SUPPLEMENT FOR 6 CYLINDER ENGINE MODEL

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.

FUJI HEAVY INDUSTRIES LTD.

G2281GE

SUPPLEMENT FOR 6 CYLINDER ENGINE MODEL

STARTING/CHARGING SYSTEMS

SC(H6)

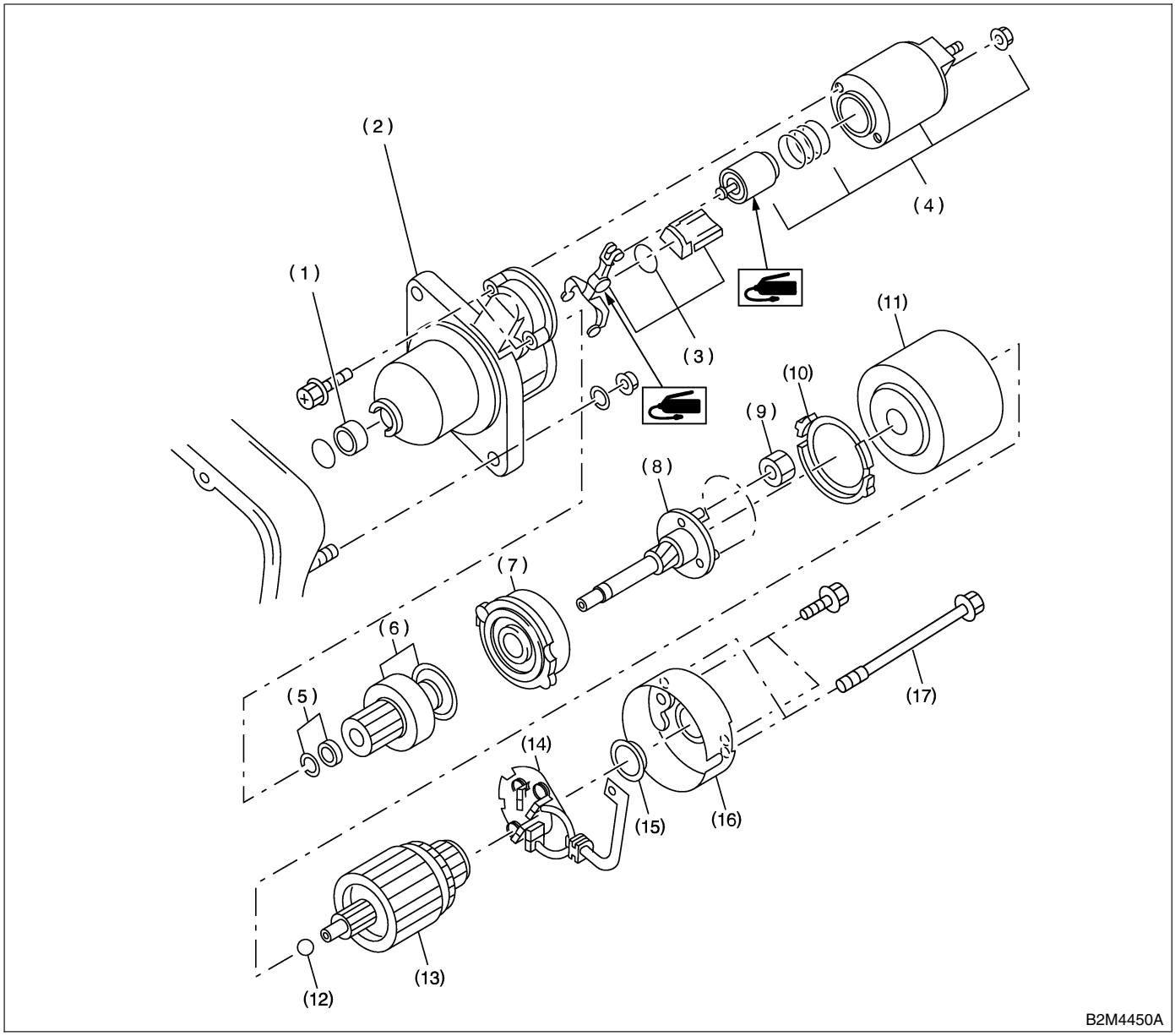
1. General Description S149001

A: SPECIFICATIONS S149001E49

Item			Designation
Starter	Type		Reduction type
	Model		TN128000-8321
	Manufacturer		NIPPONDENSO TENNESSEE
	Voltage and output		12 V — 1.4 kW
	Direction of rotation		Counterclockwise (when observed from pinion)
	Number of pinion teeth		9
	No-load characteristics	Voltage	11 V
		Current	90 A or less
		Rotating speed	2,900 rpm or more
	Load characteristics	Voltage	8 V
		Current	370 A or less
		Torque	13.7 N·m (1.4 kgf-m, 10.1 ft-lb)
		Rotating speed	880 rpm or more
	Lock characteristics	Voltage	5 V
		Current	1,050 A or less
		Torque	27.5 N·m (2.8 kgf-m, 20.3 ft-lb) or more
Generator	Type		Rotating-field three-phase type
	Model		LR190-742
	Manufacturer		MITUBISHI ELECTRIC
	Voltage and output		12 V — 100 A
	Polarity on ground side		Negative
	Rotating direction		Clockwise (when observed from pulley side.)
	Armature connection		3-phase Y-type
	Output current		1,500 rpm — 43 A or more 2,500 rpm — 76 A or more 5,000 rpm — 100 A or more
	Regulated voltage		$14.5^{+0.3}_{-0.4}$ V [20°C (68°F)]
Battery	Type and capacity		12 — 52 AH (75D23L)

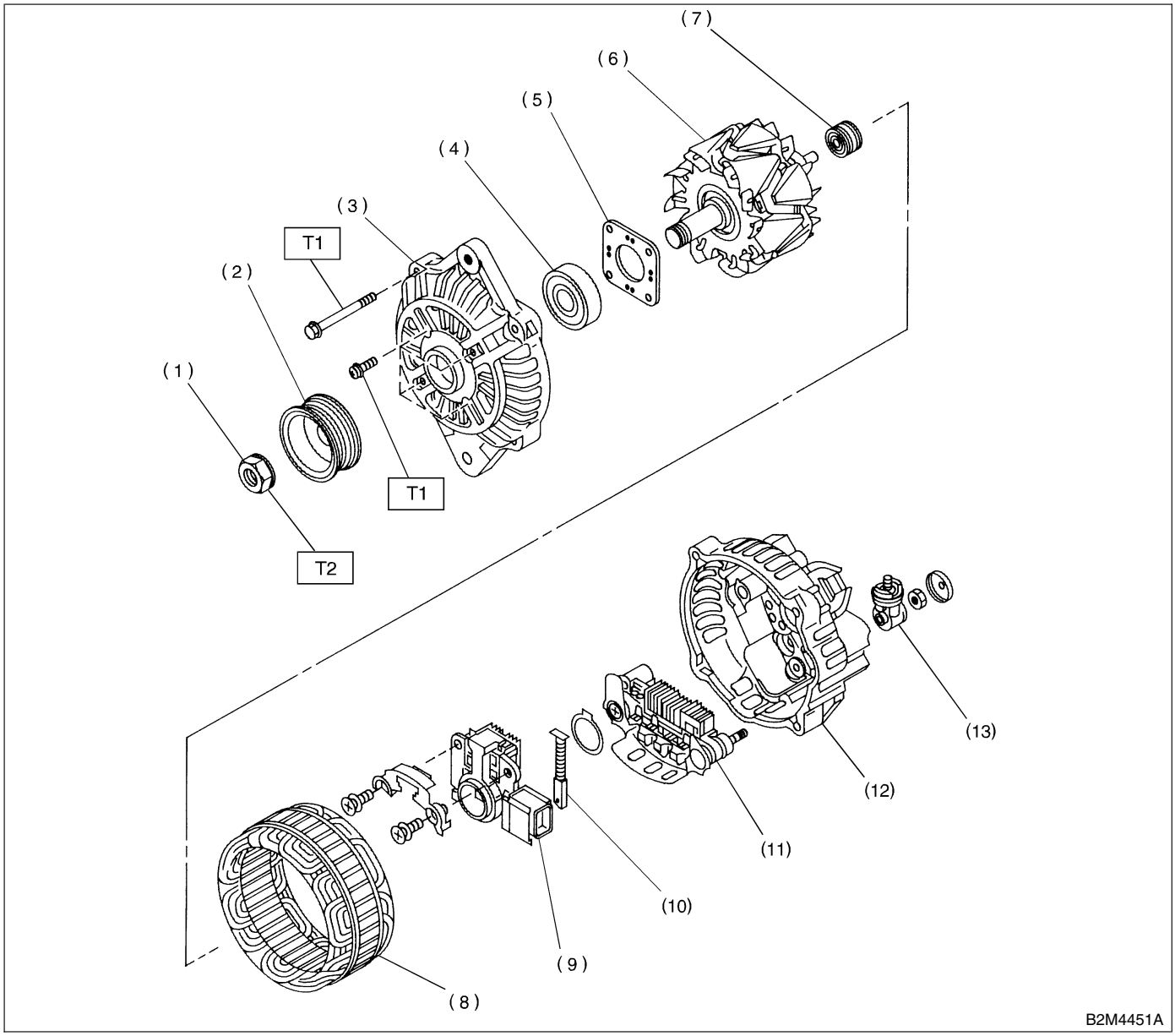
B: COMPONENT S149001A05

1. STARTER S149001A0501



(1) Sleeve bearing
(2) Front bracket
(3) Lever set
(4) Magnet switch ASSY
(5) Stopper set
(6) Overrunning clutch
(7) Internal gear ASSY
(8) Shaft ASSY
(9) Gear ASSY
(10) Packing
(11) Yoke
(12) Ball
(13) Armature
(14) Brush holder
(15) Bearing
(16) Rear bracket
(17) Through bolt

2. GENERATOR S149001A0502



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

Tightening torque: N·m (kgf-m, ft-lb)
T1: 3.1 (0.32, 2.3)
T2: 63.7 (6.5, 47.0)

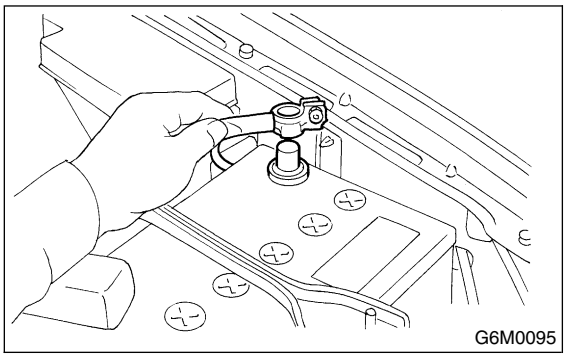
C: CAUTION S149001A03

- 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 your hands, 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 safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect negative battery terminal.

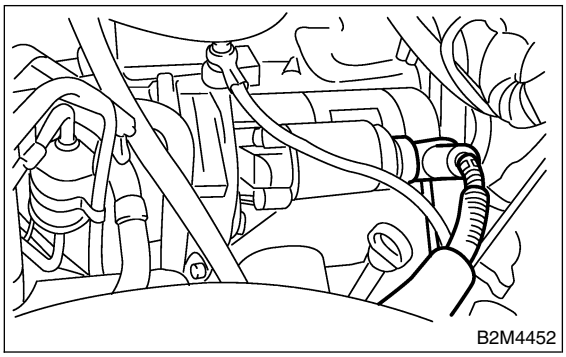
2. Starter S149012

A: REMOVAL S149012A18

1) Disconnect battery ground cable.


G6M0095

2) Remove air intake chamber. <Ref. to IN(H6)-6, REMOVAL, Air Intake Chamber.>
3) Disconnect connector and terminal from starter.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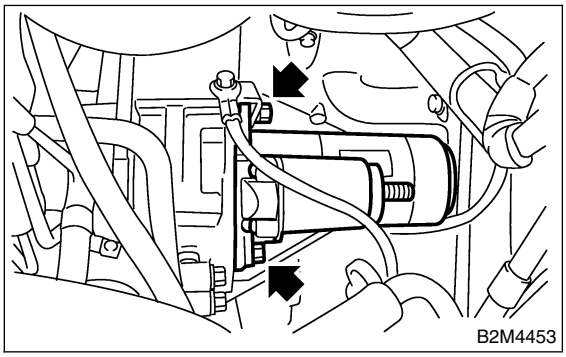
4) Remove starter from transmission.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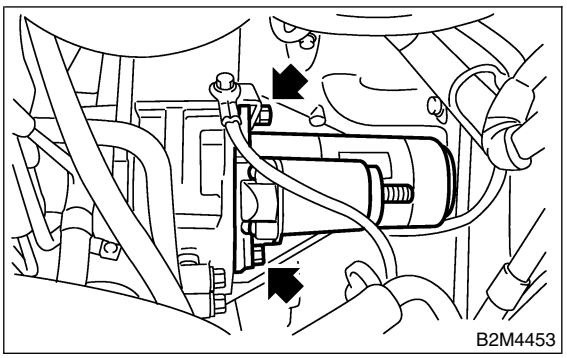
B: INSTALLATION S149012A11

Install in the reverse order of removal.

Tightening torque:
50 N·m (5.1 kgf-m, 37 ft-lb)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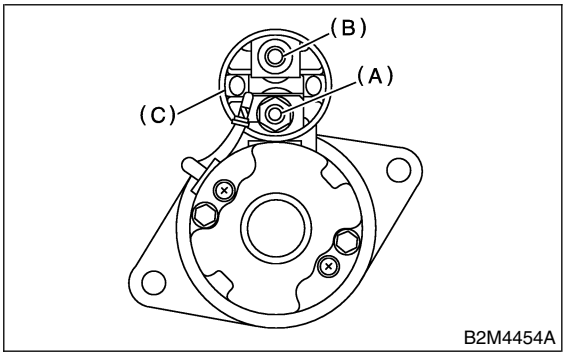
C: DISASSEMBLY S149012A06

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



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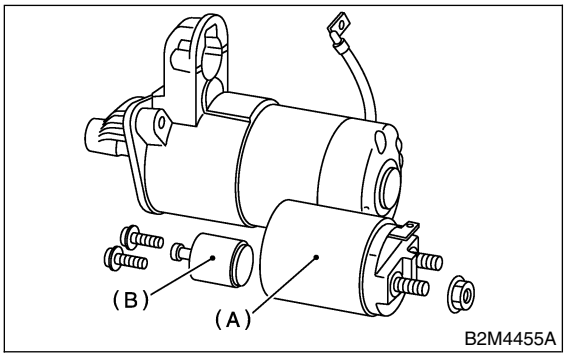
(A) Terminal M
(B) Terminal B
(C) Terminal S

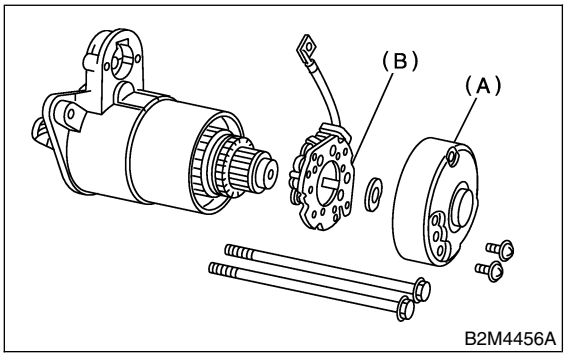
2) Remove bolts which hold switch assembly, and remove switch assembly, plunger and plunger spring from starter as a unit.

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



(A) Switch ASSY
(B) Plunger

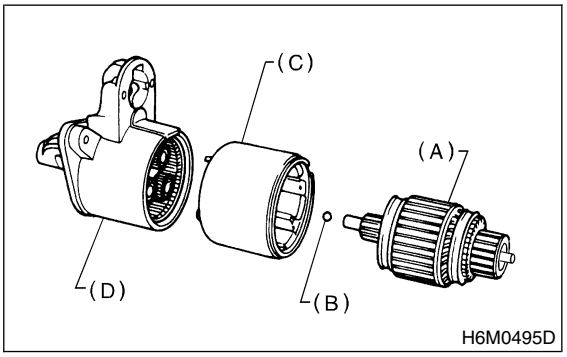
3) Remove both through-bolts and brush holder screws, and detach rear bracket and brush holder.



(A) Rear bracket
(B) Brush holder

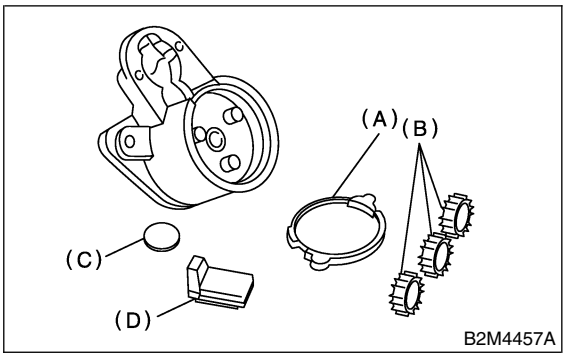
4) Remove armature and yoke. Ball used as a bearing will then be removed from the end of armature.

CAUTION:
Be sure to mark an alignment mark on yoke and front bracket before removing yoke.



(A) Armature
(B) Ball
(C) Yoke
(D) Front bracket

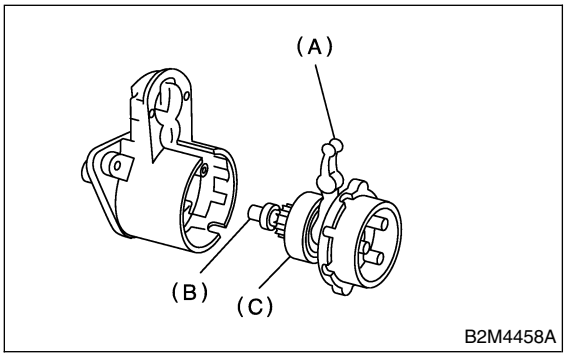
5) Remove packing A, three planetary gears, packing B and plate.



(A) Packing A
(B) Planetary gear
(C) Plate
(D) Packing B

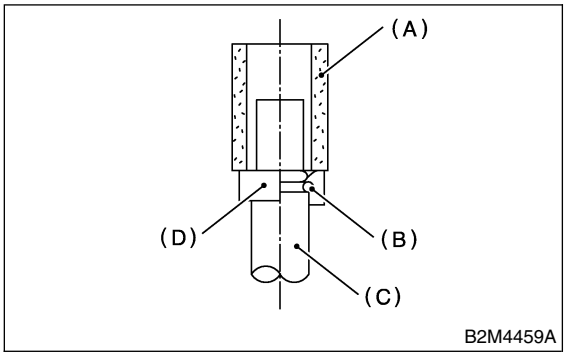
6) Remove shaft assembly and overrunning clutch as a unit.

CAUTION:
Record the direction of lever before removing.



(A) Lever
(B) Shaft ASSY
(C) Overrunning clutch

7) Remove overrunning clutch from shaft assembly as follows:
(1) Remove stopper from ring by lightly tapping a fit tool placed on stopper.
(2) Remove ring, stopper and clutch from shaft.



(A) Tool
(B) Ring
(C) Shaft
(D) Stopper

D: ASSEMBLY S149012A02

Assemble in the reverse order of disassembly. Do the following:
1) Carefully assemble all parts in the order of assembly and occasionally inspect nothing has been overlooked.
2) Apply grease to the following parts during assembly.
Grease:
ESSO BEACON 325
SHELL ALVANIA GREASE RA
or equivalent

- Front and rear bracket sleeve bearing
- Armature shaft gear
- Outer periphery of plunger
- Mating surface of plunger and lever
- Gear shaft splines
- Mating surface of lever and clutch
- Ball at the armature shaft end
- Internal and planetary gears

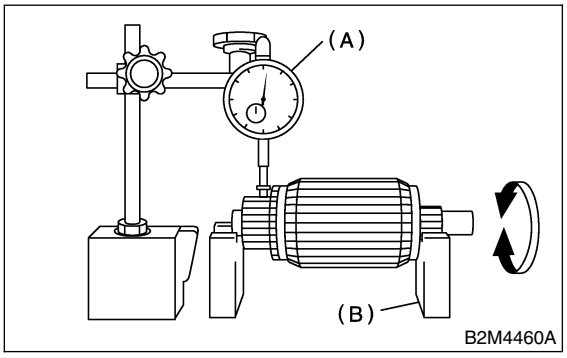
3) After assembling parts correctly, make sure starter operates properly.

E: INSPECTION S149012A10

1. ARMATURE S149012A1001

1) Check commutator for any sign of burns of 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 replace if it exceeds the limit.

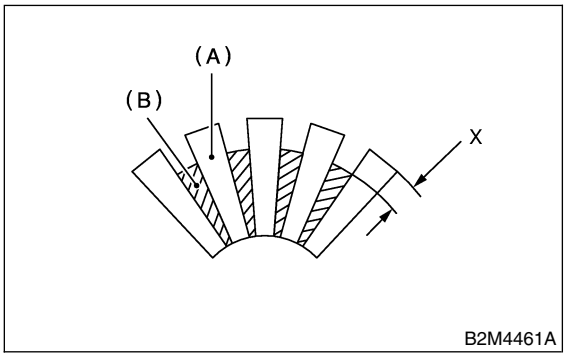
Commutator run-out:
Standard
0.05 mm (0.0020 in), or less
Service limit
Less than 0.10 mm (0.0039 in)



(A) Dial gauge
(B) Block

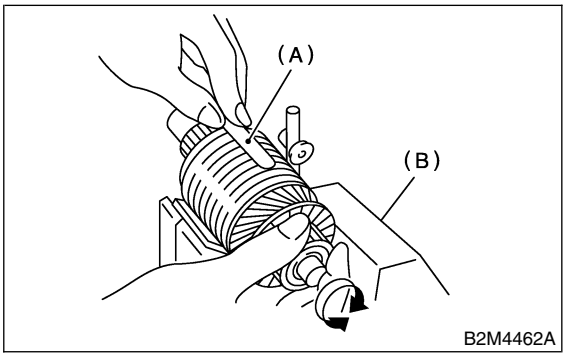
3) Depth of segment mold
Check the depth of segment mold.

Depth of segment mold X:
0.6 mm (0.024 in)
Limit
0.2 mm (0.008 in)



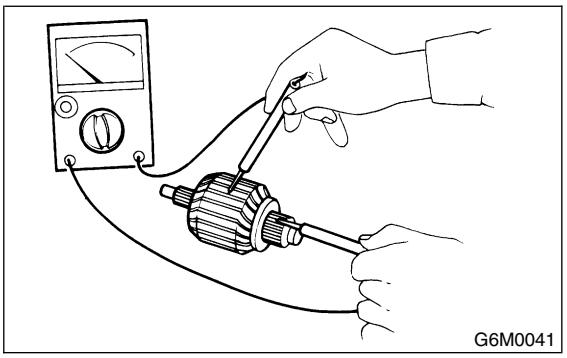
(A) Segment
(B) Mold

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



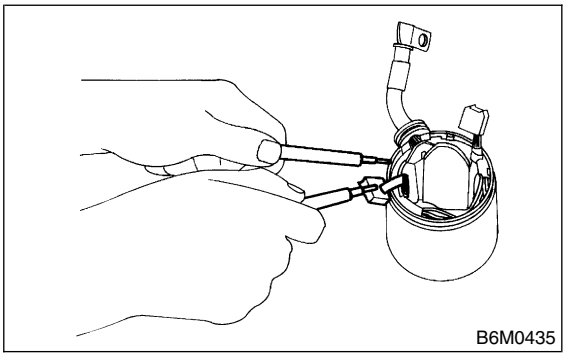
(A) Iron sheet
(B) Growler tester

5) Armature ground test
Using circuit tester, touch one probe to the commutator segment and the other to shaft. There should be no continuity. If there is a continuity, armature is grounded.
Replace armature if it is grounded.



2. YOKE S149012A1002

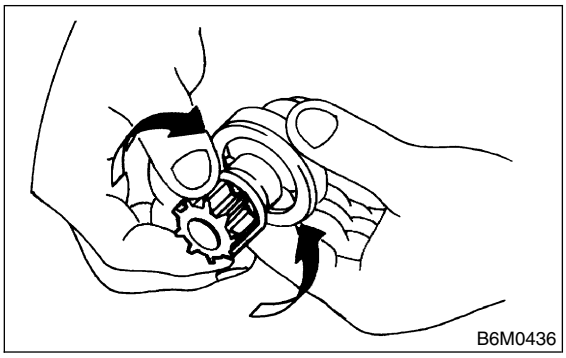
Make sure pole is set in position.



3. OVERRUNNING CLUTCH S149012A1003

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

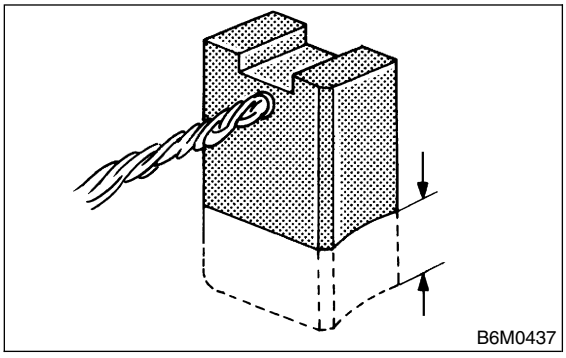
CAUTION:
Do not clean overrunning clutch with oil to prevent grease from flowing out.


B6M0436

4. BRUSH AND BRUSH HOLDER S149012A1004

1) Brush length
Measure the brush length and replace if it exceeds the service limit.
Replace if abnormal wear or cracks are noticed.

Brush length:
Standard
17.0 mm (0.669 in)
Service limit
11.5 mm (0.453 in)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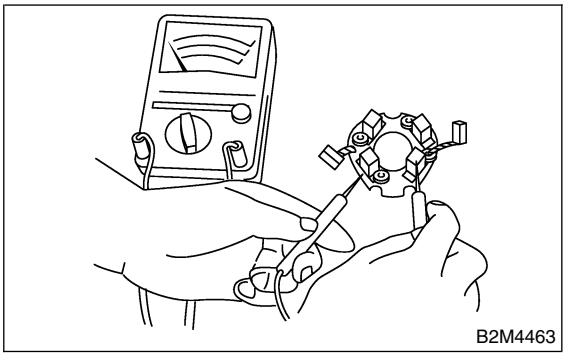
2) Brush movement
Be sure brush moves smoothly inside brush holder.

3) Insulation resistance of brush holder
Be sure there is no continuity between brush holder and its plate.


B2M4463

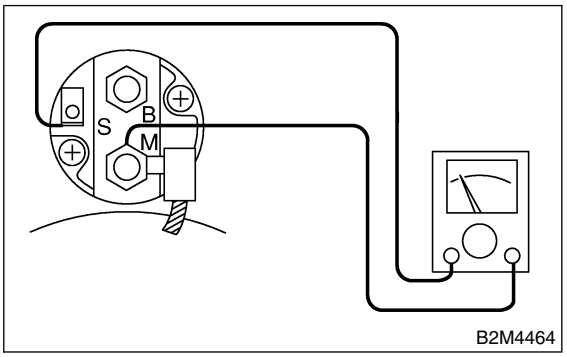
5. MAGNETIC SWITCH S149012A1005

CAUTION:
• The following magnetic switch tests should be performed with specified voltage applied.
• Each test should be conducted within 3 to 5 seconds. Power to be furnished should be one-half the rated voltage.

6. SWITCH ASSEMBLY S149012A1006

Be sure there is continuity between 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 / Continuity
S — Ground / Continuity
M — B / No continuity

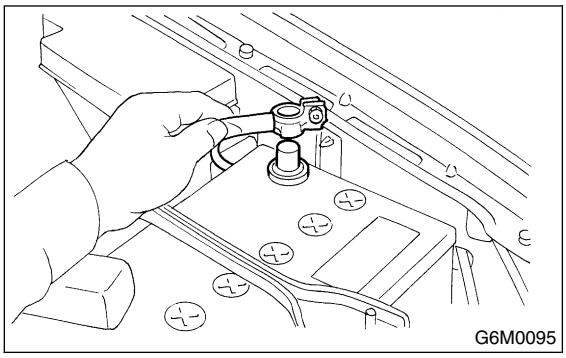


B2M4464

3. Generator S149008

A: REMOVAL S149008A18

1) Disconnect battery ground cable.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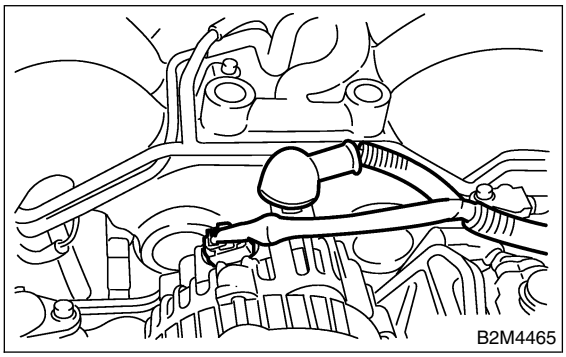
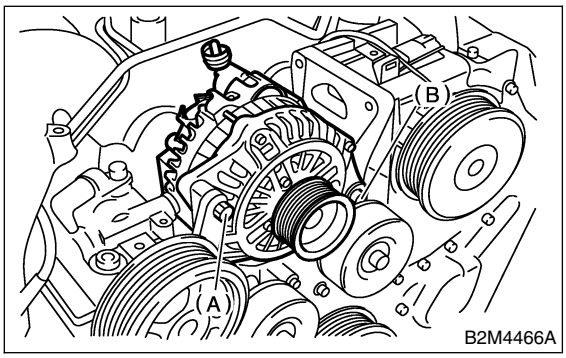
2) Disconnect connector and terminal from generator.


B2M4465

3) Remove V-belt. <Ref. to ME(H6)-31, REMOVE, V-belt.>
4) Remove bolt (A), and loosen bolt (B). Then, remove generator from bracket.



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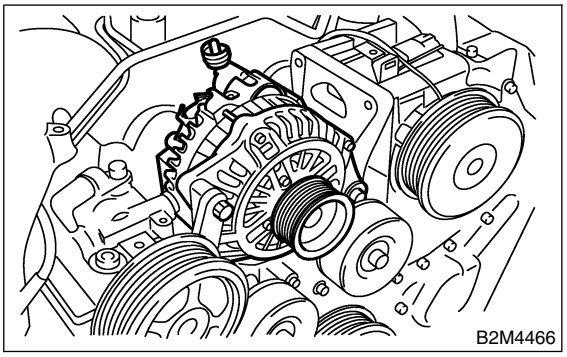
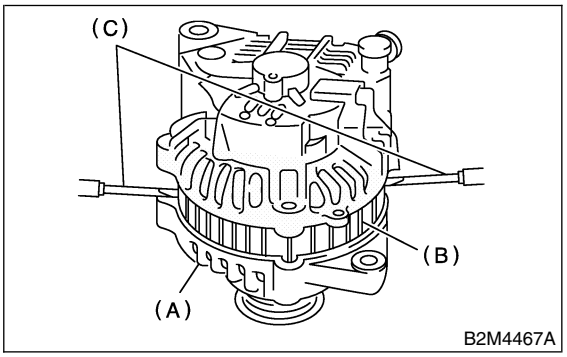
B: INSTALLATION S149008A11

Install in the reverse order of removal.


B2M4466

C: DISASSEMBLY S149008A06

1) Remove the four through bolts. Then insert the tip of a flat-head screwdriver into the gap between the stator and front bracket. Pry them apart to disassemble.

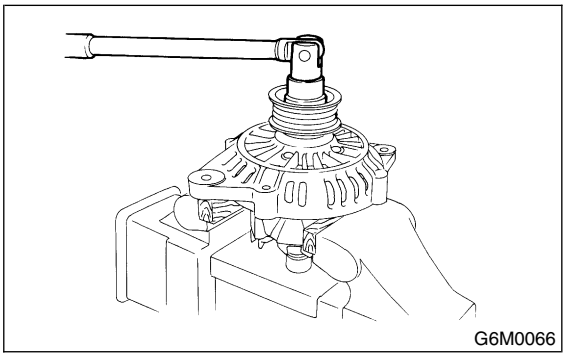


B2M4467A

(A) Front cover
(B) Stator
(C) Screwdriver

2) Hold rotor with a vise and remove pulley nut.

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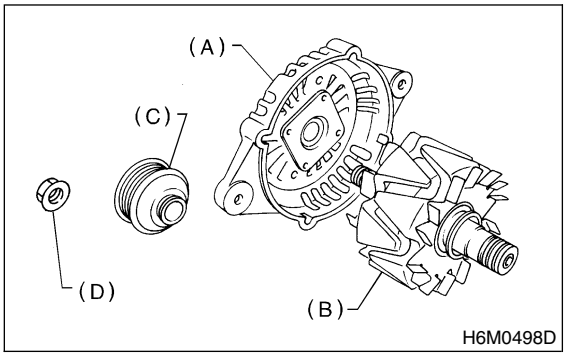
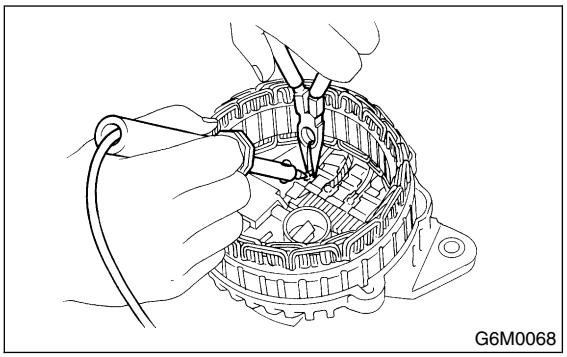


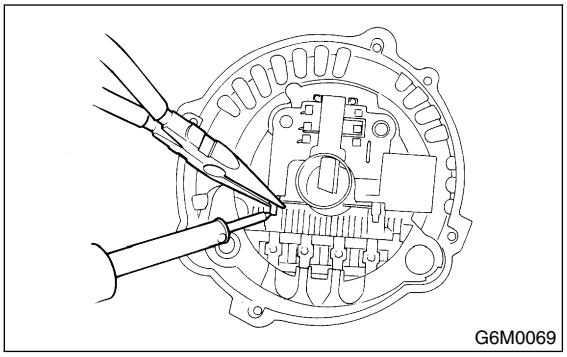
(A) Front bracket
(B) Rotor
(C) Pulley
(D Nut

3) Unsolder connection between rectifier and stator coil to remove stator coil.

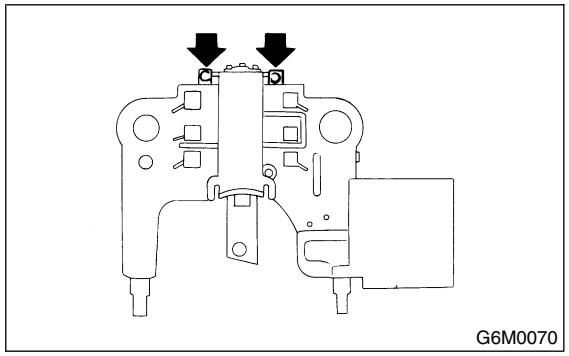
CAUTION:
Finish the work rapidly (less than three seconds) because the rectifier cannot withstand heat very well.



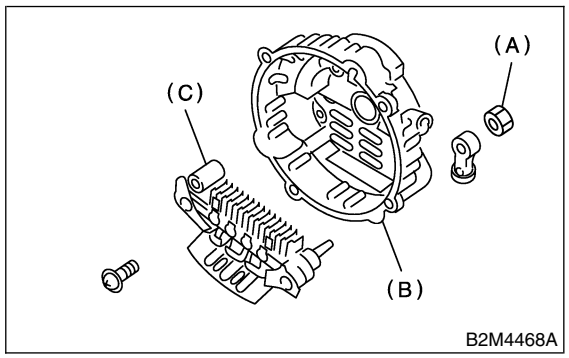
4) Remove screws which secure IC regulator to rear cover, and unsolder connection between IC regulator and rectifier to remove IC regulator.



5) Remove the brushes by unsoldering at the pigtails.



6) Remove the nut and insulating bushing at terminal B, and remove rectifier.

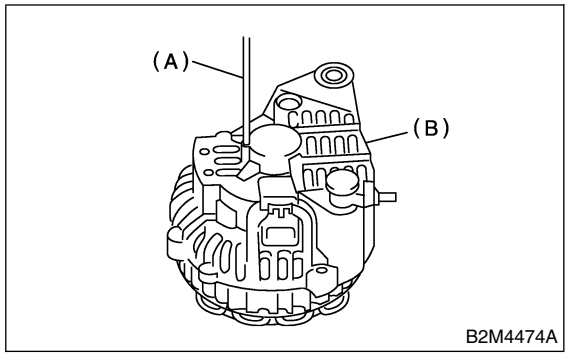


(A) Nut
(B) Rear cover
(C) Rectifier

D: ASSEMBLY *S149008A02*

Assemble in the reverse order of disassembly.
1) Pulling up brush
Before assembling, press the brush down into the brush holder with your finger and secure in that position by passing a [2 mm (0.08 in) dia. length 4 to 5 cm (1.6 to 2.0 in)] wire (A) through the hole shown in the figure.

CAUTION:
Be sure to remove the wire after reassembly.



(A) Wire
(B) Rear cover

2) Heat the bearing box in the rear bracket [50 to 60°C (122 to 140°F)] and press the rear bearing into the rear bracket.

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

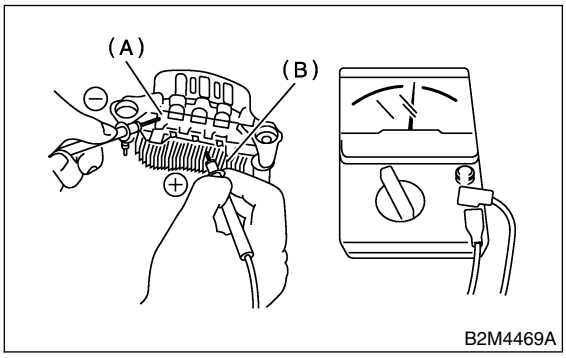
3) After reassembly, turn the pulley by hand to check that the rotor turns smoothly.

E: INSPECTION S149008A10

1. DIODE S149008A1001

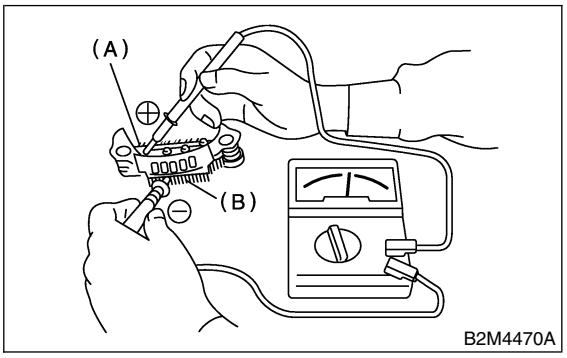
CAUTION:
Never use a megatester (measuring use for high voltage) or any other similar measure for this test; otherwise, the diodes may be damaged.

1) Checking positive diode
Check for continuity between the diode lead and the positive side heat sink. The positive diode is in good condition if continuity exists only in the direction from the diode lead to the 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 continuity exists only in the direction from the heat sink to the diode lead.



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

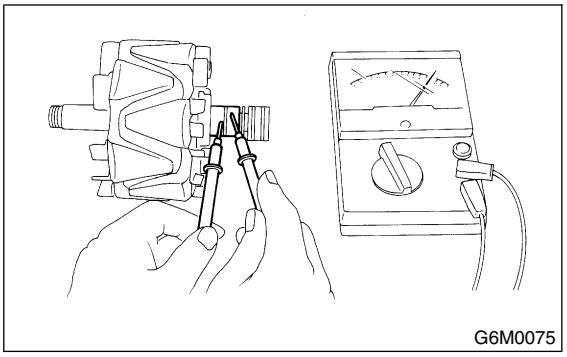
2. ROTOR S149008A1002

1) Slip ring surface
Inspect slip rings for contamination or any roughness of the sliding surface. Repair slip ring surface using a lathe or sand paper.
2) Slip ring outer diameter
Measure slip ring outer diameter. If slip ring is worn replace rotor assembly.

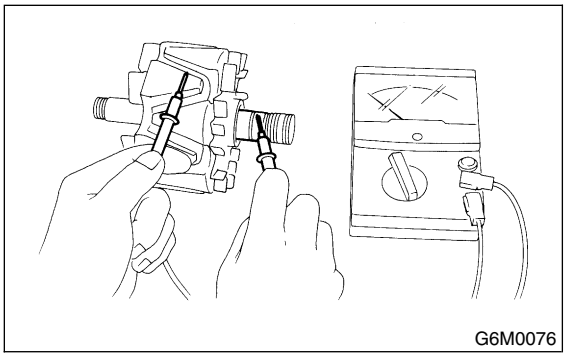
Slip ring outer diameter:
Standard
22.7 mm (0.894 in)
Limit
22.1 mm (0.870 in)

3) Continuity test
Check resistance between slip rings using circuit tester.
If the resistance is not within specification, replace rotor assembly.

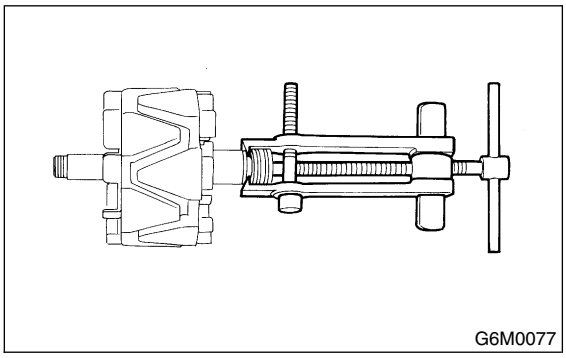
Specified resistance:
Approx. 2.7 — 3.2 Ω



4) Insulation test
Check continuity between slip ring and rotor core or shaft. If continuity exists, the rotor coil is grounded, and so replace rotor assembly.

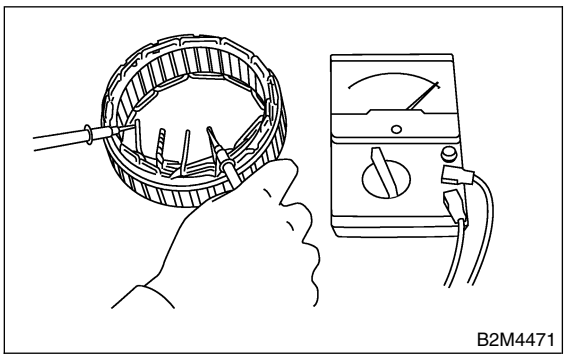

G6M0076

5) Ball bearing (rear side)
(1) Check rear ball bearing. Replace if it is noisy or if rotor does not turn smoothly.
(2) The rear bearing can be removed by using common bearing puller.


G6M0077

3. STATOR S149008A1003

1) Continuity test
Inspect stator coil for continuity between each end of the lead wires. If there is no continuity between individual lead wires, the lead wire is broken, and so replace stator assembly.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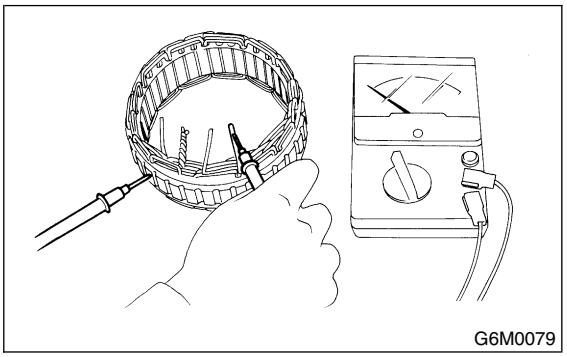
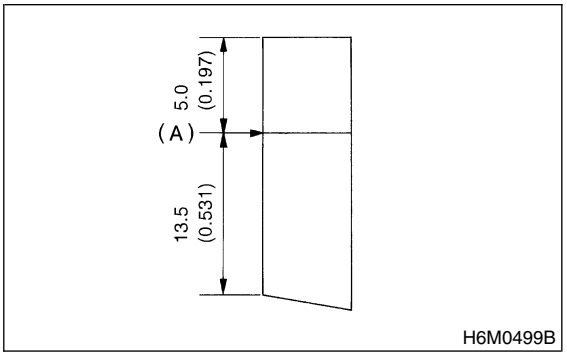
2) Insulation test
Inspect stator coil for continuity between stator core and each end of the lead wire. If there is continuity, the stator coil is grounded, and so replace stator assembly.


G6M0079

4. BRUSH S149008A1004

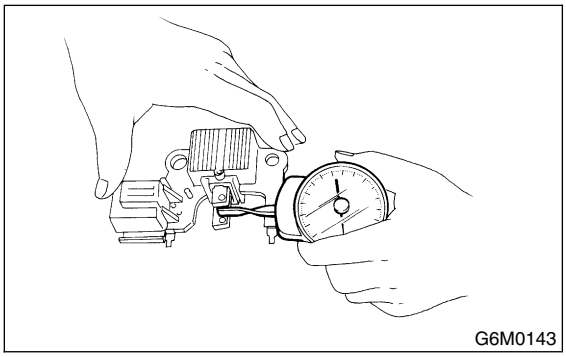
1) Measure the length of each brush. If wear exceeds the service limit, replace the brush. Each brush has the service limit mark (A) on it.

Brush length:
Standard
18.5 mm (0.728 in)
Service limit
5.0 mm (0.197 in)



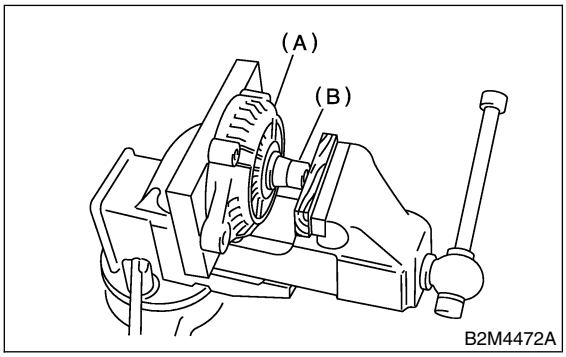
H6M0499B

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 the 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 20.81 oz).



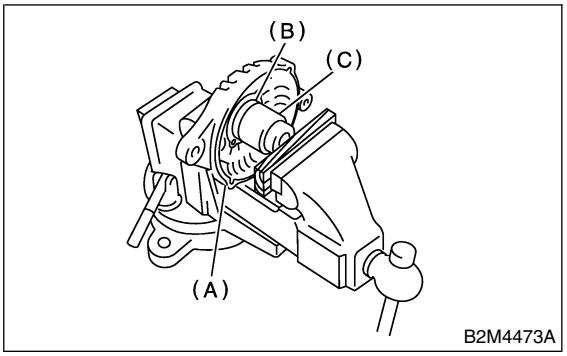
5. BEARING (FRONT SIDE) *S149008A1005*

1) Check front ball bearing. If resistance is felt while rotating, or if abnormal noise is heard, replace the ball bearing.
2) Replacing front bearing
   (1) Remove front bearing retainer.
   (2) Closely install a fit tool on the bearing inner race. Press the bearing down out of front bracket with a hand press or vise. A socket wrench can serve as the tool.



(A) Front bracket
(B) Socket wrench

(3) Set a new bearing and closely install a fit tool on the bearing outer race. Press the bearing down into place with a hand press or vise. A socket wrench can serve as the tool.
(4) Install front bearing retainer.

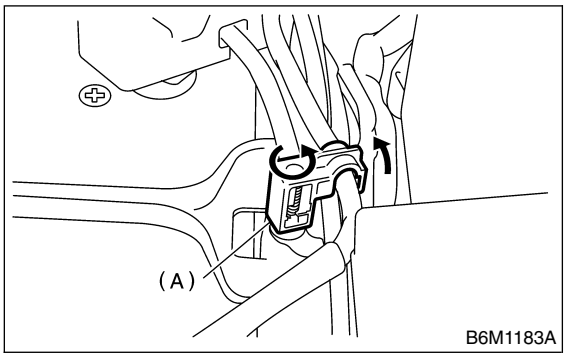


(A) Front bracket
(B) Bearing
(C) Socket wrench

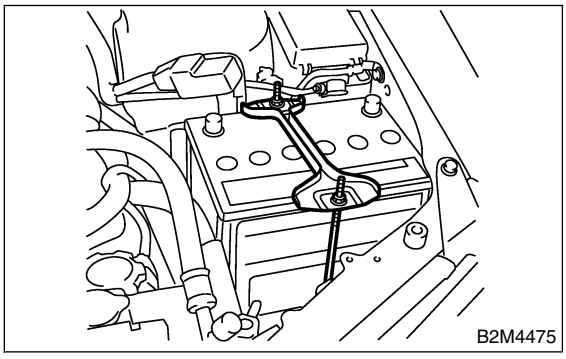
4. Battery S149011

A: REMOVAL S149011A18

1) Remove battery cable holder (A) from battery rod.



2) Disconnect the positive (+) terminal after disconnecting the negative (–) terminal of battery.
3) Remove flange nuts from battery rods and take off battery holder.



4) Remove battery.

B: INSTALLATION S149011A11

Install in the reverse order of removal.

Tightening torque:
3.4 N·m (0.35 kgf-m, 2.5 ft-lb)

NOTE:
- Clean battery cable terminals and apply grease to retard the formation of corrosion.
- Connect the positive (+) terminal of battery and then the negative (–) terminal of the battery.

C: INSPECTION S149011A10

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 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: S149011A1001

Check for the existence of dirt or cracks on the 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.

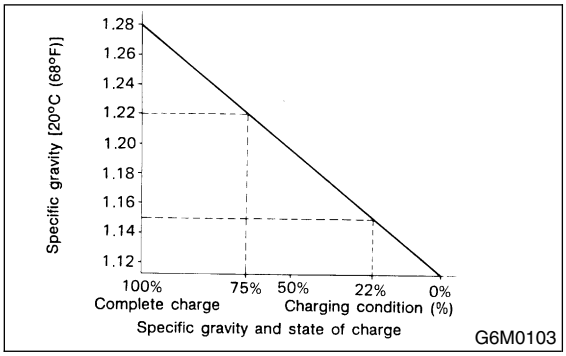
2. ELECTROLYTE LEVEL: S149011A1002

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: S149011A1003

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 × (t – 20)
S_{20}: 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)]



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

D: MEASUREMENT S149011A14

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 battery electrolyte overflows while charging the battery.
• Observe 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.

1. JUDGMENT OF BATTERY IN CHARGED CONDITION S149011A1401

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 S149011A1402

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 S149011A1403

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

4. QUICK CHARGING S149011A1404

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 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).
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.

CAUTION:
• Observe the items in 1. NORMAL CHARGING.
• Never use more than 10 amperes when charging the battery because that will shorten battery life.

MEMO: