

# STARTING SYSTEM

## ON-VEHICLE INSPECTION

ST017-01

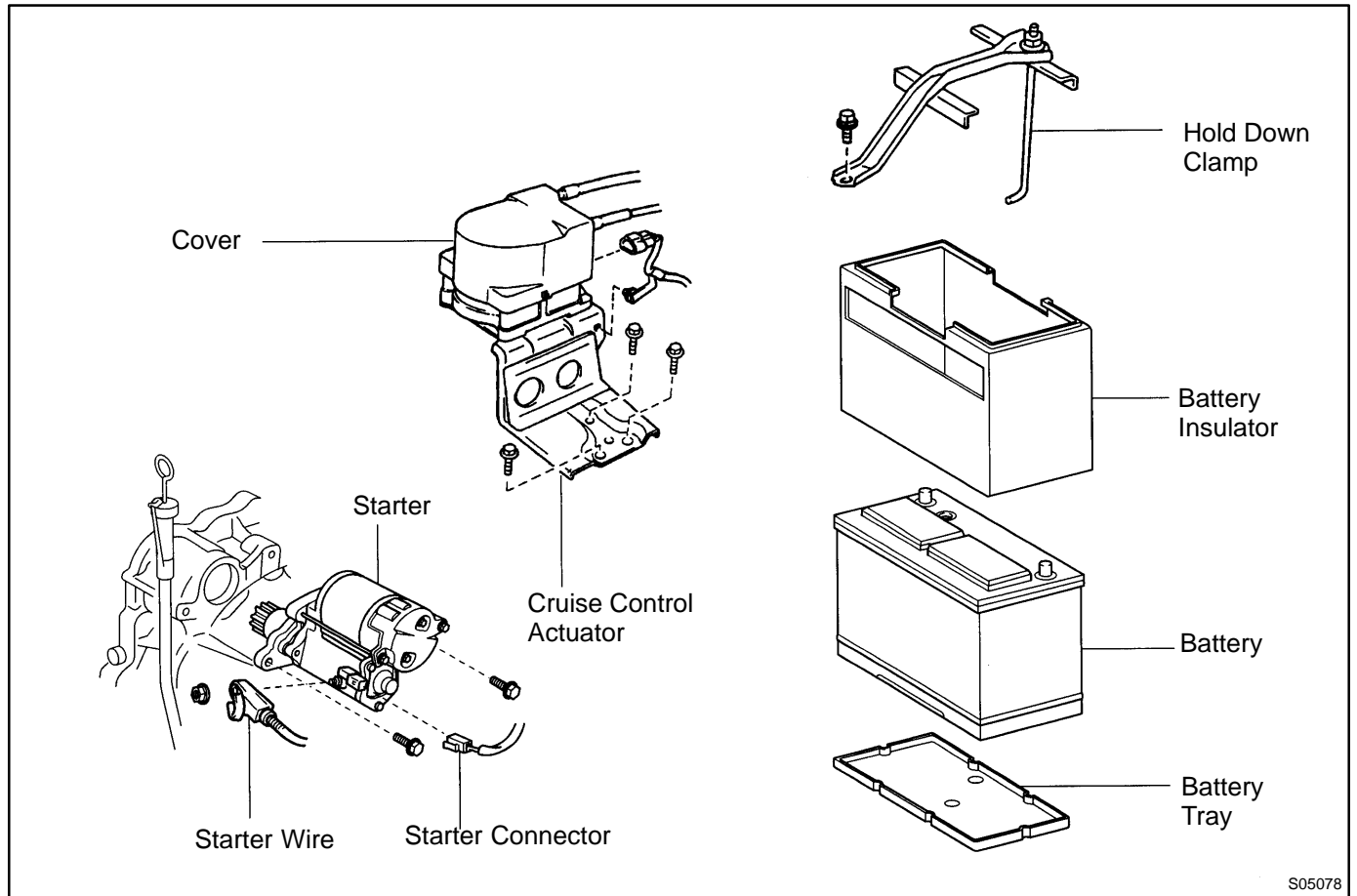
**NOTICE:**

Before changing the starter, check the following items again:

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

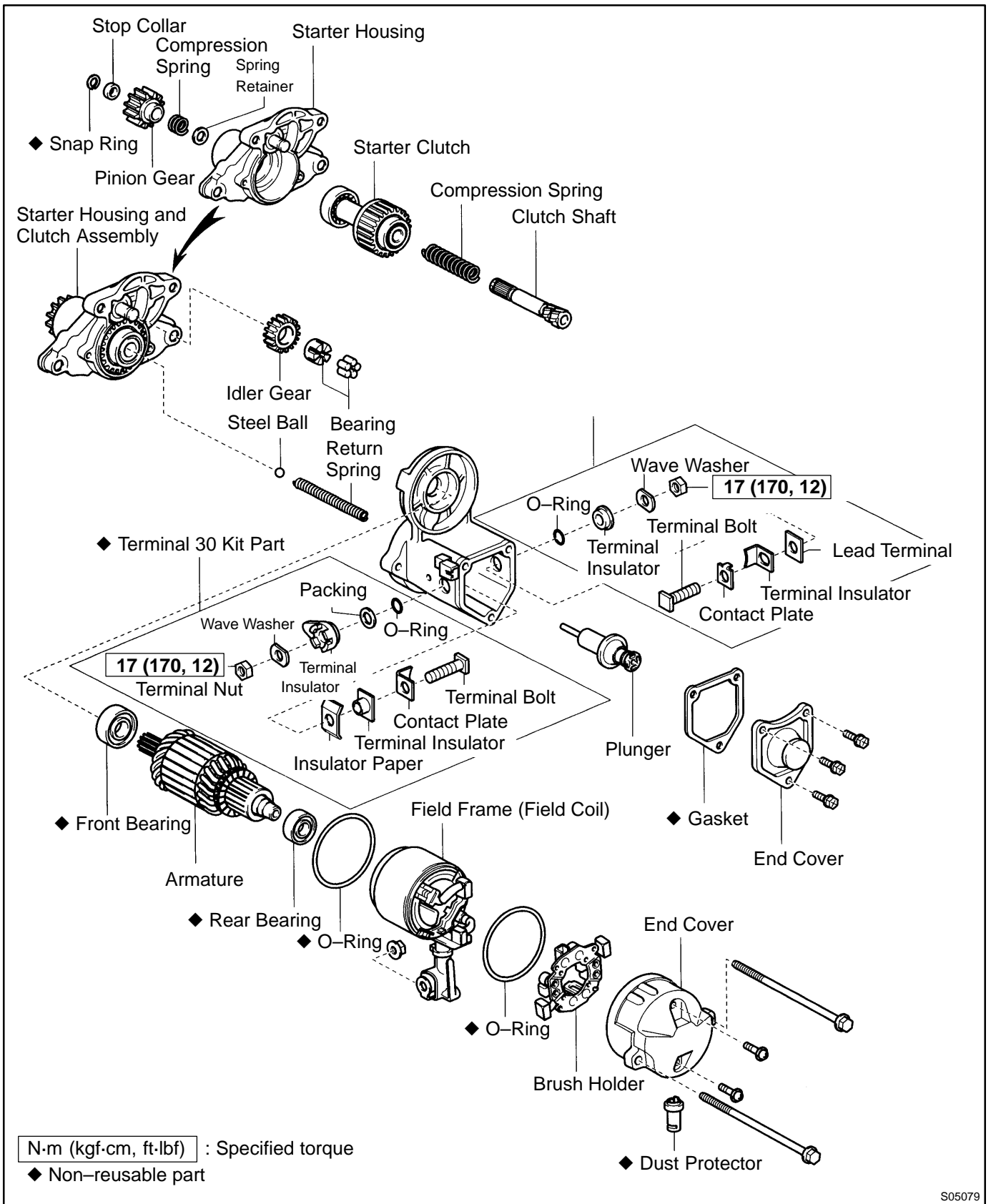
# STARTER COMPONENTS

ST0L7-01



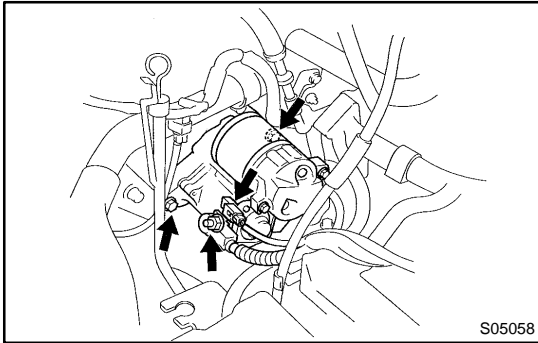
S05078

STARTING - STARTER



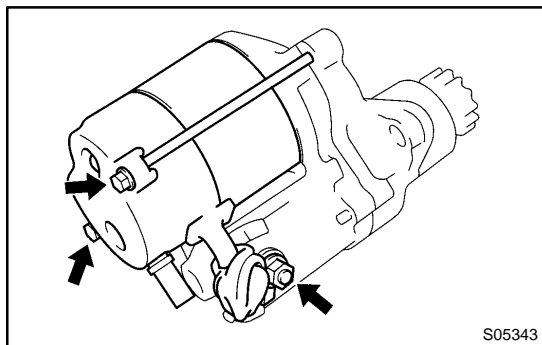
## REMOVAL

1. REMOVE BATTERY AND TRAY
2. w/ CRUISE CONTROL SYSTEM:  
REMOVE CRUISE CONTROL ACTUATOR
  - (a) Disconnect the actuator connector and clamp.
  - (b) Remove the 3 bolts, and disconnect the actuator with the bracket.



3. REMOVE STARTER
  - (a) Disconnect the starter connector.
  - (b) Remove the nut, and disconnect the starter wire.
  - (c) Remove the 2 bolts and starter.

**Torque: 37 N·m (380 kgf-cm, 27 ft·lbf)**



## 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.

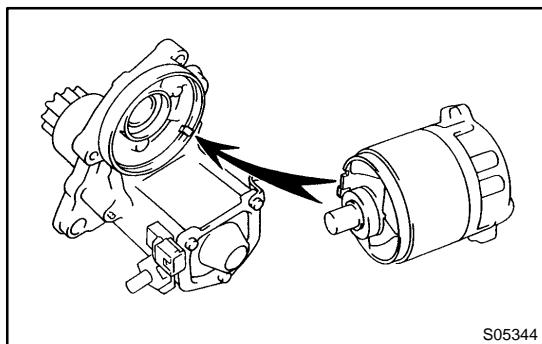
**Torque: 5.9 N·m (60 kgf·cm, 52 in.-lbf)**

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

#### NOTICE:

**At the time of assembly, please refer to the following item. Align the protrusion of the field frame with the groove of the magnetic switch.**

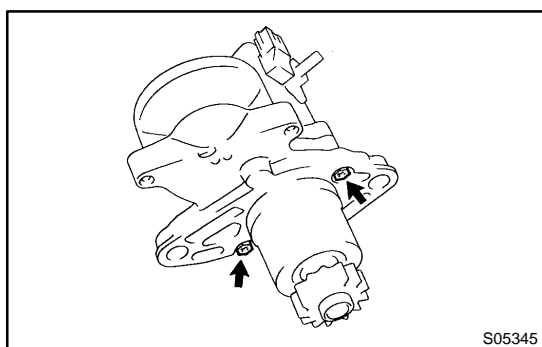
- (d) Remove the O-ring from the field frame.



### 3. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR

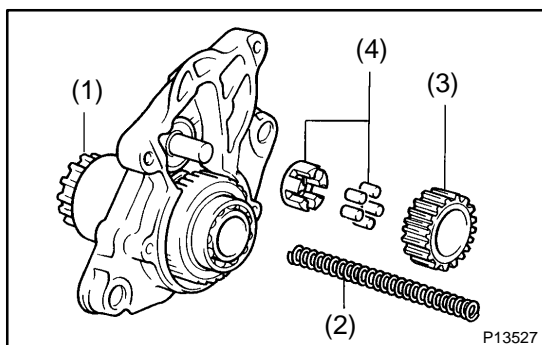
- (a) Remove the 2 screws.

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



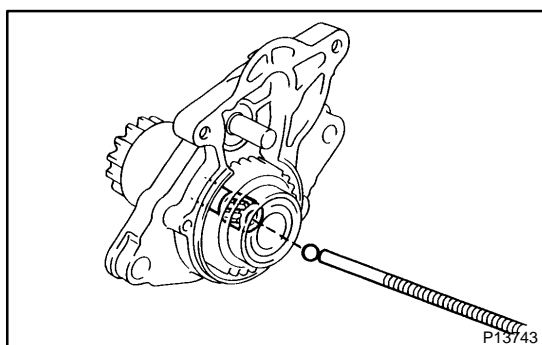
- (b) Remove these parts from the magnetic switch:

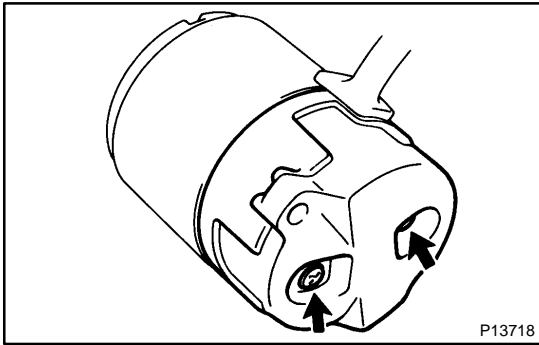
- (1) Starter housing and clutch assembly
- (2) Return spring
- (3) Idler gear
- (4) Bearing



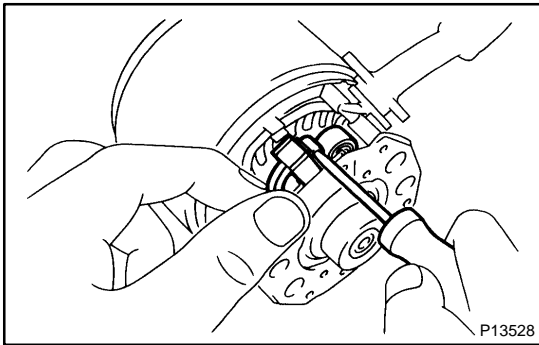
### 4. REMOVE STEEL BALL

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



**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.

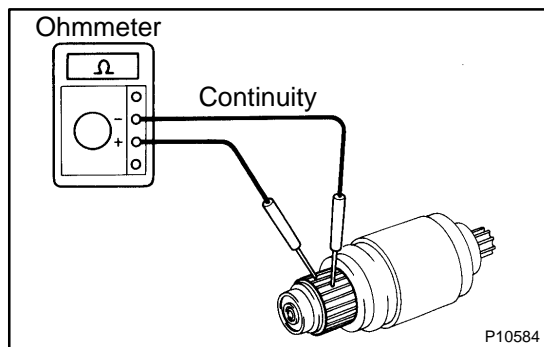


- (c) Using a screwdriver, hold the spring back and disconnect the brush from the brush holder.  
Disconnect the 4 brushes, and remove the brush holder.

**NOTICE:**

**At the time of assembly, please refer to the following item.  
Check that the positive (+) lead wires are not grounded.**

**6. REMOVE ARMATURE FROM FIELD FRAME**

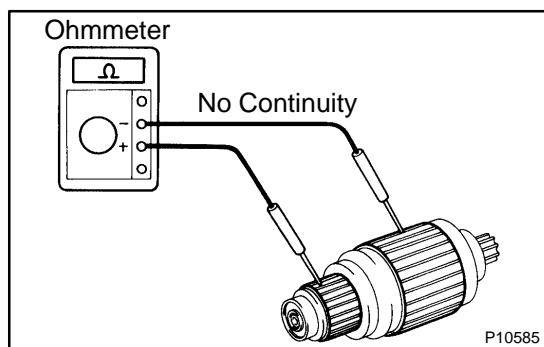


## INSPECTION

### 1. INSPECT 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.



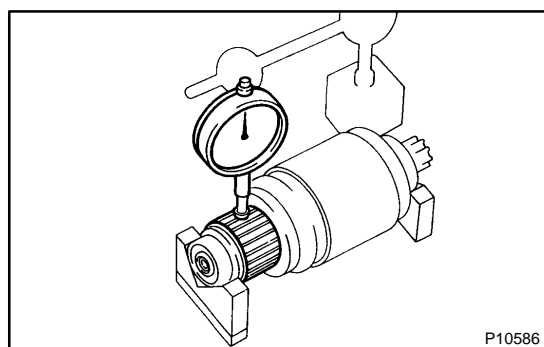
### 2. INSPECT COMMUTATOR FOR GROUND

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 it with sandpaper (No.400) or on a lathe.

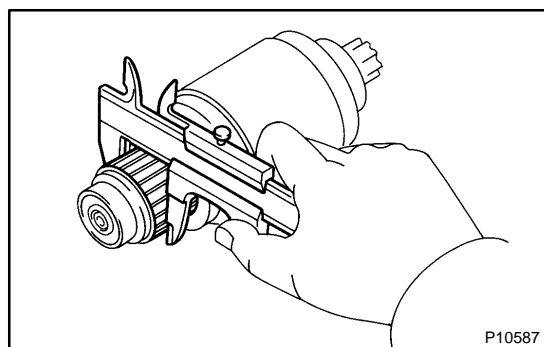


### 4. INSPECT COMMUTATOR CIRCLE RUNOUT

- (a) Place the commutator on V-blocks.
- (b) 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.



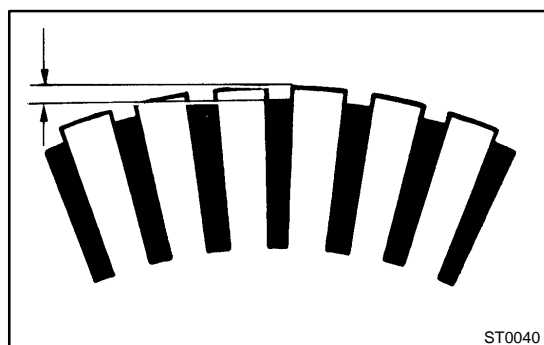
### 5. INSPECT COMMUTATOR DIAMETER

Using a vernier caliper, 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 minimum, replace the armature.



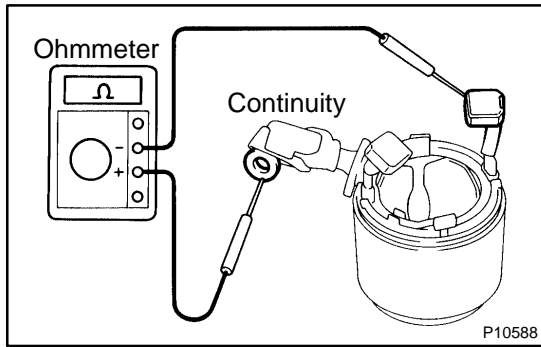
### 6. INSPECT UNDERCUT DEPTH

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.)**

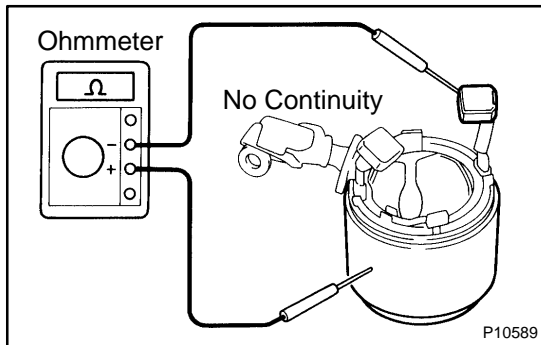
**Minimum undercut depth: 0.2 mm (0.008 in.)**

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



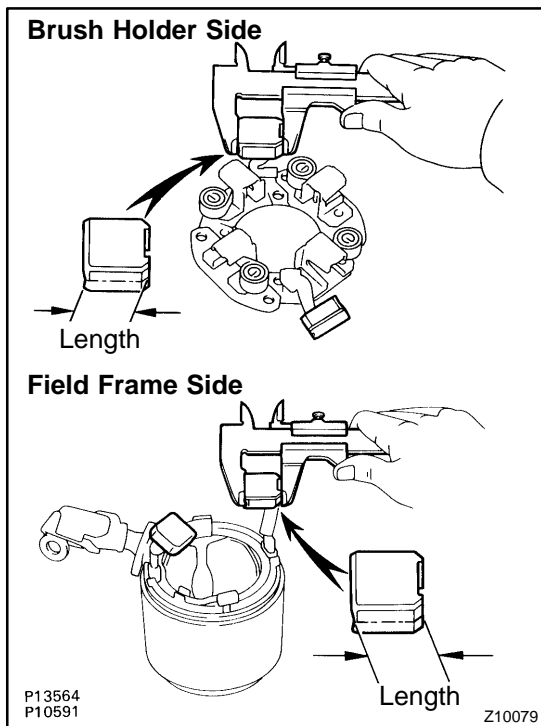
**7. INSPECT FIELD COIL FOR OPEN CIRCUIT**

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 COIL FOR 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.



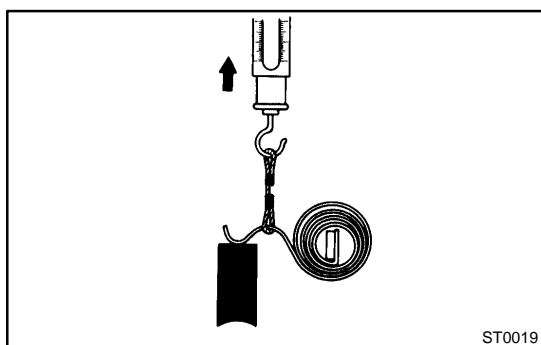
**9. INSPECT BRUSH LENGTH**

Using a vernier caliper, 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.

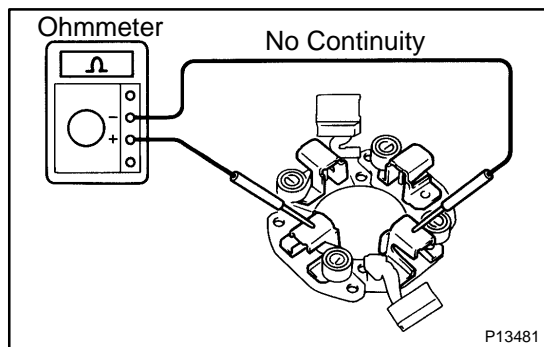
**Standard spring installed load:**

**17.6 – 23.5 N (1.8 – 2.4 kgf, 3.9 – 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 brush springs.





### 11. INSPECT BRUSH HOLDER INSULATION

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

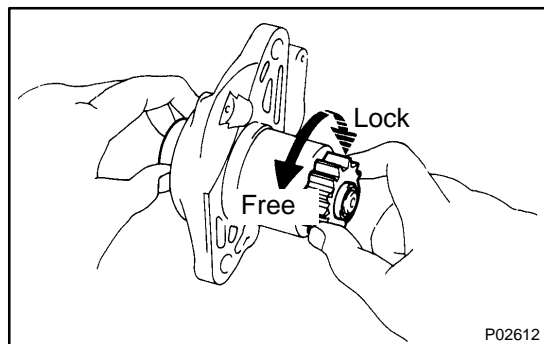
If there is continuity, repair or replace the brush holder.

### 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.

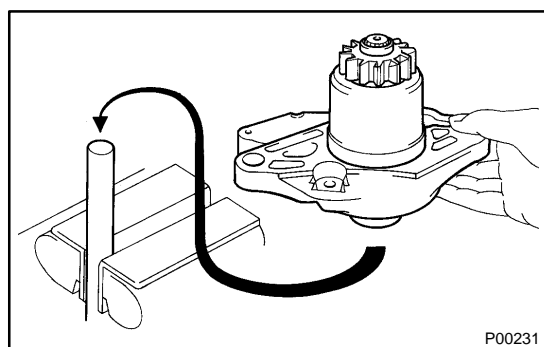
If damaged, also check the drive plate ring gear for wear or damage.



### 13. INSPECT CLUTCH 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.

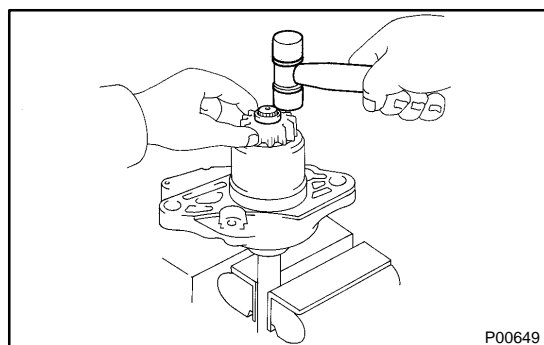
If necessary, replace the clutch assembly.



### 14. IF NECESSARY, REPLACE CLUTCH ASSEMBLY

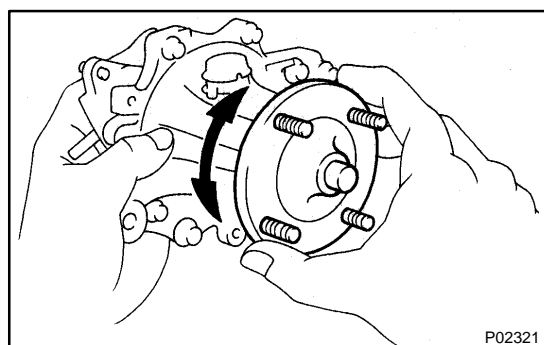
(a) Disassemble the starter housing and clutch assembly.

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

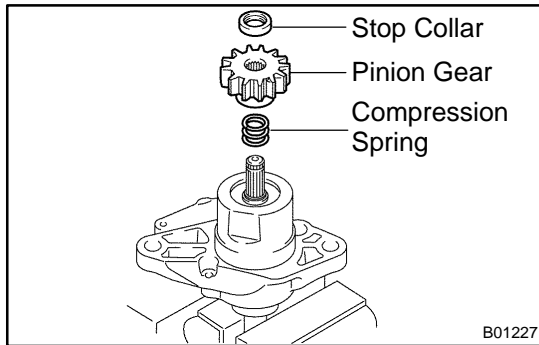


(2) Push down the pinion gear.

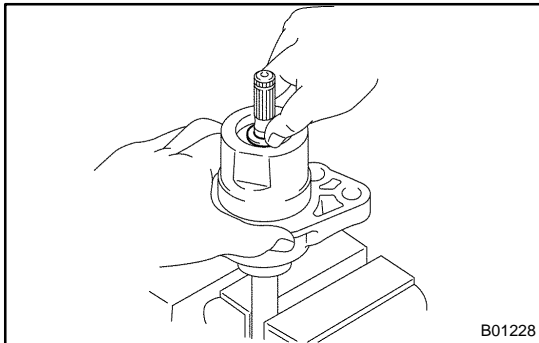
(3) Using a plastic-faced hammer, tap down the stop collar.



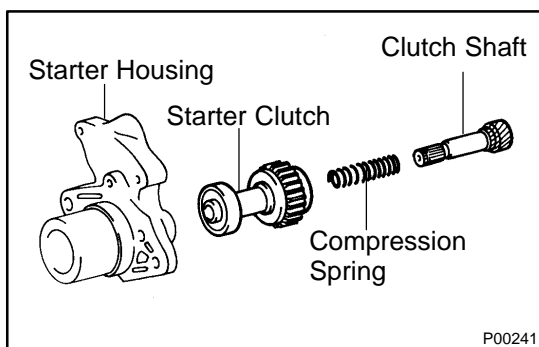
(4) Using a screwdriver, pry out the snap ring.



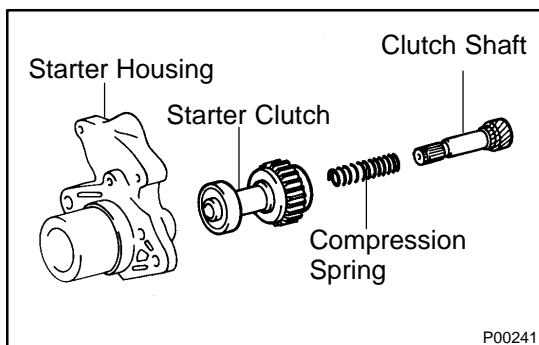
- (5) Remove these parts:
- ◆ Stop collar
  - ◆ Pinion gear
  - ◆ Compression spring



- (6) Push down the starter housing, and remove the spring retainer.

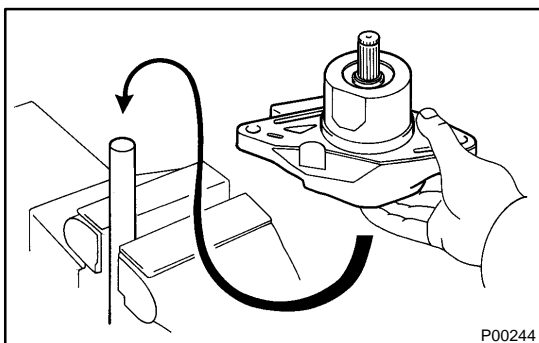


- (7) Disassemble these parts:
- ◆ Starter housing
  - ◆ Starter clutch
  - ◆ Compression spring
  - ◆ Clutch shaft

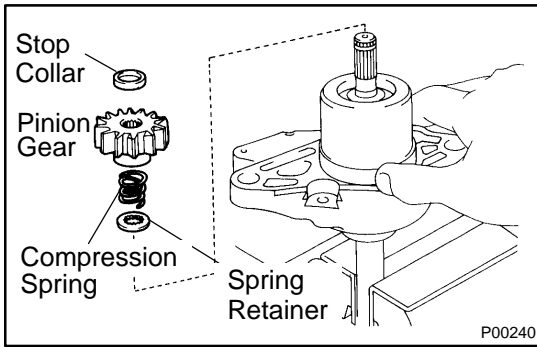


- (b) Assemble the starter housing and clutch assembly.

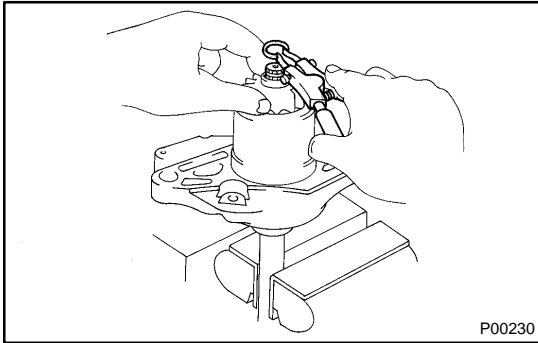
- (1) Assemble these parts:
- ◆ Starter housing
  - ◆ Starter clutch
  - ◆ Compression spring
  - ◆ Clutch shaft



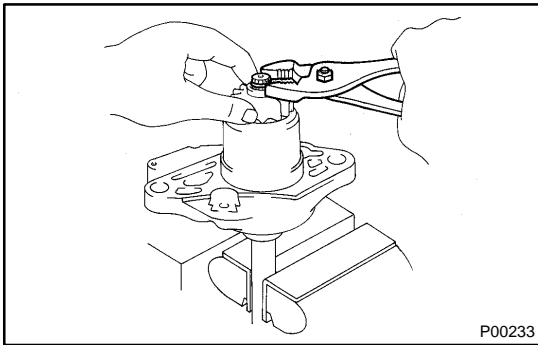
- (2) Mount a brass bar in a vise, install the starter housing and clutch assembly to the brass bar.



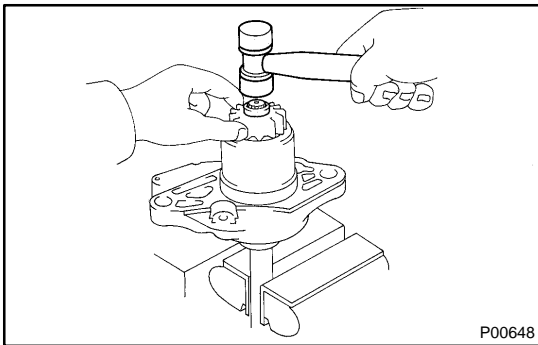
- (3) Push down the starter housing, and install these parts:
- ◆ Spring retainer
  - ◆ Compression spring
  - ◆ Pinion gear
  - ◆ Stop collar



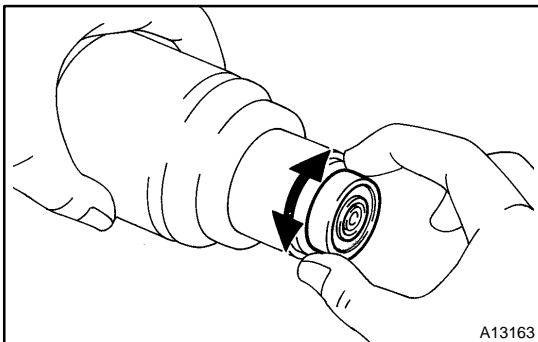
- (4) Push down the pinion gear.  
 (5) Using snap ring pliers, install a new snap ring.



- (6) Using pliers, compress the snap ring.  
 (7) Check that the snap ring fits correctly.

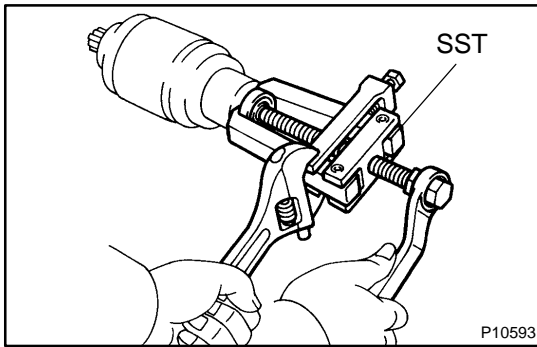


- (8) Remove the starter housing and clutch assembly from the brass bar.  
 (9) Using a plastic-faced hammer, tap the clutch shaft and install the stop collar onto the snap ring.

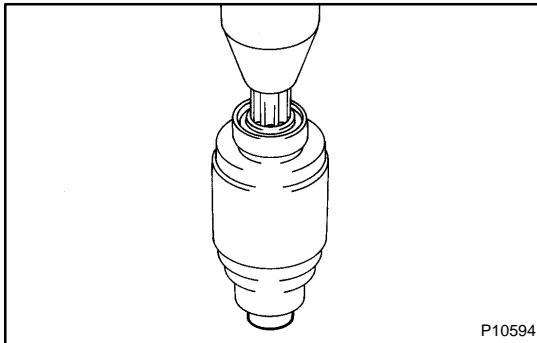


### 15. INSPECT REAR BEARING

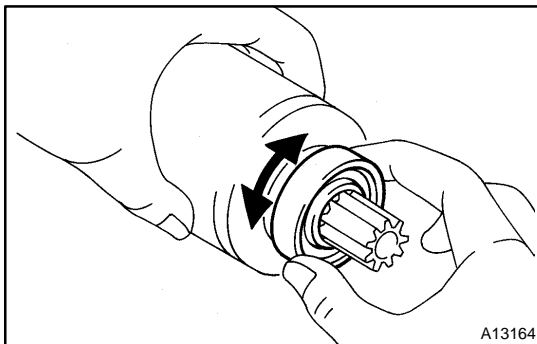
Turn each bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.

**16. IF NECESSARY, REPLACE REAR BEARING**

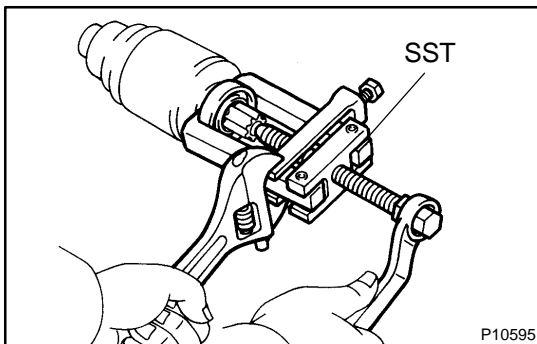
- (a) Using SST, remove the bearing.  
SST 09286-46011



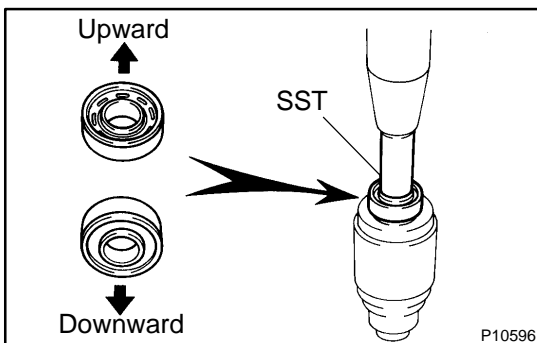
- (b) Using a press, press in a new bearing.

**17. INSPECT FRONT BEARING**

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

**18. IF NECESSARY, REPLACE FRONT BEARING**

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

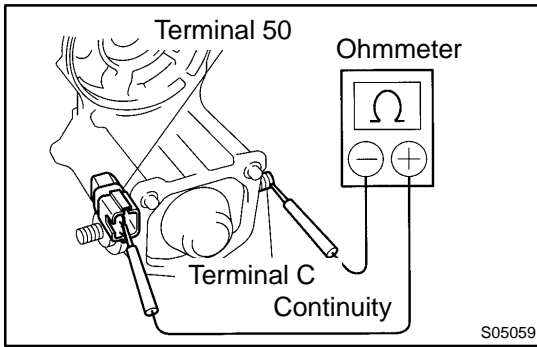


- (b) Using SST and a press, press in a new bearing.

**NOTICE:**

**Be careful of the bearing installation direction.**

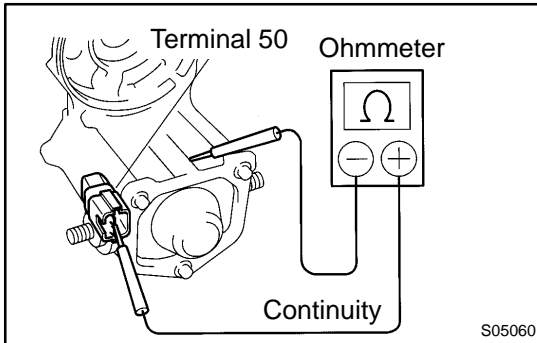
SST 09820-00030



### 19. INSPECT MAGNETIC SWITCH PULL-IN COIL OPEN CIRCUIT

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

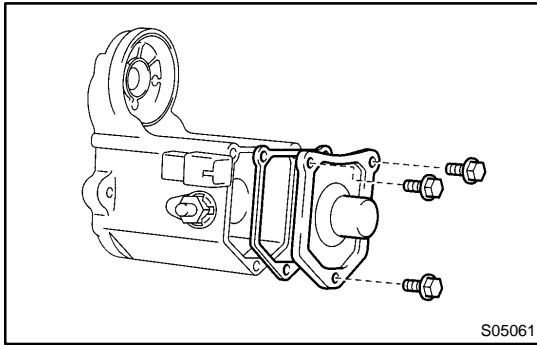
If there is no continuity, check and replace the magnetic switch.



### 20. INSPECT MAGNETIC SWITCH HOLD-IN COIL OPEN CIRCUIT

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

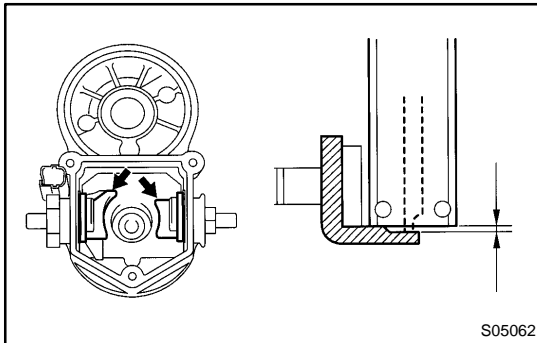
If there is no continuity, replace the magnetic switch.



## REPLACEMENT

### 1. REMOVE MAGNETIC SWITCH END COVER

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

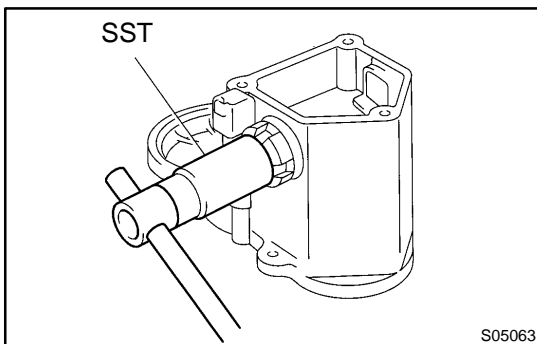


### 2. INSPECT CONTACT PLATE FOR WEAR

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.



### 3. REMOVE TERMINAL KIT PARTS

(a) Using SST, loosen the terminal nuts.

SST 09810-38140

(b) Terminal C:

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

(c) Terminal 30:

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

### 4. REINSTALL TERMINAL KIT PARTS

(a) Terminal 30:

Install these new parts:

- (1) Insulation paper
- (2) Terminal insulator (inside)
- (3) Contact plate
- (4) Terminal bolt
- (5) O-ring
- (6) Packing and terminal insulator (outside):

Install the packing to the terminal insulator, and install them.

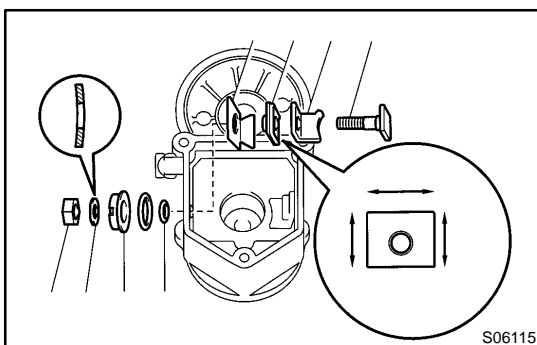
#### HINT:

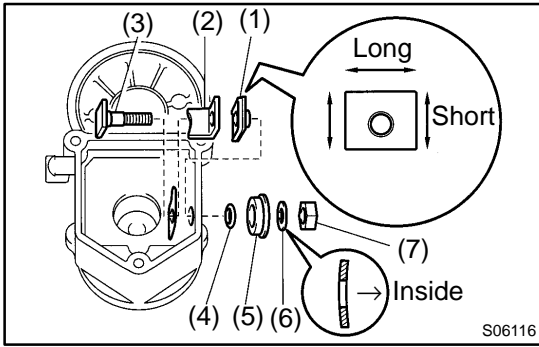
Match the protrusion of the insulator with the indentation of the housing.

- (7) Wave washer
- (8) Terminal nut

#### NOTICE:

**Be careful to install the terminal insulators (inside) and wave washers in the correct direction.**



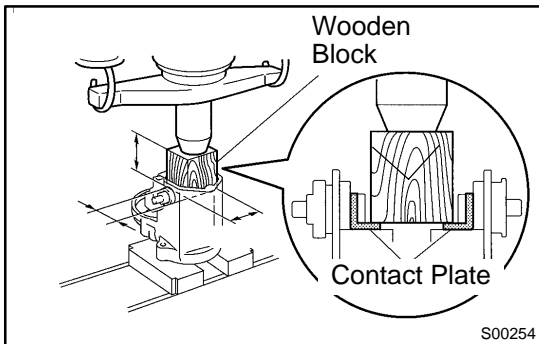


- (b) Terminal C:  
Install these new parts:
- (1) Terminal insulator (inside)
  - (2) Contact plate
  - (3) Terminal bolt
  - (4) O-ring
  - (5) Terminal insulator (outside)
  - (6) Wave washer
  - (7) Terminal nut

**NOTICE:**

Be careful to install the terminal insulators (inside) and wave washers in the correct direction.

- (c) Temporarily tighten the terminal nuts.



**5. TIGHTEN TERMINAL NUT**

- (a) 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:**

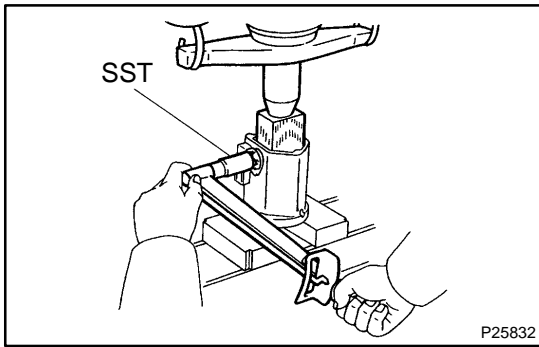
$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2}\right)^2 \times 3.14 (\pi)}$$

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

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

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

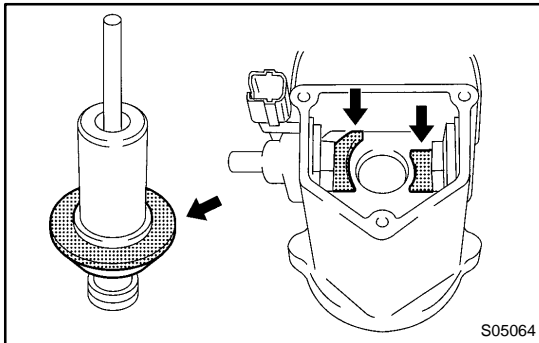
- ◆ If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.



- (b) Using SST, tighten the nuts to the specified torque.  
 SST 09810-38140  
**Torque: 17 N·m (170 kgf·cm, 12 ft·lbf)**

**NOTICE:**

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



**6. CLEAN CONTACT SURFACES OF CONTACT PLATE AND PLUNGER**

Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.

**7. REINSTALL MAGNETIC SWITCH END COVER**

Install the plunger, new gasket, end cover with 3 bolts.

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

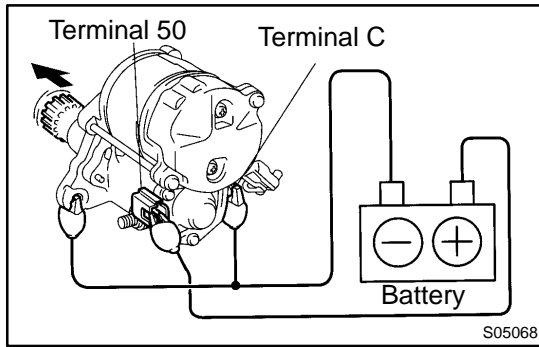


## REASSEMBLY

Reassembly is in the reverse order of disassembly (See page [ST-5](#)).

HINT:

Before reassembling, use high-temperature grease to lubricate the bearings and gears.



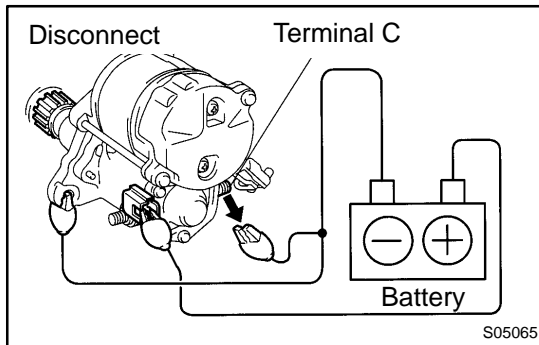
## TEST

### NOTICE:

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

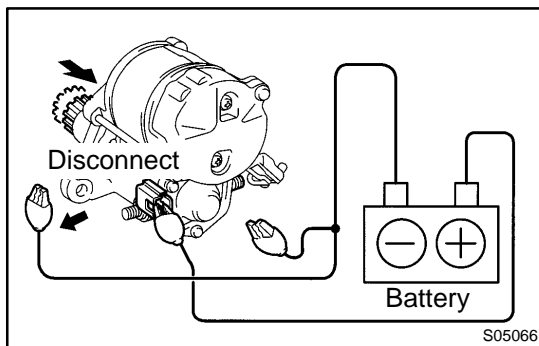
#### 1. DO PULL-IN TEST

- (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.



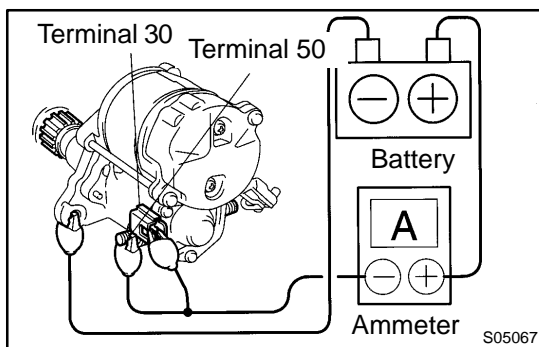
#### 2. DO HOLD-IN TEST

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.



#### 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

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

**Specified current: 90 A or less at 11.5 V**

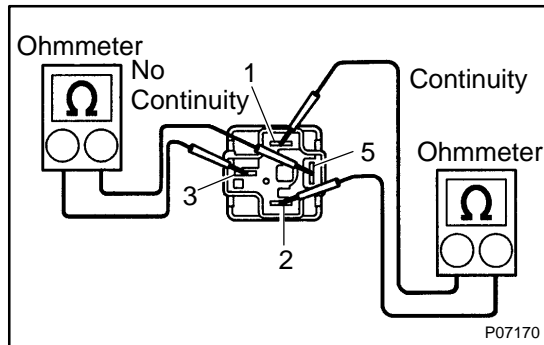
## INSTALLATION

Installation is in the reverse order of removal (See page [ST-19](#)).

# STARTER RELAY INSPECTION

## 1. REMOVE STARTER RELAY (Marking: "ST")

LOCATION: In the engine compartment relay box.  
Remove the relay box cover and starter relay.



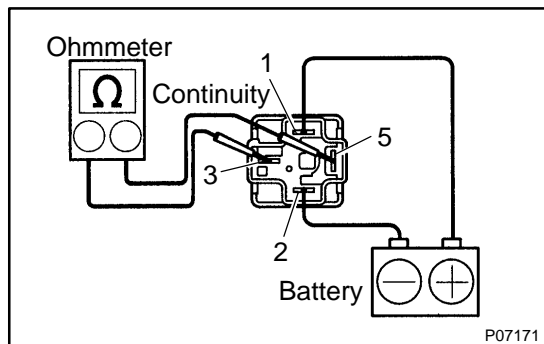
## 2. INSPECT STARTER RELAY CONTINUITY

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

If there is no continuity, replace the relay.

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

If there is continuity, replace the relay.



## 3. INSPECT STARTER RELAY OPERATION

(a) Apply battery positive voltage across terminals 1 and 2.

(b) Using an ohmmeter, check that there is continuity between terminals 3 and 5.

If there is no continuity, replace the relay.

## 4. REINSTALL STARTER RELAY