

STARTING SYSTEM

ON-VEHICLE INSPECTION

ST02L-09

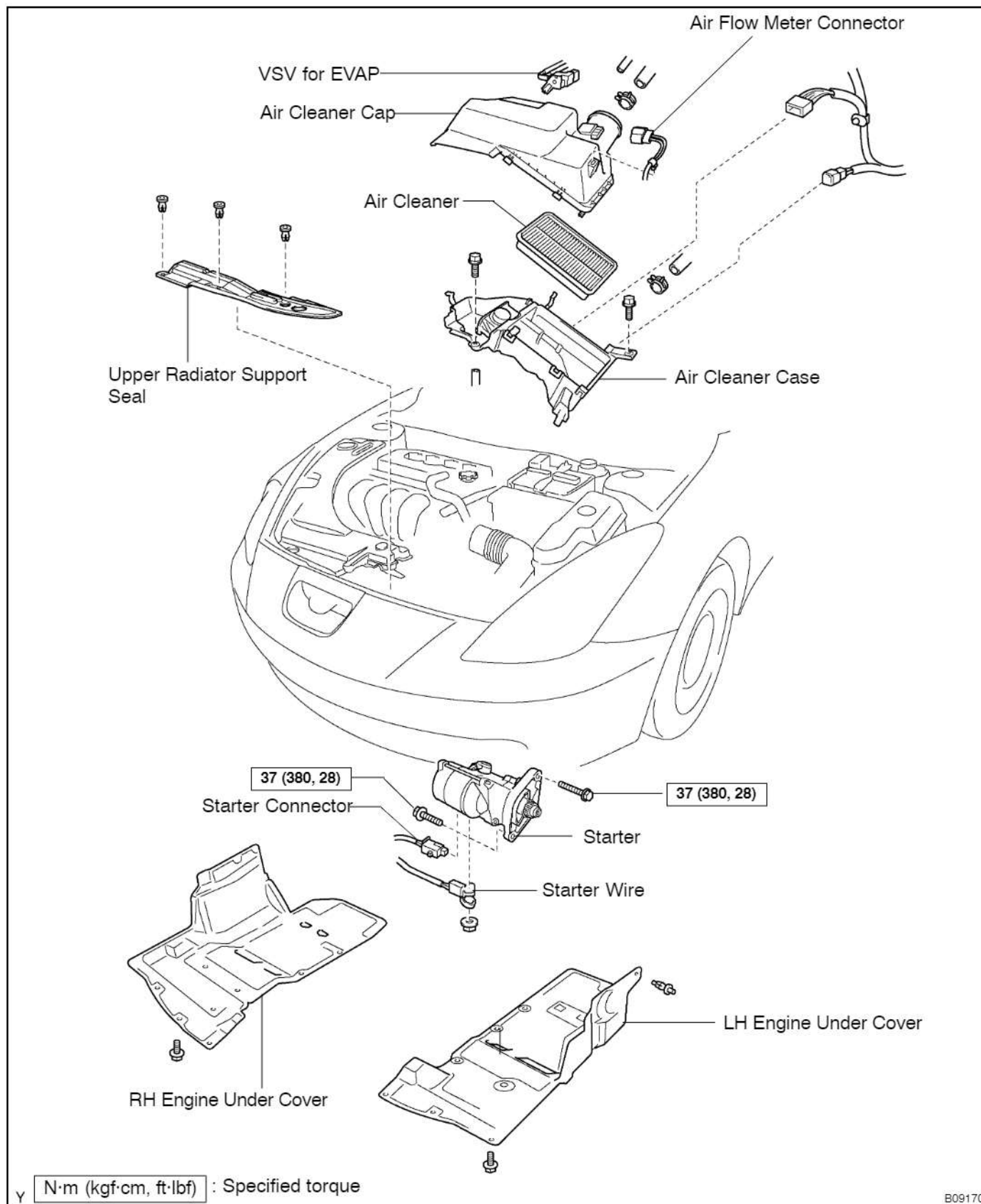
NOTICE:

Before changing the starter, check the following items again:

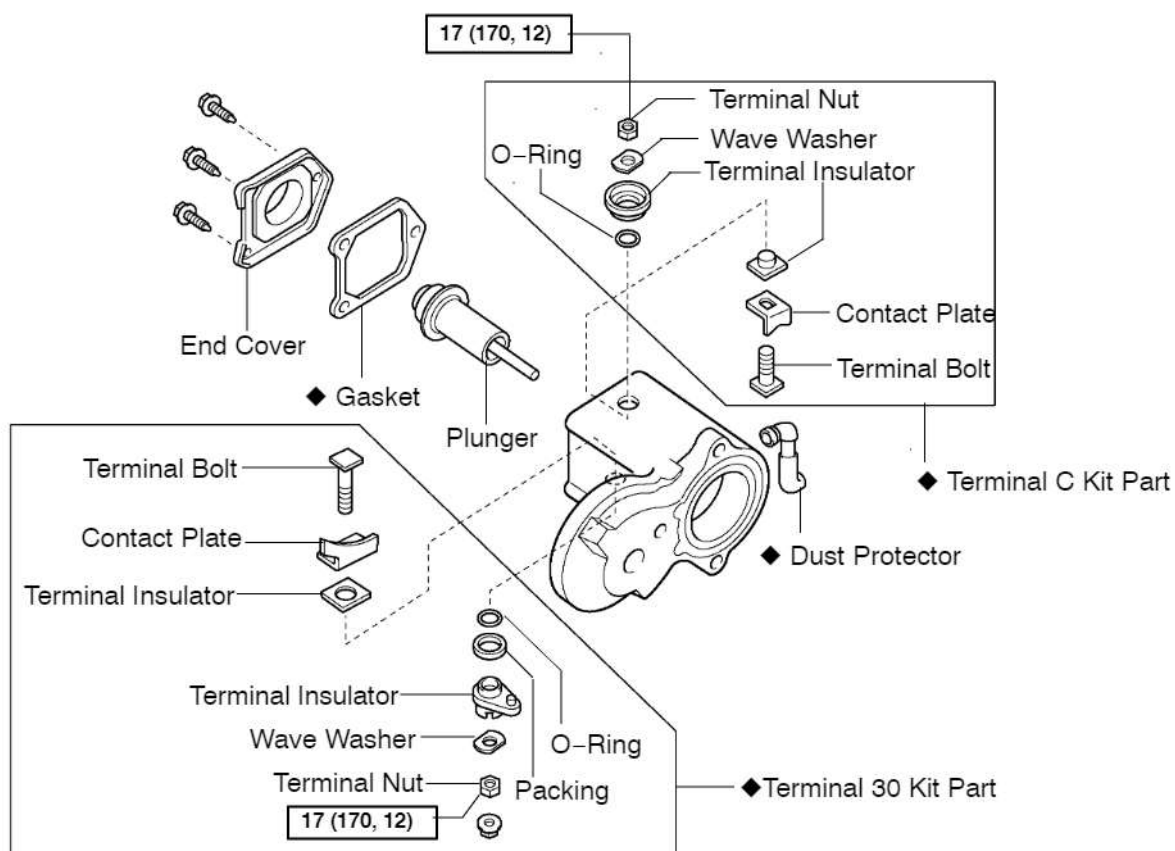
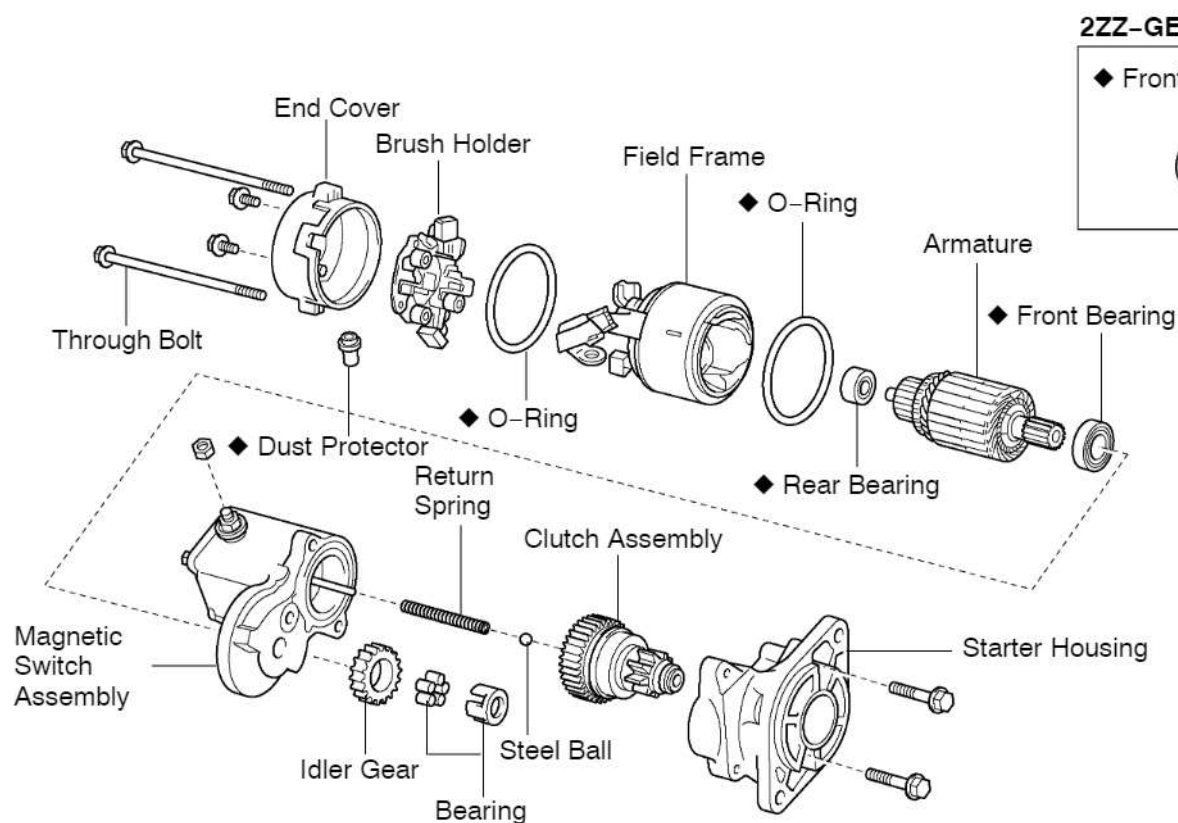
- Connector connection
- Accessory installation, e.g.: theft deterrent system

STARTER COMPONENTS

ST02M-12



B09170



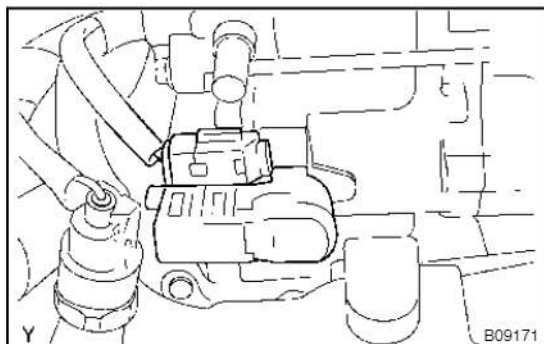
N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

B09593

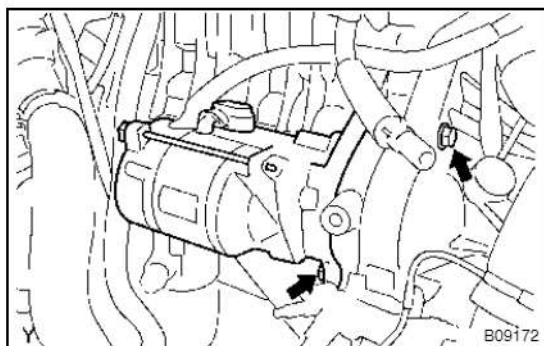
REMOVAL

1. REMOVE UPPER RADIATOR SUPPORT SEAL
2. REMOVE AIR CLEANER ASSEMBLY
(See page EM-76)
3. REMOVE RH AND LH ENGINE UNDER COVER

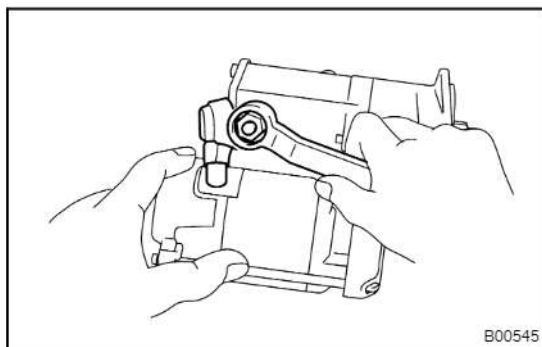


4. REMOVE STARTER

- (a) Disconnect the starter connector.
- (b) Remove the nut, and disconnect the starter wire.



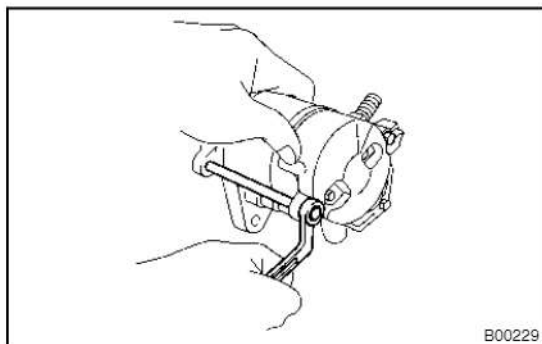
- (c) Remove the 2 bolts and starter.



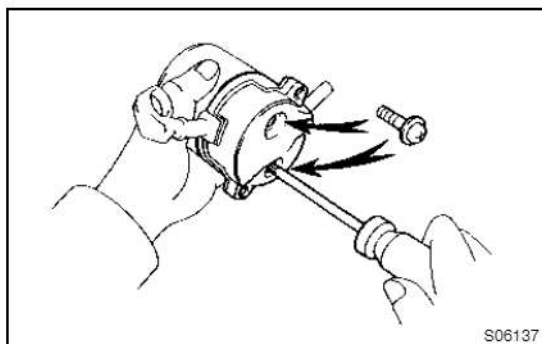
DISASSEMBLY

1. REMOVE FIELD FRAME WITH ARMATURE FROM MAGNETIC SWITCH ASSEMBLY

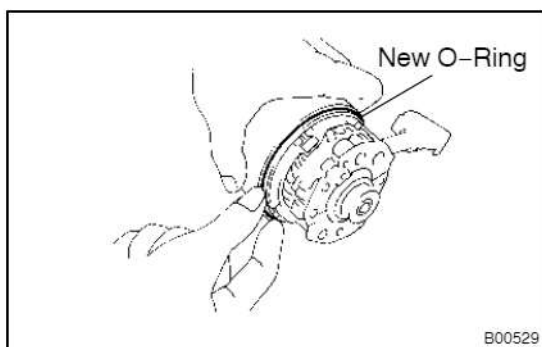
- (a) Remove the nut, and disconnect the lead wire from the magnetic switch terminal.



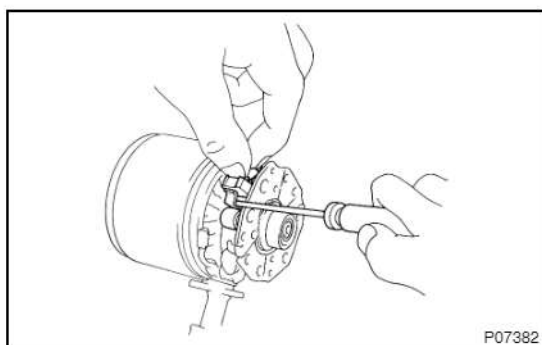
- (b) Remove the 2 through bolts.



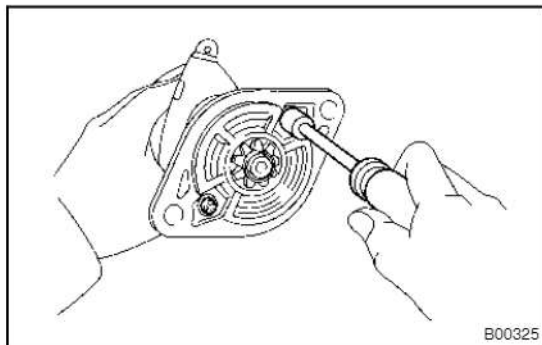
- (c) Remove the 2 screws and end cover from the field frame.



- (d) Remove the O-ring from the field frame.



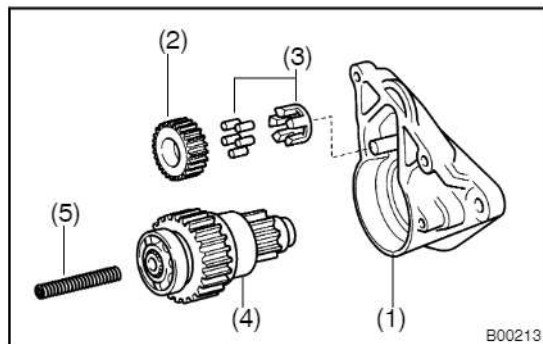
- (e) Using a screwdriver, hold the spring tank back and disconnect the brush from the brush holder. Disconnect the 4 brushes and remove the brush holder.
 (f) Pull out the field frame from the magnetic switch assembly.
 (g) Remove the O-ring.



2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

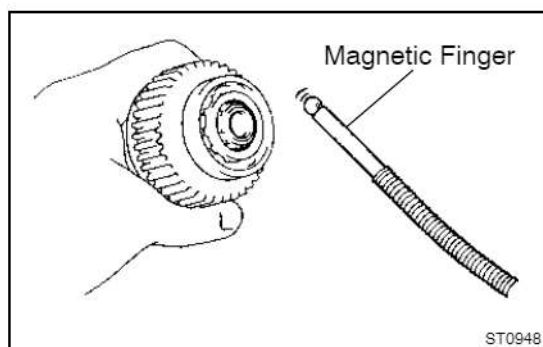
- (a) Remove the 2 bolts.

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



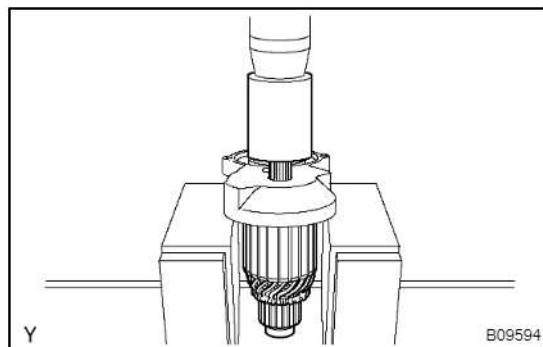
- (b) Remove these parts from the magnetic switch assembly:

- (1) Starter housing
- (2) Idler gear
- (3) Bearing
- (4) Clutch assembly
- (5) Return spring



3. REMOVE STEEL BALL

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



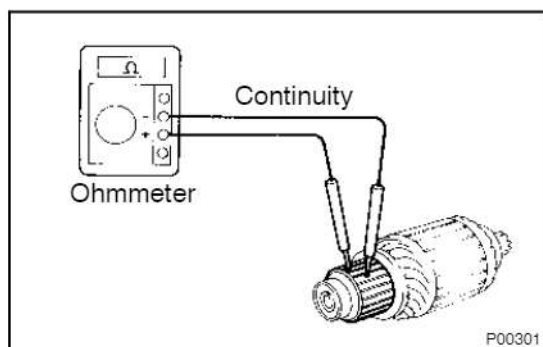
4. REMOVE ARMATURE FROM MAGNETIC SWITCH ASSEMBLY

- (a) 1ZZ-FE

Remove the armature from the magnetic switch assembly.

- (b) 2ZZ-GE:

Using a press, remove the armature from the magnetic switch assembly.

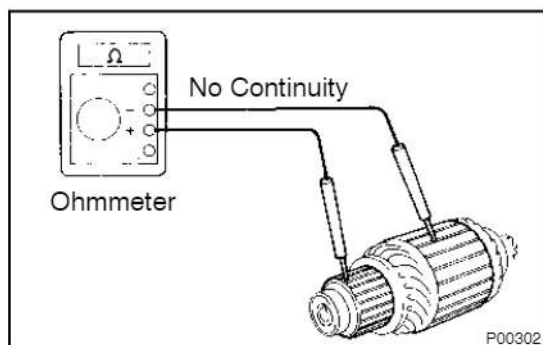


INSPECTION

1. INSPECT ARMATURE COIL COMMUTATOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the segments of the commutator.

If there is no continuity between any segment, replace the armature.



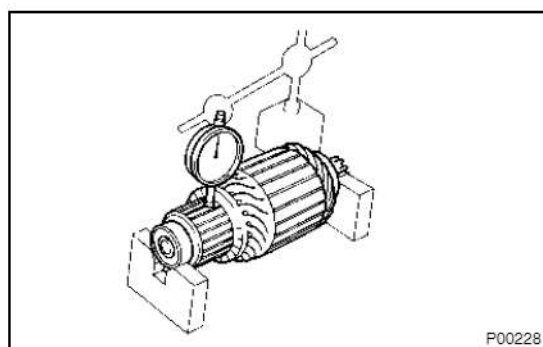
2. INSPECT ARMATURE COIL COMMUTATOR FOR GROUND

Using an ohmmeter, check that there is no continuity between the commutator and armature coil core.

If there is continuity, replace the armature.

3. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES

If the surface is dirty or burnt, correct with sandpaper (No.400) or a lathe.



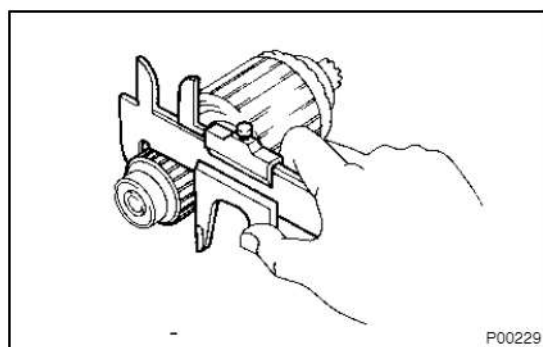
4. INSPECT COMMUTATOR CIRCLE RUNOUT

- Place the commutator on V-blocks.
- Using a dial gauge, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

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



5. INSPECT COMMUTATOR DIAMETER

Using vernier calipers, measure the commutator diameter.

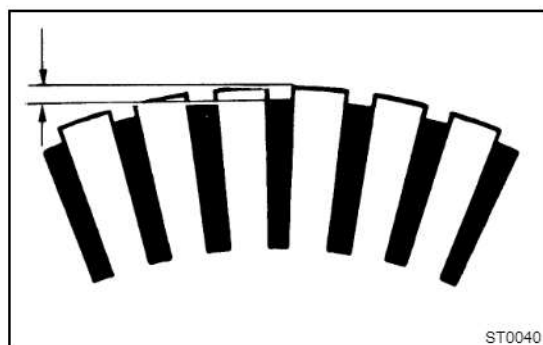
Standard diameter:

30 mm (1.18 in.)

Minimum diameter:

29 mm (1.14 in.)

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



6. INSPECT COMMUTATOR UNDERCUT DEPTH

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

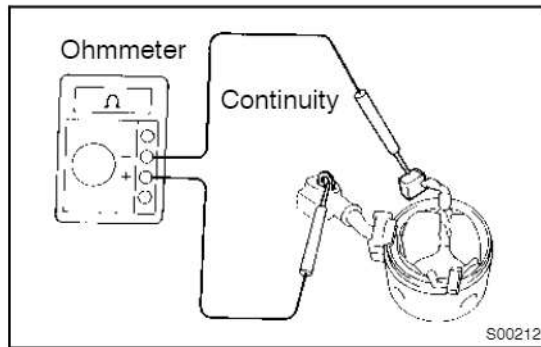
Standard undercut depth:

0.6 mm (0.024 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

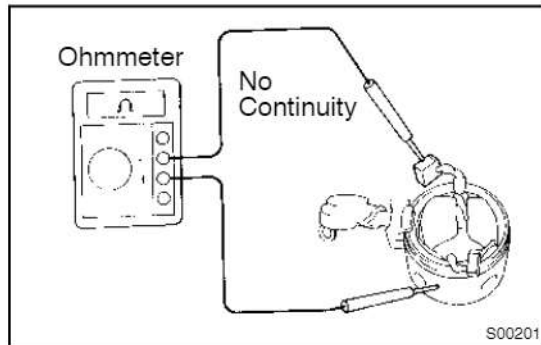
If the undercut depth is less than minimum, correct it with a hacksaw blade.



7. INSPECT FIELD FRAME (FIELD COIL) FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.

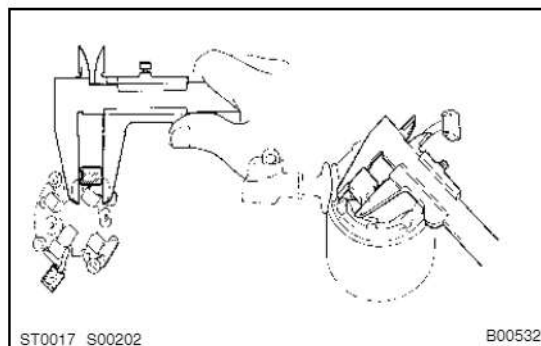
If there is no continuity, replace the field frame.



8. INSPECT FIELD FRAME (FIELD COIL) GROUND

Using an ohmmeter, check that there is no continuity between the field coil end and field frame.

If there is continuity, repair or replace the field frame.



9. INSPECT BRUSH LENGTH

Using vernier calipers, measure the brush length.

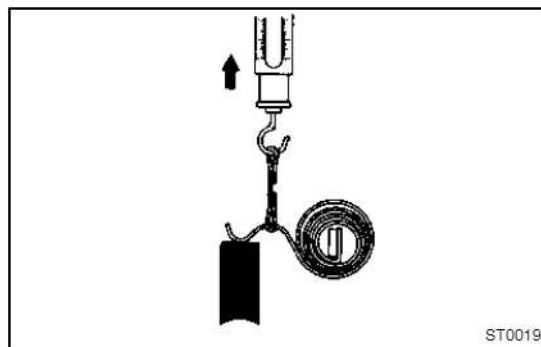
Standard length:

15.5 mm (0.610 in.)

Minimum length:

10.0 mm (0.394 in.)

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



10. INSPECT BRUSH SPRING LOAD

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

14 kW type

Standard spring installed load:

17.6 – 23.5 N (1.80 – 2.40 kgf, 4.0 – 5.3 lbf)

Minimum spring installed load:

11.8 N (1.20 kgf, 2.6 lbf)

1.2 kW type

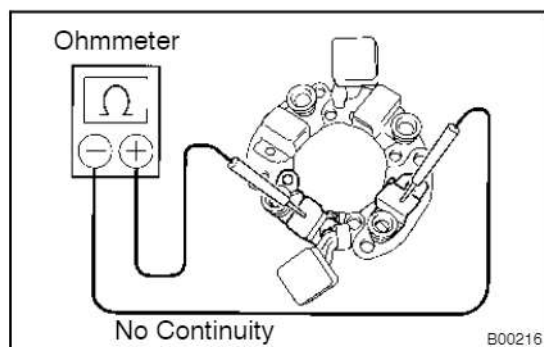
Standard spring installed load:

13.7 – 19.6 N (1.40 – 2.0 kgf, 3.1 – 4.6 lbf)

Minimum spring installed load:

8.8 N (0.9 kgf, 2.0 lbf)

If the installed load is not within specification, replace the brush springs.



11. INSPECT BRUSH HOLDER INSULATION

Using an ohmmeter, check that there is no continuity between the positive (+) and negative (-) brush holders.

If there is continuity, repair or replace the brush holder.

12. INSPECT GEAR TEETH

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.

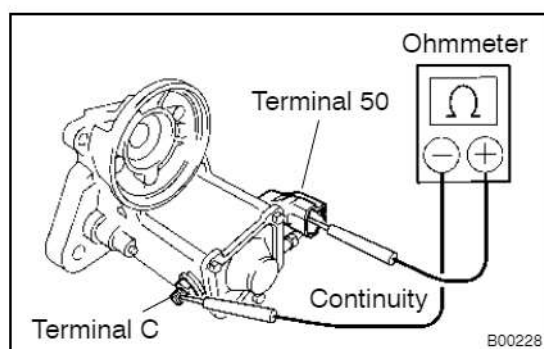
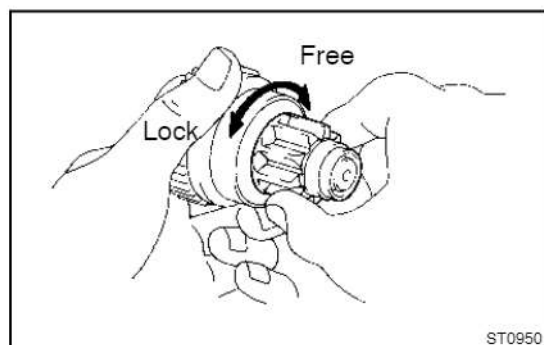
If damaged, also check the drive plate ring gear for wear or damage.

13. INSPECT CLUTCH

Rotate the clutch pinion gear clockwise, and check that it turns freely.

Try to rotate the clutch pinion gear counter-clockwise and check that it locks.

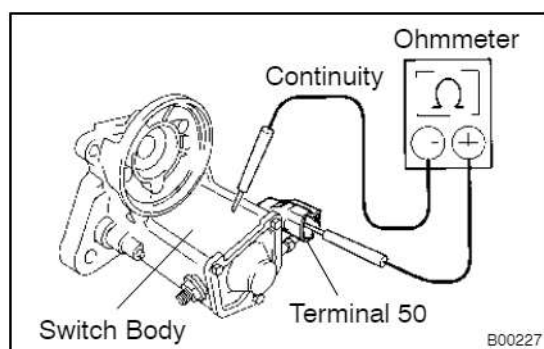
If necessary, replace the clutch assembly.



14. DO MAGNETIC SWITCH PULL-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminals 50 and C.

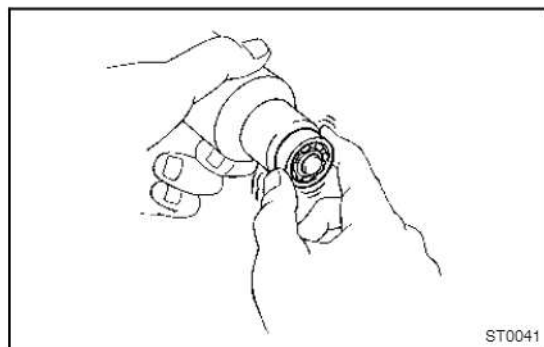
If there is no continuity, check and replace the magnetic switch.



15. DO MAGNETIC SWITCH HOLD-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminal 50 and the switch body.

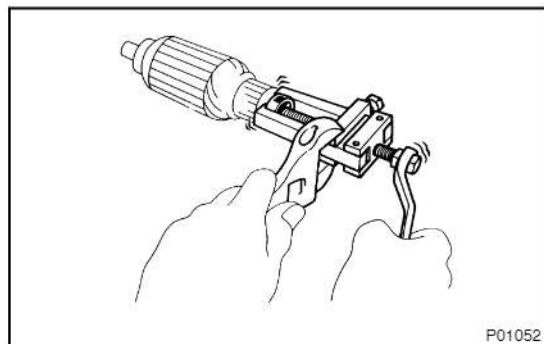
If there is no continuity, replace the magnetic switch.



REPLACEMENT

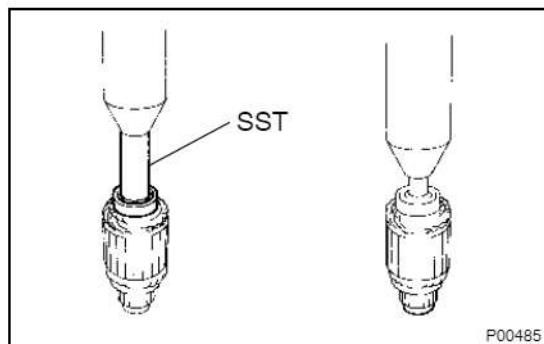
1. INSPECT BEARING

Turn the bearing by hand while applying inward force. If resistance is felt or if the sticks, replace the bearing.



2. REPLACE BEARINGS

- (a) Using SST, remove the bearing.
SST 09286-46011

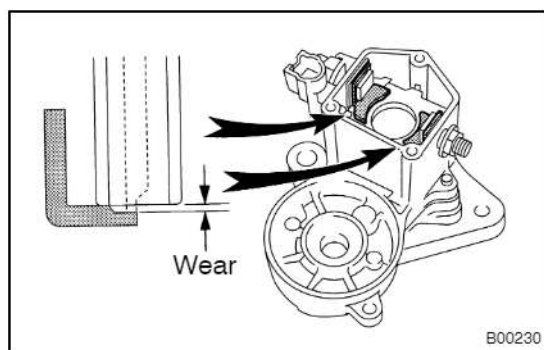


- (b) Using SST and a press, press in a new front bearing.
SST 09820-00031

- (c) Using a press, press in a new rear bearing.

3. REMOVE MAGNETIC SWITCH END COVER

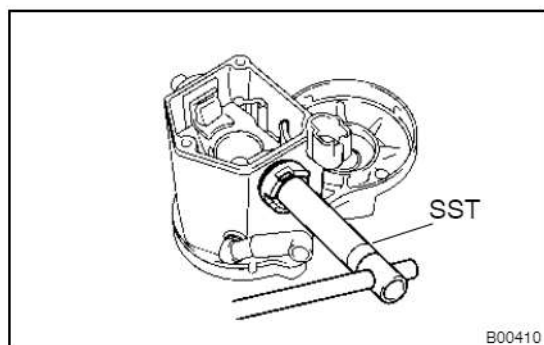
- (a) Remove the 3 bolts, end cover, gasket and plunger.



- (b) Inspect the contact plate for wear.
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.

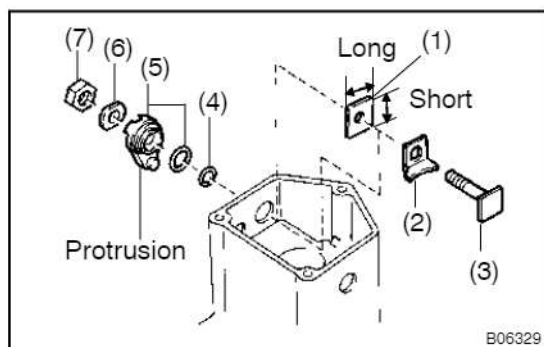


- (c) Remove the terminal kit parts.

- (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).



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

NOTICE:

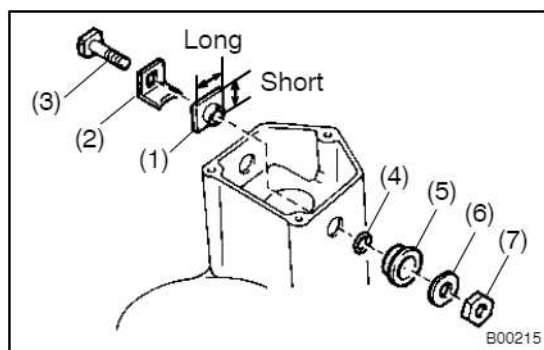
Be careful to install the terminal insulator in the correct direction.

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

HINT:

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

- (6) Install a wave washer.
(7) Install a terminal nut.

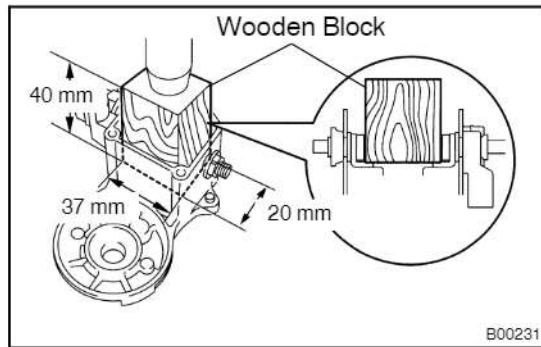


- (e) Temporarily install new terminal C kit parts.
(1) Install a terminal insulator (inside).
(2) Install a contact plate.
(3) Install a terminal bolt.
(4) Install a O-ring.
(5) Install a terminal insulator (outside).
(6) Install a wave washer.
(7) Install a terminal nut.

NOTICE:

Be careful to install the terminal insulator (inside) in the correct direction.

- (f) Temporarily tighten the terminal nuts.



- (g) Tighten terminal nut.
 (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)

NOTICE:

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:

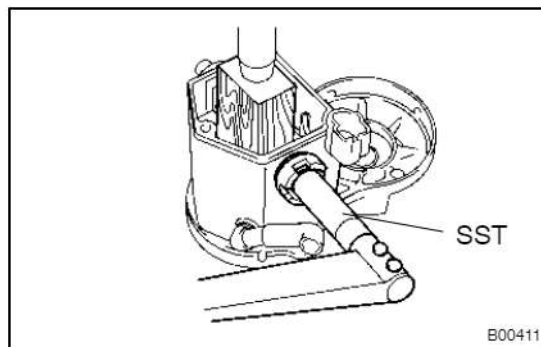
$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14(\pi)}$$

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

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

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

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.

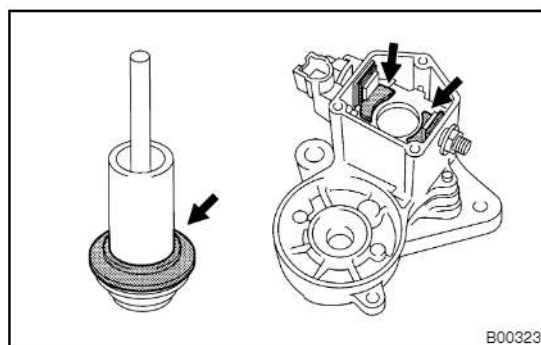


- (2) Using SST, tighten the nuts to the specified torque.
 SST 09810-38140

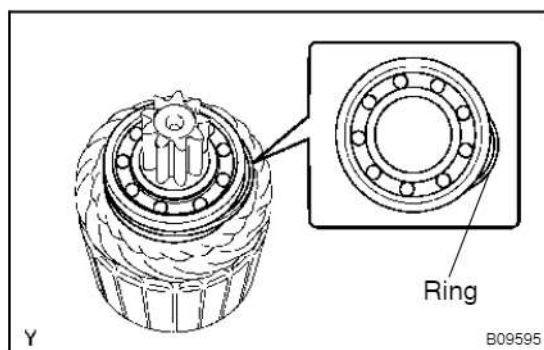
Torque: 17 N·m (173 kgf·cm, 12 ft·lbf)

NOTICE:

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



- (h) Clean contact surfaces of contact plate and plunger. Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.
 (i) Reinstall magnetic switch end cover. Install the plunger, new gasket, and cover with the 3 bolts.
Torque: 2.5 N·m (26 kgf·cm, 23 in·lbf)



REASSEMBLY

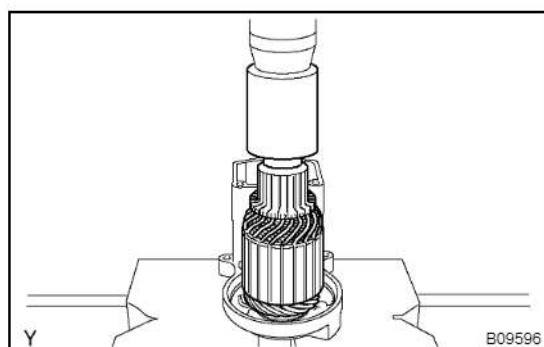
HINT:

Use high-temperature grease to lubricate the bearings and gears when assembling the starter.

1. INSTALL ARMATURE TO MAGNETIC SWITCH ASSEMBLY

(a) 2ZZ-GE:

Rotating the ring of the front bearing, set it properly so that the projection of the ring is positioned in the narrowest part.



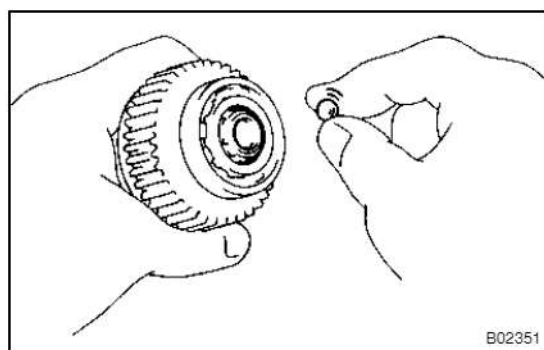
(b) Apply grease to the armature bearings.

(c) 1ZZ-FE:

Install the armature to the magnetic switch assembly.

(d) 2ZZ-GE:

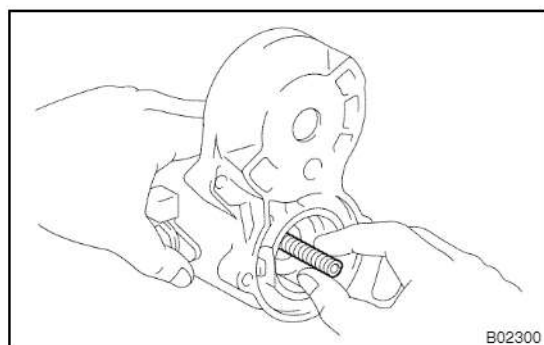
Using a press, install the armature to the magnetic switch assembly.



2. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

(a) Apply grease to the steel ball.

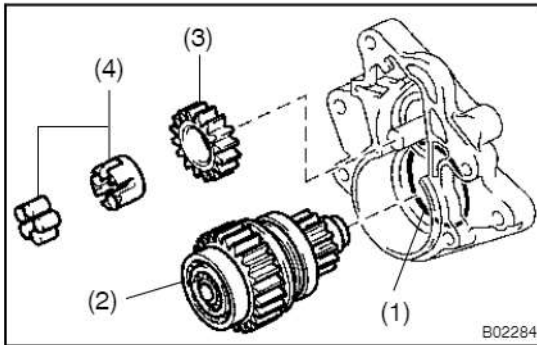
(b) Insert the steel ball into the clutch shaft hole.



3. INSTALL STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

(a) Apply grease to the return spring.

(b) Insert the return spring into the magnetic switch hole.



- (c) Place these parts on the starter housing:
 - (1) New O-ring
 - (2) Starter clutch assembly
 - (3) Idler gear
 - (4) Bearing
- (d) Install the starter housing to the magnetic switch with the 2 screws.

Torque: 9.3 N·m (95 kgf·cm, 82 in.·lbf)

4. INSTALL FIELD FRAME

- (a) Install a new O-ring to the groove of the field frame.
- (b) Align the protrusion of the field frame with the groove of the magnetic switch, and install the field frame.

5. INSTALL BRUSH HOLDER

- (a) Place the brush holder on the field frame.
- (b) Using a screwdriver, hold the brush spring back, and connect the brush into the brush holder. Connect the 4 brushes.

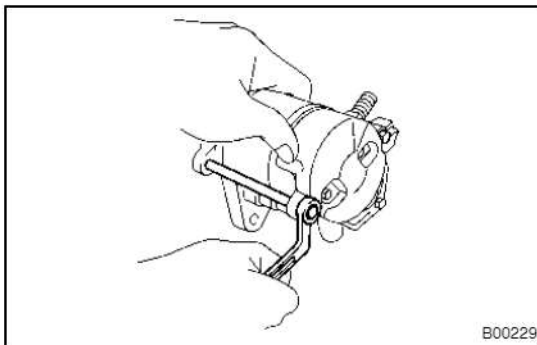
NOTICE:

Check that the positive (+) lead wires are not grounded.

6. INSTALL END COVER

- (a) Install a new O-ring to the groove of the field frame.
- (b) Install the end cover to the field frame with the 2 screws.

Torque: 3.8 N·m (39 kgf·cm, 34 in.·lbf)



- (c) Install the field frame and armature assembly with the 2 through bolts.

Torque: 9.3 N·m (95 kgf·cm, 82 in.·lbf)

- (d) Connect the lead wire to terminal C with the nut.

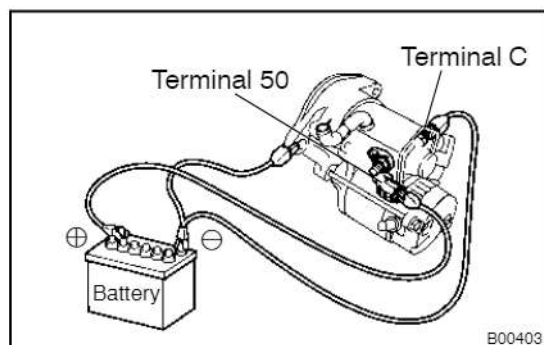
Torque: 5.9 N·m (60 kgf·cm, 52 in.·lbf)

7. INSTALL NEW DUST PROTECTOR

TEST

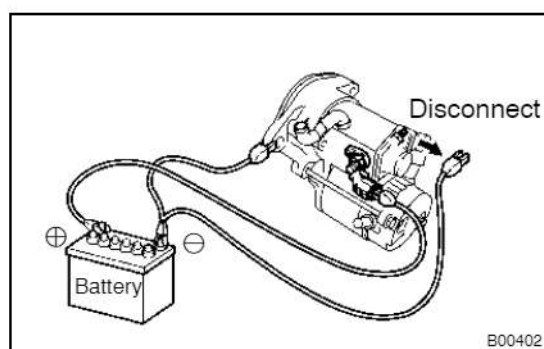
NOTICE:

These tests must be performed within 3 to 5 seconds to avoid burning out the coil.



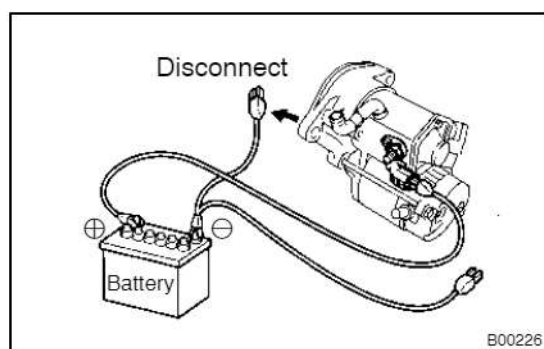
1. DO PULL-IN TEST

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



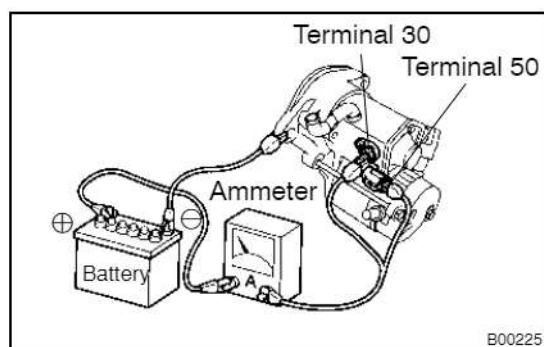
2. DO HOLD-IN TEST

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



3. INSPECT CLUTCH PINION GEAR RETURN

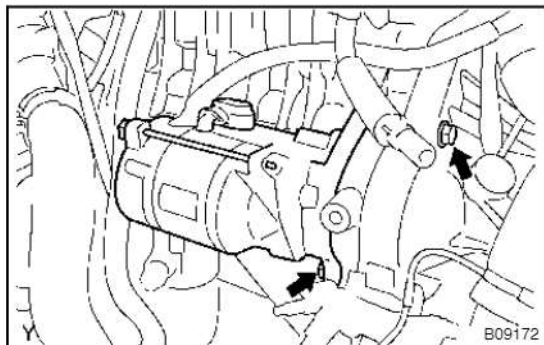
Disconnect the negative (-) lead from the switch body. Check that the clutch pinion gear returns inward.



4. DO NO-LOAD PERFORMANCE TEST

- Connect the battery and ammeter to the starter as shown.
- 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



INSTALLATION

1. INSTALL STARTER

- (a) Install the 2 bolts and starter.

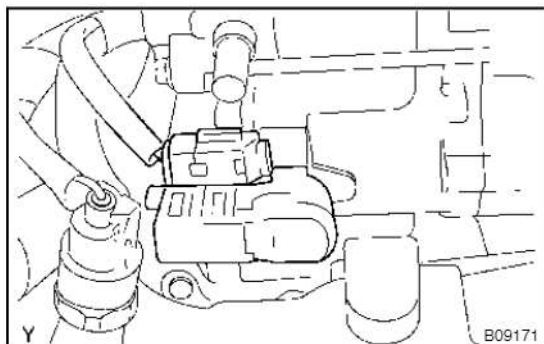
HINT:

Each bolt length is indicated in the illustration.

Bolt length

A 64 mm (2.72 in.)

B 54 mm (2.13 in.)



- (b) Connect the starter wire, and install the nut.

- (c) Connect the starter connector.

2. INSTALL RH AND LH ENGINE UNDER COVER

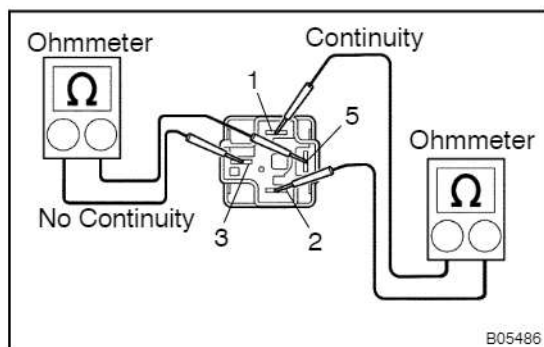
3. INSTALL AIR CLEANER ASSEMBLY

4. INSTALL UPPER RADIATOR SUPPORT SEAL

STARTER RELAY INSPECTION

ST02U-07

1. REMOVE STARTER RELAY (Marking: ST)



2. INSPECT STARTER RELAY

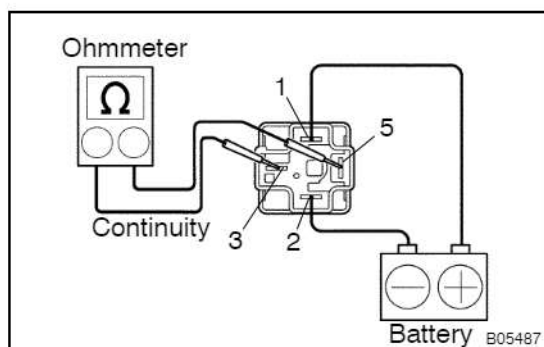
(a) Inspect the relay continuity.

- (1) Using an ohmmeter, check that there is continuity between terminals 1 and 2.

If there is no continuity, replace the relay.

- (2) Check that there is no continuity between terminals 3 and 5.

If there is continuity, replace the relay.



(b) Inspect the relay operation.

- (1) Apply battery positive voltage across terminals 1 and 2.
- (2) Using an ohmmeter, check that there is continuity between terminals 3 and 5.

If there is no continuity, replace the relay.

3. REINSTALL STARTER RELAY