

ENGINE SECTION 1

This service manual has been prepared to provide SUBARU service personnel with the necessary information and data for the correct maintenance and repair of SUBARU vehicles.

This manual includes the procedures for maintenance, disassembling, reassembling, inspection and adjustment of components and diagnostics for guidance of experienced mechanics.

Please peruse and utilize this manual fully to ensure complete repair work for satisfying our customers by keeping their vehicle in optimum condition. When replacement of parts during repair work is needed, be sure to use SUBARU genuine parts.

All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

FUEL INJECTION (FUEL SYSTEM) FU(H4SO)

**EMISSION CONTROL
(AUX. EMISSION CONTROL DEVICE) EC(H4SO)**

INTAKE (INDUCTION) IN(H4SO)

MECHANICAL ME(H4SO)

EXHAUST EX(H4SO)

COOLING CO(H4SO)

LUBRICATION LU(H4SO)

SPEED CONTROL SYSTEM SP(H4SO)

IGNITION IG(H4SO)

STARTING/CHARGING SYSTEM SC(H4SO)

ENGINE (DIAGNOSTIC) EN(H4SO)

STARTING/CHARGING SYSTEM

SC(H4SO)

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General Description

STARTING/CHARGING SYSTEM

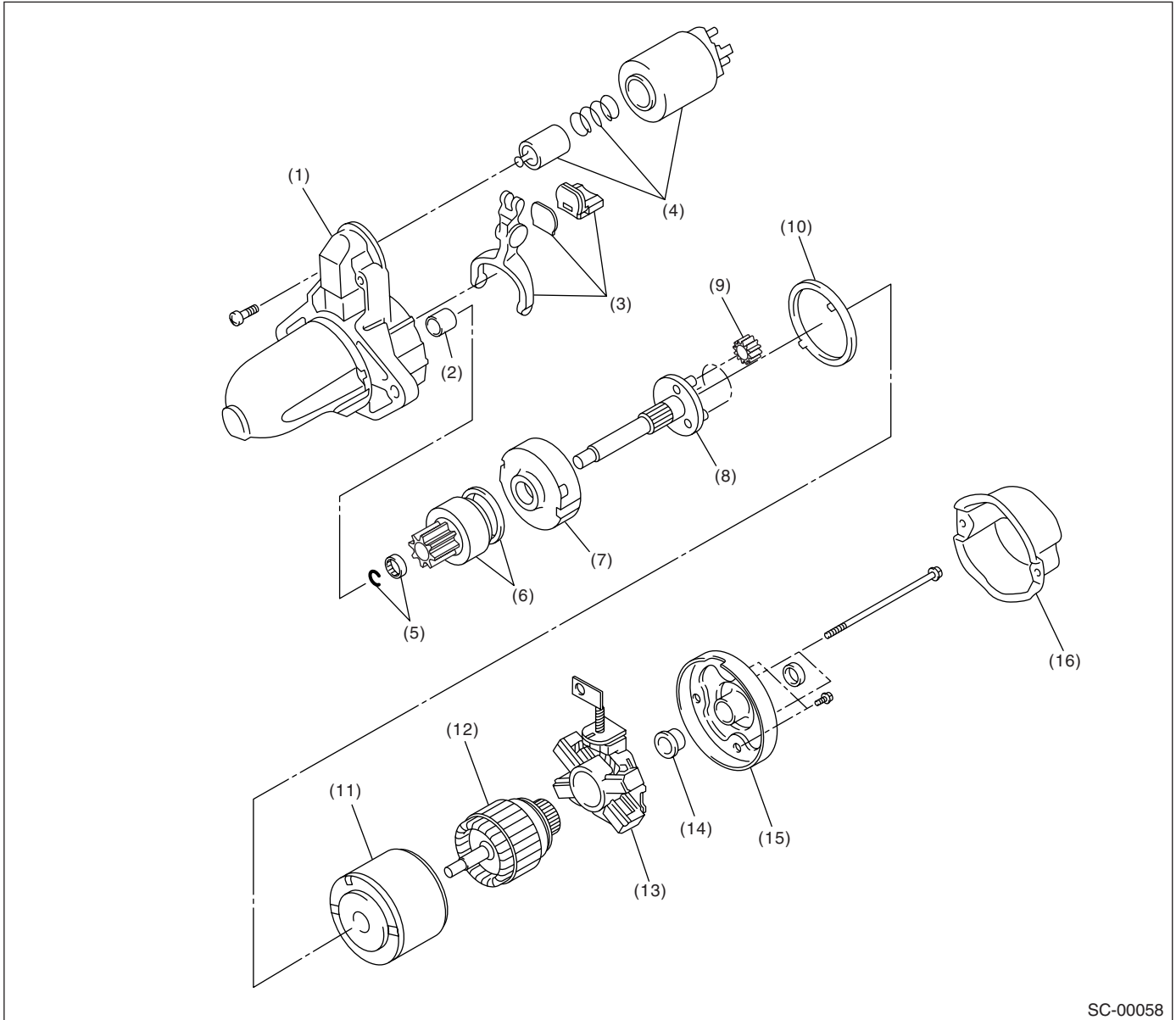
1. General Description

A: SPECIFICATION

Item		Designation		
Starter	Type	Reduction type		
	Vehicle type	MT model	AT model	
	Model	M000T30471	M000T20171	
	Manufacturer	Mitsubishi Electric		
	Voltage and output	12 V — 1.0 kW	12 V — 1.4 kW	
	Direction of rotation	Counterclockwise (viewed from pinion gear side)		
	Number of pinion teeth	8	9	
	No-load characteristics	Voltage	11 V	
		Current	95 A or less	90 A or less
		Rotating speed	2,500 rpm or more	2,000 rpm or more
	Load characteristics	Voltage	7.5 V	7.7 V
		Current	300 A	400 A
		Torque	8.84 N (0.90 kgf, 1.99 lb) or more	16.7 N (1.70 kgf, 3.75 lb) or more
		Rotating speed	870 rpm or more	710 rpm or more
	Lock characteristics	Voltage	4 V	3.5 V
		Current	680 A or less	960 A or less
Torque		17 N (1.73 kgf, 12.5 lb) or more	31 N (3.16 kgf, 22.9 lb) or more	
Generator	Type	Rotating-field three-phase type, Voltage regulator built-in type, with load response control system		
	Model	EC, EK model: A002TG0391 Other model: A002TB6991		
	Manufacturer	Mitsubishi Electric		
	Voltage and output	12 V — 90 A		
	Polarity on ground side	Negative		
	Rotating direction	Clockwise (viewed from pulley side)		
	Armature connection	3-phase Y-type		
	Output current	EC, EK model	1,500 rpm — 40 A or more	
			2,500 rpm — 74 A or more	
			5,000 rpm — 84 A or more	
Output current	Other model	1,500 rpm — 36 A or more		
		2,500 rpm — 65 A or more		
		5,000 rpm — 86 A or more		
Regulated voltage	14.1 — 14.8 V [20°C (68°F)]			

B: COMPONENT

1. STARTER



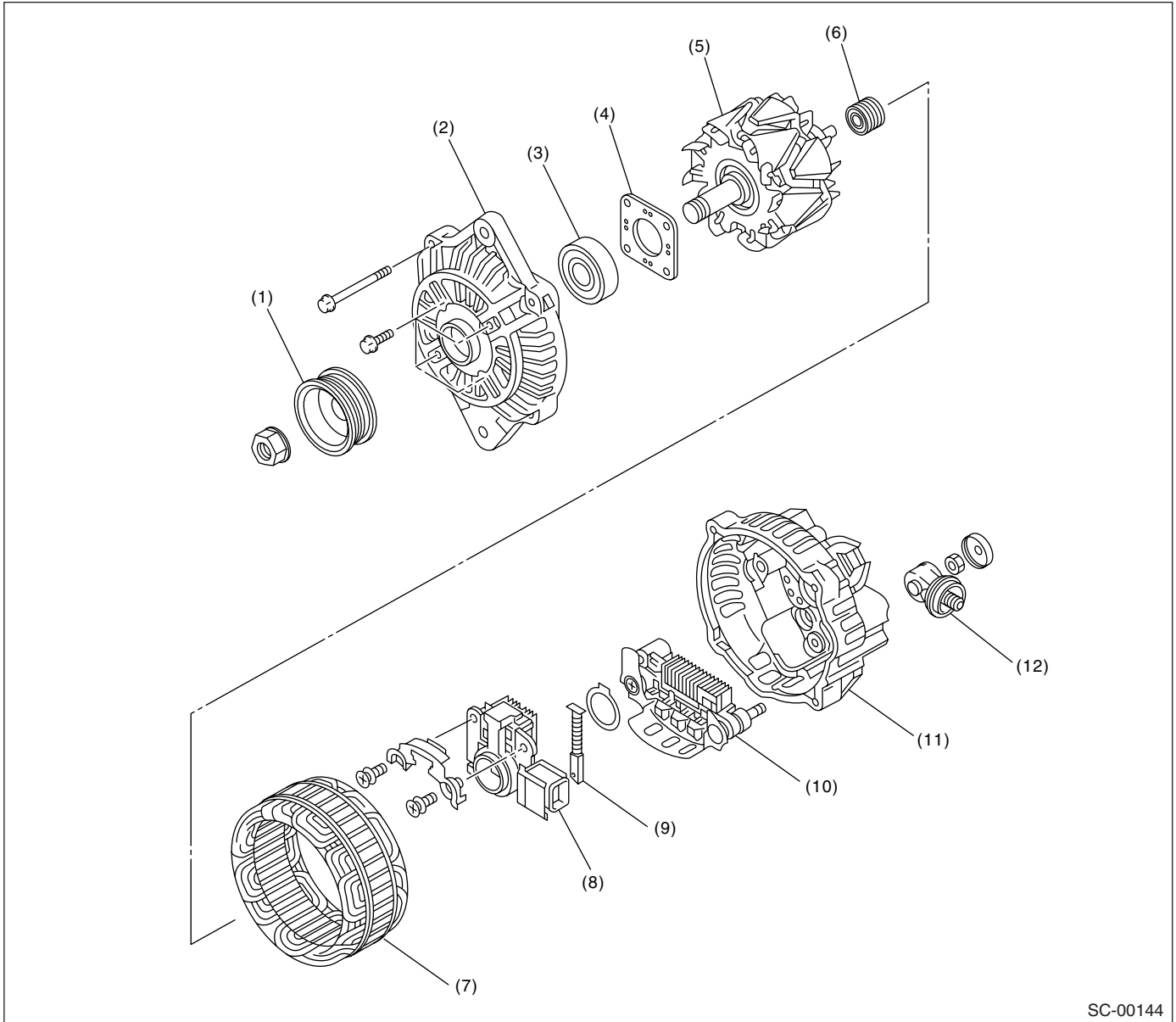
SC-00058

- | | | |
|-------------------------|------------------------|------------------------|
| (1) Front bracket | (7) Internal gear ASSY | (13) Brush holder ASSY |
| (2) Sleeve bearing | (8) Shaft ASSY | (14) Sleeve bearing |
| (3) Lever set | (9) Gear ASSY | (15) Rear cover |
| (4) Magnet switch ASSY | (10) Packing | (16) Rear cover set |
| (5) Stopper set | (11) Yoke ASSY | |
| (6) Over running clutch | (12) Armature | |

General Description

STARTING/CHARGING SYSTEM

2. GENERATOR



SC-00144

- | | | |
|----------------------|-----------------------------|-----------------|
| (1) Pulley | (5) Rotor | (9) Brush |
| (2) Front cover | (6) Bearing | (10) Rectifier |
| (3) Ball bearing | (7) Stator coil | (11) Rear cover |
| (4) Bearing retainer | (8) IC regulator with brush | (12) Terminal |

C: CAUTION

- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn yourself, because each part in the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or rigid racks at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the ground cable from battery.

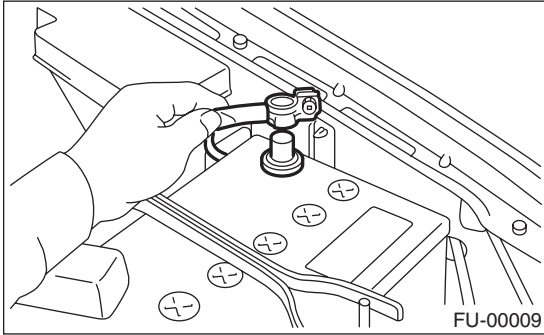
Starter

STARTING/CHARGING SYSTEM

2. Starter

A: REMOVAL

1) Disconnect the ground cable from battery.

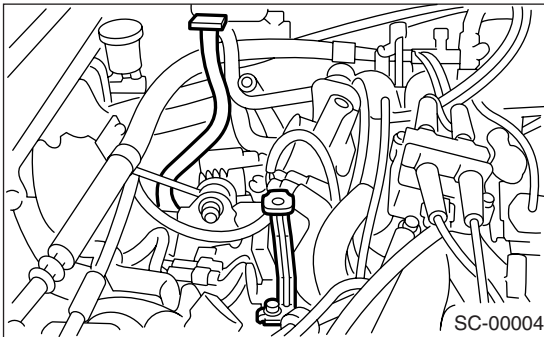


2) Remove the air cleaner case. (Non-turbo model)
<Ref. to IN(H4SO)-6, REMOVAL, Air Cleaner Case.>

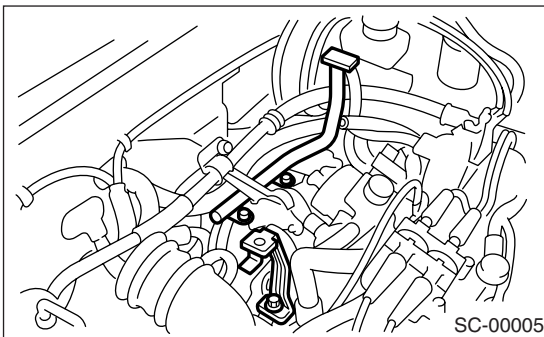
3) Remove the intercooler. (Turbo model) <Ref. to IN(H4DOTC)-10, REMOVAL, Intercooler.>

4) Remove the air cleaner case stay. (Non-turbo model)

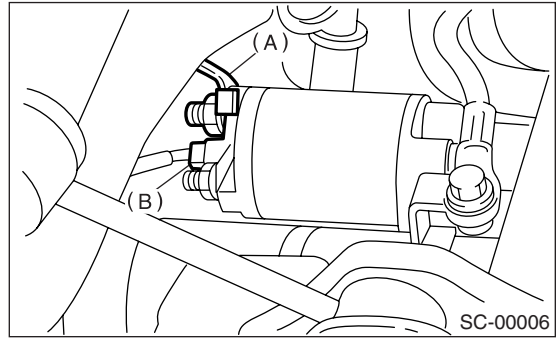
- MT model



- AT model

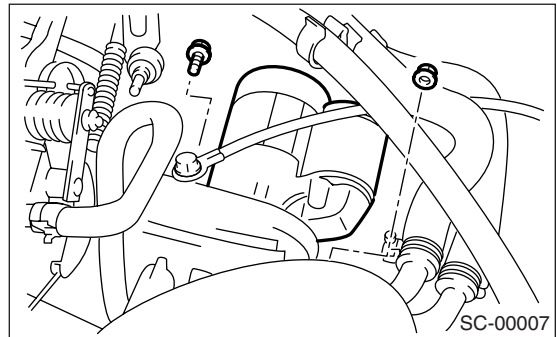


5) Disconnect the connector and terminal from starter.



- (A) Terminal
- (B) Connector

6) Remove the starter from transmission.

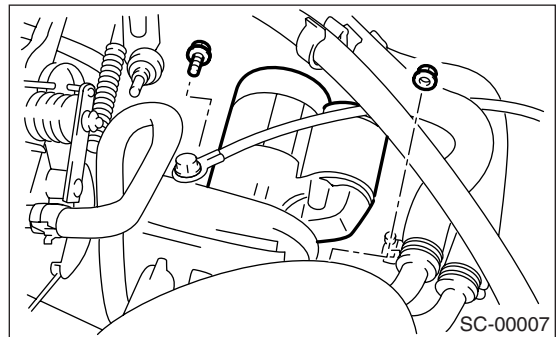


B: INSTALLATION

Install in the reverse order of removal.

Tightening torque:

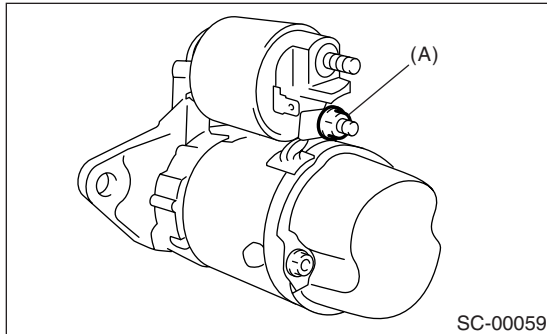
50 N·m (5.1 kgf-m, 37 ft-lb)



C: DISASSEMBLY

1. STARTER ASSEMBLY

1) Loosen the nut which holds terminal M of switch assembly, and then disconnect the connector.

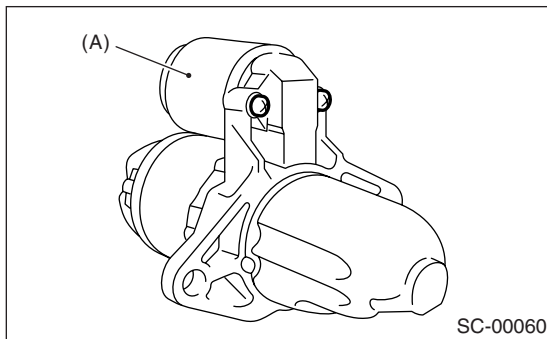


(A) Terminal M

2) Remove the bolts which hold switch assembly, and then remove the switch assembly, plunger and plunger spring from starter as a unit.

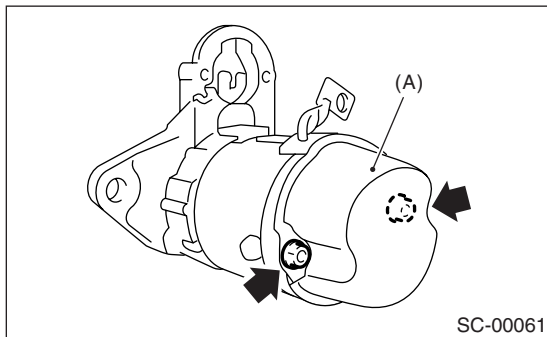
NOTE:

Be careful because the pinion gap adjustment washer may sometimes be used on the mounting surface of switch assembly.



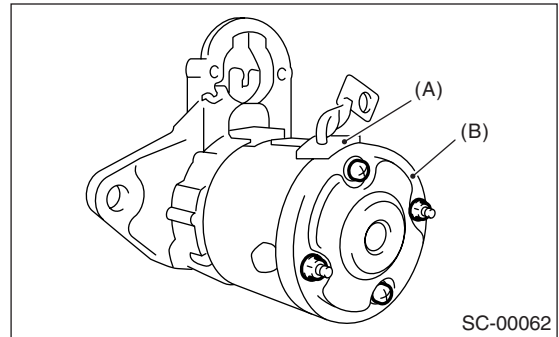
(A) Switch ASSY

3) Remove both the nuts, and then remove rear cover set.



(A) Rear cover set

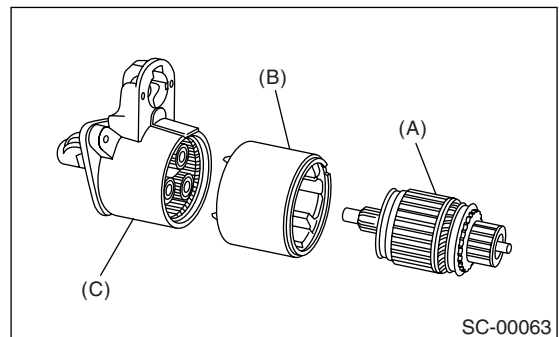
4) Remove both through-bolts and brush holder screws, and then detach the rear cover and brush holder assembly.



(A) Brush holder ASSY

(B) Rear cover

5) Remove the armature and yoke assembly from front bracket.

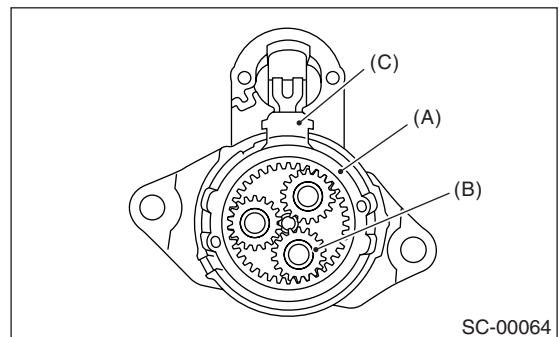


(A) Armature

(B) Yoke ASSY

(C) Front bracket

6) Remove the packing A, planetary gear and packing B.



(A) Packing A

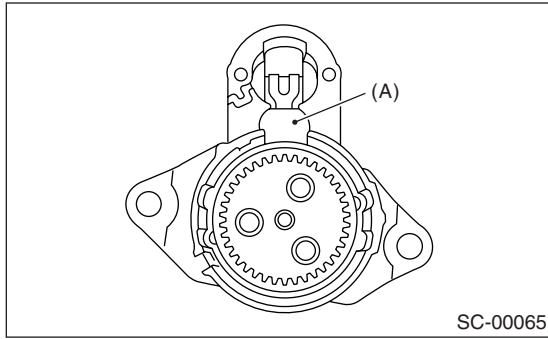
(B) Planetary gear

(C) Packing B

Starter

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7) Remove the plate.



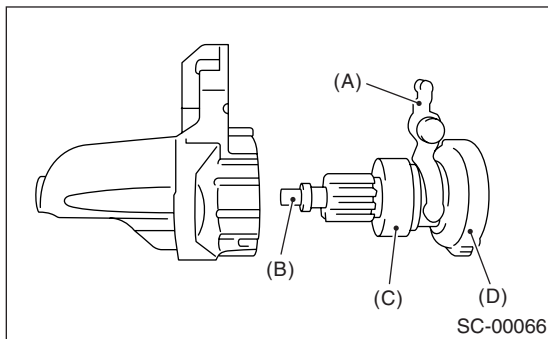
(A) Plate

8) Remove the shaft assembly and overrunning clutch from front bracket as a unit.

NOTE:

Check the following points before removal.

- Lever direction
- Position of internal gear assembly

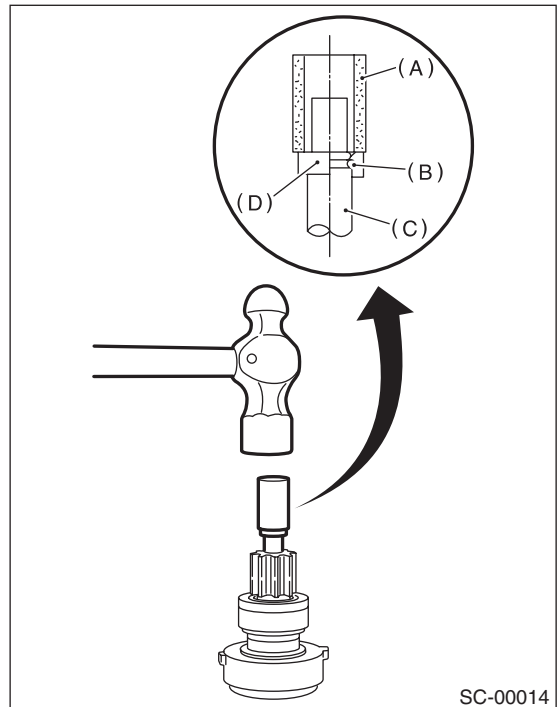


- (A) Lever
- (B) Shaft ASSY
- (C) Overrunning clutch
- (D) Internal gear ASSY

9) Remove the overrunning clutch from shaft assembly as follows:

(1) Remove the stopper from ring by lightly tapping the stopper with an appropriate tool (such as a 14 mm (0.55 in) a fit socket wrench).

(2) Remove the ring, stopper and clutch from shaft.



- (A) Socket wrench
- (B) Ring
- (C) Shaft
- (D) Stopper

D: ASSEMBLY

NOTE:

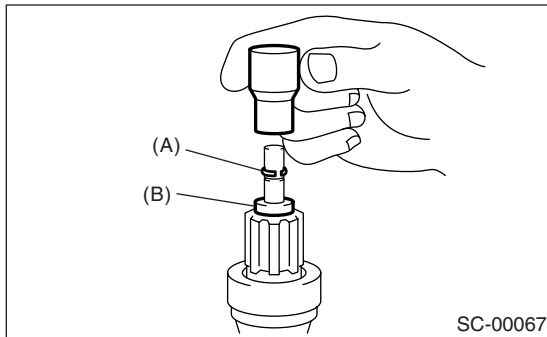
Apply grease to the following parts before assembly.

- Sleeve bearing
- Pinion shaft rotational portion
- Shaft spline portion
- Inside of reduction system
- Lever fulcrum/Clutch rotational portion

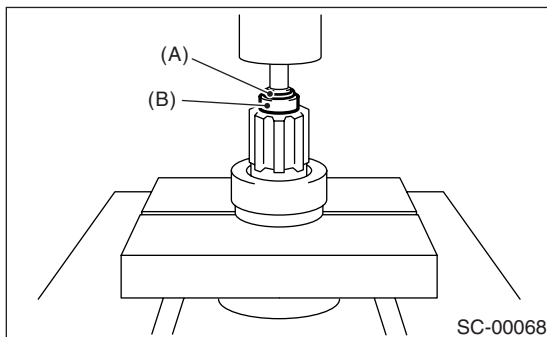
1) Install the overrunning clutch to shaft assembly.

2) Install the stopper to shaft assembly as follows.

(1) Insert the ring into the shaft groove by lightly tapping it with an appropriate tool (such as a fit socket wrench).



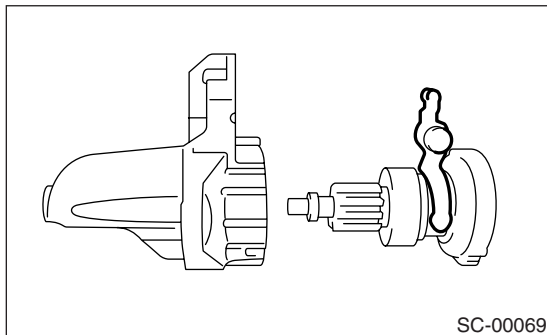
(2) Install the stopper to ring using a press.



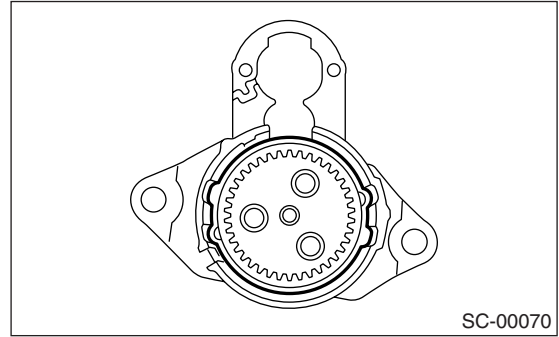
- (A) Ring
- (B) Stopper

3) Install the shaft assembly to front bracket while taking care of the following points.

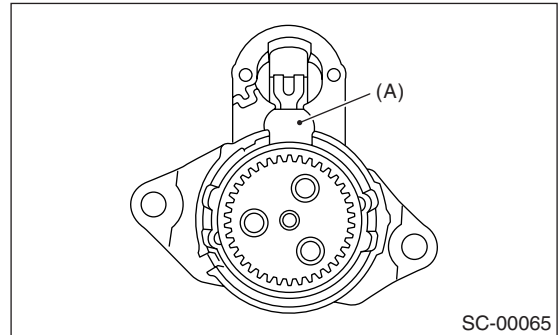
(1) Lever direction



(2) Internal gear position



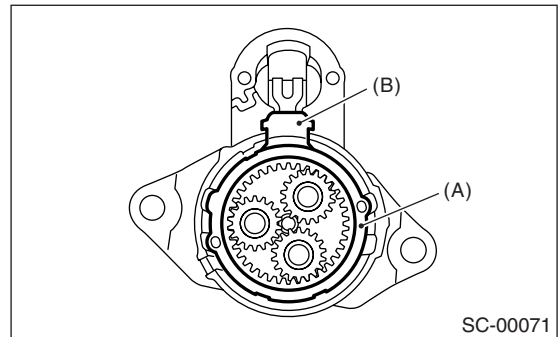
4) Install the plate.



- (A) Plate

5) Install the planetary gear.

6) Install packing A and B while taking care of installing positions.



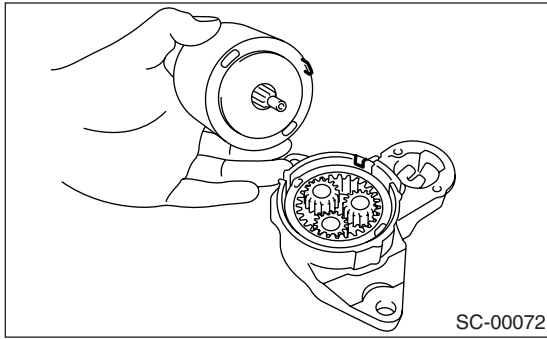
- (A) Packing A
- (B) Packing B

7) Install the armature to yoke assembly.

Starter

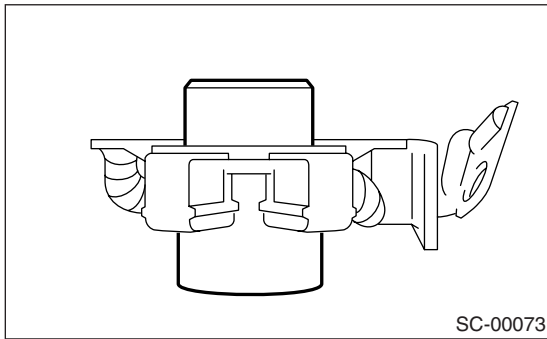
STARTING/CHARGING SYSTEM

8) Install the yoke to front bracket matching front bracket to groove of yoke assembly.

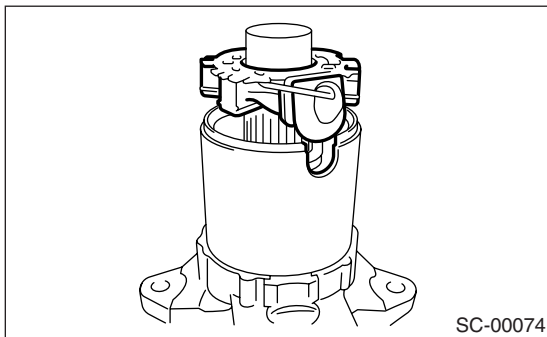


9) Install the brush holder to yoke assembly as follows.

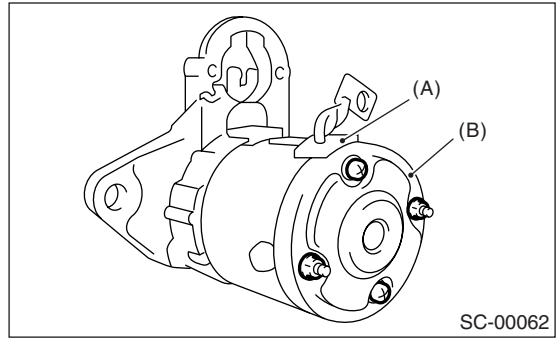
(1) Press the brush down into brush holder, and then fix the brush in that position using an appropriate tool (such as a fit socket wrench).



(2) Match the brush holder to groove of yoke, and then slide the brush holder into yoke assembly to install.

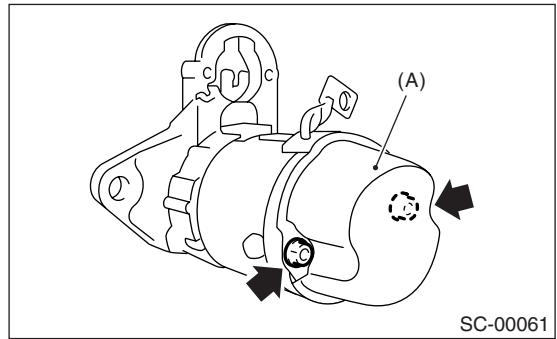


10) Install the rear cover matching its groove to brush holder assembly.



(A) Brush holder ASSY
(B) Rear cover

11) Install rear cover set.

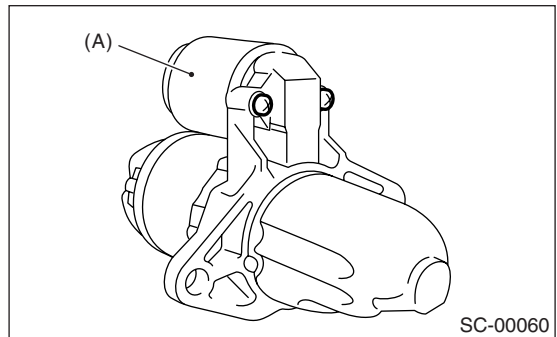


(A) Rear cover set

12) Install the switch assembly to front bracket as follows.

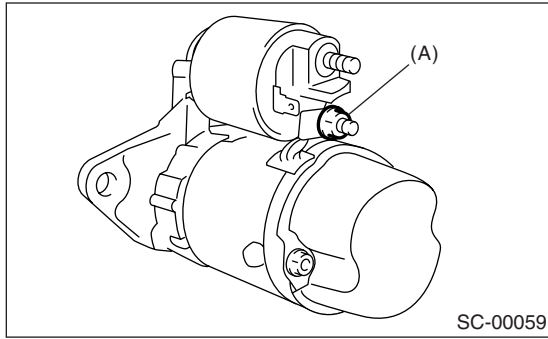
(1) Insert the plunger and plunger spring into switch assembly.

(2) Hook the plunger protrusion on lever edge to install plunger to front bracket.



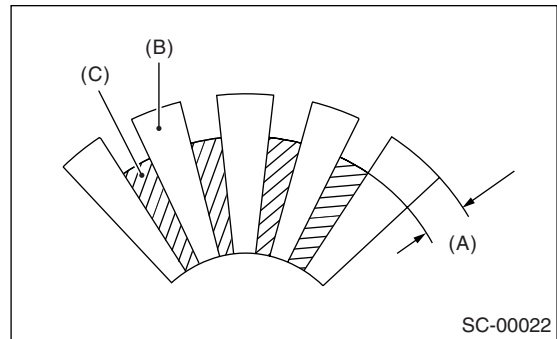
(A) Switch ASSY

13) Connect the connector to terminal M of switch assembly.



(A) Terminal M

Depth of segment mold:
0.5 mm (0.020 in)



(A) Depth of mold
(B) Segment
(C) Mold

E: INSPECTION

1. ARMATURE

1) Check the commutator for any sign of burns or rough surfaces or stepped wear. If wear is of a minor nature, correct it by using sand paper.

2) Run-out test

Check the commutator run-out, and then replace if it exceeds the limit.

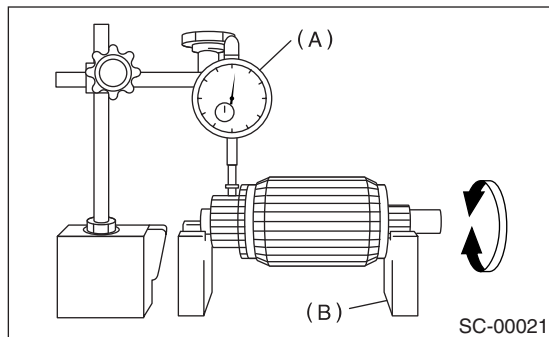
Commutator run-out:

Standard

0.05 mm (0.0020 in)

Service limit

Less than 0.10 mm (0.0039 in)

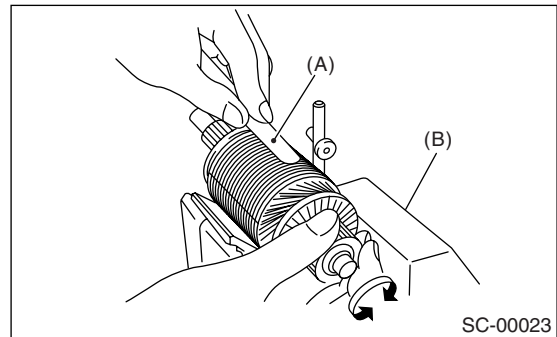


(A) Dial gauge
(B) V-block

3) Depth of segment mold
Check the depth of segment mold.

4) Armature short-circuit test

Check the armature for short-circuit by placing it on growler tester. Hold a iron sheet against the armature core while slowly rotating armature. A short-circuited armature will cause the iron sheet to vibrate and to be attracted to core. If the iron sheet is attracted or vibrates, the armature, which is short-circuited, must be replaced or repaired.

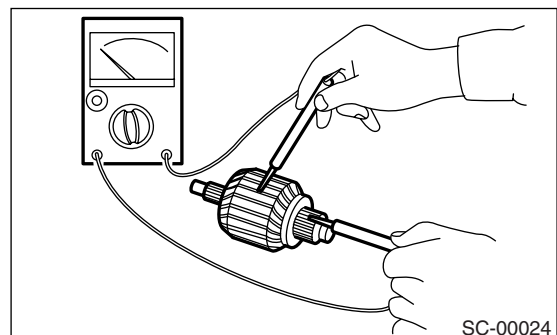


(A) Iron sheet
(B) Growler tester

5) Armature ground test

Using a circuit tester, touch one probe to the commutator segment and the other to shaft. There should be no continuity. If there is continuity, the armature is grounded.

Replace the armature if it is grounded.



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Starter

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2. YOKE

Make sure the pole is set in position.

3. OVERRUNNING CLUTCH

Inspect the teeth of pinion for wear and damage. Replace if it is damaged. Rotate the pinion in direction of rotation (counterclockwise). It should rotate smoothly. But in opposite direction, it should be locked.

CAUTION:

Do not clean the overrunning clutch with oil to prevent grease from flowing out.

4. BRUSH AND BRUSH HOLDER

1) Brush length

Measure the brush length, and then replace if it exceeds the service limit.

Replace if abnormal wear or cracks are noticed.

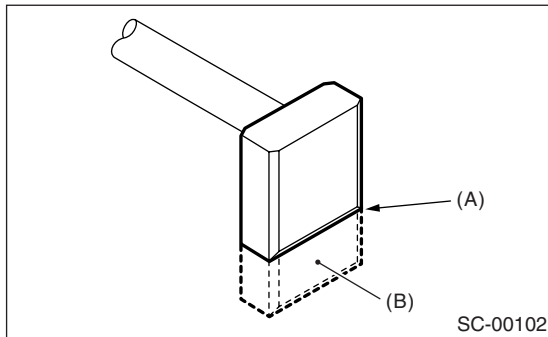
Brush length:

Standard

12.3 mm (0.484 in)

Service limit

7.0 mm (0.276 in)



(A) Service limit line

(B) Brush

2) Brush movement

Be sure the brush moves smoothly inside brush holder.

3) Brush spring force

Measure the brush spring force with a spring scale. If it is less than the service limit, replace the brush holder.

Brush spring force:

Standard

15.9 — 19.5 N (1.62 — 1.99 kgf, 3.57 — 4.38 lb) (when new)

Service limit

2.5 N (0.25 kgf, 0.56 lb)

5. SWITCH ASSEMBLY

Be sure there is continuity between the terminals S and M, and between terminal S and ground. Use a circuit tester (set in "ohm").

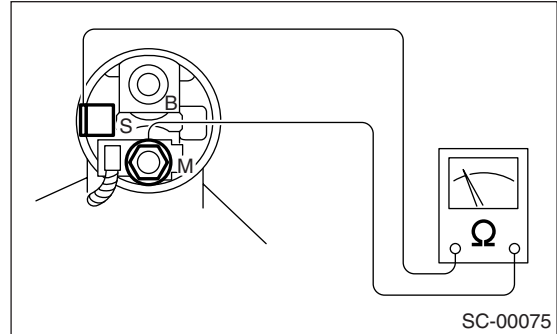
Also check to be sure there is no continuity between terminal M and B.

Terminal / Specified resistance:

S — M / Less than 1 Ω

S — Ground / Less than 1 Ω

M — B / More than 1 M Ω



6. SWITCH ASSEMBLY OPERATION

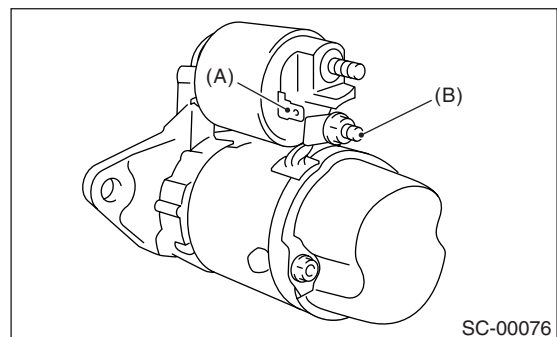
1) Connect the terminal S of switch assembly to positive terminal of battery with a lead wire, and starter body to ground terminal of battery. The pinion should be forced endwise on shaft.

CAUTION:

With the pinion forced endwise on shaft, starter motor can sometimes rotate because current flows, through pull-in coil, to motor. This is not a problem.

2) Disconnect the connector from terminal M, and then connect the positive terminal of battery and terminal M using a lead wire and ground terminal to starter body.

In this test set up, the pinion should return to its original position even when it is pulled out with a screwdriver.



(A) Terminal S

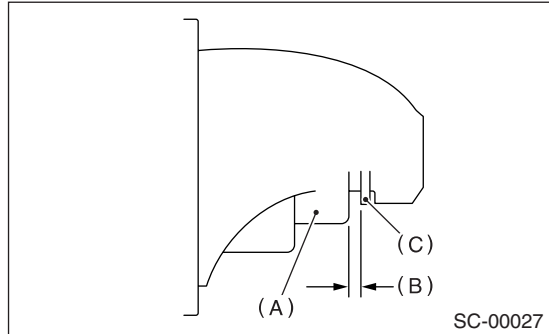
(B) Terminal M

7. PINION GAP

1) Measure the pinion gap while the pinion is pulled out as shown in the figure.

Pinion gap:

0.5 — 2.0 mm (0.020 — 0.079 in)



- (A) Pinion
- (B) Pinion gap
- (C) Stopper

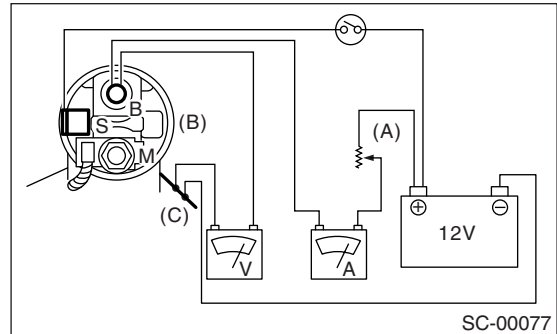
If the motor is running with the pinion forced end-wise on shaft, disconnect the connector from terminal M of switch assembly, and then connect terminal M to ground terminal (–) of battery with a lead wire. Next, gently push the pinion back with your fingertips, and then measure the pinion gap.
 2) If the pinion gap is outside specified range, remove or add number of adjustment washers used on the mounting surface of switch assembly until correct pinion gap is obtained.

8. PERFORMANCE TEST

The starter should be submitted to performance tests whenever it has been overhauled, to assure its satisfactory performance when installed on the engine.

Three performance tests, no-load test, load test, and lock test, are presented here; however, if the load test and lock test cannot be performed, carry out at least the no-load test.

For these performance tests, use the circuit shown in figure.



- (A) Variable resistance
- (B) Starter body
- (C) Magnetic switch

1) No-load test

With switch on, adjust the variable resistance to obtain 11 V, take the ammeter reading, and then measure the starter speed. Compare these values with the specifications.

No-load test (Standard):

Voltage / Current

MT model

MAX. 11 V / 95 A

AT model

MAX. 11 V / 90 A

Rotating speed

MT model

2,500 rpm or more

AT model

2,000 rpm or more

2) Load test

Apply the specified braking torque to starter. The condition is satisfactory if the current draw and starter speed are within the specifications.

Load test (Standard):

Voltage / Load

MT model

7.5 V / 8.84 N (0.90 kgf, 1.99 lb)

AT model

7.7 V / 16.7 N (1.70 kgf, 3.75 lb)

Starter

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Current / Speed

MT model

300 A / 870 rpm or more

AT model

400 A / 710 rpm or more

3) Lock test

With the starter stalled, or not rotating, measure the torque developed and current draw when the voltage is adjusted to the specified voltage.

Lock test (Standard):

Voltage / Current

MT model

4 V / 680 A or less

AT model

3.5 V / 960 A or less

Torque

MT model

17.0 N (1.73 kgf, 3.82 lb) or more

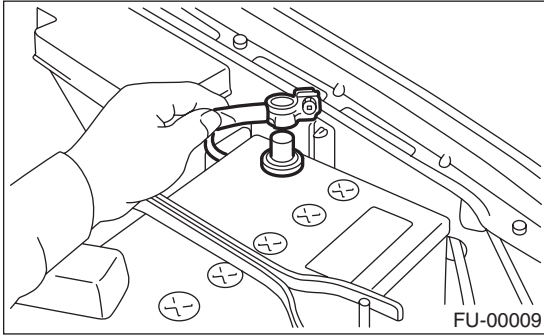
AT model

31.0 N (3.16 kgf, 6.97 lb) or more

3. Generator

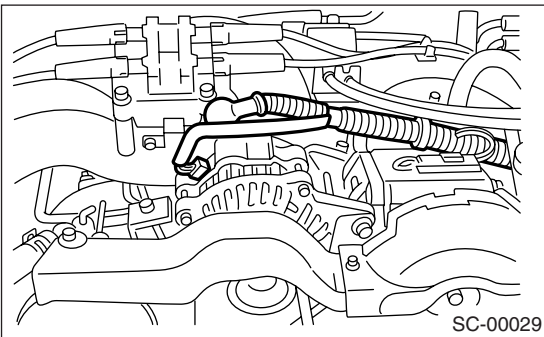
A: REMOVAL

1) Disconnect the ground cable from battery.

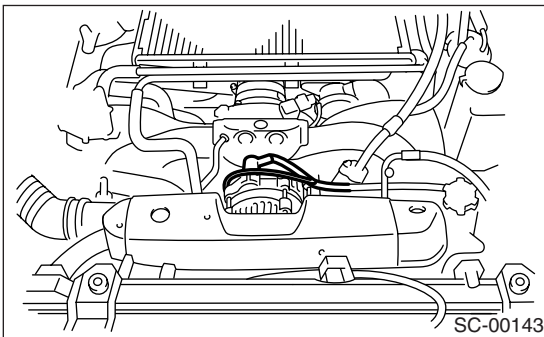


2) Disconnect the connector and terminal from generator.

- Non-turbo model

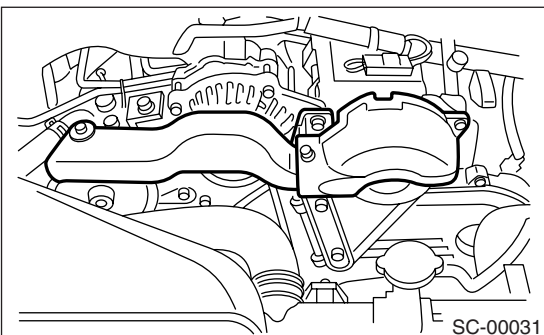


- Turbo model

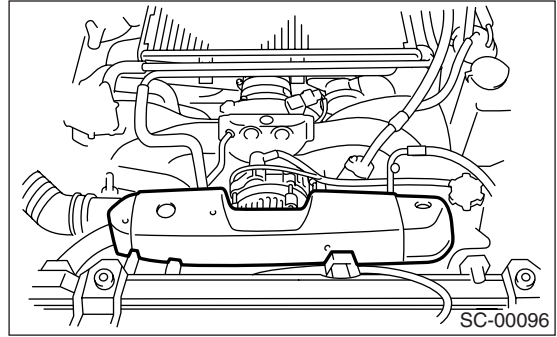


3) Remove the V-belt cover.

- Non-turbo model



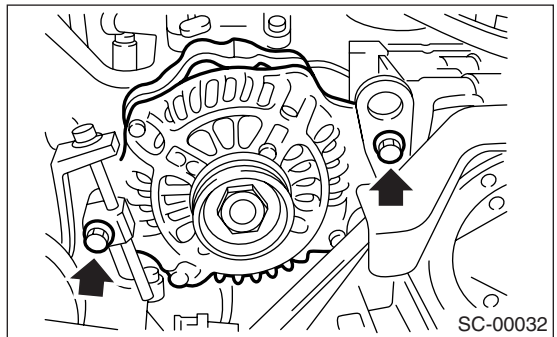
- Turbo model



4) Remove the front side V-belt.

<Ref. to ME(H4SO)-43, FRONT SIDE BELT, REMOVAL, V-belt.> or <Ref. to ME(H4DOTC)-52, FRONT SIDE BELT, REMOVAL, V-belt.>

5) Remove the bolts which install generator onto bracket.

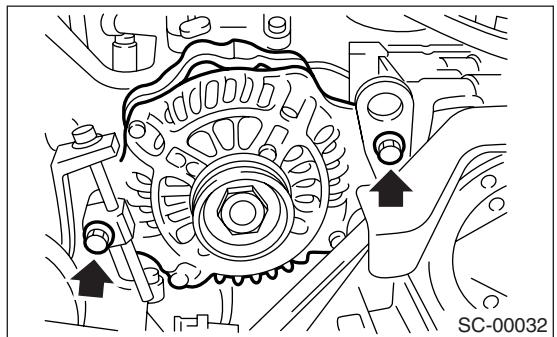


B: INSTALLATION

Install in the reverse order of removal.

CAUTION:

Check and adjust the V-belt tension. <Ref. to ME(H4SO)-44, INSPECTION, V-belt.> or <Ref. to ME(H4DOTC)-53, INSPECTION, V-belt.>

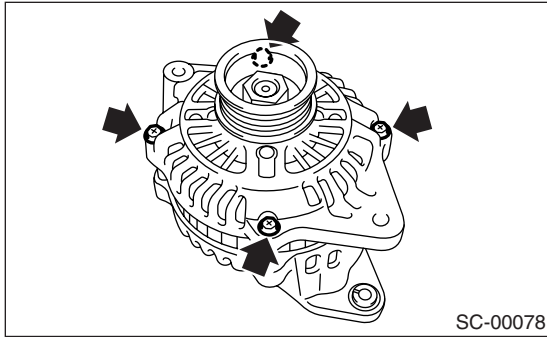


Generator

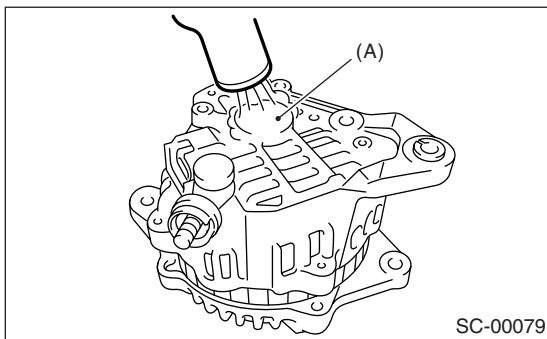
STARTING/CHARGING SYSTEM

C: DISASSEMBLY

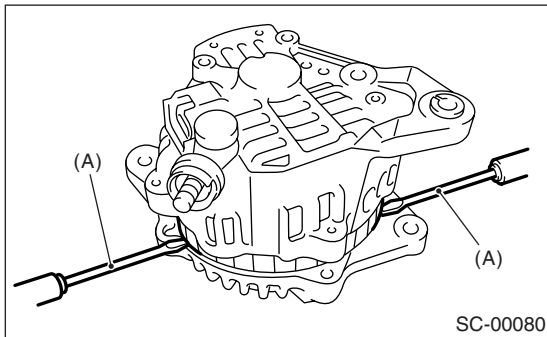
1) Remove the four through-bolts.



2) Heat the portion (A) of rear cover to 50°C (122°F) with heater drier.

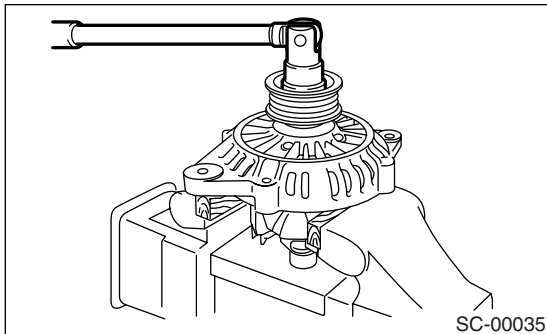


3) Then insert the tip of a flat tip screwdriver into the gap between stator core and front cover. Pry them apart to disassemble.



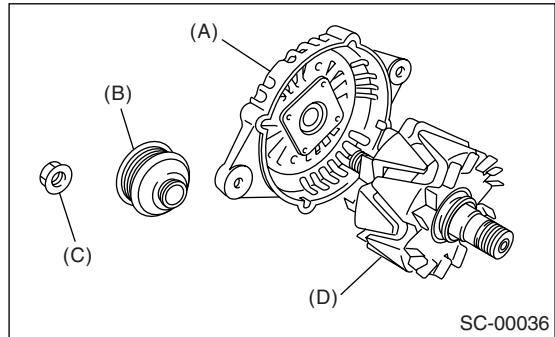
(A) Screwdriver

4) Hold the rotor with a vise and remove pulley nut.



CAUTION:

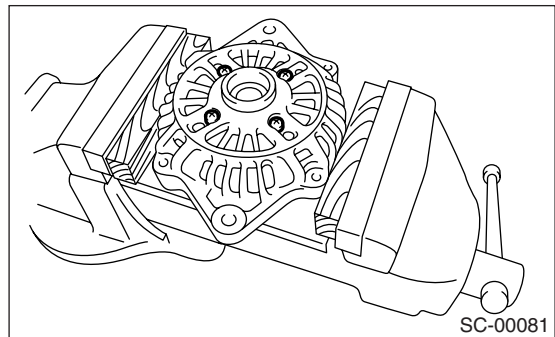
When holding the rotor with vise, insert aluminum plates or wood pieces on the contact surfaces of vise to prevent rotor from damage.



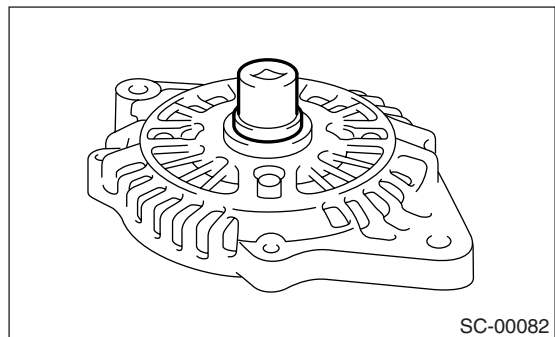
(A) Front cover
(B) Pulley
(C) Nut
(D) Rotor

5) Remove the ball bearing as follows.

(1) Remove the bolt, and then remove the bearing retainer.



(2) Firmly install an appropriate tool (such as a fit socket wrench) to bearing inner race.

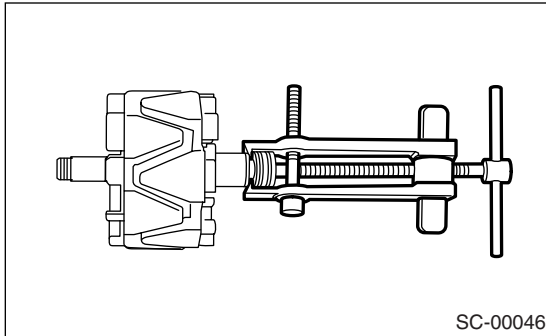


(3) Push the ball bearing off the front cover using a press.

Generator

STARTING/CHARGING SYSTEM

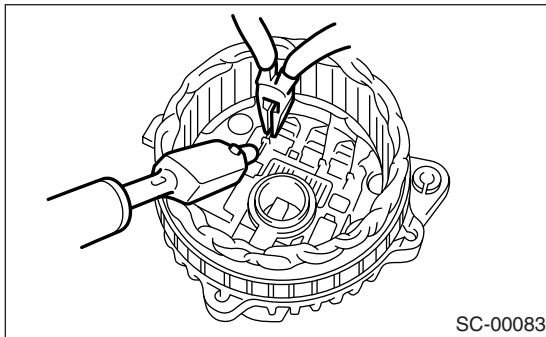
6) Remove the bearing from rotor using a bearing puller.



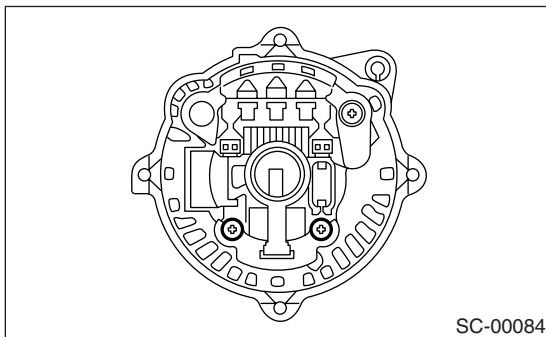
7) Unsolder connection between rectifier and stator coil to remove the stator coil.

CAUTION:

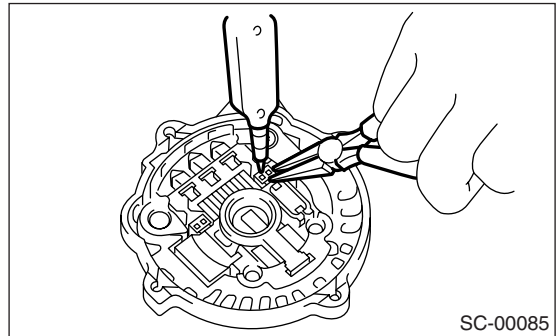
Do not allow the 180 — 270 W soldering bit to contact the terminals for more than 5 seconds at a time because the rectifier cannot withstand heat very well.



8) Remove the IC regulator as follows.
(1) Remove the screws which secure IC regulator to rear cover.

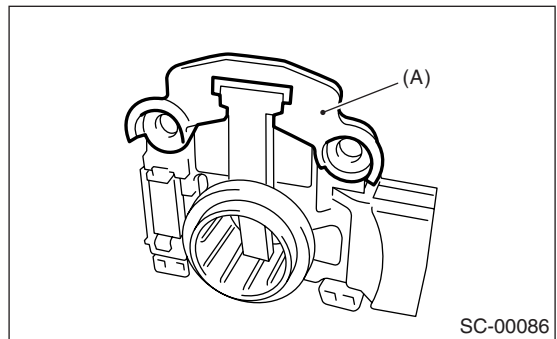


(2) Unsolder the connection between IC regulator and rectifier to remove the IC regulator.



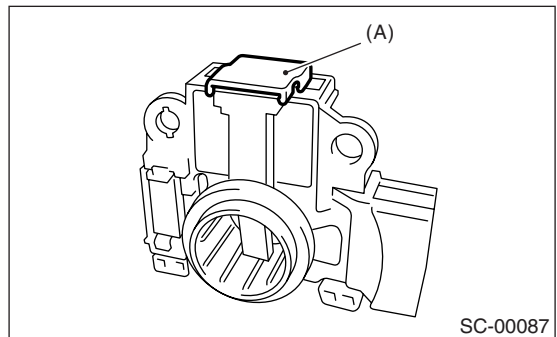
9) Remove the brush as follows.

(1) Remove cover A.



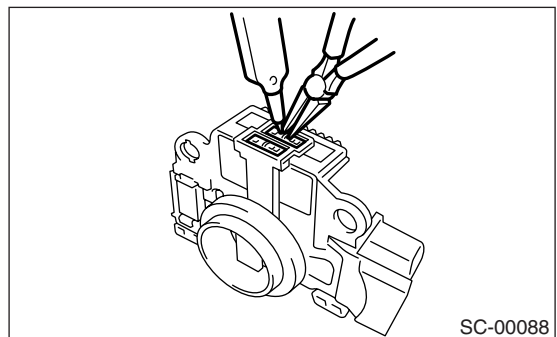
(A) Cover A

(2) Remove the cover B.



(A) Cover B

(3) Separate the brush from connection to remove.

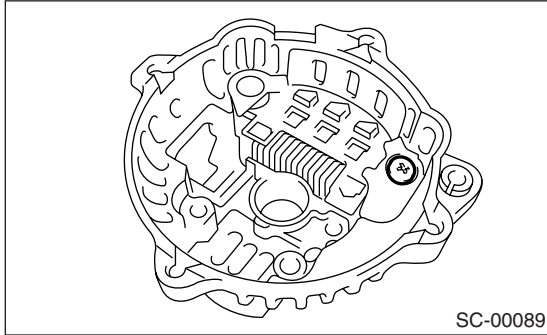


Generator

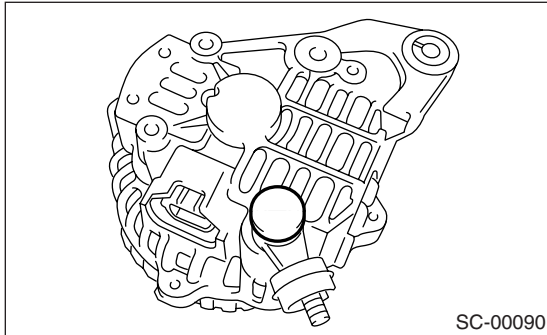
STARTING/CHARGING SYSTEM

10) Remove the rectifier as follows.

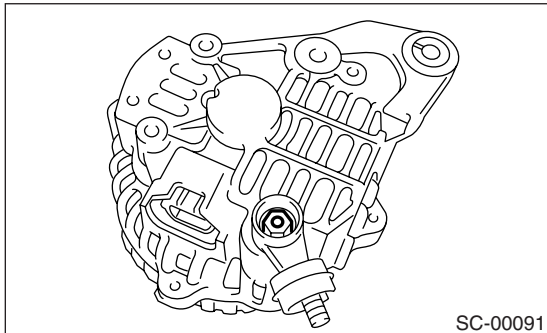
(1) Remove the bolts which secure the rectifier.



(2) Remove the cover of terminal B.



(3) Remove the nut of terminal B, and then remove the rectifier.



D: ASSEMBLY

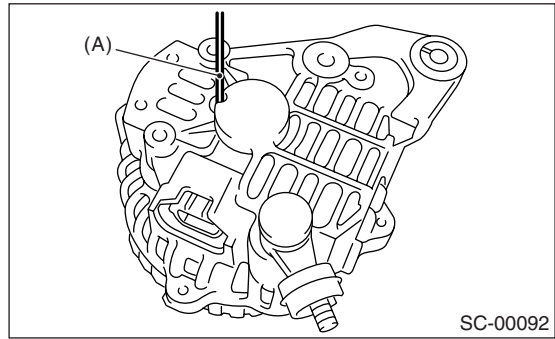
To assemble, reverse order of disassembly.

1) Pulling up brush

Before assembling, press the brush down into brush holder, and then fix them in that position by passing a [1 mm (0.08 in) dia. length 4 to 5 cm (1.6 to 2.0 in)] wire through the hole shown in the figure.

CAUTION:

Be sure to remove the wire after reassembly.



(A) Wire

2) Install the ball bearing.

(1) Set the ball bearing on the front cover, and then securely install an appropriate tool (such as a fit socket wrench) to the bearing outer race.

(2) Press the ball bearing into the specified position using a press.

(3) Install the bearing retainer.

3) Press the bearing (rear side) into the rotor shaft using a press to install.

4) Heat the bearing box in rear cover [50 to 60°C (122 to 140°F)], and then press the rear bearing into rear cover.

CAUTION:

Grease should not be applied to rear bearing. Remove the oil completely if it is found on bearing box.

5) After reassembly, turn the pulley by hand to check that rotor turns smoothly.

E: INSPECTION

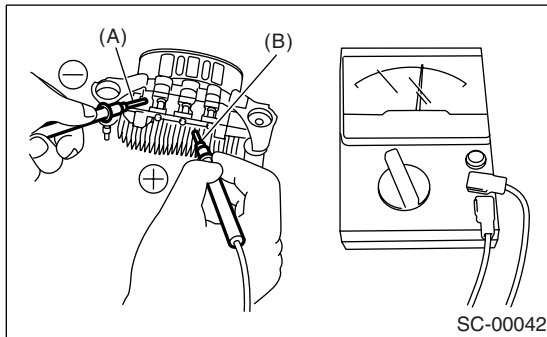
1. DIODE

CAUTION:

Never use a mega tester (measuring use for high voltage) or any other similar measure for this test; otherwise, the diodes may be damaged.

1) Checking positive diode

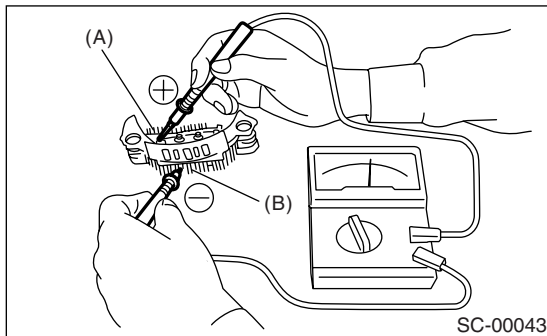
Check for continuity between the diode lead and positive side heat sink. The positive diode is in good condition if resistance is 1Ω or less only in the direction from the diode lead to heat sink.



- (A) Diode lead
- (B) Heat sink (Positive side)

2) Checking negative diode

Check for continuity between the negative side heat sink and diode lead. The negative diode is in good condition if resistance is 1Ω or less only in the direction from the heat sink to diode lead.



- (A) Diode lead
- (B) Heat sink (Negative side)

2. ROTOR

1) Slip ring surface

Inspect the slip rings for contamination or any roughness of the sliding surface. Repair the slip ring surface using a lathe or sand paper.

2) Slip ring outer diameter

Measure the slip ring outer diameter. If the slip ring is worn replace rotor assembly.

Slip ring outer diameter:

Standard

22.7 mm (0.894 in)

Limit

22.1 mm (0.870 in)

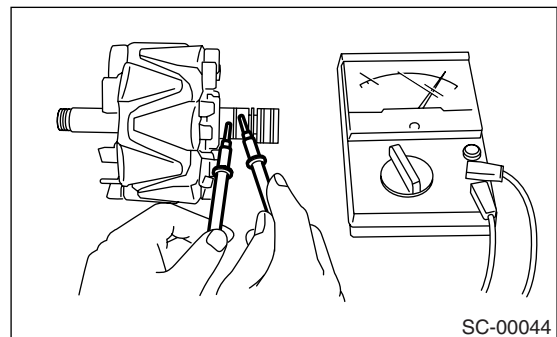
3) Continuity test

Check the resistance between slip rings using circuit tester.

If the resistance is not within specification, replace the rotor assembly.

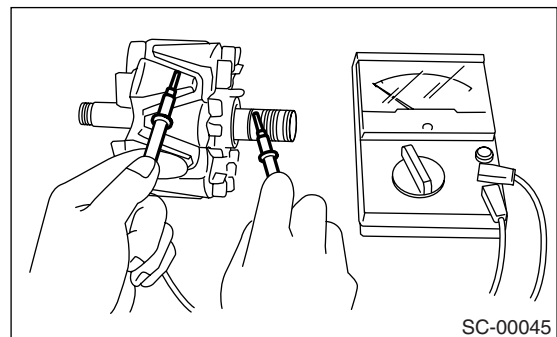
Specified resistance:

Approx. 1.8 — 2.2 Ω



4) Insulation test

Check the continuity between slip ring and rotor core or shaft. If resistance is 1Ω or less, the rotor coil is grounded, and so replace the rotor assembly.



5) Ball bearing (rear side)

Check the rear ball bearing. Replace if it is noisy or if the rotor does not turn smoothly.

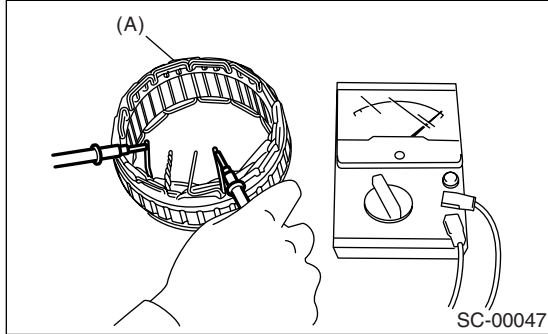
Generator

STARTING/CHARGING SYSTEM

3. STARTOR

1) Continuity test

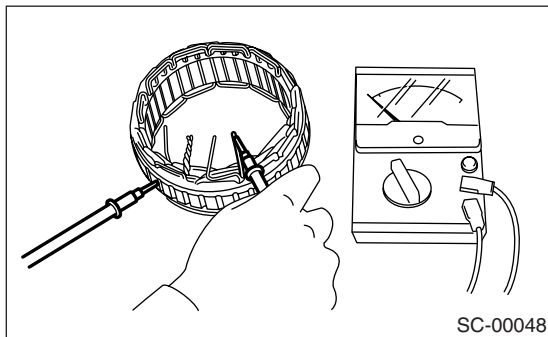
Inspect the stator coil for continuity between each end of the lead wires. If resistance is 1 M Ω or more, the lead wire is broken, and so replace the stator assembly.



(A) Stator

2) Insulation test

Inspect the stator coil for continuity between stator core and each end of lead wire. If resistance is 1 Ω or less, the stator coil is grounded, and so replace the stator assembly.



4. BRUSH

1) Measure the length of each brush. If wear exceeds the service limit, replace the brush. Each brush has the service limit mark (A) on it.

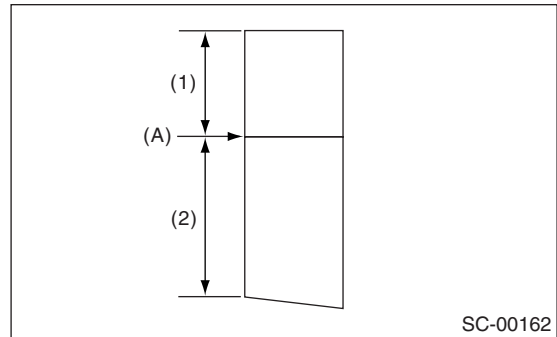
Brush length:

Service limit (1)

5.0 mm (0.197 in)

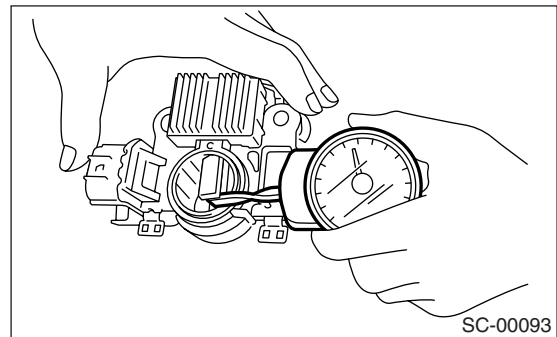
Standard (2)

18.5 mm (0.728 in)



2) Checking brush spring for proper pressure

Using a spring pressure indicator, push the brush into the brush holder until its tip protrudes 2 mm (0.08 in). Then measure the pressure of brush spring. If the pressure is less than 2.2 N (224 g, 7.91 oz), replace the brush spring with a new one. The new spring must have a pressure of 4.8 to 6.0 N (489 to 612 g, 17.26 to 21.60 oz).



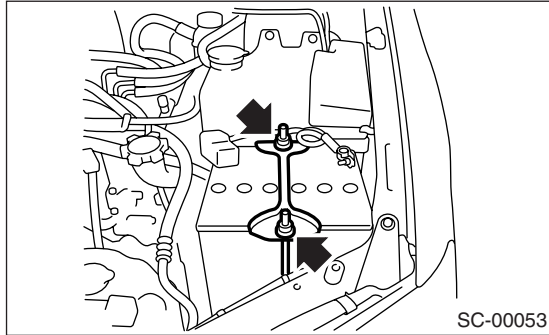
5. BEARING (FRONT SIDE)

Check the front ball bearing. If the resistance is felt while rotating, or if abnormal noise is heard, replace the ball bearing.

4. Battery

A: REMOVAL

- 1) Disconnect the positive (+) cable after disconnecting the ground (-) cable of battery.
- 2) Remove the flange nuts from battery rods, and then take off the battery holder.



- 3) Remove the battery.

B: INSTALLATION

Install in the reverse order of removal.

Tightening torque:

3.4 N·m (0.35 kgf·m, 2.5 ft·lb)

NOTE:

- Clean the battery cable terminals, and then apply grease to retard formation of corrosion.
- Connect the positive (+) cable of battery and then the ground (-) cable of battery.

C: INSPECTION

WARNING:

- Electrolyte has toxicity; be careful handling the fluid.
- Avoid contact with skin, eyes or clothing. Especially at contact with eyes, blush with water for 15 minutes and get prompt medical attention.
- Batteries produce explosive gasses. Keep sparks, flame, cigarettes away.
- Ventilate when charging or using in enclosed space.
- For safety, in case an explosion does occur, wear eye protection or shield your eyes when working near any battery. Never lean over a battery.
- Do not let the battery fluid contact eyes, skin, fabrics, or paint-work because battery fluid is corrosive acid.
- To lessen the risk of sparks, remove rings, metal watch-bands, and other metal jewelry. Never allow metal tools to contact the positive battery terminal and anything connected to it while you are at the same time in contact with any other metallic portion of the vehicle because a short circuit will be caused.

1. EXTERNAL PARTS:

Check for the existence of dirt or cracks on battery case, top cover, vent plugs, and terminal posts. If necessary, clean with water and wipe with a dry cloth.

Apply a thin coat of grease on the terminal posts to prevent corrosion.

2. ELECTROLYTE LEVEL:

Check the electrolyte level in each cell. If the level is below MIN LEVEL, bring the level to MAX LEVEL by pouring distilled water into the battery cell. Do not fill beyond MAX LEVEL.

3. SPECIFIC GRAVITY OF ELECTROLYTE:

- 1) Measure the specific gravity of electrolyte using a hydrometer and a thermometer.

Specific gravity varies with temperature of electrolyte so that it must be corrected at 20°C (68°F) using the following equation:

$$S_{20} = St + 0.0007 \times (t - 20)$$

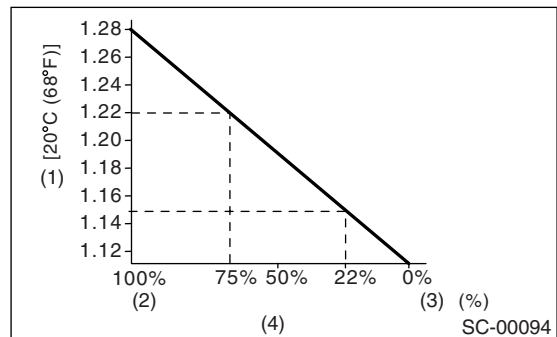
S₂₀: Specific gravity corrected at electrolyte temperature of 20°C

St: Measured specific gravity

t: Measured temperature (°C)

Determine whether or not battery must be charged, according to corrected specific gravity.

Standard specific gravity: 1.220 — 1.290 [at 20°C (68°F)]



- (1) Specific gravity
- (2) Complete charge
- (3) Charging condition
- (4) Specific gravity and state of charge

- 2) Measuring the specific gravity of the electrolyte in battery will disclose the state of charge of battery. The relation between specific gravity and state of charge is as shown in the figure.

Battery

STARTING/CHARGING SYSTEM

D: MEASUREMENT

WARNING:

- Do not bring an open flame close to the battery at this time.

CAUTION:

- Prior to charging, corroded terminals should be cleaned with a brush and common baking soda solution.
- Be careful since the battery electrolyte overflows while charging the battery.
- Observe the instructions when handling battery charger.
- Before charging the battery on vehicle, disconnect battery ground terminal. Failure to follow this rule may damage alternator's diodes or other electrical units.

CAUTION:

- Observe the items in 3. NORMAL CHARGING.
- Never use more than 10 amperes when charging the battery because that will shorten battery life.

1. JUDGMENT OF BATTERY IN CHARGED CONDITION

1) Specific gravity of electrolyte is held at a specific value in a range from 1.250 to 1.290 for more than one hour.

2) Voltage per battery cell is held at a specific value in a range from 2.5 to 2.8 volts for more than one hour.

2. CHECK HYDROMETER FOR STATE OF CHARGE

Hydrometer indicator	State of charge	Required action
Green dot	Above 65%	Load test
Dark dot	Below 65%	Charge battery
Clear dot	Low electrolyte	Replace battery* (If cranking complaint)

*: Check electrical system before replacement.

3. NORMAL CHARGING

Charge the battery at current value specified by manufacturer or at approx. 1/10 of battery's ampere-hour rating.

4. QUICK CHARGING

Quick charging is a method in which the battery is charged in a short period of time with a relatively large current by using a quick charger.

Since a large current flow raises electrolyte temperature, the battery is subject to damage if large current is used for prolonged time. For this reason, the quick charging must be carried out within a current range that will not increase the electrolyte temperature above 40°C (104°F).

It should be also remembered that the quick charging is a temporary means to bring battery voltage up to a fair value and, as a rule, a battery should be charged slowly with a low current.