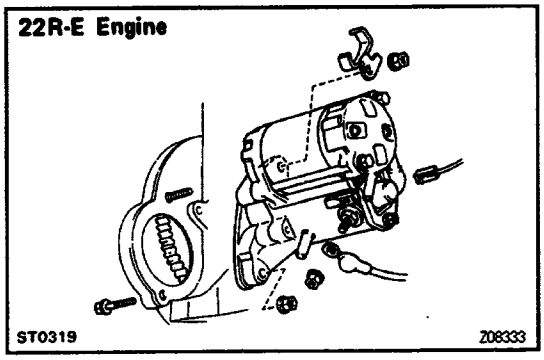
STARTER

ON–VEHCLE INSPECTION

NOTICE: Before changing the starter, check the following items again.

- **Connector connection**
- **Accessory installation (for example: Theft deterrent system)**

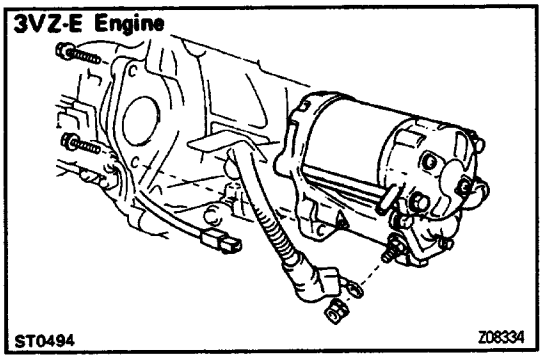


STARTER REMOVAL

1. DISCONNECT WIRES FROM STARTER

(a) Remove the nut and disconnect the battery cable from the magnetic switch on the starter motor.

(b) Disconnect the other wire from terminal 50.



2. REMOVE STARTER MOTOR

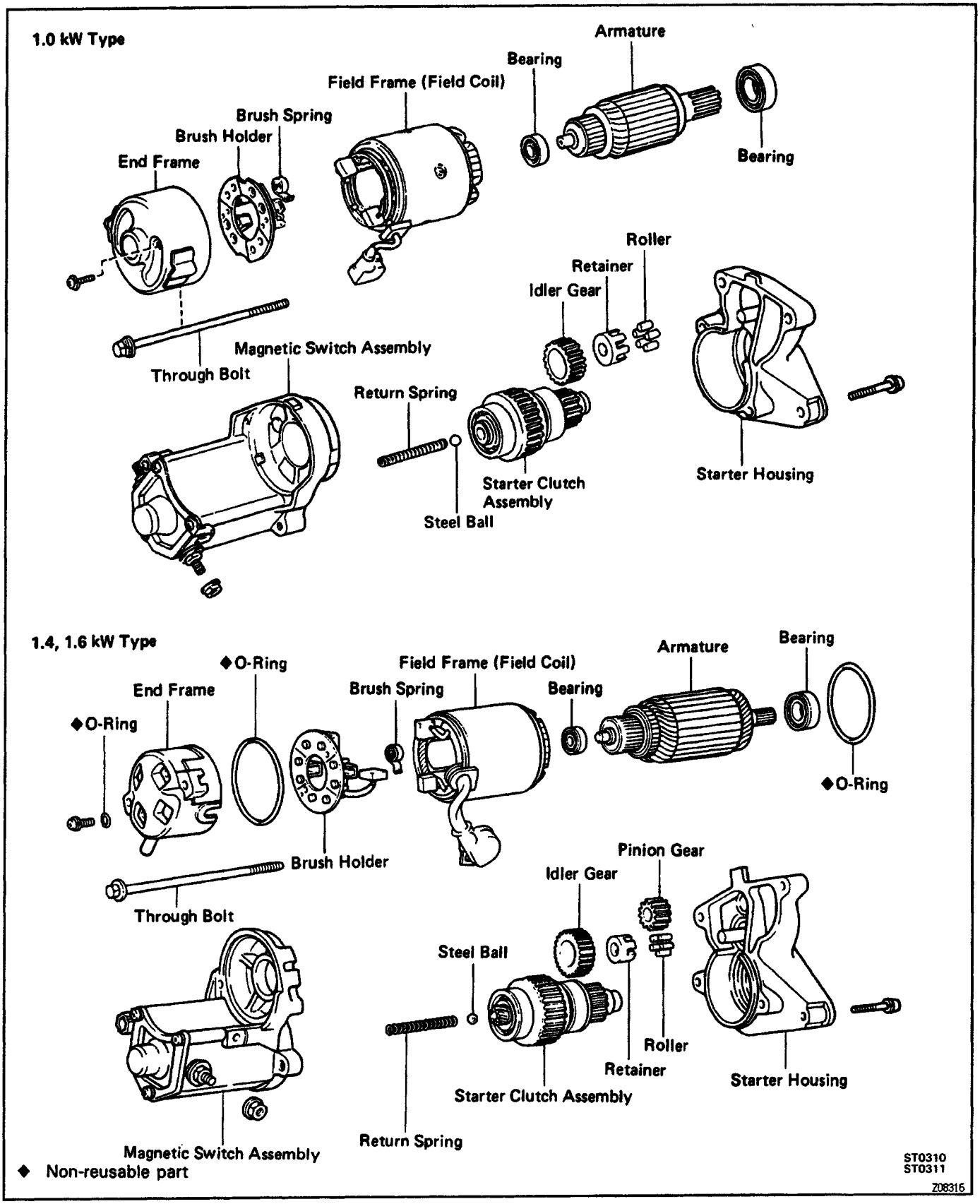
22 R – E Engine:

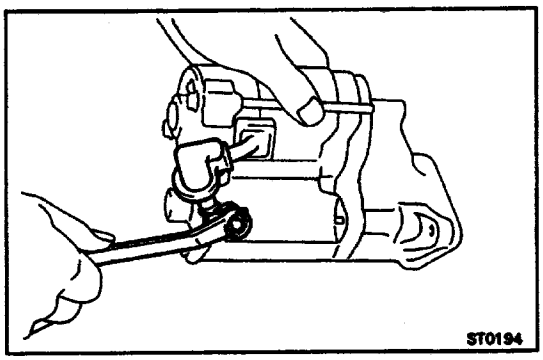
Remove the nut and bolts, and remove the starter motor from flywheel bellhousing.

3VZ – E Engine:

Remove the 2 mounting bolts, and remove the starter motor from flywheel bellhousing.

COMPONENTS FOR DISASSEMBLY AND ASSEMBLY



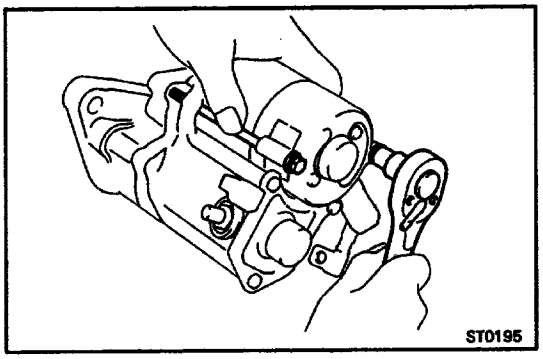


STARTER DISASSEMBLY

(See Components for Disassembly and Assembly)

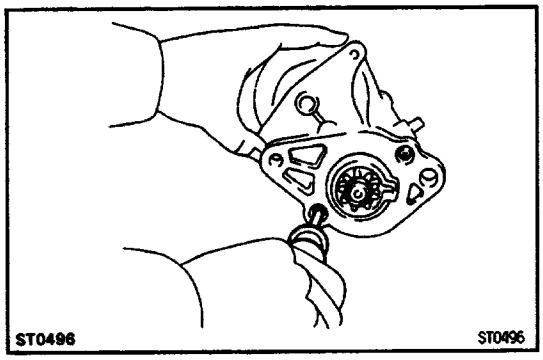
1. REMOVE FIELD FRAME WITH ARMATURE FROM MAGNETIC SWITCH ASSEMBLY

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



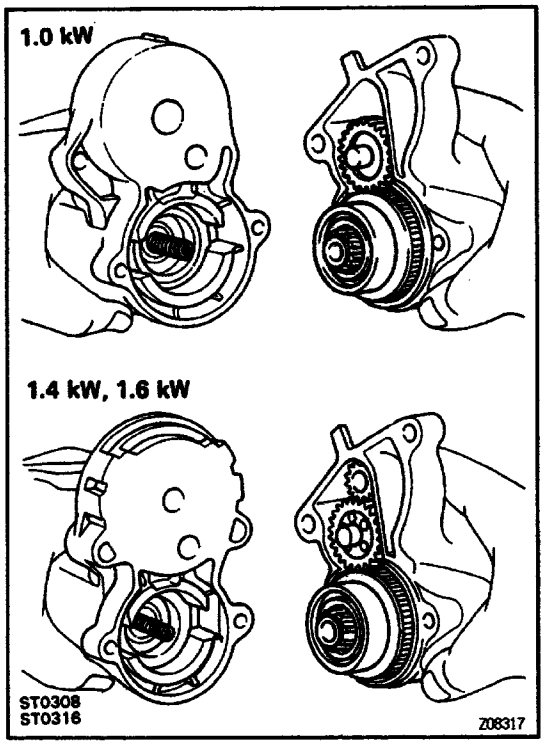
(b) Remove the 2 through bolts. Pull out the field frame with the armature from the magnetic switch assembly.

(c) 1.4 kW, 1.6 kW:
Remove the O–ring.

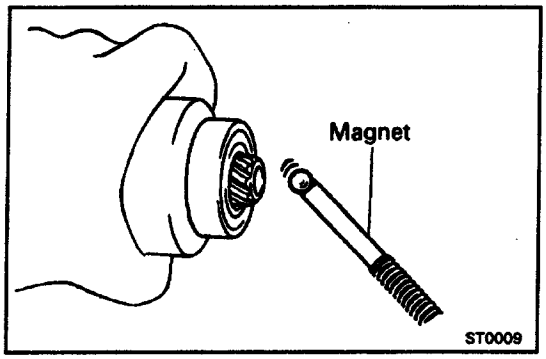


2. REMOVE STARTER HOUSING FROM MAGNETIC SWITCH ASSEMBLY

(a) Remove the 2 screws.



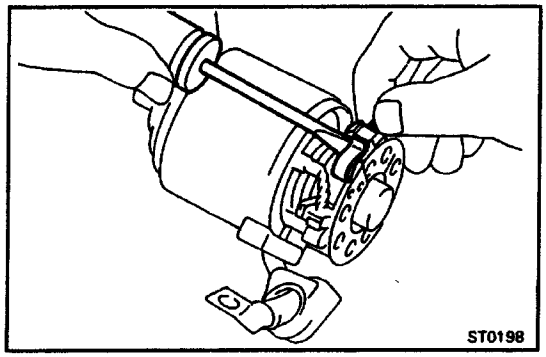
(b) Remove the starter housing with the pinion gear (1.4 kW, 1.6 kW), idler gear, bearing and clutch assembly.



3. REMOVE CLUTCH ASSEMBLY AND GEARS FROM STARTER HOUSING

4. REMOVE STEEL BALL AND SPRING

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

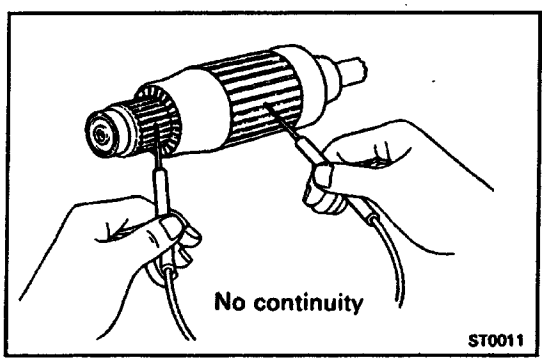


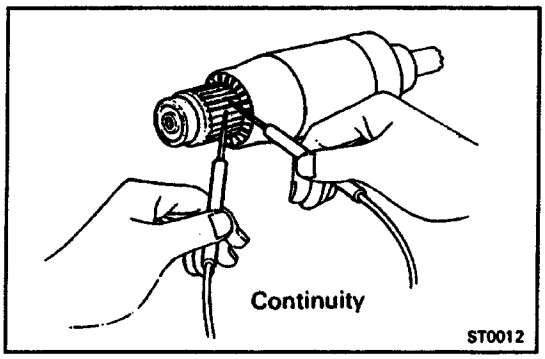
6. REMOVE BRUSHES AND BRUSH HOLDER

(a) Remove the 2 screws and pull the end cover with 0–ring (1.4 kW, 1.6 kW) oft the field frame.

(b) 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





STARTER INSPECTION

Armature Coil

1. INSPECT THAT COMMUTATOR IS NOT GROUNDED

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 FOR OPEN CIRCUIT

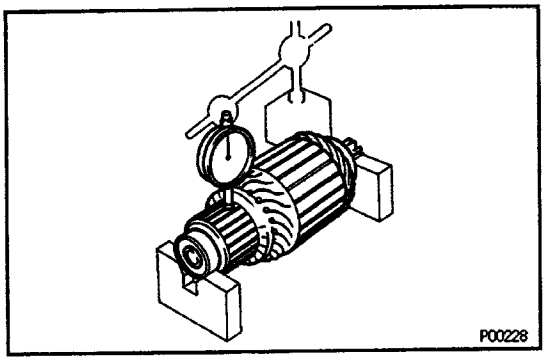
Using an ohmmeter, check that there is continuity between the segments of the comrnutator.

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

Commutator

1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES

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



2. INSPECT COMMUTATOR CIRCLE RUNOUT

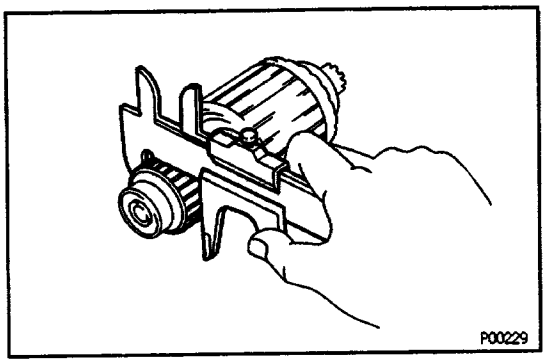
(a) Place the commutator on V–blocks.

(b) Using a dial indicator, 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 vernier calipers, measure the commutator diameter.

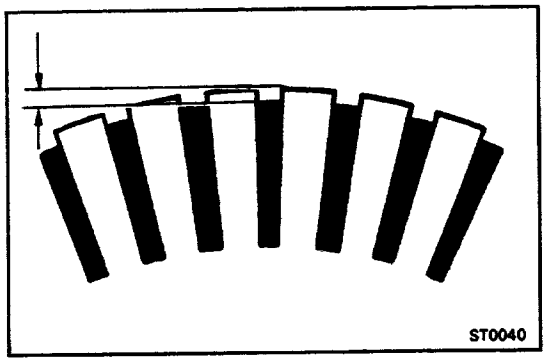
Standard diameter:

30 mm (1.18 in.)

Minimum diameter:

29 mm (1.14 in.)

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



4. INSPECT UNDERCUT DEPTH OF SEGMENT

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

Standard undercut depth:

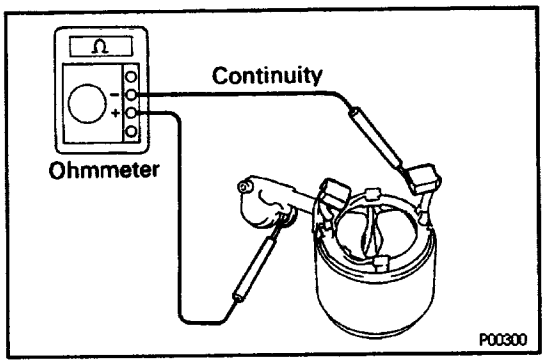
0.6 mm (0.024 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

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

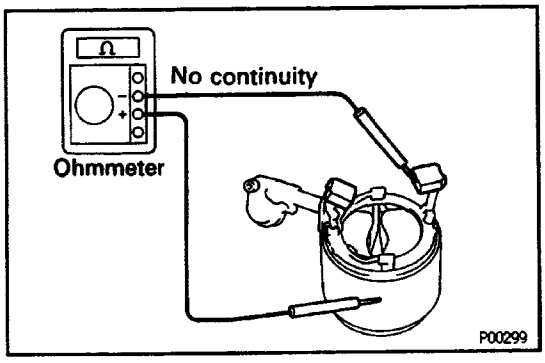
Field Frame (Field Coil)



1. INSPECT FIELD COIL FOR OPEN CIRCUIT

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

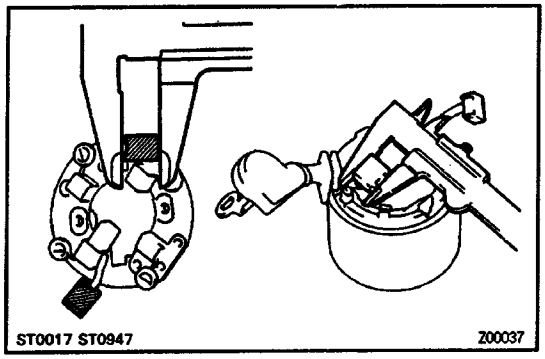
If there is no continuity, replace the field frame.



2. INSPECT THAT FIELD COIL IS NOT GROUNDED

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

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



Brushes

INSPECT BRUSH LENGTH

Using vernier calipers, measure the brush length.

Standard length:

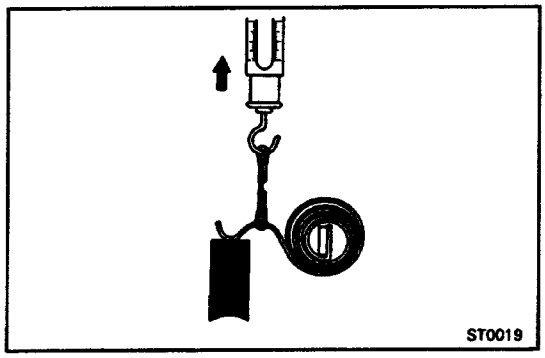
1.0kW: 13.5 mm (0.531 in.)

1.4kW,1.6kW: 15.5 mm (0.6 10 in.)

Minimum length:

8.5 mm (0.335 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.

Standard installed load:

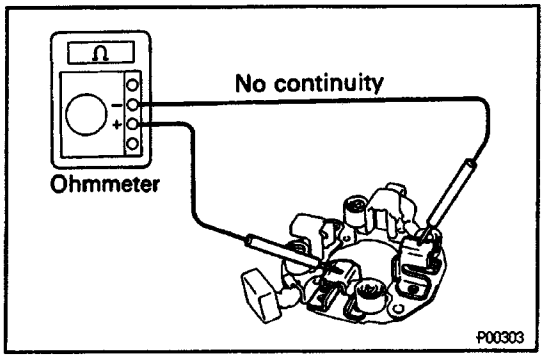
18 – 24 N (1.785 – 2.415 kgf, 3.9 – 5.3 lbf)

Minimum installed load:

12 N(1.2kgf,2.6lbf)

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

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



Brush Holder

INSPECT INSULATION OF BRUSH HOLDER

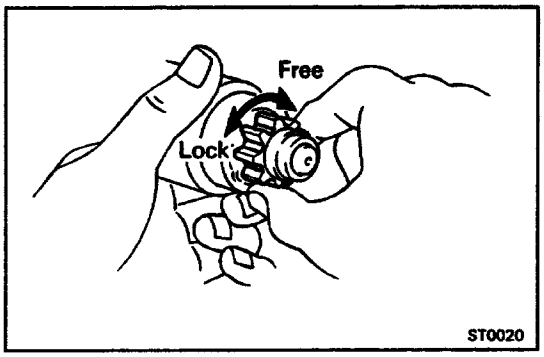
Using an ohmmeter, check that there is no continuity between the positive (+) and negative (–) brush holders.

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, idler gear and clutch assembly for wear or damage.
If damaged, replace the gear or clutch assembly.
If damaged, also check the flywheel ring gear for wear or damage.



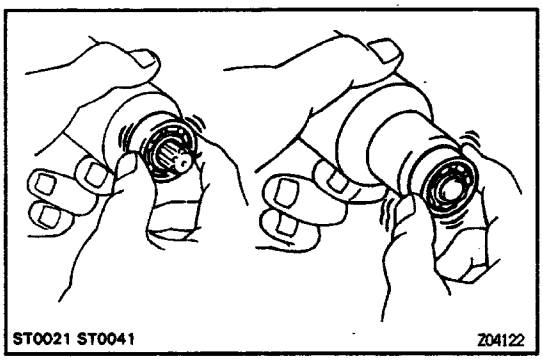
2. INSPECT CLUTCH

Rotate the clutch pinion gear clockwise and check that it turns freely. Try to rotate the clutch pinion counter-clockwise and check that it locks.
If necessary, replace the clutch assembly.

Bearings

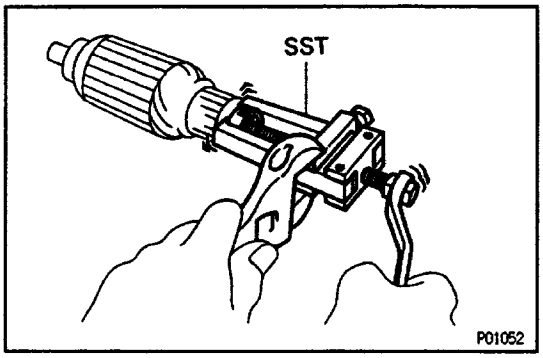
1. INSPECT BEARINGS

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

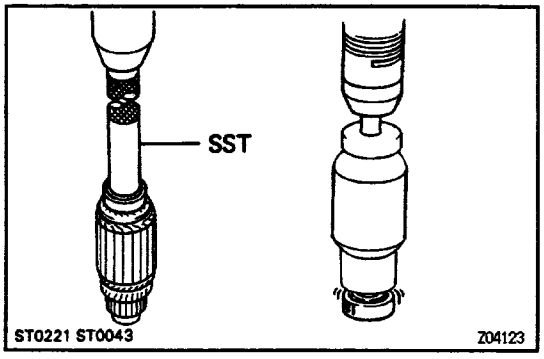


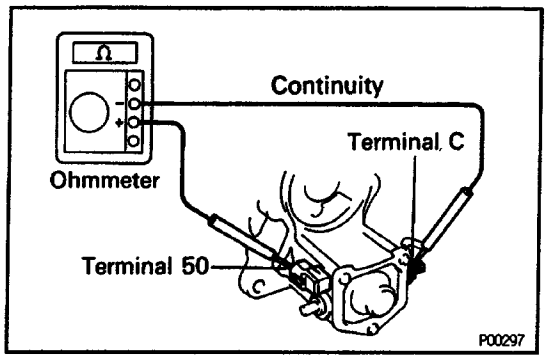
2. IF NECESSARY, REPLACE BEARINGS

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



(b) Using SST and a press, press in a new bearing.
SST
1.OkW: 09285–76010
1.4kW, 1.6kW: 09201–41020



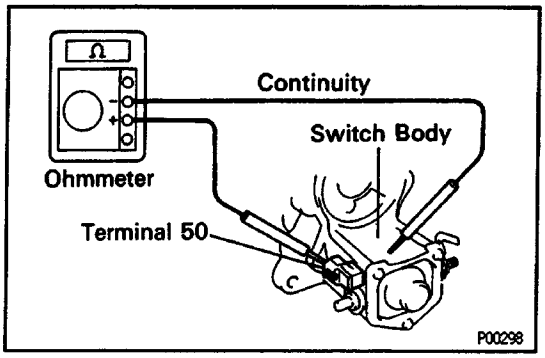


Magnetic Switch

1. 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, replace the magnetic switch assembly.



2. DO HOLD–IN COIL 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 assembly.

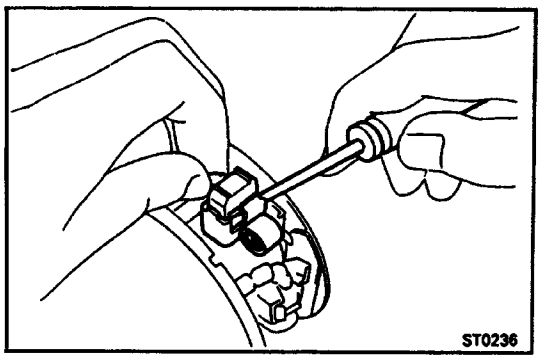
STARTER ASSEMBLY

(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

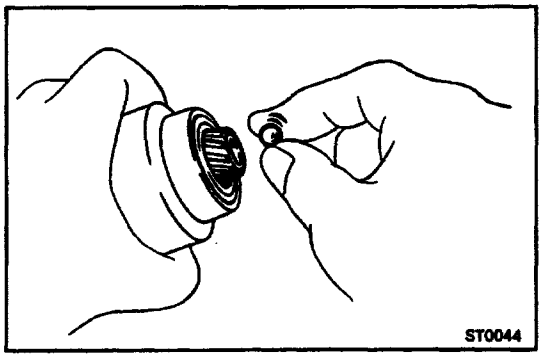
(a) Place the brush holder over the frame.

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

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

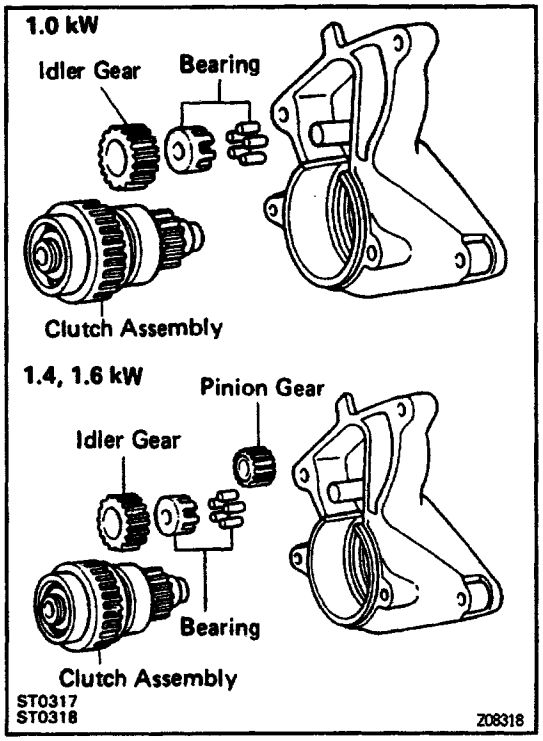
(c) 1.4 kW, 1.6 kW:
Place the O–ring on the field frame.

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



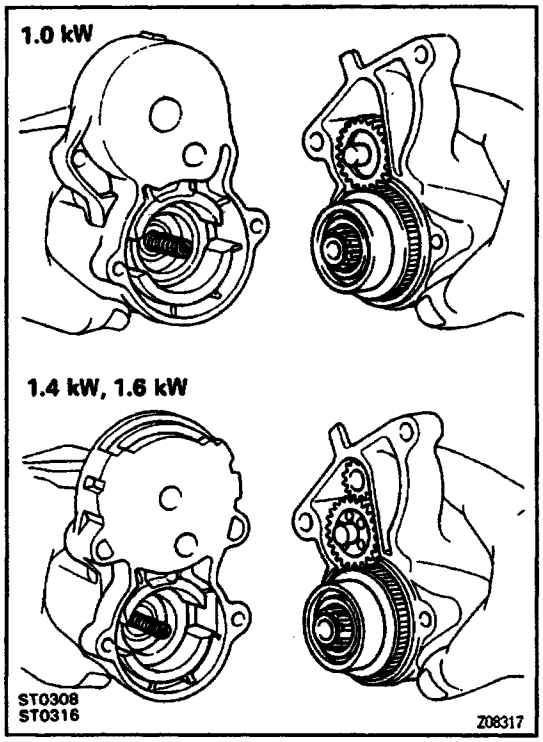
3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

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



4. INSTALL GEARS AND CLUTCH ASSEMBLY

(a) Apply grease to the gears and clutch assembly.
(b) Place the clutch assembly, idler gear, bearing and pinion gear in the starter housing.

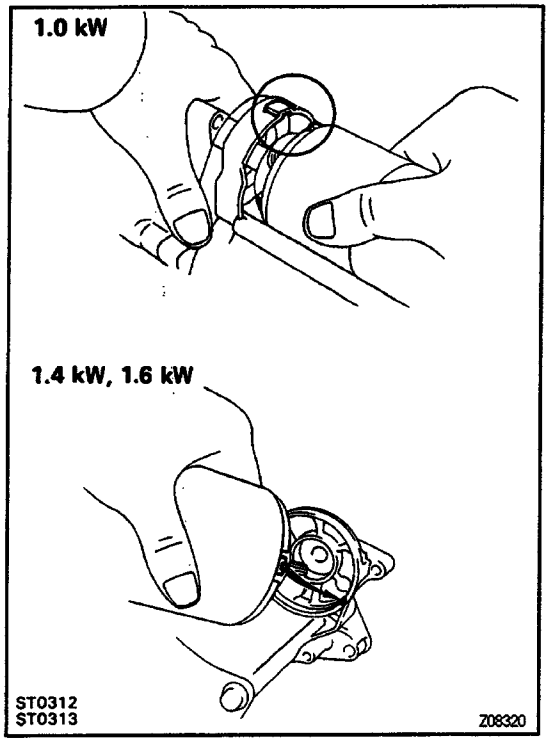


5. INSTALL STARTER HOUSING

(a) Apply grease to the return spring.
(b) Insert the return spring into the magnetic hole.
(c) Place the starter housing on the magnetic switch and install the 2 screws.

Torque:

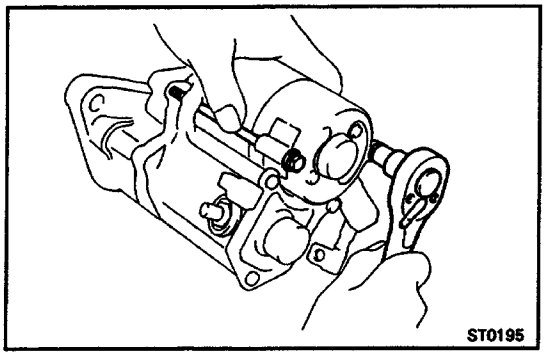
22R–E1.4kW: 5.9 N–m (60 kgf–cm 52 in.lbf)
Others: 9.3 N–m (95 kgf–cm 82 in.–lbf)



6. INSTALL FIELD FRAME WITH ARMATURE TO MAGNETIC SWITCH ASSEMBLY

(a) 1.4 kW, 1.6 kW:
Place the O–ring on the field frame.

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

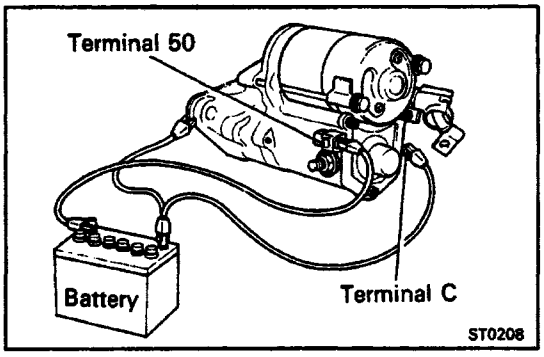


(c) Install the 2 through bolts.

Torque:
22R–E1.4kW: 5.9 N–m (60 kgf–cm 52 in.–lbf)
Others: 9.3 N–m (95 kgf–cm 82 MAW)

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

Torque: 7.9 N–m (81 kgf–cm 70 in.–lbf)



STARTER TEST

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

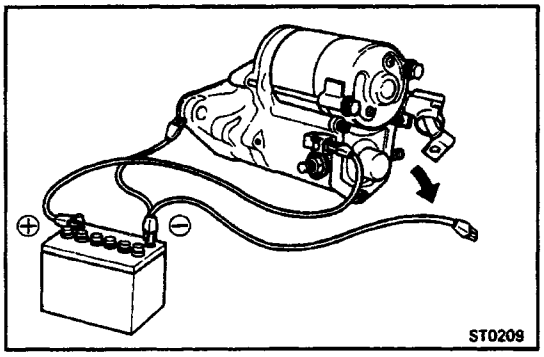
1. DO PULL–IN TEST

(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.

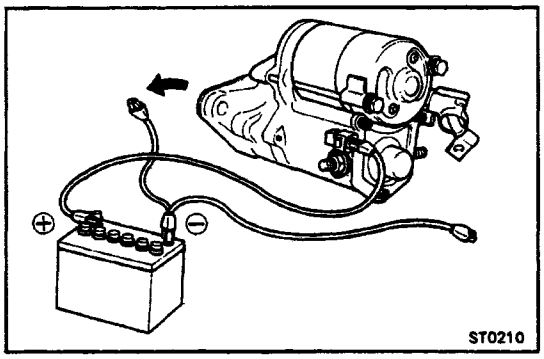
If the clutch pinion gear does not move, replace the magnetic switch assembly.



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.

If the clutch pinion gear returns inward, replace the magnetic switch assembly.

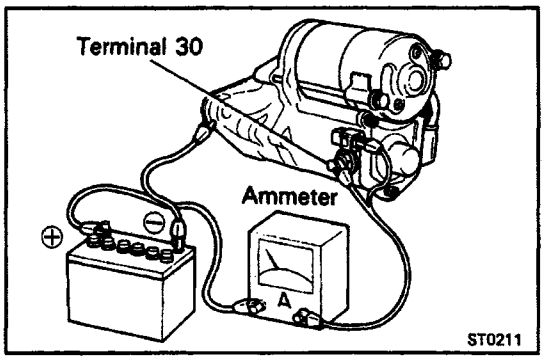


3. INSPECT CLUTCH PINION GEAR RETURN

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.



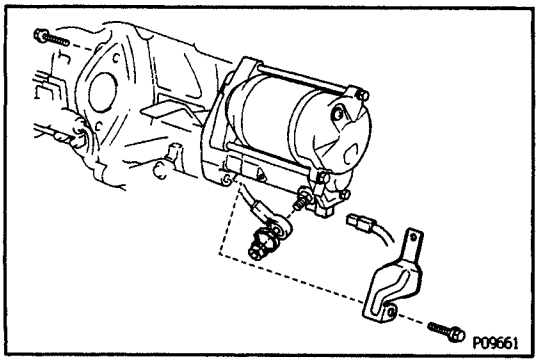
4. DO NO–LOAD PERFORMANCE TEST

(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:

At 11.5V: 90 A or less

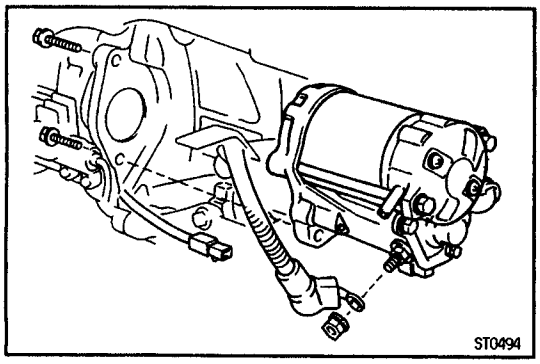


STARTER INSTALLATION

1. INSTALL STARTER MOTOR

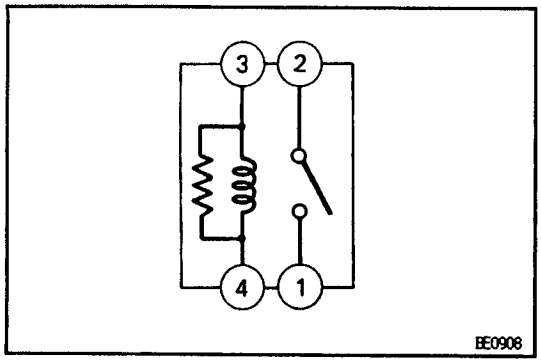
Place the starter motor in the flywheel bellhousing, and install and torque the starter mounting bolts.

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



2. CONNECT 2 WIRES TO STARTER

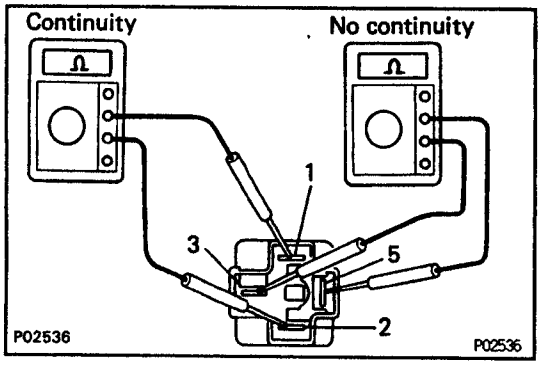
Connect the connector to the terminal on the magnetic switch. Connect the cable from the battery to the terminal on the switch, and install the nut.



STARTER RELAY

STARTER RELAY INSPECTION

LOCATION: The relay is located in the No.1 junction block on the driver's side.

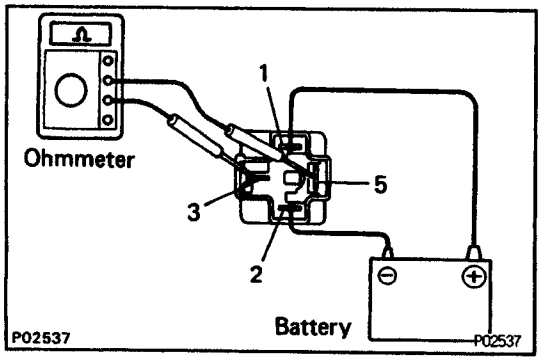


1. INSPECT RELAY CONTINUITY

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

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

If continuity is not as specified, replace the relay.



2. INSPECT RELAY OPERATION

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

(b) Check that there is continuity between terminals 3 and 5.

If operation is not as described, replace the relay.