STARTING/CHARGING SYSTEMS

1. General Description

A: SPECIFICATION

1. NON-TURBO MODEL

Item			Specification	
Starter	Type		Reduction type	
	Vehicle model		MT	AT
	Model		M000T30471	M000T20171
	Manufacturer		Mitsubishi Electric	
	Voltage and output		12 V — 1.0 kW	12 V — 1.4 kW
	Direction of rotation		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 (0.9 kgf-m, 6.5 ft-lb) or more	16.7 N·m (1.7 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	Type		Rotating-field three-phase type, voltage regulator built-in type, with load response control system	
	Model		A2TG0391	
	Manufacturer		Mitsubishi Electric	
	Voltage and output		12 V — 90 A	
	Polarity on ground side		Negative	
	Direction of rotation		Clockwise (when observed from pulley side)	
	Armature connection		3-phase Y-type	
	Output current		1,500 rpm — 40 A or more 2,500 rpm — 74 A or more 5,000 rpm — 84 A or more	
	Regulated voltage		14.1 — 14.8 V [20°C (68°F)]	
Battery	Type and capacity		12 V — 48 AH (55D 23L)	12 V — 52 AH (75D 23L)

2. TURBO MODEL

Item			Specification	
Starter	Type		Reduction type	
	Vehicle model		MT	AT
	Model		228000 — 9270	M001T20171
	Manufacturer		DENSO	Mitsubishi Electric
	Voltage and output		12 V — 1.0 kW	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	2,860 rpm or more	2,000 rpm or more
	Load characteristics	Voltage	8 V	7.7 V
		Current	280 A	400 A
		Torque	9.3 N·m (0.95 kgf-m, 6.9 ft-lb) or more	16.7 N·m (1.7 kgf-m, 12.3 ft-lb) or more
		Rotating speed	860 rpm or more	710 rpm or more
	Lock characteristics	Voltage	5 V	3.5 V
		Current	515 A or less	960 A or less
		Torque	16 N·m (1.63 kgf-m, 11.8 ft-lb) or more	31 N·m (3.16 kgf-m, 22.9 ft-lb) or more
Generator	Type		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	
	Direction of rotation		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		12 V — 48 AH (55D 23L)	12 V — 52 AH (75D 23L)

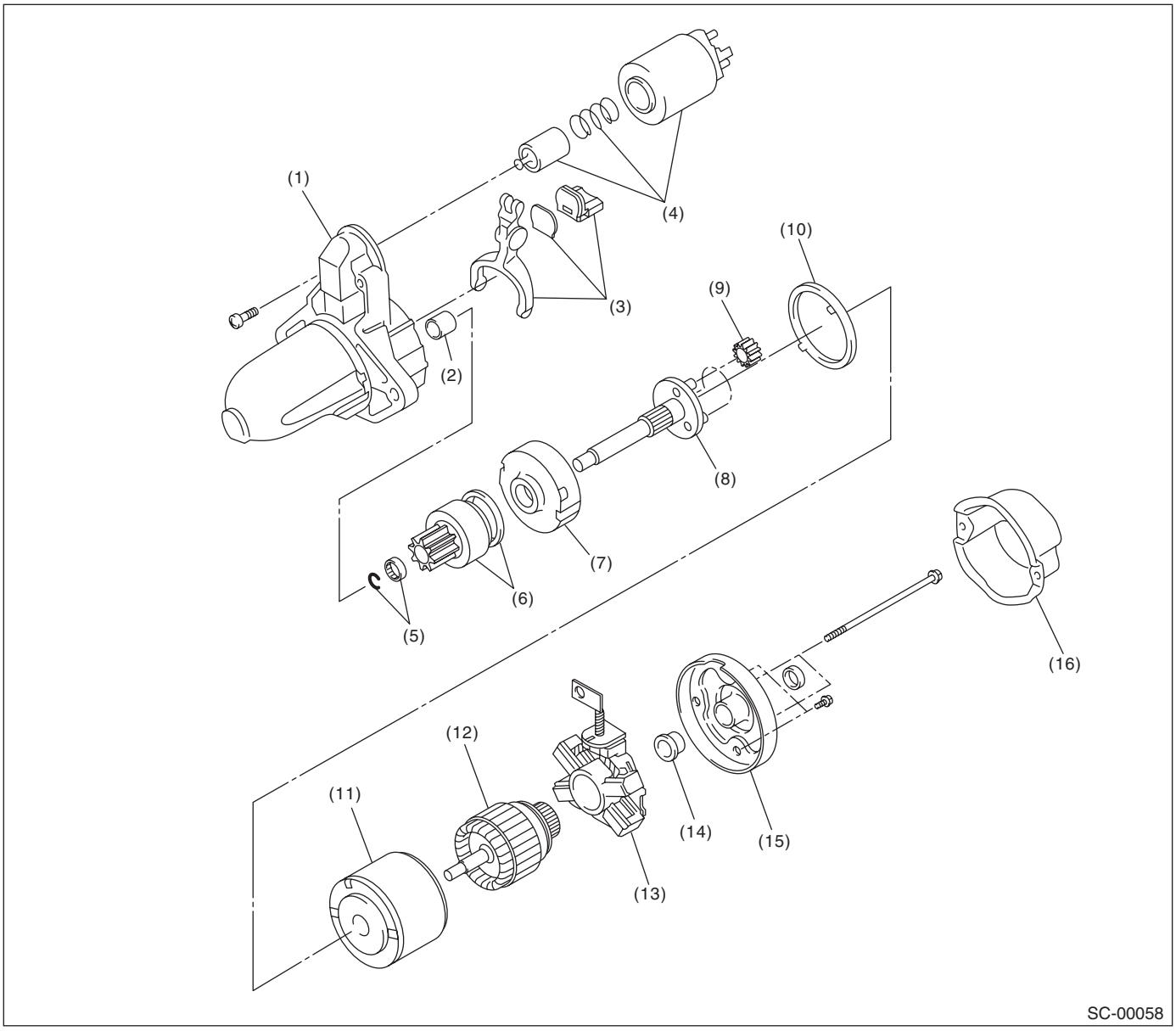
3. STI MODEL

Item			Specification
Starter	Type		Reduction type
	Vehicle model		MT
	Model		228000 — 9270
	Manufacturer		DENSO
	Voltage and output		12 V — 1.0 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	2,860 rpm or more
	Load characteristics	Voltage	8 V
		Current	280 A
		Torque	9.3 N·m (0.95 kgf-m, 6.9 ft-lb) or more
		Rotating speed	860 rpm or more
	Lock characteristics	Voltage	5 V
		Current	515 A or less
		Torque	16 N·m (1.63 kgf-m, 11.8 ft-lb) or more
Generator	Type		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
	Direction of rotation		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		12 V — 48 AH (55D 23L)

B: COMPONENT

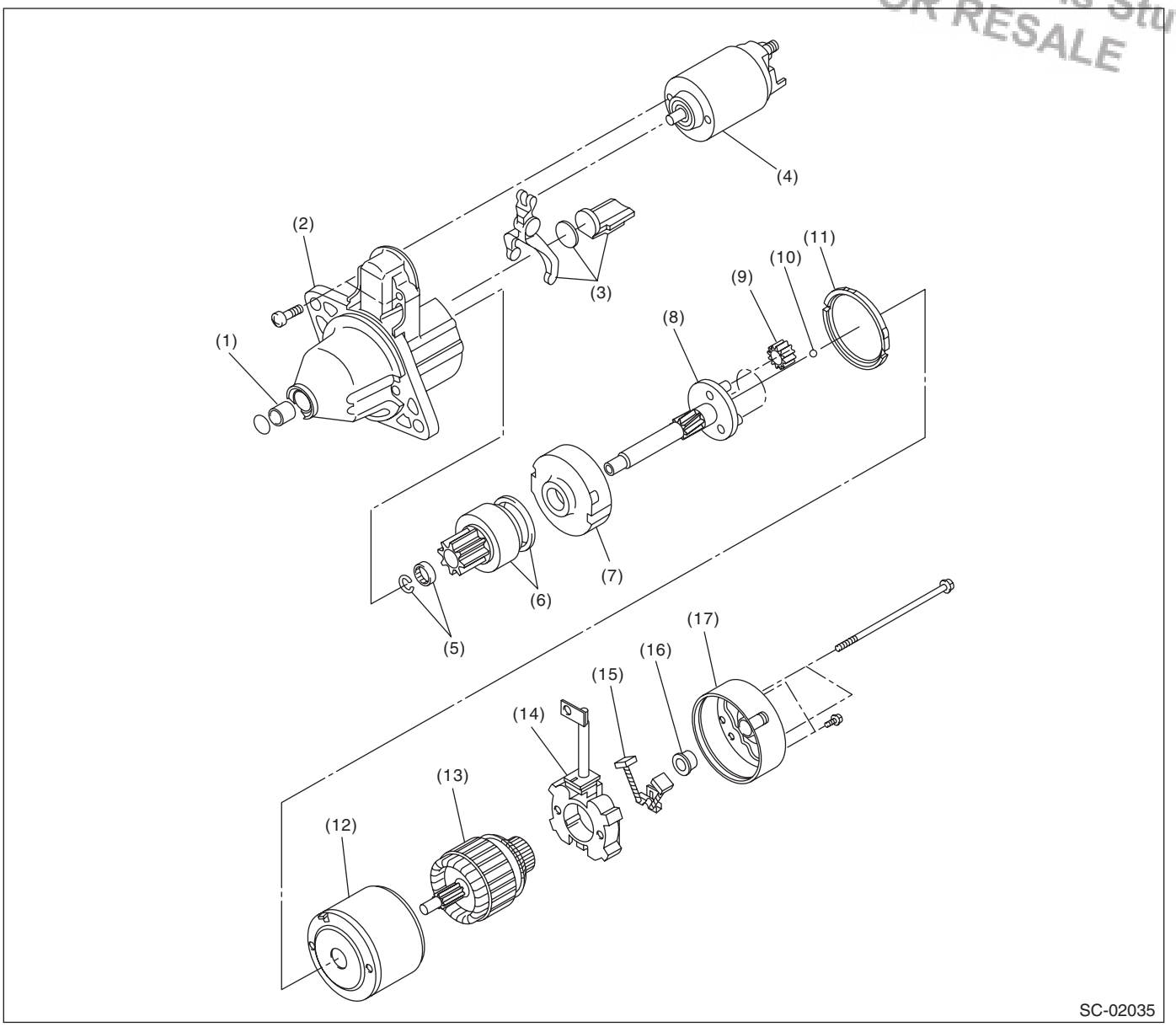
1. STARTER

Except for turbo MT model and STI model



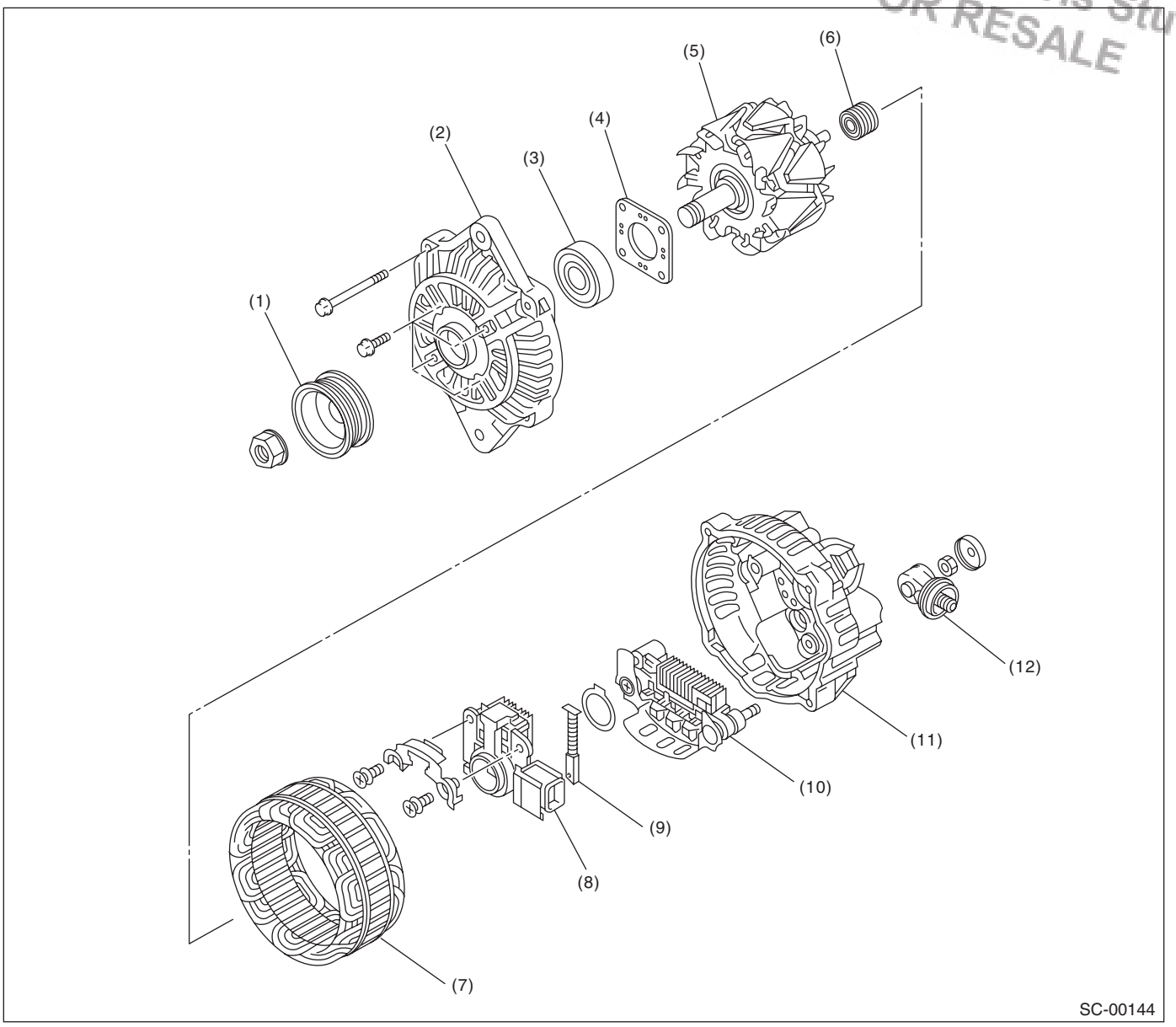
(1) Front bracket
(2) Sleeve bearing
(3) Lever set
(4) Magnet switch ASSY
(5) Stopper set
(6) Overrunning clutch
(7) Internal gear ASSY
(8) Shaft ASSY
(9) Gear ASSY
(10) Gasket
(11) Yoke ASSY
(12) Armature
(13) Brush holder ASSY
(14) Sleeve bearing
(15) Rear cover
(16) Rear cover set

Turbo MT model and STI model



(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) Ball
(11) Gasket
(12) Yoke ASSY
(13) Armature
(14) Brush holder ASSY
(15) Brush
(16) Sleeve bearing
(17) Rear bracket

2. GENERATOR



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

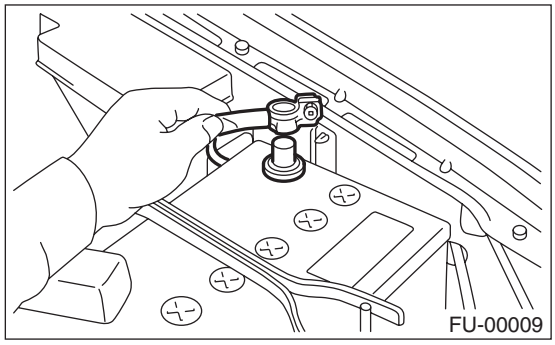
C: CAUTION

- Wear appropriate work clothing, including a cap, protective goggles and protective shoes when performing any work.
- 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.
- Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.
- 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 connectors of sensors or units, be sure to disconnect the ground cable from the battery.

2. Starter

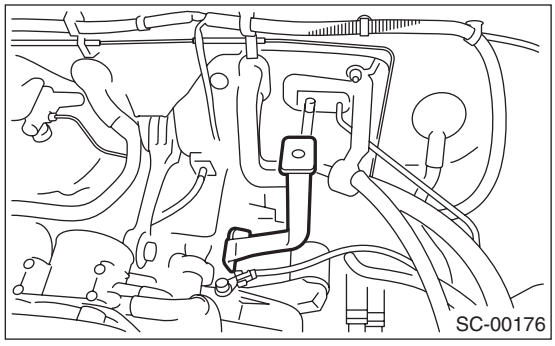
A: REMOVAL

1) Disconnect the ground cable from the battery.

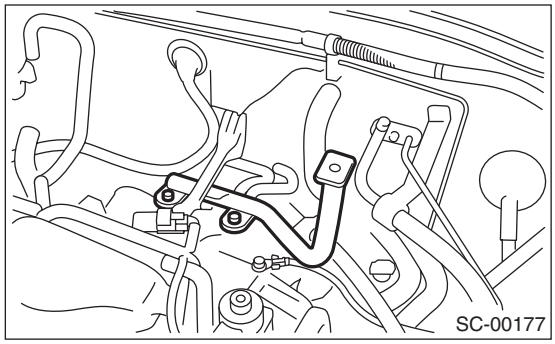


2) Remove the air intake chamber. (Non-turbo model) <Ref. to IN(H4SO)-6, REMOVAL, Air Intake Chamber.>
3) Remove the intercooler. (Turbo model) <Ref. to IN(H4DOTC)-13, REMOVAL, Intercooler.>
4) Remove the air intake chamber stay. (Non-turbo model)

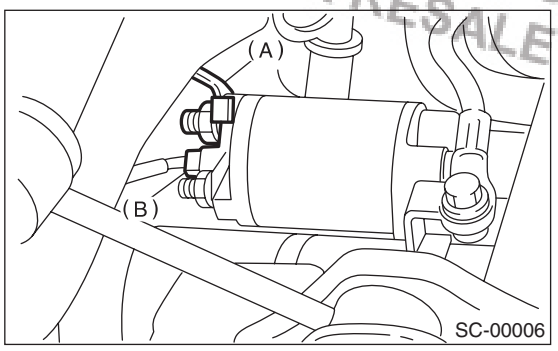
- MT model



- AT model



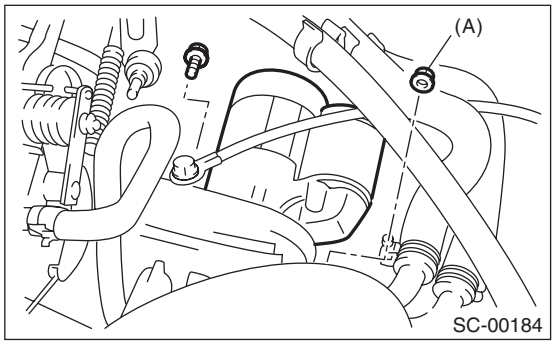
5) Disconnect the connector and terminal from starter.



(A) Terminal
(B) Connector

6) Remove the starter from transmission.

NOTE:
For the MT model, a bolt is used in place (A).

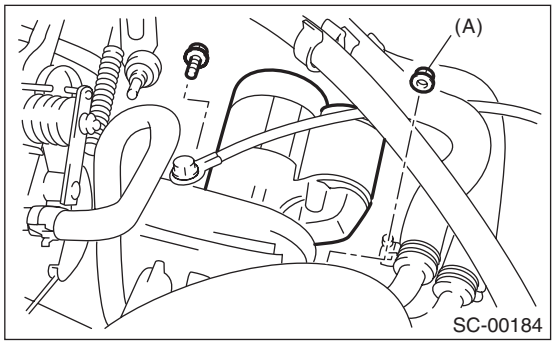


B: INSTALLATION

Install in the reverse order of removal.

NOTE:
For the MT model, a bolt is used in place (A).

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

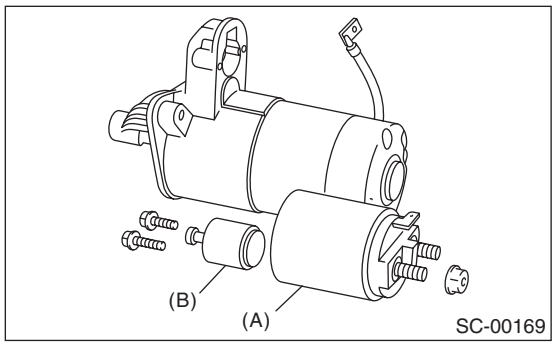


C: DISASSEMBLY

1. STARTER ASSEMBLY

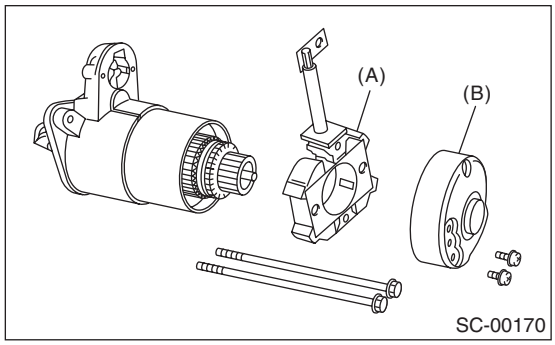
1) Loosen the nuts fastening the switch assembly terminal M, then disconnect the connector.
2) Remove the bolts fastening the switch assembly, then remove the switch assembly, plunger and plunger spring as a unit from the starter.

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



(A) Magnet switch ASSY
(B) Plunger

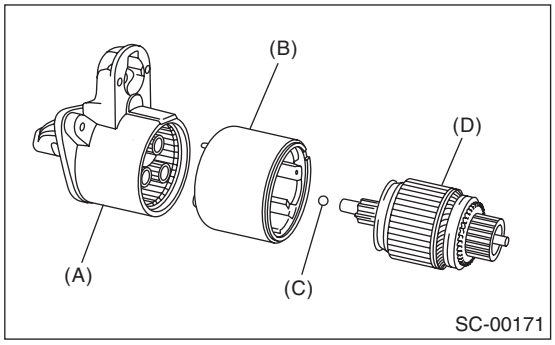
3) Remove the bolts passing through both sides, and the brush holder screws, then remove rear cover and brush holder.



(A) Brush holder
(B) Rear cover

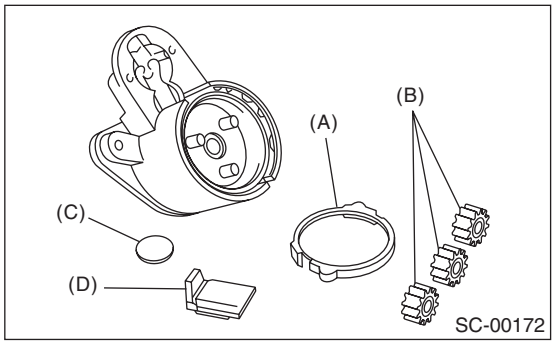
4) Remove the armature and yoke assembly from the front bracket. The ball used as a bearing will come off from the armature end.

NOTE:
Before removing the yoke, put alignment marks on the yoke assembly and front bracket.



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

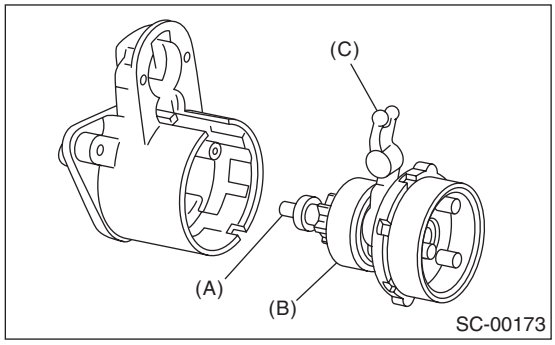
5) Remove the gasket A, planetary gears, gasket B and plate.



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

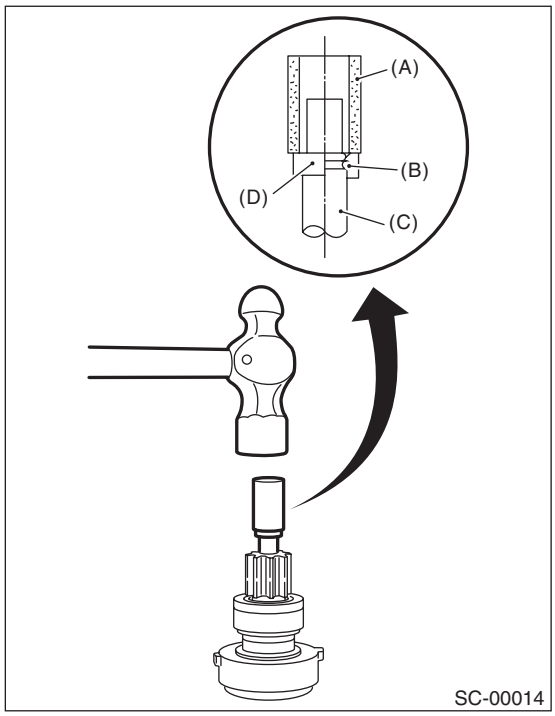
6) Remove the shaft assembly and overrunning clutch as a unit.

NOTE:
Note the direction of the lever before removing.



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

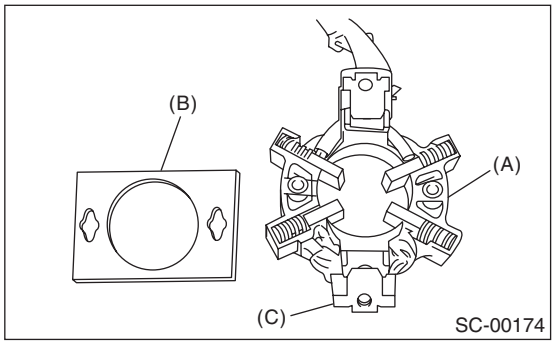
7) Use the following procedures to remove the overrunning clutch from the shaft assembly.
(1) Use the appropriate tool (such as the right size of socket wrench) to lightly tap on the stopper to remove it from the ring.
(2) Remove the ring, spacer, and clutch from the shaft.



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

2. BRUSH HOLDER

NOTE:
Only the brush holder of turbo MT model and STI model starter can be disassembled.
Slightly open the metal fitting while holding the insulating plate against the brush holder. Remove the insulating plate.
The brush and spring can be easily removed from the brush holder at this time.



(A) Brush holder
(B) Insulating plate
(C) Metal fitting

D: ASSEMBLY

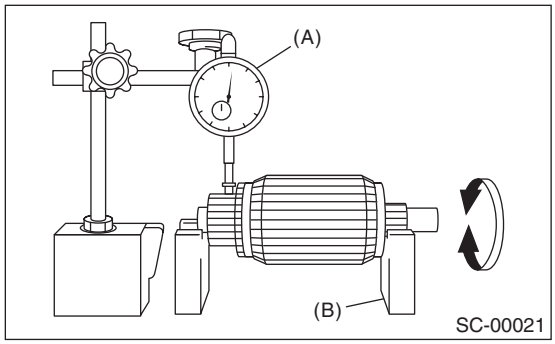
1) Assemble in the reverse order of disassembly.
2) Apply grease to the following parts before assembly.
- Front and rear bracket sleeve bearings
- Armature shaft gear
- Outer periphery of plunger
- Mating surfaces of plunger and lever
- Gear shaft splines
- Mating surfaces of lever and clutch
- Ball at armature shaft end
- Planetary gear

E: INSPECTION

1. ARMATURE

1) Check the commutator for signs of seizure or stepped wear caused by roughness of the surface. If there is light wear, use sandpaper to repair.
2) Run-out test
Check for run-out on the commutator. If excessive, replace it.

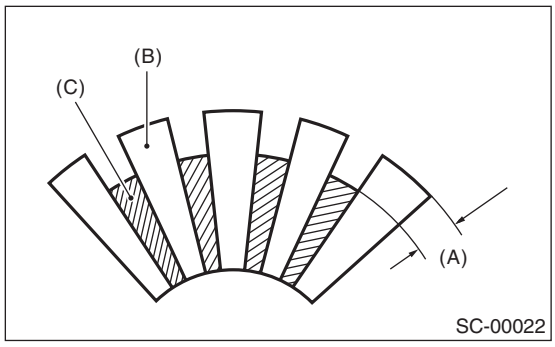
Commutator run-out:
Standard
0.05 mm (0.0020 in)
Service limit
0.10 mm (0.0039 in) or less



(A) Dial gauge
(B) V-block

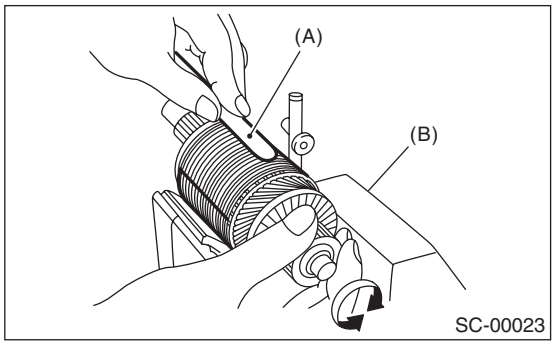
3) Depth of segment mold
Check the depth of the segment mold.

Depth of segment mold:
0.5 mm (0.020 in)



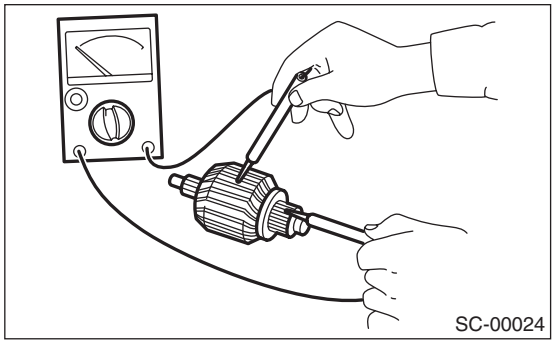
(A) Depth of mold
(B) Segment
(C) Mold

4) Armature short-circuit test
Place the armature on the growler tester to check for short circuits. While slowly turning the armature, support the steel seat for the armature core. If the circuit of the armature is shorted, the steel seat will vibrate, causing it to move towards the core. When the steel seat has moved or vibrated, replace or repair the armature with the shorted circuit.



(A) Steel seat
(B) Growler tester

5) Armature ground test
Use a circuit tester to touch the probe of one side to the commutator segment, and the other probe to the shaft. If there is no continuity, it is normal. If there is continuity, the armature is grounded.
If grounded, replace the armature.



2. YOKE

Make sure that the pole is set at the predetermined position.

3. OVERRUNNING CLUTCH

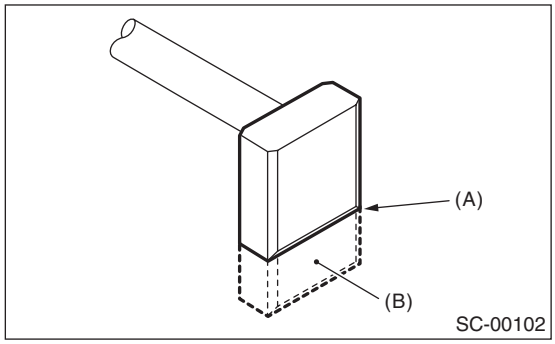
Check that there is no wear or damage to the piston teeth. Replace if it is damaged. If it rotates smoothly when rotated in the correct direction (counterclockwise) and does not return to the other direction, it is normal.

CAUTION:
To prevent spilling of grease, do not clean the overrunning clutch with oil.

4. BRUSH AND BRUSH HOLDER

1) Brush length
Measure the length of the brush. If it exceeds service limits, replace it.
Replace if there is abnormal wear or cracks.

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
Check that the brush moves smoothly in the brush holder.
3) Brush spring force
Measure the brush spring force with a spring scale.
Replace the brush holder if below the service limit.

Brush spring force:

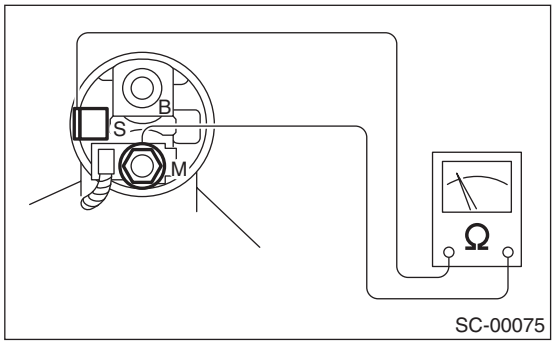
Standard
Except for turbo MT model and STI model
15.9 — 19.5 N
(1.62 — 1.99 kgf, 3.57 — 4.38 lbf) (When new)
Turbo MT model and STI model
21.6 N (2.2 kgf, 4.9 lbf) (When new)

Service limit
Except for turbo MT model and STI model
2.5 N (0.25 kgf, 0.56 lbf)
Turbo MT model and STI model
5.9 N (0.6 kgf, 1.3 lbf)

5. SWITCH ASSEMBLY

Using a circuit tester (set to "ohm"), check that there is continuity between terminals S and M, and between terminal S and ground.
Also check to be sure there is no continuity between terminal M and B.

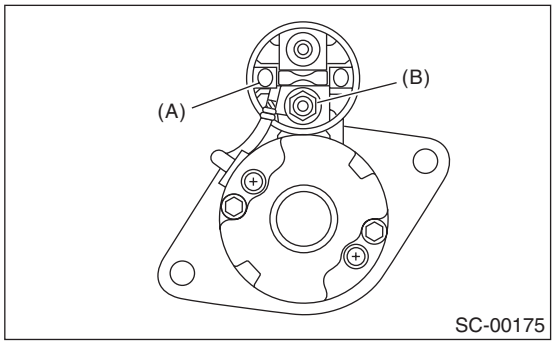
Terminal/Resistance:
S — M/1 Ω or less
S — Ground/1 Ω or less
M — B/1 MΩ or more



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.

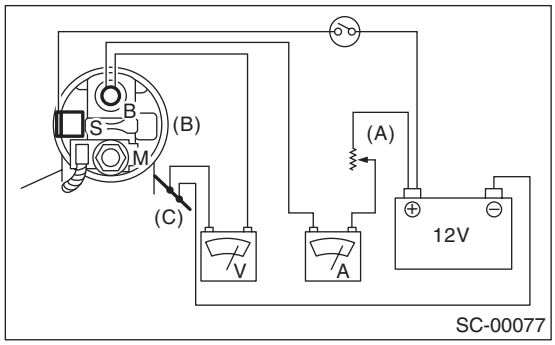
NOTE:
With the pinion forced endwise on shaft, starter motor can sometimes rotate because current flows, through pull-in coil, to motor. This is not a problem.
2) Disconnect the connector from terminal M. Then using a lead wire, connect the positive terminal of battery and terminal M and ground terminal 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 figure.



(A) Variable resistance
(B) Magnet switch
(C) Starter body

1) No-load test
With switch on, adjust the variable resistance until the voltage is 11 V, read the value of ammeter to measure starter speed. Compare these values with the standard.

No-load test (standard):

Voltage/Current
Non-turbo, MT model
Max. 11 V/95 A
Turbo MT model and STI model
Max. 11 V/90 A
AT model
Max. 11 V/90 A

Rotating speed
Non-turbo, MT model
2,500 rpm or more
Turbo MT model and STI model
2,860 rpm or more
AT model
2,000 rpm or more

2) Load test
Apply the specified braking torque to starter. The condition is normal if the current draw and starter speed are within standard.

Load test (standard):

Voltage/Load
Non-turbo, MT model
7.5 V/8.84 N·m (0.9 kgf-m, 6.5 ft-lb)
Turbo MT model and STI model
8 V/9.3 N·m (0.95 kgf-m, 6.9 ft-lb)
AT model
7.7 V/16.7 N·m (1.7 kgf-m, 12.3 ft-lb)

Current/Speed:
Non-turbo, MT model
300 A/870 rpm or more
Turbo MT model and STI model
280 A/860 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 standard voltage.

Lock test (standard):

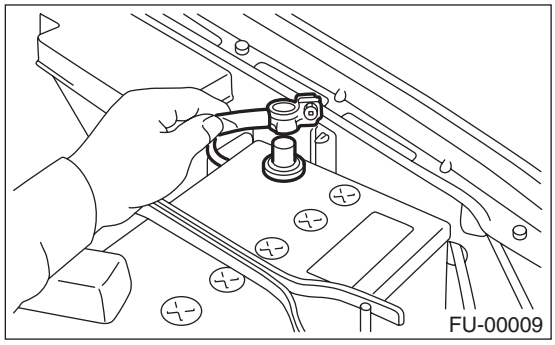
Voltage/Current
Non-turbo, MT model
4 V/680 A or less
Turbo MT model and STI model
5 V/515 A or less
AT model
3.5 V/960 A or less

Torque
Non-turbo, MT model
17 N·m (1.73 kgf-m, 12.5 ft-lb) or more
Turbo MT model and STI model
16 N·m (1.63 kgf-m, 11.8 ft-lb) or more
AT model
31 N·m (3.16 kgf-m, 22.9 ft-lb) or more

3. Generator

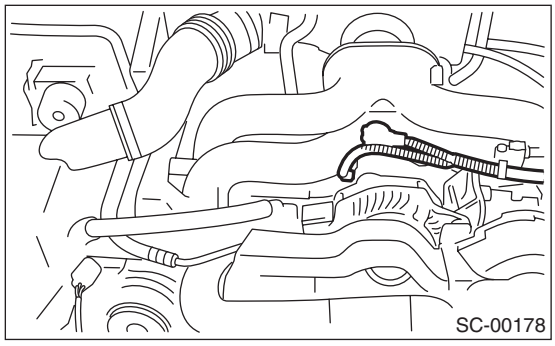
A: REMOVAL

1) Disconnect the ground cable from the battery.

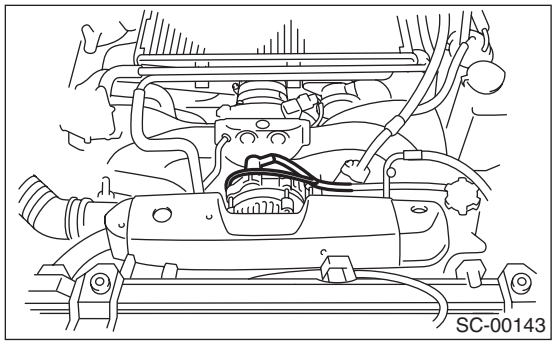


2) Disconnect the connector and terminal from generator.

- Non-turbo model



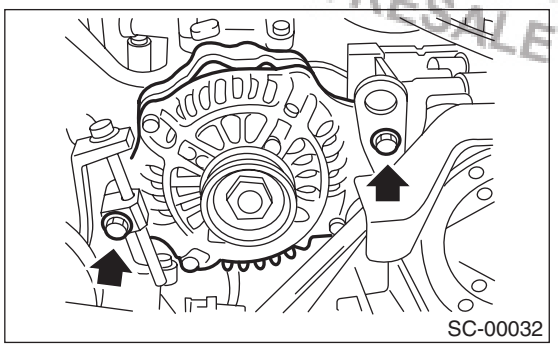
- Turbo model and STI model



3) Remove the V-belt covers.

4) Remove the front side V-belts. <Ref. to ME(H4SO)-39, FRONT SIDE BELT, REMOVAL, V-belt.> <Ref. to ME(H4DOTC)-44, FRONT SIDE BELT, REMOVAL, V-belt.>

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

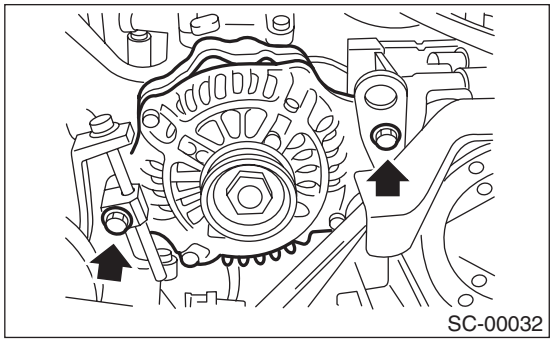


B: INSTALLATION

Install in the reverse order of removal.

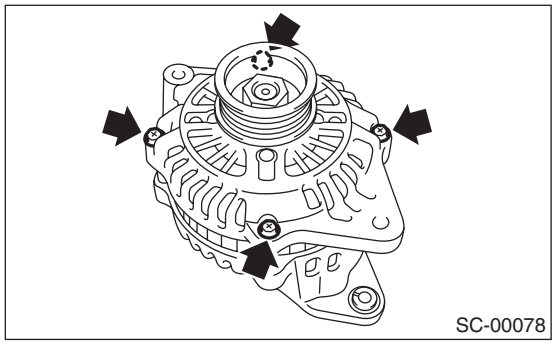
Tightening torque:
25 N·m (2.5 kgf-m, 18.1 ft-lb)

CAUTION:
Check and adjust the V-belt tension. <Ref. to ME(H4SO)-40, INSPECTION, V-belt.> <Ref. to ME(H4DOTC)-45, INSPECTION, V-belt.>

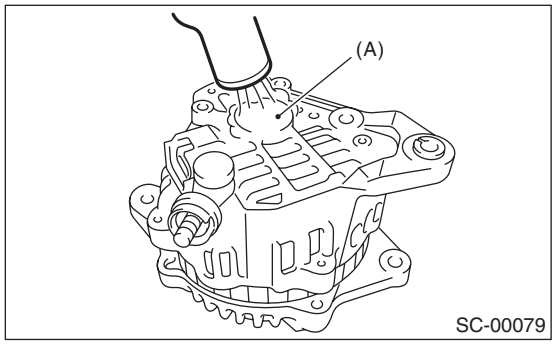


C: DISASSEMBLY

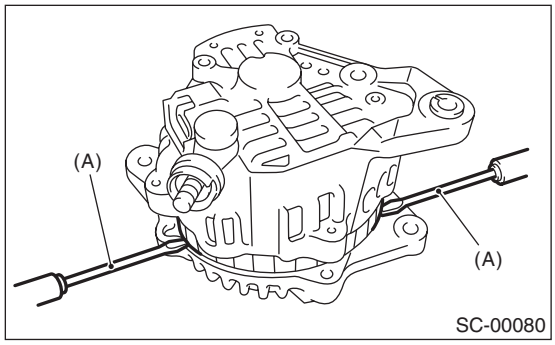
1) Remove the four through-bolts.



2) Use a drier to heat the rear cover (A) portion to 50°C (122°F).

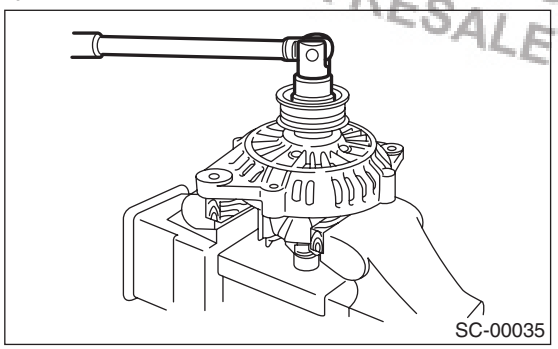


3) Insert the end of a flat tip screwdriver into the gap between stator core and front cover. Pry them apart to disassemble.

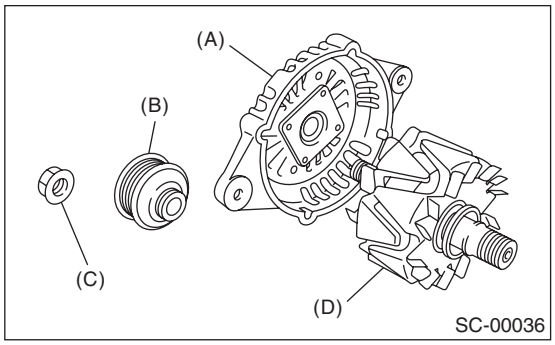


(A) Screwdriver

4) Using a vise, support the rotor and remove the pulley bolt.

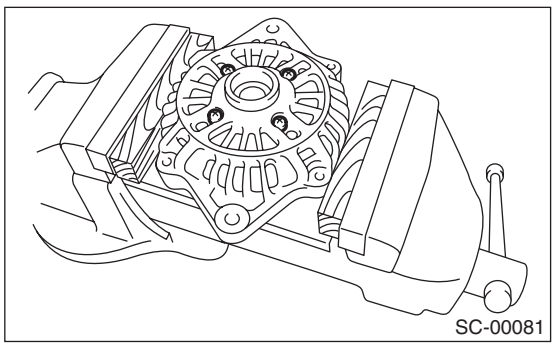


CAUTION:
When holding the rotor with a vise, place aluminum plates or wooden pieces on the vise jaws to prevent rotor from damage.

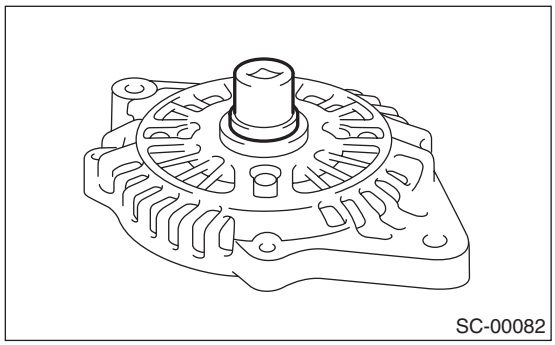


(A) Front cover
(B) Pulley
(C) Nut
(D) Rotor

5) Use the following procedures to remove the ball bearings.
(1) Remove the bolt, and then detach the bearing retainer.

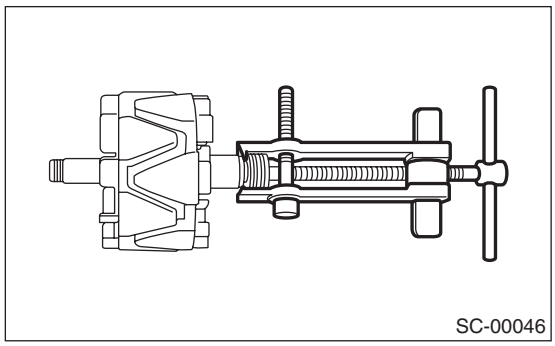


(2) Firmly attach an appropriate tool (such as a correct size socket wrench) to the bearing inner race.


SC-00082

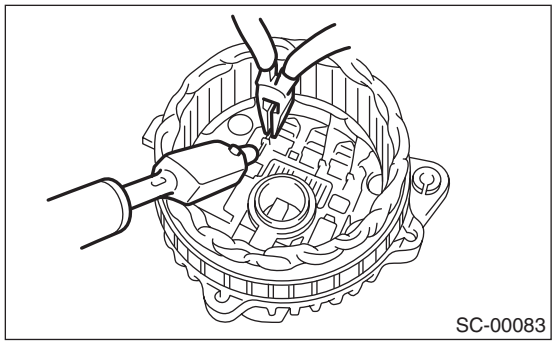
(3) Use the press to push the ball bearings out from the front cover.

6) Using the bearing puller, remove the bearings from the rotor.


SC-00046

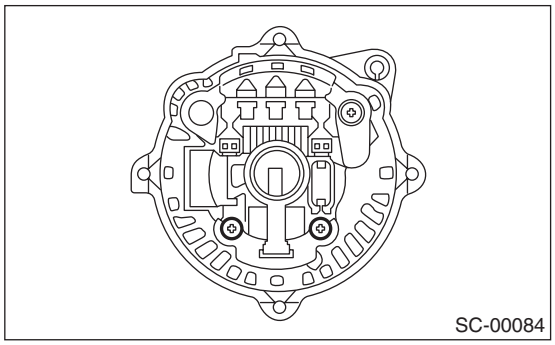
7) Disconnect the connection between the rectifier and stator coil, then remove the stator coil.

CAUTION:
The rectifier is easily damaged by heat. Do not allow a 180 — 270 W soldering iron to contact the terminals for 5 seconds or more at a time.

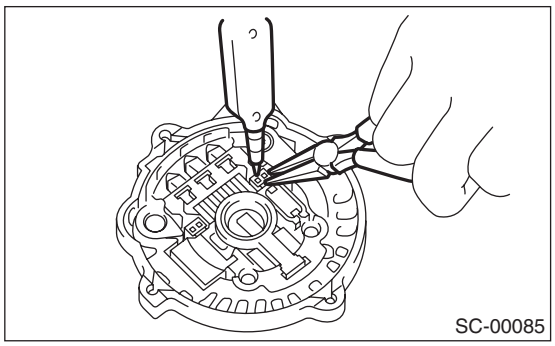

SC-00083

8) Use the following procedures to remove the IC regulator.

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

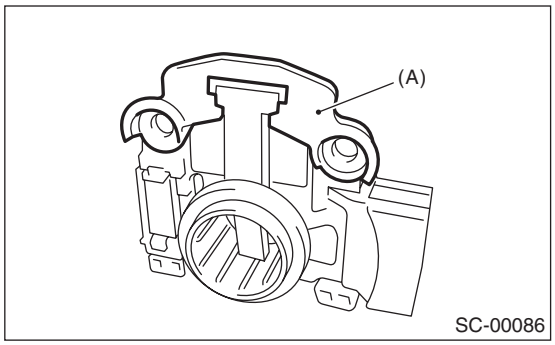

SC-00084

(2) Disconnect the connection between the IC regulator and rectifier, then remove the IC regulator.


SC-00085

9) Use the following procedures to remove the brush.

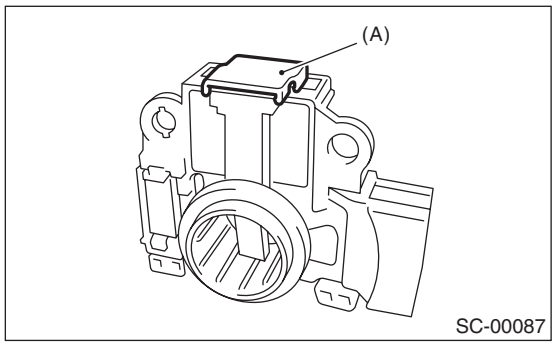
(1) Remove the cover A.



SC-00086

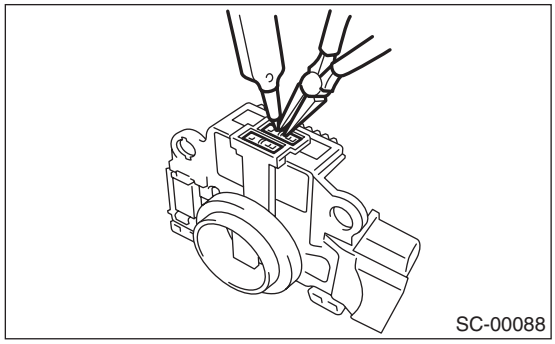
(A) Cover A

(2) Remove the cover B.

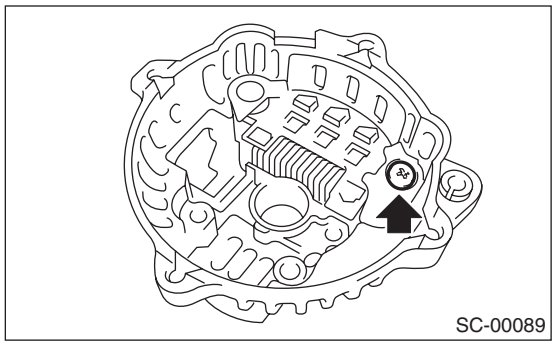


(A) Cover B

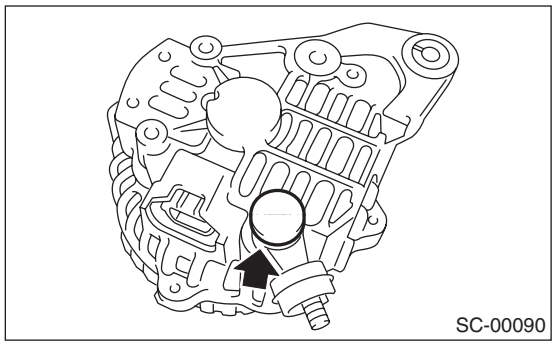
(3) Disconnect the connection and remove the brush.



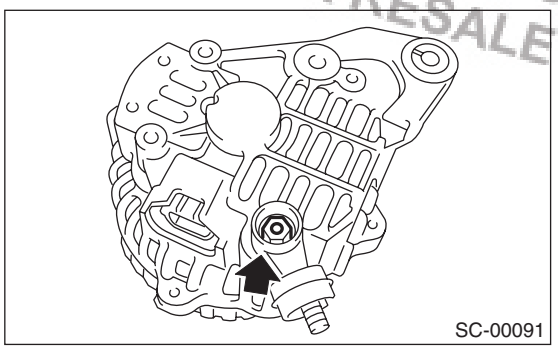
10) Remove the rectifier as follows.
(1) Remove the bolts which secure the rectifier.



(2) Remove the cover on terminal B.



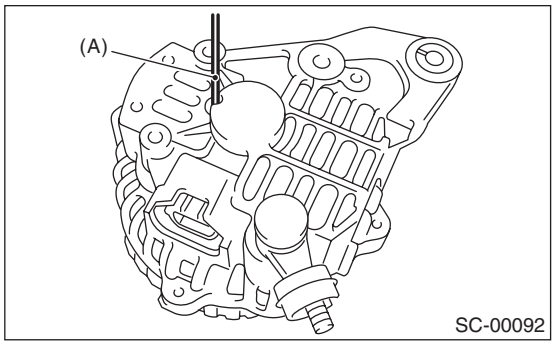
(3) Remove the nuts of terminal B, then remove the rectifier.



D: ASSEMBLY

Assemble in the reverse order of disassembly.
1) Pull-out of the brush
Before assembling, press the brush down into the brush holder, then fix the brush in that position by inserting a [1 mm (0.08 in) dia., 40 — 50 mm (1.6 — 2.0 in) long] wire through the hole as shown in the figure.

CAUTION:
After re-assembling, remove the wire.



(A) Wire

2) Install the ball bearings.
(1) Set the ball bearings in the front cover, then securely install an appropriate tool (such as a socket wrench of proper size) to the bearing outer race.
(2) Using a press to press the ball bearings into the specified location.
(3) Install the bearing retainer.
3) Use a press to install the bearings (rear side) to the rotor shaft.
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.

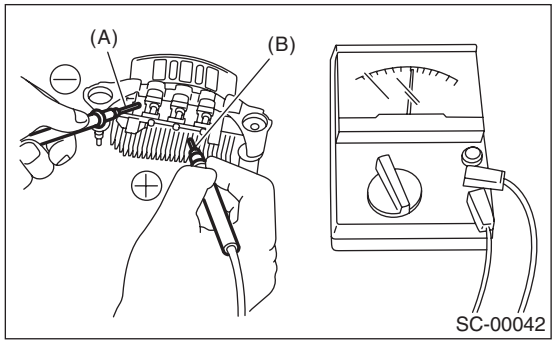
CAUTION:
Do not apply grease to the rear bearings. If there is any oil on the bearing box, remove it completely.
5) After re-assembling, manually turn the pulley to check that the rotor rotates smoothly.

E: INSPECTION

1. DIODE

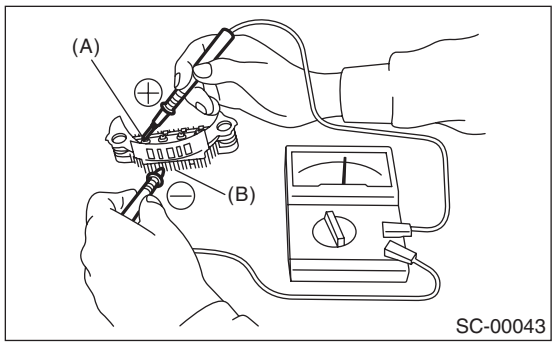
CAUTION:
There is the possibility of damaging the diodes if a mega-tester (used to measure high voltages) or a similar measuring instrument is used. Never use a mega tester or equivalent for this test.

1) Check the positive diode
Check for continuity between the diode lead and positive side heat sink. If resistance is 1 Ω or less only in the direction from the diode lead to the heat sink, the positive diode is OK.



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

2) Check negative diode
Check for continuity between the negative side heat sink and diode lead. If resistance is 1 Ω or less only in the direction from the heat sink to the diode lead, the negative diode is OK.



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

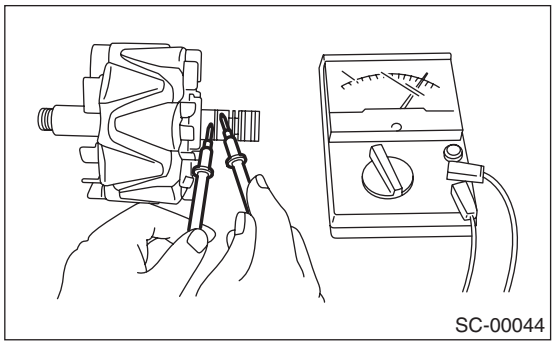
2. ROTOR

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. Replace the rotor assembly if the slip ring is worn.

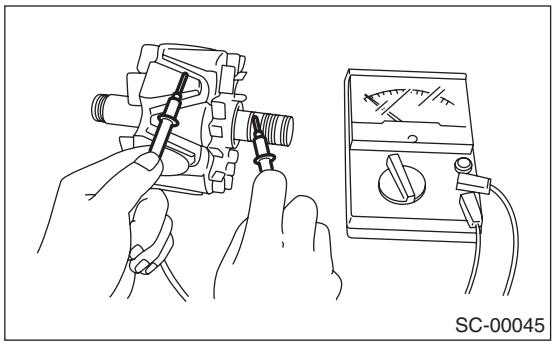
Slip ring outer diameter:
Standard
22.7 mm (0.894 in)
Limit
22.1 mm (0.870 in)

3) Continuity test
Using a circuit tester, check the resistance between slip rings.
If the resistance is not within the standard, replace the rotor assembly.

Specified resistance:
Approximately 1.8 — 2.2 Ω



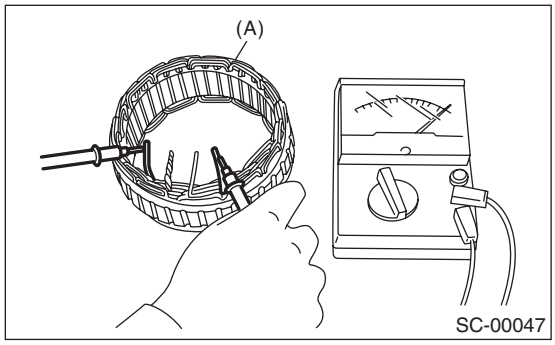
4) Insulation test
Check the continuity between slip ring and rotor core or shaft. If the resistance is 1 Ω or less, replace the rotor assembly because the rotor coil is grounded.



5) Ball bearings (rear side)
Check the rear ball bearing. If there is any noise, or the rotor does not rotate smoothly, replace the bearings.

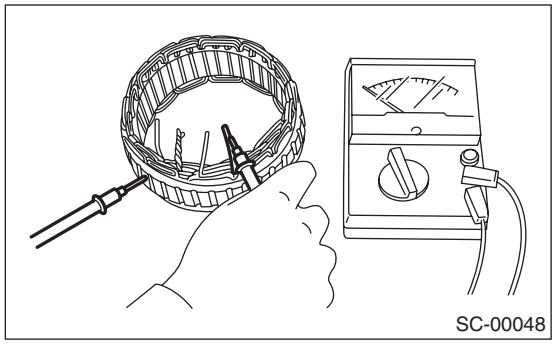
3. STATOR

1) Continuity test
Inspect continuity between the stator coil lead wire terminals. If the resistance is 1 MΩ or more, the lead wire is damaged. Replace the stator assembly.



(A) Stator

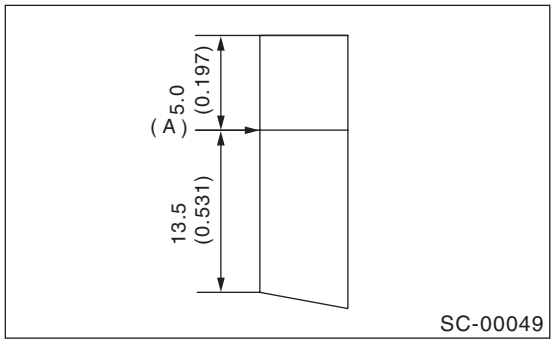
2) Insulation test
Inspect the continuity between the stator coil stator core and lead wire terminals. If the resistance is 1 Ω or less, the stator coil is grounded. Replace the stator assembly.



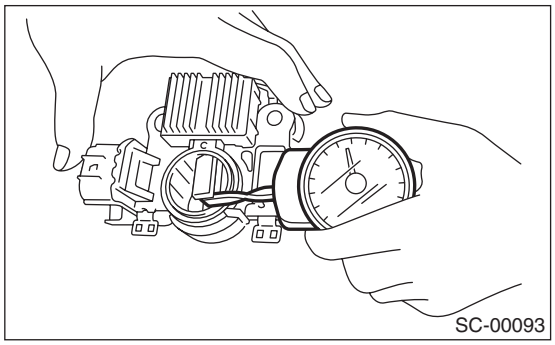
4. BRUSH

1) Measure the length of each brush. Replace the brush if wear exceeds service limits. There is a service limit mark (A) on each brush.

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



2) Check that there is appropriate pressure on the brush spring.
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 2.648 N (270 g, 9.52 oz) or less, replace the brush spring with a new part. 4.609 — 5.786 N (470 — 590 g, 16.58 — 20.810 oz) pressure is required on the new spring.



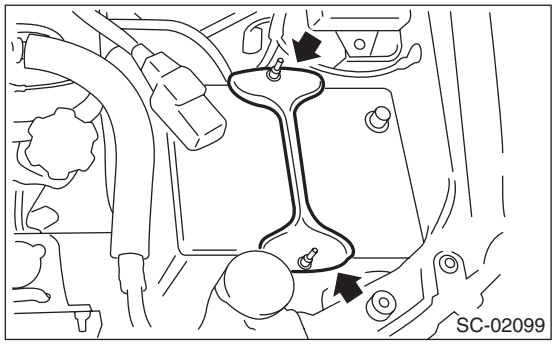
5. BEARING (FRONT SIDE)

Check the front ball bearing. Replace the ball bearings if there is resistance in the rotation, or if there is any abnormal noise.

4. Battery

A: REMOVAL

1) Disconnect the positive (+) terminal after disconnecting the negative (–) terminal of battery.
2) Remove the flange nut from battery rod and remove 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 battery positive (+) terminal, and then connect the negative (–) terminal.
• After the battery is installed, initial diagnosis of the electronic throttle control is performed. Therefore, start the engine 10 seconds or more after have turning the ignition switch to ON.

C: INSPECTION

WARNING:
• Electrolyte is corrosive acid, and has toxicity; be careful of handling the fluid.
• Make sure the electrode does not come into contact with skin, eyes or clothing. Especially at contact with eyes, flush with water for 15 minutes and get prompt medical attention.
• In addition, be careful not to let the electrode contact with the coated parts.
• Be careful when handling the batteries because they produce explosive gases.
• Be sure to keep battery away from any fire.
• For safety, in case an explosion does occur, wear eye protection or shield your eyes when working near any battery. In addition, never lean over the battery.
• Ventilate sufficiently when using or charging battery in enclosed space.
• Before starting work, 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.

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.

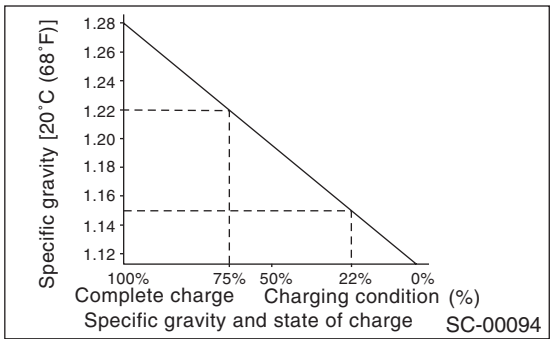
2. ELECTROLYTE LEVEL

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 calculation:

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 [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 when working.

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 the vehicle, disconnect the battery ground terminal to prevent damage of generator diodes or other electrical units.

1. JUDGMENT OF BATTERY IN CHARGED CONDITION

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

2. CHECK CONDITION OF CHARGE WITH HYDROMETER

Hydrometer indicator	State of charge	Corrective action
Green dot	65% or more	Load test
Dark dot	65% or less	Charge battery
Clear dot	Low electrolyte	Replace the battery.* (If cranking is difficult)
* Check electrical system before replacement.		

3. NORMAL CHARGING

Charge the battery at the current value specified by manufacturer or at approximately 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 raise the electrolyte temperature to 40°C (104°F) or more.
Also the quick charging is a temporary mean to bring battery voltage up to some level, and battery should be charged slowly with low current as a rule.

CAUTION:
• Observe the items in 3. NORMAL CHARGING.
• Never use 10 A or more when charging the battery because it will shorten the battery life.