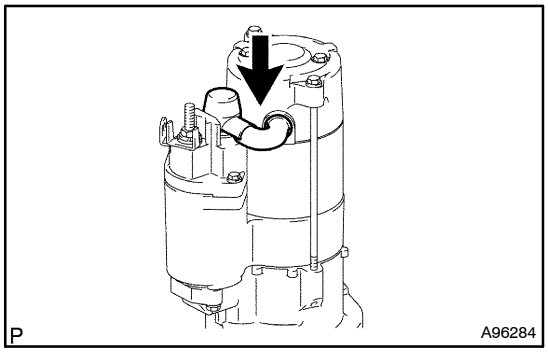
190YS–01

OVERHAUL

HINT:

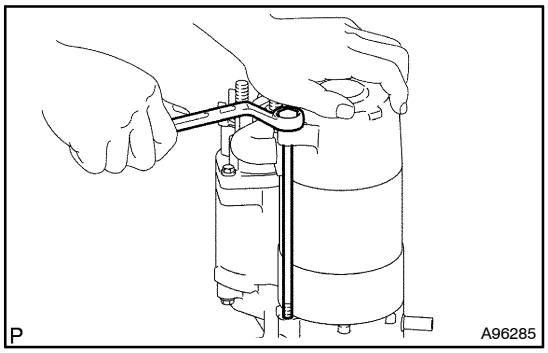
Use high–temperature grease to lubricate the bearings and gears when assembling the starter.

1. REMOVE DUST PROTECTOR CAP



2. REMOVE STARTER YOKE ASSY

(a) Remove the cap, nut and lead wire.

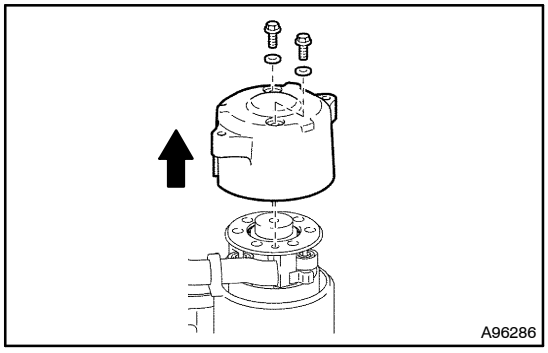


(b) Remove the 2 through bolts, and pull out the starter yoke together with the armature.

HINT:

Hold the starter with your hand so that it will not fall or drop.

(c) Remove the rubber seal from the starter motor housing.



3. REMOVE STARTER COMMUTATOR END FRAME ASSY

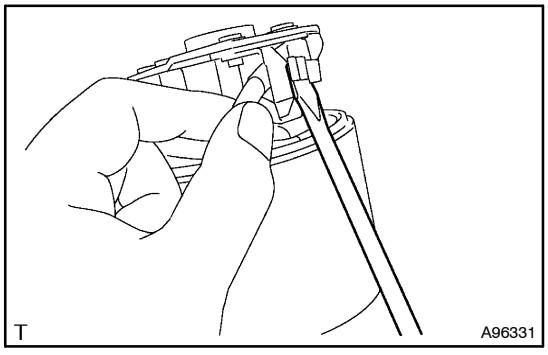
(a) Remove the 2 bolts, 2 rubber seals and end frame.

(b) Remove the starter plate.

HINT:

If the starter plate cannot be found, it may be stuck to the starter commutator end frame or starter armature bearing.

(c) Remove the rubber seal from the starter yoke assy.



4. REMOVE STARTER BRUSH HOLDER ASSY

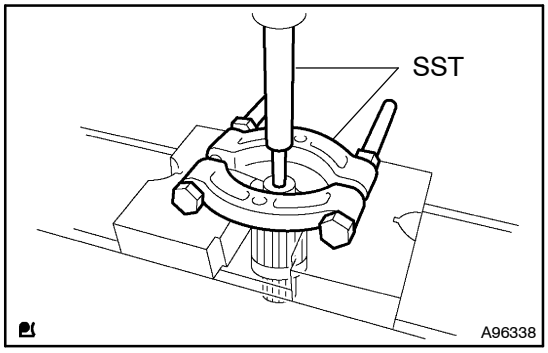
(a) Using a screwdriver, hold the spring back and disconnect the brush from the brush holder.

(b) Disconnect the 4 brushes and remove the brush holder.

5. REMOVE STARTER ARMATURE ASSY

(a) Remove the armature from the starter yoke.

(b) Remove the starter plate from the armature.



6. REMOVE STARTER ARMATURE BEARING

(a) Using SST and a press, press out the bearing from the starter armature.
SST 09950–00020, 09710–02021

7. REMOVE STARTER PLATE

8. REMOVE RUBBER CUSHION

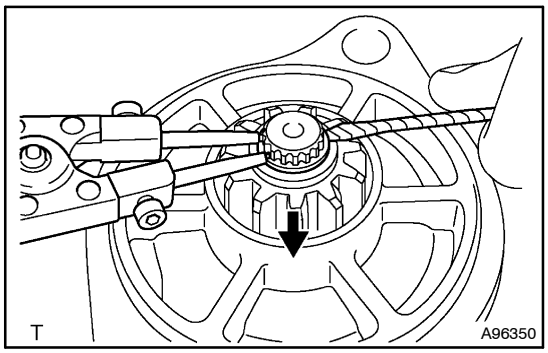
9. REMOVE PLANETARY GEAR

(a) Remove the 3 planetary gears from the starter motor housing.

(b) Remove the starter yoke plate from the planet carrier shaft.

10. REMOVE INTERNAL GEAR

(a) Remove the internal gear from the starter motor housing.



11. REMOVE STARTER IDLE GEAR PINION

(a) Attach a screwdriver to the retainer and push down on the stopper.

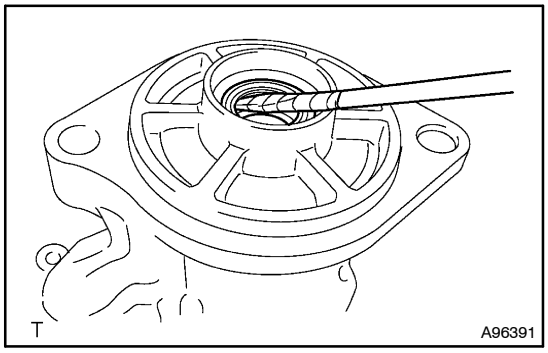
HINT:
Tape the screwdriver tip before use.

(b) Using a snap ring expander, remove the retainer with the stopper pushed down.

(c) Remove the starter idle gear pinion.

12. REMOVE STARTER DRIVE HOUSING ASSY

(a) Remove the 2 bolts and starter drive housing from the starter motor housing.



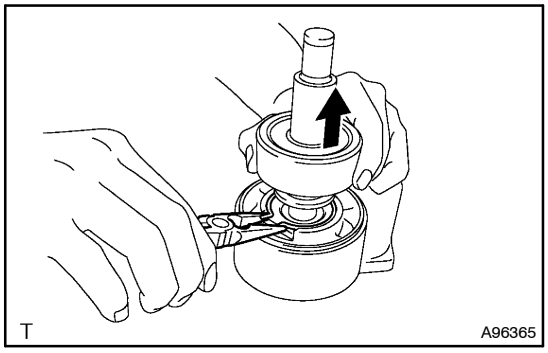
13. REMOVE DUST STARTER PROTECTOR

(a) Remove the protector by prying with a screwdriver.

HINT:
Tape the screwdriver tip before use.

14. REMOVE STARTER PINION DRIVE LEVER

15. REMOVE MAGNET SWITCH COVER GASKET



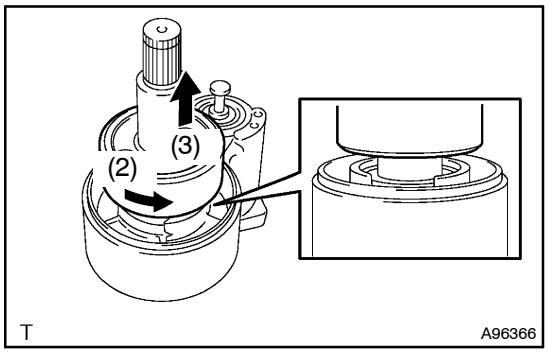
16. REMOVE STARTER ARMATURE PLATE

(a) Lift up the starter clutch. Using a needle nose plier, remove the clip.

(b) Remove the starter armature plate.

17. REMOVE STARTER CLUTCH SUB–ASSY

(a) Remove the starter clutch from the planet carrier shaft. If unable to remove the starter clutch, go to step (b). Otherwise, go to step (c).



(b) Perform (1) to (3).

(1) Push the starter clutch and planet carrier shaft together. Maintain this position for step (2).

(2) Slightly turn the starter clutch as shown in the illustration.

(3) Remove the starter clutch from the planet carrier shaft.

(c) Remove the magnet switch cover gasket.

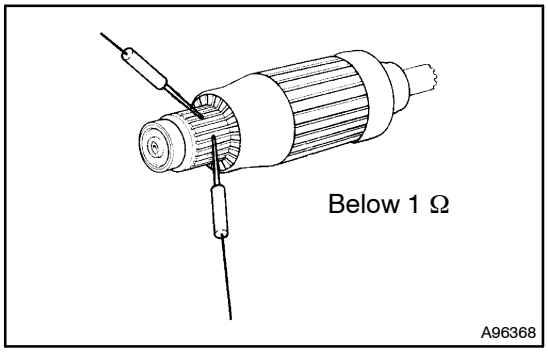
18. REMOVE PLANETARY CARRIER SHAFT SUB–ASSY

(a) Remove the planet carrier shaft and starter plate from the starter motor housing.

19. INSPECT STARTER ARMATURE ASSY

(a) Check the commutator for contamination and burns on its surface.

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

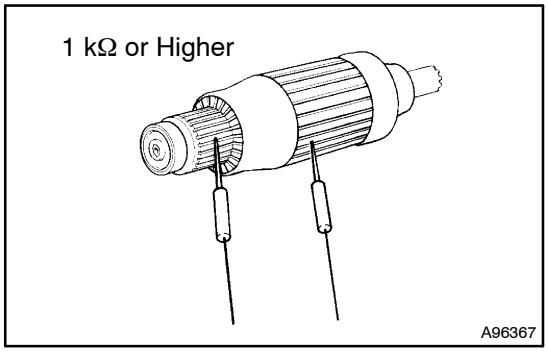


(b) Check if the commutator has an open circuit.

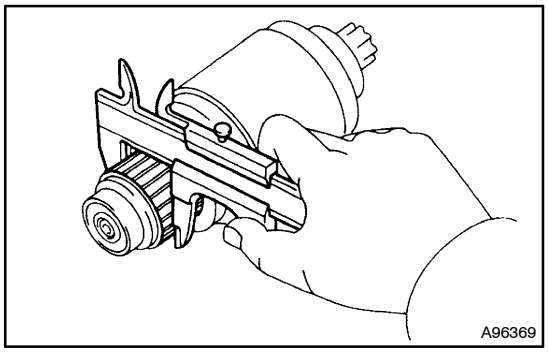
(1) Measure the resistance between the segments of the commutator.

Standard: Below 1 Ω

If the result is not as specified, replace the armature assy.



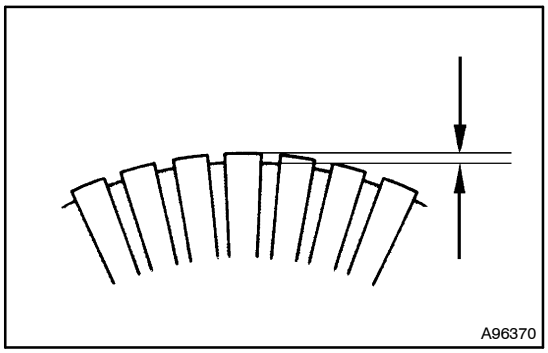
(c) Check if the commutator is grounded.
(1) Measure the resistance between the commutator and armature coil core.
Standard: 1 kΩ or higher
If the result is not as specified, replace the armature assy.



(d) Using a vernier caliper, measure the commutator diameter.
Diameter:

Standard	Minimum
36.0 mm (1.417 in.)	34.0 mm (1.339 in.)

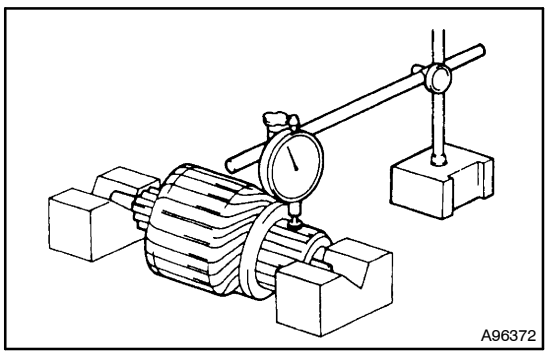
If the diameter is less than the minimum, replace the armature assy.



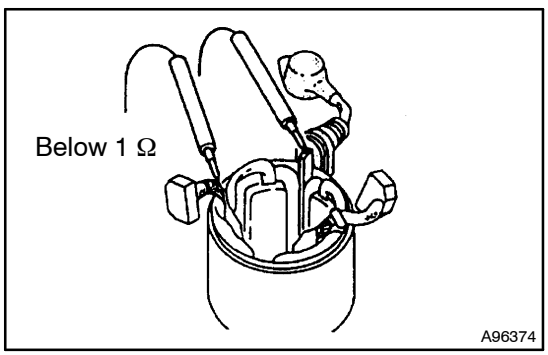
(e) Check that the undercut depth is clean and free of foreign materials.
(f) Measure the undercut depth.
Undercut depth:

Standard	Minimum
0.5 to 0.8 mm (0.020 to 0.032 in.)	0.2 mm (0.008 in.)

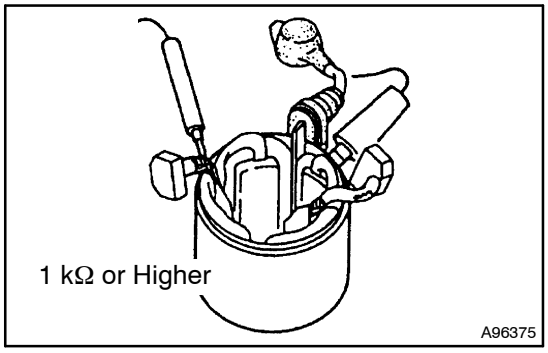
If the undercut depth is less than the minimum, increase the depth using a hacksaw blade.



(g) Check for the commutator circle runout.
(1) Place the commutator on V–blocks.
(2) Using a dial indicator, measure the circle runout.
Maximum circle runout: 0.1 mm (0.004 in.)
If the circle runout is greater than the maximum, replace the armature assy.

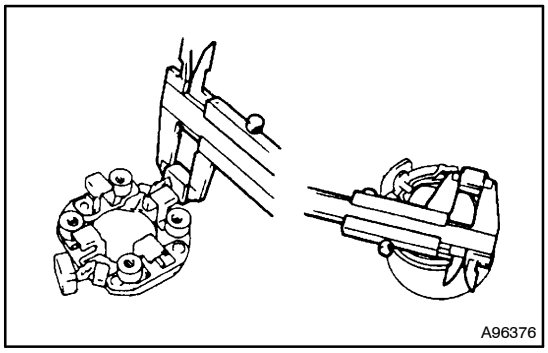


20. INSPECT STARTER YOKE ASSY
(a) Check if the starter yoke has an open circuit.
(1) Measure the resistance between the lead wire and field coil brush lead.
Standard: Below 1 Ω
If the result is not as specified, replace the starter yoke assy.
HINT:
Inspect the brushes on both sides.



(b) Check if the starter yoke body is grounded.
(1) Measure the resistance between the field coil brush and starter yoke body.
Standard: 1 kΩ or higher

If the result is not as specified, replace starter yoke assy.

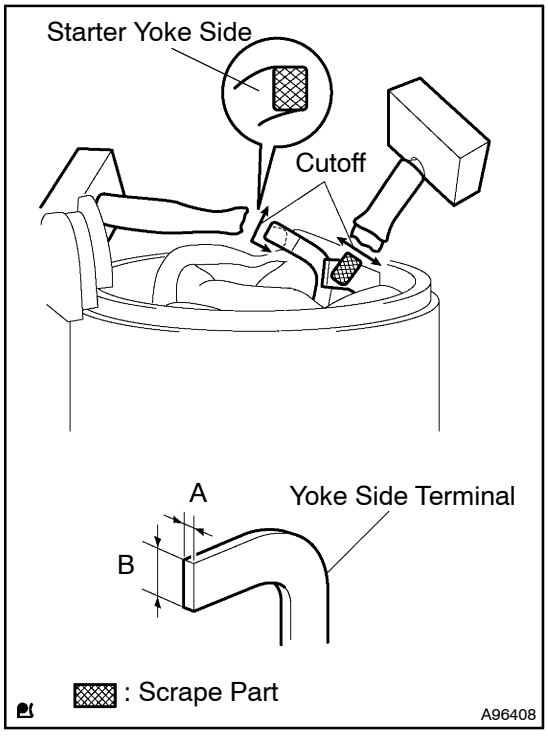


21. INSPECT STARTER BRUSH

(a) Using a vernier caliper, measure the brush length.
Length:

Standard	Minimum
18.0 mm (0.709 in.)	13.0 mm (0.512 in.)

If the length is less than the minimum, replace the brush holder assy and starter brush.

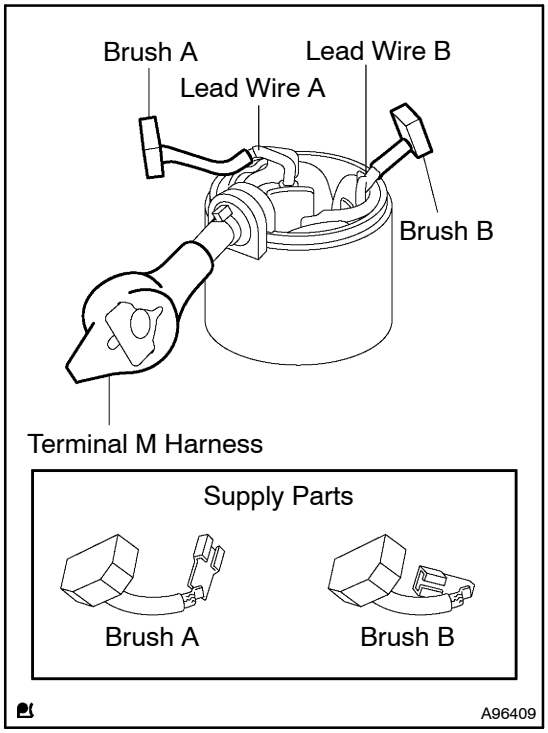


22. REPLACE STARTER BRUSH

HINT:
- Only the brushes mounted on the starter yoke can be replaced.
- When replacing the brushes mounted on the brush holder, replace the brush and brush holder as a set.

(a) Remove the clamp.
(b) When replacing brushes that were supply parts:
(1) Remove the brushes from the clamps.
(c) When replacing brushes that were pre–made parts:
(1) Cut the lead wires at the positions indicated in the illustration.
(d) File the welded parts of the lead wires on the starter yoke so that dimensions are within the specifications.
Specification:
A: 1.4 mm (0.055 in.)
B: 6.0 mm (0.236 in.)

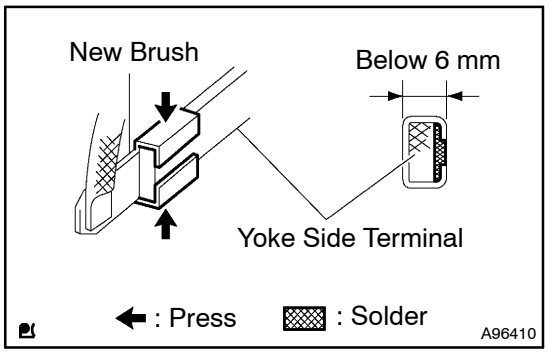
NOTICE:
Do not move the lead wires on the starter yoke or the insulation part of the field coil will incur damage.



(e) Connect brush A to lead wire A and brush B to lead wire B.

NOTICE:

Be sure to connect the brushes to the correct lead wires.



(f) Match the new brush and yoke side lead wire's tip. Then caulk the clamp of the brush.

(g) Solder the clamp of the brush.

HINT:

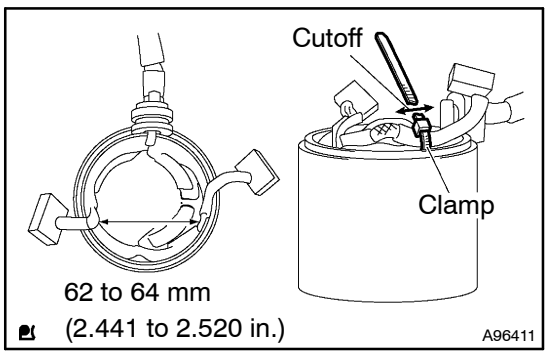
Before soldering, sufficiently heat the part to be soldered.

NOTICE:

Do not allow solder to contact any area that is not specified.

(h) Check the dimensions of the soldered part.

Standard: Below 6 mm (0.24 in.)



(i) Measure the internal dimension of the starter yoke shown in the illustration.

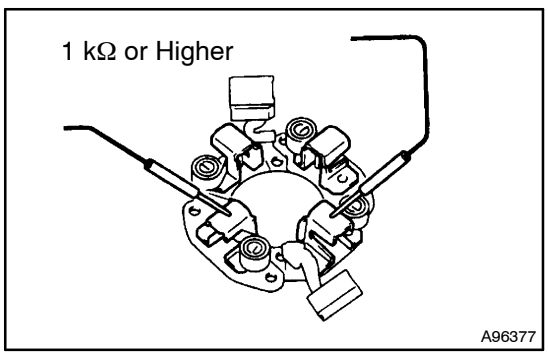
Standard: 62 to 64 mm (2.44 to 2.52 in.)

If the result is not as specified, replace the starter yoke assy.

NOTICE:

When installing the armature, make sure that the inside of the starter yoke does not contact the armature.

(j) Fix the lead wire with the clamp as shown in the illustration.

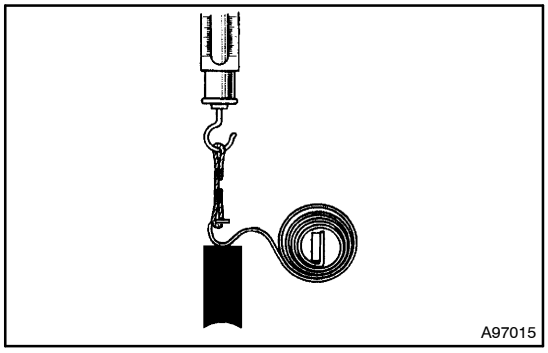


23. INSPECT STARTER BRUSH HOLDER ASSY

(a) Using an ohmmeter, measure the resistance between the positive (+) and negative (–) brush holders.

Standard: 1 kΩ or higher

If the result is not as specified, replace the brush holder assy.

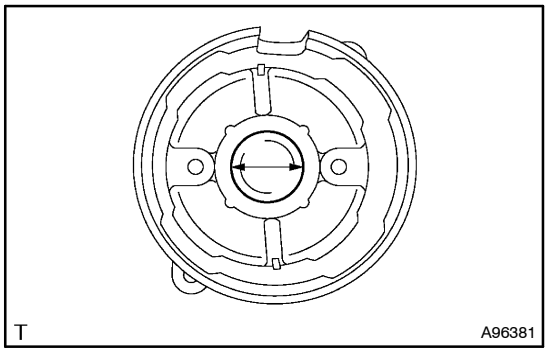


(b) Inspect the load of the brush spring.
(1) Using a pull scale, measure the installed load of the spring at the exact moment the spring separates from the brush.

Installed load:

Standard	Minimum
18 N (1.8 kgf, 4.0 lbf)	13 N (1.3 kgf, 2.9 lbf)

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



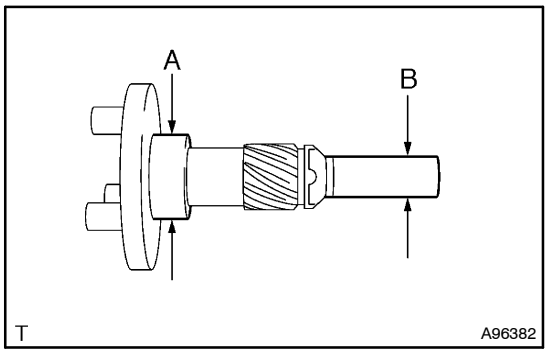
24. INSPECT STARTER COMMUTATOR END FRAME ASSY

(a) Using a cylinder gauge, measure the inside diameter of the end frame.

Inside diameter:

Standard	Maximum
28.0 mm (1.102 in.)	28.1 mm (1.106 in.)

If the inside diameter is greater than the maximum, replace the commutator end frame assy.



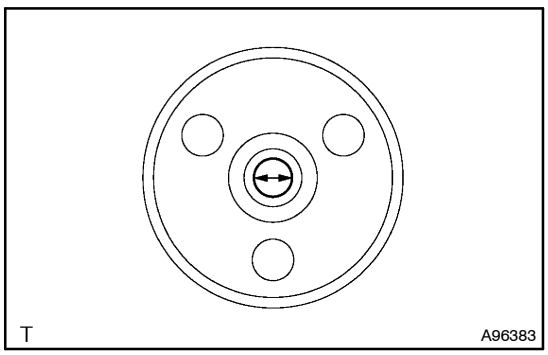
25. INSPECT PLANET CARRIER SHAFT SUB–ASSY

(a) Using a micrometer, measure each outside diameter of the shaft.

Outside diameter:

Standard	Minimum
A: 26.0 mm (1.024 in.) B: 12.1 mm (0.476 in.)	A: 25.9 mm (1.020 in.) B: 12.04 mm (0.474 in.)

If the outside diameter is less than the minimum, replace the shaft sub–assy.

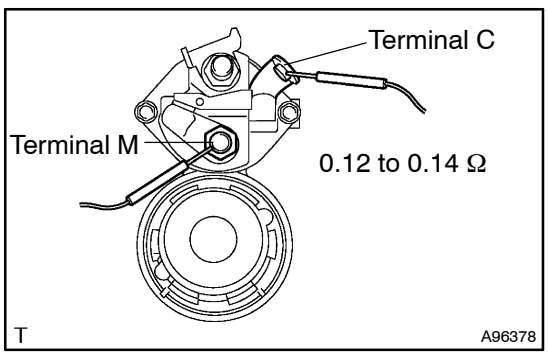


(b) Using a vernier caliper, measure the inside diameter of the shaft.

Inside diameter:

Standard	Maximum
9.0 mm (0.354 in.)	9.2 mm (0.362 in.)

If the inside diameter is greater than the maximum, replace the shaft.

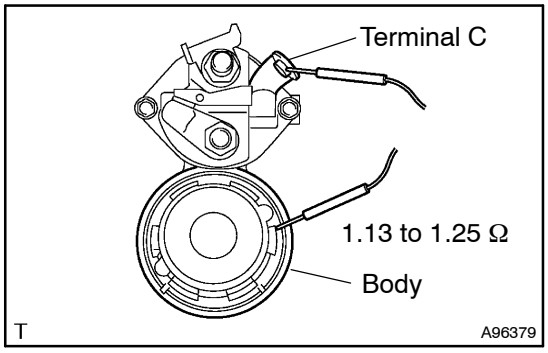


26. INSPECT STARTER MOTOR HOUSING

(a) Check if the pull–in coil has an open circuit.
(1) Measure the resistance between terminals C and M.

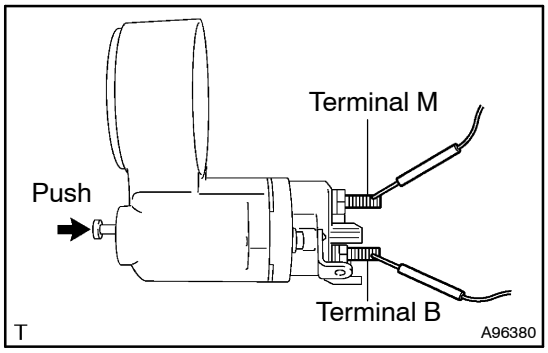
Standard: 0.12 to 0.14 Ω at 20°C (68°F)

If the result is not as specified, replace the starter cover assy.



(b) Check if the hold–in coil has an open circuit.
(1) Measure the resistance between terminal C and the motor housing body.
Standard: 1.13 to 1.25 Ω at 20°C (68°F)

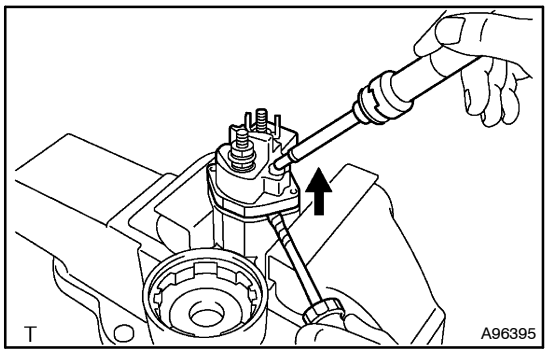
If the result is not as specified, replace the starter cover assy.



(c) Measure the resistance between terminals B and M.
Standard:

Condition	Specified Condition
Not pushed	10 kΩ or higher
Pushed	Below 1 Ω

If the result is not as specified, replace the starter cover assy.



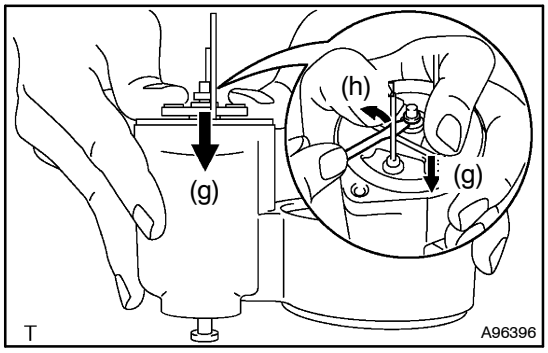
27. REMOVE STARTER COVER ASSY

(a) Using a vise and aluminum protection plates, fix the starter motor housing.
(b) Using a soldering iron, remove the solder from the soldered parts of the lead wire.
(c) Heat the soldered part of the lead wire with a soldering iron. Maintain this position for step (d).
(d) Using a screwdriver, pry up part of the cover.

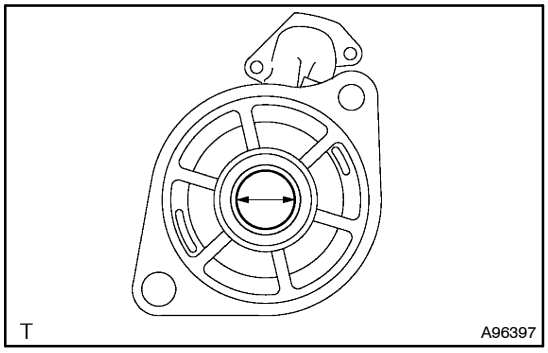
HINT:

Tape the screwdriver's tip before use.

(e) Perform steps (c) and (d) on the opposite side. Pry up the other side of the cover.
(f) Perform steps (c) to (e) several times at both soldered parts until the cover assy is fully removed.



(g) Place the starter motor housing on a table and push down on the contactor. Maintain this position for step (h).
(h) Using a screwdriver, remove the retainer hook.
(i) Remove the stopper, washer, contactor, collar washer and gasket.
(j) Remove the moving core from the motor housing.



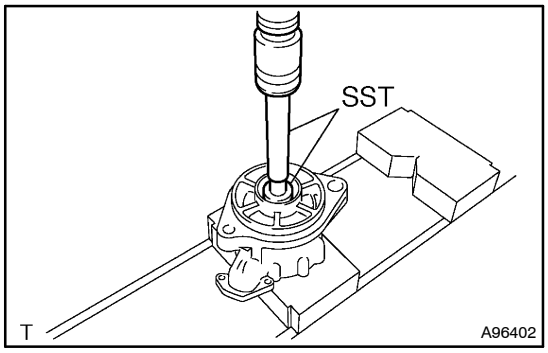
28. INSPECT STARTER HOUSING BUSH

(a) Using a cylinder gauge, measure the inside diameter of the bush.

Inside diameter:

Standard	Maximum
25.0 mm (0.984 in.)	25.2 mm (0.992 in.)

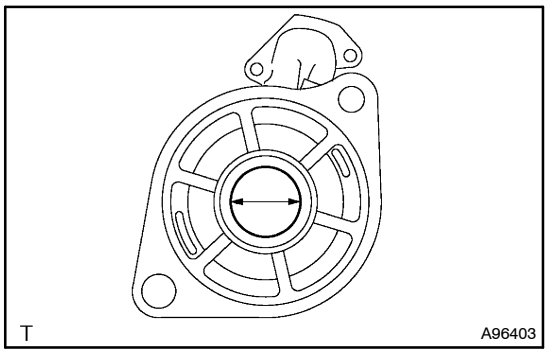
If the inside diameter is greater than the maximum, replace the bush.



29. REMOVE STARTER HOUSING BUSH

(a) Using a press and SST, press out the bush.

SST 09950–60010 (09951–00250, 09951–00300, 09952–06010), 09950–70010 (09951–07100)

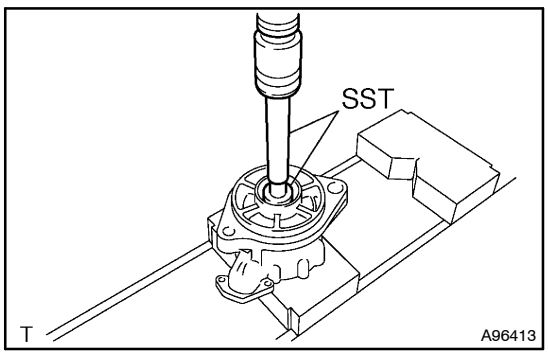


30. INSPECT STARTER DRIVE HOUSING ASSY

(a) Using a cylinder gauge, measure the inside diameter of the housing.

Maximum: 30.033 mm (1.1824 in.)

If the inside diameter is greater than the maximum, replace the housing assy.

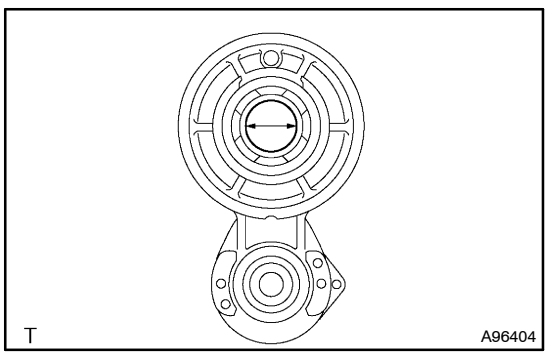


31. INSTALL STARTER HOUSING BUSH

(a) Apply grease to a new bush.

(b) Using SST and a press, press in the bush.

SST 09950–60010 (09951–00250, 09951–00300, 09952–06010), 09950–70010 (09951–07100)



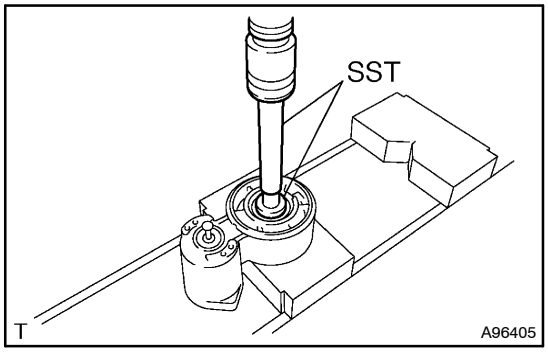
32. INSPECT STARTER CENTER BEARING BUSH

(a) Using a cylinder gauge, measure the inside diameter of the bush.

Inside diameter

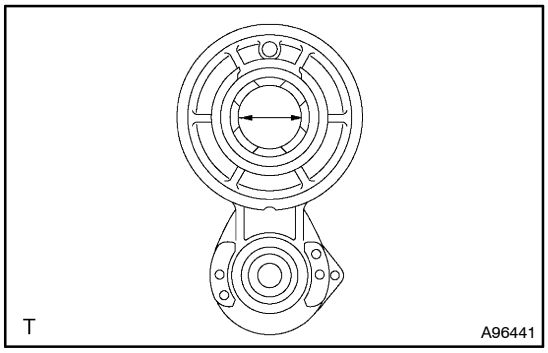
Standard	Maximum
26.0 mm (1.024 in.)	26.2 mm (1.031 in.)

If the inside diameter is greater than the maximum, replace the bush.



33. REMOVE STARTER CENTER BEARING BUSH

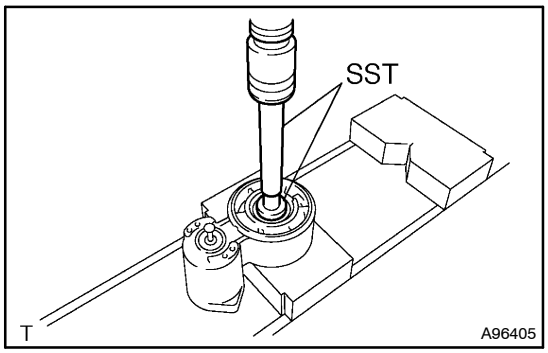
(a) Using a press and SST, press out the bush.
SST 09950–60010 (09951–00260, 09951–00310, 09952–06010), 09950–70010 (09951–07100)



34. INSPECT STARTER MOTOR HOUSING

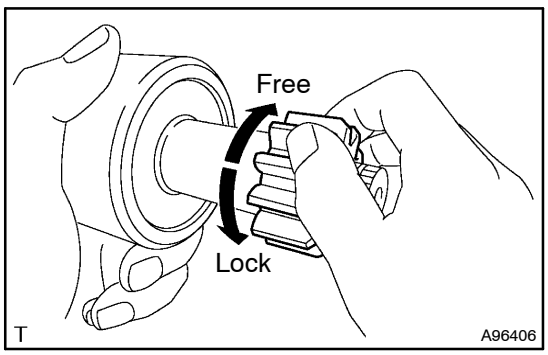
(a) Using a cylinder gauge, measure the inside diameter of the housing.
Maximum: 29.033 mm (1.143 in.)

If the inside diameter is greater than the maximum, replace the housing.



35. INSTALL STARTER CENTER BEARING BUSH

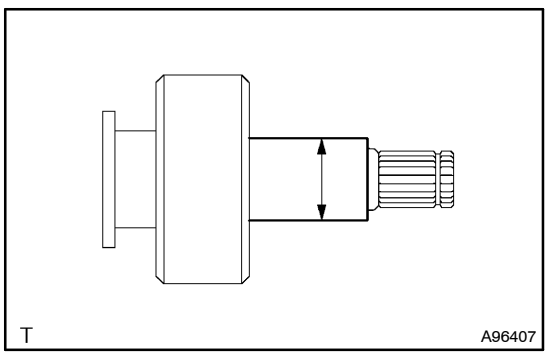
(a) Apply grease to a new bush.
(b) Using SST and a press, press in the bush.
SST 09950–60010 (09951–00260, 09951–00310, 09952–06010), 09950–70010 (09951–07100)



36. INSPECT STARTER CLUTCH SUB–ASSY

(a) Grip the clutch in one hand and turn only the inner sleeve with the other hand.
(b) Check that the inner sleeve turns easily in the ”free” direction but cannot turn in the ”lock” direction as shown in the illustration.

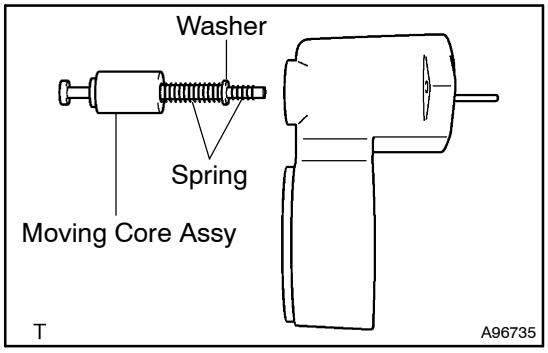
If the starter clutch does not operate as specified, replace the starter clutch.



(c) Using a micrometer, measure the outside diameter of the starter clutch.
Outside diameter:

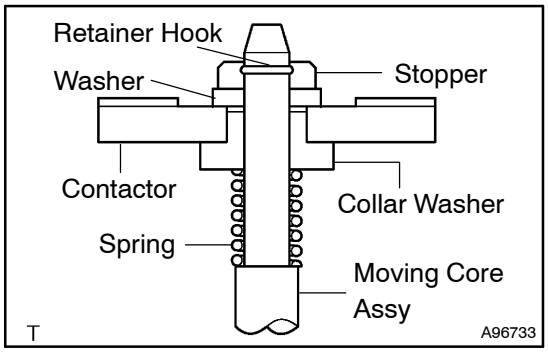
Standard	Minimum
25.0 mm (0.984 in.)	24.9 mm (0.980 in.)

If the outside diameter is less than the minimum, replace the clutch sub–assy.



37. INSTALL STARTER COVER ASSY

(a) Install 2 new springs and a new washer to a new moving core as shown in the illustration.



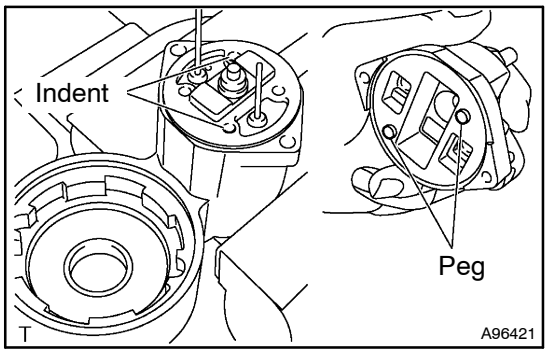
(b) Install the collar washer, contactor, washer and stopper to the moving core.

(c) Place the starter motor housing on a table and push down the contactor. Maintain this position for step (d).

(d) Install a new retainer hook.

NOTICE:

Make sure that the retainer hook is in the groove of the stopper.



(e) Using a vise and aluminum protection plates, fix the motor housing.

(f) Clean the contactor surface.

(g) Install a new gasket.

(h) Match the indent of the gasket and peg of the cover. Then install the cover with the 2 bolts.

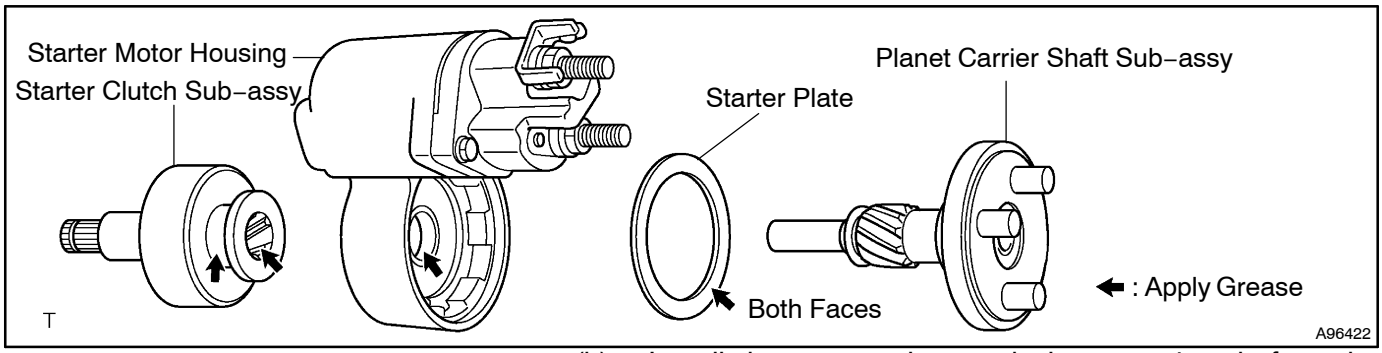
(i) Install the 2 bolts.

Torque: 4.3 N·m (44 kgf·cm, 38 in.·lbf)

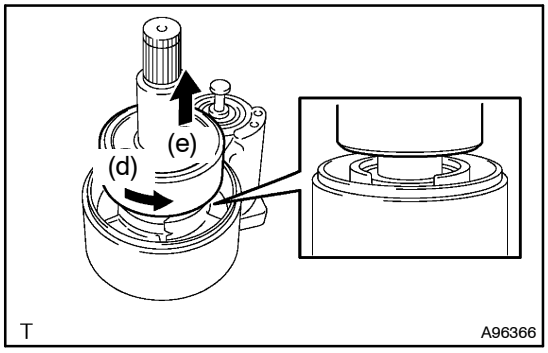
(j) Solder the 2 lead wires to the top of the starter cover.

38. INSTALL STARTER CLUTCH SUB–ASSY

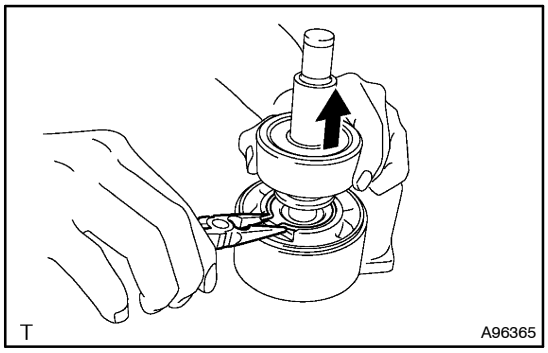
(a) Apply grease to the parts indicated by arrow marks in the illustration.



(b) Install the starter plate and planet carrier shaft to the housing.



(c) Push together the starter clutch and planet carrier shaft. Maintain this position for step (d).
(d) Slightly turn the starter clutch in the direction indicated by the arrow mark in the illustration.
(e) Check that the starter clutch is installed securely to the planet carrier shaft by pulling up the clutch.
(f) Install the starter armature plate.



(g) Lift up the starter clutch. Using needle nose pliers, install the clip.

39. INSTALL DUST STARTER PROTECTOR

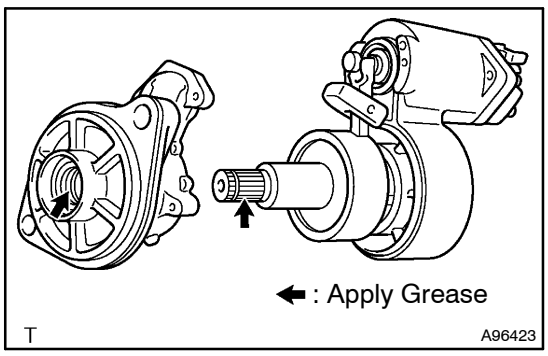
(a) Install a new dust starter protector to the starter drive housing.

40. INSTALL DUST PROTECTOR CAP

41. INSTALL MAGNET SWITCH COVER GASKET

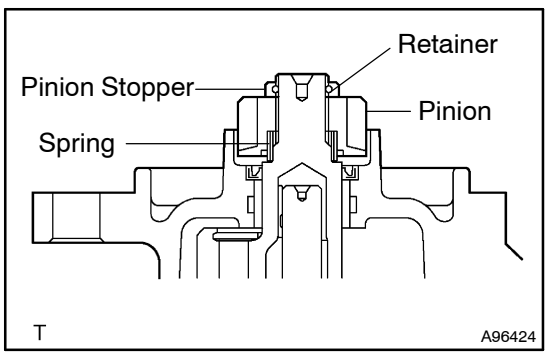
(a) Install a new magnet switch cover gasket to the starter motor housing.

42. INSTALL STARTER PINION DRIVE LEVER



43. INSTALL STARTER DRIVE HOUSING ASSY

(a) Apply grease to the housing.
(b) Install the starter drive housing with the 2 bolts.
Torque: 4.3 N·m (44 kgf·cm, 38 in.·lbf)



44. INSTALL STARTER IDLE GEAR PINION

(a) Install the spring, pinion and pinion stopper.
(b) Push down the pinion stopper to install a new retainer.

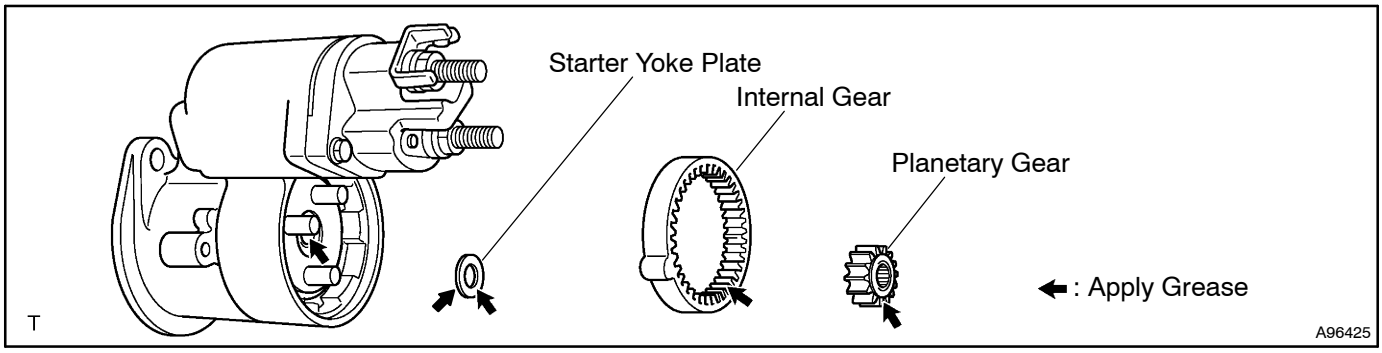
NOTICE:

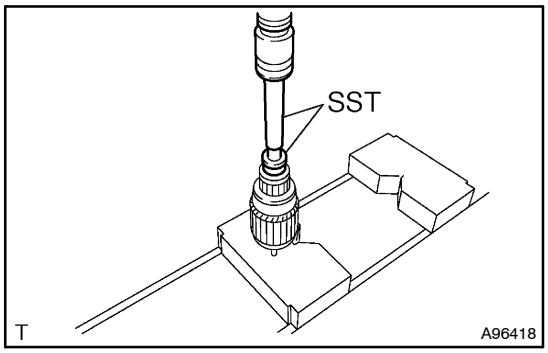
Make sure that the retainer is in the groove of the pinion stopper.

45. INSTALL PLANETARY GEAR

(a) Apply grease to the parts indicated by the arrow marks in the illustration.

(b) Install the starter yoke plate, internal gear and 3 planetary gears to the planet carrier shaft.





46. INSTALL STARTER ARMATURE BEARING

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

SST 09950–60010 (09951–00280), 09950–70010 (09951–07100)

47. INSTALL RUBBER CUSHION

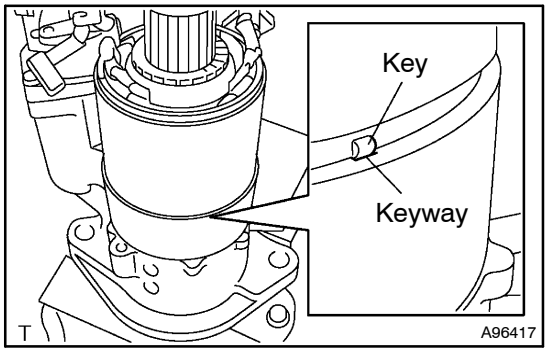
(a) Install the rubber cushion to the starter motor housing.

48. INSTALL STARTER PLATE

(a) Install the starter plate to the starter motor housing.

49. INSTALL STARTER ARMATURE ASSY

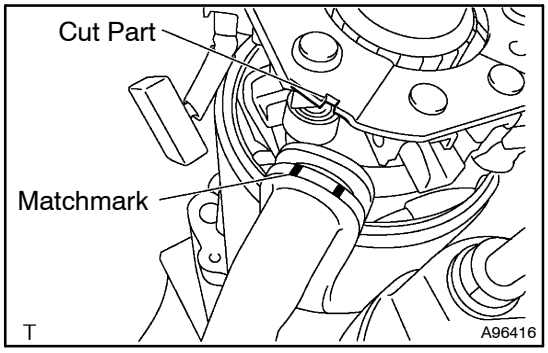
(a) Install the armature to the starter motor housing.



50. INSTALL STARTER YOKE ASSY

(a) Install 2 new rubber seals.

(b) Match the keyway of the starter yoke with the key of the starter motor housing to install the starter yoke assy.



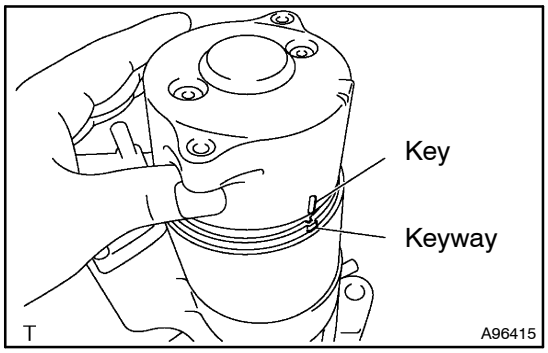
51. INSTALL STARTER BRUSH HOLDER ASSY

(a) Align the cut part of the brush holder with the matchmark on the lead wire.

(b) Install the brush holder to the armature.

52. INSTALL STARTER BRUSH

(a) Using a screwdriver, hold the brush spring back and connect the brush to the brush holder.



53. INSTALL STARTER COMMUTATOR END FRAME ASSY

(a) Install the starter plate.

(b) Align the end frame with the keyway located on the yoke.

(c) Install the commutator end frame with the 2 through bolts.
Torque: 15 N·m (152 kgf·cm, 11 ft·lbf)

(d) Install the end frame with 2 new rubber seals.
Torque: 4.3 N·m (44 kgf·cm, 38 in.·lbf)

(e) Connect the lead wire to terminal M.
Torque: 13.5 N·m (138 kgf·cm, 10 ft·lbf)