

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 SYSTEMS)	FU(H4SO 2.0)
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)	EC(H4SO 2.0)
INTAKE (INDUCTION)	IN(H4SO 2.0)
MECHANICAL	ME(H4SO 2.0)
EXHAUST	EX(H4SO 2.0)
COOLING	CO(H4SO 2.0)
LUBRICATION	LU(H4SO 2.0)
SPEED CONTROL SYSTEMS	SP(H4SO 2.0)
IGNITION	IG(H4SO 2.0)
STARTING/CHARGING SYSTEMS	SC(H4SO 2.0)
ENGINE (DIAGNOSTICS)	EN(H4SO 2.0) (diag)
FUEL INJECTION (FUEL SYSTEMS)	FU(H4SO 2.5)
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)	EC(H4SO 2.5)
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ENGINE SECTION 1

LUBRICATION

LU(H4SO 2.5)

SPEED CONTROL SYSTEMS

SP(H4SO 2.5)

IGNITION

IG(H4SO 2.5)

STARTING/CHARGING SYSTEMS

SC(H4SO 2.5)

ENGINE (DIAGNOSTICS)

EN(H4SO 2.5)
(diag)

STARTING/CHARGING SYSTEMS

SC(H4SO 2.0)

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General Description

STARTING/CHARGING SYSTEMS

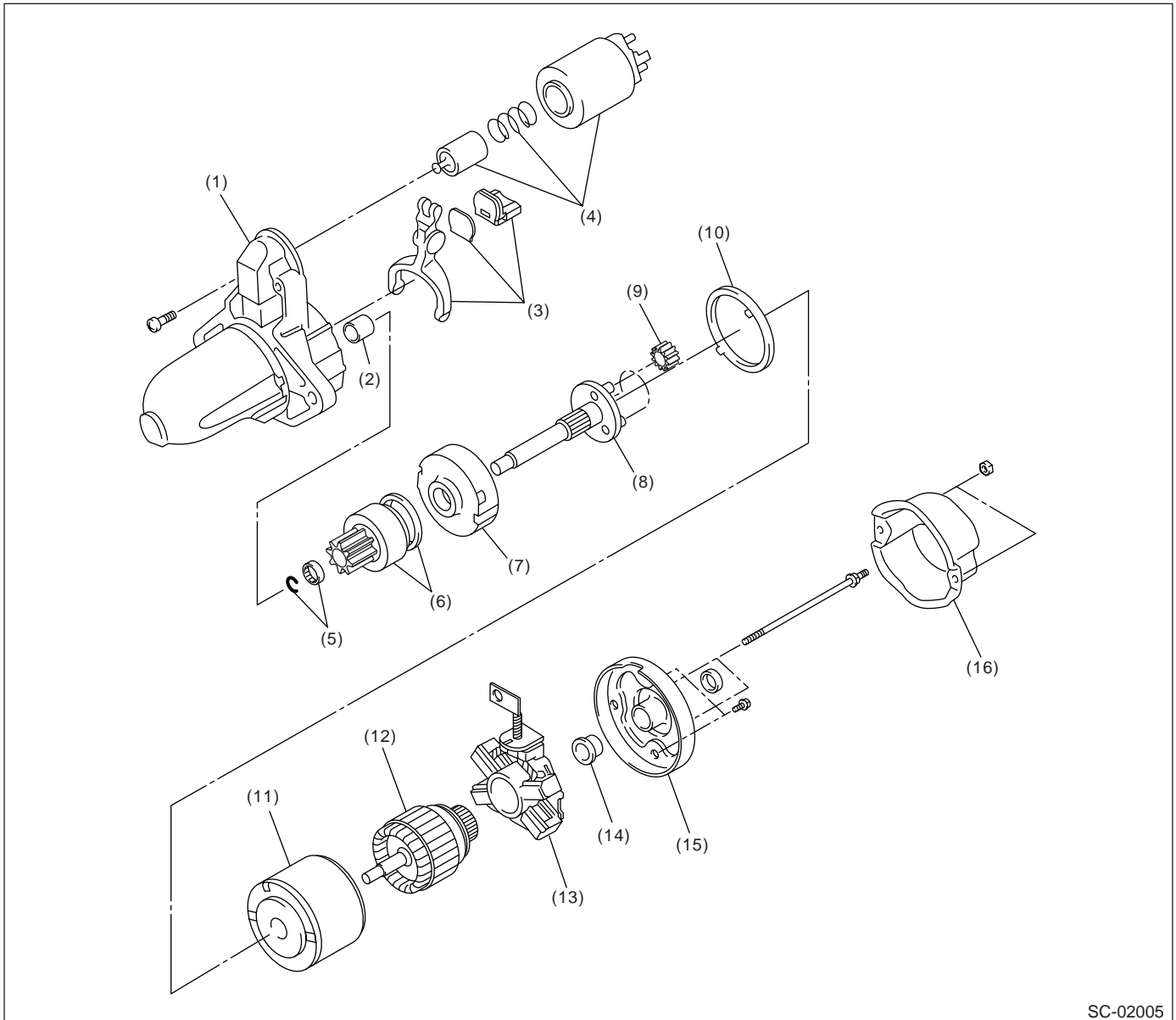
1. General Description

A: SPECIFICATION

Item		Specification		
Vehicle model		MT	AT	
Starter	Type	Reduction type		
	Model	M000T30471	M000T20171	
	Manufacturer	Mitsubishi Electric		
	Voltage and output	12 V — 1.0 kW	12 V — 1.4 kW	
	Revolving direction	Counterclockwise (when observed from pinion)		
	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·m (0.90 kgf-m, 6.5 ft-lb) or more	16.7 N·m (1.70 kgf-m, 12.3 ft-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·m (1.73 kgf-m, 12.5 ft-lb) or more	31 N·m (3.16 kgf-m, 22.9 ft-lb) or more	
Generator	Model	Rotating-field three-phase type, voltage regulator built-in type, with load response control system		
	Model	A3TG0491		
	Manufacturer	Mitsubishi Electric		
	Voltage and output	12 V — 110 A		
	Polarity on ground side	Negative		
	Revolving direction	Clockwise (when observed from pulley side)		
	Armature connection	3-phase Y-type		
	Output current	1,500 rpm — 50 A or more 2,500 rpm — 91 A or more 5,000 rpm — 105 A or more		
	Regulated voltage	14.1 — 14.8 V [20°C (68°F)]		
Battery	Type and capacity	EC, EK, K4 model	12 V — 48 AH (55D23L) 12 V — 52 AH (65D23L) 12 V — 52 AH (75D23L)	
		KS, KA model	12 V — 27 AH (34B19L) 12 V — 48 AH (55D23L)	

B: COMPONENT

1. STARTER



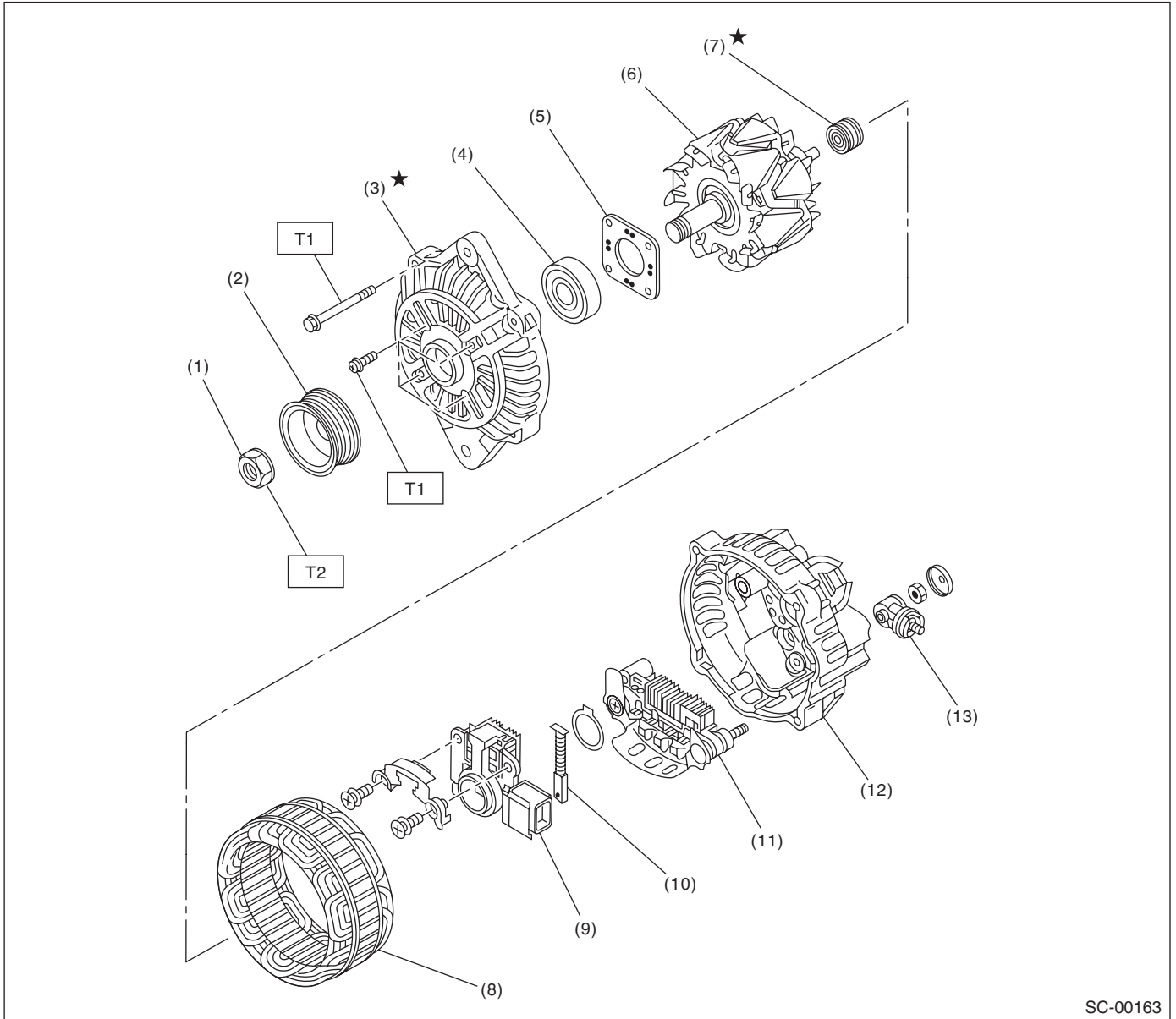
SC-02005

- | | | |
|------------------------|------------------------|------------------------|
| (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) Overrunning clutch | (12) Armature | |

General Description

STARTING/CHARGING SYSTEMS

2. GENERATOR



SC-00163

- | | | |
|----------------------|-----------------------------|---------------|
| (1) Pulley nut | (7) Bearing | (13) Terminal |
| (2) Pulley | (8) Stator coil | |
| (3) Front cover | (9) IC regulator with brush | |
| (4) Ball bearing | (10) Brush | |
| (5) Bearing retainer | (11) Rectifier | |
| (6) Rotor | (12) Rear cover | |

Tightening torque: N·m (kgf·m, ft·lb)

T1: 4.7 (0.48, 3.5)

T2: 108 (11.0, 80)

C: CAUTION

- Wear work 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 and 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 on 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.

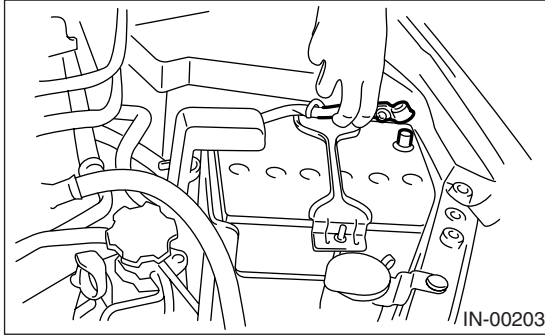
Starter

STARTING/CHARGING SYSTEMS

2. Starter

A: REMOVAL

1) Disconnect the ground cable from battery.

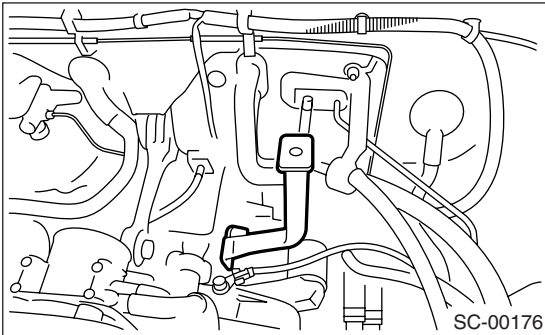


2) Remove the air intake chamber. (Non-turbo model) <Ref. to IN(H4SO 2.0)-8, REMOVAL, Air Intake Chamber.>

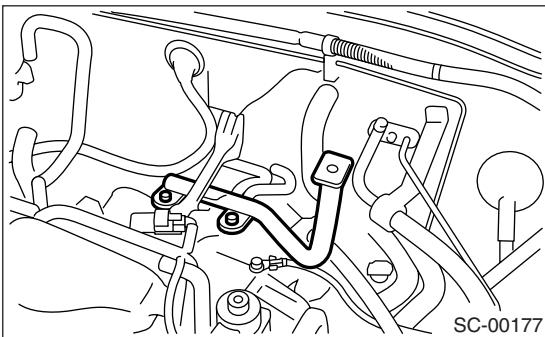
3) Remove the intercooler. (Turbo model) <Ref. to IN(H4DOTC)-12, REMOVAL, Intercooler.>

4) Remove the air intake chamber stay LH. (Non-turbo model).

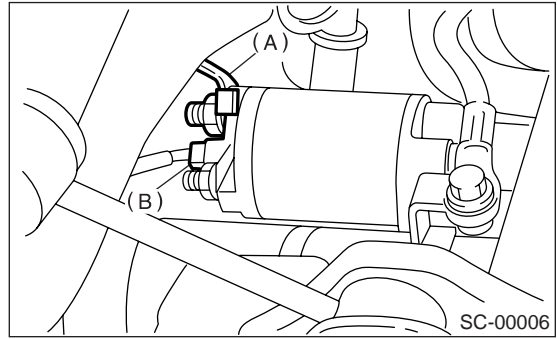
- MT model



- AT model



5) Disconnect the connector and terminal from starter.

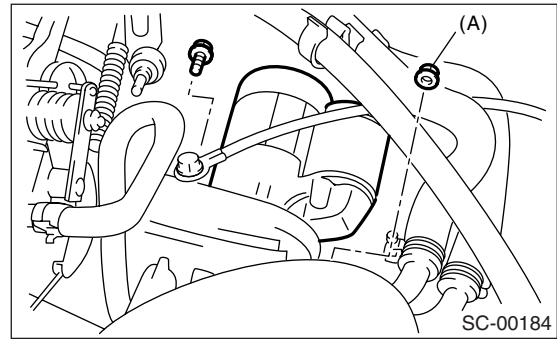


- (A) Terminals
- (B) Connector

6) Remove the starter from transmission.

NOTE:

In case of MT model, the bolt is used in place of nut (A) shown in the figure.



B: INSTALLATION

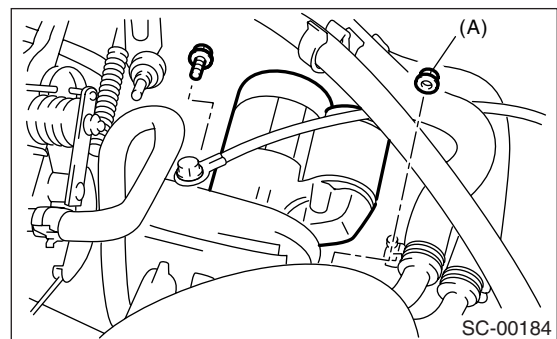
Install in the reverse order of removal.

NOTE:

In case of MT model, the bolt is used in place of nut (A) shown in the figure.

Tightening torque:

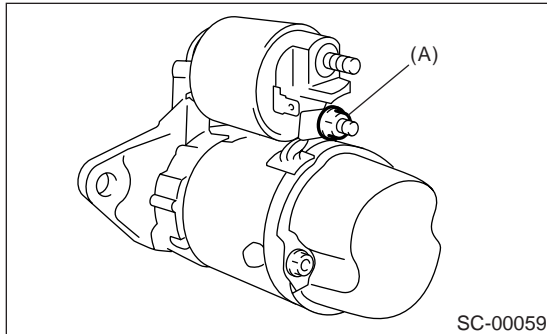
50 N·m (5.1 kgf-m, 37 ft-lb)



C: DISASSEMBLY

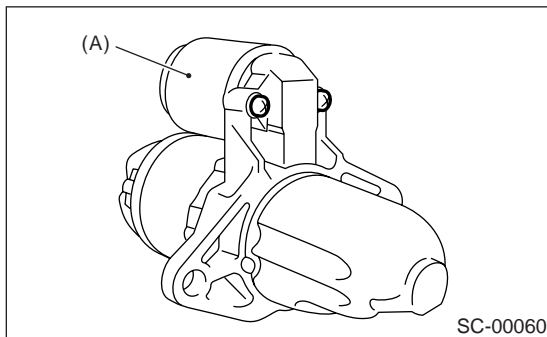
1. STARTER ASSEMBLY

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



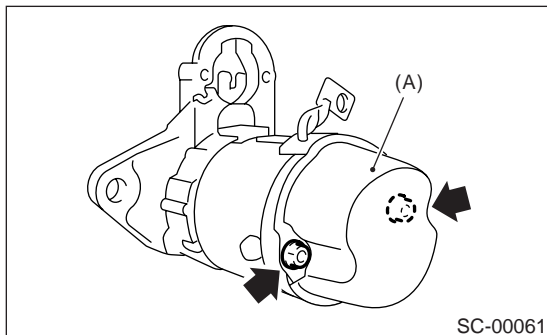
(A) Terminal M

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



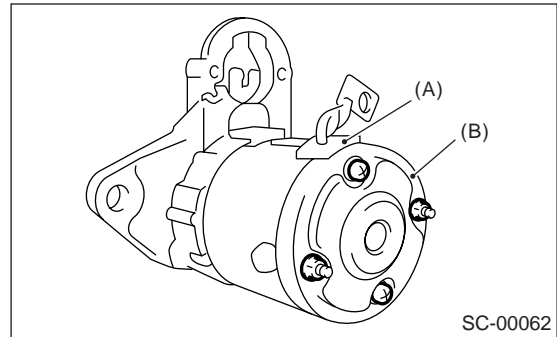
(A) Switch ASSY

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



(A) Rear cover set

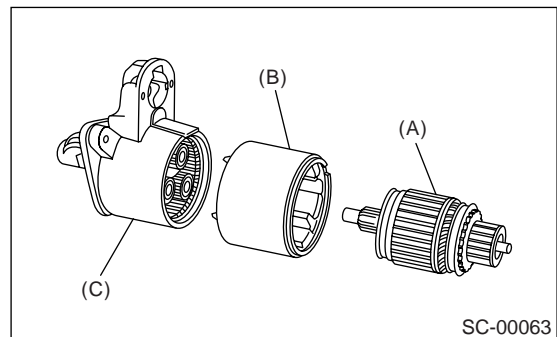
4) Remove the through-bolts and brush holder screws of both sides, and then detach the rear cover and brush holder assembly.



(A) Brush holder ASSY

(B) Rear cover

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

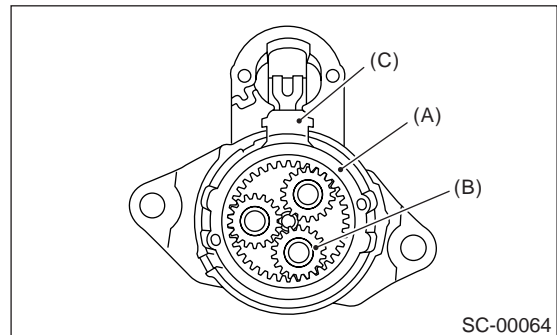


(A) Armature

(B) Yoke ASSY

(C) Front bracket

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



(A) Packing A

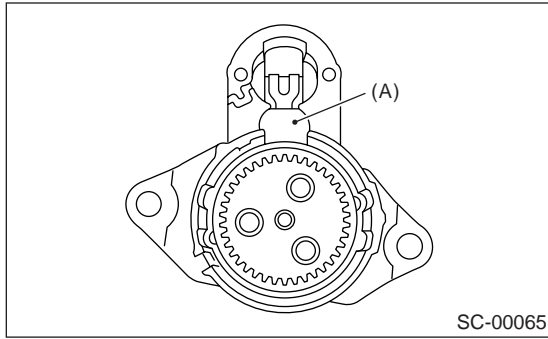
(B) Planetary gear

(C) Packing B

Starter

STARTING/CHARGING SYSTEMS

7) Remove the plate.



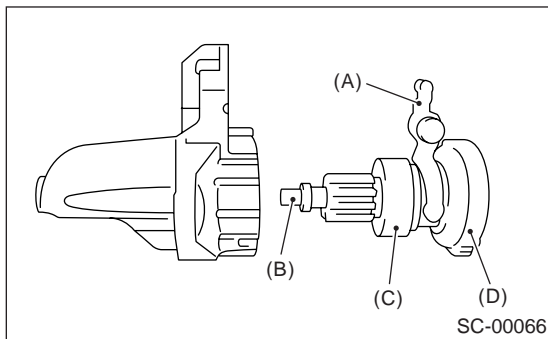
(A) Plate

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

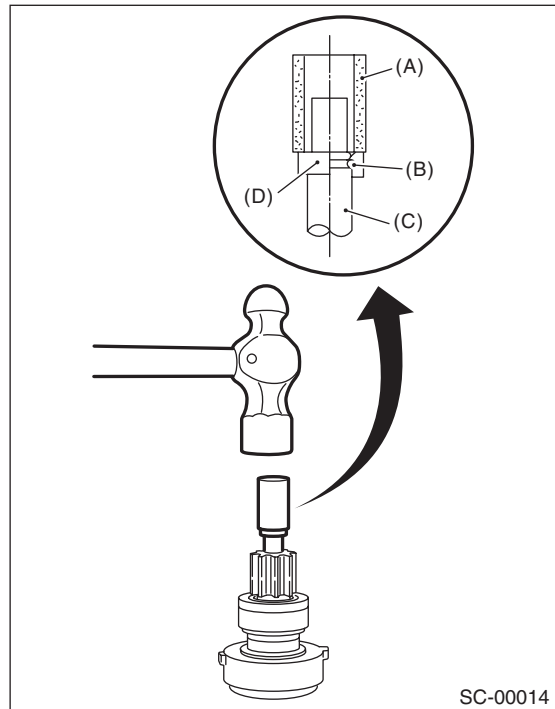


- (A) Lever
- (B) Shaft ASSY
- (C) Overrunning clutch
- (D) Internal gear ASSY

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 fit socket wrench).

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



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

D: ASSEMBLY

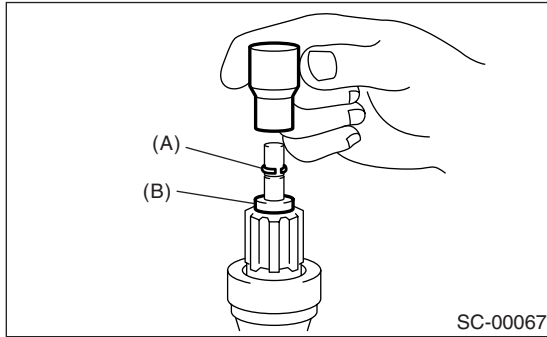
NOTE:

Apply grease to the following parts before assembly.

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

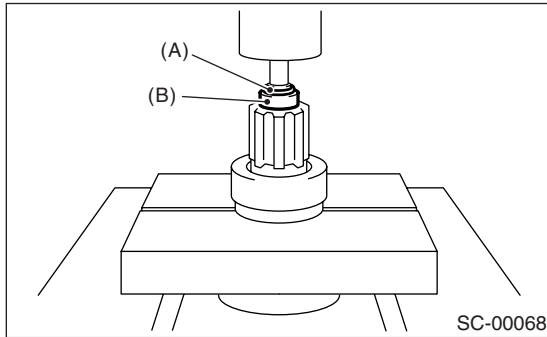
- 1) Install the overrunning clutch to shaft assembly.
- 2) Install the stopper to shaft assembly as follows.

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



- (A) Ring
- (B) Stopper

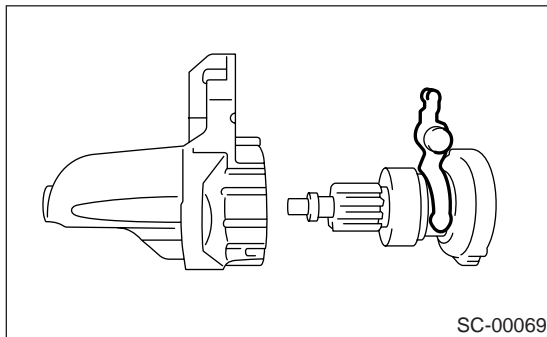
(2) Install the stopper to ring using a press.



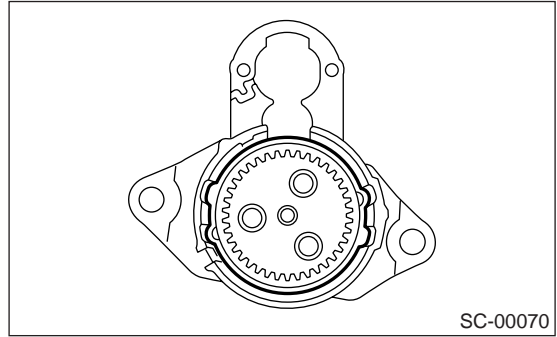
- (A) Ring
- (B) Stopper

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

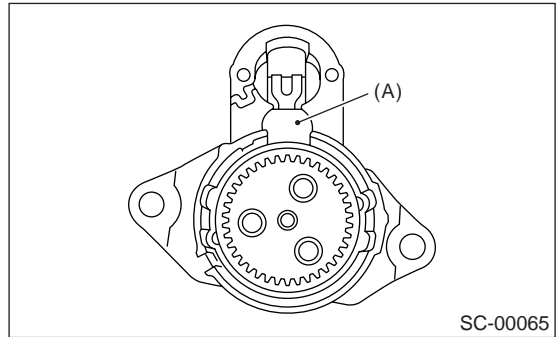
(1) Lever direction



(2) Internal gear position



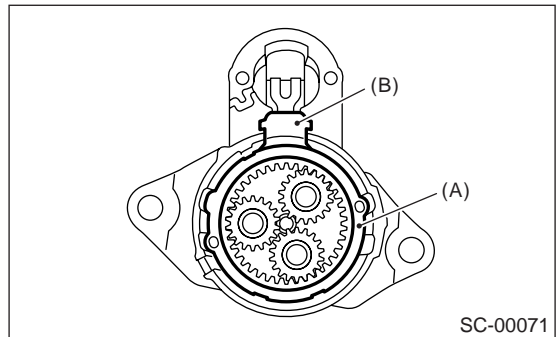
4) Install the plate.



- (A) Plate

5) Install the planetary gear.

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



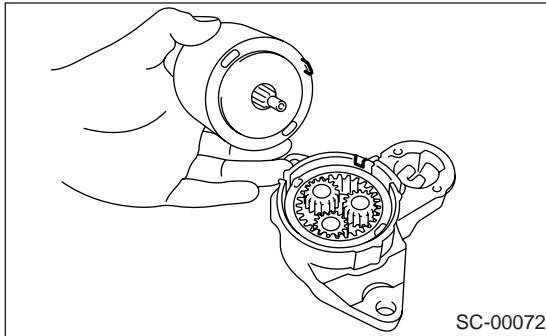
- (A) Packing A
- (B) Packing B

7) Install the armature to yoke assembly.

Starter

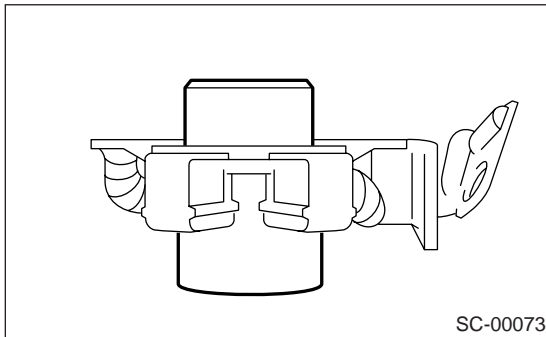
STARTING/CHARGING SYSTEMS

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

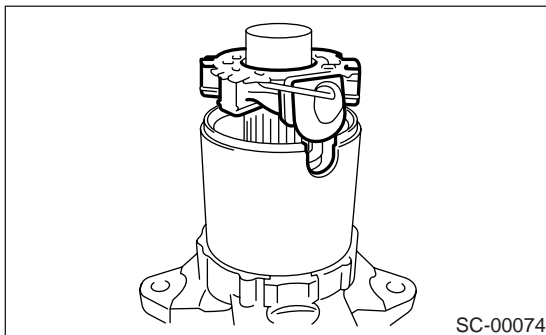


9) Install the brush holder to yoke assembly as follows.

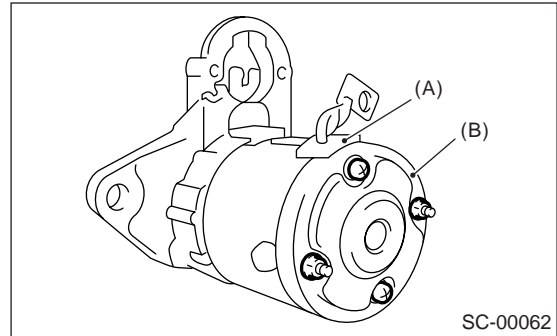
(1) Press the brush down into brush holder, and then fix the brush in that position using an appropriate tool (such as a fit socket wrench).



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

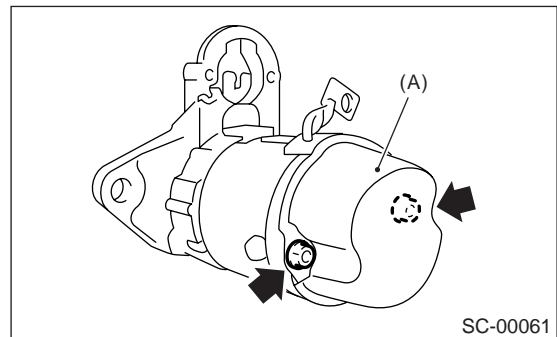


10) Install the rear cover matching its groove to brush holder assembly.



(A) Brush holder ASSY
(B) Rear cover

11) Install rear cover set.

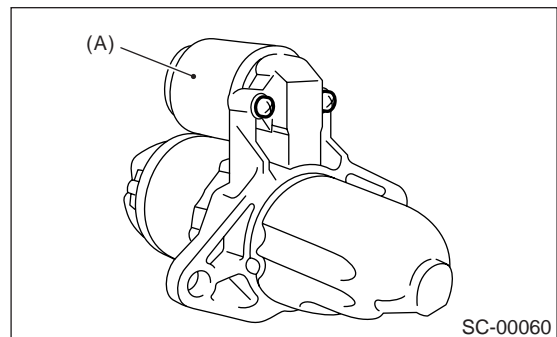


(A) Rear cover set

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

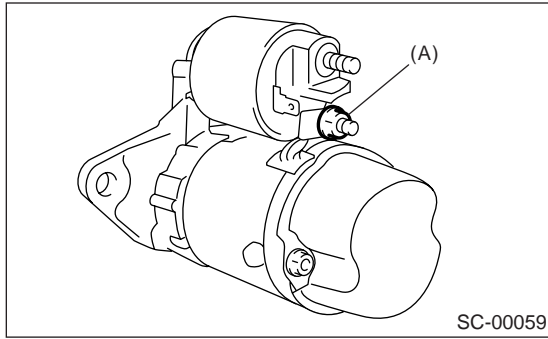
(1) Insert the plunger and plunger spring into switch assembly.

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



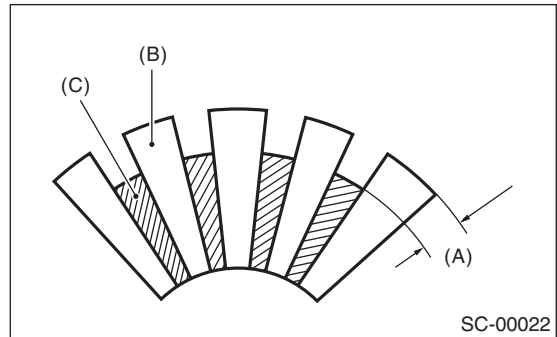
(A) Switch ASSY

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

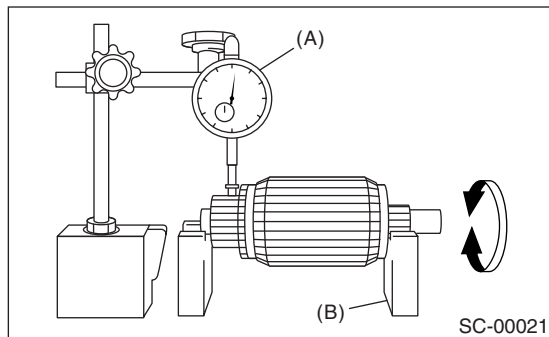
Commutator run-out:

Standard

0.05 mm (0.0020 in)

Service limit

Less than 0.10 mm (0.0039 in)

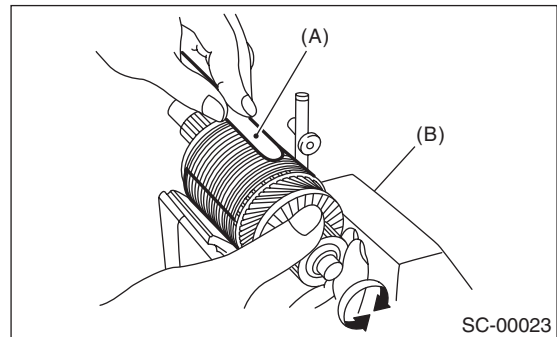


(A) Dial gauge
(B) V-block

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 an iron sheet against the armature core while slowly rotating the 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.

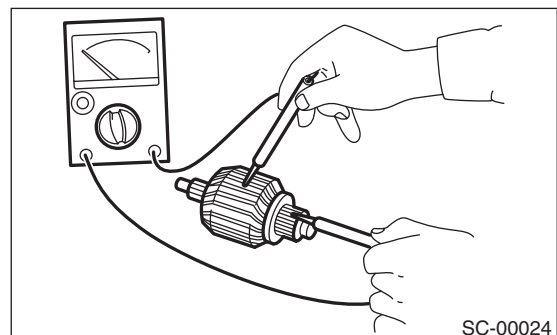


(A) Iron sheet
(B) Growler tester

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.



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 the right direction of rotation (counterclockwise). It should rotate smoothly. But in the 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.

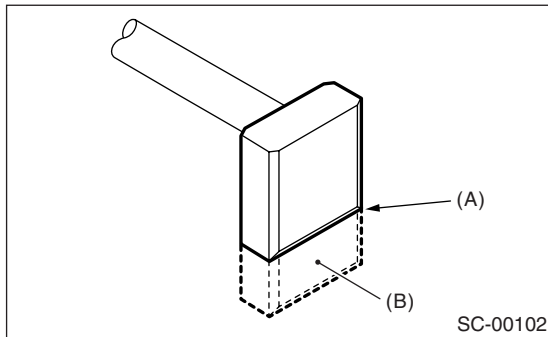
Brush length:

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”).

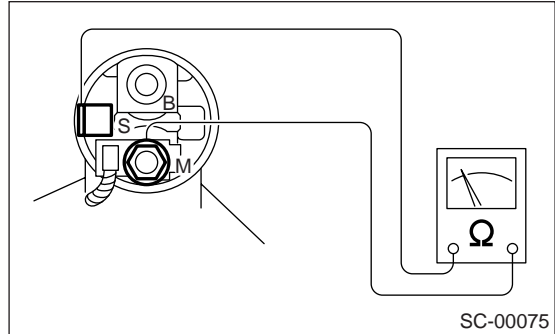
Also check to be sure there is no continuity between terminal M and B.

Terminal / Specified resistance:

S — M / Less than 1 Ω

S — Ground / Less than 1 Ω

M — B / More than 1 MΩ



6. SWITCH ASSEMBLY OPERATION

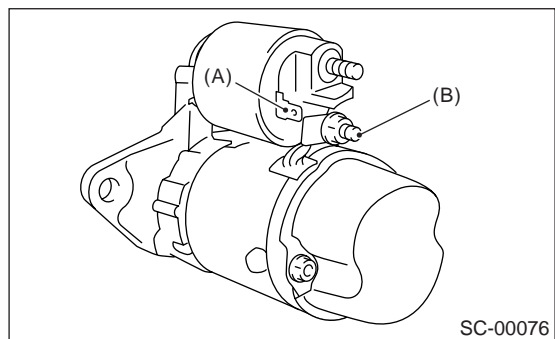
1) Using a lead wire, connect the terminal S of switch assembly to positive terminal of battery, and starter body to ground terminal of battery. The pinion should be forced endwise on shaft.

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. Then using a lead wire, connect the positive terminal of battery and terminal M 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

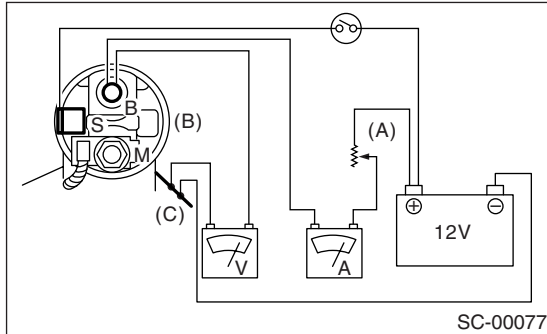
(B) Terminal M

7. 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 the figure.



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

1) No-load test

With switch on, adjust the variable resistance for the voltage to obtain 11 V, read the ammeter and measure the starter speed. Compare these values with the specifications.

No-load test (Standard):

Voltage / Current

MT model

11 V / 95 A or less

AT model

11 V / 90 A or less

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 specifications.

Load test (Standard):

Voltage / Load

MT model

7.5 V / 8.84 N·m (0.90 kgf·m, 6.5 ft·lb)

AT model

7.7 V / 16.7 N·m (1.70 kgf·m, 12.3 ft·lb)

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 N·m (1.73 kgf·m, 12.5 ft·lb)

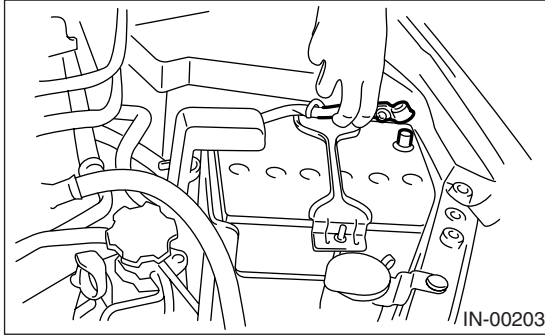
AT model

31 N·m (3.16 kgf·m, 22.9 ft·lb)

3. Generator

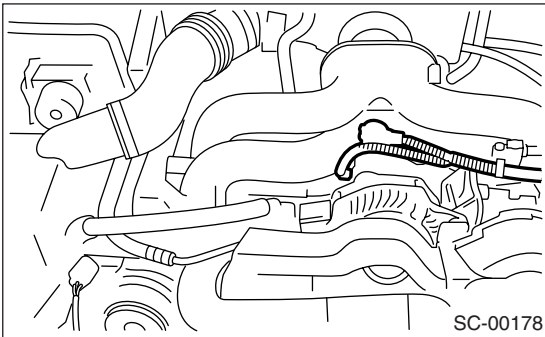
A: REMOVAL

1) Disconnect the ground cable from battery.

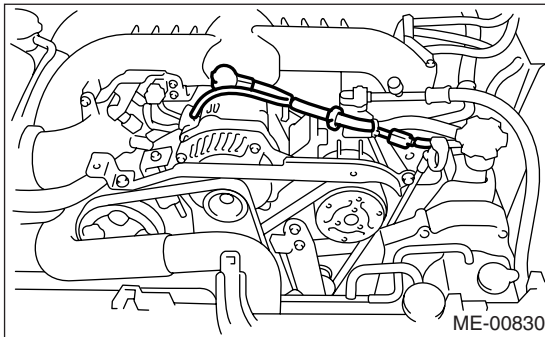


2) Disconnect the connector and terminal from generator.

- Non-turbo model



- Turbo model

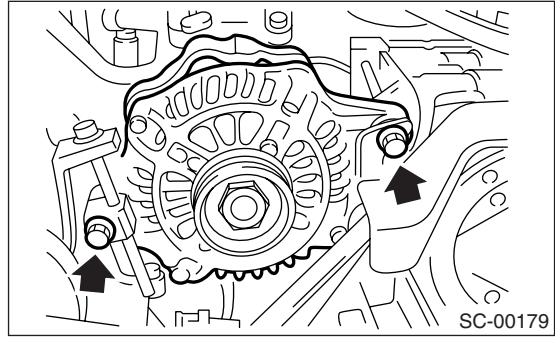


3) Remove the V-belt covers.

4) Remove the front side belts.

<Ref. to ME(H4SO 2.0)-38, FRONT SIDE BELT, REMOVAL, V-belt.> or <Ref. to ME(H4DOTC)-39, FRONT SIDE BELT, REMOVAL, V-belt.>

5) Remove the bolts which install the generator onto bracket.



B: INSTALLATION

Install in the reverse order of removal.

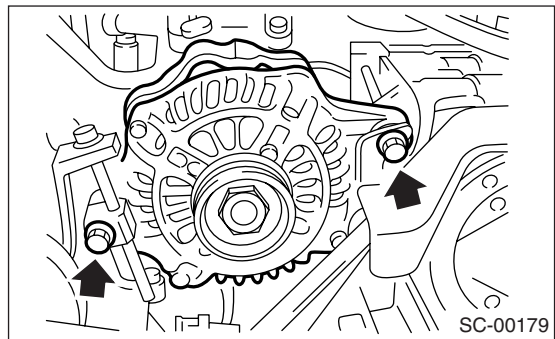
Tightening torque:

25 N·m (2.5 kgf-m, 18.1 ft-lb)

CAUTION:

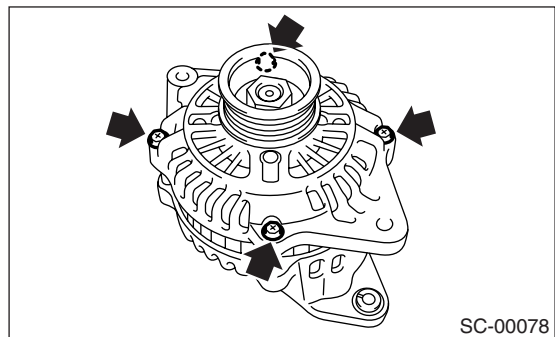
Check and adjust the V-belt tension.

<Ref. to ME(H4SO 2.0)-39, INSPECTION, V-belt.> or <Ref. to ME(H4DOTC)-40, INSPECTION, V-belt.>

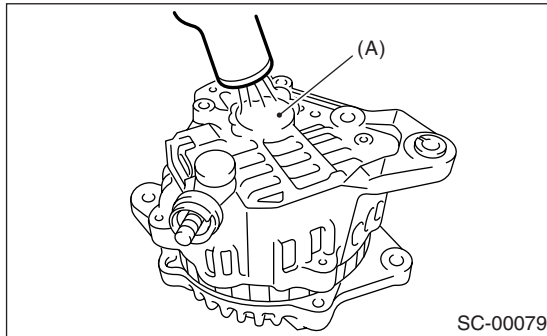


C: DISASSEMBLY

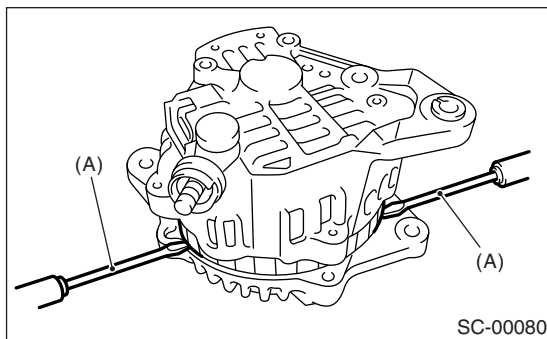
1) Remove the four through-bolts.



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

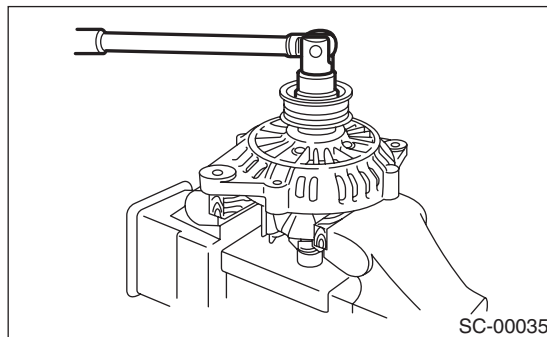


3) Then insert the tip of a flat tip screwdriver into the gap between stator core and front cover. Pry them apart to disassemble.



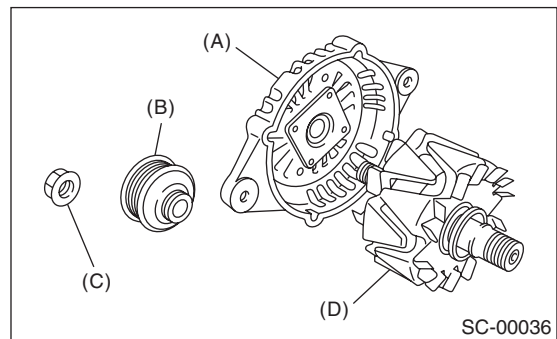
(A) Screwdriver

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



CAUTION:

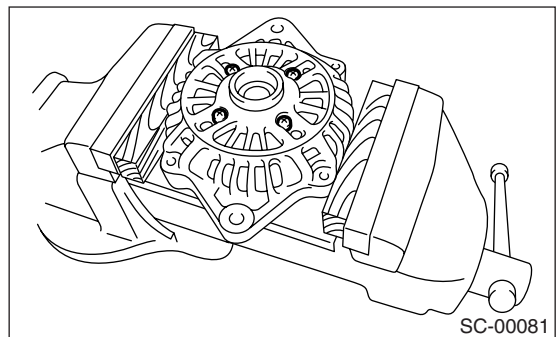
When holding the rotor with a vise, place aluminum plates or wooden pieces on the vise jaws to prevent rotor from damage.



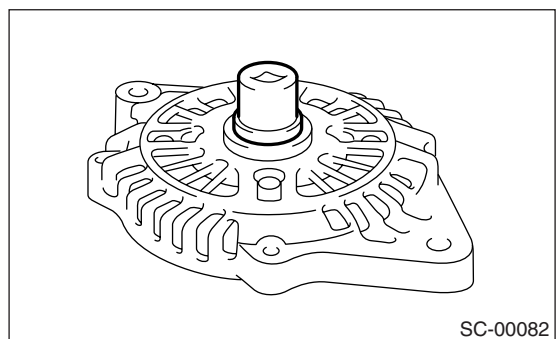
- (A) Front cover
- (B) Pulley
- (C) Nut
- (D) Rotor

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.

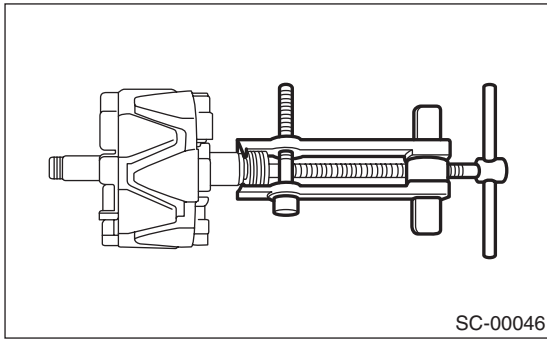


(3) Push the ball bearing off the front cover using a press.

Generator

STARTING/CHARGING SYSTEMS

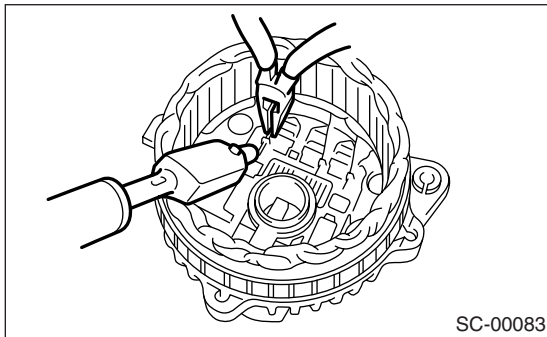
6) Remove the bearing from rotor using a bearing puller.



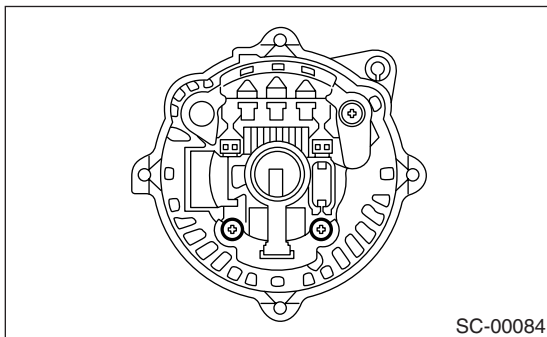
7) Unsolder connection between rectifier and stator coil to remove the stator coil.

CAUTION:

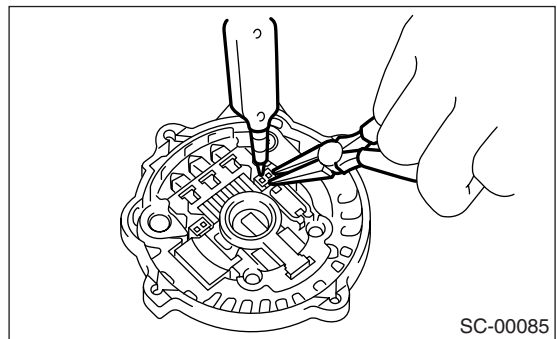
Do not allow a 180 — 270 W soldering iron to contact the terminals for more than 5 seconds at once because the rectifier cannot withstand so much heat.



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

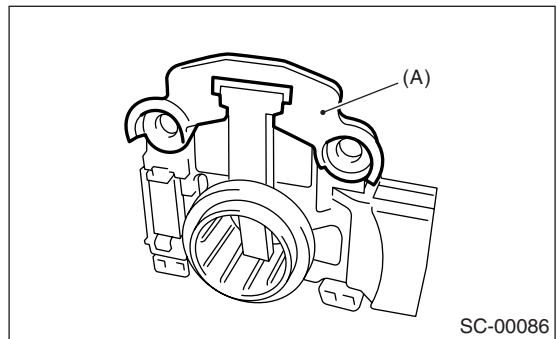


(2) Unsolder the connection between IC regulator and rectifier to remove the IC regulator.



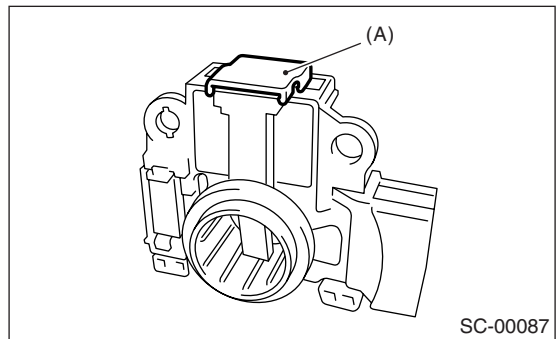
9) Remove the brush as follows.

(1) Remove cover A.



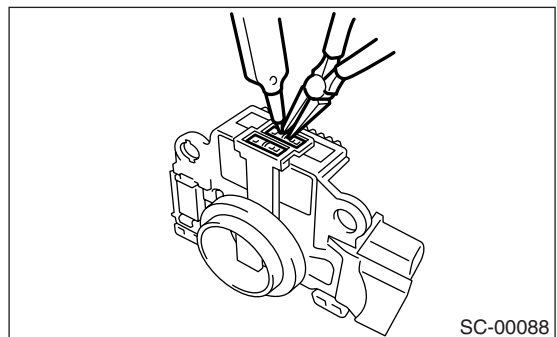
(A) Cover A

(2) Remove cover B.



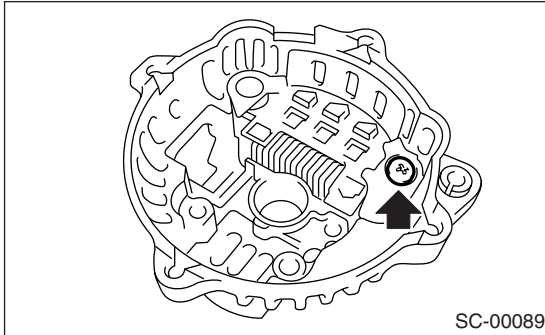
(A) Cover B

(3) Separate the brush from connection to remove.

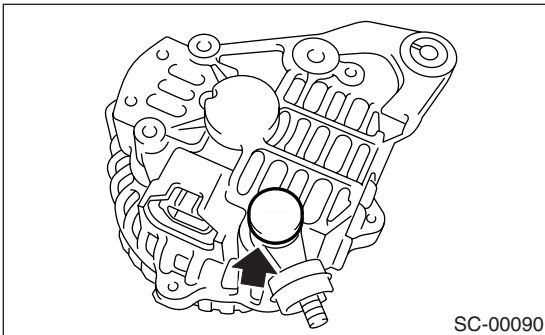


10) Remove the rectifier as follows.

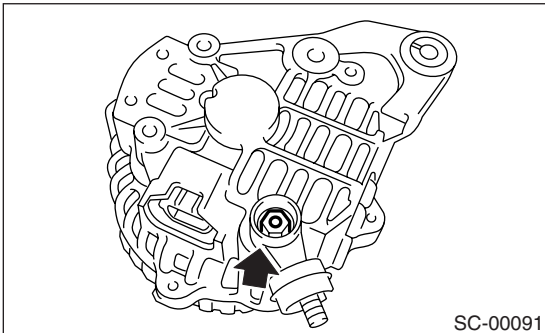
(1) Remove the bolt which secures the rectifier.



(2) Remove the cover of terminal B.

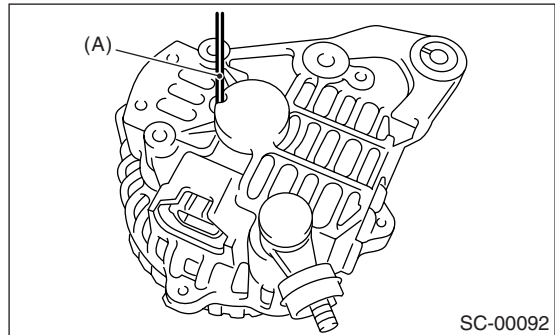


(3) Remove the nut of terminal B, and then remove the rectifier.



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.

D: ASSEMBLY

Assemble in the 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. 40 to 50 mm (1.6 to 2.0 in) long] wire through the hole as shown in the figure.

E: INSPECTION

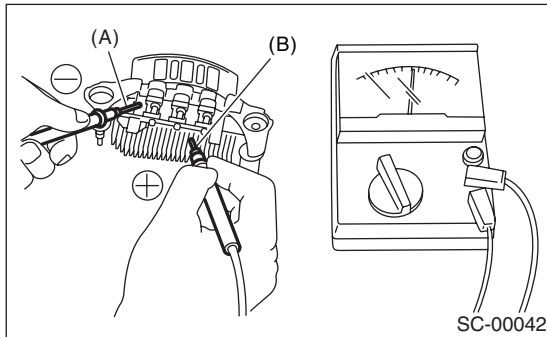
1. DIODE

CAUTION:

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

1) Checking positive diode

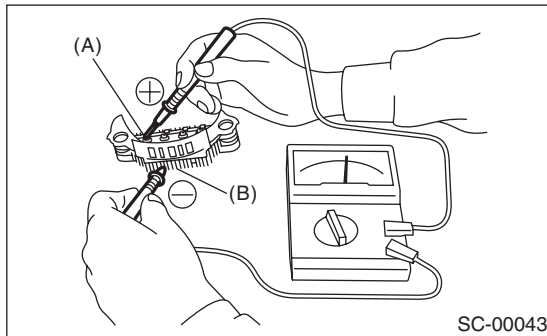
Check for continuity between the diode lead and positive side heat sink. The positive diode is in good condition if resistance is $1\ \Omega$ or less only in the direction from the diode lead to heat sink.



- (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 $1\ \Omega$ 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 on 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 the rotor assembly.

Slip ring outer diameter:

Standard

22.7 mm (0.894 in)

Limit

22.1 mm (0.870 in)

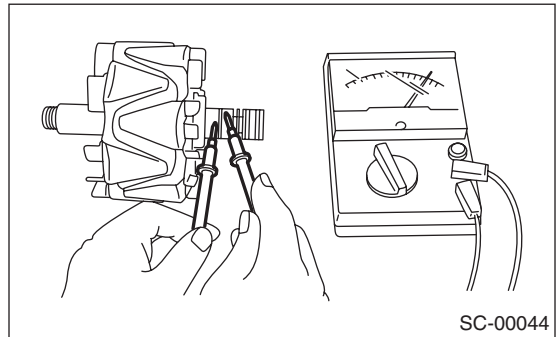
3) Continuity test

Check the resistance between slip rings using circuit tester.

If the resistance is not within the specified range, replace the rotor assembly.

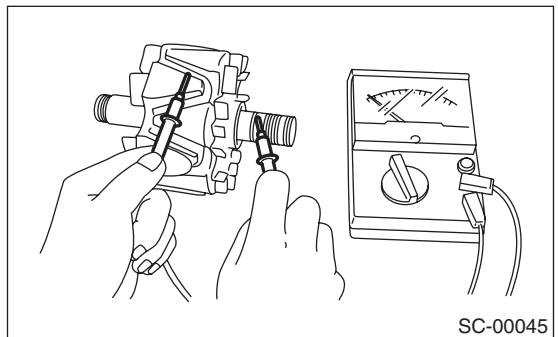
Specified resistance:

Approx. 1.8 — 2.2 Ω



4) Insulation test

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



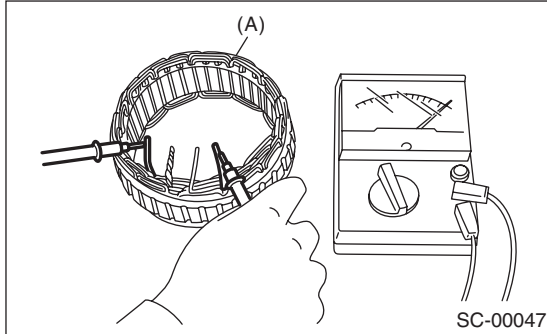
5) Ball bearing (rear side)

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

3. STATOR

1) Continuity test

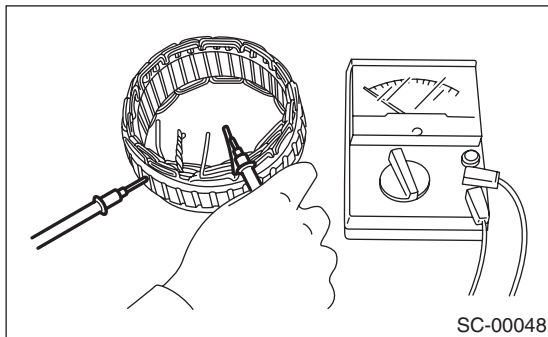
Inspect the stator coil for continuity between each end of the lead wires. If resistance is $1\text{ M}\Omega$ or more, the lead wire is broken, and so replace the stator assembly.



(A) Stator

2) Insulation test

Inspect the stator coil for continuity between stator core and each end of lead wire. If resistance is $1\ \Omega$ 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.

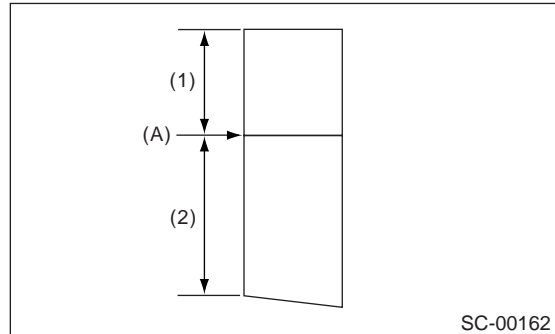
Brush length:

Service limit (1)

5.0 mm (0.197 in)

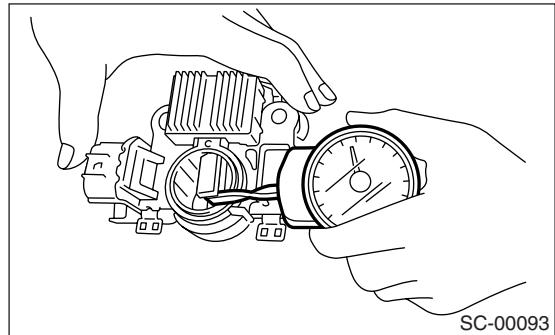
Standard (2)

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 2.648 N (270 g, 9.52 oz), replace the brush spring with a new one. The new spring must have a pressure of 4.609 to 5.786 N (470 to 590 g, 16.58 to 20.810 oz).



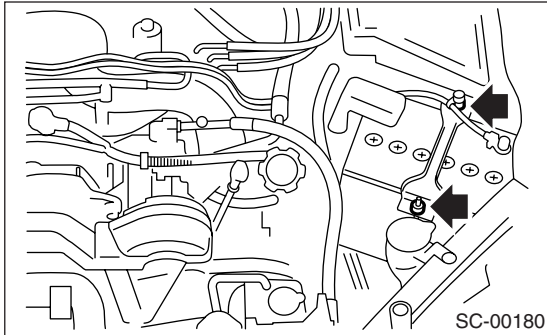
5. BEARING (FRONT SIDE)

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 (+) terminal after disconnecting the negative (-) terminal of battery.
- 2) Remove the flange nuts from battery rods and take off 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 apply grease to retard the formation of corrosion.
- Connect the positive (+) terminal, and then connect the negative (-) terminal of battery.
- Initial diagnosis of electronic control throttle is performed after battery installation. For this reason, start the engine after 10 seconds or more have elapsed since the ignition switch was turned to ON.

C: INSPECTION

WARNING:

- Electrolyte has toxicity; be careful handling the fluid.
- Avoid contact with skin, eyes or clothing. Especially at contact with eyes, flush with water for 15 minutes and get prompt medical attention.
- Batteries produce explosive gases. 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 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. This may cause short circuit.

1. EXTERNAL PARTS

Check the battery case, top cover, vent plugs, and terminal posts for dirt or cracks. 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 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:

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

S_{20} : Specific gravity corrected at electrolyte temperature of 20°C (68°F)

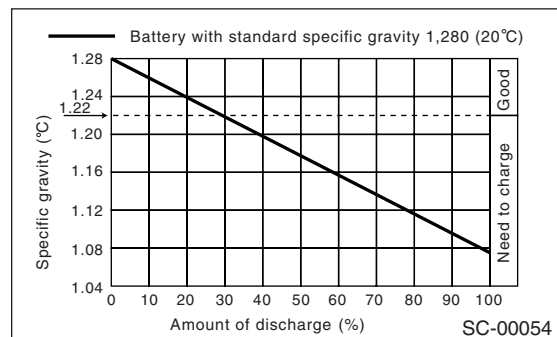
St : Measured specific gravity

t : Measured temperature (°C)

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

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

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



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 caustic soda solution.
- Be careful since battery electrolyte overflows while charging the battery.
- Observe instructions when handling the battery charger.
- Before charging the battery on vehicle, disconnect the battery ground terminal to prevent damage of generator diodes or other electrical modules.

1. JUDGMENT OF BATTERY IN CHARGED CONDITION

- 1) Specific gravity of electrolyte should be held within the specific range from 1.250 to 1.290 for more than one hour.
- 2) Voltage per battery cell should be held at a specific value in a range from 2.5 to 2.8 V for more than one hour.

2. CHECK HYDROMETER FOR STATE OF CHARGE

Hydrometer indicator	Charge battery	Corrective action
Green	Above 65%	Load test
Dark	Below 65%	Charge battery
Clear	Low electrolyte	Replace battery* (If cranking is difficult)

* 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 that 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 the 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).

Also 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.

CAUTION:

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

