

■ 1 GENERAL FEATURES

1.1 Stable Quality & High Reliability

VISION battery is well-known for its stable and reliable performance. VISION batteries are easy to maintain; thus, permitting a safe and proper operation of the equipment that the battery powers. The battery can withstand overcharge, over discharge, vibration, and shock. It is also capable of extended storage.

1.2 Sealed Construction

VISION's unique construction and sealing technique guarantees that no electrolyte leakage can occur from the terminals or case of any VISION battery. This feature insures safe and efficient operation of VISION batteries in any position. VISION batteries are classified as "Non-Spillable" and will meet all requirements of the International Air Transport Association. (IATA Dangerous Goods Regulation, 41st Edition, Section 4.5A, Special Provision: A67)

1.3 Long Service Life, Float or Cyclic

The VISION SLA battery has a long life in float or cyclic service. The expected life of float service is shown on Figure 10, and life of cyclic service as shown on Figure 11.

1.4 Maintenance-Free Operation

During the expected float service life of VISION batteries, there is no need to check the specific gravity of the electrolyte, or add water. In fact, there is no provision for these maintenance functions.

1.5 Low Pressure Venting System

VISION batteries are equipped with a safe low pressure venting system, which operates from 1 psi to 6 psi. The venting system is designed to release excess gas in the event that the gas pressure rises to a level above the normal rate. Afterwards, the venting system automatically re-seals itself when the gas pressure level returns its normal rate. This feature prevents excessive build up of gas in the batteries. This low pressure venting system, coupled with the extraordinarily high recombination efficiency, make VISION batteries the safest sealed lead-acid batteries available.

1.6 Heavy Duty Grids

The heavy-duty lead calcium-alloy grids in VISION batteries provide an extra margin of performance and service life in both float and cyclic applications, even in conditions of deep discharge.

1.7 Low Self Discharge

Because of the use of Lead Calcium grids alloy, VISION SLA battery can be stored for long periods of time without recharge.

1.8 U. L. Component Recognition

All of our VISION SLA batteries have already passed UL test which file number is MH25860.

■ 2 APPLICATIONS

A partial list of common applications includes, but is not limited to, standby or primary power for:

<i>Alarm Systems</i>	<i>Marine Equipment</i>
<i>Cable Television</i>	<i>Medical Equipment</i>
<i>Communications Equipment</i>	<i>Micro Processor Based Office Machines</i>
<i>Control Equipment</i>	<i>Portable Cine & Video Lights</i>
<i>Computers</i>	<i>Power Tools</i>
<i>Electronic Cash Registers</i>	<i>Solar Powered Systems</i>
<i>Electronic Test Equipment</i>	<i>Telecommunications Systems</i>
<i>Electric powered Bicycle and Wheelchairs</i>	<i>Television & Video Recorders</i>
<i>Emergency Lighting Systems</i>	<i>Toys</i>
<i>Fire & Security Systems</i>	<i>Uninterruptible Power Supplies</i>
<i>Geophysical Equipment</i>	<i>Vending Machines</i>

3 CONSTRUCTION

3.1 Positive plates

Positive plates are made from a Lead-Calcium system.

3.2 Negative Plates

Negative plates are made from a Lead-Calcium system.

3.3 Separators

The glass fiber separators in VISION SLA batteries have high resistance to acid. The high porosity of the separators retains adequate electrolyte for the reaction of active materials in the plates.

3.4 Safety Vents

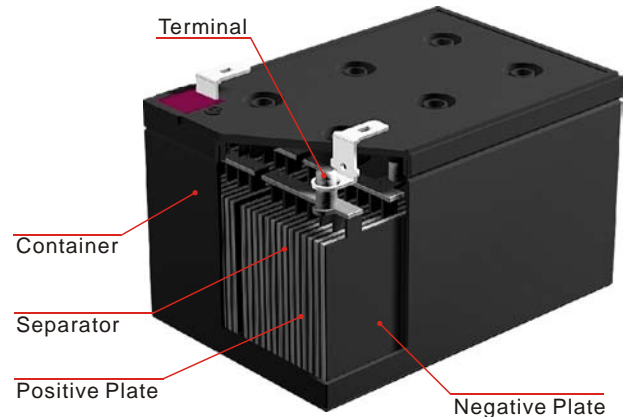
The venting system, which operates at 1 psi to 6 psi (0.07-0.43kg/cm²) is designed to release excess gas and keep the internal pressure within the optimum range of safety. At the same time, it protects the negative plates from contamination from oxygen in the air. Vents are 100% visually inspected during battery production.

3.5 Terminals

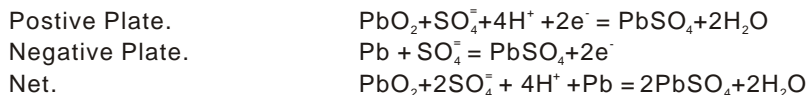
Depending on the battery model, the terminals may be F1,F2,F3,F4.....Excellent terminal sealing construction has been achieved by using long mechanical sealing paths and A selection of small shrinkage ratios for thesealing materials.

3.6 Case Materials

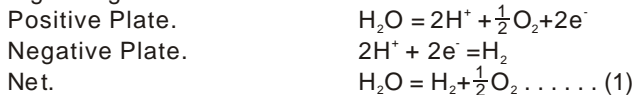
Standard case and cover are manufactured from ABS resin.



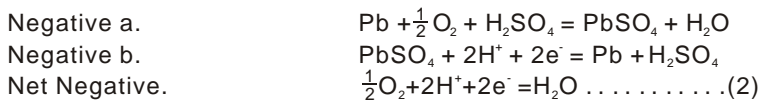
4 PRINCIPLE PROCESSES OF SEALED LEAD ACID BATTERY



The gassing and water loss reactions are as follows:

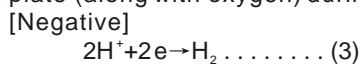


It is noted that the gassing reaction only generally occurs to any extent when the battery is almost totally charged. In the valve regulated battery, it is obvious that water loss must be avoided. This is done by limiting the escape of hydrogen and oxygen from the battery. The design accomplishes the recombination of the oxygen formed at the positive plate with the hydrogen formed at the negative plate. The reaction is as follows.



Because the oxygen gas generated in the final stage of charging is absorbed by the negative, as shown by above equations, there is no increase in internal pressure, despite the sealed construction. When the charging current exceeds or is less than the specified value, the amount of gas generated by the reaction cannot all be absorbed by the reaction (equation 1). In the event that an increase in terminal pressure develops, the safety vent opens.

Gases including Hydrogen are released from the safety vent. The Hydrogen is generated at the negative plate (along with oxygen) during the electrolysis that takes place during excessive overcharge.



[Hydrogen ions] [Electrons] [Hydrogen]

It should be noted that when the safety vent functions, electrolyte is consumed and battery performance

deteriorates. To prevent or reduce this, it is important that charging should be conducted under recommended conditions.

5 BATTERY STORAGE

It is widely recognized that VISIONSLA batteries have excellent charge retention characteristics. Their self-discharge rate is low (typically less than 3% per month at 20°C). Even though the self-discharge is low, specific precautions must be followed against possibilities that some batteries can over discharge by itself when in storage or not in operation. It is necessary to understand what is meant by a fully discharged (flat) battery. A discharged battery may be determined by the voltage of that battery. The voltage of a battery that can be described as fully discharged varies with the discharge current. For example, the higher the discharge current for a battery, the quicker the battery reaches a fully discharged state and the lower the voltage will be for a battery to be described as fully discharged (flat). At all times, a battery should be recharged immediately after discharge.

5.1 Final Acceptable Discharge Voltages

Discharge Current	Final Discharge Voltage, (Vpc)
Up to 0.1 CA	1.75
0.11-0.17 CA	1.70
0.18-0.25 CA	1.67
0.26-0.6 CA	1.60
3CA	1.30
Above 3CA	Refer for advice.

The slowest practical rate of discharge for a lead acid battery is self-discharge. As the current is very low, the fully discharged voltage is high, i.e. the battery is flat at 2.00-2.03 Vpc. Therefore, a program of stock control must be introduced to ensure that batteries are recharged well before that voltage is reached.

5.2 Supplementary Charge Advice

Storage Temperature	Charging Interval.
20°C or less	Every 9 months.
20-30°C	Every 6 months.
30-40°C	Every 3 months.

In discharging a battery, lead sulphate (sulphation) is formed. If the battery is recharged as soon as discharging is completed, then the lead sulphate is converted to active material. However, on self discharge, the lead sulphate that is formed may become inactive, and cannot be reconverted. The lower the voltage that a battery is allowed to fall to under self discharge, the more likely it is that the sulphate formation cannot be converted. This is event, the battery is damaged beyond recovery.

5.3 Precautions Against Over Self Discharge .

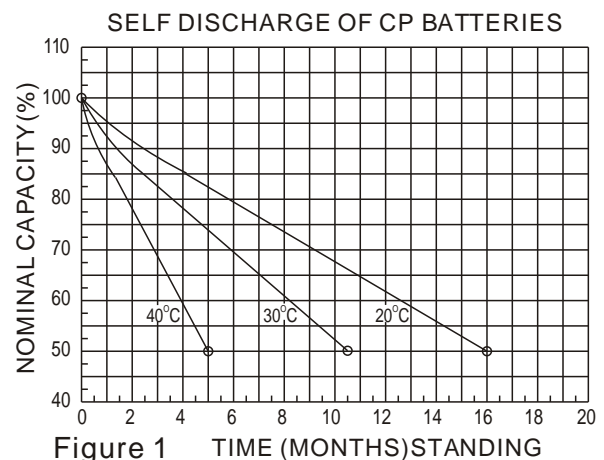
- The batteries should be stored in a cool, dry place.
- The batteries should not be stored in direct sunlight.
- The batteries should not be subjected to an external heat source.
- The voltage of batteries in stock should be regularly checked.

5.4 Precautions for Pre Installed Batteries

When batteries are installed in a product, the following precautions to avoid over discharge during storage must be taken:

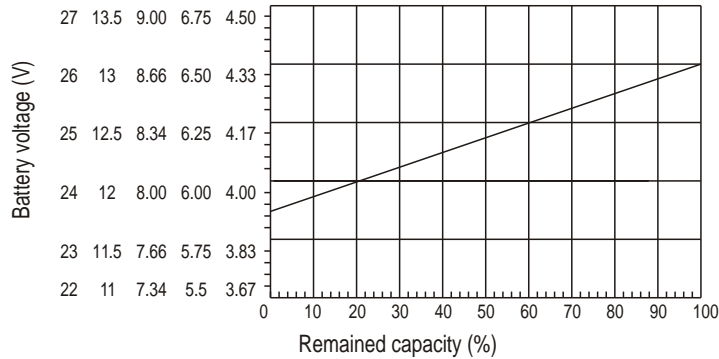
- Only new or freshly recharged batteries should be used.
- Any load that is on the battery in the product must be FULLY DISCONNECTED. Any discharge on the battery other than self-discharge will quickly flatten the battery and cause the formation of lead sulphate (which if left in this state for too long, will irreversibly damage the battery).
- The first operating instruction for equipment fitted and sold with a rechargeable lead acid battery must be, "The battery must be fully charged before use".

5.5 Self-Discharge Characteristics. (Figure 1)



5.6 Open Circuit Voltage and Remaining Capacity. (Figure 2)

Figure 2: OPEN CIRCUIT VOLTAGE(OCV)REDUCTION FROM SELF DELF DISCHARGE V'S REMAINING CAPACITY VALUES SHOWN AT 20°C FOR NORMAL ELECTROLYTE S.G.RANGE



5.7 Recharging a Self Discharging Battery

When it is necessary to give a self-discharged battery a "top up" charge, the following procedures should be observed:

1. Ensure the OCV of the battery is greater than 2 Vpc. If the voltage is lower than 2 Vpc, please refer the problem to VISION before attempting to recharge.
2. Constant voltage charging is recommended.

Storage Time	Top Up Charging Recommendation
Less than 6 months from manufacture Date or previous top up charge.	Maximum of 20 hours at a constant voltage of 2.4Vpc.
Up to 12 months after manufacture Date or previous top up charge.	Maximum of 24 hours at a constant voltage of 2.4Vpc.
Note: A faster recharge may be obtained by using the constant current method of charging. This requires a closer supervision of the charging procedures.	
Less than 6 months (As above)	Maximum of 6 hours at a constant current of 0.1C Amps.
Up to 12 months (As above)	Maximum of 10 hours at a constant current of 0.1C Amps.

6 BATTERY DISCHARGE CHARACTERISTICS

The discharge capacity of a lead acid battery varies and is dependant on the discharge current. VISION CP SLA batteries use a rate at the 20 hour rate. i.e.the capacity of the battery at 20 hours discharged to an end voltage of 1.75 Vpc at a temperature of 25°C.

6.1 General Comments

The discharge curves (Figure 3) show the minimum design parameters for each fully charged VISION battery after installation. Full capacity is reached after some initial service.

- *Float Service.*
One month after installation and recharging.
- *Cycle Service.*
Within three to five cycles after initial charge and service entry.

6.2 Technical Terms

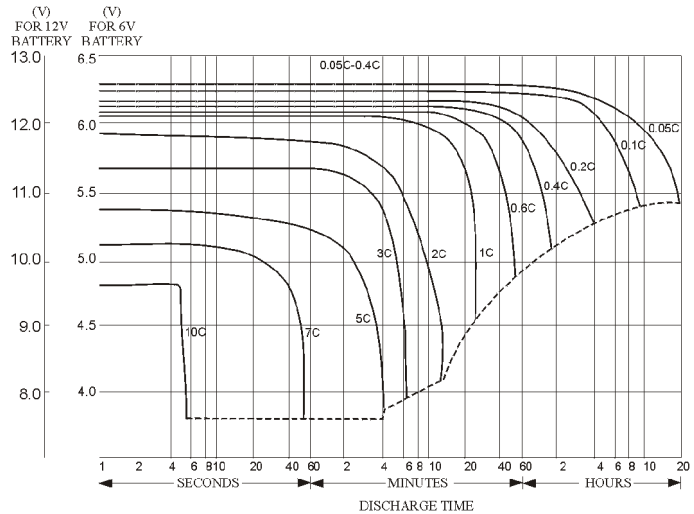
1. Battery capacity for small SLA batteries by accepted convention worldwide is described in "AMPERE HOUR" at the 20-hour rate C_{20} when discharged at 25°C. i.e. a CPI245 is 4.5 Ah at C_{20} that is the battery will

deliver 0.225 amps current for 20 hours to a cut off voltage of 1.75 volts per cell (10.5 volts per battery).

2. Battery load by convention is described in terms of a multiple of C, in amps, where C is the capacity at 25°C, i.e. for a 4.5 Ah battery:

3. Battery cut-off voltage is the volts per cell to which a battery may be discharged safely to maximize battery life. This data is specified according to the actual discharge load and run time. As a rule of thumb, high amp loads and short run times will tolerate a lower cut off voltage (eg. 3C at 1.3V/C), whereas a low amps long run time discharge will require a higher cut off voltage (eg. 0.05C at 1.75V/C).

Characteristic Discharge Curves for VISION Batteries (Figure 3)



Multiple of C	Load (Amps)	Cut off Volts/Cell
3C	13.5	1.30
1C	4.5	1.30
0.55C	2.475	1.55
0.1C	0.45	1.75
0.05C	0.225	1.75

6.3 Battery Selection

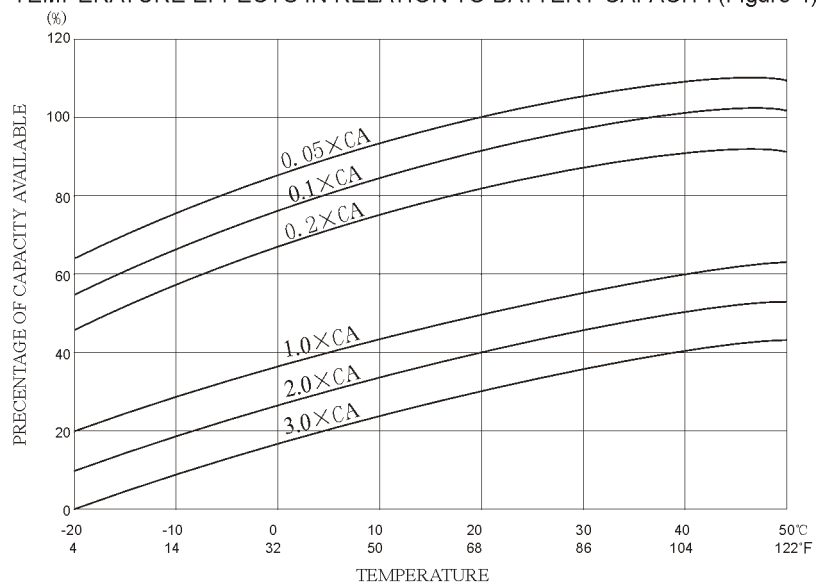
The battery discharge graph (Figure 3) may be utilized in battery selection. However, it is suggested that a review is made of the data sheet for each battery type or the chart showing the actual ampere hour capacity of each battery type at various discharge times.

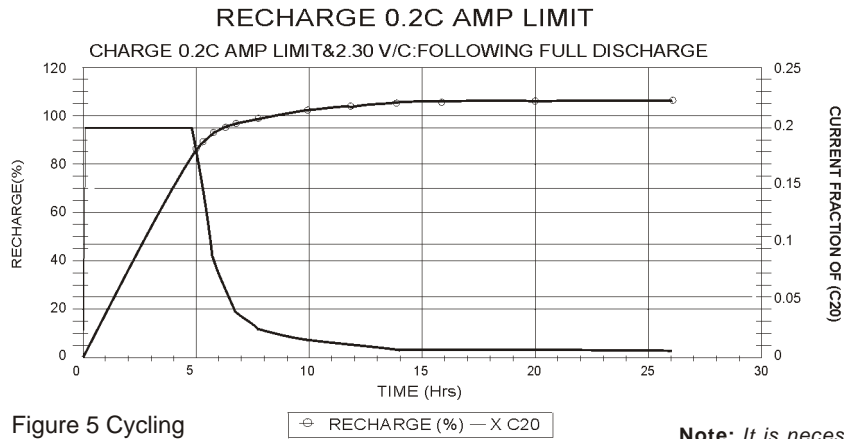
6.4 Effect of Temperature on Battery Capacity

The nominal battery capacity is based on the temperature of 25°C. Above this temperature, the capacity increases marginally but it must be noted that the working battery should be kept within the temperature design limitations of the product.

Below 25°C, the capacity decreases. This decrease in capacity becomes more prominent at temperatures below 0°C and in heavy discharge rates. Figure 4 illustrates the situation and the decrease in capacity with the decrease in operating temperature. Temperature must be taken into capacity design calculations in applications where the operating temperature of the system is below 20°C.

TEMPERATURE EFFECTS IN RELATION TO BATTERY CAPACITY (Figure 4)





Note: It is necessary to ensure that the voltage is correctly set. A charging voltage set too high will increase the corrosion of the positive plates and shorten battery life. A charging voltage set too low will lead to sulphation of the plates causing loss of capacity and ultimately shortening the life of the battery.

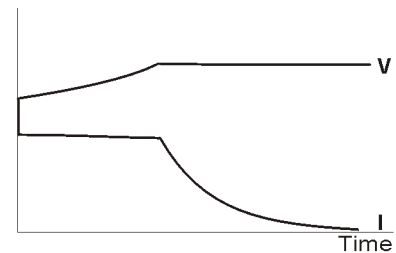
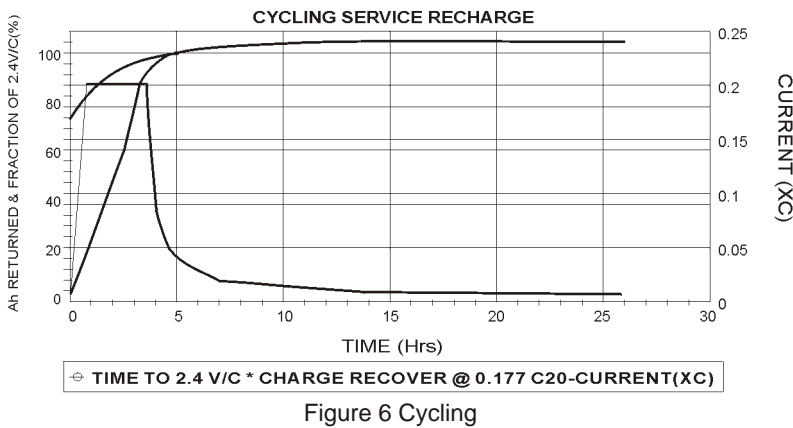


Figure 7: Constant-Voltage Charge With Current Limited

7 BATTERY CHARGING

Correct battery charging ensures the maximum possible working life for the battery. There are four major methods of charging:

- **Constant Voltage Charging.**
- **Constant Current Charging.**
- **Two Stage Constant Voltage Charging.**
- **Taper Current Charging.**

7.1 Constant Voltage Charging

This is the recommended method of charging for SLA batteries. It is necessary to closely control the actual voltage to ensure that it is within the limits advised.

Float Service: 2.27-2.30 Vpc at 25°C .

Cycle Service: 2.40-2.45 Vpc at 25°C .

SZCPT suggest that the initial current be set within 0.4 C Amps. The attached Figure 6 indicates the time taken to fully recharge the battery. It should be noted that the graph illustrated is for a fully discharged battery, i.e; a battery that has reached the minimum cell voltage recommended for its discharge time. As shown on the graph, it is necessary to charge a greater amount of energy into the battery than was taken out of the battery on discharge. The actual current indicating that the battery is fully charged is approx 5mA/Ah under charging voltage is 2.30 Vpc.

7.2 Constant Current Charging

This method of charging is generally not recommended for SLA batteries. It is necessary to understand that if the batteries are not removed from the charger after reaching a state of full charge, considerable damage will occur to the batteries due to overcharging.

7.3 Two Stage Constant Voltage Charging

This method should not be used when the battery and load are connected in parallel. If this method is to be used, it is suggested that the VISION technical department is contacted.

7.4 Taper Current Charging

This method is not recommended for SLA batteries. However, if this method is to be used, it is suggested that the VISION technical department is contacted.

7.5 Effect of Temperature on Charging Voltage

As temperature rises, electrochemical activity in a battery increases. Similarly, as temperature falls, electrochemical activity decreases. Therefore, conversely, as temperature rises, charging voltage should be reduced to prevent overcharge, and increased as temperature falls to avoid undercharge. In general, to assure optimum service life, use of a temperature compensated charger is recommended. The recommended compensation factor for CP batteries is $-3\text{mV}/^\circ\text{C}/\text{Cell}$ (stand by) and $-4\text{mV}/^\circ\text{C}/\text{Cell}$ (cyclic use). The standard center point for temperature compensation is 20°C . Figure 8 shows the relationship between temperatures and charging voltages in both cyclic and standby applications.

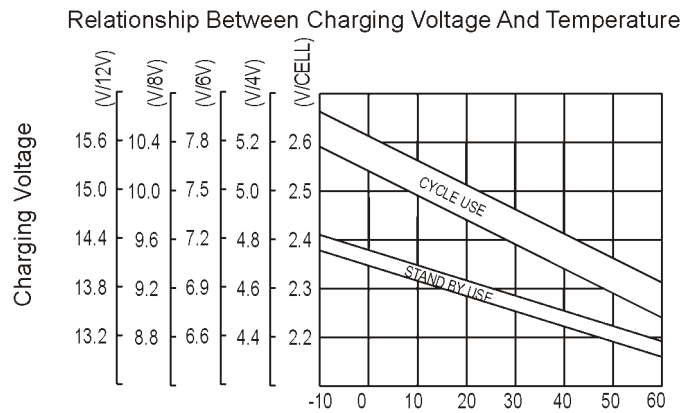


Figure 8: Ambient Temperature(°C)

7.6 Effect of Voltage on Battery Gassing

Although the batteries are of the recombination type and the amount of gassing at normal operating voltages and temperature is negligible, if the charging voltage is increased, gassing will occur despite the recombination design of the product. Gassing does not normally occur while the battery is operating under float conditions and normal constant voltage recharge of 2.27-2.30 Vpc at 25°C . Very little gassing occurs when the battery is recharged under normal cycling recharge procedures. However, it can be seen on the accompanying graph the higher voltages that this especially under conditions of constant current charging will substantially increase the volume of gas.

8 BATTERY LIFE

Battery life depends on a number of key factors. These include:

- Operating temperature of the battery;
- Method of charging utilized;
- Actual use of the product i.e.: float or cycle service; etc.

8.1 Float Service

The estimated life under float service is 3-5 years. The float service is affected by the factors listed above, and the number and depth of discharges the battery suffers during its life time. Basically, the more discharges suffered and the deeper the discharges, the shorter the battery life.

Figure 10: Cycle service life in relation to depth of discharge

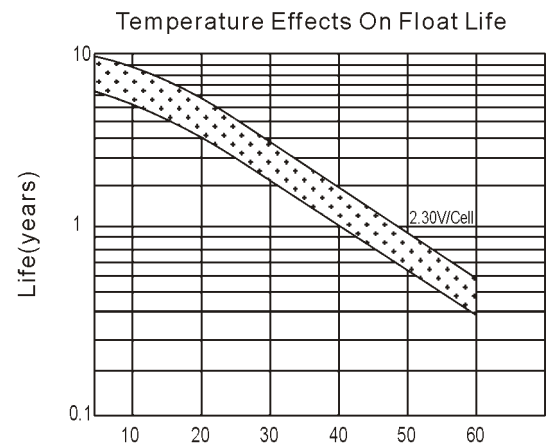
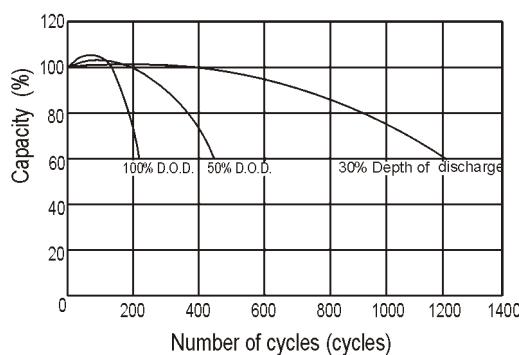
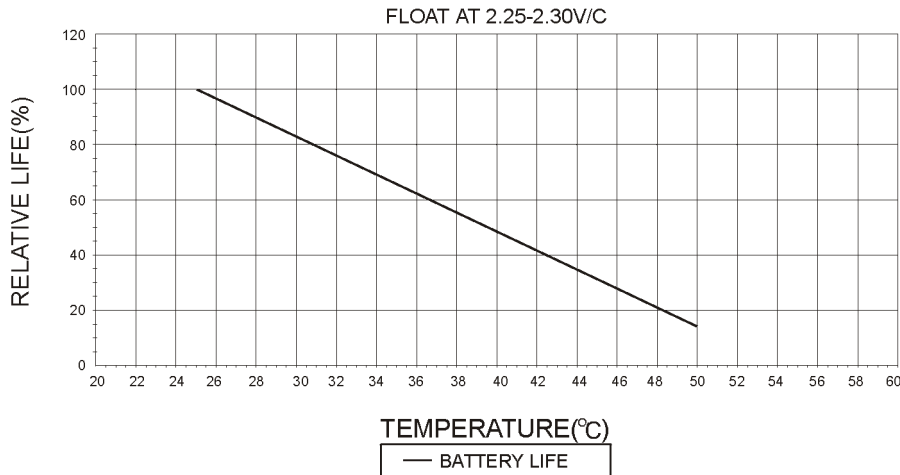


Figure 9: Temperature(°C)

8.2 Cycle Service

Giving due consideration to the above factors, the actual life of a battery in cycle service is depends on the depth of discharge of each cycle. The greater the depth of discharge of each cycle, the lesser the number of cycles available from the battery.

Figure 11: RELATIVE BATTERY LIFE V'S TEMPERATURE



9 PROLONGING BATTERY LIFE

CHARGING INSTRUCTIONS

1. Always recharge the battery immediately after use.
2. Constant voltage charging is recommended. At 25°C, 2.27-2.30Vpc for float use and 2.40-2.45Vpc for cycle use.
3. The maximum initial charging current should be 0.4CA.
4. If batteries are used in series or parallel, the correct size cabling should be used.
5. Don't charge the battery in upside-down position.
6. The battery requires approx. 110% of the total discharging energy to fully recharge.

SUPPLEMENTARY CHARGE ADVICE

Storage Temp.	Charging Interval.
20°C or Less	Every 9 months.
20-30°C	Every 6 months.
30-40°C	Every 3 months.

DISCHARGING INSTRUCTIONS

1. Never leave a battery in a discharging condition.
2. Never allow a battery to fall below 2 Vpc in storage. The full capacity may not be able to be reached and actual service life decreases.
3. Maximum continuous discharge current is 5CA. For greater continuous discharge currents, please consult our technical staff.
4. Avoid over discharging the battery.
5. Stored batteries should receive a supplementary charge at intervals suggested.

OTHER CONSIDERATIONS

Ensure the operating temperature is below 40°C.

10 STORAGE

- (1) When storing the batteries, be sure to remove them from the equipment, or disconnect them from the charger and load. Keep them in a place where the air is dry and the temperature is sufficiently low.
- (2) Charge the batteries at least once every six months during storage.
- (3) The batteries gradually deteriorate even during storage.

■ 11 OTHER CAUTIONS

(1) When cleaning the batteries, use soft cloth only. Use of organic solvents such as gasoline or thinner, and application or adherence of oil to the batteries must be avoided. Do not clean the batteries using dirty or oily cloth. Also contact with soft polyvinyl chloride or the like must be avoided.

(2) Batteries may generate inflammable gas in some cases. Do not expose them to flame or excess heat. Do not short batteries.

(3) Do not attempt to disassemble the batteries. Avoid contact with sulfuric acid leaking from broken batteries. If acid gets into contact with clothes, rinse the area generously with water. If acid gets into contact with your skin or eyes, generously wash the affected area with clean water, and consult a physician immediately.

(4) Batteries explode if put into the fire. Never dispose of batteries in the fire.

(5) Mixed usage of batteries differing in capacity, type, manufacturer or history of use (charge/discharge operation) must be AVOIDED for this may damage the batteries and the equipment due to the difference in characteristic values.

(6) While our batteries are exceptionally dependable, we do not recommend use in life support medical applications unless there is an alternate battery or back-up power supply.

(7) When the batteries come to their end of life, discharge duration time becomes shorter. Finally, batteries lose their available capacity by internal short-circuit and/or dry out of electrolyte. Therefore, please consider the design of the charger for the battery with some care regarding above battery damage modes, such as short-circuit protection for out put.