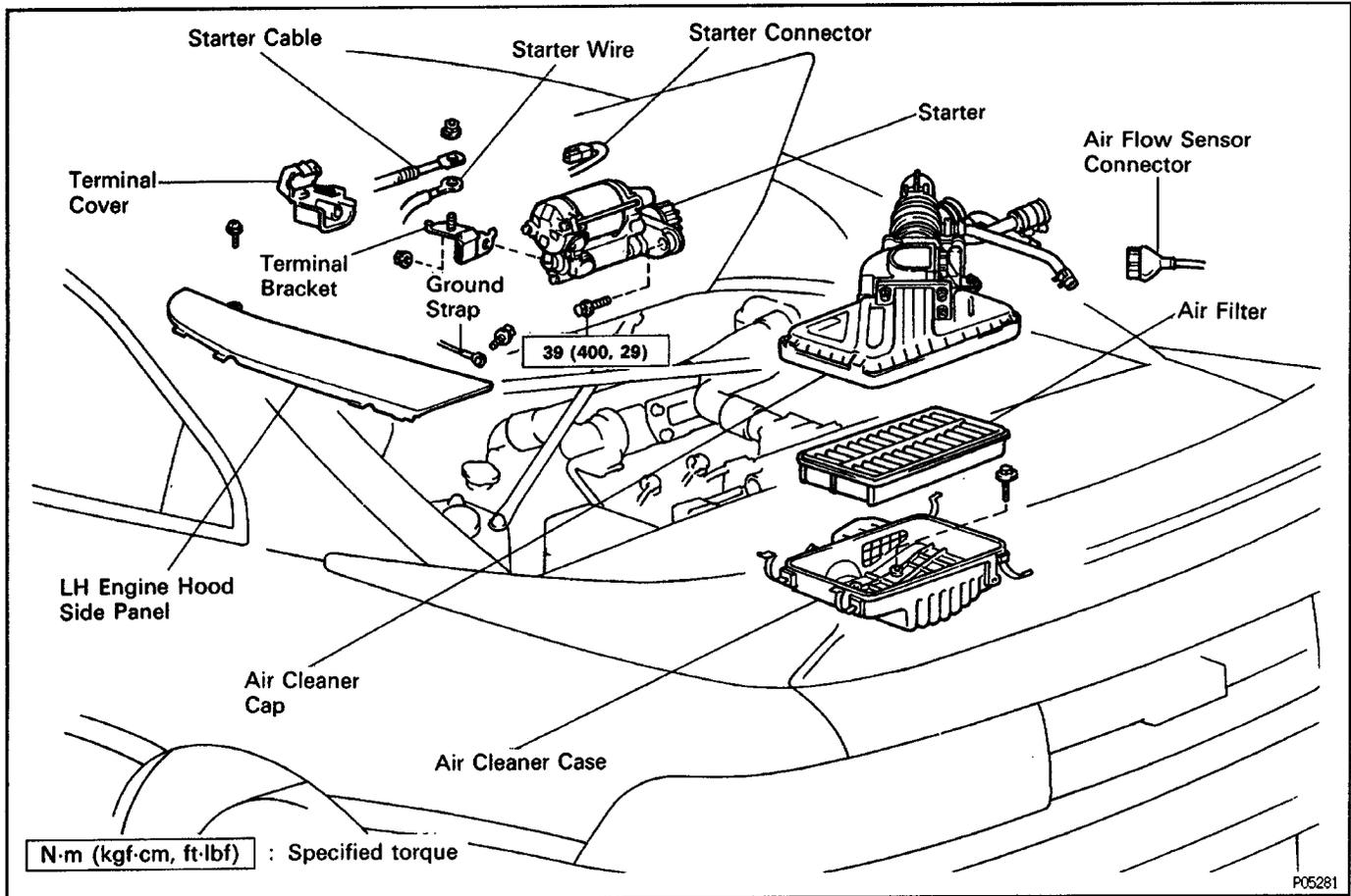


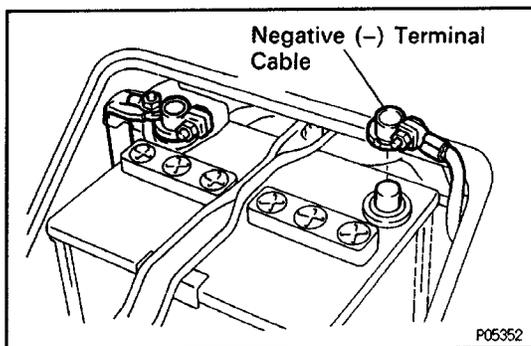
# STARTER

## COMPONENTS FOR REMOVAL AND INSTALLATION (3S-GTE)

ST00W-04



ST028-01



### STARTER REMOVAL (3S-GTE)

(See Components for Removal and Installation)

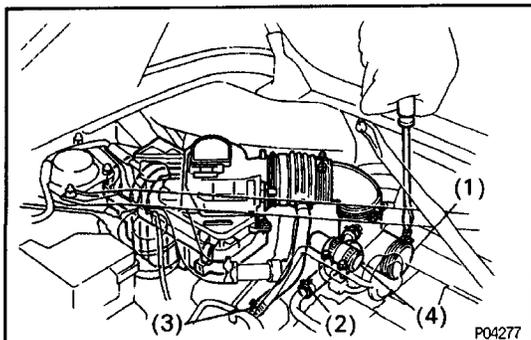
1. DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY

**CAUTION:** Turn the ignition switch to "LOCK". Disconnect the negative terminal from the battery. Wait at least 20 seconds before proceeding with work.

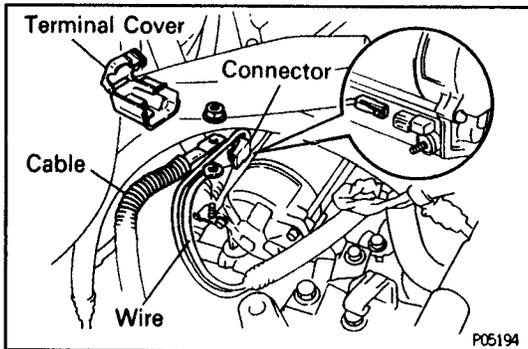
2. REMOVE LH ENGINE HOOD SIDE PANEL

3. REMOVE AIR CLEANER HOUSING

- (a) Disconnect the air flow sensor connector.
- (b) Disconnect the following hoses:
  - (1) Air cleaner hose from turbocharger
  - (2) PCV hose from cylinder head cover
  - (3) Air hose from No.2 air hose
  - (4) Air hose from air by-pass valve

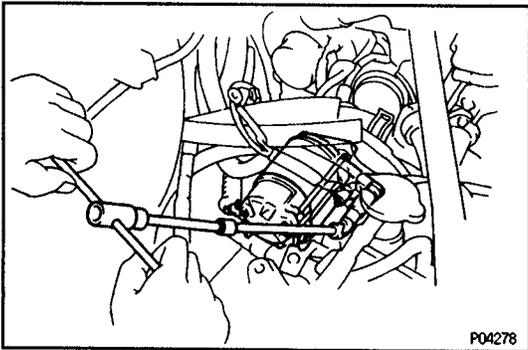


- (c) Disconnect the four clamps, and remove the air cleaner cap and air flow sensor assembly.
- (d) Remove the air filter.
- (e) Remove the three bolts and air cleaner case.

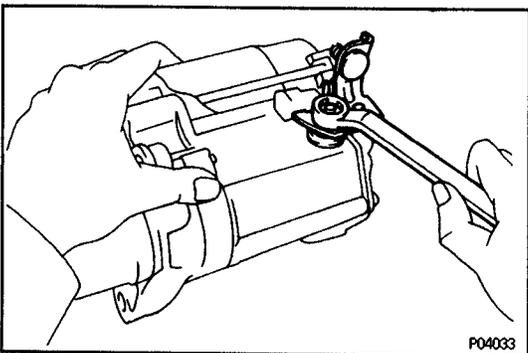


#### 4. REMOVE STARTER

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

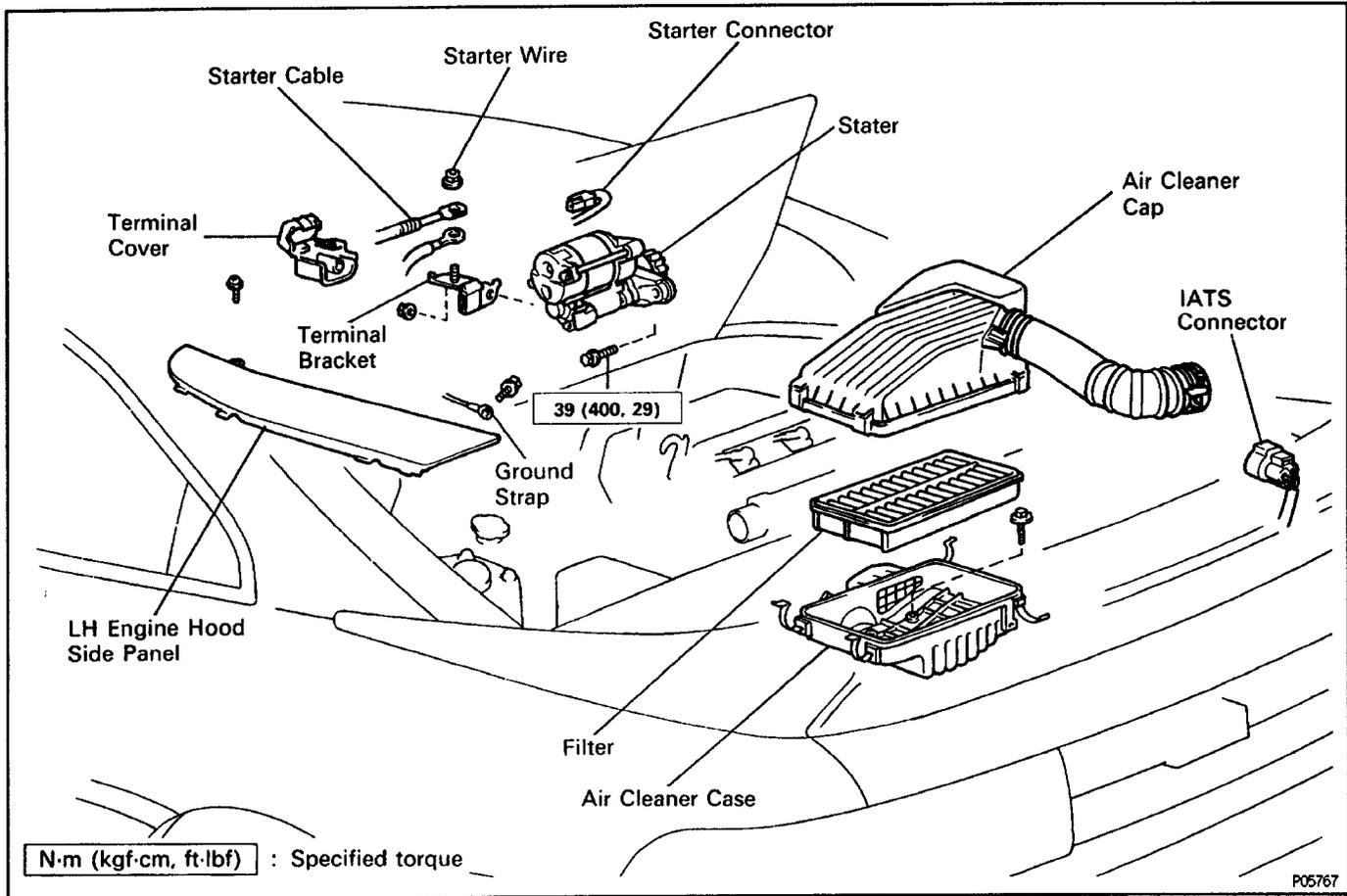


- (d) Remove the two bolts and starter.

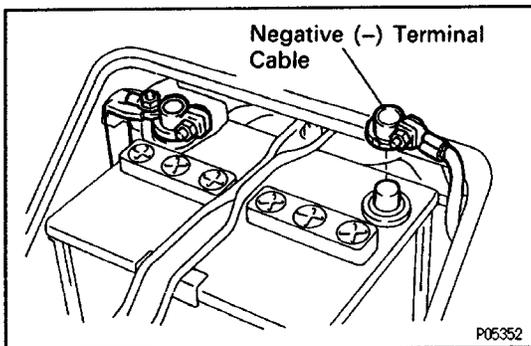


- (e) Remove the nut and terminal bracket from the starter.

## COMPONENTS FOR REMOVAL AND INSTALLATION (5S-FE)



P05767



### STARTER REMOVAL (5S-FE)

(See Components for Removal and Installation)

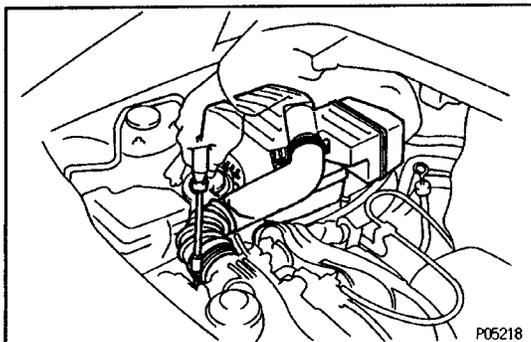
#### 1. DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY

**CAUTION:** Turn the ignition switch to "LOCK". Disconnect the negative terminal from the battery. Wait at least 20 seconds before proceeding with work.

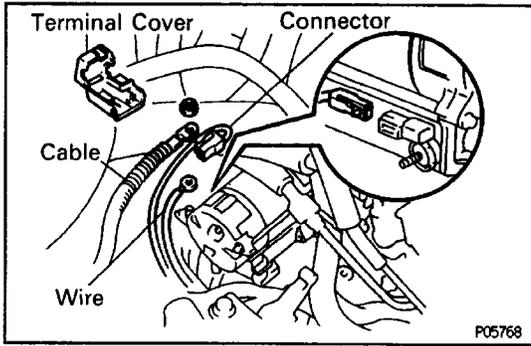
#### 2. REMOVE LH ENGINE HOOD SIDE PANEL

#### 3. REMOVE AIR CLEANER HOUSING

- (a) Disconnect the IATS connector.
- (b) Disconnect the air cleaner hose from the throttle body.
- (c) Disconnect the four clamps, and remove the air cleaner cap.
- (d) Remove the air filter.
- (e) Remove the three bolts and air cleaner case.

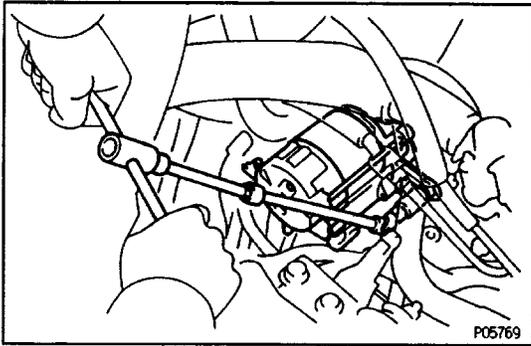


8Y02T-01

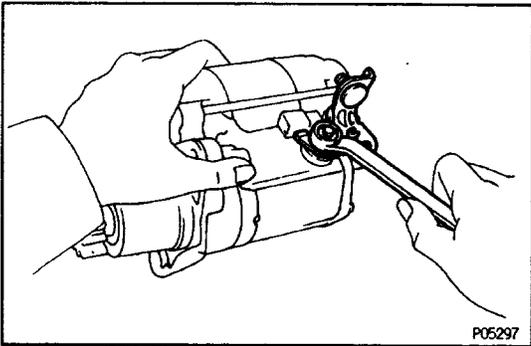


#### 4. REMOVE STARTER

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



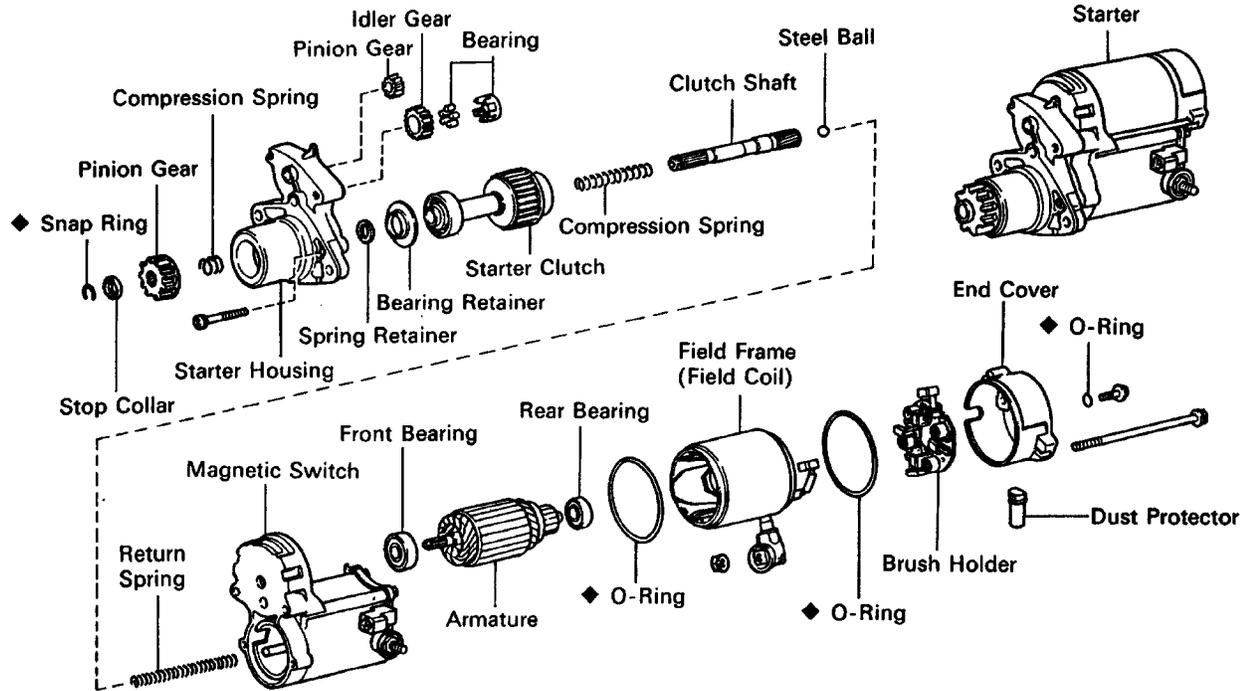
- (d) Remove the two bolts and starter.



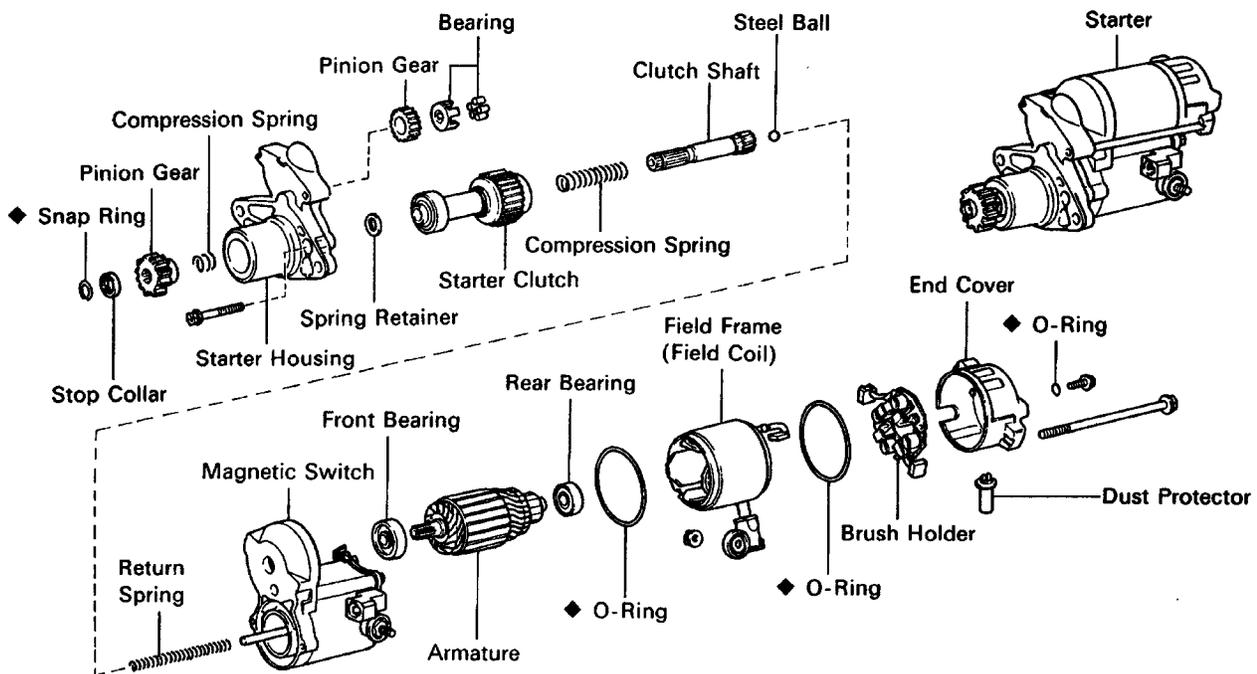
- (e) Remove the nut and terminal bracket from the starter.

# COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

## Conventional Type (1.4 kW and 1.6 kW)

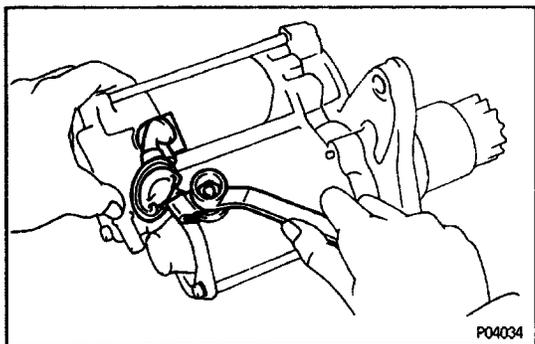


## Compact Type (1.4 kW)



◆ Non-reusable part

P04072  
P05210

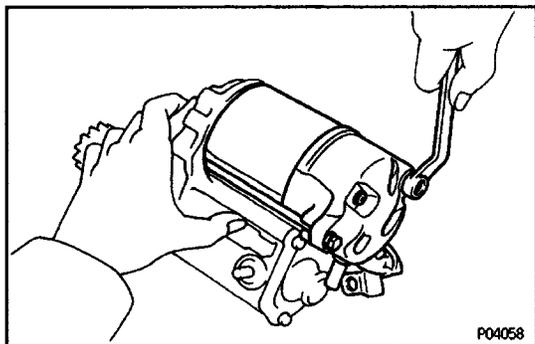


## STARTER DISASSEMBLY

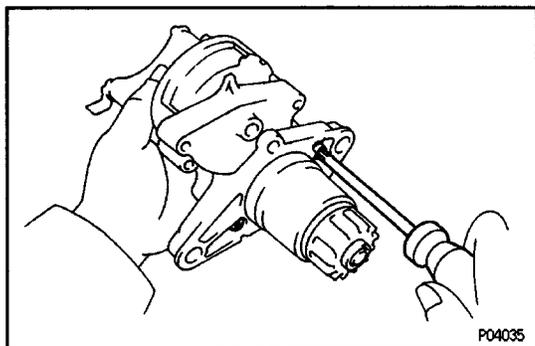
(See Components for Disassembly and Assembly)

### 1. REMOVE FIELD FRAME AND ARMATURE

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

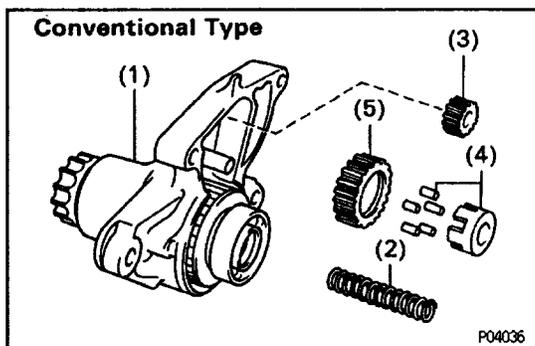


- (b) Remove the two through bolts.  
 (c) Pull out the field frame together with the armature from the magnetic switch.  
 (d) Remove the O-ring.



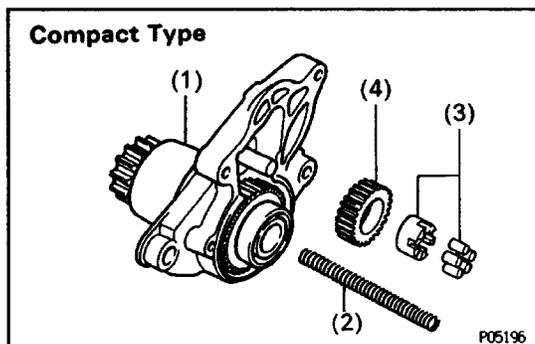
### 2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR

- (a) Remove the two screws.



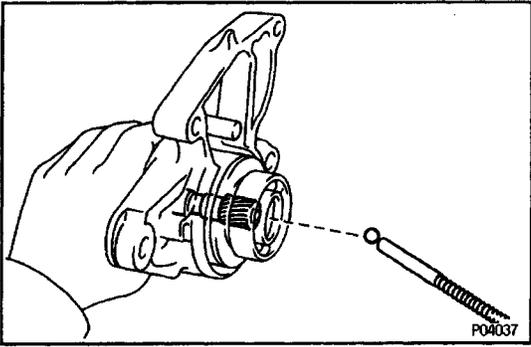
- (b) Remove the following parts from the magnetic switch:  
 (Conventional Type)

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



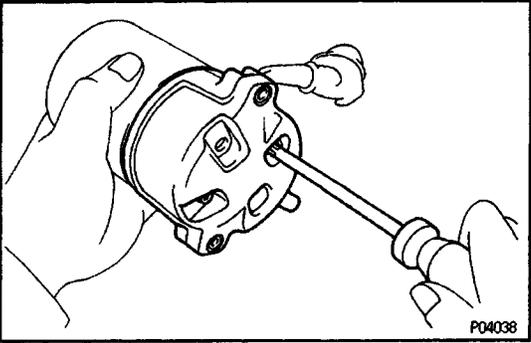
- (Compact Type)

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



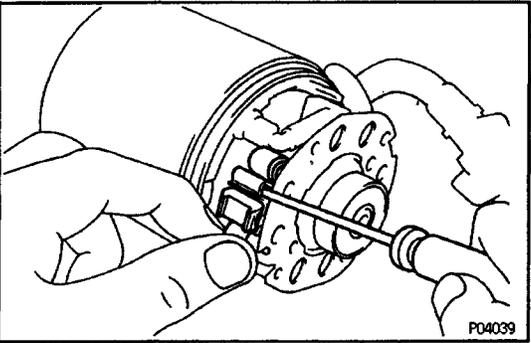
### 3. REMOVE STEEL BALL

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

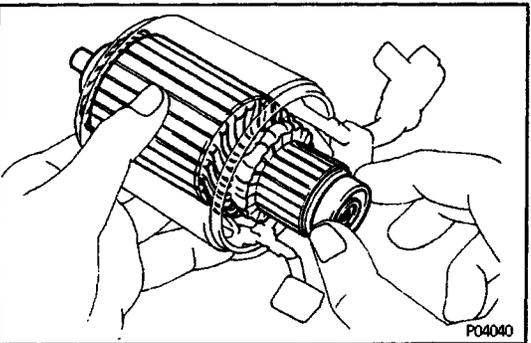


### 4. REMOVE BRUSH HOLDER

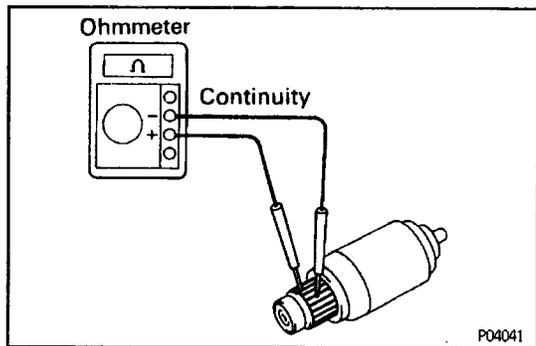
- (a) Remove the two screws, two O-rings and end cover from the field frame.
- (b) Remove the O-ring from the field frame.



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



### 5. REMOVE ARMATURE FROM FIELD FRAME

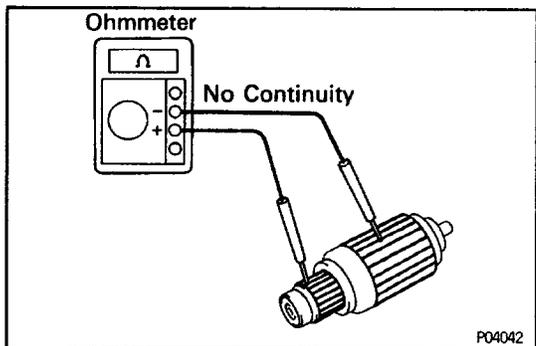


## STARTER INSPECTION AND REPAIR

### Armature Coil

#### 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.



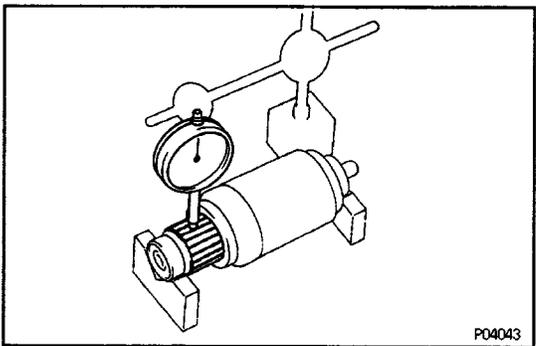
#### 2. INSPECT COMMUTATOR FOR GROUND

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

## Commutator

#### 1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES

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



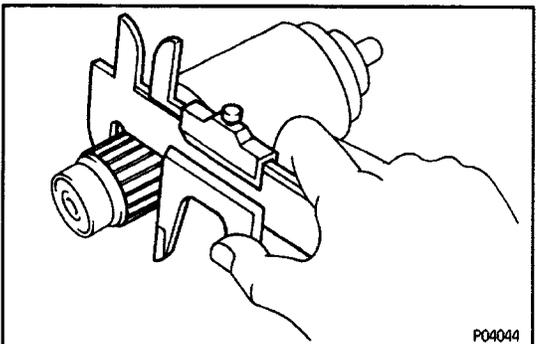
#### 2. INSPECT COMMUTATOR CIRCLE RUNOUT

- (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.



#### 3. INSPECT COMMUTATOR DIAMETER

Using a vernier caliper, measure the commutator diameter.

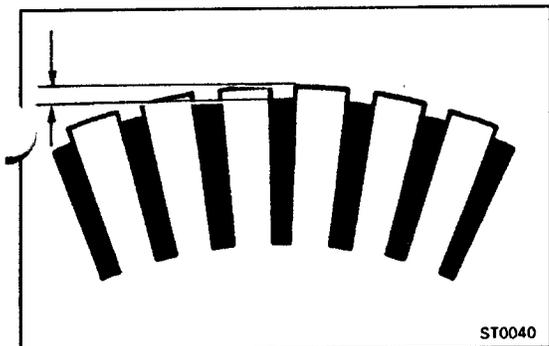
**Standard diameter:**

**30mm(1.18in.)**

**Minimum diameter:**

**29 mm (1.14 in.)**

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



#### 4. INSPECT UNDERCUT DEPTH

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

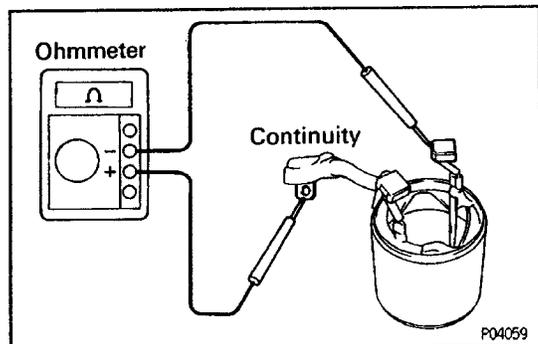
**Standard undercut depth:**

**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.

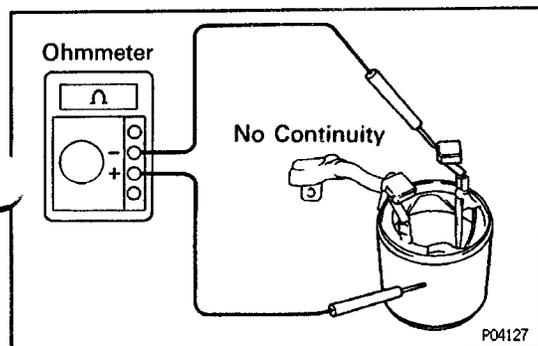


### Field Coil (Field frame)

#### 1. INSPECT FIELD COIL FOR OPEN CIRCUIT

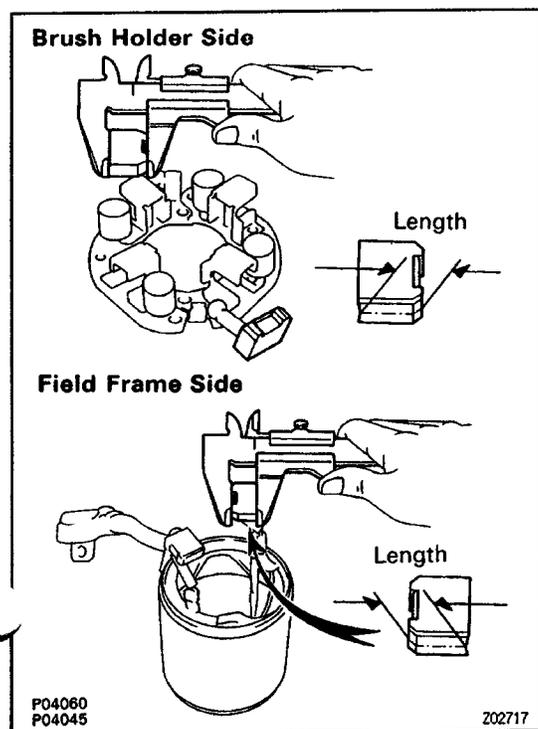
Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.

If there is no continuity, replace the field frame.



#### 2. INSPECT FIELD COIL FOR GROUND

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



### Brushes

#### INSPECT BRUSH LENGTH

Using a vernier caliper, measure the brush length.

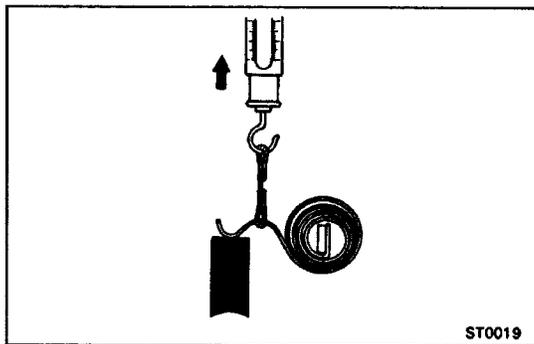
**Standard length:**

**15.0 mm (0.591 in.)**

**Minimum length:**

**10.0 mm (0.394 in.)**

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



## Brush Springs

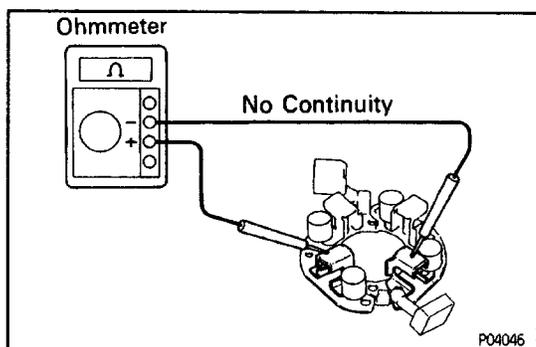
### INSPECT BRUSH SPRING LOAD

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

#### Spring installed load:

**18–24N(1.79–2.41kgf,3.9–5.311bf)**

If the installed load is not as specified, replace the brush springs.



## Brush Holder

### 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.

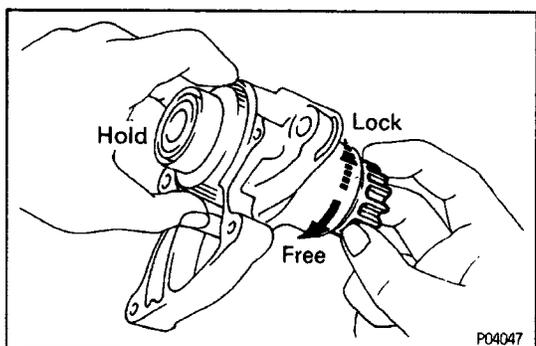
## Clutch and Gears

### 1. INSPECT GEAR TEETH

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

If damaged, replace the gear or clutch assembly.

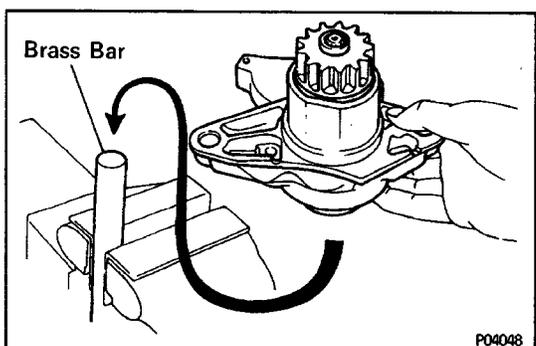
If damaged, also check the drive plate ring gear for wear or damage.



### 2. 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.

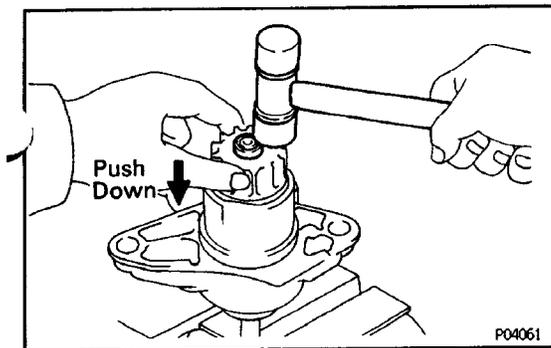
If necessary, replace the clutch assembly.



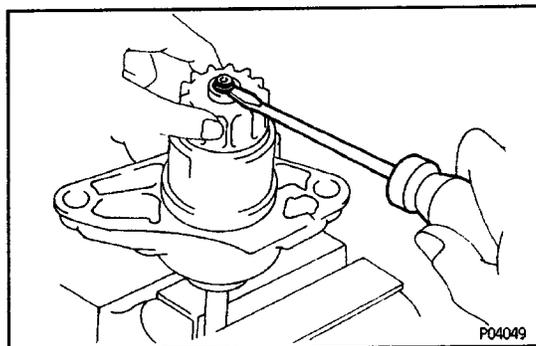
### 3. IF NECESSARY, REPLACE CLUTCH ASSEMBLY

#### A. Disassembly of starter housing and clutch assembly

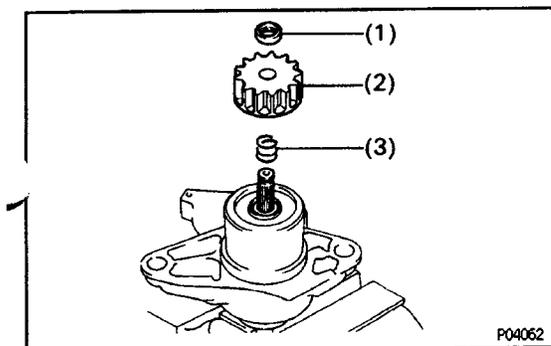
- (a) Mount a brass bar in a vise, and install the starter housing and clutch assembly to the brass bar.



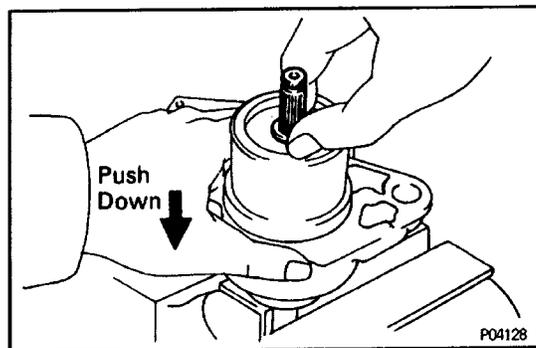
- (b) Push down the pinion gear.
- (c) Using a plastic-faced hammer, tap down the stop collar.



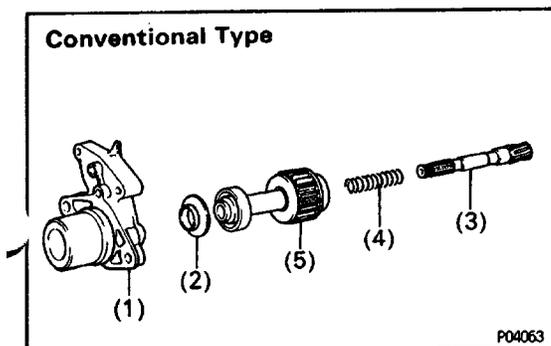
- (d) Using a screwdriver, pry out the snap ring.



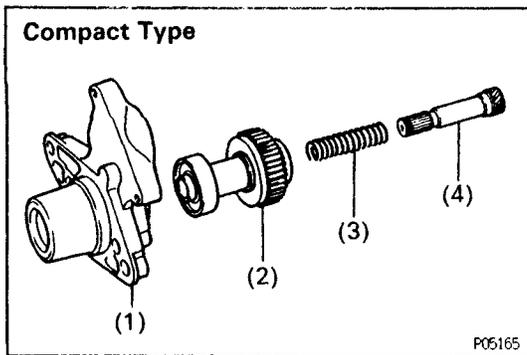
- (e) Remove the following parts:
- (1) Stop collar
- (2) Pinion gear
- (3) Compression spring



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

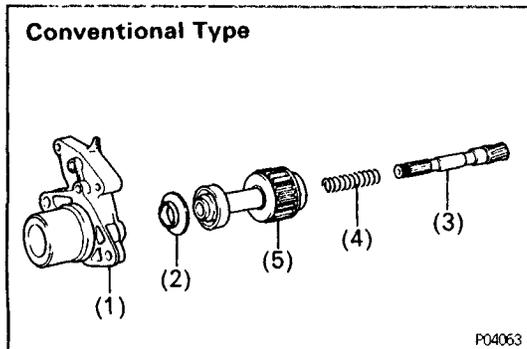


- (g) Disassemble the following parts:  
(Conventional Type)
- (1) Starter housing
- (2) Bearing retainer
- (3) Starter clutch
- (4) Compression spring
- (5) Clutch shaft



(Compact Type)

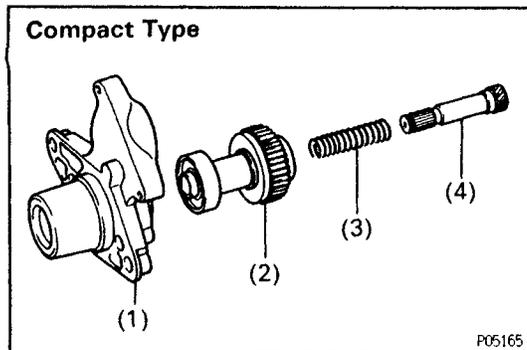
- (1) Starter housing
- (2) Starter clutch
- (3) Compression spring
- (4) Clutch shaft

**B. Assemble starter housing and clutch assembly**

(a) Assemble the following parts:

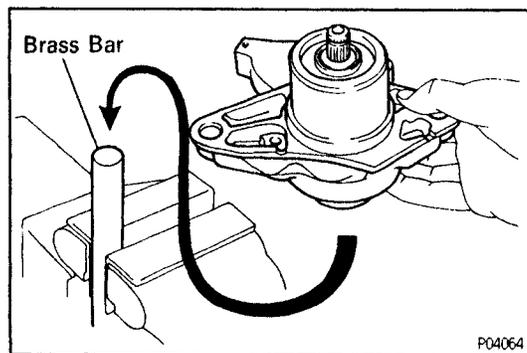
(Conventional Type)

- (1) Starter housing
- (2) Bearing retainer
- (3) Starter clutch
- (4) Compression spring
- (5) Clutch shaft

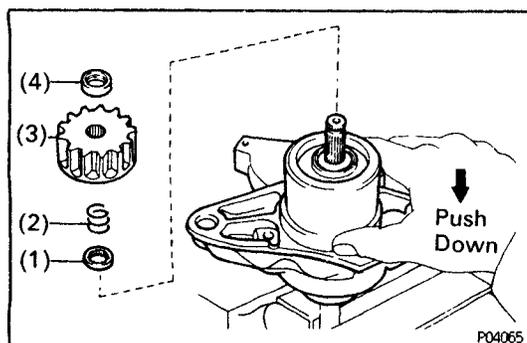


(Compact Type)

- (1) Starter housing
- (2) Starter clutch
- (3) Compression spring
- (4) Clutch shaft

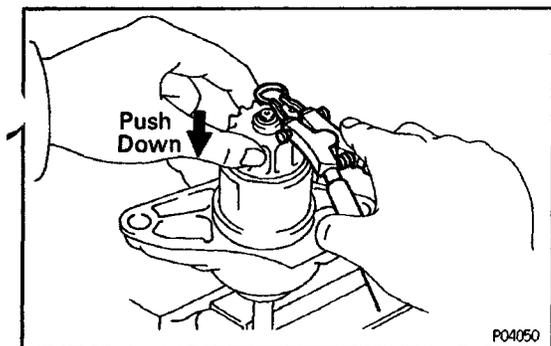


(b) Mount a brass bar in a vise, install the starter housing and clutch assembly to the brass bar.

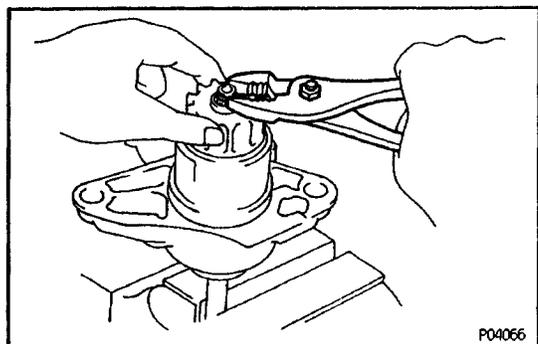


(c) Push down the starter housing, and install the following parts:

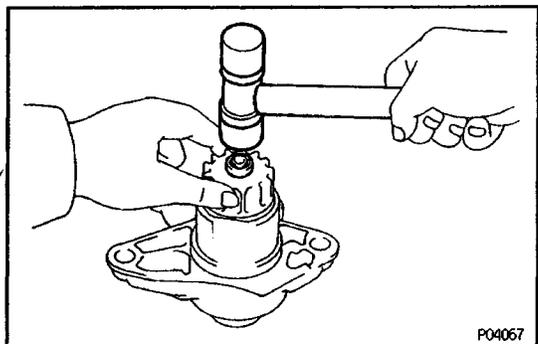
- (1) Spring retainer
- (2) Compression spring
- (3) Pinion gear
- (4) Stop collar



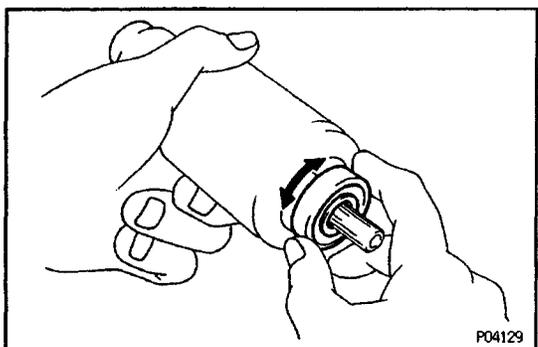
- (d) Push down the pinion gear.
- (e) Using snap ring pliers, install a new snap ring.



- (f) Using pliers, compress the snap ring.
- (g) Check that the snap ring fits correctly.



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

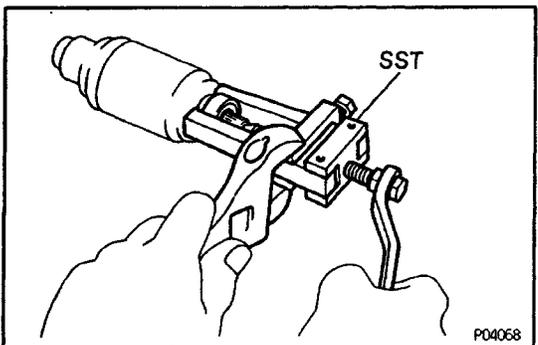


## Bearings

### 1. INSPECT FRONT BEARING

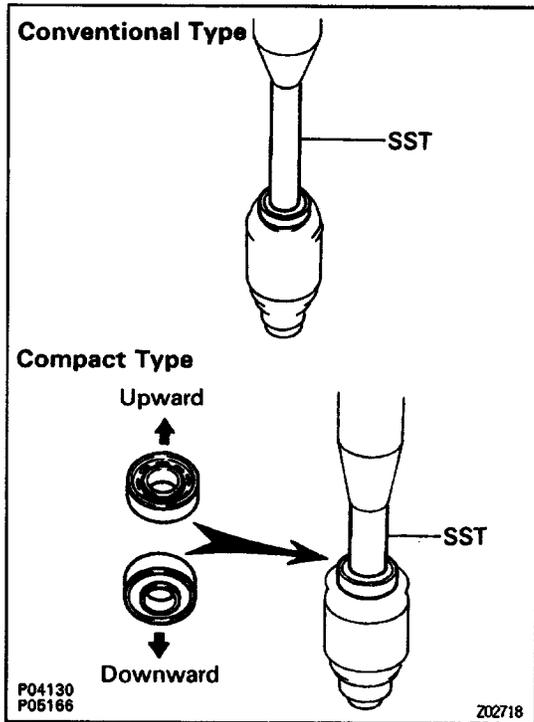
Turn each bearing by hand while applying inward force.

If resistance is felt or the bearing sticks, replace the bearing.



### 2. IF NECESSARY, REPLACE FRONT BEARING

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

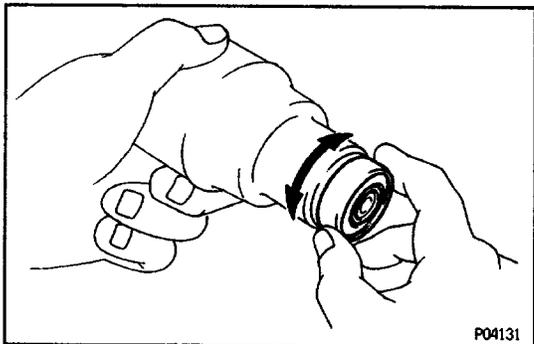


(b) Using SST and a press, press in a new bearing.  
SST

09825 - 76010 for Conventional type

09820-00030 for Compact type

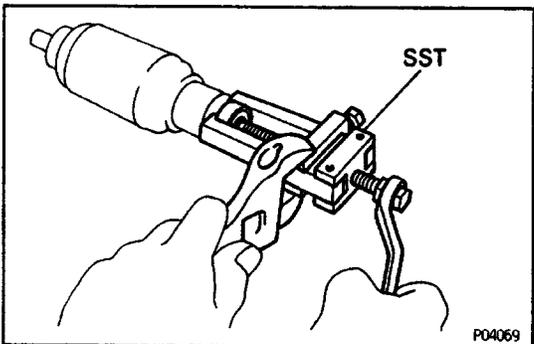
**NOTICE (Compact type):** Be careful of the bearing installation direction.



### 3. INSPECT REAR BEARING

Turn each bearing by hand while applying inward force.

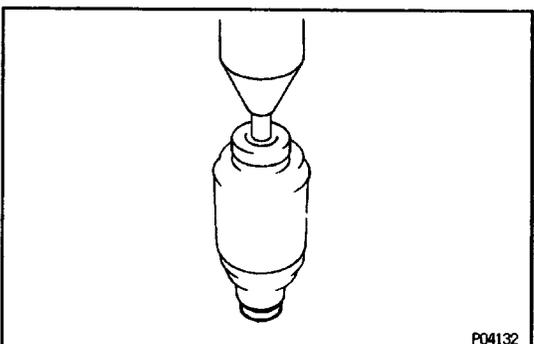
If resistance is felt or the bearing sticks, replace the bearing.



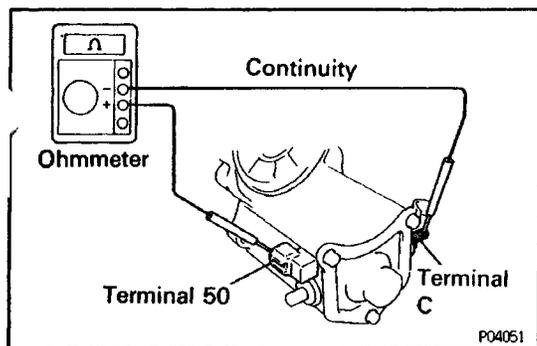
### 4. IF NECESSARY, REPLACE REAR BEARING

(a) Using SST, remove the bearing.

SST 09286-46011



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

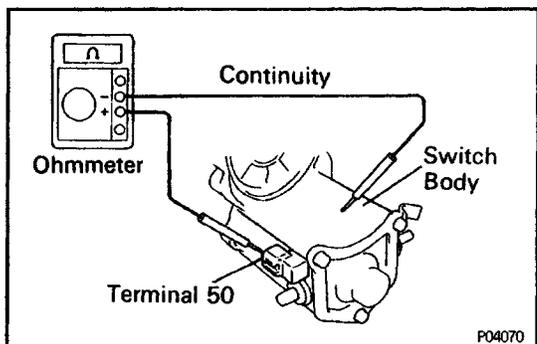


## Magnetic Switch

### 1. PERFORM PULL-IN COIL OPEN CIRCUIT TEST

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

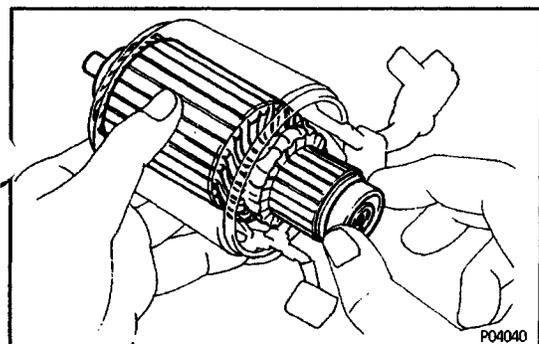
If there is no continuity, replace the magnetic switch,



### 2. PERFORM 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.:



## STARTER ASSEMBLY

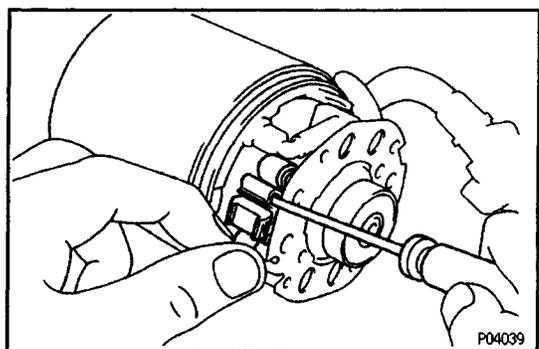
ST02W-01

(See Components for Disassembly and Assembly)

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

### 1. PLACE ARMATURE INTO FIELD FRAME

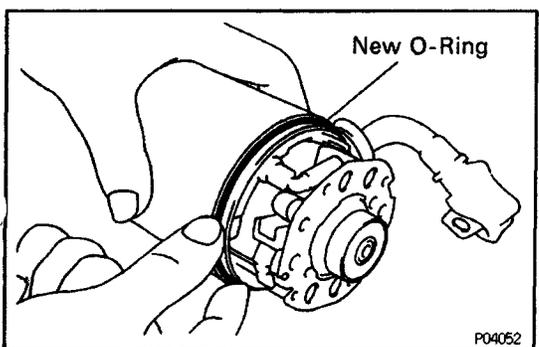
Apply grease to the armature bearings, and insert the armature into the field frame.



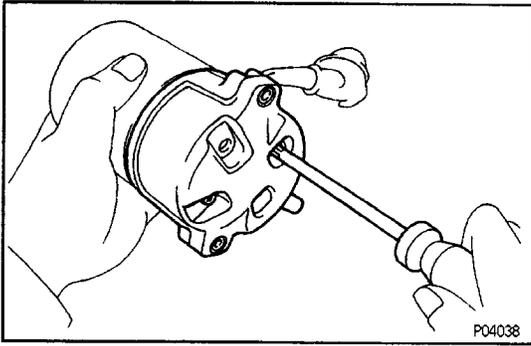
### 2. INSTALL BRUSH HOLDER

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

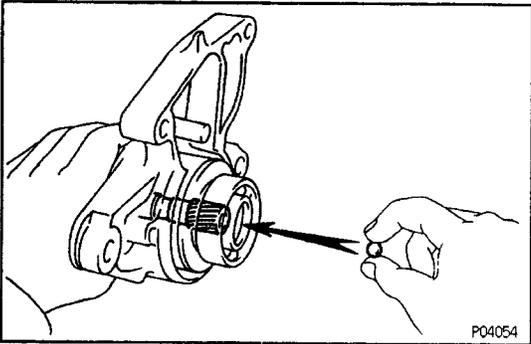
**NOTICE:** Check that the positive (+) lead wires are not-grounded.



- (c) Install a new O-ring to the groove of the field frame.

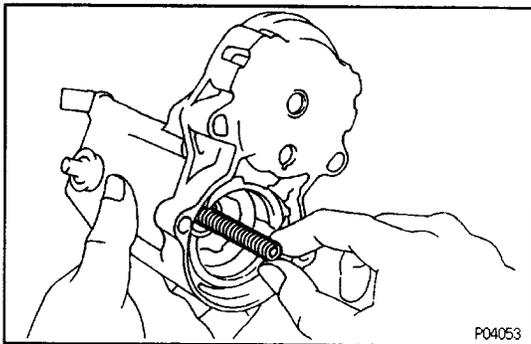


- (d) Install a new O-ring to the screw.
- (e) Install the end cover to the field frame with the two screws.



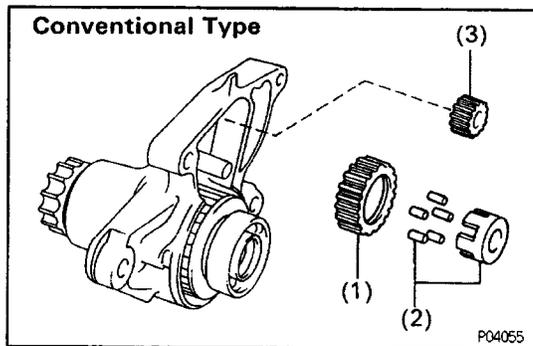
### 3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

- (a) Apply grease to the steel ball.
- (b) Insert the steel ball into the clutch shaft hole.



### 4. INSTALL STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR

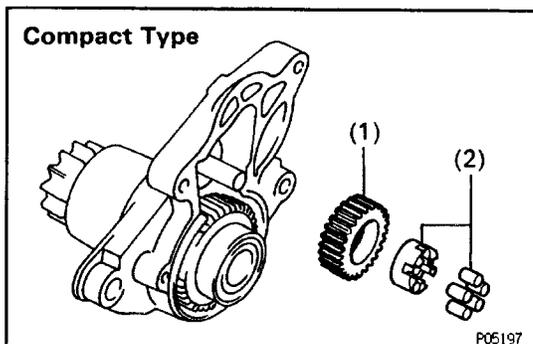
- (a) Apply grease to the return spring.
- (b) Insert the return spring into the magnetic switch hole



- (c) Place the following parts in position on the starter housing:

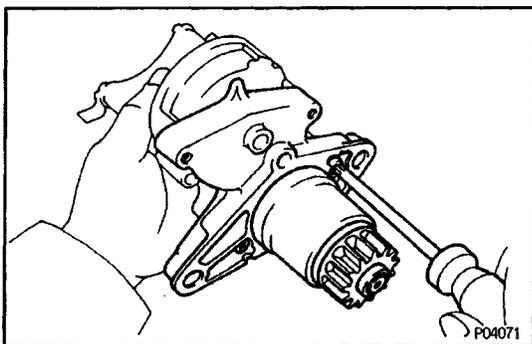
(Conventional Type)

- (1) Idler gear
- (2) Bearing
- (3) Pinion Gear

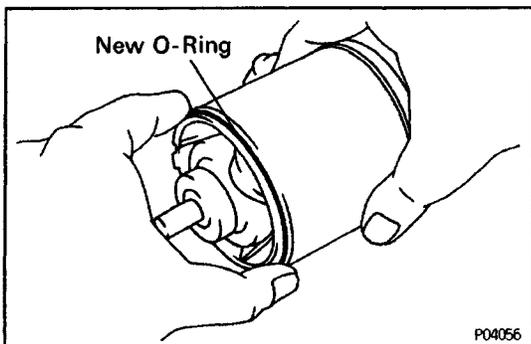


(Compact Type)

- (1) Idler gear
- (2) Bearing

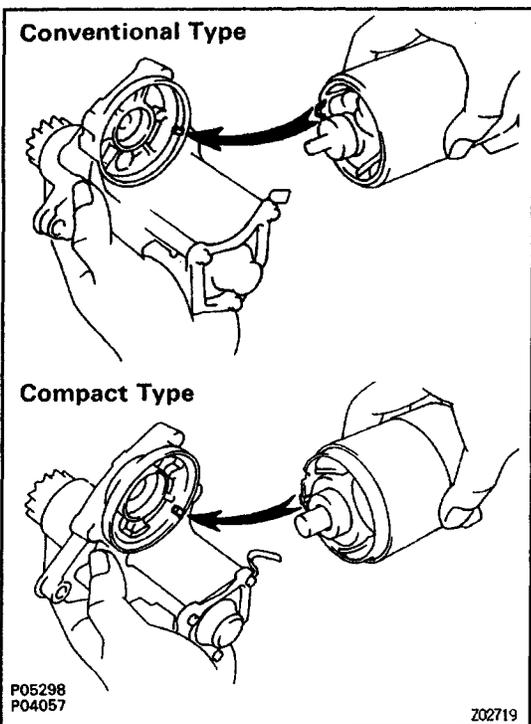


- (d) Install the starter housing to the magnetic switch the two screws.

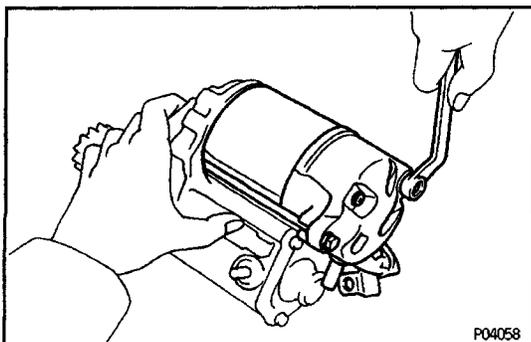


## 5. INSTALL FIELD FRAME AND ARMATURE ASSEMBLY

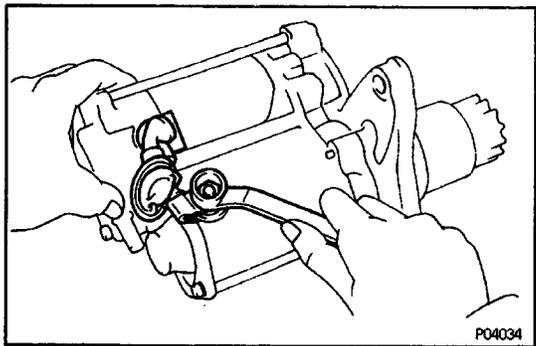
- (a) Install a new O-ring to the groove of the frame



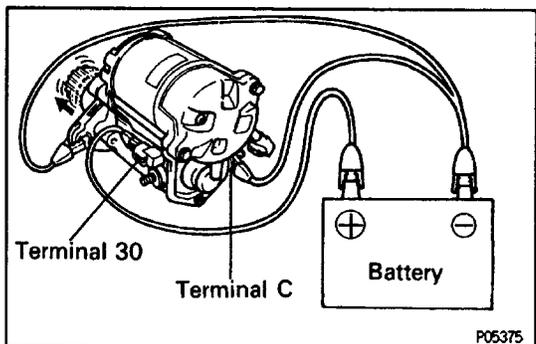
- (b) Align the protrusion of the field frame with the cutout of the magnetic switch.



- (c) Install the field frame and armature assembly, two through bolts.



- (d) Connect the lead wire to terminal C, and install the nut.



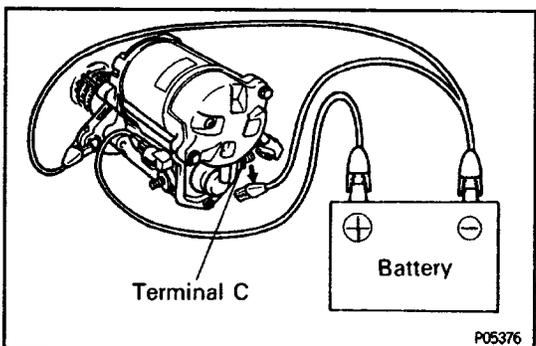
## STARTER PERFORMANCE TEST

87010-04

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

### 1. PERFORM PULL-IN TEST

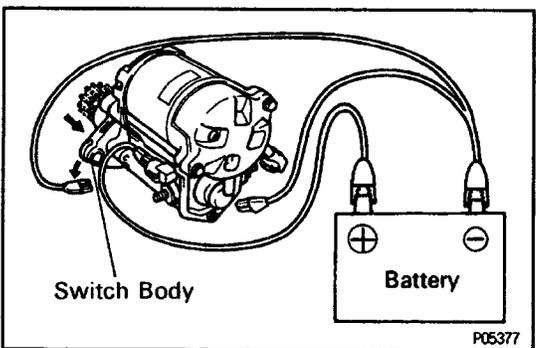
- Disconnect the field coil lead wire from terminal C.
- Connect the battery to the magnetic switch as shown.  
Check that the clutch pinion gear moves outward.  
If the clutch pinion gear does not move, replace the magnetic switch assembly.



### 2. PERFORM HOLD-IN TEST

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

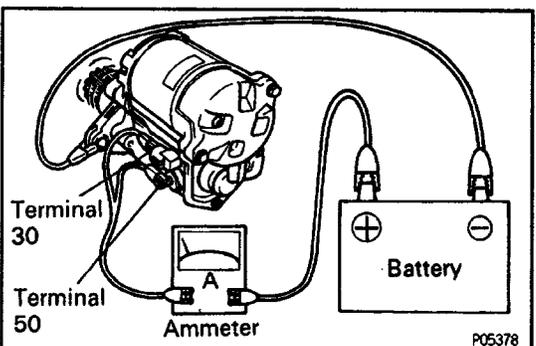
- Check that the pinion gear remains out.  
If the clutch pinion gear returns inward, replace the magnetic switch assembly.



### 3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (-) lead from the switch body.

Check that the clutch pinion gear returns inward.  
If the clutch pinion gear does not return, replace the magnetic switch assembly.



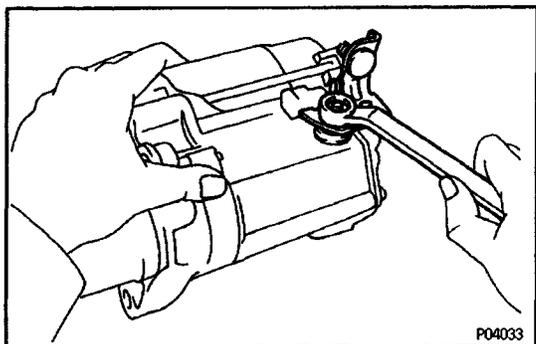
### 4. PERFORM NO-LOAD PERFORMANCE TEST

- 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**

ST02X-01

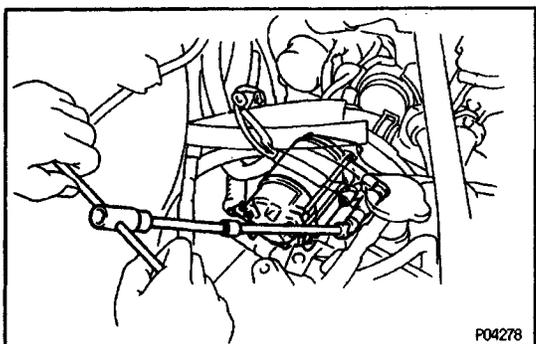


## STARTER INSTALLATION (3S-GTE)

(See Components for Removal and Installation)

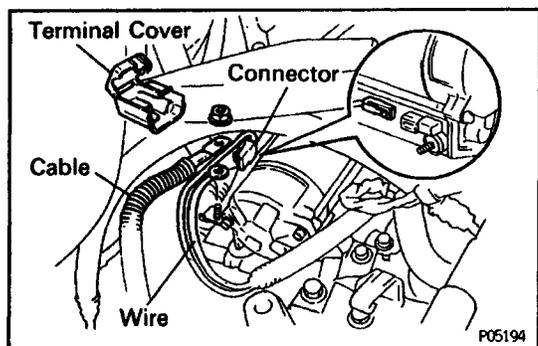
### 1. INSTALL STARTER

- (a) Install the terminal bracket to the starter with the nut.

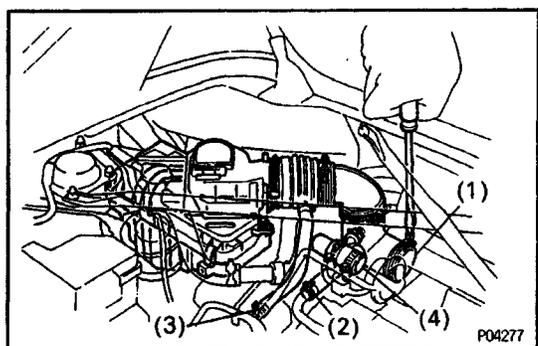


- (b) Install the starter with the two bolts.

**Torque: 39 N-m (400 kgf-cm, 29 ft-lbf)**



- (c) Connect the starter wire and cable with the nut.  
 (d) Connect the starter connector.  
 (e) Install the terminal cover.



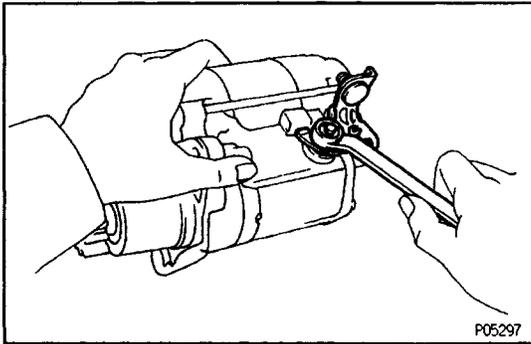
### 2. INSTALL AIR CLEANER HOUSING

- (a) Install the air cleaner case with the three bolts.  
 (b) Install the air filter.  
 (c) Install the air cleaner cap and air flow sensor assembly with the four clips.  
 (d) Connect the following hoses:  
 (1) Air cleaner hose to turbocharger  
 (2) PCV hose to cylinder head cover  
 (3) Air hose to No.2 air tube  
 (4) Air hose to air by-pass valve  
 (e) Connect the air flow sensor connector.

### 3. INSTALL LH ENGINE HOOD SIDE PANEL

### 4. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

### 5. CHECK THAT ENGINE STARTS

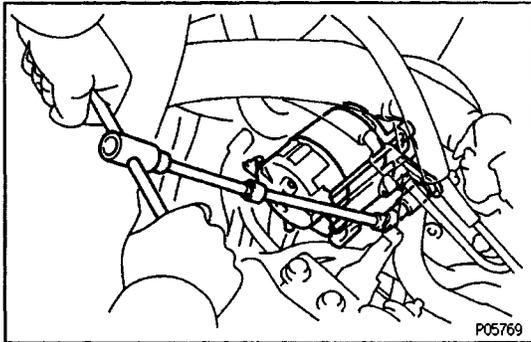


## STARTER INSTALLATION (5S-FE)

(See Components for Removal and Installation)

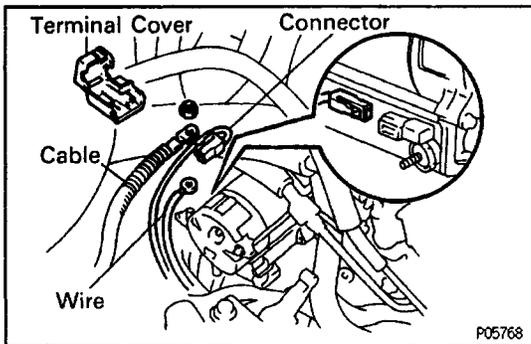
### 1. INSTALL STARTER

- (a) Install the terminal bracket to the starter with the nut.



- (b) Install the starter with the two bolts.

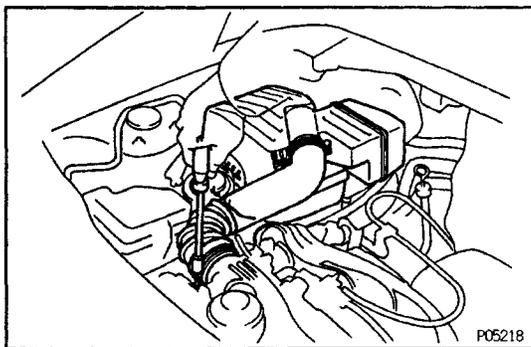
**Torque: 39 N-m (400 kgf-cm, 29 ft-lbf)**



- (c) Connect the starter wire and cable with the nut.

- (d) Connect the starter connector.

- (e) Install the terminal cover.



### 2. INSTALL AIR CLEANER HOUSING

- (a) Install the air cleaner case with the three bolts.

- (b) Install the air filter.

- (c) Install the air cleaner cap with the four clamps.

- (d) Connect the air cleaner hose to the throttle body.

- (e) Connect the IATS connector.

### 3. INSTALL LH ENGINE HOOD SIDE PANEL

### 4. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

### 5. CHECK THAT ENGINE STARTS