

2005 Toyota RAV4
2005 ENGINE Starting - RAV4

2005 ENGINE

Starting - RAV4

STARTING SYSTEM

ON-VEHICLE INSPECTION

NOTE: Before changing the starter, check the followings:

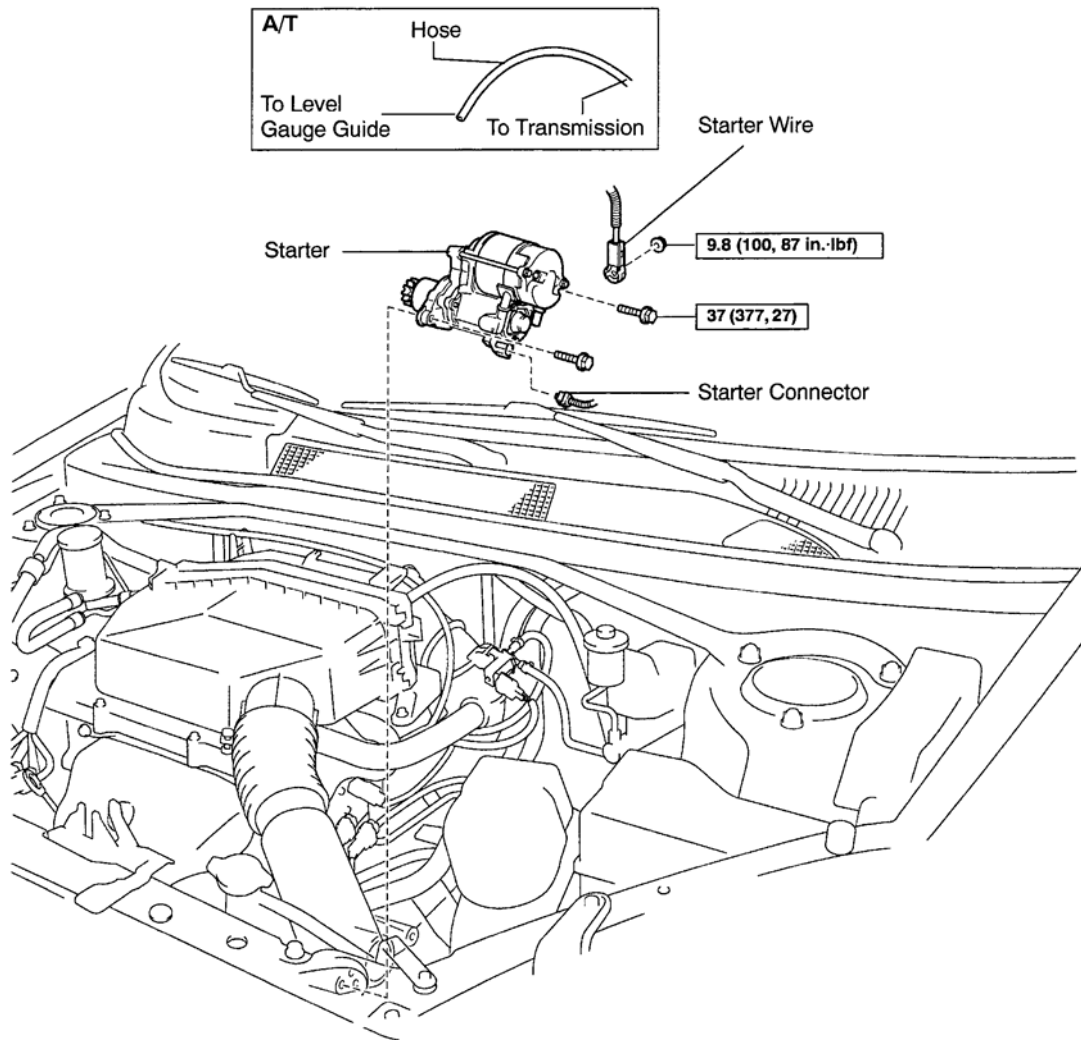
- Connector connections
- Accessory installation, e.g.: theft deterrent systems

STARTER

COMPONENTS

2005 Toyota RAV4

2005 ENGINE Starting - RAV4



N·m (kgf·cm, ft·lbf) : Specified torque

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Fig. 1: Identifying Starter Components & Torque Specifications (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2005 Toyota RAV4

2005 ENGINE Starting - RAV4

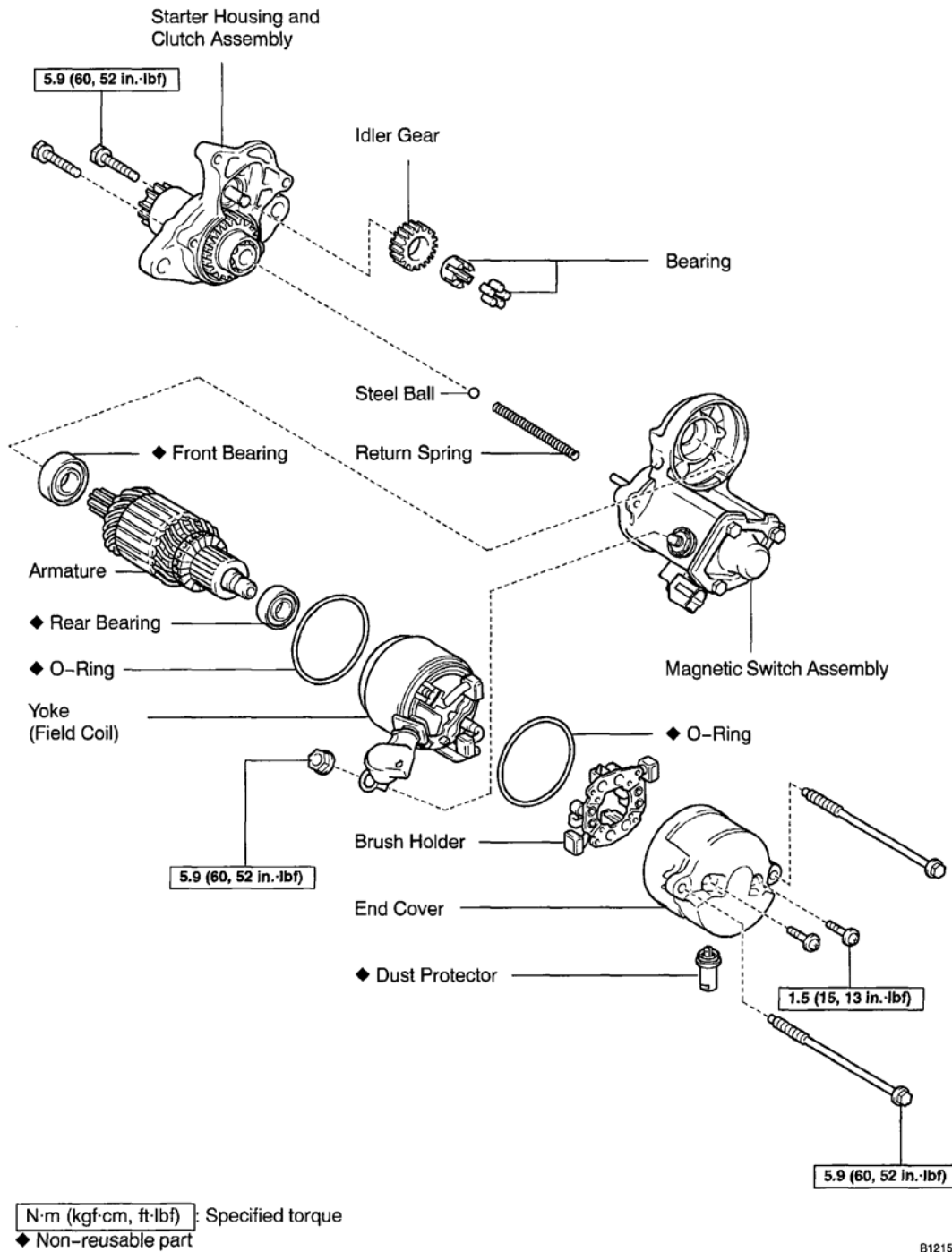
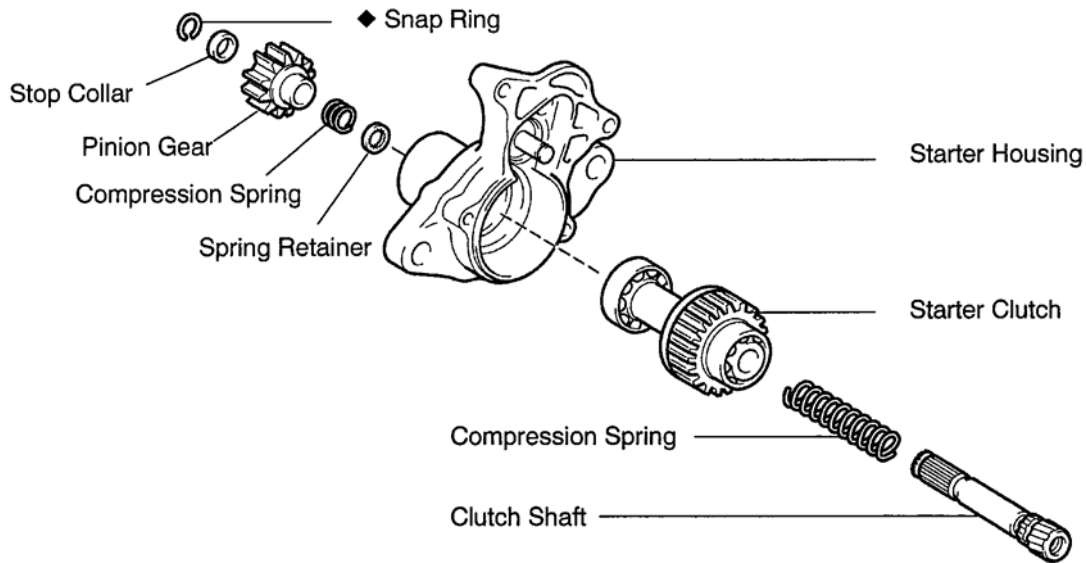


Fig. 2: Identifying Starter Components & Torque Specifications (2 Of 2)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Starter Housing and Clutch Assembly



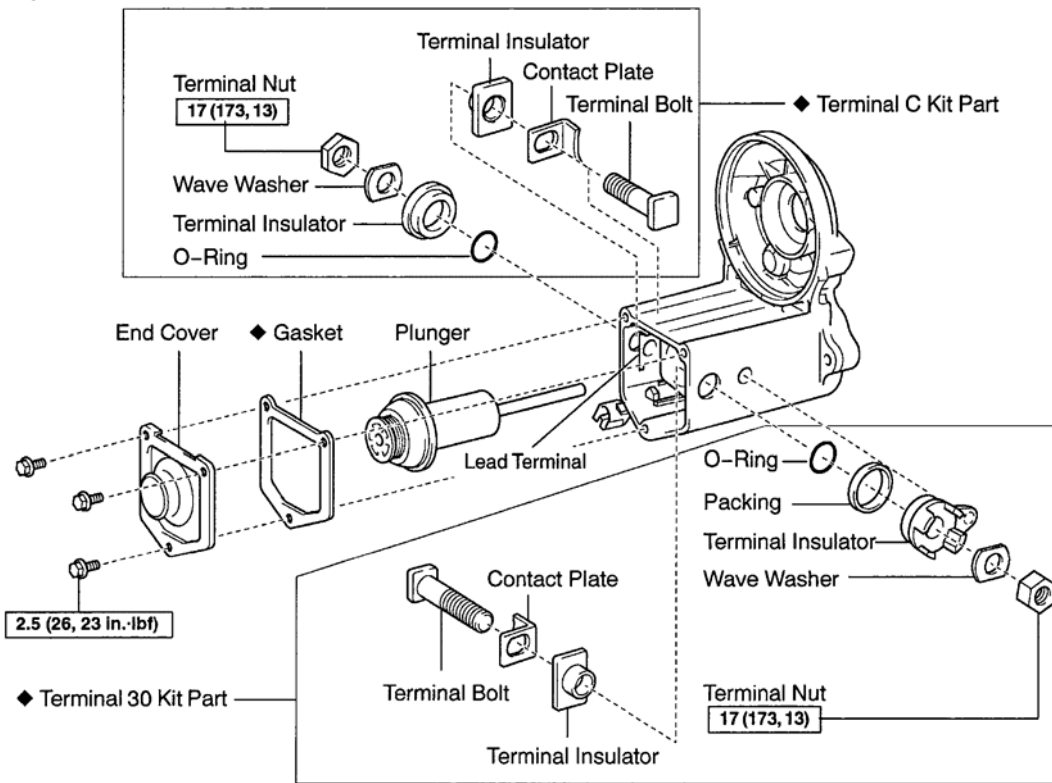
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Fig. 3: Identifying Starter Housing And Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2005 Toyota RAV4

2005 ENGINE Starting - RAV4

Magnetic Switch Assembly



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

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Fig. 4: Identifying Magnetic Switch Assembly & Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVE STARTER

a. A/T:

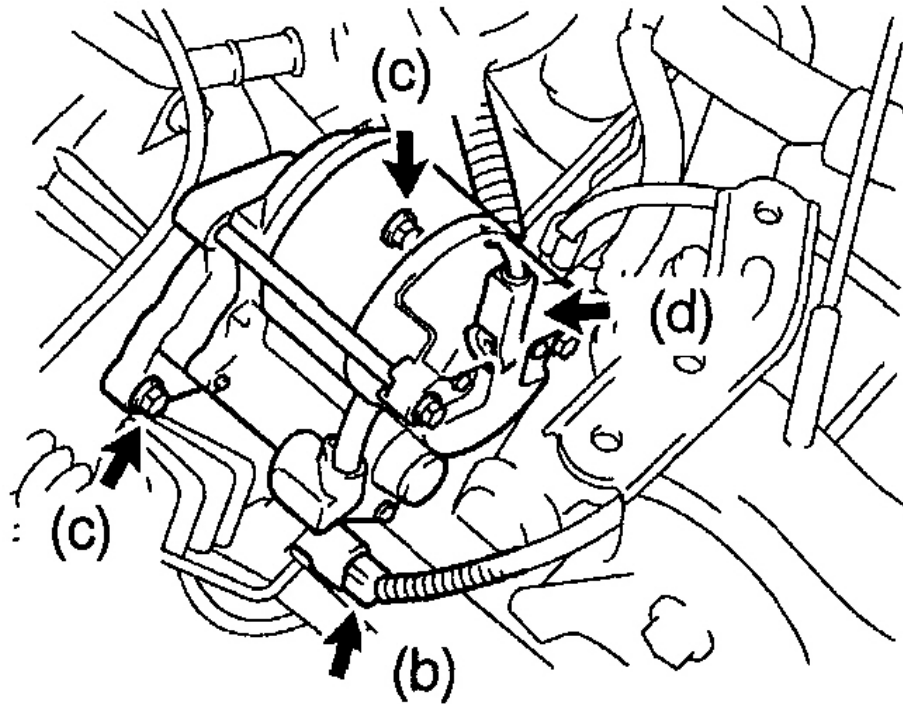
Disconnect the hose from the fluid level guide.

b. Disconnect the starter connector.

c. Remove the 2 bolts and pull out the starter.

d. Remove the nut, and disconnect the starter wire.

e. Remove the starter.



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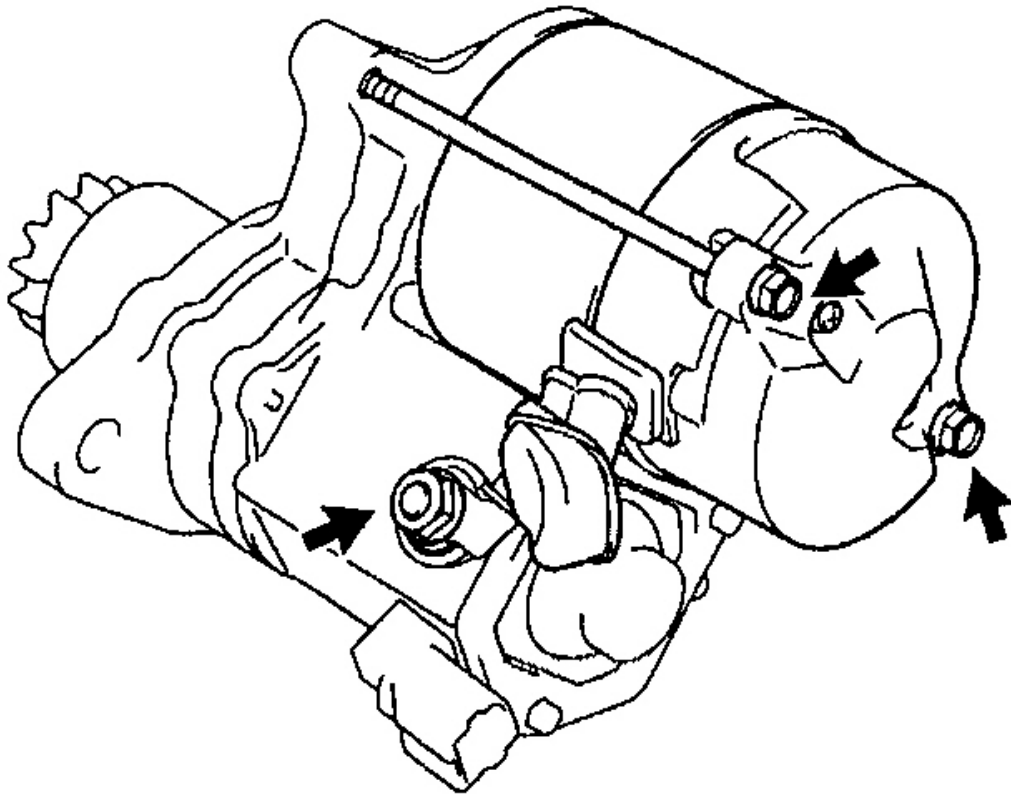
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Fig. 5: Removing Starter

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

DISASSEMBLY

1. **REMOVE DUST PROTECTOR**
2. **REMOVE FIELD FRAME AND ARMATURE**
 - a. Remove the nut, and disconnect the lead wire from the magnetic switch terminal.
Torque: 5.9 N.m (60 kgf.cm, 52 in.lbf)
 - b. Remove the 2 through bolts.
Torque: 5.9 N.m (60 kgf.cm, 52 in.lbf)



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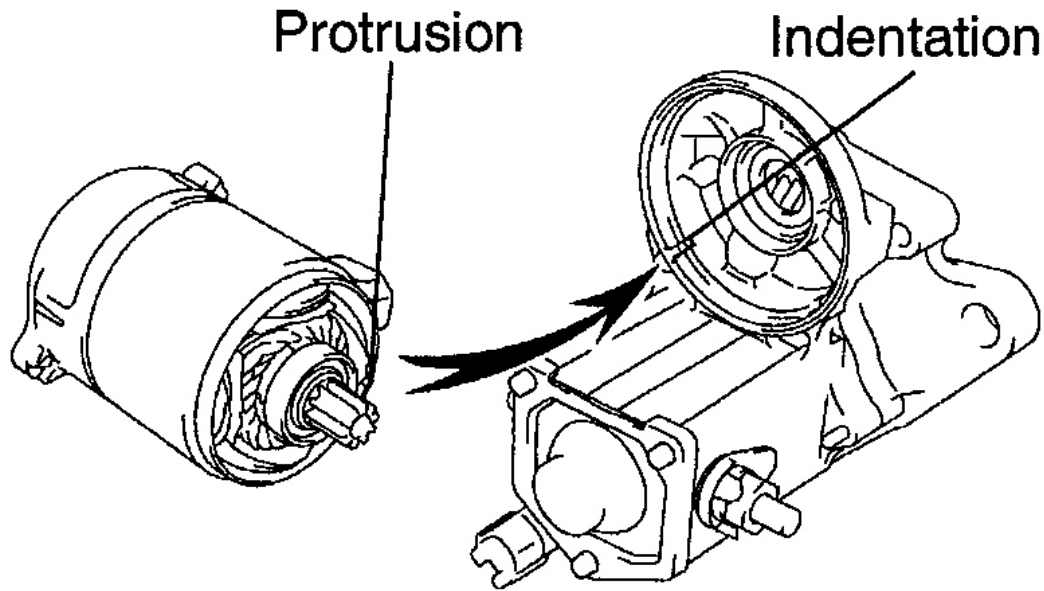
Fig. 6: Removing Field Frame And Armature

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

- c. Pull out the field frame together with the armature.

HINT:

At the time of reassembly, align the protrusion of the field frame with the indentation of the magnetic switch.



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Fig. 7: Identifying Protrusion & Indentation

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

- d. Remove the O-ring from the yoke.

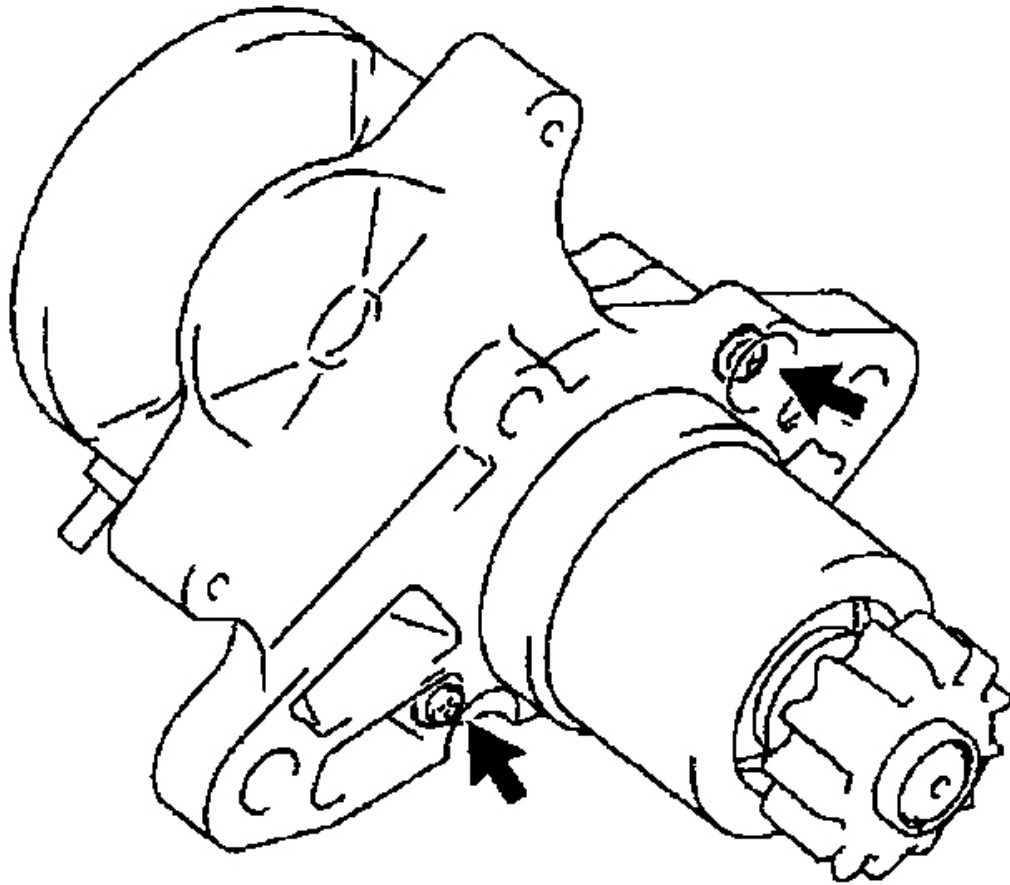
HINT:

At the time of reassembly, use a new O-ring.

3. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR

- a. Remove the 2 screws.

Torque: 5.9 N.m (60 kgf.cm, 52 in.lbf)

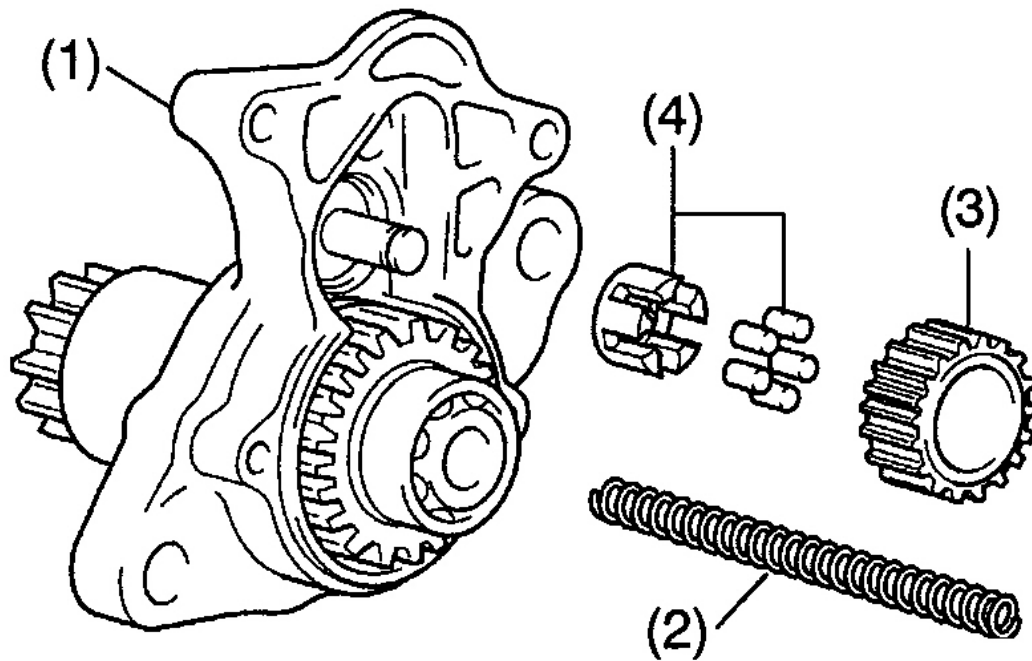


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Fig. 8: Removing Starter Housing Screws

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

- b. Remove the starter housing and clutch assembly (1), return spring (2), idler gear (3) and bearing from the magnetic switch.

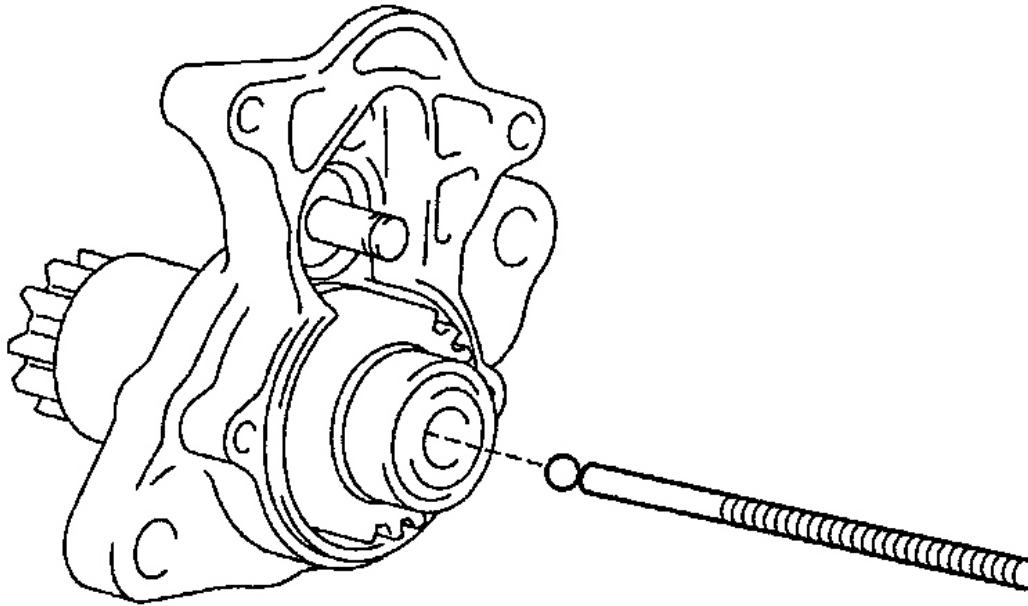


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Fig. 9: Removing Starter Housing And Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. REMOVE STEEL BALL

Using a magnetic finger, remove the steel ball from the clutch shaft hole.



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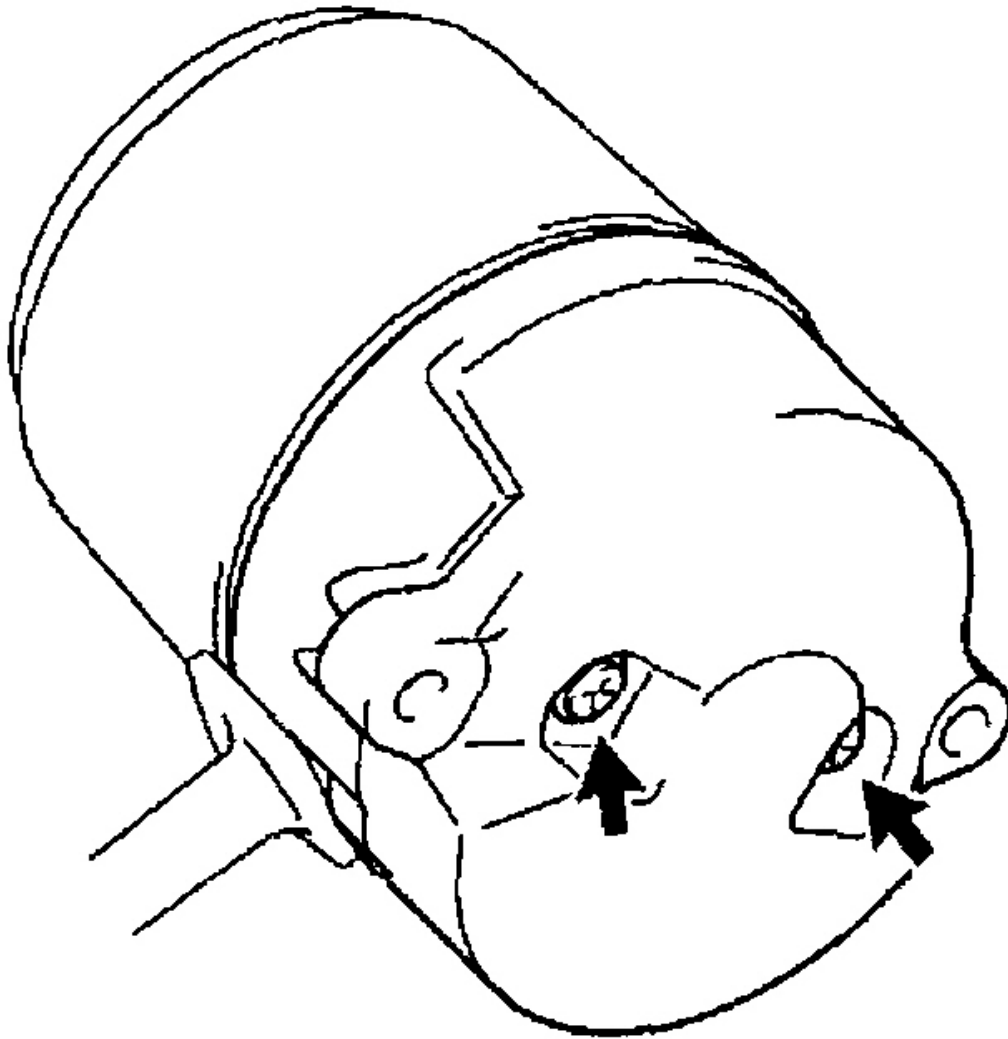
Fig. 10: Removing Steel Ball From Clutch Shaft Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. REMOVE BRUSH HOLDER

- a. Remove the 2 screws and end cover from the field frame.

Torque: 1.5 N.m (15 kgf.cm, 13 in.lbf)

- b. Remove the O-ring from the field frame.



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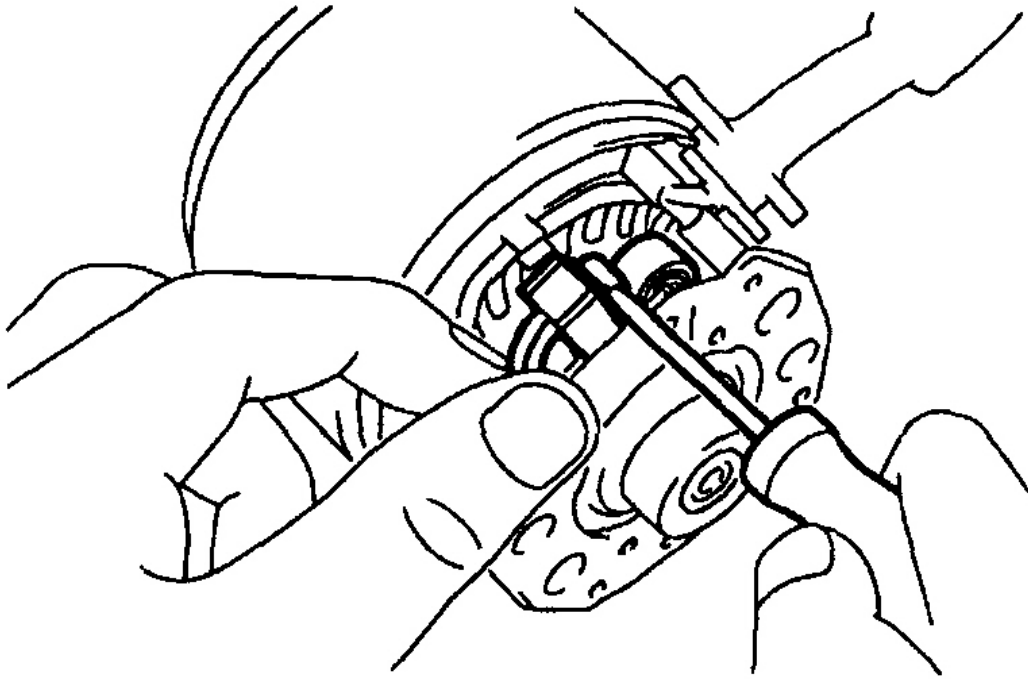
Fig. 11: Removing End Cover From Field Frame

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

- c. Using a screwdriver, hold the spring back and disconnect the brush from the brush holder. Disconnect the 4 brushes, and remove the brush holder.

NOTE: At the time of reassembly, check that the positive (+) lead wires are not grounded.

6. REMOVE ARMATURE FROM FIELD FRAME



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Fig. 12: Removing Brush Holder

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

INSPECTION

1. INSPECT ARMATURE COIL

- a. Check the commutator for open circuit.

Using an ohmmeter, measure the resistance between the segments of the commutator.

Standard: Below 1 ohm

If the result is not as specified, replace the armature.

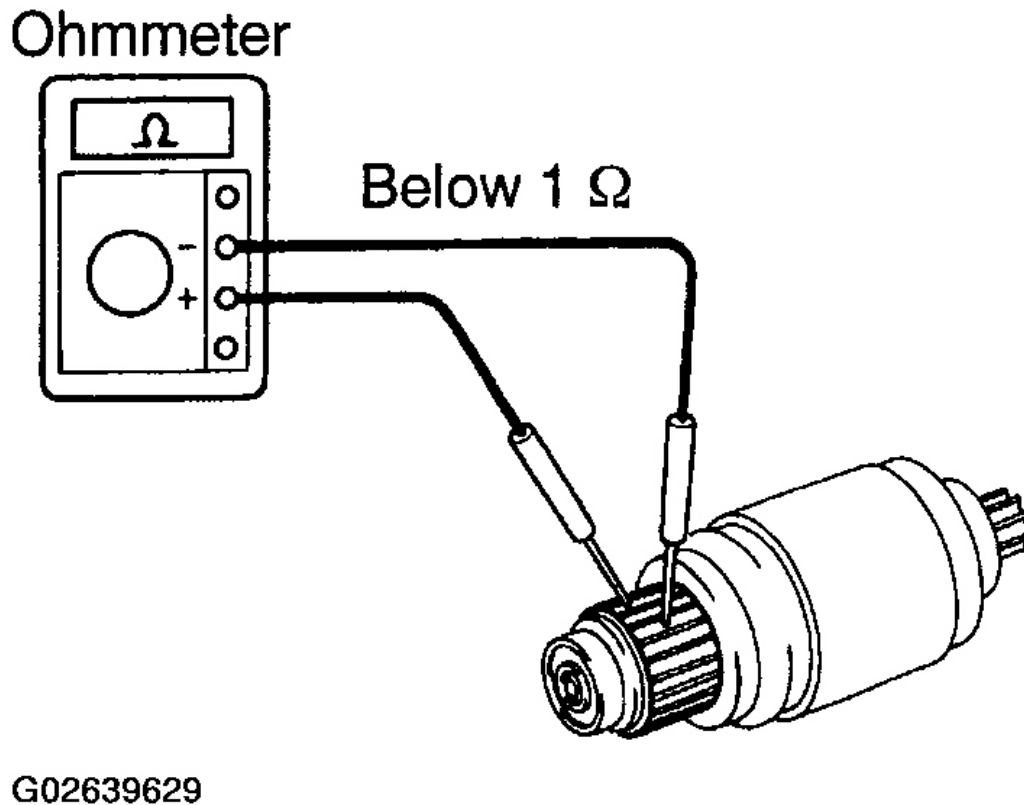


Fig. 13: Measuring Resistance Between Segments Of Commutator
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Check the commutator for ground.

Using an ohmmeter, measure the resistance between the commutator and armature coil core.

Standard: 10 Mohm or higher

If the result is not as specified, replace the armature.

2. INSPECT COMMUTATOR

- a. Check the commutator for the dirty and burnt surfaces. If the surface is dirty or burnt, correct it with sandpaper (No. 400) or on a lathe.

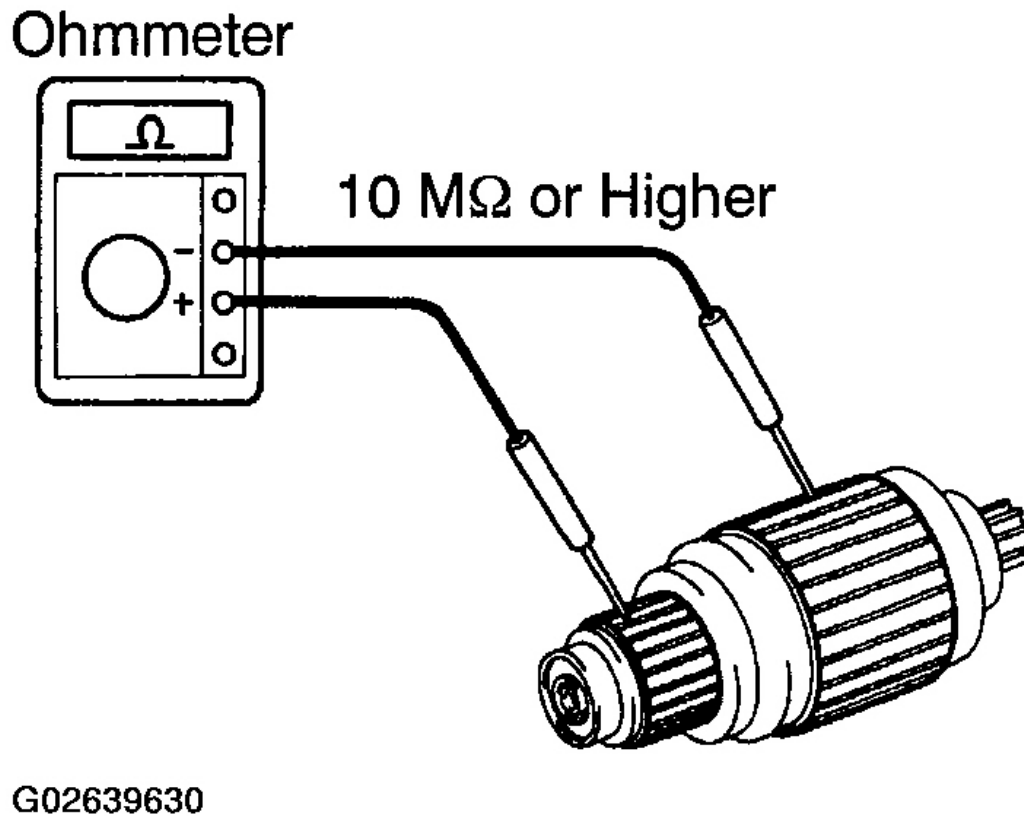
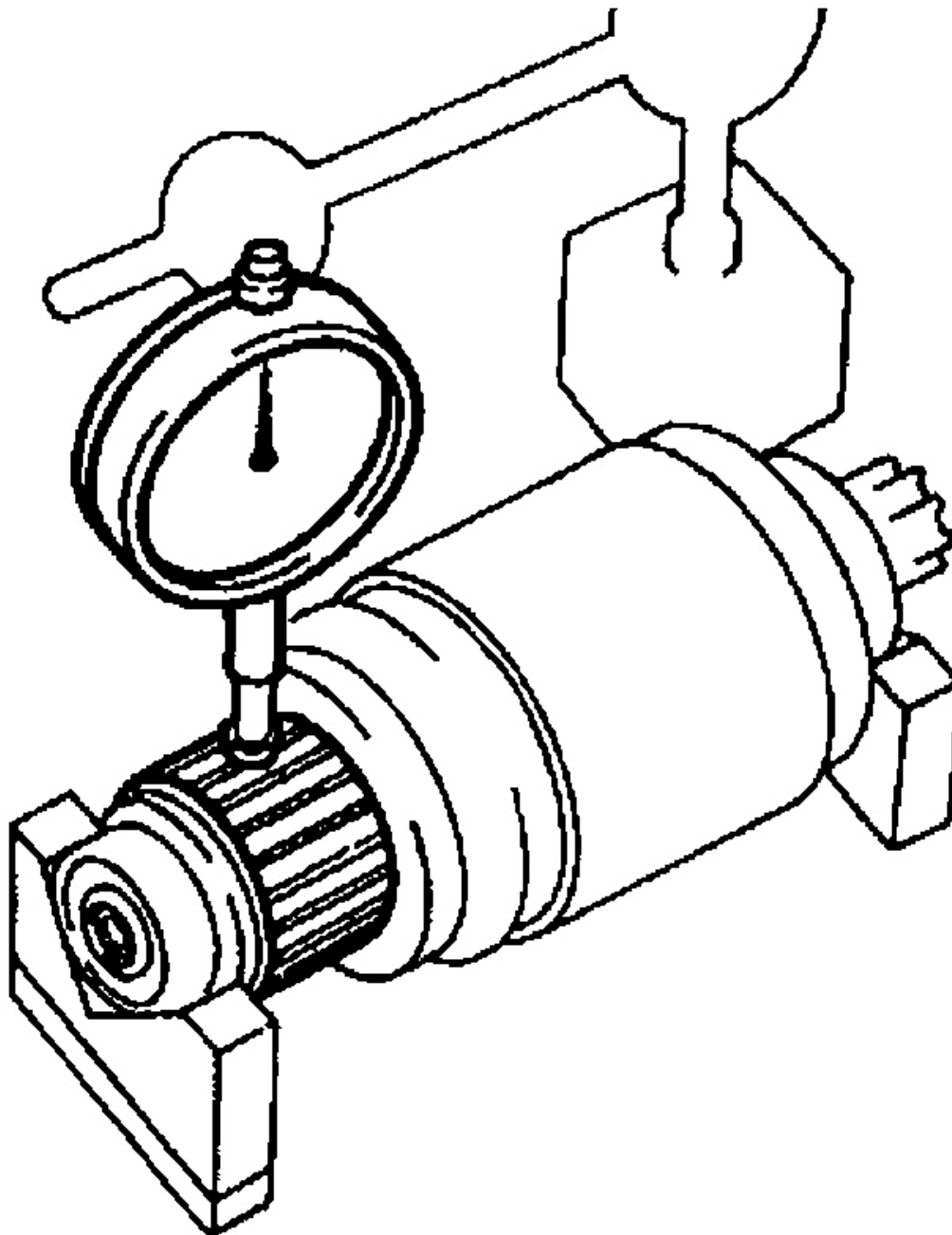


Fig. 14: Measuring Resistance Between Commutator And Armature Coil Core
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Check for the commutator circle runout.
 - 1. Place the commutator on V-blocks.
 - 2. Using a dial gauge, measure the circle runout.

Maximum circle runout: 0.05 mm (0.0020 in.)

If the circle runout is greater than the maximum, correct it on a lathe.



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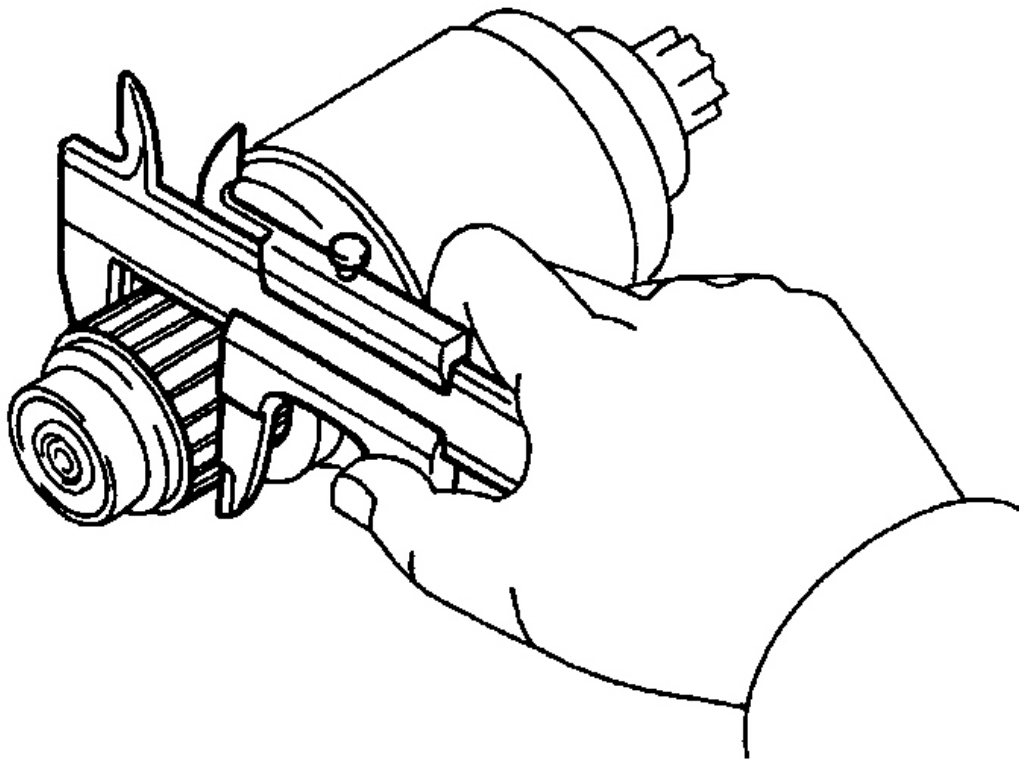
Fig. 15: Measuring Circle Runout
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Using vernier calipers, measure the commutator diameter.

Standard diameter: 30.0 mm (1.181 in.)

Minimum diameter: 29.0 mm (1.142 in.)

If the diameter is less than the minimum, replace the armature.



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Fig. 16: Measuring Commutator Diameter

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

- d. Check that the undercut depth is clean and free of foreign materials. Smooth out the edge.

Standard undercut depth: 0.6 mm (0.024 in.)

Minimum undercut depth: 0.2 mm (0.008 in.)

If the undercut depth is less than the minimum, correct it with a hacksaw blade.



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Fig. 17: Checking Undercut Depth

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

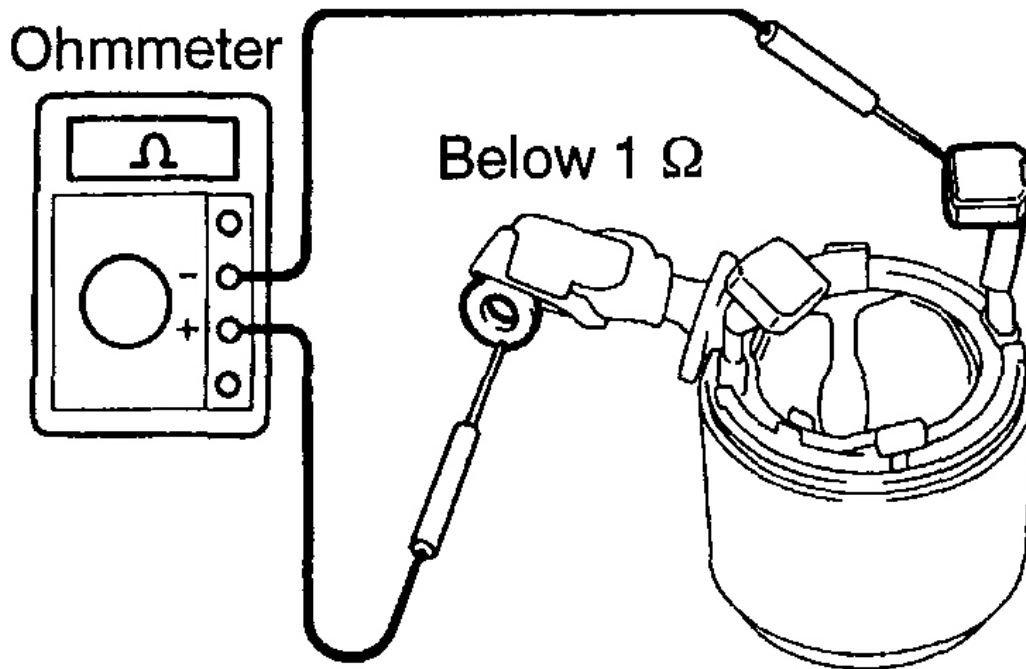
3. INSPECT FIELD COIL

- a. Check the field coil for open circuit.

Using an ohmmeter, measure the resistance between the lead wire and field coil brush lead.

Standard: Below 1 ohm

If the result is not as specified, replace the field frame.



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Fig. 18: Measuring Resistance Between Lead Wire And Field Coil Brush Lead
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Check the field coil for ground.

Using an ohmmeter, measure the resistance between the field coil brush lead and field frame.

Standard: 10 Mohm or higher

If the result is not as specified, repair or replace the field frame.

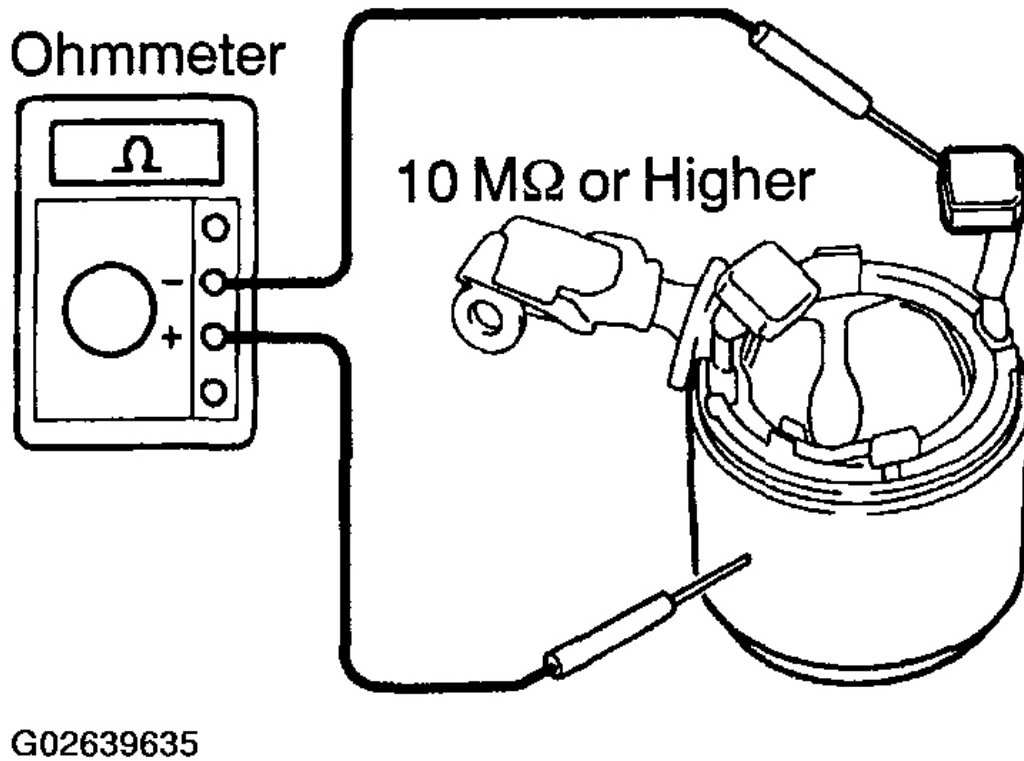


Fig. 19: Measuring Resistance Between Field Coil Brush Lead And Field Frame
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. INSPECT BRUSHES

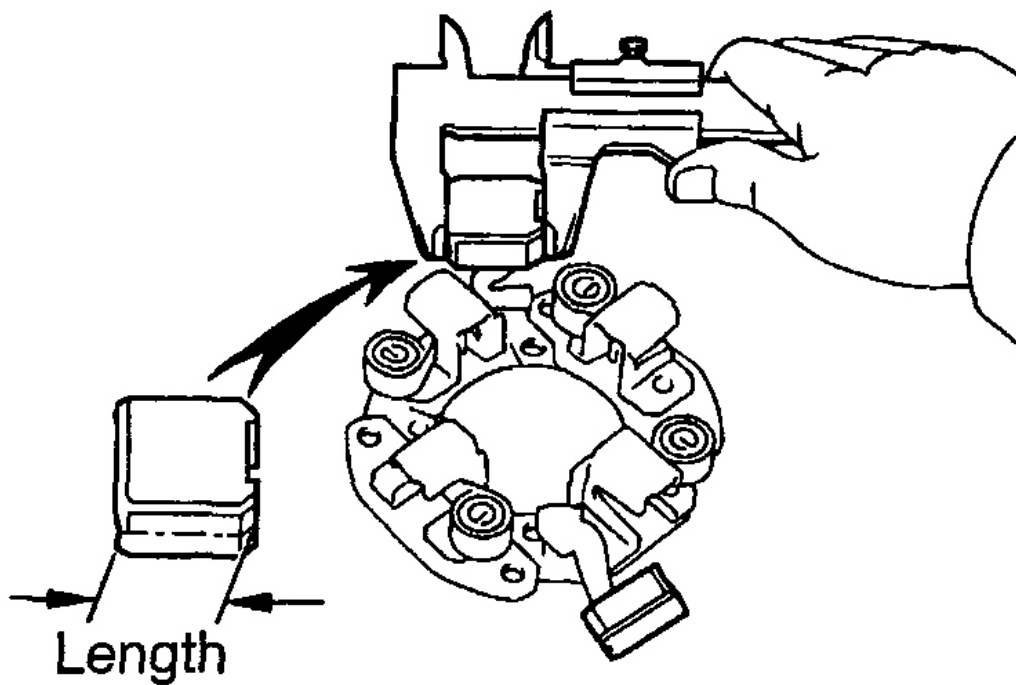
Using vernier calipers, measure the brush length.

Standard length: 15.5 mm (0.610 in.)

Minimum length: 10.0 mm (0.393 in.)

If the length is less than the minimum, replace the brush holder and field frame.

Brush Holder Side



Field Flame Side

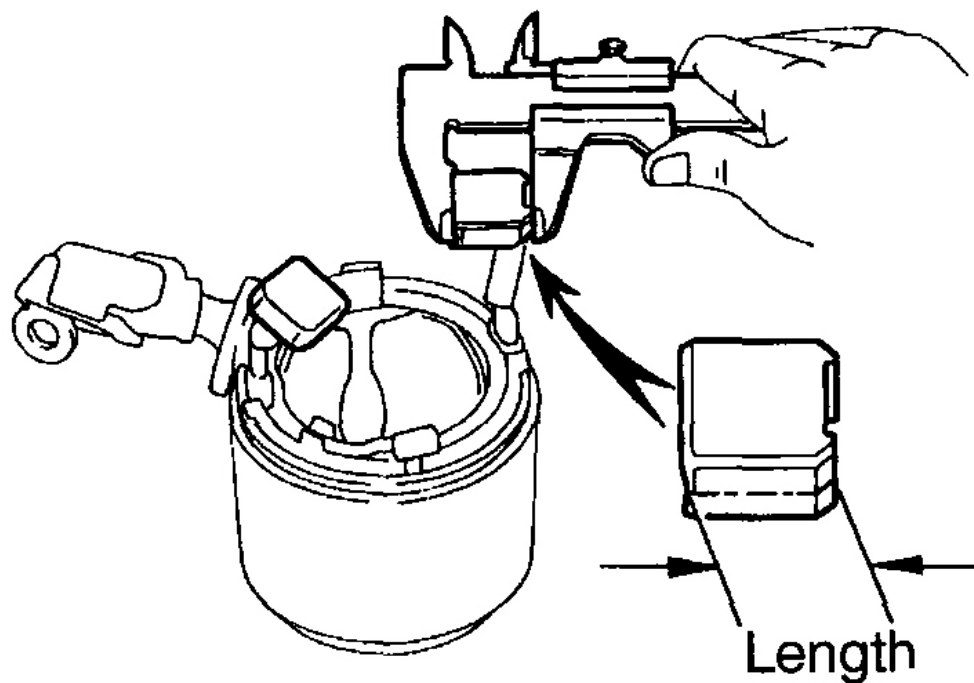


Fig. 20: Measuring Brush Length

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

5. INSPECT BRUSH SPRING

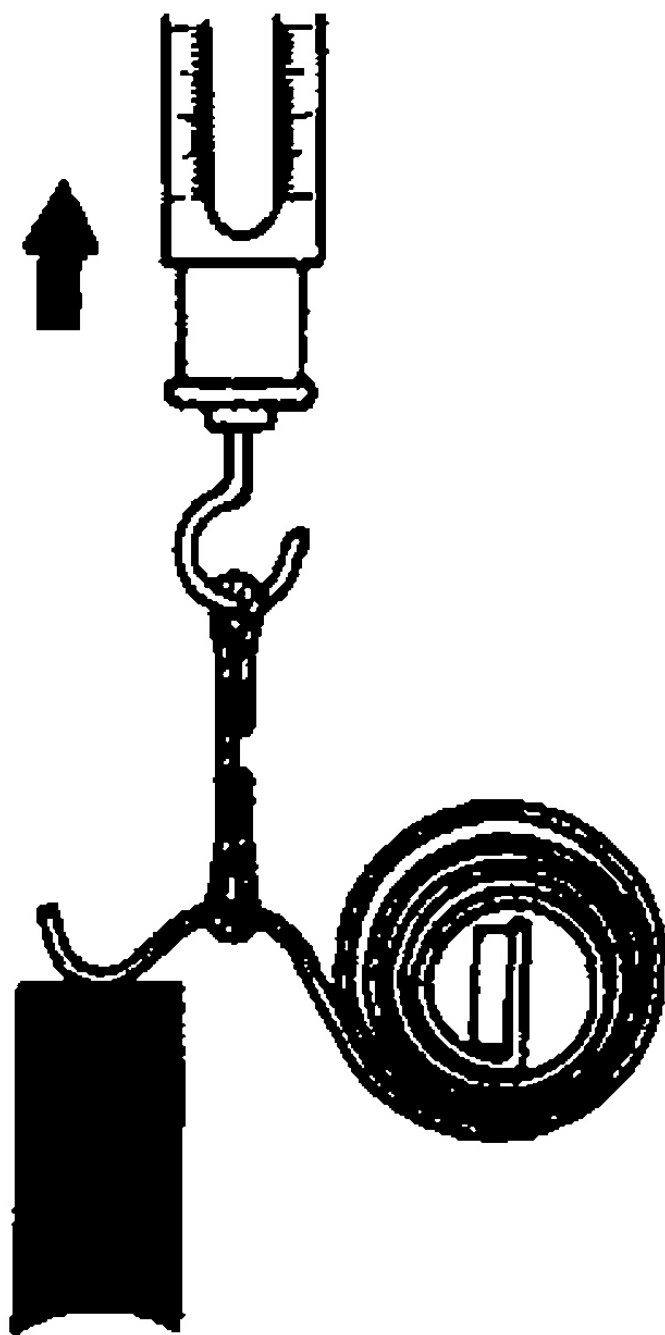
Check the brush spring load.

Take the pull scale reading the instant the brush spring separates from the brush.

Standard spring installed load:

17.6 to 23.5 N (1.80 to 2.40 kgf, 4.0 to 5.3 lbf) Minimum spring installed load: 11.8 N (1.2 kgf, 2.6 lbf)

If the installed load is less than minimum replace the springs.



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Fig. 21: Checking Brush Spring Load
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

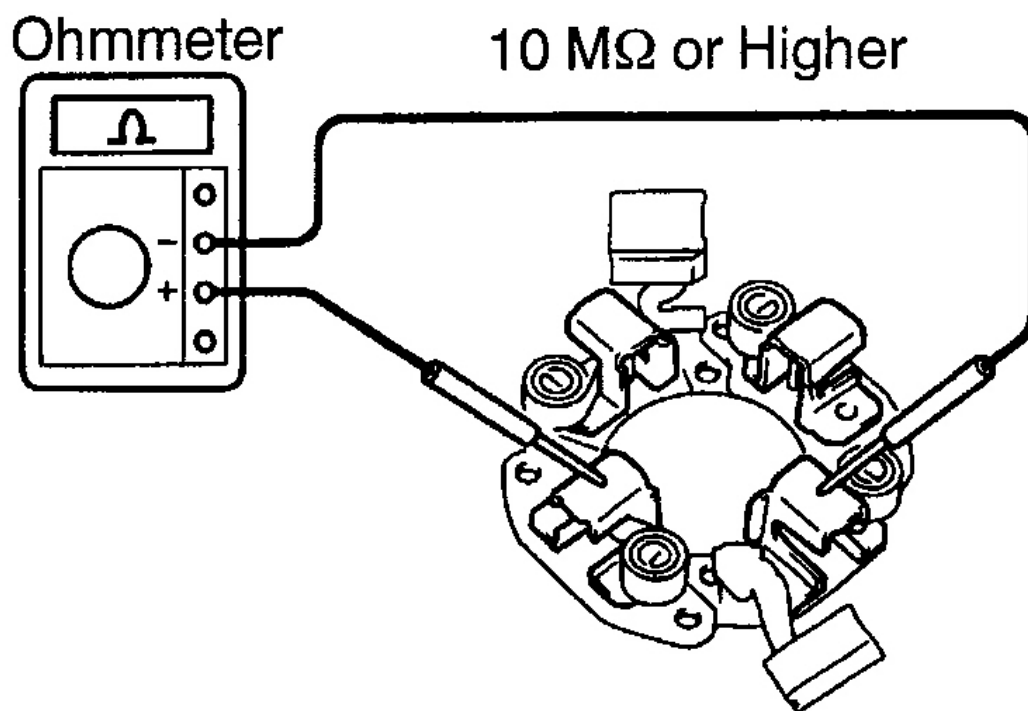
6. INSPECT BRUSH HOLDER

Check the brush holder insulation.

Using an ohmmeter, measure the resistance between the positive (+) and negative (-) brush holders.

Standard: 10 Mohm or higher

If the result is not as specified, repair or replace the brush holder.



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Fig. 22: Checking Brush Holder Insulation

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

7. INSPECT CLUTCH AND GEAR

- Check the gear teeth on the pinion gear, idler gear and clutch assembly for wear or damage.

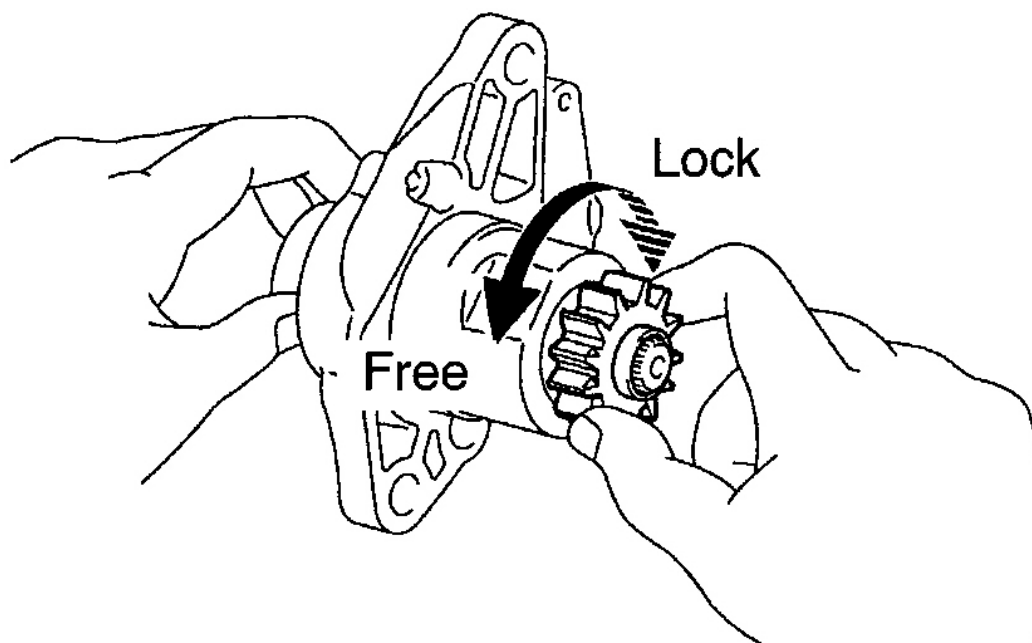
If damaged, replace the gear or clutch assembly.

If damaged, also check the ring gear of the flywheel/drive plate for wear or damage.

- Check the clutch pinion gear.

Hold the starter clutch and rotate the pinion gear counterclockwise, and check that it turns freely. Try to rotate the pinion gear clockwise and check that it locks.

If necessary, replace the clutch assembly.



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Fig. 23: Checking Clutch Pinion Gear

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

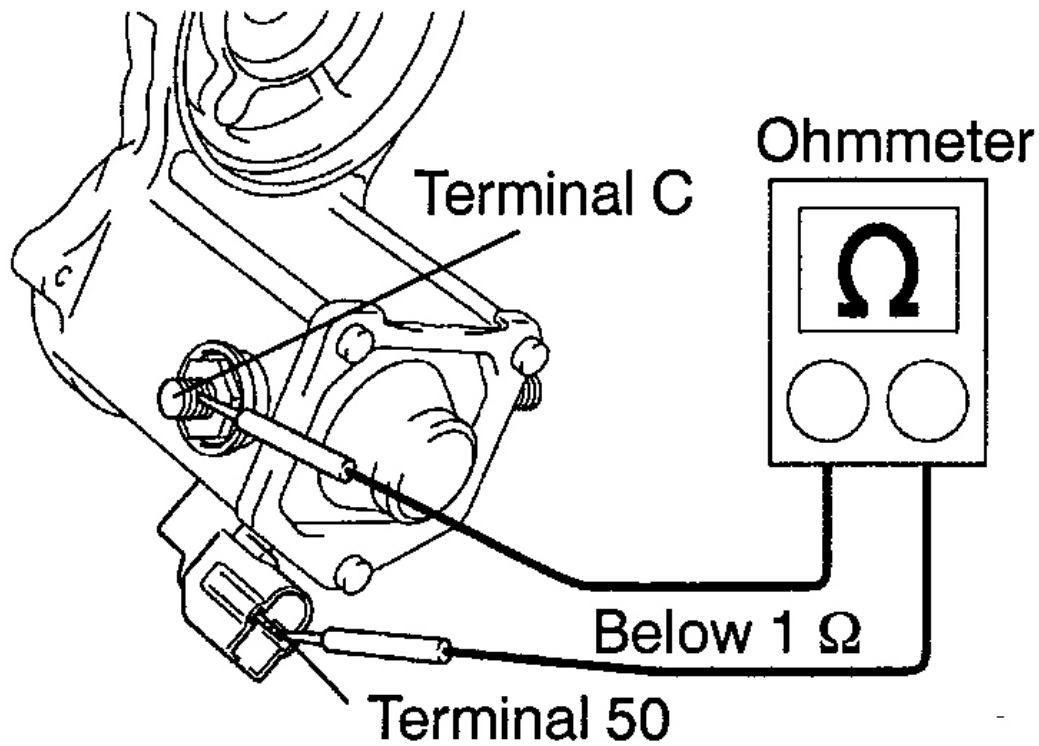
8. INSPECT MAGNETIC SWITCH

- a. Check the pull-in coil for open circuit.

Using an ohmmeter, measure the resistance between terminals 50 and C.

Standard: Below 1 ohm

If the result is not as specified, check and replace the magnetic switch.



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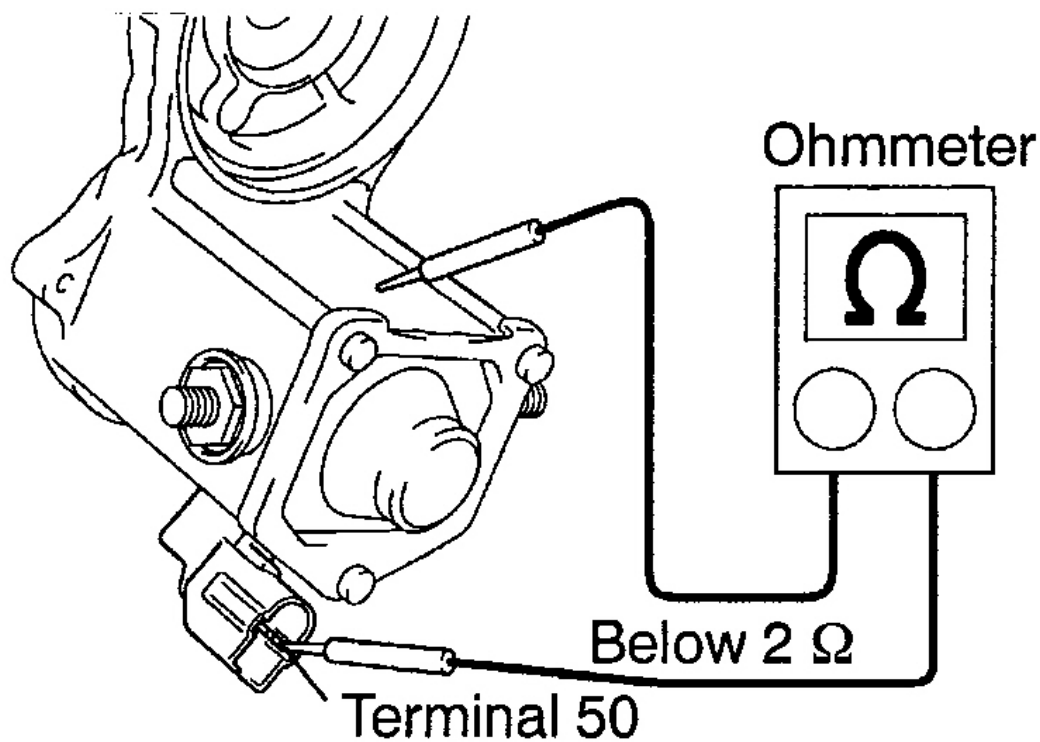
Fig. 24: Measuring Resistance Between Terminals 50 And C
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Check the hold-in coil for open circuit.

Using an ohmmeter, measure the resistance between terminal 50 and the switch body.

Standard: Below 2 ohm

If the result is not as specified, replace the magnetic switch.



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Fig. 25: Measuring Resistance Between Terminal 50 And Switch Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. INSPECT BEARING

Turn the bearing by hand while applying inward force.

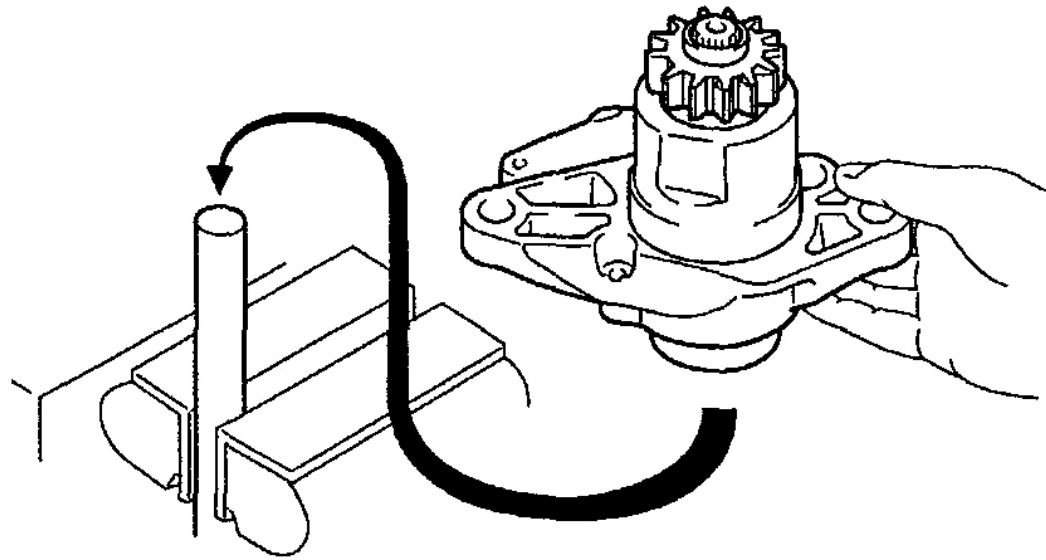
If resistance is felt or the bearing sticks, replace the bearing (see **REPLACEMENT**).

REPLACEMENT

1. REPLACE CLUTCH ASSEMBLY

- a. Disassemble the starter housing and the clutch assembly.

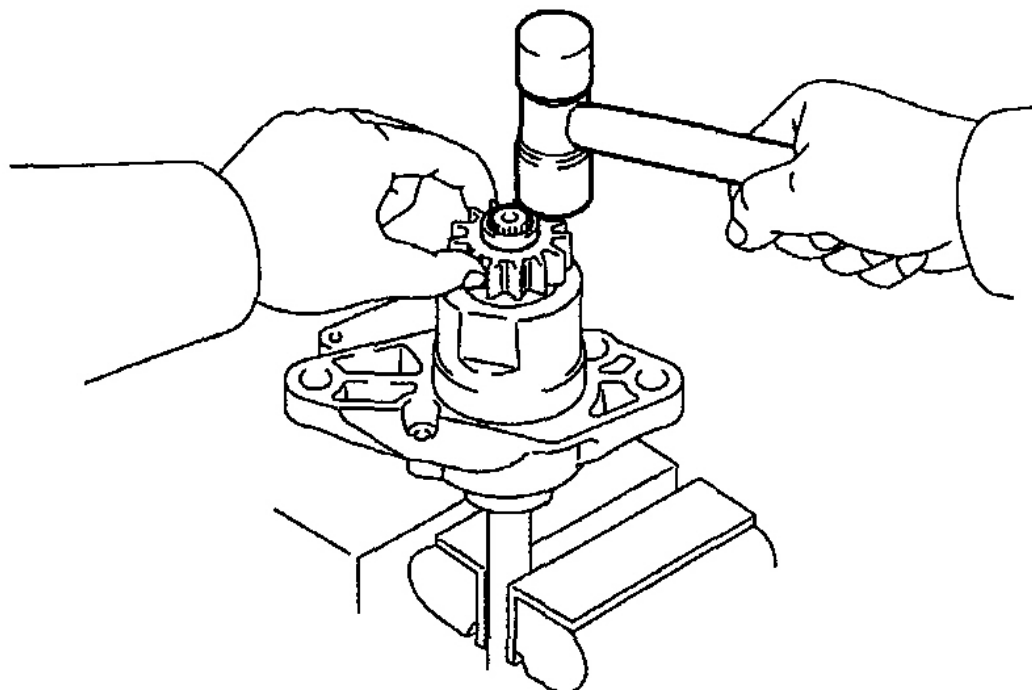
1. Mount a brass bar in a vise, and install the starter housing and clutch assembly to the brass bar.



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Fig. 26: Installing Starter Housing And Clutch Assembly To Brass Bar
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Push down the pinion gear.
3. Using a plastic-faced hammer, tap down the stop collar.

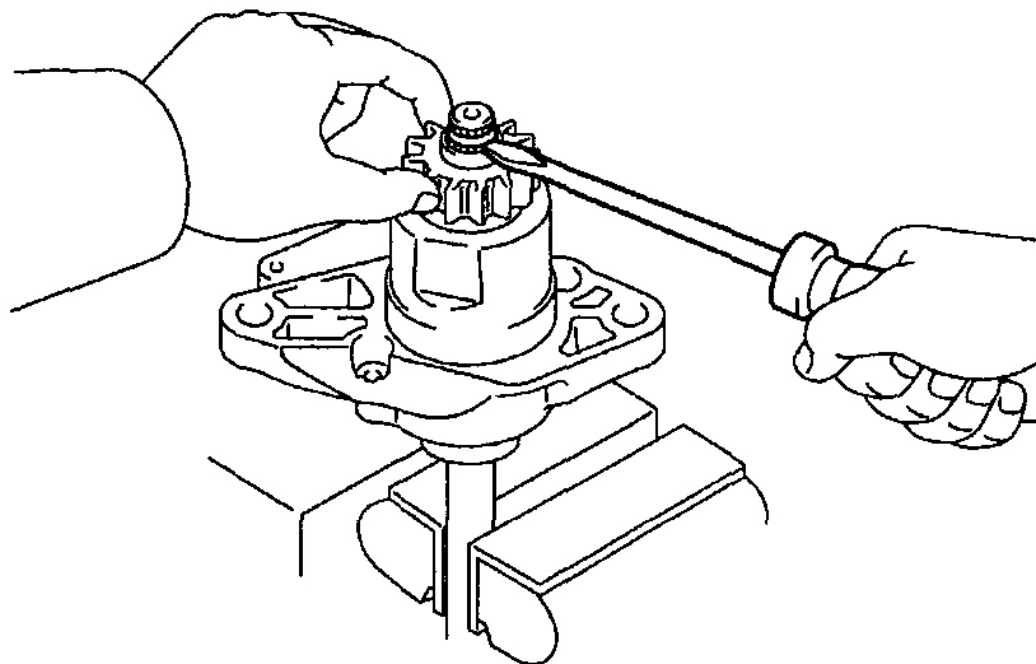


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Fig. 27: Tapping Down Stop Collar

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

4. Using a screwdriver, pry out the snap ring.

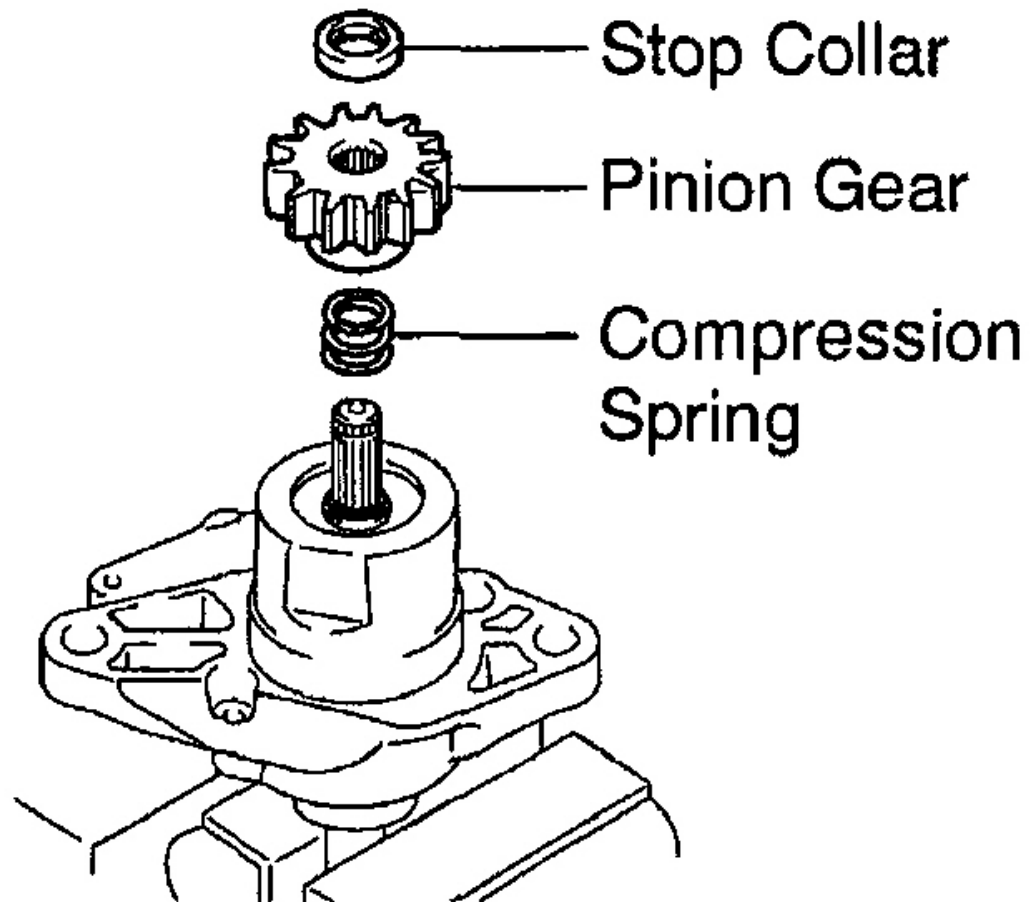


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Fig. 28: Prying Out Snap Ring

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

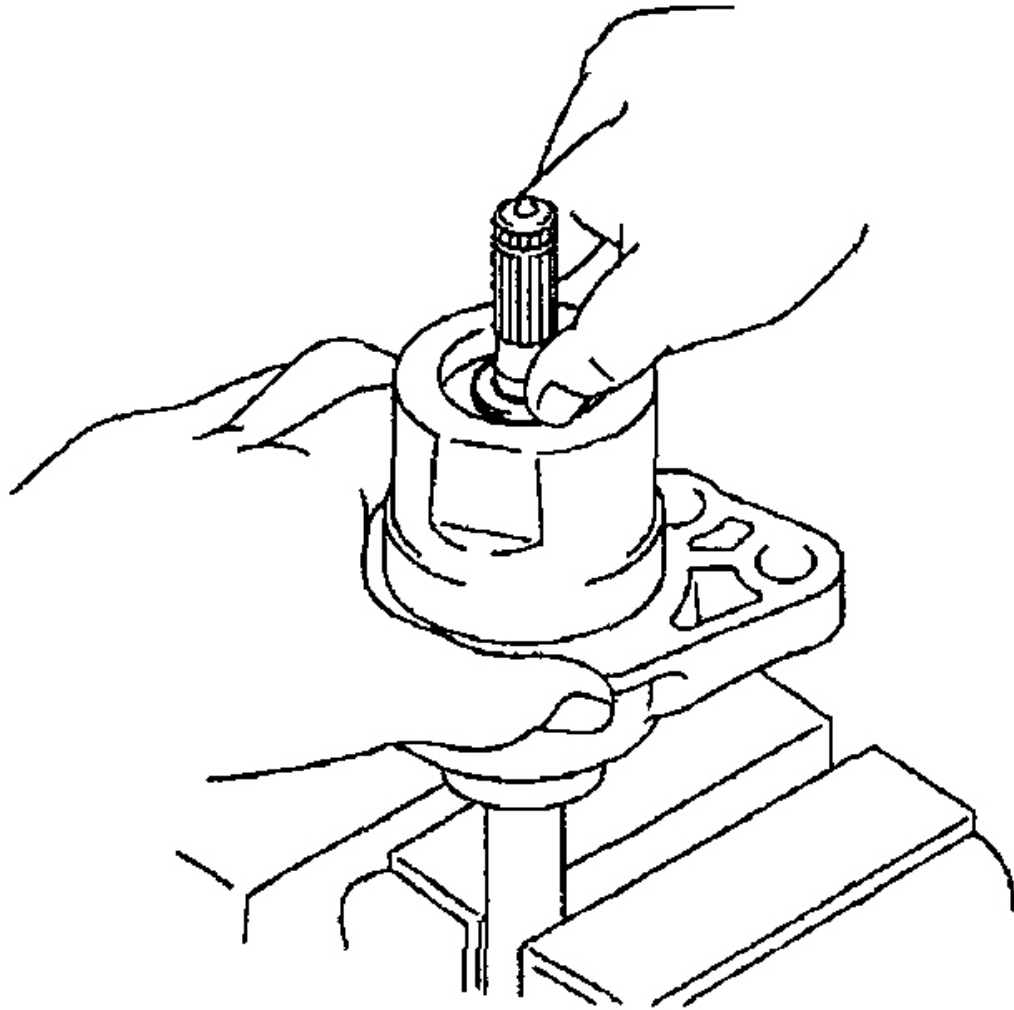
5. Remove the stop collar, pinion and compression spring.



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Fig. 29: Removing Stop Collar, Pinion And Compression Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Push down the starter housing, and remove the spring retainer.
7. Remove the clutch shaft, compression spring and starter clutch from the starter housing.

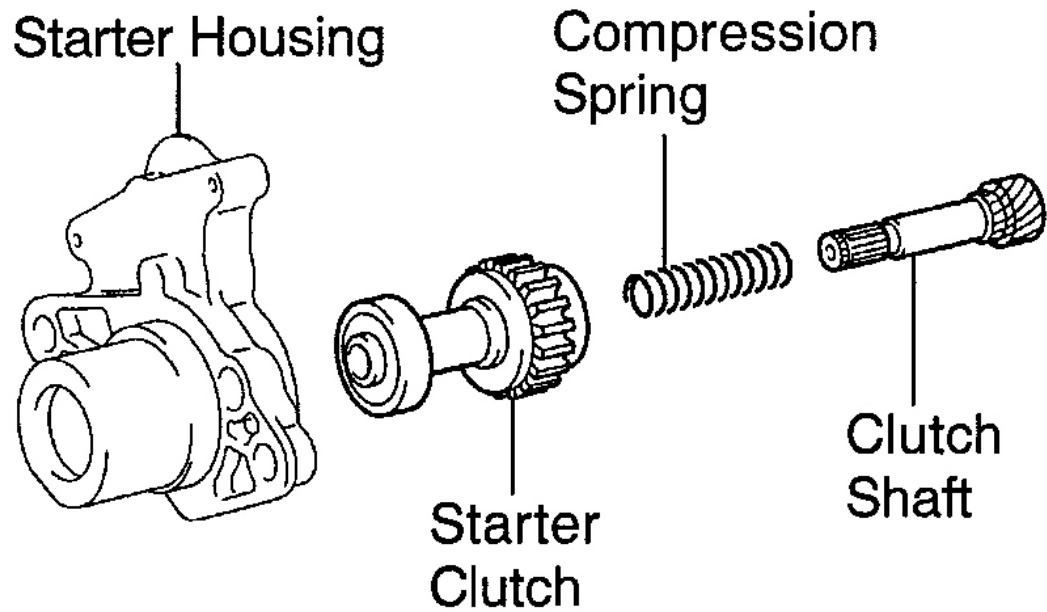


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Fig. 30: Removing Clutch Shaft

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

- b. Assemble the starter housing and the clutch assembly.
 - 1. Install the starter clutch, compression spring, and clutch shaft to the starter housing.

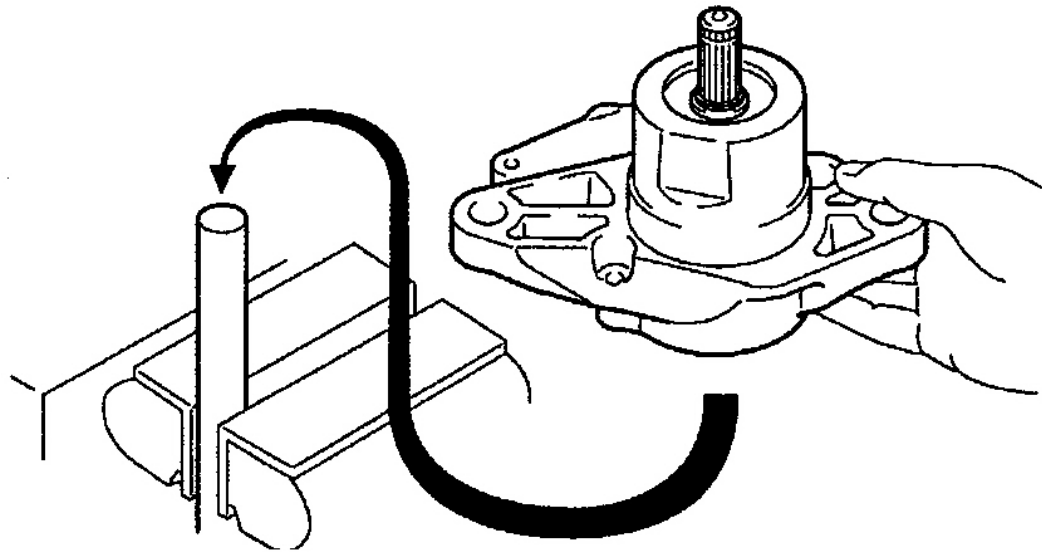


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Fig. 31: Installing Starter Clutch, Compression Spring, And Clutch Shaft To Starter Housing

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

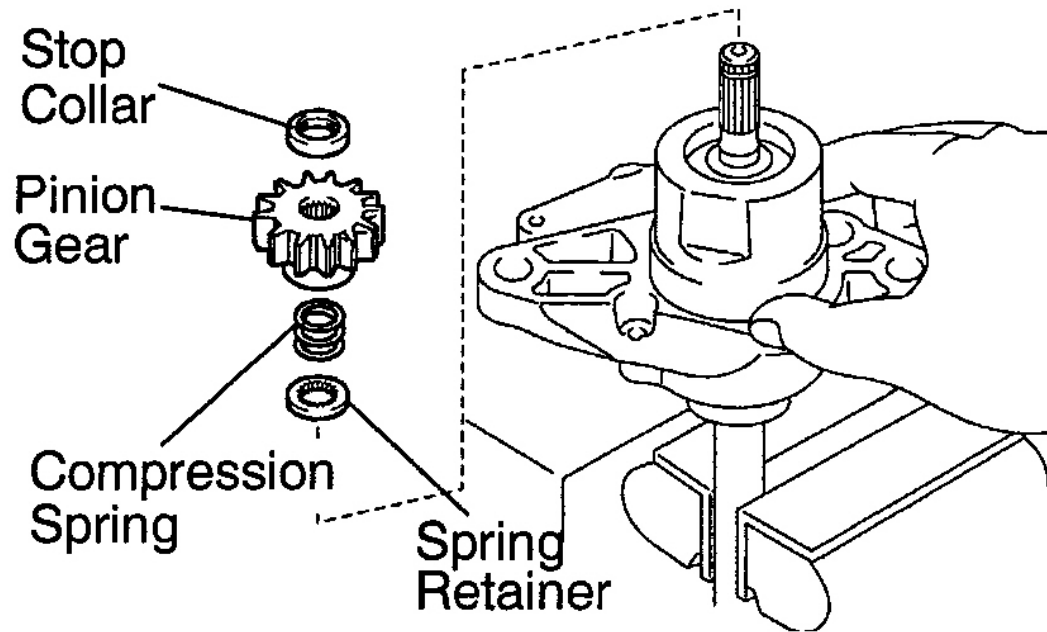
2. Mount a brass bar in a vise, install the starter housing and clutch assembly to the brass bar.



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Fig. 32: Installing Starter Housing And Clutch Assembly To Brass Bar
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

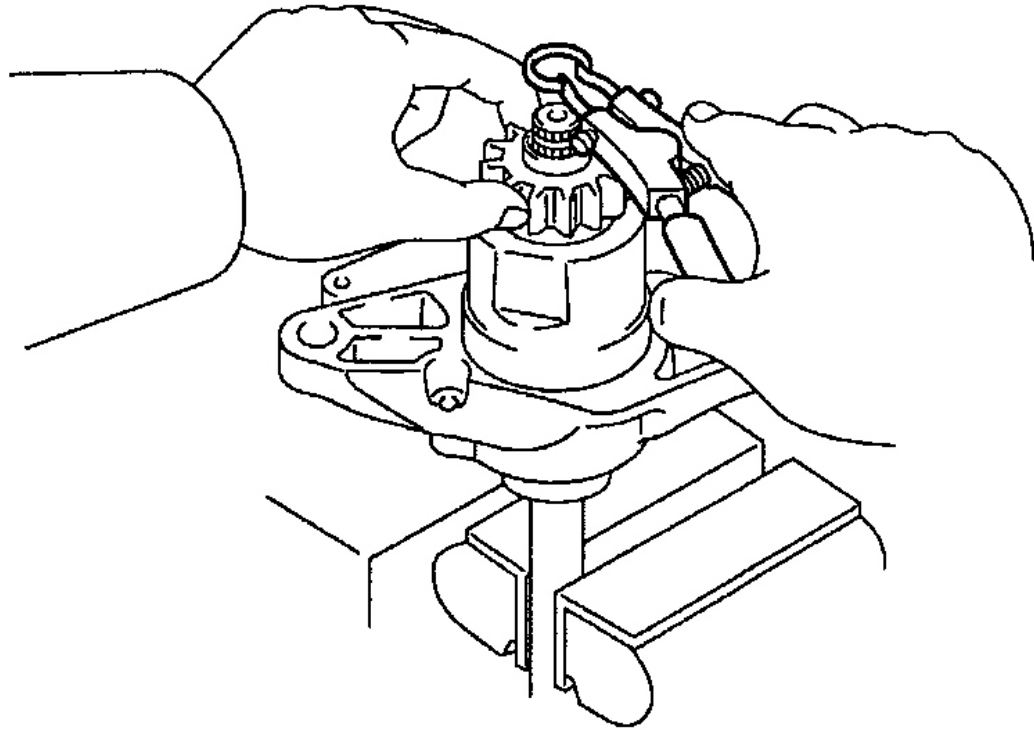
3. Push down the starter housing, and install the spring retainer, compression spring, pinion gear and stop collar.



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Fig. 33: Installing Spring Retainer, Compression Spring, Pinion Gear And Stop Collar
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Push down the pinion gear.
5. Using snap ring pliers, install a new snap ring.

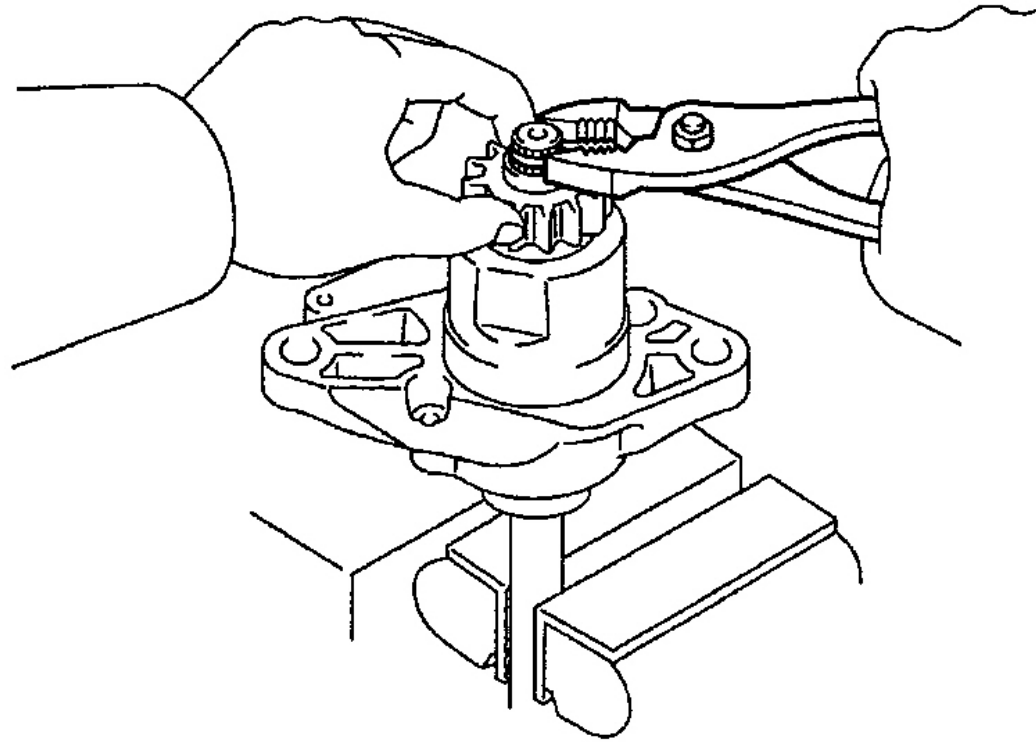


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Fig. 34: Installing New Snap Ring

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

6. Using pliers, compress the snap ring.
7. Check that the snap ring fits correctly.
8. Remove the starter housing and clutch assembly from the brass bar.

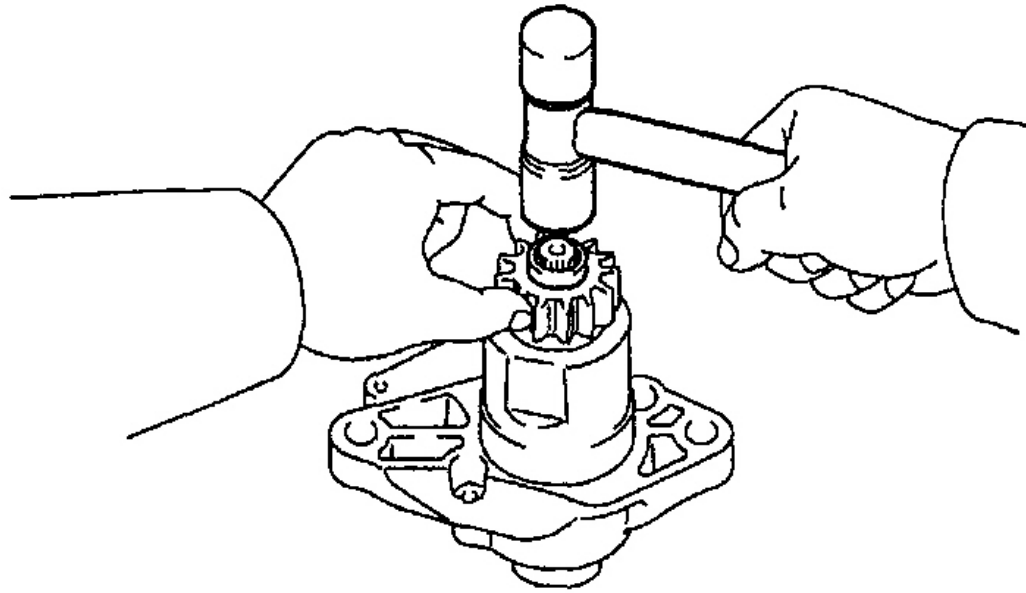


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Fig. 35: Compressing Snap Ring

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

9. Using a plastic-faced hammer, tap the clutch shaft and install the stop collar onto the snap ring.



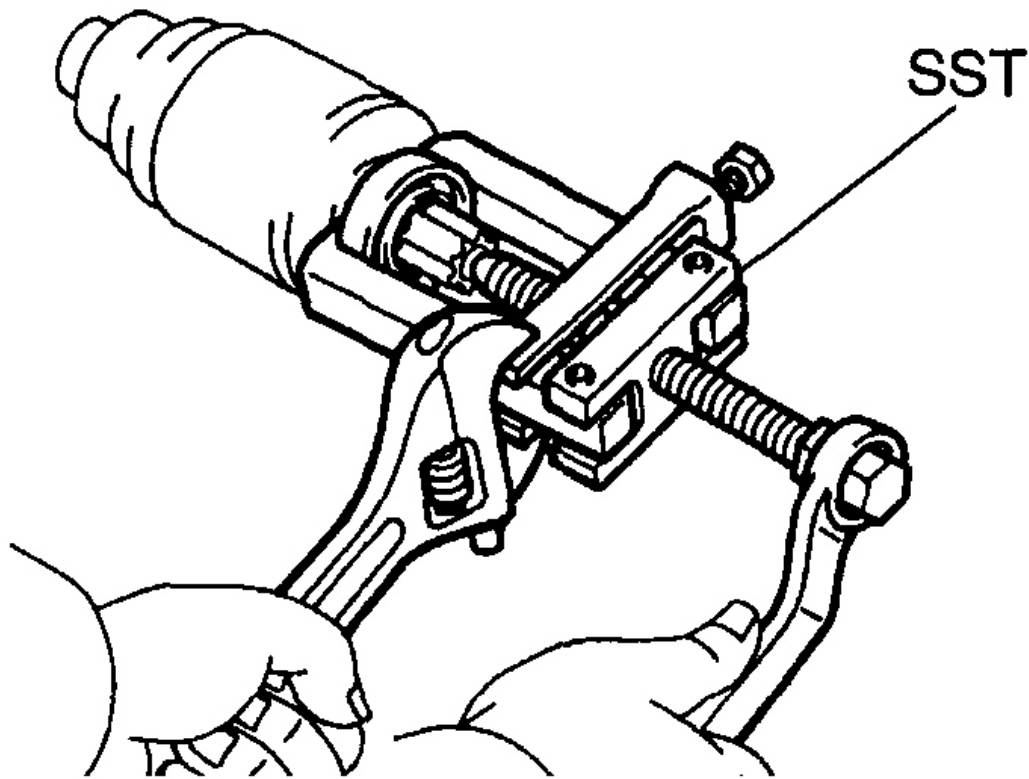
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Fig. 36: Installing Stop Collar Onto Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. REPLACE FRONT BEARING

- a. Using SST, remove the bearing.

SST 09286-46011



G02639653

Fig. 37: Removing Bearing Using SST

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

- b. Using SST and a press, press in a new bearing.

NOTE: Be careful of the bearing installation direction.

SST 09820-00031

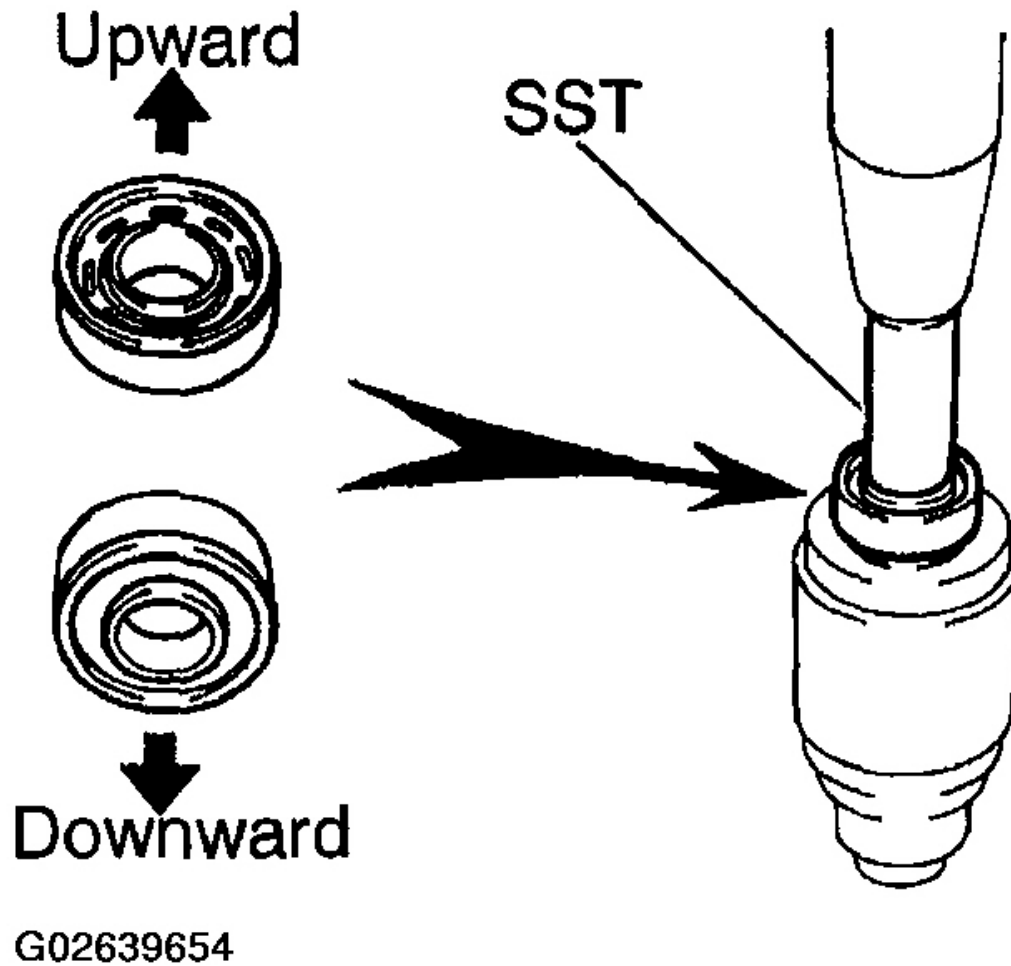


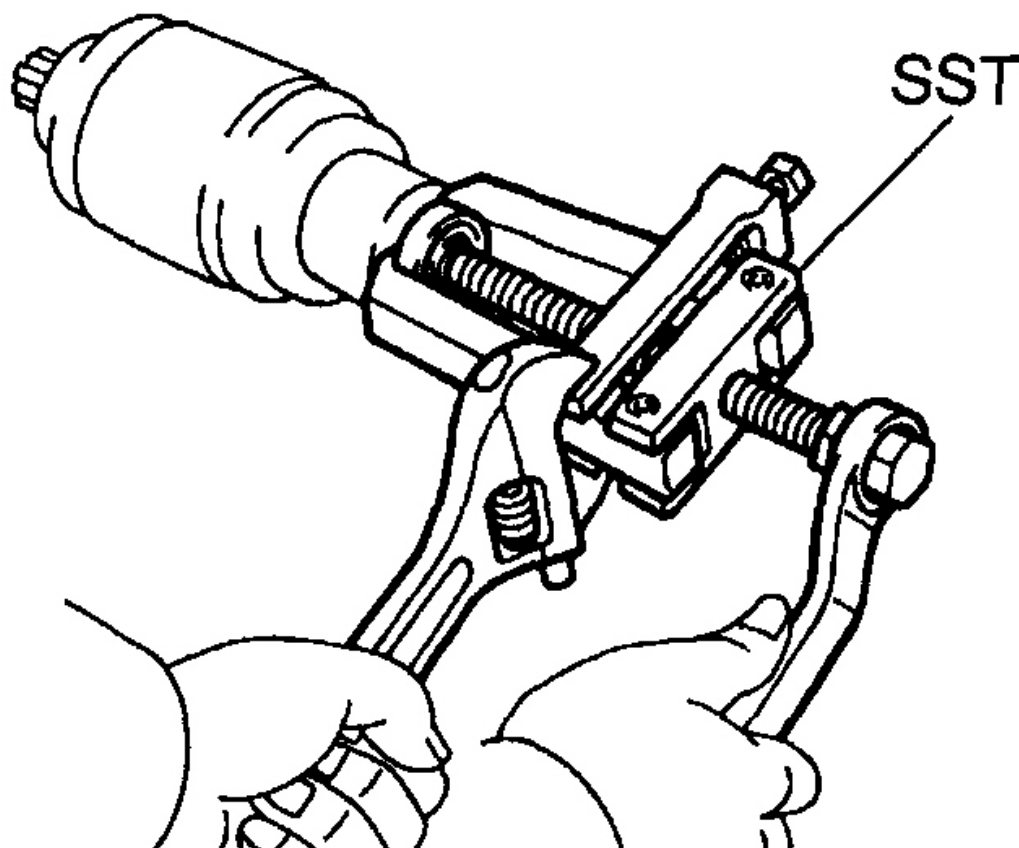
Fig. 38: Pressing New Bearing

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

3. REPLACE REAR BEARING

- a. Using SST, remove the bearing.

SST 09286-46011

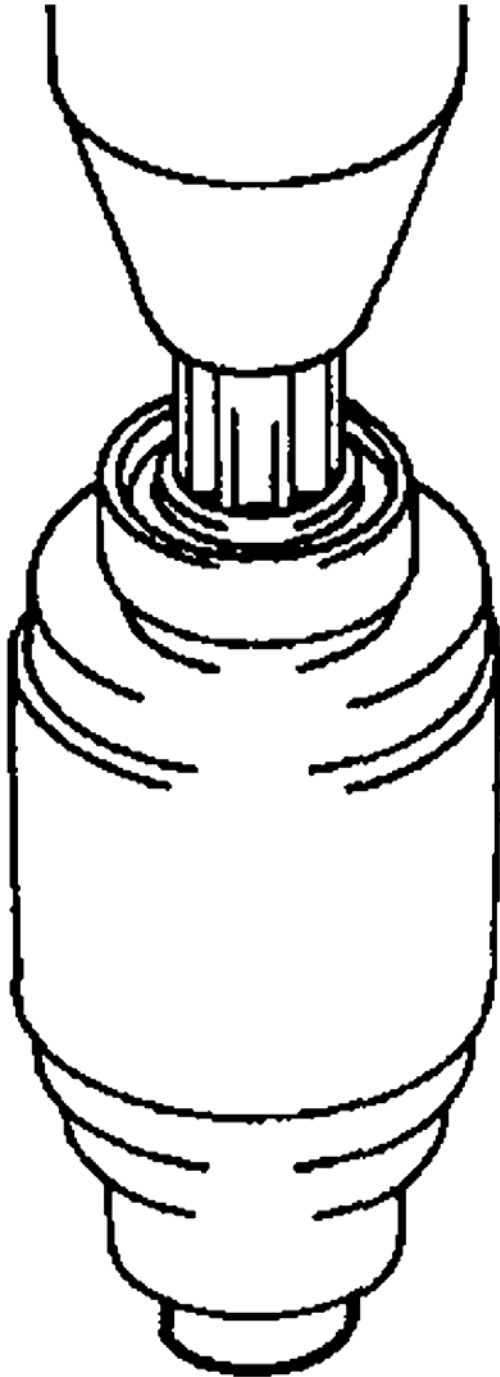


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Fig. 39: Removing Bearing

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

- b. Using a press, press in a new bearing.



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Fig. 40: Pressing New Bearing

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

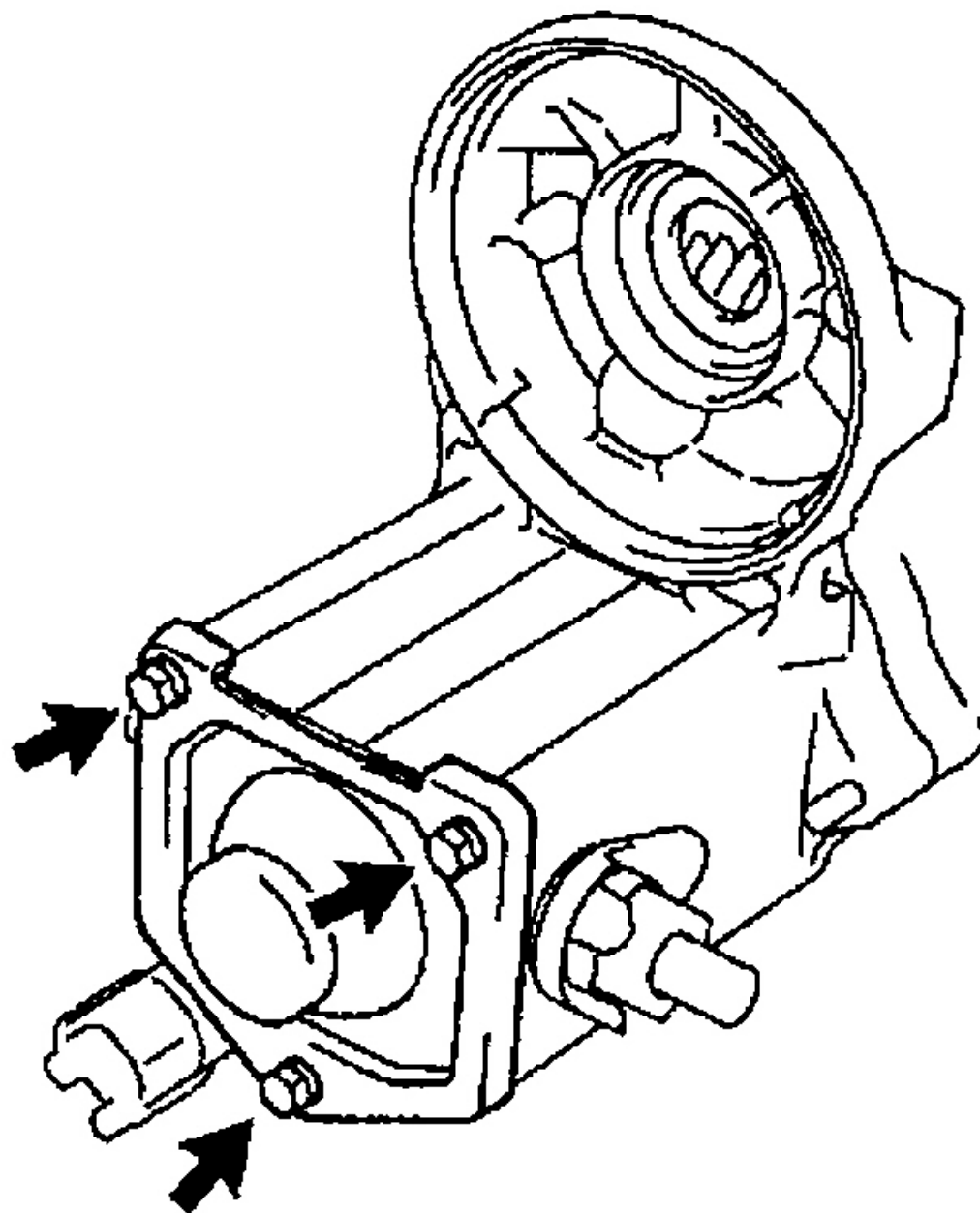
4. REPLACE MAGNETIC SWITCH TERMINAL KIT PARTS

2005 Toyota RAV4

2005 ENGINE Starting - RAV4

- a. Remove the 3 bolts, end cover, gasket and plunger.

Torque: 1.5 N.m (15 kgf.cm, 13 in.lbf)



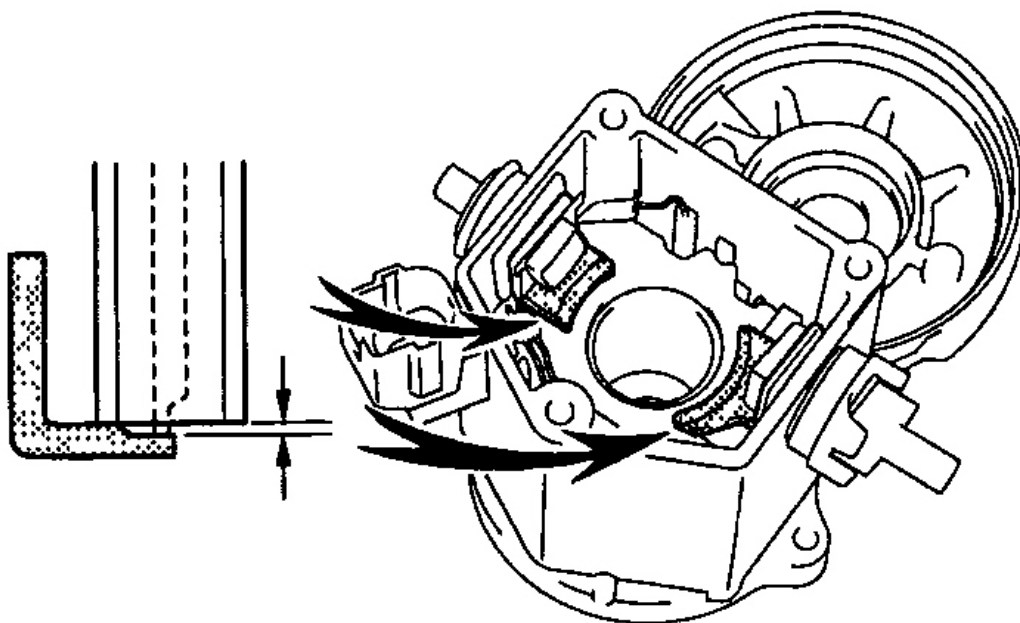
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Fig. 41: Removing End Cover, Gasket And Plunger
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using vernier calipers, measure the contact plate for depth of wear.

Maximum wear: 0.9 mm (0.035 in.)

If the depth of wear is greater than the maximum, replace the contact plate.



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Fig. 42: Measuring Contact Plate For Depth Of Wear

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

- c. Remove the terminal kit parts.
1. Using SST, loosen the terminal nuts.

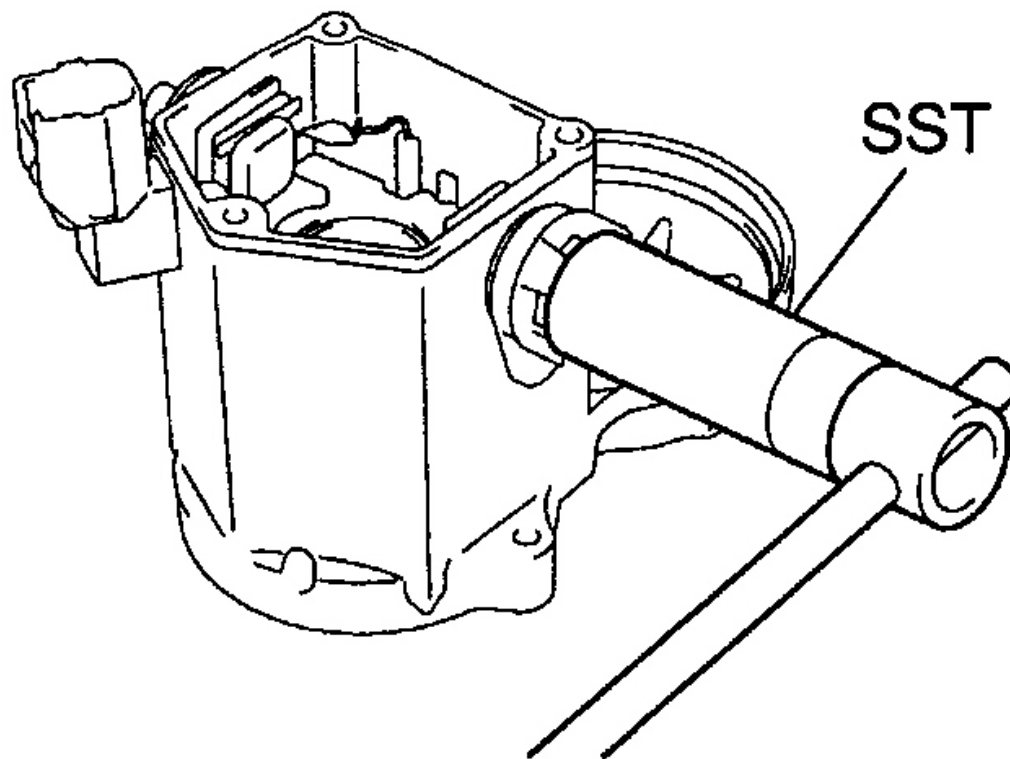
SST 09810-38140

2. Terminal C:

Remove the terminal nut, wave washer, terminal insulator (outside), O-ring, terminal bolt, contact plate and terminal insulator (inside).

3. Terminal 30:

Remove the terminal nut, wave washer, terminal insulator (outside), packing, O-ring, terminal bolt, contact plate, and terminal insulator (inside).



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Fig. 43: Loosening Terminal Nuts

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

- d. Temporarily install new terminal 30 kit parts:
1. Install a new terminal insulator (inside).

NOTE: Be careful to install the terminal insulator in the correct direction.

2. Install a new contact plate.
3. Install a new terminal bolt.
4. Install a new O-ring.
5. Install a new packing to a new terminal insulator, and install them.

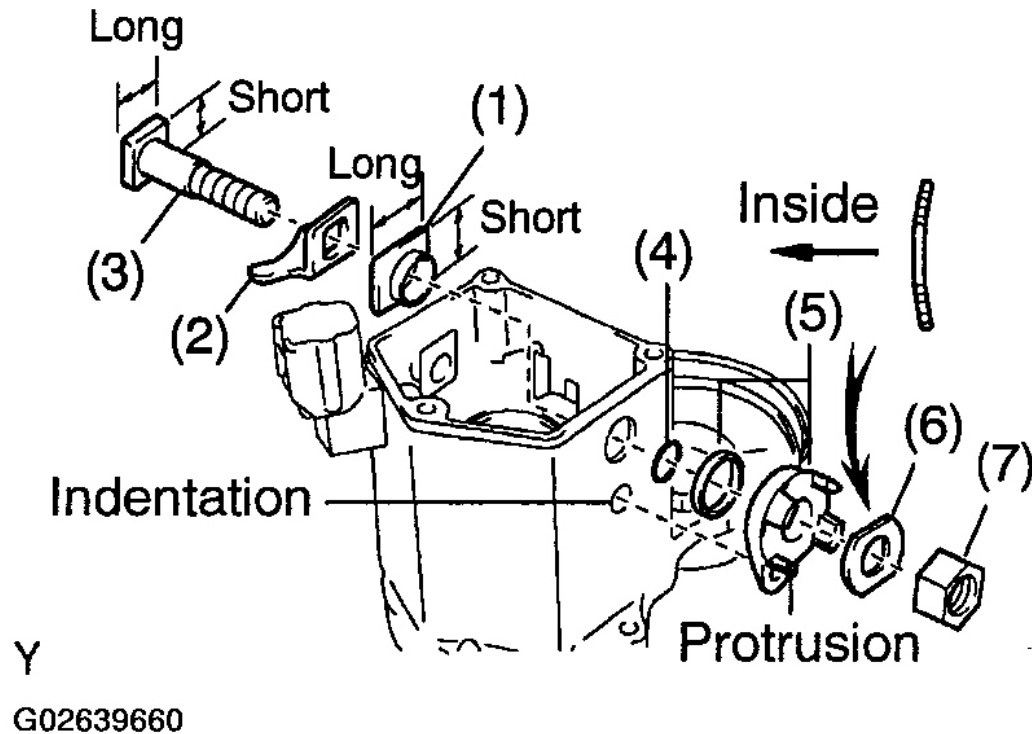


Fig. 44: Installing New Terminal Insulator

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

HINT:

Match the protrusion of the insulator with the indentation of the housing.

6. Install a new wave washer.

NOTE: Be careful to install the wave washers in the correct direction.

7. Install a new terminal nut.

Temporarily tighten the terminal nut.

- e. Temporarily install new terminal C kit parts:

1. Install a new terminal insulator (inside).

NOTE: Be careful to install the terminal insulator in the correct direction.

2. Install a new contact plate.
3. Install a new terminal bolt.
4. Install a new O-ring.
5. Install a new terminal insulator (outside).
6. Install a new wave washer.

NOTE: Be careful to install the wave washer in the correct direction.

7. Install a new terminal nut.

Temporarily tighten the terminal nut.

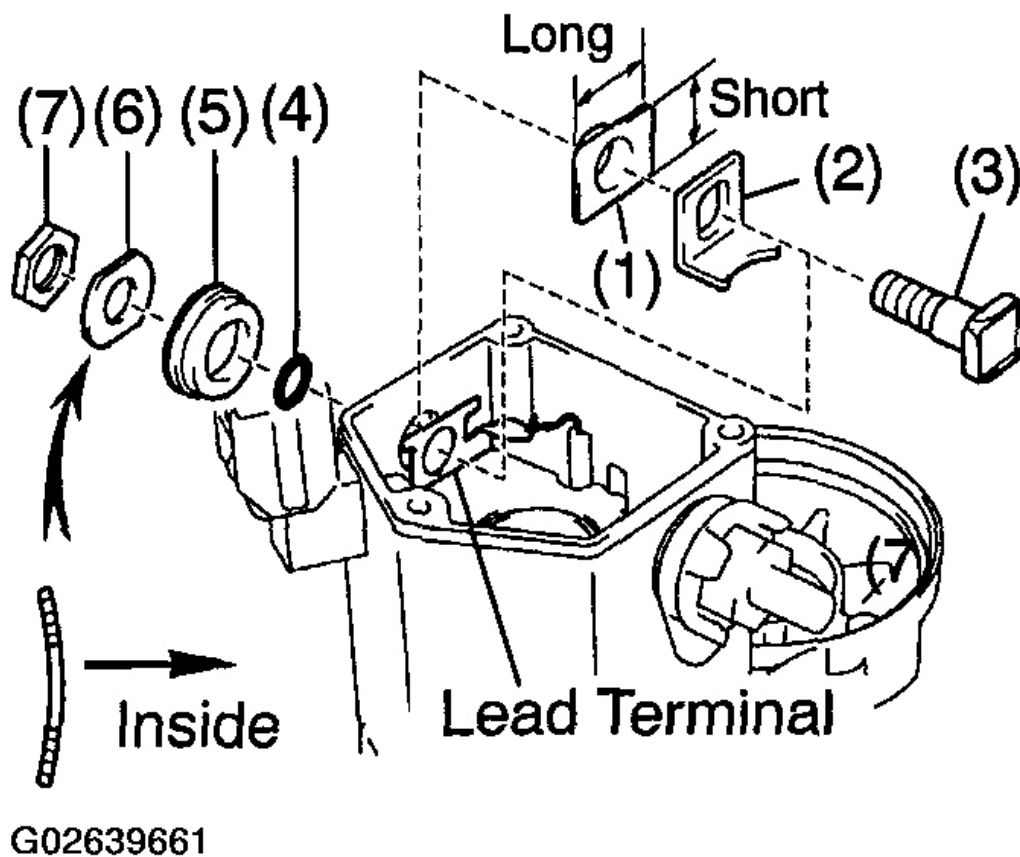


Fig. 45: Installing New Terminal Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Tighten terminal nuts.

1. Put a wooden block on the contact plate and press it down with a hand press.

Dimensions of wooden block: 20 x 37 x 40 mm (0.79 x 1.46 x 1.57 in.)

Press force: 981 N (100 kgf, 221 lbf)

NOTE:

- Check the diameter of the hand press ram. Then calculate the gauge pressure of the press when 981 N (100 kgf, 221 lbf) of force is applied.
Gauge pressure:

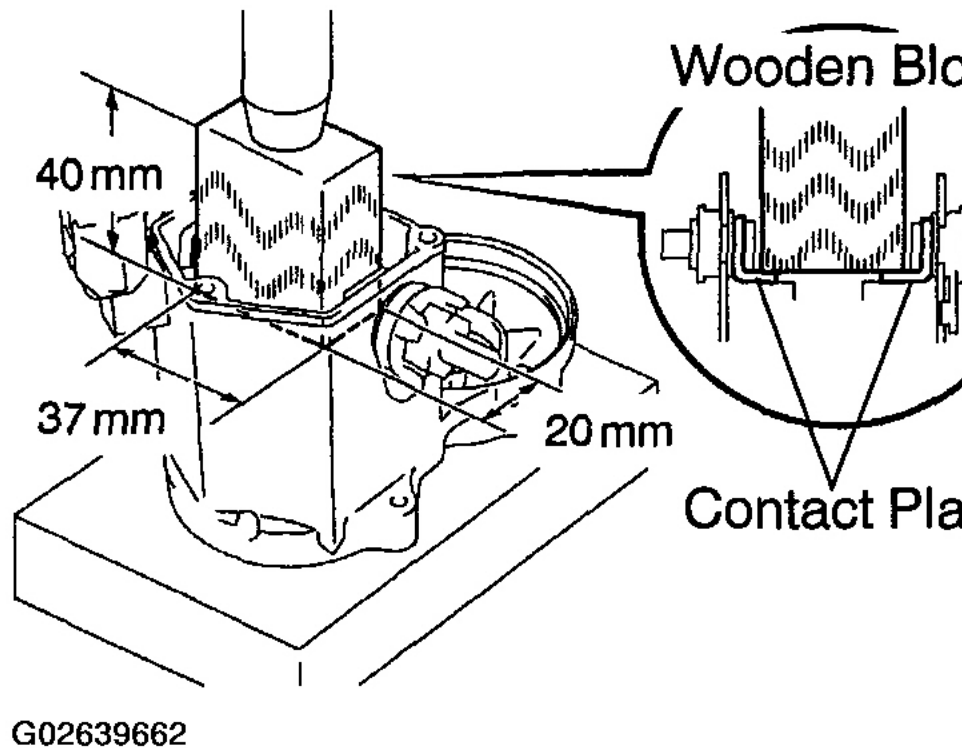


Fig. 46: Identifying Wooden Block On Contact Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2} \times 3.14$$

$$(\text{psi}) = \frac{221 \text{ lbf}}{\left(\frac{\text{Ram diameter (in.)}}{2} \right)^2} \times 3.14 (\pi)$$

$$(\text{kPa}) = (\text{kgf/cm}^2) \times 98.1$$

$$(\text{kPa}) = (\text{psi}) \times 6.9$$

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Fig. 47: Calculating Gauge Pressure Of Press
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

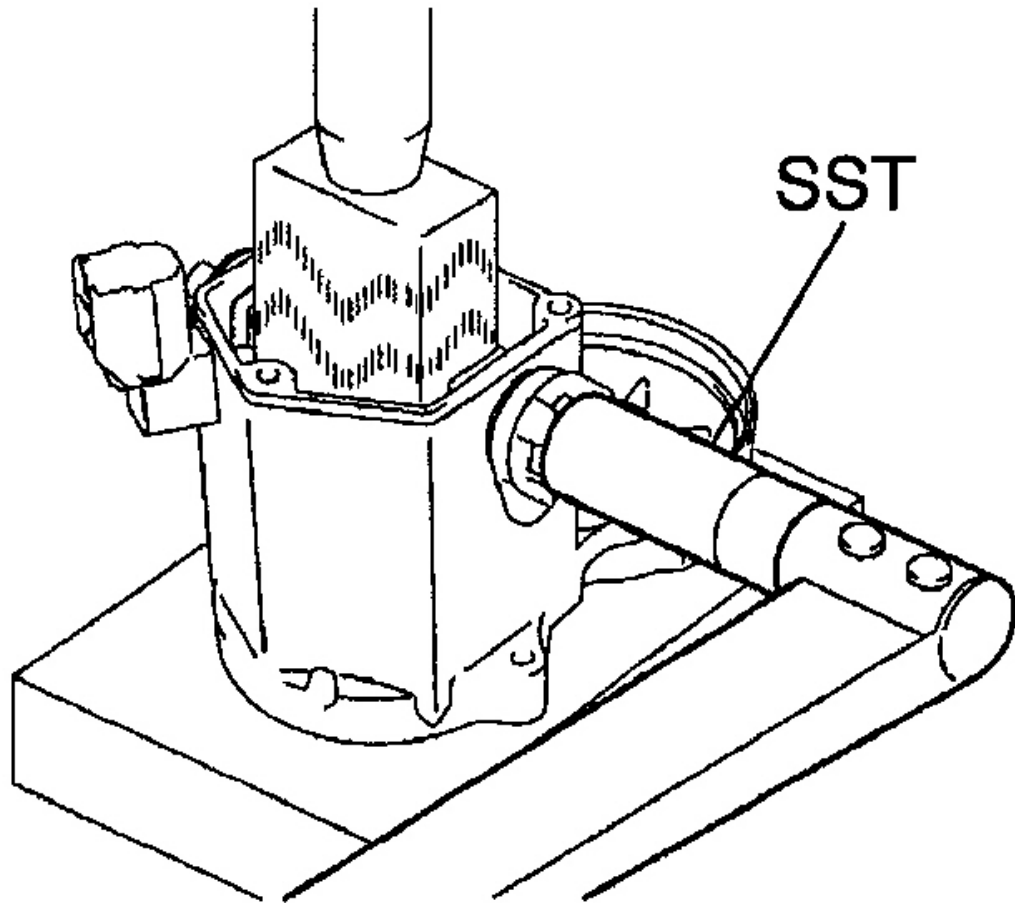
- If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.

2. Using SST, tighten the nuts to the specified torque.

SST 09810-38140

Torque: 17 N.m (173 kgf.cm, 13 ft.lbf)

NOTE: If the nut is over tightened, it may cause cracks on the inside of the insulator.



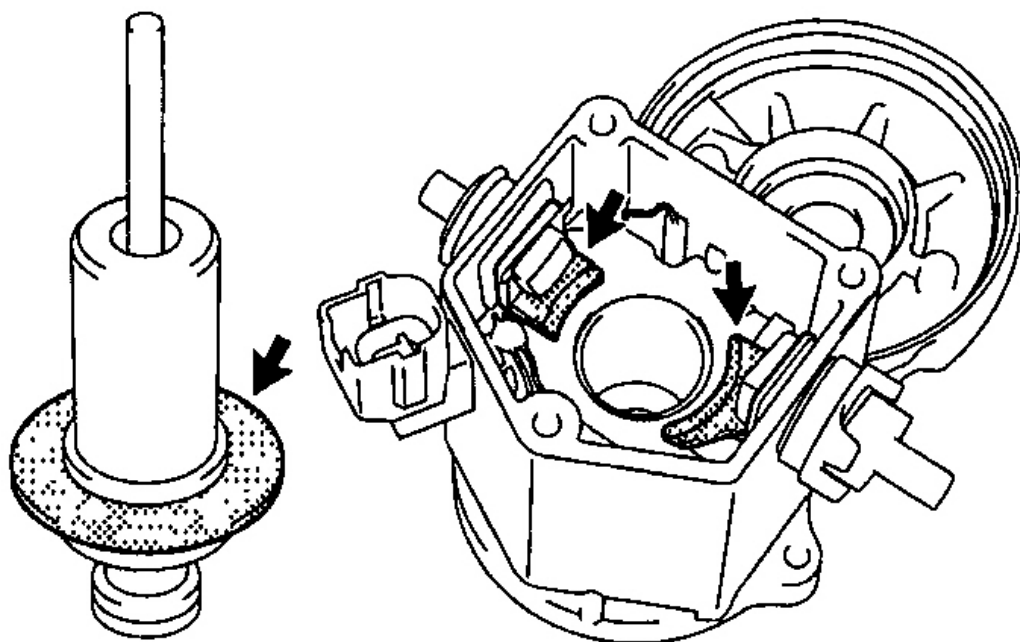
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Fig. 48: Tightening Nuts

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

- g. Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.
- h. Reinstall the plunger, a new gasket and the end cover with the 3 bolts.

Torque: 2.5 N.m (26 kgf.cm, 23 in.lbf)



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Fig. 49: Cleaning Contact Surfaces Of Contact Plate And Plunger
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

Reassembly is in the reverse order of disassembly (see DISASSEMBLY).

HINT:

Before reassembly, use high-temperature grease to lubricate the bearings, springs, steel ball and gears when assembling the starter.

TEST

NOTE: These tests must be done within 3 to 5 seconds to avoid burning out the coil.

1. DO PULL-IN TEST

- a. Disconnect the field coil lead wire from terminal C.
- b. Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward.

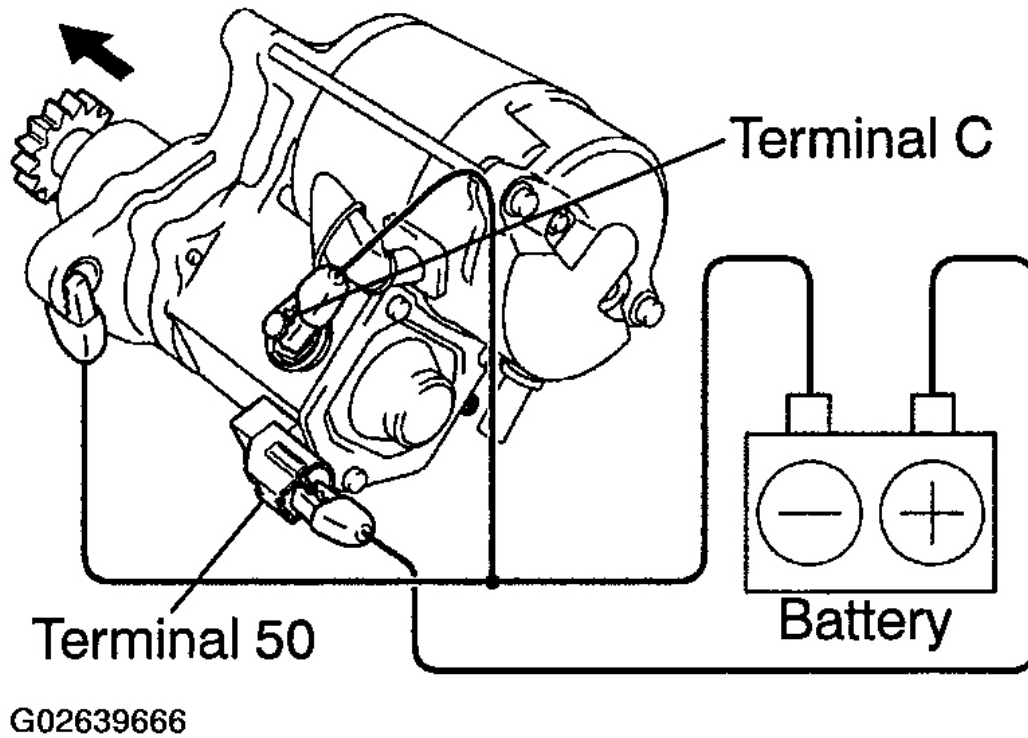
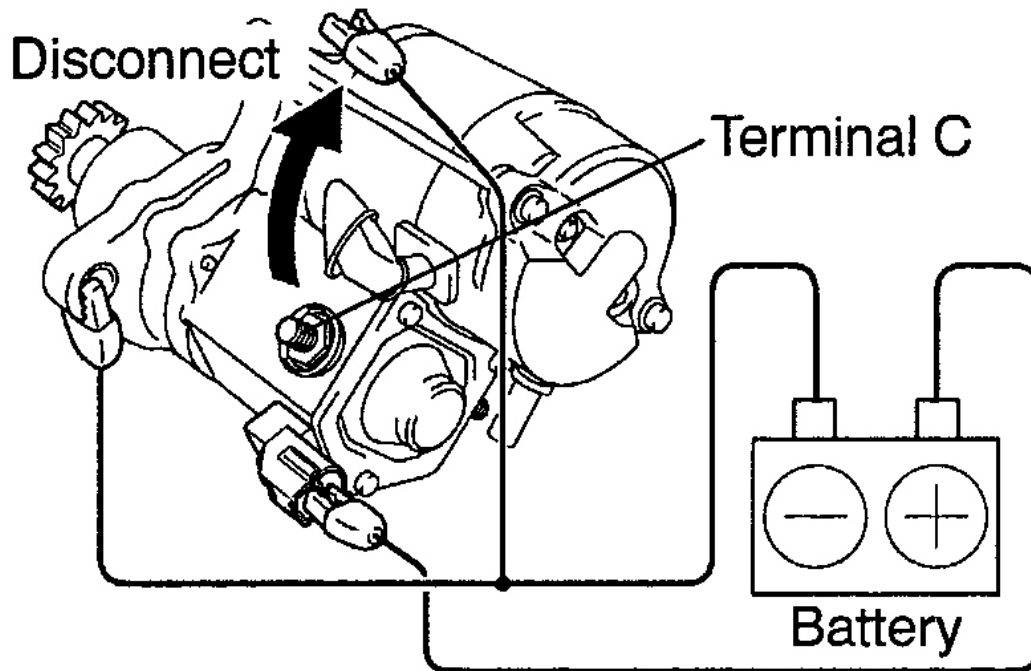


Fig. 50: Testing - Pull-In Test

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

2. DO HOLD-IN TEST

With battery connected as above with the clutch pinion gear out, disconnect the negative (-) lead from terminal C. Check that the pinion gear remains out.



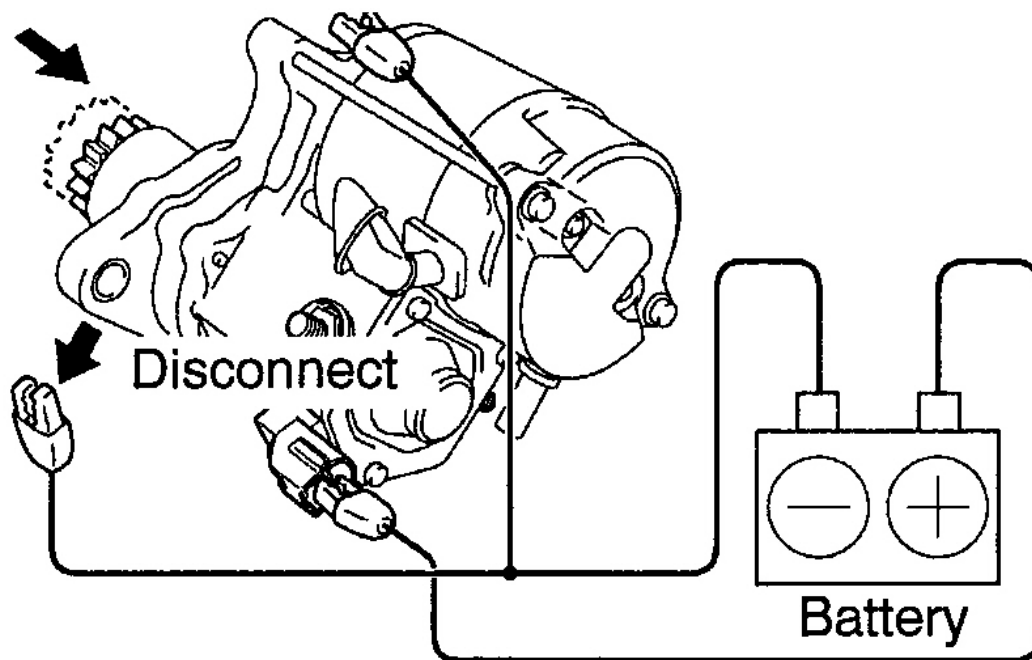
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Fig. 51: Testing - Hold-In Test

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

3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (-) lead from the switch body. Check that the clutch pinion gear returns inward.



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Fig. 52: Inspecting Clutch Pinion Gear Return
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

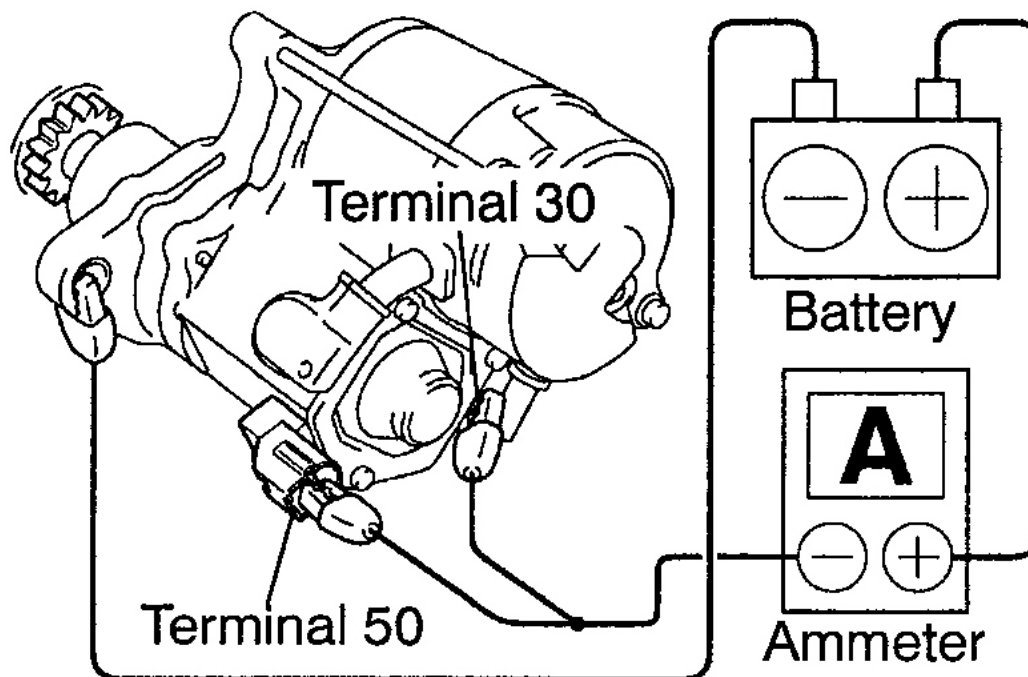
4. DO NO-LOAD PERFORMANCE TEST

- a. Connect the field coil lead wire to terminal C.

Torque: 5.9 N.m (60 kgf.cm, 52 in.lbf)

- b. Connect the battery and ammeter to the starter as shown.
- c. Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current: 90 A or less at 11.5 V



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Fig. 53: Testing - No-Load Performance Test
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

- a. Install the starter.
- b. Connect the starter wire, and install the nut.

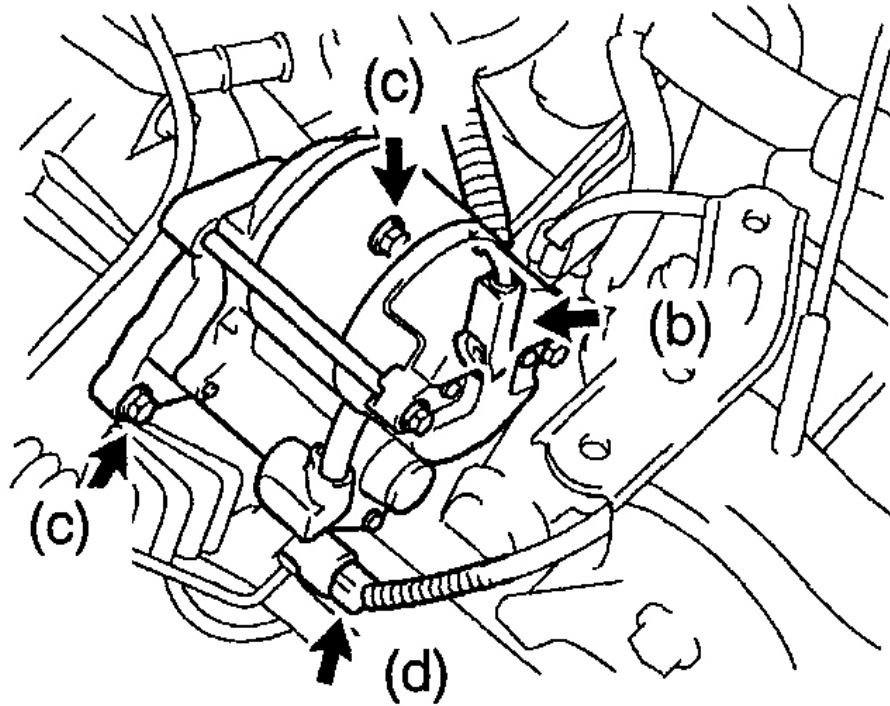
Torque: 9.8 N.m (100 kgf.cm, 87 in.lbf)

- c. Install the 2 bolts.

Torque: 37 N.m (377 kgf.cm, 27 ft.lbf)

- d. Connect the connector.
- e. A/T:

Connect the hose to the fluid level guide.



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Fig. 54: Installing Starter

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

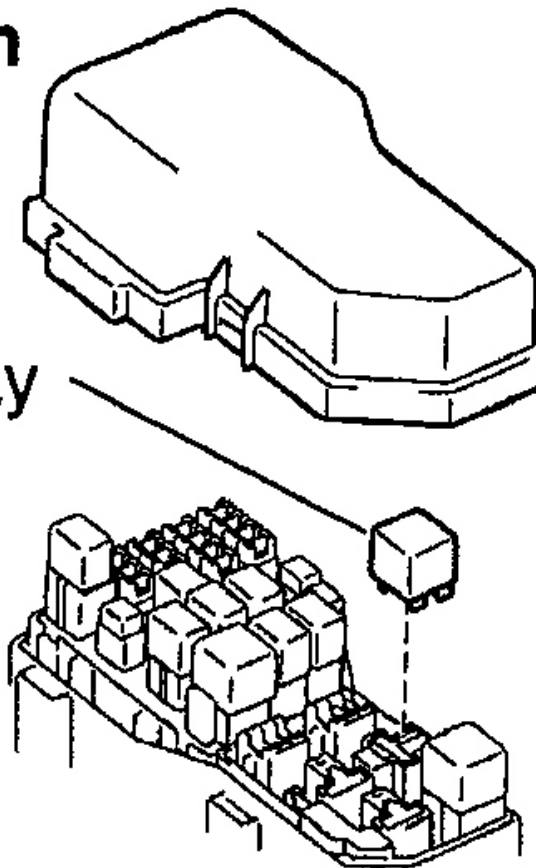
STARTER RELAY

INSPECTION

1. REMOVE STARTER RELAY (Marking: ST)

Engine Room R/B

Starter Relay



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Fig. 55: Identifying Location Of Starter Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. INSPECT STARTER RELAY

- Check the resistance of the ST relay.

Standard:

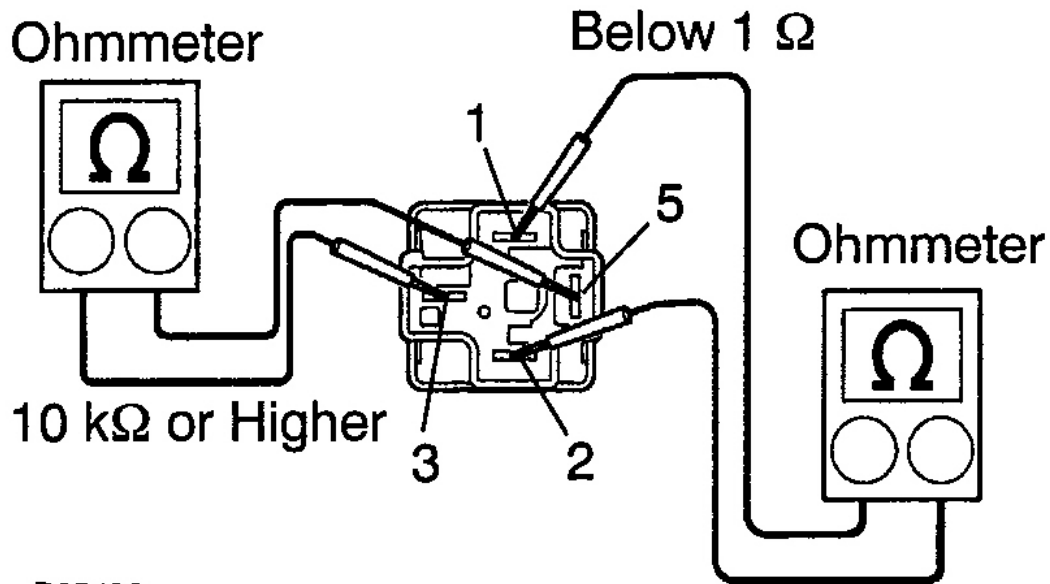
SPECIFIED CONDITION CHART

Tester Condition	Specified Condition
3 - 5	10 kohm or higher
3 - 5	Below 1 ohm (when battery voltage is applied to

2005 Toyota RAV4
2005 ENGINE Starting - RAV4

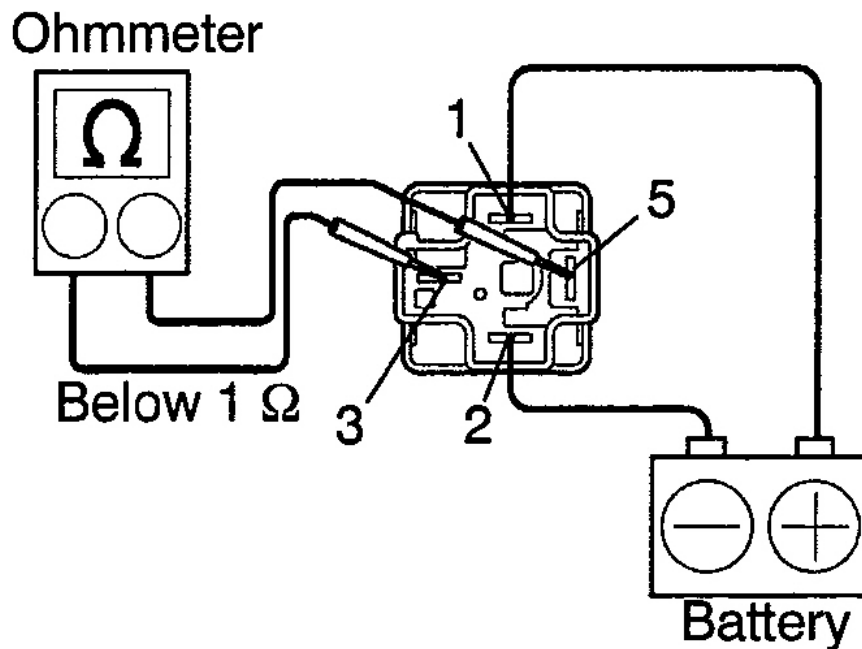
	terminals 1 and 2)
--	--------------------

If the result is not as specified, replace the relay.



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Fig. 56: Inspecting Starter Relay

2005 Toyota RAV4
2005 ENGINE Starting - RAV4

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

3. REINSTALL STARTER RELAY