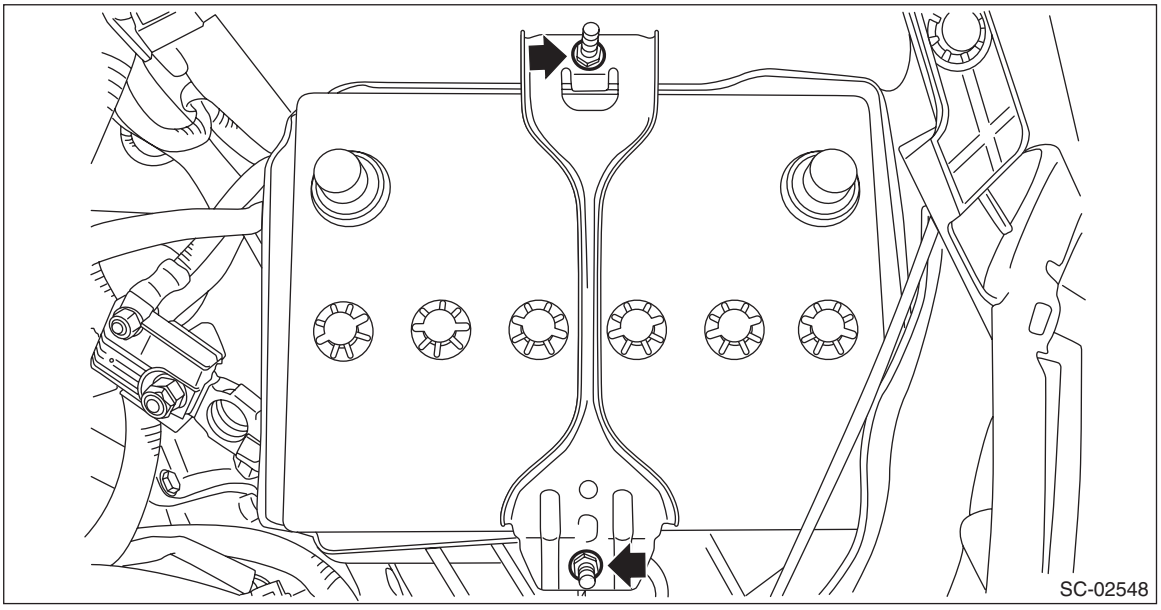
4. Battery

A: REMOVAL

1. 12 VOLT AUXILIARY BATTERY

1) Disconnect the ground cable from battery. <Ref. to NT-5, BATTERY, NOTE, Note.>

NOTE:
For the 12 volt engine restart battery, disconnect the ground terminal from 12V engine restart battery sensor.
2) Disconnect the terminal boot from the battery positive terminal, and disconnect the positive terminal.
3) Remove the battery cable holder from the battery rod.
4) Remove the flange nut from battery rod and remove battery holder.



5) Remove the battery.

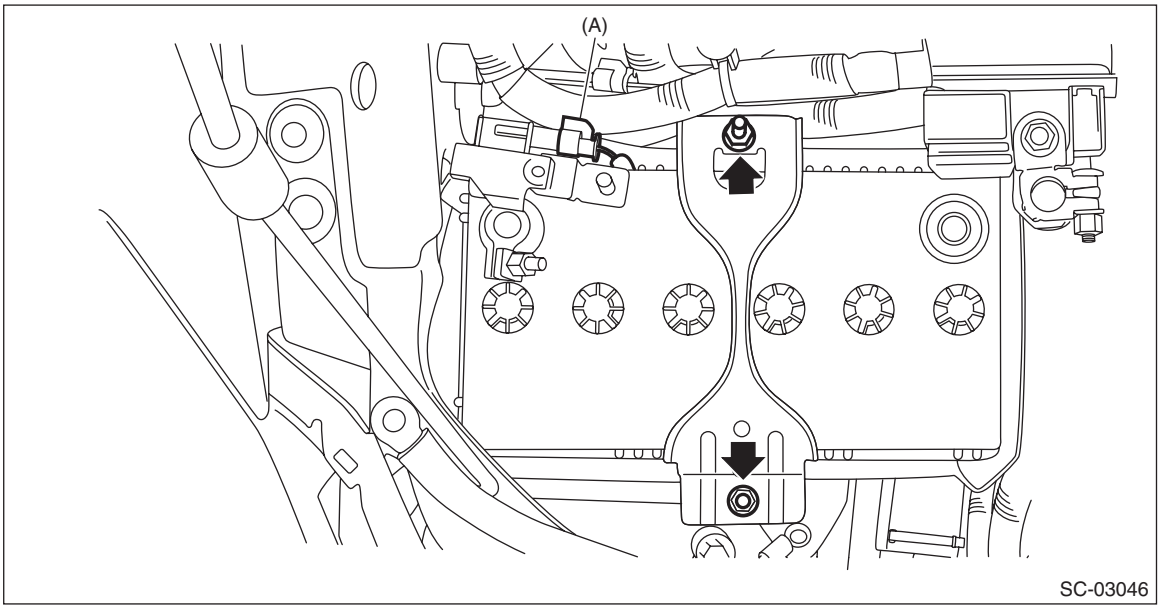
2. 12 VOLT ENGINE RESTART BATTERY

CAUTION:
Do not detach the 12V engine restart battery sensor from the 12 volt engine restart battery except when replacing the 12 volt engine restart battery.

1) Disconnect the ground cable from battery. <Ref. to NT-5, BATTERY, NOTE, Note.>

NOTE:
For the 12 volt engine restart battery, disconnect the ground terminal from 12V engine restart battery sensor.

2) Disconnect the positive (+) terminal after disconnecting the negative (–) terminal of battery.
3) Remove the battery cable holder from the battery rod.
4) Disconnect the connector (A) from the 12V engine restart battery sensor.
5) Remove the flange nut from battery rod and remove battery holder.



6) Remove the battery.

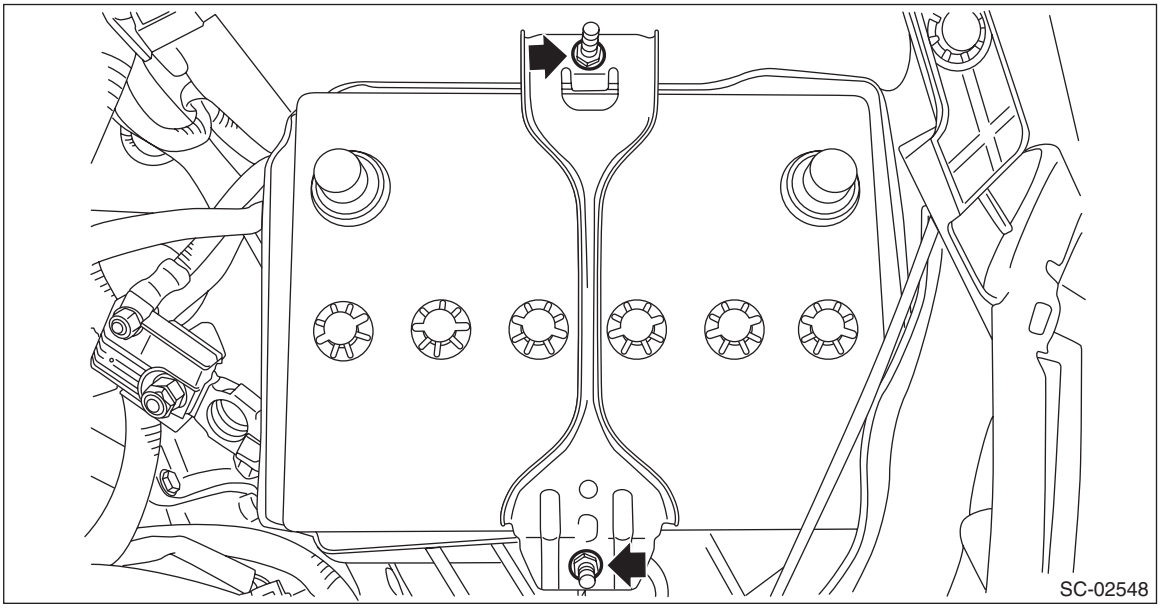
B: INSTALLATION

1. 12 VOLT AUXILIARY BATTERY

CAUTION:
• When installing the 12 volt auxiliary battery, wait at least one minute after removing the 12 volt auxiliary battery.
• Be careful not to contact the cable with the battery terminal during work because the power supply switches ON/OFF in a short time. Besides, in case trouble occurs in the vehicle during work, remove the 12 volt auxiliary battery again, and wait for one minute or more to install the 12 volt auxiliary battery. After that make sure there is no trouble anymore.
• After connecting the ground terminal to the battery, the following operations are automatically performed in the vehicle. Therefore, before starting the engine, place the select lever in the "P" position and wait for 10 seconds or more after turning the ignition switch to ON with the brake pedal released.
– Initial diagnosis of electronic throttle control
– Learning control of brake pedal stroke sensor

1) Install the battery.
2) Set the battery holder and install the flange nut to the battery rod.

Tightening torque:
3.5 N·m (0.4 kgf-m, 2.6 ft-lb)



3) Install the battery cable holder to the battery rod.
4) Connect the positive terminal to the battery and install the terminal boot.

NOTE:
Clean the battery cable terminals and apply grease to prevent corrosion as necessary.
5) Connect the ground cable to battery. <Ref. to NT-5, BATTERY, NOTE, Note.>

NOTE:
For 12 volt engine restart battery, connect the ground terminal to the 12V engine restart battery sensor.

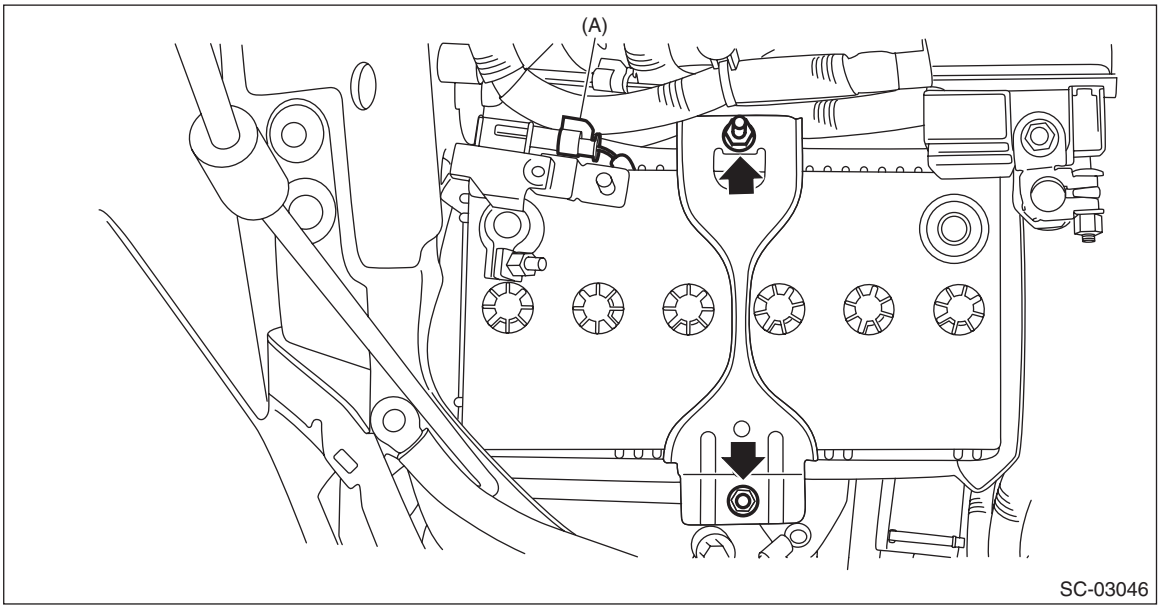
2. 12 VOLT ENGINE RESTART BATTERY

CAUTION:
• Do not detach the 12V engine restart battery sensor from the 12 volt engine restart battery except when replacing the 12 volt engine restart battery.
• After connecting the ground terminal to the battery, the following operations are automatically performed in the vehicle. Therefore, before starting the engine, place the select lever in the "P" position and wait for 10 seconds or more after turning the ignition switch to ON with the brake pedal released.
– Initial diagnosis of electronic throttle control
– Learning control of brake pedal stroke sensor

1) Install the battery.
2) Set the battery holder and install the flange nut to the battery rod.

Tightening torque:
3.5 N·m (0.4 kgf-m, 2.6 ft-lb)

3) Connect the connector (A) to 12V engine restart battery sensor.



4) Install the battery cable holder to the battery rod.
5) Connect the positive terminal and then connect the negative terminal to the battery.

NOTE:
Clean the battery cable terminals and apply grease to prevent corrosion as necessary.

6) Connect the ground cable to battery. <Ref. to NT-5, BATTERY, NOTE, Note.>

NOTE:
For 12 volt engine restart battery, connect the ground terminal to the 12V engine restart battery sensor.

C: DISASSEMBLY

Remove the 12V engine restart battery sensor. <Ref. to SC(H4DO(HEV))-60, REMOVAL, Battery Sensor.>

D: ASSEMBLY

Install the 12V engine restart battery sensor. <Ref. to SC(H4DO(HEV))-61, INSTALLATION, Battery Sensor.>

E: INSPECTION

WARNING:
- **As batteries produce flammable gases, be careful not to bring an open flame close to the batteries.**
- **Ventilate sufficiently when using or charging battery in enclosed space.**
- **Electrolyte is corrosive acid, and has toxicity; be careful of handling the fluid.**
- **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.**
- **Be careful that 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.**
- **Be careful not to let the electrode contact with the coated parts.**
- **Before starting work, remove rings, metal watch-bands, and other metal jewelry.**
- **Be careful not to let the metal tools contact the positive battery terminal and anything connected to it. When the operation using a metal tool to the positive terminal or anything connected to it is required, disconnect the battery ground terminal before starting the operation.**

1. APPEARANCE

Check the battery case, top cover and terminal post for contamination or cracks and perform the following procedures as necessary.
- Clean the battery with water and wipe with a dry cloth.
- Apply a light coat of grease to the terminal post to prevent corrosion.

Check

- ***Normal → Go to the check item 2.***
- ***Abnormal → Replace the battery.***

2. ELECTROLYTE LEVEL

Check the electrolyte level in each cell.

CAUTION:
Do not fill beyond MAX level.

NOTE:
If the level is below the middle point between MIN level and MAX level, pour distilled water into the battery cell to bring the level to MAX.

Check

- ***MAX level → Go to the check item 3.***
- ***Below the middle point between MIN level and MAX level → Fill → Go to the check item 3.***

3. SPECIFIC GRAVITY OF ELECTROLYTE

Check the specific gravity of the electrolyte using a hydrometer and a thermometer.

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

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

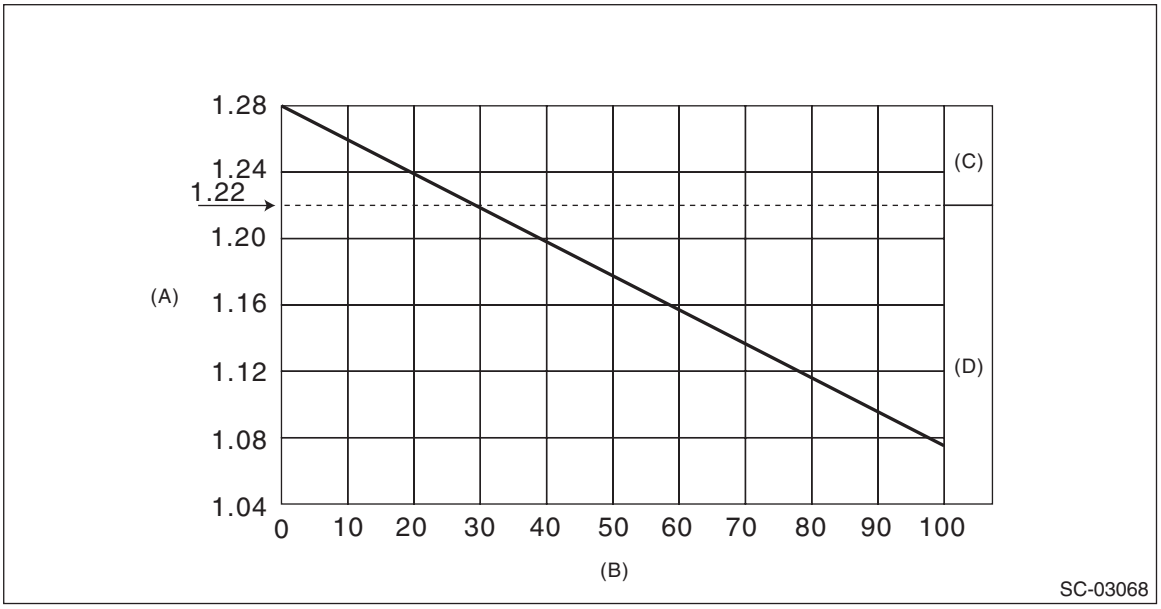
S_{20}: Specific gravity corrected at electrolyte temperature of 20°C
St: Measured specific gravity
t: Measured temperature (°C)

- When measuring in a simplified manner using the battery terminal voltage, calculate the specific gravity by the following formula.

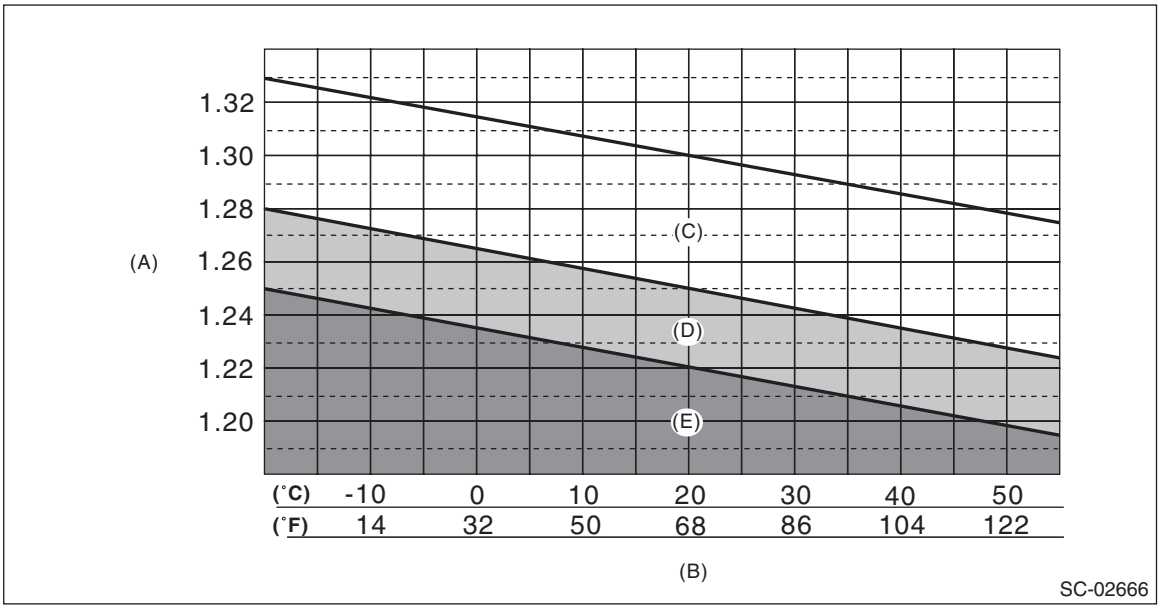
Specific gravity = [0.187 × battery terminal voltage (V)] – 1.1

Perform the steps 1) and 2) before measuring the voltage in order to stabilize the voltage.
1) Turn the ignition switch to OFF and illuminate the headlight for 30 seconds.

2) After turning off the headlight, leave the vehicle for one minute.
• 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.



(A) Specific gravity [20°C (68°F)] (B) Amount of discharge (%) (C) Good
(D) Need to charge or replace



(A) Specific gravity [20°C (68°F)] (B) Electrolyte temperature (C) Good
(D) Caution (E) Need charging

Check

- ***Specific gravity: 1.250 — 1.290, and difference between cells is 0.04 or less → Battery is normal***
- ***Specific gravity: Less than 1.250, or difference between cells is 0.04 or more → Battery needs to be charged or replaced***

4. STANDBY CURRENT

1) Prepare the circuit tester which can measure down to 1 mA.

NOTE:
For models with keyless access function, the standby current changes regularly. Therefore, prepare an analog type circuit tester.

2) Using the circuit tester, check the standby current.
   (1) Check the battery. <Ref. to SC(H4DO(HEV))-43, APPEARANCE, INSPECTION, Battery.> <Ref. to SC(H4DO(HEV))-43, ELECTROLYTE LEVEL, INSPECTION, Battery.> <Ref. to SC(H4DO(HEV))-43, SPECIFIC GRAVITY OF ELECTROLYTE, INSPECTION, Battery.>

NOTE:
The standby current may be displayed lower than the actual value if the battery is weak, so be sure to check the battery. Charge or replace if necessary.

   (2) Check that the fuse is not blown out and is properly inserted.
   (3) When non-genuine electrical parts (including parts sold in authorized workshops) are installed, remove all parts except for genuine electrical parts.
   (4) Check that back-up fuse is inserted. <Ref. to PI-4, FUSE INSTALLATION, PRE-DELIVERY INSPECTION (PDI) PROCEDURE, Pre-delivery Inspection.>
   (5) Start the engine, and set the switch positions for each system as shown in the following table.

NOTE:
Some of the listed systems are not equipped depending on the vehicle. Set only the systems equipped on the vehicle to the positions as shown.

System	Position
Headlight	ON or Auto
Fog light	ON
Wiper (front and rear)	ON or Low speed
Audio and navigation system	ON
Rear defogger	ON
Room light	DOOR
Luggage light	DOOR
Map light	OFF
Auto A/C	ON (AUTO)
Manual A/C	ON (Speed 1)
Electronic parking brake	ON
Electrical parts other than listed above (electrical parts that users can confirm the operation with the key removed)	OFF

   (6) Turn the ignition switch to OFF.
   (7) Operate the front hood lock release lever to unlock the front hood.

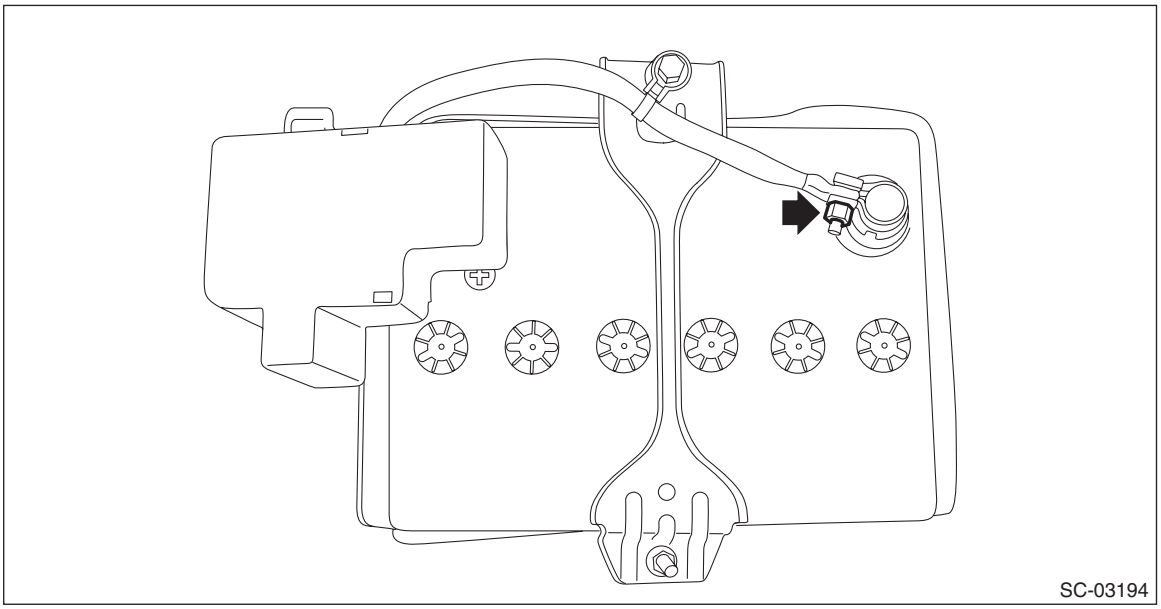
(8) Close all the doors (including rear gate and trunk lid) and then lock the doors. (Security alarm is in set condition)

NOTE:
For models with keyless access function, take the access key 1.5 m or more away from the vehicle after the door lock. And do not put the access key close to the vehicle while measuring the standby current.

(9) Wait for 5 minutes after door lock until the standby current stabilizes.

(10) Loosen the nut which holds the ground terminal to the battery.

NOTE:
Do not remove the ground terminal.

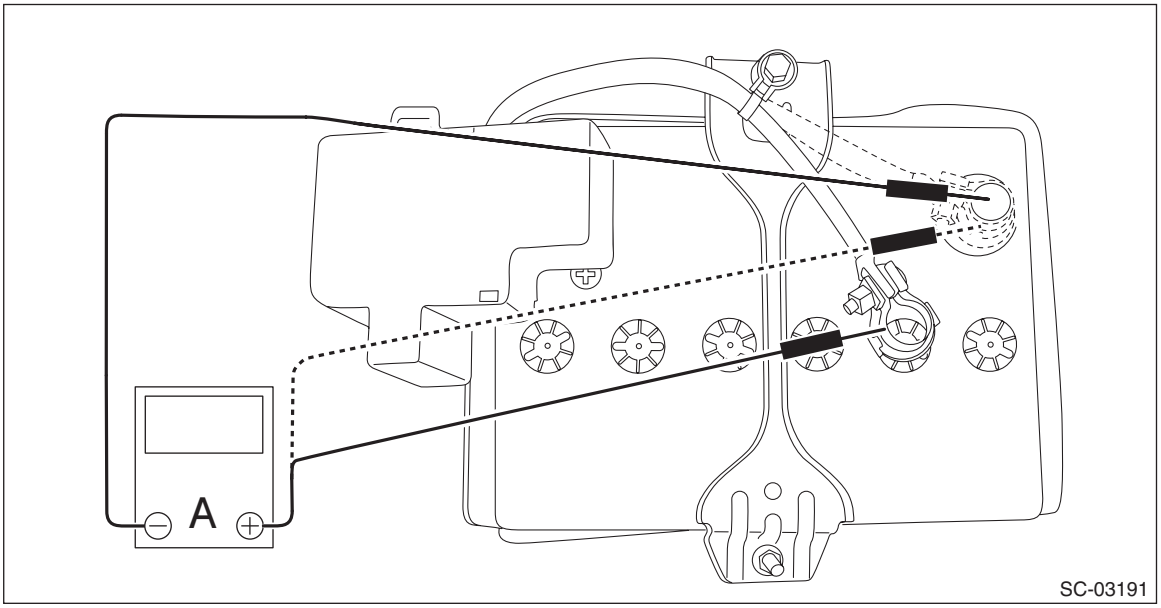


(11) Connect the circuit tester positive terminal to the ground terminal.

NOTE:
To prevent the damage to the circuit tester, set the circuit tester range to a large value first, then gradually change it to smaller values.

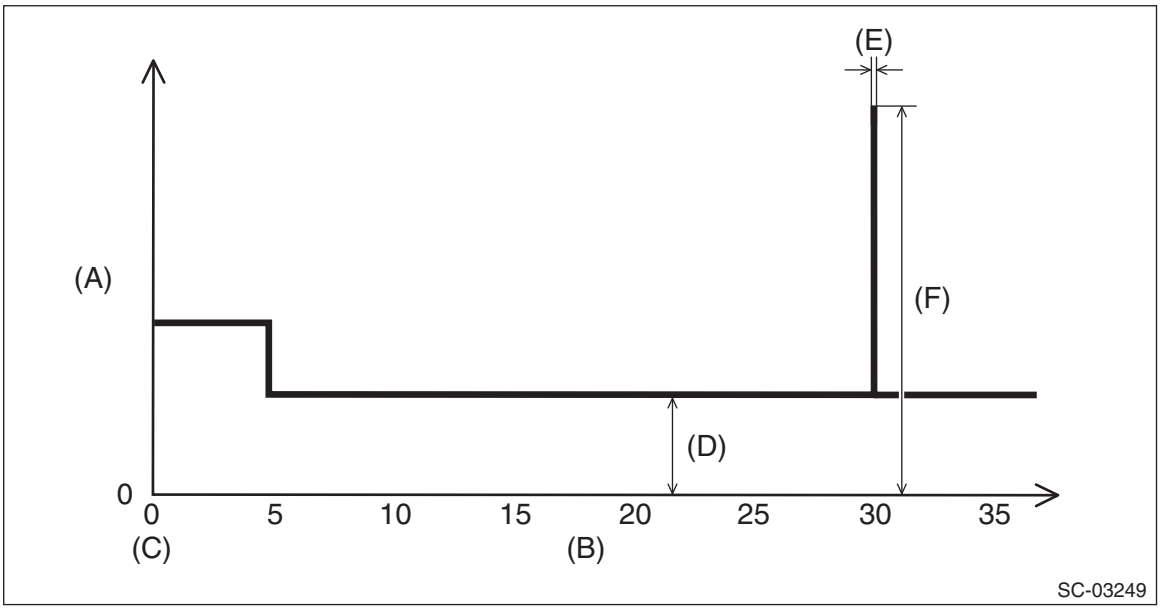
(12) Connect the circuit tester negative terminal to the ground terminal installation part of the battery.

(13) While connecting the circuit tester positive terminal with the ground terminal as shown in the figure below, remove the ground terminal from the battery.



(14) Check the standby current.

NOTE:
• For models with keyless access function, the standby current changes periodically because the keyless access system continuously searches the access key (polling).
• When measuring the standby current, the reading of the circuit tester oscillates. Therefore, read the average value (median value).
• As shown in the figure below, the standby current may become large when the vehicle system is activated 5 times at 30-minute intervals or 5 hours after turning the ignition switch to OFF. Therefore, the measurement should be completed in 20 minutes. If it takes more than 20 minutes, start the engine once, stop the engine, then perform the inspection.



(A)	Current/mA	(B)	Time/minute	(C)	Ignition OFF
(D)	Less than 70 mA	(E)	5 seconds (system operation)	(F)	300 mA or more

Check

- ***When the maximum measurement value is less than 70 mA → Standby current is normal.***
- ***When the maximum measurement value is 70 mA or more → Go to step (15).***

(15) Remove all fuses one by one to identify which system changes the standby current value significantly. <Ref. to WI(HEV)-21, WIRING DIAGRAM, Power Supply Circuit.>
(16) Check the harness and connector of the system whose standby current has changed significantly.

F: CHARGE

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 while charging the battery because it produces flammable gasses.
• 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. NORMAL CHARGE (CONSTANT CURRENT CHARGE)

Charge the battery with the current value specified by manufacturer or with approximately 1/10 of battery's rating capacity. (See the table below.)

Battery size	Charging current (A)	CCA (A)
55D23L	4.0 — 5.0	390
N55-R	4.0 — 5.0	450

CAUTION:
• The charge control feature and specifications for judgment of charge completion depend on the device. Follow the instruction manual of the charger used.
• Keep the electrolyte temperature at 45°C (113°F) or less while charging. Stop charging when the temperature exceeds this value.

NOTE:
The characteristics of typical charging methods are as follows.
• Constant current charging
This method makes it easy to charge to 100%, since the electrolyte is agitated by the gassing occurred at the end of charging. However, the time for charging is comparatively long because the current value is kept constant.
• Constant voltage charging
This method completes charging in a short period of time due to the large current. However, it is difficult to charge to 100% because no gassing occurred at the end of charging and the electrolyte is not agitated. Therefore, the combined use with the constant current charging is preferable.
• Quasi-constant voltage charging
This method is widely used for commercially available chargers.
Compared to the constant voltage charging whose charging current at the beginning of charging becomes large, it reduces the charging current by lowering the voltage at the initial stage, resulting in battery load reduction. The time for charging is comparatively long. However, this type of chargers can be manufactured comparatively inexpensive due to the simple control circuit (or manual settings). After the initial stage of charging is completed, it gradually raises the charging voltage so that the charging current is within the specification, until the battery is fully charged.
• Constant voltage/current charging
In addition to the constant voltage charging, this method controls the upper limit of the current.
The constant current charging is applied at the beginning of charging, and the constant voltage charging is applied at the end. This makes battery charge comparatively efficient in a short period of time. Charging by generators is similar to this method.
Judgment of charge completion
1) Specific gravity of electrolyte should be held within the specific range of 1.250 — 1.290 for one hour or more.
2) Voltage while charging should be held within the specified range of 15.0 — 16.8 V for one hour or more.
3) Gas is actively generated in all cells.

4) The amount of charge reaches 1.2 — 1.5 times of the amount of discharge.

NOTE:
The amount of discharge/charge can be calculated by the following formula.
Amount of discharge (Ah) = Remaining capacity (%) calculated by specific gravity × 5 hour rate capacity (Ah)
Amount of charge (Ah) = Charging current value (A) × Time for charging

2. QUICK CHARGING

Charge the battery in a short period of time with a relatively large current by using a quick charger.
Charge the battery with the current value at approximately 1/2 of battery's rating capacity. (See the table below.)

CAUTION:
• Quick charging is accompanied by a large amount of heat generation. Charging should be completed in up to 30 minutes regardless of battery size.
• Quick charging is used to recover the battery until it can start the vehicle. For full charging, use the normal charging method.
• Keep the electrolyte temperature at 55°C (131°F) or less while quick charging. Stop charging when the temperature exceeds this value.

Battery size	Charging current (A)	CCA (A)
55D23L	20.0 — 25.0	390
N55-R	20.0 — 25.0	450