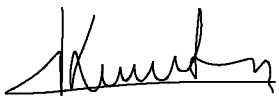
STANDARD SPECIFICATION

Medium Prismatic Lithium-Ion Rechargeable Battery

Model
1s1p MP 174865 IS
(Intrinsically Safe model)

	Name	Position	Date	Signature
Written by	A. Kerouanton	Lithium Product Manager	02/06	
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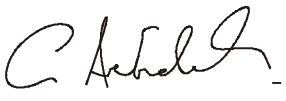
Approved by	G. Archdale	Rechargeable Lithium Sales Manager	02/06	

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1. Scope

This specification presents typical and guaranteed ex-works values for the rechargeable Lithium-Ion, Medium-sized, Prismatic-shaped and single-cell battery Model 1s1p MP 174865 IS.

This battery consists of a MP 174865 IS cell fitted with an electronic monitoring circuit and a thermal fuse as protection devices.

It has been specially designed for high-end cycling applications meeting the requirements of the EN 50020 "Intrinsic Safety" Standard, which is a prerequisite for integration within devices due to operate in potentially explosive atmospheres. In Europe, such devices need to be compliant with the Directive 94/9/EC commonly known as the "ATEX Directive". .

2. Reference documents

- Secretariat of the United Nations - *"Recommendations on the Transport of Dangerous Goods – Model Regulations"* Ref. ST/SG/AC.10/1 - Revision 13 - 2003 + "Manual of Tests and Criteria" 4th Revised Edition - 2003 - Ref.ST/SG/AC.10/11/Revision 4.
- International Electrotechnical Committee Specification IEC/CEI "*Secondary lithium cells and batteries for portable applications"* Ref. IEC/CEI 61690-First edition - 2003.
- CEN-CENELEC "Electrical apparatus for potentially explosive atmospheres Section EN 50020 - Intrinsic Safety" - 2002.

3. Construction and visual aspect

A. Construction

The 1s1p MP 174865 IS prismatic battery is assembled from a cell constructed according to the spiral electrode technology. The cell features a built-in circuit breaker and safety vent. It is fitted with an electronic protection circuit positioned in the topshell area and a thermal fuse positioned on top of the cell, under the plastic sleeving.

The electronic circuit reversibly protects the battery from accidental overcharge, overdischarge and overcurrent. It limits the maximum charge and discharge currents that are acceptable. Multi-cell battery packs assembled from MP174865 IS cells may feature other types of electronic protection circuits with different limitations.

The 7 bar-rated circuit breaker irreversibly interrupts the current flow in case of excessive internal pressure, due to overcharging (with defective charger and/or electronic protection circuit) or excessive temperature.

The thermal fuse irreversibly opens when the temperature exceeds 93°C.

A built-in safety vent protects the battery in case of excessive temperature environment (such as fire condition) leading to an internal pressure exceeding 12 bars.

B. Visual aspect

When inspected by naked eyes, The 1s1p MP 174865 IS battery should not show any trace of dents, swelling, corrosion or leakage. Marking should be readable.

4. Typical values

A. Designation

1s1p MP 174865 IS

(the 1s1p prefix indicates that the product consists of just a single cell in series: "1s", and a single cell in parallel: "1p").

(the suffix "IS" makes referennce to the "Intrinsic Safety" of the product).

B. Nominal voltage

3.6 V

(at C/5 rate, +20°C, mid-discharge)

(Nota: the open circuit voltage is dependent on the state of charge of the battery).

C. End-of-charge voltage

4.1 V recommended

(Charge up to 4.2 V is possible in certain conditions. Consult Saft).

D. End-of-discharge voltage

2.5 V

(the battery electronic protection circuit activates at 2.3 V in order to prevent irreversible battery performance degradation).

(Multi cell battery packs assembled from MP 174865 IS cells may feature electronic protection circuit with slightly different voltage cut-offs. Consult Saft).

E. Rated capacity

4.8 Ah

(Battery charged at a constant current of 1 A (≈ C/5-rate) for 7 hours, up to 4.1V, followed by 1 to 4 hours of rest at 20°C, and discharged at 20°C, at a constant rate of 1 A (≈ C/5-rate) down to 2.5 V).

(The capacity restored by the battery varies with the end-of-charge voltage, the discharge current, the temperature, the voltage cut-off, the age, and the number of cycles already performed. Consult Saft for specific details).

F. Recommended charge conditions

Up to 5 A (≈ C-rate)

(Limitation coming from the characteristics of the electronic protection circuit)

At room temperature:

- first step, at constant current until the voltage reaches the recommended 4.1V voltage,
- second step, at constant voltage, until the current falls to 50 mA (≈ C/100).

In case the time to reach the 50 mA minimum current is excessive, it is recommended stopping the charge with a timer set at 4 hours (timer starting counting when the selected end-voltage is reached).

Other charge conditions are possible. Consult Saft, as well as for optimised charging below 0°C where rates preferably not exceeding C/5 are recommended.

Maximum recommended discharge conditions

5 A continuous.

(If exceeded the 1s1p MP 174865 IS battery standard electronic protection circuit will activate. Continuous discharge up to 10 A (≈ 2C-rate) and pulse discharge up to 20 A (≈ 4C-rate) are possible with specific electronic protection circuits used in multicell battery packs assembled from MP cells. Consult Saft).

G. Operating temperature range

Charge is possible from -20°C to + 60°C.

Charge above 60°C would affect noticeably subsequent battery performance.

Charge is still possible at lower temperature under certain conditions. Consult Saft.

Discharge is possible from - 50 to + 60°C.

Discharge above 60°C would affect subsequent battery performance.

H. Cycle life

When charged at 20°C at 1 A (≈ C/5-rate) for 7 hours, followed by 1-4 hours of rest and discharged at 1 A down to 2.5 V, the 1s1p MP 174865 IS battery typically loses 30 % of the rated capacity after 850 cycles.

(Different cycle life is possible if the battery is cycled at other current or shallower discharge cycles, i.e. less than full charge/discharge. Consult Saft).

I. Internal resistance

110 mΩ max (at + 20°C)

Typically, 25-50 mΩ comes from the MP 174865 IS cell itself (25 mΩ when new and 50 mΩ when cycled 850 time) and the rest from the protection devices and external wiring.

(measurement with an a.c. method at the frequency of 1.0 kHz).

J. Typical weight

130 grams, with a contribution of 125 grams from the cell itself and the rest from the protection devices, external wiring and sleeving.

5. Environment, mechanical and electrical abuse testing

The 1s1p MP 174865 IS battery typically behaves as following:

Test	Source	Procedure	Typical performance
Free fall	IEC	from 1.0 m onto a hard wood floor 6 times at + 20°C	NL NV NE NF
Thermal test	UN	Storage 6 hrs minimum at + 75°C followed by 6 hrs minimum at - 40°C Repeated 10 times	NL NV NE NF OCU after test not less than 90% of OCV before test
Vibration	UN	Sinusoidal vibration 7 to 200 Hz and back to 7 Hz, traversed in 15 mn. Amplitude 1.6 mm (total excursion) Cycle repeated 12 times	NL NV NE NF
Shock	UN	Half-sine shock Peck acceleration 150 g Duration 6 millisec. 18 shocks in total	NL NV NE NF
External short circuit	EN 50020	At + 40°C (MP 174865 IS cell, without electronic protection circuit) on a resistance not exceeding 3 mΩ	NL NV NE NF Cell external T not exceeding 85°C → **assignment to Temperature Class T6**
Heating	IEC	Cell in an oven whose T is increased at 5°C/mn until the oven reaches 130°C 130°C maintained 30 mn	NE NF
Overcharge	UN	Charge 24 hrs at 10 A (≈2C)	NE NF

NL: No Leakage *NV: No Vent* *NE: No Explosion* *NF: No Fire*

6. Storage

Storage is possible between - 50 and + 60°C without circuit breaker activation nor leakage.

Storage conditions affect the battery's charge retention. For long-term (up to 1 year) storage, Saft recommends to keep the battery with a (30 ± 15) % state of charge in a dry and cool place at a temperature not exceeding 30°C.

7. Charge retention after storage

The capacity lost by the 1s1p MP 174865 IS during storage depends in part from its state of charge.

After 1 month of storage at + 20°C, the capacity loss of a 100 %-charged 1s1p MP 174865 IS battery typically does not exceed 10 % of the rated capacity in the discharge conditions given in § 4.E.

After 6 months at + 20°C, the capacity loss of a 100 %-charged 1s1p MP 174865 IS battery typically does not exceed 20 % of the rated capacity in the discharge conditions given in § 4.E.

After 12 months at + 20°C, the capacity loss of a 100 %-charged 1s1p MP 174865 IS battery typically does not exceed 30 % of the rated capacity in the discharge conditions given in § 4.E.

The above numbers are divided by a 3-factor for batteries stored with 50 % state-of-charge.

8. Handling

Saft advises, during the handling of the 1s1p MP 174865 IS battery, to observe the following precautions:

a) Do not remove the batteries from their original packaging* before use.

b) Do not store the batteries in bulk in order to avoid accidental short-circuiting.

c) Do not expose to heat above 60°C, flame, or incinerate.

d) Do not disassemble or modify.

e) Do not solder directly onto the battery, (*excessive heat may damage cell's insulation or circuit breaker).*

f) Pay attention to the polarities when installing the battery.

g) Do not short circuit.

* *original packaging may be re-used for end-of-life disposal.*

h) Do not immerse in any liquid.

i) Do not drop or subject to shock.

j) Do not remove the protection circuit.

k) Use appropriate charger.

9. Transport

The MP 174865 IS cell passes the safety tests listed in the United Nations "Manual of Tests and Criteria" (4th Revised Edition Ref. ST/SG/AC.10/11/Rev. 4).

Based on the criteria mentioned in the United Nations "Recommendations on the Transport of Dangerous Goods – Model Regulations" (13th Revised Edition – Ref. ST/SG/AC.10/1/Rev 13 – 2003) the cell, which contains 4.8 x 0.3 = 1.44 gram of lithium-equivalent content, below the 1.5 gram limit, is **non-restricted to transport** and **non-assigned to Class 9.**

The same applies to battery packs assembled from 2 up to 5 MP 174865 IS cells.

Guaranteed minimum values

Rated capacity *(in conditions given in § 4.E* *charge C/5 up to 4.1 V + discharge C/5)*	4.5 Ah minimum (Uncycled cells within 3 months following cell date code printed on the sleeve).

10. Incoming inspection

Prior to release from factory, the 1s1p MP 174865 IS battery is 100 % inspected for rated capacity and self-discharge rate.

In case of incoming inspection, Saft recommends the following:

A. Sampling standards

French	British	German	American	ISO
NFX 06-022 NFX 06-023	BS 6001 BS 6002	DIN 40080 DIN ISO 3951	MIL STD 10 5D MIL STD 414	2859 3951

B. Acceptable Quality Levels (AQL)

Cell lot size	Sampling size	AQL
1-3 200	32	0.4 %
3 201-10 000	50	0.25 %
> 10 000	80	0.15 %

11. Marking

The external surface of the 1s1p MP 174865 IS battery bears two labels, which display the following:

Identification label:

SAFT 1s1p MP 174865 IS — Li-Ion rechargeable battery
Nominal voltage 3.6 V — Nominal capacity 4.8 Ah
CHARGE — Recommended charge voltage 4.1 V
Recommended max. current 5 A
DISCHARGE — Maximum current 5 A
P/N XXXX/Y — Made in France
Date code with month/year of production

Safety warning label:

Do not crush .....Do not short circuit Do not heat or incinerate
Do not dismantle.....Do not immerse in any liquid

The cell inside may vent or rupture Observe charging instructions
Charge -20°C < T < 60°C Discharge: -50°C < T < 60°C

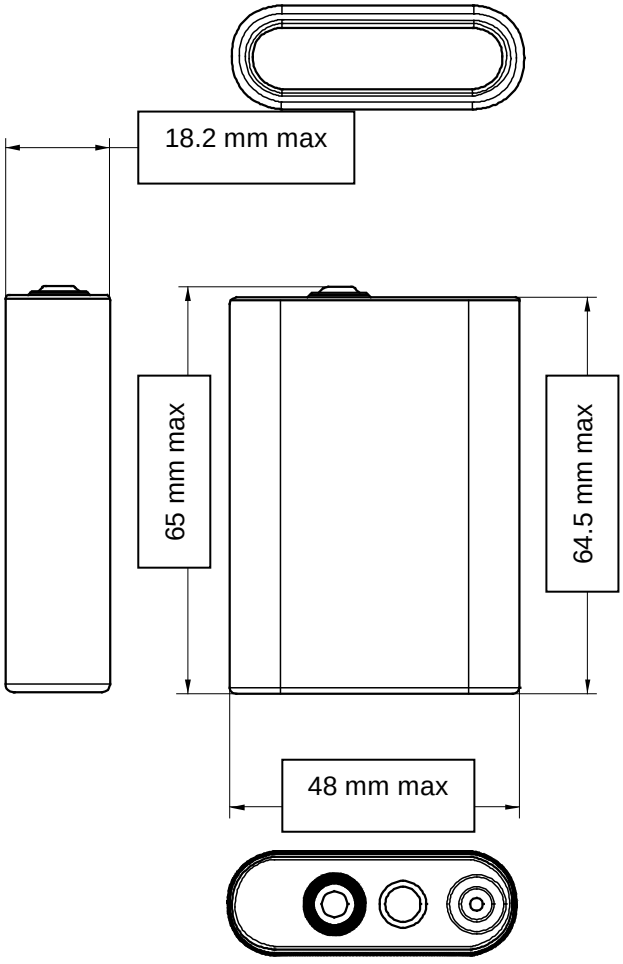
For best long-term performance: store at (30 ± 15) % of capacity
and below 30°C

12. End-of-life disposal

The 1s1s MP 174865 battery does not contain heavy metals such as Mercury. It is also Lithium metal-free.

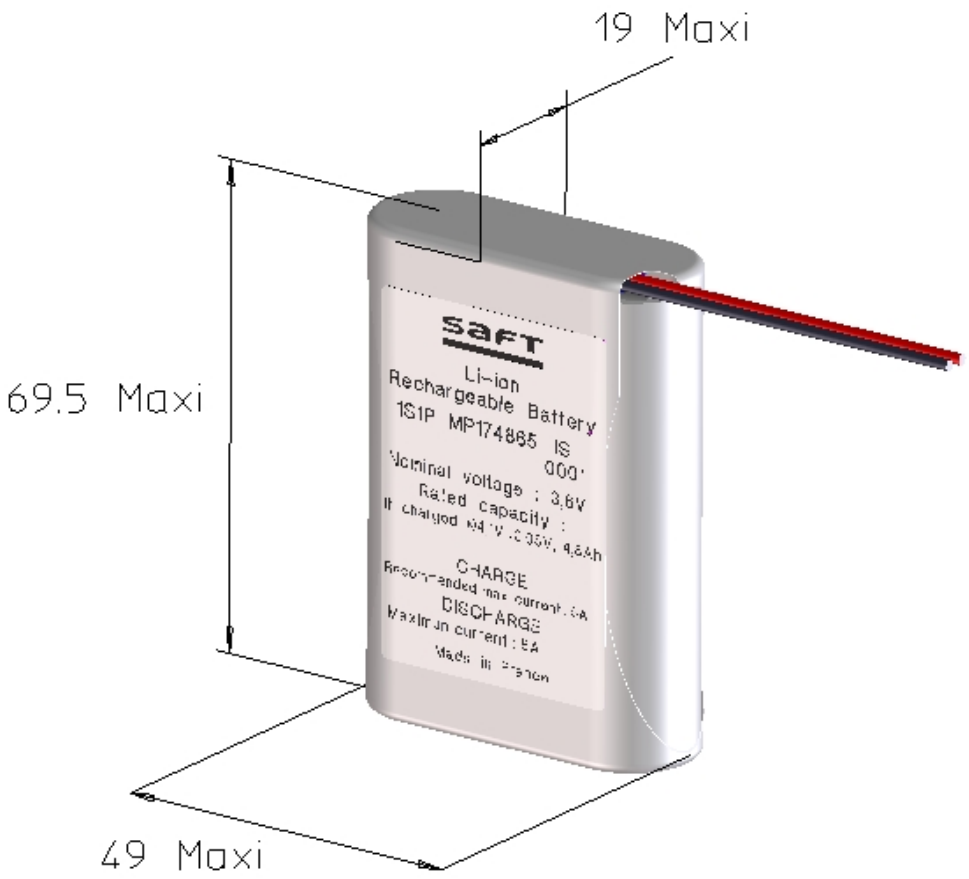
Dispose according to local regulations. Recycling allows recovery of the valuable Cobalt it contains.

13. Untabbed/Unsleeved MP 174865 IS cell dimensions (100% charged, uncycled)



NOTA : Following multiple cycling the thickness of the bare cell may go up to 19.0 mm.

14. Sleeved 1s1p MP 174865 IS battery dimensions (100% charged, uncycled)



NOTA: The thickness 19.0 mm max. corresponds uncycled batteries; 0.8 mm to be added for batteries cycled 850 times.

Several finish types are available. These vary by the type of electronic protection circuit used, the positioning of the thermal fuse, the lead types and lengths, and the connector type.