For maintenance and handling of battery, please read this instruction manual before use.

Instruction Manual

For

Valve Regulated Lead-Acid Batteries

For Cycle Use

SLR-1000,SLR-500

Please attach this instruction manual to the batteries and make sure to hand this to the end user.

MKT-016, Rev. A

This instruction manual is applied to valve regulated lead-acid batteries for SLR-1000 and SLR-500.

⚠ CAUTION

- The batteries must be charged under the conditions specified by GS Yuasa. If the batteries are charged under conditions other than those specified by GS Yuasa, it may cause the batteries to not charge fully, leak, become hot or ignite and explode. It may also cause the deterioration of battery life and performance.
- Before installing or using this battery, please read this instruction manual thoroughly and carefully. Please keep this manual available for future reference. If there are any questions, please contact GS Yuasa. The improper installation or use of the batteries may result in short circuiting, electric shock and/or breakage of the batteries.
- This battery is designed for cyclic use.
- To maintain the life performance of the batteries, please use the batteries in a position in which the terminals are at the top right and bottom left positions as shown below. If the batteries are placed and used in the normal upright position in which both terminals are at the top, an imbalance in the charge/discharge reactions may occur. If installed in this manner, it may become impossible to control charge/discharge cell balancing, thus resulting in shorter battery life.

Note: Placing the batteries in the upside-down position with terminals facing downward may cause a leakage of the electrolyte since the regulating valves are located by the terminals.

(Battery Position)

SLR-1000

SLR-500

Valve Regulated Lead-Acid Battery for Cycle Use

This battery has a system that controls the emission of gas to the outside of the battery by having the negative plates absorb oxygen gas generated by the positive plates during charging. It has minimal water loss during charging and requires no watering.

However, a small amount of hydrogen gas will be emitted through the operation of the regulating valves and by passing through the case and cover of the battery. Please take necessary precautions when handling this battery.

CONTENTS

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1. SAFETY PRECAUTIONS

Batteries are different from general consumer electronics. Energy is not only stored as potential energy inside the battery but is also converted during charging/discharging operations. Due to these reasons, if the batteries are handled or used improperly, dangerous conditions may arise. To ensure safety, proper handling and maintenance of the batteries is necessary. In this instruction manual, warning symbols are used to indicate that the failure to follow the instructions may result in bodily injury. As shown below, there are three different symbols that indicate the degree of danger- Danger, Warning, and Caution. Please fully understand the warning symbols and their meanings before reading the rest of the instruction manual.

⚠ **DANGER**	The danger symbol indicates imminently hazardous conditions in which serious injury or death may occur if this warning is ignored.
⚠ **WARNING**	The warning symbol indicates that serious injury or death could possibly occur, and slight injury or damage to the products often occurs if this warning is ignored.
⚠ **CAUTION**	The caution symbol indicates that injury may occur or damage to the products may occur.
"Serious injury" described above may include but not limited to: the loss of eyesight, injury, burn, electric shock, bone fracture and/or poisoning that leaves after effects, or other injury that requires hospitalization or long-term outpatient care for treatment. "Injury" includes such conditions as injury, burn and electric shock that do not require the long-term outpatient medical treatment. "Damage to the Product" is defined as the extensive damage to the building and/or equipment.	

In this instruction manual, the symbols below indicate caution and prohibition.


KEEP AWAY FROM INFLAMMABLES!


DO NOT USE IN WATER PLACE!


CAUTION NO DISASSEMBING!


CAUTION: EXPLOSION!


CAUTION: ELECTRIOLYTE!


CAUTION: ELECTRIC SHOCK!


CAUTION: IGNITION!


EYE PROTECTOR USE!


READ MANUAL CAREFULLY!

2. UNPACKING, TRANSPORTING, AND STORING

2.1. Unpacking and Transporting

1) The batteries are filled with electrolyte and charged before shipping.
2) Please unpack close to the area for installation.
3) After unpacking, count the number of batteries and accessories to check if any items are missing and also inspect for any visible damage.

CAUTION

- Take the necessary precautions to avoid physical shocks to the batteries when unpacking, as they may cause the batteries to break.
- If a crack in the case, leakage or any other abnormalities are found at the time of unpacking, do not use the batteries and please contact GS Yuasa. If used, the battery may short circuit, cause a fire, or break.

- Do not hold the terminals when carrying the batteries. Doing so may cause the batteries to break. Please always follow the methods specified by GS Yuasa.
  When temporarily suspending or lifting the batteries, please follow the standard procedure described in **Table 1** below.

- When carrying the batteries, avoid strong physical shocks such as banging and dropping, as such shocks may cause the batteries to break.
- Please take precautions when transporting the batteries to avoid injury and back pain.

Table 1 Standard Procedure for Transporting and Temporarily Suspending or Lifting Batteries

Battery Type	Suspending and Lifting Temporarily	Transporting
SLR-1000 SLR-500	Use Jig to lift up battery supporting lid	Use hand truck, cart or something to move smoothly

2.2. Battery storage

The batteries gradually lose their capacity, even if they are not used, due to self-discharge. Please charge the batteries according to the instructions shown in **Section 4.1.** The charging requirements may vary depending on the temperature of the storage area. Please refer to **Table 2** below as a guideline. If possible, the batteries should be stored in a dry place and at a low temperature.

Table 2 Guideline for Charging Intervals

Storage Temperature	25℃ or less	30℃ or less	35℃ or less	40℃ or less
Fresh Charge Interval	Within 6 months	Within 4 months	Within 3 months	Within 2 months

WARNING

Please ventilate the battery storage area. The batteries emit hydrogen gas even at rest, which may cause fire or explosion if not ventilated.

CAUTION

When storing, disconnect the batteries from the load and the charger and store in the conditions specified in the Installation Environment section. Charge the batteries to compensate for self-discharge. Failure to do so may result in the breakage or deterioration of the batteries.

3. INSTALLATION

3.1. Installation and Installer

CAUTION

Batteries should be installed by professionals such as certified technicians. Installation by less qualified personnel may result in improper installation.

3.2. Material used for Installation

WARNING

- The battery case and cover should not come in contact with the following materials: coated wires or sheets that are made of soft vinyl chloride or rubber containing plasticizer; organic solvents such as benzene, thinner, or gasoline; detergent containing a surfactant; chemically treated cleaning cloths; or oils. The use of any of the above materials may cause the battery case and/or the cover to crack, which may result in leakage.

- Metal tools such as torque wrenches and other wrenches used to install the batteries should be insulated. If an un-insulated metal tool comes in contact with the area between the positive terminal (+) and the negative terminal (-), it may cause a short circuit, which may result in injury, burn, breakage, and ignition or explosion.

CAUTION

Do not use plastic sheets to cover the batteries, as they may cause static electricity that may result in an ignition or explosion.

3.3. Installation Environment

DANGER

- Ventilate the room to keep the concentration of hydrogen in the air less than 0.8%. Hydrogen emitted from the batteries may cause ignition or explosion if the room is not ventilated. Make sure that the airflow moves the hydrogen throughout the room evenly, leaving no area with a high hydrogen concentration.

- Do not install batteries near a flame, as this may cause ignition, explosion or fire.

CAUTION

The standard operating temperature for this battery is –15°C ~+45°C. Usage outside of this range may cause the batteries to deteriorate quickly. It may also cause batteries to freeze or heat up, resulting in breakage or deformation. Store the battery in an air-conditioned facility and keep the temperature between +5°C and +30°C if possible. Cells within a string should be maintained within 5°C of other cells in that string. Temperature differences may result in decreased battery life.

CAUTION

- Do not use batteries in the areas that they would get exposed to direct sunlight, as this may cause the deterioration of the batteries.
- Do not allow the batteries to come into contact with seawater. If this happens, the batteries may be damaged or catch on fire. It may also cause the corrosion of the terminals and connecting plates (or wires).
- Do not use batteries near a heat-generating device. Doing so may cause the breakage or deterioration of battery life and performance.
- Do not use the batteries in a dusty area, as dust may cause short-circuiting.



As a general rule, batteries are stored in metal case which GS Yuasa designated. By necessity, use it anything other than GS Yuasa designated metal case, please be careful about following points.

1. Please take into consideration temperature increase of battery when designing the cubicles/cabinet.
2. When placing more than two batteries side by side, leave 1mm to 2mm between the batteries, as this improves heat release.
3. If batteries are installed in multiple stairs, which are more than 2 stairs, consider the placement of the batteries to minimize the temperature variation between the top and bottom batteries and make sure to have good ventilation as well.

- If the batteries are to be used for cycle use as a stored electrical energy system as well as emergency power supply for emergency use, please consult GS Yuasa group.
- Batteries should be placed in the lowest part of the equipment when mounted.
- Do not install electric switches that may cause sparks near the batteries.

3.4. Installation Area

WARNING

Do not install batteries in the areas where they may come in contact with water. If the batteries come in contact with water, an electric shock or fire may occur.

3.5. Installation Method

CAUTION

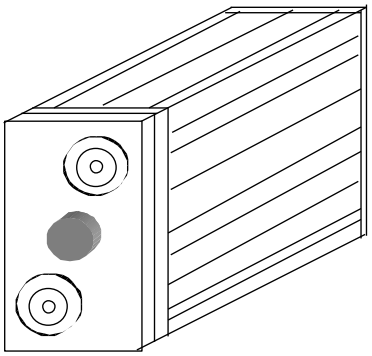
Please take precautions when carrying the batteries to avoid back pain and injury.

⚠ CAUTION

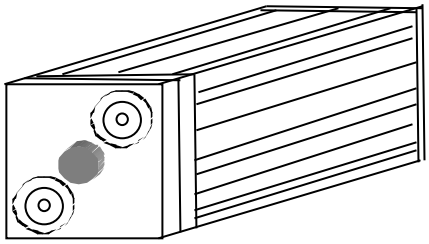
To maintain the performance of the batteries, please use the batteries in a position in which the terminals are in the up-down position as shown below. If the batteries are placed and used in the normal upright position in which both terminals are at the top, an imbalance in the change/discharge reactions may arise in the batteries. If this happens, the charge/discharge operations can not be controlled properly, resulting in a shorter battery life.

Note: Placing the batteries in the upside-down position with terminals facing downward may cause leakage of the electrolyte, as the regulating valves are located by the terminals.

(Battery Position)



SLR-1000



SLR-500

- Please make sure to place the batteries correctly, connecting the correct poles (+,-). Connecting to wrong poles with the opposite charge may cause fire or damage to the batteries.
- Batteries are placed horizontally in GS Yuasa designated metal case. The battery slightly swells when the internal pressure rises which may shorten battery service life or cause a burst.

1. If using metal case other than GS Yuasa designated, please use the batteries in a position in which the terminals are in top right corner and the bottom left and keep the upper surface and the sides of the battery from expanding not more than 3 mm by placing solid surfaces around the batteries.
2. Before connecting the batteries, clean the terminals with brass wire brush, and apply oxide inhibitor to prevent future oxidation issues.
3. In order to prevent short circuit, when connecting multiple batteries in series, the most positive battery should be connected last and connecting all others first to the charger and/or the load: positive pole (+) of the batteries to the positive terminal (+) of the charger and/or to the positive terminal (+) of the load, and the negative pole (-) of the batteries to the negative terminal (-) of the charger and/or to the negative terminal (-) of the load: The charger and the load must be turned off during this process.

⚠ CAUTION

Fasten the bolts with the torque specified in Table 3 below.
Not using the correct torque may cause the battery terminals to spark or break.

Table 3 Recommended Torque Settings

Battery Type	Bolt	Fastening Torque N・m {kgf・cm}
SLR-1000 SLR-500	M10	17.2±2.5{175±25}

WARNING

Avoid doing work or putting down metal objects such as wrench on top of the batteries, as doing so may cause the batteries to break or ignite and explode.

CAUTION

After connecting the batteries, please apply a thin anti-corrosion coating to the connecters and the battery terminals. Failure to do so may cause the formation of high –resistive corrosion layers in the batteries.

DANGER

Use a damp(pure watered) cloth to clean the batteries. Do not use a duster or dry cloth, as they may cause static electricity which could result in ignition or explosion.

WARNING

Place the insulation covers over the terminals, connecters, and bolts to prevent an electric shock.

CAUTION

When painting cubicles/cabinet, floors, or walls, make sure that the paint does not touch the batteries. The paint may cause the battery case or the cover to crack, resulting in leakage.

3.6. Installation Requirements

1. Please connect the batteries in series for use. If the batteries are connected in parallel and the charge/discharge cycle is repeated, variations in the charge/discharge amount will arise, especially if the depth of discharge is high, which may cause an early decrease of battery life. To maximize the battery life when parallel connections are required, make sure the circuit resistance between each parallel string is equal, limit the DOD to 50% ideally, and limit the number of parallel strings to 6.

2. This battery is designed for cyclic use. Please contact GS Yuasa for charger settings for applications which require both emergency power supply and cyclic use.

4. SUPPLEMENTARY CHARGE and TRIAL RUN

4.1. Supplementary Charge (Top Charge)

CAUTION

The batteries should be handled by professionals such as certified technicians. If handled by un-qualified personnel, mistakes may occur.

The battery gradually loses its capacity during transportation or storage due to self-discharge. Please charge the battery with constant current at 0.5 × I_{10} (0.05 C_{10}) for 4 to 8 hours prior to use.

Note: "I_{10}" in a current value denotes a 10-hour rated discharge current, "C_{10}" denotes a 10-hour rated capacity.

CAUTION

- A supplementary charge (top charge) should be given to the batteries under the specified conditions by using the charger specified by GS Yuasa or the one included with the equipment. Using without charging may result in an insufficient load. If the batteries are charged under the conditions other than those specified by GS Yuasa, it may cause the batteries not to charge fully, or cause leakage, heat generation and ignition or explosion, or may cause the deterioration of battery life and performance.

- Keep the surface temperature of the batteries below 50℃ as much as possible when performing a refresh charge. If the surface temperature rises above 50℃, it may cause the batteries to break or deteriorate. Please stop performing a refresh charge to prevent the rise of the battery temperature when there is a risk that the temperature rises above 50℃.

Note: At the time of delivery or during performing a refresh charge, a part of the battery case may appear sagged or expanded slightly. However, this is normal. It is acceptable to use the batteries with these conditions. However, please contact GS Yuasa if the condition worsens during charging.

4.2. Trial Run

1. When conducting the performance tests for the batteries or batteries coupled with a load or a charger, follow the procedures in Section 5 and Section 6.
2. Charge the battery according to Section 4.1 before the trial run.
3. If not using the batteries immediately after the trial run, store the battery according to Section 2.2.

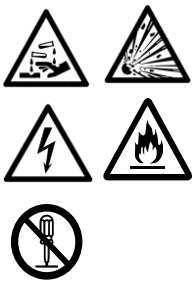
4.3. Preparation Prior to Operation

Please charge the batteries according to Section 4.1, if the batteries are not used immediately after charging or after trial run.

5. HANDLING and OPERATION

⚠ WARNING

- Risk of fire, explosion or burns. Do not disassemble, heat above 50°C or incinerate.
- When handling the batteries, avoid causing a short circuit between the positive (+) and negative (-) terminals. A short circuit may cause leakage, heat generation, ignition, explosion, fire, and/or smoke.
- Place the insulation covers over the terminals and connectors properly. Not doing so may cause an electric shock or short circuit, and may result in breakage, burn, ignition and explosion.



⚠ CAUTION

- The batteries should be handled by professionals such as certified technicians. Mishandling may occur if they are handled by less qualified personnel.
- When handling and using the batteries, observe the precautions listed below to avoid leakage, heat generation, ignition, explosion, and/or smoke. Please take these precautions to ensure safety:
  a) Do not heat or throw the batteries into fire.
  b) Do not disassemble or modify the batteries.
  c) Do not charge or use the batteries with a reversed connection [between the batteries] in which the positive (+) terminal is connected to the negative terminal (-).
  d) Do not mix and use different types and brands of batteries together.
  e) Do not cause a strong physical shock or drop the batteries.
  f) Avoid partially replacing batteries and use new and old batteries together.
- This battery has regulating valves inside. Do not touch the valves. Touching them may cause performance deterioration, shorter life, and rupture of the batteries.
- Store the battery in an air-conditioned facility and keep the temperature between 5°C and 30°C. If the ambient temperature becomes lower than -15°C, discharging is not only working but also electrolyte may freeze, which cause the batteries to break. In an environment where the ambient temperature is constantly above 45°C, the batteries deteriorate more rapidly, which may cause the batteries to break.
- Maintain ambient temperature variation within ±5°C. Cells within a string should be maintained within 5°C of other cells in that string. Temperature differences may result in decreased battery life.

5.1. Charging

⚠ CAUTION


- The batteries must be charged under the specified conditions, using the charger specified by GS Yuasa or the one included in the equipment. Using without recharging may result in an insufficient load. If the batteries are charged under the conditions other than those designated by GS Yuasa, it may cause the following negative effects including leakage, heat generation and fire hazard.
  a) Over Charge: Accelerated water loss and corrosion on positive grid.
  b) Insufficient Charge: Deterioration of positive and negative active material.
- Keep the surface temperature of the batteries below 50℃ as much as possible while charging. If the surface temperature rises above 50℃, it may cause the batteries to break or deteriorate. Please stop performing a refresh charge to prevent the rise of the battery temperature when there is a risk that the temperature rises above 50℃.

5.1.1. Standard Charging

- Correct battery charging is very important for optimum battery life. Improper battery charging may result in decreased battery life, battery leakage, potential risk of fire or other catastrophic battery damage. Recommended charging is below.

Bulk : 0.2CA (SLR1000:200A, SLR500:100A) MAX, Constant Current Charge up to 2.4VPC
Absorption : 0.1CA (SLR1000:100A, SLR500:50A) MAX, Constant Voltage Charge 60-90 mins
Float Application : Not Applicable

- Example) Charge and Discharge Cycle

Discharge condition: DOD70% (0.1CA*6h)
Charging condition:
- Normal charge:
  - 0.1CA for 6h, estimated 90%SOC
- Equalization charge:
  - 0.025CA for 2.5h after charged (to 104% of rated capacity)

- Efficiency of Discharge and Charge

- Approximately 88% at normal charge condition
- Approximately 83% at equalization charge condition

⚠ CAUTION

Charging the batteries with methods other than the method recommended by GS Yuasa may cause the following adverse effects:

a) Overcharge: accelerates the decrease in electrolyte and corrosion of the grid frame of the positive plates and shortens battery life.
b) Insufficient Charge: accelerates the deterioration of the active materials of the positive and negative plates and shortens life.

5.1.2. Equalization Charging

These batteries may require periodic equalization charging shown in Table 4 below after standard charging. Perform equalization charge under the following conditions (whichever comes first):

- Every 20 days
- Discharge amount = 14x rated capacity
- Even if there is no charge and discharge, once per week.

Table 4 Recommended Equalization Charge

Battery Type	Charge Current	Charge Duration
SLR-1000 SLR-500	0.25 × I_{10} (0.025 C_{10})	2.5 hours

**Please contact GS Yuasa for charger settings based on your application and battery charger.

5.2 Discharge

⚠ CAUTION

Must keep the discharge current below the maximum amount shown in Table 5 below even in the emergency condition to avoid damage to the battery.

Table 5 Maximum Discharges Current

Discharge Current (A)	Specified Time
30 × I_{10} (3 C_{10})	1 minute
60 × I_{10} (6 C_{10})	5 seconds

**Please set discharge current up to 6.5 × I_{10} A in normal use.

The discharge cutoff voltage is shown in Table 6 below. Make sure that the end of discharge voltage at the terminals of the batteries does not fall below these values.

Table 6 The size of the Discharge Current and the Minimum Discharge Cutoff Voltage

Discharge Current (A)	Allowable Minimum Discharge Cutoff Voltage (V)
Current less than 0.5 × I_{10}(0.05 C_{10})	1.90
Current over 0.5 × I_{10} (0.05 C_{10}) to less than 1.0 × I_{10} (0.1 C_{10})	1.80
Current over 1.0 × I_{10} (0.1 C_{10}) to less than 1.6 × I_{10} (0.16 C_{10})	1.75
Current over 1.6 × I_{10} (0.16 C_{10}) to less than 2.3 × I_{10} (0.23 C_{10})	1.70
Current over 2.3 × I_{10} (0.23 C_{10}) to less than 6.5 × I_{10} (0.65 C_{10})	1.60

Maximum allowable Depth of Discharge (DOD) based on capacity discharged by Table 6 is 80% for batteries in series applications. Maximum allowable discharging time (at DOD 70%) with each discharging current is shown in Table 7. Remaining battery capacity is decreased based on degradation in use time to time.

Table 7 The size of the Discharge Current and the Maximum Discharge time（at DOD 70 %）

Discharge Current (A)	Maximum Discharge time (h)
$1.0 \times I_{10}$ (0.1 C_{10})	7.0
$1.6 \times I_{10}$ (0.16 C_{10})	3.5
$2.3 \times I_{10}$ (0.23 C_{10})	2.1
$6.5 \times I_{10}$ (0.65 C_{10})	0.7

It is possible to perform deeper discharge, however, it may result in shorter life / less performance of the battery. Maximum allowable Depth of Discharge (DOD) is 70% for batteries in parallel applications by balancing circuit resistance between strings. A maximum parallel connection is 6 strings.

In case of deeper discharges than 70%, the deeper the discharges, the more unbalancing will be caused between parallel string, and will cause shorter life of battery.

Under ideal conditions, the battery should be restored to 100% State of Charge(SOC) following 5.1.1. Standard Charging. As a general rule, leaving the battery in a discharged condition is allowed up to 24 hours. Before charging per 5.1.1 Standard Charging. In case of over 24 hours, the maximum leave time to charge is up to 7 days, followed by charging per 5.1.1. Standard Charging and 5.1.2. Equalization Charging.

Battery Performance table by discharge hour with final voltage is on Appendix.

5.3. Procedures after Natural Disasters

⚠ CAUTION

- After an earthquake or other natural disaster, refasten all the bolts with their specified torque. Use without refastening the bolts may cause sparks or the breakage of the batteries.

- After an earthquake or other natural disaster, check the batteries for cracks in the case, leakage, and any other abnormalities. Using the batteries with an abnormal condition may result in leakage and fire.

6. MAINTENANCE

To prevent problems, perform inspections within the recommended intervals and take all the proper actions.

⚠ CAUTION

- Perform periodic inspections at intervals set by the fire code and other regulations. If anything is found to not meet the standards described in this instruction manual, take the appropriate actions according to this manual. Using batteries that do not meet the standards may result in the breakage or burnout of the batteries.
- Inspections of the batteries should be performed by professionals such as certified technicians. Inspections may not be performed properly by less qualified personnel.

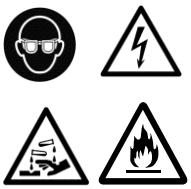
Inspect both the batteries and the areas around the batteries. Organize the areas to make sure no unwanted objects are left to interfere with ventilation and inspections. Also, inspect for water leak or wet spots on the floor. If any problem is found, please take measures to keep the area dry.

⚠ DANGER

- The electrolyte of the batteries is a diluted sulfuric acid solution. If the electrolyte comes in contact with skin and/or clothing, wash with clean water immediately.
- If the electrolyte gets in the eyes or in case of accidental ingestion, consult a doctor immediately. Contact with sulfuric acid can cause burns or loss of eyesight.
- Use a damp cloth to clean the batteries. The use of a dry cloth or duster can create static electricity that may cause a spark, which may cause the batteries to ignite and explode.

⚠ WARNING

- Make sure to wear protective gear, including protective eyewear, rubber gloves, and rubber-soled shoes when performing maintenance and inspections. If the body comes in contact with the conductive parts and protective gear is not worn, an electric shock may occur.
- Do not clean the batteries using the following: organic solvents such as thinner, gasoline and benzene; solutions containing a surfactant such as detergent; chemically treated cleaning cloth; and oils. These substances may cause cracks in the battery case, which may result in the leakage of electrolyte.



CAUTION

- Please discharge static electricity from your body by touching metal away from the batteries before cleaning or inspecting the batteries. If the body has static electricity, touching the conductive parts may cause a spark, which may ignite and cause explosion.

- Inspect the voltage, battery temperature and the appearance periodically, and refasten the bolts periodically as well. Failure to perform periodic inspections may result in the breakage of the batteries and ignition and explosion.

- This battery has regulating valves inside. Do not touch the valves. Touching them may cause performance deterioration, shorter life, and rupture of the batteries.

- This battery has a system that uses an absorption reaction in which the negative plates absorb the oxygen gas generated by the positive plates. Each battery may experience voltage fluctuations toward the end of charging. Also, the temperature of the battery increases toward the end of charging since this reaction is exothermic. If the battery surface temperature exceeds 50℃, please suspend charging and prevent temperature increase.

6.1. 6-month Inspection

Item	Description	Standards	Action
Appearance of battery	Check for damages such as cracks and deformation of the case and cover and leakage	No damages such as cracks, and deformation, no leakage	If there is any damage or leakage, confirm the causes and replace the damaged batteries
	Check for defacement due to dust etc.	No defacement	If they are dirty, clean with a wet (with pure water) damp cloth
	Check for corrosion in racks, connecting bars, connecting wires, battery terminals etc.	No corrosion	Clean and apply anti-corrosive coat or paint

6.2. One Year Inspection

For one year inspection, add this item to the items of 6month inspection

Item	Description	Standard	Action
Connection	Check if any of the bolts needs fastening	No loosening	Refasten the bolts to their specified torque according to Table 3, using a torque wrench

6.3. Procedures for Emergency

⚠ CAUTION

- If there is leakage from the battery, do not use it and contact GS Yuasa. Using the battery in such a condition can damage the equipment and may result in ignition and explosion, smoke or fire due to the electrical leakage.
- If the appearance of battery is abnormal, do not use it and contact GS Yuasa. Using such a battery may cause the battery to break or leak and result in smoke or fire.
- If the battery is heating up and its temperature rises over 60℃ while discharging, stop the use immediately and contact GS Yuasa. Using a battery in such a condition may result in the breakage or burnout of the battery.
- If there is an offensive odor, please discontinue use of the battery and contact GS Yuasa. It may cause an explosion of the battery.



⚠ CAUTION

- If there are cracks in the case, cover or terminal, do not use the battery and contact GS Yuasa. Using batteries in such a condition may result in smoke or fire caused by ignition/explosion and leakage.
- If electrolyte is spilled on the floor, neutralize the acid with baking soda. Not neutralizing the acid may cause corrosion of the floor surface, parts, and equipment.
- If a battery is on fire, extinguish the fire using a dry powder fire extinguisher instead of water. Using water may cause an electric shock and expand the fire.


7. WHEN to REPLACE BATTERIES

The life of the valve-regulated lead-acid batteries for cycle use changes depending on the conditions of use such as battery temperature and the value set for charge/discharge control requirements; however, the batteries can be used for the duration shown in Table 8, if the conditions for use are appropriate and the batteries are connected in series.

Use the timeframe shown in the table as a guideline and replace all the batteries with new batteries before this time.

⚠ WARNING

Continuous use after the replacement time may cause the rapid decrease of capacity and may result in potential risk of fire by hydrogen gas or other secondary hazardous condition.

Table 8 Replacement time for Batteries

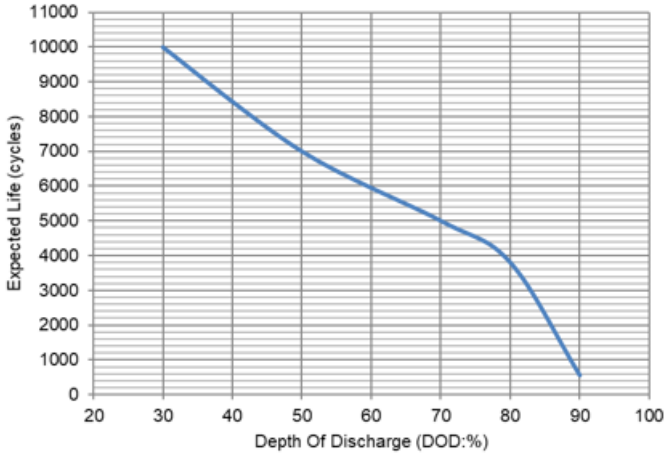
Battery Type	DOD 50%	DOD70%
SLR-1000 SLR-500	Expected life 7000 cycles	Expected Life 5000 cycles

Note: It is time to replace all batteries when the batteries reach the expected life (measured in number of cycles) or the maximum length of use (15 years), whichever comes first.

Battery end of life is defined as 70% of rated capacity (10HR). Replace all batteries at or before 15 years of use regardless of remaining percent (%) of rated capacity.

Please understand that the replacement time (expected life) may vary based on all the applications and methods of use. For other Depth of Discharge (DOD), please determine the replacement time using Chart 1. Chart 1 shows the relationship between the depth of discharge and the expected life. The data in Chart 1 is obtained through our various test results; however, it does not cover all the applications and methods of use. If there are any questions, please contact GS Yuasa.

Chart1. The Relationship between DOD and Expected Life
(Average battery temperature: 25℃)



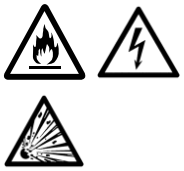
Note: When it discharges according to Table 6 by the maximum discharge current assumed, let electric discharge depth be the depth (%) on the basis of the capacity which can be taken out.

8. BATTERY DISPOSAL

Please remember the following when disposing the batteries.

WARNING

- Remove the connecters. If the connecters are not removed, the electric energy still left in the battery may cause a fire or electric shock.
- Electricity is still left even in the used batteries. Be careful not to cause a spark or short, as they may cause ignition and explosion.

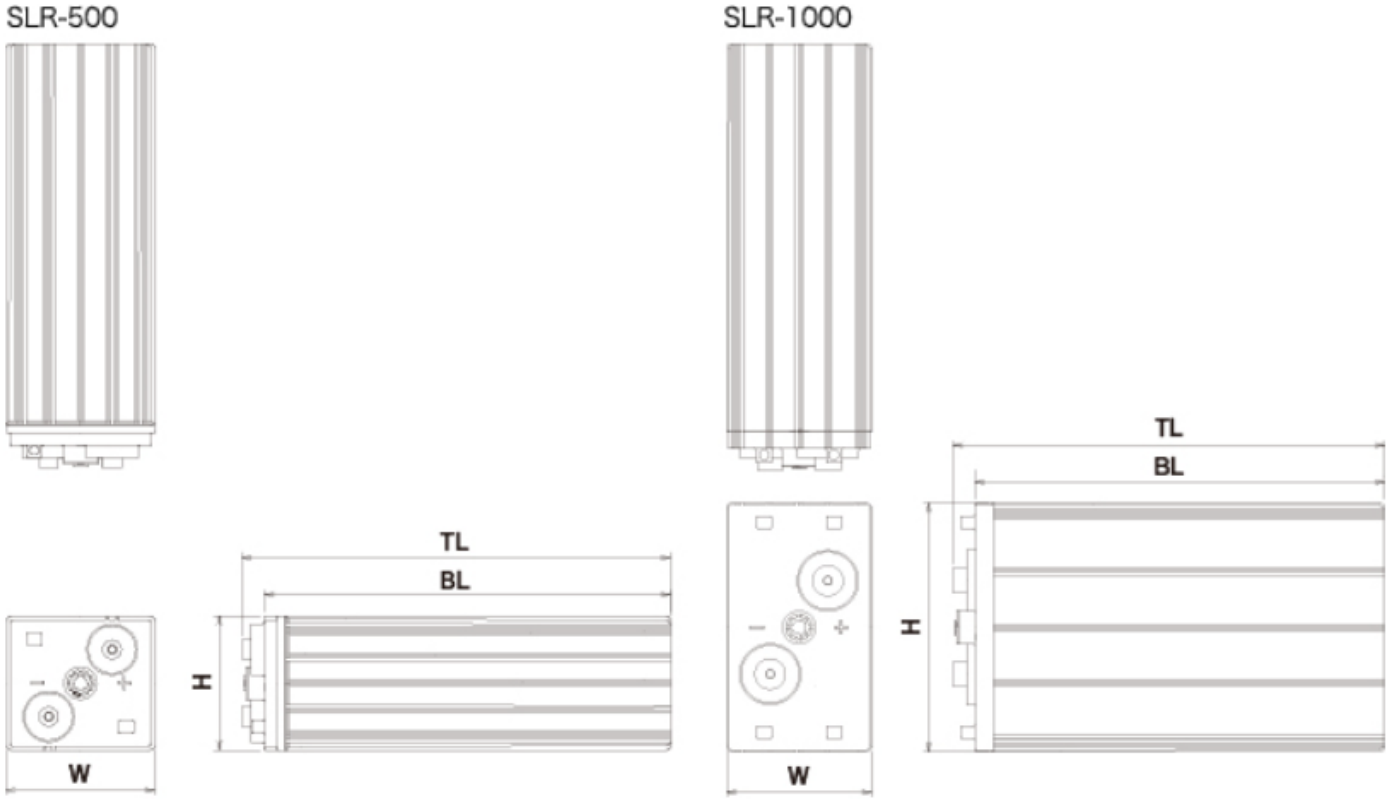


CAUTION

Please recycle used batteries. If you need assistance to dispose batteries, please contact GS Yuasa.

9. APPENDIX

9.1. Battery Dimension and Weight



Dimension inch(mm)	Total Length (TL)	Box Length (BL)	Width (W)	Height (H)	Weight Lb(kg)
SLR-500	19.41"(493)	18.43"(468)	6.7"(171)	6.1"(156)	75(34)
SLR-1000	19.41"(493)	18.43"(468)	6.5"(165)	11.30"(287)	147.71(67)

9.2. Battery Discharge performance table

- **Battery performance table of Amperes and watts to final voltage by hour (100% Depth of Discharge)**

SLR1000

Amperes to final voltages per cell

Temperature: 25 deg. C. (77 deg. F.)																		
	Discharge time / hours																	
V\h	240	120	100	72	48	24	20	12	10	9	8	7	6	5	4	3	2	1
1.60	(5.95)	(11.6)	(13.8)	(18.8)	(27.7)	(53.6)	(62.8)	(90.0)	(102)	(112)	(122)	(133)	(148)	(164)	(193)	(238)	349	649
1.65	(5.94)	(11.6)	(13.7)	(18.7)	(27.6)	(53.4)	(62.7)	(89.9)	(102)	(111)	(122)	(133)	(148)	(163)	(193)	(237)	346	639
1.70	(5.92)	(11.5)	(13.7)	(18.7)	(27.5)	(53.2)	(62.4)	(89.6)	(102)	(111)	(121)	(132)	(147)	(163)	192	234	340	622
1.75	(5.87)	(11.4)	(13.6)	(18.5)	(27.3)	(52.5)	(61.7)	(88.9)	(101)	110	120	131	145	161	190	229	329	588
1.80	(5.80)	(11.3)	(13.4)	(18.3)	(26.9)	51.9	60.9	87.7	100	109	119	129	143	158	185	221	310	535
1.85	(5.60)	(10.9)	(13.0)	(17.7)	(26.0)	50.0	58.7	84.6	96.5	104	114	124	137	151	176	208	284	465
1.90	(5.23)	(10.2)	(12.1)	(16.4)	(24.1)	46.3	54.4	78.1	89.5	97.3	106	114	126	141	161	195	249	380
1.95	4.43	8.77	9.79	13.3	19.6	-	-	-	-	-	-	-	-	-	-	-	-	-

( ) :Not recommended because of over discharge.

Watts to final voltages per cell

Temperature: 25 deg. C. (77 deg. F.)												
	Discharge time / hours											
V\h	20	10	9	8	7	6	5	4	3	2	1	0.5
1.60	(121.9)	(199.4)	(224.8)	(245.8)	(262.4)	(293.1)	(324.7)	(362.3)	(460.8)	645.9	1149	(1509)
1.65	(120.0)	(197.5)	(222.0)	(243.0)	(260.6)	(290.4)	(320.5)	(358.2)	(458.3)	644.2	1144	(1500)
1.70	(119.1)	(195.7)	(220.1)	(241.1)	(257.9)	(286.0)	(318.7)	355.8	452.5	637.4	1140	(1474)
1.75	(118.1)	(193.8)	217.3	239.2	253.3	281.5	314.5	350.2	444.3	628.9	1112	(1398)
1.80	115.3	191.1	215.4	236.3	248.8	278.8	307.6	346.2	436.1	603.4	1047	(1249)
1.85	114.4	189.2	207.8	226.9	244.3	272.6	299.1	334.1	419.6	577.9	945.0	1139
1.90	112.5	181.6	196.5	217.4	235.2	254.7	282.0	314.0	386.7	518.4	806.0	992.0

( ) :Not recommended because of over discharge or temperature increase.

SLR500

Amperes to final voltages per cell

Temperature: 25 deg. C. (77 deg. F.)																		
	Discharge time / hours																	
V\h	240	120	100	72	48	24	20	12	10	9	8	7	6	5	4	3	2	1
1.60	(2.98)	(5.80)	(6.89)	(9.40)	(13.9)	(26.8)	(31.4)	(45.0)	(51.0)	(56.0)	(61.0)	(66.5)	(74.0)	(82.0)	(96.5)	(119)	175	325
1.65	(2.97)	(5.78)	(6.86)	(9.37)	(13.8)	(26.7)	(31.3)	(44.9)	(51.0)	(55.5)	(61.0)	(66.5)	(74.0)	(81.5)	(96.5)	(118)	173	320
1.70	(2.96)	(5.76)	(6.84)	(9.34)	(13.8)	(26.6)	(31.2)	(44.8)	(51.0)	(55.5)	(60.5)	(66.0)	(73.5)	(81.5)	96.0	117	170	311
1.75	(2.93)	(5.72)	(6.79)	(9.27)	(13.6)	(26.3)	(30.9)	(44.5)	(50.5)	55.0	60.0	65.5	72.5	80.5	95.0	115	165	294
1.80	(2.90)	(5.63)	(6.69)	(9.14)	(13.4)	25.9	30.5	43.8	50.0	54.5	59.5	64.5	71.5	79.0	92.5	111	155	268
1.85	(2.80)	(5.45)	(6.48)	(8.85)	(13.0)	25.0	29.4	42.3	48.2	52.0	57.0	62.0	68.5	75.5	88.0	104	142	233
1.90	(2.62)	(5.08)	(6.03)	(8.22)	(12.0)	23.2	27.2	39.0	44.8	48.7	52.9	57.0	63.0	70.5	80.5	97.5	125	190
1.95	2.22	4.39	4.89	6.67	9.79	-	-	-	-	-	-	-	-	-	-	-	-	-

( ) :Not recommended because of over discharge.

Watts to final voltages per cell

Temperature: 25 deg. C. (77 deg. F.)												
	Discharge time / hours											
V\h	20	10	9	8	7	6	5	4	3	2	1	0.5
1.60	(60.9)	(99.7)	(112)	(122)	(131)	(146)	(162)	(181)	(230)	322	574	754
1.65	(60.0)	(98.8)	(111)	(121)	(130)	(145)	(160)	(179)	(229)	322	572	750
1.70	(59.5)	(97.8)	(110)	(120)	(128)	(142)	(159)	177	226	318	570	737
1.75	(59.1)	(96.9)	108	119	126	140	157	175	222	314	556	699
1.80	57.7	95.5	107	118	124	139	153	173	218	301	523	624
1.85	57.2	94.6	103	113	122	136	149	167	209	288	472	569
1.90	56.2	90.8	98.2	108.0	117	127	141	156	193	259	403	496

( ) :Not recommended because of over discharge or temperature increase.

- **Final voltage/cell by Hours/Ampere and Depth of Discharge**

SLR1000

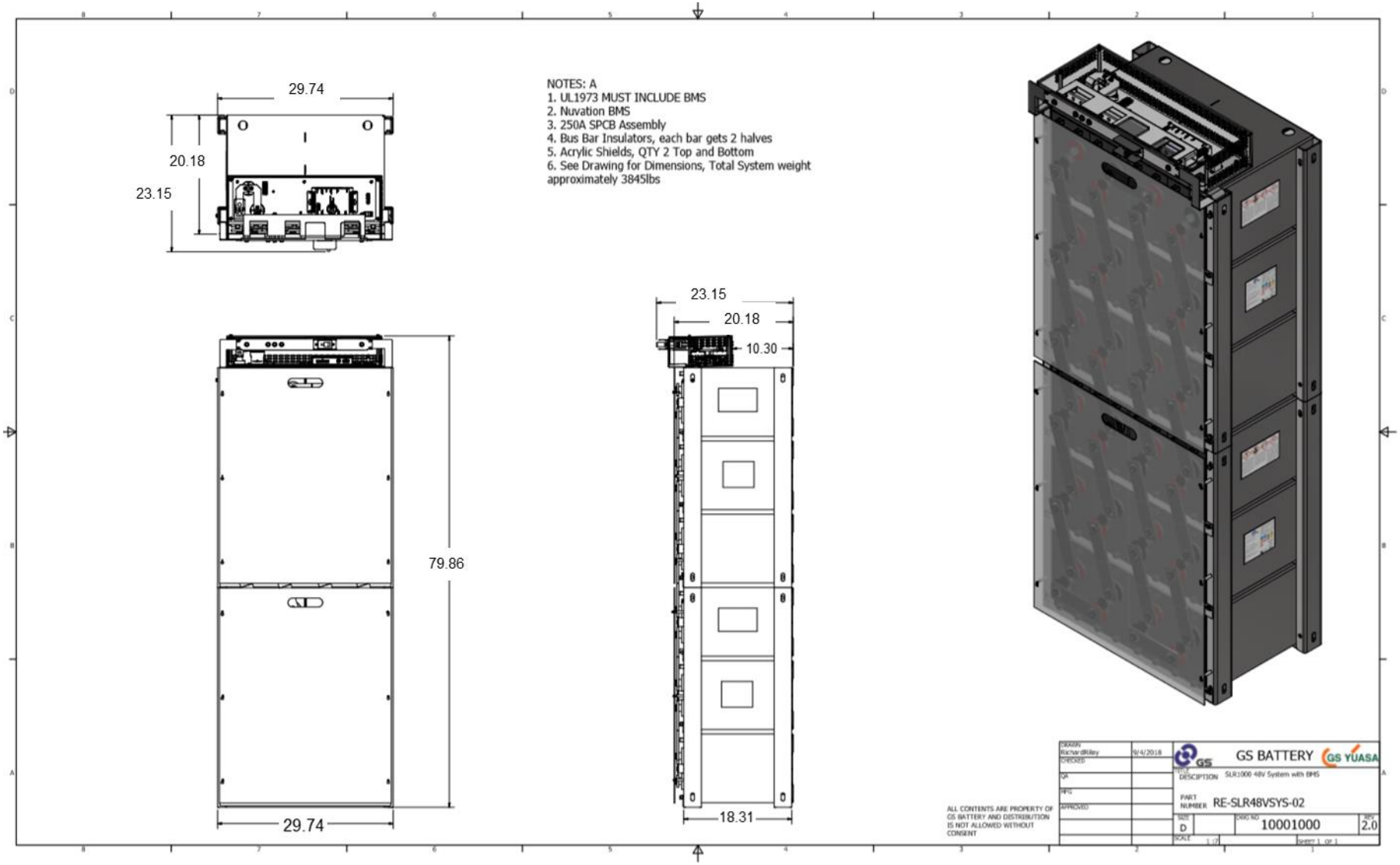
Hour		100	48	24	20	12	10	9	8	7
CA/A		0.0098/9.8	0.0196/19.6	0.046/46	0.061/61	0.088/88	0.1/100	0.11/110	0.12/120	0.13/130
DOD										
30	%	2.09	2.09	2.07	2.07	2.07	2.05	2.05	2.05	2.05
40	%	2.08	2.07	2.06	2.06	2.06	2.04	2.04	2.04	2.03
50	%	2.06	2.05	2.04	2.04	2.04	2.00	2.00	2.00	2.00
60	%	2.04	2.04	2.02	2.02	2.02	1.98	1.98	1.98	1.98
70	%	2.02	2.02	2.00	2.00	2.00	1.95	1.95	1.95	1.95
80	%	2.00	2.00	1.98	1.97	1.97	1.94	1.93	1.93	1.93

SLR500

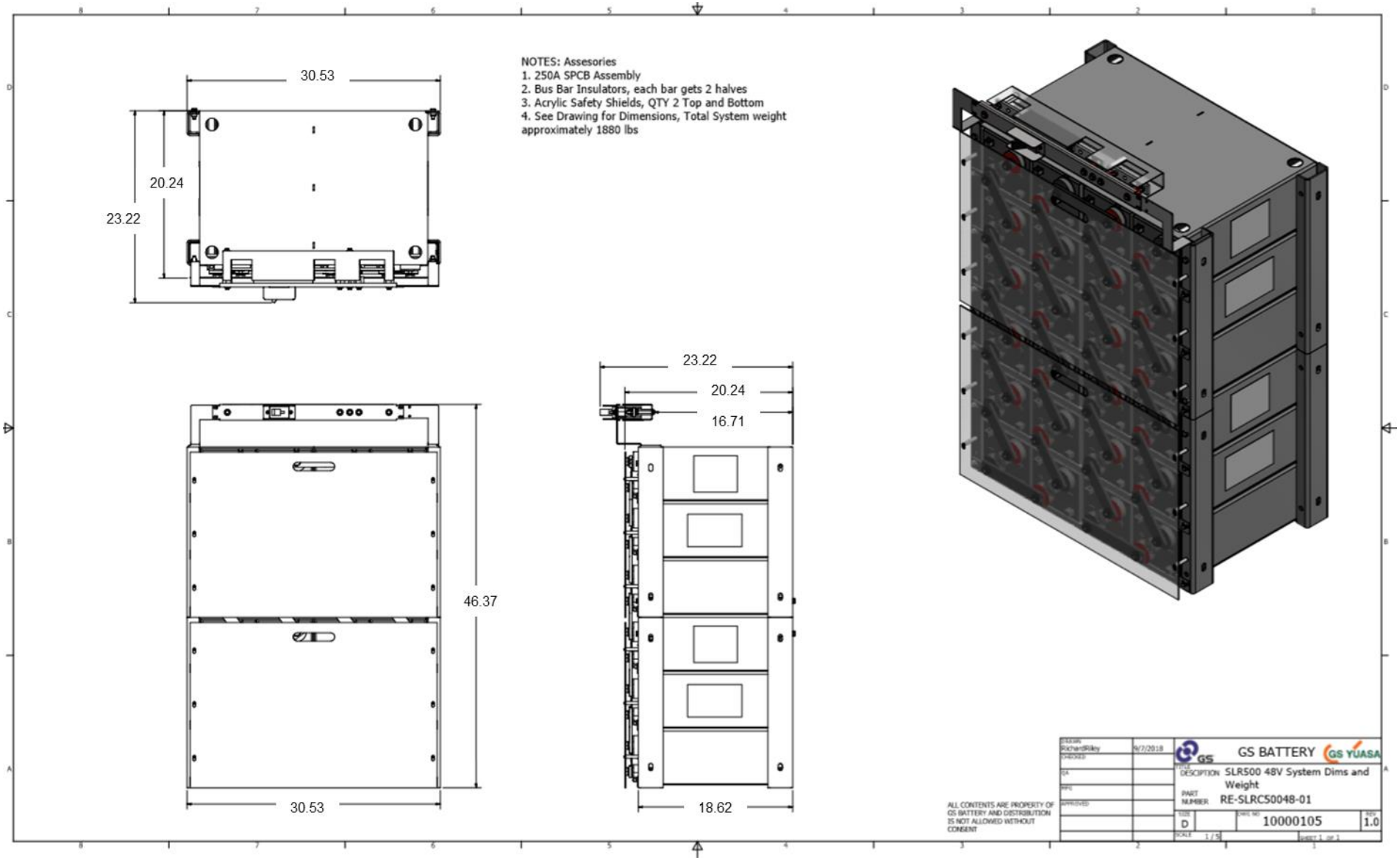
Hour		100	48	24	20	12	10	9	8	7
CA/A		0.0098/4.9	0.0196/9.8	0.046/23	0.061/30.5	0.088/44	0.1/50	0.11/55	0.12/60	0.13/65
DOD										
30	%	2.09	2.09	2.07	2.07	2.07	2.05	2.05	2.05	2.05
40	%	2.08	2.07	2.06	2.06	2.06	2.04	2.04	2.04	2.03
50	%	2.06	2.05	2.04	2.04	2.04	2.00	2.00	2.00	2.00
60	%	2.04	2.04	2.02	2.02	2.02	1.98	1.98	1.98	1.98
70	%	2.02	2.02	2.00	2.00	2.00	1.95	1.95	1.95	1.95
80	%	2.00	2.00	1.98	1.97	1.97	1.94	1.93	1.93	1.93

9.3. System Drawing

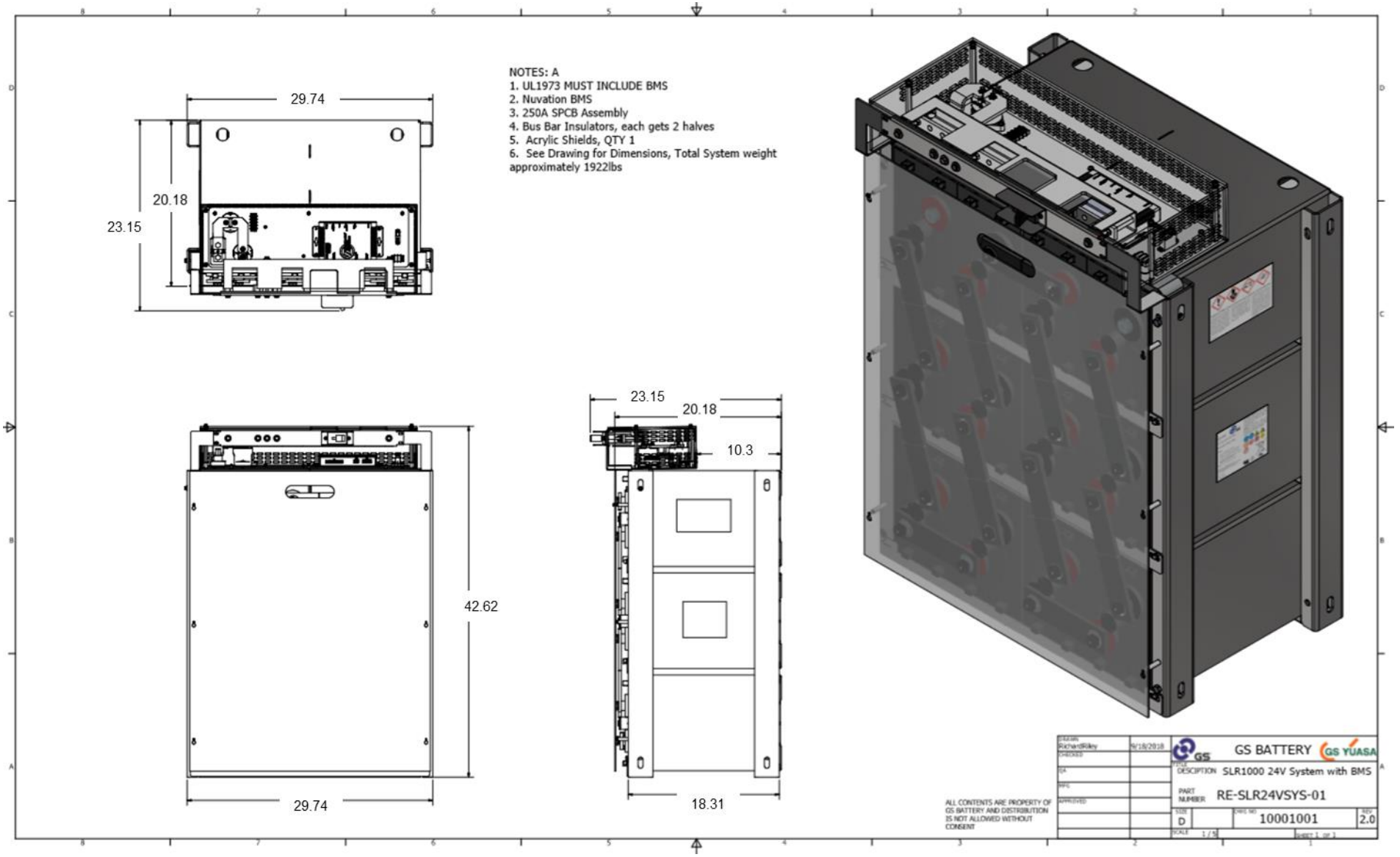
9.3.1. System Name: RE-SLR48VSYS-02 (48kWh, 48V system with SLR1000)



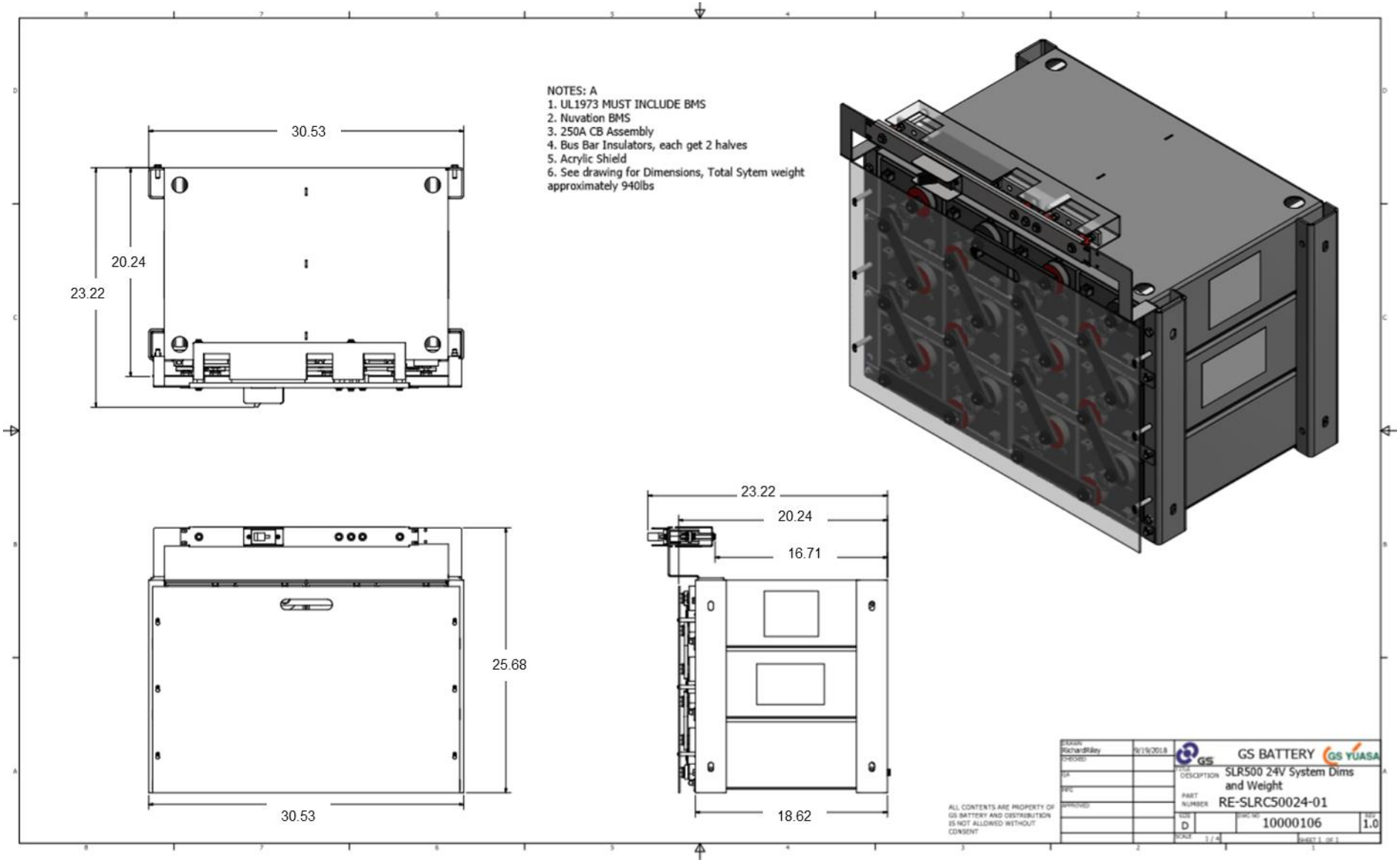
9.3.2. System Name: RE-SLRC50048-01 (24kWh, 48V system with SLR500)



9.3.3. System Name: RE-SLR24VSYS-01 (24kWh, 24V system with SLR1000)



9.3.4. System Name: RE-SLRC50024-01 (12kWh, 24V system with SLR500)



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