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 Dangerors Goods Regulation,41# 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 Figure10, 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

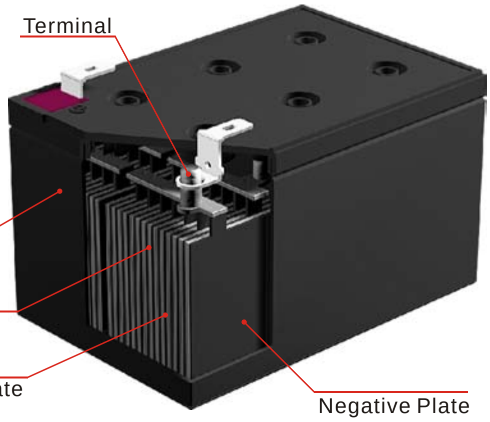
All of our VISION SLA batteries have already passed UL test which file number is MH25860.

2 APPLICATIONS

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

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

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/cm^2)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 the sealing materials.

3.6 Case Materials

Standard case and cover are manufactured from ABS resin.

4 PRINCIPLE PROCESSES OF SEALED LEAD ACID BATTERY

Postive Plate.	$PbO_2+SO_4^{=}+4H^+ +2e^- = PbSO_4+2H_2O$
Negative Plate.	$Pb + SO_4^{=} = PbSO_4+2e^-$
Net.	$PbO_2+2SO_4^{=} + 4H^+ +Pb = 2PbSO_4+2H_2O$

The gassing and water loss reactions are as follows:

Positive Plate.	$H_2O = 2H^+ + \frac{1}{2}O_2+2e^-$
Negative Plate.	$2H^+ + 2e^- = H_2$
Net.	$H_2O = H_2+\frac{1}{2}O_2$ . . . . . . (1)

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.

Negative a.	$Pb +\frac{1}{2}O_2 + H_2SO_4 = PbSO_4 + H_2O$
Negative b.	$PbSO_4 + 2H^+ + 2e^- = Pb + H_2SO_4$
Net Negative.	$\frac{1}{2}O_2+2H^++2e^- =H_2O$ . . . .(2)

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.

[Negative]

$2H^++2e \rightarrow H_2$ . . . . (3)

[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 VISION SLA batteries have excellent charge retention characteristics.Their self-discharge rate is low(typically less that 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. Therefores, 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 .

a. The batteries should be stored in a cool, dry place.
b. The batteries should not be stored in direct sunlight.
c. The batteries should not be subjected to an external heat source.
d. 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:

a. Only new or freshly recharged batteries should be used.

b. 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).

c. 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)

SELF DISCHARGE OF CP BATTERIES

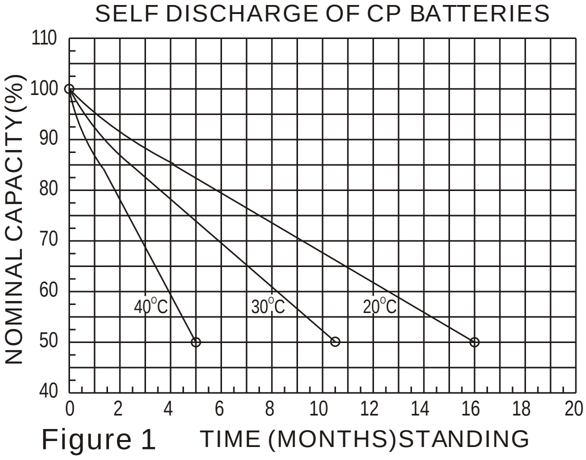
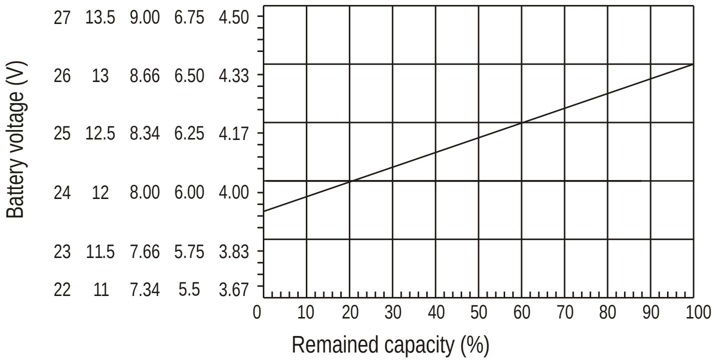


Figure 1

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

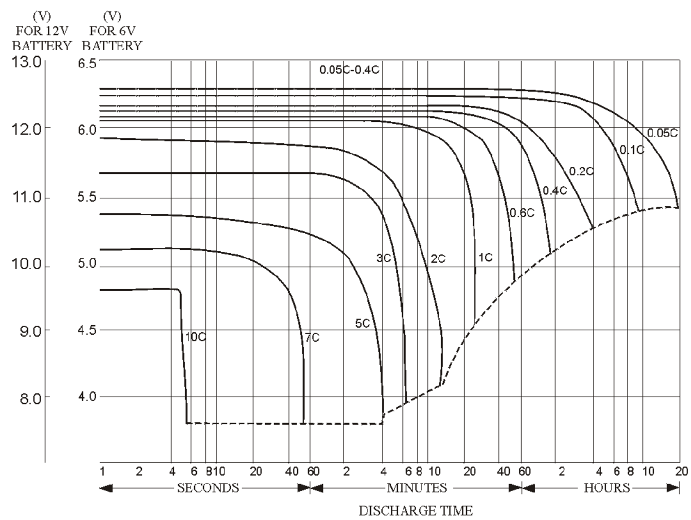
1. Battery capacity for small SLA batteries by accepted convention worldwide is described in "AMPERE HOUR" at the 20-hour rate C_{20} when discharged at 25°C. i.e. a CPI245 is 4.5 Ah at C_{20} that is the battery will

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 (Fingure 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

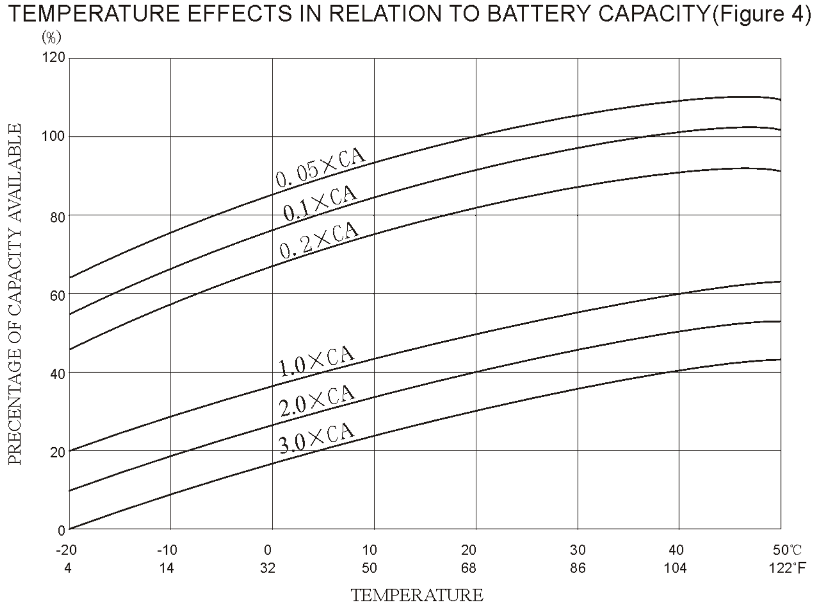
The battery discharge graph (Figure 3) may be utilized in battery selection. However, it is suggested that a review is made of the data sheet for each battery type or the chart showing the actual ampere hour capacity of each battery type at various discharge times.

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)



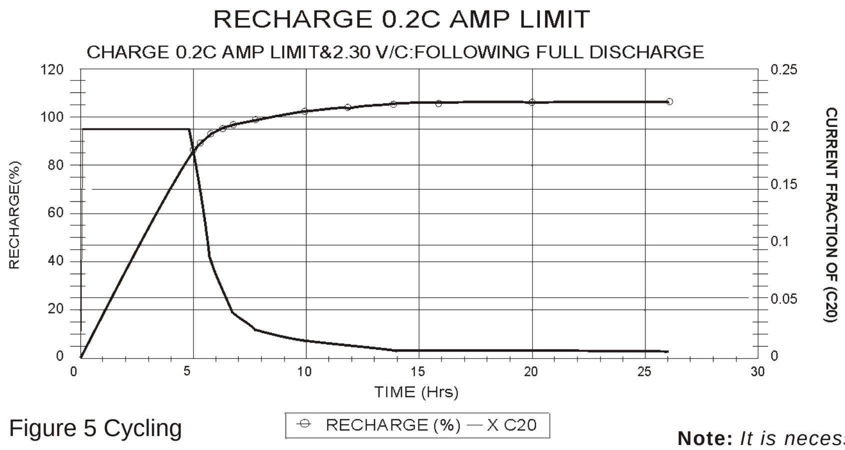


Figure 5 Cycling

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.*

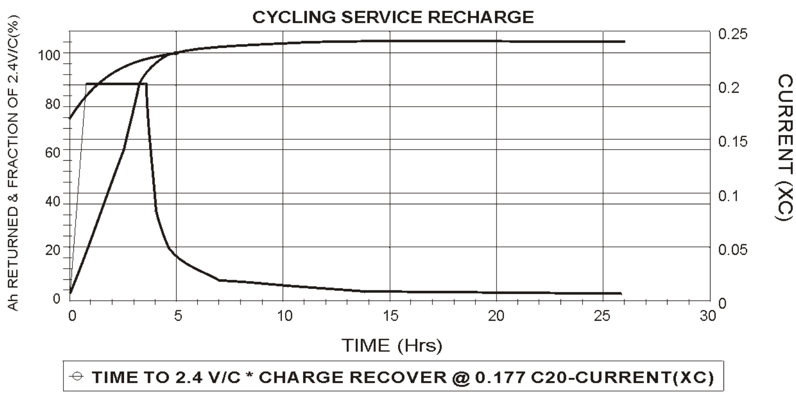


Figure 6 Cycling

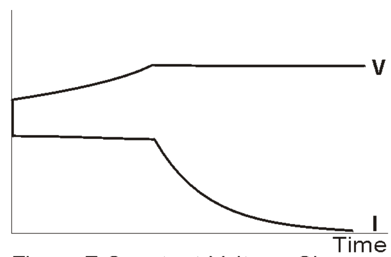


Figure 7:Constant-Voltage Charge With Current Limited

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.