SPECIFICATION FOR VH F 15000

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1/ SCOPE

This specification applies to a Nickel-Metal Hydride cylindrical rechargeable single cell which SAFT designates as VHF 15000. This cell belongs to the SAFT High Power Ni MH series and has been designed for power or energy OEM applications, such as Electric Bike and mobility applications , professional video cameras and lighting,

2/ GENERAL ELECTRICAL CHARACTERISTICS

All the figures listed in the following tables are based on new single cells within one month after delivery. Tests are carried out in accordance with International standard document IEC 61951-2 (ex. 61436).

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ITEM	SPECIFICATION	UNITS	NOTES
MAIN CHARACTERISTICS			
SAFT cell designation	VH F 15000		
IEC cell designation	HRH 33/91		
Nominal voltage	1.2	Volt	
IEC rated capacity	14000	mAh	As IEC 61951-2 (4.1; 4.2; 6.1)
Typical capacity*	15000	mAh	* After charge 16h at C/10 and discharge at C/5
Typical impedance	4	mOhm	At 1000 Hz
CHARGE CURRENT			
Standard	1400	mA	
Fast*	Up to 5000	mA	* Charge termination recommended. (5.2)
Topping**	500-1500	mA	** After a main charge (5.2)
Trickle***	300-400	mA	*** After a topping charge
Pulsed	-		Consult SAFT for details
CHARGE DURATION			
Standard	16	hours	Charge termination recommended (5.2)
Fast	3-4	hours	
Charge retention 28 days at. 20°C +/- 2°C	>65	%	Storage in full charge state discharged at C/5
DISCHARGE CURRENT			At 20°c +/-5°C
Maximum continuous current	50	A	End of discharge voltage 0.8V/cell
Max peak (<0.3s)	180	A	max end of discharge voltage 0.6V/cell
TEMPERATURE RANGE			Temperature of start up
In slow/standard charge	0/40	°C	
In fast charge	0/35	°C	
In discharge	-10/40	°C	Until to 12A at –10°C
In storage			See § 7
Recommended	5/25	°C	
Low limit range High limit range	-40 to +5 25 to + 60	°C	Shorter than 1 month
TYPICAL WEIGHT	250	g	

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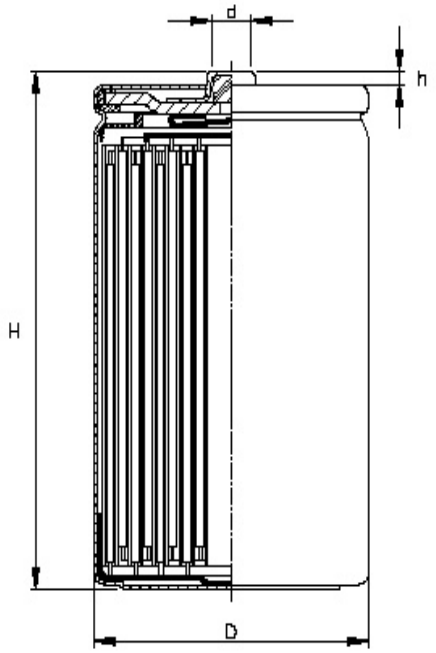
3/ GENERAL MECHANICAL CELL SPECIFICATION

BARE CELL DRAWING	BARE CELL DIMENSIONS (mm)
	**Diameter:** D= 32.15 +/- 0.10 **Height:** H= 88.8 +/- 0.4 **Positive contact** **Flat area diameter:** d= 5.6 **Overstep:** h= 1.4 +/- 0.4

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4/ CAPACITY

IEC Capacity is defined as required in IEC 61951-2 (§4.1;4.2;6.1)

- Temperature : +20° +/- 2°C
- Charge current : 1400 mA constant current (C/10)
- Charge duration : 16 hours
- Period of rest : 1 hour
- Discharge current : 2800 mA constant current (C/5)

Minimum capacity : 14000 mAh

5 cycles are allowed to get the specified value.

5/ CHARGE RECOMMENDATIONS

Global Charge control methods:

Ni-MH cells are normally assembled in series. Charging of Ni-MH cells shows many analogies and similarities as with that of Ni-Cd cells. The main difference is that the temperature change is exothermic from the beginning of the charge. As temperature increase is detrimental to life duration of the cell (due to MH alloy corrosion), and in order to ensure a good compromise between capacity and life duration, it is highly recommended to charge the VHF 15000 (single cell or pack) by managing the temperature change of the single cell or of the battery pack. DT/dt level should be calibrated at the slope value corresponding to approximately 40°C (in the cell or pack), in order to detect the end of the main charge before the peak voltage.
The value of this dT/dt, depends upon the battery pack configuration and charge rate, for single cells, 0.5°C is generally permitted. Use of –dV charge termination is not recommended as main charge method because when the detection of –dV occurs, the temperature is too high to ensure good cycling, especially in battery packs.

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SAFT DOES NOT RECOMMEND THE CHARGING OF A CELL OR BATTERY PACK AT CONSTANT CURRENTS HIGHER THAN 5A, BECAUSE THE TEMPERATURE INCREASE IS TOO FAST.

Fast charge:

Fast charge (up to 5000mA) can be stopped before excessive temperature in the cell or battery pack with a good calibration of the dT/dt measurement. Then, the charge can be completed with a topping charge to stop the temperature increasing too rapidly. A topping charge corresponding up to 10% of the rated capacity at a rate from 500 to 1500mA, can be applied. A trickle charge can be added at lower current rate (from 300 to 400mA) to be adapted according to the pack configuration. For quick charge on single cell (up to 2500mA), -dV (0.1 to 0.5%) can be admitted even if dT/dt is more suitable. However, -dV can be admitted as cut-off for quick charge on a single cell, but **never** as the main charge cut-off system for a battery pack, it can only be considered as a back-up system. In addition, a TCO at 50°C and a timer can be used as the second back-up system.

Standard charge:

At very low charge rate (C/10) the charge of single cell can be controlled by a timer, but on a pack, even at this low rate, it is recommended to use dT/dt as charge cut-off. As for other charge rates, -dV can be used as a back-up charge cut-off, with a TCO at 50°C and timer as the second back-up system. Trickle charge can be added at lower current rate (from C/30 to C/100), which has to be adapted according to the battery pack configuration.

6/ CYCLE LIFE

The cycle life of a rechargeable cell depends on various parameters such as charge rate, discharge rate, depth of discharge, overcharge, temperature, period of rest between charge and discharge. Typically a rechargeable cell reaches its end of life when its capacity is 70% of the average capacity obtained in the first 10 cycles.

Typical cycle life values for a single cell VHF 15000 are listed as:

TEMPERATURE: +20° +/- 5°C CAPACITY MEASURED AT 1,0 VOLT/CELL	EXPECTED CYCLE LIFE (NUMBER OF CYCLES)
Charge 5Awith (dT/dt) cut-off; Discharge 7A	>500
Charge 5A with (dT/dt) cut-off; Discharge 15A	>500

7/ CELL AND BATTERY MANAGEMENT

- Overcharge :

The VHF 15000 cell is not designed to be permanently overcharged. Repeated overcharging could cause leakage and results in the deterioration of the cell performance.

- Over discharge :

A deep discharge or “over discharge“ (at a current rate higher than C/10) could damage the cell/battery performance, so it is recommended to manage the discharge with appropriate cut-off systems(consult SAFT) and to avoid to let the cell/ battery connected to the equipment for a long period.

- Storage :

After a 28 days storage at +20° ± 5°C, or 7 days storage at +40° ± 5C the VHF 15000 cell shall retain typically 80% (minimum 65%) of its initial capacity, the cell being initially fully charged. In both cases, the VHF 15000 cell shall recover full initial capacity after a complete cycle. **In all cases, it is recommended to store the cell or battery in minimum charged state of (30/35%) and in an open circuit condition.**

- Normal conditions:

SAFT recommends to store the cell or battery within a temperature range of +5° to +25°C in a 65 ± 5% relative humidity atmosphere and to avoid storing the cell or battery in a discharged state.
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After 4 months storage at room temperature or 2 months at 40°C, the VHF 15000 shall recover 100% of its minimum capacity (after 5 application cycles).

An extended storage between -20°/+5°C and +5°C/60°C and 65% relative humidity is permitted for no more than one month.

- Long term storage (up 6 months):

Long term storage leads to an acceleration of battery self discharge and deactivation of chemical components. SAFT recommends to store the cell or battery under Normal conditions listed above.
In such a case, it is recommended to partially recharge the (cells/battery), every 6 months. In addition, when using the batteries for the first time after 6 months storage and in order to restore the initial cell performance, it is recommended to full cycle the cell/battery (maximum 5 cycles). In these conditions, the VHF 15000 shall recover 95% of its initial capacity, even after 12 months storage.

- Service life :

Normally, if a cell or battery pack is used under normal conditions as described above, a cell should last for 2 years or 500 cycles. Failure in charging, discharging, storage or temperature range can reduce the service life and damage the cell performances.

- Battery assembly :

Consult SAFT for advice in battery assembly.

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8/ SPECIFICATION APPROVALS

PRODUCT MANAGER:	**F.Auriol**
TECHNICAL DIRECTOR:	**C.Chanson**
PROJECT MANAGER:	**I.Belkhir**
QUALITY DIRECTOR:	**J.Seganti**