List of abbreviations

- OCV : Open circuit voltage
- SPG: Specific gravity
- AMB: Automotive battery
- MF: Maintenance free
- RO: Reverse osmosis
- NG: Not good
- Tester BT-300: High rate discharge tester for automotive battery.

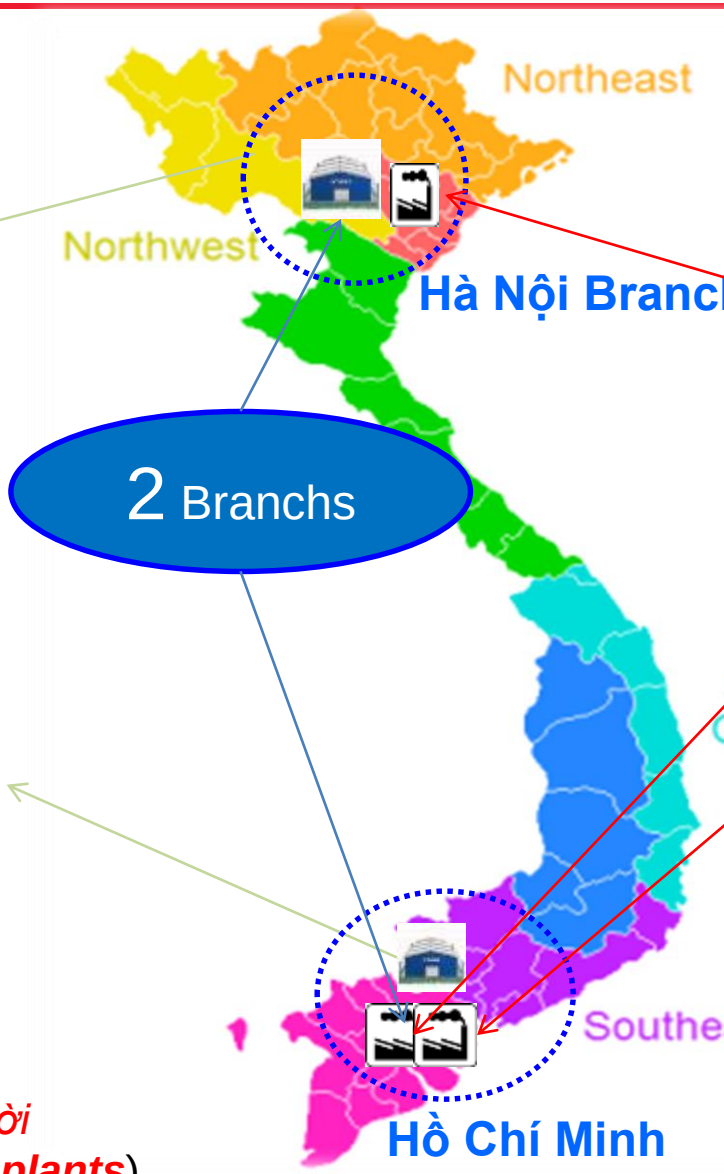
GS Battery Vietnam, BATTERY TECHNICAL AND USING INSTRUCTION

Content:

1. Introduce about GSV

Ha Noi branch

Ho Chi Minh branch



Vĩnh Phúc
(07 /12/ 2017)

Bình Dương No.2

Bình Dương No.1

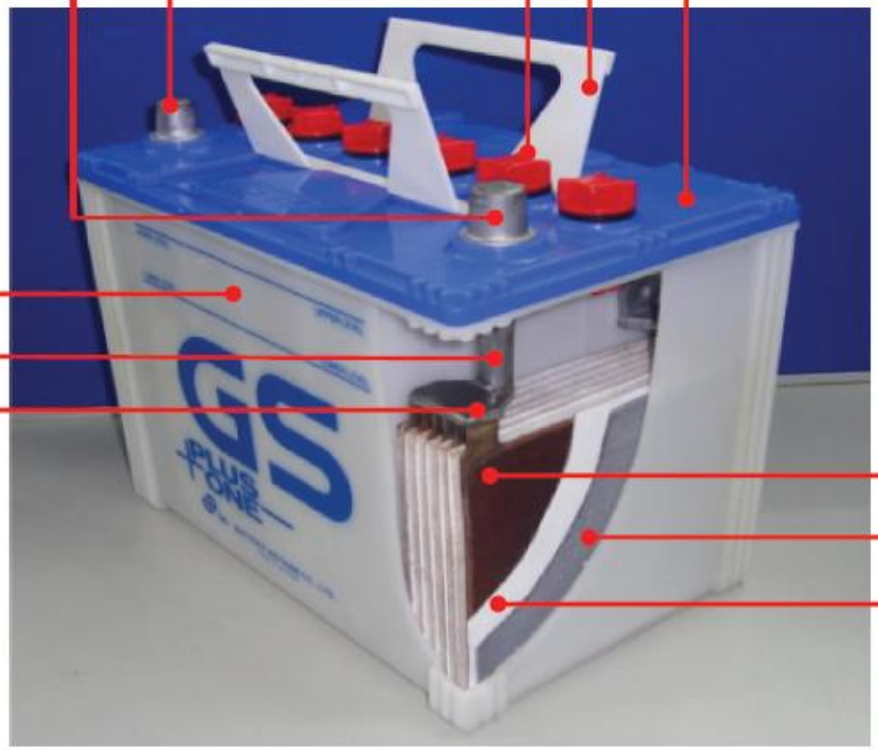
- *Establish date: 12/05/1997*
- *Total employee: ~ 1,500 người*
- ***Total square ~ 45,043 m² (3 plants)***

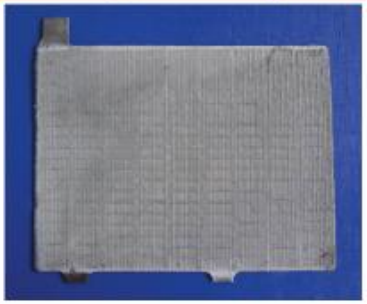
1. Introduce about GSV

Battery type	Battery photo
Motorcycle 	Maintenance free   **GS brand & Yuasa brand**
Automotive 	*Conventional*  *Maintenance free*  *DIN type*  *Hybrid type* 
Lighting 	*L30*  *L100* 
Fork lift 	
Industrial battery 	 

2. Structure of lead-acid battery

① Negative terminal
② Positive terminal
③ Container
④ Pole
⑤ Vent plug
⑥ Handle
⑦ Cover
⑧ Cell
⑨ Positive plate
⑩ Negative plate
⑪ Separator

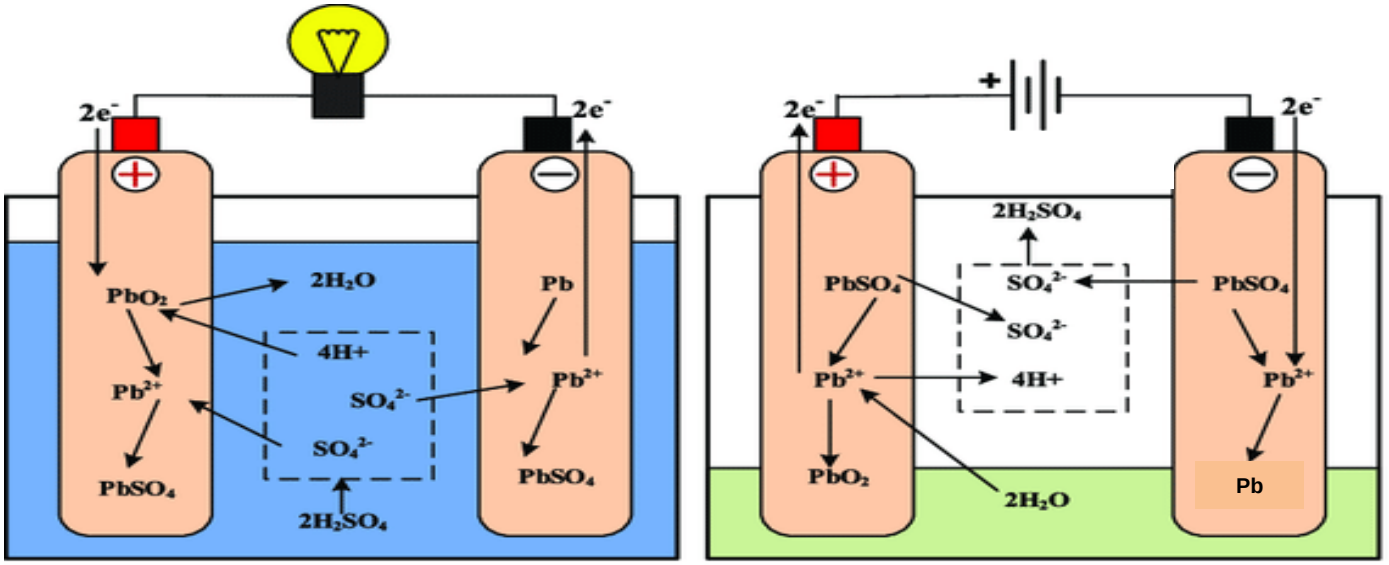




Conventional battery

2. Structure of lead-acid battery

PRINCIPLES OF OPERATION :



Chemical reaction:

+ At positive: $2PbO_2 + 2H_2SO_4 = 2PbSO_4 + 2H_2O + O_2\uparrow$

+ At negative: $Pb + H_2SO_4 = PbSO_4 + H_2\uparrow$

General chemical reaction:

$$PbO_2 + Pb + 2H_2SO_4 \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} 2PbSO_4 + 2H_2O$$

2. Structure of lead-acid battery

Advantages and dis-advantages of automotive battery

Battery characteristic		Conventional	Hybrid	MF
Grid alloy	Positive	Pb-Sb	Pb-Sb	Pb-Ca
	Negative	Pb-Sb	Pb-Ca	Pb-Ca
Maintenance	Prevent water loss	△	○	◎
	Capacity retention	△	○	◎
Life time	Normal using	◎	◎	◎
	Deep discharge	○	○	△～○
	Using under high temperature	○	○	△～○

Judgment: ◎ : Very good ○ : Good △ : Normal

According to the general trend in the world, automotive batteries demand change from Conventional to Hybrid and Maintenance free.

3. AMB claim checking process.

Information checking (warranty card, using time…)

NG → No warranty

OK

Appearance check

NG → No warranty

OK

Tester (Conventional)

Bubbling when testing → Battery damaged need to change

No bubbling

Check OCV ,recharge and keep stable 2 hours

Recharge with current = 1/10 capacity, follow table below:

OCV (V)	<11.75	11.75-12.00	12.00-12.25	12.25-12.45	12.45-12.60
Charging time (hours)	12	10	8	6	4

Refer to Safety when recharge battery (5.3).

Battery does not receive charge current → Battery damaged need to change

OCV <12.6 (V), recharge max 1 time

Check OCV and SPG (conventional and HYB only)

Only check SPG with Conventional and hybrid battery. If SPG is 1.250~1.270 (at 20°C (*)), go to next step. If SPG is not in range 1.250~1.270 (at 20°C (*)):

- Adjust SPG by distilled water when SPG >1.270
- Adjust SPG by H_2SO_4 50% when SPG < 1.250

→ Recharge 30 minutes and keep 30 minutes.

If OCV ≥ 12.6 V, go to next step.

If OCV < 12.6 V, return to recharge step (maximum recharge 1 more time).

SPG: 1.250~1.270 (at 20°C (*))

OCV ≥12.6 (V)

Test BT-300

Red → Battery damaged need to change

Yellow → Battery damaged need to change

Green → Battery is good

3. AMB claim checking process

(*) Convert SPG to 20°C following formula: **$D_{20} = D_t + 0.0007(t-20)$, in which:**

- D_{20} is SPG at 20 Celsius degree (g/cm^3)
- D_t is SPG at "t" Celsius degree (g/cm^3)
- t is temperature of electrolyte (Celsius degree)

For example: Measured SPG is 1,260 (g/cm^3) and electrolyte temperature is 30°C. So we can convert to SPG at 20°C will be: D_{20} = 1.260 + 0.0007(30-20)= 1.267 (g/cm^3)

Instruction of checking dark current and charging voltage of vehicle (if necessary):

1) **Checking dark current method**: Turn off engine car 5 minutes, check dark current by clamp meter (reference number ≤ 0.05 (A))
2) **Checking charge voltage method**:
   - Pull handbrake to N
   - Start engine, Hold down the accelerator pedal at 2000 rpm
   - Check charging voltage of battery (reference number 13.8 V - 14.5 V)

   If there is a problem after checking, instruct the customer go to Vehicle repair shop to check and repair to avoid running out of battery.

Check dark current and charge voltage after install again to vehicle

4. Appearance checking instruction

4.1. Container and top cover appearance

Battery got cracked, broken, swollen, deformed, exploded, burned…

4.2. Terminal appearance

The terminal got deformed, there are signs of repair & re-casting.

Positive terminal got deformed or corroded when using for Generator.

4.3. Cell appearance (if possible)

Impurity fault

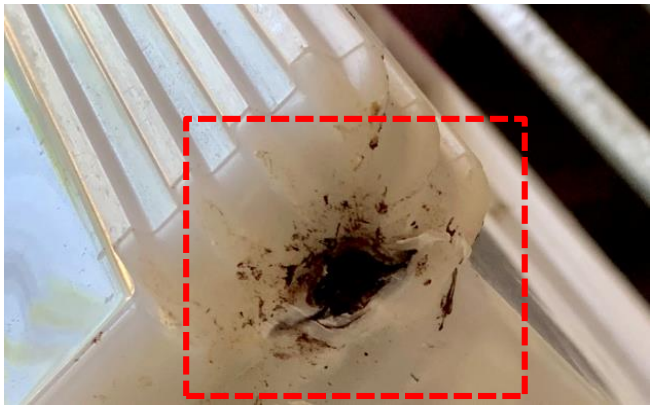
Corroded positive plate (Over charge fault)

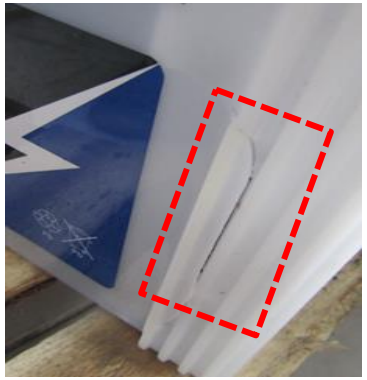
Sulfated negative plate (Over discharge fault)

4. Appearance checking instruction

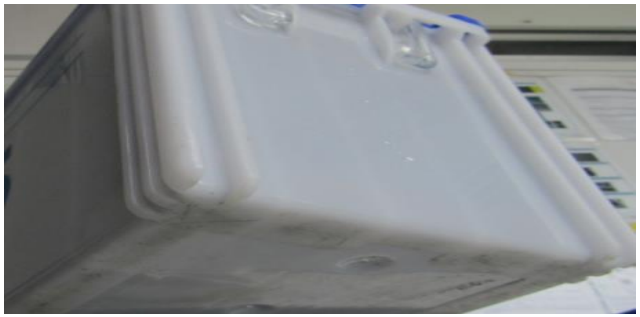
4.1. Container and top cover appearance

Container and top cover appearance do not meet warranty condition:
Battery got cracked, broken, swollen, deformed, exploded, burned…





Battery got deformed – Bottom got damaged



OK battery appearance, without any physical damaged (can get warranty)

4. Appearance checking instruction

4.2. Terminal appearance

The terminal got deformed, there are signs of repair & re-casting.

Terminal is broken, deform, re-casting, melted, repair, leak acid or loss the main function (connect cable and terminal)

OK terminal

Broken, repair or re-casting terminal, leakage acid: NG, refuse to warranty.
Deform, melted terminal (can not connect the cable): NG, refuse to warranty.
Deform, melted terminal (still connect the cable well): OK, accept to warranty.

Cause:

+ Connection of cable and terminal is loose.
+ Strong vibration due to fix bar did not tighten.

Recommendation actions:

+ Check and maintain connection of cable and terminal regularly.
+ Check and tighten the fix bar regularly.

4. Appearance checking instruction

4.2. Terminal appearance

Terminal appearance do not meet warranty condition: positive terminal got deform or corroded when using for generator (happen in conventional & hybrid only).



Positive terminal got deformed or corroded

OK terminal

Cause: Acid contaminated (Cl^-).

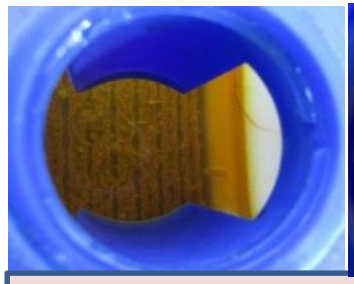
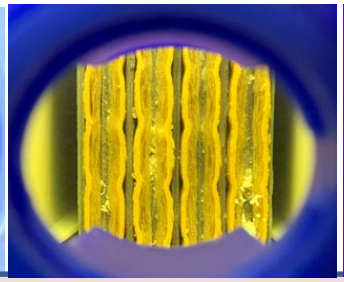
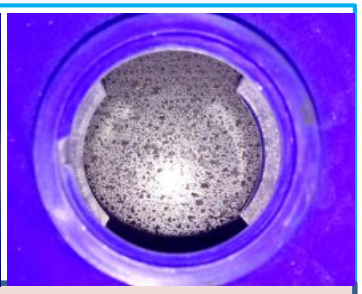
Recommendation actions:

+ Do not use acid contaminated by Cl^-.
+ Recommend: Concentration of Cl^- in acid ≤ 30 (ppm - part per million).
+ Only re-fill by RO water or distilled water.

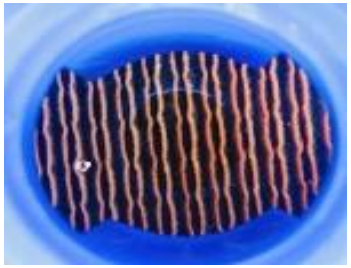
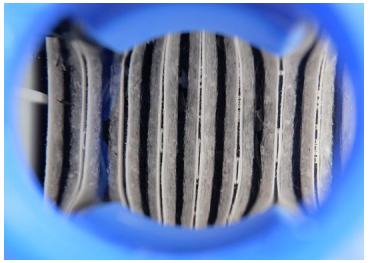
4. Appearance checking instruction

4.3. Cell appearance.

Cell do not meet warranty condition: Cell has impurity chemical inside.

Cell has impurity (change color of electrolyte or have bubble), can see through vent plug

Cell OK-No change color, no bubble (can get warranty)

Cause:

+ Filling concentrate acid.
+ Add water mixed impurity or chemicals such as alum water, oil, soap, iron powder...or unintentionally contaminate from outside objects such as iron bolt, metal bar.

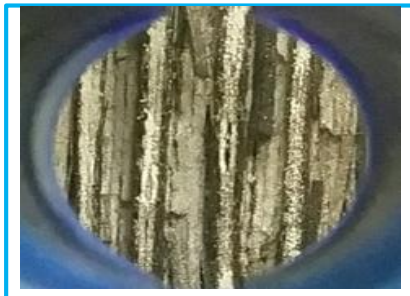
Recommendation actions:

+ Filling acid with SPG 1.250~1.270 g/cm^3. Not contaminated.
+ Do not add diluted acid or impurities (only add distilled water or RO water).

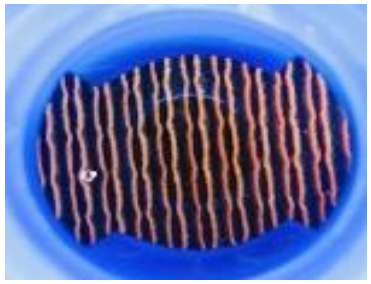
4. Appearance checking instruction

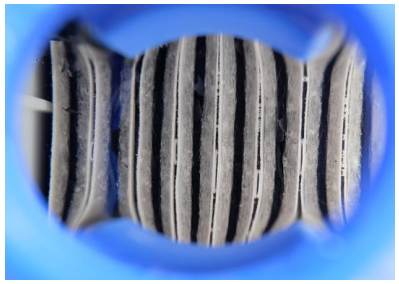
4.3. Cell appearance.

Cell does not meet standard: Plate got corroded inside cell (due to over charge)



Corroded plate (the grid frame is broken, active material is outcrop) can see through vent lug hole





OK cell-No broken grid frame, no outcrop active material (can get warranty)

Cause:

+ Charging system got damaged (charging current is too high, charging system is still charging when battery is full).
+ Start engine many times continuously (when engine can not start).
+ Battery was installed at high temperature area.
+ High using frequency: Taxi, forklift…

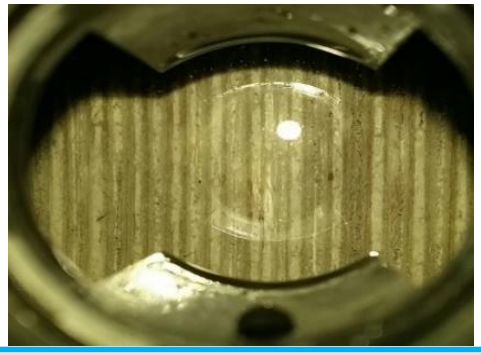
Recommendation actions:

+ Frequently checking and maintain charging system.
+ Do not start engine over 5 seconds/ times and should rest at least 3 minutes between 2 times of starting engine.
+ If battery is near high temperature resource, should apply heat insulation sheet.

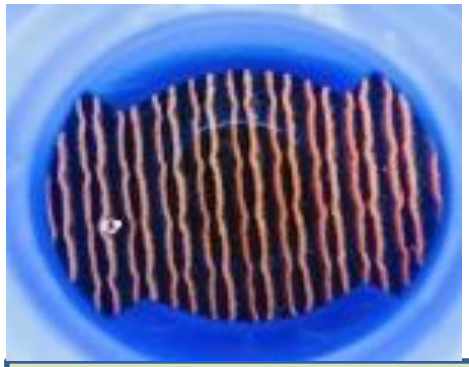
4. Appearance checking instruction

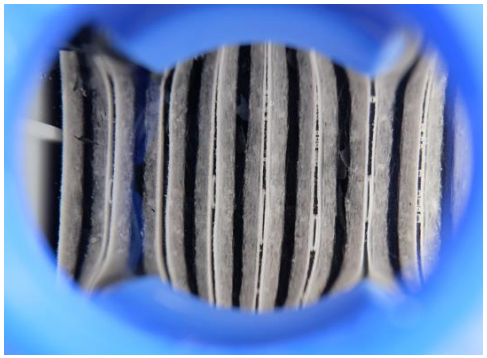
4.3. Cell appearance.

Cell does not meet standard: Plate got sulfated inside cell (due to over discharge)



Sulfated all cells (cell surface is white), can see through vent plug hole.





OK cell (can get warranty)

Cause:

Over discharge.

+ Turn on vehicle light overnight.
+ Turn on electric devices while turn off engine.
+ Install more loads such as DVD, TV, radio, meter (taxi), telephone…
+ Vehicle has high dark current.

Not enough charge.

+ Charger of vehicle was down or broken.
+ Vehicle run with short distance (charging time is not enough).
+ Vehicle run at rush hour (Low charging current).
+ Using frequency of vehicle is low.

4. Appearance checking instruction

4.3. Cell appearance.

Recommendation actions:

+ Regularly checking car charger, dark current of vehicle.
+ Do not install additional electric devices out of the original vehicle design.
+ When the vehicle is not used for long time:

1) If the charger is available, recharge regularly when the voltage is below 12.6 V (should keep the voltage above 12.4 V) and standard charge is 1/10 of the capacity of the battery. (For example N100 - 100Ah, 10A charging current). Charging time according to the following table:

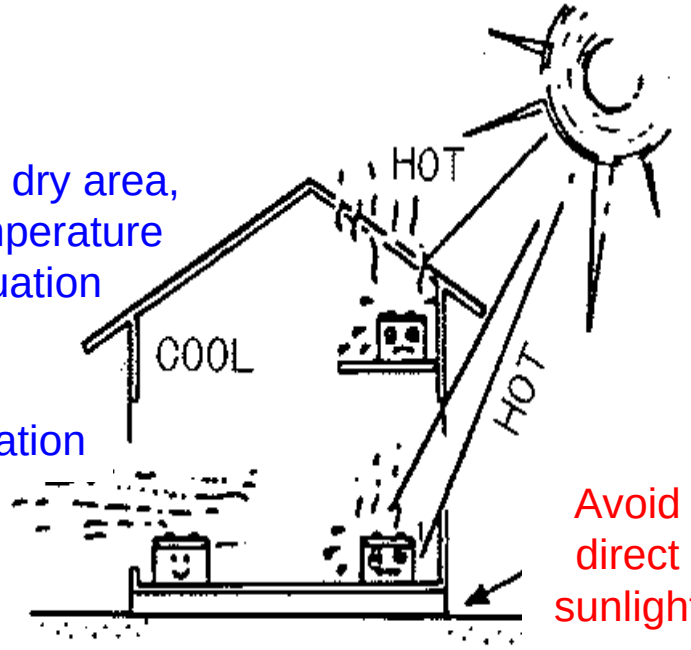
Battery voltage (V)	<11.75	11.75-12.00	12.00-12.25	12.25-12.45	12.45-12.60
Charging time (hours)	12	10	8	6	4

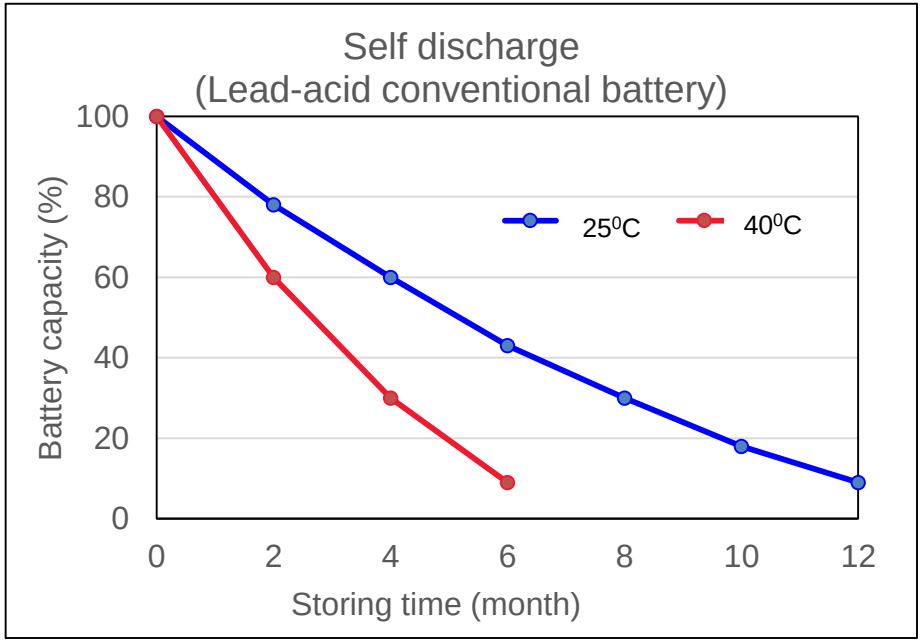
2) If charger is not available. Start engine 20~30 minutes per week to recharge battery.

5. Maintenance instruction

5.1 Storage:

- Store in dry and cool area, little temperature fluctuation.
- Do not leave the battery under sunlight because it may cause damaged battery due to high temperature.



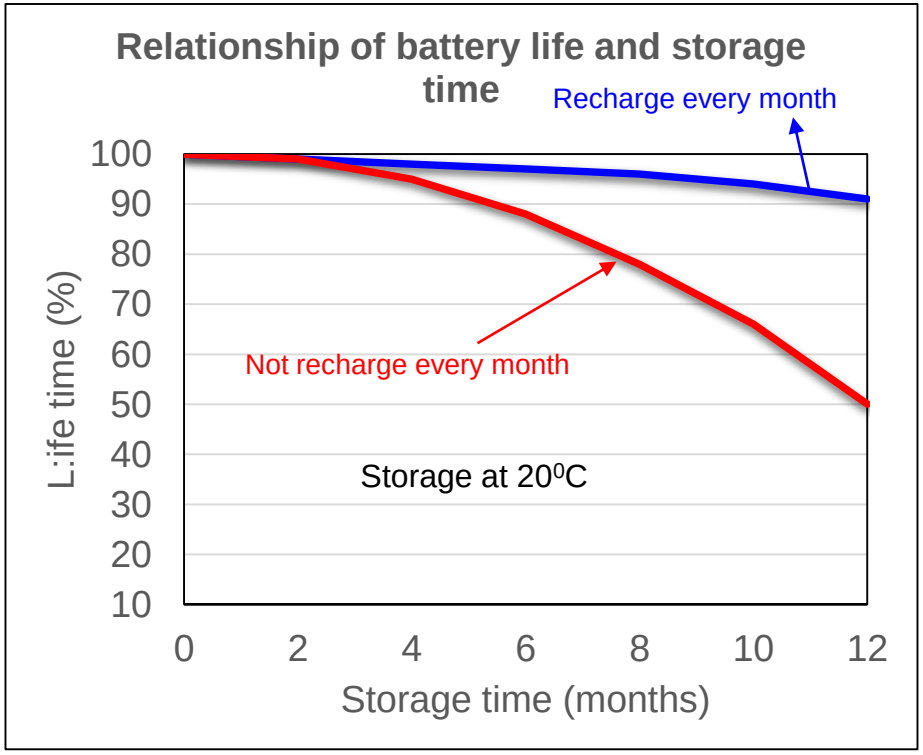


Self discharge level depend on temperature when storing.

5. Maintenance instruction

5.2 When the vehicle is not used for long time or storing long time, should check voltage every month and recharge the battery if the voltage is lower than12.6V (**should maintenance voltage ≥ 12.4V**). Charge by machine: Current 1/10 capacity in 4 ~ 12 hours depend on voltage

Battery voltage (V)	<11.75	11.75-12.00	12.00-12.25	12.25-12.45	12.45-12.60
Charging time (hours)	12	10	8	6	4



Model	N100	MF 46B24L
Capacity 20 HR (Ah)	100	45
Current (A)	10	4.5

Attention:
Check the battery voltage again after 24 hours from the end of charging. If the voltage is lower than 12.6V, continue to apply recharging according to the table above (max 1 times).

5. Maintenance instruction

5.3 Safety when recharge battery.

Cause of fire and explosion:

Hydrogen (H_2) and Oxygen (O_2) generate during charging with ratio 2:1

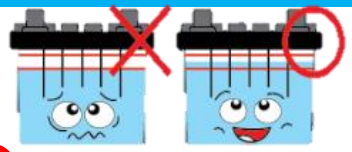
+

Source of fire:
- Smoke cigarette
- Electric spark
- Connection of terminal
- Electrostatic

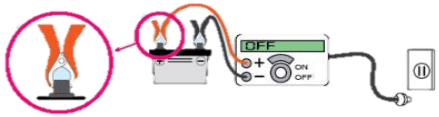
→

Prepare to charge:

1 **Open vent plug**
To release air during charging

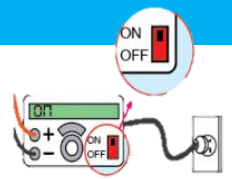


2 **Refill distilled water**
Use distilled water or RO water to fill to the upper level



3 **Connect charger cable to battery terminal**
Connect positive first, negative later

4 **Connect the charger to the power source**

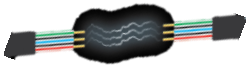


5 **Turn the charging switch to ON → Set appropriate charging current**

4 No during charging

1 **No smoking**

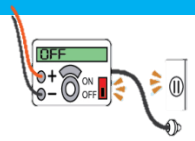
2 **No short circuit between positive and negative**



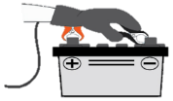
3 **No electric arc**

4 **No electrostatic**

End of charging



1 Reduce current to 0 → turn off charger switch → unplug



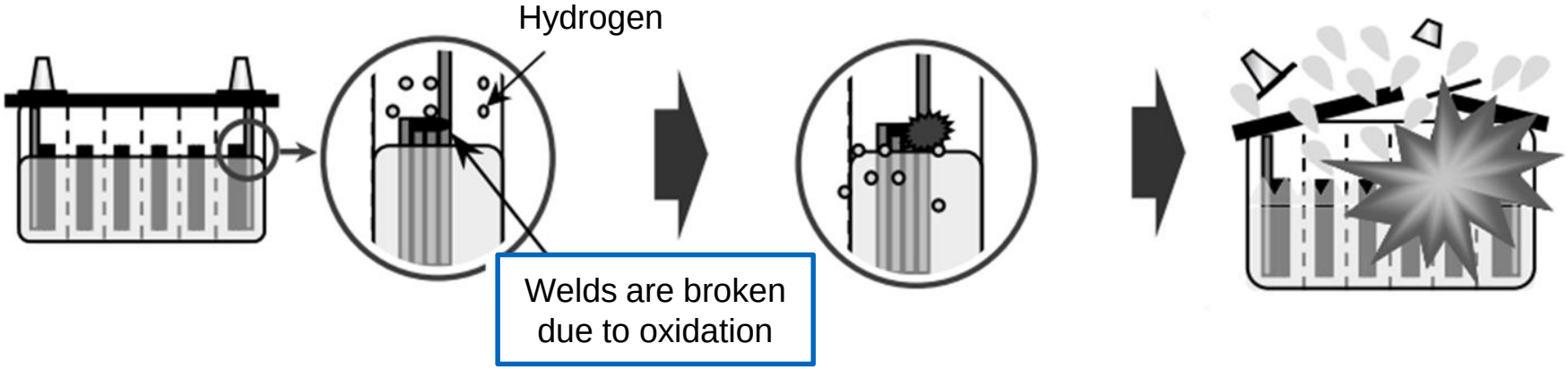
2 **Disconnect the cable**
Disconnect negative first, positive later

3 **Tighten the vent plug**
Waiting 30 minutes after charge then tighten the vent plug

5. Maintenance instruction

5.4 Check acid level and refill distilled water to the appropriate level (between UPPER LEVEL and LOWER LEVEL) periodically.
Do not add more diluted acid because it may cause damaged battery.
Do not overfill the UPPER LEVEL as it may cause acid leakage and car corrosion.
Do not use the battery when the acid level is lower than LOWER LEVEL because it may cause an explosion

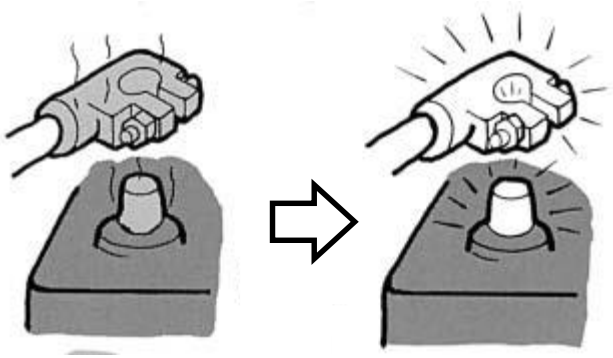
The mechanism can cause the battery explode when the acid level is low :

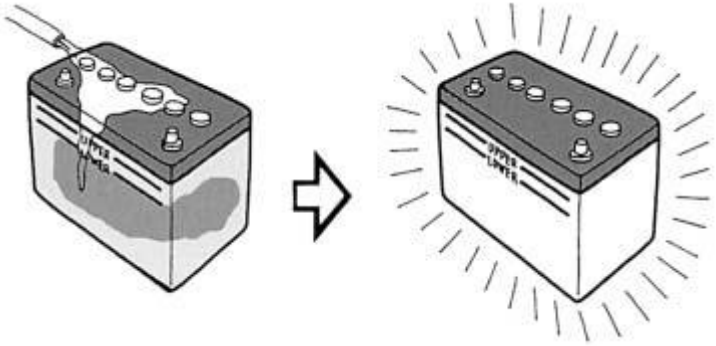


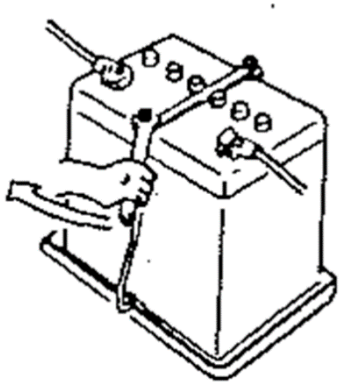
5. Maintenance instruction

5.5 Check and maintain battery every month:

- Check and clean terminal, tighten cable connection, and apply anti-oxidation grease to prevent corrosion.
- Check and clean top cover, vent plug.
- Check and tighten the vehicle fix bar.







Survey and test exam after training

Please click the link below or scan the QR code to enter the exam:

http://portal.gsbattery.vn/GSVI/HoatDongGSV/LamBai?idhd=2401afa1-c016-41a3-bdfe-d38f3a509bff

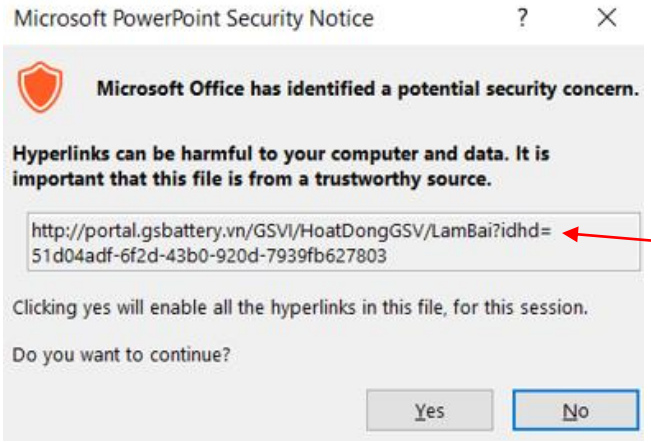
Log in instruction:

1. Enter your phone number here
2. Enter technician name and distributor name here

   For example: Nguyen Van A - Tan Toan
3. Click here to enter the test

Instructions for handling errors of not being able to access the test

If you have got the fault as below, please copy the link and past to your browser.



1 Copy link in here

2 Past the link to browser and press Enter.