

1.1 Cycle life test (Endurance in Discharge – Charge Cycles)

The purpose of the test is to measure the endurance in discharge-charge cycles for applications where frequent discharges of the battery are to be encountered due either to a deliberate choice of operational or to frequent power-line outages.

Instruction: IEC 60896-11, chapter 16

Test items: 6pcs, 2V – 6 OPzS 420

Test Result: **1520 cycles to reach 80% C10**

Test procedure: The test was performed under the following profile:

- a. Capacity test settings: 10h rate at 1.80V/c according DIN capacity and current values (C10=420Ah, I10=42A). Capacity is implemented after an equalizing charge
- b. Discharge cycling settings: Discharge with 2.0 x I10 for 3 hours. This current corresponds to ~4h discharge DIN rate. The 3h discharge out of 4h nominal yields 75% DoD for each cycle.
- c. Recharge the battery for 21h at 2.40 ± 0.01 V/cell
- d. Nominal electrolyte density is 1.240 ± 0.010 gr/ml at 20°C
- e. Nominal single cell voltage deviation is -50 to +100mV from the average battery voltage
- f. During test, the electrolyte temperature is 25± 5 °C

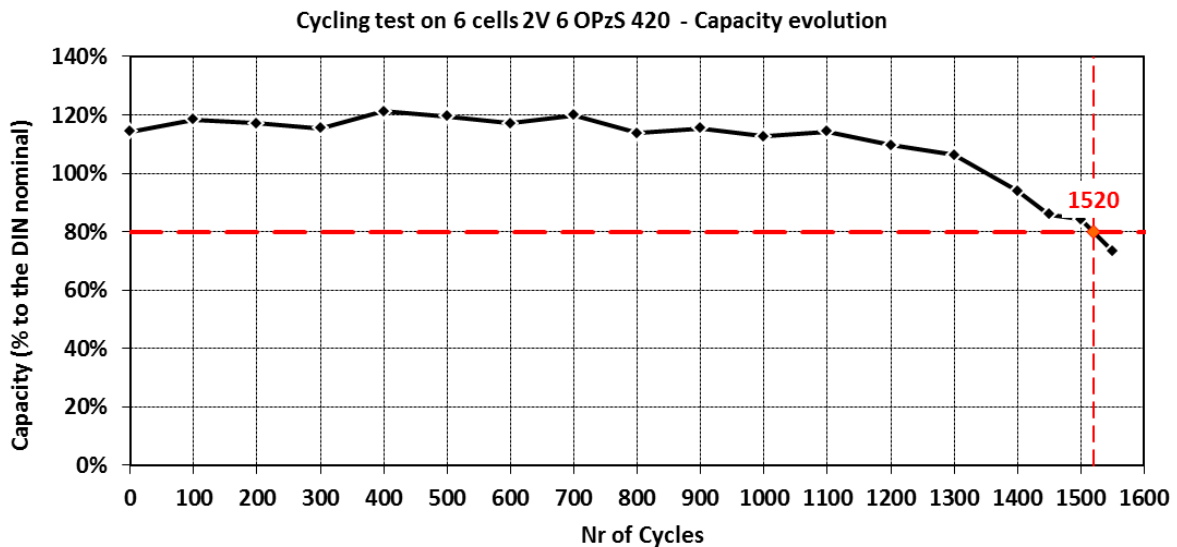


Figure 1. Capacity vs Cycles

1.2 Service Life Test (at 60 °C)

The purpose of the test is to define the expected lifetime of the battery under normal service conditions (floating voltage of 2.23 V/c and temperature 20 °C).

The parameter that is used to accelerate the test is the temperature. The batteries are subjected to the normal floating voltage but at a much higher temperature (60 °C).

The acceleration factor to extrapolate the service life at 20°C from the achieved duration at 60°C is the value that corresponds to the halving of the lifetime for every 9°K temperature rise.

$$F_{(60vs20)} = 2^{[(60-20)/9]} = 21.77 \text{ times}$$

$$\text{LifeTime at } 20^{\circ}\text{C} = \text{LifeTime at } 60^{\circ}\text{C} \times 21.77$$

Test items: 6pcs, 2V – 6 OPzS 420

Test Result: **Days at 60°C: 472.8**

Equivalent Service Life at 20°C: 28.2 years

Test procedure: The batteries are subjected to the test conditions for periods of 30 days each. After the end of each period a discharge test was applied in order to measure the available capacity under the following conditions:

- 10h capacity test at 1.80V/cell at 20°C (DIN values)
- Full charge before and after a capacity test
- The end-of-test criteria is the capacity drop below 80% of the DIN nominal value

Results - 6 cells 6 OPzS 420

Days at 60°C achieved: 472.8 days

Equivalent service life at 20°C: 28.2 years

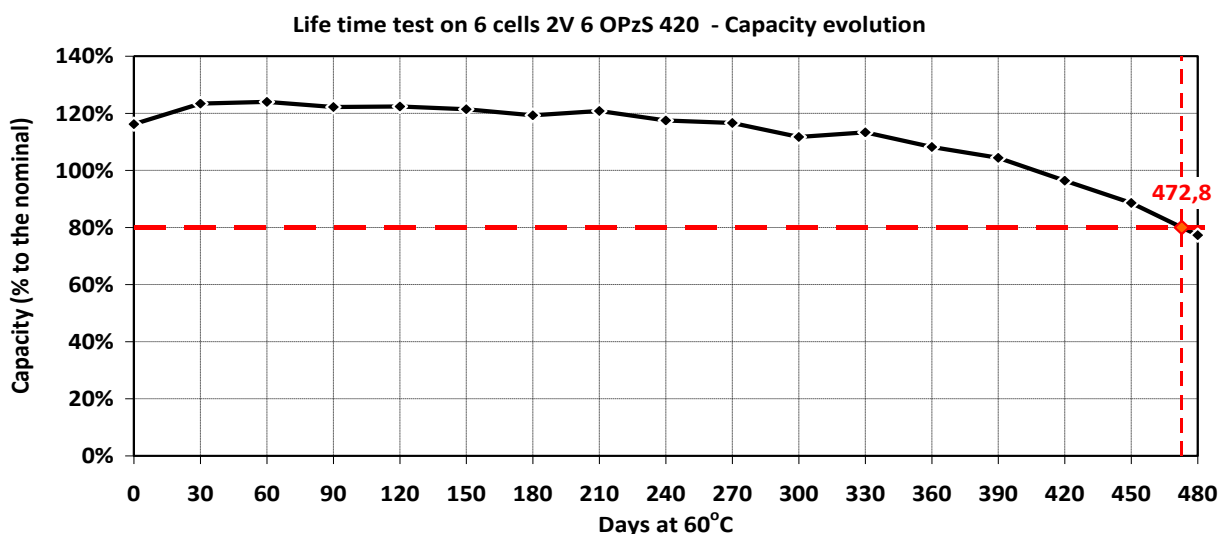


Figure 2. Days vs Capacity