

## Precautions for handling the Rechargeable Valve Regulated Lead Acid Batteries

This document should be read in its entirety and its content fully understood before handling or using Panasonic rechargeable valve regulated lead-acid batteries. If there are any questions, please contact Panasonic (the address, phone number, and facsimile number are listed below). Please keep this document always available. Due to the potential energy stored in the batteries, improper handling or use of the batteries without understanding this document may result in bodily injury caused by electrolyte leakage, heat generation, or explosion.

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\*All descriptions are subject to modification without notice.

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### Degree of damage

(1) “Danger”

When the batteries are handled or used improperly, death or severe injury shall occur.

(2) “Warning”

When the batteries are handled or used improperly, death or severe injury may occur, and sight injury or loss of products often occurs.

(3) “Caution”

When the batteries are handled or used improperly, slight injury may occur and damage to the batteries and equipment may occur.

(4) “Request”

When the batteries are handled or used improperly, damage to their quality or performance may occur.

Note (1): Improper handling and use of the batteries may cause dangerous conditions to arise. All precautions should be taken to prevent any harmful effects from the use of the batteries.

Note (2): “Severe injury” as a result of improper handling or use of the batteries may include but are not limited to loss of eyesight, injury/burn/electric shock/fracture of a bone/poisoning with after effect, or injury that requires long-term medical treatment. “Slight injury” covers such conditions as burns or electric shock that do not require long-term medical treatment. Damage to products is defined as extensive damage to a house, a house hold effects, a livestock, or pets.

Note (3): “Requests” are meant to prevent a decrease in the quality or the performance of the batteries.

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### 1. Environments and conditions

#### Danger

(1) Do not put the batteries into airtight containers or bags. The batteries tend to generate inflammable gas upon excess charge, which may cause an explosion if enclosed in an airtight container.

#### Warning

(1) The batteries must be charged using the specified charger or by maintaining the charging conditions indicated by Panasonic. If the batteries are charged under conditions other than those specified by Panasonic, they may leak, generate excessive heat, or explode.

(2) When using the batteries in medical equipment, incorporate a back-up system other than the main battery in the event of power failure.

(3) Insert insulation that is resistant to heat and sulfuric acid between the batteries and any metallic housing. Failure to do so may cause the batteries to smoke or burn in case of electrolyte leakage.

(4) Do not place the batteries near a device that may generate sparks (such as a switch or fuse) and do not place the batteries close to fire. The batteries may generate an inflammable gas when charged excessively that may ignite upon contact with a spark or they may burn or explode due to sparks or fire.

#### Caution

(1) Use or store the batteries in the temperature range specified below:

Discharge (operating an application): 5°F ~122°F (-15°C ~50°C)

Charge: 32°F ~104°F (0°C ~40°C) Storage: 5°F ~104°F (-15°C ~40°C)

Temperatures above or below those recommended could result in damage or deformity of the batteries.

(2) Avoid placing batteries near a heat-generating device (such as a transformer) which may cause the batteries to generate excessive heat, leak or explode.

(3) Do not allow the batteries to be exposed to rain or seawater. If the battery terminals should get wet, they may corrode.

(4) Do not use or store the batteries in a car under the blazing sun, in direct sunlight. To do so may cause the batteries to leak, generate excessive heat, or explode.

(5) Do not use or store the batteries in a dusty place as dust may cause them to short between their terminals. When using the batteries in a dusty place, check them periodically.

(6) In application requiring more than one battery, first connect the batteries together and then connect the batteries to the charger or the load. Be careful to connect the (+) pole of the batteries to the (+) terminal of either the charger or the load. Improperly connecting the batteries, or load may cause an explosion or fire to occur. In some cases, bodily injury may occur.

(7) When handling the batteries, wear steel-tipped shoes to prevent possible injury to the feet if the batteries are accidentally dropped.

### Request

(1) Dropping a battery may cause a strong physical shock that may damage the performance of the battery.

(2) Confirm the life of the batteries using the real load and charger. Differences in the charging and the discharging conditions may cause a big difference in the life of the batteries.

## 2. Installation

### Danger

(1) Tools such as wrenches used to install the batteries should be insulated. Bare metal tools may cause an abnormal short circuit accident to occur resulting in bodily injury, damage to the batteries, explosion or fire.

(2) Do not install the batteries in a room without ventilation. The batteries tend to generate an inflammable gas upon excess charge resulting in an explosion or fire if the room is closed.

### Warning

(1) Do not contact any plastic or resin (\*) which contains the migrating plasticizer with the batteries. Furthermore, avoid using organic solvents such as thinner, gasoline, lamp oil, benzine and liquid detergent to clean the batteries. The use of any of above materials may cause the containers and/or the covers (ABS resin) of the batteries to crack and leak. There may be possibilities for the batteries to generate fire in the worst case. Need to make sure the use of material will not cause the containers and/or the covers (ABS resin) of the batteries to crack due to the migration of plasticizer within the material by asking the manufacturer of the material if necessary.

(\*) Examples for plastic or resin which should be avoided using;

Vinyl chloride, Oily rubber.

Examples for plastic or resin which is proper for the use;

Polyolefin resin such as polypropylene, polyethylene.

(2) Always use such as rubber gloves when handling batteries with the voltages higher than 45 volts in order to prevent severe bodily injury from occurring.

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

### Caution

(1) During unpacking, handle the batteries carefully and check for cracks, breakage, or electrolyte leakage. Failure to handle carefully may result in damage due to physical shock.

(2) When the batteries are being mounted in the equipment, consider the best position for easy checking, maintenance and replace ability. In addition, the batteries should be located in the lowest part of the equipment as possible. The rechargeable Valve Regulated Lead-Acid Batteries, mentioned in this document, are designed for use in any position, but charging the batteries in the upside-down position should be avoided. When these batteries are charged excessively in the upside-down position, leakage of electrolyte from the rubber vents may occur.

The upside-down is shown on the left side of the next drawings. In this upside-down position, the mark “Panasonic” on the battery is turned upside-down. The drawings are only for explanation of the battery’s position; therefore these are not equal to the real appearance of the battery that the specifications describe.

Can be used in the vertical position and the side-down position. (maximum angle of 90 degrees from the normal position).

(3) Do not carry the batteries by picking up them by their terminals or lead wires. To do so may damage the batteries.

(4) Be careful not to jolt the batteries as it may result in damage to them.

(5) Be aware the batteries are relatively heavy compared to their volume. Not to be so may cause injury and/or lumbago.

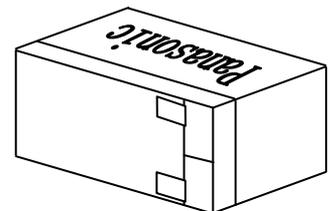
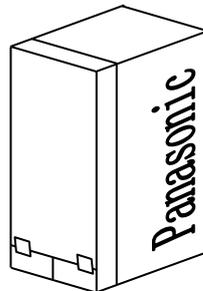
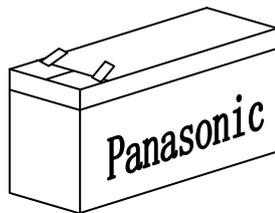
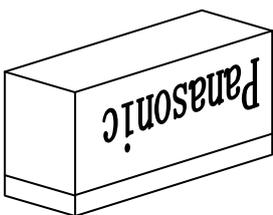
(6) Do not cover the batteries with plastic sheet as it may cause a fire or an explosion by conducting static electricity.

(Upside-down position)

(Normal position)

(Vertical position)

(Side-down position)



(7) Fasten the bolts and the nuts with the torque as shown below: Not to do so may cause the battery terminals to spark and/or break.

Bolt (Nut) Size			Fastening torque
Diameter	Pitch	Length	
M5(5mm)	0.8mm	15±1mm	20~30kgf • cm
M6(6mm)	1.0mm	20±1mm	40~55kgf • cm
M8(8mm)	1.25mm	20±1mm	80~100kgf • cm
M10(10mm)	1.5mm	36±1mm	150~200kgf • cm

(8) Place the necessary insulating covers over the terminals, the connecting bars, and bolts and nuts to prevent a dangerous electric shock.

(9) Please consult Panasonic prior to using the batteries in applications such as a motor bicycle, an engine driven lawn mower, etc., which may generate severe vibration.

(10) Fasten the batteries firmly to the equipment's to avoid the influence of vibration and/or physical shock. When the total product of equipments of battery installed in public、 normal capacity of batteries and the amount of container is more than 4800amp/cell,sometimes there are regulations in law about the ground structure as installing batteries and management benchmark of battery's equipments and so on.

### Request

(1) A certified technician should install the batteries.

## 3.Preparation prior to operation

### Danger

(1) Be sure to provide enough insulation around the lead wires and/or plates used between the batteries and the application. Insufficient insulation may cause an electric shock heat generating from a short circuit (or excess current) may result in an injury, burn, smoke or fire.

### Caution

(1) Do not plug the batteries directly into the outlet or the cigarette receptacle of a car without inserting a charger between the batteries and the outlet or the receptacle. To do so may cause electrolyte leakage, heat generation, or explosion of the battery.

(2) Turn off the circuit switch when the connections between the batteries and the charger/load are made.

(3) When using the batteries for the first time, check for rust, heat generation, or any other abnormalities. If found, do not use as it may cause electrolyte leakage, heat generation, or explosion.

### Request

(1) Since the batteries tend to lose a part of their capacity due to self-discharge during shipment and storage, recharge the batteries before you use them after purchase or long-term storage in order to restore their full capacity.

As following, there is relation between storage time and temperature without charging batteries:

Below 20°C :9 months

Below 20-30°C :6 months

Below 30-40°C: 3 months

Check for the following conditions before to recharge:

Charge method	Charging condition (at 77°F,25°C)
Constant voltage	<p>*Regulation range of the controlled voltage: 7.25V to 7.45V/6V battery, 14.5V to 14.9V/12V battery; Initial current:0.1CA to 0.4CA; Maximum charging time: 24hours.</p> <p>*Short-time charge is possible when several batteries of the same model, under the same storage conditions can be charged in series. Otherwise they can be charged separately.</p>
Constant current	<p>*Charging current:0.1CA *Charging time (hours) =[Amount of self-discharge (Ah)/0.1CA] X 120% Rough estimation of amount of self-discharge is as follows (for an example): When the storage ambient temperature is lower than 77°F (25°C), and storage time is known, assume the following amount of self-discharge: [5%/month] X storage months Multiply this by the rated capacity (at 20 hours rate) of the battery.</p> <p>*Regardless of the above calculation, the charge time for a refresh charge must be less that 12 hours.</p> <p>*When the storage ambient temperature is higher than 77°F (25°C), please consult Panasonic.</p>

#### 4.Unspecified use

##### Caution

(1) Do not place the batteries in an unspecified use or they may leak, generate heat, or explode.

#### 5.Methods of handle and operation

##### Danger

(1) Do not directly connect the positive and negative terminals with conductive materials such as a wire. Be careful while using a metal tool such as a wrench and/or carrying the batteries with metallic necklaces and hairpins to prevent a short circuit.

A short of the battery's terminals may cause heat generation, explosion or fire.

##### Warning

(1) Never dispose of the batteries in a fire as it may cause them to explode or generate a toxic gas.

(2) Do not attempt to disassemble the batteries as it could cause leakage of sulfuric acid and body injure.

## Caution

- (1) To prevent accidents from happening, change any battery that is found to have an abnormality such as crack, deformity, or leakage. The batteries must be kept clean and free from dust to prevent loss of capacity or accident.
- (2) If any abnormality of the charge voltage or the discharge voltage is detected, replace the batteries with new ones.
- (3) Charging the batteries with an inverse polarity connection between the batteries and the charger could cause electrolyte leakage, heat generation, or a fire.
- (4) Do not solder directly on the batteries' terminal tabs. Soldering directly on the batteries' terminals may cause leakage of electrolyte. Consult Panasonic when soldering is necessary.
- (5) Avoid the use of the batteries differing in capacity, type, or history of use (charge/discharge operation). These differences could cause electrolyte leakage or heat generation.
- (6) Do not remove or scratch the outer tube of the battery or it may cause an electrolyte leakage or electrical leakage.
- (7) Do not allow the batteries to be subjected to any strong physical shocks or jolts while moving them. Treating the batteries roughly could cause leaks, heat generation, or explosion.
- (8) Do not charge the batteries beyond the amount of the time indicated in the specifications, or do not charge after the charge indication lamp indicates a full charge. Take the batteries off the charger if the charge is not finished after the specified charge time. Over-charging can cause leakage, heat generation, or explosions.
- (9) Children should be taught how to handle and use the batteries correctly.
- (10) Keep the batteries out of the reach of small children at all times.

## Request

(1) The cut-off voltage during discharge should vary depending on the discharge current. Do not discharge the batteries lower than the recommended cut-off voltage shown in Panasonic specifications or Panasonic technical handbooks. Recharging a battery which was, once discharged below the recommended cut-off voltage, may generate heat, resulting in the deformation of the battery or in condensation around the battery cover caused when moisture within the battery evaporates. In addition, the efficiency of the battery would eventually decrease.

Over-discharging a battery may result in reduced performance. Always recharge the batteries immediately after discharge even if the batteries were not discharged to the recommended cut-off voltage. If the batteries are not charged soon after discharge, the battery performance may be reduced due to the so-called "sulfation phenomena".

Note: the cut-off devices to prevent over-discharge should cut off all discharge current including any weak current.

- (2) Thoroughly study the charge methods and the conditions of the batteries before adopting other charge methods, which are not shown in the Panasonic specifications or the Panasonic technical handbook, for safety reason
- (3) Measure the total voltage of the batteries during trickle charge (or float charge), using a voltage meter with the accuracy of Class 0.5 (Japan Industrial Standard). If the total voltage of the batteries provide an indication deviating from the specified voltage range, be sure to investigate the cause. If the total voltage is lower than that specified, the batteries may lose their capacity because of a lack of sufficient charge. However, if the total voltage is higher than that specified, the batteries may lose their capacity by damage due to overcharge and

may suffer from “thermal run-away” and other accidents.

(4) Switch off the equipment after use to prevent loss of performance or shortened life of the batteries due to damage over-discharges.

(5) When storing the batteries, be sure to remove them from the equipment or disconnect them from the charger and the load to prevent over-discharge and loss of capacity. Before storing batteries, charge the batteries fully. Do not store batteries in a highly humid place to prevent rust from forming on the terminals.

## 6. Maintenance

### Warning

(1) When cleaning the batteries, use a soft damp cloth. A dry cloth may cause static electricity, which could result in a fire or explosion.

(2) Replace batteries with the new ones before the end of their useful life as determined in the specifications. When the batteries near the end of their life (50% state of their initial discharge duration time) will shorten remarkably. Finally the batteries will lose their available capacity by either drying out their electrolyte (causing increase in their internal resistance) or an internal short circuit. In such case, if the batteries go on charging, thermal runaway and/or leakage of electrolyte may occur. The batteries should be replaced before becoming in these states.

The expected life of the batteries (in trickle or float use) will decrease to half (50%) with each 18°F (10°C) rise in temperature above 77°F (25°C). In particular, the life of the batteries will be shortened remarkably at approximately 104°F (40°C). Accordingly, precautions are required to prevent the use of batteries at high temperatures.

### Caution

(1) Avoid using organic solvents such as thinner, gasoline, lamp oil or benzene and liquid detergent to clean the batteries. These substances may cause the battery containers to crack or leak.

### Request

(1) Keep the battery terminals clean in order to avoid interruption in the discharge and/or to maintain the charge.

## 7. Treatment at emergency

### Warning

(1) The batteries have toxic liquid-dilute sulfuric acid solution in them. If the acid comes into contact with skin or clothes, wash skin or cloth with lots of clean water to prevent scalding from occurring. If the acid should come into contact with the eyes, wash the eyes with lots of clean water and consult a physician immediately to prevent possible loss of sight.

### Caution

(1) Check the batteries visually for any sign of irregularities in appearance. If any damage exists such as cracks, deformation, leakage of electrolyte, or corrosion, the batteries must be replaced with the new ones. Irregularities in the batteries could result in bodily injury, electrolyte leakage, excessive heat generation or explosion, if used. Furthermore, make sure the batteries are clean and free from dirt and dust.

## 8. Storage

## Caution

- (1) Store the batteries in a fixed position separate from metal or other conductive materials.
- (2) Keep the batteries from rainwater that could cause corrosion on the terminals of the batteries.
- (3) Keep the batteries right side up during transportation and do not give any abnormally strong shock and jolt to the batteries. Transporting the batteries in an abnormal position or handling them roughly could destroy the batteries or cause their characteristics to deteriorate.
- (4) When storing the batteries, be sure to remove them from the equipment or disconnect them from the charger and the load, then store them at room temperature or lower temperature. Do not store the batteries at direct sunlight, higher temperature or high humidity atmosphere. To do so cause the batteries short life, performance deterioration or corrosion on terminals.

## Request

- (1) Charge the batteries at least once every six months if they are stored at 77°F (25°C). Use the charge method specified in “3.Preparation prior to use”. The interval of this charge should be reduced to 50% by each 18°F (10°C) rise in temperature above 77°F (25°C).  
The self-discharge rate doubles for each 18°F (10°C) in temperature. If they are stored for a long time in a discharged state, their capacity may not recover even after charge. If the batteries are stored for more than a year at room temperature, the life of the batteries may be shortened.
- (2) Store the batteries starting from the fully charged state to prevent the life of the batteries being shortened.
- (3) Use the batteries as quickly as possible after receiving them as they gradually deteriorate even under proper storage conditions.

## 9. Disposal and Recycling

### Caution

- (1) Please write the information about battery recycling on the equipment, the package, the carton, the instruction manual, etc. in countries where legal or voluntary regulations on battery recycling are applicable.
- (2) Design the equipment such that exchange and disposal of the batteries can be undertaken easily.
- (3) Used batteries should be recycled, when returning used batteries, insulate their terminals using adhesive tape, etc, even used batteries still have electrical charge and an explosion or a fire may occur, if proper insulation is not given on the terminals of the used batteries.

## 10.Recommended timing for battery replacement for backup applications

### Why do I have to replace batteries?

As the period in use becomes longer, the run time gradually becomes shortened. When the runtime becomes shortened and its life comes to an end eventually, deterioration of the battery such as internal short circuit, poor electrolyte and positive grid corrosion results inside of the battery. If the battery continues to be used in this condition, the electrolyte leakage and/or thermal runaway may result in the battery while its capacity reaches 0. Before any of these phenomena is found, preventive measures such as replacing batteries should be taken.

## Without such preventive measures, what will happen?

If no preventive measures are taken, there may be a possibility of the battery to generate fire in the worst case. One of the mechanisms to generate fire is stage 1. positive electrode grid corrosion, 2. damaged on the battery case caused by its own expansion due to the corrosion, 3. electrolyte leakage, 4. generation of fire. Another is 1. positive electrode grid corrosion, 2. internal short-circuits due to the corrosion, 3. arch , 4. generation of fire.

In order to avoid the worst consequences, please make sure that your batteries are properly replaced at regular intervals. In case the battery can not be replaced for some reason, stop charging the battery immediately.

## How can I identify proper replacing intervals for my battery?

Please see the table for the proper intervals in replacing batteries.

Replacing timing differs depending on a temperature of the battery surface. The interval for replacement becomes shortened approximately half as much every time the temperature rises by 10°C (18°F). In identifying the specific replacing time for your specific battery, please refer to the ambient temperature of the battery.

### Intervals of replacement for VRLA battery

Type	Temperature of the battery surface	Recommended interval of replacement
LC-V/UP-V /LC-WTV	25°C	3 years
	30°C	2 years
	40°C	1 year
LC-P/UP-P/ LC-WTP	25°C	6 years
	30°C	4 years
	40°C	2 years
LC-Q	25°C	10 years
	30°C	7 years
	40°C	3.5 years

Note: The temperatures in the table are ambient temperatures of VRLA batteries.

If you keep charging the battery over the years in the table, the battery will lose the capacity and may generate fire. The numbers of the years in the table are different from its guaranteed battery life or expected battery life as an average life assumed through high temperature lab tests.

We recommend early battery replacement for backup operation even before the time show in the table has passed.

In case the battery continues to be used after its proper replacement timing because of negligence, we are not liable for any damaging consequences such as fire and smoke caused by the battery.

Please understand this and take proper preventive actions.