

WHAT IS A BATTERY C RATING?

A battery's charge and discharge rates are controlled by battery C Rates. The battery C Rating is the measurement of current in which a battery is charged and discharged at. The capacity of a battery is generally rated and labelled at the 1C Rate (1C current), this means a fully charged battery with a capacity of 10Ah should be able to provide 10 Amps for one hour. That same 10Ah battery being discharged at a C Rating of 0.5C will provide 5 Amps over two hours, and if discharged at a 2C Rate it will provide 20 Amps for 30 minutes. The C Rating of a battery is important to know as with the majority of batteries the available stored energy depends on the speed of the charge and discharge currents.

BATTERY C RATE CHART

The below chart shows the different battery C Rates along with their service times. It is important to know that even though discharging a battery at different C Rates should use the same calculations as an identical amount of energy, in reality there are likely to be some internal energy losses. At higher C Rates some of the energy can be lost and turned in to heat which can result in lowering the capacity by 5% or more.

C Rating	Time
30C	2 mins
20C	3 mins
10C	6 mins
5C	12 mins
2C	30 mins
1C	1 hour
0.5C or C/2	2 hours
0.2C or C/5	5 hours
0.1C or C/10	10 hours
0.05C or C/20	20 hours

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HOW TO CALCULATE C RATING OF A BATTERY?

A battery's C Rating is defined by the rate of time in which it takes to charge or discharge. You can increase or decrease the C Rate and as a result this will affect the time it takes the battery to charge or discharge. The C Rate charge or discharge time changes in relation to the rating. 1C is equal to 60 minutes, 0.5C to 120 minutes and a 2C rating is equal to 30 minutes.

The formula is simple

t = Time

Cr = C Rate

$t = 1 / Cr$ (to view in hours)

$t = 60 \text{ minutes} / Cr$ (to view in minutes)

0.5C RATE EXAMPLE

2300mAh Battery

$2300\text{mAh} / 1000 = 2.3\text{A}$

$0.5\text{C} \times 2.3\text{A} = 1.15\text{A}$ available

$1 / 0.5\text{C} = 2$ hours

$60 / 0.5\text{C} = 120$ minutes

2C RATE EXAMPLE

2300mAh Battery

$2300\text{mAh} / 1000 = 2.3\text{A}$

$2\text{C} \times 2.3\text{A} = 4.6\text{A}$ available

$1 / 2\text{C} = 0.5$ hours

$60 / 2\text{C} = 30$ minutes

30C RATE EXAMPLE

2300mAh Battery

$2300\text{mAh} / 1000 = 2.3\text{A}$

$30\text{C} \times 2.3\text{A} = 69\text{A}$ available

$60 / 30\text{C} = 2$ minutes

You can see the 30C rate example on the datasheet for Power Sonic 26650 LiFePO4 power cell



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You can use the formula below to calculate output current, power and energy of a battery based on its C rating.

Er = Rated energy (Ah)

Cr = C Rate

I = Current of charge or discharge (Amps)

$I = Cr * Er$

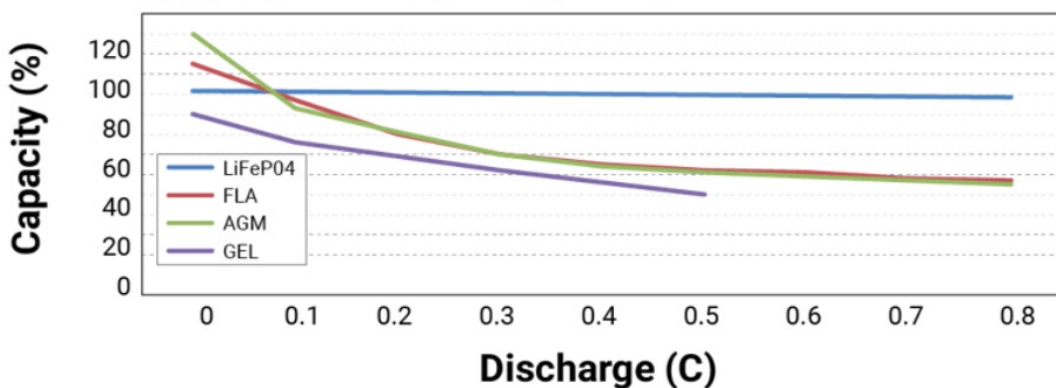
$Cr = I / Er$

HOW TO FIND C RATING OF A BATTERY

Smaller batteries are commonly rated at the 1C rating, which is also known as the one-hour rate. For example, if your battery is labeled 3000mAh at the one-hour rate, then the 1C rating is 3000mAh. You will generally find the C rate of your battery on its label and on the battery data sheet. Different battery chemistries will sometimes display different C rates, for instance lead acid batteries are generally rated at a very low discharge rate, often 0.05C, or 20-hour rate. The chemistry and design of your battery will determine the maximum C rate of your battery, lithium batteries for instance can tolerate much higher discharging C rates than other chemistries such as alkaline. If you cannot find the battery C rating on the label or data sheet, we advise you contact the battery manufacturer directly.

CAPACITY OF LiFePO4 vs. LEAD ACID AT VARIOUS CURRENTS OF DISCHARGE

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Capacity of lithium battery vs lead acid at various discharge currents

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APPLICATIONS REQUIRING HIGH C RATES

There are an increasing number of applications and devices on the market that require a high C Rate discharge battery. These include industrial and consumer applications like RC models, drones, robotics and vehicle jump starters. All these applications require a powerful energy burst in a short period of time.



Most jump starters can require up to 35C Rate discharge and in the RC industry there are high rate discharge batteries used up to 50C Rate! There are some batteries on the market that claim even higher C Rates based on maximum pulse discharge rates which require the battery to reach full discharge in just a few seconds. Most applications, however do not need such high C Rates

If you need any help finding the right battery for your application please get in touch with one of the the Power Sonic application engineers.

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