

STARTING SYSTEM

ON-VEHICLE INSPECTION

ST017-01

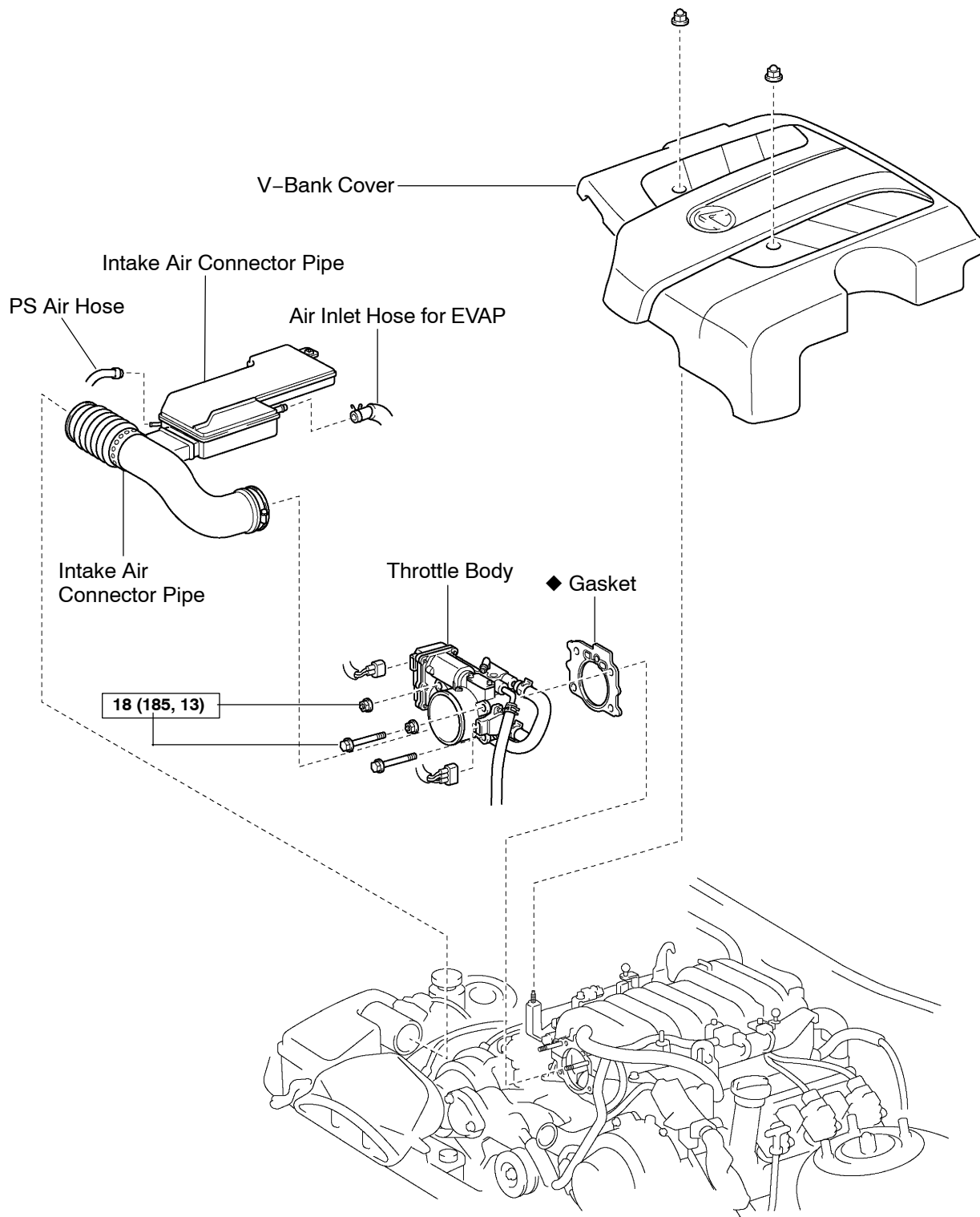
NOTICE:

Before changing the starter, check the following items again:

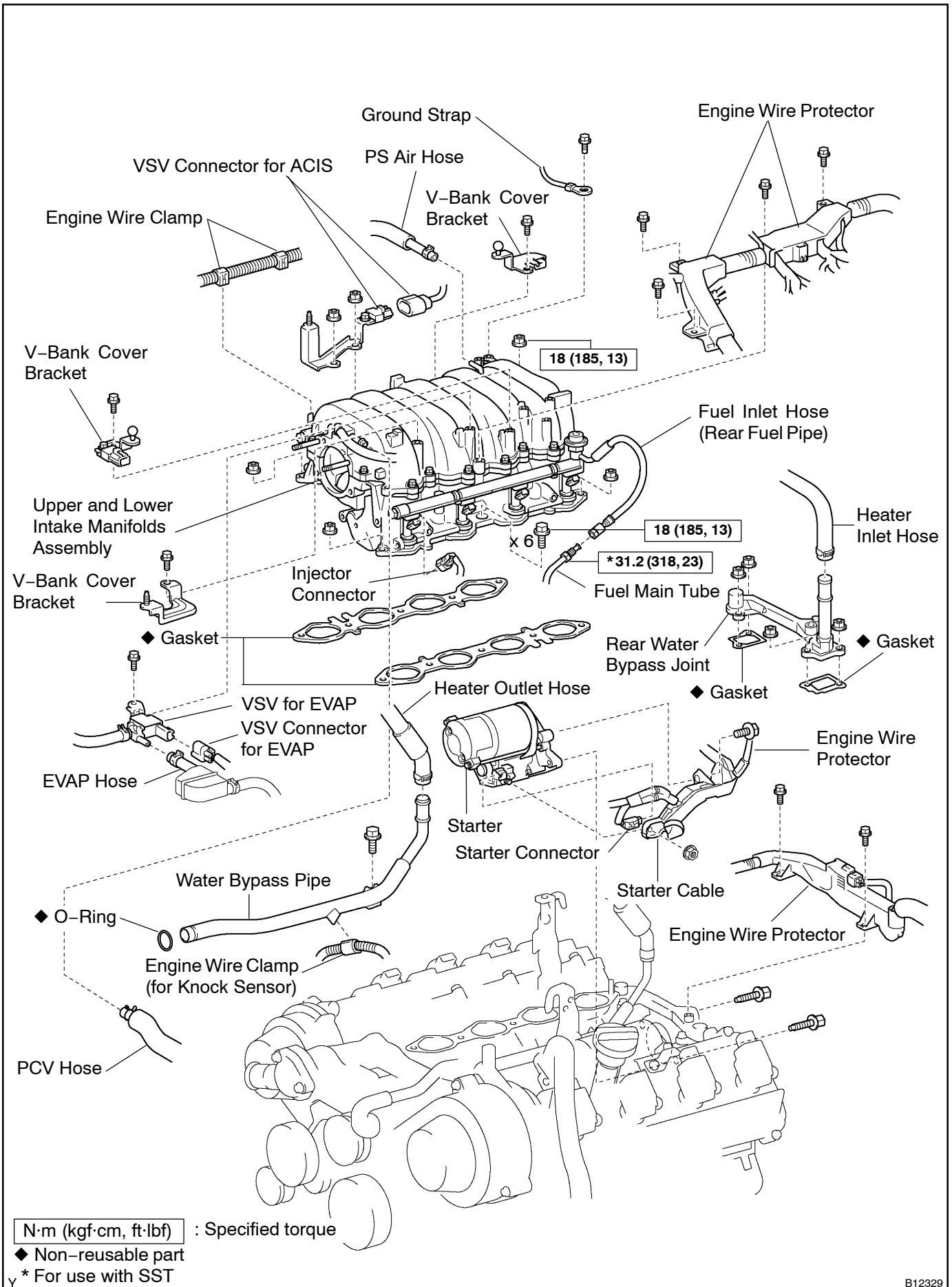
- Connector connection
- Accessory installation, e.g.: theft deterrent system

STARTER COMPONENTS

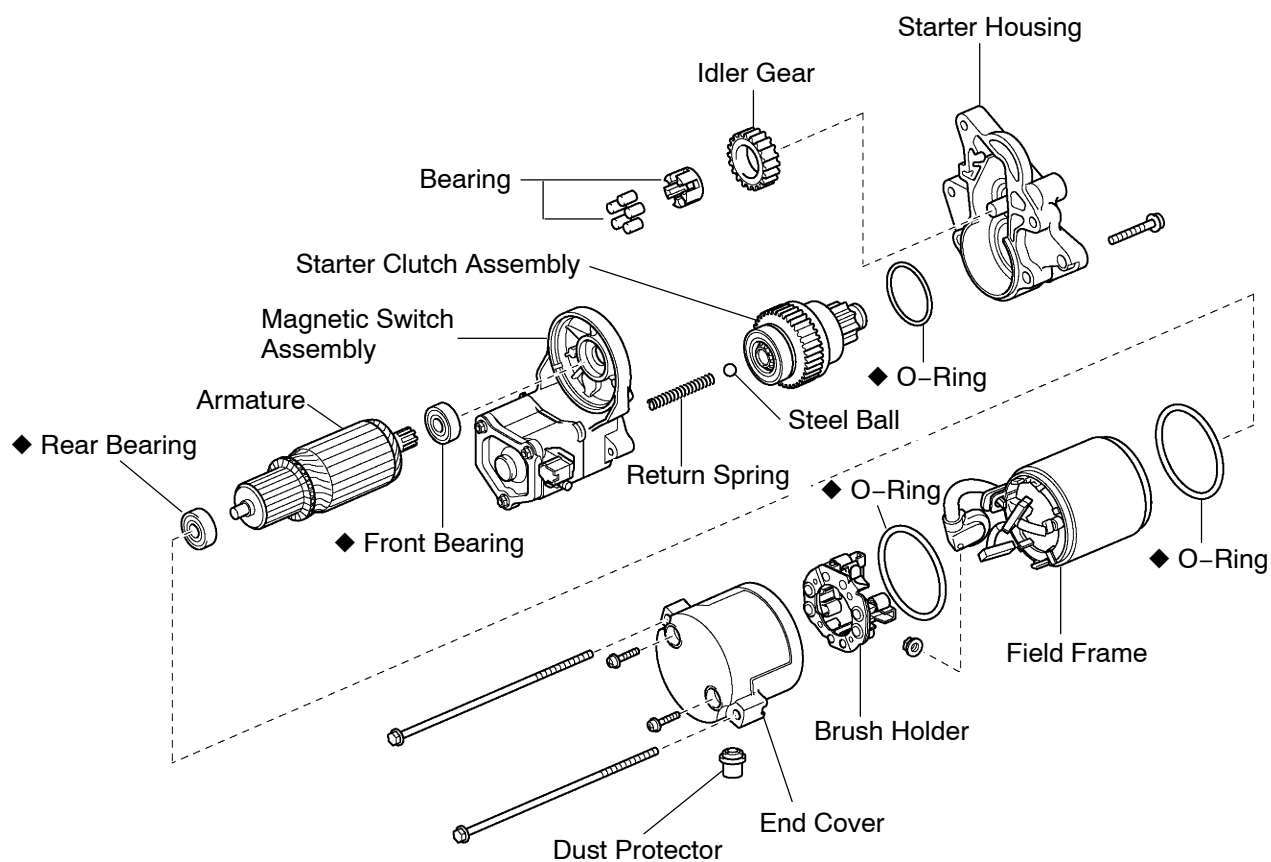
STOMF-01



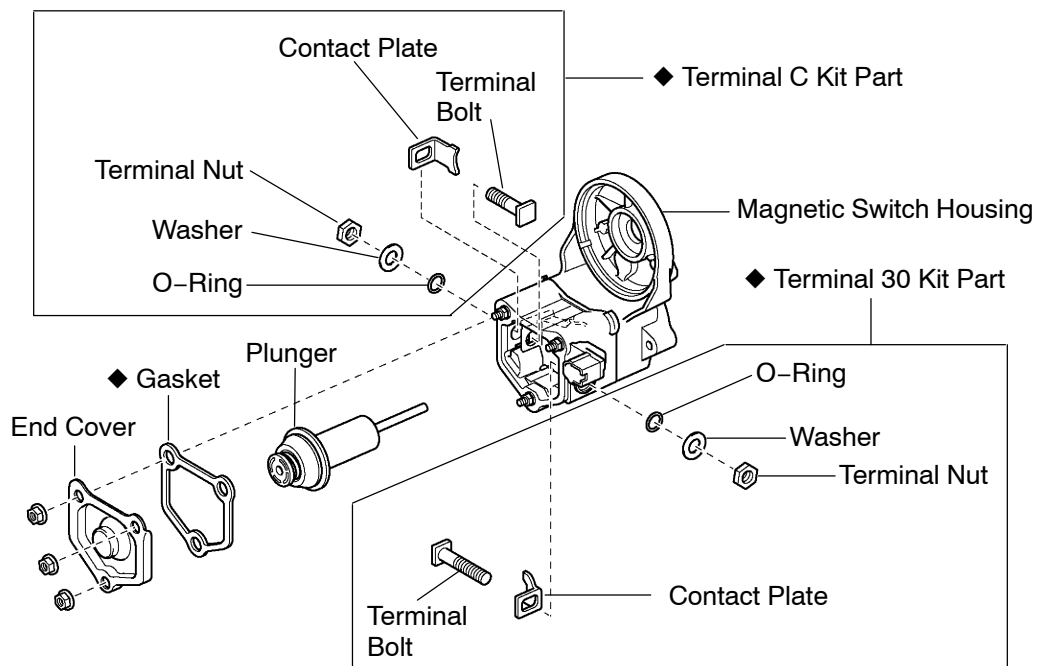
B12251



B12329



Magnetic Switch Assembly

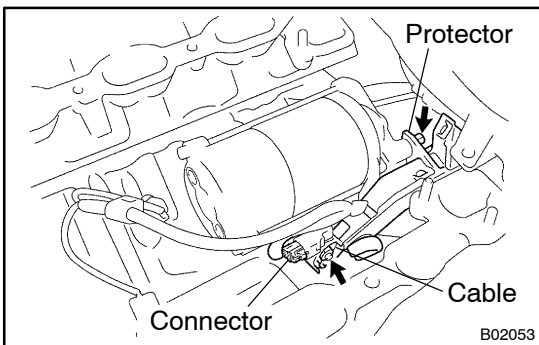


◆ Non-reusable part

B12317

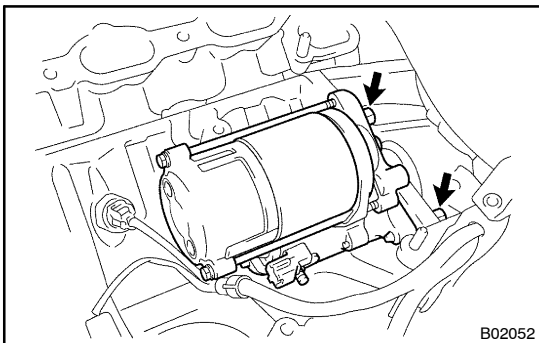
REMOVAL

1. DRAIN ENGINE COOLANT
2. REMOVE V-BANK COVER
3. REMOVE INTAKE AIR CONNECTOR PIPE
4. □ REMOVE THROTTLE BODY (See page FI-38)
5. REMOVE UPPER AND LOWER INTAKE MANIFOLDS ASSEMBLY (See page EM-36)
6. □ REMOVE WATER BYPASS PIPE (See page EM-36)
7. REMOVE REAR WATER BYPASS JOINT (See page EM-36)

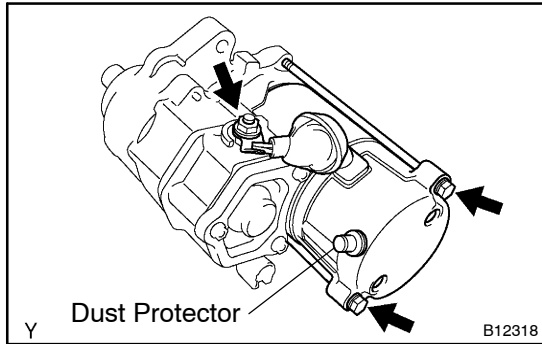


8. REMOVE STARTER

- (a) Disconnect the starter connector.
- (b) Remove the nut, and disconnect the starter cable.
- (c) Remove the bolt, and disconnect the engine wire protector.



- (d) Remove the 2 bolts and starter.

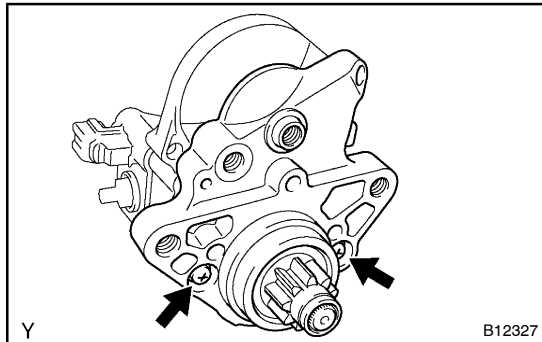


DISASSEMBLY

1. REMOVE DUST PROTECTOR

2. REMOVE FIELD FRAME AND ARMATURE

- Remove the nut, and disconnect the lead wire from the magnetic switch terminal.
- Remove the 2 through bolts.
- Pull out the field frame together with the armature from the magnetic switch.
- Remove the O-ring from the field frame.

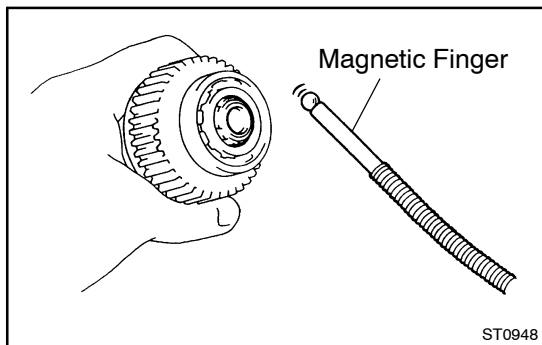


3. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

- Remove the 2 screws.
- Remove these parts from the magnetic switch:
 - Remove the starter housing.
 - Remove the return spring.
 - Remove the idler gear.
 - Remove the bearing.
 - Remove the starter clutch assembly.
- Remove the O-ring from the starter housing.

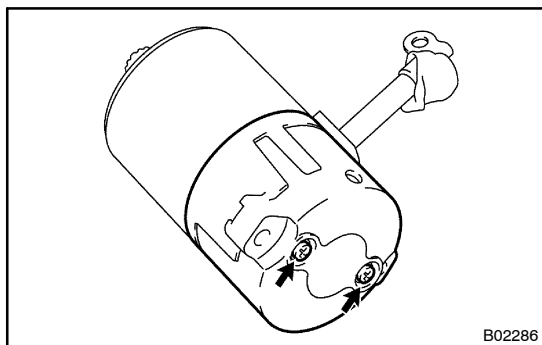
4. REMOVE STEEL BALL

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



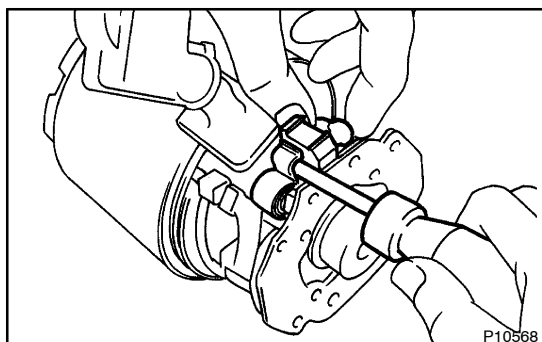
5. REMOVE BRUSH HOLDER

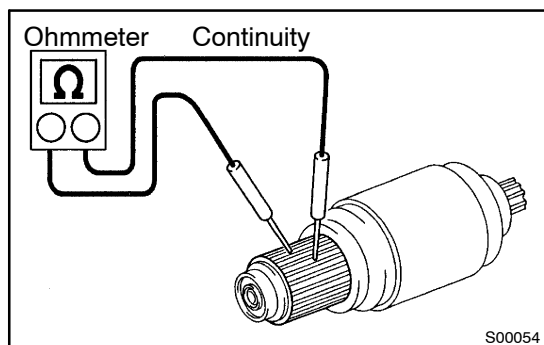
- Remove the 2 screws and end cover from the field frame.



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

6. REMOVE ARMATURE FROM FIELD FRAME



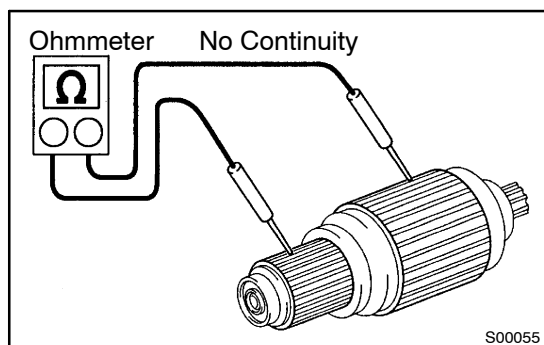


INSPECTION

1. INSPECT ARMATURE COIL

- (a) Check the 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.

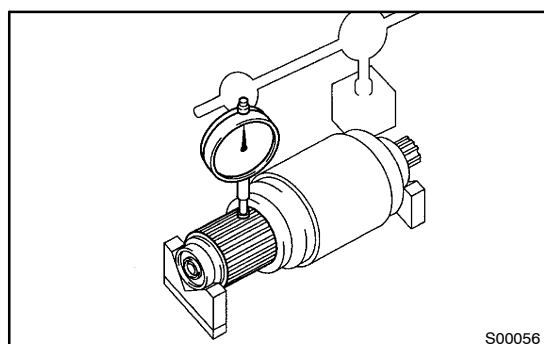


- (b) Check the commutator for ground.
Using an ohmmeter, check that there is no continuity between the commutator and armature coil core.

If there is continuity, replace the armature.

2. INSPECT COMMUTATOR

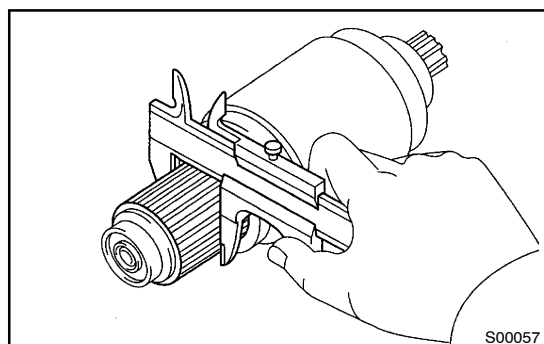
- (a) Check the commutator for the dirty and burnt surfaces.
If the surface is dirty or burnt, correct it with sandpaper (No. 400) or on a lathe.



- (b) Check 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 maximum, correct it on a lathe.



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

Standard diameter:

1.4kW: 30.0 mm (1.181 in.)

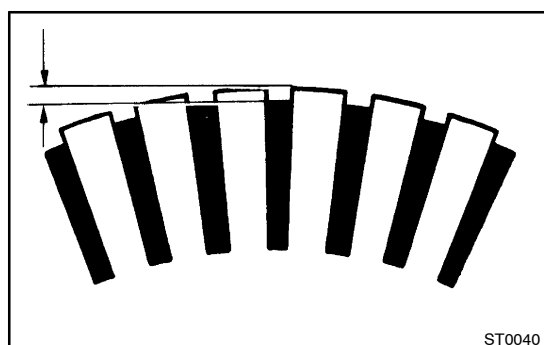
2.0kW: 35.0 mm (1.378 in.)

Minimum diameter:

1.4kW: 29.0 mm (1.142 in.)

2.0kW: 34.0 mm (1.339 in.)

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



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

Standard undercut depth:

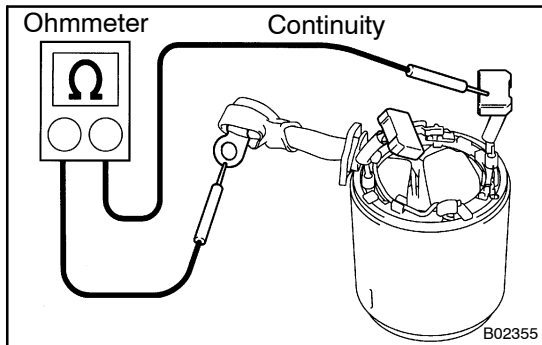
1.4 kW: 0.6 mm (0.024 in.)

2.0 kW: 0.7 mm (0.0281.339 in.)

Minimum undercut depth:

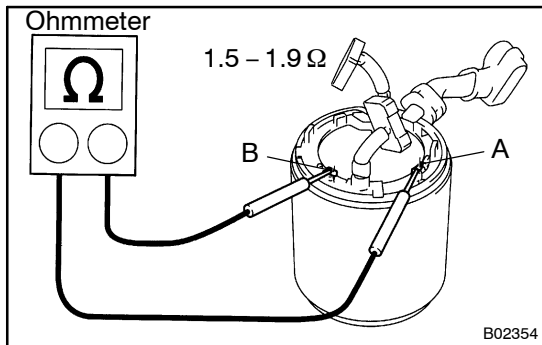
0.2 mm (0.008 in.)

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



3. INSPECT FIELD FRAME

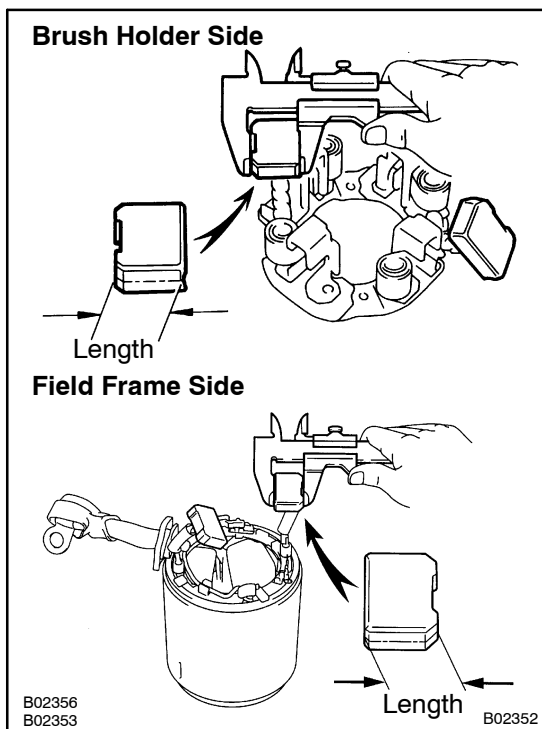
- (a) Check the field coil for open circuit.
Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.
If there is no continuity, replace the field frame.



- (b) 2.0 kW type:
Check the shunt coil for open circuit.
Using an ohmmeter, measure the resistance between shunt coil terminals A and B.

Resistance: 1.5 – 1.9 Ω at 20°C (68°F)

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



4. INSPECT BRUSHES

Using vernier calipers, measure the brush length.

Standard length:

1.4 kW: 15.5 mm (0.610 in.)

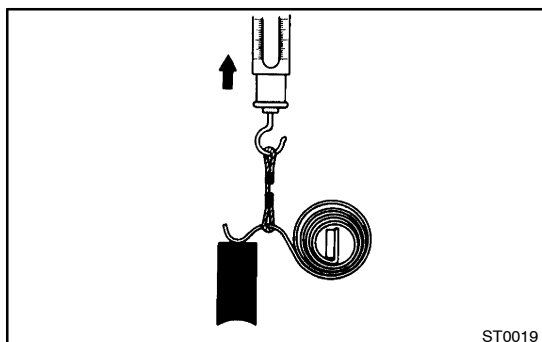
2.0 kW: 15.0 mm (0.591 in.)

Minimum length:

1.4 kW: 8.5 mm (0.335 in.)

2.0 kW: 9.0 mm (0.354 in.)

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



5. INSPECT BRUSH SPRINGS

Check the brush spring load.

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

Standard spring installed load:

1.4 kW: 17.6 – 23.5 N (1.8 – 2.4 kgf, 4.0 – 5.3 lbf)

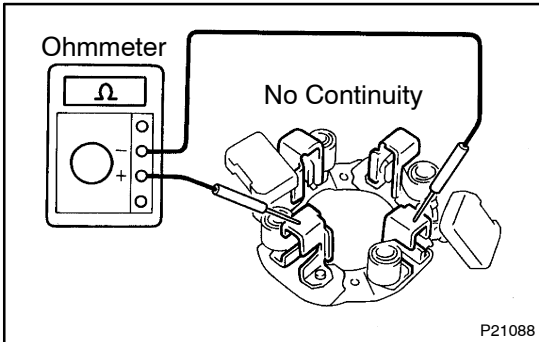
2.0 kW: 21.5 – 27.5 N (2.2 – 2.8 kgf, 4.9 – 6.2 lbf)

Minimum spring installed load:

1.4 kW: 11.8 N (1.2 kgf, 2.7 lbf)

2.0 kW: 12.7 N (1.3 kgf, 2.9 lbf)

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



6. INSPECT BRUSH HOLDER

Check the brush holder insulation.

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

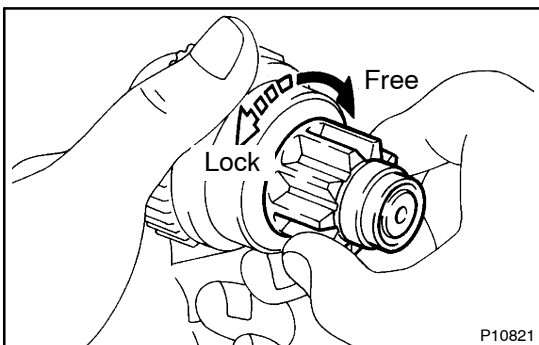
If there is continuity, repair or replace the brush holder.

7. INSPECT CLUTCH AND GEARS

- (a) 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 ring gear of the flywheel for wear or damage.



- (b) Check the clutch pinion gear.

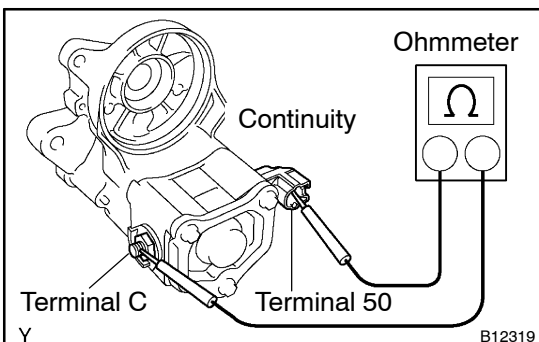
Hold the starter clutch and rotate the pinion gear clockwise, and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.

If necessary, replace the clutch assembly.

8. INSPECT BEARINGS

Turn the bearing by hand while applying inward force.

If resistance is felt or the bearing sticks, replace the bearing ([See page ST-11](#)).

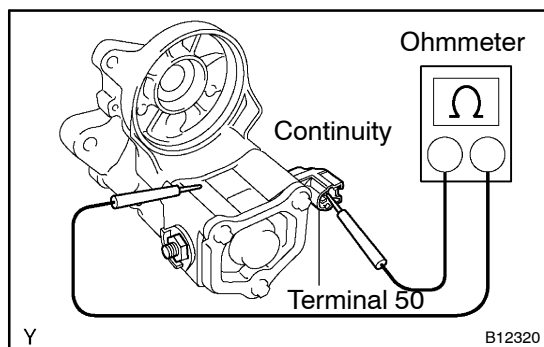


9. INSPECT MAGNETIC SWITCH

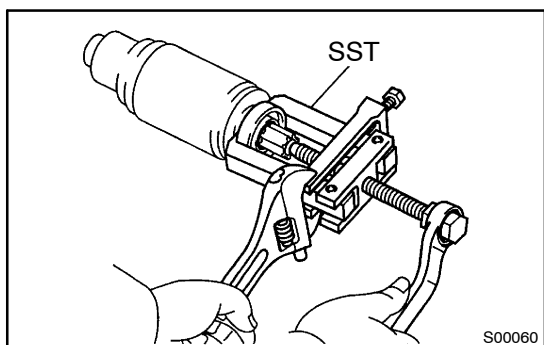
- (a) Check the pull-in coil for open circuit.

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

If there is no continuity, replace the magnetic switch.



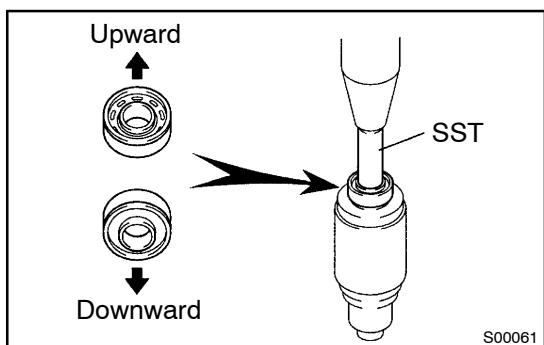
- (b) Check the hold-in coil for open circuit.
Using an ohmmeter, check that there is continuity between terminal 50 and the switch body.
If there is no continuity, replace the magnetic switch.



REPLACEMENT

1. REPLACE FRONT BEARING

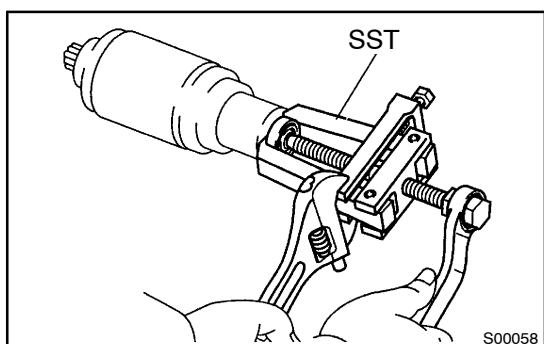
- (a) Using SST, remove the bearing.
SST 09286-46011



- (b) Using SST and a press, press in a new bearing.
SST 09820-00030

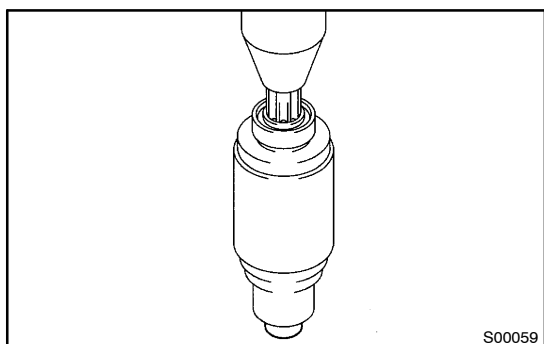
NOTICE:

Be careful of the installation direction.

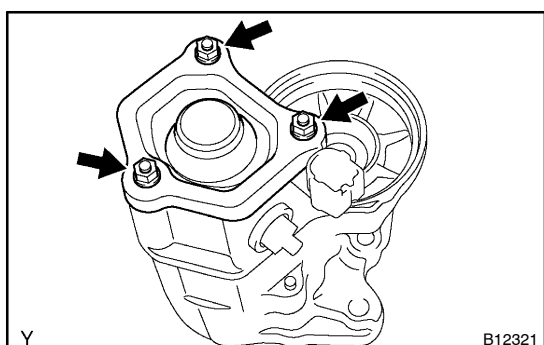


2. REPLACE REAR BEARING

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



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

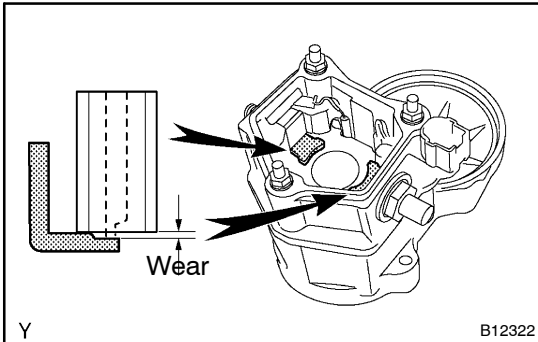


3. REPLACE MAGNETIC SWITCH TERMINAL KIT PARTS

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

NOTICE:

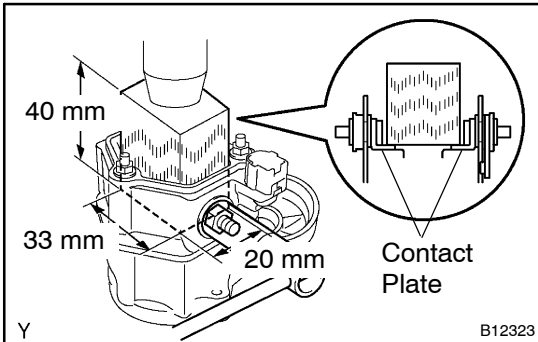
Do not loosen the 3 stud bolts.



- (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.



- (c) Remove the terminal kit parts.
(1) Put a wooden block on the contact plate and press it down with a hand press.

Dimensions of wooden block:

20 x 33 x 40 mm (0.79 x 1.30 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:

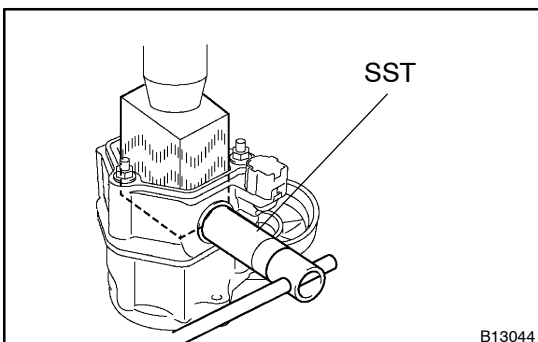
$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14 (\pi)}$$

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

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

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

- 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, loosen the terminal nuts.

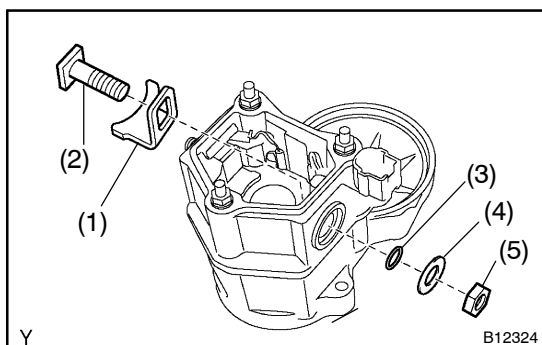
SST 09810-38140

- (3) Terminal C:

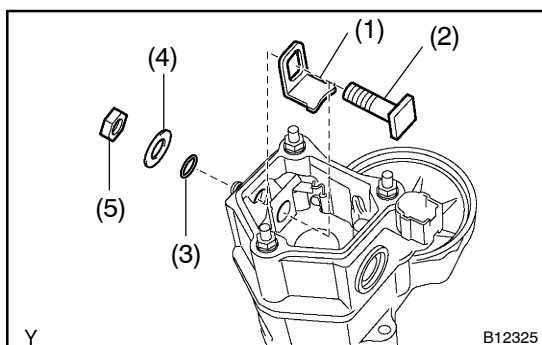
Remove the terminal nut, washer, O-ring, terminal bolt and contact plate.

- (4) Terminal 30:

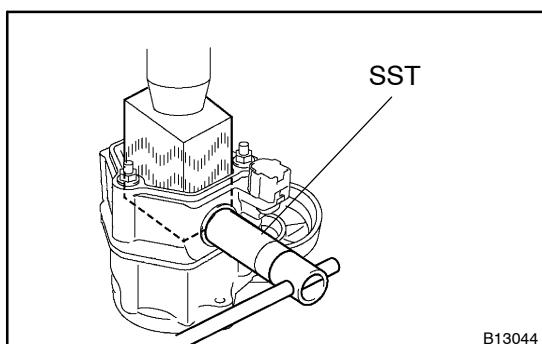
Remove the terminal nut, washer, O-ring, terminal bolt and contact plate.



- (d) Temporarily install these new terminal 30 kit parts:
- (1) Install the contact plate.
 - (2) Install the terminal bolt.
 - (3) Install the o-ring.
 - (4) Install the washer.
 - (5) Install the terminal nut.



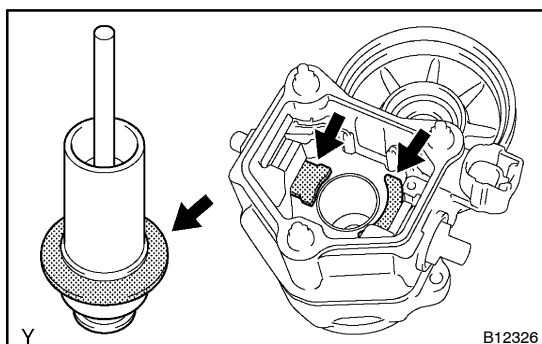
- (e) Temporarily install these new terminal C kit parts:
- (1) Install the contact plate.
 - (2) Install the terminal bolt.
 - (3) Install the o-ring.
 - (4) Install the washer.
 - (5) Install the terminal nut.
- (f) Temporarily tighten the terminal nuts.



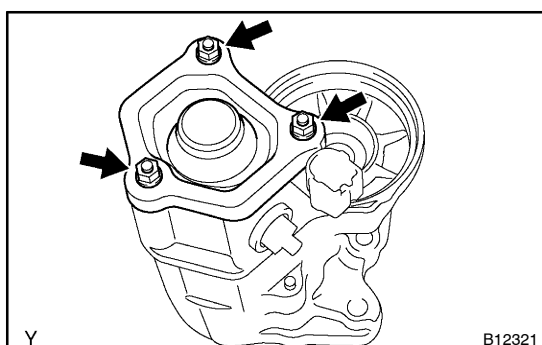
- (g) Tighten terminal nuts.
- (1) Put a wooden block on the contact plate and press it down with a hand press.
 - (2) Using SST, tighten the nuts to the specified torque.
- SST 09810-38140
Torque: 17 N·m (173 kgf·cm, 13 ft·lbf)

NOTICE:

If the nut is over tightened, it may cause cracks on the plastic frame.



- (h) Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.



- (i) Reinstall the plunger, a new gasket and end cover with the 3 nuts.
- Torque:**
1.4 kW: 2.5 N·m (25 kgf·cm, 22 in·lbf)
2.0 kW: 3.6 N·m (37 kgf·cm, 32 in·lbf)

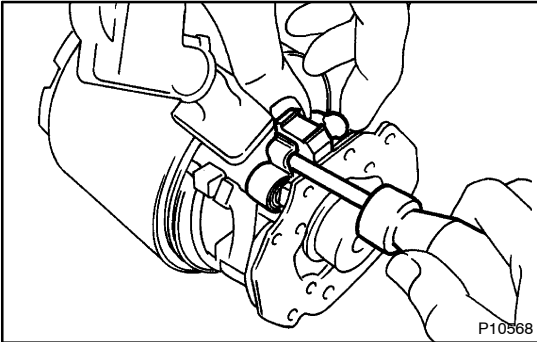
REASSEMBLY

HINT:

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

1. PLACE ARMATURE INTO FIELD FRAME

- (a) Apply grease to the armature bearings.
- (b) Insert in armature into the field frame.



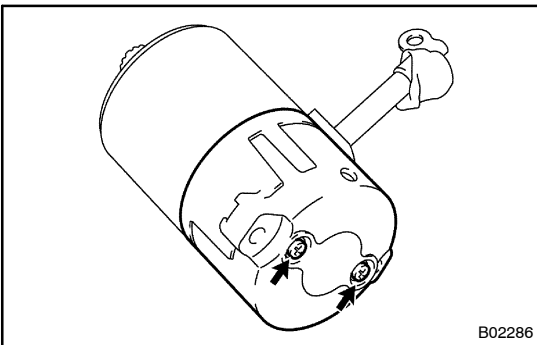
2. INSTALL BRUSH HOLDER

- (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.

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

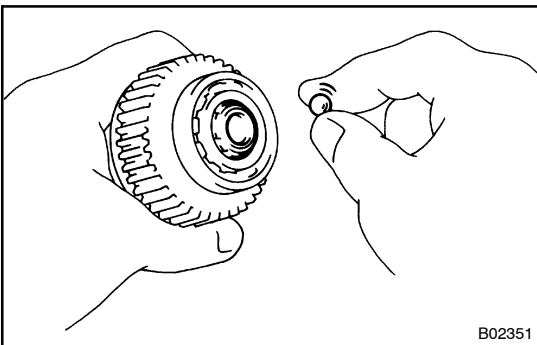


- (d) Install the end cover to the field frame with the 2 screws.

Torque:

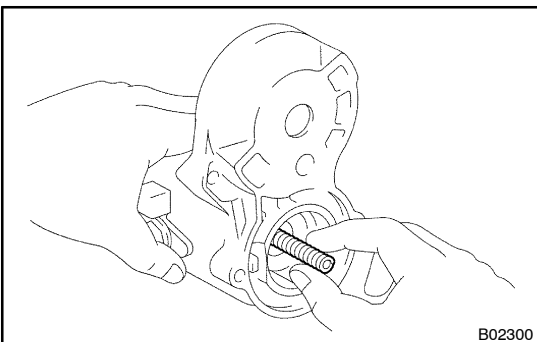
1.4 kW: 1.5 N·m (15 kgf·cm, 13 in.·lbf)

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



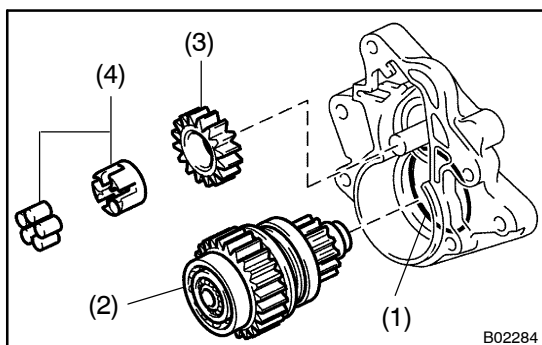
3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

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

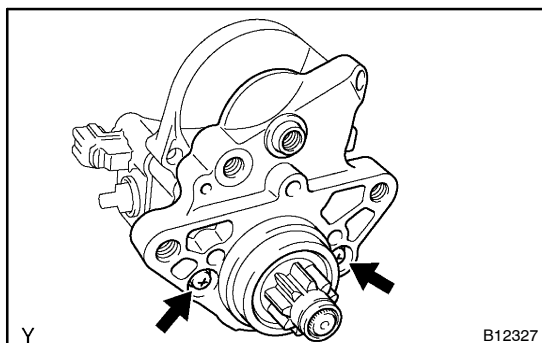


4. INSTALL STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

- (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) Place the new O-ring
 - (2) Place the starter clutch assembly
 - (3) Place the idler gear
 - (4) Place the bearing

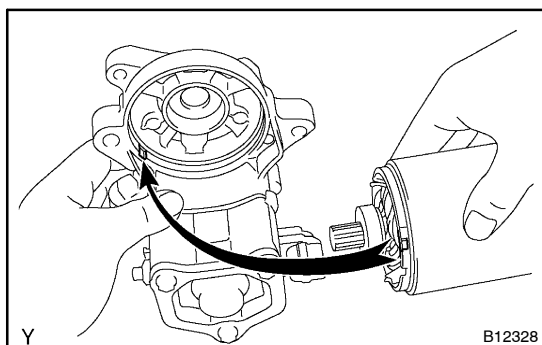


- (d) Install the starter housing to the magnetic switch with the 2 screws.

Torque:

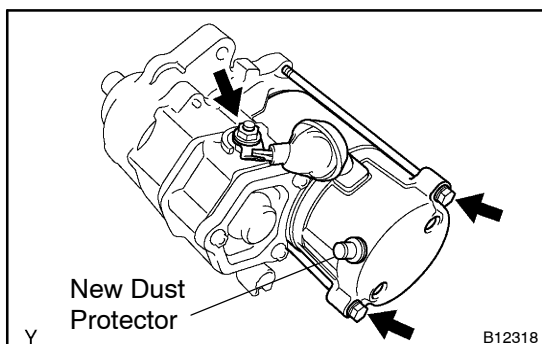
1.4kW: 5.9 N·m (60 kgf·cm, 52 in·lbf)

2.0kW: 9.3 N·m (95 kgf·cm, 82 in·lbf)



5. INSTALL FIELD FRAME AND ARMATURE ASSEMBLY

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



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

Torque:

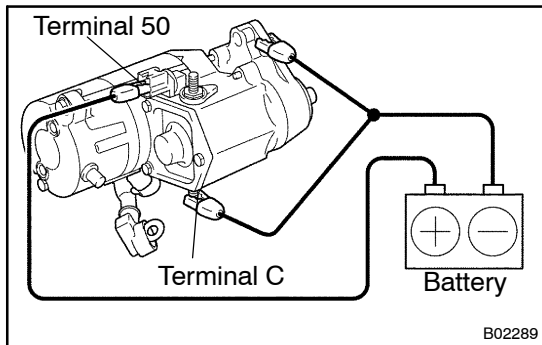
1.4kW: 5.9 N·m (60 kgf·cm, 52 in·lbf)

2.0kW: 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)

6. INSTALL NEW DUST PROTECTOR



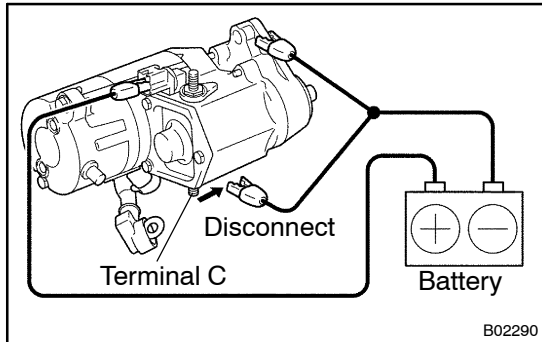
TEST

NOTICE:

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

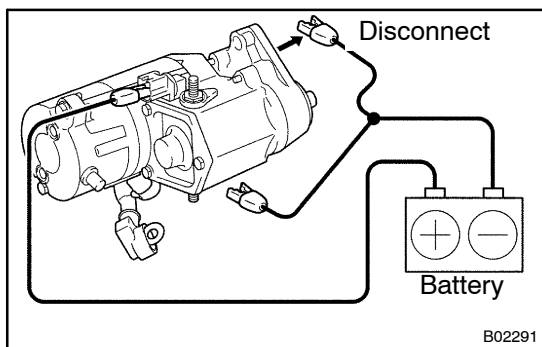
1. PERFORM PULL-IN TEST

- 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.



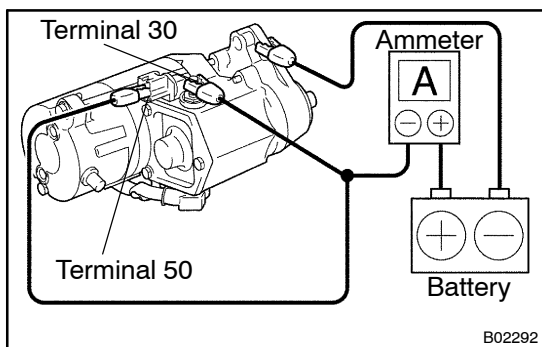
2. PERFORM HOLD-IN TEST

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.



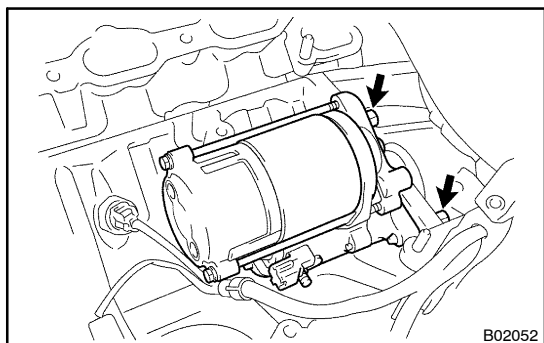
4. PERFORM NO-LOAD PERFORMANCE TEST

- 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:

1.4 kW: 90 A or less at 11.5 V

2.0 kW: 100 A or less at 11.5 V

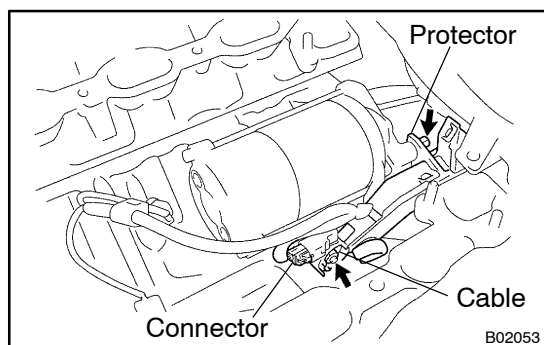


INSTALLATION

1. INSTALL STARTER

- (a) Install the starter with the 2 bolts.

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



- (b) Connect the starter cable with the nut.

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

- (c) Install the engine wire protector to the starter with the bolt.

- (d) Connect the starter connector.

2. INSTALL REAR WATER BYPASS JOINT

(See page EM-60)

3. □ INSTALL WATER BYPASS PIPE (See page EM-60)

4. □ INSTALL UPPER AND LOWER INTAKE MANIFOLDS ASSEMBLY (See page EM-60)

5. □ INSTALL THROTTLE BODY (See page FI-39)

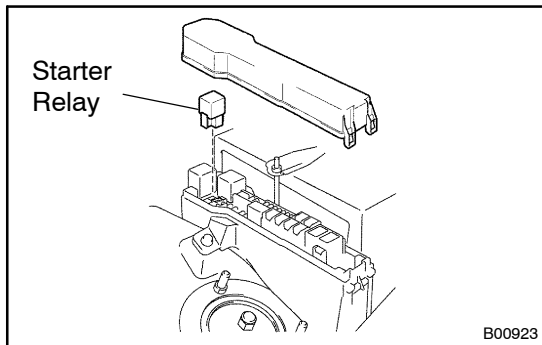
6. □ INSTALL INTAKE AIR CONNECTOR PIPE

7. □ FILL WITH ENGINE COOLANT (See page CO-2)

8. □ CHECK THAT ENGINE STARTS

9. □ START ENGINE AND CHECK FOR ENGINE COOLANT AND FUEL

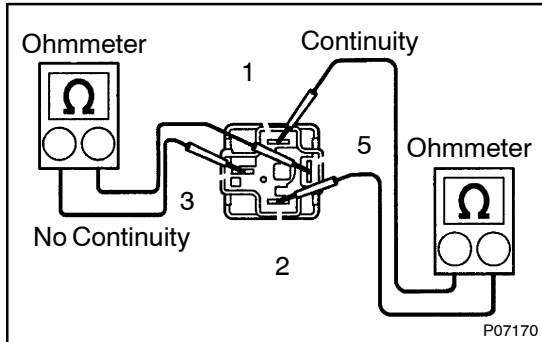
10. □ INSTALL V-BANK COVER



STARTER RELAY INSPECTION

ST01G-03

1. REMOVE RELAY BOX COVER
2. REMOVE STARTER RELAY



3. INSPECT STARTER RELAY

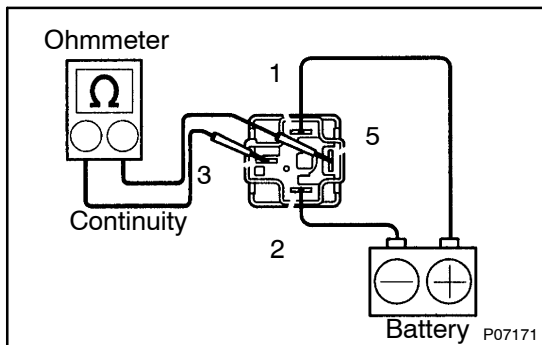
- (a) Inspect the relay continuity.

- (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.

4. REINSTALL STARTER RELAY

5. REINSTALL RELAY BOX COVER