

1. Scope

This specification applies to a Nickel-Cadmium cylindrical rechargeable single cell which SAFT designation is VEC 2200. This cell belongs to the SAFT high energy sealed Ni-Cd cell range. It has been designed with positive and negative sintered electrodes and therefore is well adapted for cycling applications.

2. Reference documents

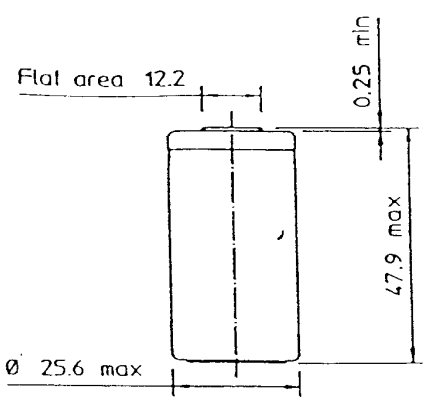
IEC 285/1993 Sealed Ni-Cd cylindrical cells.

3. General Electrical Specification

Item	Specification	Units	Notes
SAFT cell designation	VEC 2200		
IEC cell designation	KRH 26/50		
Nominal voltage	1.2	Volt	
IEC rated capacity	2200	mAh	at 0.2C
Typical impedance	5	mOhms	at 1000 Hz
CHARGE CURRENT			
Standard	220	mA	0.1C
Fast	2200	mA	C (See 6.1)
CHARGE DURATION			
Standard	16	hours	
Fast	about 1	hour	
PEAK VOLTAGE IN CHARGE			
Standard	1.40/1.50	Volt	at 20° ± 5°C
Fast	1.50/1.60	Volt	
MAXIMUM CONTINUOUS DISCHARGE CURRENT	6.6	A	3 C
TEMPERATURE RANGE			
In fast charge	+10/+40°	°C	
In standard charge	0/+50°	°C	
In discharge	-20/+60°	°C	
In recommended storage	+5/+25°	°C	
in extended storage	-40/+60°	°C	Short duration < 1 month

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4. General mechanical specification

Bare Cell Drawing (mm)	Bare Cell Dimensions
	Maximum diameter (mm) : 25.60 Maximum height (mm) : 47.90
	Positive contact Diameter (mm) : 12.2 Overstep (mm) : 0.25
	Typical weight (g) : 75.0

5. Capacity

5.1 IEC Capacity

IEC capacity is defined as follows :

- ▶ Temperature : $+20^{\circ} \pm 5^{\circ}\text{C}$
- ▶ Charge current : $C/10 = 220 \text{ mA}$ (constant current)
- ▶ Charge duration : 16 hours
- ▶ Period of rest : 1 to 4 hours
- ▶ Discharge current : $C/5 = 440 \text{ mA}$ (constant current)

The operating time until the voltage drops to 1.0 volt/cell must not be less than 300 minutes - 2 cycles are permitted.

The IEC capacity is then minimum 2200 mAh.

5.2 Available capacity

The following cross table give minimum available capacities of a multi-VEC 2200 battery under various charge and discharge conditions. The temperature is $+20^{\circ} \pm 5^{\circ}\text{C}$. Deviation depending on test conditions may be observed.

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CHARGE			STANDARD
Rate			C/10
Current	(mA)		220
Charge duration	(hour)		16
Rest after charge	(hour)		1
DISCHARGE CONDITIONS			CAPACITY
Rate	Current (mA)	End of charge Voltage	(mAh)
C/5	0.44	1 V/Cell	2200
C	2.2	1 V/Cell	1980
3C	6.6	1 V/Cell	1760

6. Charge

6.1 *Fast Charge*

The multi-VEC 2200 battery can be fast charged within about 1.0 hour with a suitable end of charge detection and cut-off. The temperature range is +10°/+40°C. The recommended maximum charge current is 2200 mA.

6.1.1 *Negative Delta V Detection*

The fast charge is stopped when voltage drops down at 10/15 mV per cell. This cut-off system must be inhibited during the starting 1 or 2 minutes of the charge to avoid early detection.

A trickle charge may complete the fast charge to balance the battery and to maintain a full availability of its capacity.

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6.2 Other charge rates

Within the following charge rates the charge does not need to be controlled. Nevertheless a TIMER is recommended in the case of a QUICK charge. The TRICKLE charge terminates a FAST charge.

Within low temperatures, below 0°C, charge voltage must be limited to 1,55 volts per cell.

CHARGE	RATES	CURRENTS (mA)	DURATION (hours)	TEMPERATURE (°C)
STANDARD	C/10	220	16	0° / +50°C
QUICK	C/5	440	about 7	+5° / +50°C
TRICKLE	C/40	55	Permanent	-20° / +50°C

7. Temperature characteristics

The following table gives the typical available capacity of a multi-VEC 2200 battery the under the charge conditions :

- ▶ Standard charge : C/10 x 16 h
- ▶ Temperature : +20° ± 5°C

Capacities (Ah) are given for a final discharge voltage of 1 volt/cell. Deviation depending on test conditions may be observed.

	Rate of Discharge			
	C/5 = 440 mA		C = 2200 mA	
Temperature of Discharge	Capacity (mAh)	%C	Capacity (mAh)	%C
+40°C	2110	96	1890	86
+20°C	2200	100	1980	90
+ 5°C	2110	96	1890	86
-20°C	1620	77	1250	57

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8. Charge retention

After a 28-day storage at $+20^{\circ}\pm 5^{\circ}\text{C}$ the multi-VEC 2200 battery shall retain typically 65% of its initial capacity, the battery being initially fully charged.
 After a 7-day storage at $+40^{\circ}\pm 5^{\circ}\text{C}$ the multi-VEC 2200 battery shall retain typically 60% of its initial capacity, the battery being initially fully charged.

9. Storage

SAFT recommends to store the battery within the temperature range $+5^{\circ}$ to $+25^{\circ}\text{C}$ in a $65\% \pm 5\%$ Relative Humidity room in a discharged state with open circuit.

An extended storage within -40° to $+60^{\circ}\text{C}$ temperature range and $65\% \pm 20\%$ Relative Humidity room is permitted.

After one year storage up to 3 IEC cycles are permitted to allow the battery to recover its performance.

10. Overcharge

After a 28 day continuous charge at 0.1C (0.22A) the IEC capacity of a multi-VEC 2200 battery is typically 2.2 Ah. Occasional overcharge (less than 100 hours) is permitted at maximum rate of 0.20C (0.44A).

11. Cycle life

The cycle life of a rechargeable battery depends on various parameters such as charge rate, discharge rate, depth of discharge, overcharge, temperature, period of rest between charge and discharge and so on.

In fast charge, cycle life depends also on the cut-off method (Negative Delta V, TCO 45°C , ...) in addition to the battery configuration (see PN51.007.108 "Safety of Ni-Cd batteries through the use of rapid charge").

The rechargeable battery reaches its end of life when its capacity is 75% of the 10th cycle capacity.

Typical values for a multi-VEC 2200 battery are following :

Temperature : $+20^{\circ}\pm 5^{\circ}\text{C}$ Capacity measured at 1,0 volt/cell	Expected cycle life (Number of cycles)
Negative Delta V Fast charge/Fast discharge Cycling conditions : Charge at C No rest Discharge at C	> 500

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