NanoPower

Battery 3500m Ah

Datasheet

Lithium Ion 18650 cells for space flight products – 3500mAh

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Datasheet for the NanoPower Battery 3500m Ah

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GOMSPACE

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1 Introduction

When choosing batteries for a satellite mission it is important to make sure that they can withstand the hostile environment encountered in space. The GomSpace batteries provide extensive testing and are chosen specifically for their suitability in satellite missions. NanoPower Battery 3500mAh is space proven and with a flight heritage.

2 Characteristics

The battery available from GomSpace are lithium-ion and from the rugged and space proven 18650 form factor.

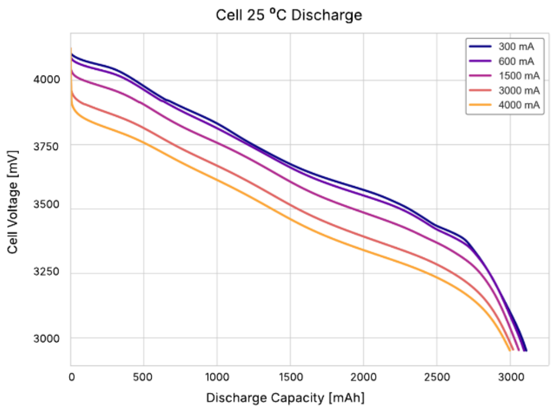
2.1 Electrical and thermal characteristics

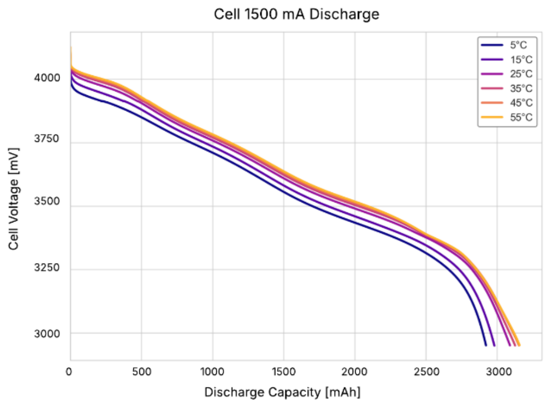
The electrical and thermal characteristics are given in Table 2.1.

Table 2.1: Electrical and thermal characteristics

Parameter	Condition	Min	Typ	Max	Unit
Nominal Capacity , for 1500mA discharge	@ 2.5 V cut-off @ 2.95 V cut-off @ 2.95 V cut-ff, and charging to 4.0 V	3350	3500 3100 3000		mAh mAh mAh
Voltage	Safe Recommended	2.5 2.95	3.6	4.2 4.0	V V
Current - Charge	0 to +45 °C		1700	3400	mAh
Current - Discharge	-20 to +60 °C		680	10000	mAh
Temperature – Storage (recommended)	3 months 12 months	-20 -20		45 20	°C °C
Temperature - Operating	Charge Discharge	0 -20		45 60	°C °C
Internal impedance	1 s, 3000 mA, 60% SOC 20 s, 3000 mA, 60% SOC 1 kHz		 <40		mΩ mΩ mΩ

Battery discharging characteristics:

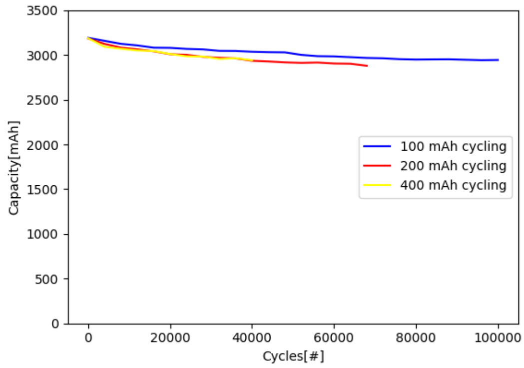




3 Cycle Life

The cycle life of any rechargeable battery depends on a number of factors, but most importantly the Depth-Of-Discharge (DOD) of the cycles, temperature, charge/discharge current and End of Charge Voltage (EOCV). General rules are that:

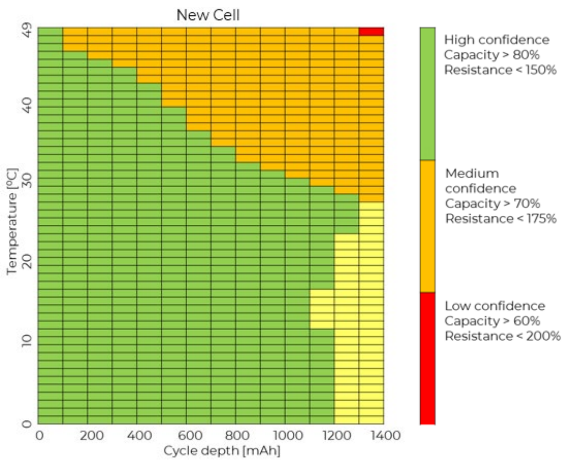
- The lower the DOD, the better the cycle life.
- The lower the temperature, the better the cycle life (unless too low for charging).
- The lower the charge/discharge current, the better the cycle life.
- The lower the EOCV, the better the cycle life.



A sample of experimentally measured data:

- For aging: the cells were cycled at a specific DOD (100, 200 or 400 mAh) and charged to a specific charging cut-off voltage (4.0 V).
- The remaining capacity presented is related to the respective charging conditions (charging to the charging cut-off voltage of 4.0 V)

The presented curves were obtained in an accelerated testing manner



Lifetime projections for a 5-years LEO mission:

- Projections based on experimental testing and modelling
- Included dependence on battery temperature and cycle depth (depth-of-discharge)
- It is considered 5500 cycles per year

Projections are split by the confidence of staying above-selected thresholds

4 Storage

For prolonged storage, it is recommended to charge the batteries to 30 – 60 % SOC (approximately 3.6 – 3.9 V voltage limit with 50 mA charging cut-off) and keep temperatures lower than 20°C (preferably 0 - 10°C).

The cells are expected to self-discharge 0.004 – 0.03 Ah per month according to the storage conditions (higher self-discharge for higher SOC and higher temperature).

To avoid over-discharge and consequent deterioration of the batteries, it is advised to consider the cell's self-discharge, together with a battery pack / an electrical power supply self-consumption, or to monitor battery voltage and recharge the batteries when needed over prolonged storage.

5 Protection

The cells are equipped with a current-interrupt device (CID) and a vent. The CID is triggered by an increase of an internal pressure because of overcharging or overheating of the cell. The estimated threshold is 1.017 MPa. Triggering the CID causes disconnecting conductive paths inside of a cell to prevent further (dis)charge and it causes a permanent open circuit across the cell. The vent is triggered by an internal pressure exceeding an estimated value of 1.906 MPa, which results into releasing accumulated gases inside of the cell to prevent or reduce the risk of a rupture or an explosion.

Protections regarding undervoltage, overvoltage and overcurrent are typically implemented at a battery pack or at an electrical power supply unit.

6 Quality Control

Samples from every LOT are tested according to "Requirements for flight certification and acceptance of commercial off the shelf (COTS) Lithium-Ion (Li-Ion) batteries," JSC 66548, for physical characteristics, overcharge and external short.

Every cell goes through the flight acceptance test (FAT), which is based on the document "NASA Aerospace Flight Battery Program" by NASA, document no.: RP-08-75 Rev. 1.0. The cells are checked for their physical and electromechanical characteristics, i.e., any occurrence of deformations, open-circuit voltage, capacity, and internal resistance.

7 Safety Test

The battery cell has been tested, by the Manufacturer, according to the following standards:

- UL1642; Safety Standard for Lithium Batteries
- UN38.3; Transportation Testing for Lithium Batteries and Cells
- IEC 62133; Safety requirements for portable sealed secondary cells and batteries.

8 Disclaimer

The information in this document is subject to change without notice and should not be construed as a commitment by GomSpace. GomSpace assumes no responsibility for any errors that may appear in this document.