



## CYCLE PERFORMANCE FRONIUS SOLAR BATTERY

### / Introduction

The Fronius Solar Battery is based on the Sony FORTELION™ Technology, a high quality Lithium iron phosphate (LiFePO<sub>4</sub>) battery cell.

The main advantages of Sony's FORTELION™ Technology are

- / No maintenance needed
- / High level of safety
- / Short charging and discharging times
- / High depth of discharge
- / Long service life
- / High cycle life

The cycle performance of the Solar Battery is one of its major advantages. To underline the outstanding performance it shall be explained in brief what cycle life exactly means:

### / Definitions:

/ SOC: *State of charge (related to usable capacity); The SOC is defined as the available capacity expressed as a percentage of some reference, sometimes its rated capacity but more likely its current capacity.*

*100% = battery fully charged; 0% = battery discharged*

/ Cycle: *One cycle describes one complete charge process (form 0% to 100% SOC) and one complete discharge process (100% to 0% SOC) at specific conditions (e.g. temperature).*

/ Cycle life: *The cycle life describes the number of cycles a battery can perform before its capacity falls below a specific percentage of its initial capacity. Most often this value is stated at a remaining capacity of 80%. The number of cycles can be found on mostly every battery manufacturer's datasheets.*

/ EOL *End of life. In contrast to other battery technologies (Lead Acid batteries), Li-Ion batteries do not suffer from "sudden-death" failure. Instead they exhibit a gradual decrease in performance over their service life. So their EOL is defined by a reduction in initial capacity, by typically 20%. It is important to remember that a Li-ion battery is not "dead" at its EOL, it has simply reached a pre-defined measure of aging. For the Solar battery EOL is defined as 80% of its initial capacity which correspond to more than 8000 full charge and discharge cycles at an ambient temperature of 23°C. (see Diagram 1)*

### / Cycle life of the Solar battery:

Under optimum conditions the Fronius Solar battery can be cycled over 8000 times, still having 80% of its initial capacity. In a typical self-consumption system (loading the batteries during daytime and discharging batteries in the night) it can be expected that the battery is cycled once a day. Assuming 250\* full cycles a year a service life of more than 20 years can be expected ( $8000/250 = >20$ ). (\* depending on location and PV system design)

As stated, those cycle numbers are measured under optimum conditions. The high cycle life of the battery is depending on several factors. The ambient temperature can be considered as one of the main influences.

Fronius states an ambient temperature range of 5-35°C on the datasheet of the Solar battery, which is seen as the optimum temperature range for the battery. In order to reach a maximum of cycles and longest service life we recommend not to go beyond those temperature values.

As stated above the cycle life of the battery is mostly dependent on the ambient temperature. In more detail this behavior can be described like shown in the following diagram:

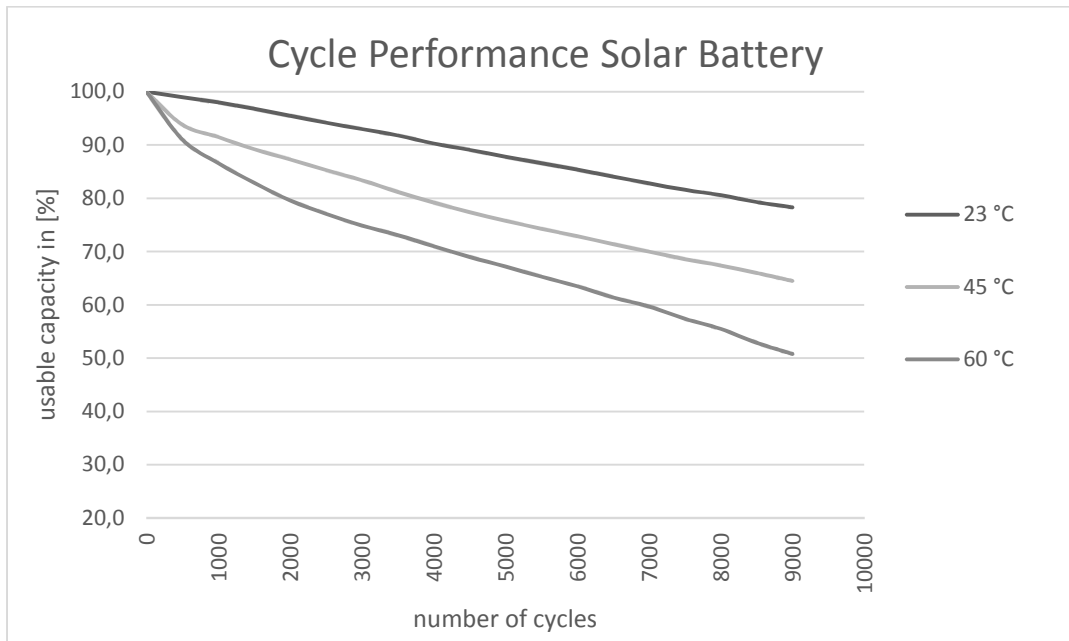


Diagram 1: Cycle Performance Solar Battery; Values measured by Sony<sup>1</sup>

As can be seen in Diagram 1 the best cycle life is reached at low ambient temperatures. An increase of the temperature leads to less cycle life. The temperature values in the diagram (23°C, 45°C, 60°C) are constant temperatures. This means that in these tests the battery cells were exposed to those temperatures 24 hours a day, 365 days a year, which will never occur in reality.

If the Solar battery is operated in temperate climate areas, considering a temperature range of 5-35°C at the installation site, it can be expected that the average temperature is around 25°C or less. Also in that case up to 8000 cycles can be expected.

### / Warranty

The Fronius Solar Battery comes with a warranty of up to 5 years and extended warranties are available additionally.

### / Summary

The Fronius Solar Battery is a high quality product designed for a maximum service life and high cycle life. The cycle performance strongly depends on the ambient temperature of the battery and decreases with higher temperature values.

Operating the Solar Battery at the optimum temperature range of 5-35 C° it can be expected that the battery can be cycled up to 8000 times before dropping below 80% of its initial usable capacity.

### / Notes and References

[1] Values of Sony FORTELION™ battery cell used in the Fronius Solar Battery; Values measured by Sony  
 SOC: 0 to 100%  
 Charge: 3.6V, 1ItA (2.85A), 100mA cutoff  
 Discharge: 1ItA (2.85A), 2.0V cutoff