147180

Gates®

Energy Products

The unique design of the Gates Energy Cell overcomes many of the former limitations of the lead-acid system. At the same time, it retains the low cost, reliability, ruggedness and long life which have always been assets of the lead-acid battery. The cell is truly sealed—no acid, acid vapor or water loss—and incorporates recombination of gases within a starved electrolyte system. This unique maintenance-free rechargeable lead-acid cell is constructed with thin, spirally wound, pure lead plates which result in low impedance, low corrosion and long life. The self-resealing safety valve will vent under abusive overcharge conditions at an internal pressure of about 50 psi.

- Can be charged or discharged in any position.
- Use constant current or constant voltage charging.
- The same cell can be used for fast cycling or long-term float applications.
- Low internal impedance allows very high discharge currents.
- No loss of electrolyte during normal overcharging.
- Excellent mechanical and vibrational strength.
- Absolutely no "memory" effects.
- No damage due to cell reversal.
- The metal can is electrically isolated preventing accidental shorting.
- Fewer cells per battery for lower battery cost and better reliability.
- Cells can be paralleled for additional capacity.
- Can be used safely in proximity of electronic circuitries.
- Construction allows air transportation without restriction due to IATA "dry battery" classification.

## TYPICAL SPECIFICATIONS ($T_A$ = 25°C)

| | |
|---|---|
| Nominal Cell Voltage | 2.0V |
| Capacity Rating | |
| 20 hour rate (125mA) | 2.7Ah |
| 10 hour rate (250mA) | 2.5Ah |
| 1 hour rate (2.5A) | 1.8Ah |
| Cell Power Rating | |
| Peak Power (at 135A) | 135 W |
| Energy/unit volume (at C/10 rate) | 1.47 W-h/in$^3$<br>0.09 W-h/cm$^3$ |
| Energy/unit weight (at C/10 rate) | 12.5 W-h/lb<br>27.5 W-h/kg |
| Cell Temperature Range | |
| Storage | −65°C to +65°C |
| Discharge | −65°C to +65°C |
| Charge | −40°C to +65°C |

| | |
|---|---|
| *Internal Resistance (max) (Charged Cell) | 10x10$^{-3}$ Ω |
| Storage Time | |
| $T_A$ =0°C | 7,200 days |
| $T_A$ = 23°C | 1,200 days |
| $T_A$ = 65°C | 60 days |
| Atmospheric Pressure Range | 0-8 atmospheres |
| Cell Charging | |
| Constant Voltage (Cyclic) | 2.40-2.60V |
| (Float) | 2.30-2.40V |
| Constant Current (Cyclic) (max) | C/3 rate |
| (Float) (max) | C/500 rate |
| **Cycle Life | 200 - 2,000 cycles |
| ***Expected Float Life | 8 years |

*Measured on Hewlett-Packard 4328A milliohm meter.

**200 cycles—100% depth of discharge, one cycle per day (Charge: 2.45V constant voltage, no current limit; Discharge: C/5 rate)

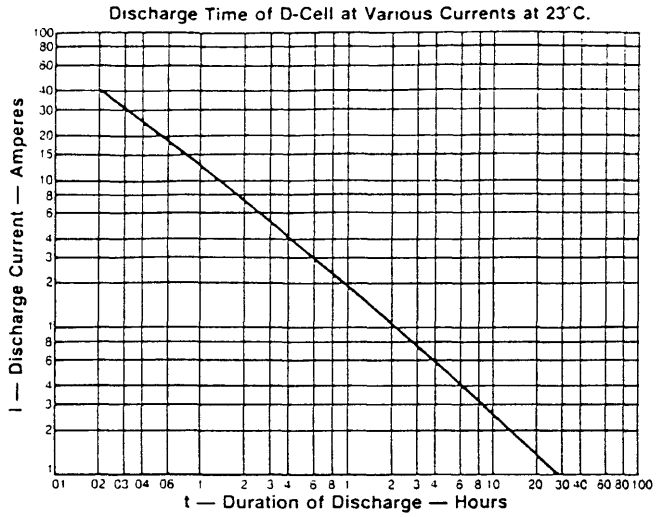
2000 cycles—25% depth of discharge (Charge: 2.45V/cell for 7.5 hrs—2.0A current limit; Discharge: C/2 rate for 30 min.)

More cycles are available with shallower discharges.

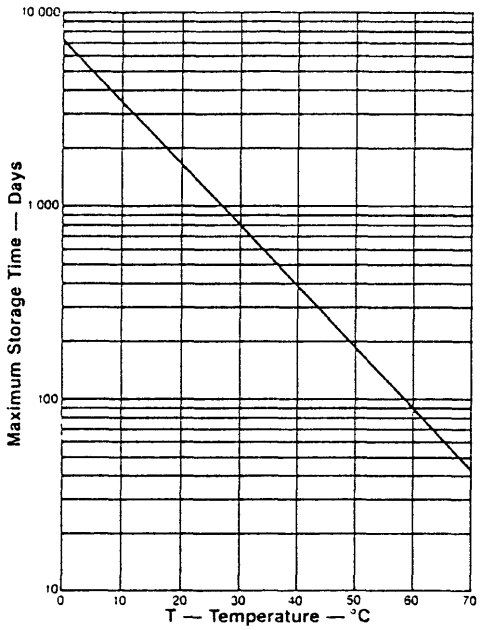
***Based on accelerated test methods, 2.35 volts constant voltage charge at 23°C ambient temperature.

Shown 77% actual size

# 2V, 2.5Ah sealed rechargeable "D" cell

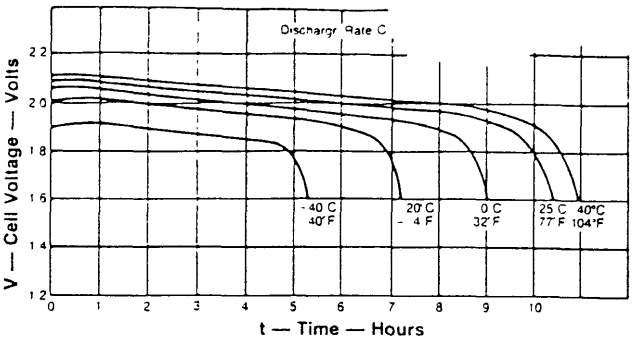



**Discharge Characteristics.** Based on data from standard production, 90% of all cells produced by GEP meet or exceed these discharge characteristics. New cells must be cycled or floated appropriately before full rated capacity, as shown on this curve, is reached.

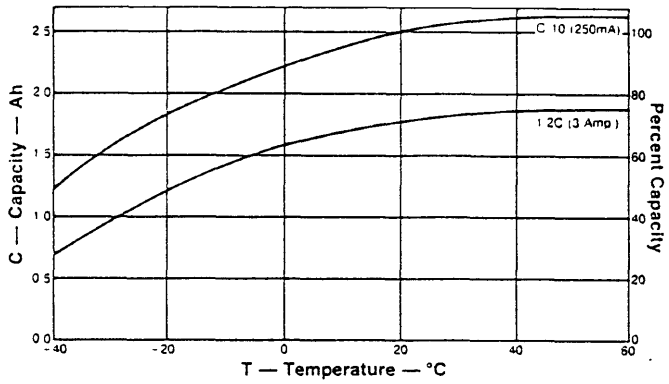



**Storage Characteristics.** The storage time is very dependent on the storage temperature as shown in this maximum allowable storage time versus temperature curve for a charged cell.

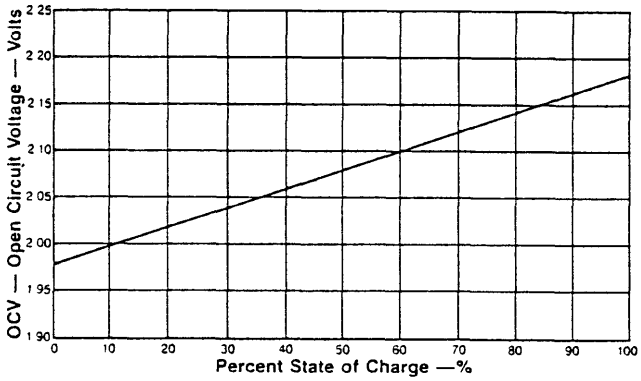
*Leaving the Gates Energy Cell connected to a load for a long period of time after it has been discharged may cause difficulties in recharging and/or reduce cell life. The cell should be put on open circuit or recharged soon after the discharge is completed.*



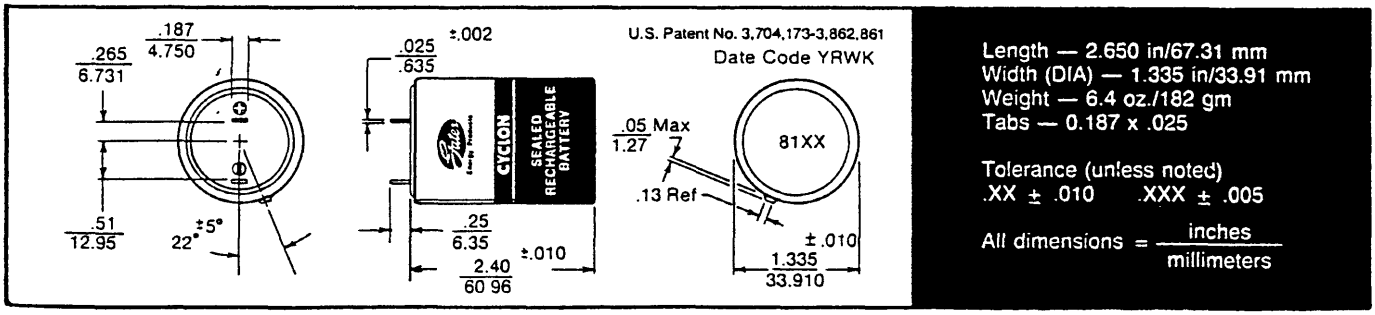

**Voltage Regulation.** The voltage regulation of the Gates cell is equal to or better than any other commercially available system.




**Temperature Characteristics.** The graph illustrates the capacity available in the cell as a function of temperature at two different discharge rates.




**State of Charge.** This curve of OCV vs state of charge is accurate within 20% of the rated capacity of the cell being measured if it has not been charged or discharged within the past 24 hours. The accuracy increases to 5% if the cell has not been charged or discharged within the past 5 days.




1050 S. Broadway
P.O. Box 5887
Denver, Colorado 80217
U.S.A.
(303) 744-4806

Gates Energy Products

Little Mead Industrial Estate
Cranleigh, Surrey
GU6 8ND
England
(0) 4866-71181

INFORMATION ONLY - Please Read Attachment

Farnell Order Code 147180, 147181, 147182, 147183 Data Sheet No CSH00159

# Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

**U.S. Department of Labor**
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

| IDENTITY *(As Used on Label and List)* | *Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.* |
|---|---|
| Sealed Lead Battery closed cylindrical | |

## Section I

| | |
|---|---|
| Manufacturer's Name<br>Gates Energy Products, Inc. | Emergency Telephone Number<br>Not Applicable |
| Address *(Number, Street, City, State, and ZIP Code)*<br>617 N. Ridgeview Drive | Telephone Number for Information<br>(816) 429-2165 |
| Warrensburg, MO 64093 | Date Prepared<br>March 1, 1990 |
| | Signature of Preparer *(optional)* |

## Section II — Hazardous Ingredients/Identity Information

| Hazardous Components (Specific Chemical Identity; Common Name(s)) | OSHA PEL | ACGIH TLV | Other Limits Recommended | % *(optional)* |
|---|---|---|---|---|
| Lead - Lead Oxides | | 0.05 ug/$m^3$ | | 69 |
| Sulfuric Acid Electrolyte | | 1.0 mg/$m^3$ | | 21 |
| Non-Hazardous Materials | | - - - - - | | 10 |

## Section III — Physical/Chemical Characteristics

| | | | |
|---|---|---|---|
| Boiling Point | N/A | Specific Gravity ($H_2O$ = 1) | N/A |
| Vapor Pressure (mm Hg.) | N/A | Melting Point | N/A |
| Vapor Density (AIR = 1) | N/A | Evaporation Rate (Butyl Acetate = 1) | N/A |

Solubility in Water
N/A

Appearance and Odor
N/A

## Section IV — Fire and Explosion Hazard Data

| Flash Point (Method Used) | Flammable Limits | LEL | UEL |
|---|---|---|---|
| Non-flammable | N/A | | |

Extinguishing Media
Multi-purpose dry chemical or multi-purpose $CO_2$.

Special Fire Fighting Procedures
Cool battery exterior to prevent rupture. Acid mists and vapors in a fire are toxic and corrosive.

Unusual Fire and Explosion Hazards
Hydrogen gas may be produced and may explode if ignited. Remove all sources of ignition. Ventilate area.

## Section V — Reactivity Data

| | | | |
|---|---|---|---|
| Stability | Unstable | | Conditions to Avoid: Avoid Shorting. |
| | Stable | X | Use only approved charging methods. |

Incompatibility (*Materials to Avoid*)

Hazardous Decomposition or Byproducts

| | | | |
|---|---|---|---|
| Hazardous Polymerization | May Occur | | Conditions to Avoid: Do not puncture battery case. |
| | Will Not Occur | X | |

## Section VI — Health Hazard Data

Route(s) of Entry: Inhalation? Skin? Ingestion?

Health Hazards (*Acute and Chronic*) Not applicable for finished product used in normal conditions.

Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure

Medical Conditions Generally Aggravated by Exposure

Emergency and First Aid Procedures Battery contains acid electrolyte. If battery case is punctured, completely flush any released material from skin or eyes with water.

## Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled Avoid contact with acid materials. Use soda ash or lime to neutralize. Flush with large amounts of water.

Waste Disposal Method Place in acid resistant containers. Dispose in accordance with Federal, State and local regulations. Do not incinerate.

Precautions to Be Taken in Handling and Storing

Other Precautions Read manufacturers literature, which is available upon request.

## Section VIII — Control Measures Not applicable for finished product.

Respiratory Protection (*Specify Type*)

| | | |
|---|---|---|
| Ventilation | Local Exhaust | Special |
| | Mechanical (*General*) | Other |

| | |
|---|---|
| Protective Gloves | Eye Protection |

Other Protective Clothing or Equipment

Work/Hygienic Practices

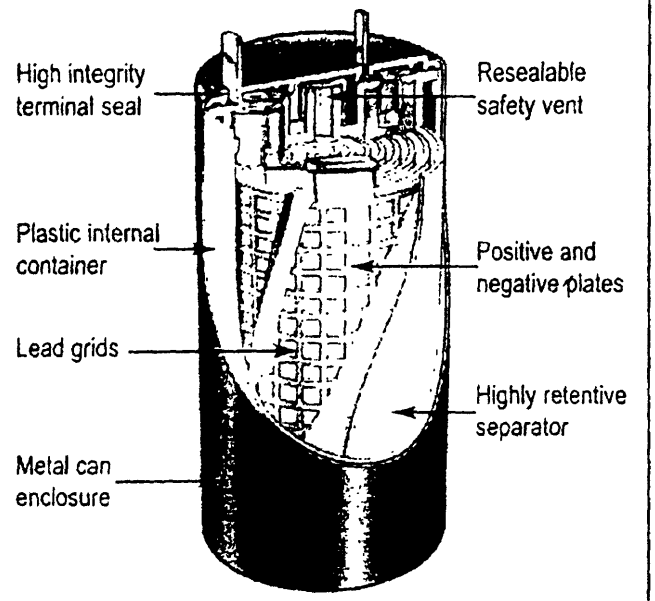


* U.S.G.P.O.: 1986-491-529/45775

147180 — 147183

## Introduction to Cyclon Cells and Monoblocs

Cyclon Valve Regulated Lead Acid (VRLA) Cells and Monoblocs are a unique technology using wound electrodes made of pure lead (99.004%) alloyed with 0.65% of tin.




Gasses produced in normal overcharge are recombined within the cell. A re-sealable bunsen valve is incorporated to permit gas venting in the case of abusive overcharge.

Both Cyclon Cells and Cyclon Monoblocs can be charged and discharged in any attitude.

Both Cells and Monoblocs can be assembled into many different configurations providing maximum design flexibility.

Product can be transported by land, sea and air as non-hazardous cargo. Cyclon Cells are a recognised component meeting UL924 and UL1778. Cyclon Monoblocs meet UL924.

## Performance Characteristics

Cyclon Cells and Monoblocs have outstanding performance in the following areas.

- Long float life - Cyclon Cells: 15 years at 20°C.
  - Cyclon Monoblocs: 10 years at 20°C
- Long storage life (greater than 2 years at 25°C before recharge is necessary).
- Exceptional high rate discharge (Up to 26C).
- Wide operating temperature range
  - Cyclon Cells -65°C to +80°C
  - Cyclon Monoblocs -40°C to +40°C
- Very high shock and vibration resistance in all planes.
- Cycle life up to 2500 cycles at 30% DOD.

## Discharge Characteristics

**Maximum current capabilities**

| Cyclon Type | Pulse Amps | Continuous Amps |
|---|---|---|
| D Single Cell (2.5 Ah) | 200 | 65 |
| D Monobloc (2.5 Ah) | 200 | 50 |
| TD Single Cell (4.5 Ah) | 200 | 65 |
| X Single Cell (5.0 Ah) | 285 | 65 |
| X Monobloc (5.0 Ah) | 285 | 50 |
| E Single Cell (8.0 Ah) | 330 | 65 |
| E Monobloc (8.0 Ah) | 330 | 50 |
| J Single Cell (12.5Ah) | 400 | 65 |
| BC Single Cell (25.0 Ah) | 665 | 250 |

Table 1

The extremely low internal resistance of Cyclon cells gives excellent voltage regulation on discharge which is equal to or better than other VRLA systems.

As with all lead battery systems discharge energy available is reduced as temperature decreases.

**Variation of discharge capacity with temperature.**

**% of rated C/10 Capacity Available**

| Temp °C | C/10 | C |
|---|---|---|
| 80 | 105 | 75 |
| 60 | 105 | 75 |
| 40 | 105 | 75 |
| 20 | 100 | 72 |
| 0 | 85 | 65 |
| -20 | 70 | 50 |
| -40 | 50 | 30 |

*These values should be taken as a guide only.*

Table 2

If the application fully discharges the battery it is recommended that a low voltage cut out is employed to protect the battery against overdischarge. The end of discharge voltage varies according to the rate of discharge (See Table 3). Overdischarging the battery can lead to recharging difficulties and also damage the battery. For design details of low voltages cut out circuits please contact our Customer Support Staff on +44 (0) 1794 830111.

**Recommended minimum End of Discharge Voltage (EODV).**

| Discharge Rate Amps | Min. EODV per cell |
|---|---|
| 0.05C (C/20) | 1.75V |
| 0.10C (C/10) | 1.70V |
| 0.20C (C/5) | 1.65V |
| 0.40C (C/2.5) | 1.65V |
| 1.00C | 1.60V |
| 2.00C | 1.55V |
| >5.00C | 1.50V |

*Discharging the Cyclon cell below these voltage levels or leaving the cell connected to a load in a discharged state may impair the cell's ability to accept a charge.*

Table 3

## Temperature Compensation

If operating temperatures are above 30°C or below 0°C temperature compensation should be applied to the charging voltage as shown below.

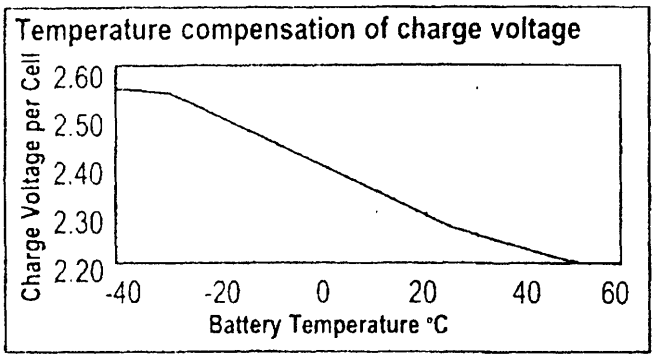



Table 8

### Two State Constant Voltage Charging

To allow fast recharge but maximise standby life, two level voltage charging can be used. Charging should commence at the cyclic rate and switch down to the float charge voltage after a preset time has elapsed. The time is established with reference to the charge current limit (See Table 7 page 5).

### Constant Current Charging

This technique can be used with Cyclon cells and Monobloes providing charging is terminated before excessive overcharge occurs. Charge can be terminated by time or voltage sensing but long term overcharge must be limited to C/500. Please contact our Customer Support Staff for further assistance.

### Taper Charging

Although taper current chargers are the least expensive type of chargers, their lack of voltage regulation can be detrimental to the life of any cell type. Half wave rectification should be avoided because the high peak-to-average voltage ratio will reduce the service life of the cell. It is recommended that charge rate at 2.50 volts/cell be between C/50 and C/100 to prevent serious overcharge if the charger is left connected for extended periods.

The normal recharge time for a taper charger can be assessed by reference to the charge current available at charge voltage of 2.2VPC allowing for the return of 120% of discharged capacity.

### Other Charging Methods

For application engineering support on solar, vehicle systems or other charging methods please refer to our Customer Support Staff.

## Service Life

End of service life of Cyclon products is defined as the point when the battery delivers less than 80% of its rated capacity.

### Float Life

Cyclon cells have a design life of 15 years at 20°C for floating applications.

Cyclon Monobloes have a design life of 10 years at 20°C for floating applications.

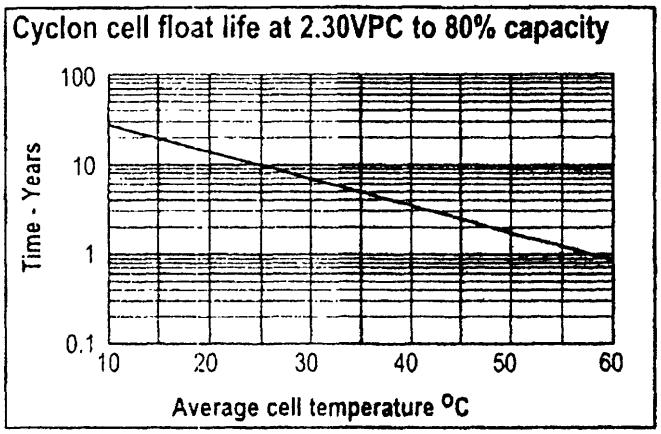



Table 9

### Cycle Life

Cycle Life varies with depth of discharge (D.O.D.)

| DOD % | Cycle Life |
|---|---|
| 100 | 300 |
| 80 | 450 |
| 60 | 700 |
| 25 | 1,600 |
| 10 | 3,000 |
| 5 | 10,000 |

Table 10

N B Service life is dependent on correct charging of the product and operating temperature.

## Storage

The state of charge of the Cyclon cell can be estimated by using the graph below.

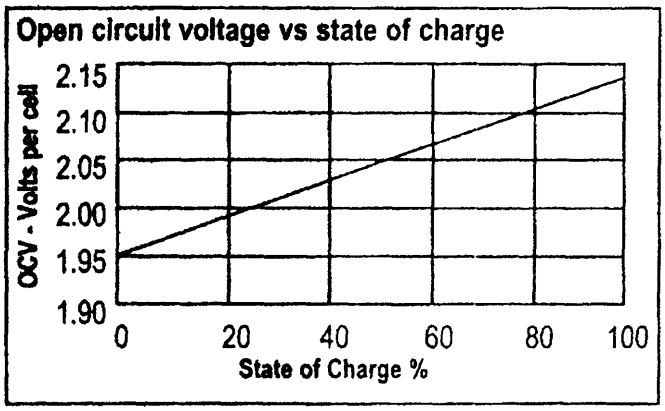



Table 4

*Note:- This curve is accurate to within 20% of the cell s rated capacity, if it has not been charged or discharged within the past 24 hours The curve is accurate to within 5% if the cell has not seen any activity, charge or discharge, for the past 5 days.*

### Storage

Most batteries lose their stored energy when allowed to stand open circuit. The self discharge rate is dependent both on the system's chemistry and on the temperature at which the battery is stored. Lead-tin technology gives the lowest self discharge and the longest shelf life of any VRLA battery system. Storage life is shown in Table 5 and is dependent on temperature

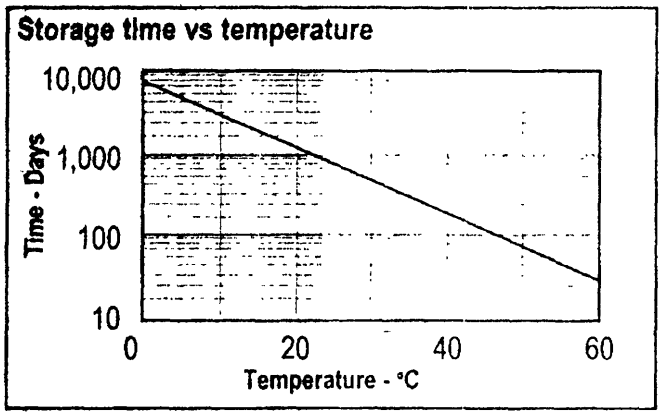



Table 5

Cyclon's self discharge rate is non linear. Table 6 indicates capacity remaining against time.

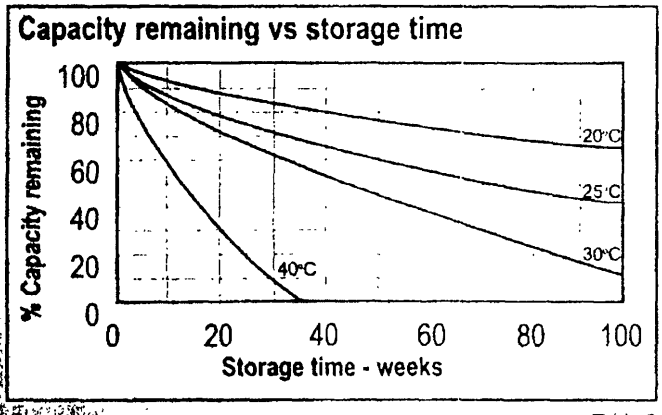



Table 6

## Charging

Constant Voltage Charging is the most efficient method of charging Cyclon VRLA products.

To obtain full recharge and maintain the capacity of the cell it is necessary to return a minimum of 110% of the energy that has been removed during the last discharge. Correct voltage setting and good voltage regulation of the charger are essential to maintain an acceptable battery life. Fast recharge is possible with Cyclon products although for economic reasons batteries are usually recharged at the C/10 or C/5 rate.

Voltage levels differ for float and cyclic applications.

The table below shows the correct charger voltage setting for both cyclic and float applications.

### Charge Voltages

Float charge = 2.27-2.35V per cell at 25°C

Cyclic charge = 2.45-2.5V per cell at 25°C

### Recharge Time

Cyclon products can be recharged to 95% capacity in under one hour. No current limit is necessary at either float or cyclic voltages. If a fast charge regime is used it is necessary to allow a longer period of recharge (typically 7 to 10 hours) every 7-10 cycles. This permits cells to fully recharge and ensures a maximum cycle life.

**Typical recharge time in hours for different current rating chargers at 25°C**

| | Charge Voltage | | | |
|---|---|---|---|---|
| | 2.3VPC (Float) | | 2.45VPC (Cyclic) | |
| Charger Rating | 90% Rech. | 100% Rech. | 90% Rech. | 100% Rech. |
| 5C | - | - | 0 5 | 7 |
| C | - | - | 1 5 | 8 |
| C/5 | 7 | 45 | 6 | 16 |
| C/10 | 12 | 50 | 11 | 24 |

Table 7