brush spring snaps onto the end of the brushes, pushing them toward the commutator.
12. Make sure that the brush wires are positioned so they do not contact any metal parts of the starter or the armature.
13. Install the rear cover over the brush plate, engaging the field strap grommet with its slot in the cover.
14. Install the two cover retaining screws and tighten.
15. Install the two through bolts through the rear cover and engage them with their threaded holes in the drive end housing.
16. Tighten the through bolts to 6-8 N·m (54-70 lb-in). Tighten through bolts alternately and evenly.
17. Install the solenoid to the drive end housing, being sure to replace any shims that were removed on disassembly. Install and tighten the two solenoid retaining screws to 4.1-7.5 N·m (36-67 lb-in).

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	Nm	Lb-Ft
Starter Motor-to-Engine Retaining Bolts	31-41	23-30
Support Retaining Nuts	6-8	54-70 (Lb-In)
Support Bracket Through Bolt	6-8	54-70 (Lb-In)
B Terminal Retaining Nut	8-12	71-106 (Lb-In)
Solenoid Retaining Screws	4.1-7.5	36-67 (Lb-In)

SPECIAL SERVICE TOOLS

Tool Number	Description
TOOL-4201-C	Dial Indicator

ROTUNDA EQUIPMENT

Model	Description
059-00010	Inductive Dwell-Tach-Volts Ohms Tester
078-00005	Starting and Charging Tester