

2003-04 STARTING & CHARGING SYSTEMS**Starters - RAV4****DESCRIPTION & OPERATION**

Rav4 models use 4-brush, solenoid-actuated, reduction gear type starters, equipped with overrunning clutches. The brush holder assembly retains 4 brushes and springs in the starter housing.

Reduction gear type starters contain an integral solenoid attached to drive housing, a reduction idler gear and bearing installed into starter housing, and a clutch drive assembly. The clutch drive assembly is mounted to starter housing and is driven by the reduction idler gear from armature shaft. The brush holder assembly retains 4 brushes and 4 springs in the end cover of field frame housing.

Rav4 uses a starter relay to energize starter. It also uses a park/neutral position switch, or a clutch start switch to interrupt starter relay ground.

TROUBLE SHOOTING

NOTE: See **STARTER - GENERAL TROUBLE SHOOTING** article in **GENERAL INFORMATION**.

NO-START

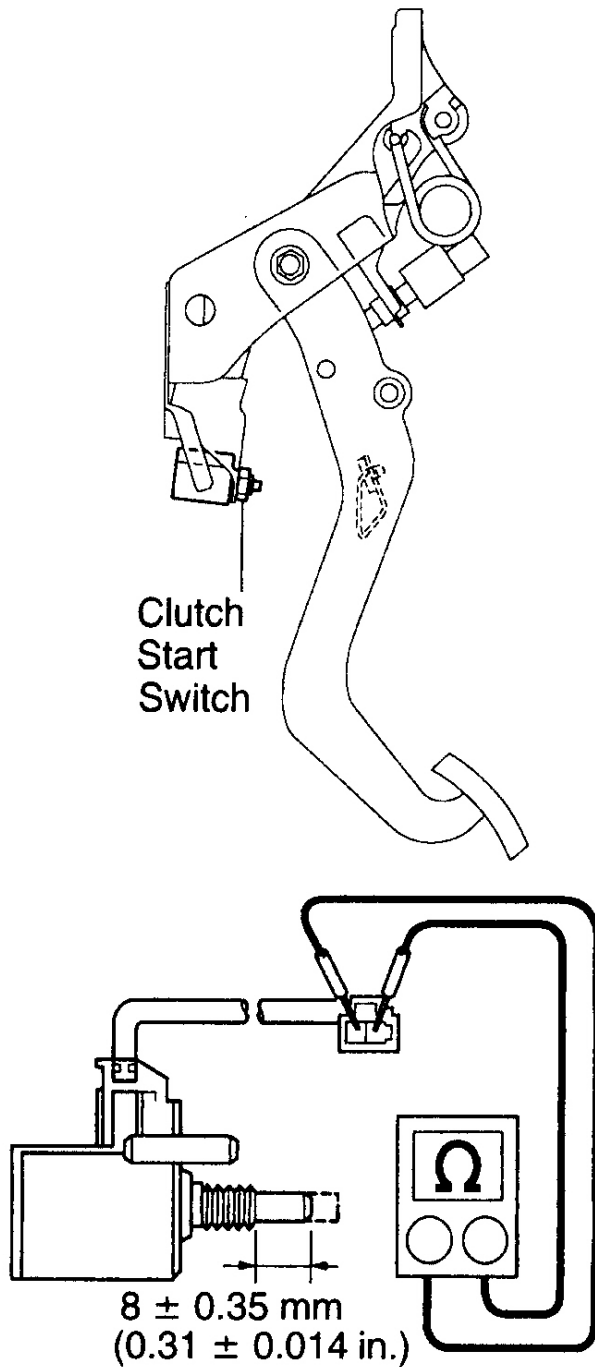
If a no-start condition exists and battery is known to be good, check main fusible links and large ampere main fuses in engine compartment relay box. If fusible links and fuses are okay, see **STARTER RELAY TEST** , **IGNITION SWITCH TEST** , **CLUTCH START SWITCH** and/ or **PARK/NEUTRAL SWITCH TEST** under ON-VEHICLE TESTING.

ON-VEHICLE TESTING

NOTE: Before testing, ensure battery is fully charged, battery cables and terminal ends are tight and clean, and engine grounds are secure.

CLUTCH START SWITCH

On manual transmission models, vehicle will not crank unless clutch pedal is depressed. If vehicle will not crank while clutch pedal is depressed, test clutch start switch by testing continuity. With switch ON (pushed in) there should be continuity. when the switch is OFF (out), there should not be continuity. See **Fig. 1** .



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Fig. 1: Testing Clutch Start Switch
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See appropriate STEERING COLUMN SWITCHES article in ACCESSORIES & EQUIPMENT.

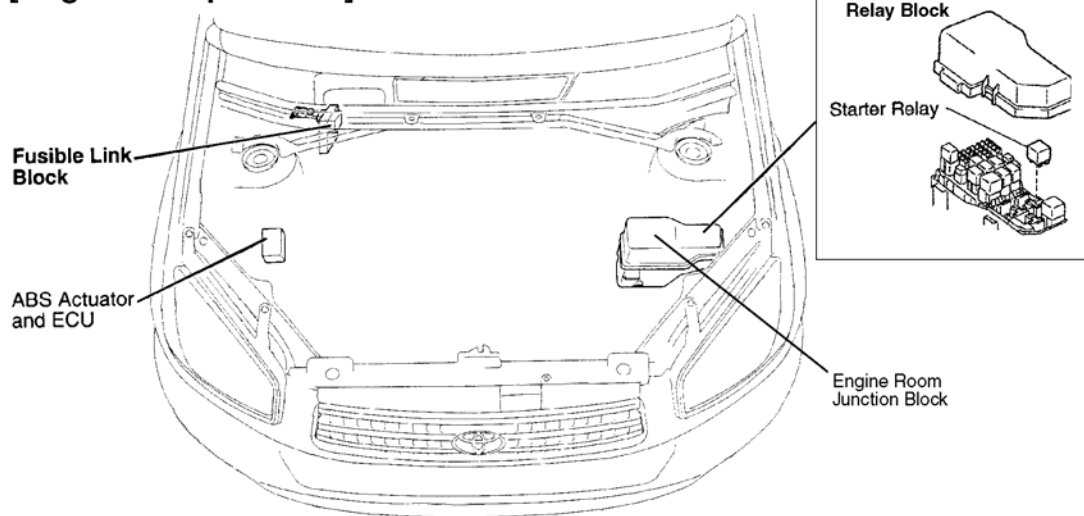
PARK/NEUTRAL SWITCH TEST

NOTE: If vehicle will not crank with shift lever in Park or Neutral position, verify correct park/neutral switch adjustment. See **ADJUSTMENTS in AUTOMATIC TRANSMISSIONS SERVICING - RAV4** article. If park/neutral switch is correctly adjusted, verify switch continuity. For continuity inspection of the park/neutral position switch, see appropriate **AUTOMATIC TRANSMISSION DIAGNOSIS** article.

STARTER RELAY TEST

1. Remove starter relay box cover. See **Fig. 2**.
2. Remove starter relay located and in engine compartment right back junction block marked "ST".
3. Using an ohmmeter, verify continuity between relay terminals No. 1 and 2. See **Fig. 3**. Continuity should not exist between terminals No. 3 and 5. If continuity is not as specified, replace relay.
4. Check relay operation by applying battery voltage through terminals No. 1 and 2. See **Fig. 3**. Continuity should now exist between terminals No. 3 and 5. If relay does not test as indicated, replace relay.
5. Install starter relay.
6. Install starter relay box cover.

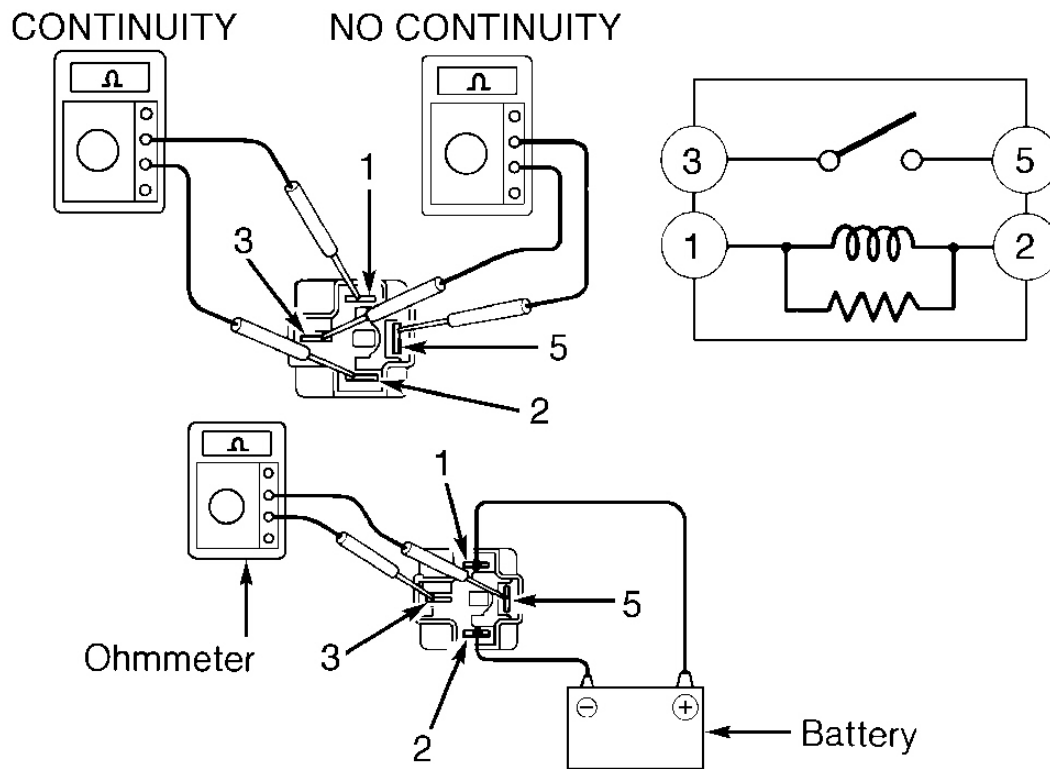
[Engine Compartment]



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Fig. 2: Locating Starter Relay

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Fig. 3: Testing Starter Relay

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

BENCH TESTING

BEARING TEST

While applying inward force, turn bearing by hand. If resistance is felt or the bearing sticks, replace bearing.

NO-LOAD TEST

CAUTION: DO NOT engage starter solenoid for more than 5 seconds during testing, or damage to coil winding will result.

1. Remove starter. See **STARTER** under REMOVAL & INSTALLATION.
2. Connect ammeter in series between starter motor terminal No. 30 (battery terminal) and a fully charged 12-volt battery. Connect battery negative lead to starter case ground. See **Fig. 4**.
3. Connect jumper wire to terminals No. 30 and 50 to engage starter. Starter drive pinion gear should extend quickly and spin smoothly. Verify starter amperage draw is within specifications of 90 amps or less at

11.5 volts.

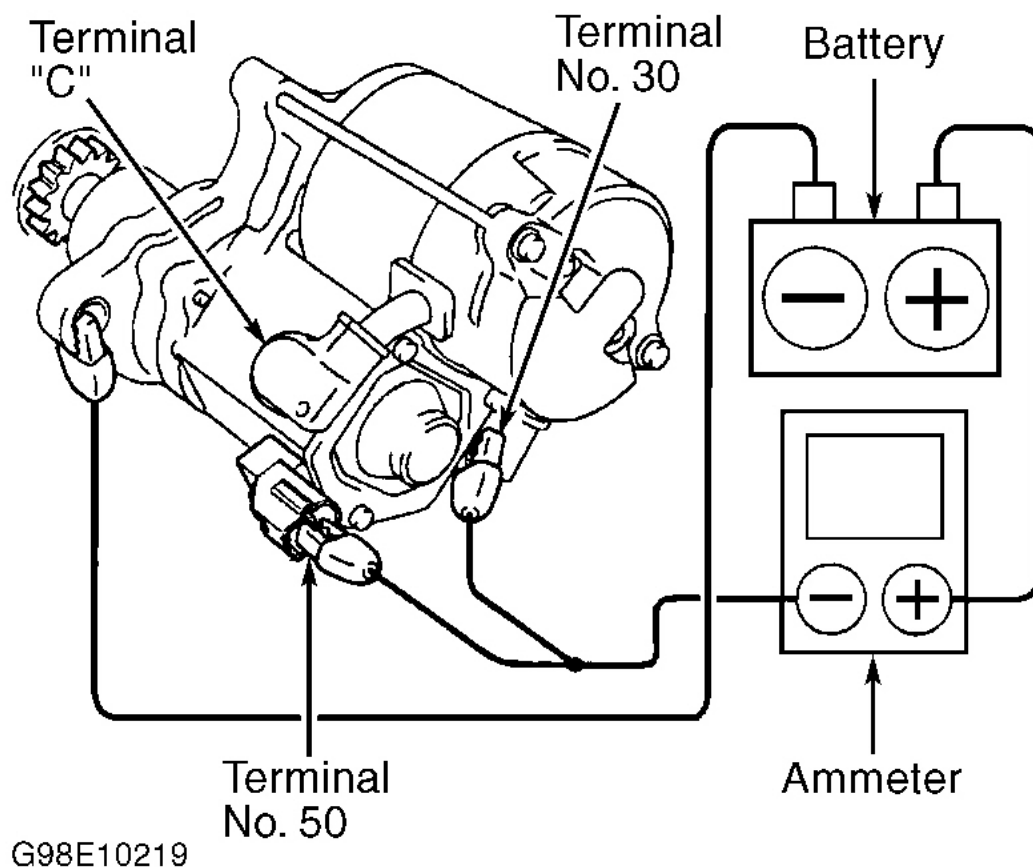


Fig. 4: Starter No-Load Test

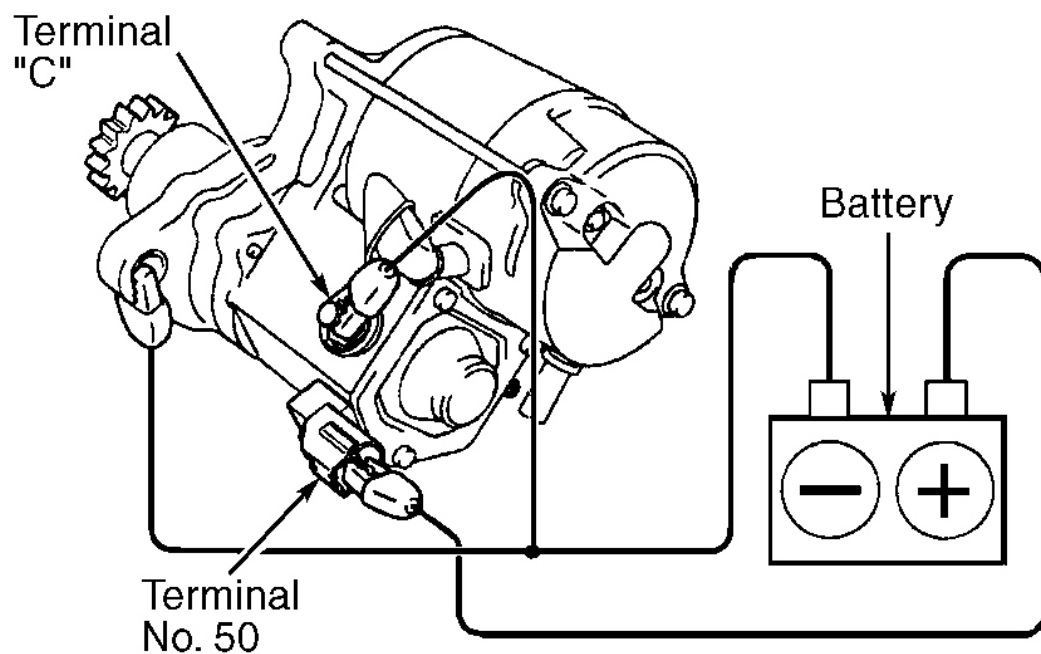
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SOLENOID TESTS

CAUTION: DO NOT engage starter solenoid for more than 5 seconds during testing, or damage to coil winding will result.

1. **Pull-In Coil Test** - Disconnect field coil lead from terminal "C". Connect battery positive to the magnetic switch (Terminal 50). Clip ground to terminal "C" and the main body of the starter. See **Fig. 5**. Ensure that the pinion gear moves outward. If not as specified, check and replace the magnetic switch. If as specified, go to step 2.
2. **Hold-In Coil Test** - Disconnect ohmmeter lead from terminal "C". See **Fig. 6**. Ensure that the pinion gear remains in outward position. If not as specified, check and replace the magnetic switch. If as specified, go to step 3.

3. **Pinion Gear Return Test** - Disconnect the negative lead from the switch body. See **Fig. 7** . Verify that clutch pinion gear returns inward. If not as specified, check and replace the magnetic switch. If as specified, switch is good.



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Fig. 5: Solenoid Pull-In & Hold-In Coil Test
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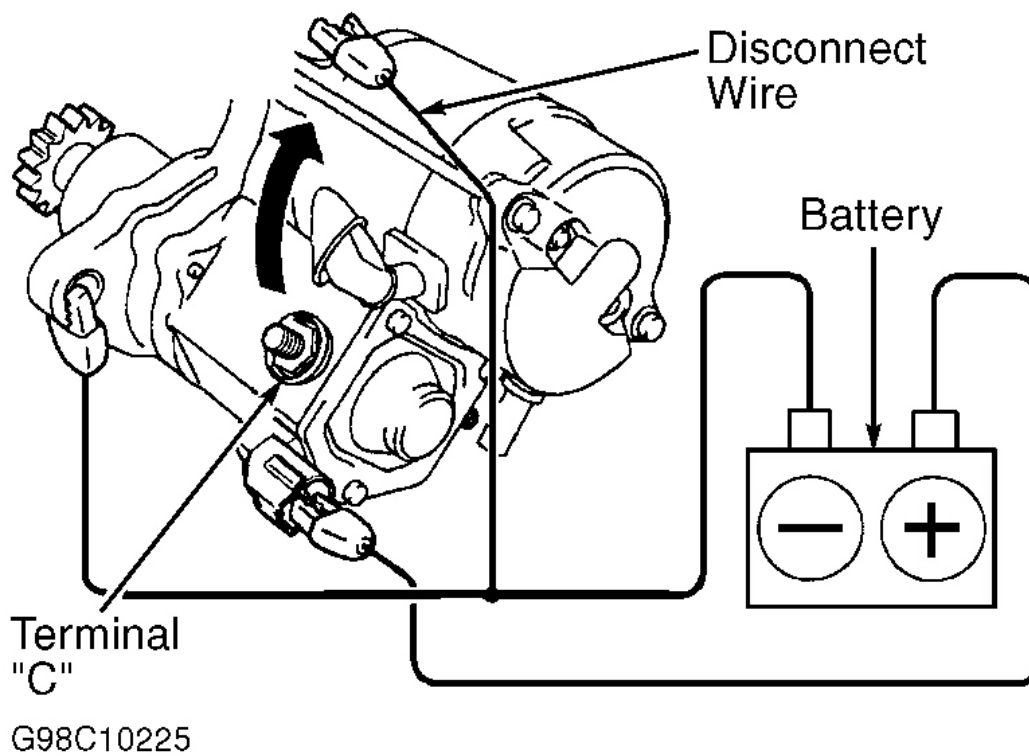
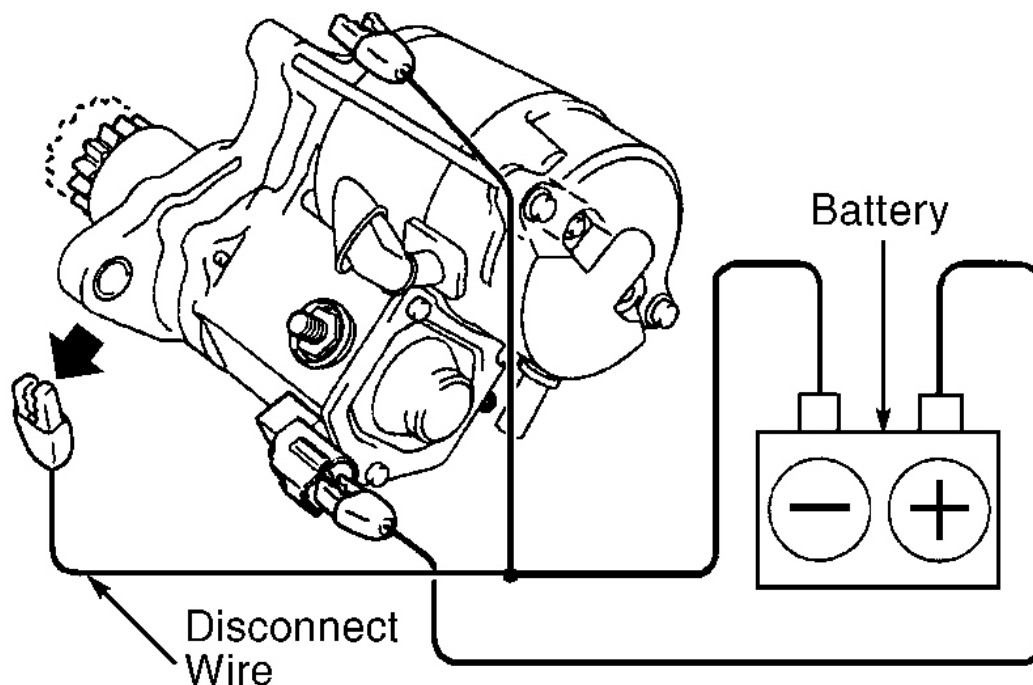


Fig. 6: Solenoid Hold-In Coil Test

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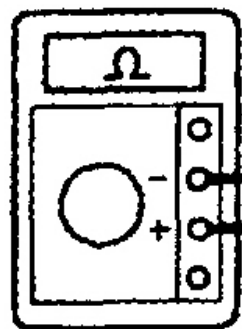
Fig. 7: Solenoid Drive Pinion Return Test

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

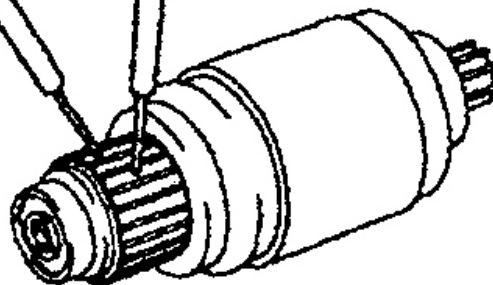
ARMATURE COIL TEST

1. Check for continuity between segments of commutator. See **Fig. 8** . If continuity is not present between any segment, replace armature.
2. Using ohmmeter, check for continuity between armature coil core and commutator. See **Fig. 9** . If continuity is present, replace armature.

Ohmmeter

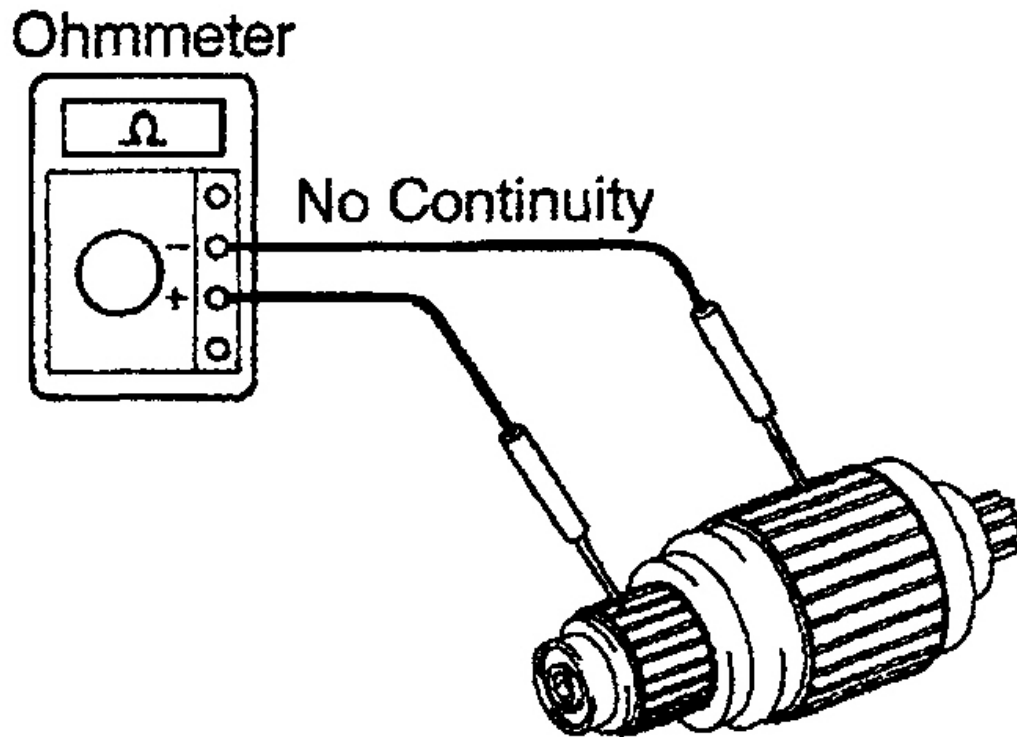


Continuity



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Fig. 8: Testing Armature Coil For Open Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



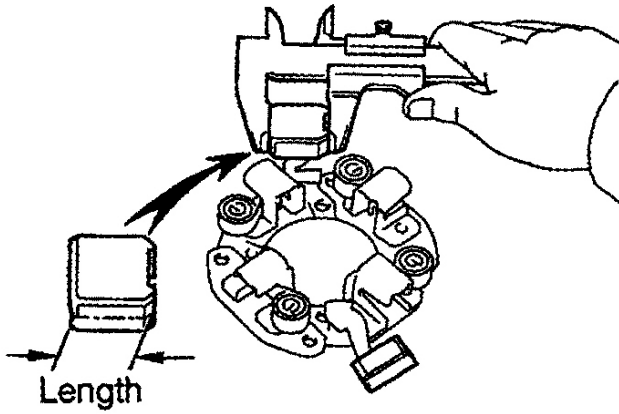
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Fig. 9: Testing For Continuity Between Armature Coil Core & Commutator
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

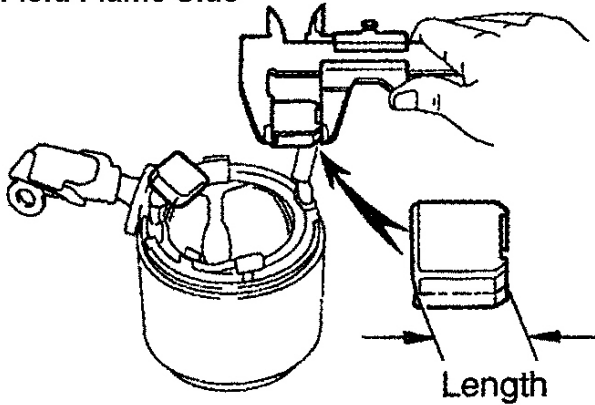
BRUSHES & SPRINGS TEST

1. Use vernier calipers to check brush length. See **Fig. 10** . If length is less than specification, replace brush holder and field frame. See **STARTER SPECIFICATIONS** . If brushes are okay, go to step 2 .
2. Check brush spring load using a spring scale. See **Fig. 11** . Pull the scale and take reading when spring separates from the brush. If the spring load is less than specification, replace the springs. See **STARTER SPECIFICATIONS** .
3. Using an ohmmeter, check that there is no continuity between the positive and negative brush holders. See **Fig. 10** .

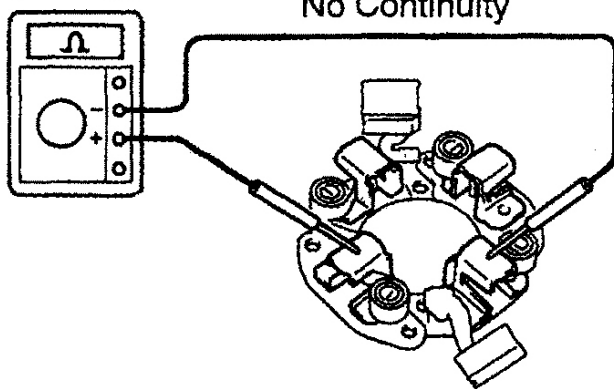
Brush Holder Side



Field Flame Side

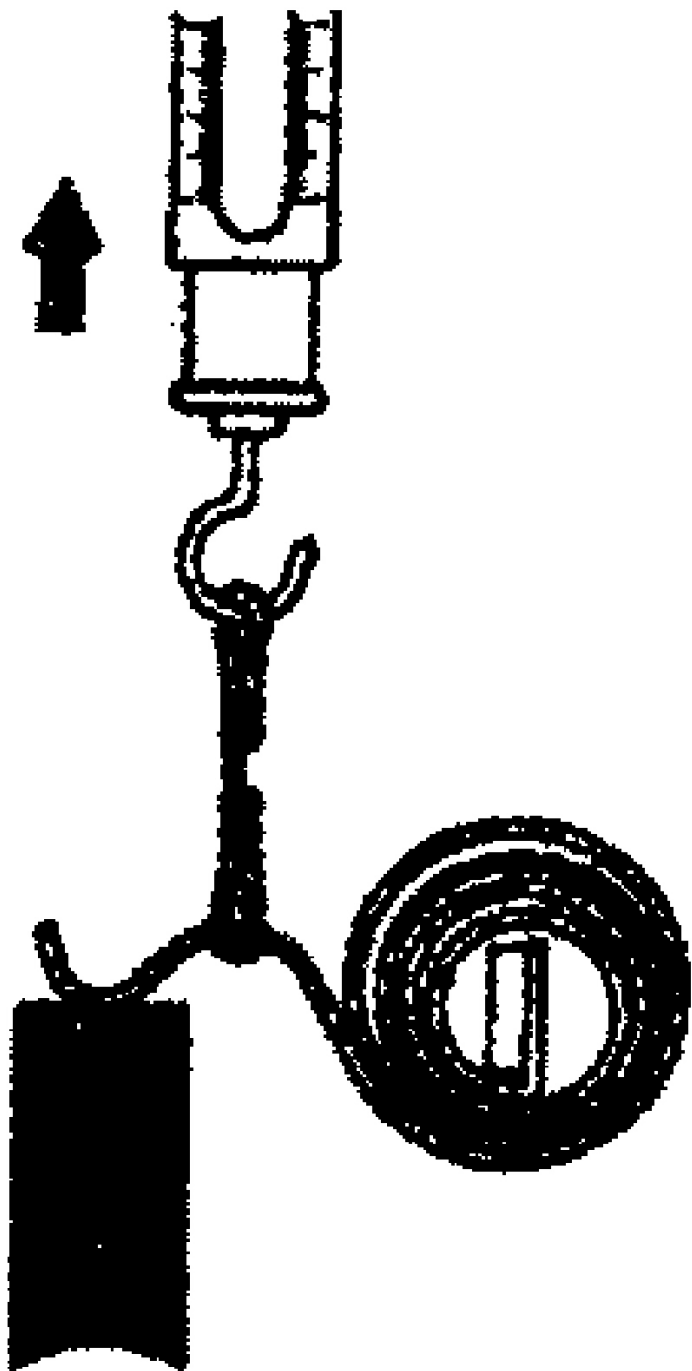


Ohmmeter



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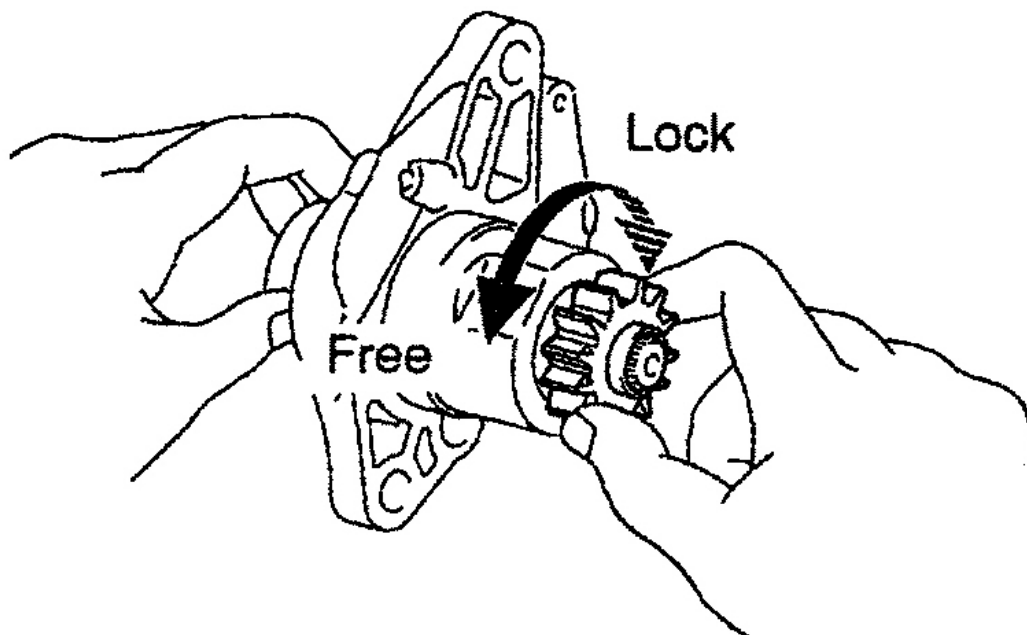
Fig. 10: Measuring Brush Length & Testing Brush Holder Continuity
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 11: Performing Brush Spring Load Test
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Inspect teeth on pinion gear, idler gear and clutch assembly for wear or damage. If damaged, replace gear or clutch assembly and inspect flywheel ring gear for wear or damage.
2. Inspect clutch pinion gear by rotating pinion gear counterclockwise. Ensure gear turns freely in counterclockwise direction, but locks up when turned clockwise. See **Fig. 12** . If not as specified, replace clutch assembly.

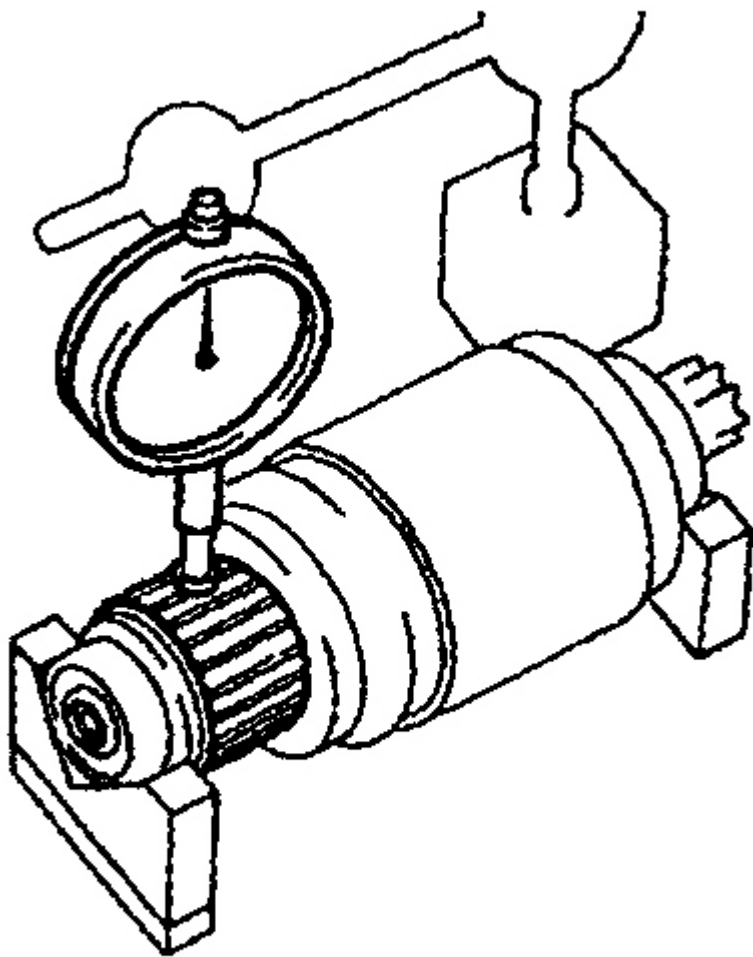


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Fig. 12: Testing Starter Clutch Pinion Gear
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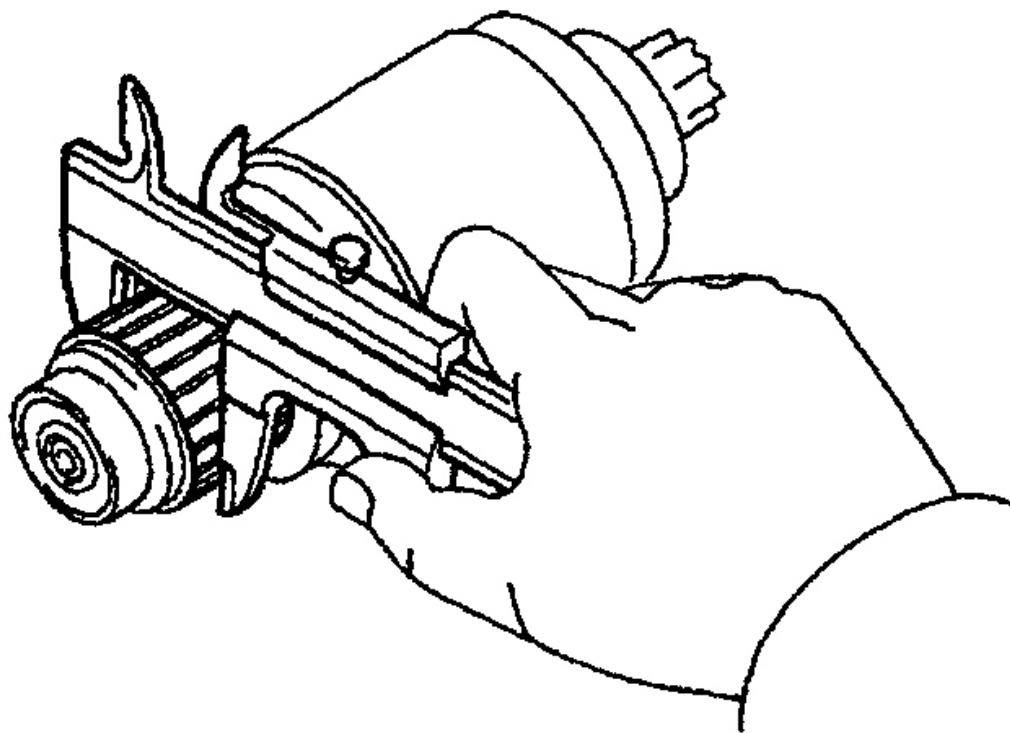
COMMUTATOR TEST

1. If commutator surface is dirty or burnt, it can be cleaned with No. 400 grit sandpaper or on a lathe.
2. Place the commutator on V-blocks and use a dial indicator to measure runout (out-of-round). See **Fig. 13** . If commutator runout is more than specification, turn commutator on a lathe and proceed to step 3 . For specification, see **STARTER SPECIFICATIONS** .
3. Measure commutator diameter. See **Fig. 14** . If commutator diameter is less than minimum specification, see **STARTER SPECIFICATIONS** , replace armature.
4. Ensure undercut depth between commutator segments are clean, free of debris, and that edges are smooth, and within specification, see **Fig. 15** . If undercut depth is less than minimum, use a hacksaw blade to correct it. See **STARTER SPECIFICATIONS** .



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Fig. 13: Measuring Commutator Runout
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Fig. 14: Measuring Commutator Diameter
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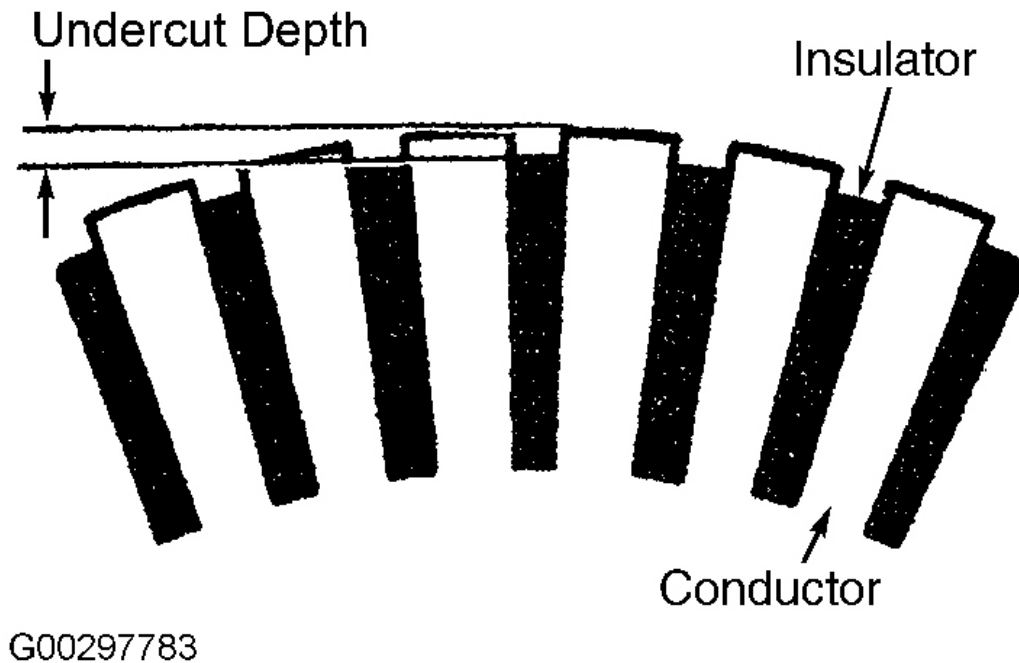
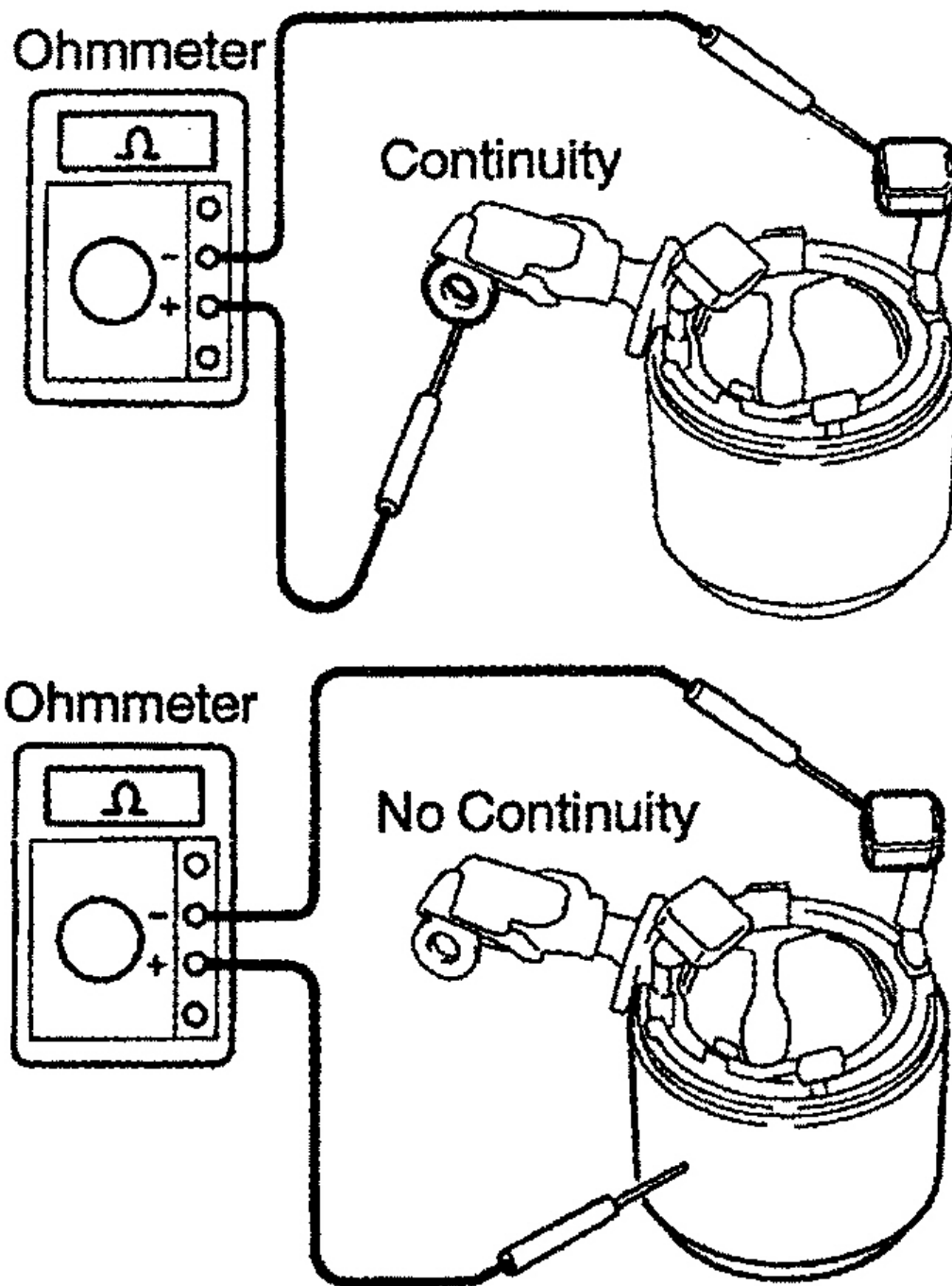


Fig. 15: Measuring Undercut Depth

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FIELD FRAME (FIELD COIL) TEST

1. Using an ohmmeter, verify that there is continuity between the lead wire and field coil brush lead. If there is no continuity, replace the field frame. See **Fig. 16**.
2. Using an ohmmeter, verify that there is no continuity between the field coil end and field frame. If continuity is present, replace the field frame. See **Fig. 16**.



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Fig. 16: Testing Field Coil

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MAGNETIC SWITCH TEST

1. Using an ohmmeter, check that there is continuity between terminals 50 and "C". See **Fig. 17** . If there is no continuity, replace the repair service starter kit.
2. Using an ohmmeter, check. that there is continuity between terminal 50 and the switch body. See **Fig. 17** . If there is no continuity; replace the repair service starter kit.

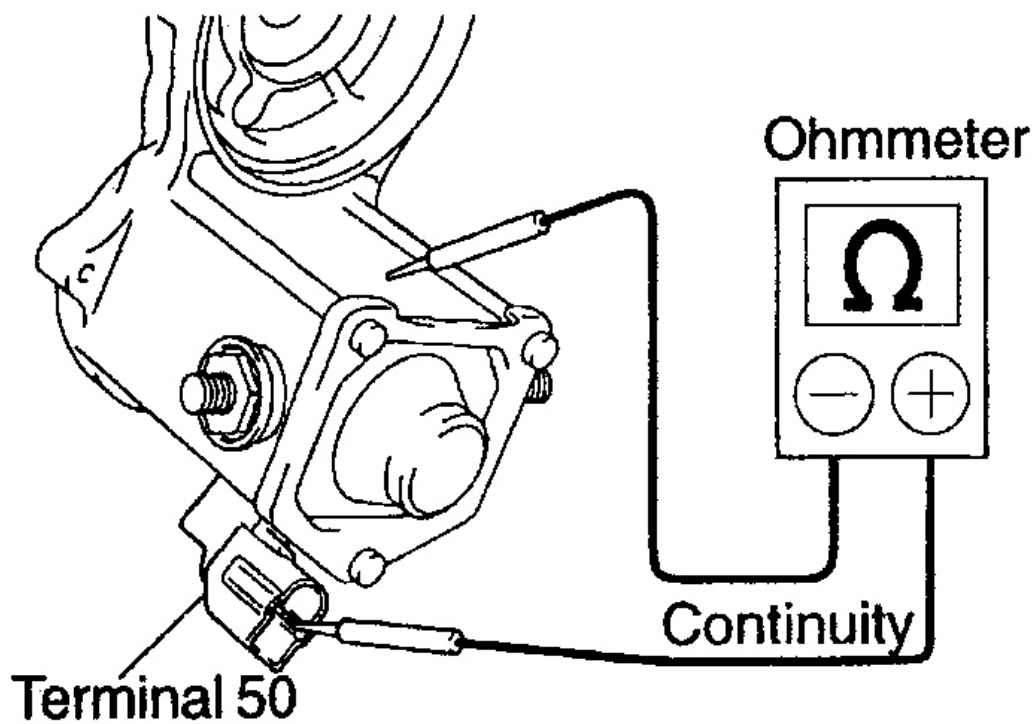
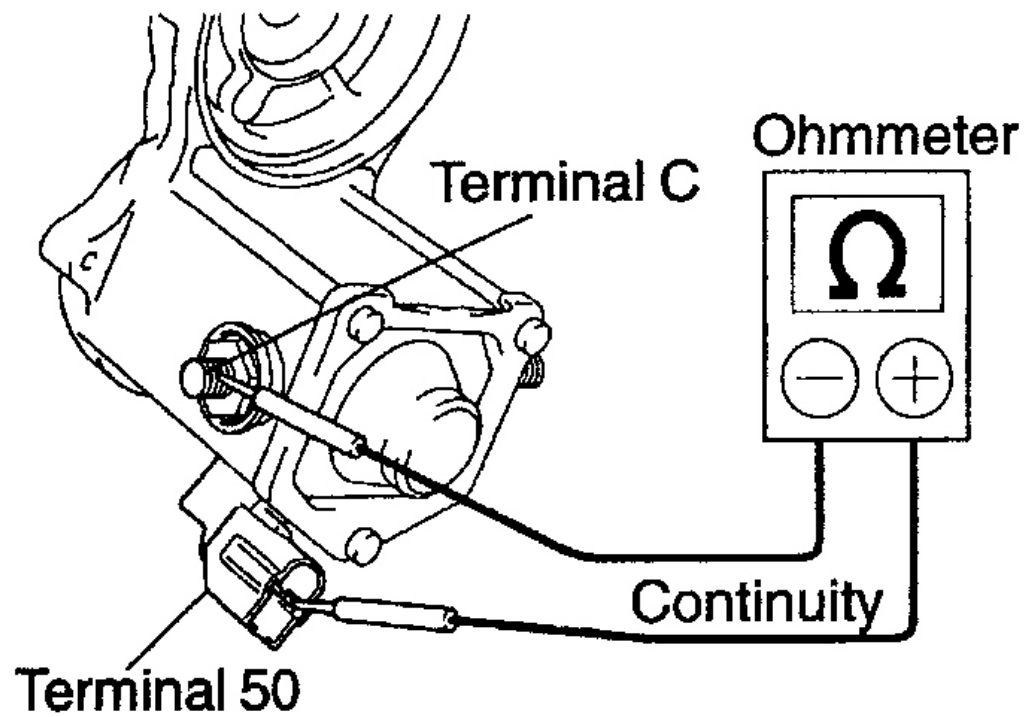


Fig. 17: Testing Magnetic Switch

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REMOVAL & INSTALLATION

STARTER

Removal & Installation

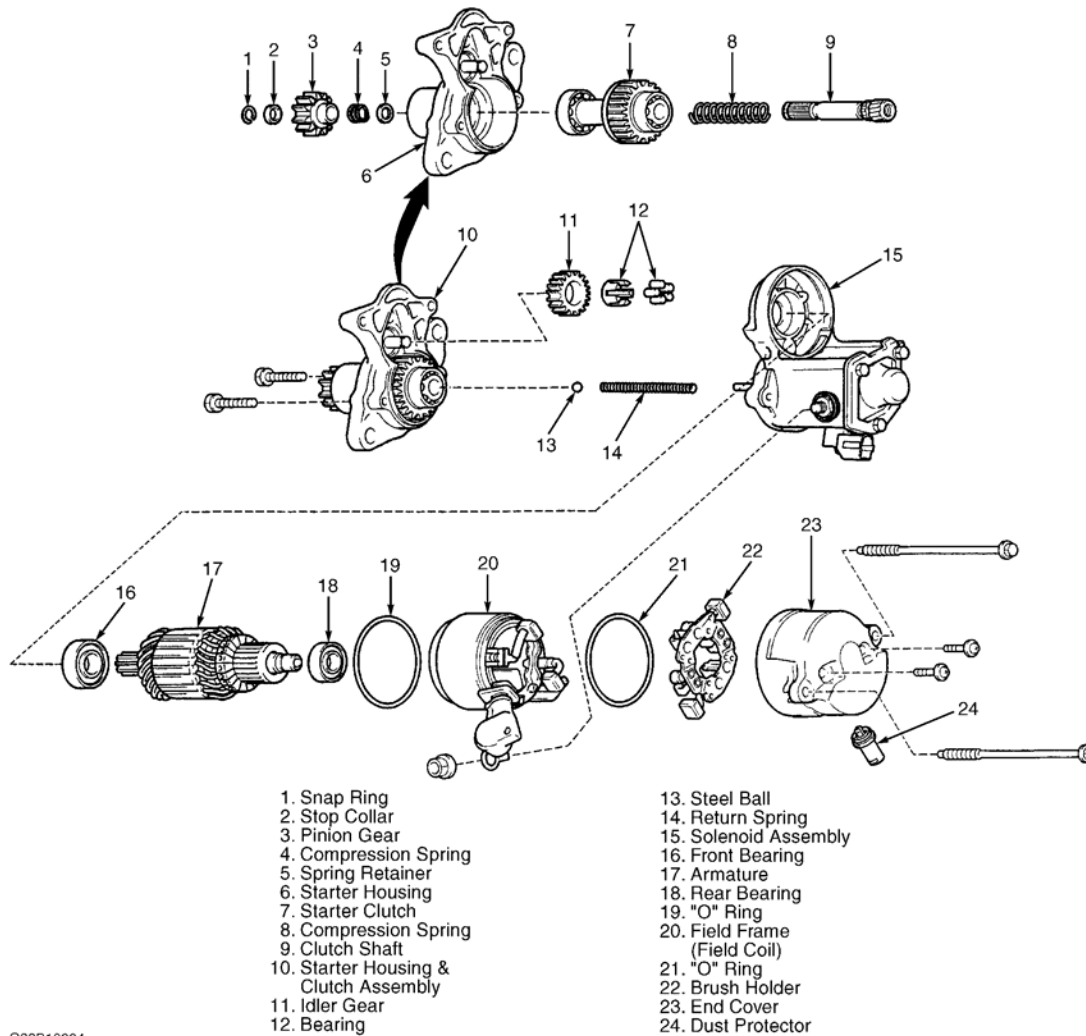
1. Disconnect negative battery cable and then positive cable.
2. If equipped with an automatic transmission, disconnect the hose from the fluid level guide.
3. Remove starter. See **Fig. 18** :
 - A. Disconnect the starter connector.
 - B. Remove the terminal nut and disconnect the starter cable from starter.
 - C. Remove the mounting bolts, and starter.
4. To install, reverse removal procedure. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** .

OVERHAUL

NOTE: See **Fig. 18** for overhaul procedure.

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Fig. 18: Exploded View Of Reduction Gear Starter
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STARTER SPECIFICATIONS

STARTER SPECIFICATIONS

Application	In. (mm)
Brush Length	
Standard	.610 (15.5)
Minimum	.335 (8.5)
Commutator	
Diameter	
Minimum	1.142 (29)
Standard	1.181 (30)

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Runout	.0020 (.05)
Undercut Depth	
Standard	.024 (.6)
Minimum	.008 (.2)
Contact Plate Maximum Depth Of Wear	0.35 (.9)
Spring Load	
1.2 Kw	
Installed Minimum	2 Lb. (1 Kg.)
Installed Standard	3.1-4.4 Lb. (1.4-2 Kg.)
1.4 Kw	
Installed Minimum	2.6 Lb. (1.2 Kg.)
Installed Standard	4-5.3 Lb. (1.8-2.4 Kg.)

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Starter Mounting Bolt	27 (37)
Terminal Nuts	13 (17)
INCH Lbs. (N.m)	
Clutch Housing Screws	52 (5.9)
End Cover Bolts	26 (3)
Field Frame Screws	13 (1.5)
Magnetic Switch End Cover Bolts	23 (2.5)
Starter Through Bolt	52 (5.9)
Starter Wire Nut	78 (8.8)
Terminal "C" Nut	52 (5.9)
Through Bolts	52 (5.9)

WIRING DIAGRAMS

For 2003 wiring diagram, see **STARTING/CHARGING** under TOYOTA - RAV4 article in SYSTEM WIRING DIAGRAMS. For 2004 wiring diagram, see STARTING/CHARGING under TOYOTA - RAV4 article in appropriate SYSTEM WIRING DIAGRAMS.