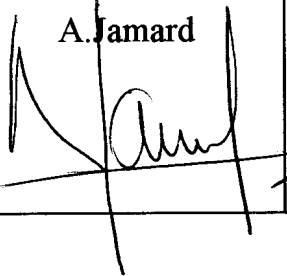





Specification for
VSE AA

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1. Scope

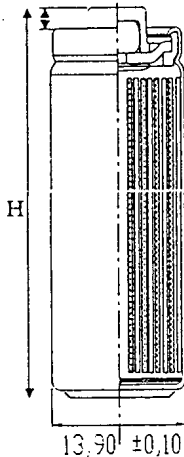
This specification applies to a Nickel-Cadmium cylindrical rechargeable single cell which SAFT designation is VSE AA. This cell has been designed for cycling applications requiring a super high capacity.

2. General electrical specification

Item	Specification	Units	Notes
SAFT cell designation	VSE AA		
IEC cell designation	KRH 15/51		
Nominal voltage	1.2	Volt	
Rated capacity	940	mAh	at 0.2C
Typical impedance	16	mOhms	at 1000 Hz
Charge current			
Slow	94	mA	0.1C
Fast	940	mA	with end of charge detection See 5.1
Charge duration			
Slow	16	hours	
Fast	about 1	hour	
Peak voltage in charge			at 20° ± 5°C
Slow	1.45/1.50	Volt	
Fast	1.55/1.60	Volt	
Maximum continuous discharge current	2.9	A	3 C
Temperature range			
In fast charge	+10/+40°C	°C	
In slow charge	0/+50°C	°C	
in discharge	-20°/+60°C	°C	
Recommended storage	+5/+25°C	°C	
Extended storage	-20/+40°C	°C	less than 1 month

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3. General mechanical specification

Bare Cell Drawing (mm)	Bare Cell Dimensions
	Diameter (mm) : 13.9 ± 0.1 Height (mm) : 48.9 ± 0.3
	Positive Contact Flat Area Diameter (mm) : 5.6 Overstep (mm) : 0.9 max
	Typical wWeight (g) : 22

4. Capacity

4.1 0.2C Discharge rate capacity

Capacity is defined as follows :

- Temperature : $+20^{\circ} \pm 2^{\circ}\text{C}$
- Charge current : 94 mA constant current
- Charge duration : 16 hours
- Period of rest : 1~4 hours
- Discharge current : 188 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.

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4.2 Available capacity

The following cross table gives minimum available capacities and typical voltage get a half discharge of a multi-VSE AA battery under various discharge currents. The temperature is $+20^{\circ} \pm 5^{\circ}\text{C}$, the battery being initially fully charged. Deviation depending on test conditions may be observed.

Discharge Rate	Current (mA)	End of discharge voltage	Capacity Fast charge (mAh)	Capacity Normal Charge (mAh)	Half discharge voltage (mV/cell)
C/5	188	1.0 Volt/Cell	950	940	1250
C	940	1.0 Volt/Cell	890	870	1220
3 C	2820	0.8 Volt/Cell	800	740	1160

5. Charge

5.1 Fast charge

The multi-VSE AA battery can be fast charged within about 1 hour with a suitable end of charge detection and cut-off, two systems are listed below. The temperature range is $+10^{\circ}/+40^{\circ}\text{C}$. The recommended maximum charge current is 950 mA.

5.1.1 *Negative Delta V Detection*

The fast charge is stopped when voltage drops of 10/15 mV per cell. This cut-off system must be inhibited during the starting 3 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. Charge must be limited to maximum 1.70V per cell.

5.1.2 *Derivative Temperature versus time*

The fast charge is stopped when battery temperature ratio ($\Delta T / \Delta t$) reaches a minimum gradient of 1°C per minute. This charging method depends on the battery configuration : assembly, number of cells, localisation of the sensor, nature of the plastic case, ambient temperature and so on.

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5.2 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.

Charge	Rate	Current (mA)	Duration (Hours)	Temperature (°C)
Standard	C/10	94	16	0° / +50°C
Quick	C/3	313	about 4	+5° / +50°C
Trickle	# C/25	35	Permanent	-20° / +50°C

Within low temperatures, below 0°C, charge voltage must be limited to 1.70 Volt per cell.

6. Temperature characteristics

The following table gives the minimum capacity of a multi-VSE AA battery under various discharge rate and temperature and after the following charge conditions :

- ➔ Fast charge : 72 minutes at 1.0C
- ➔ Temperature : +20°C ± 5°C
- ➔ Maximum rest of charge : 4 hours at temperature of discharge

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

	Rate of Discharge			
	0.2 C = 188 mA		C = 940 mA	
Temperature of Discharge	Capacity (mAh)	% C	Capacity (mAh)	% C
+40°C	900	95	840	88
+20°C	940	100	870	92
0°C	870	92	700	74
-20°C	760	80	450	47

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7. Storage

7.1 Short term (less than 3 months)

Store the cells or batteries in places where the humidity is low: max 70%, avoid places where the air is corrosive and keep the temperature between +15°C to +25°C. During short periods of time, cells and batteries can be kept in a temperature range between -20°C and +40°C, though keep in mind that storage out of +15°C to +25°C will increase the selfdischarge and ageing the cells.

7.2 Long term (more than 3 months)

Cells which are stored for a long period of time should be kept in temperature ranges between +15°C and +25°C, to prolong the passivation of the active material in the cell. It is recommended to cycle the cells several times after long time storage in order to restore the active and gain the optimal performance. When cells are stored for 1 year or more, it is recommended to charge the cells minimum one time per year to a residual charge of 30%. This is to avoid pasivation and increased ageing of the cell due to selfdischarge.

8. Overcharge

A multi-VSE AA battery is not designed to be permanently overcharged. Nevertheless it can withstand an overcharge at a C/10 rate at +20°C for one month. The repetition of a fast charge without a discharge on battery fully charged is not recommended.

9. Charge retention

After a 28-day storage at $+20^{\circ} \pm 5^{\circ}\text{C}$ the multi-VSE AA battery shall retain typically 75% of its initial capacity, the battery being initially fully charged. After 7-day storage at $+40^{\circ} \pm 5^{\circ}\text{C}$ the multi-VSE AA battery shall retain typically 70% of its initial capacity, the battery being initially fully charged.

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10. 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.

Typical values for a multi-VSE AA battery are listed below :

Temperature : +20°±5°C Capacity measured at 1,0 volt/cell	Expected Cycle Life (Number of cycles)
Negative Delta V Fast charge / Fast discharge	> 500 (*)
(Delta T / Delta t) Fast charge / Fast discharge	> 500 (*)

(*) 80% of the average capacity obtained in the first 10 cycles.

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