STARTING SYSTEM

ST040–01

ON–VEHICLE INSPECTION

NOTICE:

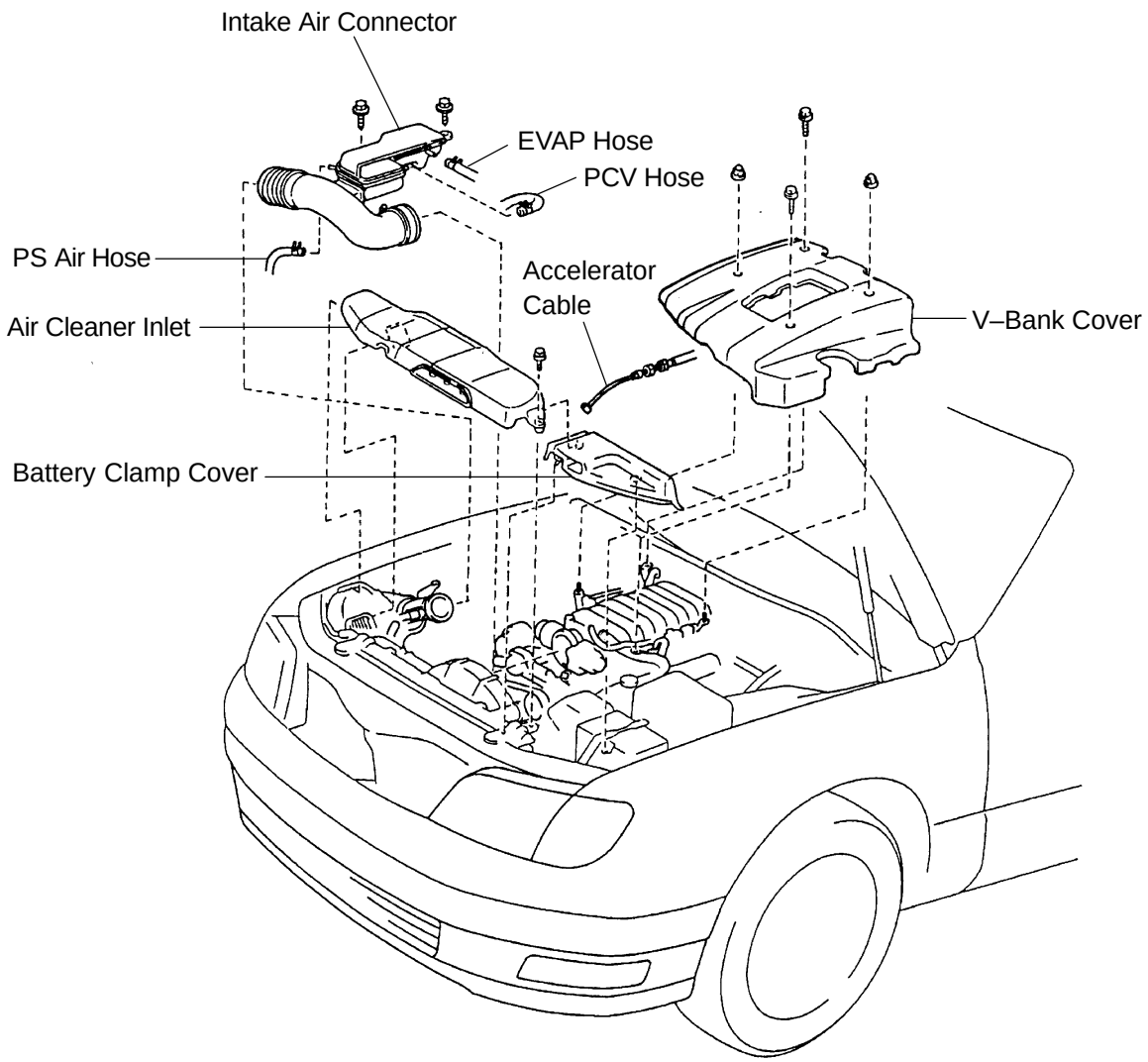
Before changing the starter, check these items again:

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

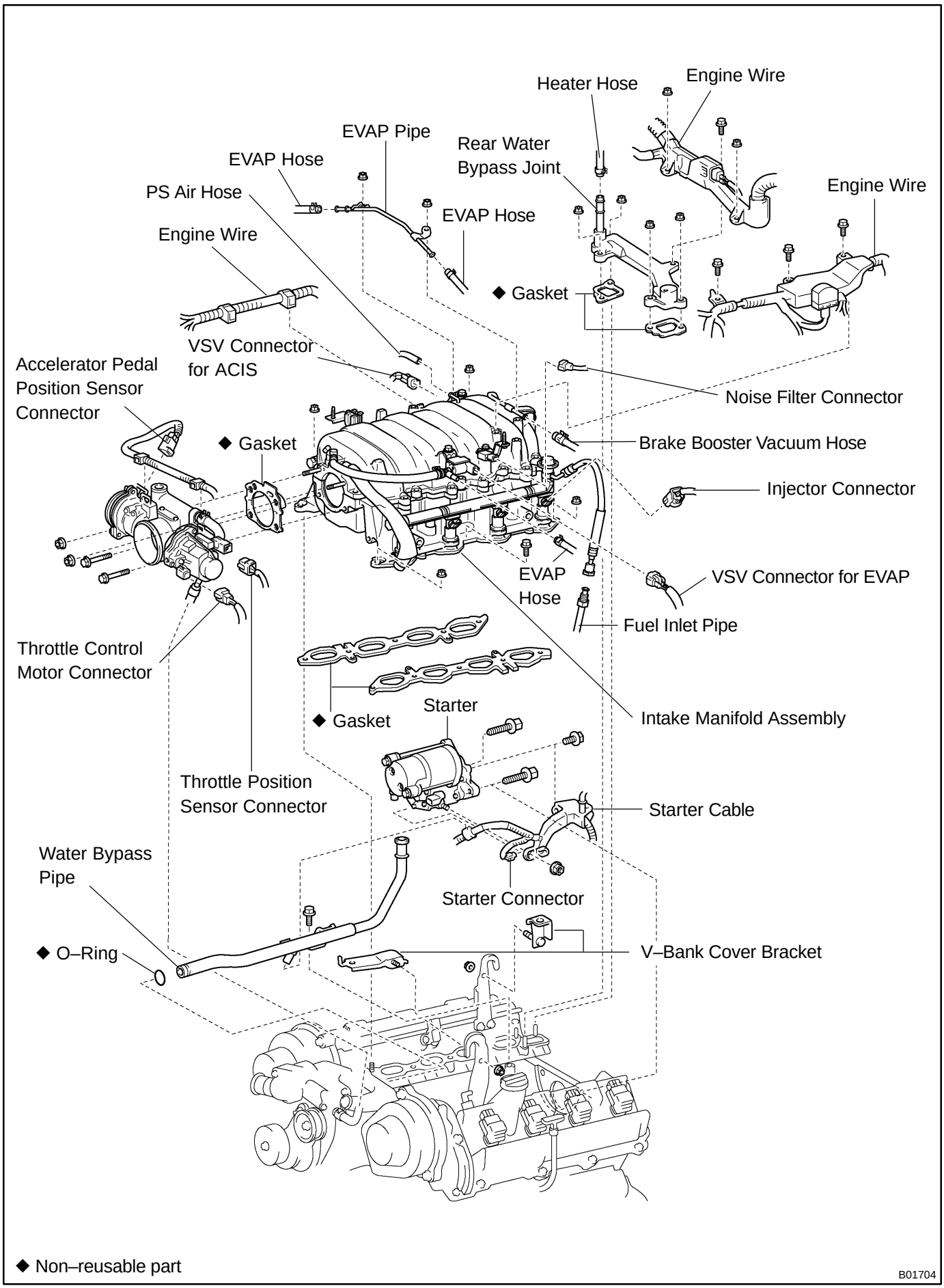
STARTER

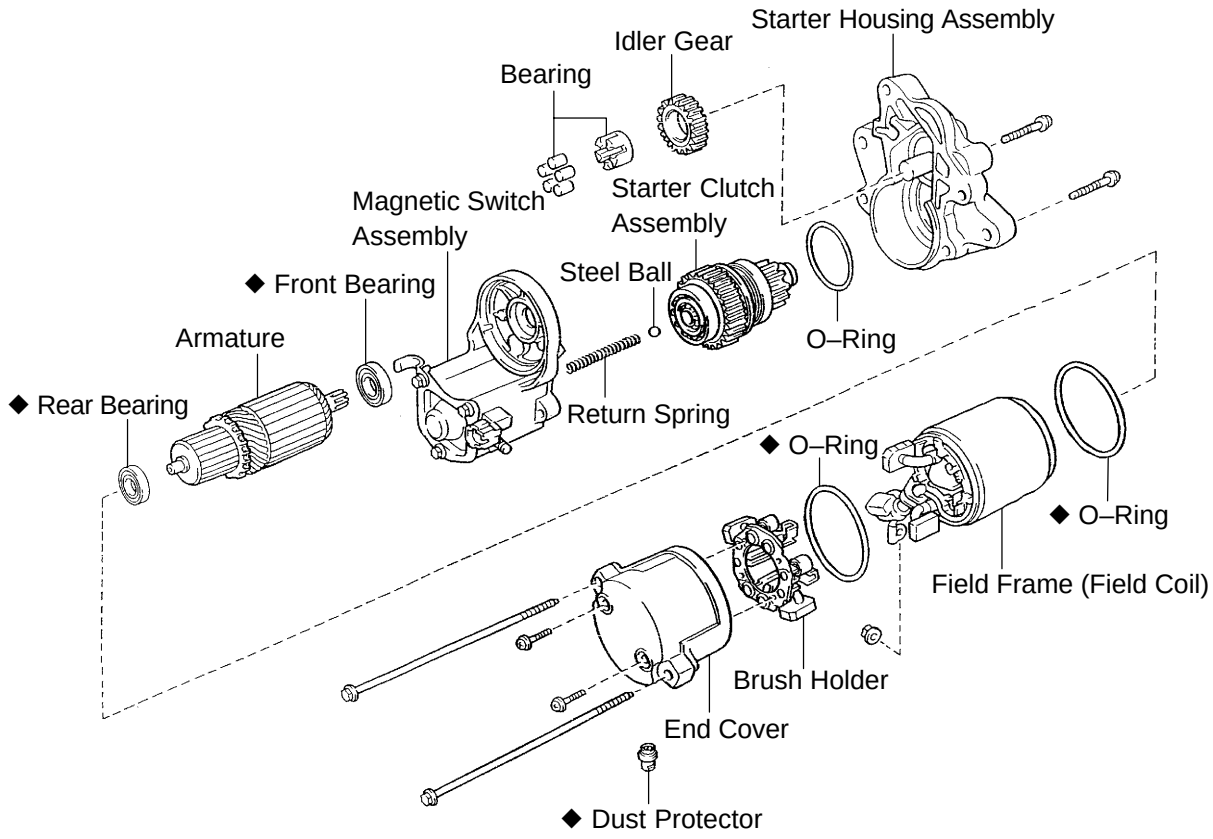
COMPONENTS

ST041–01

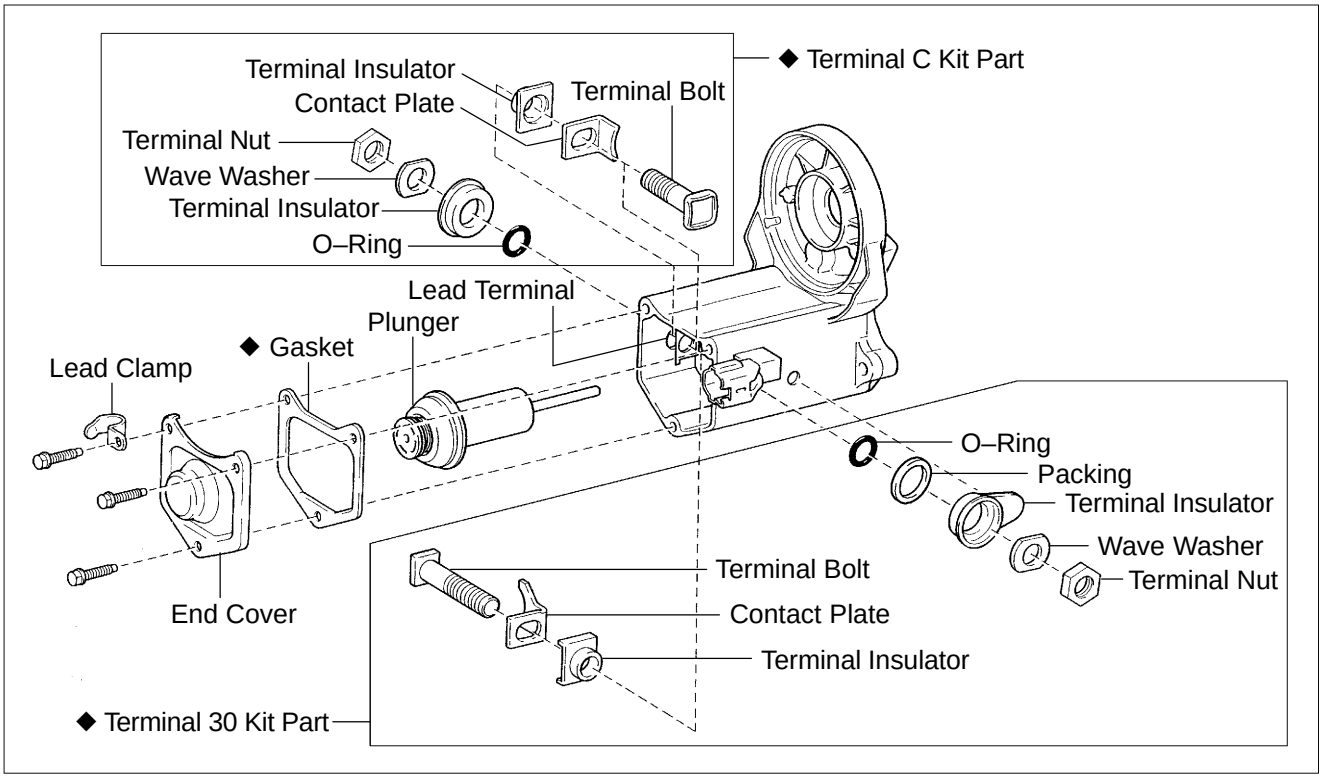


B01306


Heater Hose
Engine Wire
EVAP Pipe
EVAP Hose
Rear Water Bypass Joint
PS Air Hose
EVAP Hose
Engine Wire
Engine Wire
◆ Gasket
VSV Connector for ACIS
Accelerator Pedal Position Sensor Connector
Noise Filter Connector
◆ Gasket
Brake Booster Vacuum Hose
Injector Connector
EVAP Hose
VSV Connector for EVAP
Fuel Inlet Pipe
Throttle Control Motor Connector
◆ Gasket
Starter
Intake Manifold Assembly
Throttle Position Sensor Connector
Starter Cable
Water Bypass Pipe
Starter Connector
◆ O–Ring
V–Bank Cover Bracket
◆ Non–reusable part
B01704



Magnetic Switch Assembly



◆ Non–reusable part

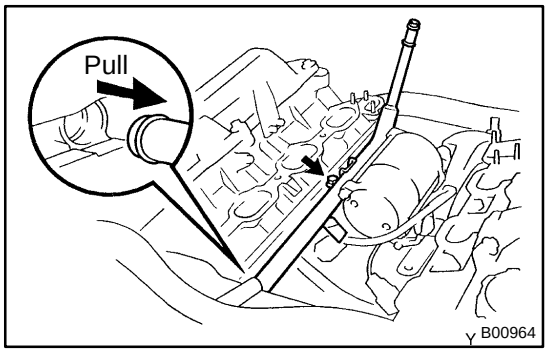
B00968

ST042–01

REMOVAL

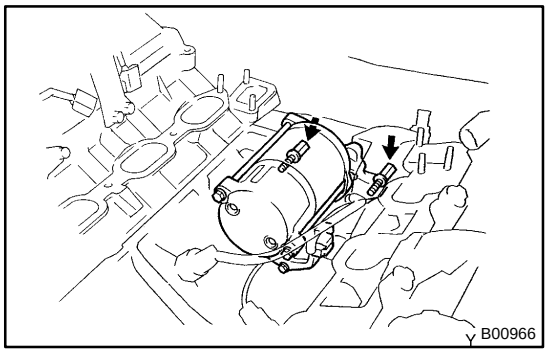
1. **REMOVE V–BANK COVER**
2. **DISCONNECT ACCELERATOR CABLE**
3. **REMOVE BATTERY CLAMP COVER, AIR CLEANER INLET AND INTAKE AIR CONNECTOR**
4. **DISCONNECT THROTTLE BODY (See page SF–59)**
5. **REMOVE INTAKE MANIFOLD ASSEMBLY (See page EM–34)**
6. **REMOVE REAR WATER BYPASS JOINT (See page EM–34)**
7. **REMOVE WATER BYPASS PIPE**

(a) Remove the bolt.
(b) Pull out the water bypass pipe from the water pump.
(c) Disconnect the wire clamp from the bracket on the water bypass pipe.
(d) Remove the O–ring from the water bypass pipe.

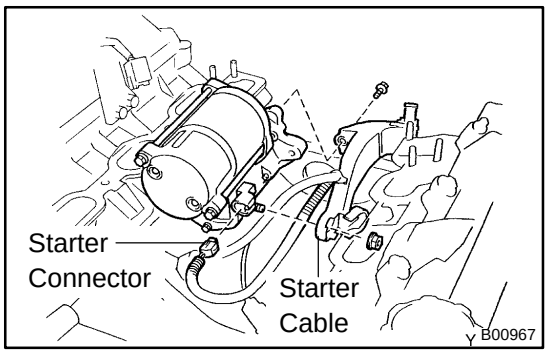


8. **REMOVE STARTER**

(a) Remove the 2 bolts holding the starter to the cylinder block.
(b) Disconnect the starter from the cylinder block.

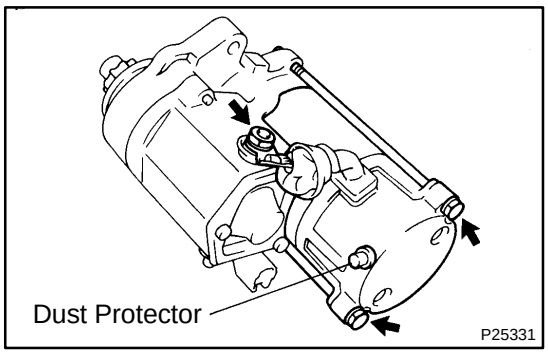


(c) Disconnect the starter connector.
(d) Remove the nut, and disconnect the starter wire.
(e) Remove the bolt, and disconnect the wire clamp from the starter and remove the starter.



ST043–01

DISASSEMBLY

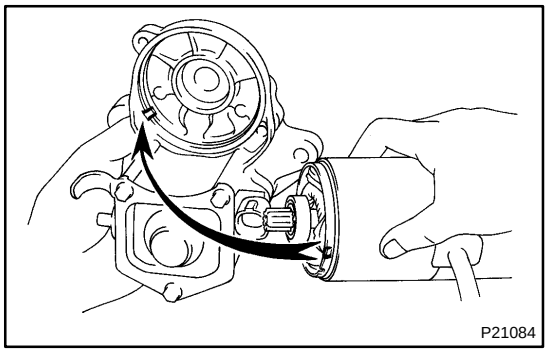


1. REMOVE DUST PROTECTOR

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: 9.3 N·m (95 kgf·cm, 82 in.·lbf)



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

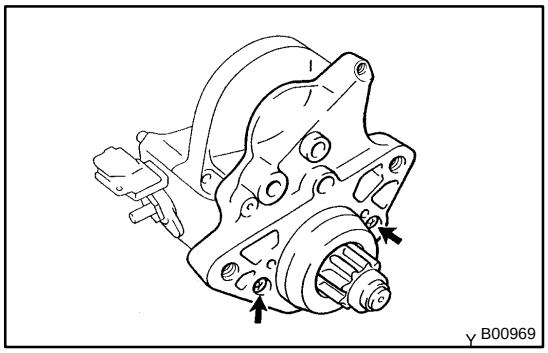
NOTICE:

At the time of notice, please refer to the following items.
Align the protrusion of the field frame with the groove of the magnetic switch.

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

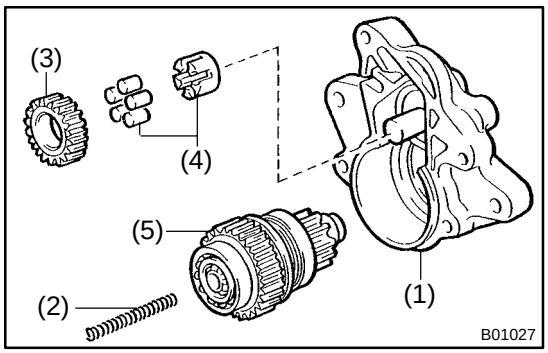
HINT:

At the time of assembly, please refer to the following items.
Use a new O–ring.



3. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR

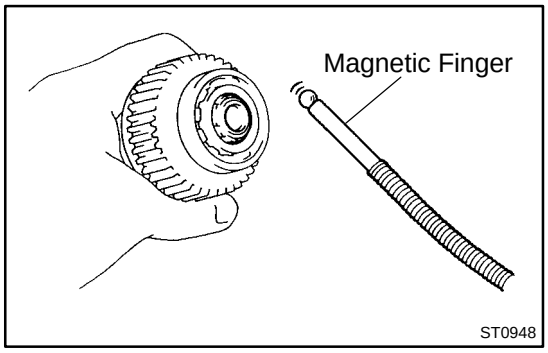
(a) Remove the 2 screws.
Torque: 9.3 N·m (95 kgf·cm, 82 in.·lbf)



(b) Remove these parts from the magnetic switch:
(1) Starter housing
(2) Return spring
(3) Idler gear
(4) Bearing
(5) Starter clutch assembly

HINT:

At the time of assembly, please refer to the following items.
Apply grease to the return spring and insert the return spring into the clutch shaft hole.

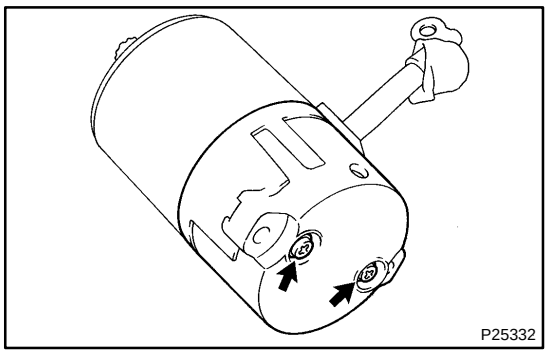


4. REMOVE STEEL BALL

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

HINT:

At the time of assembly, please refer to the following items.
Apply grease to the steel ball and insert the steel ball into the clutch shaft hole.



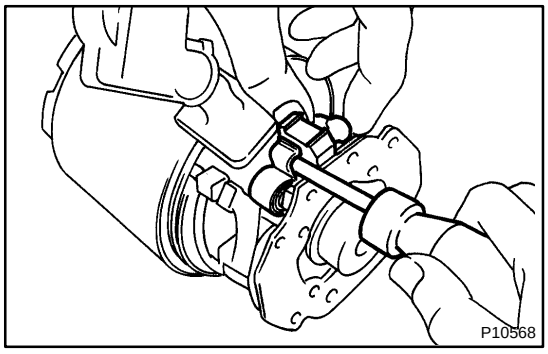
5. REMOVE BRUSH HOLDER

(a) Remove the 2 screws, and end cover from the field frame.
Torque: 3.8 N·m (39 kgf·cm, 34 in.·lbf)

(b) Remove the O–ring from the field frame.

HINT:

At the time of assembly, please refer to the following items.
Use a new O–ring.



(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.

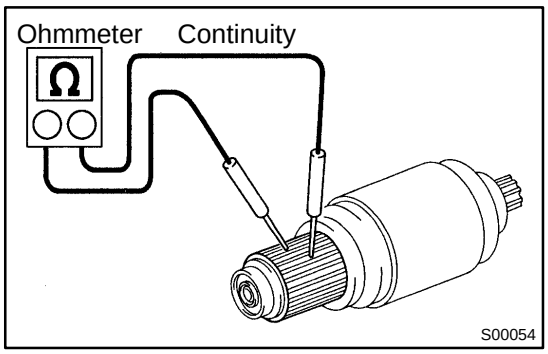
NOTICE:

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

6. REMOVE ARMATURE FROM FIELD FRAME

ST044–01

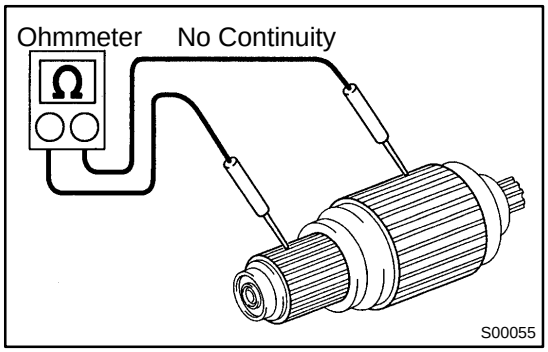
INSPECTION



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.



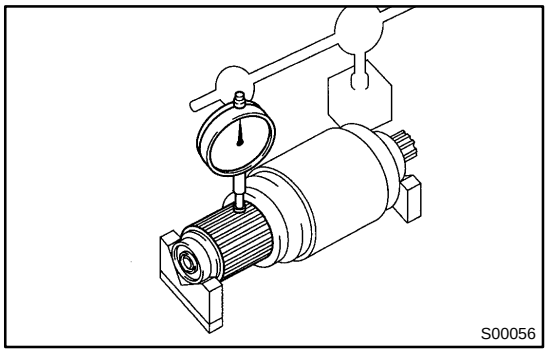
2. INSPECT COMMUTATOR FOR GROUND

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 SURFACE

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



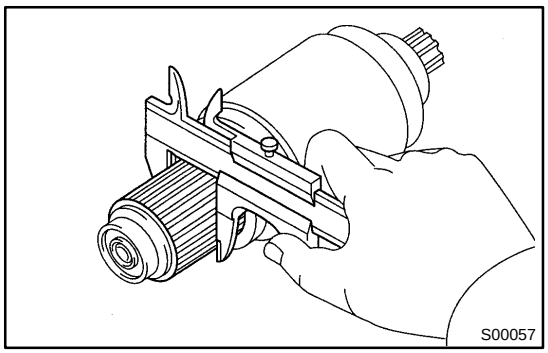
4. INSPECT COMMUTATOR CIRCLE RUNOUT

(a) Place the commutator on V–blocks.

(b) Using a dial indicator 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.



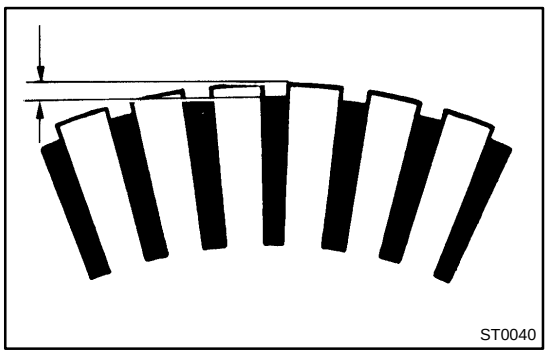
5. INSPECT COMMUTATOR DIAMETER

Using vernier calipers, measure the commutator diameter.

Standard diameter: 35.0 mm (1.378 in.)

Minimum diameter: 34.0 mm (1.339 in.)

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



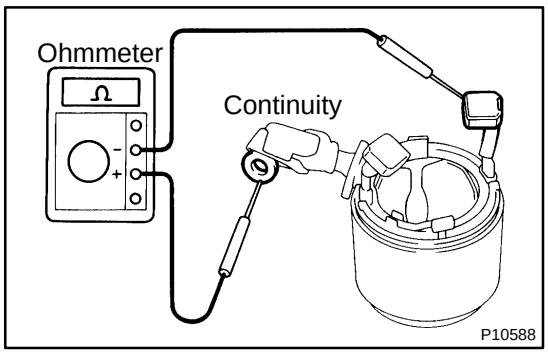
6. INSPECT UNDERCUT DEPTH

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

Standard undercut depth: 0.7 mm (0.028 in.)

Minimum undercut depth: 0.2 mm (0.008 in.)

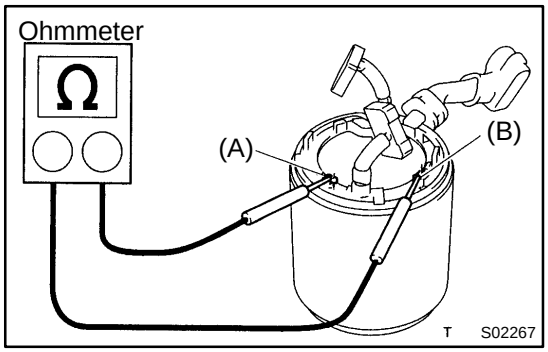
If the undercut depth is less than minimum, correct it with a hacksaw blade.



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.

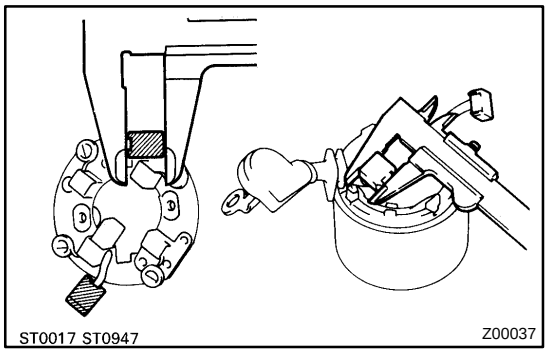


8. INSPECT SHUNT COIL FOR OPEN CIRCUIT

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.



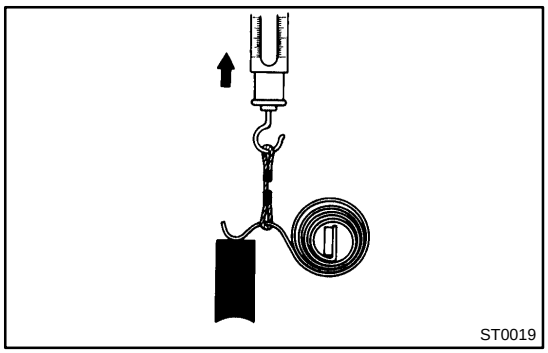
9. INSPECT BRUSH LENGTH

Using vernier calipers, measure the brush length.

Standard length: 15.0 mm (0.591 in.)

Minimum length: 9.0 mm (0.354 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.

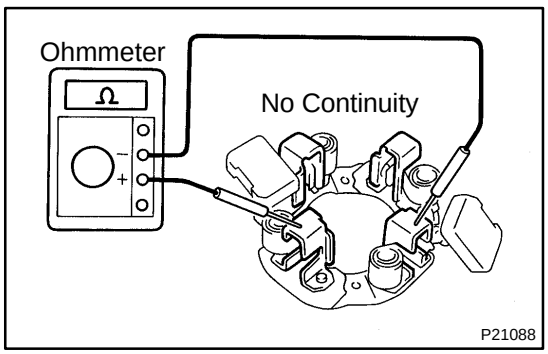
Standard spring installed load:

21.5 – 27.5 N (2.2 – 2.8 kgf, 4.8 – 6.2 lbf)

Minimum spring installed load:

12.7 N (1.3 kgf, 2.9 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.

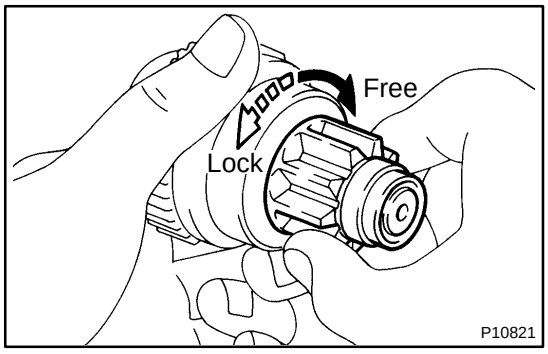
If there is continuity, repair or replace the brush holder.

12. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idle gear and the 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

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.

14. INSPECT REAR BEARING

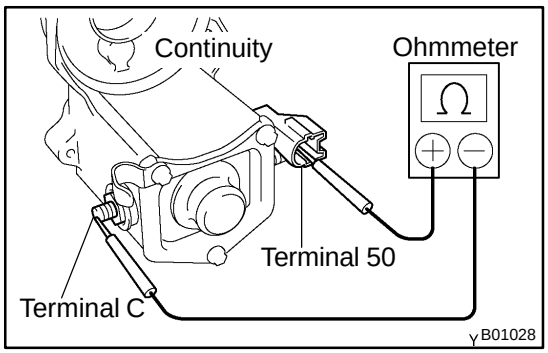
Turn the bearing by hand while applying inward force.

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

15. INSPECT FRONT BEARING

Turn the bearing by hand while applying inward force.

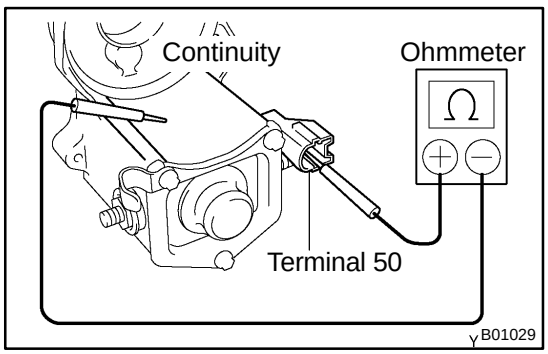
If resistance is felt or the bearing sticks, replace the bearing.



16. DO 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.



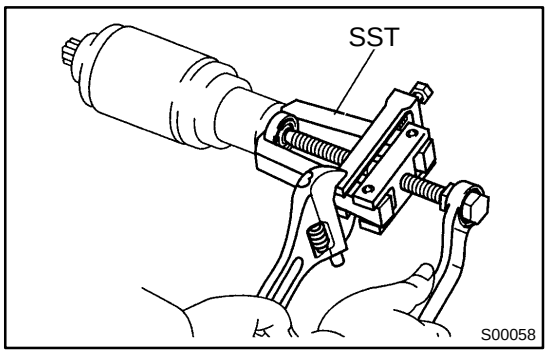
17. DO HOLD–IN COIL OPEN CIRCUIT TEST

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

If there is no continuity, replace the magnetic switch.

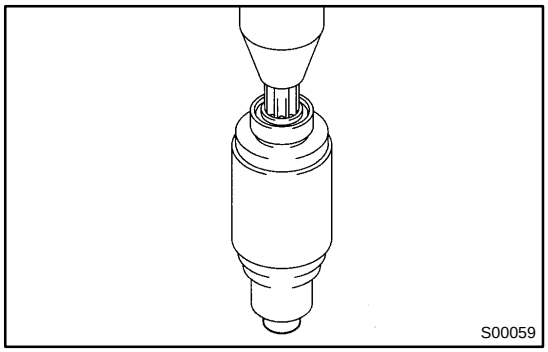
ST045–01

REPLACEMENT

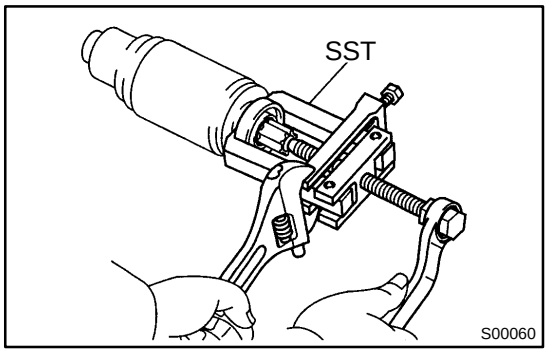


1. REPLACE REAR BEARING

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

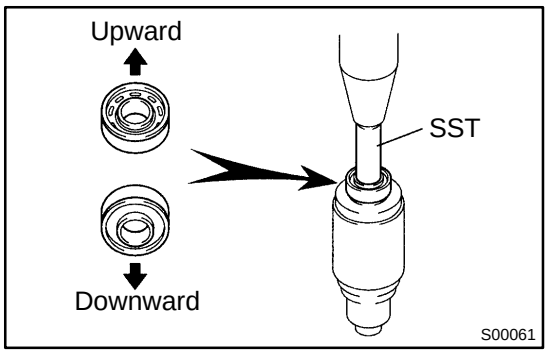


(b) Using a press, press in a new bearing.



2. REPLACE FRONT BEARING

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

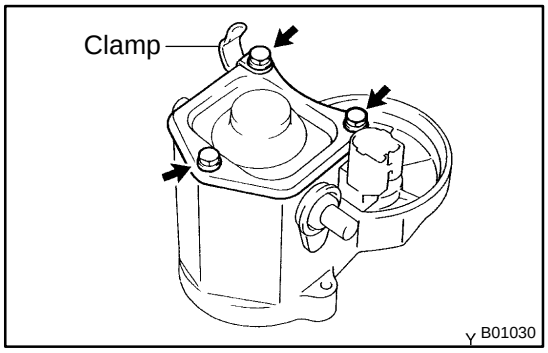


(b) Using SST and a press, press in a new bearing.

NOTICE:

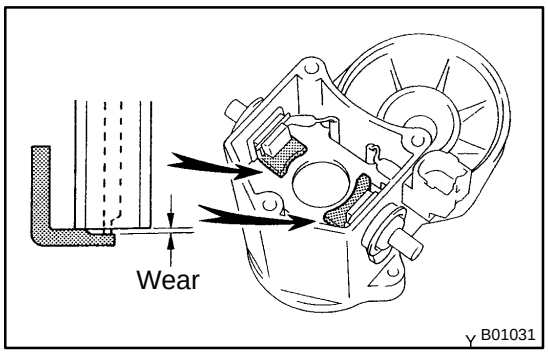
Be careful of the bearing installation direction.

SST 09820–00030



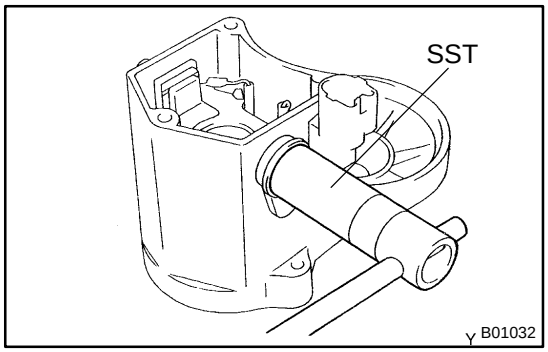
3. REPLACE MAGNETIC SWITCH TERMINAL KIT PARTS

(a) Remove magnetic switch end cover.
Remove the 3 bolts, lead clamp, end cover, gasket and plunger.

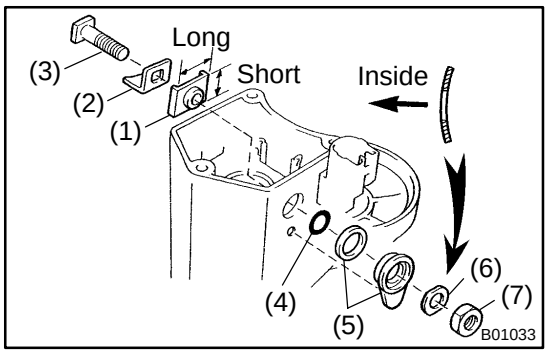


(b) Inspect contact plate for wear.
Using vernier calipers, measure the contact plate for depth of wear.
Maximum wear: 0.9 mm (0.035 in.)

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



(c) Remove 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), O–ring, terminal bolt, contact plate, terminal insulator (inside) and insulation paper.

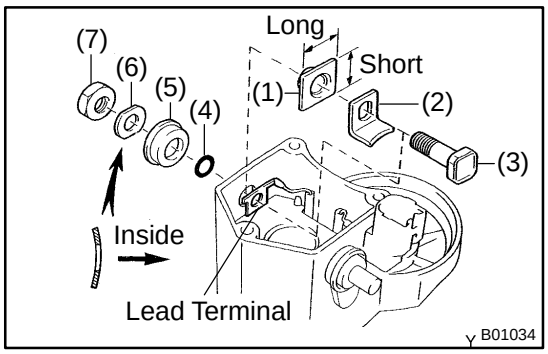


(d) Temporarily install these new terminal 30 kit parts:
(1) Terminal insulator (inside)
(2) Contact plate
(3) Terminal bolt
(4) O–ring
(5) Packing and terminal insulator (outside)
Install the packing to the terminal insulator, and install them.

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

(6) Wave washer
(7) Terminal nut

NOTICE:
Be careful to install the terminal insulator (inside) and wave washer in the correct direction.

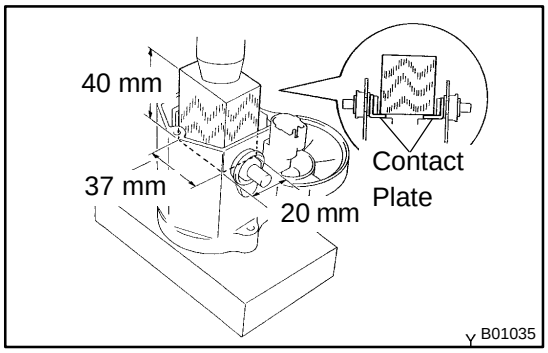


(e) Temporarily install these new terminal C kit parts:
(1) Terminal insulator (inside)
(2) Contact plate
(3) Terminal bolt
(4) O–ring
(5) Terminal insulator (outside)
(6) Wave washer
(7) Terminal nut

NOTICE:

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

(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.

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:

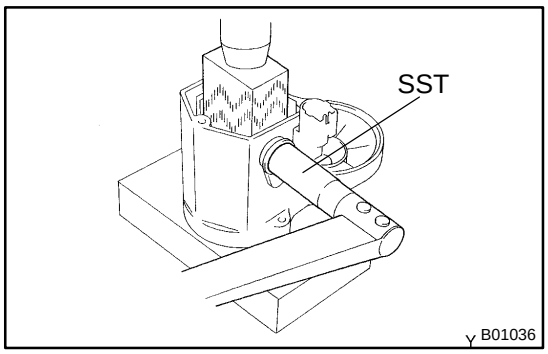
$$(\text{kgf/cm}^2) = \frac{100\ \text{kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2}\right)^2 \times 3.14\ (\pi)}$$

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

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

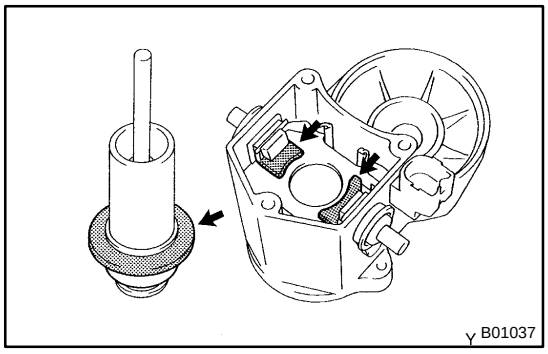
$$(\text{kPa}) = (\text{psi}) \times 6.9$$

- **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 (170 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, end cover and lead clamp with the 3 bolts.
Torque: 3.6 N·m (37 kgf·cm, 32 in.·lbf)

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REASSEMBLY

Reassembly is in the reverse order of disassembly.

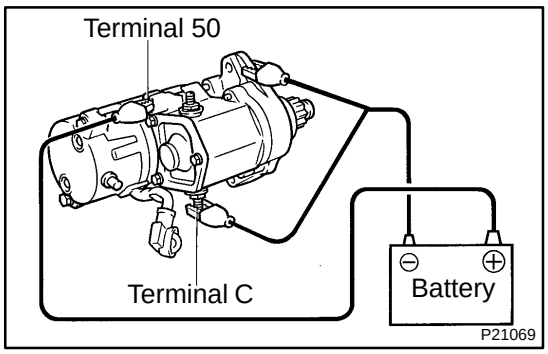
(See page ST–6)

HINT:

At the time of assembly, please refer to the following items.

Use high–temperature grease to lubricate the bearing and gears when assembling the starter.

ST047–01



TEST

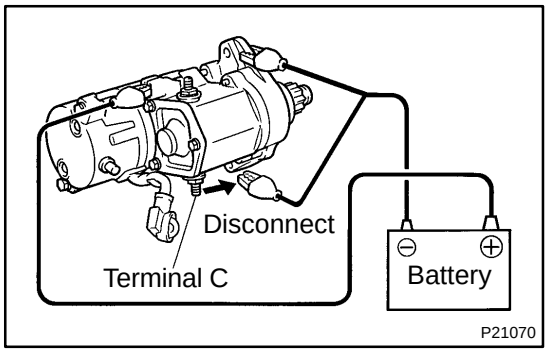
NOTICE:

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

1. DO PULL–IN TEST

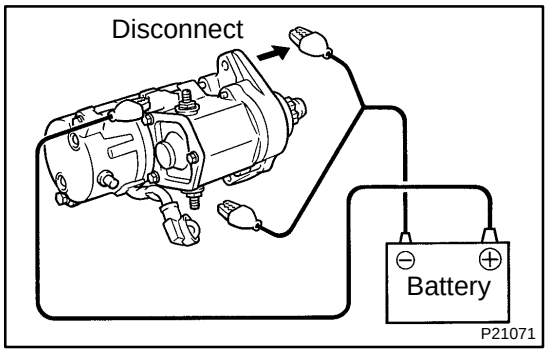
(a) Disconnect the field coil lead wire from terminal C.

(b) Connect the battery to the magnetic switch as shown. Check that the pinion gear moves outward.



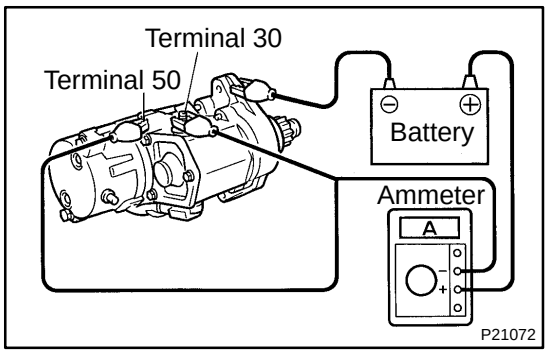
2. DO HOLD–IN TEST

While connected as above with the 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 starter body. Check that the pinion gear returns inward.



4. DO NO–LOAD PERFORMANCE TEST

(a) Connect the battery and ammeter to the starter as shown.

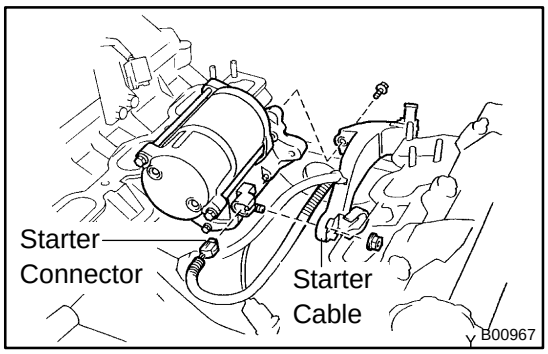
(b) Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current:

At 11.5 V: 100 A or less

ST048–01

INSTALLATION

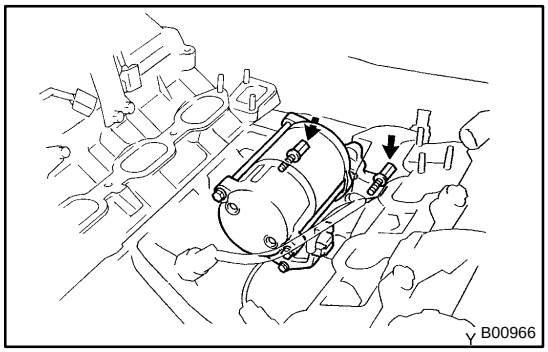


1. INSTALL STARTER

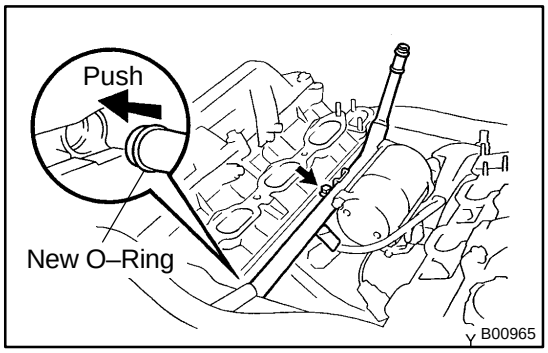
(a) Install the wire clamp to the wire bracket with the bolt.
Torque: 9.81 N·m (98 kgf·cm, 84 in.·lbf)

(b) Connect the starter wire with the nut.
Torque: 9.81 N·m (98 kgf·cm, 84 in.·lbf)

(c) Connect the starter connector.



(d) Install the starter with the 2 bolts.
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)



2. INSTALL WATER BYPASS PIPE

(a) Install a new O–ring to the water bypass pipe.

(b) Apply soapy water to the O–ring.

(c) Push in the water bypass pipe end into the pipe hole of the water pump.

(d) Install the wire clamp to the bracket on the water bypass pipe.

(e) Install the water bypass pipe with the bolt.
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

3. INSTALL REAR WATER BYPASS JOINT
(See page EM–58)

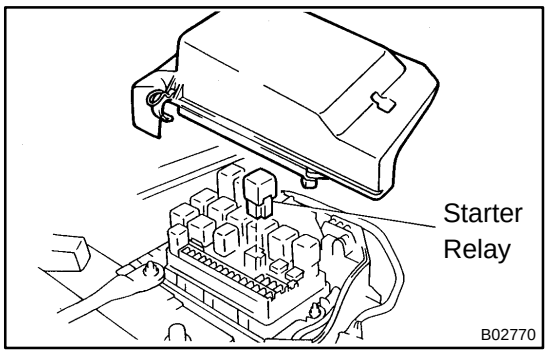
4. INSTALL INTAKE MANIFOLD ASSEMBLY
(See page EM–58)

5. CONNECT THROTTLE BODY
(See page SF–61)

6. INSTALL INTAKE AIR CONNECTOR, AIR CLEANER INLET AND BATTERY CLAMP COVER

7. CONNECT ACCELERATOR CABLE

8. INSTALL V–BANK COVER



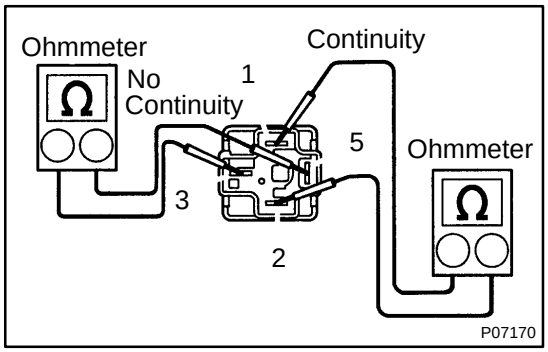
STARTER RELAY

ST049–01

INSPECTION

1. REMOVE STARTER RELAY (Marking: ”ST”)

Remove the relay box cover and starter relay.



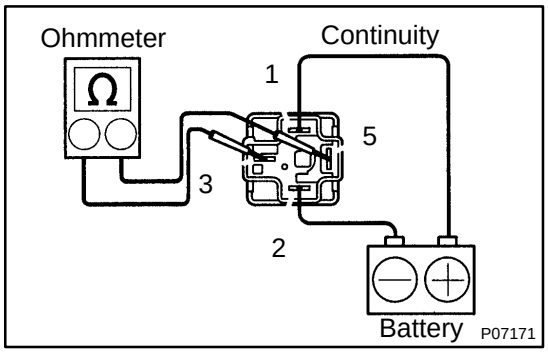
2. INSPECT RELAY CONTINUITY

(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 RELAY OPERATION

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

(b) Using an ohmmeter, check that there is continuity between terminals 2 and 5.

If there is no continuity, replace the relay.

4. REINSTALL STARTER RELAY